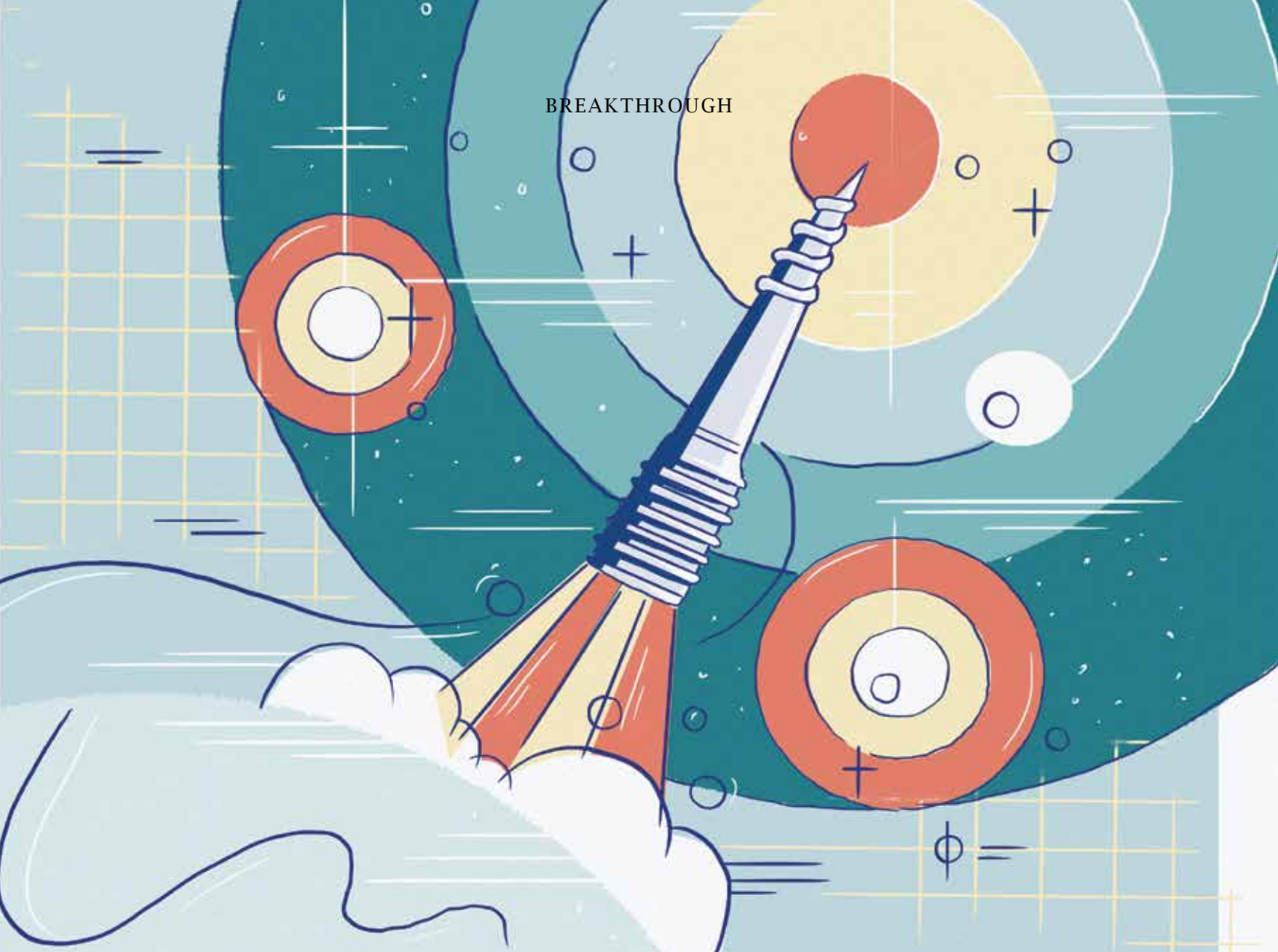


SILVER BULLETS IN MEDICINE

With the world in a period of flux – some might argue crisis – solutions-driven thinking is more important than ever. Innovation in healthcare is becoming a major global focus as medical-related organisations face unprecedented challenges to improve quality and access, increase efficiency, eliminate waste and reduce harm and infection, while containing costs. But it takes resolute, lateral thinkers to focus unwaveringly on the problem until a solution is found. Once in a while, a new technology, an old problem and a big idea turn into an innovative solution. Health journalist **KATHY MALHERBE** focuses on two innovations that provide simple, yet brilliant solutions.

ILLUSTRATIONS **ELOISE TIMMIS**

‘BLOOD IS THAT FRAGILE SCARLET TREE WE CARRY WITHIN US’

Osbert Sitwell, poet and author

The network of arteries that carries oxygen-rich blood from the heart to the brain and body and returns deoxygenated blood via the veins is indeed the tree of life. Any rapid loss of blood is life-threatening. ‘There is a term in emergency medicine, the “golden time”,’ says Dr Jonathan Louw, CEO of the South African National Blood Service (SANBS). It’s a time period lasting a few minutes to several hours, during which prompt medical attention is imperative in order to prevent death. When a patient loses massive amounts of blood, there is only one hour to give them the lifesaving transfusion that will deliver oxygenated blood to the brain.

‘One of the problems that the SANBS has been wrestling with for years,’ says Dr Louw, ‘is getting blood delivered to rural hospitals in South Africa in time.’

The solution, developed by a team of blue-sky thinkers from SANBS and German start-up Quantum Systems, comes in the form of a highly specialised drone, which can be used to transport emergency blood from blood banks to hospitals in remote areas more efficiently and faster than ever before.

Dr Louw explains: ‘Our concept is globally unique in that we will provide two-way logistics. O-negative blood is universally compatible, ideal for emergencies, but only as a temporary measure. To save the patient’s life, the O-negative blood is dispatched rapidly to the hospital. The drone returns with a blood sample from the patient for a cross-match, and then we safely and rapidly deliver compatible blood back to the patient.’ The cost? A paltry R10 per flight.

The team has called the drone ‘*Ntinga*’ from the Xhosa proverb ‘Ntinga, ntaka, ndini’ which, loosely translated, means ‘Commanding an eagle to fly’.

Ntinga takes off and lands vertically and, once in flight, is highly efficient and streamlined. Like a drone, it is controlled remotely.

‘A MILESTONE IN THE HISTORY BLOOD TRANSFUSION’

For the aerophiles, *Ntinga* is engineered to meet seven criteria: speed, two-way logistics, physical conditions, safety, payload capacity, distance and cost. Which it does more than adequately. *Ntinga* is a professional and high-performing unmanned aerial vehicle (UAV) with a maximum take-off weight of 13.5kg (up to four units of blood) and can fly at speeds of up to 180km/h. It was designed from the outset as a fully electric transition aircraft, is able to glide to the ground or deploy a parachute in the event of an emergency, and is fully autonomous.

There’s something for the petrolheads too. The drone has a miniature 1960s VW air-cooled radiator, created by a 3-D printer – the electrical charge over the plate acts as an air conditioner keeping the blood cool.

Blood cargo is fragile, so the integrity of the blood or sample cannot be compromised during the flight. Unlike 007’s martini, it can neither be shaken, nor stirred. Which is why the cargo department in the fuselage is as ‘protective as a womb’ and is designed to ensure the temperature during the flight and G-forces do not jeopardise the blood. Dr Louw believes that this is, ‘a milestone in the history of blood transfusion, not only in South Africa but the entire world’.

So how long did it take from concept to prototype? ‘We could have just outsourced the development but instead we wanted to build a competence within the company. We put together a drone task team consisting of senior managers across the working group. The internal campaign to train people included technicians, safety officers, ground-station operators and drone pilots.’ It was led by Dr Louw, who is not only a medical doctor but also a qualified drone pilot.

When *Ntinga* lands at a hospital, what’s to prevent just anyone from taking the blood? Security is tight, says Dr Louw: ‘A unique identification system is being developed to verify who opens the fuselage through fingerprinting or inputting a code received by SMS. On-board cameras record the entire flight and handover.

In South Africa, ‘the problem of postpartum haemorrhage is of particular concern,’ says Dr Louw. In the last year for which comparative international statistics are available, 123 mothers per 100 000 live births died soon after delivery. The losses place us 121 out of 138 countries. Excessive blood loss is a significant cause of maternal death in the hours following birth.

READY FOR TAKE-OFF

Like many innovations, transporting blood is just the beginning. Dr Louw believes the possibilities are endless: snakebite antivenom, vaccines, emergency antibiotics, even organs for transplant, could be transported.

Ntinga is a dream come true for SANBS, a real solution for patents in dire need of lifesaving blood transfusions. Its development has also been significant for 29-year-old Lebohang Lebogo, the first drone pilot at SANBS who will be controlling the craft.

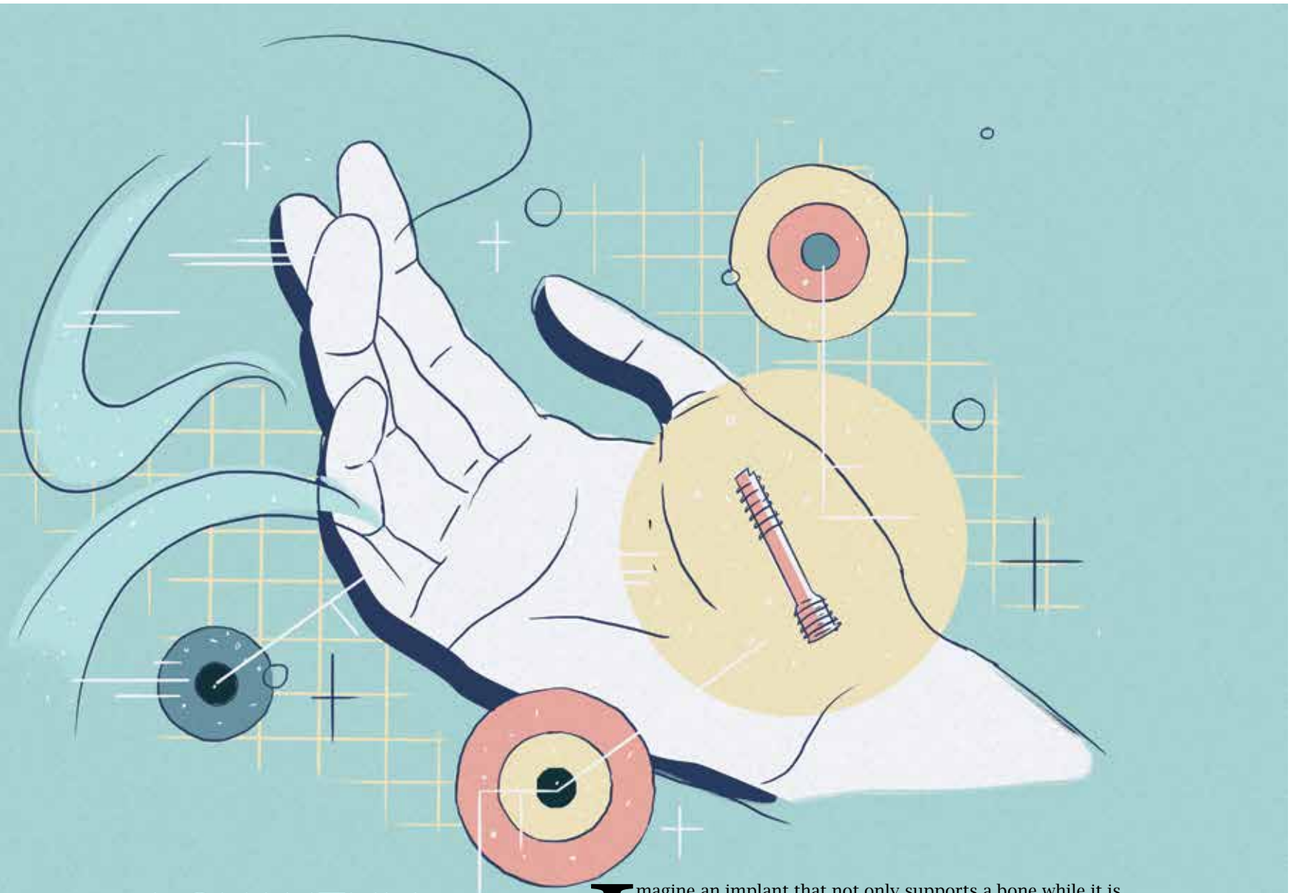
Lebogo always wanted to be a pilot. ‘My parents could not afford to send me to aviation school. So my mom told me about an opportunity to work as a temp at the blood bank and I joined in 2008,’ she says.

The dream to become a pilot never dissipated and she decided to put herself through school to achieve her goals. ‘Right now,’ she says, ‘I have my student licence and I’m working towards getting my private licence.’

Approval by the CAA (Civil Aviation Authority) is the only thing standing in the way of *Ntinga*’s lift-off. But Dr Louw is optimistic that the go-ahead will be received in the next few months.

Soon, ‘Flight O-negative’ will be cleared for its all-important take-off, touch down gently, release its precious cargo, collect a blood sample and make the flight back to the SANBS base.

This is ‘a milestone in the history of blood transfusion, not only in South Africa but for the entire world’



A QUANTUM LEAP IN IMPLANTOLOGY

Imagine an implant that not only supports a bone while it is healing but is reintegrated into it. Imagine that the implant is made of an element that is the natural base of our bones and is also a biological nutrient. Imagine that after a few years, radiologists studying X-rays can no longer differentiate between the original bone and the implant because it has been seamlessly assimilated into the body's skeleton. Could that happen?

Professor Utz Claassen, CEO of German-based Syntellix AG, did more than just imagine. An indefatigable solutions-driven entrepreneur, management consultant, investor and scientist, he took a problem that researchers had been battling with for more than 100 years, and found a solution by developing a bio-absorbable, biocompatible implant.

Magnezix is the first globally approved, resorbable, orthopaedic magnesium implant in the world. It's a quantum leap in implantology and bears testament to the work of a nebula of bright minds in bioengineering, material sciences and medicine.

Magnesium is an essential mineral in our bodies, a kind of *wunderkind* that activates 300 enzymes crucial for human metabolism, efficient muscle and nerve function, a strong immune system, a healthy heart, and the construction and reinforcement of bones.

Professor Claassen says, 'In 2007, I would have been told I'm crazy.' Perhaps that's inevitable, as billionaire Larry Ellison, founder of Oracle said: 'When you innovate, you've got to be prepared for people telling you that you are nuts.'

Despite being a brilliant idea, there was the development and extensive clinical trials to get through. Claassen says, 'It's been a long road to the final product and years have been spent in meticulous research and development before the right compound material was earmarked and the corresponding advanced production processes were developed.'

MENDING BROKEN BONES

So what's wrong with current implants? Quite a lot, in fact. Professor Claassen says polylactide, a natural polymer, and titanium have been the 'go-to' materials for implants for at least the last 50 years. The problem is that even though polylactide is resorbable it leaves, 'hollow' spaces in the bone – undesirable in terms of future stability. He also says that up to 30% of polylactide implants cause irritations, which is not conducive to healing.

Then there's titanium. Light and strong, it is considered ideal for implants. 'Not so,' he says. The rigidity of titanium is not compatible with the natural state of bones. It may be stable and strong but it is inflexible. Unlike bones, which 'may seem like stone but are connective tissue which is tirelessly, ambitiously alive and more animate than muscle'. And, finally, although titanium is generally considered a safe metal to use for implants, some studies have suggested that it may cause health problems, either at the site overlying the implant or in distant organs, particularly after frictional wear.

Titanium implants also cause stress-shielding, a reduction in bone density due to reduced stress loads on bone. Understandably, this could lead to refracture later (up to 27%) and possible infection rates of up to 20%. In many cases a second surgery is needed to remove the metal implant.

Professor Claassen says, 'Magnezix combines the advantages and stability of conventional implants and the degradation of resorbable implants (polymers) – creating an implant that morphs into natural bone through resorption, offering an ideal combination of metallic stability, near-bone elasticity and bio-absorbability. Magnesium not only accelerates healing, but has an antibacterial function and creates an osteoconductive surface that allows bone growth on the surface and down into the pores, channels or pipes.'

Preliminary studies carried out by a leading research group from the University of Shanghai in China showed that the hydrogen given off during the reabsorption process could potentially inhibit future cancers.

EVERYBODY WINS

Tens of thousands of Magnezix implants have been used by a growing number of leading orthopaedic surgeons, sports physicians and paediatric surgeons worldwide. There is an exponential benefit to patients, hospitals, the health system, the environment and society in general.

FUTURE IMPACT

Is Magnezix a true disruptor? Disruptive technologies are born from the need to solve a current and pertinent problem with an out-of-the-box solution. It is welcomed by the end user and feared by competitors. 'But it is not about the competitors,' says Professor Claassen. 'It's about the patient, the healthcare system and the medical practitioners. No surgeon wants to use his expertise removing implants when there are more beneficial surgeries to be done.'

Plans are in place to develop and expand the range to include use in traumatology and paediatrics, with a promising future to enter additional markets such as neuro and dental surgery. It's unsurprising that close to 90% of revenue at Syntellix AG is used in R&D.

Equally unsurprising is that Professor Claassen has been the recipient of a number of awards including the 2019 German Innovation Award in Gold, the Product of the Year category in the Sustainability Award 2018 program and Innovator of the Year in 2017 (with Syntellix AG).

In South Africa, Magnezix is being used in Chris Hani Baragwanath, King Edward, Livingstone, Port Shepstone, Edendale and RK Khan hospitals.

There is only one thing stronger than all the armies in the world. That is an idea whose time has come. Magnezix's time has come. It's what we informally call a 'no-brainer.' ■

Disruptive technologies are born from the need to solve a current and pertinent problem with an out-of-the-box solution