

Presidential address: Thoracic surgery education—Responding to a changing environment

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It is human nature to believe that the changes we witness and participate in are the most profound in history. In one lifetime, my grandfather witnessed a change in transportation from horseback to space travel and flights to the moon. In roughly the same 100 years, our specialty evolved from draining empyemas and a fear of even suturing the heart to repairing the most complex congenital defects, heart and lung transplantation, and even replacement of the heart with a mechanical device. Despite these advances, some fear that our specialty may be facing significant decline—even extinction—because of equally impressive advances by our colleagues, especially in cardiology. Bill Baumgartner, in his wonderful presidential address to The Society of Thoracic Surgeons (STS), described the changes occurring in our specialty and the opportunities afforded by these changes.¹ Today I would like to discuss how these changes and the environment in which they are occurring are affecting our educational process and how cardiothoracic surgery education is evolving to respond to this changing environment. Please note that I chose the title “Thoracic Surgery Education” *not* “Thoracic Surgery Resident Education,” because surgical education is a continuous process extending from medical school through the postgraduate years. Because general and thoracic surgery education have been so closely intertwined, many of the issues important to one are also critical to the other.

The American Association for Thoracic Surgery (AATS) was founded in 1917, and the first president was Samuel Meltzer, who stated in his presidential address, “The chief aims of the Association are the advancement of knowledge and skill in thoracic surgery.”² He went on to say in the discussion, “I am confident that a time will come when thoracic surgery will be equal in importance to surgery of the abdomen.”² One prospective member disapproved of the founding of the AATS, indicating that once empyema was cured, the association would dry up for lack of other topics. Instead, our specialty and the association have thrived. Today, 86 years later, we have a 5-day international meeting with multiple simultaneous sessions, a record 717 abstracts submitted, and 4389 attendees from 79 different countries.

The first thoracic residency was established at Michigan by John Alexander in 1928. At the 1936 meeting of the AATS, in an article entitled, “The Training of a Surgeon Who Expects to Specialize in Thoracic Surgery,” Alexander stated that “two years of intensive study and practice in an active. . . thoracic surgery clinic are sufficient to take the examination of a board,” but went on to say that “a greater length of time would be desirable.”³ This 2-year training requirement was initiated when our specialty treated mostly empyema and tuberculosis. Predating the 80-hour work week requirements by 67 years, Alexander stated that his residents’ work “occupies an average of nine or ten hours a day during two years except for two vacations of a month each.”³

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The American Board of Surgery (ABS) was formed in 1937, and initially there was a strong determination for thoracic surgery to stay within the specialty of general surgery. However, thoracic surgery matured rapidly during World War II, and at the 1947 meeting the members of the AATS voted for establishment of a subsidiary American Board of Thoracic Surgery (ABTS). Thus the board was a direct outgrowth of this association. The first written examination (28 candidates) was held August 1, 1949, and the first oral examination was held the following October. The only cardiac question on the first written examination was, "Discuss the alterations in physiology which occur in children with congenital heart anomalies resulting in cyanosis."⁴ The other 9 questions dealt with pulmonary problems.⁴ As our specialty continues to evolve, I wonder what questions will be on the 2049 examination at the time of the board's 100th anniversary. The ABTS subsequently became an independent board in 1971. Other milestones in thoracic surgery education included the Residency Review Committee for Thoracic Surgery (RRC-TS) founded in 1967, the Thoracic Surgery Directors Association in 1977, the matching program in 1982, the first in-training examination in 1983, and the Joint Council on Thoracic Surgery Education in 1996.

Most cardiothoracic surgeons educated in the United States probably believe that cardiothoracic surgery education is reasonably similar throughout the world. Only recently have I learned how significant the variations are. Some of these differences were noted by Bainbridge⁵ in 1992, and again recently by José Pomar⁶ in an address at last year's European Association for Cardio-thoracic Surgery (EACTS) meeting. Pomar⁶ found that in Europe the total length of cardiothoracic training ranged from a low of 22 months to a high of 90 months and was not even defined in 2 countries. Exposure to general surgery (before cardiothoracic surgery) varied between 0 and 72 months, most often between 12 and 24 months. The time subsequently dedicated to cardiothoracic education ranged from 2 to 9 years, in most cases 5 or 6 years. Significant differences exist among other countries as well. Clearly, there are different ways to educate cardiothoracic surgeons. We will learn tomorrow from Frank Culbertson about the international space station and the future of space exploration. Participation in such ventures by international crews necessitates a significant commonality of training, and as the world grows smaller through improved communication, it is likely that the education of cardiothoracic surgeons will become increasingly similar throughout the world.

Medical education is an interesting process. My parents were both professional educators and were appropriately prepared for their careers. It is safe to say that academic cardiothoracic surgeons are surgeons first and educators a more or less distant second. Few of us were taught how to

teach, how to examine, or how to evaluate our students. One change to improve future surgical education will almost certainly involve increased reliance on professionally trained educators, as is occurring in some departments. With the many changes currently affecting our specialty, now is an appropriate time to comprehensively reevaluate our educational system to determine whether it can be improved. Bill Baumgartner¹ spoke about the pioneers who developed our specialty—we must be sure that our educational process inspires and equips new pioneers to meet the challenges of the future.

It would of course be inaccurate to imply that no change has occurred since Alexander developed the first residency. The Thoracic Surgery Directors Association has been responsible for many positive changes, including the matching program, the development of a standardized curriculum, and the exciting new computer-based prerequisite curriculum for incoming residents. The RRC-TS has moved from a more or less "old boy" network to a rigorous process for program evaluation and accreditation, and in recent years it has closed or forced reorganization of programs that have emphasized service over education. However, in my opinion, much work remains to be done in this area. The examination process by the ABTS has been strengthened by the adoption of criterion-referenced written and oral examinations and by the use of advanced psychometric statistical evaluation of the examination itself. The resident in-training examination has been significantly improved and is now computer-based and administered through the Cardiothoracic Surgery Network (CTSNet). In the near future, part I of the board examination will also be computer-based and administered to candidates closer to or at home. Recent changes in board requirements will be discussed later in this article. The STS database is an extremely valuable resource that has educated us about our patient outcomes relative to those of our peers.

The role of CTSNet as an educational tool by providing access to databases, on-line journals, multimedia programs, and the like is sure to increase. The significant financial support provided by the STS, AATS, and EACTS will at some point be viewed by our successors as an extraordinarily wise investment. In addition, CTSNet has made the world much smaller by increasing communications and collaboration with our colleagues in other countries.

Despite these significant advances, much remains to be done.

I believe that additional changes in the educational process are needed to address the following issues:

1. Declining interest in medical school and especially in surgery
2. Changing demographics of medical students and residents

3. Lifestyle of cardiothoracic residents and practicing cardiothoracic surgeons
4. Changing societal expectations
5. The need for improved tools to assess surgical education
6. Continued competence of practicing surgeons.

Changes that will be proposed should not be viewed as attempts to simply make our specialty more attractive. Instead we must make the educational process the best that it can be and then let supply and demand take over. The goal remains to attract the best qualified candidates and provide them with the best possible education.

First, let's consider the potential effects of the decreased interest in medicine as a career. Medical school applications in the United States were down in 2002 for the seventh year in a row, some 26% below the peak of 1996.⁷ This has occurred despite the change from a previously predicted physician oversupply to now a projected shortage of 75,000 to 100,000 physicians (mostly specialists) by 2020.⁸ The number of medical students choosing general surgery has declined, from 12.1% in 1981 to 5.1% in 2002.⁹ In the last several years, the number of unmatched general surgery positions has increased, and more positions are being filled by international graduates, although this trend did improve in this year's match. Because historically general surgery has been the only pathway to a thoracic surgery residency, this decline in interest in general surgery has real implications for our specialty and may partially explain the recent decline in interest in cardiothoracic surgery. This decreased interest has occurred despite the projection from our most recent manpower study that cardiothoracic surgeons will decrease from 1.3/100,000 population to 0.9/100,000 population by the year 2020.¹⁰ Because of the continued population growth, especially in the elderly component with the aging of the baby boomers, and the growing epidemic of obesity, diabetes, and related diseases, I believe that the current difficulties in the job market being experienced by our residents are temporary and that we are heading toward a real shortage of general and cardiothoracic surgeons in the next 2 decades, despite the continuing inroads made by other specialties.

Surgical educators must quickly address these issues, because the pipeline for surgical training is so long. First we must rekindle the interest of our most talented students in a career in medicine by taking every opportunity to serve as mentors and advisors, even at the high school level. The bursting of the stock market bubble and the economic recession will probably cause some highly qualified candidates to once again consider medicine as an attractive career, but the bias of medical school admission committees against candidates interested in specialty careers must be overcome. Today's malpractice climate clearly deters some students, but there are encouraging developments on the

horizon. I believe that our patients will be more effective on our behalf than professional lobbyists. When patients begin to experience decreased access to physicians, as has been the case recently in Nevada, Mississippi, West Virginia, and other states, then tort reform will begin to occur, as happened in Mississippi in the past year. It is encouraging that President Bush has made this a priority, and I was further encouraged by Secretary Thompson in his remarks to the STS as well as by recent activities in Congress.

Continued decline in physician reimbursement will also adversely affect patient access, and eventually this will result in changes favorable to cardiothoracic surgery. Senator Frist, our colleague and now Senate majority leader, spoke out last fall on the issue of physician reimbursement, stating, "There is simply no choice but to act. . .to prevent draconian cuts in physician reimbursement and other areas that will prevent beneficiaries from gaining access to quality health care."¹¹ Indeed, recent acts by Congress have decreased but not eliminated further cuts scheduled for the next few years.

However, we must stop focusing on our personal income. Tom Krizek,¹² in the 2001 American College of Surgeons ethics lecture, stated, "We have run the risk of exchanging virtue and respect for money. One of the most impairing facts of our profession may be that we have become rich, that we expect to be rich, and at the same time society does not highly regard the rich." In fact, the average income of cardiothoracic surgeons easily places us in the top 1% of US wage earners. It is to be hoped that few of us chose cardiothoracic surgery for purely economic reasons, and society is unlikely to have much sympathy for our small profession unless the debate is framed in the context of decreased *access* to care by patients caused by continued decline in physician reimbursement.

Surgeons must aggressively seek access to medical students in the first year by serving as advisors, by participating in basic science teaching, by sponsoring surgical interest clubs, and by welcoming them to operating rooms, grand rounds, and conferences. Surgical faculty members must be acutely aware of their importance as role models and transmit more of the satisfaction that we all get from patient care, research, and teaching instead of focusing on our unhappiness with government regulation and reimbursement. Curriculum changes, including true redesign of the fourth year, could potentially shorten surgical residencies of all types by a full year. The balance between service and education must clearly shift toward education. Students and residents can no longer be expected to function as cheap labor for the hospital or for individual attendings. Program director turnover, currently as high as 30%/y, must be decreased by recognition of this important position through appropriate compensation, and promotion.

The changing demographic characteristics of medical students and residents necessitate a change in thoracic surgery education. Today's students are older, they have often had one or more previous careers, they are frequently married, usually with children, and their debt load at graduation averages \$100,000, all factors making it less likely that they will pursue a 7- to 10-year cardiothoracic residency. The number of women in medical school has increased dramatically, but the number of women interested in surgery has remained relatively constant. I find that women are just as fascinated by the technical aspects of surgery as men, but they are simultaneously afraid that the surgical lifestyle will be intolerable. Currently only about 20% of candidates certified by the ABS are women. Since the founding of the ABTS, only 139 of 6748 diplomates (2.1%) have been women. In the past 10 years the percentage has increased, but only to 4.6% (Glennis Lundberg, ABTS. Personal communication, 2002). An optimistic view is that women represent virtually an untapped source for future cardiothoracic surgeons. However, thoracic residency and the current practice of cardiothoracic surgery are not friendly to women. If we are to attract this important segment of medical students into surgical specialties, we must recognize and increase our sensitivity to their special needs. The emphasis of education over service, the 80-hour work week mandate, *team* continuity of care, and the gradual increase in women surgeons who can serve as role models should help in this regard. Surgical residency programs must be permitted increased flexibility by the RRC-TS to more easily address medical leave for pregnancy. We should consider shared residency positions that, although requiring more years for completion, would allow women surgeons to begin a family at an earlier age.

Thoracic surgery education must change to improve the lifestyles not just of women but of all residents and subsequently of practicing cardiothoracic surgeons. Modern surgical education was initiated by William S. Halsted at Johns Hopkins. Most of us, particularly those who were outgrowths of the Halsted system as was the case at Duke, were not too concerned about the work environment as residents. We just wanted to be cardiothoracic surgeons, and this was part of the price. Few of us were perceptive enough to recognize the impact on either ourselves or our families. I vividly recall two quotes from medical school and residency that set the tone. Eugene Stead, the chairman of medicine at Duke, frequently stated, "If you can't get your work done in 24 hours, you had better work nights."¹³ Dr Sabiston often reminded us of Osler's statement that the "master word (in medicine) is WORK."¹⁴ It is interesting that both statements came from internists. *Times have obviously changed!*

As the interest in surgery has declined, interest has increased in specialties with more controllable lifestyles, such as radiology, emergency medicine, dermatology, and

others. When I talk to third-year medical students rotating on surgery and ask what will be the most important factor influencing their choice of a career, almost invariably the first answer is "lifestyle," and, as noted by a medical student recently, the definition of lifestyle is "time."¹⁵ Surgeons, and especially surgical residents, are not perceived as having a particularly good lifestyle, primarily because of the number of hours worked by both residents and surgeons in practice. The newly mandated 80-hour work week should have a positive effect in this regard, although surgeons will continue to work more hours than most other specialists. One obvious consequence of the new regulations, however, is that surgical residents will miss some operative procedures, conferences, and clinics. To maintain these educational experiences, some 2-year programs will probably apply to become 3-year programs. Two-year programs with one resident in each year will find it difficult to meet the work hour requirements, and some may close. Virtually all programs will need significant financial assistance from their hospitals for physician extenders to meet service requirements currently being provided by residents. From an educational standpoint, the *net* effect should be positive. However, more time away from the hospital will require residents to assume increased responsibility for self-education. It is our responsibility as educators to design methods and teach residents the most effective ways to educate themselves, first as residents and, equally important, for the remainder of their careers. Innovative tools such as those currently being developed by the Thoracic Surgery Directors Association will be extremely useful in this regard.¹⁶

The work hour regulations will also preclude the type of continuity of care provided by previous generations of residents and surgeons. Continuity of care will by necessity become more of a team effort, and we must teach residents how to do this without compromising patient safety. *In the process, the responsibility and accountability for the patient's welfare that has characterized cardiothoracic surgeons must not be lost.* Team continuity of care involving the attending surgeon, residents, intensivists, and others could provide *both* superior patient care *and* the opportunity for a better lifestyle for the surgeon. However, I am concerned about the rigidity of these work hour requirements and especially about the development of a "shift mentality" among surgical residents. We must carefully evaluate both the positive and negative effects of the work hour mandate on surgical resident education and be ready to modify it if needed.

If limitation of work hours is good (supposedly because of decreased errors) for airline pilots, commercial truck drivers, and now surgical residents, it is inevitable that these limitations will also be applied to practicing surgeons, as predicted in this recent quote from *The New England Journal of Medicine*: "Although residents have been the focus of

the debate, the strategy should ultimately apply to experienced clinicians as well, especially since older persons are more likely than younger persons to be adversely effected by sleep deprivation.”¹⁸ This is already an issue for our colleagues in Europe, where resident and attending work hours are being severely restricted.

Societal changes are dictating changes in surgical education. Concern about work hours has just been discussed. Alexander³ in his 1936 article on thoracic surgery education stated, “The time has passed when surgeons must gain their experience at the expense of their patients.” However, 66 years later, Antul Gawande,¹⁸ a surgical resident at the Brigham and Women’s Hospital, points out that “surgical residency still largely relies on the wonderful, time honored, throat constricting methods of learning-by-doing.” In his book *Complications*,¹⁹ he states, “In medicine we have long faced the conflict between the imperative to give patients the best possible care and the need to provide novices with experience.” The old surgical dictum of “see one, do one, teach one” is no longer acceptable in an environment charged by the report from the Institute of Medicine documenting the large number of errors committed in patient care. Future residents will learn to perfect basic surgical skills in the laboratory and more advanced skills by surgical simulation. As we will learn tomorrow from Frank Culbertson, enormous advances are being made in imaging techniques that will allow the surgical attending and resident to practice, in advance, different operative approaches to a particular problem in an environment that poses no threat to the patient or the surgeon. Further advances in technology, including imaging, simulation, and virtual reality, will provide important educational tools not only for residents but also as ways of measuring and maintaining technical competence after residency is completed. The increasing emphasis on minimally invasive surgery, continued development of robotically assisted procedures, and other technologic advances, will provide additional challenges, because we must teach all these new skills without further prolonging the cardiothoracic residency.

As we teach technical skills, we must remain cognizant of what Gawande¹⁸ has termed the fundamental conflict in surgical education “between the desire to create technical experts and the desire to create surgeons with a larger vision of what they do.” He goes on to say, “If the surgeon is to be more than a technician, surgical training should not be confined to learning operative care. It needs to involve learning the broader base of skills required for managing the diseases we care for.”¹⁸ Although we as surgeons should never apologize for our technical skills, at the same time we must be careful neither to de-emphasize the underlying disease process nor to abandon the overall care of the patient to others. In the future a significant part of the education of cardiac and vascular surgeons, cardiologists,

and perhaps interventional radiologists will involve the mastery of a fundamental core of knowledge about cardiovascular disease before moving on to the technical skills peculiar to the individual specialty, and even these will increasingly overlap. The same will be true for thoracic surgeons, pulmonologists, gastroenterologists, and oncologists.

The assessment of surgical education is changing. Historically, we have been more concerned with assessing the educational process by making sure that an appropriate learning environment existed, that appropriate conferences were held, and that adequate numbers of each kind of operative procedure were performed by each resident. We have then depended on the program director’s honesty in recommending a resident for the ABTS examination, although aware that some have in turn relied on the ABTS examination to hopefully weed out marginal and unqualified candidates.

The emphasis is changing from evaluating *process* to evaluating the *outcome* of resident education, with success on the ABTS examination as only one of the variables. Resident evaluation, which has been highly variable from program to program, will become increasingly standardized, and residents will now be evaluated not only by faculty but by peers, nurses, patients, and others in the six core areas of competence: (1) patient care, (2) clinical science, (3) practice-based learning, (4) interpersonal skills and communication, (5) professionalism, and (6) systems-based practice. Although the exact definitions of these terms continue to evolve, this clearly represents a major change in the assessment of a resident’s progress toward assuming independent care of patients. In the future, successful accomplishment of specific objectives, rather than an arbitrary number of years, may determine the length of the residency. Improved methods of assessing the outcomes of resident education will be extremely important in determining the success or failure of changes that are currently being proposed in thoracic resident education.

Continuing medical education is assuming increasing importance as more stringent methods are used to assess the ongoing competence of practicing surgeons. The original stated purpose of the AATS was to “advance knowledge and skills in thoracic surgery.”² Education continues to be the most important responsibility of the AATS, and this annual educational meeting and our journals have become our most important activities. In recognition of the diversity of educational needs and tools, this meeting has evolved to include plenary and breakout sessions, postgraduate courses, fundamental forums for surgical investigation, ethical and practical debates, and exhibits. In recent years the meeting has even been broadcast live worldwide on the Internet in an attempt to disseminate new information as widely and quickly as possible.

Originally the ABTS certificate was good for life, but in 1976 our specialty actually helped lead the way in the development of a 10-year limited certificate that required a recertification process for renewal. In the future, recertification at much shorter intervals than 10 years will be required. As a part of this process, the practicing surgeon will also be assessed by peers and coworkers on the six core areas of competence. A more rigorous examination will replace the current open-book examination. The evaluation of surgical skills will require documentation of patient outcomes, perhaps by using the STS database for comparisons with peers. Technical skills may be assessed in the future by surgical simulators. An unanswered question is whether recertification will continue for the specialty as a whole or be directed toward one or more of its components (general thoracic, adult cardiac, or congenital heart surgery).

Will Sealy²⁰ pointed out in his 1971 STS presidential address that many organizations influence thoracic surgery education, thus making it difficult for any single organization to effect real change. The Joint Council on Thoracic Surgery Education was formed in 1996 in an attempt to address this issue by bringing together representatives from the key thoracic surgical organizations. After several meetings, it became clear that the major issue blocking substantive change was the ongoing requirement for ABS certification. Subsequently, in 1999, the board unanimously passed a resolution that recommended that the ABTS change its policy regarding ABS certification so that at some time in the future yet to be determined, ABS certification will become optional. The reason for making the time of implementation indefinite was to allow all those interested in thoracic surgery education the opportunity to provide input. The joint council subsequently proposed a series of recommendations that were carefully considered, modified and approved by the ABTS in October 2001. It is important that the entire community of thoracic surgery understand the logic behind this process and the opportunity for educational change that these proposals have brought about.

The most important changes adapted by the ABTS can be summarized by some quotes from the board's Web site. "Certification by the American Board of Surgery (ABS) is optional rather than mandatory for residents who begin thoracic surgery training in July 2003 and after."²¹

"One pathway to ABTS certification will consist of successful completion of a full General Surgery residency in an ACGME-approved or a Royal College of Physicians and Surgeons of Canada (RCPSC)-approved program, with or without ABS certification, followed by successful completion of a 2 or 3 year ACGME-approved Thoracic Surgery residency. Individuals entering Thoracic Surgery residencies in July 2003 or after will be eligible under this path."²¹

The traditional pathway of cardiothoracic education was thereby preserved, but ABS certification is now optional.

"A second pathway to ABTS certification will be a categorical-integrated 6-year Thoracic Surgery residency, to be developed by the Thoracic Surgery Directors Association (TSDA). Residents in these programs will be under the direction of the Thoracic Surgery program director. Before this pathway is implemented, the Residency Review Committee for Thoracic Surgery (RRC-TS) must first approve the standards and requirements for such programs. Individuals will match for such programs directly from medical school or at some later time. It is estimated that the first such programs would begin to accept residents in 2004 at the earliest."²¹ Candidates choosing this pathway would spend their entire residency under the direction of the thoracic surgery program director. Some of the first 3 years would be devoted to traditional surgical rotations, but significant elective time would be available, and I expect much of this time to be spent in areas that overlap with related specialties, such as cardiology and pulmonology. Concern has been expressed that few individuals might choose this pathway because of the lack of exposure to cardiothoracic surgery by current medical students. However, other surgical specialties including neurosurgery, orthopedic surgery, and urology have had no difficulty matching superior candidates directly out of medical school, and it is unclear to me why cardiothoracic surgery should be significantly different.

"A third pathway to ABTS certification will be through successful completion of an ACGME-approved 3-year Thoracic Surgery residency after a minimum of 3 years in an ACGME-approved General Surgery residency, so long as certain prerequisite criteria are met during the general surgery training."²¹ This pathway could prove disruptive to general surgery residency programs, because individuals would leave the program before completing it, thus creating midlevel vacancies that could probably not be filled.

"The ABTS is committed to working closely with the ABS and other organizations in General Surgery toward the development of combined 4/3 programs leading to the possibility of certification by both the ABS and the ABTS."²¹ These actions by the ABTS, the recent initiative by vascular surgery and the declining number of applicants for general surgery positions have stimulated the ABS. In recent months a proposal has been made that would allow an individual to complete 4 years of general surgery, take part I of the ABS examination, and then pursue a residency in pediatric or vascular surgery. On completion of the second residency, such individuals would then be eligible to be certified by both boards. Such a program would be attractive for thoracic surgery as well, because it would permit an additional year of cardiothoracic education without prolonging the overall process. After literally years of negotiations and even tentative approval by the ABS, however, this

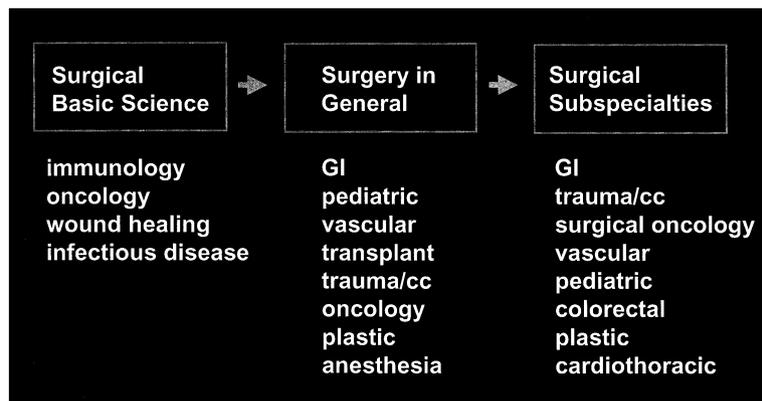


Figure 1. Proposed alternative to the current residence program. GI, Gastrointestinal; cc, critical care.

proposal has been stalled once again, and the executive secretary of the board indicates that the 4/3 option appears to be a dead issue for thoracic surgery.

Another alternative *not* currently under serious consideration but favored by some would allow individuals to use a significant portion of the fourth year of medical school to study the basic science of surgery. The first 3 years after medical school would be spent in a core program developing the basic surgical skill set in such areas as gastroenterology, pediatric care, vascular surgery, and trauma and critical care. Near the end of the core program, the individual would take an examination and, if successful, would then be eligible to begin a residency in a subspecialty such as cardiothoracic, pediatric, plastic, or colorectal surgery or in a specialized residency program in an area currently included in general surgery, such as vascular surgery, trauma and critical care, gastroenterology, surgical oncology, or transplantation. For an individual who sought more broad-based training, a combination of several of these might be designed. Such a program would obviate the need for subsequent fellowship years in most cases, thus shortening the educational process (Figure 1).

What could be lost by these proposed changes? Certification by the ABS will no longer be required and will probably not be sought by some candidates, just as most cardiothoracic surgeons do not currently recertify in general surgery after their original certificate expires. For the two new pathways, ABS certification is not even possible under current rules. The most significant loss will be the senior level experience gained as chief resident in general surgery.

It is impossible to predict how changes already made by the ABTS, as well as other proposals that have been suggested, will affect cardiothoracic surgery. They have been made carefully and deliberately and with the best possible intentions. For those who prefer it, the traditional route with full certification by both boards is possible, and programs and individuals who want to continue this approach are

encouraged to do so. Although thoracic surgery is an outgrowth of general surgery, and the close association of our specialties has been important, the fund of knowledge and skills required by our specialty today has now increased to the point that most of the time allocated to a cardiothoracic surgeon's education needs to be devoted to those areas unique to cardiothoracic surgery, with less emphasis on general surgery. Accordingly, I believe that ultimately the cardiothoracic resident educational process will evolve either into the "core plus subspecialty" process or into a 6-year completely integrated residency that matches directly out of medical school. I believe that the current "one-size-fits-all" approach by the RRC-TS to cardiothoracic resident education will change, that we will see increased subspecialty tracking, and that there will be increasing educational overlap with related specialties, such as between cardiology and cardiac surgery.

The ABTS has set the stage for new and innovative approaches to cardiothoracic resident education, and it is time that we moved ahead with the changes that will best position our specialty for the future without waiting any longer for action by others. It is completely appropriate that new approaches be tried at first by a few dedicated and committed programs and program directors and that the outcomes be carefully assessed. If nothing else, our generation of thoracic surgery educators can look back with confidence that change and new alternatives were carefully considered and tried.

In summary, I believe that the following changes in thoracic surgical education and actions by thoracic surgery educators are extremely important to the continued success of our specialty:

1. We must rekindle interest in medicine and especially in the surgical subspecialties.
2. We must aggressively participate in medical student education from day 1, emphasizing the future need for

surgeons as well as the true rewards and satisfaction that we all receive.

3. We should use the 80-hour work week mandate as an *opportunity* to seriously address lifestyle issues important to today's students and residents. In the process, we must address issues specific to women that will make surgery, specifically cardiothoracic surgery, more attractive.
4. We must teach basic surgical skills in the laboratory and design techniques such as simulation and virtual reality for teaching advanced skills to residents *and* practicing surgeons. Simultaneously, we must guard against training surgical technicians.
5. We should shorten the overall thoracic surgery educational process by using the fourth year of medical school more effectively and simultaneously allocate more time to cardiothoracic surgery education and less to general surgery.
6. We must use the opportunity afforded by the ABTS to test completely new models of cardiothoracic education while continuing to improve the more traditional model through collaboration with the ABS if possible.
7. We must design new methods to assess outcomes of these proposed changes, as well as of the continued competence of practicing surgeons.
8. We must collaborate more closely with colleagues throughout the world to move toward a more common educational process for cardiothoracic surgeons.

In closing, I am indebted and grateful to those who provided me my education—my parents and family, my teachers and mentors at Duke, and those who continue the process today. I cannot imagine having selected a better career than cardiothoracic surgery, and believe that its future continues to be bright. Finally, I could not have had a greater honor than the opportunity to serve as your president. Thank you for your help and support.

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Changes in the structure and tools for cardiothoracic education will adapt training to a changing milieu of surgical techniques that, in turn, will help fulfill an increasing demand for cardiothoracic surgeons. Finally, global political and technological changes will alter the structure of the workforce and the daily practice of the cardiothoracic surgeon over the next 20 years. The new educational and clinical tools at cardiothoracic surgeons' disposal, coupled with an increasing need for cardiothoracic surgery and innovative techniques, make this an incredibly exciting time to enter the... Crawford FA. Presidential address: thoracic surgery education—responding to a changing environment. J Thorac Cardiovasc Surg 2003;126:1235–42.