Integrated Thoracic Surgery Residency: Current Status and Future Evolution

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Cardiothoracic surgery training has evolved after a fading interest in the traditional pathway. Despite recent stagnation, the integrated pathway will likely further grow in popularity and acceptance.

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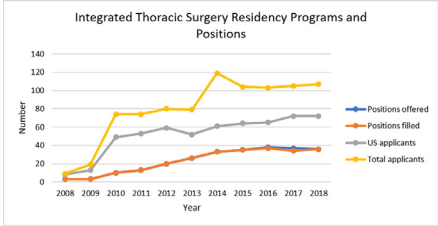

Positions and applicants for integrated thoracic surgery residency programs.

Central Message

There are 28 integrated thoracic surgery residency programs. Program growth has plateaued, and training evolutions are anticipated.

The traditional 2-year cardiothoracic surgery residency program was first developed in 1928 at the University of Michigan and was tailored to residents after the completion of a general surgery residency.[1] In 2003, the American Board of Thoracic Surgery made certification by the American Board of Surgery optional, therefore allowing the creation of an alternate training pathway.[2] The first 6-year Integrated Thoracic Surgery (I-6) residency program in the nation was formed at Stanford University and was approved by the Thoracic Surgery Residency Review Committee in 2007. The I-6 training pathway is now one of the most competitive residencies to match in the United States.[3]

The I-6 training pathway was initially developed in response to the decline in applicants to the traditional cardiothoracic surgical residencies. Surveys conducted on cardiothoracic surgery residents, general surgery residents, and other potential applicants in the mid-2000s suggest that job availability, security, and lifestyle concerns were some of the factors that have contributed to the decline in interest and satisfaction in cardiothoracic surgery (Fig. 1).[4–6] However, given the growing population of older patients, increased rate of retirement among practicing cardiac surgeons, and the technical evolution in the field, the demand for cardiothoracic surgeons is estimated to increase by as much as 46% by the year 2025.[7] The I-6 programs were created to offset the declining interest in cardiothoracic surgery, and simultaneously aimed to attract "the best and the brightest" to the field directly out of medical school, a platform that many surgical subspecialties had already adopted.

Since the inception of the first I-6 program, the number of programs, positions offered, and applicants has continued to grow (Fig. 2). In 2018, a total of 107 applicants applied to 36 positions offered by 28 I-6 programs, and all positions were filled.[3] The proportion of US applicants has steadily increased over time (Fig. 2), and the caliber of applicants has escalated greatly.[8] In fact, first-year residents matching into I-6 programs in 2017–2018 had an average of 10 abstracts, presentations and publications, and United States Medical Licensing Examination Step 1 and Step 2 Clinical Knowledge scores comparable to some of the most competitive surgical subspecialties (Fig. 3).[9] As of 2018, there are 202 active I-6 residents, 24.8% of whom ($n = 50$) are women.[9] Although one may expect higher drop-out rates in I-6 residents given their limited exposure to surgical training and younger age, the attrition rate of I-6 residents was reported to be 3.2% per year, compared to 5% per year in general surgery programs.[10]

Resident motivations, experiences, and expectations have also been studied. According to several nationwide surveys, a majority of residents reported faculty mentorship and significant clinical exposure in medical school as the primary motivations behind pursuing an I-6 residency. Most I-6 residents were satisfied with their training program and envisioned an academic career. Career plans appear to skew toward adult cardiac surgery (67%), followed by pediatric cardiac surgery (24%) and general thoracic surgery (9%).[11–13] Surveys conducted on I-6 program directors showed that most believe that I-6 graduates will be well trained and equally competent in independently performing routine adult cardiac and general thoracic operations compared to graduates from the traditional training pathway. Less general surgical training was not viewed as a disadvantage to I-6 residents in terms of their career, and in fact, most program

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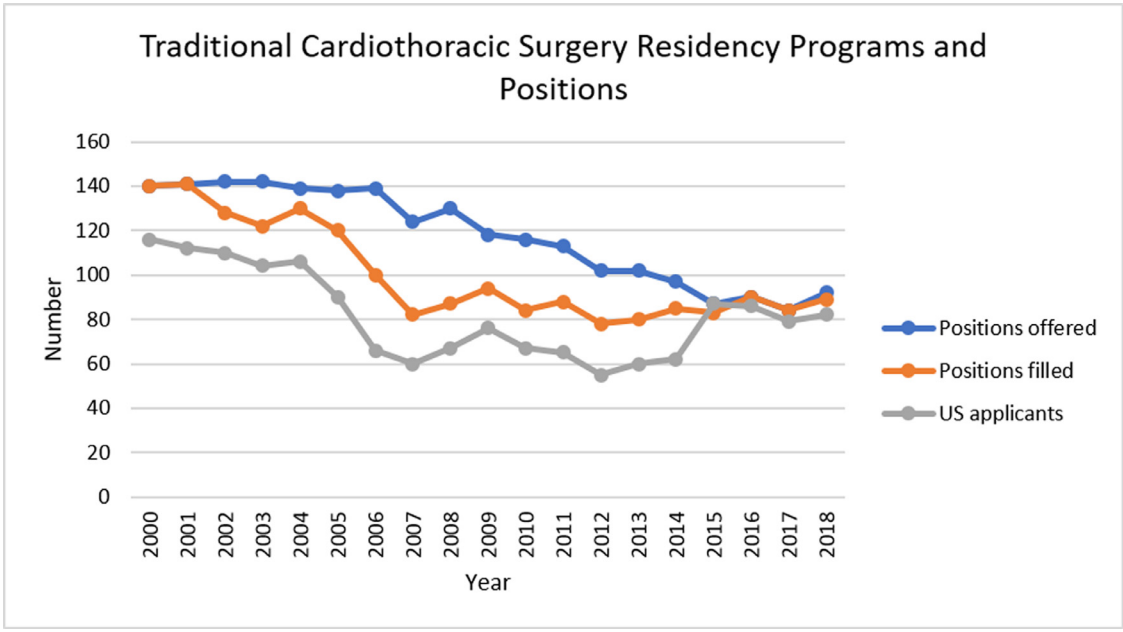

Figure 1. Positions and US applicants for traditional cardiothoracic surgery programs. Data source: National Resident Matching Program.

directors would have chosen the I-6 pathway for themselves if given the choice.[14]

Several advantages of I-6 programs have also been identified in surveys, including focused training curricula, and early exposure to both operative and academic cardiothoracic surgery.[11–13,15] Another clear advantage of the integrated pathway is the room for customization, both within the framework of a program, as well as for individual residents. While some general surgery residents have little or no exposure to cardiothoracic surgery during their training,[16] I-6 residents typically have several months of cardiothoracic surgery rotations starting their intern year, during which they gain experience in surgical access to the thorax, chest, closure, and cannulation as junior residents. In fact, in some I-6 programs, the repeated, extensive exposure to cardiac surgery very early in the residency can lead to I-6 residents occasionally performing basic cardiac operations such as coronary artery bypass grafting and aortic valve replacement in their first year and more involved operations such as mitral valve repair and

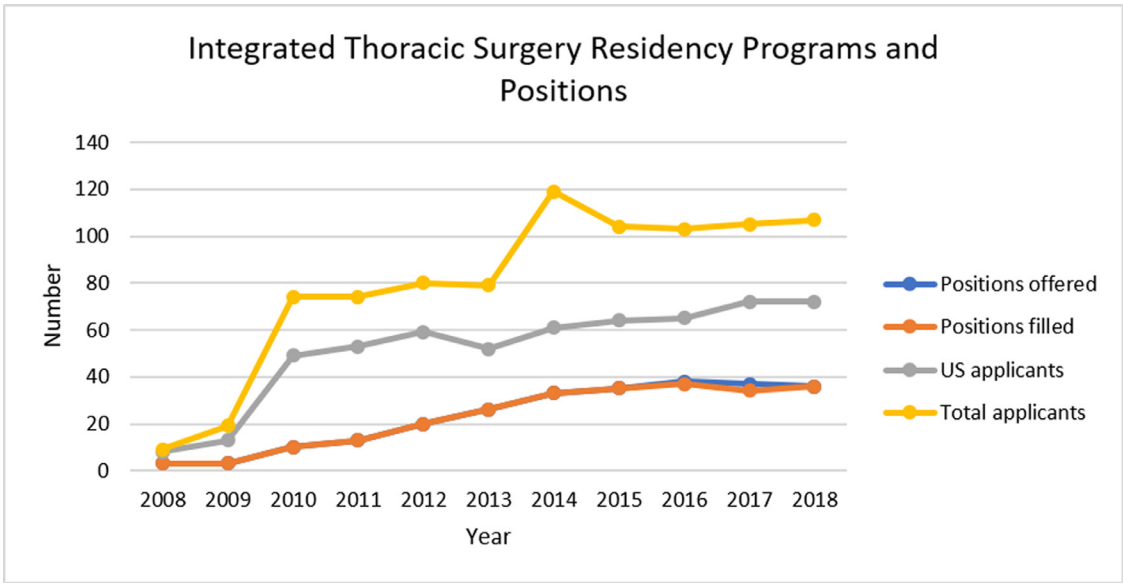

Figure 2. Positions and applicants for integrated thoracic surgery residency programs. Data source: National Resident Matching Program.

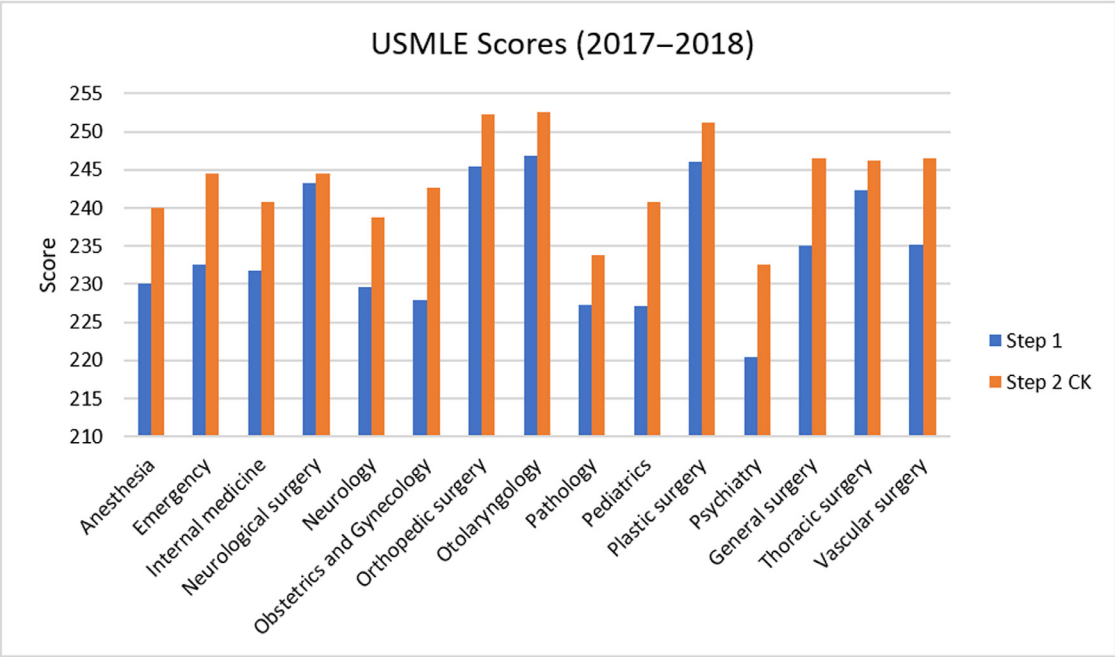

Figure 3. United States Medical Licensing Examination (USMLE) Step 1 and Step 2 Clinical Knowledge scores of first-year residents for different specialties in 2017–2018. Data source: Association of American Medical Colleges.

aortic root replacement in their second year. I-6 residents also have the opportunity to work closely with faculty on research projects and attend national conferences for presentations and scholarly activities. Some programs even have the flexibility and financial capability to support residents in pursuing advanced degrees to shape their niche in future practice. The networks I-6 residents build during their training will also serve them particularly well and may be especially helpful when it is time to apply for jobs.

While I-6 programs have ignited a large amount of excitement, concerns have been raised about this training pathway. The biggest of which is the development of mature, well-rounded cardiothoracic surgeons. New medical school graduates have little training experience so clinical concepts and surgical skills well-understood by general surgery graduates may be foreign to junior I-6 residents. These same I-6 residents may also lack clinical and surgical maturity as a result of less training and simply just younger age. Understandably so one may perceive greater challenges in training I-6 residents compared to traditional cardiothoracic surgery fellows.

The selection process for I-6 candidates has gone through several iterations. Unlike selecting cardiothoracic surgery fellows, I-6 candidates lack the evaluation from nationally renowned surgeons, and therefore one may find it difficult to assess technical proficiency and potential. Several programs in the country have adopted a technical skills component as part of the interview process, and another solution could be standardized letters of recommendation. While these may provide insight into a candidate's current technical level, correlation to subsequent clinical performance and growth during training remains uncertain.

A reported disadvantage of I-6 programs is curriculum heterogeneity,[11–13] as the quantity of general surgery training, the timing and depth of cardiothoracic surgery rotations, and the integration of ancillary rotations such as non-invasive cardiovascular imaging, heart failure, and interventional cardiology vary widely.[17] Another source of heterogeneity includes a lack of resources at some programs that do not have experience in specialized fields of cardiothoracic surgery such as complex valve repair, transplantation, endovascular, and transcatheter valve technology, to name a few. These programs would not be able to provide the specialized training that is anticipated by most I-6 residents.[11–13,18] In addition, most programs are cardiac surgery-focused[15]; very few have a separate thoracic surgery track. This may limit residents' experiences or even deter some from applying to I-6 programs. Along similar lines, research opportunities and requirements differ across programs - some require mandatory academic enrichment years and provide significant mentoring and financial support, while others lack funding and flexibility to accommodate scientific or academic pursuits outside of the structured residency program.

After the initial surge in I-6 programs around the country, the total number of I-6 programs has plateaued (Fig. 2). Meanwhile, the number of traditional cardiothoracic surgery fellowship positions has remained the same (Fig. 1). Establishing an I-6 program requires a significant amount of resources and relies on a strong collaboration between the divisions of general surgery and cardiothoracic surgery within an institution. Time is still needed to prove the efficacy of I-6 programs as the community remains unsure about this new training pathway.[19] In fact, many I-6 programs in the country have yet to graduate a resident. As of 2018, a mixture of academic,

private, and subspecialty positions were secured by I-6 graduates, yet, the number is too small to draw any meaningful conclusion. Additionally, it is unclear whether I-6 residents will likely to engage in subspecialty training via "super fellowships" after residency. Ideally, earlier exposure to cardiothoracic surgery should permit more elective time to limit such a need for post-residency training.

Several changes may happen in the upcoming decade with regards to I-6 cardiothoracic surgery training. In order to ensure similar training experiences in subspecialized fields, such as minimally invasive procedures, transplantation, and aortic surgeries, we may see implementation of a more uniform curriculum in I-6 programs. In fact, the American Board of Thoracic Surgery has already added certain procedures, such as transcatheter valve replacement to its operative requirements. Programs that lack the infrastructure or case volume may need to create elective rotations for residents to fulfill graduation requirements from other centers. Additionally, given the perceived limited exposure to thoracic surgery, we may see more I-6 programs establish a separate thoracic surgery track to ensure production of well-trained thoracic surgeons. Lastly, research during training may become a requirement given the disproportionate number of I-6 residents interested in academia medicine. Nonetheless, prolonged training may deter certain students from applying, especially those who are interested in private practice and an overall shortened program. Therefore, two separate tracks including an academic track (3 + 3 + 3) and a true integrated track may be a possibility. In the academic track, the first three years would focus on general and vascular surgery, with early exposure to thoracic and cardiac surgery to master basic operative techniques and clinical skills. The middle three years would focus on academic enrichment, including but not limited to research and the pursuit of advanced degrees. The final three years would encompass the traditional three-year fellowship in cardiac and thoracic surgery. In the true integrated track, residents will likely pursue a curriculum similar to that of most I-6 programs in the country, finishing residency in six years.

In addition to the I-6 training pathway, other pathways exist to train cardiothoracic surgeons. The traditional training pathway will likely continue to exist, as a number of residents are undecided as medical students and prefer to complete general surgery training prior to pursuing a career in cardiothoracic surgery. Another relatively new pathway is the 4 + 3 training pathway, where general surgery residents internally transition to a three-year cardiothoracic surgery fellowship after four years of general surgery training. This pathway has several advantages. For example, residents can maintain board-eligibility for both general and thoracic surgery and have more time to decide whether cardiothoracic surgery is the right field for them; programs can also better evaluate their applicants. As of 2018, there are 13 programs that offer the 4 + 3 training pathway,[20] and we anticipate this number will increase.

The emergence of I-6 programs signifies a new era for cardiothoracic surgical training. Although there are valid concerns, we are cautiously optimistic about the I-6 training pathway. The Royal College of Physicians and Surgeons of Canada has used a similar, six-year integrated pathway for cardiac surgery training since 1994,[21] and in the United States, other highly specialized surgical fields, such as neurologic surgery and otolaryngology, have produced well-trained surgeons under similarly focused training pathways. I-6 programs are now considered some of the most competitive residencies in the country, and applicant qualifications continue to escalate. We believe the integrated training pathway will continue to evolve as we gather data from current and former residents, and we are eager to observe how the landscape of cardiothoracic surgery training will change.

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