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Cardiothoracic Anaesthesiology
and Intensive Care

**European Association of Cardiothoracic Anaesthesiology and Intensive Care
Pediatric Cardiac Anesthesia Fellowship Curriculum: First Edition**

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1. Introduction

Pediatric cardiac anesthesia is a subspecialty of cardiac and pediatric anesthesiology dedicated to perioperative care of patients with congenital heart disease (CHD). The care of patients with CHD ranges in age from the neonatal period to adulthood. Fellowship programs for pediatric cardiac anesthesia are established in the USA but not accredited by the Accreditation Council for Graduate Medical Education (ACGME) [1, 2]. No comparable fellowship program is currently available in Europe. Over the last few years, Members of the Education and Congenital Subcommittees of the European Association of Cardiothoracic Anaesthesiology and Intensive Care (EACTAIC) have increasingly recognized the necessity to establish an European Pediatric Cardiac Anesthesia (PCA) fellowship program. For this reason, they chose to formulate a PCA program curriculum with the aim of educating anesthesiologists to follow a defined training program that will improve their knowledge and skills in the perioperative care of patients with CHD.

2. Methods

EACTAIC's Board of Directors approved the development of a standardized curriculum for the EACTAIC Fellowship Programs in cardiothoracic and vascular anesthesia, including PCA, on October 02, 2017. On September 2019 and November 2020, members of the EACTAIC Pediatric and Congenital Subspecialty Committees held two meetings, to discuss the feasibility of developing an advanced training module or a separate Fellowship Program in PCA.

On November 17, 2020, the members of the EACTAIC Educational Committee established a task force including twelve members experienced in the PCA from both Pediatric and Congenital Subspecialty and Education Committees to draft curriculum for a PCA Fellowship Program. The project's overall scope was determined through a search and review of available literature on the PCA published until December 11, 2020.

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The members of the Task Force actively involved in the first draft of the EACTAIC PCA Fellowship followed the regulations of EACTAIC for the curriculum of adult cardiothoracic and vascular anesthesia, [3] the white paper of the board of directors, [4] the tasks required by the EACTAIC hosting centers and [5] other EACTAIC regulatory policies for the fellowship programs [6] [7]. We also considered the PCA Proposal submitted by the Task Force for Standardization of the Pediatric Cardiac Anesthesiology Fellowship to the ACGME. [1] [2] [8]

Two internet-based surveys regarding the PCA fellowship program were performed. Recipients of the questionnaires along with written information about the aims and objectives of the survey, data handling and management were current members of EACTAIC Education Committees and Task Force. Questionnaires were uploaded to the Survey Monkey® platform, and the survey links were distributed by email to all members of the EACTAIC Education Committee and Task Force. Reminders were emailed until the end of the stated collection periods.

The first questionnaire was distributed to the 30 members in December 2020 by sending two email invitations. All participants provided consent for participation and data analysis and participation was voluntary and anonymous. All collected data was anonymized, secured and will remain confidential in the EACTAIC archiving system for ten years following the general data protection regulations (accessible at <https://eugdpr.org/>).

The questionnaire included the following questions: the minimum duration of training in the EACTAIC PCA Fellowship, the minimum required number of cardiac surgical cases per year during the PCA Fellowship and required prior experience in pediatric general anesthesia and/or cardiac anesthesia.

Using a modified Delphi process to generate an agreement among the 35 current members, the second survey was undertaken in May 2021, followed by sending an email invitation and seven reminders. The survey was composed of two parts,

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including a 137-item questionnaire on the proposed knowledge, technical skills, and non-technical skills, the 'obligatory' rotation through a pediatric intensive care unit (PICU), and minimum caseloads for the different types of cardiac surgery and interventional procedures required to be performed. The first part of the survey included a screening of the acceptability of respondents using a traffic light system to evaluate whether this proposed knowledge, technical skills, non-technical skills, 'obligatory' rotation in a PICU, and types of surgical and interventional procedures performed should be included in the final curriculum. The traffic light system was defined as green indicated needed and yellow as useful to be included whereas red signified that the subject was not important enough to be included. Respondents were instructed to choose only one traffic light color for each suggested solution. Successful suggestions required at least two thirds of the respondents giving green or yellow rating to be considered a consensus in the EACTAIC Education Committee and Task Force.

The second part of the questionnaire included a quantitative survey with responses on an ordinal 5-point Likert scale defined as a score of 1–5 corresponding to 'strongly agree,' 'agree,' 'neither agree nor disagree,' 'disagree' and 'strongly disagree.' The agreement was defined as achieved when > 70% of experts strongly agreed or agreed to a given option on the Likert scale for a statement. [9]

All participants provided consent for participation and data analysis. Participation in this study was voluntary and anonymous. All data collected were anonymized and secured and will remain confidential in the EACTAIC archiving system for ten years following the general data protection regulations (accessible at <https://eugdpr.org/>).

The final results of these surveys and the expert clinical practice statements were circulated amongst the experts in Task Force. A draft manuscript was then distributed to all the experts in the EACTAIC Education Committee and Board of Directors for editing and approval before it was submitted for publication.



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Statistical analysis

Data management and descriptive statistics (number, percentages, median and interquartile range) were performed using the IBM SPSS Statistics Subscription, Base Edition (Statistical Package for Statistical Analysis, IBM Ireland Product Distribution Limited, IBM House, Shelburne Road, Ballsbridge, Dublin 4, Ireland).



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3. Results

The initial survey period was set from December 7 to 14, 2020. Upon closure of the survey, 27 responses were received (90% response rate). All respondents completed the questionnaire. The majority of respondents chose 1-year (82%) and 100 cases (70%), as the minimum duration of training and number of cardiac surgical patients performed per year that would be required during the EACTAIC PCA Fellowship training. A minority of respondents chose 6-month (4%) or 2-year periods (18%). One-third of the respondents reported that the applicant to the EACTAIC PCA program should be required to have had a minimum of one year's prior experience in both adult cardiothoracic and vascular anesthesia and pediatric anesthesia to enroll in the EACTAIC PCA Fellowship Program. All responses indicated by respondents are reported in Figure 1.

The second survey was undertaken from May 1 to 10, 2021. Two members within the Education Committee declined to participate because they had very limited experience in pediatric anesthesia. Upon closure of the survey, a total of 30 responses were received from the 33 members of the EACTAIC Education Committee and Task Force (response rate of 91%), Twenty-seven respondents provided responses to all questions in the questionnaire.

More than 90% of 30 respondents indicated green or yellow traffic lights to rate the importance of including knowledge, technical skills, non-technical skills, an obligatory rotation through PICU, and types of cardiac surgery and interventional procedures in the final version of the curriculum. As only eighty-two percent of respondents chose green or yellow traffic lights to rate the importance of including the minimum exposure to 20 cases with extracorporeal life support over the year in the curriculum (Supplement A) these 20 cases were excluded from the suggested number of cases in Table 1.

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At the end of the second round of the survey, 40 of the 41 statements (98%) had achieved agreement from the proposed Union Européenne des Médecins Spécialistes (UEMS) levels for knowledge, technical skills, and non-technical skills and 'obligatory' rotations in a pediatric intensive care unit (PICU) and interventional pediatric cardiology. Agreement was achieved in fifteen of the 23 statements (65%) on the proposed 'optional' numbers of surgical and interventional procedures performed during the fellowship training year (Supplement B). The nine statements, including the types of cases that failed to reach consensus, were excluded from Table 1.

Limitations of the surveys

These surveys have some limitations. First, many respondents to the surveys are not involved in European societies' programs interested in pediatric cardiac anesthesia training. However, some members of the Task Force are involved in the Congenital Cardiac Anaesthesia Network in the United Kingdom and the European Society for Paediatric Anaesthesiology. Second, there seems to be a considerable adult bias to the survey as many respondents practice adult and pediatric cardiac anesthesia. However, this does not mean minimizing the experience in pediatric anesthesia and pediatric intensive care. This PCA program instead will help standardize this curriculum and emphasizes the importance of the pediatric aspect.



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4. Curriculum design and certification

The PCA fellowship program will be open to all physicians irrespective of their country of origin, religion, gender, or sexual orientation [3]. Before being accepted as a Fellow, candidates must provide evidence of their valid license to practice medicine and a specialist qualification in anesthesiology at their national level. Furthermore, candidates must provide evidence of their prior fellowship training or work experience in A) adult cardiac anesthesia for a minimum of 1 year and B) general pediatric anesthesia for a minimum of 1 year at a nationally or internationally recognized center with dedicated care for this patient population. Preferably, this training may have taken place within the framework of a fellowship, e.g., adult cardiovascular and thoracic (CVTA) fellowship program of EACTAIC [3]. That is not similar to the USA centers, which require prior completion of a pediatric anesthesia fellowship or an adult cardiothoracic anesthesia fellowship to join the dedicated second-year fellowship training in PCA. [1]

Candidates are required to be members in good standing, of EACTAIC. A letter of recommendation from two established members of EACTAIC specialized in cardiac and/or pediatric anesthesia should be submitted together with the application for the PCA program. The candidate's supporters vouch for the candidate's successful completion of prior training and suitability to train as a pediatric cardiac anesthesiologist. Applicants must present proof of appropriate language skills as defined by the host centers and required in accordance with national and international regulations (generally level B2) [3].

The PCA program's total duration is 12 months, including a one-month rotation through PICU. The center hosting the fellowship program must undertake a minimum of 100 pediatric cardiac surgery cases and 50 pediatric cardiac interventional procedures per calendar year. The majority of surgical cases should be performed



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using extracorporeal circulation. [2] The cardiac interventional experience needs to be considered important, as it is an evolving part of managing patients with CHD. Ideally, 50% of cases should be performed in children aged younger than four years and 20% in children aged younger than one month. Patients will be considered pediatric as long as their age is 16 years or younger [1, 2]. Simultaneous management of adults with congenital heart disease (ACHD) is encouraged and should be considered in the center's PCA certification process whenever possible.

Ideally, EACTAIC accredits one center to stand alone to host the PCA Fellowship Program if it has enough cases. EACTAIC favorably considers accreditation of two or more centers collaborating together to stand as a single host center that offers the full EACTAIC PCA Fellowship Program with a three-to-six-month exchange fellowship training rotations between them. Prior agreement regarding the duration of the rotation and the number of cases to be performed, should be achieved between these centers. All the following regulations will apply to each of the collaborating centers so as to support the fellow achieving the required minimum number of cases performed per year and levels of competencies. Where only few or limited varieties of pediatric cardiac cases are performed in a host center, a compound exchange training plan involving more than one center should be discussed with all parties involved (e.g., fellow PCA program director) before the PCA fellowship is initiated. The Chair of the EACTAIC Education Committee must approve in advance an appropriate exchange-training plan.

The training period will be completed under the close supervision of a mentor who is also the local PCA Program Director or the responsible consultant for pediatric cardiac anesthesia. Mentors who are the Program Director and faculty members involved in the training program should all be members of EACTAIC in good standing [3]. The mentor must provide the Fellow with one-on-one clinical supervision during the first six-months of the training and based on the conditional independence on a

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case-by-case assessment by the mentor. Fellows may manage simple cases with supervision from elsewhere in the hospital, but complex cases must have direct supervision. According to educational attainment, the mentor's supervision of the Fellow should become more indirect. The mentor should nevertheless be physically present in the hospital and promptly available within a short duration.

The PCA fellowship program should be completed uninterrupted by frequent and/or prolonged periods of absence because of illness or personal circumstances. Absence from training for sick leave or personal circumstances requires a proportionate extension of the training period. Annual and maternity leave are regulated following local contractual requirements, provided that the knowledge, skills, and competency levels and the required number of cases are completed. Should it prove impossible to complete the required number of cases, the fellowship training period should be extended so that they can be completed. Appeals for exceptional circumstances because of illness or personal circumstances that have resulted in repeated or prolonged interruption of training will be reviewed by the Chair of the EACTAIC Education Committee who will forward it to delegated members for arbitration [3].

EACTAIC undertakes indirect measures for (1) quality assurance on completion of Fellowship Programs, including the collection of feedback from all graduates, (2) a graduate survey to facilitate the search for suitable post-graduate job opportunities, (3) re-accreditation of host centers every four years to ensure the maintenance of the required educational level, and (4) forwarding collected feedback arising from the final Exit Interviews to the program directors for self-improvement of host centers[3]. To be noted, EACTAIC does not receive any fees for auditing programs and certification of individuals. The applying center for hosting the EACTAIC PCA fellowship program will cover the travel costs and the hotel accommodations of the two inspectors evaluating the host center during the one-day site visit [4].



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5. Competencies for a PCA fellowship program

The PCA fellowship program's competencies and milestones are based on a combination of medical knowledge, technical skills, didactic teaching program, and non-technical skills. For each domain, learning objectives are deemed necessary to achieve the required level of competence, as defined by the UEMS [10-11]:

- A: observer level (has knowledge of, describes).
- B: performs, manages, demonstrates under direct supervision.
- C: performs, manages, demonstrates under distant supervision.
- D: performs, manages, demonstrates independently.

To ensure that all content and skills can be adequately trained during the PCA Fellowship, EACTAIC recommends a minimum number of procedures/patients treated per domain, as outlined in Table 1. The candidate is required to have met these minimum requirements before applying for the final assessment. The recommended numbers of different types of cases in Table (1) are not obligatory and depend mainly on where the fellowship program occurs.

5.1. Medical knowledge [Level A]

5.1.1. Cardiac and extracardiac anatomy and related factors

- Knowledge of congenital cardiac anatomy and morphology as well as congenital and acquired cardiac lesions.
- Knowledge of congenital anomalies, associated syndromes, and extracardiac comorbidities.
- Knowledge of the pathophysiology of congenital cardiac lesions.
- Knowledge and understanding of cardiovascular surgical and catheter-based therapeutic procedures.
- Knowledge of pathophysiology associated with surgical and catheter-based diagnostic and therapeutic procedures

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- Understanding the decision-making steps for surgical and catheter-based interventional procedures from the neonatal period to adulthood.
- To be aware of potential complications associated with the placement of arterial and venous catheters. To have knowledge of the specific material **[Level A]**
- Knowledge of transesophageal echocardiography (TEE) imaging in CHD and the complications related to the TEE probe insertion. **[Level A]**
- Knowledge of the basic principles of ultrasound and Doppler technology **[Level A]** and the uses of ultrasound imaging for facilitating vascular access. **[Level A]**

5.1.2. Principles of cardiopulmonary bypass and extracorporeal life support **[Level A]**

- Knowledge of basic principles of cardiopulmonary bypass (CPB) and extracorporeal life support (ECLS).
- Knowledge of adverse events related to CPB and ECLS.
- Knowledge of myocardial protection during cardiac surgery.
- Knowledge of non-cardiac organ protection.
- Knowledge of hypothermic circulatory arrest and cerebral perfusion strategies.
- Knowledge of circuit priming strategies for CPB.
- Knowledge of the actions of different cardioplegic solutions and their benefits and drawbacks.
- Knowledge of coagulopathies related to CPB and their prophylaxis and treatment.
- Knowledge of hemodynamic and pharmacokinetic management during CPB.

5.1.3. Pharmacology of Pediatric Cardiac Anesthesia **[Level A]**

- Knowledge of pharmacologic principles and action of anesthetic agents in pediatric patients with CHD.
- Knowledge of pharmacologic principles of positive inotropic, vasoactive, anti-arrhythmic, and pulmonary vasodilator drugs.



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- Preparation of a safe anesthetic plan, including an adequate perioperative analgesia, taking into account the hemodynamic status of the patient and expected postoperative recovery.

5.1.4. Cardiac imaging

- To interpret echocardiographic images, it is recommended to follow the EACTAIC (or European Society of Cardiology) echocardiography course on congenital heart disease or any local affordable pediatric echocardiography course. **[Level C]**
- Understanding cardiac catheterization images. **[Level C]**
- Knowledge of intraoperative transesophageal echocardiography related to CHD and recognition of complications. **[Level A]**
- Basic understanding of other cardiac imaging modalities including magnetic resonance imaging and computed tomography. **[Level A]**

5.1.5. Anesthesia for cardiovascular surgical and catheter-based interventional procedures

- Pre-anesthetic assessment (obtaining medical and surgical history including any associated syndromes (e.g., Trisomy 21, DiGeorge, Williams etc.) or comorbidities, the performance of physical examination and obtaining informed consent). **[Level D]**
- Optimizes preparation of CHD patients including medical therapy and need for further investigation. **[Level D]**
- Interprets data from preoperative cardiothoracic diagnostic imaging. **[Level C]**
- Identifies and anticipates hemodynamic, medical, and surgical issues in the pre- and post-CPB periods in the function of the predicted risk estimation as defined by Risk Adjustment for Congenital Heart Surgery (RACHS-1). **[Level D]**
- Identifies and anticipates hemodynamic, medical, and surgical issues in patients undergoing palliative surgery without CPB. **[Level D]**
- Applies and correctly interprets necessary invasive hemodynamic and non-invasive neurologic monitoring and TEE. **[Level D]**

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- Applies safe perioperative patient blood management and is aware of transfusion-related complications. **[Level D]**
- Applies safe anesthesia for diagnostic and interventional heart catheterizations in patients ranging in age from neonates to adults. **[Level C]**
- Applies safe anesthesia for electrophysiological procedures in children and adults. **[Level C]**
- Has knowledge of the type and the duration of the most important operations and related anesthetic management. **[Level D]**
- Applies safe transport of patients to the PICU. **[Level D]**

5.2. Technical skills [1, 2]

- Recognizes unique characteristics of pediatric cardiac anatomy, airway management, and vascular access. **[Level D]**
- Anticipates difficult airway management in patients with specific syndromes and uses specific equipment and demonstrates competency in managing the difficult airways in neonates, children, and adults. **[Level D]**
- Demonstrates competency in placement of peripheral and central venous lines and arterial catheters with and without ultrasound imaging. **[Level D]**
- Passing the theoretical part of an adult TEE certification course as for example, European Association of Cardiovascular Imaging (EACVI)-EACTAIC or any other recognized national or international certification, is mandatory to complete the PCA fellowship program. Completion electronic case book is recommended. **[Level C]**
- Use TEE for diagnosis and management of various cases. **[Level C]**
- Is familiar with point-of-care coagulation testing and can guide transfusion based on their results. **[Level D]**
- Is familiar with the use of cerebral and somatic near-infrared spectroscopy (NIRS). **[Level D]**
- Applies regional analgesia and lung-isolation techniques when required. **[Level D]**



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5.3. Didactic program and non-technical skills

- Fellows must participate in journal clubs, multidisciplinary discussions, morbidity and mortality meetings organized within the host center. **[Level D]**
- Fellows must participate in online webinars and annual scientific meetings to obtain 5 - 10 CME credits and participation in EACTAIC's Annual Congress is highly recommended.
- Fellows must undertake self-directed learning and scholarly activity by reviewing literature related to a case or a specific patient-related topic. **[Level D]**
- Whenever possible, the Fellow actively participates in research projects or the development of guidelines or policies. **[Level B]**
- Fellows must present at least once per year, case reports or research projects at departmental educational, national and international meetings. **[Level D]**
- Fellows must develop:
 - communication skills with patients and parents. **[Level D]**
 - communication of appropriate information to families and patients in the pre- and post-operative periods. **[Level D]**
 - the ability to communicate with families from different cultural and/or religious backgrounds. **[Level D]**
 - skills to communicate adverse information about patient complications, or medical errors. **[Level D]**
- Fellows seek to establish effective collaboration with other team members within and outside the department. Fellows accept feedback and incorporate it into their practice to improve their skills. **[Level D]**
- Fellows develop effective communication skills with members of other departments including surgeons, cardiologists, intensive care physicians, and nurses. **[Level D]**
- Fellows strictly follow Patient Safety Guidelines. **[Level D]**

6. Assessment

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6.1. General principles of assessment

Faculty members responsible for teaching Fellows will provide the PCA Program Director with critical evaluations of each Fellow's progress and competence at four-month intervals using a standardized format. Evaluations will assess essential and acquired character attributes, level of knowledge, clinical judgment, psychomotor skills, and specific procedural skills needed for patient management and critical analysis of clinical situations [3].

The PCA Program Director or a designate will provide feedback to Fellows on their evaluations at least every four months during their training, identifying areas in need of improvement, and document the communication in writing. Fellows must obtain a satisfactory overall evaluation on completion of their training to receive certification [3]. A portfolio containing logbook of all cases undertaken by Fellows, is required for each assessment period (see template).

6.2. Assessment of Fellows

The following elements will form part of the assessment of the Fellow during their training. In addition to evaluation by faculty members and EACTAIC Representative(s), it will be essential for the Fellow to learn from reflection on their training experiences [3].

The following assessment tools should be used: [3]

- Four-monthly evaluation discussions through the fellowship program.
- During discussions with Fellows, the tutor or Head of Training will address:
 - Results of 360-degree evaluations* and clinical skills evaluations**
 - Personal reports from the faculty (if available).
 - Reflections and self-assessments by the Fellow.
 - Learning goals for the next four months.
 - Feedback from Fellows on the quality of the education and any aspects of the curriculum that has not been addressed in their training.



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*360-degree evaluation (of CanMEDS competencies): 360-degree feedback is a diagnostic tool that helps the candidate to improve his/her personal competencies and supports the self-assessment. During the fellowship, a minimum of one 360-degree feedback must include at least five colleagues invited to submit an evaluation of the candidate's competencies. Feedback is restricted to internal sources (supervising anesthesiologists, surgeons, nurses) using a standardized questionnaire based on existing multi-source feedback forms [11, 12].

** Clinical skills evaluation (CSE) or Direct Observation of Procedural Skills (DOPS): Clinical skills evaluation (CSE) is intended to give feedback to the Fellow about his ability to plan and perform various clinical tasks. CSE is to be performed by a supervisor, the head of training, or another appropriate person (cardiothoracic anesthesiologist with experience in CHD) based on a standardized form, which can be based on already existing forms [13].

6.3. Documentation

Fellows are required to complete a record of their training during their fellowship in the form of a logbook. If available, an electronic system such as a computer database may be used. The following information should be documented in the logbook:

- Anonymized record of all patients managed by Fellows during their fellowship. The data set recorded for each case must include a minimum of age, weight, sex, RACHS-1, type of surgery or percutaneous intervention procedure, anesthetic procedure(s), relevant comorbidities, and the performed techniques.
- If applicable, reports of TEE exams.
- Summaries of their four-monthly evaluations and related discussions.



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- Results of their clinical skills evaluations. [13]
- 360-degree multi-source feedback. [11]

6.4. External evaluation/assessment

At the end of the fellowship and with the exception of the 360-degree multi-source feedback, all the contents of the logbook must be sent to the Chair of the Education Committee [3]. The Chair will then forward it to two representatives of EACTAIC who are external to the host center, for assessment [3]. Also, Fellows must undergo an exit interview by an Advisory Committee formed by two external examiners and the Program Director alone from the host center [Supplement C; The Sequence of Procedures of EACTAIC Exit Interviews] [6]. Fellows can apply for the interview once they have completed the required number of procedures, internships outside the operating room, CSE and 360-degree evaluation. The external evaluation or assessment is scored as pass or fail and yes or no (360-degree evaluation). An average score of 70% or above is required to pass [Supplement D; EACTAIC Evaluation Form and Scoring Sheet]. [3] The Advisory Committee should provide feedback to the Fellow, describing both the documentary evidence's strengths and weaknesses. Fellows will be awarded certification if they obtain a 'pass' mark on CSE and completed all other assessment tools (e.g., 360-degree evaluation). [3] If this is not the case, training will be deemed incomplete, and the Fellow will not be awarded certification in the EACTAIC Fellowship Program. [3] These Fellows will have to be enrolled for an additional period of training at the host center under either direct or remote supervision until showing the competency, knowledge, and skills levels required based on the conditional independence on a case-by-case assessment by the mentor in order to satisfactorily fulfill the requirements. [3] Fellows who feel they were unfairly denied certification may appeal decision of the Advisory Committee's within seven working days from the day after the interview. [3] The appeal must be submitted in the form of a signed and dated letter to the Chair of the Education Committee and sent by registered mail within the expiration period. The

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Advisory Committee's decision regarding the appeal will be communicated to Fellows within twenty calendar days following that on which the appeal was received [Supplement E; EACTAIC appeal process]. [7]

6.5. Program assessment

6.5.1 There will be regular opportunities for Fellows to provide confidential written evaluations of the faculty and program to the Chair EACTAIC Education Committee. [14]

6.5.2 Fellows who experience difficulty during their training period may turn for advice to the Program Director, faculty members, and the head of the department at the host center. Fellows who feel unable to approach any of these people should contact the Chair of the EACTAIC Education Committee. The Chair can provide confidential, neutral, independent, and informal advice to help Fellows address their concerns. [3, 14] The Chair can support the Fellow in person in any discussions of problems or issues with faculty or administrators as well as act as an informal mediator between the trainee and the faculty or administrators. The Chair can also help effect positive change by providing feedback on patterns in problems and complaints submitted to the Program Director. Fellows can contact the Chair with general questions by email, telephone, or in person. A staged approach policy is available in escalating issues with non-compliant host centers for EACTAIC PCA fellowship programs [Supplement E; EACTAIC appeal process]. [15]

6.5.3 Periodic evaluation of patient care (quality assurance) is mandatory. [3] Subspecialty trainees in adult cardiac (preferentially ACHD) and general pediatric anesthesia will be involved in continuing quality improvement and risk management.

6.5.4 Should unforeseen circumstances arise, such as a personal conflict between a Fellow and one or more tutors, this should be reported immediately to the Chair of the Education Committee. The Board of Directors then has the right to

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appoint an independent EACTAIC officer as a "mentor" to help resolve the circumstances and protect both parties. [3, 4]

7. Conclusion

EACTAIC initiated its fellowship program in PCA to ensure training is both of high quality and standardized. A consensus requires to be developed between centers hosting Fellowship Programs as to the knowledge, skills, and competence that are necessary to take care of children and adults with CHD. The EACTAIC Curriculum for PCA includes requirements for, and certification of, training, educational objectives, relevant competences, and learning and teaching methods. Further assessments of the diverse practice among the European centers and the PCA Fellowship Program are essential to establish the efficacy of the proposed curriculum. The goal of EACTAIC's PCA Fellowship Program is to produce highly trained and competent perioperative physicians who can care for patients with CHD undergoing cardiac surgery and interventional procedures as well as a non-cardiac surgery.



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Table 1: Minimum recommended number of cases for anesthetic management of cardiac surgery and interventional procedures in patients with congenital heart disease (CHD) [1, 2] * †

Surgical cases with CPB	Case number required
Ventricular /atrial septal defect	15
Atrioventricular septal defect	10
Tetralogy of Fallot	10
Left-sided valvular lesions	12
Bidirectional Glenn	5
Fontan procedure	5
Miscellaneous including Rastelli and Damus-Kaye-Stansel procedures, intracardiac tumors	2
Surgical cases without CPB	
Modified Blalock-Taussig shunts	5
Coarctation repair	5
Pulmonary artery banding	5
PDA closure	2
Treatment of vascular rings	1
Cardiac percutaneous intervention procedures	
Diagnostic	10
Neonatal aortic/pulmonary vessel or valve treatment (e.g., pulmonary artery stenosis, coarctation)	5
ASD/VSD/PDA device closure	20
Other therapeutic	15
Electrophysiology studies	5



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Where: CPB: cardiopulmonary bypass, ASD; atrial septal defect, VSD; ventricular septal defect, PDA; patent ductus arteriosus.

*These recommended numbers of cases are not obligatory and depend mainly on where the fellowship program takes place. However, as stated in the text a minimum of 100 surgical cases and a minimum of 50 pediatric cardiac interventional procedures need to be performed per calendar year.

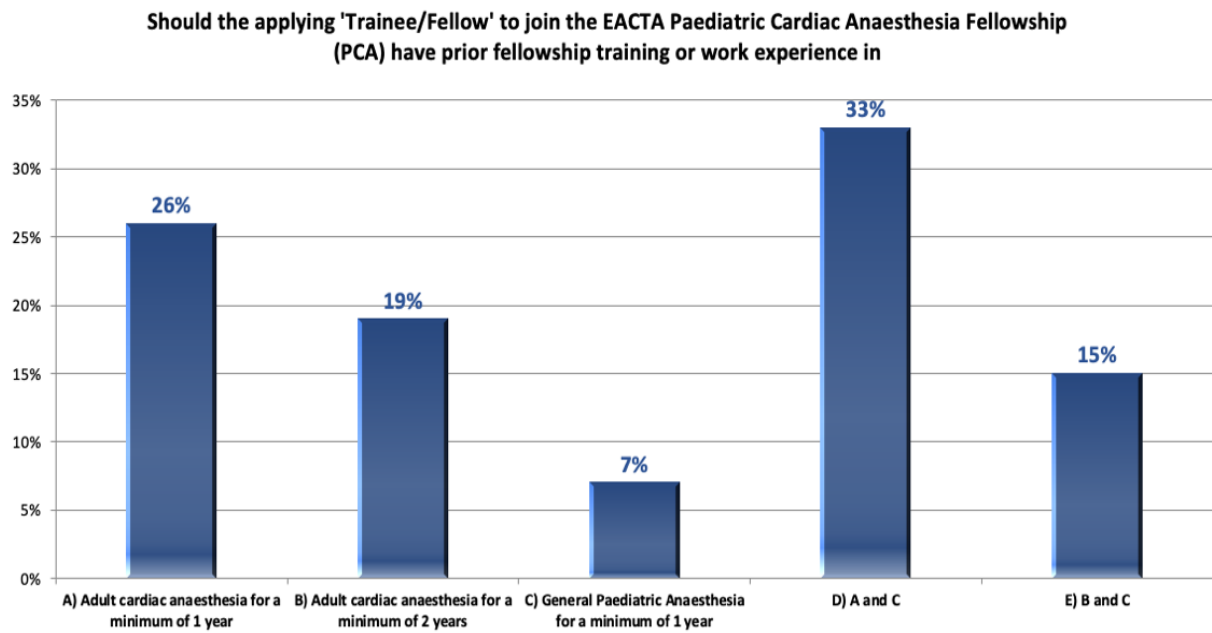
† The types of cases that failed to reach consensus were excluded.



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Figures legend

Figure (1). The choices on the duration of the previous experience in pediatric anesthesia and adult cardiac anesthesia.





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10. Supplements Legends

Supplement A: Votes on the importance of including the medical knowledge, technical skills, non-technical skills, and type of cases recommended during the Pediatric Cardiac Anesthesia Fellowship training based on a traffic light signals scale, where green indicates that it needs to be included, yellow would be useful to be included, and red is not important enough to be included. The sum of percentages can be read as less than 100% due to rounding.

Supplement B: Consensus analysis on including the medical knowledge, technical skills, non-technical skills, and type of cases recommended during the Pediatric Cardiac Anesthesia (PCA) Fellowship training based on five-point, ordinal Likert's scale. The sum of percentages can be read as less than 100% due to rounding.

Supplement C: EACTAIC Exit interview [6] The sequence of procedures for exit interviews.

Supplement D: EACTAIC Evaluation Form.

Supplement E: EACTAIC appeal process [8] The process for appealing the decisions of an examiner or their professional conduct during an exit interview from an EACTAIC Fellowship.

Supplement F: [15] A staged approach policy in escalating issues with non-compliant host centers for EACTAIC Fellowship Programs.



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Supplement A: Votes on the importance of including the medical knowledge, technical skills, non-technical skills, and type of cases recommended during the Pediatric Cardiac Anesthesia Fellowship training based on a traffic light signals scale, where green indicates that it needs to be included, yellow would be useful to be included, and red is not important enough to be included. The sum of percentages can be read as less than 100% due to rounding.

	Variable	Green	Yellow	Red
	Medical Knowledge			
1.	Cardiac and extracardiac anatomy and related factors.	28/28 (100%)	0/28 (0%)	0/28 (0%)
2.	Cardiopulmonary bypass and extracorporeal life support principles.	28/28 (100%)	0/28 (0%)	0/28 (0%)
3.	Drug-induced anesthetic management and pharmacology.	28/28 (100%)	0/28 (0%)	0/28 (0%)
4.	Cardiac imaging modalities: understanding echocardiographic images.	26/28 (93%)	2/28 (7%)	0/28 (0%)
5.	Understanding cardiac catheterization images.	21/28 (75%)	7/28 (25%)	0/28 (0%)
6.	Knowledge of intraoperative transesophageal echocardiography related to congenital heart disease and recognition of complications	26/28 (93%)	2/28 (7%)	0/28 (0%)
7.	Basic understanding of other cardiac imaging modalities such as Magnetic Resonance Imaging and Computerized Tomography scan	17/28 (60%)	10/28 (36%)	1/28 (4%)
8.	Pre-anesthetic assessment	27/28 (96%)	1/28 (4%)	0/28 (0%)
9.	Optimizes preparation of congenital heart disease patients in terms of medical therapy and need for further investigation	27/28 (96%)	0/28 (0%)	1/28 (4%)
10.	Interprets data from preoperative cardiothoracic diagnostic imaging	23/28 (82%)	5/28 (18%)	0/28 (0%)
11.	Identifies and anticipates hemodynamic, medical and surgical issues for cardiopulmonary bypass cases	28/28 (100%)	0/28 (0%)	0/28 (0%)
12.	Identifies and anticipates hemodynamic, medical, and surgical issues for palliative surgery	26/28 (92%)	1/28 (4%)	1/28 (4%)
13.	Applies and interprets the necessary monitoring correctly	28/28 (100%)	0/28 (0%)	0/28 (0%)
14.	Applies safe perioperative patient blood management and is aware of transfusion-related complications	27/28 (96%)	1/28 (4%)	0/28 (0%)

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15.	Applies safe anesthesia for diagnostic and interventional heart catheterizations from the neonatal period up to adulthood	26/28 (93%)	2/28 (7%)	0/28 (0%)
16.	Applies safe anesthesia for electrophysiological procedures in children as well as in adults	25/28 (89%)	3/28 (11%)	0/28 (0%)
17.	Has knowledge of the type and the time course of the most important operations and related anesthetic management	28/28 (100%)	0/28 (0%)	0/28 (0%)
18.	Applies safe transport to the pediatric intensive care unit	27/28 (96%)	1/28 (4%)	0/28 (0%)
19.	Recognizes unique characteristics of pediatric cardiac anatomy, airway management and vascular access	28/28 (100%)	0/28 (0%)	0/28 (0%)
Technical Skills				
20.	Recognizes unique characteristics of pediatric cardiac anatomy, airway management, and vascular access.	28/28 (100%)	0/28 (0%)	0/28 (0%)
21.	Anticipates difficult airway management in patients with specific syndromes and uses specific equipment.	28/28 (100%)	0/28 (0%)	0/28 (0%)
22.	Shows competency in placing the peripheral and central venous lines and arterial catheters with or without ultrasound guidance.	28/28 (100%)	0/28 (0%)	0/28 (0%)
23.	Passing the theoretical part of the transesophageal echocardiography exam.	23/28 (82%)	5/28 (18%)	0/28 (0%)
24.	Uses transesophageal echocardiography for diagnostic management of the patients.	23/28 (82%)	3/28 (11%)	2/28 (7%)
25.	Is familiar with Point-of-Care coagulation tests and guides transfusion based on these tests.	28/28 (100%)	0/28 (0%)	0/28 (0%)
26.	Is familiar with the use of cerebral and somatic near-infrared Spectroscopy.	25/28 (89%)	3/28 (11%)	0/28 (0%)
27.	Whenever available or possible, is familiar with intraoperative electroencephalogram monitoring.	17/28 (61%)	11/28 (39%)	0/28 (0%)
28.	Applies regional and lung isolation techniques whenever necessary.	24/28 (86%)	4/28 (14%)	0/28 (0%)
29.	Participates in journal clubs, multidisciplinary discussions, morbidity/mortality conferences.	24/28 (86%)	4/28 (14%)	0/28 (0%)
Non-Technical Skills				
30.	Didactic program and non-technical skills.	22/28 (79%)	6/28 (21%)	0/28 (0%)
31.	Aims at self-directed learning and scholarly activity by reviewing the literature related to a case or specific	24/28 (86%)	4/28 (14%)	0/28 (0%)



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	patient-related topic.			
32.	Whenever possible, participates in research projects or the development of guidelines or policies.	22/28 (79%)	5/28 (17%)	1/28 (4%)
33.	Presents at least once per year cases or research projects at departmental educational conferences, at national and international meetings.	23/28 (82%)	4/28 (14%)	1/28 (4%)
34.	Develops skills regarding communication with patients and parents.	26/28 (93%)	2/28 (7%)	0/28 (0%)
35.	Provides the appropriate information to the family and the patients in the preoperative and postoperative periods.	27/28 (96%)	1/28 (4%)	0/28 (0%)
36.	Can communicate with families with different cultural and/or religious backgrounds.	24/28 (86%)	4/28 (14%)	0/28 (0%)
37.	Develops skills to announce bad news, complications, or eventual medical errors.	25/28 (89%)	3/28 (11%)	0/28 (0%)
38.	Seeks good collaboration with other members of the department. Accepts and incorporates feedback to improve his skills.	26/28 (93%)	2/28 (7%)	0/28 (0%)
39.	Develops communication skills with members of other departments such as surgeons, cardiologists, intensive care physicians and nurses.	27/28 (96%)	1/28 (4%)	0/28 (0%)
40.	Strictly follows Patient Safety Guidelines.	24/28 (86%)	4/28 (14%)	0/28 (0%)
Suggested case type and numbers for anesthetic management of surgical repair				
'Obligatory' rotations				
41.	A dedicated 'obligatory' rotation in the pediatric intensive care unit for one month in addition to the earlier agreed 100 pediatric surgical cases with the majority with cardiopulmonary bypass during the last survey on December 2020	22/27 (82%)	4/27 (14%)	1/27 (4%)
42.	A minimum of 'obligatory' 50 pediatric percutaneous interventional procedures is performed per calendar year	22/27 (81%)	5/27 (19%)	0/27 (0%)
'Optional' varieties of cases suggested				
43.	A minimum of 15 Ventricular/ atrial septal defect procedures using cardiopulmonary bypass are performed per calendar year.	22/27 (81%)	5/27 (19%)	0/27 (0%)
44.	A minimum of 10 atrioventricular septal defect procedures using cardiopulmonary bypass is performed per calendar	23/27 (85%)	4/27 (15%)	0/27 (0%)



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	year.			
45.	A minimum of 10 Tetralogy of Fallot procedures using cardiopulmonary bypass is performed per calendar year.	20/27 (74%)	7/27 (26%)	0/27 (0%)
46.	A minimum of 12 procedures for right-sided valvular lesions using cardiopulmonary bypass is performed per calendar year.	19/27 (70%)	7/27 (26%)	1/27 (4%)
47.	A minimum of 12 procedures for left-sided valvular lesions using cardiopulmonary bypass is performed per calendar year.	20/27 (74%)	7/27 (26%)	0/27 (0%)
48.	A minimum of 5 bidirectional Glenn procedures using cardiopulmonary bypass is performed per calendar year.	21/27 (78%)	5/27 (18%)	1/27 (4%)
49.	A minimum of 5 Fontan procedures using cardiopulmonary bypass is performed per calendar year.	19/27 (70%)	7/27 (26%)	1/27 (4%)
50.	A minimum of 6 transpositions of great arteries procedures using cardiopulmonary bypass is performed per calendar year.	18/27 (66%)	8/27 (30%)	1/27 (4%)
51.	A minimum of 1 total anomalous pulmonary venous return procedure using cardiopulmonary bypass is performed per calendar year.	19/27 (70%)	6/27 (22%)	2/27 (8%)
52.	A minimum of 1 truncus arteriosus procedure using cardiopulmonary bypass is performed per calendar year.	18/27 (67%)	7/27 (26%)	2/27 (7%)
53.	A minimum of 1 hypoplastic left heart syndrome procedure using cardiopulmonary bypass is performed per calendar year.	18/27 (67%)	8/27 (30%)	1/27 (3%)
54.	A minimum of 1 double switch procedure using cardiopulmonary bypass is performed per calendar year.	17/27 (63%)	7/27 (26%)	3/27 (11%)
55.	A minimum of 1 interrupted aortic arch procedure using cardiopulmonary bypass is performed per calendar year.	19/27 (70%)	7/27 (26%)	1/27 (4%)
56.	A minimum of 5 modified Blalock-Taussig shunts is performed per calendar year.	23/27 (86%)	2/27 (7%)	2/27 (7%)
57.	A minimum of 5 procedures for repair of aortic coarctation is performed per calendar year.	21/27 (78%)	6/27 (22%)	0/27 (0%)
58.	A minimum of 5 pulmonary artery banding procedures is performed per calendar year.	21/27 (78%)	6/27 (22%)	0/27 (0%)
59.	A minimum of 2 procedures for ligation of patent ductus arteriosus is performed per calendar year.	21/27 (78%)	4/27 (15%)	2/27 (7%)
60.	A minimum of 1 vascular ring procedure is performed per calendar year.	18/27 (67%)	7/27 (26%)	2/27 (7%)
61.	A minimum of 10 diagnostic percutaneous interventional procedures is performed per calendar year.	22/27 (81%)	5/27 (19%)	0/27 (0%)

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62.	A minimum of 5 percutaneous interventional neonatal aortic/pulmonary dilatation procedures is performed per calendar year.	20/27 (74%)	6/27 (22%)	1/27 (4%)
63.	A minimum of 20 percutaneous interventional atrial septal defect/ventricular septal defect/patent ductus arteriosus device closure procedures is performed per calendar year.	19/27 (70%)	5/27 (19%)	3/27 (11%)
64.	A minimum of 20 other percutaneous interventional therapeutic procedures is performed per calendar year.	21/27 (78%)	4/27 (15%)	2/27 (7%)
65.	A minimum of 5 electrophysiology study procedures is performed per calendar year.	21/27 (78%)	5/27 (19%)	1/27 (3%)
66.	A minimum of 20 cases with extracorporeal life support is performed per calendar year. *	18/27 (67%)	4/27 (15%)	5/27 (18%)

* We excluded the minimum of 20 cases with extracorporeal life support per calendar year in the curriculum because only 81.4% of respondents chose green or yellow traffic lights to rate its importance of including.



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Supplement B: Consensus analysis on including the medical knowledge, technical skills, non-technical skills, and type of cases recommended during the Pediatric Cardiac Anesthesia (PCA) Fellowship training based on five-point, ordinal Likert's scale. The sum of percentages can be read as less than 100% due to rounding.

	Variable	Strongly agree	Agree	Neither agree, nor disagree	Disagree	Strongly disagree
	Medical Knowledge					
1.	Cardiac and extracardiac anatomy and related factors.	17/28 (61%)	7/28 (25%)	1/28 (3%)	3/28 (11%)	0/28 (0%)
2.	Cardiopulmonary bypass and extracorporeal life support principles.	22/28 (79%)	3/28 (11%)	2/28 (7%)	0/28 (0%)	1/28 (3%)
3.	Drug-induced anesthetic management and pharmacology.	19/28 (68%)	4/28 (14%)	0/28 (0%)	3/28 (11%)	2/28 (7%)
4.	Cardiac imaging modalities: understanding echocardiographic images.	14/28 (50%)	11/28 (39%)	2/28 (7%)	1/28 (4%)	0/28 (0%)
5.	Understanding cardiac catheterization images.	9/28 (32%)	11/28 (39%)	5/28 (18%)	3/28 (11%)	0/28 (0%)
6.	Knowledge of intraoperative transesophageal echocardiography related to congenital heart disease and recognition of complications.	15/28 (54%)	9/28 (32%)	1/28 (3%)	3/28 (11%)	0/28 (0%)
7.	Basic understanding of other cardiac imaging modalities such as Magnetic Resonance Imaging and Computed Tomography scan.	11/28 (39%)	14/28 (50%)	2/28 (7%)	1/28 (4%)	0/28 (0%)
8.	Pre-anesthetic assessment	20/28 (71%)	8/28 (29%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
9.	Optimizes preparation of congenital heart disease patients in terms of medical therapy and need for further investigation	16/28 (57%)	10/28 (36%)	2/28 (7%)	0/28 (0%)	0/28 (0%)
10.	Interprets data from preoperative cardiothoracic diagnostic imaging	10/28 (36%)	16/28 (57%)	2/28 (7%)	0/28 (0%)	0/28 (0%)
11.	Identifies and anticipates hemodynamic, medical and surgical issues for cardiopulmonary bypass cases	20/28 (71%)	8/28 (29%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
12.	Identifies and anticipates hemodynamic, medical, and surgical issues for palliative surgery	16/28 (57%)	10/28 (36%)	1/28 (3%)	1/28 (4%)	0/28 (0%)
13.	Applies and interprets the necessary	23/28	5/28	0/28	0/28	0/28



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	monitoring correctly	(82%)	(18%)	(0%)	(0%)	(0%)
14.	Applies safe perioperative patient blood management and is aware of transfusion-related complications	21/28 (75%)	7/28 (25%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
15.	Applies safe anesthesia for diagnostic and interventional heart catheterizations from the neonatal period up to adulthood	18/28 (64%)	10/28 (36%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
16.	Applies safe anesthesia for electrophysiological procedures in children as well as in adults	14/28 (50%)	12/28 (43%)	0/28 (0%)	2/28 (7%)	0/28 (0%)
17.	Has knowledge of the type and the time course of the most important operations and related anesthetic management	20/28 (71%)	7/28 (25%)	1/28 (4%)	0/28 (0%)	0/28 (0%)
18.	Applies safe transport to the pediatric intensive care unit	18/28 (64%)	10/28 (36%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
19.	Recognizes unique characteristics of pediatric cardiac anatomy, airway management and vascular access	25/28 (89%)	3/28 (11%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
	Technical Skills					
20.	Anticipates difficult airway management in patients with specific syndromes and uses specific equipment.	20/28 (71%)	6/28 (21%)	1/28 (4%)	1/28 (4%)	0/28 (0%)
21.	Shows competency in placing the peripheral and central venous lines and arterial catheters with or without ultrasound guidance.	22/28 (79%)	5/28 (18%)	0/28 (0%)	1/28 (3%)	0/28 (0%)
22.	Passing the theoretical part of the transesophageal echocardiography exam.	13/28 (46%)	8/28 (29%)	6/28 (21%)	1/28 (4%)	0/28 (0%)
23.	Uses transesophageal echocardiography for diagnostic management of the patients.	12/28 (43%)	12/28 (43%)	3/28 (11%)	1/28 (3%)	0/28 (0%)
24.	Is familiar with Point-of-Care coagulation tests and guides transfusion based on these tests.	21/28 (75%)	5/28 (18%)	0/28 (0%)	2/28 (7%)	0/28 (0%)
25.	Is familiar with the use of cerebral and somatic near-infrared Spectroscopy.	15/28 (54%)	12/28 (43%)	1/28 (3%)	0/28 (0%)	0/28 (0%)
26.	Whenever available or possible, is familiar with intraoperative electroencephalogram monitoring. *	10/28 (35%)	9/28 (32%)	7/28 (25%)	2/28 (8%)	0/28 (0%)
27.	Applies regional and lung isolation techniques whenever necessary.	14/28 (50%)	11/28 (39%)	2/28 (7%)	1/28 (4%)	0/28 (0%)
28.	Participates in journal clubs,	17/28	8/28	3/28	0/28	0/28

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	multidisciplinary discussions, morbidity/mortality conferences.	(61%)	(29%)	(10%)	(0%)	(0%)
Non-Technical Skills						
29.	Didactic program and non-technical skills.	13/28 (46%)	11/28 (39%)	3/28 (11%)	1/28 (4%)	0/28 (0%)
30.	Aims at self-directed learning and scholarly activity by reviewing the literature related to a case or specific patient-related topic.	18/28 (64%)	8/28 (29%)	2/28 (7%)	0/28 (0%)	0/28 (0%)
31.	Whenever possible, participates in research projects or the development of guidelines or policies.	10/28 (36%)	14/28 (50%)	2/28 (7%)	2/28 (7%)	0/28 (0%)
32.	Presents at least once per year cases or research projects at departmental educational conferences, at national and international meetings.	9/28 (32%)	16/28 (57%)	1/28 (4%)	2/28 (7%)	0/28 (0%)
33.	Develops skills regarding communication with patients and parents.	19/28 (68%)	8/28 (29%)	1/28 (3%)	0/28 (0%)	0/28 (0%)
34.	Provides the appropriate information to the family and the patients in the preoperative and postoperative periods.	18/28 (64%)	8/28 (28%)	1/28 (4%)	1/28 (4%)	0/28 (0%)
35.	Can communicate with families with different cultural and/or religious backgrounds.	15/28 (54%)	8/28 (28%)	4/28 (14%)	1/28 (4%)	0/28 (0%)
36.	Develops skills to announce bad news, complications, or eventual medical errors.	12/28 (43%)	10/28 (36%)	5/28 (17%)	1/28 (4%)	0/28 (0%)
37.	Seeks good collaboration with other members of the department. Accepts and incorporates feedback to improve his skills.	21/28 (75%)	7/28 (25%)	0/28 (0%)	0/28 (0%)	0/28 (0%)
38.	Develops communication skills with members of other departments such as surgeons, cardiologists, intensive care physicians and nurses.	20/28 (71%)	7/28 (25%)	0/28 (0%)	1/28 (4%)	0/28 (0%)
39.	Strictly follows Patient Safety Guidelines.	16/28 (57%)	11/28 (39%)	1/28 (4%)	0/28 (0%)	0/28 (0%)
Suggested case type and numbers for anesthetic management of surgical repair						
'Obligatory' rotations						
40.	A dedicated 'obligatory' rotation in the pediatric intensive care unit for one	15/27 (56%)	7/27 (26%)	3/27 (11%)	2/27 (7%)	0/27 (0%)

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	month.					
41.	A minimum of 'obligatory' 50 pediatric percutaneous interventional procedures is performed per calendar year	12/27 (44%)	10/27 (37%)	5/27 (19%)	0/27 (0%)	0/27 (0%)
	'Optional' varieties of cases suggested					
42.	A minimum of 15 Ventricular/ atrial septal defect procedures using cardiopulmonary bypass are performed per calendar year.	13/27 (48%)	8/27 (30%)	6/27 (22%)	0/27 (0%)	0/27 (0%)
43.	A minimum of 10 atrioventricular septal defect procedures using cardiopulmonary bypass is performed per calendar year.	13/27 (48%)	9/27 (33%)	5/27 (19%)	0/27 (0%)	0/27 (0%)
44.	A minimum of 10 Tetralogy of Fallot procedures using cardiopulmonary bypass is performed per calendar year.	9/27 (33%)	13/27 (48%)	5/27 (19%)	0/27 (0%)	0/27 (0%)
45.	A minimum of 12 procedures for right-sided valvular lesions using cardiopulmonary bypass is performed per calendar year.*	8/27 (30%)	10/27 (37%)	8/27 (30%)	1/27 (3%)	0/27 (0%)
46.	A minimum of 12 procedures for left-sided valvular lesions using cardiopulmonary bypass is performed per calendar year.	9/27 (33%)	12/27 (44%)	6/27 (23%)	0/27 (0%)	0/27 (0%)
47.	A minimum of 5 bidirectional Glenn procedures using cardiopulmonary bypass is performed per calendar year.	9/27 (33%)	12/27 (44%)	5/27 (19%)	1/27 (4%)	0/27 (0%)
48.	A minimum of 5 Fontan procedures using cardiopulmonary bypass is performed per calendar year.	6/27 (22%)	15/27 (56%)	5/27 (18%)	1/27 (4%)	0/27 (0%)
49.	A minimum of 6 transpositions of great arteries procedures using cardiopulmonary bypass is performed per calendar year. *	6/27 (22%)	12/27 (44%)	8/27 (30%)	1/27 (4%)	0/27 (0%)
50.	A minimum of 1 total anomalous pulmonary venous return procedure using cardiopulmonary bypass is performed per calendar year. *	6/27 (22%)	10/27 (37%)	10/27 (37%)	1/27 (4%)	0/27 (0%)
51.	A minimum of 1 truncus arteriosus procedure using cardiopulmonary bypass is performed per calendar year. *	6/27 (22%)	10/27 (37%)	10/27 (37%)	1/27 (4%)	0/27 (0%)
52.	A minimum of 1 hypoplastic left heart	7/27	9/27	9/27	2/27	0/27

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	syndrome procedure using cardiopulmonary bypass is performed per calendar year. *	(26%)	(33%)	(33%)	(8%)	(0%)
53.	A minimum of 1 double switch procedure using cardiopulmonary bypass is performed per calendar year. *	6/27 (22%)	11/27 (41%)	7/27 (26%)	2/27 (7%)	1/27 (4%)
54.	A minimum of 1 interrupted aortic arch procedure using cardiopulmonary bypass is performed per calendar year. *	7/27 (26%)	11/27 (40%)	8/27 (30%)	1/27 (4%)	0/27 (0%)
55.	A minimum of 5 modified Blalock-Taussig shunts is performed per calendar year.	10/27 (37%)	11/27 (40%)	5/27 (19%)	0/27 (0%)	1/27 (4%)
56.	A minimum of 5 procedures for repair of aortic coarctation is performed per calendar year.	12/27 (45%)	9/27 (33%)	6/27 (22%)	0/27 (0%)	0/27 (0%)
57.	A minimum of 5 pulmonary artery banding procedures is performed per calendar year.	11/27 (41%)	10/27 (37%)	6/27 (22%)	0/27 (0%)	0/27 (0%)
58.	A minimum of 2 procedures for ligation of patent ductus arteriosus is performed per calendar year.	11/27 (41%)	8/27 (30%)	6/27 (22%)	2/27 (7%)	0/27 (0%)
59.	A minimum of 1 vascular ring procedure is performed per calendar year.	8/27 (30%)	11/27 (41%)	6/27 (22%)	2/27 (7%)	0/27 (0%)
60.	A minimum of 10 diagnostic percutaneous interventional procedures is performed per calendar year.	13/27 (48%)	7/27 (26%)	7/27 (26%)	0/27 (0%)	0/27 (0%)
61.	A minimum of 5 percutaneous interventional neonatal aortic/pulmonary dilatation procedures is performed per calendar year.	10/27 (37%)	10/27 (37%)	6/27 (22%)	1/27 (4%)	0/27 (0%)
62.	A minimum of 20 percutaneous interventional atrial septal defect/ventricular septal defect/patent ductus arteriosus device closure procedures is performed per calendar year.	10/27 (37%)	9/27 (33%)	6/27 (22%)	2/27 (8%)	0/27 (0%)
63.	A minimum of 20 other percutaneous interventional therapeutic procedures is performed per calendar year.	8/27 (30%)	14/27 (51%)	4/27 (15%)	1/27 (4%)	0/27 (0%)
64.	A minimum of 5 electrophysiology study procedures is performed per calendar year.	9/27 (33%)	10/27 (37%)	7/27 (26%)	1/27 (4%)	0/27 (0%)
65.	A minimum of 20 cases with extracorporeal life support is performed	6/27 (22%)	8/27 (29%)	7/27 (26%)	5/27 (19%)	1/27 (4%)

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per calendar year. *					
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Likert scale responses are presented as a percentage of agreement, neutral and disagreement.

Consensus was achieved when there was > 70% agreement for the Likert scale.

*The statements that did not reach consensus.



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Supplement C: EACTAIC Exit interview [6]

The sequence of procedures for exit interviews

1. The Education Chair will assign two members of the Education Committee as 'examiners' for the exit interview, depending on their availability and interest. The Fellowship host center's submitted material will be made available in advance to the examiners to allow an initial assessment.
2. A standard letter is sent to the Fellow, the Program Director on site, and the two examiners with the request to arrange a suitable date and time for all parties within a specified time frame.
3. The examiners will sign a conflict-of-interest declaration form and a declaration of agreement to share the exit interview recordings with Education Committee panel members in case of an appeal process.
4. The examiners will review the performance of the Fellow mentioned in the European Association of Cardiothoracic Anesthesiology and Intensive Care (EACTAIC) Fellowship curriculum in a non-standard interview fashion by asking questions, for example, about previous experience, the most challenging case performed, availability of support and mentoring, the Fellow's opinion of the Fellowship program, points for improvement, the intention to receive future Fellowship training, etc. The examiners can also ask questions about the procedures included in the logbook. Likewise, the Program Director can be asked about training and internal procedures at the center.
5. All exit interviews are planned by the EACTAIC secretariat and made available through a secured Internet access media platform.
6. The Education Chair does not participate in any of the exit interviews to ensure transparency in case of an appeal.
7. All exit interviews will be recorded after obtaining written consents from all participants in compliance with the data protection regulations of the general data protection regulations (GDPR). The recordings are confidential and archived for internal use to communicate the points for improvement to the centers, to handle future complaints and to maintain quality.

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8. After the interview, the Education Chair reviews the recording and sends feedback to the local Fellowship Program Director.
9. The examiners send the completed and signed standard evaluation form within 24 hours of the exit interview to the Education Chair to issue the fellowship with the Fellowship program's final certificate.
10. After obtaining the examiners' evaluation forms, the Education Chair reviews all the materials, including recordings, and will communicate feedback to the Fellowship Program Director.
11. Appeals against the Education Chair's decision or the professional conduct of the examiners will be handled according to the appeal procedure.



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Supplement D: EACTAIC Evaluation Form

Fellow's Name: _____

The final evaluation consists of four assessment tools that are graded by the Advisory Committee: (1) number of cardiac, thoracic, and vascular procedures and TEE/TTE performed, (2) number of internships outside the operating room (OR), (3) results of 360-degree evaluation (360 Multi-source Feedback (MSF)), and (4) results of clinical skills evaluation (CSE). These documents will be submitted to the Advisory Committee at least two weeks before the interview to give adequate time to review. These evaluation tools are scored by each member of the Advisory Committee, with an average score of 70% or above required to pass. The literature review is scored pass/fail, and a passing grade is required by at least 2 members of the Committee. The Committee should provide feedback to the Fellow, describing both the strengths and weaknesses of each document.

	PROPOSAL	REVIEW	SCORE (1-25)
1	<u>Logbook: Adequate numbers and spread of procedures</u>	Satisfactory / Unsatisfactory	
2	Number and duration of internships outside the OR	Satisfactory / Unsatisfactory	
3	The 360-degree evaluation (360 MSF) has been undertaken which has included responses from an appropriate number and spread of colleagues within the multidisciplinary team. There were no areas of concern.	Satisfactory / Unsatisfactory	
4	<u>Appropriate number and spread of clinical skills evaluations have been performed</u>	Satisfactory / Unsatisfactory	

EACTA Education Chair *Date*

Examiner (1) *Date*

Examiner (2) *Date*

Program Director *Date*

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Supplement E: EACTAIC appeal process [7]

The process for appealing the decisions of an examiner or their professional conduct during an exit interview from an EACTAIC Fellowship

1. Should an European Association of Cardiothoracic Anesthesiology and Intensive Care (EACTAIC) PCA Fellow or their Program Director wish to appeal against the decision made in the exit interview conducted for the EACTAIC Fellowship Program or make a grievance against the professional conduct of an 'examiner' present at the interview then the Fellow or the Program Director (hereinafter referred to as the appellant) must inform the Chair of the EACTAIC Education within seven calendar days of the interview with a written statement providing the reasons for the appeal. The appeal request must be written in English and sent by registered mail or an email to the Educational Chair.

2. Before the appeal process starts, the examiner will be informed directly by the Education Chair of the allegations made against him or her and provided with the relevant evidence. If the appeal comes from the Fellow alone, the Education Chair will inform the Fellowship Director of the appeal. At this point, the Education Chair will try to mediate between the affected party so that the initiation of an official appeal may be reconsidered.

3. The appeal process will start if reconciliation proves impossible or if the examiner's behavior has been unprofessional. The process will only begin after receipt of all the required documents no later than midnight of the seventh calendar day after the exit interview based on the appellant's time zone as identifiable by the date of the registered mail's postmark sending of the email.

4. The EACTAIC Education Chair will formally interview the examiner to explain their conduct and be questioned on it.

5. After that, the Education Chair calls to action the appeal panel and conducts the appeal in whole or in part as oral interviewing of the panel members and the examiner. The appeal panel will consist of a minimum of two members of the EACTAIC Education Committee (hereinafter referred to as panel members) or unavailability or conflict of interest, inviting a third-panel member to review the appeal and the exit interview. The selection of the panel members will be the responsibility of the EACTAIC Education Chair. In writing, panel members must confirm that they have no conflicts of interest with either the appellant (Fellow and Program Director) or



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the examiner. Likewise, the appellant and examiner must provide consent for panel members reviewing the appeal to access the recorded interview.

6. The EACTAIC Education Chair will provide each panel member and the examiner with all relevant materials and documents concerning the appeal.

7. Response to the appeals will be in the form of written statements by the panel members.

8. Within 20 calendar days of the panel members' appointment and following formal virtual interview with the EACTAIC Education Chair, they independently and confidentially give an account of the situation according to/her assessment and submit their decision and recommendations in writing to the EACTAIC Education Chair.

9. It is the EACTAIC Education Chair and appeal panel's responsibility to recommend an initial decision on the appeal.

10. The EACTAIC Board of Directors has to approve the EACTAIC Education Chair and appeal the panel's decision. The EACTAIC Secretariat will then inform all parties involved: the appellant, the examiner, and the panel members. This ends the appeal procedure finally, and no further appeal will be considered regardless of whether the appellant later cites additional evidence.

11. If the final decision supports the examiner's professional misconduct, the examiner should be removed from the EACTAIC Education Committee for their remaining term of office.

12. If the final decision is that the evidence does not support grounds for professional misconduct, the Board of Directors may remove the accusing Program Director from the EACTAIC Education Committee for their remaining term of office.

13. The conduct of every appeal investigation will be reported to the Education Committee once the Board of Directors has approved a decision.



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Supplement F: Staged approach policy in escalating issues [14]

A staged approach policy in escalating issues with non-compliant host centers for EACTAIC Fellowship Programs

1. All centers participating in the EACTAIC Fellowship Program are treated equally and are subject to the same reporting criteria. Where centers do not provide regular reports or become unresponsive, the process described below will be followed by the Chair of the Education Committee or his/her delegate.
2. If hosting centers do not respond or supply regular reports, the local leaders will be emailed with a reminder that this is a requirement of hosting the EACTAIC Fellowship and asked for a response within 15 working days. Where possible, it would be helpful to follow this email up with a phone call.
3. If there is no response within 15 working days, a further email will be sent to both the local program lead and the Head of Department indicating that EACTAIC is concerned about the lack of contact and that regular reporting to EACTAIC is a formal requirement for hosting an EACTAIC Fellowship program. Further, EACTAIC is keen to support all centers and requests an online meeting with the Program Lead and Head of Department to discuss any local problems with the Fellowship program. It will be requested that this meeting takes place within 28 days of the email.
4. If the center engages and local problems are identified, these can be addressed on a case-by-case basis. If there is no response, the Chair of the Education Committee (or delegate) will send an email and a follow-up letter by post to the Program Director with a copy to the Head of Department. This will state that EACTAIC is keen to retain the connection and Fellowship Program at the center, but that engagement with the EACTAIC Education Committee is essential to sustain this. It will be stated that EACTAIC will have to consider withdrawing approval for the Fellowship program unless the center's Fellowship Program Lead meets with EACTAIC representatives online as soon as possible. Further, it will be indicated that EACTAIC will be contacting local EACTAIC Fellows directly for their feedback.
5. If there is still no response after one month, EACTAIC will send an official email and letter indicating that the Fellowship Program's approval at the center will be withdrawn at the end of the tenure of the current Fellows.



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11. List of Abbreviations

Abbreviation	Explanation
ASD	Atrial septal defect
CanMEDS	Canadian Medical Education Directives for Specialists
CHD	Congenital heart disease
CPB	Cardiopulmonary bypass
CSE	Clinical skills evaluation
CVTA	Cardiovascular and thoracic anesthesia
DOPS	Direct Observation of Procedural Skills
EACTAIC	European Association of Cardiothoracic Anaesthesiology and Intensive Care
EACVI	European Association of Cardiovascular Imaging
ECLS	Extracorporeal life support
GDPR	General Data Protection Regulation
MSF	Multi-source feedback
NIRS	Near-infrared spectroscopy
PCA	Pediatric Cardiac Anesthesia Fellowship
PDA	Patent ductus arteriosus
PICU	Pediatric intensive care unit
OR	Operating room
RACHS-1	Risk Adjustment for Congenital Heart Surgery-1
TEE	Transesophageal echocardiography
TTE	Transthoracic echocardiography
UEMS	Union Européenne des Médecins Spécialistes
VSD	Ventricular septal defect