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SPECIAL ARTICLE

Advanced Second Year Fellowship Training in Pediatric Anesthesiology in the United States

Dean B. Andropoulos, MD, MHCM,*† Scott G. Walker, MD,†§ C. Dean Kurth, MD,‖¶ Randall M. Clark, MD,#** and Desmond B. Henry, MD††‡‡

Pediatric anesthesiology as a subspecialty in the United States traces its origins to the post–World War II era when Dr. Robert M. Smith joined the faculty at Harvard Medical School and Boston Children's Hospital and devoted his career exclusively to this new subspecialty including the creation of a fellowship. Other anesthesiologists soon followed to specialize in pediatric anesthesiology and create pediatric anesthesiology fellowships during the 1950s and 1960s, such as Drs. Margot van Deming and Jack Downes at the Children's Hospital of Philadelphia and Dr. George Gregory at the University of California, San Francisco.[1–3] Pediatric anesthesiology fellowships spread to many institutions during the 1980s and varied somewhat among programs, consisting of 6 to 12 months clinical training in pediatric anesthesiology and often critical care medicine and pain medicine after completing an anesthesiology residency. This mirrored the dramatic growth of pediatric anesthesiology in U.S. academic programs and freestanding children's hospitals.

In 1987, the Society for Pediatric Anesthesia was formed to foster quality of anesthesia and perioperative care and to alleviate pain in children through development of clinical care models, research, and education focused on pediatric anesthesiology and critical care medicine. By 2013, this society had 2814 U.S. members.[a] In 1997, pediatric anesthesiology met the criteria for recognition as a subspecialty by the Accreditation Council for Graduate Medical Education (ACGME) in the United States, and the Anesthesiology Residency Review Committee developed program requirements for a 12-month subspecialty fellowship training program.[4] The Pediatric Anesthesiology Program Directors Association (PAPDA) was formed in 2007 and is a component of the Association of Anesthesiology Subspecialty Program Directors.[b] In 2011, the first pediatric anesthesiology fellowship matching program was administered through the National Resident Matching Program,[c] with 75% of positions nationwide being offered within the fellowship match. In 2013, there are 51 accredited pediatric anesthesiology fellowship programs, with 215 available positions.[d] In October 2013, the first pediatric anesthesiology subspecialty examination was offered by the American Board of Anesthesiology, with >1500 candidates sitting for the examination.[e]

The significant growth and development of pediatric anesthesiology and need for a forum to identify strategies to further its growth and development led to the formation of the Pediatric Anesthesia Leadership Council (PALC) in 2008, a group of chairs and chiefs of pediatric anesthesiology departments or divisions primarily within children's hospitals and academic anesthesiology departments in the United States. PALC arrived at a consensus that a strategy was required to develop the skills of the workforce to advance pediatric anesthesiology to serve patients better and to align with the health care system of the future. In particular, pediatric anesthesiology fellowships should not only be assessed for clinical skill mastery but also for preparing graduates for roles in leadership, research, education, quality improvement, and pediatric anesthesia subspecialties. In November 2010, PALC joined forces with PAPDA and formed a Pediatric Anesthesia Fellowship Task Force, with the charter to formally evaluate the strengths and weaknesses of the current fellowship training, to elucidate the opportunities and threats as compelling reasons for change, to make specific recommendations for improving the fellowship education of the next generation of leaders and academicians in pediatric anesthesiology, and to communicate these recommendations to stakeholders within and outside the subspecialty.

The purpose of this article is to present the work of this task force and the recommendations for an optional Second Year Advanced Pediatric Anesthesiology Fellowship. This

From the *Departments of Anesthesiology and Pediatrics, Baylor College of Medicine; †Department of Pediatric Anesthesiology, Texas Children's Hospital, Houston, Texas; ‡Department of Anesthesia, Indiana University School of Medicine; §Department of Anesthesiology, Riley Hospital for Children, Indianapolis, Indiana; ‖Departments of Anesthesia and Pediatrics, University of Cincinnati College of Medicine; ¶Department of Anesthesia, Cincinnati Children's' Hospital Medical Center, Cincinnati, Ohio; #Department of Anesthesiology, University of Colorado School of Medicine; **Department of Anesthesiology, Children's Hospital Colorado, Aurora, Colorado; ††Departments of Anesthesiology and Pediatrics, University of Texas Southwestern School of Medicine; and ‡‡Department of Anesthesiology, Children's Medical Center, Dallas, Texas.

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Requests for reprints should be addressed to Dean B. Andropoulos, MD, at dbandrop@texaschildrens.org.

Address correspondence to Dean B. Andropoulos, MD, MHCM, Department of Pediatric Anesthesiology, Texas Children's Hospital, 6621 Fannin, WT 17417, Houston, TX 77030. Address e-mail to dbandrop@texaschildrens.org.

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[a] Society for Pediatric Anesthesia Web site. Available at: http://www.pedsanesthesia.org. Accessed June 27, 2013.

[b] Association of Anesthesia Subspecialty Program Directors (Web site): Available at: www.saaahq.org/aaspd.htm. Accessed June 27, 2013.

[c] National Resident Matching Program Web site. Available at: http://www.nrmp.org. Accessed June 27, 2013.

[d] Accreditation Council on Graduate Medical Education Web site. Available at: http://www.acgme.org. Accessed July 16, 2013.

[e] American Board of Anesthesiology Web site. Available at: http://www.theaba.org. Accessed June 27, 2013.

work includes the detailed recommendations, rationale for change, and barriers and tactics for implementation. The formation of a Second Year Advanced Pediatric Anesthesiology Fellowship Network is described for the areas of pediatric cardiac anesthesiology, pediatric anesthesiology education, pediatric anesthesiology pain medicine, pediatric anesthesiology quality and safety, and pediatric anesthesiology research.

CURRENT ACGME FELLOWSHIP TRAINING IN PEDIATRIC ANESTHESIOLOGY

The ACGME Program Requirements specify that, "The subspecialty program in Pediatric Anesthesiology must be structured to ensure optimal patient care while providing fellows the opportunity to develop skills in clinical care and judgment, teaching, administration, and research."[d] The clinical components of the curriculum emphasize the great expansion in knowledge and practice areas in pediatric anesthesiology, including acute and chronic pain management, palliative care, regional anesthesia, critical care, and anesthesia sedation outside the operating room. The expansion of subspecialty surgical care requires extensive clinical experience caring for neonates and pediatric patients undergoing cardiac, thoracic, neurosurgical, and transplant as well as fetal surgery. Development as a fully qualified consultant and training in the coordination and direction of anesthesia care teams are also specified in the Program Requirements. The required didactic components emphasize both the basic science and clinical science of providing complex subspecialty care to this wide variety of pediatric patients. The didactic components do not specify training in research, education, quality improvement, safety, or operating room management. The consensus of the Pediatric Anesthesiology Fellowship Task Force was that the current 12-month ACGME fellowship with its clinical emphasis would not be able to provide education in these areas without compromising clinical exposure or clinical didactic teaching.

The ACGME Program Requirements address fellows' scholarly activities by stating that the curriculum should "provide the opportunity for active resident participation in research projects," and the fellow "should be instructed in the conduct of scholarly activities and the evaluation of investigative methods and interpretation of data," and "develop competence in critical assessment of new therapies and of the medical literature."[d] There is not a requirement for an enduring scholarly, academic, research, or educational work product.

In contrast to the current Pediatric Anesthesiology Fellowship Program Requirements, pediatric medicine subspecialty fellows in disciplines such as critical care, neonatology, and cardiology spend 3 years in fellowship, with 12 to 18 months devoted to training in research, quality and outcomes, academic, educational, business, or leadership roles. On July 1, 2004, the American Board of Pediatrics fellowship requirements to qualify for subspecialty examinations changed from requiring research training and producing an original research publication as a primary author to one of producing enduring scholarly material in any of the following: research, education, leadership, public health, or administration.[f] In a 2007 survey of a random sample of all pediatric subspecialty fellowship graduates generated from the American Board of Pediatrics subspecialist database who completed training between 2002 and 2006 (1–5 years after completion of training), 64% practiced in an academic health center with a full-time medical school academic faculty appointment. Seventy-four percent regularly taught or precepted clinically for students, residents, or fellows. Clinical practice in 67% consisted of full-time or substantial inpatient subspecialty care. Thirteen percent devoted substantial time to research and administrative duties with limited clinical care. Thus, their fellowship experience provided them with important nonclinical skills, and this survey data provide some evidence that pediatric medicine subspecialty training has enhanced the academic and leadership mission of these disciplines.[5] Over the past decade, many pediatric medicine subspecialty fellows occupy positions in leadership and academics with formal training in research, or master's degrees in education, public health, business administration, or health care management, the skills of which were developed during their time as fellows.

Finally, a number of pediatric nonmedicine subspecialties such as pediatric surgery, pediatric psychiatry, and pediatric radiology require 2 years of pediatric subspecialty fellowship training to learn the clinical information and to receive training in research, education, and administration.[g] Pediatric surgical and nonsurgical disciplines requiring only 1 year of pediatric subspecialty fellowship training (congenital heart surgery, pediatric otolaryngology, pediatric ophthalmology, pediatric orthopedic surgery, pediatric neurosurgery, pediatric plastic surgery, and pediatric pathology) all have 5 to 7 years of residency training before entering the fellowship.

NEED FOR ADVANCED FELLOWSHIP TRAINING IN PEDIATRIC ANESTHESIOLOGY

Rationale for Advanced Fellowship Training

Against this backdrop of additional training in academic and leadership skills by pediatric medicine, surgery, and other fellowship disciplines in the pediatric subspecialties and the opinion of the Pediatric Anesthesiology Fellowship Task Force that pediatric anesthesiology was already falling behind these disciplines in terms of hospital leadership positions, research productivity, education, clinical subspecialization, and systems-based medicine, the Task Force arrived at the consensus that the field of pediatric anesthesiology would be better positioned for the future by the creation of a formal network to organize and promote academic, leadership, and advanced clinical subspecialty training. These specially trained fellows would then be better equipped for academic and leadership careers, better able to compete in the health care marketplace with other pediatric specialists, and better skilled to advance the scientific and clinical

[f]American Board of Pediatrics Web site. Available at: http://www.abp.org. Accessed June 27, 2013.

[g]American Board of Surgery Web site. Available at: http://www.absurgery.org; American Board of Radiology Web site. Available at: http://www.theabr.org; American Board of Urology Web site. Available at: http://www.abu.org; American Board of Otolaryngology Web site. Available at: http://www.aboto.org; American Board of Thoracic Surgery Web site. Available at: http://www.abts.org; American Board of Surgery Web site. Available at: http://www.absurgery.org; American Board of Psychiatry and Neurology Web site. Available at: http://www.abpn.com; American Board of Pathology Web site. Available at: http://www.abpath.org. All Web sites accessed June 27, 2013.

aspects of pediatric anesthesiology. Graduates would also be better able to influence the allocation of financial and manpower resources to the perioperative care of children, as it assumes a more central role in all of pediatric health care.[6] The further differentiation and development of the subspecialty argued for improved formal training of a generation of leaders and academics who could move the field forward in the future. The increasing use of nonphysicians and nonphysician anesthesia providers to deliver basic perioperative care of children mandates the evolution of pediatric anesthesiologists to deliver advanced perioperative care, lead systems-based practice, and manage personnel in the anesthesia team delivery model. Structured education in leadership, business, management, quality improvement, and safety is essential to achieve these positions.

The changes in health care delivery and financing mandated by the Affordable Care Act and other government programs, as well as market forces, argue for pediatric anesthesiologists with formal education in leadership and management to add the unique perspective of the anesthesiologist in the provision and financing of perioperative care for children. New concepts such as the Perioperative Surgical Home™ require significant participation by pediatric anesthesiologists to design and manage systems for optimal perioperative care in this new era.[7] For more than a decade, there has been increased emphasis on delivering higher quality health care with better outcomes from the perspective of the patient and family. This requires that pediatric anesthesiologists have specific training in quality improvement, outcomes research, and operating room management to contribute to leadership in perioperative care in more meaningful ways than "on the job" training.[8–10] The requirement for competency-based training and value-based continuing medical education in pediatric anesthesiology means that formal training in newer educational methods including simulation and adult learning is crucially important to better education programs.[11–13]

Also evident to the task force was the exponential increase in knowledge and complexity in the subspecialties pediatric cardiac anesthesiology, pediatric pain medicine, pediatric critical care, neuroanesthesia, palliative care, fetal surgery, and regional anesthesia.[14,15] The Congenital Cardiac Anesthesia Society (CCAS) published an article in 2010 describing the state of training in pediatric cardiac anesthesiology for anesthesia residents and pediatric anesthesiology fellows. The CCAS leadership concluded that the great increase in complexity of pediatric cardiac medicine, surgery, and critical care required advanced fellowship training in pediatric cardiac anesthesiology beyond the 1-year base training in pediatric anesthesiology or adult cardiac anesthesiology fellowships to achieve optimal status as a consultant and participant in this field.[16] They concluded that a period of specialized training of at least 6 months was necessary beyond the ACGME pediatric anesthesiology fellowship, even though the ACGME fellowship already included experience in pediatric cardiac anesthesiology. A minimum total of 9 months of pediatric cardiac anesthesiology training was specified, including the core ACGME pediatric anesthesiology fellowship and the advanced training after the core clinical year. They specified minimum case numbers and competencies emphasizing complex cases involving neonates and infants. Guidelines also included a didactic curriculum and additional training in echocardiography, extracorporeal support, cardiac intensive care, and participation in multidisciplinary care planning.

The Pediatric Pain Special Interest Group concluded that special advanced training beyond the ACGME pediatric anesthesiology fellowship was highly desirable to effectively practice pediatric acute and chronic pain medicine because of the advances in the field, increased patient complexity, and the increase in technical knowledge required to deliver complex care.[17] This includes a large increase in ultrasound-guided regional anesthesia procedures, multidisciplinary pain management approaches for both inpatients and chronic pain management, and palliative care.[18] The Pediatric Pain Special Interest Group developed guidelines for an additional 12 months of fellowship training that, where possible, would be combined with an adult pain fellowship program and meet the requirements for an ACGME certified training experience in pain medicine.

Research in pediatric anesthesiology is essential for innovation and creativity that will advance knowledge and practice and eventually improve the outcomes for pediatric patients undergoing anesthesia. Structured research experiences during anesthesia residency training result in improved productivity, and the lack of such experiences in many pediatric anesthesiology fellowships led to an unprepared workforce in this important discipline.[19] In the past decade, the concern over the potential for anesthetic toxicity in the developing brain has emphasized the pressing need for formally trained pediatric anesthesiology researchers in basic science, clinical research, epidemiology, and public policy. The manpower shortage in clinical anesthesiology from 1995 to 2005 also contributed to the dearth of formally trained researchers in pediatric anesthesiology.[20] Without guidance from basic and clinical researchers with formal fellowship training in pediatric anesthesiology, the search for answers to these complex questions risks not being fully informed by those experts who provide and direct the care of pediatric patients and who also educate the many other anesthesia providers who provide anesthesia care for the 4 to 6 million children undergoing anesthesia annually in the United States.[21,22]

It was the consensus of PALC and PAPDA that these important and rapidly advancing clinical and nonclinical developments in pediatric anesthesiology, pediatric surgery, pediatrics, and health care in general provide strong rationale for the organization and promotion of advanced fellowship training in pediatric anesthesiology beyond the 12-month core clinical ACGME fellowship.

Survey of Pediatric Anesthesiology Leaders, Junior Faculty, and Fellows

In early 2011, the Pediatric Anesthesiology Fellowship Task Force sent a 32-question Internet survey to all members of the PALC and the PAPDA (Appendix 1 http://links.lww.com/AA/A814). Survey responses were limited to 1 per institution. Fifty-three responses were received from chiefs and program chairs representing nearly all of the 46 ACGME pediatric anesthesiology fellowship program institutions

Table 1. Survey Results for Chairs, Chiefs, and Program Directors: Fellowship Skills (*n* = 53)

1. What skills are desired in some or all of fellowship graduates?	Percent answering affirmatively	
Excellent general clinical care	96	
Formally trained educator	62	
Formally trained researcher	44	
Formally trained in quality and outcomes improvement	44	
Subspecialty trained and qualified, e.g., cardiac, pain, ICU	37	
Formally trained in leadership and management	33	
Other	4	
2. Which skills does the core clinical ACGME fellowship provide?	Percent answering affirmatively	Actual – desired skills (%)
Excellent general clinical care	100	+4
Formally trained educator	23	−29
Subspecialty trained and qualified, e.g., cardiac, pain, ICU	21	−16
Formally trained in quality and outcomes improvement	14	−30
Formally trained researcher	12	−32
Formally trained in leadership and management	0	−33
Other	4	0
3. Is the pediatric anesthesia workforce for the future being trained through the ACGME fellowship (clinical subspecialties, research, quality, education, leadership)?	Percent answering affirmatively	
	47	

Actual minus desired skills represents the percent answering affirmatively to question 2 minus percent answering affirmatively to question 1.
ACGME = Accreditation Council for Graduate Medical Education; ICU = intensive care unit.

Table 2. Survey Results for Chairs, Chiefs, and Program Directors: Current Advanced Fellowships (*n* = 29)

What advanced training do you offer after the core clinical ACGME fellowship?	Percent answering affirmatively
Clinical subspecialty: cardiac	73
Research: formal training	63
Clinical subspecialty: pain	43
Education: master's degree or other formal training	30
Leadership/business/quality: MPH, MBA, or other formal program	30
Clinical subspecialty: other	27
Clinical subspecialty: ICU	13
Other	3
What sources of funding are utilized for advanced training?	
Department funds	62
Part-time clinical work as attending	52
Hospital or medical school funds	38
Research grant support	24
Other	10

Responses are only for those programs who answered affirmatively to providing additional advanced training (29 of 53, 53%).
ACGME = Accreditation Council for Graduate Medical Education; ICU = intensive care unit; MPH = Master's in Public Health; MBA = Master's in Business Administration.

Table 3. Survey Results for Chairs, Chiefs, and Program Directors: Resources and Support for Advanced Fellowship Training (*n* = 53)

Does your institution have faculty, expertise, and clinical/nonclinical material to provide advanced training?	Percent answering affirmatively
Research	96
Education	90
Clinical subspecialty: cardiac	82
Leadership/business	82
Quality and outcomes	78
Clinical subspecialty: pain	74
Clinical subspecialty: ICU	68
Could the existing ACGME fellowship be changed to meet clinical subspecialty/academic/leadership goals?	49
Should the ACGME fellowship be lengthened?	
Mandatory lengthening to 24 months	33
Optional lengthening to 24 months or longer	64
Do not support any lengthening	4

ACGME = Accreditation Council for Graduate Medical Education; ICU = intensive care unit.

and several other institutions with either anesthesiology residency programs without fellowships or freestanding children's hospitals participating in the training of pediatric anesthesiology fellows. There was a 98% response rate for all questions, and 60% of surveys had at least 1 narrative comment. The responses are summarized in Tables 1 to 3. Major conclusions reached by the Task Force from the survey included the following: (1) The majority of respondents (53%) felt that the current 12-month ACGME fellowship was not preparing the pediatric anesthesiology workforce of the future in the necessary skills needed to advance these clinical and nonclinical disciplines. (2) There was a training and knowledge gap in the 12-month ACGME fellowship between actual and desired skill sets. (3) There were already substantial offerings for advanced pediatric anesthesiology fellowship training, and a majority of programs had the potential to either expand existing advanced fellowship programs or initiate new programs in these areas. (4) The most common barrier to instituting new advanced fellowships was funding. (5) Thirty-three percent supported mandatory lengthening of the ACGME fellowship to 24 months or longer, 64% supported optional lengthening of the fellowship to 24 months or longer, and 4% did not support any change to the current fellowship.

A second survey was sent to current pediatric anesthesiology fellows and recent graduates within 5 years of completion of training (Appendices 2 and 3 http://links.lww.com/AA/A815 and http://links.lww.com/AA/A816). The chiefs and program directors were asked to forward the survey to

Table 4. Survey Results for Current and Recently Graduated Pediatric Anesthesiology Fellows (*n* = 166)

Question	Percent answering affirmatively
Do you/did you have the opportunity for advanced training after the core ACGME fellowship?	59
Do you plan to or did you complete advanced training?	17
Would you be willing to complete advanced training for improved career prospects?	40
Would you be willing to complete advanced training for improved career prospects if PGY-6 salary could be increased?	63

ACGME = Accreditation Council for Graduate Medical Education; PGY-6 = postgraduate year 6.

these groups at their institutions. A 24-question survey was sent, and responses from 64 current fellows (32% of ACGME fellows in 2011) and 102 recent graduates (12% of graduates 2006–2010) were received (Table 4). Conclusions drawn from this survey by the task force included the following: (1) The majority of fellows were not taking advantage of already existing advanced training. (2) Finances were a major barrier to further training. (3) Insufficient numbers of fellows were receiving advanced training for later academic and leadership roles during the existing 12-month ACGME fellowship.

These data provided support for further development of advanced second year fellowships in pediatric anesthesiology.

PEDIATRIC ANESTHESIOLOGY SECOND YEAR ADVANCED FELLOWSHIP NETWORK

Based on discussions from PALC and PAPDA joint semiannual meetings in 2010, 2011, and 2012, a Pediatric Anesthesiology Second Year Advanced Fellowship Network was created to provide a forum to standardize the advanced training among departments, to exchange information about advanced fellowship offerings, and to promote advanced training by consistent communication from pediatric anesthesiology leadership. A Pediatric Anesthesiology Second Year Advanced Fellowship Committee and subsequent subcommittees in the potential disciplines for advanced training were formed to make detailed recommendations to the PALC and PAPDA for each program, including Program Requirement documents (members listed in Appendix 4 http://links.lww.com/AA/A817). This network was formally launched on November 2, 2012, and more information is available at the Society for Pediatric Anesthesia Web site. Available at: http://www.pedsanesthesia.org. Accessed July 16, 2013. As of that time, of the 46 programs sponsoring an ACGME pediatric anesthesiology first year fellowship, 21 (46%) were offering at least 1 advanced second year fellowship within network guidelines. Cardiac anesthesia was the most frequently offered program with 18. Research fellowships were offered by 17 institutions, pain medicine fellowships by 9, quality improvement and safety by 6, and education by 5. Of these 21 programs, none offers all 5 advanced fellowships, 6 offer 4 of the 5, 3 offer 3, 7 offer 2, and 5 offer 1 fellowship. There were 69 fellows serving in these positions as of November 2012, including 22 fellows in cardiac, 24 in research, 11 in pain, 5 in education, and 7 in quality. By comparison, there were a total of 207 first year ACGME fellowship positions in 46 programs giving approximately 1 advanced fellow for every 3 first year fellows.

These second year advanced fellowships in the network are optional and not certified by the ACGME except where such certification already exists and the fellowship meets ACGME requirements, that is, pain medicine. Common requirements for inclusion in the network include a minimum 12-month duration, which can be extended at the discretion of the program, and review and approval as non-ACGME training programs by the local graduate medical education (GME) authority, that is, medical school or hospital, and acceptance by other regulatory agencies, that is, state medical boards, where applicable. A program director for the advanced fellowship training is required, and this individual must have expertise in the content area. This person may also serve as the ACGME Pediatric Anesthesiology Program Director when appropriate. A formal diploma or certificate from the local GME authority is a requirement after successful completion of the advanced fellowship. An additional degree or certificate, that is, master's degree in education, public health, research, or certificate of special competency, is a highly desirable outcome of the advanced fellowship. Although not ACGME certified except for several of the pain medicine advanced fellowships, most requirements of the ACGME must be adhered to for the network, including formal curricula with goals and objectives, description of training and competencies, formal evaluation and feedback conforming to ACGME principles, and adherence to ACGME duty hour standards while working as an advanced fellow. In addition, a formal enduring scholarly activity is a requirement of the advanced fellowship in the form of a peer-reviewed publication, book chapter, or significant quality or educational project leading to publication or presentation at a national meeting. A funding mechanism for the fellowship is required and may include hospital or medical school GME funding, research or other institutional grants, endowed fellowships, and part-time work as an attending pediatric anesthesiologist. Minimum salary is the corresponding postgraduate year 6 level for that institution, with supplemental increased salary allowed where possible. Work as an attending pediatric anesthesiologist is limited to no more than 40% time.

PEDIATRIC ANESTHESIOLOGY SECOND YEAR ADVANCED FELLOWSHIP NETWORK DISCIPLINES

Initially, subcommittees evaluated and presented 9 possible content areas to be considered for inclusion in the Second Year Advanced Fellowship Network. These disciplines were chosen based on existing second year training and the skills lacking among current faculty and desired by chiefs, chairs, and current and recently trained fellows to match job openings. The perceived strategic needs to advance the specialty of pediatric anesthesiology were the primary consideration. Five 12-month second year advanced fellowship programs were selected for inclusion in the network: cardiac, education, pain, quality improvement and safety, and research. Others may be included in the future (see below under Future Directions). Complete program requirements as well as details about existing academic programs can be accessed at www.pedsanesthesia.org.[i] All programs require

successful completion of the core clinical pediatric ACGME fellowship education. Some programs allow for some integration in training, that is, pain medicine fellowship that could begin with a chronic pain continuity clinic during the first year or master's degree program didactic courses that could also begin in the latter half of the first year. Summaries of these advanced fellowship programs are as follows:

Pediatric Cardiac Anesthesiology

Training guidelines are based on the curricula published by the CCAS in 2010.[16] They include 8 months of clinical exposure caring for patients primarily in the cardiac operating room, with the equivalent of 1 day per week outside of the cardiac operating rooms, including cardiac catheterization laboratory, cardiac magnetic resonance imaging, and noncardiac surgical cases in patients with congenital heart disease. One month of intensive care experience caring for patients with critical medical and surgical cardiac disease is also a requirement. Two elective months should be offered, with choice of rotations including time dedicated to echocardiography, cardiopulmonary bypass and extracorporeal support, research, or adult congenital heart disease. Involvement in 100 to 200 cardiopulmonary bypass cases is expected, with 50% of patients aged <1 year and 25% aged <30 days. Attendance and active participation in multidisciplinary perioperative planning conferences, education conferences, and outcomes conferences are expected. Both knowledge-based and competency-based evaluations are performed. Scholarly activity resulting in enduring material in education, research, or clinical care is an expected outcome. Attendance at 1 national or international meeting where perioperative care of the pediatric cardiac patient is the primary subject is also required.

Pediatric Anesthesiology Education

Where possible, a master's degree in education should be offered in conjunction with a graduate school of education either within or affiliated with the program. If this is not possible, a certificate of special competence in education should be offered. Formal coursework in adult educational methods is essential. This includes assessment of learners' needs and different types and levels of learning styles. Teaching and learning in the clinical setting, simulation, problem-based learning discussions, lecturing to small or large groups, interactive learning, for example, hands-on workshops, and 1:1 teaching are all required didactic and practical components. Required outcomes include development of 3 educational projects, that is, lectures, problem-based learning discussions, or interactive conferences for anesthesiology residents in their institution. Another requirement is 1 abstract presentation at a national or international anesthesiology conference. Finally, completion and publication, either internally within the program or department or externally in a peer-reviewed publication of an enduring clinical or educational work, is required, that is, book chapter, case report, or journal article. Advanced education fellows are expected to work in the clinical pediatric anesthesia setting, either as attending physicians or advanced fellows, up to 40% of their time to actively apply educational principles to a variety of learners in the clinical arena.

Pediatric Pain Medicine

Where possible, this 12-month advanced fellowship will meet the ACGME requirements for pain medicine certification. This will often require affiliation with an adult pain medicine fellowship program within the same academic medical center to provide for the requirements for ACGME certification. Objectives are to develop physicians who are fully qualified in both specialties. The advanced pediatric pain medicine fellow will be competent in pain assessment, formulation, and coordination of a multidisciplinary and multimodality treatment plan. The fellow should be able to plan integration of pain treatment with primary disease management and palliative care and interact with all members of the multidisciplinary team. Emphasis on complex patients and leadership in the field is the focus of advanced fellowship training in pediatric pain. Both acute pain management, including comprehensive training and skills in ultrasound-guided regional anesthesia techniques, and consultative and chronic pain management and palliative care are expected outcomes of the training. Requirements include at least 40 days of pediatric chronic pain clinic, 50 acute inpatient pain consultations, 25 interventional pain procedures, treatment of 20 patients with cancer pain, 10 palliative care patients, 15 patients with a complete psychiatric history with focus on pain comorbidities, 15 patients evaluated in the physical medicine–rehabilitation inpatient or outpatient settings, and 15 patients with complex neurologic components including neuroimaging of the spine and brain.

Pediatric Anesthesiology Quality Improvement and Safety

Key components include a department and hospital with a well-established quality and safety culture, including pediatric anesthesiology faculty with formal training in these areas. Didactic quality improvement course lectures and participation in quality improvement training such as that offered by Intermountain Health Care, Institute for Healthcare Improvement, and The Joint Commission are a core requirement. Participation in national safety and quality organizations such as Anesthesia Patient Safety Foundation, Society for Pediatric Anesthesia Wake Up Safe, or Anesthesia Quality Institute is required. Participation in all department quality improvement conferences and being a member of the department quality improvement committee are also necessary. Choice and design of a comprehensive year-long quality improvement project, including IRB protocol when necessary, plan-do-study-act cycles, data collection, and presentation, including run charts, are components of the fellowship. Leadership and presentation of at least 1 quality improvement or morbidity/mortality conference are also required. If possible, offering the quality improvement and safety fellowship in conjunction with a degree program such as a masters in public health is highly desirable. An enduring scholarly project resulting in presentation of an abstract at a national meeting and submission of a manuscript for publication or enduring work for widespread distribution, including the Internet, is required. Service in the clinical perioperative setting as an attending

pediatric anesthesiologist or advanced pediatric anesthesiology fellow up to 40% time is required to put into practice newly acquired knowledge and skills.

Pediatric Anesthesiology Research

The overall goal is to provide concentrated formal training in basic or clinical research to build the research capacity of the subspecialty. Educational objectives related to the responsible conduct of research include avoidance of conflict of interest, study design including controls and appropriate statistical techniques, mentor/mentee responsibilities and relationships, collaborative research including collaborations with industry, peer review, data acquisition including management, sharing, and ownership, research misconduct, responsible authorship and publication, and ethical and societal implications of biomedical research. For human subject research, educational objectives include training and credentialing for clinical research, IRB proposal preparation and submission, and registration of clinical trials with governmental registries such as ClinicalTrials.gov. Completing all training related to the humane treatment of animals for research, preparation of a protocol for animal research with detailed study protocol that includes sample size estimation, and submission for approval to the Institutional Animal Care and Use Committee are requirements for laboratory research. Specific objectives for the required research project include developing a hypothesis-testing study protocol under the supervision of a research mentor. A thorough literature search and preparation of a systematic review of data in the chosen field is a requirement. Learning of different approaches to study design for the question, including strengths and limitations of each, and performing a power analysis for sample size calculation as well as a detailed statistical analysis plan are components for every project. Training in the technical skills is necessary for the protocol: data collection, reviewing data, and analyzing data and communicating findings and conclusions are necessary. Preparation of an abstract for presentation at a scientific meeting and preparation of a peer-reviewed journal article are required. When possible, preparation of grant applications and applying for funding from entities such as the Foundation for Anesthesia Education and Research, Anesthesia Patient Safety Foundation, International Anesthesia Research Society, or National Institutes of Health (e.g., K08, K23, or T32 training grants) are also accomplished during the research fellowship. At the discretion of the institution, advanced fellowship research training can be extended with additional time to master techniques in the chosen area of research. Although clinical work as an attending pediatric anesthesiologist or advanced pediatric anesthesiology fellow is allowed, it should be limited to allow for significant concentration on the research training experience.

BARRIERS TO IMPLEMENTATION AND TACTICS FOR MITIGATION

Based on survey results and discussions between PALC and PAPDA members, the primary barrier to implementation of the advanced Second Year Pediatric Anesthesiology Fellowship training is financial (funding for additional GME programs). Federal limitations on funding for existing GME programs are well documented, and funding for pediatric subspecialty training is especially tenuous. Many academic and pediatric institutions are forced to rely on hospital or department funding for any expansion in pediatric anesthesiology fellowship training.[23,24] Of the 47 responses in the chiefs and chairs survey, 36% responded that they would not be able to fund second year advanced fellowship training, even though 80% would have the faculty and expertise to sponsor these programs. This dilemma has led to several tactics beyond traditional government or hospital funding for advanced fellowships. Part-time work as an attending pediatric anesthesiologist during the advanced fellowship was cited by 51% of chiefs and chairs as the mechanism for at least part of the funding for the advanced fellowships. This approach has been used for many years for advanced fellowship training in many clinical and nonclinical disciplines in anesthesiology and has been described as the faculty-fellow model.[25] Funding and salary levels for the advanced fellow range from the equivalent of a postgraduate year 6 level, all the way to full junior faculty salary, depending on the clinical effort of the fellow and the exact funding mechanisms. Since all Second Year Advanced Pediatric Anesthesiology Fellows have completed the ACGME-required fellowship for privileges in pediatric anesthesiology, they can function as an attending physician and staff operating rooms. ACGME duty hours and work regulations for "moonlighting" are a guideline for work as an attending physician during second year advanced fellowships. Careful attention to time spent as an attending physician complicates advanced training but is possible on the limited basis described above. Indeed, without this mechanism, many of these advanced fellowship programs would not exist.

Another nearly equally important barrier to expansion of Second Year Advanced Pediatric Anesthesiology Fellowship training is reluctance by fellows to spend an additional year of training, particularly at lower income, with unclear future benefit. The mean educational debt for medical students in the United States is now $158,000. Forty-three percent of 537 anesthesia residents responding to a survey in 2012 had >$150,000 in educational debt. Residents with >$90,000 in debt were significantly less likely to desire either additional fellowship training or a position in an academic department.[26] Mitigation of this barrier, besides part-time work as an attending physician with its resulting higher salary, is difficult. Fellows willing to commit at least 2 years to qualified clinical or basic science pediatric research, and spending at least 20 hours per week doing so, can apply for the National Institutes of Health Loan Repayment program of up to $35,000 annually for 2 years.[j] Approximately 40% of these loan applications were funded in 2011 and 2012. Another mitigation strategy successfully used to motivate second year advanced fellowship training has been commitment by the sponsoring department to provide a faculty position after the training, along with further mentorship for career development as a junior faculty member. This strategy can be highly effective but is limited by available funding or positions in some departments, and the difficulty

[j]National Institutes of Health Loan Repayment Program Web site. Available at: http://www.lrp.nih.gov. Accessed June 27, 2013.

of predicting staffing needs 2 or 3 years in the future. The Second Year Advanced Fellowship Network structure may facilitate application and training of advanced fellows at a different program with a commitment to return to the core clinical fellowship program for a faculty position. Despite these financial concerns by pediatric anesthesiology fellows, most expressed interest in the advanced fellowship if it provided a more fulfilling career and better opportunities over their lifetime. Indeed, the financial hardships of pediatric, surgical, and radiological residents are identical to anesthesia residents, yet they pursue the fellowships of longer duration because they must do so to gain an academic position and they recognize the importance of the advanced training to their career over the long term.

Another barrier is the possibility that second year advanced fellowship training would reduce the quality of the training experience and case volumes in subspecialty areas for the core clinical ACGME pediatric anesthesiology fellows and also for core anesthesia residents.[27] Careful evaluation of this potential and mitigation strategies are required by most local GME bodies before a new non-ACGME fellowship is approved. Adequate experience and case numbers in each discipline must be present before contemplating second year advanced fellowship training. Strategies involving the advanced fellow supervising the core clinical fellow or resident are permissible under many circumstances and may be used as a mitigating strategy. The expectation that the advanced fellows will serve as teachers of core residents is a positive offset for the concern about possible impact of second year fellowships on resident education.

The administrative burden of an advanced second year fellowship may also render creation or expansion of such a program difficult. At the local level of the advanced fellowship network, the overall ACGME Core Fellowship Program Director and staff may administer the advanced fellowship, or the faculty and staff of the subspecialty area may administer the advanced fellowship. At the national level, the PAPDA membership is appropriately focused on its extensive existing responsibilities in administering the ACGME core fellowship programs and associated activities such as the fellowship match, milestone development, and maintenance of ACGME accreditation. Therefore, at the present time, PALC and its Advanced Fellowship Committee have assumed administrative and financial responsibility for administering the network.

Finally, publicizing and promoting the advanced fellowships remains a barrier for implementation, as the advanced fellowships in many departments are not well known even though they have existed for many years. As a mitigation strategy, the PALC and PAPDA developed a communication plan to include anesthesia residents, anesthesia resident program directors, as well as pediatric anesthesiologists in academic and nonacademic institutions. Each base fellowship program director is now aware of their existence even if not offered at their institution and has been asked to inform applicants and new fellows of their existence early on in the first year. Programs offering second year fellowships are publicizing and promoting this to their applicants, and some programs are even inviting promising candidates for second year fellowship back for a second recruiting visit. Although application deadlines are rolling for most second year fellowships and there is no match process, first year fellows may become aware too late in the year and may have made other plans. Encouraging second year training in an institution different from the ACGME fellowship may increase opportunities for training in disciplines not offered in the original fellowship program. The Society for Pediatric Anesthesia has agreed to maintain comprehensive information and fellowship listings on its Web site, and these fellowship listings will be updated regularly.

FUTURE DIRECTIONS

It was recognized by the task force that several other disciplines, durations of training, and arrangements for providing the training (i.e., as a junior faculty member) already existed, and for this reason they were not included in the network. Critical care, regional anesthesia, palliative care, neuroanesthesia, and operating room management were formally evaluated but were not included for reasons such as overlap with other programs and insufficient time for complete training in 12 months. It was agreed that these disciplines, and others, could be considered in the future for inclusion in the network. Another emerging field for second year advanced training is pediatric anesthesia in the developing world, and most base fellowship programs are well connected to institutional and national programs providing specific training, travel, and clinical experiences in international medicine.

As was evident from the survey of chairs and chiefs, there is broad consensus that there would be no interest to lengthen the ACGME core pediatric anesthesiology fellowship at the present time. Funding for mandatory lengthening of the ACGME fellowship remains problematic even if this was preferred.

The outcome of the second year advanced fellowship will be objectively assessed for metrics of success, to help plan further expansion if possible. Success will be gauged by biannual surveys of the advanced fellowship directors, base program directors, and chairs and chiefs to determine numbers of applicants and fellows in each discipline, funding mechanisms, academic work products, and job placements for graduates. Current and recent graduates will also be surveyed about their experiences and career development and satisfaction with their training and current positions.

CONCLUSIONS

We have presented an overview of the newly formed Second Year Advanced Pediatric Anesthesiology Fellowship Network in the United States. The network contains fellowships in pediatric cardiac, pain medicine, research, education, and quality improvement and safety. All the fellowships are standardized among the institutions in the network. The rationale for change, process of choosing disciplines, duration, curricula, and funding options for the 1-year advanced fellowship are described. The goal of the network is to improve education, training, and preparation of the pediatric anesthesia workforce for the future of the specialty in health care, especially academic leaders, to be able to meet the myriad challenges as pediatric health care evolves and to advance the knowledge of the specialty to improve outcomes of pediatric patients.

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Name: Dean B. Andropoulos, MD, MHCM.
Contribution: This author participated in collection of survey data for the study and participated in writing and editing.
Attestation: This author approved the final manuscript.
Name: Scott G. Walker, MD.
Contribution: This author participated in collection of survey data for the study and participated in writing and editing.
Attestation: This author approved the final manuscript.
Name: C. Dean Kurth, MD.
Contribution: This author participated in collection of survey data for the study and participated in writing and editing.
Attestation: This author approved the final manuscript.
Name: Randall M. Clark, MD.
Contribution: This author participated in collection of survey data for the study and participated in writing and editing.
Attestation: This author approved the final manuscript.
Name: Desmond B. Henry, MD.
Contribution: This author participated in collection of survey data for the study and participated in writing and editing.
Attestation: This author approved the final manuscript.
This manuscript was handled by: Peter J. Davis, MD.

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