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Editorial Comment

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Interventional paediatric echocardiography: a call to action for training, competency, and sustainable practice standards

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Paediatric cardiac intervention now includes complex catheter-based and hybrid procedures requiring advanced imaging guidance. Unlike adult structural heart disease, interventional paediatric echocardiography lacks clearly defined roles and training standards.[1–3] Interventional paediatric echocardiography requires expertise in congenital anatomy, size-adapted imaging, real-time procedural guidance, and multimodality collaboration. Although current ACC/AHA/ASE documents address interventional echocardiography and acknowledge added complexity in CHD, they do not establish a paediatric-specific training pathway, competency standards, or sustainable practice models for interventional paediatric echocardiography.[4]

The case for a paediatric-specific discipline

CHD presents imaging challenges fundamentally different from adult structural heart disease. CHD anatomy is highly variable, and procedures span a heterogeneous repertoire—from septal defect closure to hybrid procedures—and imaging workflow cannot be standardised the way adult valve-based platforms allow.[5] Patient size dictates probe selection: micro-transesophageal echocardiography is feasible in patients as small as 2.5 kg; 3D paediatric transesophageal echocardiography from approximately 5 kg, while intracardiac echocardiography remains limited by 8–10F sheath requirements.[5,6] Echocardiographic guidance also serves as an active radiation reduction strategy; 3D transesophageal echocardiography-guided atrial septal defect closure has demonstrated significantly reduced fluoroscopy and radiation dose compared with standard fluoroscopic guidance.[5]

Training and competency frameworks

Current paediatric cardiology training lacks a dedicated pathway for interventional paediatric echocardiography. Existing paediatric imaging and transesophageal echocardiography guidelines define foundational competencies but do not establish interventional paediatric echocardiography-specific training standards.[8,9] Adult guidelines recommend at least 75 echocardiography-guided procedures for advanced competency, but these benchmarks are not tailored to the lower procedural volumes, greater heterogeneity, and unique complexity of congenital interventions.[4]

Interventional paediatric echocardiography training should therefore use a paediatric-specific, competency-based framework, incorporating simulation, supervised procedural guidance, progressive entrustment, and longitudinal assessment (Figure 1). Training should address image acquisition, procedural guidance, multimodality integration, communication, complication recognition, and procedural judgement. Operator ergonomics and safety should be incorporated, including room setup, positioning, fatigue mitigation, radiation protection, and closed-loop communication in the crowded catheterisation and hybrid procedural environment (Table 1).

Completion of an advanced imaging fellowship will not, in most cases, establish readiness for independent interventional paediatric echocardiography practice. Structured mentorship should continue after fellowship, with the mentor initially present in the catheterisation laboratory or operating room, followed by graduated supervision in which the mentor remains available for consultation. Progression should depend on directly observed performance across procedure types and levels of complexity, including communication and complication management. Paediatric-specific experience thresholds should be developed through multicentre assessment of these competencies and procedural exposure.

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Table 1. Core domains for interventional paediatric echocardiography (IPE)

Domain	Core skills	Paediatric/congenital considerations	Representative procedures
CHD procedural planning	Segmental analysis, repaired/palliated anatomy, targets and landing zones	Variable anatomy, altered landmarks, small structures	ASD/VSD closure; Fontan or baffle interventions
Imaging strategy	TTE, TEE, micro-TEE, ICE, 3D imaging, multiplanar reconstruction, multimodality integration	Patient size, probe availability, limited windows, high heart rates	Defect sizing, valve guidance, hybrid procedures
Intraprocedural guidance	Real-time catheter/device guidance, rapid plane adjustment, hemodynamic assessment	Nonstandard views, loading changes, altered CHD physiology	Septal defect closure, transseptal puncture, valvuloplasty
Device and complication assessment	Device position, residual shunt, obstruction, valve impingement, effusion	Narrow safety margins and rapidly evolving complications	Occluder devices, stents, transcatheter valves
Teamwork, safety, and ergonomics	Closed-loop communication, room setup, probe handling, radiation awareness, fatigue mitigation	Crowded procedural environment, sterile fields, prolonged procedures	Complex CHD, neonatal, and hybrid interventions
Postprocedural care and professional development	Immediate outcome assessment, documentation, quality review, simulation, post-training mentorship, graduated supervision, ongoing competency assessment	Variable case volume and complexity; sustainable training, practice models, appropriate coding and reimbursement	Post-device assessment, case review, competency assessment

3D = three-dimensional; ASD = atrial septal defect; CHD = congenital heart disease; ICE = intracardiac echocardiography; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography; VSD = ventricular septal defect.

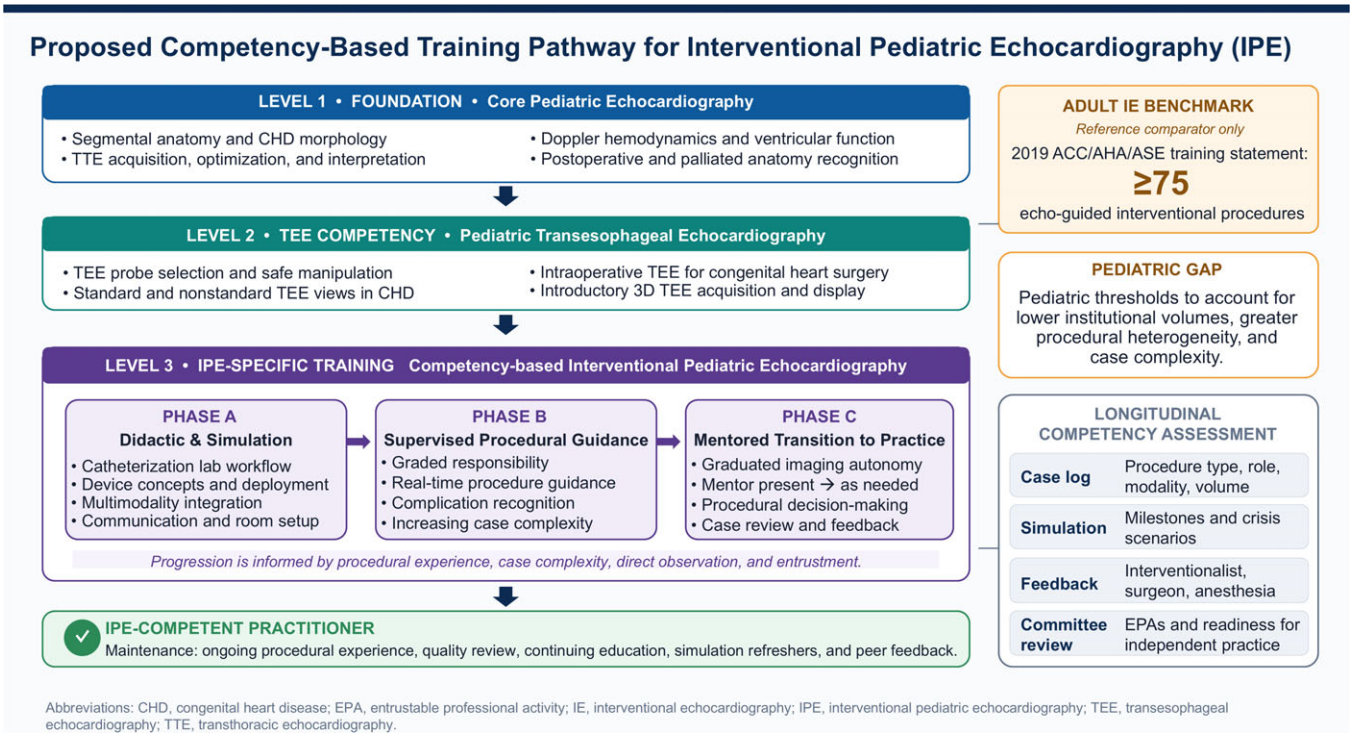


Figure 1. Proposed competency-based training pathway for interventional paediatric echocardiography (IPE). Training progresses from core paediatric echocardiography and TEE competency to IPE-specific education through simulation, supervised procedural guidance, and independent practice. Longitudinal competency assessment incorporates procedural experience, case complexity, direct observation, and multisource feedback. Adult interventional echocardiography volume benchmarks are shown for reference; paediatric-specific thresholds remain to be defined. CHD = congenital heart disease; EPA = entrustable professional activity; IE = interventional echocardiography; IPE = interventional paediatric echocardiography; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography.

Sustainability and reimbursement

Sustainable interventional paediatric echocardiography requires practice models that recognise real-time imaging guidance as procedural work. Current reimbursement structures undervalue this contribution: interventional transesophageal echocardiography (CPT 93355) generates 4.66 wRVUs—a twofold increase over diagnostic transesophageal echocardiography (CPT 93312, ~2.3 wRVUs)—yet may still undercompensate prolonged procedural

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imaging relative to the interventionalist's credited work for comparable bedside time.[2,7,10,11] For intracardiac echocardiography-guided procedures, the add-on code (+93662, 2.80 wRVUs) can only be billed by the interventionalist, leaving no reimbursement mechanism for the imaging physician.[12]

This mismatch has workforce implications. When a full day of interventional paediatric echocardiography supports one or two complex cases, conventional productivity models under-recognise the imager's contribution, discouraging training investment and making it harder to recruit and retain interventional paediatric echocardiography expertise. Solutions include institutional credit for interventional imaging effort, revenue-sharing within congenital intervention programmes, and advocacy for coding reform. Existing expert consensus statements already endorse these approaches, which better reflect value beyond RVU-based productivity.[12,13]

Conclusion

Interventional paediatric echocardiography remains under-formalised despite its growing procedural role in CHD. The anatomic complexity of CHD, size-related technical challenges, radiation stewardship imperatives, and ergonomic demands of prolonged procedural imaging collectively argue for a paediatric-specific framework rather than an extension of adult interventional echocardiography models. Formal recognition of interventional paediatric echocardiography as a defined area of advanced paediatric imaging would standardise training, improve team communication, and promote sustainable models that value the echocardiographer as an essential procedural partner.

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