Qeios

Peer Review

Review of: "The Evolution and Future of Pediatric Cardiology"

Joseph Vettukattil[1]

1. Independent researcher

I reviewed the uploaded preprint **"The Evolution and Future of Pediatric Cardiology"** by Abenezer Kebede. Overall, it is a broad, readable narrative review, but it is **too generic**, historically uneven, and misses several important modern pediatric/congenital cardiology innovations.

Overall assessment

The paper's main strength is that it gives a sweeping overview of pediatric cardiology from ancient medicine to future technologies. It correctly identifies many major pillars: echocardiography, catheterization, congenital cardiac surgery, prostaglandin E1, transplantation, mechanical circulatory support, fetal cardiology, genetics, quality improvement, transition to adult congenital heart disease, AI, digital twins, and tissue engineering. The abstract and introduction frame pediatric cardiology as an integrated lifelong system of care, which is appropriate and modern.

But as a scholarly review, it has important weaknesses: it is **descriptive rather than critical**, sometimes uses broad statements without enough precision, omits key contributors, and relies on a reference list that appears incomplete, uneven, and occasionally weak for the claims made. Its "future" section is ambitious, but not sufficiently discriminating between technologies already in clinical practice, early feasibility work, speculative translational science, and industry/device innovation.

Major strengths

The paper correctly presents pediatric cardiology as more than lesion diagnosis. It emphasizes a full system of care: fetal diagnosis, imaging, catheterization, surgery, ICU care, electrophysiology, heart failure, transplantation, registries, neurodevelopmental follow-up, and adult congenital transition. That is one of its strongest conceptual points.

doi.org/10.32388/I7SPE1

It also gives appropriate prominence to **measurement technologies**—stethoscope, ECG, catheterization, echocardiography, CT, MRI, and later AI—as drivers of the field. This is a useful organizing theme because pediatric cardiology has indeed evolved by making hidden structure and physiology visible.

The review also does well to include **quality improvement and outcomes science**, including STS-CHSD, IMPACT, and PC4, and to recognize neurodevelopmental outcomes as primary endpoints rather than late incidental concerns.

Major weaknesses

The paper is **too broad and superficial**. It covers almost every area of pediatric cardiology but rarely goes deep enough to explain what changed technically, who changed it, what the limitations are, and which innovations are truly transformative. For example, interventional catheterization is summarized mainly as balloon valvuloplasty, ASD/PDA closure, and stenting, but without a meaningful discussion of newer structural interventions, hybrid platforms, patient-specific planning, device engineering, or emerging lesion-specific devices.

The historical section is long but not always useful for the stated purpose. The Ebers Papyrus, Hippocrates, Galen, Harvey, digitalis, and Laennec sections are interesting, but they occupy space that could have been used for the modern evolution of pediatric/congenital cardiology. The paper's title promises the "evolution and future" of pediatric cardiology, but the modern congenital structural-intervention revolution is underdeveloped.

The paper also does not adequately distinguish **pediatric cardiology** from **congenital heart disease medicine across the lifespan**. It mentions adults with congenital heart disease, but it does not fully discuss how ACHD has changed the field's priorities: Fontan failure, arrhythmia burden, pregnancy in CHD, liver disease, pulmonary hypertension, reintervention, device surveillance, and long-term imaging.

Inaccuracies or questionable statements

A few statements are imprecise or overgeneralized.

First, the paper says pediatric cardiology became a "fully developed, independent medical discipline by the late 20th century." That is broadly true, but vague. Pediatric cardiology emerged as a distinct specialty much earlier in some centers, especially around the postwar congenital surgery and catheterization era.

Second, the paper's discussion of **3D echocardiography, Interventional cardiology, and advanced imaging** is too thin. It says 3D echocardiography is increasingly used for structural planning, virtual surgical planning, and 3D printing, but cites a 3D printing review rather than the major pediatric/congenital 3D echo literature. This is not exactly false, but it is incomplete and poorly referenced.

Third, the paper's "AI" section is broad and optimistic, but it does not sufficiently separate validated clinical tools from research-stage tools. AI for fetal echo quality scoring, function quantification, segmentation, and monitoring is promising, but much of it remains under validation, affected by dataset bias, image-quality variability, and limited generalizability. The paper's tone is more promotional than critical.

Fourth, the "Use of Generative AI" declaration says AI-assisted language tools were used only for formatting and grammar and not for "original scientific content, data, analysis, clinical interpretation, or references." Yet the paper's prose has signs of AI-like generic synthesis, and several references are incomplete, oddly formatted, or weakly matched to claims. That does not prove improper use, but it weakens confidence in the manuscript's scholarly rigor.

Missing innovation: dedicated congenital devices

The paper's section on transcatheter structural interventions is quite generic. It mentions transcatheter pulmonary valves, native/augmented RVOTs, durability, size constraints, growth adaptability, and bioresorbable devices. But it misses several concrete device-level innovations that would make the review more valuable.

Specialization in Pediatric Cardiology

In the United States, formal pediatric cardiology fellowship training was established by at least 1950, when Alexander S. Nadas founded the Cardiology Fellowship Program at Boston Children's Hospital. Pediatric cardiology then became the first pediatric subspecialty board of the American Board of Pediatrics in 1961. In the United Kingdom, the dedicated CCST-era higher specialist training pathway in paediatric cardiology appears to have been established later; one of the earliest dedicated UK programmes began only as late as May 1997 at Birmingham Children's Hospital, leading to CCST.

Missed innovation from Global South

The paper is US-centered and globally thin. It briefly mentions global equity and access, but does not adequately discuss innovation from India, China, Brazil, South Africa, and other high-volume congenital heart disease environments.

This is especially relevant because several pediatric cardiac interventions and device adaptations have emerged from high-volume, resource-constrained environments.

If the paper wants to predict the future of pediatric cardiology, it should not only discuss AI, genomics, and digital twins. It should also discuss **frugal innovation**, **locally designed devices**, **simplified workflows**, **low-cost imaging**, and **scalable congenital care models**.

Reference weaknesses

The reference list is uneven. Some landmark historical references are appropriate, but many modern sections rely on broad or secondary references. Several entries appear incomplete, for example, lacking full page ranges, article titles, or complete bibliographic details. The paper also cites company updates and generic web pages for some advanced therapy claims, which is weaker than peer-reviewed clinical trial literature.

For a review article, especially one predicting the future, the references should be more curated. It should include major guidelines, position statements, multicenter trials, registries, and landmark device papers. It should also cite the most relevant primary literature for 3D echo, fetal intervention, interventional CHD, and transcatheter sinus venosus ASD repair.

Innovations the paper should add

A revised version should include a dedicated section such as **"Image-guided structural intervention and congenital device innovation."** That section should cover: **3D echocardiography** as a conceptual shift from planar imaging to spatial morphology. **3D TEE and transthoracic 3D echo** for real-time procedural guidance. **CT/MRI-derived 3D models**, Integrated 3D printing, virtual reality, and simulation. **Patient-specific planning** for complex baffles, Fontan pathways, RVOT interventions, and sinus venosus ASD closure. **Dedicated devices**, including newer ASD occluders, transcatheter pulmonary valve systems, bioresorbable devices, and sinus venosus ASD covered-stent and self-expanding platforms. Role of VR/AR in the future of image visualization and interventional planning.

Final judgment

This is a useful **introductory narrative overview**, but it is not yet a strong scholarly review. Its strengths are breadth, readability, and recognition of pediatric cardiology as a lifelong system of care. Its weaknesses are lack of critical depth on areas of priority, uneven referencing, underdeveloped structural-intervention content, weak discussion of echocardiography, and omission of major innovators.

Declarations

Potential competing interests: No potential competing interests to declare.