

## Training pediatric heart surgeons for the future: A global challenge

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The global burden of congenital heart disease (CHD) is substantial. Assuming an incidence of 8/1000 live births, it can be estimated that approximately one million children are born each year with CHD.<sup>[1]</sup> In absolute terms the number of children born with CHD in the low- and middle-income countries (LMICs) is several times that of advanced nations quite simply because the vast majority of the world's population live in the LMICs. Further, birth rates in most LMICs are substantially higher than in advanced high-income nations. Thus, it can be estimated the over ninety percent of the world's children are born in LMICs.<sup>[1]</sup>

It is estimated that approximately a third of babies born with CHD require some form of an intervention early in life; in the vast majority of instances this is an open-heart operation. Therefore, it is perhaps fair to state that newborn and infant heart surgery forms the very essence curative and palliative services for CHD and the pediatric heart surgeon is arguably the most indispensable human resource. For a pediatric heart surgeon to be effective, he or she needs to be competent and supported by a team of highly trained professionals that include pediatric cardiologists, intensivists, anesthesiologists, nurses, and perfusion technologists. It is widely recognized that comprehensive pediatric heart programs that are well staffed with personnel representing various disciplines who work cohesively as a team deliver the best outcomes for children with heart disease.<sup>[2]</sup> There are several examples of highly successful comprehensive programs in high-income countries that have set global standards in pediatric heart care.

When compared to high-income countries, very few comprehensive pediatric heart centers with the capability for infant and newborn heart surgery exist in the low- and middle-income countries. Personnel with limited specialized training often deliver pediatric heart care. In a number of centers, surgeons who also do adult heart operations perform pediatric heart surgery. There are vast areas where children have no access whatsoever to pediatric heart care in Asia, Africa, and South America. Most African countries do not have any capability of heart surgery.<sup>[3]</sup>

It is increasingly apparent that CHD surfaces as an important pediatric health priority as infant mortality declines. A declining trend in infant mortality is now being witnessed in almost every part of the world except for regions that are affected by conflict (such as in Iraq or Afghanistan). This decline is almost entirely attributable to reductions in mortality from communicable diseases. As a result of this demographic transition, congenital heart defects has started to surface as a significant health problem among infants and newborns in many parts of the world that are now witnessing rapid and substantial improvements in human development indices. The need for specialized care for children with CHD is clearly felt and several new pediatric heart programs have been established in these regions and an increasing number of heart operations and catheter interventions are being performed here. The growth in pediatric cardiac care has been particularly striking in regions that have shown the most impressive decline in infant mortality rate. A number of new pediatric heart programs are being established in emerging economies that include China, India, Vietnam, Malaysia, Sri Lanka, and Brazil. The majority of this planet's children live in these nations. Even within countries, pediatric cardiac care has developed faster in regions with better human development. In the South Indian state of Kerala, for instance, four programs now have the capacity to deliver advanced pediatric cardiac services. Three of these have been established in the last 20 years. The growth of pediatric heart care in the private sector in India has been impressive suggesting that market forces have also started to recognize the growing health care needs of children with heart disease from families who can afford to pay out of pocket.<sup>[4]</sup>

In spite of the recent developments, it is important to recognize that only a small fraction of children with heart disease receive adequate pediatric heart care in LMICS. It is estimated that for India that only 7-10% of neonates and infants with CHD receive timely surgery in the available centers. Clearly, there is a substantial shortfall that cannot be addressed easily. There is a massive need to build capacity in pediatric heart care at the national level for India. This is likely to be the situation in most other LMICs. In the coming decades, the global focus in

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pediatric heart care should be to improve access for the average child with CHD.

A critical element in developing pediatric cardiac care involves training pediatric heart surgeons. However, this is also perhaps the most neglected element in building capacity for pediatric cardiac care. Conservative estimates for numbers of infants and newborns needing surgery are ~70,000-100,000 for all of India. This will require nearly 300-500 pediatric heart programs. Assuming a minimum requirement of two pediatric heart surgeons per center, it can be estimated that the country needs at least a 1000 dedicated pediatric heart surgeons. There are presently <50 dedicated pediatric heart surgeons in India who have the capability of performing infant and newborn heart surgery. In spite of this sobering statistic, there is a very little collective effort to train pediatric heart surgeons for the future in India. The situation is similar in many other emerging economies. The availability of quality pediatric heart surgeons is clearly the most important bottleneck in pediatric heart care.<sup>[5]</sup> This bottleneck is only going to get considerably tighter in the coming years because very few new surgeons are being trained in pediatric cardiac surgery in the country.

Because it is a lot easier to train pediatric cardiologists, the situation is a lot better for pediatric cardiology in India and in many other LMICs. However, in the foreseeable future we can expect a situation where many pediatric cardiologists may not be able to function effectively because of a shortage of surgeons.

## WHAT ARE THE BARRIERS?

It is important to identify the barriers that come in the way of training pediatric heart surgeons for the future. This list has been made with the Indian situation in mind. However, it is conceivable that other LMICs would face similar challenges.

### Training opportunities and institutions

Of the few institutions that regularly perform pediatric heart surgery in India, a tiny fraction is located in academic university hospitals. Even in these hospitals a degree for formal advanced training can only be obtained for a combined adult and pediatric cardiovascular and thoracic surgery (CVTS). During these training years, there is variable, often little, exposure to pediatric heart surgery. To become a pediatric heart surgeon, one needs to train further after obtaining a degree (MCh or DNB) for super specialization in CVTS. This training is of an unspecified duration and completely unstructured.<sup>[5]</sup> There are no formal degrees awarded for pediatric heart surgery. During these years, the trainee typically works under the tutelage of an established surgeon and acquires gradual independence over several years. The trainee may also spend some time overseas

in an established program to fine-tune surgical skills and broaden horizons. However, training in overseas centers is now becoming increasingly difficult. Training opportunities in established programs in North America, Europe, Australia, and New Zealand for pediatric heart surgeons have declined over the years. This is perhaps as a result of declining caseloads, stringent regulatory requirements for overseas doctors, and a paucity of funding for overseas trainees. In addition, the case profiles of training institutions in high-income countries are often quite different from LMICs and may not prepare the prospective trainee for the specific challenges faced later in his or her career.<sup>[6]</sup> Notwithstanding all the exposure under supervision, acquisition of skills required for consistently safe newborn and infant surgery takes considerable additional time. This process is reflected in the long learning curve that is often visible even after becoming an independent surgeon.

### The training environment

In the ideal situation, the prospective pediatric heart surgeon should train in a pediatric heart program that is a part of an academic teaching hospital. All disciplines, pediatric cardiology, intensive care, and anesthesiology should be well represented and should work closely together. The leadership should nurture cohesive teamwork.<sup>[2]</sup> The case volume should be adequate with plenty of variety to enable exposure to all types of conditions. An active teaching program with multidisciplinary participation and research should be integrated into the program. Such an ideal situation is present in very few institutions in LMICs. As a result, many trainees are groomed in isolation in the insular confines of the operation room. Important lessons in preoperative case selection and postoperative care are lost because of limited academic multidisciplinary cross talk.

### Mentorship

The ideal mentor is a senior cardiac surgeon who freely shares his or her craft with his trainee without compromising patient safety. This requires an experienced, confident, and compassionate surgeon. It is important to recognize that the best surgeons are not necessarily the best mentors. Pediatric heart surgery is a stressful discipline. Seemingly small errors can seriously impact outcomes. As a result, the process of evolution to an independent surgeon almost invariably requires a long and painful gestation.

### Working conditions

The trainee often has to contend with long working hours. Unexpected emergencies are common. Since training for pediatric heart surgery starts at a relatively late age, trainees often need to balance the needs of establishing a family with work.

### **Establishing a successful career**

On completion of training, most pediatric heart surgeons are likely to face significant career uncertainties.<sup>[5]</sup> A number of questions do not often have ready answers. These questions relate to finding an institution that will support and nurture a newly trained surgeon. The quality of support from other members of the team, existence of a referral base of primary care providers with awareness of CHD, systems for charity for needy patients and personal remuneration, and salaries are also potential sources of anxiety. Learning curves are steep and painful in the early stages. There is a need for constant introspection and even established surgeons may feel the need to retrain to overcome specific technical limitations.<sup>[5,7]</sup>

### **Emotional challenges**

Among all medical and surgical specialties, pediatric cardiac surgery is arguably one of the most challenging. Notwithstanding the fact that numerous variables influence outcomes, the responsibility of delivering an excellent outcome after the operation falls squarely on the surgeon. Parents and family members of affected children are often young, anxious, and economically challenged. Clearly, this situation can be quite overwhelming and not everyone can cope with the emotional demands of the specialty.

Given these very significant barriers, it is important to recognize that those who eventually choose to become pediatric cardiac surgeons are doctors with exceptional courage and motivation perhaps largely driven by a passion for excellence and love for the specialty. The situation may have become a little easier for the more recent trainees when compared to the pioneers who have been through considerable hardship and sacrifice. Nonetheless, very few surgeons are willing to pursue pediatric cardiac surgery as their careers.

## **THE WAY FORWARD**

A list of potential solutions is presented here. Again, this list is fairly India-specific and not comprehensive but serves to identify a few pragmatic action items for consideration.

### **Role of established pediatric heart surgeons**

Established senior surgeons should accept the responsibility of leaving behind a legacy by passing on their skills to the next generation. In India, while some of the pioneers in pediatric cardiac surgery have sought to train and mentor junior surgeons, it is perhaps fair to state that a lot more could have been accomplished. The fraternity of heart surgeons in India needs to come together and first recognize the extent of the problem. Efforts should then be directed towards established a

formal and structured training program that will prepare the trainee to deal with the specific challenges faced in India.

### **Liaison with existing regulatory bodies of postgraduate medical education**

A dialog needs to be initiated with accreditation councils for postgraduate medical education (such as the Medical Council of India and the National Board of Examinations). It should be possible to set a few modest goals such as creating a curriculum for training in pediatric heart surgery, defining minimum training requirements, and identifying prospective institutions for the establishment of formal training in pediatric heart surgery.

### **International initiatives**

Globally, societies that focus on pediatric heart care, such as the Pediatric Cardiac Society of India, Asia Pacific Pediatric Cardiac Society, the World Society of Cardiothoracic Surgeons, and the World Congress Steering and Organization Committee should look to organize discussion forums in their meetings to define the extent of the problem and seek to come up with solutions. The possibility of starting an internationally accredited structured training program in pediatric cardiac surgery in selected pediatric heart programs in emerging economies that have accomplished a high standard of care should be actively explored. Once a robust framework for training is created, it should be possible for prospective surgical fellows from one LMIC to train in another. A formal certificate of training from an internationally recognized body would lend credibility and serve as strong incentive to attract committed trainees. This system could overcome some of the significant barriers that exist for training in pediatric heart surgery in high-income countries of North America, Europe, and Asia-Pacific (Japan, Korea, Australia, and New Zealand) with the added advantage of exposure to a “developing country profile” of pediatric heart disease. This model can also be used to build capacity in other components of pediatric heart care such as pediatric cardiology and intensive care.

### **Interim solutions**

Until formal systems are established, senior surgeons could consider volunteering to make themselves available for online advice and mentorship. This process can be facilitated by websites of pediatric cardiac societies.

### **Advocacy**

It is important to advocate with the government to nurture and support existing institutions that have active training programs both within and outside the government sector. This could be in the form of funding support for infrastructure, human resources, and subsidies to ensure a steady surgical volume.

## CONCLUSION

The shortage of appropriately trained pediatric heart surgeons is global and particularly acute in LMICs. This does not appear to have surfaced in the collective consciousness of the pediatric cardiac fraternity. There are no visible systematic efforts to address the problem as of now. Recognizing the fact that pediatric heart surgery requires highly specialized and intense training, it is imperative that we collectively work to address the problem for the sake of the coming generations.

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#### DOI:

10.4103/0974-2069.157020