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.

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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.

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REPLY FROM THE AUTHORS: MINIMALLY INVASIVE ALTERNATIVES IN DEVELOPING COUNTRIES: EXCESS OR NEED?

Reply to the Editor:

We sincerely thank Vervoort and colleagues¹ for their valuable contribution to highlight the central message of our case. The surgical scar is definitively the only sign of a cardiac repair or palliation, and surgeons should make every effort to reduce the number and dimension of incisions. On the other hand, increased expertise and available sources have decreased the risk related to re sternotomy.² The question is, how much of this consideration is applicable outside developed countries?

The management of univentricular physiologies must consider the benefit to the patient, which is the first and leading goal of each procedure. A beneficial effect means reducing risks (as those encountered when performing re sternotomy, such as bleeding) when you cannot rely on

plentiful resources (eg, blood products). A subaxillary incision has the advantages of being hidden under the arm and having a lower rate of readmission for healing problems (eg, infections, dehiscence), which are a daily issue in underdeveloped countries. However, beyond the speculation about surgical risks and costs, the real concern is about the number of patients who continue to be followed after a Glenn procedure and reach Fontan completion. Over a 5-year program, our center performed 19 Glenn palliations, but none of these involved a total cavopulmonary connection. These numbers strongly encouraged us to think about a subaxillary off-pump approach, which seems to be costless, but effective.³

In conclusion, despite the growing effort to guarantee reasonable follow-up for pediatric patients undergoing cardiac surgery in developing countries, we still face constant economic, geographic, and cultural limits. At some point, these barriers lead us to shift from a “what we should do for the good of the child” to a “what we can do” approach, where sometimes a small incision becomes a precious need.

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