



Assessment for learning of paediatric cardiology trainees in 41 centres from 19 European countries

Original Article

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Corresponding author:

Colin J. McMahon;

Email: cmcmahon992004@yahoo.com

Colin J. McMahon^{1,2,3} , Ornella Milanesi⁴, Olli Pitkänen-Argillander⁵,
Dimpna C. Albert-Brotons⁶ , Ina Michel-Behnke⁷ , Inga Voges⁸,
Skaiste Sendzikaite⁹  and Ruth Heying¹⁰ 

¹Department of Paediatric Cardiology, Children's Health Ireland at Crumlin, Dublin, Ireland; ²School of Medicine, University College Dublin, Belfield, Dublin 4, Ireland; ³School of Health Professions Education (SHE), Maastricht University, Maastricht, Netherlands; ⁴Paediatric Cardiac Unit, Department of Paediatrics, University of Padova, School of Medicine, Padua, Italy; ⁵Children's Hospital, Helsinki University Hospital and University of Helsinki, Helsinki, Finland; ⁶Heart Center, King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia; ⁷Division of Pediatric Cardiology, University Hospital for Children and Adolescent Medicine, Paediatric Heart Centre, Medical University Vienna, Vienna, Austria; ⁸Department for Congenital Heart Disease and Paediatric Cardiology, University Hospital Schleswig Holstein, Kiel, Germany; ⁹Faculty of Medicine, Vilnius University, Vilnius, Lithuania and ¹⁰Department of Paediatric Cardiology, University Hospital Leuven, Leuven, Belgium

Abstract

Background: Limited data exist on how trainees in paediatric cardiology are assessed among countries affiliated with the Association of European Paediatric and Congenital Cardiology. **Methods:** A structured and approved questionnaire was circulated to educationalists/trainers in 95 Association for European Paediatric and Congenital Cardiology training centres. **Results:** Trainers from 46 centres responded with complete data in 41 centres. Instructional design included bedside teaching (41/41), didactic teaching (38/41), problem-based learning (28/41), cardiac catheterisation calculations (34/41), journal club (31/41), fellows presenting in the multidisciplinary meeting (41/41), fellows reporting on echocardiograms (34/41), clinical simulation (17/41), echocardiography simulation (10/41), and catheterisation simulation (3/41). Assessment included case-based discussion (n = 27), mini-clinical evaluation exercise (mini-CEX) (n = 12), directly observed procedures (n = 12), oral examination (n = 16), long cases (n = 11), written essay questions (n = 6), multiple choice questions (n = 5), and objective structured clinical examination (n = 2). Entrustable professional activities were utilised in 10 (24%) centres. Feedback was summative only in 17/41 (41%) centres, formative only in 12/41 (29%) centres and a combination of formative and summative feedback in 10/41 (24%) centres. Written feedback was provided in 10/41 (24%) centres. Verbal feedback was most common in 37/41 (90%) centres. **Conclusion:** There is a marked variation in instructional design and assessment across European paediatric cardiac centres. A wide mix of assessment tools are used. Feedback is provided by the majority of centres, mostly verbal summative feedback. Adopting a programmatic assessment focusing on competency/capability using multiple assessment tools with regular formative multisource feedback may promote assessment for learning of paediatric cardiology trainees.

Although enormous strides have been made in congenital cardiology care, increasing attention to how we train fellows and indeed their trainers is a welcome development in the wider congenital cardiology community.^{1–2} Despite several clear guidelines on training in North America, published under the umbrella of the Accreditation Council for Graduate Medical Education,^{3–8} and publications for general and specialist training from the Association for European Paediatric and Congenital Cardiology working groups,^{9–15} there are limited data on current status of teaching and assessment in different European centres. Assessment for learning is an important concept, recently developed, highlighting the critical nature of assessment in driving learning for trainees (Fig 1). Trainees often experience stress with the volume of new knowledge they encounter in paediatric cardiology fellowship training.¹⁶ This has prompted some innovative and effective approaches to assisting learning such as echocardiography bootcamps.¹⁷ Guidelines have recently tried to take this into account and, whilst ensuring some structure, have tried not to be too restrictive in how they define training.¹⁸ Similarly, provision of feedback to trainees is fundamental to them setting goals and reaching required competences and capabilities to advance on the entrustment scale.¹

We hypothesised that there is marked variation in training and assessment techniques between different countries. The research questions in this study included 1) what instructional techniques are employed in the teaching of paediatric cardiology trainees across different

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Figure 1. A paediatric cardiology fellow undergoes end of year objective structured clinical examination (OSCE) assessment.

European centres and countries, 2) what types of assessment of paediatric cardiology trainees are undertaken, and 3) how is feedback provided to trainees in such centres and countries?

Definitions

Workplace-based assessments assess a trainee's professional skills and attitude and provide evidence of appropriate everyday clinical competences. It has high content validity through assessing actual performance in the workplace. Workplace-based assessments are promoted as an integral part of curriculum design and educational planning, in which teaching, learning, assessment, and feedback are closely integrated. Workplace-based assessments include the following:

Case-based discussion is a method for trainees to present and discuss their cases with trainers and obtain systematic and structured feedback. It is designed to assess decision-making and the application or use of medical knowledge in relation to patient care.

Directly observed practices is a trainee-led method that has been designed specifically for trainees to be assessed for competence in the day-to-day practical procedures that they undertake as part of their training, for example, echocardiogram and right heart catheterisation.

Mini-clinical evaluation exercise (Mini-CEX) is a trainee-led snapshot of trainee-patient interaction. It is designed for the trainer to provide feedback on skills essential to the provision of good clinical care by observing an actual clinical encounter. The setting is usually a clinic or ward, and the assessment is usually only concerned with one aspect of the clinical encounter, such as taking a history or one part of the clinical examination. The assessment is recorded on a standard proforma and strengths, and areas for development and action points are identified.

Multisource feedback is a method of obtaining feedback in a structured form from staff associated with the trainee who have the opportunity to observe their practice.

Summative feedback is provided at the end of the learning process and serves to provide trainees with an overall assessment of their learning often with an associated grade.

Formative feedback is typically ungraded or low-stakes opportunities to measure trainee knowledge and skills. Formative feedback is ongoing and helps trainers to focus on trainee learning and trainees to better understand the limits of their own knowledge and how to improve.

Reliability refers to whether an assessment instrument gives the same results each time it is used in the same setting with the same type of subjects. Reliability essentially means consistent or dependable results. Reliability is a part of the assessment of validity.

Validity refers to how accurately a method measures what it is intended to measure.

CORE training represented basic general paediatric cardiology training and **subspecialist training** represented training which focussed on subspecialist areas such as interventional cardiac catheterisation, cardiac MRI, fetal imaging, or electrophysiology.

Entrustable professional activities are key tasks of a specialty or subspecialty that a trainee can be trusted to perform once sufficient competence has been demonstrated.

Methods and materials

In December 2020, an approved and structured questionnaire was designed to ascertain the training and assessment of trainees in European training centres. After several iterations, approved by two independent paediatric cardiologists and reviewed by the Association for European Paediatric and Congenital Cardiology council, a questionnaire was finalised. Association for European Paediatric and Congenital Cardiology training centres are usually registered on the website and are defined as centres capable of providing the core training to enable fellows to reach competency/capability to work as an independent paediatric cardiologist.



Figure 2. Geographical distribution of participating European centres. One red dot represents one centre, except for Munich, from where two centres submitted data.

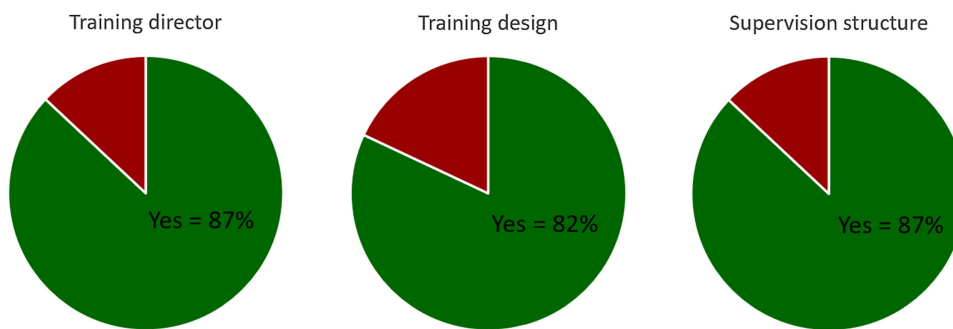


Figure 3. Organisation of training in 41 paediatric cardiology training centres. Training is organised by a responsible training director in 87% of the participating 41 centres. A distinct design of training is present with a respective structure of supervision in the majority of centres.

Most training centres are surgical centres, but some are medical with links to other surgical centres.²

The questionnaire was circulated to all recorded training centres registered with the Association for European Paediatric and Congenital Cardiology (<https://www.surveymonkey.com/r/DB7VSZB>). We requested that the survey be completed, when possible, by either a training director or one of the cardiologists actively involved in training and/or assessment of cardiology trainees/fellows. The questionnaire detailed the number of training programmes, number of general congenital cardiology fellows (or trainees), teaching design, breakdown in training, assessment techniques, reviews, and feedback. Open-ended questions searched for strengths and weaknesses of the programme. Consent was obtained from Children's Health Ireland, Crumlin, to conduct the survey.

Results

Of 95 centres invited to participate in the study, 46 (49%) responded (Fig 2). A complete dataset was available for 41 (43%) of these centres from 19 countries. The breakdown of centres and country are provided in Figure 2. There was a fellowship director in 36/41 (87%) centres and a structured training programme in 34/41

(83%) centres (Fig 3). The majority of respondents were either the training director or a trainer (training cardiologist or an educationalist within the cardiology department). The vast majority of respondents came from a centre with a training director (87%). There were 26 male and 15 female respondents. The responsibility of each centre is to provide trainees with a broad exposure to all the core areas of paediatric cardiology and to ensure they reach competency in delivering care for each of these areas using each of the competences identified through different frameworks. Different national structures provide governance to training often with an overall national lead in training (e.g., United Kingdom Shape of Training programme).² However, within individual countries, there may be several different centres with very variable communication or interaction between these centres.

Training programmes in Europe

There was a wide variation in the structure and duration of training programmes between the different countries. The median duration of training was 3 years (range from 2 to 6 years). The median core training was 3 years (range 1–5 years) with median 1 year (range 0–5 years) advanced training. Although all programmes offered

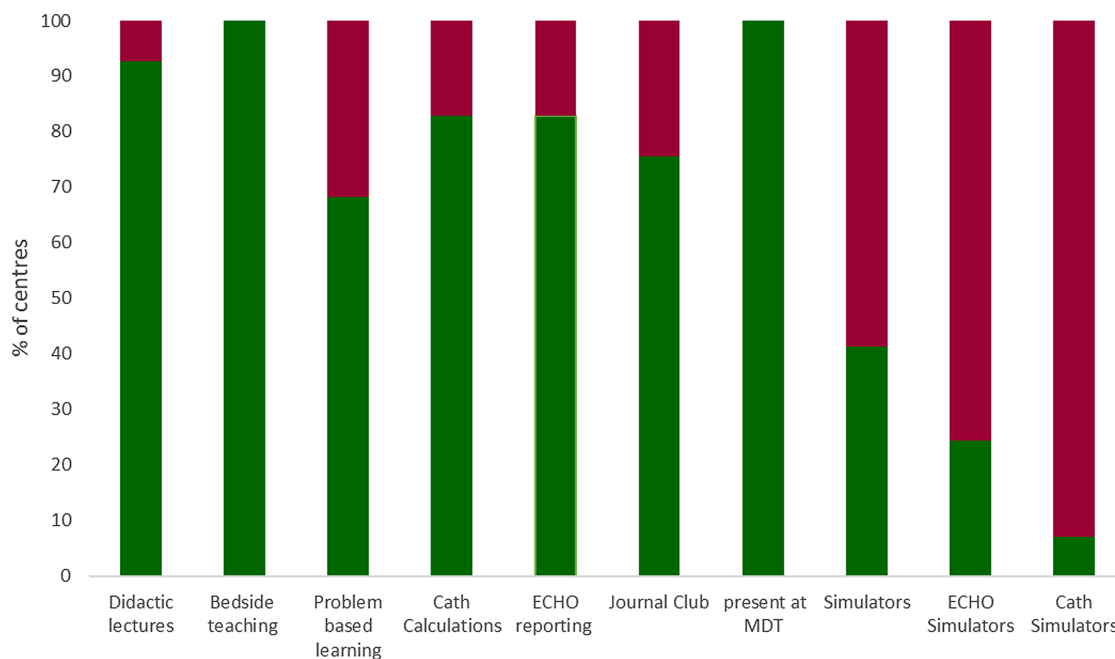


Figure 4. Instructional techniques among 41 paediatric cardiology training centres. The use of various instructional techniques is represented in % of all 41 participating centres. The green bar represents the number of centres which make use of the respective technique, and the red bar the centres which do not use the technique. Cath = catheterisation, Echo = echocardiography, MDT = multi-disciplinary team meeting.

general cardiology training, advanced subspecialist training in imaging, electrophysiology, catheterisation, heart failure/transplant, and pulmonary hypertension was typically limited to larger centres.

Structure of teaching

The breakdown of instructional techniques are provided in Figure 4 and Supplemental Table S1. These include bedside teaching (41/41, 100%), didactic teaching (38/41, 93%), problem-based learning (28/41, 68%), journal club (31/41, 76%), fellows presenting in the multidisciplinary meeting (41/41, 100%), fellows reporting on echocardiograms (34/41, 83%), clinical simulation (17/41, 41%), echocardiography simulation (10/41, 24%), and catheterisation simulation (3/41, 7%).

Breakdown of training

The median duration of fellowship training was 3 years (range 2–6 years). The median duration of training in the outpatient department was 8 months (range 2–30 months), inpatient ward was 6 months (range 3–40 months), echocardiography department was 6 months (range 1–24 months), catheterisation 3 months (range 0–12 months), intensive care 4 months (range 0–18 months), heart failure/transplant 1 month (range 0–6 months), advanced imaging (MRI/CT) 1 month (range 0–6 months), electrophysiology 1 month (range 0–6 months), and adult CHD 2 months (range 0–12 months). Two programmes listed the same duration of training as 36 months for echocardiography, in-patient and outpatient care as fellows covered all three areas simultaneously. Three other programmes provide training in echocardiography throughout the training of 36 months.

Numbers of procedures

The numbers of echocardiograms (transthoracic, transoesophageal, and foetal echocardiograms), cardiac catheterisation procedures, electrophysiology studies, balloon atrial septostomies, placement of temporary pacing wires, and pericardiocentesis performed during training are presented in Table 1. National guidelines are not always available for each of these procedures.

Assessment

Fellow assessments comprised bedside assessment/case-based discussions (n = 27), mini-clinical examination (mini-CEX) (n = 12), directly observed practices (n = 12), oral examination (n = 16), long cases (n = 11), written essay questions (n = 6), multiple choice questions (n = 5), and objective structured clinical examination (n = 2). Entrustable professional activities were utilised in 10 (24%) centres. Data are shown in Figure 5 and Supplemental Table S2.

Feedback

There was significant variation in how feedback was delivered to trainees. This was described as summative only in 17/41 (41%) centres, formative only in 12/41 (29%) centres, and a combination of formative and summative feedback in 10/41 (24%) centres. Written feedback was provided in 10/41 (24%) centres. Data reveal that some form of verbal feedback is most common and provided to trainees in 37/41 (90%) centres (Fig 6 and Supplemental Table S3).

Feedback was provided by their trainer in 34/41 (83%) centres, any consultant cardiologist in 30/41 (73%) centres, by peers in 8/41 (20%) centres, by parents of patients in 7/41 (17%) centres, and other allied health care professionals in 6/41 (15%) centres.

Table 1. Comparison of number of procedures during training in evaluated European centres compared to US centres

Procedure	Number (Median)	Range	*US
Transthoracic Echocardiography (TTE)	500	40–3000	300
TTE – supervised	500	20–2000	
TTE – unsupervised	375	0–2500	
Transoesophageal echocardiography (TOE)	30	0–150	
Cardiac catheterisation	50	0–150	100
Fetal echocardiography	20	0–100	
Electrophysiology (attendance)	3	0–100	(part 100)
Pericardiocentesis	2	0–10	–
Balloon atrial septostomy	3	0–10	–
Temporary pacing lead	1	0–10	–

*United States training previously required minimum of 300 transthoracic echocardiograms and 100 catheterisations (combined cardiac catheterisation and electrophysiology procedures). More recently, this has been replaced by requirement to reach certain milestones during training.

Discussion

Training to become a paediatric cardiologist in Europe varies markedly from one country to another and although there is excellent training in many countries, the findings of this study clearly show that there is potential for improvement in consistency of assessment and feedback to trainees. The findings of this study support our hypothesis that assessment varies widely across different European centres. Feedback also takes many different forms. Even though 87% of centres have a training director and a structured supervision, the instructional training and assessment varies widely and does not make use of standardised techniques, only in a minority of centres. When comparing centres within one country, data do not provide a similar pattern in training or assessment either. This led us to conclude that the structure and assessment of training in Europe is mainly centre-dependent and probably influenced by the personal engagement of the training director.

Recently, it has become clear, using grounded theory, that the relationship between assessment and learning is complex.¹⁹ The impact may be adverse if “passing the assessment is the only goal, resulting in poor learning styles, a grade culture of grade hunting and competitiveness and grade inflation.”^{20–21} This can also result in “reductionism if there is poor feedback, misalignment with learning goals, non-meaningful aggregation of assessment data, inadequate longitudinal elements and if the assessment is treated like a tick-box exercise” (work-based assessments or objective structured clinical examinations).²⁰ Learners build knowledge from an inner scaffolding of their individual and social experiences, emotions, will, aptitudes, beliefs, values, self-awareness, and purpose.²¹ What you understand in what you have learned is determined by how you understand things, who you are, and what you already know.²¹

Although there is wide variation in the duration of exposure of trainees to each of the areas of training, the majority of programmes offer a broad exposure of training in the basics of

paediatric cardiology with several offering subspecialist exposure. There is also a wide variation in both the different assessment tools (workplace-based assessments, objective structured clinical examination, etc.) employed as well as the numbers of procedures that trainees are expected to complete during their training between different centres. One wonders if greater focus on the quality of the procedure rather than the number of procedures would be a more useful form of assessment. In the UK, the “Shape of training” model has embraced a move towards a more competency/capability approach with an annual review of competency progression in addition to multisource feedback of performance during different rotations.

Entrustable professional activities

A minority of centres assess trainees using entrustable professional activities. These are standalone tasks that can be “entrusted” to a learner with supervision of a trained professional and were introduced by ten Cate.^{22–23} A recent review of entrustable professional activities in paediatric cardiology reported marked variation in how they are employed in the assessment of trainee entrustment level as well as uncertainty over whether such instruments will bridge the gap between competency and clinical practice.²⁴ Conflation of different competences can prove problematic with entrustable professional activities, and caution should be employed before adopting a widespread roll out to every paediatric cardiology training programme.²⁵ Increasingly in North American programmes, entrustable professional activities are being implemented as competency and milestone assessment tools.

Feedback

Lessons derived from medical education include there can be no assessment without meaningful feedback.^{26–27} Feedback also takes many different forms between different centres. Formative feedback has a far greater impact on complex skills than summative feedback and grades. Feedback is a dialogue which is a continuous to-and-fro process.^{28,29} Understanding of feedback requires an integrated approach incorporating both the trainee and the training culture. The training culture fosters an environment which allows effective feedback to occur and the trainee to respond to it.³⁰ The training culture should aspire to normalise feedback, promote a trusting trainer/trainee relationship, define clear performance goals, and ensure goal alignment for both the trainee and trainer.³⁰ Recent studies have reported that if well implemented, feedback from workplace-based assessments, particularly multisource feedback, leads to a perceived positive effect on practice.³¹ This should be part of a longitudinal assessment process. The majority of programmes in this study provided some form of feedback, primarily in verbal form.

Coaching

Coaching, a process of guiding the trainee towards improvement, is a particularly effective surrogate to providing feedback.³² More recently, especially in Canadian centres, coaching has become incorporated into the training model for trainees. Coaching in the medical training environment has been conceptualised into two types. “Coaching in the Moment” relates to coaching between the trainer and trainee within the clinical practice environment and encompasses observation, feedback, and actionable suggestions for the improvement of performance.³³ The second type of coaching, “Coaching over Time,” occurs between the trainer and trainee

Figure 5. Mix of assessment techniques among 41 European paediatric cardiology training centres. The use of various assessment techniques is represented in % of all 41 participating centres. The green bar represents the number of centres which make use of the respective technique, and the red bar represents the centres which do not use the technique. mini-CEX = mini-clinical evaluation exercise, CBD = case-based discussion (bedside exam), DOPS = directly observed procedures, OSCE = objective structured clinical examination.

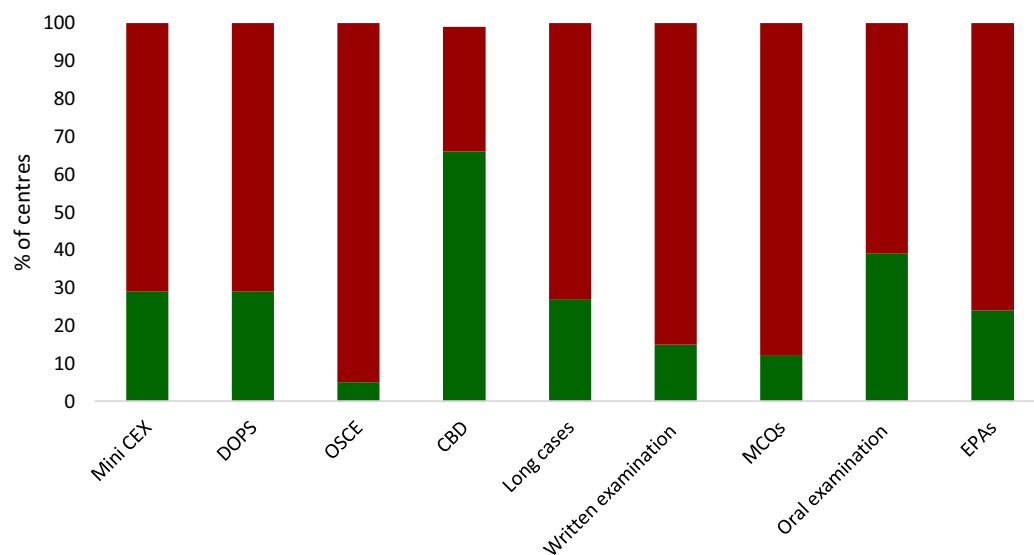
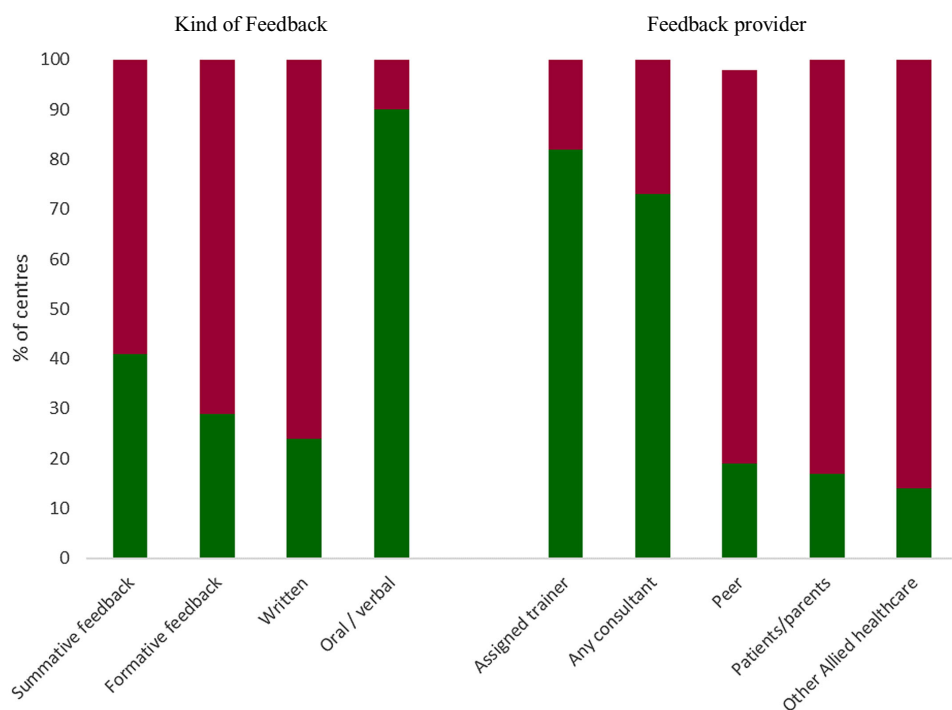


Figure 6. Variation of feedback provided to trainees from 41 European training programmes. Feedback provided to trainees is provided in % of all 41 participating centres. The green bar represents the number of centres which make use of the respective feedback/technique, and the red bar represents the centres which do not use the respective item.



outside of the clinical environment. Here, observation is primarily related to the trainees performance data that have been collated over time. Feedback and suggestions for improving performance are critical components to each type of coaching. “Coaching over Time” is essential to guiding trainees in their development as competent cardiologists.³³

Programmatic assessment

Currently, the Association for European Paediatric and Congenital Cardiology has developed a certification examination in addition to a logbook for skills acquired. Although these are very welcome developments to ensure an equally high standard of education throughout Europe, the additional benefit of multiple forms of assessment in addition to formative feedback cannot be

overemphasised. Schuwirth and van der Vleuten first espoused the need for a programmatic assessment in 2011.³⁴ This has led to a broadened perspective on the “types of construct assessment tries to capture, the way information from various sources is collected and collated, the role of human judgement and the variety of psychometric methods to determine the quality of the assessment.”³⁵ A far richer narrative and clearer image of the trainees progress can be garnered through multiple different assessment tools at different time points, each with appropriate feedback to the trainee.³⁶ This should ensure a high reliability (sampling) and validity (authenticity of competences tested) of the assessments undertaken.

Using programmatic assessment, individual assessment points are maximised for learning and feedback value, while high-stake decisions are only determined by an aggregation of many data

Table 2. Proposed sample of programmatic assessment programme for 3-year paediatric cardiology programme

	Instrument	Number	Frequency	Who
Year 1.	MCQ	1	at 6 months (mths)	T
	Case-based discussion	4	3 monthly	T
	Mini-CEX	3	4 monthly	T
	Multisource feedback		at 6 & 12mths	T, P, Par(t)
	ARCP	1	at 12mths	Committee
Year 2.	Bedside examination	1	at 15mths	T
	Mini-CEX	2	at 18 & 24mths	T
	DOPS	3	at 18, 22 & 24mths	T
	OSCE	1	at 24mths	T
	Multisource feedback		at 15,18 & 24mths	T, P, Par(t)
	ARCP	1	at 24mths	Committee
Year 3.	Long case (patient)	1	at 27mths	T
	Case-based discussions	4	3 monthly	T
	DOPS	6	2 monthly	T
	OSCE	1	at 36mths	T
	Oral examination	1	at 36mths	T
	Multisource feedback		at 36mths	T, P, Par(t)
	ARCP	1	at 36mths	Committee

Final high-stakes assessment by committee reviewing electronic portfolio and feedback.

+ Required number of procedures.

+/- Progress to AEPC or national exit examination and certification.

Abbreviations: AEPC, Association for European Paediatric and Congenital Cardiology; ARCP, annual review of competency progression; DOPS, directly observed procedures; mini-CEX, mini-clinical evaluation exercise; OSCE, objective structured clinical examination. P, peer feedback; Par(t), parent (or patient) feedback; T, trainer feedback.

points.³⁷ This approach is very different from historical practices where high-stake pass-fail decisions were decided on single assessments, a limited number of assessment methods were employed, expert judgements were minimised, and often limited feedback was provided to trainees.³⁷ A potential programme of assessment is provided in Table 2, but this could be tailored differently for each training centre according to resources available. Programmatic assessment-for-learning can be applied to any part of the paediatric cardiology training continuum, provided that the underlying learning conception is constructivist.³⁷

AEPC certification examination

Given the need for standardisation of standards of training across Europe, the education committee of the AEPC developed a certification examination based on their training recommendations, which would contribute partly towards Association for European Paediatric and Congenital Cardiology certification. A logbook further completes the certification process, with trainees signed off on their performance, by their trainers at their local centres.

Common problems in training

Several delegates reported many positive aspects of training in European centres. Trainees themselves have reported high satisfaction with overall training from countries with well-established programmes.³⁸ One of the most cited problems in training was limited time availability. Other weaknesses reported

included too few fellows in the programme, lack of formalised training structure (teaching/assessment), lack of standardisation of subspecialist services, smaller centres with limited capacity to deliver all subspecialist services, and lack of local access to a cardiac morphology course.² The lack of access of trainees to all subspecialist services is a challenge for smaller programmes, and perhaps there is the potential for trainees from smaller programmes to spend time in larger centres with greater exposure to subspecialist services.

Comparison with United States training and assessment

Training in the United States of America is well organised with over 60 paediatric cardiology fellowship programmes now in existence (<https://www.nrmp.org/fellowship-match-data/>). Most cardiac programmes have a dedicated fellowship director who meets regularly with trainees and monitors their progress in reaching the six competences promoted by the Accreditation Council for Graduate Medical Education. Monthly evaluations of trainee performance in different rotations are provided. Knowledge-based assessments are undertaken in several programmes at different stages during the training year. Trainees meet with the fellowship director every 6 months or year to evaluate how they are progressing and whether they are reaching important competences.²

One of the challenges for European programmes is significant resource limitation, especially in terms of faculty. US medium-sized programmes often have larger faculty numbers than European centres. In addition, many also have a dedicated

fellowship director who is properly trained as an educationalist or has some degree of educationalist training. This enables faculty to spend greater time training and also undertake more comprehensive fellow assessments. Increased resources, often a challenge for smaller European centres, in terms of faculty and educationalist training are critical to implementing an effective training framework.²

Limitations

This study attempted to review different pedagogical techniques and forms of assessment across Europe. Although several centres (49% of those surveyed) participated, several also failed to respond to invitation. The response rate was low at approximately one half which may have biased the overall findings of the study. We tried when possible to survey the training director, educationalists or a cardiologist actively involved in training at each centre. We did not provide definitions of workplace assessments as we anticipated those involved in training could differentiate between different assessments, for example, directly observed procedures differing from case-based discussions. However, there may be subtle differences in comprehension and application of these assessments between trainers. The study failed to address the impact of different educational techniques and assessment of the quality of their training on the clinical competence of the trainee at the end of their training.

Conclusion

In conclusion, there is marked variation in the assessment of paediatric cardiology trainees across different centres in Europe. Assessment is not a box-ticking exercise but should aim to assess clinical competence as a global construct. Given resource limitations, we must be pragmatic in how we can implement assessment of training. However, encouraging training centres to move towards a competency/capability based programmatic assessment model, using multiple assessment techniques at different time points with multisource feedback may promote assessment for learning of paediatric cardiology trainees.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S1047951123003098>.

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Competing interests. There are none to report.

Ethical standard. Approval of the above study was obtained from the Ethics Department at CHI Children's Health Ireland, Crumlin, Dublin, Ireland.

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