



The ripple effect

How better imaging shapes the future of a child with congenital heart disease

The economic burden of complex congenital heart disease is among the highest of any pediatric condition. Research estimates the average lifetime cost per patient can be as high as \$2 million¹ — driven by repeated hospitalizations, multiple surgical interventions, and decades of clinical follow-up. But cost is only one dimension of what these families will experience. At TUM University Hospital German Heart Centre, Prof. Dr. Christian Meierhofer and his team have observed something that published

research increasingly supports: the quality and timing of imaging create a cascade effect that ripples through a patient's entire life. Better images support better-timed interventions, which may mean fewer total surgeries. Fewer surgeries mean less risk, less recovery, less cost and more life. This is not a story about a technology. It is a story about what happens when clinical teams have the imaging confidence to act at exactly the right moment.

The cascade begins in the scanner room

Imagine a child born with a heart defect. By the time they reach adulthood, they may have undergone two, three, perhaps four cardiac surgeries. Each intervention carries risk. Each recovery takes time. Each hospitalization has a cost, to the family, to the health system, and to the patient themselves. Research estimates the average annual cost of complex congenital heart disease at nearly \$50,000 per patient,¹ with admissions for congenital heart disease costing an estimated \$5.6 billion annually in the United States alone — comprising 15% of all inpatient pediatric care costs.²

These numbers reflect a clinical reality that Prof. Dr. Meierhofer knows intimately.

“Patients often don’t just have one examination with us. They have been coming for follow-up for 10, 20 years — every two years. We now have ten datasets from repeated examinations for many of these patients in our system.” Each of those datasets represents a decision point. And the quality of the image at each point shapes what happens next.

“Between 20 and 40% time reduction is possible — with very good image quality.”

Prof. Dr. Dr. Christian Meierhofer, TUM University Hospital German Heart Centre, Munich, Germany



Efficiency that goes beyond the scan

At TUM University Hospital German Heart Centre, performing nearly 1,200 cardiac MRI examinations for congenital heart disease every year, a reduction in acquisition time has direct operational consequences. SmartSpeed Precise is designed to deliver a decrease of up to 30% in scan time for cardiac imaging, with equal or better image quality.³

What does this mean for the healthcare delivery chain? More patients scanned per day. Shorter exam slots. And for children under five — who typically require sedation to complete the exam, a shorter scan means a shorter sedation window.

Dr. Elisabeth Rabl, Senior Anesthesiologist at TUM University Hospital German Heart Centre, highlights how significant this is.

At TUM University Hospital German Heart Centre, this has enabled the team to move away from general anesthesia for most pediatric cardiac scans, choosing lighter sedation in which the child breathes independently. “We get the patients out of the MRI and they wake up on the way back to the ward. That means we don’t need a recovery room.” Across hundreds of sedation-requiring scans per year, the cumulative effect of this approach is substantial.



“The shorter a scan takes, the shorter the sedation. This means advantages for us — we use less medication, and the children don’t cool down so much during the MRI examination.”

Dr. Elisabeth Rabl, Senior Anesthesiologist, TUM University Hospital German Heart Centre, Munich, Germany

The cascade extends to the operating room

But the true impact lives further down the timeline, in the decisions that are driven by imaging. Consider the timing of a pulmonary valve replacement in a child with congenital heart disease. Research highlights the importance of optimizing the timing of this intervention to balance the risk of irreversible ventricular remodelling⁴ against the cumulative burden of repeated operations over a lifetime. ‘Act too early, and the prosthetic valve will need replacing sooner.

Act too late, and irreversible damage may already have occurred. In patients with repaired Tetralogy of Fallot, the consequences of suboptimal surgical timing are well documented. Those who undergo pulmonary valve replacement after the age of 35 face a 5.6-fold higher risk of death at 10 years compared to those operated on earlier — a finding that underscores the critical role of timely, imaging-guided clinical decision-making.⁶

“By using MRI, we can determine the time of surgery much better. Patients are often operated on later — which means that heart valves last much longer, and perhaps one less heart valve is necessary throughout the entire phase of life.”

Prof. Dr. Dr. Christian Meierhofer, TUM University Hospital German Heart Centre, Munich, Germany



Cardiac MRI is now central to making this call — providing precise measurement of ventricular volumes, flow ratios, and functional data that echocardiography cannot fully capture. And Prof. Dr. Meierhofer has seen in practice what better image resolution makes possible.

That’s incredible impact, to both the patient and the healthcare environment. One less valve replacement means one fewer open-heart surgery. In a patient who might otherwise have required three or four cardiac interventions across their lifetime, each deferred procedure represents not only avoiding surgical risk — but avoiding cost, recovery time, and disruption to life.

The cascade reaches the patient

The economic framing, however, only captures part of what is at stake. For Paul's mother, the value of a confident scan result is not measured in euros. It is measured in the relief she feels walking out of the building.

For a child who will undergo follow-up scanning every two years, potentially for the rest of their life, the accumulated experience of those visits matters. Shorter scans mean less time away from school. Less sedation means faster recovery and fewer complications. Better images mean fewer

repeat examinations. And a confident diagnosis means a family that can plan — not just wait.

Prof. Dr. Meierhofer's vision is clear. "We are away from 90 minutes of examinations. We are now at 30 minutes routine. And we will certainly get to the point where we can take less than ten minutes." His goal: the MRI room as the first stop for every cardiac patient, delivering anatomy, volume, and flow before anything else is decided. "That is the vision. And I think we are close to that."



"We are always happy when they say: it's unchanged. Then you come out very relieved — thinking: okay, this time it went well."

Paul's Mom

The ripple effect of better imaging, in the space of pediatric cardiac care, is not just clinical. It is economic, logistical, and deeply human. A cascade of smaller decisions, made with

greater confidence, that adds up to something no balance sheet can fully capture: a longer, lighter life for a child born with a heart that needed a little more help.



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Footnotes

- 1 <https://www.additionalventures.org/news/the-disproportionate-economic-burden-of-complex-congenital-heart-disease/>
- 2 <https://www.acc.org/latest-in-cardiology/articles/2022/11/28/12/46/health-care-policy-and-chd>
Noonan K et al. Health Care Policy and Congenital Heart Disease: 2020 Focus on Our 2030 Future. J Am Heart Assoc. 2020;9:e020605.
- 3 SmartSpeed Precise enables the decrease of scan time up to 30% with equal or better image quality. Compared to SENSE imaging, for Cardiac imaging. SmartSpeed Precise enables the increase of resolution up to 30% within similar scan time with equal or better image quality. Compared to SENSE imaging, for Cardiac imaging.
- 4 <https://www.mdpi.com/2077-0383/15/3/1295>
Unsere KA et al. Pulmonary Valve Replacement: Update on Timing and Ventricular Remodelling. J Clin Med. 2026;15(3):1295.
- 5 <https://pubmed.ncbi.nlm.nih.gov/32187367/>
Karbassi A et al. Age over 35 years is associated with increased mortality after pulmonary valve replacement in repaired tetralogy of Fallot. Eur Heart J. 2021.
- 6 <https://pubmed.ncbi.nlm.nih.gov/22921970/>
Harrild DM & Powell AJ. Timing of Pulmonary Valve Replacement in Tetralogy of Fallot Using Cardiac MRI. JACC. 2012;60(8):932–934.

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