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Graduate Medical Education in Surgery in the United States

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Graduate medical education in surgery currently consists of 5 or more years of post-medical school training. This training occurs in hospital-based residency programs, and is financed largely by the federal government. The traditional model of hospital-based surgical residency, in which aspiring surgeons participate in the care of patients under the tutelage of fully-trained surgeons, is a century old, and is under increasing scrutiny from patients, educators, and regulatory bodies. As the profession responds to these challenges, our current model of training may be on the brink of significant change.

Brief history of graduate medical education in surgery in the United States

The concept of the hospital-based residency in surgery is attributed to William S. Halsted, MD, [1] professor of surgery at Johns Hopkins University, who in 1904 advocated for a "system which will produce ... surgeons of the highest type." In the Halstedian model, several house officers began the Hopkins residency program each year, but half were only permitted to train for 1 year, and few completed a full course of training. This "pyramidal" style of residency was subsequently adopted by many hospitals. In the 1940s, Dr. Edward Churchill at the Massachusetts General Hospital proposed trading the "pyramidal" structure for a "rectangular" design in which all accepted residents were able to complete training [2], but the pyramidal nature of surgical training persisted at many programs until the 1980s, when

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the Residency Review Committee for Surgery (RRC) of the Accreditation Council on Graduate Medical Education (ACGME) began to require programs to choose the same number of starting residents as finishing residents. Such residents, guaranteed full training as long as their performance is satisfactory, are currently referred to as "categorical" residents. The number of categorical positions available in each general surgery residency is dictated by the RRC. In theory, the number of surgical training positions is also limited by the amount of federal funding to hospitals, but the RRC limit is the dominant factor in determining the number of surgical trainee positions available in the United States. Many hospitals would probably choose to fund additional resident positions out of their own revenues if the RRC limit were not in place. The RRC has been conservative about allowing new residency slots; as a result, the number of categorical positions in surgery has been relatively flat for the last 2 decades (Fig. 1).

In addition to categorical positions, residency programs are permitted to recruit "preliminary" residents, who are not guaranteed full 5-year training in general surgery. This group of residents is in turn divided into "designated" and "nondesignated" preliminary residents. Designated preliminary residents are those residents who have been offered full training in a specialty other than general surgery (for example, neurosurgery), but who complete 1 or more years of preparatory training in general surgery before entering their chosen specialty. In recent years, the number of designated preliminary positions in general surgery residencies has diminished as specialties such as orthopedic surgery and otolaryngology have chosen to take responsibility for the entire period of training of their residents.

Nondesignated preliminary residents are not offered full training in any surgical field, but are offered only a first-year residency position in general surgery. They may subsequently be offered a second year of preliminary status, but must be accepted into a categorical position after their second year

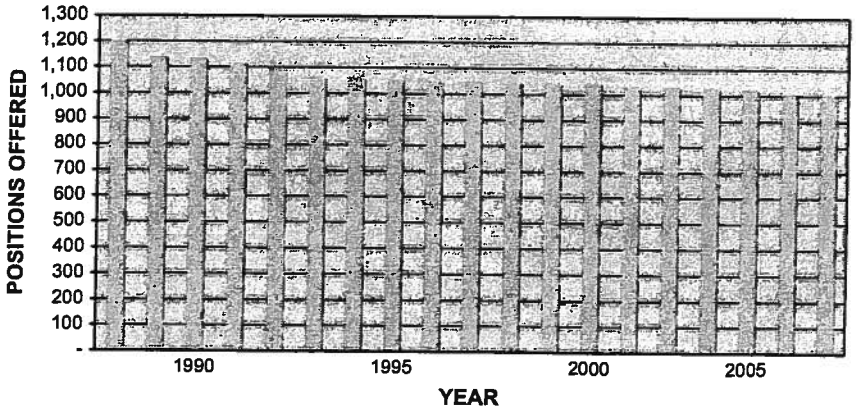

Fig. 1. The number of categorical R1 general surgery residency positions offered in the United States 1988-2006 (*Data courtesy of* National Resident Matching Program.)

to continue training. At the present time, residency programs are allowed to have a total number of nondesignated preliminary residents equal to twice the number of categorical entering positions. For example, a residency program that is allowed five categorical positions in its first-year residency class would be able to have at any given time a total of up to 10 nondesignated preliminary residents in the program.

Residency programs

There are currently 251 approved allopathic training programs in surgery in the United States. The programs vary in size; the average residency graduates 6 trainees per year, with the smallest graduating 1 trainee per year, and the largest approved to graduate 13. Of the 251 programs, approximately half are affiliated with medical schools, and the remainder are based in community hospitals not affiliated with a university. Altogether, these residency programs graduate approximately 1000 individuals each year. Of the 1000 graduates, about 300 go directly from residency into the practice of general surgery. The other 700 graduates enroll in additional training in cardiothoracic surgery, plastic surgery, vascular surgery, transplantation, advanced gastrointestinal surgery, surgical oncology, colorectal surgery, breast surgery, endocrine surgery, surgical critical care, or other subspecialties of general surgery.

In addition to the approximately 1000 people who graduate from allopathic training programs each year, about 80 osteopathic surgeons graduate annually from 30 US training programs.

Funding for graduate medical education in surgery

In 1966, as part of the landmark Medicare law, the federal government assumed the responsibility for funding graduate medical education (GME) in the United States. The Medicare-Medicaid program pays hospitals, not medical schools, for the training of residents. Medicare-Medicaid payments to hospitals for training in surgery currently amount to about 93% of the total budget for GME, with the remainder coming from the Department of Defense, Department of Veterans Affairs, and US Public Health Service. The current federal budget for GME is approximately $9 billion dollars per year, or approximately $90,000 dollars per resident per annum. Medicare funds for GME are dispersed to hospitals in two forms: direct medical education (DME) payments and indirect medical (IME) payments. DME payments are intended to provide direct salary support for residents and partial salary support for teachers, as well as to defray overhead costs of the educational program. Total annual DME payments to a hospital are based on a historical per-resident stipend, which is then multiplied by the number of residents in the hospital and multiplied by the fraction of total hospital

in-patient days that are Medicare patient days. IME payments are also based upon the proportion of services provided by the hospital to Medicare beneficiaries. IME payment levels also depend upon the ratio of residents to hospital beds. IME funds are intended to compensate for the greater patient care expenses that teaching hospitals incur as a function of providing GME. The IME component of payment to hospitals is approximately twice the amount of the DME component. In 1997, the Balanced Budget Act enacted by the US Congress froze the level of resident positions paid for by Medicare, as well as the rates for some parts of the funding. There is currently debate about whether funding for GME should be provided by a different government mechanism, such as an endowment, or whether the federal government should be funding GME at all.

Resident salaries are determined by individual hospital programs, and typically range between $30,000 and $60,000 per year, rising with each year of training. In 2002, three former resident physicians filed a class-action antitrust lawsuit against the National Resident Matching Program (NRMP), which administers the senior medical student match program for residency positions, the ACGME, and 29 hospitals that sponsor residency programs, claiming that the match has restrained trade and kept salaries artificially low. The suit, Paul Jung, MD and colleagues vs. Association of American Medical Colleges, et al, was ultimately dismissed in 2004 after Congress intervened and passed legislation asserting that the NRMP process did not violate antitrust law.

Legal status of residents

Residents at publicly owned hospitals are considered government employees, and have been able to form unions since the 1957 National Labor Relations Act. In 2000, the National Labor Relations Board overturned its own long-standing policy and ruled that residents in private hospitals are also employees, giving all residents in the United States the right to form or join unions and engage in collective bargaining. Although all residents have had the ability to form collective bargaining units for the last 6 years, episodes of labor unrest at hospitals have been relatively rare.

Residents thus occupy the somewhat unusual position of being students and employees at the same time. No one disputes the necessity for learning during residency, but the legal status of residents as employees creates the potential for friction between hospitals, which can assert that residents have "service" responsibilities, and educators, who in general advocate for reducing service requirements and maximizing educational opportunities.

Regulatory oversight of graduate surgical education

The oversight of surgical GME in the United States falls largely to two organizations. The American Board of Surgery (ABS), founded in 1937

and located in Philadelphia, is responsible for assessing the knowledge of graduating residents, and certifies them based on an examination process. Candidates for ABS certification must be graduates of an ACGME approved residency program, and must pass the written (qualifying) examination of the ABS, a 300-item, multiple choice examination of cognitive knowledge, before being permitted to sit for the oral (certifying) examination, which is a 90-minute examination that assesses clinical judgment and decision-making.

The ABS takes the process of examination very seriously and conducts examinations in a scientific and professional manner. It has developed a question-writing training program for all of its examination committee members. Questions written for ABS examinations are scrutinized carefully in a multilevel review process and rewritten if necessary before they are used on an examination. The ABS employs a full-time psychometrician to evaluate the degree of difficulty and validity for all questions used on its written examinations.

Currently, approximately 20% of candidates taking the qualifying examination do not earn a passing grade on their first attempt. After having passed the qualifying examination, approximately 20% of candidates fail the oral (certifying) examination on their first attempt. Candidates are able to repeat either examination five times in 5 years. In the last decade, 5% to 6% of candidates could not pass the examinations on repeated attempts, and ultimately failed to become certified.

The ABS is an independent non-profit organization. Its directors (who review and select test items and administer the examinations) are volunteers. There are currently 31 ABS directors, all of whom are practicing surgeons. Twenty-eight are nominated by national academic and regional surgical societies, and there are three at-large directors. The ABS has a full-time executive director, two additional full-time physician staff members, a psychometrician, and several support personnel.

The ABS is one of 24 member boards of the American Board of Medical Specialties (ABMS), which encompasses all of the disciplines of allopathic medicine.

Because the ABS examines candidates for certification on the knowledge accumulated during residency, it in essence defines the educational content of surgical training. The ABS provides general guidelines as to the body of knowledge which it expects a certified surgeon to have mastered. These guidelines are modified as necessary as new knowledge enters the field of surgery and other knowledge becomes outdated.

In contrast to the ABS role of certifying individual surgeons, the RRC certifies that individual residencies are discharging their educational responsibilities successfully. The RRC is a unit of the ACGME, which is currently an independent corporation. It was founded in 1981 by the American Medical Association (AMA), the American Association of Medical Colleges (AAMC), the ABMS, the Council of Medical Specialty Societies (CMSS).

and the American Hospital Association (AHA). The ACGME is located in Chicago. It is charged with accrediting all medical core residency programs in the United States, and in addition accredits some, but not all, post-residency fellowships. In essence, the ABS is responsible for defining the body of knowledge required of trainees in surgery, whereas the RRC assures that individual residency programs provide the proper environment for residents to acquire the knowledge.

The program requirements of the RRC are rather detailed, and encompass areas such as the work environment, the curriculum, and the eligibility requirements for faculty and program directors. Professional ACGME inspectors review residency programs for compliance with RRC standards through an in-person site visit, and then report their findings to the RRC. Following a site-visit report, the RRC may grant a program full accreditation for a period of 5 years (the maximum) or less. Alternatively, it may grant conditional accreditation, and request that evidence be provided of satisfactory resolution of deficiencies. When more serious problems are present, the RRC may place a program on probationary status or revoke its accreditation. Currently, 95% of US residency programs are accredited, about half for the maximum period of 5 years; 2% are in the initial/provisional stage of accreditation, and 3% are in probationary or warning status.

The RRC has nine members, all of whom are surgeons. One member is a resident. The members are nominated for service by the American College of Surgeons (ACS), the ABS, and the AMA. In addition, the RRC has a full-time professional executive director and support staff.

Issues currently confronting graduate surgical education

Attractiveness of surgery as a career

For many years, more applicants from US medical schools applied for categorical surgical residency positions than the system could accept. In the 1990s, the number of applicants to surgical residency programs by US medical students began to fall. Between 1992 and 2002, the number of US medical school graduates who applied to general surgery residency programs fell from 1381 to 931, 100 less than the number of positions offered. In 2002, 7% of categorical residency positions went completely unfilled in the initial phase of the match. Since 2002, the trend has reversed, categorical positions are filling in the match, and increasing numbers of US students are applying for surgery programs, but not yet at historic levels (Fig. 2).

The decline in applications to surgery residency programs by US medical graduates has prompted a number of studies of medical student attitudes toward surgery as a career. Many of today's students view the lifestyle of a practicing surgeon as the primary deterrent to choosing surgery as a profession [3].

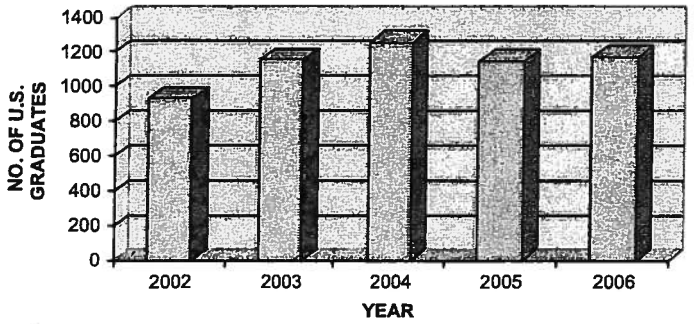

Fig. 2. The number of graduates of US medical schools applying for categorical general surgery training positions during the years 2002–2006. (*Data courtesy of* the National Resident Matching Program.)

There is a perception that surgery is not attractive to female medical students, who now constitute half of the student body in the US, but only one fourth of surgery residents. It is true that a smaller proportion of female medical students apply to surgery programs than their male counterparts, but an ABS study of residents in training reveal that the rate of increase in female residents has accelerated, and has been increasing by about 2% per year for the last 5 years, which will result in gender parity in surgery residency programs within the next 10 years (F. Lewis, unpublished data, 2006).

The question remains whether surgery is attracting top medical students. Data from the National Resident Matching Program (NRMP), which administers the residency match process, show that about 20% of students entering surgical residency programs are Alpha Omega Alpha honor society members. General surgery applicants are not on average as academically successful in medical school as those students entering other surgical specialties [4]. Students entering surgery residency are approximately equivalent to those entering internal medicine residency in terms of test scores and academic achievement. Of course, the generally high quality of US medical students guarantees that even average students are gifted, and it is not a given that surgery as a profession would be better served by attracting only the highest-achieving students.

In the meantime, the number of applicants to surgery residency programs from non-US medical schools has increased. By and large, international medical graduates (IMGs) fill surgical positions in residency programs that are not considered desirable by US medical school graduates. In 2006, 99 of 1046 categorical surgical positions (9.5%) were filled by IMGs. The success rate of US medical school graduates in the match for categorical positions is approximately 75% (3 out of 4 match to a position somewhere), whereas only one of 10 IMGs matches successfully to a categorical position. IMGs are more successful in obtaining nondesignated preliminary resident positions. Last year, 238 of 748 available preliminary positions were filled by IMGs.

Attrition from surgical residency programs

A major problem in surgical training is the attrition rate from categorical residency positions. RRC data [5] suggest that about 2% of all surgery residents are either terminated or withdraw from residency every year; however, their data use the total of categorical and preliminary residents as the denominator, and therefore may underestimate the losses from categorical training positions. Studies recently begun at the ABS suggest that the percentage of residents leaving categorical positions is much higher, and that approximately 20% or more of residents beginning a categorical surgery residency ultimately fail to complete it. Because the RRC has eliminated the "pyramid," filling vacant categorical positions usually involves moving a nondesignated preliminary resident into a categorical position, or accepting a resident in transfer from another program. Neither group represents a particularly optimal source for replacements—nondesignated preliminary residents are often those who failed to match to categorical positions in the first place, and transferring residents may have a history of underperformance. The data at ABS indicate that residents who train in more than two programs perform very poorly on our examinations.

Increasing subspecialization within general surgery

As knowledge has increased dramatically in surgery and as new technology has led to a steady expansion of the surgical therapeutic armamentarium, the broadly trained general surgeon capable of treating a wide variety of conditions in multiple organ systems has become a rarity. In the past 30 years, general surgery has calved a number of subspecialties, including relatively broad fields such as thoracic surgery, transplantation, oncology, and surgical critical care, as well as "niche" subspecialties such as breast surgery or bariatric surgery. Today's well-informed patients continue to drive the process of subspecialization by seeking out experts in particular diseases in lieu of a general surgeon. In addition, much has been written about the fact that practitioners who have significant experience with certain complex operations have better outcomes than surgeons who do the operation only occasionally [6], again reinforcing the value of a limited subspecialty practice.

Currently, 70% of the graduates of general surgery residencies opt for additional subspecialty training before entering practice. It is difficult to know with certainty all of the factors that are driving this sea change in surgical training. A great many residents, particularly those in large university-based programs, are exposed almost exclusively to subspecialists during their residency, and probably choose to emulate their mentors. Another factor undoubtedly driving the rapid growth in advanced surgical fellowships is the desire of faculty subspecialists to recruit motivated and experienced apprentices. Residents probably perceive competitive and financial advantages to

subspecialization. Certain subspecialties also offer the likelihood of a more controllable lifestyle than traditional general surgery.

Unfortunately, the rapid proliferation of postresidency fellowships has created a self-fulfilling prophecy; as more and more operations are performed by postresidency fellows, residency training becomes less and less robust. As a result, many residents believe that general surgery training as it currently exists fails to prepare them adequately for practice, and so they feel compelled to seek additional training. Nowhere is this more apparent than in the extraordinary growth of postresidency fellowships in gastrointestinal surgery (now numbering well over 100), a field which has traditionally been at the core of general surgery.

It will be very difficult if not impossible to reverse the trend toward more and more subspecialization, but there are problems surfacing that suggest that the process has had some undesired side effects. For one thing, many subspecialists appear to be choosing not to take emergency general surgery or trauma call, leading to a potential crisis in our emergency rooms [7]. This is an issue that will definitely require the attention of the profession soon.

Limitations on resident work hours

Beginning July 1, 2003, ACGME mandated that surgical residents were required to work no more than 80 hours per week. Other policies regarding length of work shifts and on-call frequency were instituted simultaneously. The avowed purpose of the new regulations was to improve patient safety by reducing the likelihood of an error committed by a fatigued resident. Because surgical residents in most hospitals had typically worked approximately 100 hours per week before the ACGME mandate, the work hours limitation had the direct effect of limiting residents' direct exposure to patients by about 20%. There have been beneficial effects of the change in terms of resident satisfaction with their personal lives [8], but no plan was in place to replace the educational value of the lost hours or to make the remaining training time more efficient. Residents are generally not used to "homework" assignments, nor does the profession have any significant ability to simulate the clinical environment outside the hospital to allow off-duty residents to hone their clinical skills.

In Europe, legislation adopted by the European Union (EU) currently limits resident works hours in member nations to 58 hours per week. The legislation will require the reduction of work hours to 48 per week by the year 2009. Resident work hours in Canada vary by province, but generally are close to those in the United States. In Canada, however, work hour schedules are negotiated between resident provincial unions and the provincial government. Whether the United States will follow the example of either Canada or the EU is not yet clear. There has not been a rigorous examination of the number of hours required to train the types of surgeons we need in the United States, and this is a study in which the profession might wish

to engage. Absent such an examination, work hour limits may be imposed based on superficial arguments, strictly noneducational considerations, or political pressure.

Competency of graduating surgical residents

There is currently a perception in the profession that today's residency graduates are not as capable as those of a generation ago. It is difficult to substantiate this belief, but it seems pervasive. Today's residents have a higher pass rate on ABS examinations than their predecessors, but direct comparison is difficult, because the examinations have changed over time. The certifying (oral) examination, which aims to test clinical skills and judgment, has a more formalized grading process than in the past, and the questions are much more standardized than they were when today's older surgeons took the examination.

Even if the competence of today's graduating residents compared with their predecessors is open to question, there is no doubt that the training is much different. In addition to the reduced hours of direct patient exposure, today's residents are much more heavily supervised and have less (if any) independent operative experience. Independent action, which was the mark of a senior resident a generation ago, is rightfully viewed with skepticism today, but there is a distinct possibility that today's residents are having decisions made for them (by attending surgeons), and may not even realize that a decision was necessary. If so, the resident leaves training unprepared when confronted with the need to make a judgment.

Much of the problem of inexperience could be dealt with by simulating clinical scenarios. Residents could conceivably learn technical skills as well as accumulate experience in decision-making in safe simulated environments. Early studies demonstrate that skills learned in a simulated setting transfer to real patient care, but the tools for clinical simulation remain relatively impractical, expensive, and primitive at this time. Nevertheless, simulation promises to completely transform surgical education in the coming years, and would be a very appropriate area for government research funding as well as private initiatives.

Response of the profession to issues in graduate surgical education

Although surgeons have always considered training to be an important part of their mission, relatively little attention has been paid to education in comparison with clinical care or research. Unfortunately, many view the education process as a natural by-product of patient care. This is clearly not the case, but this prevalent attitude has impeded efforts to define curriculum, enhance faculty teaching skills, create instructional tools, and other initiatives that are second-nature to educators in other disciplines.

In 2002, Dr. Haile Debas [9] called attention to the beleaguered state of graduate surgical education in his presidential address to the American Surgical Association (ASA), following which the ASA convened a "Blue Ribbon Panel" with representation from the ACS, the ABS, the RRC, and the ASA itself. The panel considered a broad range of issues related to surgical education, deliberated over a period of 20 months, and published its conclusions in January 2005 [10]. These recommendations included, among others

- Increasing the number of surgical trainees and establishing a permanent task force to monitor surgical manpower needs
- Strengthening the teaching skills of academic faculty and stimulating educational research
- Dividing surgical training into basic and advanced levels, leading to an earlier opportunity for specialization/differentiation
- Developing a standardized, national curriculum in general surgery

During approximately the same time frame, the ABS created a new standing committee on resident education to examine the curriculum in surgery. The ABS was motivated by the sense among its directors that a significant number of candidates presenting for certification had insufficient knowledge and experience in major relevant areas of surgery, such as complex trauma and complex gastrointestinal operations. It was the opinion of the ABS directors that initiatives to improve resident education should be a coordinated effort of all the major organizations with an interest in and responsibility for surgical GME. As a result, the ABS convened a meeting in November 2004 of representatives of the six stakeholder organizations: ABS, ACS, ASA, RRC, Association of Program Directors in Surgery (APDS) and the Association for Surgical Education (ASE). This group met in Philadelphia and agreed to join forces to work on a standardized national curriculum in surgery, and to create a national Web site for resident education. In addition, the group agreed that a surgeon should be chosen who would be based at the ABS office in Philadelphia and be able to devote full-time attention to surgery GME. The ABS agreed to fund much of the cost for this new position, but other attending organizations were asked to contribute toward the position and subsequently agreed to do so. A search process led to the appointment of author Dr. Richard Bell, who began work August 1, 2006. One of Dr. Bell's first projects was to reconvene the multiorganization task force that met in 2004. Before meeting, the members of the group agreed to adopt the name Surgical Council on Resident Education (SCORE).

A critical first step in building a general surgery curriculum is to define the scope of the specialty [11]. SCORE agreed to endorse a defined list of conditions and diseases and a defined list of categories of operative procedures as being within the scope of general surgery. This list of conditions, diseases, and procedures is organized into 40 subject matter modules and can be examined in full at http://www.SurgicalCORE.org. This list of

diseases, conditions, and procedures will form the basis of the curriculum for general surgery training, and is intended to encompass the learning needs of surgery residents between their graduation from medical school and entrance into practice. SCORE is focusing its initial curricular efforts on those residents who enter practice after 5 years of general surgical training, and does not at this time foresee a shortening in the length of training. This list of diseases, conditions, and procedures is intended to be a living document, which will be updated on a regular basis as new procedures are developed and new conditions are recognized, or when certain conditions or procedures are no longer relevant to general surgical training. Using the data that recertifying surgeons provide to ABS, it will be possible in the future to test the curriculum against the actual operative experience of graduates. This will insure that residents receive sufficient training in the procedures that they actually perform in practice, and conversely will assure that residents do not waste educational time learning skills that will not be employed in practice.

The Internet offers new learning opportunities for residents and new teaching opportunities for faculty. SCORE has begun the process of developing a national Web site for general surgery education. The Web site will present integrated text, images, audio, and video, and will link to existing content from other sources such as surgical texts and journals. It will feature case-based learning scenarios. It will be possible for local program directors to add enrichment material to the site. The site will incorporate assessment tools such as mock cases, multiple choice quizzes, and other exercises based on the content. The ABS will initially provide administrative support for this project and assume the Webmaster functions. The majority of the content for the site will be provided by members of the APDS, working through the APDS Curriculum Committee.

The RRC now requires a surgical skills laboratory as part of residency training. In addition, the ACS has started a program to accredit skills laboratories. To optimize the use of these laboratories for general surgery training, a curriculum is required. A surgical skills curriculum task force was initiated by the APDS, which is working jointly with the ACS with the objective of improving resident performance through skills practice, and using assessments of skills to determine "OR readiness" of surgical residents.

The ACS Fundamentals of Surgery curriculum is being developed by the ACS's Division of Education, and is focused on basic cognitive and judgment skills in surgery. It is a tool that first-year residents in all surgical specialties can use to gain clinical skills. It is an extension of the ACS's prior work in defining an essential set of skills for first year residents in surgery. The proposed basic surgery curriculum is case-based, and focuses on specific learning objectives and critical thinking. ACS intends to provide access to cases and the curriculum on a Web site.

The list of challenges for the profession in improving the training of the next generation of surgeons is long. In addition to the curricular efforts

outlined above, there needs to be an assessment of the public need for surgeons. It is becoming clear that we face a shortage of surgeons, yet we have been loath to increase our training positions. Whether the current focus on subspecialty training matches the public need is not clear. There is evidence that the lack of surgeons with broad training willing to take call for general surgery and trauma emergencies is becoming a pressing problem. The profession also needs to address the structure of training, and be proactive in defining the work hours and length of training on a rational basis. Compensation for residents is an issue that needs attention in view of the increasing number of residents with families, and the substantial debt that today's residents incur in attending college and medical school, which currently averages about $100,000. Finally, the profession needs to seriously deal with the diminishing attractiveness of surgery as a profession, and the high attrition rate from surgical residencies. For example, we should consider being more flexible in our training requirements so as to allow residents the possibility of interrupting residency for child-raising. Serious efforts in these areas will guarantee that surgical training and the profession of surgery will continue to deserve the highly regarded and sought-after status it has traditionally enjoyed.

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