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Special Article

Preparing for a Fellowship in Adult Cardiothoracic Anesthesiology: Resources and Approaches for the Anesthesiology Trainee

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Adult cardiothoracic anesthesiology (ACTA) is a competitive fellowship. Despite increases in both the number of programs offering cardiothoracic fellowships and the number of residents applying each year, there is little direction or advice for prospective candidates. This review aims to educate anesthesiology residents who are hoping to pursue cardiothoracic anesthesiology, by examining a brief history of the advanced perioperative echocardiography qualification, the credentialing goals of ACTA fellowships, and the current status of ACTA fellowships. The second part of the review covers the ACTA fellowship application and aims to assist the candidate in navigating this process. The review examines the qualifications that fellowship programs look for in a candidate, including a discussion on professional behavior, and what an applicant can look for in a program. Finally, there is a brief discussion on post-match preparation.

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Key Words: cardiothoracic anesthesiology; fellowship; National Board of Echocardiography; perioperative echocardiography certification; Accreditation Council for Graduate Medical Education; Society of Cardiovascular Anesthesiologists; San Francisco Match; National Resident; Matching Program

History of the Advanced Perioperative Echocardiography Qualification

The Society of Cardiovascular Anesthesiologists (SCA) was formed in 1978; however, it was not until 2004 that official board certification in perioperative echocardiography was possible from the National Board of Echocardiography (NBE).¹ The NBE is an independent organization that provides recognition of a standard of training in echocardiography. It is not affiliated with the Accreditation Council for Graduate Medical Education (ACGME). Recognition of adult cardiothoracic anesthesiology fellowship training by the ACGME followed in 2006, and there are currently 66 ACGME accredited programs in the United States (Table 1).² More recently, in 2012, the application process was formalized using a matching system: the Adult Cardiothoracic Anesthesiology (ACTA)

Fellowship Match. This match is the official application pathway for applying to cardiothoracic anesthesiology fellowship programs and is carried out via the Central Application Service (CAS) of the San Francisco Match (SF Match). The CAS is used by SF Match for document gathering. Of the 66 ACGME accredited programs listed by the SCA, 65 were active on SF Match in 2018³ (Table 1). For a detailed review of the history of ACTA fellowships in the United States, Capdeville et al. describe the history, progression to recognition as a subspecialty, and rationale for ACGME accreditation.⁴

Goals of ACTA Fellowships: Management of the Cardiac Surgical Patient and Certification in Perioperative Transesophageal Echocardiography

Management of the Cardiac Surgical Patient

The ACGME has provided oversight of ACTA fellowship training since 2006. The goals of the ACTA fellowship year are laid out in the ACGME Milestones Project.^{5,6} The trainee is required to participate in a minimum length of training and

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Table 1
Current (2018) ACGME-Accredited US ACTA Fellowship Programs

Region	State	Program	Number of Positions in 2020	Dual Fellowships Currently Available	Visa
Midwest	Illinois	Loyola University Medical Center	2	No	J1
		Northwestern University	3	No	J1 and H1b
		University of Chicago Medical Center	2	No	J1 and H1b
	Iowa	University of Iowa	1	No	J1 and H1b
		Henry Ford Hospital	1	No	J1
	Michigan	University of Michigan	6	No	J1 and H1b
		Mayo Graduate School of Medicine/Mayo Clinic	3	No	J1 and H1b
		University of Minnesota	2	No	J1
	Missouri	Washington University School of Medicine	4	Yes	J1 and H1b
	Nebraska	University of Nebraska Medical Center	2	No (but some flexibility/ could be arranged)	J1 and H1b
	Ohio	Cleveland Clinic Foundation	16	No	J1 and H1b
		The Ohio State University	2	No	J1
		University of Cincinnati College of Medicine	1	No (but some flexibility/ could be arranged)	J1 and H1b
	Wisconsin	Medical College of Wisconsin	2	Yes (research or critical care)	No
		University of Wisconsin	2	No	J1
North-East	Connecticut	Yale University School of Medicine	4	Yes	J1
		Johns Hopkins University	6	Yes	J1 and H1b
	Maryland	University of Maryland School of Medicine	3	Yes	J1
		Beth Israel Deaconess Medical Center	3	Yes	J1 and H1b
	Massachusetts	Brigham and Women's Hospital	6	Yes	J1 and H1b
		Massachusetts General Hospital	6	Yes	J1 and H1b
		St. Elizabeth's Medical Center	2	No	No
		Tufts Medical Center	3	Yes	J1
		Cooper University Hospital	1	No	J1
	New Jersey	Rutgers Robert Wood Johnson Medical School	2	No	J1
		Albany Medical College	1	No	J1
	New York	Columbia University Medical Center	7	Yes	J1
		Montefiore Medical Center	3	No	J1 and H1b
		Mount Sinai School of Medicine	7-8	No	J1 (H1b varies yearly)
		New York University Langone Medical Center	4	No	J1 and H1b
		SUNY Buffalo Affiliated Hospitals	2	No	J1
		University of Rochester Medical Center	2	No	J1
		Weill Cornell Medical College	3	Yes	J1
		Allegheny Health Network	1	No	J1
	Pennsylvania	Penn State Hershey Medical Center	1	No	J1
		Sidney Kimmel Medical College at Thomas Jefferson University	1	No	J1 and H1b
		Temple University Hospital	1-2	No	J1
		University of Pennsylvania	5	Yes	J1 and H1b

(continued on next page)

Table 1 (Continued)

Region	State	Program	Number of Positions in 2020	Dual Fellowships Currently Available	Visa
South-East	Alabama	University of Pittsburgh	4	Yes	J1 and H1b
		University of Alabama at Birmingham (UAB) Medical Center	3	Yes	J1 and H1b
	Florida	University of Florida	3	Yes (critical care)	No
		University of Miami	3	Yes	J1
	Georgia	Emory University School of Medicine	6	No	J1
	Kentucky	University of Kentucky	1	No	J1
	North Carolina	Duke University Medical Center	13	Yes	J1 and H1b
		Wake Forest University School of Medicine	2	No	J1
	South Carolina	Medical University of South Carolina	2	No	No
	Tennessee	Vanderbilt University Medical Center	5	Yes	J1 and H1b
Virginia	Virginia Commonwealth University Medical Center/ MCV Campus	2	No	J1	
South-West	Louisiana	Ochsner Clinic Foundation	2	No	J1
	Texas	Texas A&M University College of Medicine/Scott & White Memorial Hospital	2	No	J1
		Texas Heart Institute at Baylor St. Luke’s Medical Center	10	Yes (critical care)	J1
		The University of Texas Medical Branch at Galveston	1	No	No
		University of Texas Health Science Center - Houston	4	No	J1
	University of Texas Southwestern Medical Center	2	No	No	
West	California	Cedars-Sinai Medical Center	5	No	J1 and H1b
		Keck School of Medicine, University of Southern California	4	Yes (critical care)	J1
		Loma Linda University Medical Center	1	No	J1 and H1b
		Stanford University	4	Yes	J1
		University of California, Davis Medical Center	1	No	No
		University of California, Los Angeles	4	Yes (critical care)	J1 and H1b
		University of California, San Diego Medical Center	3	No	No
		University of California, San Francisco	1	Yes	J1
	Colorado	University of Colorado Denver	3	Yes	No
	Oregon	Oregon Health & Science University	1	No (but co-ordination with critical care fellowship possible)	J1 and H1b
		Washington	University of Washington	4	Yes

NOTE. Grouped by geographic location (alphabetically) with information regarding the number of positions for 2020, dual fellowship options, and visa acceptance. Data source: www.scahq.org, ACTA fellowship program websites, and correspondence with ACTA fellowship programs.²

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; ACTA, adult cardiothoracic anesthesiology.

number of cases and achieve an acceptable standard in the ACGME Adult Cardiothoracic Anesthesiology Milestones. There is no American Board of Anesthesiology (ABA) certification of ACTA, nor an examination (the currently achievable certification is in perioperative transesophageal echocardiography [TEE] by the NBE). By comparison, certification in critical care was approved by the ABA in 1985, pain medicine in 1991, and pediatric anesthesiology in 2012.⁷ Board examinations in critical care, pain medicine, and pediatric anesthesia are offered annually.⁸

The fellowship must be 12 months long and include at least 6 months of clinical anesthesia. At a minimum, the fellow must participate in 100 cardiac surgical procedures with >50 requiring cardiopulmonary bypass (CPB). Of these 100 procedures, at least 25 should involve aortic or mitral valve surgery (with a minimum of 5 each of aortic or mitral valve repairs/replacements requiring CPB). At a minimum, the 100 procedures must include 25 myocardial revascularization surgeries, with or without CPB. The fellow also must gain experience in 2 or more of the following: (1) correction of congenital cardiac lesions in the adult patient, (2) organ transplantation (cardiac and lung), (3) placement of circulatory assist devices, and (4) electrophysiology procedures under general anesthesia. Within thoracic anesthesia, the fellow must manage at least 15 patients undergoing noncardiac thoracic surgery. This includes anesthesia for airway/lung repair, lung resection, and esophageal resection/repair, as well as anesthesia for surgery of the thoracic aorta—including management, but not necessarily placement, of CSF drains. A fellow must have at least a 1 month in a critical care setting, managing adult cardiothoracic surgical patients. Each fellow must have 2 months of elective time for either cardiac-relevant clinical rotations or a research project.⁶ These ACGME requirements were agreed upon with the realization that there is considerable variability among programs and clinical case exposure for the ACTA fellow.

The ACGME Adult Cardiothoracic Milestones include categories of Patient Care, Medical Knowledge, Systems-based Practice, Practice-based Learning and Improvement, Professionalism, and Interpersonal and Communications Skills. Patient Care is divided into (1) periprocedural assessment and management and (2) technical/procedural skills. Medical Knowledge includes (1) the principles of extracorporeal circulation and circulatory assist devices, (2) cardiovascular/thoracic imaging and monitoring, (3) cardiovascular/thoracic pathophysiology and pharmacology, and (4) diagnostic and therapeutic interventions. Within the Medical Knowledge section on cardiovascular imaging, the graduation target involves meeting all the requirements for NBE certification in advanced perioperative TEE—highlighting that TEE is only one aspect of a successful ACTA fellowship. Embedded in the Milestones are opportunities to participate in root cause analyses and improve patient safety by involvement in a quality improvement project (as part of the Systems-based Practice Milestone) and participation in clinical research projects within cardiothoracic anesthesia (as part of the Practice-based Learning and Improvement Milestone). Demonstration of Professionalism may include serving on departmental and institutional

committees while Interpersonal and Communications Skills involves managing complex issues in communication with patients and families. A detailed description of the ACGME Adult Cardiothoracic Anesthesiology Milestones is available from www.acgme.org.⁹

Certification in Perioperative TEE

The first examination in perioperative TEE, also known as the PTEeXAM, was given by the SCA in 1997. Since 1999, it has been offered annually under the NBE.¹ Board certification in perioperative TEE was introduced in 2004 to recognize physicians with skills in performing and interpreting perioperative cardiac ultrasound. Board certification gives the recipient the title of diplomate of the NBE.

The board certification process in perioperative TEE involves 2 examination options: Examination of Special Competence in Basic Perioperative Transesophageal Echocardiography (Basic PTEeXAM) and Examination of Special Competence in Advanced Perioperative Transesophageal Echocardiography (Advanced PTEeXAM). The Basic PTEeXAM is available to non-fellowship trained physicians, whereas the Advanced PTEeXAM requires at least 12 months of cardiothoracic anesthesia fellowship training at an accredited institution (ACGME or other national accrediting agency).¹

For the current anesthesia resident, Basic PTE certification would require completion of the Supervised Training Pathway (Table 2). In anesthesia, this involves completing an anesthesia residency, passing the ABA examinations, and attaining board certification in anesthesiology. The practitioner must hold a current medical license. Regarding TEE training, the requirement is for supervised reading of a total of 150 perioperative TEE examinations, of which 50 are personally performed, and completion of the Basic PTEeXAM (administered annually by the NBE; Table 2).

By comparison, an anesthesiologist who is interested in Advanced PTE certification and board certification in TEE by the NBE will need the following: completion of an anesthesia residency and ABA examinations, board certification in anesthesiology, and a current medical license. The TEE training is pursued while completing a fellowship in ACTA (accredited fellowships in the United States have ACGME oversight, and applications are submitted through the CAS to the SF Match), and the trainee completes a minimum number of perioperative TEE examinations—a minimum of 150 exams performed and a total of 300 exams read/performed. Finally, the practitioner must complete the Advanced PTEeXAM (administered annually by the NBE; Table 2).

Advanced certification is intended to allow use of the complete diagnostic potential of perioperative TEE, including making recommendations that may change or guide surgical management.¹ The NBE does not direct or limit the procedures or recommendation level of a TEE practitioner; any requirements for the Advanced PTEeXAM, or limitations on an anesthesiologist's scope of practice, are institution specific. For financial incentives, the Advanced PTEeXAM does not provide additional privileges for billing by the Centers for

Table 2
Requirements for Basic and Advanced Perioperative Transesophageal Echocardiography Certifications

Exam	Basic PTE Certification			Advanced PTE Certification	
	Basic PTEeXAM or Advanced PTEeXAM*			Advanced PTEeXAM	
<i>Pathways</i>	<i>Supervised Training</i>	<i>Practice Experience</i>	<i>Extended CME</i>	<i>Fellowship</i>	<i>Practice Experience</i> (not an option for current anesthesia residents)
Valid medical license required	Yes	Yes	Yes	Yes	Yes
Board certification[†]	Yes	Yes	Yes	Yes	Yes
Graduation date restriction	No	No	No	No	Yes: Completed core residency before June 30, 2009
Clinical training			Completed review of 100 basic perioperative TEEs in ASA/SCA Basic Perioperative TEE Education Program	12 months of accredited cardiothoracic anesthesiology fellowship (ACGME or other national body)	24 months of clinical experience managing perioperative surgical patients with cardiovascular disease (≥150 in each year of the 2 years preceding the application for ≥300 total patients)
TEE personally performed	50	150 Performed and read; intraoperative; within 4 consecutive years immediately prior to application; ≥25/y	50 Performed and read; basic perioperative; within 2 consecutive years immediately prior to application; ≥25/y	150 Comprehensive intraoperative	300 - Performed and read - comprehensive perioperative (of which at least 150 are intraoperative) - within 4 consecutive years - ≥50 in any year, <10 years prior to application. - Average of 50 comprehensive perioperative TEE in the 4 years immediately prior to application
TEE read	150 read (of which 50 are above in TEE examinations personally performed)			300 (of which 150 are above in TEE examinations personally performed)	
CME (additional requirement)					≥50 h of AMA category 1 CME on echocardiography during the same period as the clinical experience in TEE
Fee exam 2018 (US\$)	Basic PTE exam: Early registration \$795 After early registration deadline \$995			Advanced PTEeXAM: Early registration \$995 After early registration deadline \$1,195	
Fee[‡] NBE Certification (US\$)	Not applicable	Not applicable	Not applicable	Passed PTEeXAM 1998-2003: \$175 Passed PTEeXAM after 2004: No additional charge (included in above exam fee)	
Eligible for NBE board certification	No	No	No	Yes	Yes

NOTE. Data sources: <https://www.echobords.org>, Advanced PTE Certification Handbook.¹

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; ASA, American Society of Anesthesiologists; CME, continuing medical education; NBE, National Board of Echocardiography; PTE, perioperative transesophageal echocardiography; SCA, Society of Cardiovascular Anesthesiologists; TEE, transesophageal echocardiography.

* Without fellowship training, or the Practice experience pathway, the physician is granted testamur status.

† Board certification in any specialty (a fellowship in cardiothoracic anesthesia would require an anesthesia residency).

‡ Fee information is current as of 2018.

Medicare and Medicaid Services—these are determined at an institutional level. For scope of practice, the American Society of Anesthesiologists (ASA) recommends that perioperative TEE only be performed by physicians with appropriate training or equivalent experience who have been credentialed in basic or advanced perioperative TEE.¹⁰

Outside of an ACTA fellowship, the other pathway to Advanced PTE certification is the Practice Experience pathway. This is only available for those who finished their core residency training before June 30, 2009 and is not relevant for current anesthesia trainees.¹

For those licensed physicians who do not meet the criteria for certification, the NBE allows access to the Advanced PTEeXAM, granting testamur status to those who pass. The option of testamur status encourages physicians to acquire echocardiography skills and demonstrate their knowledge of advanced perioperative TEE. Physicians who have passed the Advanced PTEeXAM and have testamur status are also eligible for Basic PTE certification. The scope of practice of a physician with testamur status is defined by institutional policy at the physician's hospital—no specific limitations regarding billing, generation of reports, or consultation exist from the NBE or Centers for Medicare and Medicaid Services.

Current ACTA Fellowship Program Status

There are 66 ACGME-accredited ACTA fellowships listed by the SCA. Of these, 65 participated in the SF Match in 2018^{2,3} (Table 1). Table 1 lists the ACGME accredited programs by geographic location and details the projected number of trainees for 2020, the acceptance of visas, and whether the program supports dual fellowships.

The SCA also provides a list of nonaccredited ACTA fellowships.² Currently, among this list, there are no active non-accredited programs for adult cardiac anesthesiology fellowship training. There is an active nonaccredited program for thoracic anesthesiology (Table 3).

Adult cardiothoracic anesthesiology fellowships from Canada are accepted for NBE board certification if they are at least 12 months long, occur after an anesthesiology core residency of 5 years, and are at an institution with a nationally accredited training program in anesthesiology.¹

ACTA Fellowship Application: A Competitive Subspecialty

A 2014 ABA survey of CA-1 and CA-2 residents showed that 59% of CA-1s and 54% of CA-2s planned to go into fellowship programs (34% of residents responded). By the CA-2 year, the most popular program among residents was cardiac anesthesiology, followed by pediatric anesthesiology and pain medicine.¹¹ There are no comparable survey results for previous years as this was the first general survey of trainees. The survey used the opportunity of early registration with the ABA, for the staged examination, to gather information from junior residents on a wide range of topics from work hours and job satisfaction to future career plans.

According to data from the National Resident Match Program and SF Match, pain medicine was the most competitive choice in the 2017 Fellowship Match, followed by ACTA and pediatric anesthesiology (Fig 1).^{3,4,12,13} In 2017, for every fellowship position in pain medicine, 1.27 applicants applied compared with 1.25 applicants for ACTA, 0.98 applicants for pediatric anesthesiology, and 0.78 applicants for critical care.^{3,13,14}

Examination of the ACTA Fellowship SF Match results (Table 4) shows there has been an 18% increase in the number of applicants over the past 5 years from 267 to 316.³ The number of programs offering ACTA fellowships, through SF Match, increased from 54 to 64 (there are 66 ACGME-accredited ACTA fellowship programs, of which 64 programs participated in the SF Match in 2017), with an increase in the total number of positions from 168 to 207 (a 23% increase; Fig 2 and Table 4). Even though both the number of applicants and the number of positions offered increased between 2013 and 2017, the number of applicants who submitted a rank list, per position offered, has decreased slightly from 1.37 in 2013 to 1.3 in 2016 and further to 1.25 in 2017 (Fig 2) because the number of ACTA fellowship positions increased proportionately more than the number of applicants. A similar pattern of an increased number of fellowship positions is seen across critical care, pain, and pediatric anesthesiology fellowships (Table 5 and Fig 3).

ACTA Fellowship Program Application: Timeline and Process

Most of the ACGME-accredited fellowships participate in the formalized matching process organized by SF Match. Participation via the match provides a neutral application system for all candidates and makes the appointment procedure easier.

ACTA Fellowship Application: Application Timeline

The timeline for application to ACTA ACGME-accredited programs registered via SF Match is summarized in Fig 4. There is no timeline for applicants applying to non-ACGME accredited fellowship programs, and those positions can be offered to candidates at any time.

The application portal at the CAS, for the SF Match, opens on the second Friday in November.¹⁵ Although SF Match continues to accept applications until June, most programs interview between January and May with the peak months for interviews being March and April (Fig 5). Programs will review applications and begin to offer interviews early in the match cycle so that late applications may not provide the applicant with many opportunities for an interview. The deadline for submission of a rank list is the first Monday in June, and the Match results are released on the third Monday in June.

A candidate also should consider the deadlines for submission of abstracts on cardiothoracic topics to conferences such

Table 3
Non-ACGME-Accredited US Cardiothoracic Anesthesia Fellowship Programs

State	Program	Status 2018	Notes
Illinois	Rush-Presbyterian-St. Luke's Medical Center (now: Rush University Medical Center)	Non-active	
	University of Illinois at Chicago	Non-active	
Kentucky	University of Louisville	Non-active	
Massachusetts	Boston University Medical Center	Non-active	
	Children's Hospital Boston	Pediatric fellowship – ACGME-accredited, pediatric cardiac fellowship nonaccredited*	
New York	Memorial Sloan-Kettering Cancer Center	Active for thoracic anesthesia only	Interview season: June- September (Applications accepted year round) Mount Sinai School of Medicine has an active, ACGME-accredited program.
	St. Luke's-Roosevelt Hospital Center (now: Mt. Sinai West)	Non-active	
	SUNY Health Science Center, Syracuse	Non-active	
Ohio	University Hospital at Stony Brook	Non-active	
	University Hospitals of Cleveland	Non-active	
Pennsylvania	The Children's Hospital of Philadelphia	Pediatric fellowship— ACGME-accredited, pediatric cardiac fellowship non-accredited*	
Texas	Methodist DeBakey Heart Center/Baylor College of Medicine	Non-active	Program is now affiliated with Texas Heart Institute at Baylor St. Luke's Medical Center and is ACGME-accredited.
	Texas Children's Hospital-Baylor College of Medicine	Pediatric fellowship—ACGME-accredited, pediatric cardiac fellowship†	

NOTE. As listed by the Society of Cardiovascular Anesthesiologists, grouped by state location (alphabetically) with information regarding active status. Data sources: www.scahq.org, fellowship program websites, and correspondence with fellowship programs.²

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; TMB, Texas Medical Board.

* ACGME accreditation is not available for pediatric cardiac fellowships.

† Texas Medical Board-accredited.

as the SCA Annual Meeting, ASA Annual Meeting, and the PostGraduate Assembly in Anesthesiology (Fig 4).

ACTA Fellowship Application: Application Process

San Francisco Match uses the CAS to distribute fellowship applications to the programs. The CAS charges a fee that varies depending on the number of programs applied to (Table 6)¹⁵ and requires the following: (1) an online application form, (2) 3 letters of reference (either mailed by the

referees to the SF Match office in San Francisco or uploaded directly to the site, by the referee), (3) selection of programs, and (4) online payment.

The CAS requires 2 weeks to forward the application to the programs, so an applicant should pay attention to a chosen fellowship program's application deadline. Although the SF Match submission is open from November to May, an early application is advisable to allow programs time to review the application and offer an interview early in the interview season. Apart from the application requirements from SF Match,

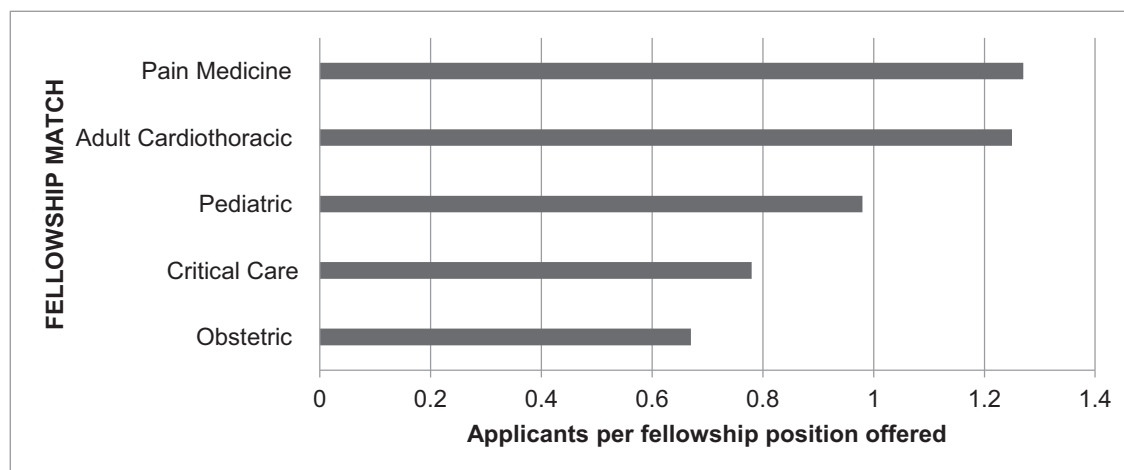


Fig 1. The number of applicants for each available position in the 2017 anesthesiology fellowship programs of pain medicine, adult cardiothoracic anesthesiology, pediatric anesthesiology, critical care, and obstetric anesthesiology. Data from www.sfmach.org and www.nrmp.org.^{3,11–13}

Table 4
ACTA Fellowship Match Statistics from 2013 to 2017

Year	2013	2014	2015	2016	2017
Applicant Data					
Applicant registrations	267	268	268	331	316
Applicant rank lists submitted	230	213	211	258	258
Matched total	166	172	182	199	202
Unmatched total	64	41	29	59	56
Applicants matching (%)	72	81	86	77	78
Total withdrawals	9	21	14	25	22
Program Data					
Number of participating programs	54	55	57	60	64
Fellowship positions offered	168	174	183	199	207
Fellowship positions filled	166	172	182	199	202
Unfilled positions	2	2	1	0	5

NOTE. Reproduced with permission from San Francisco Match.³

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; ACTA, adult cardiothoracic anesthesiology.

programs require the candidate to send in various other documents that may include a curriculum vitae, personal statement, medical school transcripts, in-training exam (ITE) scores, and United States Medical Licensing Examination (USMLE) scores. Applicants who are not US citizens or permanent residents are advised to check the visa requirements for the program before sending an application.

ACTA Fellowship Application: Nontraditional and Foreign Applicants

There are some exceptions to the standard match process via SF Match as follows: (1) applicants in active military duty at the time of application; (2) applicants currently in the institution as internal candidates; (3) applicants who are making a commitment to the institution of the fellowship for more than 1 year—such as critical care followed by cardiothoracic anesthesiology, or combinations of cardiothoracic with pediatrics, obstetrics, regional, research, or perioperative medicine; (4)

applicants in a foreign residency program; and (5) applicants with a partner applying for a training program in a medical specialty in the same region as the fellowship.¹⁶ The candidates who use the match exception still are required to use the SF Match ranking process and complete an exception agreement with their future fellowship program director (available on the SCA website: www.scahq.org). Most match exceptions are for internal candidates, followed by agreements to commit to the institution for more than 1 year (Table 7).

For an anesthesia fellowship candidate who has not completed either an ACGME-accredited or an accredited Canadian residency program, there is an exception for gifted fellowship applicants. A fellowship may consider an “exceptionally qualified” applicant (ACGME Program Requirements for Graduate Medical Education in Anesthesiology).¹⁷ This is defined as someone who has demonstrated academic dedication and clinical excellence, including participation in research and scholarly activity in the specialty. Such a candidate may be selected for a fellowship provided that they complete USMLE

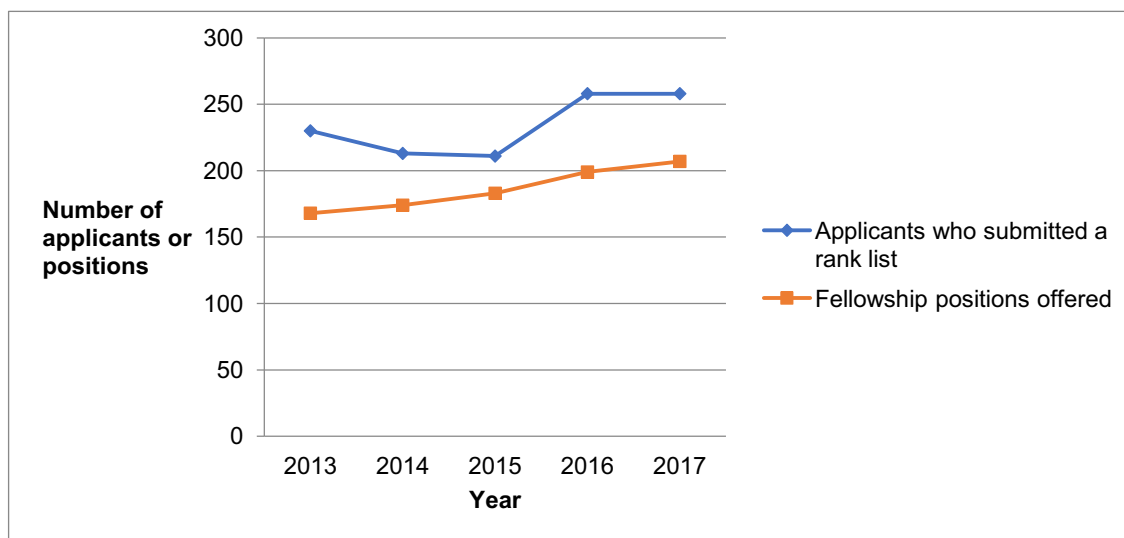


Fig 2. Comparison of the total number of adult cardiothoracic anesthesiology fellowship positions offered and number of applicants who submitted a rank list in the San Francisco Match from 2013 to 2017. (Data source: www.sfmacth.org).⁶

Table 5
2017 Comparative Fellowship Match Data Among Anesthesia Subspecialties

Fellowship Match (2017)	Positions offered	Applicants (ROL submitted)	Applicants per fellowship position offered
Obstetric anesthesiology	43	29	0.67
Critical care	202	157	0.78
Pediatric anesthesiology	210	207	0.98
Adult cardiothoracic anesthesiology	207	258	1.25
Pain medicine	316	401	1.27

NOTE. Data from www.sfmatch.org and www.nrmp.org.^{13,14}
Abbreviations: ROL, rank order list.

examinations and, for an international graduate, have Educational Commission for Foreign Medical Graduates certification. Data from the SF Match regarding match exceptions suggest that, from 2013 to 2016, 2 candidates have matched to ACTA fellowships from non-US residency programs and no candidate has used the “exceptionally qualified” category (Table 7).

ACTA Fellowship Program Application: Dual Fellowships

The most common dual fellowship combination is ACTA with critical care; however, other combinations, such as ACTA with pediatric, regional, or obstetric anesthesiology, are also possible (Table 1). There is no formal process for the critical care/ACTA combination regarding application. At a single institution the programs may allow a single application via SF Match (ie, the applicant applies to either ACTA or critical care having notified the institution of the dual interest), but this is institution dependent. The order of fellowship (ACTA first or vice versa) is not set, but some institutions have a preference. An applicant’s commitment to an institution for more than 1 year enables them to use a match exception, involving an exception agreement with the fellowship director, and may allow the candidate to secure a position ahead of the match

(although the candidate still submits an SF Match rank list with the single chosen program listed).

Recently, SF Match has added a check box that communicates the applicant’s interest in dual critical care/ACTA fellowships to the program. This is translated into a line on the candidate’s application document (stating a “yes/no” response to interest in a dual fellowship) but does not change the application process otherwise.

ACTA Fellowship Application: Candidate Selection

Owing to a lack of published information about the preferred attributes of a cardiothoracic anesthesia fellowship applicant, the authors composed an email survey to identify which aspects of a fellowship application were considered most important by ACTA program directors. The survey was emailed to the fellowship directors of 66 US ACTA ACGME-accredited fellowship programs, asking them to rank 8 different elements of a candidate’s application. Individual responses were not linked to individual email addresses, providing response anonymity. The survey consisted of 8 graded-response questions (0, no importance, to 5, critically important) and 1 free comment question. The 8 elements of an application addressed by the survey were critical care board

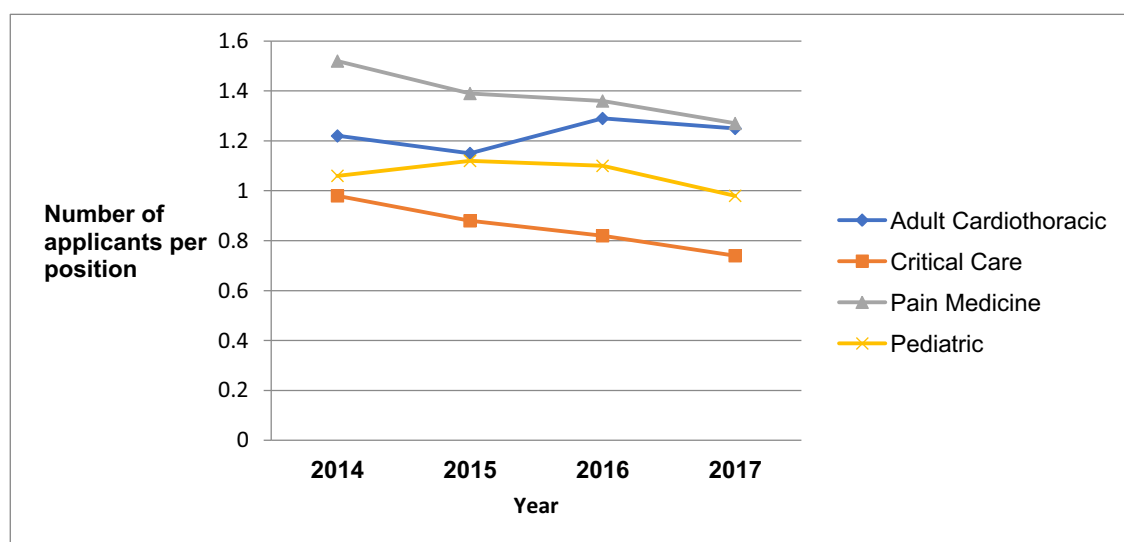


Fig 3. A comparison of the number of applicants per available fellowship position for adult cardiothoracic anesthesiology critical care, pain medicine, and pediatric anesthesiology fellowships, between 2014 and 2017 (data from National Resident Match Program and San Francisco Match).^{3,14}

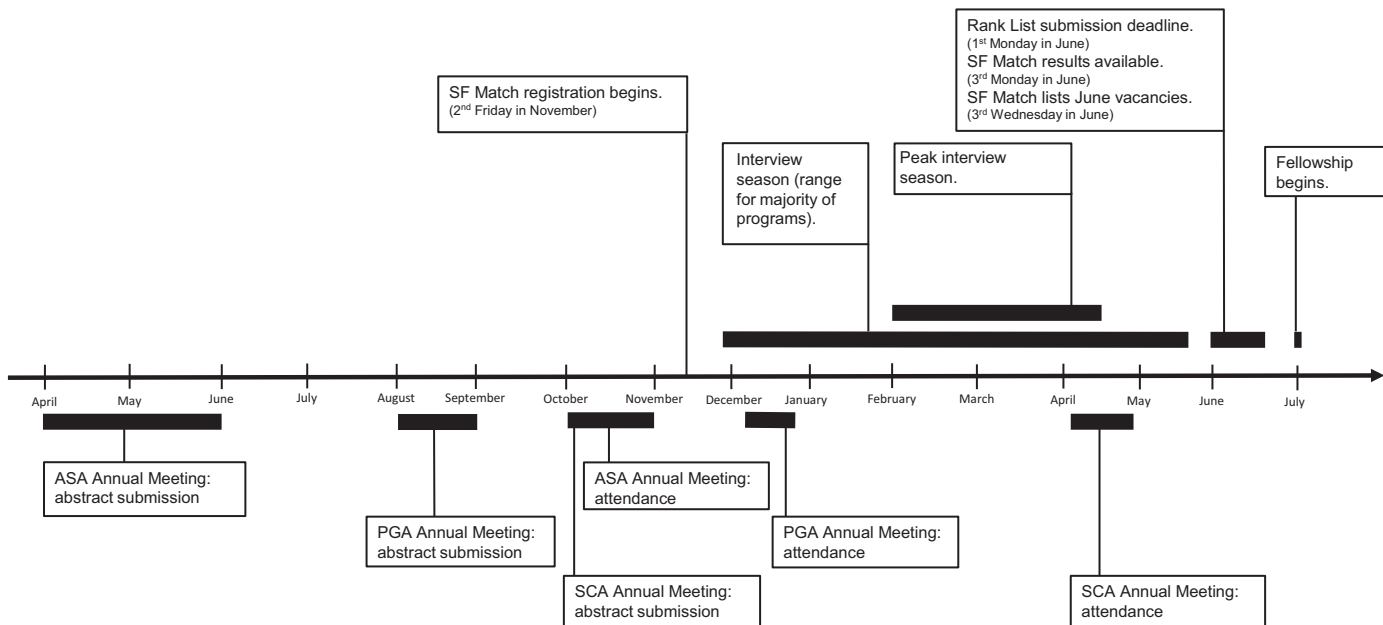


Fig 4. Timeline of the adult cardiothoracic anesthesiology fellowship application process. Information on interview season from individual programs (see also Fig 5). Data source: San Francisco Match, www.asahq.org, www.scahq.org, www.nyssa-pga.org/pga-meeting. The ASA, PGA, and the SCA are not part of the application process but may provide opportunities for candidates to demonstrate their interest in the specialty. ASA, American Society of Anesthesiologists; PGA, PostGraduate Assembly in Anesthesiology; SCA, Society of Cardiovascular Anesthesiologists; SF Match, San Francisco Match.

certification (or desire for double-board training), personal statement, letters of recommendation, Basic Exam score, USMLE scores, ITE scores, cardiothoracic-relevant research, and reputation of residency program. The survey had a response rate of 54.5% (36 of 66 ACGME accredited fellowship directors responded), which is comparable to the response rate for similar surveys in other anesthesia subspecialties.¹¹

Of the factors in a candidate’s application that were assessed, the survey revealed that having a strong letter of recommendation that was *relevant to cardiothoracic anesthesiology* was the most important factor (45.7% of the respondents scored this as critically important; Figs. 6 and 12). This was followed by the reputation of the candidate’s residency program. Regarding the importance of exam scores, the ITE score

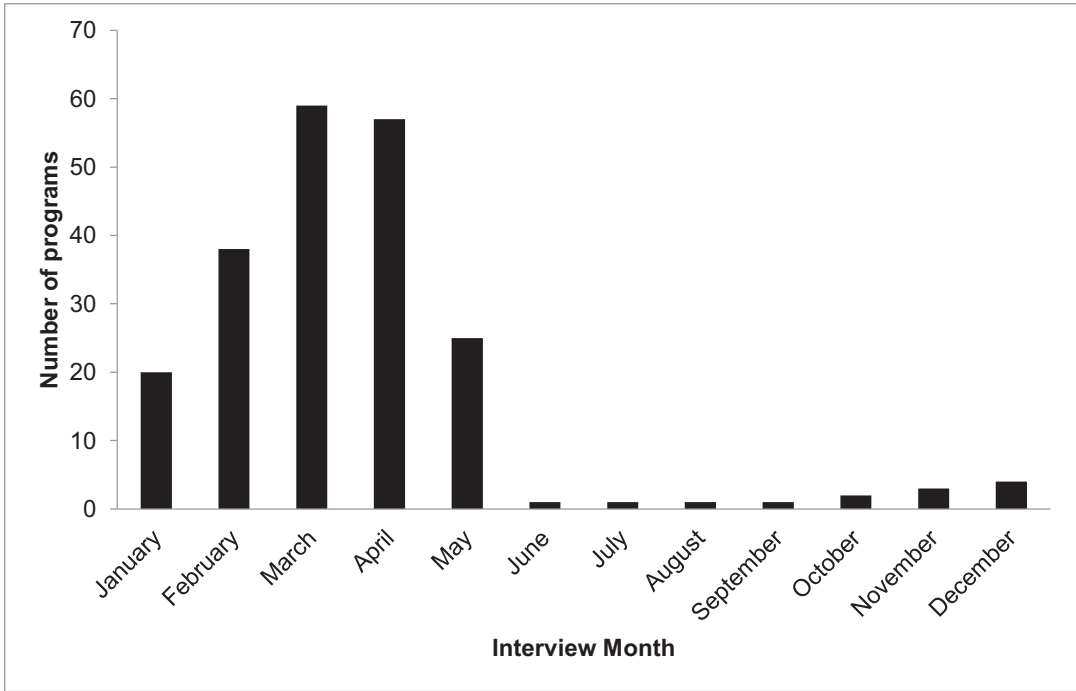


Fig 5. The calendar distribution of adult cardiothoracic anesthesiology fellowship interviews by the number of ACGME-accredited programs that interview each month. Data source: correspondence with fellowship programs. ACGME, Accreditation Council for Graduate Medical Education.

Table 6
Application Fees (2018) for ACTA Fellowships

Number of programs applied to	Fees (US\$)
1-10	\$60 (total)
11-20	\$10 per program (after the initial 10)
21-30	\$15 per program (after the initial 20)
31-40	\$20 per program (after the initial 30)
41 and more	\$35 per program (after the initial 40)

NOTE. Fees in 2018 for application to ACTA fellowships via San Francisco Match using the CAS service. Source: www.sfmacth.org.¹⁵
Abbreviations: ACTA, adult cardiothoracic anesthesiology; CAS, Central Application Service.

was given greater weight than the ABA Basic Exam and USMLE. The ABA Basic Exam is relatively new, and this weighting could change as ACTA directors gain experience with the exam results. Strong examination performance in residency gives confidence that the fellow also will pass the ABA Final Examinations and be focused suitably on the academic challenges of the ACTA fellowship.

The personal statement was given a slightly higher but similar importance as research in the field of cardiothoracic anesthesia. Being board-certified in critical care was given the lowest importance of the factors assessed; however, this was not differentiated clearly from an applicant who is applying for both critical care and ACTA. The importance of each factor (as the mean score from all respondents) is depicted in Fig 6. The distribution of scores for each factor is presented in Figs. 7 to 14.

Letters of recommendation describing the candidate as suited to the cardiothoracic operating room (OR) are extremely important. Letters from cardiothoracic anesthesiologists, especially someone known to the interviewer, allow a degree of confidence that the person being presented in a curriculum vitae also will excel in practice. The SCA has introduced an “Adult Cardiothoracic Anesthesiology Fellowship Standardized Recommendation Letter”¹⁸ for ACGME-accredited fellowships, but this is not in use by all fellowship programs. Securing letters of recommendation from cardiothoracic anesthesiologists requires participation in cardiothoracic rotations in the OR. It is preferable to request a letter from the ACTA fellowship director or, in programs without a fellowship, from senior faculty, who are more likely to be known to the

recipients of the letter. Letters are more valuable from faculty with whom the trainee has worked closely and repeatedly, rather than on single occasions. It takes time to write a detailed letter, and the candidate should be considerate of faculty by requesting letters well in advance of application deadlines. Because fellowship application is required relatively early in training, a resident who may be interested in ACTA should get exposure to the cardiothoracic OR early in residency. It is advisable to find a departmental mentor who can help find interesting cases to present at conferences and who can invite the trainee to participate in relevant research. A mentor is also a valuable person for discussions about the personal implications of fellowship training, such as the time commitment, potential relocation, and decision to forego a year of higher salary.¹⁹ When a mentoring relationship is being established, it is advisable to set specific parameters including the number and timing of meetings, as well as to discuss the expectations that each side brings.^{19–21} In the event that a resident is unable to change the order of their rotations, to allow a cardiothoracic OR experience early in training, mentorship may also help - a motivated trainee could volunteer to participate in interesting cardiothoracic cases with the mentor outside of working hours, and participate in research with the mentor.

It may be beneficial to organize an early interview at the resident’s home institution—this allows the candidate practice in cardiothoracic fellowship interviews and, for residents who are interested in matching outside their residency institution, faculty may be able to provide feedback to the resident on their interview performance.

General anesthesia training is an obvious prerequisite to fellowship training; no matter how appealing the subspecialty, it is important that an anesthesia trainee not narrow their goals too early in training because all core anesthesiology and subspecialty rotations need attention. Individualized goals are available from the Anesthesiology Milestone Project, which was developed jointly by the ACGME and ABA to help evaluate residents.²²

The free-comment question in the survey highlighted other elements in the fellowship selection process. Primarily, the importance of performance during the interview was emphasized. Most programs sought compatibility with the program and institutional culture. For some fellowship directors, the goodness of fit was more important than test scores, prior

Table 7
Match Exception Use—ACTA Fellowship Match (2013 to 2016)

Reason for Match Exception	Year			
	2013	2014	2015	2016
Internal candidate	31	46	21	21
Commitment to institution for more than 1 year	7	8	9	10
Active military duty	3	1	-	-
Spouse/partner in region	1	-	1	-
Residency outside the United States	-	1	-	1
Residency outside the United States and ineligible for ABA certification due to non-US training	-	-	-	-

NOTE. Data from San Francisco Match.
Abbreviations: ABA, American Board of Anesthesiology; ACTA, adult cardiothoracic anesthesiology.

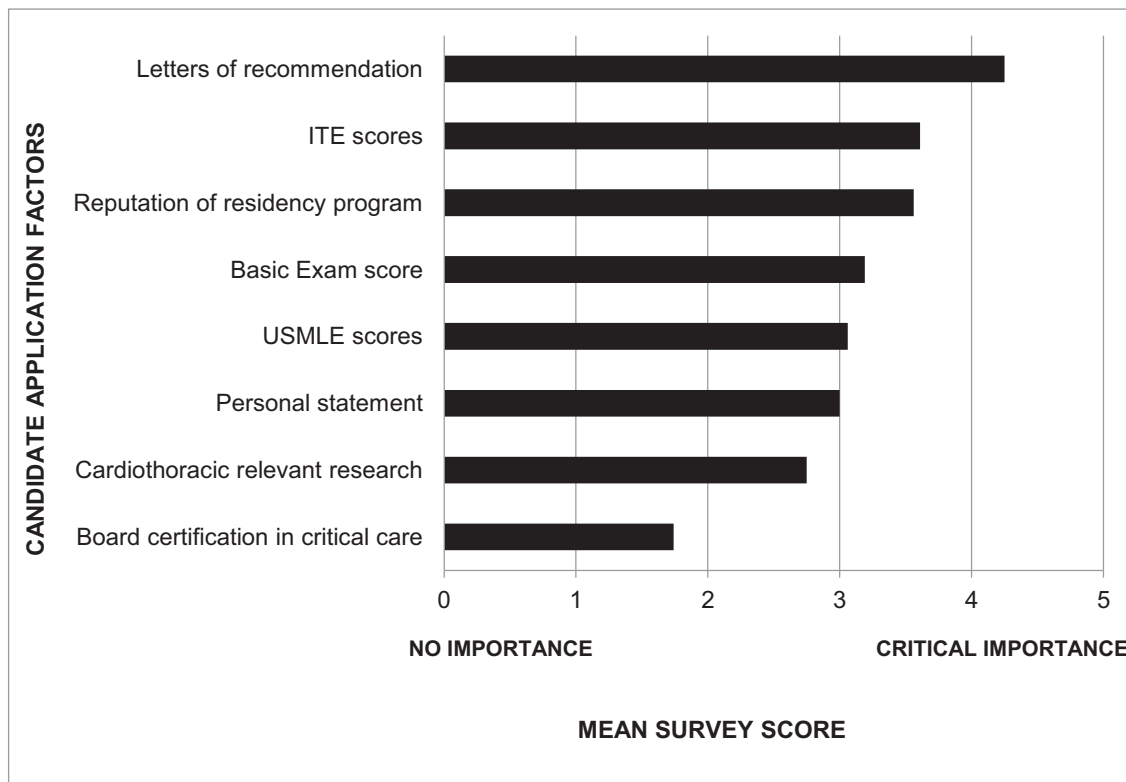


Fig 6. The mean ranking of 8 candidate application factors that may be taken into consideration when selecting fellowship candidates for adult cardiothoracic anesthesiology. Ranking from 0 (no importance) to 5 (critically important). Ranking is from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors. The scores for each individual factor are presented separately (Figs. 7–14). ITE, in-training exam; USMLE, United States Medical Licensing Examination.

publications/research projects, or residency of origin. Programs look for motivated learners who are open and eager to benefit from the educational opportunities that the program can provide. Wanting to live in the geographical area (or to

relocate) was important, but any indication that the candidate wanted to get into the program just to be able to relocate to the area was a negative factor. Selection as future chief resident or top resident was very helpful. In addition, evidence of

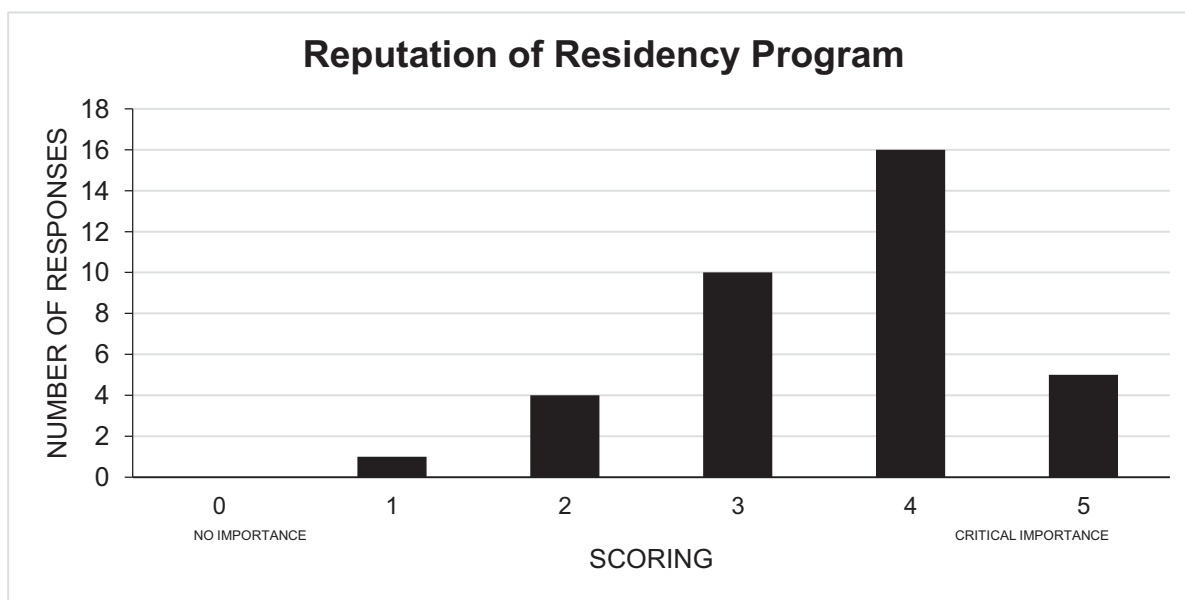


Fig 7. Importance of the reputation of an applicant’s residency program, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

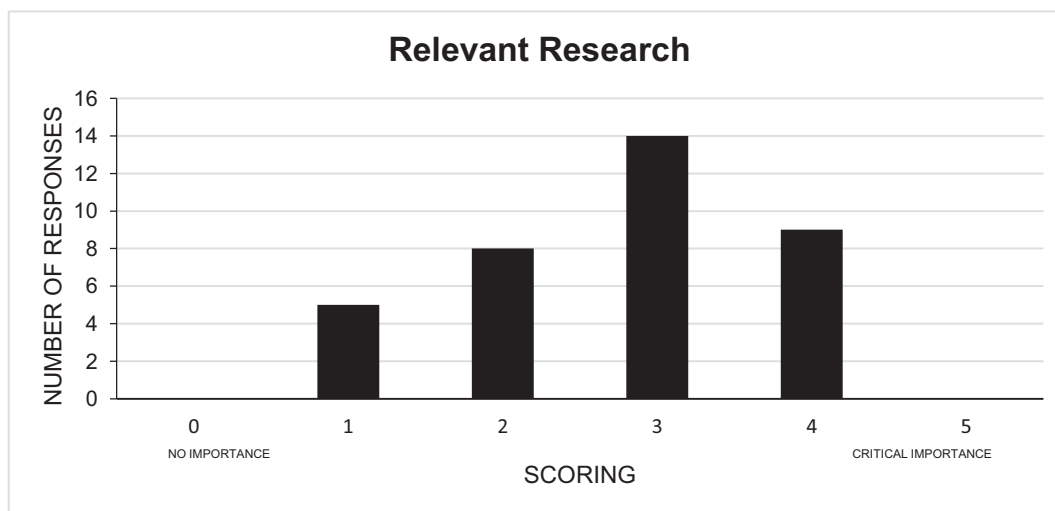


Fig 8. Importance of relevant cardiothoracic research by applicant, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

participation in hospital or departmental committees was helpful. Programs are looking for a genuine interest in cardiothoracic anesthesia and physiology, rather than simply wanting to improve general scope of care. Presentations or posters at national meetings (SCA, ASA, the PostGraduate Assembly in Anesthesiology, including complex cardiothoracic cases), was also seen as favorable. According to similar surveys from the National Resident Match Program—sent to non-cardiothoracic anesthesia fellowships—interpersonal skills, interview performance, and letters of recommendation were also emphasized by other anesthesia fellowship programs.¹⁴

Apart from the factors mentioned in the surveys, other activities that may help demonstrate the candidate's interest in the subspecialty include taking extra rotations and electives in cardiothoracic anesthesiology, becoming a member of the SCA,

and attending relevant conferences, even if not presenting. Beyond being an excellent learning environment, conferences are an opportunity to meet program directors and current fellows.

ACTA Fellowship Application: Professionalism

Professionalism begins with honesty in a candidate's documents and curriculum vitae. It is vital that the applicant portray their achievements in a realistic fashion and avoid falsification of publications at all costs. The consequences of falsified information can extend to disciplinary action by the ACGME.

If an applicant is offered an interview, the applicant only should accept the interview date if they are able to attend. A program has a limited number of interview openings, and considerable time is expended in the organization of the interview

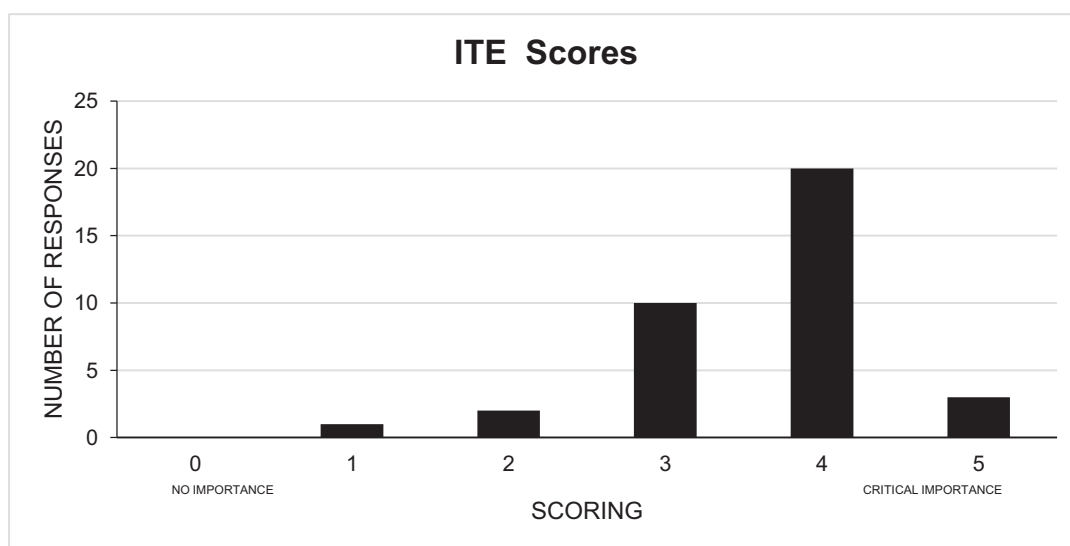


Fig 9. Importance of the applicant's ITE score, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors. ITE, in-training exam.

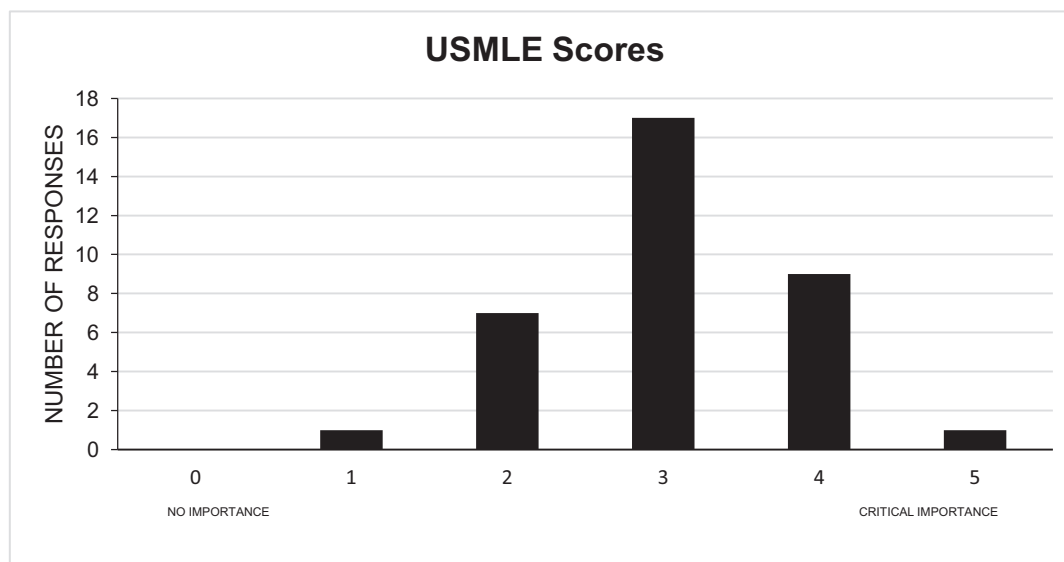


Fig 10. Importance of the applicant's USMLE scores, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors. USMLE, United States Medical Licensing Examination.

season—it is discourteous to reschedule with short notice. In the event that an applicant cannot attend a scheduled interview, it is vital to inform the program as soon as possible—the applicant may have deprived another candidate of an interview and they risk creating a negative professional reputation, not just for themselves but for future applicants from their institution. An applicant who decides to withdraw from the fellowship application process after interviewing should inform the programs where they interviewed. Fellowship programs take considerable care in interviewing and ranking applicants, and it is extremely unprofessional to remain on a program's active list of candidates with no intention of participating in the match.

Regarding the SF Match, there are 7 match rules that match participants agree to abide by. First, they are solely responsible

for their own rank list and the consequent match outcome. Second, they understand that ranking information (both their own and that of the program) is strictly confidential and neither side should try to elicit ranking details from the other. Third, to break with a matched appointment, the applicant requires a written release from the program. Without a written release, no other program may offer the applicant a position. Granting a release from a matched position is at the discretion of the program and is not automatic. Fourth, the submission of a match list constitutes a binding agreement between the applicant and the program, but any program offer depends on the applicant completing any required training (in the case of an anesthesia resident, this would be an anesthesia residency). Fifth, if the applicant is successful in matching, they will

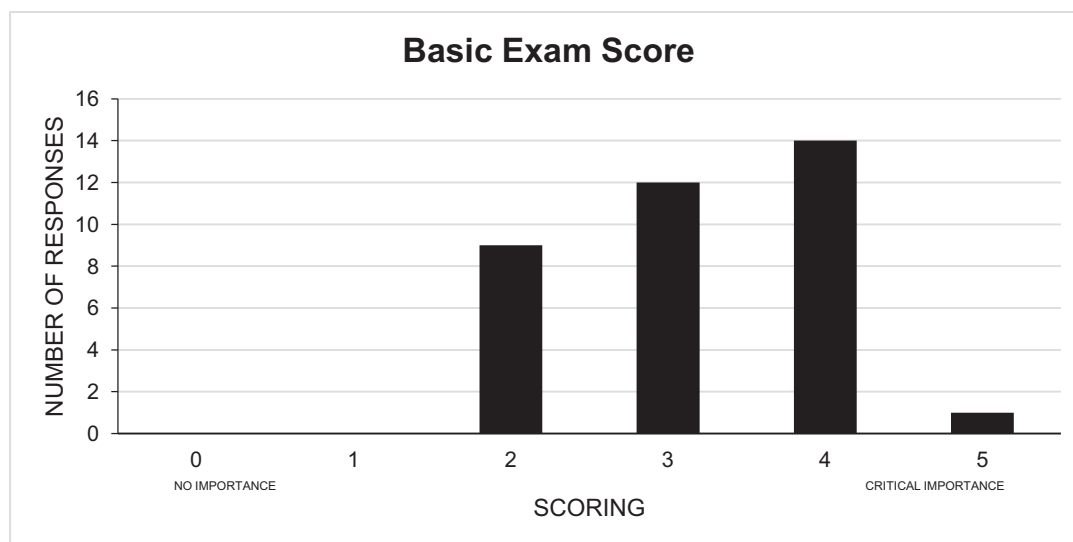


Fig 11. Importance of the applicant's American Board of Anesthesiology Basic Exam score, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

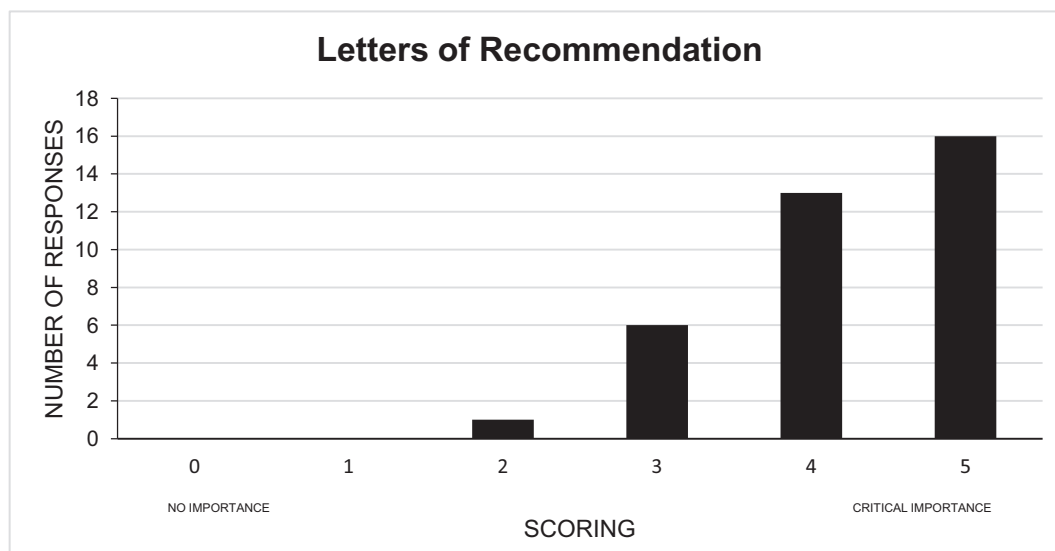


Fig 12. Importance of the applicant's letters of recommendation, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

withdraw from all other postgraduate medical matches that are in conflict with completion of the matched program. Six, the applicant must declare that they have no other obligations (such as military service) that could prevent them from fulfilling the program requirements. Lastly, the applicant gives SF Match permission to use anonymized information, gathered from match data, for any SF Match-approved study.³

The consequences of breaking the match rules are penalty action by the SCA (the sponsoring organization for the SF Match in ACTA). It is critical that the applicant understand the detrimental effect that withdrawal has on a program in the short prefellowship period. A program may not be able to fill the position with resultant effects on program structure, rotations, and call. In addition, for any fellow who was unmatched,

or for a fellow who ranked the now-vacant program higher, withdrawal is extremely unfair.

ACTA Fellowship Application: Selection of a Program

There are currently 66 ACGME-accredited ACTA fellowship programs.² How should a candidate choose among them?

An ACGME-accredited fellowship allows the graduating fellow to take the Advanced PTEeXAM and apply for board certification to become a diplomate of the NBE. If the candidate is mainly interested in additional experience with managing cardiothoracic cases and does not require certification from the NBE, then a nonaccredited fellowship may be a very useful option. Nonaccredited programs may have a partial staff

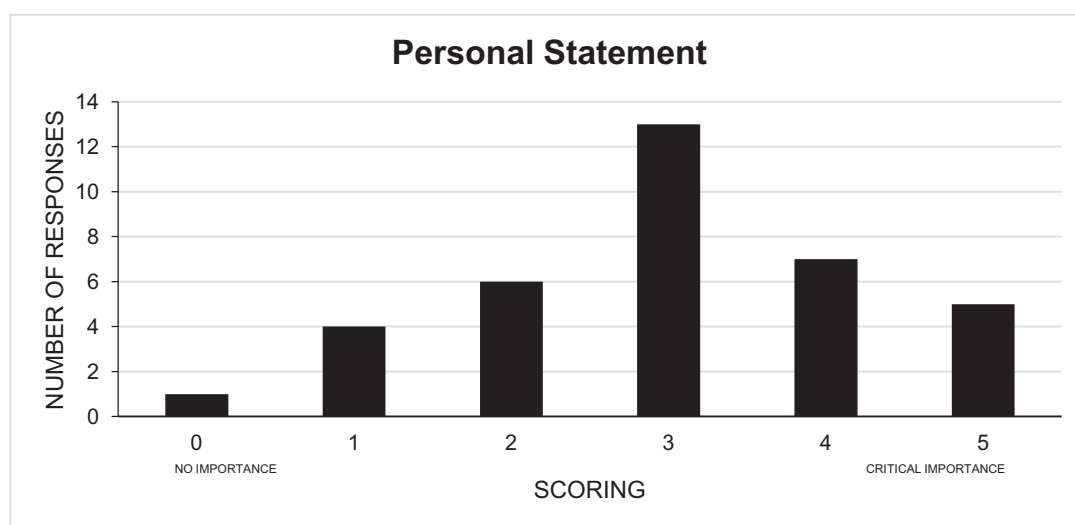


Fig 13. Importance of the applicant's personal statement, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

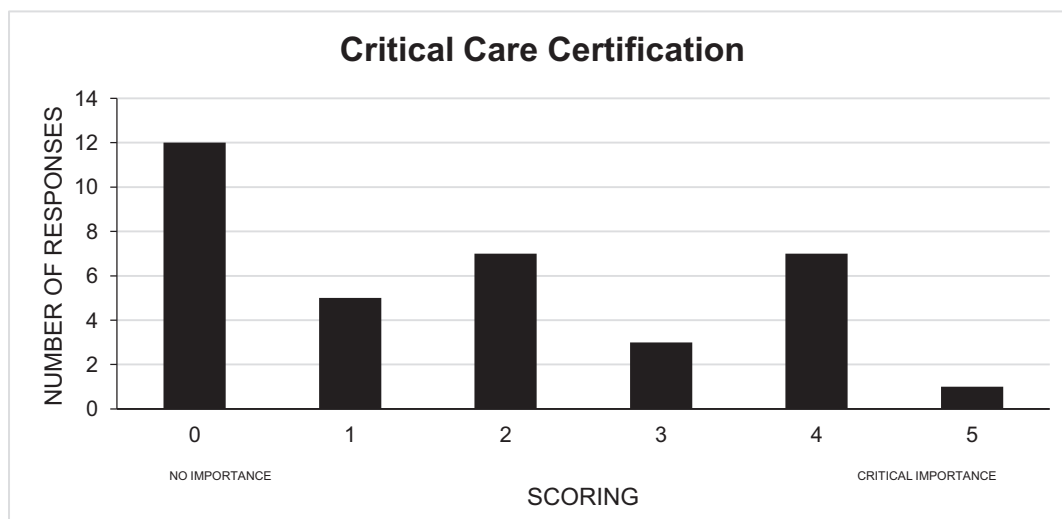


Fig 14. Importance of the applicant having critical care fellowship training, as ranked from 0 to 5 by adult cardiothoracic anesthesiology fellowship directors (0, no importance to 5, critically important), when considering an applicant for a fellowship position. Results from a 2018 email survey of adult cardiothoracic anesthesiology fellowship directors.

appointment, providing a higher salary or allowing a current faculty member to remain at the same institution while pursuing extra training. However, there is only 1 active, adult US program for thoracic anesthesiology (Table 3), suggesting that this is no longer a common pathway. Among accredited fellowships, there are many factors to consider.

The ACGME recommends a mixture of *supervisory* (attending/fellow/resident) and *primary* (attending/fellow-only) cases. At a minimum, a fellow must perform 35 cases as the primary provider while being supervised by a faculty anesthesiologist.⁶ A detailed description of the ACGME requirements is available from <http://www.acgme.org/Portals/0/PDFs/Milestones/AdultCardiothoracicAnesthesiologyMilestones.5>. Although all ACGME-accredited programs must allow the fellow to experience minimum numbers of certain case types, most institutions have a particular emphasis. There are national centers for transplant, aortic surgery, minimally invasive surgery, mitral valve repair, etc., where a trainee will be exposed to more of certain type of surgery. An individual may have a particular interest or be looking for an institution that performs a very wide variety of cases.

Fellowship program size is another differentiating factor. A recent article by Capdeville et al. addresses the different US ACTA fellowships on this topic, suggesting a classification of 3 groups: small (1-4 fellows), medium (5-8 fellows), and large programs (>8 fellows).⁴ Capdeville et al. suggest that different program sizes are suited to different individuals or to trainees with different career trajectories—community-based practice as opposed to high-acuity tertiary practice with more complex patients and cases such as mechanical assist devices. A single fellow will have a different experience from a group of fellows: there may be less competition for desired cases but less camaraderie with fellow trainees. Depending on the staffing model (residents or certified registered nurse anesthetists working with attendings or attendings working alone), competition for cases also may occur with anesthesia residents, especially if the

program has a relatively low cardiothoracic case volume.^{23,24}

The program size may affect the call pattern and call volume. Size can influence the percentage of cases in which the fellow is *supervisory* as opposed to *primary*. In smaller programs, fellows may receive greater individual attention from a higher ratio of faculty to trainees, but close mentorship is also possible in larger programs with large numbers of faculty. Educational sessions may have a different style because larger programs may attract outside speakers who may be more challenging to arrange for a single fellow. However, it is also possible to collaborate with allied groups of fellows or faculty, for example, with heart failure trainees to learn about ventricular assist devices or pediatric fellows to learn about congenital heart disease.⁴ Extra educational opportunities may include resources that are independent of program size, such as multimedia, online learning, or simulation experiences (either live or online).

Geographic location and the cost of living in the area, or commute, are important issues for many applicants. Proximity to family or desire to move to the area after fellowship may be significant influences.

It may be beneficial to get some insight into the culture of the hospital and the program, including level of formality and patient population. It is possible to get much of this information from colleagues, current and previous fellows. This will allow a candidate to decide if they are compatible with the institutional culture. For this reason, some applicants prefer to remain at their residency institution—there are fewer new systems and new personalities to learn. Other residents prefer the opportunity to learn new approaches via a different hospital. Depending on the size of the resident's home institution, and the interest from coresidents, there may be a number of fellowship positions available internally. Internal candidates, using the exception rule, still use the SF Match system but can avoid uncertainty and travel to interviews. The candidate should be aware that acceptance of an internal position excludes them from accepting an external position via the matching process.

Although some candidates may prefer the security of an internal position, they forgo the chance to train at other, more competitive institutions and need to make the decision about accepting internal positions before the match deadline.

The opportunity to pursue a dual fellowship is another differentiating factor. If a candidate wishes to pursue a dual fellowship, it is important to recognize that these 2-year programs are not offered at every institution. Combinations include ACTA with critical care, pediatrics, obstetrics, regional, OR management, and perioperative medicine. It is possible to apply jointly for both fellowships at a single institution or to plan to change locations. Although many programs value research and academic participation, there is a recognizable limitation within a single year, especially if large-scale or long-term research is involved. If the candidate is interested in research, there are research-oriented programs, some with a dedicated research pathway for independent investigators after fellowship. A 2-year (dual fellowship) commitment also extends access to meaningful involvement in research, even outside a dedicated research track. Ongoing involvement in research may be an additional reason to stay at the same institution from residency. Despite the appeal of the extra qualifications and certification, dual fellowships do not save the candidate any training time: the fellow participates sequentially and overlap exists in the material covered in ACTA and critical care (eg, fellows who have completed critical care fellowships are still required to participate in a 1-month critical care rotation during an ACTA fellowship).

Time will be needed to attend fellowship interviews. This should be discussed in advance with the residency program or workplace administration to allow flexibility for call schedules. If offered, the candidate should try to attend a preinterview dinner; this provides greater opportunity to understand the work culture of the program. Time also is required to prepare for the interview circuit: the candidate should learn about the institution and cardiac program. An understanding of what differentiates one training program from another allows the applicant to ask relevant questions (Table 8) and show interest in any unique features a specific fellowship may offer.

Post-Match Preparation

For most resident applicants, the ABA Final Examination will be the main focus in the last months of residency. Board certification is critical to final NBE certification, and the pre-fellowship resident must complete all ABA requirements. Despite the pressure of the ABA Final Examination, academic preparation toward fellowship can start by finding relevant books on cardiothoracic anesthesiology and reviewing the ACGME expectations of ACTA fellows. The revised ACGME requirements for Graduate Medical Education in Adult Cardiothoracic Anesthesiology give a broad outline of the expectations from a cardiothoracic fellow, including specific medical knowledge and practical application of the knowledge in the operating room.^{9,17}

There are many opportunities to develop TEE skills: reading, online, and via TEE rotations during residency. The University of Toronto developed an interactive website of virtual

Table 8

Interview Questions for an ACTA Fellowship Candidate

Candidate selection:

How many places are available this year?

What are you looking for in a candidate?

Fellowship opportunities:

What is the clinical focus or specialty of the cardiac surgical group?

Are all case types for ACGME minimums achievable?

What type of TEE education is provided?

What elective rotations are available?

What research opportunities do you offer?

Do you support dual fellowships (eg, critical care, regional, obstetrics, pediatrics)?

What is the policy on conference attendance during the fellowship year?

What resources are available for study (books/e-books/simulators)?

How does the program fulfill the QI requirement for the ACGME?

Candidate outcome:

What are the graduate outcomes for employment?

- Private v academic

- Pure cardiac v general

What is the examination pass rate?

Abbreviations: ACGME, Accreditation Council for Graduate Medical Education; ACTA, adult cardiothoracic anesthesiology; QI, quality improvement; TEE, transesophageal echocardiography.

TEE using computed tomography models of cardiac anatomy (the website includes 20 of the 28 views of the basic TEE examination).²⁵ Online anesthesia resources (such as the Anesthesia Toolbox)²⁶ are widely available. Collecting echocardiography guidelines, for reference and study, such as the latest perioperative TEE guidelines from the American Society of Echocardiography and the SCA, allows the fellow to be prepared for focused TEE study.^{27,28}

In the final months of residency, a cardiac rotation may help to refresh the flow of cardiac cases. In addition, it may be valuable to contact the current fellows at the fellowship institution to discuss institutional differences in case flow and to benefit from their recent experience. At the same time, the intensity of residency training and ABA final exam preparation also will start to increase. A prospective fellow should start exam study early and progress methodically to avoid a potentially stressful pre-exam period while changing hospitals and relocating.

Conclusion

The trend toward increasing oversight by regulatory bodies has led to accredited training programs and the possibility of NBE certification. Although there is benefit from the increased credibility associated with external certification, there is also more complexity to the application and accreditation process.

Above and beyond the requirements for strong academic credentials, fellowship programs seek evidence of successful anesthesia practice in the cardiac operating room. Recommendations describing suitable cardiac OR behavior and skills, as judged by other cardiac anesthesiologists, allow advance evaluation of practical traits. Appropriate personality characteristics and a congruent personality with the institution also are confirmed in the interview. Cardiothoracic fellowship training is challenging. To meet the challenge and find the ideal

trainee, current training programs look at many aspects of an application but give most importance to strong letters of recommendation from cardiothoracic anesthesiologists and ITE scores. Applicants should pay attention to the application calendar as mentorship, research, or poster presentations require advance planning.

Future directions for research in this area include a more in-depth survey of fellowship directors including questions regarding the importance of examination scores (such as minimum requirements) and research. The other area of interest is dual fellowship application: dual fellowships currently lack an official application framework, and there is limited data on the numbers of candidates pursuing this training track. Future surveys of fellowship directors could consider differentiating between an applicant interested in both critical care and ACTA, as opposed to an applicant with existing critical care qualifications who is applying for an ACTA fellowship. The lack of publicized, nonaccredited US programs is also an interesting phenomenon that could be addressed in future publications.

Supplementary materials

Supplementary data are available in the online version of this article at doi:10.1053/j.jvca.2018.12.006.

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