Fellowship Training
Need and Contributions

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KEYWORDS

• Surgical education • Fellowship • Surgical specialties • Surgical residency
• Advanced laparoscopy • Board certification

KEY POINTS

- Most graduating surgery residents pursue fellowship training.
- The current status of residency training and multiple societal changes have contributed to the increased reliance on fellowship training.
- Surgery fellowships provide the opportunity to master surgical skills, gain confidence and progressive autonomy, and receive further mentorship before entering independent practice.
- Surgical education is a dynamic process that will continue to evolve as we face the challenges ahead. Despite these challenges, North American residencies and fellowships are among the best in the world.

HISTORICAL REVIEW

Eighty percent of graduating residents now apply for fellowship training.[1] In an effort to understand this phenomenon, it is beneficial to review the history and evolution of surgical education and subspecialization.

Dr William Halsted is credited with being the father of current surgical education. In 1890 he became the first chief in the department of surgery at Johns Hopkins University and around that time established the first formal general surgery residency. Halsted based his residency program on an apprenticeship model with hospital-based training. The internship had no established length of time; rather, advancement was granted when he decided the trainee was ready to progress. This internship was typically followed by 8 years of additional training as a "house surgeon."[2] Trainees typically lived in the hospital; thus, the term *residency* came into use. The system

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Halsted established was pyramidal in structure, that is, more residents began training than were allowed to finish. Dr Halsted is credited with training some of the key educators of surgical subspecialization, including Harvey Cushing and Walter Dandy in neurosurgery, Samuel Crowe in otolaryngology, and Hugh Young in urology.[3,4]

In the early 1920s, medical and surgical care grew increasingly complex, and participation in internships in the United States became more common. By the 1930s, the American College of Surgeons (ACS) was pressing for better surgical training. At this time, a Committee on Graduate Training in Surgery was created. The committee determined that the best approach to surgical training was through general surgery residency. The committee also established minimum standards of education in the understanding of surgical anatomy, physiology, and pathology.[5] Around the same time, multiple certifying boards in subspecialties of surgery were established, including the American Board of Surgery (ABS) (**Table 1**).[6]

In the 1940s, Dr Edward Churchill at Massachusetts General Hospital advocated for a change from the pyramidal structure of training to a rectangular model in which all residents who started training would have an opportunity to finish, so long as they showed satisfactory progress.[2,7] He thought that general surgical training could be accomplished with a 5-year residency.[6] It was not until the 1980s that the Residency Review Committee (RRC), an arm of the Accreditation Council on Graduate Medical Education (ACGME), mandated that programs shift from the pyramidal to the rectangular structure.[8]

Table 1
Timeline of American board certification of surgical specialties and subspecialties

Specialty Board	Year
American Board of Ophthalmology	1917
American Board of Otolaryngology	1924
American Board of Obstetrics and Gynecology	1930
American Board of Orthopedic Surgery	1934
American Board of Colon and Rectal Surgery	1935
American Board of Urology	1935
American Board of Anesthesiology	1937
American Board of Plastic Surgery	1937
ABS	1937
American Board of Neurologic Surgery	1940
ABTS	1948
ABS, Pediatric Surgery	1973
ABS, Vascular Surgery	1982
ABS, Surgical Critical Care	1986
ABS, Surgery of the Hand	1989
ABTS, Congenital Heart Surgery	2006
ABS, Hospice and Palliative Medicine	2008
ABS, Complex General Surgical Oncology	2012

Abbreviations: ABS, American Board of Surgery; ABTS, American Board of Thoracic Surgery.

Adapted from Bruns SD, Davis BR, Demirjian AN, et al; Society for Surgery of Alimentary Tract Resident Education Committee. The subspecialization of surgery: a paradigm shift. J Gastrointest Surg 2014;18:1526.

The drive for surgical subspecialization became more profound during World War II. Physicians who had subspecialized training were given higher military rank, increased pay, and better assignments.[2]

In the 1970s and 1980s, competition increased between general surgery specialties and subspecialized surgical groups. The ABS established board certification in multiple subspecialties, including pediatric surgery, vascular surgery, critical care, and hand surgery. The establishment of these subspecialties laid the groundwork for the current state of fellowship training (**Table 2**).

FACTORS CONTRIBUTING TO THE NEED FOR FELLOWSHIP TRAINING

Multiple factors over several decades have led to our current state of surgical education and reliance on fellowship training. Some of these are attributable to influences outside of training, and others are directly related to changes in surgical residency training. Regardless of these influences, many choose fellowship training in order to focus their clinical practice and to become known as experts in their particular subspecialty of surgery.

Among the external forces that have propelled us toward an increased reliance on fellowships for surgical training are significant advances in surgical technology. Along with these advances comes the requirement that surgeons learn entirely new sets of skills. For example, in vascular surgery it is now the standard of care to treat many conditions with endovascular or microvascular techniques. Rather than performing

Table 2
Current status of surgical specialties and subspecialties in the United States

Discipline	Certifying Body	Board Certificate	ACGME-Regulated Residency/Fellowship
General surgery	ABS	Yes	Yes
Vascular surgery	Vascular Surgery Board of the ABS	Yes	Yes
Pediatric surgery	Pediatric Surgery Board of the ABS	Yes	Yes
Surgical critical care	Surgical Critical Care Board of the ABS	Yes	Yes
Thoracic surgery	American Board of Thoracic Surgery	Yes	Yes
Colorectal surgery	American Board of Colon and Rectal Surgery	Yes	Yes
Plastic surgery	American Board of Plastic Surgery	Yes	Yes
Advanced gastrointestinal surgery	The Fellowship Council	No	No
Surgical oncology	None	No	No
Transplant surgery	None	No	No
Breast surgery	None	No	No
Endocrine surgery	None	No	No
Acute care surgery	None	No	No

Adapted from Bell RH Jr. Graduate education in general surgery and its related specialties and subspecialties in the United States. World J Surg 2008;32:2182.

surgery directly on affected vessels through larger open incisions, many vascular disease processes can be treated through arterial or venous punctures and the utilization of specialized wires, catheters, and stents. These minimally invasive vascular techniques benefit patients by decreasing morbidity and length of hospital stay.[9] Despite these technological advances and the additional training their use requires, vascular surgeons must still be trained in traditional open techniques because not all disease processes are amenable to the minimally invasive options.

Advances in energy-based sources and endomechanical (ie, stapling) devices have profoundly affected the general and thoracic surgeon. These devices and associated technologies have reshaped the landscape of surgical care. The introduction of laparoscopic/thoracoscopic surgery demands that trainees obtain a new skill set during their years of residency training. The robot has now obtained a firm footing in surgical subspecialties, such as gynecology and urology, and is breaching into the realms of colorectal and general surgery practices as well.

Public perception that better care can be provided by specialists, such as those with fellowship training, has also made subspecialization more attractive. Advertising and market forces attempt to draw patients to physicians who have subspecialty training. There have been attempts to regionalize complex surgical cases, bringing patients to centers with high volumes and fellowship-trained specialists.[8,10]

Societal changes over the last several decades have also affected surgical education. Historically it was thought acceptable to have residents see one, do one, teach one. As residents achieved seniority in their training programs, they became accustomed to operating independently.[8] This resident autonomy has been greatly diminished by Medicare regulations that require direct attending supervision and by changes in the legal climate. For all its shortcomings, the system of the past provided a framework for confidence as new surgeons completed residency and entered practice.

Expansion of surgical knowledge over the past several decades requires that trainees gain command of a far greater body of knowledge than in the past. There has also been a shift in how disease processes are treated. Conditions that, in the past, frequently required surgery, such as peptic ulcer disease, common bile duct pathology, certain traumatic injuries, and portal hypertension, are now rarely treated with surgical interventions.

Limitations placed on resident work hours directly and greatly affect current residency training. The infamous death of Libby Zion in 1984 prompted the creation of The Bell Commission in the State of New York. The Commission concluded that resident fatigue, lack of resident supervision, and unfamiliarity with the patient's complex condition led to her death. In 1989, these findings led to the creation of New York State laws that limited resident work hours to a maximum of 80 hours per week, of which no more than 24 hours could be worked consecutively. In 2003, the ACGME mandated that similar guidelines be instituted in all residency programs throughout the Unites States. This decision reduced the hours spent in surgical training by 20% over 5 years—the equivalent of a full year of hands-on surgical education.[8]

In 2011, additional work-hour restrictions and supervision regulations were placed on interns. These restrictions limited first-year trainees to no more than 16 hours of consecutive work, no at-home call responsibilities, and no in-house responsibilities without a more senior resident or attending being physically present. It also mandated at least 8 hours of off-duty time between scheduled duty periods, with a recommendation for 10 hours off.

The goals of duty-hour restrictions were to improve patient safety, resident education, and overall resident well-being. Multiple studies have attempted to quantify the

impact of the duty-hour restrictions on patient safety and surgical education, with mixed results. Some studies show no change in patient safety, and others show a deleterious effect.[11,12] A recent study on the impact of the 2011 duty-hour changes on patient safety showed no difference in mortality rates, serious complications, or readmissions when compared with those of the 3 years preceding these changes.[13] In a systematic review of the literature, Ahmed and colleagues[12] evaluated publications about the impact of duty-hour restrictions on patient safety and resident education. They reviewed more than 700 published articles, of which 135 met inclusion criteria. Of the included articles, 57 were considered to be of moderate or high quality. Findings from their review show no improvement in patient safety and, in fact, a detrimental effect in higher-acuity patients. Furthermore, nearly 90% of publications reported neither improvement nor worsening of resident education. General surgery oral examination board failure rates have climbed by 44% since implementation of duty-hour restrictions.[1] Nine of the 57 studies deemed to be of moderate or high quality evaluated resident well-being. More than 70% of respondents reported improvement in quality of life with the initial duty-hour changes made in 2003, but further enhancement was not observed with the additional changes made in 2011. Results of the studies using validated measures showed no change in resident fatigue, wellness, or burnout.[12]

Whether limitations in resident duty hours have positive or negative effects is not the intended point of this discussion; rather, the point is that these changes have altered surgical education and have been a major factor in the current need for fellowship training. It is the authors' belief that many of these restrictions will continue to remain in force for the foreseeable future, thus necessitating a change in how surgical education is implemented. Opinions about what the future landscape of residency training should look like are many and varied. Some argue that we should *fix the five*. That is, we should change how we educate and become more efficient with the time we are allotted.[1,14,15] Others suggest the establishment of core general surgery training for 3 to 4 years, followed by subspecialized training for an additional 1 to 3 years.[14] This early track approach has the theoretic advantage of reserving specific cases for those who plan to do them for the rest of their career rather than distributing these cases among all residents, some of whom have no intention of performing the case in their clinical practice. One key disadvantage of this approach is the need to conduct an additional match following the initial phase of training. This approach also raises the dilemma of how residents who complete only the initial phase of training and do not go on to finish the remaining subspecialty years would fit into the profession.

Not only have duty hour changes affected residency training but the operative experience has also shifted. As mentioned previously, more diseases and conditions are treated nonoperatively than in the past. Additionally, there has been a shift from open vascular cases to endovascular techniques and a decrease in open abdominal surgery due to the explosion of laparoscopic techniques. In several of the defined categories of training, the volume of cases with which residents graduate is lower than what is deemed necessary to provide confidence in independent practice.[14,16–18]

The aggregate of these and many other factors have influenced surgical education, thus creating an environment in which fellowship and surgical subspecialized training is quickly becoming the expected pathway for most graduating surgery residents.

FELLOWSHIP TRAINING, THEN AND NOW

The practice of the general surgeon managing a broad array of diseases ranging from thoracic, vascular, alimentary tract (foregut, midgut, and hindgut), solid organ, head

and neck, and skin and soft-tissue diseases has significantly shifted over the past 30 years. These diseases remain core components of resident education, but fellowship training has profoundly altered who manages them.

In the United States, more than 20 specialty fellowships of surgery are recognized, not including subspecialties of surgery, such as orthopedics, neurosurgery, urology, ophthalmology, and otolaryngology (**Fig. 1**). Traditionally, these subspecialties required 1 to 2 years of general surgery training as a prerequisite to the specialty education.[19] Some of these programs have reevaluated the need for more time in subspecialty training and have eliminated or decreased the number of years spent in general surgery. The first to do away with general surgery training was ophthalmology.[20] Neurosurgery and orthopedic surgery have since excluded this requirement as well, and there is currently one urology program that has followed suit. The perception is that there is so much to learn within the surgical subspecialty that all of the trainees' time should be spent focused on the knowledge they will need in their future practice.[19]

The first ABS-certified fellowships in general surgery included colorectal surgery, plastic surgery, and thoracic surgery. At the inception of these fellowships, it was expected that the trainees would complete a 5-year general surgery residency, followed by fellowship training. Graduates of these fellowships were considered board-eligible in both general surgery and their respective subspecialty. It was not uncommon for a trainee to spend 7 to 8 years in residency and fellowship training combined to complete their formal educational experience in order to start their own practice in surgery. In 2003, the ABS proposed an early specialization program (ESP) authorizing vascular fellowship programs to pull residents from their general surgery training after only 4 years directly into the 2-year fellowship training, thus, decreasing the total time of training from 7 years to 6 years.[21] Early specialization has the theoretic advantage of directing surgical cases to the trainee who will need it most for future practice. More recently, medical school graduates have begun matching directly into some subspecialty surgical training programs, such as vascular, plastic, and thoracic

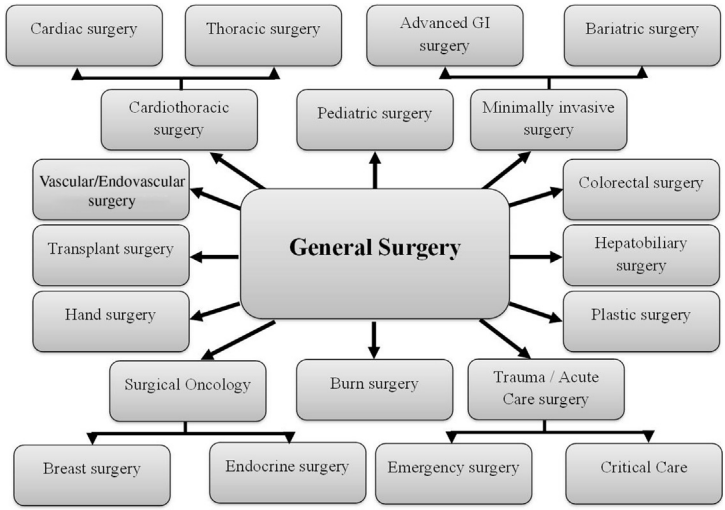

Fig. 1. The subspecialization of surgery. GI, gastrointestinal. (*Adapted from* Bruns SD, Davis BR, Demirjian AN, et al; Society for Surgery of Alimentary Tract Resident Education Committee. The subspecialization of surgery: a paradigm shift. J Gastrointest Surg 2014;18:1524; with permission.)

surgery. This training paradigm is referred to as an *integrated* pathway and consists of 3 years of general surgery training followed by 3 years of subspecialty training, all managed by the subspecialty program director.[20] Graduates from these integrated pathway programs are board eligible for their subspecialty but not necessarily for general surgery.[17]

Although pediatric surgery was authorized to participate in the ESP at the same time as vascular fellowship programs, they have elected to stay with the traditional 5 years of general surgery residency training followed by the 2-year pediatric surgery fellowship. It is theorized that the practice of pediatric surgery is similar enough to its general surgery roots that there is still a significant benefit in the knowledge and skill set attained during a general surgery residency. This training is in contrast to vascular surgery whereby there has been a major shift to endovascular treatments, drastically changing training.[20]

CURRENT STATUS OF SURGICAL FELLOWSHIPS AND SUBSPECIALTIES

The high rate of graduating residents who pursue fellowship training is not likely to decrease in the near future. There is a widespread perception that many chief residents graduate lacking the skills necessary to confidently perform some basic and many advanced laparoscopic operations.[17,18,22] Fellowships have the potential to bridge the gaps found in many residencies by providing the graduating resident with an opportunity to master surgical skills, gain confidence and progressive autonomy, and receive further mentorship. The experience also facilitates the transition from training to independent practice. Additionally, fellowship experience allows a surgeon to tailor his or her training to coincide with personal interests and future practice goals.

The number of graduating surgery residents who apply for fellowships is now more than 80%.[17,23] This number has progressively increased over the last decade and a half. In 2001, 65% of graduating surgery residents thought that they would benefit from additional training.[18] The ABS estimates that around 90% of chief residents will seek additional surgical training following graduation from general surgery residency.[24]

Some believe that the current state of fellowship training, including the rapid explosion of fellowships offered in advanced laparoscopic and gastrointestinal surgery, have placed stress on our surgical education process.[1,20,23] They contend that fellowship training has increased at the expense of residents, with the more advanced cases funneled to the fellow.

In contrast to this perception, Kothari and colleagues[25] and Hallowell and colleagues[24] independently evaluated the impact of a minimally invasive surgery (MIS) fellowship on their residency programs. Kothari and colleagues[25] looked at the number of nonbariatric advanced laparoscopic cases performed by residents both before and after the establishment of an MIS fellowship. Results from their single-institution study revealed an increase in resident experience with basic and advanced laparoscopic cases after the fellowship was created compared with before its inception: 193.3 ± 34.5 versus 140.5 ± 19.5 and 113 ± 23.5 versus 77 ± 17.8, respectively. Conclusions from their study were that a general surgery residency and an advanced laparoscopic fellowship can coexist without a detrimental effect on resident case volume. In fact, surgery residents experienced an increase in both basic and advanced laparoscopic surgery cases, while a successful fellowship was created and sustained.[24]

Hallowell and colleagues[24] performed a retrospective review of the laparoscopic operative cases for their residents and fellows over a 10-year period (2001–2011) and compared them with the national average found in the ACGME's case log system.

Their graduating chief residents performed on average 116.2 ±4.9 basic and 91.5 ±7.2 complex laparoscopic cases. During the same period, their fellows completed an average of 118 ±10.8 mostly complex laparoscopic cases as fellows and 118 ±20.9 basic and complex cases as the attending surgeon. Their resident numbers were similar to the national average and increased overall during the study period. Like Kothari and colleagues,[25] Hallowell and colleagues[24] concluded that a general surgery residency and laparoscopic fellowship can coexist. They acknowledged that a robust program was necessary in order to have adequate laparoscopic case volumes for both the resident and fellows. They believe that having the fellow enhanced the resident experience, especially when the fellow was acting as the attending during on-call responsibilities.

Not all programs have successfully sponsored concomitant laparoscopic fellowship and general surgery resident programs. Linn and colleagues,[26] from Northwestern University, described their experience of discontinuing their laparoscopic fellowship because of concerns about its adverse effect on their residency program. Although Hallowell and colleagues[24] concluded that fellowship and residency could coexist, they were obliged to decreased the number of fellows from 2 to 1 per year as bariatric case volumes declined. Therefore, each program must carefully evaluate its own circumstances and verify that it has sufficient case volume to support a fellowship program with a determined number of fellows without harming the residency training experience.

The number of advanced laparoscopic fellowship programs has increased over the past decade, from 80 in 2004 to 121 in 2015.[27] These programs and other fellowship positions are fulfilling the needs of graduating chief residents: whether to rectify a lack of experience during residency, to enhance laparoscopic skills, to become more competitive in finding a job, to focus future practice in a particular specialty, or to further their aspirations to become leaders in the field.[17,28,29]

The impact of fellowship training on future clinical practice can be difficult to quantify. In an effort to look at the benefits of laparoscopic fellowship training, researchers conducted a survey of former MIS fellows.[28] Although the response rate was low at 30%, the survey revealed that 90% of respondents thought that their fellowship was either extremely beneficial (75%) or beneficial (15%) to their career. The reasons cited for pursuing an MIS fellowship included to enhance laparoscopic skills (34%), to improve the chances of obtaining a job in a competitive market (22%), to improve the chances of becoming a future leader in the field (20%), to compensate for a lack of exposure and/or case volume during residency (19%), and to jump start a career in academics (5%).[28] Most of these MIS-trained surgeons still incorporated a broad range of laparoscopic gastrointestinal surgery into their clinical practice.

Some leaders in surgery have raised concerns that these fellowships and others that do not fall under the umbrella of board certification are unregulated and lack oversight.[1,19,20] In 2004, the American Surgical Association Blue Ribbon Committee published a report on surgical education. They described subspecialty fellowship training as, “largely unregulated, unsupervised, nonuniform, and uncertified.”[30] At the time of this report, progress was already being made to correct many of the deficiencies cited. Laparoscopic fellowship programs act under the direction of the Fellowship Council (FC) established in 1997, initially known as the Minimally Invasive Surgery Fellowship Council. The initial goals of the FC were administrative in nature. They wanted to provide order to the application and match process and to properly define relationships with other organizations that were attempting to influence fellowship training. The ACS, ABS, Association of Program Directors in Surgery, and the RRC were all initially in opposition to the expansion of fellowships in MIS and advanced gastrointestinal surgery because of concerns that resident education would suffer and that the end

result could lead to "franchises in gastrointestinal surgery."[23] Despite the disapproval of these influential societies, MIS fellowships have continued to expand as the perceived need for training beyond residency has skyrocketed. The FC has been instrumental in providing leadership and structure to this process.[31] The goals of the FC have shifted from where they were initially. Their main focus now is to organize and promote the development of high-quality fellowship programs.[27] The FC first provided oversight and regulation of the match process for the 2004 academic year. The FC has grown significantly since its inception and now aids in the regulation of a wide variety of fellowship programs, including advanced gastrointestinal surgery, endoscopy, MIS, bariatric/metabolic, hepatobiliary, colorectal, and thoracic surgery. More than 30% of postresidency fellowship applications are now managed by the FC.[23] The FC has been involved in the accreditation of fellowships since 2004. Individual programs are required to be in compliance with established guidelines and to submit annual reports. Every 3 years reaccreditation must occur through a formal application, and site visits are currently required every 6 years. Additionally, the FC has been instrumental in establishing a formal curriculum for each type of fellowship, which has helped to ensure uniformity in the acquisition of knowledge and surgical skills for each of the subspecialized fellowship categories.

Pursuing fellowship training is not unique to graduating general surgery residents. Ninety-five percent of responding pathology residents surveyed during their annual training examination planned to complete one or more postresidency fellowship programs. Their reasons for pursuing fellowship were similar to those given by surgery residents: to enhance skills with additional training (41%), to obtain a desired position (33%), to enhance the ability to secure employment (23%), and because a desirable job was not available immediately after residency (4%).[32]

Fellowship training provides an unparalleled opportunity to transition from formal training to independent practice. Many fellowship programs require application for hospital credentials so that fellows can take some independent calls.[28] This requirement affords fellows the autonomy that they typically did not experience during residency training and helps boost their confidence in managing emergency and acute surgical cases. Fellowship programs that have an associated surgery residency give fellows the opportunity to become the teacher. In this role, fellows have the opportunity to significantly enhance resident education.

The authors believe that MIS fellowships have been the true model for transition to practice over the past several decades. MIS fellowship training fits within the realm of general surgery; but the fellowship year provides additional mentorship and an environment capable of providing confidence and autonomy, both in and out of the operating room. Results of a survey about anticipated practice patterns after fellowship training indicated that none of the respondents planned to have a bariatric-only surgical practice.[29] Thus, most graduating MIS/bariatric fellows enter a surgery practice in which general surgery remains a significant component. MIS fellowship-trained surgeons can use the skills and knowledge attained during fellowship to educate other surgeons and, equally important, to provide expert care to surgical patients. Many of the challenges found in today's surgical education climate can be overcome by fellowship training without sacrificing the practice of general surgery.

Although the precise nature of surgical education as we move forward is uncertain, the future is bright. At no other time in history have we had the resources available that we do now. We have outstanding residencies and fellowships, state-of-the-art technology, and major advances in surgical education and simulation. Surgical education in North America continues to draw applicants from all over the globe because our training programs are widely recognized as among the best in the world.

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