Pulse oximeters breathe life into surgery in poorer nations

Anaesthetists worldwide have joined forces with safer-surgery advocate Atul Gawande to enable low-income nations to buy vital pulse oximeters. Tony Kirby reports.

With worldwide demand for surgery reaching an all time high, so attention has focused on outcomes of surgical procedures. Among the many things taken for granted in the operating theatre in high-income countries is the availability of good quality pulse oximeters—devices that monitor the level of oxygenation in a patient’s blood and alert the physician if oxygen concentrations drop below safe levels, allowing rapid intervention. The devices are essential in any setting in which a patient’s blood oxygenation is unstable, including routine operations, emergency and intensive care, and also hospital wards. Unsurprisingly, low-income and middle-income countries have little or no access to such devices, and poor or non-existent training for the often low-quality devices they do have.

Pulse oximeters use a finger probe to measure the oxygen saturation of haemoglobin in the peripheral circulation. The technology in its current form became available in the early 1980s, and by the early 1990s pulse oximeters were adopted as a standard of care in international anaesthesia. Today, 58 countries have established anaesthesia-monitoring standards, and all include pulse oximetry as a minimum requirement. The World Federation of Societies of Anaesthesiologists (WFSA) includes pulse oximeters as a minimum standard of care in all hospitals where surgery is undertaken. Introduction of these devices into developed countries such as the UK reduced death rates by 20 times, from one in 10 000 operations to one in 185 000. In stark contrast, anaesthesia mortality in low-income countries today has been reported to be as high as one in 133.

A study published in 2010 by Gawande and colleagues in The Lancet showed that across sub-Saharan Africa, between 60% and 70% of operating theatres have no pulse oximeter, compared with a global average of 20%. Almost 100% of high-income country operating theatres possess these vital devices. This followed a 2009 study that showed substantial gaps in pulse oximetry availability and training in pilot sites in Uganda, Vietnam, India, and the Philippines. But the introduction of oximetry led to a sustained change in anaesthesia practice in these settings; with early detection of hypoxia that was managed appropriately, and, vitally, the characteristics of the ideal oximeter for low-resource settings were defined.

Stephen Ttendo, President of the Uganda Society of Anaesthetists, says that the reality faced at present by many anaesthetists in resource-poor operating theatres is that they can only monitor patients by feeling their radial artery or watching for their blood going dark. “Use of pulse oximeters will fundamentally improve the way we look after our patients in developing countries”, he says. “Helping these countries to reach a critical mass of trained anaesthetists is essential. If these numbers are in place, advocacy and sustainability of essential health services will become a reality because the voices of these professionals will be so loud that they cannot be ignored by policy makers.” The Association of Anaesthetists for Great Britain and Ireland (AAGBI), WFSA, Harvard University, and other partners are helping Uganda to increase its numbers of anaesthetists from the current 20 to 40 by 2013, with hopes of more than 100 by 2020. About 7 million people die or have major complications from surgery worldwide every year. The introduction of WHO’s Safe Surgery Checklist—created by surgeon Atul Gawande (Brigham and Women’s Hospital, Boston, MA, USA)—in 2008 has been changing the landscape of surgery in many settings, including the UK. The checklist enables medical teams to eliminate errors that can lead to increased morbidity and mortality. The strength of the checklist comes through its simplicity and near-universal applicability in all countries, irrespective of income. But one item on the checklist prevents its complete roll-out in poor countries: the requirement for a pulse oximeter. Anaesthetists, including Ian Wilson, President of AAGBI, raised concerns during the checklist drafting that without the introduction of pulse oximeters, mortality and complications would remain unacceptably high. Wilson and WFSA colleagues then worked with Gawande and partners to develop the Lifebox project—to bring cheap, good quality pulse oximeters to low-income countries. The result is that early this year, the Lifebox oximeter devices (Lifeboxes) will be available for US$250 through the Lifebox website, with vital replacement probes (needed on average every 6 months) available for just $25. In the USA, pulse oximeters can cost $1000.

Gawande has seen first-hand the dire need for pulse oximeters during a trip to India. “The man had been seen in the emergency ward for a tubercular empyema and left to wait in the emergency ward more than an hour for an operating room”, he recalls. “Even in the operating room...”

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An oximeter in use during anaesthesia at Kayunga Hospital in Uganda

Concerns have been raised that these low-cost devices could be bought or sold on to more wealthy nations. “The contract between the project and the manufacturer stipulates that the Lifebox oximeters will only be available to not-for-profit hospitals in low-income, or lower middle-income countries”, says Wilson. “The project will monitor purchasers who have to agree not to re-sell the oximeters. Clearly there is some risk that oximeters will end up in the wrong places, but we hope strict monitoring will prevent this.”

A key part of the project is that each oximeter is supplied with educational materials including videos, tutorials, and a manual—all available free on a CD. Part of the project is to run training workshops, so that the technology is accompanied by the knowledge of how to use and look after the oximeters to make them last longer and sustain improved standards of operative care.

Gawande and Wilson hope that donors will step in to bulk-buy the oximeters for distribution to those countries most in need. Such efforts will, says Gawande, save vital time in getting the devices rolled out. “A donor taking on the purchase and distributing free devices to countries could happen much more quickly than lengthy negotiations with health ministries of low-income countries such as many found in Africa. Such negotiations could take a year or more”, he says. Ongoing WHO pilot projects in Moldova and Zambia are testing the effects of pulse oximeters on outcomes of surgery in low-income nations, as well as the other aspects of the Safe Surgery Checklist.

Developing effective procurement systems for hospitals in low-income and middle-income countries will make a major contribution to the quality and safety of anaesthesia and surgical care. Wilson and Gawande agree that there is potential to increase access to devices such as combined anaesthesia monitors (non-invasive blood pressure, capnography, and electrocardiogram) and essential items of disposable equipment such as spinal needles, sutures, and sterile gloves. Currently, items as basic as alcohol gel rub for hand-washing can cost nine times as much in Africa as in developed countries.

The Lifebox project has now, with the help of the global children’s charity Smile Train, ordered 2000 Lifeboxes for delivery in spring 2011 to various countries. But the Lifebox team are now appealing for extra help to get past the finishing line for this initial phase. “We are seeking other partners and funds, and those will be crucial to our success”, says Gawande. “This is a gamble and an experiment in providing market power for poor hospitals and using it to drive the checklist into place as well. The two go hand in hand. The oximeters are an essential component of dramatically improving the safety of surgical care. The surgery checklist is another. And local training and monitoring to drive a culture of increasing safety is important as well. This together is the Lifebox mission.”

Before this large-scale roll out, 200 oximeters are being shipped out to test and refine the best strategies for ensuring reliable delivery, learning, and governance. The ultimate aim is to update the more than 70 000 operating theatres worldwide without the monitors, with an expected order of more than 10 000 monitors in the first 2 years.

Like Wilson, Gawande is excited about the precedent that Lifebox could be setting: “If this works, imagine being able to further build the market power of low-income hospitals to lower the price barrier for all kinds of essential technologies for safety and basic health-care services, while also helping us bring quality and safety practices.”

Tony Kirby