It is nearly 20 years since market liberalization was introduced in India. This has ushered in an era of unprecedented economic growth and many benefits have reached the common man. More recently the tremendous growth in the information technology sector in India has empowered the average Indian in a variety of ways. Perhaps the most visible symbol of today’s digital times is the mobile phone revolution. The growth in this sector has been truly staggering and clearly everyone has benefited. In the last 12 years mobile charges have nosedived, allowing almost everyone to own a mobile phone. There are more mobile phones today than there are toilets in India. Most consumer goods that are essentially the products of digital technology (laptops, cameras, DVD players, television sets, etc.) have also shown impressive reduction in costs and are rapidly becoming affordable to more and more people. Additionally, progressive miniaturization of the components of digital technology has allowed most gadgets to become smaller with time. Most companies that manufacture these products recognize the value of reducing costs to reach out to more and more people. The economics of scale allows substantial profit generation in spite of a relatively smaller profit margin for an individual item. Clearly, the “bottom of the pyramid approach” makes economic sense here and no one is complaining.

Let us look at the situation in healthcare. Today, healthcare is increasingly driven by digital technology. Most medical equipments today run on digital platforms. Hospitals, clinics and many other healthcare facilities are increasingly dependent on hospital information software. Yet, healthcare is becoming increasingly expensive and out-of-reach for the common man. Clearly, there are many other elements that contribute to the spiraling healthcare costs. Digital technology does not seem to empower the average patient. Rather it sometimes does the reverse. It makes them more vulnerable and helpless. Two examples are worth studying, especially because they represent applications in digital technology that have tremendous potential to meet the needs of the common man. However, they have not developed along the lines that would have improved their reach.

Echocardiography: The potential of ultrasound technology to diagnose a number of ailments is immense. Almost all organ systems use ultrasound imaging. It is safe and lends itself to miniaturization. A variable amount of training is necessary to acquire the expertise to obtain and interpret...
images obtained through ultrasound. Echocardiography involves ultrasound technology to diagnose a variety of heart ailments. The technology has rapidly evolved over the last 35 years and grown exponentially in sophistication. Today’s echocardiography machines can display the heart in three dimensions in real time and provide a vast array of measurements.

A limited number of multinational companies dominate the market for echocardiography. They have all sought to incorporate advances to improve the quality of images (accuracy). Additionally, a lot of efforts of these companies relate to providing many features to score over their competitors. Unfortunately, these matter very little in day-to-day decisions. There is very little focus on making this technology widely accessible and inexpensive. Ultrasound technology can be easily miniaturized without additional cost. Portable echo machines can provide the basic information required to make most decisions. Over 95% of heart ailments can be diagnosed accurately using a portable echo machine. While leading companies that make echo machines have sought to make portable machines, they have not sought to make them inexpensive. In the same time period that we have seen an exponential decline in cell phone costs, the cost of obtaining an echocardiogram has not changed. In many instances, the costs to the patient have increased.

Telemedicine: Today we have the technology to transfer large amounts of digital information effortlessly at relatively low costs. While telemedicine holds considerable promise we have not done enough to translate this powerful tool to help the common man. Today it is easily possible to listen to a patient’s heart remotely, look at and opine on an electrocardiogram (ECG), X-rays, computed tomography (CT) scans and other imaging data obtained several hundred miles away. While this technology has been available for at least 10 years very little systematic effort has been made to use it to make a real difference in the lives of people in India and much of the developing world.

**WHY HAS THE DIGITAL REVOLUTION NOT CONTRIBUTED TO REDUCTIONS IN HEALTHCARE COSTS?**

The technology is used on the consumer and not by the consumer: The actual “consumer” is still the patient because it is he or she that eventually pays for the product (and the service). This is particularly true in most of the developing world where healthcare delivery is completely disorganized with a very tiny proportion of the population having health insurance. While the patient (consumer) pays for the product (to the manufacturer) and the service (to the health professionals), the demand is not necessarily created by the consumer. When the demand is artificially created to justify the use of technology, it becomes exploitative. Further, with time the cost of service often increases.

A bottom of the pyramid (BOP) model [1] has not been developed for many medical specialties. While the “Jaipur foot” and “The Aravind eye network” stand out as successful examples of implementation of the BOP model in healthcare, many specialties require complex systems and expensive infrastructure that would challenge the development of a BOP approach. Pediatric cardiac care is perhaps an example where the BOP approach may be difficult with the available technology. Novel approaches will be needed to deliver heart care in large numbers using inexpensive models. This requires the collective will of a large number of committed individuals that includes those developing technology, entrepreneurs and health professionals. Visionary leadership, teamwork and external support (such as from the government) are also vital requirements.

Most multinational companies that manufacture echo machines (and other equivalent digital products) are not convinced about the BOP approach. They do not seem to be inspired by the success story of the cell phone technology. A generous profit margin for every individual item is still the most important strategy used to offset research, development and marketing costs. They are not completely convinced that “economics of scale” with small profit margins for every unit can be applied to their products. They often use similar strategies as they would in developed countries and essentially concentrate on selling their products to select affluent facilities in metros.

What about doctors and health administrators? Most doctors are looking to do better and better for the individual patient who comes to them. They often do not think of those who do not reach them. Progressive improvements in outcomes require increasing resource deployment. The relationship is exponential. Initially, small investments in basic resources result in impressive improvements in outcomes. But after a certain level, considerable material (equipment and infrastructure) and human (personnel) resources are required to accomplish small improvements in outcome. In situations where healthcare is not organized in accordance with the needs of the population, health facilities that strive to achieve exceptional results (state-of-the-art) are completely out of reach of the average citizen. Indeed the poorest are seriously intimidated and are completely excluded from the ambit of these facilities. Pediatric cardiologists and cardiac surgeons who spend most of their lives inside hospital environments often completely lose sight of the situation in the community. The fact that only 2-3% of children born with significant congenital heart disease reach hospitals to undergo surgery or

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**References**

[1] Krishna Kumar: Technology and healthcare costs

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interventions has not been internalized by most of us. We need to rethink about how we should define progress in the healthcare sector. We should find a way to measure the proportion of patients who are excluded from a healthcare facility because of costs of care and this parameter should perhaps be a part of the evaluation process for accreditation of institutions that aspire to meet acceptable standards of healthcare.

A paradigm shift in healthcare delivery is desperately needed. The facts and figures on the actual proportion of patients that are being excluded from access to available technology will need to figure in the collective consciousness of doctors, entrepreneurs, policymakers and members of the healthcare industry. Realistic business models that are aimed at least a part of the population that is completely excluded and marginalized will need to be pursued recognizing that there are vast numbers that can allow the economics of scale to become operational.

TECHNOLOGY AND COSTS OF PEDIATRIC HEART CARE

Pediatric heart care is iconic of the situation in today’s healthcare environment. The individual specialties of pediatric cardiology, pediatric cardiac surgery and intensive care are very much technology-dependent. This technology is becoming increasingly sophisticated and expensive and can only be made available through massive investments that only few organizations can now afford. The overhead costs are considerable and it is becoming increasingly challenging to deliver affordable care to the average child with heart disease without additional subsidy. Despite impressive economic growth in recent times in India (and many other developing nations), the overwhelming majority of Indian families will be severely burdened in the event a child requires congenital heart surgery or catheter intervention. While a considerable proportion of the expense relates to service costs, there are areas that we can all address through conscious efforts.

As a first step we need not embrace technology that comes at an extremely high cost with a marginal impact on overall outcomes without serious thought. Hybrid catheterization labs-operation rooms, three-dimensional echocardiography, extra-corporeal membrane oxygenation (ECMO), and robotic surgery are all examples of high-end technology that are not indispensable. Consistently excellent outcomes can be accomplished without them. We need to avoid the trap of equating progress with acquisition of sophisticated technology. As pediatric cardiac professionals, we especially run into the danger of getting seduced by high-end and expensive technology and lose sight of the big picture of trying to reach out to the average child in our country. Doing heart transplantation and staged palliation for hypoplastic left heart syndrome often figure prominently as important benchmarks of progress of pediatric heart programs in India.

A number of very simple and inexpensive measures can substantially improve outcomes after congenital heart surgery and catheter interventions. These include basic infection control practices, establishing a cohesive team, meticulously adhering to a surgical checklist, and robust vigilance in postoperative intensive care through nurse training. Most of these quality improvement initiatives can be implemented with little material resources and the benefits are substantial. Most of us who take care of children with heart disease with limited resources are often forced to innovate. A number of cost-effective practices that help reduce healthcare expenses are widely used for catheter interventions, cardiac surgery and intensive care. We need to test and standardize some of these practices, to enable widespread acceptance.

True progress is perhaps best measured by outcomes. In the truest sense, however, we can actually claim to have progressed only if the average child in India has access to centers with comprehensive pediatric cardiac services. This may appear to be a distant dream but may well be the most worthwhile goal for us to pursue.

REFERENCES

1. Prahalad CK. Fortune at the bottom of the pyramid: Eradicating poverty through profits. University of Pennsylvania, USA: Wharton School Publishing; 2004.
2. Balachandran R, Nair SG, Kumar RK. Establishing a pediatric cardiac intensive care unit—Special considerations in a limited resources environment. Ann Pediatr Cardiol 2010;3:40-9.
3. Kumar RK. Teamwork in pediatric heart care. Ann Pediatr Cardiol 2009;2:140-5.
4. Kumar RK, Shrivastava S. Pediatric heart care in India. Heart 2008;94:984-90.

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