Could you begin by introducing your team and explain what drove you to work in the field of child and maternal health?

Public health programme officer Elizabeth Abu-Haydar, PATH product development engineer Gene Saxon and senior commercialisation officer Mutsumi Metzler work with me at PATH to implement maternal and newborn health projects. My role is to lead the Health Technologies for Women and Children Group, which sits within the Devices and Tools product development platform at PATH. This means that I work with a talented and dedicated group of about 25 team members who are skilled in science, engineering, public health, commercialisation and research, as well as with in-country staff from around the world to create products that address the health needs of women and children in low-resource settings. I am inspired to come to work every day because I believe that our product development efforts will result in improvements in the health of families around the world.

How do you translate your ideas for solutions into usable products?

At PATH, our user-centred product development approach begins with the needs of our end users, and factors in the desires and demands of other critical stakeholders who influence product availability, acceptability and use. Our multidisciplinary teams consist of engineers, scientists, public health professionals and business experts who work to define the problem through several methods and bring appropriate technology solutions to the people who need them most. These include needs assessments, establishing product objectives and requirements, developing and testing prototypes, and validating and refining them in low-resource settings until we arrive at the features and functionality needed.

Simultaneously, our teams work to identify market dynamics and develop strategies for market shaping to accelerate product introduction. Throughout the product development process, PATH works with public- and private-sector partners who bring additional skills to move these lifesaving technologies toward validation and market availability. Our teams assess market viability of technology solutions, forge relationships with private-sector partners and create commercialisation strategy together with partners. Our trajectory for product development and introduction efforts includes product validation, regulatory approvals, policy alignment, establishment of manufacturing supply, and the introduction and scale up of new technologies through demand generation and commodity procurement guidance. In this way we are able to improve the lives of women, newborns and children in a tangible way.

The work that PATH does addresses some of the leading causes of maternal morbidity and mortality in developing countries, such as postpartum haemorrhage (PPH). Could you tell us more about this condition?

PPH causes an estimated 25 per cent of all maternal deaths and is the leading direct cause of maternal mortality worldwide. These deaths are especially tragic because PPH is a treatable condition. Immediate PPH accounts for most cases of obstetric haemorrhage and 70-90 per cent of all PPH is due to uterine atony – the failure of the uterus to contract adequately after delivery of the placenta. Although it is hard to predict if a woman will develop PPH, risk factors include prolonged labour, multiple births and previous history of PPH. If PPH is not controlled in a timely manner, some women may require emergency hysterectomies. Additionally, if women survive PPH, approximately 12 per cent will have severe anaemia and they are significantly more likely to die in the year following PPH.

In settings where maternal mortality is highest, three crucial delays are directly associated with elevated rates: first, a delay in seeking healthcare; second, a delay in reaching a health facility; and third, a delay in obtaining appropriate care upon reaching a health facility. Many women experiencing an obstetric complication arrive at public hospitals in a critical state because of the first two delays. Unfortunately, although women may overcome the first two delays, they often die at the health facility because they do not receive timely, appropriate care.

Preeclampsia and eclampsia are other significant causes of maternal morbidity and mortality in developing countries. What are these conditions and how are they treated?

Preeclampsia is the rapid elevation of blood pressure during pregnancy. If untreated, it can lead to seizures (eclampsia), kidney and liver damage, and ultimately death. Over the years, different anticonvulsants have been used, including magnesium sulphate (MgSO₄),
A fair chance of leading a healthy life

PATH is a world leader in developing technology solutions that improve health and save lives. The international non-profit organisation has advanced many affordable and user-friendly innovations to transform the lives of the world’s most vulnerable women and children.

AT THE BEGINNING of the 20th Century, the average life expectancy for a US citizen was approximately 47 years. By the start of the 21st Century, the average had leapt to almost 78 years. This dramatic increase is in no small part thanks to developments in medicine and vaccinations. However, prevention and treatment are only effective if administered – high incidences of particular diseases that have practically been eradicated in the Western world remain significant health concerns in many developing countries.

By its nature, private industry must ensure profitability in its R&D activities. As a result of this, poorer countries – many with large populations – are often neglected, in terms of being provided effective, affordable medicines, vaccinations and equipment. Fortunately, partnerships between industry and not-for-profit organisations exist as a means to address the issue of neglect, helping millions of people gain access to the health services they need.

TECHNOLOGICAL SOLUTIONS

PATH (formerly known as the Program for Appropriate Technology in Health) is one such organisation intent on establishing health equity through a belief in the power of innovation. For almost 40 years, PATH has been translating concepts for improving and saving lives into technological innovations that make a real difference to millions of people around the world.

Along with public- and private-sector partners, PATH develops health technologies across a broad area, spanning devices, drugs, diagnostics, vaccines, and system and service innovations. Three of PATH’s most recent projects focus on providing and facilitating the use of technological solutions to improve newborn and maternal health by addressing the leading causes of maternal and infant mortality.

A real difference to millions of people around the world.

 Are there projects you are currently working on to deal with these conditions?

The technologies within our Health Technologies for Women and Children Group focus on addressing user needs related to disease burden of women, newborns and children. Our vision is to protect and promote the safety and health of all mothers and babies by ensuring utilisation of appropriate care. PATH is developing products to offer solutions for the maternal health problems we have already discussed including a uterine balloon tamponade as a treatment option for postpartum haemorrhage and user-friendly administration options for MgSO₄ to manage convulsions related to preeclampsia and eclampsia. Product development for newborn health provides solutions for vulnerable preterm infants by offering respiratory support via bubble continuous positive airway pressure and oxygen blender devices.

Two randomised control trials – the Collaborative Eclampsia Trial and the MgSO₄ for Prevention of Eclampsia Trial – provided the scientific evidence needed to promote MgSO₄ as the anticonvulsant of choice for the treatment of severe preeclampsia and eclampsia.

UTERINE BALLOON TAMPONADE

Postpartum haemorrhage (PPH) is defined as the loss of more than 500 ml of blood within the first 24 hours of childbirth and is the leading cause of maternal death worldwide. Although it can be prevented and treated, women in low-resource settings often only receive the most basic emergency obstetric care. PATH has advanced an innovation that aims to treat and stabilise the condition until the patient can be moved to higher-level facilities. The organisation is collaborating with Sinapi Biomedical in South Africa to develop an affordable and optimised uterine balloon tamponade (UBT) device. The UBT is an effective means of stopping the haemorrhage quickly (typically within 5-15 minutes of insertion), often saving the woman’s life.

The UBT is inserted into the woman’s uterus and filled with water, causing it to exert pressure in the uterine cavity and act as a tamponade to stop the bleeding. While there are standard treatments such as uterotonic drugs that are generally effective, UBT is especially important when more conventional methods fail or are unavailable. Its lifesaving potential is crucially important, but it also functions as a less radical means of stopping bleeding than other invasive procedures. “UBT could help women avoid emergency surgery,” explains Dr Patricia S Coffey, PATH Senior Program Officer. “It is currently being introduced in several countries in Africa for use by trained midwives and nurses, and has been found to be safe, easy to use and very effective.”

Despite the obvious benefits of the UBT, it is still largely underused in low-resource settings, mainly because many are unaware of its existence and how effective it is, but also because the few commercially available devices are prohibitively expensive. However, the PATH team is working hard to address the issues surrounding PPH. “There is a condom catheter balloon which is assembled using off-the-shelf components available at the clinic level, but it requires assembly at the time of emergency and, while effective, is not ideal,” Coffey highlights. “Pilot introduction projects are being created in Africa to increase awareness of the intervention and to support plans for introduction efforts within ongoing maternal health programmes. Our collaboration with ministries of health means PPH strategies will be updated to include lifesaving interventions such as the UBT.”
THE bCPAP DEVICE

Complications resulting from preterm birth are a leading cause of infant mortality in many of the world’s poorest places but are easily preventable if the right treatment is administered.

PATH’s team developed a low-cost bubble continuous positive airway pressure (bCPAP) kit and oxygen blender for neonates. Although such devices are standard in developed countries, their high cost – along with the need for pressurised oxygen and air, steady power, and access to trained technicians and replacement parts – necessitated the design of a low-cost bCPAP made from medical supplies kept in stock by most vendors in developing countries.

PATH set about developing a low-cost pre-assembled kit that did not require the use of valuable hospital supplies. As well as the development of a pre-packaged, pre-assembled kit, PATH included an oxygen blender that mixes oxygen gas with room air prior to delivering it to the baby. This was an essential consideration, as Coffey elaborates: “Premature babies who breathe 100 per cent oxygen are at risk of blindness, brain damage and chronic lung injury. An oxygen blender is a device that cannot be improvised by healthcare workers”.

Alongside ongoing product development, PATH members are interviewing stakeholders and visiting health facilities. They anticipate that they can identify future target markets and potential early adopters by talking to healthcare professionals who use their devices.

Three project examples from PATH illustrate how the organisation develops and facilitates the use of technological solutions to improve newborn and maternal health.
With these innovations, along with the many HEATH EQUITY to-use pack – containing essential items facilitate the use of MgSO₄. The MgSO₄ ready-to-use pack – containing essential items for MgSO₄ administration – is one such tool. After surveying policy makers and healthcare professionals in the Democratic Republic of Congo, Ethiopia, Senegal and Uganda, the team realised that, although the concept of a ready-to-use pack was well accepted, there were some concerns regarding the overall cost, different expiration dates for each component in the pack, and the risk that packs would be opened and components used for other purposes.

First, the standard regimens recommended by WHO are complex and require different dilutions of MgSO₄ for intravenous and intramuscular administration. Most service providers encounter eclampsia infrequently and remembering the complex regimen in an emergency is daunting. Second, there are multiple presentations of MgSO₄ currently available on the market, making the calculation of the correct dosage and dilution complex and confusing. Third, there are frequent stockouts of the items necessary for MgSO₄ administration, such as lidocaine and large syringes, due to weak supply chains and inadequate inventory control.

To address these issues, PATH has been developing and evaluating various tools to facilitate the use of MgSO₄. The MgSO₄ ready-to-use pack – containing essential items for MgSO₄ administration – is one such tool. After surveying policy makers and healthcare professionals in the Democratic Republic of Congo, Ethiopia, Senegal and Uganda, the team realised that, although the concept of a ready-to-use pack was well accepted, there were some concerns regarding the overall cost, different expiration dates for each component in the pack, and the risk that packs would be opened and components used for other purposes.

With this feedback in mind, the team at PATH changed tack. “We realised that additional effort should be made to increase and ensure the proper use of MgSO₄ at lower-level healthcare facilities,” Coffey outlines. Validating potential solutions with users is a critical part of PATH’s product development effort. Shifting direction may be an outcome, but this is a way to ensure introduction of products that will reach as many people as possible. “PATH’s work in developing a reusable, electricity-free, low-cost infusion delivery system, as well as a gel form of MgSO₄ for rectal administration, are the areas of focus in this regard. These new technologies would make it easier for healthcare professionals at lower-level facilities to administer MgSO₄, thereby increasing proper use of the product.”

HEALTH EQUITY
With these innovations, along with the many others already in widespread use, PATH is helping improve the health and saving the lives of people around the world. Previous, existing

INNOVATION PLATFORMS
PATH solves health challenges by taking a multidimensional approach that accelerates the development and delivery of innovations, focusing on five different areas they call ‘platforms’.

Devices: such as water filters for use in the home and prefilled, nonreusable syringes
Diagnostics: to detect and track diseases
Drugs: to effectively treat diseases at lower cost
System and service innovations: to ensure that all the tools they develop reach the people who need them
Vaccines: to give children the best possible start in life

HEALTH TECHNOLOGIES FOR WOMEN AND CHILDREN GROUP
OBJECTIVES
To accelerate innovation and drive improvements in the health of women, children and newborns around the world, the Health Technologies for Women and Children Group at PATH harnesses entrepreneurial insight, scientific and public health expertise, and passion for health equity.

PARTNERS
Balloons tamponade: Massachusetts General Hospital, USA • Sinapi Biomedical (Pty Ltd), South Africa
Magnesium sulphate: UN Commission on Life-Saving Commodities for Women and Children, Maternal Health Technical Resource Team • Sinclair Research, USA
bCPAP: University of Washington Department of Pediatrics, USA • Seattle Children’s Hospital, USA • Adara Development and Kiwoko Hospital, Uganda

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