

# Issues in General Surgery Residency Training—2012

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The operations which are done by general surgeons, and the way in which they are done, have undergone radical change during the last 2 decades, yet the impacts on residency training have not been generally recognized. The change has come about because of 2 principal factors—evolutionary and technological changes, which have occurred in the treatment of several common diseases, and the conversion of a major proportion of abdominal surgery from an open to a laparoscopic approach.

In addition to the change in the nature of the surgery done, the impact of the 80-hour workweek on resident experiences with urgent and emergent conditions has also been significant. The impact of this on the development of resident independence and autonomy has not been analyzed.

This article will attempt to describe qualitatively the nature of the changes, the negative impacts on resident training, and some proposed measures to mitigate the impact.

## ENVIRONMENTAL AND TECHNOLOGICAL CHANGE IN DISEASE MANAGEMENT

Four common disease categories, which involve intra-abdominal pathology, have undergone major technological change in management during the last 20 years.

### Benign Peptic Ulcer Disease

Benign gastric and duodenal ulcer disease has been a staple of general surgical management for decades, for treatment of the complications of bleeding, perforation, and intractability. Three advances in medical treatment have markedly altered the incidence of these complications, and the consequent need for surgical intervention: H<sub>2</sub> receptor blockers, proton pump inhibitors, and treatment of *Helicobacter pylori* gastric infection. As a result of medical management with these 3 modalities, intractability of ulcer disease has virtually disappeared, and perforation and hemorrhage have been markedly reduced. The result is that surgery is infrequently necessary today for treatment of peptic ulcer complications and resident experience with gastric surgery is largely limited to malignancy and other less common conditions. Interestingly, the increase in laparoscopic bariatric surgery has provided the bulk of a typical resident experience in gastric surgery in recent years, but exposure to these procedures is highly variable, and residents are rarely the operating surgeon in these complex technical procedures.

### Biliary Tree Stone Disease

Common duct stone disease is a frequent general surgical problem, typically causing ductal obstruction or pancreatitis, which in the

past often required surgical intervention for stone removal. Today, the technological innovations possible with flexible endoscopy and endoscopic retrograde cholangiopancreatography have allowed most stones to be extracted endoscopically; these have markedly reduced the need for common duct exploration and stone removal. The consequence of this on resident training has been so dramatic that most graduating surgical residents today have done no common duct explorations, whereas it was previously a common part of abdominal surgical experience.

### Abdominal Vascular Surgery

Intra-abdominal aortoiliac occlusive and aneurysmal disease have been treated by both general surgeons and vascular surgeons since the 1950s, when synthetic vascular graft replacements first became available. Both of these disease categories were typically treated with aortoiliac and aortofemoral graft replacement via open abdominal procedures. Two changes, both technological, occurred in the 1990s which altered this scenario: endovascular manipulation of occlusive disease became feasible and effective, allowing the dilatation and stenting of most aortoiliac lesions; and intraluminal endovascular graft insertion, a remarkable technological achievement, was developed for the treatment of aneurysmal disease, with markedly reduced patient morbidity from the treatment. Both of these procedures are technologically complex, and competence in the performance of such procedures became possible only with the additional training that occurred with vascular fellowship after general surgical training. Most general surgeons without additional vascular surgical training, and general surgical residents, were unable to gain sufficient experience with these procedures to become proficient, and were opted out of them, effectively removing aortoiliac vascular disease from the conditions which general surgeons could treat.

### Trauma

Injuries have constituted a significant portion of general surgical experience for decades, and continue to do so, but the nature of traumatic injuries, and their management, has changed significantly. Three specific events account for this: (1) the incidence of abdominal penetrating trauma, which requires surgical intervention in 80% to 90% of cases, decreased markedly in the United States between 1992 and 2002. Overall, the incidence of penetrating trauma decreased by approximately 60% during this decade in all geographical regions, both urban and rural, and has remained low even now. Despite the dramatic nature of this decline, it has largely escaped public notice and causation is undefined. Whatever the reason, the decrease caused a marked reduction in the need for abdominal surgery in most urban centers, as penetrating trauma has always been the injury requiring the largest proportion of open surgical intervention.

In addition to the decline in penetrating trauma, the incidence of blunt trauma, due largely to automobile trauma, declined by about 20% between 1980 and 2010, as seat belts and airbags came into universal usage. Although blunt trauma is mostly managed nonoperatively and requires surgery only 10% to 20% of the time, this caused a further decrease in the operative experience of residents and trauma surgeons.

Lastly, from the mid 1980s onward to 2000, the advent of computerized tomographic scanning, and the steady increase in resolution of that modality, made it possible to diagnose in greater detail

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the intra-abdominal pathology, which was present with most blunt trauma and with some penetrating trauma. The increased diagnostic accuracy often allowed the anatomical details of intra-abdominal pathology to be more fully defined and therefore reduced the need for exploratory laparotomy, which was often nontherapeutic when the pathology was relatively minor. The efficacy and resolution of computerized tomographic scanning was great enough that it led to an entirely new genre of nonoperative trauma management for blunt trauma affecting the liver, spleen, pancreas, and kidney, when ongoing bleeding was not a problem.

The 3 changes detailed earlier have led to a decline of 70% to 80% in the incidence of abdominal exploration necessary for trauma management in trauma centers today. Whereas previously surgical residents would commonly document 40 to 50 trauma cases requiring abdominal exploration by completion of training, today the Residency Review Committee for Surgery has lowered the required threshold to 10.

All of the aforementioned changes in disease management have been beneficial to patients and have reduced the magnitude of treatment and the physiological disruption which were previously incident to these disease processes and their treatment. At the same time, they have markedly reduced the experience of surgical residents in performing open abdominal surgery and decreased the breadth of experience they have for multiple disease processes.

### IMPACT OF LAPAROSCOPIC SURGERY

The final and most significant technological change which has occurred is the development of laparoscopic surgery for intra-abdominal surgical management, replacing open surgery and the abdominal incision, which was previously necessary. Laparoscopic surgery arrived on the US scene around 1990 and has expanded steadily since then, as laparoscopic surgical capabilities and instrumentation have improved. Initially laparoscopic surgery was largely limited to simple procedures such as cholecystectomy, which did not require significant amounts of intra-abdominal suturing or performance of intestinal anastomoses. With steadily increasing experience, the range and complexity of procedures has progressively expanded, and today more complex procedures involving intestinal anastomoses such as laparoscopic colectomy and laparoscopic gastric bypass are routinely performed with low morbidity.

When laparoscopic surgery was introduced to the United States in the 1990s, the academic community was slow to awaken to the revolution it represented, slow to adopt laparoscopic surgery in most academic centers, and slow to develop significant numbers of faculty who were proficient in its performance. As a result, it advanced more rapidly in the private practice community, often accompanied by a significant entrepreneurial element. Surgical faculty in academic centers were often late in acquiring laparoscopic surgery expertise, and as a result, the majority of residents in the early years of its development were not trained because they had insufficient faculty to act as role models, teachers, and advocates.

The private practice community early on developed private community hospital fellowships, which were not located at academic centers, and began training fellows who had already completed surgical training, but were in need of further training in laparoscopy. Such fellowships were outside the Accreditation Council for Graduate Medical Education (ACGME) accreditation system, and did not entail certification in a subspecialty defined by the American Board of Medical Specialties (ABMS). Development of this system was enhanced by funding from device manufacturers who sold the equipment needed for laparoscopic surgery, and who saw the benefit of expanding the fellowships, which would train surgeons to use the equipment that they manufactured. Funding was generally provided

to pay for the salary of the fellows during their training, and often for other costs of establishing and operating the fellowships. The availability of such funding continues to the present and operates outside any regulatory framework related to surgical education.

Because of the slower development of laparoscopic surgery in the academic community, the paucity of academic faculty who were proficient in laparoscopic surgery, and the development of private community fellowships in laparoscopic surgery, the training of surgery residents in laparoscopic surgery expanded more slowly than it might have. While the Residency Review Committee (RRC) for Surgery has been steadily increasing the requirements for surgical resident training, it is still the rule that the most complex laparoscopic surgery is reserved for fellows in postresidency fellowships and not for residents during surgical training, although there is no reason this should be the case.

In summary, the principal change in surgical residency training of the last 20 years has been the loss of many areas of open abdominal surgery, but at the same time, this has not been replaced by a comparable volume of the same surgery done by complex laparoscopic techniques. Moving this laparoscopic experience back into surgical residency would be possible today, as the deficiency in faculty who are proficient in laparoscopic surgery has been fully addressed, but the laparoscopic surgery fellowships which are in competition with residents for cases are already in existence and are maintained in part by external funding unrelated to hospital or educational budgets. Because this entire system operates outside any regulatory framework, neither the ACGME nor the ABMS have any control over these fellowships.

### IMPACT OF THE 80-HOUR WORKWEEK

The imposition of the 80-hour workweek by the ACGME in 2003 produced a dramatic change in the scheduling of most resident rotations. Although the 80-hour workweek had been recommended previously, it had not been stringently enforced, as it was after 2003, and this necessitated significant changes in the scheduling of resident rotations at most centers.

Research before 2003, although not extensive or rigorous in most cases, indicated that surgical residents on average spent 90 to 100 hours per week in the hospital, if their time on night call was included. If a resident spends an average of 100 hours in the hospital for 48 weeks yearly for 5 years, then they have spent approximately 24,000 hours in the hospital during residency. If one does the same calculation for 90-hour workweeks, the time in hospital is 21,600 hours, and for 80-hour workweeks, it is 19,200 hours. If a resident decreases from 100-hour weeks to 80-hour weeks, the reduction in total hours over 5 years is 4800 hours, and if it decreases from 90 hours to 80 hours, the reduction is 2400 hours. The first figure is equal to 1 year of 100-hour weeks, and the second to 6 months of 100-hour weeks. Thus, the impact of the 80-hour weeks on surgical residents is that it has effectively reduced in-hospital time by 6 months to a year in most programs, a 10% to 20% overall reduction in clinical time.

The time which residents spend on daytime activity, Monday to Friday, has been minimally affected by the 80-hour week, and constitutes the bulk of their clinical experience. One can estimate this daytime weekday commitment as 5 days/week  $\times$  12 hours/day = 60 hours/week. The balance of their time is spent on night and weekend duty. Therefore, if they were previously working 100-hour weeks, approximately 40 hours per week was spent on night and weekend responsibilities; if 90 hours/week, 30 hours/week were devoted to night/weekend activity, and with an 80-hour week, 20 hours are so devoted, assuming the daytime weekday responsibilities are invariant. These “back of the napkin” calculations show that the transition from

a 100-hour week to an 80-hour week reduces night and weekend experience by 50%, and a 90 hour to 80 hour transition by 33%.

The impact of the 80-hour workweek is therefore that overall resident experience over 5 years of residency is reduced by 6 months to a year of in-hospital experience, and that reduction is principally taken out of night and weekend experience, when residents are more likely to see urgent and emergent conditions, and to have a greater degree of independent functioning, autonomy and indirect supervision, with fewer other residents and faculty on site.

Elective surgical experience doing scheduled nonemergent cases in the operating room has been minimally impacted by the 80-hour week, which is why the numbers often quoted in the literature regarding resident experience seem to show so little change. However, the overall in-hospital experience, and particularly the opportunity to see and participate in the management of urgent and emergent conditions, has been dramatically impacted, with a roughly estimated reduction of 33% to 50%, which has not been compensated for in other ways. The effect of this on the development of resident self-reliance, clinical judgment, and independent functioning has not been recognized or analyzed but is unquestionably detrimental.

## RESIDENT OPINION

The fraction of residents finishing general surgical residency who continue their training in a postresidency specialty or subspecialty fellowship has been steadily increasing for the last 3 decades, and at this time it exceeds 80%. The reasons for this are multiple, but among others is their belief that they are not ready for independent practice and require further training to be competent or competitive in a specific area of practice. The majority of these fellowships are of a 1-year duration, but many extend 2 or 3 years beyond the 5 years of surgical training.

An extensive survey of resident opinions regarding surgical training was completed by Yeo et al<sup>1</sup> and is the most authoritative such survey ever conducted. They obtained input from 4402 surgical residents at all levels of seniority, representing 82% of all categorical residents at the time, from 248 of 249 surgical programs.

Several questions were asked in regard to postresidency specialty training, as follows:

When presented with the statement “General surgeons must become specialty trained to be successful,” 55% of residents agreed and 26% disagreed (the remainder were neutral).

For the statement “I must complete specialty training to be competitive in the market,” 64% agreed and 21% disagreed.

For the statement “If I complete specialty training I’ll have a better lifestyle,” 63% agreed and 12% disagreed.

For the statement “If I complete specialty training I’ll have a better income,” 78% agreed and 7% disagreed.

From these responses, it seems clear that residents feel training beyond residency is necessary if they are to be successful in practice and competitive in the marketplace. Because the job market for general surgeons per se is stronger today than the market for most surgical specialists, these impressions relative to competitiveness and practice success are in fact incorrect, although the conclusions about lifestyle and income may be accurate.

In any case, it is clear that 4 of 5 finishing general surgery residents, for whatever reason, undertake further training before they enter practice. Thus, for practical purposes, the length of surgical training for more than 80% of surgical residents is 6 to 7 years, not 5 years.

## AMERICAN BOARD OF SURGERY EXAMINATION PERFORMANCE

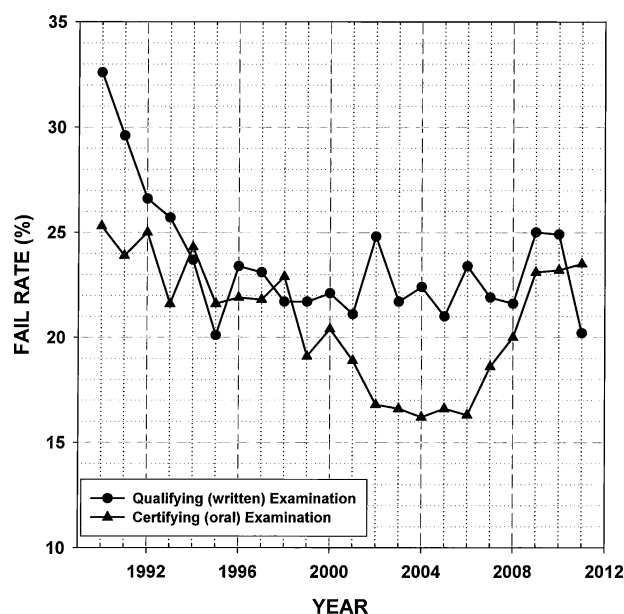
The American Board of Surgery conducts a written examination after completion of residency primarily focused on the testing of objective knowledge across the breadth of general surgical subjects. Upon successful completion, a subsequent oral examination is conducted by 6 independent examiners who are all experienced practicing surgeons, to evaluate clinical management, safety of clinical decision-making, clinical judgment in difficult surgical situations, and management of common complications. The methods of conducting this examination and the grading standards have not changed over an extended period of time.

Failure rates on the written and oral examinations are shown in Figure 1 for the last 20 years. It can be seen that performance on the written examination has been consistent during this time, with no evidence of change. The oral examination, on the other hand, showed the lowest failure rate during a plateau phase from 2002 to 2006, and then began a steady rise to the present time, with an overall increase in the failure rate of 44%.

Although this change correlates with the enforcement of the 80-hour workweek after 2003, and with successive yearly cohorts of residents working within this rubric, it also corresponds to other changes in the surgical environment already described, in particular the increasing role of laparoscopic surgery, and the gradual loss of several areas of open abdominal surgical experience to general surgical residents. Thus, causation cannot be determined for the increase in the oral examination failure rate with any degree of confidence, but it does appear that there has been a decline in residents’ perceived abilities in clinical care management, although their overall knowledge of surgical subjects has not changed.

## GRADED RESPONSIBILITY, AUTONOMY, AND INDEPENDENT FUNCTIONING IN RESIDENCY

The legal strictures relative to residency training have a logical inconsistency, which has never been adequately addressed. For the



**FIGURE 1.** American Board of Surgery examination failure rates by year.

duration of residency, until the last day of the fifth year of training, residents are not considered capable of independent or autonomous functioning and the treatments they render to patients are always considered to be dependent on the direction of a responsible attending surgeon who provides direct or indirect supervision as necessary, but is legally responsible for all the resident's actions. One day later, after completing residency, the same resident is legally considered to be "board eligible" and is subsequently "board certified," and in both instances is considered to possess sufficient competence to function independently and to manage the full gamut of surgical conditions in all patients without supervision or oversight by anyone else. That such a dramatic enhancement of competence can occur overnight is obviously illogical and fallacious.

What actually occurs, the signal accomplishment of residency training in the United States since the model defined by William Halstead in the 1890s, is that surgical residents improve their knowledge and surgical capabilities in a steady fashion throughout 5 years of residency and become progressively more able to manage more involved and complex conditions with increasing time. A successful model has evolved in which the hierarchy of residency and faculty oversight, beginning with the attending surgeon who is in charge and extending downward through different levels of resident oversight of other residents, allows the development of progressively more detailed knowledge and skills through resident functioning at increasing levels of responsibility. Attendings and more senior residents initially teach and oversee more junior residents in the performance of the dozens of skills necessary for patient management, as well as diagnostic evaluation and management; as junior residents become competent in these, they begin to function with a degree of independence and no longer need direct supervision. During the early years of residency, competence is initially gained in basic skills and simple operations. With increasing experience, diagnostic skills increase and the ability to evaluate and manage more complex diseases evolves. Manual skills in performance of operations increases in parallel with this, and the ability to perform more complex operations similarly evolves, but it is universally accepted in surgical training that it is much more difficult to acquire the diagnostic acumen and surgical judgment needed for independent practice than it is to acquire the manual skills.

Residents may initially learn how to do operations by watching others, but ultimately they must manage patients themselves and do operations themselves if they are to become competent. The American system of resident education is unique in that residency training allows residents to do so while being directly overseen and supervised by attendings who are already competent in the management of patients and performance of operations and who allow residents to manage patients and perform operations while being directly observed and overseen to prevent errors from occurring. The ability of residents to do this in progressively more complex situations is a hallmark of increasing years of experience, and in the ideal residency environment they reach the point where they can do the full spectrum of operations by the completion of residency training.

This system has been negatively impacted by the 80-hour workweek as stated earlier, but additionally by the decline in opportunities for assisting at operations in most training programs, where the opportunity to watch, before doing, is gained. Longitudinal experience with patients, from preoperative admissions through prolonged postoperative stays have been markedly reduced by the transition from inpatient to outpatient treatment for large numbers of surgical operations. Hernia repair, breast surgery, and cholecystectomy—3 staples of general surgical experience—are all managed primarily as outpatient procedures today, and residents have minimal opportunity to evaluate these patients before surgery or to follow them afterward to observe their clinical course. It was through more prolonged

in-hospital stays that residents were exposed to many of the conversations about and with patients, where matters instilling judgment, issues around palliation and provision of ethical and compassionate care took place. By reductions in work hours and changes in the "typical" in-patient, the opportunities for mentoring and apprenticeships are reduced, a formerly central component to the training process.

## ADDRESSING THE ISSUES

The environmental and technological changes described earlier are irreversible and have fundamentally altered the types of disease that require surgical treatment and the way in which the treatment is done. Such change will undoubtedly continue, and the directions in which surgery will evolve in the future are not predictable. Similarly, the resident's workweek is not going to return to 100 hours; if anything it is likely to be further shortened, as has happened in Europe. The most effective way in which to address the changes is therefore to look at the things which can be changed in resident training, the many areas in which improvements in resident teaching are possible, and the areas in which residents' capabilities could be productively expanded.

### Defining and Continually Updating the Curriculum

The starting point for making change in residency is to recognize that much of what is being taught is obsolete, and addresses diseases that are no longer a significant problem, or those for which surgical treatment is rarely needed. Teaching and testing the extensive amount of information, which exists in regard to gastric physiology, for example, is of little value to current residents who will rarely see a complication of benign peptic ulcer disease. The subjects taught in the curriculum should be continually updated to correspond to medical problems which are currently seen and treated, and new areas of technological development should be rapidly incorporated so that residents are kept abreast of current information. Bariatric surgery currently represents the most common operation that is performed in many hospitals, yet residents generally have limited knowledge of the subjects related to the causes of obesity, the physiological changes which occur after bariatric surgery, or the technical details of the various operations performed. In most residencies they have almost no direct operative experience in developing competence in performing the procedures themselves.

There should be a continuous process by which the medical conditions which are currently being treated and the surgical treatments administered are tracked and used to modify the teaching curriculum to keep residents knowledgeable regarding that which they will be treating presently and as to be fully abreast of current practices. Knowledge related to diseases which are no longer a significant problem, while it may be intellectually fascinating in many cases, should be pruned from the active curriculum.

### Improving the Efficiency of Learning

The general process of teaching residents has changed little in several decades, and is still primarily based on a preceptorship model in which the resident learns about whatever happens to walk through the door of the hospital that day, rather than through a comprehensive curriculum which covers all relevant subjects in a defined period of time, with competency testing at regular intervals to evaluate comprehension and understanding. The principles of education that are widely known and applied elsewhere are not staples of residency teaching. This in large part is because the service demands placed on residents keep them continually responding to the next significant patient care problem throughout the day and prevent structured time from being set aside for didactic teaching. Realistically, the patient care needs which residents provide will never be eliminated but the

menial and unnecessarily repetitive clerical functions which are a staple of their daily work could be dramatically reduced.

Residency training can never be a didactic classroom experience as it is in graduate schools. What could occur, however, is the delivery of a more defined and comprehensive curriculum to residents at an individual level through the multiplicity of handheld devices and small computers, which are available today and usable in any environment. Teaching of residents needs to evolve to a system in which the learning primarily occurs at the individual resident level, rather than via classroom or other group experience, but it should be governed by a structured and defined curriculum which the resident can access in his or her own time frame and in any environment where he or she finds time available for learning. Numerous studies have shown that the 80-hour workweek has not resulted in increased time reading and studying by trainees. If we wish to change this, the expectations must be more explicitly defined via a curriculum, which outlines specific levels of achievement by year of residency, and provides low-stakes online methods of self-assessment.

The variety of online and sophisticated resources for learning, including annotated operative videos, the Surgical Council on Resident Education portal and curriculum and other resources make self-directed learning more efficient now than it has ever been. Teaching material could be delivered easily in discrete increments, and could be accompanied by self-assessment upon completion that provides comparative performance data relative to one's peers, or to an absolute standard. The enormous success and rapid growth of the Khan Academy teaching modules ([www.khanacademy.com](http://www.khanacademy.com)) has demonstrated in the last few years just how dynamic such a model can be, and how effective and attractive it is to users. An almost identical model could be developed for resident learning.

Similarly, maximal learning needs to occur in all available clinical opportunities. This can be achieved in 2 ways. First, to the extent feasible, physician extenders (physician assistants and nurse practitioners) should offload the "service" components of resident work so that maximal time for clinical assessments and therapeutic decision-making can be left for the residents, and maximal time for participation in the operating room. Secondly, the teaching faculty in training programs need to understand how to teach more effectively and deliberately. We need to be cognizant of the changes to the case mix that have occurred over the past few decades and train residents deliberately in focused areas. For instance, given the urgent but rare nature of perforated peptic ulcer, residents need to be trained on the principles of gastric surgery on the cases they are seeing in elective situations, such as bariatric surgery. Teaching faculty need to be deliberate in their goals for each operation they do with trainees, with specific teaching done in every case. The laparotomy being performed for a cancer resection could and should also include a brief description and demonstration of how one might obtain vascular control of traumatic injuries in any number of intra-abdominal organs. Through these deliberate teaching moments, the case at hand can be completed, but the resident can learn two- or threefold from a given case. Teaching faculty how to effectively and efficiently do this will be crucial.

Lastly, we should consider uniform adoption of preresidency "boot camps" (held in the fourth year of medical school) that bring all entering interns to the same level of skill in regard to several basic procedures. In this way, the intern year is maximally spent on development of skills and attributes unique to surgeons and the often underutilized fourth year of medical school can be used to better benefit.

### Utilizing Simulation and More Structured Teaching and Assessment

A third improvement in teaching can occur through the development and use of simulation in focused areas, which allow the

more rapid accretion of specific skills, and the ability to objectively assess competence in these areas. The first of these to be mandated by the American Board of Surgery is Fundamentals of Laparoscopic Surgery, a course of instruction and assessment developed by the Society of Gastrointestinal and Endoscopic Surgeons. Completion of Fundamentals of Laparoscopic Surgery at an early stage in residency moves the resident to a standardized threshold of knowledge and skills for laparoscopy and allows him or her to move more confidently and rapidly into the utilization of laparoscopy in a variety of operative cases. It ensures that all residents have reached approximately the same threshold, and eliminates much of the variability and uncertainty that surrounds such skill acquisition when there is no standardized teaching or testing.

A similar evolution is occurring presently with the Fundamentals of Endoscopic Surgery, a parallel course developed by Society of Gastrointestinal and Endoscopic Surgeons for the teaching of upper and lower gastrointestinal endoscopy skills. When integrated into a complete endoscopic curriculum which specifies clinical rotations and experience, it ensures that residents have acquired a baseline competence in performing these skills. This development promises to provide an assurance that residents who complete such training will have achieved a uniform competence in endoscopic performance.

Although still not widely adopted, residents need to receive explicit instruction in basic surgical skills and techniques, which should be practiced in a simulated environment and then tested to proficiency. Studies have shown that performance of technical skills improves most when practice to defined goals is included; these should be outlined for trainees and rigorously measured. As with Fundamentals of Laparoscopic Surgery certification, if basic surgical skills are mastered early in training, more rapid and confident adoption of advanced techniques is possible.

Simulators directed toward the teaching of operative skills for specific operations such as cholecystectomy have been developed, but in general lack a close correspondence to the real thing. Such simulators have never been able to duplicate tissue characteristics in regard to blunt and sharp dissection, nor to simulate bleeding and the methods used for its control. As a result, simulators in this area have never achieved much success other than in teaching manual skill manipulation which is necessary in laparoscopic surgery, intracorporeal suturing, and similar skills which do not require an accurate depiction of tissue manipulation and dissection.

It seems likely that with increasing computer power, the accurate replication of tissue characteristics may become possible, and when that occurs it should be feasible to simulate virtually all operative procedures that are done in the abdomen. Such a development would allow for the full development of skills and the presentation of variant anatomy, difficult operative situations, etc, all before an actual encounter with patients.

An area of simulation, which has been attempted by dozens of authors, but has been of limited scope to date has been the attempt to duplicate the diagnostic workup and clinical decision-making, which is at the core of surgical treatment. The ability to conduct a skilled history and physical assessment, formulate a working differential diagnosis, and utilize testing to exclude or establish the correct diagnoses and determine the best treatment remains difficult to teach and is generally learned only through extensive real-world experience. It is often not learned well, and the well-documented errors of commission and omission in actual practice clearly indicate the need for improvement. Although this theoretically should be an ideal framework in which computer simulation might be of benefit, the ability to accurately mimic in computer programming the complex ways in which information is actually gathered and the processing which occurs in a skilled clinician's brain has so far eluded programmers,

and the programs which exist only simulate very basic situations and conditions. Even those often have an enforced linearity and lack of logical branching for the multiple scenarios which are present in reality, and therefore are of limited value in teaching the needed skills. Improvements in this area are badly needed.

### Earlier Specialty Focus in Residency Training

Three “real-world” experiments have been conducted during the last 7 to 8 years in regard to defining the preferences of medical students to undergo the classical model of training for a surgical specialty (5 years of general surgery followed by 1–3 years of specialty fellowship) or to enter instead an “integrated” specialty track directly out of medical school in which the general surgical training is incorporated into the first 3 years of training but seamlessly transitions into the specialty training, which is the ultimate goal of the fellowship. Plastic surgery was the first to introduce this model, vascular surgery was the second, and thoracic surgery the third. In plastic surgery, the overall integrated model requires 6 years, the vascular surgery model requires 5 years, and the thoracic surgery model requires 6 years.

In each of these cases, the “integrated” model has proven to be the overwhelming preference of medical students, as evidenced by a dramatic increase in the number of applications for such programs in the internship match. In plastic surgery, this has resulted in a steady increase of such integrated programs and the phasing out of the classical model. In vascular surgery, the number of integrated programs is steadily increasing and now accounts for approximately half of the 120 training programs that exist. In thoracic surgery, the experience is more limited in numbers but appears to have a similar appeal.

This experiment has clearly indicated that for medical students who already have a clear focus on a specialty area for future practice, the 5-year general surgical residency is seen as an unnecessary diversion before getting to their intended area of practice. Concerns remain as to their overall breadth of experience and areas of operative competence, and experience with these programs is not yet sufficiently great to know whether graduates in the new paradigms will function equivalently to those who completed the classical programs. However, such concerns are increasingly moot as the overwhelming preference of medical students is driving these developments in an irreversible way.

In recognition of the desire of medical students to focus earlier on the specialty area they hope to practice in, the American Board of Surgery 2 years ago adopted a “flexibility” option in regard to residency training in which an individual resident could spend 12 months during the last 3 years of residency focused on a single specialty area. It was intended that beginning in the third year and extending through the fourth and fifth years a resident could accumulate 12 months of experience in a specialty before actually entering that specialty after residency. Such experience would allow them to enter fellowship with significantly enhanced knowledge of the field, and to progress more rapidly during the 1 to 3 years of fellowship training. Utilization of this option by program directors has been limited to date, but it remains an option that can be used to allow residents to focus earlier on more specialized training during general surgical residency.

### Expanded Laparoscopic Surgery Training

In the earlier discussion, it was noted that overall, surgical residents have lost significant operative experience in open abdominal surgery, but that this has not been replaced with comparable experience doing more complex laparoscopic abdominal surgery, in part due to the development of laparoscopic surgery fellowships. Although the RRC for Surgery has mandated gradually increasing complexity and

volume of laparoscopic surgery, the requirements are still modest in regard to the breadth and complexity of laparoscopic procedures done in practice today.

There is no intrinsic reason why the requirements for breadth and volume of laparoscopic surgery during residency should not steadily increase to correct this deficiency. The initial lack of faculty with sufficient experience to teach the laparoscopic procedures has been long since corrected, and the skills of fourth- and fifth-year surgical residents are essentially the same as the fellows 1 year their senior who enter the laparoscopic fellowships. Making this transition would require the coordinated efforts of department chairs and program directors, but overall it would strengthen and expand the capabilities of graduating residents.

### Increasing Length of Residency

The time which has effectively been lost from residency because of the 80-hour workweek was noted earlier to be in the range of 6 to 12 months of in-hospital experience, largely in the urgent and emergent experience that occurs at night and on weekends. The only ways to compensate for this and achieve the same level of final training is to either train more efficiently, which has already been described, or to increase the length of residency. When the question of increasing time in residency is raised, the immediate reaction is generally that this would not be possible, because the present 5-year residency is already often viewed as too long. However, this overlooks the fact that more than 80% of surgical residents already elect to take a postresidency fellowship in a specialty or subspecialty area. Most of these fellowships are 1 year in length, whereas several of them are 2 years (vascular surgery, pediatric surgery, surgical oncology, transplantation) and some are 3 years (thoracic surgery, plastic surgery). Thus, any discussion of extending residency only applies to the 20% of residents who currently complete only general surgical residency and do not seek subspecialty training. Extending residency by 1 year to obtain more extensive training in general surgery per se would not seem to be an insurmountable issue if the benefits clearly warranted it.

The method by which training might be increased is open to considerable debate. Currently a few of the additional fellowships are subject to accreditation by the ACGME (vascular surgery, pediatric surgery, surgical critical care, hand surgery) but the majority are not. The other specialty fellowships are generally overseen by surgical specialty societies, and the degree of standardization and rigor in the oversight process is variable. Nevertheless, most of these fellowships seem to function effectively in providing the expected specialty training, and complaints are almost never heard from fellows who complete them that their training was insufficient or inadequate. Because no examinations are given for these nonaccredited fellowships, nor are other assessments made, we have no objective data in regard to differences in quality of training in different fellowships, or of overall competence gained in the specific area of training.

A characteristic of the fellowships which follows from the fact that the fellow is board eligible or board certified is that he or she is legally entitled to function independently in patient care and does not need documented oversight for all of their clinical activities as residents do. This allows the fellow to have a degree of conditional independence and to develop conditional autonomy as their skills dictate, and this has made the fellowships attractive to surgeons who find similar experience lacking in residency today. There has been no systematic study of the effect of this greater degree of autonomy, nor has there been any comparison of the performance of surgeons who have completed fellowship versus residency only in this regard, but it is an effective way of obtaining a period of training in which some independence and autonomy is available.

Utilization of the “flexibility” option during the 5 years of residency would allow fellowship candidates to utilize a sixth year training to maximal benefit, possibly eliminating the need for any specialty to require training beyond 6 years.

### **Adding Additional Skills to Surgical Residency Training**

The final area in which surgical residency might be strengthened is in the addition of technical skills which are not presently taught, but which would allow surgeons to provide more unified and comprehensive treatment for the patients they already see. One such area is the use of ultrasound for better diagnosis of conditions in breast, endocrine, vascular, and trauma diseases. This is currently done in many programs, but there are no standardized requirements established by the RRC. A second is the use of interventional catheter techniques for the diagnosis or treatment of a variety of conditions. Vascular surgery has expanded their abilities in use of catheter techniques in the last 15 years in a dramatic way to increase the endovascular capabilities of their specialty. General surgery has not done this, but there are a number of conditions in which simple catheter techniques might be used for more efficient treatment of surgical disease. Consideration should be given to the more uniform teaching and testing of such targeted skills, where it would make unified disease management more effective and efficient.

### **SUMMARY**

The practice of general surgery has undergone a marked evolution in the last 20 years, which has been inadequately recognized and minimally addressed. The changes that have occurred have been disruptive to residency training, and to date there has been minimal compensation for these. Evidence is now emerging of significant issues in the overall performance of recent graduates from at least 3 sources—the evaluation of external agents who incorporate these graduates into their practice or group, the opinions of the residents themselves, and the performance of graduates on the oral examination of the American Board of Surgery during the last 8 years. The environmental and technological causes of this situation represent improvements in care for patients and are clearly irreversible. Hence, solutions to the problems must be sought in other areas. The problems brought about by the 80-hour workweek are somewhat different and dictate that more efficient and perhaps additional training is needed. To address the issues effectively, greater recognition and engagement is needed by the surgical community so that effective solutions can be crafted.

### **REFERENCE**

1. Yeo H, Viola K, Berg D, et al. Attitudes, training experiences, and professional expectations of US general surgery residents. *JAMA*. 2009; 302:1301–1308.