Authors have nothing to disclose with regard to commercial support.

4. World Bank. World development open data. Available at: <https://datacatalog.worldbank.org/>. Accessed August 31, 2019.
5. Nathoe HM, van Dijk D, Jansen EWL, Suyker WJ, Diephuis JC, van Boven WJ, et al. A comparison of on-pump and off-pump coronary bypass surgery in low-risk patients. *N Engl J Med*. 2003;348:394-402.

<https://doi.org/10.1016/j.jtcvs.2019.09.069>

**REPLY: ETHICAL
CONSIDERATIONS
WHILE ATTEMPTING
CONGENITAL HEART
SURGICAL CARE WITH
LIMITED RESOURCES
AT DISPOSAL: ONE**

SCAR IS STILL BETTER THAN TWO

Reply to the Editor:

Vervoort and colleagues¹ challenge my response in an invited commentary² regarding a report on an infant with single-ventricle physiology who qualified for a primary bidirectional cavopulmonary anastomosis (Glenn operation), in the setting of a developing program with limited resources and a visiting team helping the local team as best they could.³ I commended the authors for achieving good outcomes, perioperatively and out to 2 years follow-up, while sparing preoperative catheterization and cardiopulmonary bypass to perform off-pump surgery using a temporary veno-venous shunt. This was done by relying on intraoperative direct pressure measurements (which is smart) and out of financial necessity for the program (which is commonplace in many underserved countries with constrained resources), respectively.

I did take a position on the chosen surgical approach in a baby with single-ventricle physiology, a minimally invasive subaxillary thoracotomy, which I found unjustified, given the fact that the infant will inevitably go on to need Fontan completion, requiring a second surgical incision through a midline sternotomy.

We are indebted to Dr Sade as a leader in our field, bringing us wisdom and clarity on ethical principles through his writings, presentations, teachings, and editorial guidance.⁴ The Letter to the Editor defends the choice made by the surgical team from an ethical standpoint, given their circumstances. I shall try to respond to the points made in order of their appearance:

Justice. I fully agree that distribution of scarce resources should benefit the entire population. Having had the privilege to go on yearly congenital heart surgical humanitarian missions in underserved areas, I realize the demographic needs, understand the goal in achieving the

same results with less resources available than back home, and treat as many children as possible in the shortest time available. I have been in the shoes of Predegan and colleagues,³ who boldly improvise under difficult conditions, and still get the children through with laudable outcomes.⁵⁻⁷ Their innovation is to be commended and is not at question.

Autonomy and Beneficence. I fully agree that both were respected, and that informed consent was obtained with an infant/child who has been doing well.

Nonmaleficence. My commentary and wording were not directed at the authors of the case report, but *The Journal* Editor asks us to provide thought-provoking narratives. The aim was to point out that minimally invasive surgery should not be considered lightly as a simple cosmetic tool or to serve our comfort level as surgeons, but rather as a true means to enhance children's lives when used selectively. Please remember that I am a big fan of minimal invasive thoracotomy for the repair of certain congenital heart defects.

In my opinion, neonates, infants, children, and even adolescents who undergo surgery for a congenital heart defect, with single or biventricular physiology, with a predictable and probable need for future redo surgery, should not undergo a minimal invasive approach through 1 scar, given the predictable and probable need for a future second scar. I sincerely doubt that performing an operation from a lateral approach, which involves extensive dissection close to the aorta, the superior vena cava, the pulmonary arteries, the sinus node, and the aid of a temporary veno-venous shunt, will preclude adhesions that will make a future first-time sternotomy for completion of Fontan a walk in the park.

In agreement with the authors, in a setting with minimal resources, real cost considerations, and the desire to help as many patients as possible during a limited time span, I also would have skipped the costly and cumbersome preoperative diagnostic cardiac catheterization, obtained intraoperative measurements to confirm the safety of the procedure, and performed the bidirectional Glenn surgery off-pump.³ However, the procedure could have been done through a median sternotomy, extubation could have been done in the operating room to spare precious ventilators and nursing staff, and the infant could have been discharged from the intensive care and hospital in the same time frame. Whether the child will be lost to follow-up—common in certain countries—or whether future adhesions will be minimized when going back through the front for Fontan completion is speculative. One can only hope that the patient will be followed up and will return for future care.

In summary, although I agree that successful palliation is more important than an additional scar, the same outcome, using the same diagnostics and technique and in the same setting of constrained resources, could have and

Author has nothing to disclose with regard to commercial support.

perhaps should have been performed through a median sternotomy. In agreement with Vervoort and colleagues, cost-containment settings should impose efficiency, safety, and justice with equal distribution, without compromising quality of life. When sensible, keeping a child's self- (body) image as intact as possible, physically and psychologically, may be better served by only 1 scar and the child's future in mind, instead of 2 scars.

Ali Dodge-Khatami, MD, PhD
Children's Memorial Hermann Hospital
McGovern Medical School
University of Texas Health Science Center at Houston
Houston, Tex

References

1. Vervoort D, Sade RM, Luc JGY. Ethics in resource-constrained settings: when palliation is more important than another scar. *J Thorac Cardiovasc Surg.* 2020; 159:e243-4.
2. Dodge-Khatami A. Commentary: Minimally invasive approaches in congenital heart surgery—A service we owe children to help them thrive, not a gimmick to make our lives easier. *J Thorac Cardiovasc Surg.* 2020;159:e239-40.
3. Pradegan N, Mariñez Muñoz Y, Vida VL, Leon-Wyss JR. Subaxillary bidirectional cavopulmonary anastomosis in an infant. *J Thorac Cardiovasc Surg.* 2020;159:e235-7.
4. Jones JW, Novick WM, Sade RM. Should a medical center deny employment to a physician because he smokes tobacco products? *Ann Thorac Surg.* 2014;98:799-805.
5. Polivenok IV, Molloy FJ, Gilbert CL, Danton M, Dodge-Khatami A, Rao SO, et al. Results of international assistance for a paediatric heart surgery programme in a single Ukrainian centre. *Cardiol Young.* 2019;29:363-8.
6. Fenton KN, Cardarelli M, Molloy F, Novick WM. Ethics in humanitarian efforts: when should resources be allocated to paediatric heart surgery? *Cardiol Young.* 2019;29:36-9.
7. Schidlow DN, Gauvreau K, Cherian KM, Du X, Kappanayil M, Kumar RK, et al. Single-ventricle palliation in low- and middle-income countries. *J Am Coll Cardiol.* 2019;74:928-31.

<https://doi.org/10.1016/j.jtcvs.2019.09.071>

REPLY: TAKING SURGICAL ADVANCEMENTS IN THE DEVELOPING WORLD TO HEART—A CASE FOR TRICKLE-UP INNOVATION?

Reply to the Editor:

Addressing global congenital heart disease (CHD) poses significant economic challenges. In this issue of the *Journal*, Vervoort and colleagues comment on the importance of surgical innovation for cost-containment in developing countries such as the Dominican Republic. Could surgical programs in developed countries learn a valuable lesson from this progress?

We agree with Vervoort and colleagues that cost-containment approaches in heart surgery are reasonable if outcomes are maintained and patient autonomy is respected.¹ It is important to note that the center being discussed, CEDIMAT, is a reputed medical center dedicated to teaching and discovery. The center is poised to continue making a large impact in the quality and amount of care delivered, having performed more than 1000 congenital cardiac operations over the last 4 years with a mean complexity of RACHS 2.9.² These cost-containment efforts have helped allow CEDIMAT to reach a rapidly increasing, vulnerable patient population with high rates of poverty (30%) and no health insurance (38%), all while becoming less reliant on philanthropic support.²

In addition, as mentioned by Vervoort and colleagues and us previously, the CEDIMAT team's decision to proceed with a minimally invasive Glenn procedure was made for the patient's benefit in a setting where resources are limited and seeing follow-up patients is not guaranteed.^{1,3} As long as such advancements adhere to medical ethics and are shown to be safe in randomized studies, the global CHD community should be firmly supportive of the innovators.

To advance this discussion, we believe that healthcare programs in the developed world can implement these promising cost-containment approaches to surgery. The concept of "trickle-up innovation," also known as "reverse innovation," was coined by Ahmed and colleagues⁴ to describe developments in resource-poor nations that are then implemented in more industrialized nations. Trickle-up innovation challenges the status quo whereby high-income countries are the driving force behind innovation and instead looks to those efficient practices that underlie functional developing healthcare systems. For instance, it has been shown that minimally invasive valve surgery reduces both direct (ie, operative) and indirect (ie, hospital stay) costs compared with sternotomy, with no differences in mortality.⁵ However, whether the same relationship holds for congenital heart surgery remains to be explored. Vervoort and colleagues powerfully state that minimally invasive approaches could result in 1 additional patient being treated for every 8 to 10 patients in the Dominican Republic. Could the same be true for sick uninsured patients in highly industrialized countries?

In summary, advances in congenital heart surgery worldwide have the potential to reduce costs and increase access to care. As a testament to this, the team at CEDIMAT has developed a novel, timely operation that yields successful results and is sensitive to the needs of their milieu. A remaining question to consider is whether aspects of their innovation could be adapted in the larger healthcare systems of the Western world to improve efficiency. To answer this question will require taking these global advances in surgical care to heart.