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Support for Simulation-based Surgical Education through American College of Surgeons – Accredited Education Institutes

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Abstract The American College of Surgeons (ACS) recently launched a new program to provide regional support for simulation-based surgical education through the establishment of a consortium of accredited education institutes. The goals of the program are to enhance surgical patient safety, support efforts of surgeons to meet the requirements for Maintenance of Certification, address the core competencies that all surgeons and surgical residents need to achieve and demonstrate, and enhance access to contemporary surgical education. The ACS-accredited institutes will comprehensively address the needs of a broad spectrum of learners and advance the science of simulation-based surgical education. Accreditation is being offered at two levels—Level I (Comprehensive) and Level II (Basic)—based on three standards that focus on the learners served, the curricula offered, and the technological support and resources available. Initial plans of the consortium of ACS-accredited Education Institutes include development and dissemination of innovative curricula, peer review of new educational programs and products, sharing of limited educational resources, and pursuit of collaborative research and development. This program should be of great value in supporting the professional activities of surgeons, surgical residents, medical students, and members of the surgical team, and in delivering surgical care of the highest quality.

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The milieu of health care in the United States has changed dramatically in recent years. Patient safety has dominated national dialogues since publication of the landmark report of the Institute of Medicine, *To Err Is Human: Building a Safer Health System* [1]. National efforts are underway to increase accountability and transparency in health care. Evaluation of outcomes of patient care and verification of physician competence are beginning to receive significant attention. Outcomes of individual surgeons are frequently published in documents readily accessible to the public, and large consumer groups continue to influence health policy decisions. The patients are now better informed than in the past regarding disease entities and treatment options, and they frequently request information on the credentials, education, experience, and outcomes data of surgeons. Also, scientific advances and emerging technologies continue to have a dramatic effect on both surgical practice and surgical education.

Surgeons need to learn new procedures and acquire proficiency in the use of new technologies throughout their professional careers. These developments have brought into sharp focus the myriad challenges associated with acquisition of new knowledge and skills during and following residency training, as well as the complexities relating to credentialing and privileging [2]. Pursuit of appropriate educational programs to address individual learning needs can be especially challenging for surgeons in practice [3, 4]. Educational programs that are based on contemporary educational principles and lead to the development of expertise and mastery may not be readily available; preceptorship necessary for safe transfer of newly acquired surgical skills to practice is often difficult to arrange; and the need for a surgeon to take time from a busy practice to participate in an educational program remains a major obstacle.

Other recent developments in this changing milieu are the broad range of professional opportunities beyond clinical practice that are now available to surgeons and the greater diversity of the surgical workforce. These factors increase the likelihood that surgeons would require the use of leave or scale down their practices for a period of time for professional or personal reasons. Also, surgeons who have been clinically inactive for a period of time may need to undergo additional training or demonstrate specific surgical skills prior to re-entering the surgical workforce.

Both the American Board of Medical Specialties (ABMS) and the Accreditation Council for Graduate Medical Education (ACGME) have defined the same core competencies that all surgeons and surgical residents must acquire and demonstrate throughout their professional careers [5, 6]. These are medical knowledge, patient care, interpersonal and communication skills, professionalism, practice-based learning and improvement, and systems-based practice. The Maintenance of Certification (MOC) Program recently implemented by the ABMS requires surgeons to furnish evidence of evaluation of performance in practice, as well as evidence of commitment to lifelong learning and involvement in a periodic self-assessment process [5]. The new accreditation standards of the ACGME emphasize evaluation of resident performance using valid and reliable assessment methods. Also, the Accreditation Council for Continuing Medical Education (ACCME) has recently developed accreditation standards that require providers of continuing medical education programs to evaluate the impact of such programs on physician performance and patient care outcomes [7].

The aforementioned changes have resulted in a need to re-evaluate and redesign traditional methods that have been used to educate surgeons and surgical residents and have served the surgical professional well for many decades. Several efforts have been undertaken to develop and implement new educational models, and simulation is a key component of many of these models.

Use of simulation in surgical education

Simulation-based education is beginning to receive great attention across all surgical specialties. An impressive array of simulations and simulators are available for use in teaching, learning, and assessment of surgical knowledge and skills. These include computer-based case simulations, standardized patients, part-task trainers, simulators, and virtual reality [8]. Computer-based case simulations and standardized patients are helpful in addressing cognitive knowledge and clinical skills, respectively. Low- and high-fidelity simulations are useful in technical skills education, especially in acquisition of new surgical skills and maintenance of skills in infrequently performed procedures. Several features and uses of high-fidelity simulations have been found to promote learning. These are providing feedback, offering opportunities for repetitive practice, integrating simulation into the curriculum, providing a range of difficulty levels, using multiple learning strategies, capturing clinical variation, controlling the learning environment, and focusing on individualized learning [9]. Research has revealed that achievement of competence leading to expertise and then mastery requires definition of specific tasks, deliberate practice, reflection, and feedback [10]. These elements need to be incorporated into simulation-based education models that focus on surgical skills.

Advances in technology have led to the development of computerized mannequins that possess a high degree of fidelity and offer educational options heretofore not available. Human patient simulators have been found to be useful in team training [11–13]. These simulators can be used to present a variety of clinical conditions and crises in realistic settings and learners asked to address the challenges. The challenges presented require the use of surgical knowledge and skills, as well as communication skills, professionalism, and leadership in coordinating the efforts of the team. Such encounters are videotaped and debriefings are conducted with the learners to emphasize the effective and ineffective actions of the learners. Different types of simulations and simulators may be combined to address the core competencies in an integrated fashion. For example, learners may be asked to counsel a patient preoperatively and obtain informed consent, to participate in a simulated operation, and then to explain an adverse event to the patient's family member [14]. Simulations that involve full immersive experiences may be used to recreate clinical environments that include several patients who require immediate care, such as in disaster and trauma scenarios. Further, the continuum of surgical care may be simulated through a variety of interconnected stations, each one of which focuses on a key phase in the care of the surgical patient. Thus, simulation-based surgical education can address the broad spectrum of core competencies.

Simulation-based surgical education has many advantages of over traditional educational methods [11, 15]. Promotion of patient safety and the ability to address the specific needs of individual learners are major benefits of such education. Learners can acquire a range of surgical skills in controlled environments without compromising patient safety or comfort. They can be offered opportunities for repeated practice and receive specific feedback through the simulators, the faculty, or both. Learners may be exposed to complex and life-threatening events in simulated environments, and errors may go uncorrected so that learners can acquire skills in handling critical events

without exposing patients to risk [11, 15, 16]. Such experiences are especially valuable in residency education, because surgical residents often are not exposed to the spectrum of critical events needed for a complete educational experience as a result of short hospital stays and restrictions on resident work hours. Simulated experiences prepare learners to work in real settings with the requisite levels of knowledge, skills, and confidence. Surgeons and surgical residents may "warm up" on a simulator before starting an operation. As technology advances further, opportunities to input specific patient data into a simulator and allow surgeons and surgical residents to participate in a "dry run" of an operation are likely to become widely available. Integration of simulation-based educational experiences with clinical work should help in the transfer of new knowledge and skills to practice.

Despite the major advances, simulation-based surgical education continues to be associated with a number of weaknesses and limitations. Technologic capabilities rather than the educational underpinnings often drive opportunities for teaching, learning, and assessment, which may limit or compromise educational effectiveness. Also, new simulations and simulators need to be validated and their added value studied through well-designed research. Because of a number of shortcomings, research studies often have not yielded conclusive evidence in support of simulation-based surgical education. Comparisons are frequently made between use of a simulator and no intervention, or the numbers of subjects are too small to draw appropriate conclusions. Furthermore, the studies have generally focused only on technical skills and not on the full range of knowledge and skills needed to provide surgical care. Scientifically-sound, multi-institutional studies are needed to demonstrate the added value of the use of simulators or simulations over traditional teaching and learning methods, and to study generalizability of the findings. Also, the use of simulators in learning major operations, acquiring requisite judgment, and addressing the range of core competencies needs further study. Other problems relating to simulation-based surgical education are the need for complex logistical support and additional resources, which are difficult to secure during fiscally challenging times. These factors have discouraged broad adoption of simulation-based surgical education despite its potential and appeal.

Establishment of simulation centers

Simulation centers can be of immense help in realizing the full potential of simulation-based surgical education and addressing many of the challenges cited above. Over the past few years, a number of institutions have established simulation centers that offer training in new minimally invasive surgery (MIS) procedures and address acquisition of technical skills. Some centers have expanded their activities beyond MIS to encompass certain open procedures and have also added education in communication skills and teamwork. The principal focus of these centers has been teaching, learning, and formative assessment, and some have pursued high-stakes summative assessment. The most common learners served by these centers have been surgical residents, although practicing surgeons, medical students, and other health care professionals have also benefited from the educational programs offered. Educational research conducted at a few centers has advanced the field of simulation-based surgical education.

Several important lessons have been learned as a result of the experiences at these simulation centers [17–22]. Careful planning from the very early stages is essential to achieve optimal outcomes. The mission and vision of the center need to be defined first. This process should include identification of the learners that will be served and the educational programs that would be offered. Based on these considerations, key decisions regarding the facilities, equipment, and resources need to be made. Existing space may be remodeled or new space identified for construction of the center, based on the available resources. Location and accessibility are major considerations. Close proximity to the medical center, and especially the surgical suite, encourages participation. Also, the simulation center should be accessible to residents around-the-clock to promote use.

The simulation center needs to be equipped with the appropriate types and numbers of simulators and other devices to achieve the learning objectives. The facilities should permit sufficient flexibility to change settings in order to maximize utilization of resources [23]. The rooms may be equipped with one-way mirrors for observation, and a central control room is useful in simultaneously monitoring activities in all rooms. Adequate storage space is also essential. The environment must be conducive to learning and help place the learners at ease. Sufficient attention must be devoted to traffic flow; for example, the learners should not see a standardized patient prior to meeting the same standardized patient in a simulated encounter. This is important to suspend disbelief and create the desired immersive experience.

A thorough educational and business analysis must be conducted, and the positive impact of a simulation center on the entire institution needs to be considered. Reduction of liability risk can add real value to such an undertaking. The simulation center may also enhance the prestige of the institution and help in recruiting residents and medical students. The business model must carefully consider all potential sources of revenues and the anticipated expenses.

Common sources of revenue for simulation centers are listed in Table 1. Metrics useful in determining the success of a simulation center should be defined at the outset. These include the impact on safety and quality of patient care, educational outcomes, numbers and types of learners and specialties served, feedback from learners and faculty, and net profit/loss.

The faculty members are generally the most valuable resource of a simulation center. Appropriate levels of ancillary support are necessary to ensure optimum use of faculty time and effort. A small core of permanent faculty members should be complemented by a larger group of faculty who may be recruited to support educational programs on an ad hoc basis [23]. Faculty members should be offered special incentives to encourage participation. These may include academic credit following peer review of educational resources developed by them and opportunities to conduct original scholarly work. Another important consideration is faculty development. The faculty may require training in the principles of contemporary adult education, and in the effective use of simulations, simulators, and advanced educational technologies [24]. The unique features of the simulation-based educational environment need to be emphasized during faculty development efforts. For example, in simulated environments, the learners' needs become central, as opposed to education in clinical settings when the patients' needs always get precedence over educational considerations [24, 25].

In spite of the contributions of various simulation centers, many opportunities exist to take simulation-based surgical education to the next level. There is great variation in the educational programs, facilities, and support systems at such centers. Also, their scope of activities is generally limited. Simulation centers have principally focused on the learning needs of residents, and the needs of practicing surgeons and other members of the surgical team have often not been sufficiently addressed. Also, the numbers of simulation centers are not adequate to address the current and future needs of various groups of learners. Few efforts have been made to standardize educational programs across the centers, and the impact of educational interventions on the performance of learners and patient outcomes has usually not been rigorously evaluated. In addition, simulation centers established by surgery departments have often worked in isolation and limited efforts have been made to link their activities with activities of other departments and institutional educational resources. Thus, there has been a need for a consolidated national effort to address the aforementioned limitations and opportunities.

Table 1 Common sources of revenue for simulation centers

Internal	External
Charge-back to various residency programs and clinical practices	Continuing education programs
Support from the surgery department and other departments within the medical school and university	Philanthropic donations
Support from the medical school	Grants
Support from the university	Endowments
Support from the hospital system	Support from industry
	Consultation revenues

The American College of Surgeons Program for Accreditation of Education Institutes

Since its establishment approximately 6 years ago, the American College of Surgeons (ACS) Division of Education has been pursuing a spectrum of educational programs to promote patient safety, help surgeons meet the requirements for Maintenance of Certification (MOC), and address the core competencies. The strategic plan developed by the founding director of the division (A.K.S.) included the concept of creating a network of simulation centers across the country that would offer educational support at the regional level to promote patient safety and enhance the quality of surgical care. The vision was that the facilities would play a key role in supporting continuing professional development efforts, helping surgeons meet various requirements, and enhancing the education of surgical residents. In addition, the centers would focus on the needs of medical students, members of the surgical team, and other health care professionals. Learners would be able to participate in educational programs to acquire skills in new procedures and emerging technologies and to refresh their skills in infrequently performed procedures. Individually tailored educational experiences would include pre-course interventions and post-course support. Pre-course interventions would offer learners the opportunity to acquire the requisite knowledge prior to coming to a simulation center for the skills training, which should facilitate achievement of the educational goals and reduce the length of time learners need to take away from their practice locations to participate in educational programs. Post-course interventions would help in transfer of newly acquired knowledge and skills to surgical practice. Also, requisite documentation would be provided to help in credentialing and privileging after successful completion of educational programs. Innovative educational research and development conducted at these centers would advance the science of surgical education. Collaboration between the centers would permit design and implementation of multi-institutional research studies with

sufficient power to yield useful data. Also, as new simulators are developed and incorporated into educational programs, the need for wet laboratories, animals, and cadavers should progressively diminish.

Following further discussions at the ACS, a decision was made to accredit simulation centers to achieve the aforementioned vision. The program would encourage existing simulation centers that focus principally on MIS to undertake necessary steps to enhance their facilities and programs to meet ACS accreditation standards. The ACS would establish the standards for accreditation, provide guidance to help centers meet those standards, assist in designing educational programs, and play a key role in pursuing collaborative projects and multi-institutional research. The program would be voluntary and supportive, and not punitive. The accredited simulation centers would offer both ACS courses and courses designed locally.

The aforementioned concept was refined after discussions with the leaders and key stakeholders within ACS, including a Regent (C.A.P.), who has special interest and expertise in simulation-based surgical education. A decision was made to focus on the broad spectrum of surgical knowledge and skills and to call the facilities "education institutes," instead of simulation centers. The overarching goal of these institutes would be to enhance patient safety through simulation. The institutes would be required to offer educational programs that are founded on principles of contemporary surgical education and assess the impact of those programs. The institutes may decide to implement train-the-trainer programs as well. The accredited institute could serve as a resource for an entire region. Thus, surgeons practicing in remote areas and in rural communities would be able to access contemporary simulation-based surgical education. Such outreach would be important in serving the broad needs of the population in rural communities [26]. Access to educational programs could be further enhanced through innovative approaches that involve the use of mobile simulation units.

The option of establishing a national education institute owned and operated by ACS was carefully considered, and a decision was made to not pursue this direction because of a number of important factors. Practicing surgeons would find traveling to a single location difficult, which may discourage participation in educational programs. Also, the ACS did not want to be in competition with the other ACS-accredited Education Institutes not owned and managed by ACS. Without an ACS-owned and operated institute, the ACS would be in a strong and impartial position to support the entire network of accredited institutes. In addition, establishment of a new institute owned and operated by ACS without the benefit of starting with an existing simulation center would require allocation of considerable resources, lead to duplication of effort, and delay the implementation of this important and timely program.

The accreditation concept was formally presented to the ACS Board of Regents in 2003. The Regents received this concept very favorably and appointed an ad hoc committee to develop the model for accreditation of education institutes, which would be implemented by the ACS Division of Education. The committee was chaired by a Regent (C.A.P.), included individuals with expertise in establishing surgical simulation centers and in surgical education, and was supported by the director and staff of the ACS Division of Education [27].

The committee began by performing a comprehensive needs assessment. Background information was obtained from the surgical education literature and from established accreditation programs, including those of the ACGME, ACCME, The Joint Commission, and other professional societies, as well as from the Trauma and Cancer Programs of the ACS. The ACS General Counsel provided input into the design of the accreditation program and helped to address various legal issues.

The committee decided that the overarching goal would be to create an accreditation program with high standards, but one that would not become unduly cumbersome or onerous. The accreditation program would aim to standardize the educational processes and catalyze the development and implementation of new educational programs. Education to support the learning needs of individual learners based on their specific practice patterns would be pursued. This would be especially valuable to surgeons in practice. Although the accreditation standards and criteria would need to be applied uniformly, the program would encourage institutions to pursue areas of special interest, thereby enriching the activities of the entire network. Each institute would select the specific educational programs to serve the needs of learners at that location, and decisions relating to the choice of simulations and simulators would be made accordingly. Thus, the accreditation program would not require use of certain specific simulations or simulators. The committee decided that collaboration with other medical disciplines and health professions would be beneficial to all parties, and that accredited institutes should serve as central educational resources within their respective institutions. This would take advantage of the expertise of individuals from across the organization and maximize use of limited and expensive resources.

Considerable thought went into defining the accreditation standards and criteria, because they would drive the educational agenda of the ACS-accredited Education Institutes. Also, specific standards and criteria would ensure reliable accreditation decisions. The process resulted in definition of two levels of accreditation—Level I and

Level II. The Level I education institutes are required to provide comprehensive educational support within the institution and the region, whereas Level II institutes are required to provide basic educational support principally to the surgery department, and perhaps a few other departments and programs within the institution. Standards and criteria for accreditation focus on the learners served, the curricula offered, and the technologic support and resources available [28].

Level I accreditation

For accreditation at Level I, the institutes must offer educational programs to surgeons and to at least three other learner groups. The learners may include physicians from other disciplines, residents, medical students, allied health professionals, and nurses. Thus, although Level I institutes must serve the needs of surgeons, they need to be multidisciplinary in focus. The institutes are required to address both cognitive and procedural skills through educational programs that are based on principles of contemporary surgical education. Development of educational models must include the following key steps: assessment of educational needs, definition of goals and objectives, selection of instructional methods, creation of educational materials, delivery of effective education, assessment of learners, and assessment of the effectiveness of educational programs. The programs offered by the institutes should meet the accreditation standards of the appropriate national accreditation bodies, such as the ACGME, the ACCME, and the Liaison Committee on Medical Education. Also, the faculty and preceptors must be appropriately trained.

Space requirements for Level I accreditation include a minimum of 1,200 square feet of dedicated contiguous space, with 4,000 square feet of additional space to house conference rooms, storage facilities, a lounge, locker rooms, restrooms, and other support systems needed to implement the educational programs. The educational space must be able to accommodate at least 20 trainees at a time for hands-on training. Appropriate space must be available for surgical simulations and simulators, and capabilities for Internet support, teleconferencing, and teleproctoring should be made available, as necessary, to support the programs.

Personnel requirements for Level I accreditation include an Institute Director with a minimum of 0.25 FTE time commitment and a term of appointment of at least 3 years. The committee felt that definition of minimum FTE required for this position would help the director in fulfilling the important responsibilities associated with this position, and continuity in this role for a period of time would be desirable. The Institute Director need not necessarily be a surgeon, which would permit recruitment of the most qualified individual from the organization. However, if the Institute Director is not a surgeon, there must be a Director of the Surgical Program who possesses the appropriate surgical credentials. This individual needs to have a minimum of 0.1 FTE time committed to the institute and the responsibilities associated with the position. Support personnel required for Level I accreditation include a 0.5 FTE Administrator and a 0.5 FTE Coordinator. Each Level I institute must possess the equipment and devices necessary to effectively conduct the educational programs it plans to offer. Although the accreditation standards and criteria do not specify the types of simulations and simulators that must be used, there must be sufficient variety and numbers of such devices to support the educational programs. The simulations and simulators must match the educational programs; thus, the accreditation process supports the concept that educational needs, and not just the availability or access to technology, should drive the educational opportunities. The accreditation standards and criteria also focus on the financial and educational resources. Each institute is required to submit an annual budget and provide appropriate letters of commitment from key institutional leaders. These requirements should help to ensure stability and institutional support for the program.

Level II accreditation

Standards and criteria for Level II accreditation include the requirement that the institute serve at least one learner group, such as surgeons, residents, or medical students. The curriculum needs to address both cognitive and procedural skills through contemporary educational models, similar to Level I institutes. However, the numbers and types of educational programs are likely to be more limited because of the narrower range of learners served. Similar to the requirements for Level I institutes, the simulations and simulators must match the educational programs that are offered. Space requirements for Level II accreditation include a minimum of 800 square feet of contiguous space that can accommodate 6–10 learners at a time for hands-on training. The requirements relating to the Education Institute Director and the Director of the Surgical Program are similar to those for Level I institutes. A 0.5 FTE Coordinator is also needed, but there is no requirement for an Administrator. The application must include the annual budget and supporting letters, similar to the requirements for Level I accreditation.

The standards for accreditation and the criteria within each standard are available at the ACS Website, www.facs.org. The ACS Division of Education has created

a pre-application questionnaire to allow facilities interested in applying for accreditation to conduct a quick self-assessment to determine whether they are ready. Also, the staff of the ACS Division of Education are available to provide guidance.

The process for review and accreditation of education institutes was then developed by the committee. This process involves a number of steps. Following initial review of the application submitted to the ACS Division of Education, a site visit is conducted by trained surveyors appointed by the division. Surveyors are required to review the entire application packet and supporting documents, corroborate the information submitted with the findings on site, and collect additional information. Two surveyors visit institutions applying for Level I accreditation, and one surveyor visits institutions applying for Level II accreditation. The entire application is then assigned to a member of the ACS Accreditation Review Committee by the ACS Division of Education. The committee member reviews the information and presents a summary report to the entire committee. The committee collectively evaluates each finding against the appropriate standard and criterion to determine the level of compliance—full compliance, partial compliance, or noncompliance. A final decision regarding the application is then made by the committee as a whole. An institution that is granted accreditation may be asked to submit a progress report if the committee has a concern regarding any item. The overall decision and information on the level of compliance for each standard and criterion are conveyed to the respective institute by the ACS Division of Education. The steps of this accreditation model are presented in Figure 1. The initial period of accreditation is 3 years. The accredited institutes need to submit annual reports, and any major change in the organization or activities of an institute must be reported to the ACS Division of Education during the accreditation cycle.

Once the committee developed the draft of the accreditation model, including the standards and criteria, two existing simulation centers were used for benchmarking. Appropriate modifications were made in the accreditation standards and criteria as a result of this process. A mock survey was subsequently conducted at a third simulation center, and extensive debriefings within the committee followed. At the completion of the exercise, the accreditation model and review process were deemed to be sound; however, a few changes were made in the accreditation documents.

Development of the accreditation model took approximately 18 months, and the program was formally launched in October 2005 following approval by the ACS Board of Regents. Training of surveyors commenced at that time. The ad hoc committee that had developed the accreditation model was dissolved after completion of its charge. Two

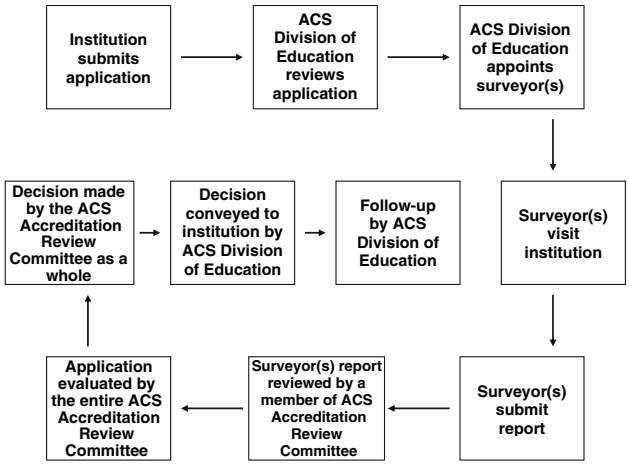

Fig. 1 Model for accreditation of Education Institutes by the American College of Surgeons

smaller Accreditation Review Committees were then appointed by the ACS Board of Regents to review and accredit education institutes under the authority of the ACS. The same individual (C.A.P.) serves as chair of the two committees, and both committees are staffed by the same members of the Division of Education (A.K.S., K.A.J.). This helps to ensure consistency in accreditation decisions across the committees. Other efforts to ensure consistency include periodic conference calls, during which members of both committees discuss issues relating to the accreditation standards and criteria, and the standardized accreditation process also helps in this regard.

Results of the accreditation process

During 2006, 11 applications were received and 10 institutes were accredited at Level I. Each received accreditation for the maximum period of 3 years; however, five institutes were asked to submit progress reports. The institutes accredited in 2006 are listed in Table 2. Another nine applications for Level I accreditation were reviewed in June 2007 and eight were accredited, each for a period of 3 years. These are listed in Table 3. One of these recently accredited institutes was asked to submit a progress report.

The accredited institutes embody the diversity that was originally intended for the program. They are geographically spread across the United States and Canada. The institutes are not limited to university hospitals, and three are located at community hospitals. The resources at these accredited education institutes include both low- and high-fidelity simulations and simulators, and some include virtual operating rooms, intensive care units, trauma bays, and in-patient facilities. The space available at these institutes ranges from the minimum needed to meet Level I accreditation standards to 20,000 square feet, and there are

plans to expand several of these facilities. All accredited institutes have a strong multidisciplinary and interdisciplinary emphasis, and one focuses specifically on a surgical subspecialty area. Another institute is an internationally renowned leader in research in surgical skills education. A total of 32 surveyors have been trained, and additional surveyors will be trained based on the future needs of the program.

The accreditation program has been helpful in identifying common areas of weakness across the accredited institutes. These need to be addressed collaboratively to enhance the educational programs. One such area is objective assessment of outcomes of educational programs and long-term follow-up of learners. Longitudinal educational programs that involve evaluation of performance of learners and outcomes of patient care will be designed and implemented across institutes, and central support for these activities will be provided by the ACS Division of Education. Another problem has been the lack of uniform terminology relating to various administrative and academic positions within the accredited institutes. Although this inconsistency may appear to be trivial, efforts will be made to standardize the terminology where possible, to facilitate coordination of efforts across the institutes.

Table 2 Education Institutes accredited at Level I by the American College of Surgeons in 2006

1.	Minimally Invasive Surgery Education Center, University of California, Irvine School of Medicine, Orange, California
2.	Simulation and Skills Center of the Carl J. Shapiro Institute at Beth Israel Deaconess Medical Center, Boston, Massachusetts
3.	William Beaumont Hospital, Royal Oak, Michigan
4.	The University of New Mexico Health Science Center BATCAVE Medical Simulation Program, Albuquerque, New Mexico
5.	Center for Medical Education & Innovation at Riverside Methodist Hospital, Columbus, Ohio
6.	Institute for Clinical Simulation and Patient Safety, Temple University School of Medicine, Philadelphia, Pennsylvania
7.	Southwestern Center for Minimally Invasive Surgery, UT Southwestern Medical Center, Dallas, Texas
8.	Institute for Surgical and Interventional Simulation (ISIS), University of Washington, Seattle, Washington
9.	Centre of Excellence for Surgical Education & Innovation, University of British Columbia, Vancouver, British Columbia, Canada
10.	University of Toronto Surgical Skills Centre at Mount Sinai Hospital, Toronto, Ontario, Canada

A decision has been made not to limit the number of accredited institutes by geography or total numbers. Each institution that meets the standards and criteria will be offered accreditation status. The accreditation process will be rolling and review committees will meet every 6 months to review additional applications. A number of institutions have expressed interest in applying for accreditation at Level I but have postponed this decision until they can meet the space and resource requirements. As their facilities are redesigned or renovated, additional applications are expected to be submitted to the ACS.

The applications received by the ACS thus far have all been for Level I accreditation. This is most likely because many of the institutes that applied for accreditation already had existing simulation centers that met the standards and criteria for Level I accreditation or were enhanced to meet these standards and criteria. Also, organizations and institutions interested in this new program made substantial investments that led to the establishment of comprehensive facilities that would qualify for Level I accreditation. However, there is a need to establish Level II institutes as well, to help in further disseminating educational programs and increasing access to these programs. The ACS anticipates receiving applications for Level II accreditation in the future, as institutes recognize the value of this level of accreditation. The impetus for establishing Level II institutes may also come from the new ACGME Program Requirements for Residency Education in Surgery that specify that resources at residency programs should include "simulation and skills laboratories" [29]. Surgical residency programs should be able to fulfill this requirement through access to a Level I institute at their institutions or within the region; alternatively, they may wish to establish a Level II accredited institute.

Impact of the ACS accreditation program

Achievement of ACS accreditation status should add real value to an institute beyond the prestige that such accreditation brings. The process of preparing for accreditation should help to obtain the necessary commitments for support from various leaders and stakeholders within the institution and to secure the necessary resources and space. The process of applying for accreditation is likely to galvanize resources within an institution and bring additional recognition to the faculty members involved. Collaboration with other accredited institutes should help in advancing common educational goals, exploring new directions that have heretofore not been possible, sharing limited resources, and pursuing joint research and development. This section describes the impact of ACS Accreditation Program on one education institute. The authors believe that

Table 3 Education Institutes accredited at Level I by the American College of Surgeons in June 2007

1.	Department of Surgery Education Institute at Stanford, Stanford University, Stanford, California
2.	Northwestern Center for Advanced Surgical Education, Northwestern University, Chicago, Illinois
3.	Louisiana State University Health Sciences Center, New Orleans Learning Center, New Orleans, Louisiana
4.	Maryland Advanced Simulation, Training, Research and Innovation Center, University of Maryland, Baltimore, Maryland
5.	Baystate Simulation Center, Baystate Medical Center, Springfield, Massachusetts
6.	University of Michigan Clinical Simulation Center, Ann Arbor, Michigan
7.	Mayo Clinic Multidisciplinary Simulation Center, Rochester, Minnesota
8.	Penn State Milton S. Hershey Simulation Center, Pennsylvania State University, Hershey, Pennsylvania

highlighting the experience of this institute from its early stages of establishment through its accreditation by ACS may be valuable to others already accredited or considering applying for accreditation.

Case study: University of Washington

The effort involved with the establishment of the multidisciplinary education institute at the University of Washington in Seattle started with a small group of general surgeons and electrical engineers who commenced collaborative work on the development of robots. They used simulation as a tool to develop skills and evaluate the performance of learners. In 2004, an open forum was organized, and anyone interested in the field of simulation was invited to participate. Eighteen individuals from 15 departments of the medical school participated in this forum. They proposed to the Dean of the School of Medicine the creation of a center within the medical school under the name of the Institute for Surgical and Interventional Simulation (ISIS). The group envisioned that ISIS would benefit from the medical school's well-recognized telemedicine program that serves five states, including Washington, Wyoming, Alaska, Montana, and Idaho. The mission of ISIS would be to promote patient safety, and its goal would be to address the learning needs of surgeons, physicians from other disciplines, residents, and medical students. The activities of ISIS would advance the use of simulation for teaching, learning, assessment, and research.

The Dean partnered with the Departments of Surgery and Anesthesia to provide the initial resources to establish ISIS. Administrative support for this effort was provided by the Department of Surgery. Additional support for curriculum development was secured through the efforts of a full-time educator. Collaborative alliances were pursued with other departments within the medical school and the university, as well as beyond the confines of the university. An Academic Board was appointed and includes medical school Department Chairs or their designees. This board is chaired by the Chair of the Department of Surgery and reports to the Executive Vice President for Medical Affairs. A faculty member was appointed as the Executive Director of ISIS at a 0.5 FTE time commitment. Individuals interested in ISIS and willing to participate in its programs were invited to become members of a group called "the champions," which was led by a senior member of the Academic Board with substantial experience in simulation. Two groups composed of "champions" were created—one to pursue education and the other to pursue research. A Corporate Board was also appointed, and includes donors, individuals with interest in information technology, representatives from industry, a representative from an insurance company, and members of the public. The Corporate Board functions as an advisory group to the Academic Board and has proven to be extremely helpful in identifying new initiatives, defining fundraising opportunities, and providing general guidance and direction.

Identifying space for this new facility was a challenge. Collaboration between the Departments of Surgery and Anesthesia and support from the Dean resulted in remodeling space and consolidating institutional resources. Additional support was provided by the hospital and the university. Faculty members were recruited to participate in the educational programs of ISIS. The commitment required from each faculty member is at least 0.1 FTE, which must be approved by the individual's Department Chair and is considered a contribution to ISIS by the respective department. Opportunities to pursue research and work with new technologies help to sustain the interest of the faculty in the programs. Teaching efforts of individual faculty members are recognized and used in institutional decisions relating to academic promotions. However, retention of faculty still remains a challenge because of the many competing professional priorities. Another challenge has been securing sufficient resources to support all the educational programs of ISIS, and a variety of sources of extramural and intramural support are being pursued.

The decision by leaders of ISIS to seek accreditation by the ACS proved to be extremely beneficial. The entire process of applying for and achieving accreditation occurred during the early stages of establishment of ISIS. This fueled the growth of the institute and helped to unify faculty efforts. The faculty member selected to head the accreditation process assumed a visible leadership role among the faculty. The process of applying for

accreditation resulted in further refinement of the mission, values, and goals of ISIS. Deliverables for the first and second years of operations were clearly defined. Also, the accreditation requirements helped to secure additional resources and space from the institution.

When the institute received accreditation, it was publicized widely, both internally and externally. The University President was invited to celebrate in this achievement, and great enthusiasm was generated within the participating departments, which led to recruitment of additional faculty. The Corporate Council also became more active since accreditation. A number of new initiatives have been defined and external partners identified. Broad educational collaboration in simulation-based surgical education has now been established across the northwestern region of the U.S. and into Canada.

During the 2006 Annual Meeting of the Association of American Medical Colleges, special tours of ISIS were arranged for the Deans of medical schools and other interested faculty members and administrators. The accreditation by ACS was specifically highlighted during the tours and briefings. These tours generated tremendous excitement at the national level, and several key leaders, including medical school Deans and administrators, returned to their institutions with the goal of establishing simulation facilities at their institutions.

Future directions

Similar positive experiences at other ACS-accredited Education Institutes underscore the value of ACS accreditation. However, for the full potential of the accreditation program to be realized, the network of accredited institutes needs to function as a unified consortium to pursue a more ambitious and robust agenda. Such collaboration begins with excellent communication between the accredited institutes, and the ACS has created a computerized listserv to facilitate such communication. The Web page of each accredited institute includes a brief description of the institute, along with the list of educational opportunities offered at the institute.

An invitational meeting of leaders of the accredited institutes was convened by ACS in March 2007, and opportunities for education and research were discussed. There was consensus that the ACS-accredited Education Institutes would collaboratively pursue a broad range of innovative activities relating to teaching, learning, and assessment. Common areas of weakness across the accredited institutes identified during the review process will be addressed. Also, the institutes would focus on developing and implementing uniform curricula for specific surgical procedures. The curricula may be developed by the accredited institutes or by other national organizations and then adopted or adapted by the institutes following review. Opportunities to share educational resources would be pursued and digital libraries of educational resources created. The ACS Division of Education would serve as a clearinghouse for the educational resources and materials. Curricula authored by individual faculty members would be subjected to peer review similar to journal articles, and with the permission of the authors, they could be made available to other members of the consortium, with appropriate attributions. The ACS would provide recognition and appropriate documentation of this peer review, which may be used at the authors' institutions for credit during academic promotion and tenure decisions.

The education of surgeons would be a major focus of Level I institutes. The institutes would help surgeons acquire skills in new procedures and emerging technologies and maintain skills in infrequently performed procedures. The institutes should prove to be especially valuable to surgeons who want to re-enter the clinical workforce following a period of clinical inactivity. As the MOC Program continues to evolve, there may be requirements in the future for surgeons to demonstrate certain skills in controlled settings. The consortium of ACS-accredited Education Institutes would be well-positioned as a resource for surgeons who are interested in seeking verification of their skills to meet various regulatory mandates. Development of validation of simulations and simulators would be essential for high-stakes summative assessment of skills relating to various surgical procedures, and the accredited institutes could play a pivotal role in such efforts. The institutes would serve as resources within their regions and even across state lines, and some may be identified as demonstration sites for new procedures and emerging technologies. Long-term goals include pursuit of a variety of innovative directions, such as education to address judgment in surgery, and intelligent tutoring, telementoring, and teleproctoring. These would be important in shaping surgical education of the future [30]. Collaboration with other academic societies and stakeholders will be actively pursued, and opportunities for joint ventures will be explored under the aegis of the ACS Division of Education

Standardization of educational models and approaches should permit rigorous study of the efficacy and outcomes of the interventions through collaborative research. Guidelines will need to be developed regarding participation of various accredited institutes in specific projects. Procedures for application of grants, management of the projects, mining and analysis of the data, and publication of findings would need to be established. Opportunities for research would be made available to all consortium members, and individual institutes could choose whether or

not to participate. Collaborative research and development programs would be centrally coordinated and managed by the ACS Division of Education.

A meeting of representatives of the accredited institutes will be convened annually to share current and future plans. This meeting will provide the opportunity for individuals to present results of their research efforts and share experiences with innovative educational programs. Each institute would highlight its achievements from the previous year, present results of scholarly work, and demonstrate new simulation-based education models. Scholarly efforts should culminate in publications in peer-reviewed journals, which would help faculty members in their professional careers and advance the field of simulation-based surgical education. All these efforts should result in the enhancement of the quality of care of surgical patients.

Conclusion

The ACS has established a program to accredit education institutes to address the challenges and opportunities resulting from a variety of recent developments. These include the sharp focus on patient safety, the need for practicing surgeons to meet MOC requirements, and requirements of ABMS and ACGME relating to the core competencies. The goals of consortium of ACS-accredited Education Institutes are to promote patient safety and enhance the quality of surgical care through contemporary simulation-based surgical education. The accredited institutes will comprehensively address the learning needs of surgeons, surgical residents, medical students, and other members of the surgical team. Ten institutes were accredited at Level I in 2006 and another eight institutes were accredited at Level I in June 2007. The ACS Division of Education is fully committed to this new venture, which should result in a major positive impact on patient safety and the quality of surgical care, enhance access to state-of-the-art educational programs, and advance the science of simulation-based surgical education.

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