VOICES OF SURGERY

INTO THE FUTURE

A PUBLICATION DEDICATED TO GLOBAL SURGERY
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No Power, No Oxygen, No Problem
Gradian Health Systems, a non-profit medical technology company discusses their transforming impact in multiple hospitals around the world.

Using a 3D Printer In Reconstructive Neurosurgery
Nadia Ekinovic describes a cost effective and innovative approach to reconstructive surgery in Bosnia and Herzegovina.

The Power of Collaboration
Orthopaedic residents from Ethiopia and the UK have been collaborating in multiple research projects, celebrating their achievements in an annual “Resident's Day”

My Voice Of Hope
Henang Kwasau takes on a journey through her medical training, including witnessing the E-bola outbreak in Sierra Leone and her new determination to pursue a career in surgery.

Digitalizing and Distributing Essential Clinical Knowledge In Zimbabwe
Michael Dera and Dr Tafadzwa have created an online platform to distribute essential clinical knowledge throughout Zimbabwe. They explain how they did it.

Minimally Invasive Global Surgery
Nejra Selak and Amila Šabić highlight the importance of minimally invasive surgery in low income settings, as well as the challenges and successes of implementation.
INTO THE FUTURE

February 2019

Dearest Readers,

Our technological world is rapidly advancing whilst it spins through the solar system. We, as humans, are reaching higher, travelling further, digging deeper to further our understanding of life and all its meanings.

It is inevitable that this growing knowledge will envelop all spheres of life. In our combined quest to improve access to safe surgery worldwide, we as committed partners must also capitalise on new and emerging technology to achieve our goals.

As we will read in this issue, technology can help surgical care reach the farthest and remotest corners of the world. It can help create economically feasible solutions to vexatious challenges. It helps connect the skills and expertise of the global surgery workforce into a united, stronger voice.

Simultaneously, whilst we advance in our knowledge, committed young individuals power their medical training with a dream of overturning this world of neglected surgery. Current medical students, residents and trainees will be the future leaders of the global surgery movement, implementing policies, action plans and care for the under-served.

Within this issue, we present this vision of the future with stories of hopeful training of surgeons, residents and trainees collaborating from LMICs and HICs. As a community, we must strive to provide this boundless young optimism with rational opportunities in research, training and teaching.

It is therefore essential that to get the most out of our sustained advocacy efforts, we do not undermine the importance of technology and training in global surgery. Frugal innovation, technological solutions and ingenious training models are keys to realizing the goals of global surgery.

With love always,

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&

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NO POWER, NO OXYGEN, NO PROBLEM.

ONE.SURGERY interviews Adam Lewis from Gradian Health Systems, a nonprofit medical technology company that works to transform the impact of medical equipment in low-resource hospitals around the world.
Dear Adam, thank you for joining us at One.Surgery. There has been some remarkable recent advances in surgical technology, from robotic surgery to training in augmented reality, yet most of the world lags behind in the most basic of equipment. Despite well meaning donations, sadly, old, broken and obsolete technology often filters down to operating rooms in austere settings. How is Gradian tackling this problem?

First of all, thank you to Saqib and One.Surgery for the opportunity to share our work with the global surgery community. Gradian was borne out of exactly the challenges you describe around the provision of safe surgery in low- and middle-income countries—the fact that most surgical equipment is old or non-functional, that most surgeries are conducted in settings with weak infrastructure, and that most providers are non-physicians with limited specialty training. We believe we’ve built a business model and a global network that solves for these issues.

The technology we develop is rooted in two main principles:

1) it must have specific features designed to overcome infrastructure challenges in low-resource settings (lack of electricity, oxygen, running water, etc.).

2) It must be certified to meet international standards of quality (from regulatory bodies like CE or FDA).

Also, thanks to our network of local distributors and biomedical technicians covering all our markets, we are able to offer a three-year parts and service warranty, which keeps our equipment up and running and mitigates many of the circumstances that lead medical devices to fail or become obsolete.

Lastly, we make sure every new user knows how to operate our equipment safely and effectively. To do that, we deploy teams of local physicians along with high-fidelity medical manikins to simulate surgical scenarios and enable rural, non-physician providers to refresh key clinical techniques while learning how to use our product.

Our ability to offer this package hinges on a hybrid, nonprofit business model: we sell our products at an affordable price, reinvesting all revenue into product development or in-country operations (like service and training); and then we leverage grant funding to cover all other expenses related to service and training. This blended revenue structure enables us to go beyond the offerings of traditional medical device companies to better meet the needs of our customers in more difficult markets.

What are the specific challenges you have faced when designing equipment in austere environments?

One major challenge we face is aligning need with demand (and too often, conflating the two). It’s not enough to design a technology that solves for the needs of low-income countries if it’s not viable in the market; likewise, it’s not enough to design a technology that’s viable in a low-income markets if it doesn’t solve for the needs of its users and environment. Balancing these two factors is crucial to developing and commercializing medical equipment in the places where we work.

Another challenge is ensuring that the inputs and parts needed for our equipment are accessible locally (geographically and financially). A well-designed product that requires proprietary consumables only available in the U.S. or Europe (or simply too costly) would fail to fulfill its function in a region like sub-Saharan Africa, where supply chains are less developed and it’s expensive to import equipment parts.
Finally, perhaps the harshest truth about product design for low-resource settings is that no technology can prove its value in a lab or workshop (even ones that pass rigorous regulatory approval). It’s impossible to overstate the importance to validating products in their place of final use to ensure that all factors related to their effectiveness—voltage, dust, humidity, user education, local epidemiology, etc.—are accounted for.

The universal anaesthesia machine (UAM) was designed specifically for surgery in low income settings. I remember operating once with a mobile phonestorch light when the electricity went during a case in Sub Saharan Africa. During such a scenario, how does the UAM help save lives?

Unfortunately the UAM doesn’t offer any lighting solution, but it does have two major features that make it ideal for settings like the one you’re describing.

First is its ability to generate its own medical oxygen. With a built-in oxygen concentrator, the UAM draws in air from whatever room it’s in, purifies it, and then uses that gas to deliver anesthesia to the patient. (It also connects to other oxygen sources as needed.) The UAM is the first CE-certified anesthesia machine in the world with this capacity—a huge benefit for facilities with unreliable access to oxygen, which is often expensive to procure and transport.

Second is its ability to work without electricity. If the power fails, so will the UAM’s oxygen concentrator, so the machine automatically transitions to “draw over” mode, which allows it to use room air to deliver anesthesia to the patient. The UAM also comes with an automatic ventilator, patient monitor, and oxygen monitor that all run on long-life battery backup, preventing operations from being postponed or referred.
Where is the UAM now being used in the world?

The UAM is currently being used in more than 550 operating theaters across 26 countries, 21 of which are in sub-Saharan Africa.

How do you provide maintenance to your equipment, being based so far away?

All of our equipment is maintained by local biomedical technicians who we certify at our training center in Nairobi. For every unit we place, we guarantee at least three years of customer service that includes annual preventive maintenance, on-demand repairs, unlimited spare parts, and remote support via phone and WhatsApp. By bringing our after-sales service operations to each of our markets—often relying on our distribution partners—we’ve managed to reduce downtime on the UAM, extend its lifespan in many cases, and empower local entrepreneurs and companies to grow their service offerings and expand their business.

You have multiple partners in researching the UAM for on-going improvements. Has the design been upgraded as a result of ongoing research?

By far the most important research we could undertake is communicating directly with our users, trainers, and technicians to understand how the UAM is performing, trends behind common failures, and opportunities to enhance both the product and how we support it. Over the past few years, we’ve collected hundreds of insights from our in-country colleagues that have informed the evolution of the UAM’s design. First came the addition of the UAM’s automatic ventilator in 2015, in response to demand from users who were using the UAM for longer operations. Next came the addition of a sevoflurane vaporizer (for more advanced markets) and a few other small tweaks. Then came a more robust upgrade in 2018, which included a consolidated breathing block, a more durable shipping crate, and a revamped look and feel.
We’ve also amended our surrounding services to be more responsive to the needs of our markets. For instance, we began to hear feedback that our standard product training—one day of lectures and one day of proctored cases—was often insufficient: maybe the facility didn’t have any cases to practice on, or the cases were too high-risk, or the providers had never used an anesthesia machine before so their skills were rusty.

We took this feedback to heart and enlisted a team of doctors from Sierra Leone, Zambia, and Tanzania to help us redefine our training offering so it centered on simulation-based scenarios and clinical techniques—carried out either on-site through portable simulation technology or in a centralized simulation lab.

On a similar token, we are in the process of revamping our after-sales service strategy based on customer and distributor input. After recently moving from a two-year warranty to three years, we realized that we were still facing market and supply chain difficulties after the warranty period, with customers often unable or unwilling to devote tight budgets to equipment maintenance and parts. So we’re exploring a new offering that would make it easier (and more affordable) for our distributors to support hospitals with Gradian parts and service.

Funding a sustainable project is an enormous challenge in low income countries. Whilst hospitals in developing countries cannot forever rely on inappropriate equipment donations, non-government and charitable organisations must also find a way to fund their activity. How does Gradian Health sustain its service and do you feel this is the best model for long term sustainability?

This question is of utmost importance to us at Gradian. Most countries in sub-Saharan Africa do not have the purchasing power or health systems for device companies to make large margins on equipment sales, so the economics may prevent a for-profit company from thriving in these markets. However, donor-driven efforts are unsustainable on their own, they can skew market dynamics, and they often neglect on-the-ground preferences and demand.

We’ve found that using commercial forces creates a sense of local ownership that contributes to sustainability: a hospital or government that pays for the UAM has a vested interest in keeping it operational. At the same time, the cost to produce and locally support a high-quality machine like the UAM is significant; so for it to remain affordable in low-income markets, we have to sell it at a price that leaves little-to-no profit for our operations. As a result, we’ve relied on philanthropic funds to round out our service and training needs in markets where our customers require
more support than our sales revenue can cover. (In 2018, our revenue was split almost evenly between sales and grants.)

Whether or not this model is scalable or replicable for other industries is something we’re currently testing. Our hope is that there is a model (Gradian’s or another one entirely) that can enable low- and middle-income countries to “graduate” past donations, make their own decisions on medical equipment, and finance the full spectrum of related costs to ensure long-term sustainability of their investment.

**What are the next goals for Gradian Health now?**

Our core goals for 2019 (and beyond) involve our training model and second product. We are seeing significant commercial demand for the UAM throughout markets in East and West Africa, and in parallel, we believe we could set a new standard for product training in these regions. We hope to test and validate our simulation-based training curriculum and expand it to new markets later this year. We expect this pursuit to include the establishment of simulation labs at major teaching hospitals as well as an innovative model for mobile simulation training that could be ideal for rural facilities.

We are also excited to roll out our second product: the Gradian CCV (Comprehensive Care Ventilator)—a portable mechanical ventilator with 21 hours of battery backup that has been certified by the CE and cleared by the FDA. With configurations for ICUs as well as emergency transport—along with easy-to-use features and a durable construction—the CCV has the potential to transform critical care in low-resource settings. We’re eager to integrate it into our distribution network and begin marketing it throughout sub-Saharan Africa.

**How can any interested parties best communicate with Gradian?**

We’re always delighted to hear from colleagues and friends who share our mission and might be interested in our work. We encourage interested parties to connect with us on social media (Twitter and Facebook), check out our website for updates and job postings, and reach out to us as opportunities arise!

Many thanks Adam for joining us as One.Surgery. For further information and contact details, please visit their website at GradianHealth.org, or view a TED talk about the universal anaesthetic machine here:

https://www.ted.com/talks/erica_frenkel_the_universal_anesthesia_machine
USING A 3D PRINTER IN RECONSTRUCTIVE NEUROSURGERY IN BOSNIA AND HERZEGOVINA

NADIJA EKINOVIC
Not very long ago, in the small town of Zenica in the
heart of Bosnia and Herzegovina, a neurosurgeon
came up with an ingenious innovation that
transformed the life of an individual and brought
Bosnia and Herzegovina on the world map of global
neurosurgery. This is also a fairy tale story of
technological and economical alternatives in lower
resources settings to what is considered a
financially catastrophic specialty.

"I was on a scaffold and they told me I fell down.
According to their words, I was aware of myself and
my surroundings, I talked to people and answered
every question in the emergency room, but I do not
remember that. I only remember the moment when I
woke up in the hospital and was asked about the
whereabouts of my van and my belongings."

That is how a young man recounts his story from two
years ago. He would later learn that a group of
neurosurgeons had to perform an emergency
procedure. Half of his skull had to be removed in
order to give sufficient space to his inflamed and
subsequently expanding brain.

Eventually he came out of coma, recovered
gradually and was ultimately discharged from
the hospital. Unfortunately he was left with
a continuous reminder of this incidence - an obvious
layer of thick skin covering his brain where the
fragments used to be.

The initial recovery went well and there were no
significant complications. His family was thankful to
God and to the doctors. He was lucky, some said but
ultimately, the patient was very conscious of the
missing part of his skull whenever he would look into
a mirror.

However, the neurosurgeons had planned for
reconstructive surgery from the very beginning of his
care. Neurosurgeon, Hakija Bećulić from the
Cantonal Hospital of Zenica had a choice of three
methods for the reconstruction of the skull
defect.

Most commonly used method is to place a
titanium plate over the missing bone fragment.
But given the extent of this young man’s injury, a
titanium plate would be too heavy and all heavily
needed future MRI scans would be out of
question.

Dr. Hakija could also use a hand-made implant or
a 3D printed bio implant. Both of these options
faced problems of cost and other consequences
of the extent of his injury. Since no one in the
region used a 3D Bioprinter, Dr. Hakija came up
with a fourth option, an economically better
alternative. His idea was to create a plastic mould
of the missing fragment. It had the added
advantage of being lighter in weight
and furthermore it could endure future MRI
scans. All he had to do was find a person who
could create such a mould and a series of CT
scans of Ibrahim’s head in order to make a digital
3D reconstruction.

During this time a group of engineering students
led by their professor, Denis Spahić had created
an Idealab Centre and had subsequently
everything Hakija needed to transform his idea
into a reality. Soon a partnership was made and a
mould was created in no time.

PRIOR TO RECONSTRUCTIVE SURGERY
The mould resembled a mirror image of the left side of Ibrahim’s head so it could be used on his right side. The next step was to make a cast replica of the right side of his head. In order to evade any possibility of infection and bodily rejection of the cast, Dr. Hakija decided to use dental stone.

Made out of special gypsum material, its hardness and chemical structure imitates a human skull. With minor modifications, the implant was ready to replace missing skull fragments.

Thanks to the innovative idea of neurosurgeon Hakija, his determination to succeed and the partnership with the Idealab Center, the highly complex reconstruction was successfully performed.

The patient was reborn, reconstruction giving the possibility to move willingly and confidently.

The patient was able to take selfies and to perform tasks that he had been hesitant to undertake after his injury. His head is more or less symmetrical again and the scar will soon fade away underneath his growing hair. It was a historic moment for the country, the entire surgical society, but the neurosurgical society in particular and the Idealab team involved in the care of this extraordinary case.

About the author

Nadija is a medical doctor in Bosnia and Herzegovina and a member of the One.Surgery team. She can be contacted via Twitter @miss_nadija
THE POWER OF COLLABORATION

THE USE OF TECHNOLOGY BY THE NORTHWEST ORTHOPAEDIC AND TRAUMA ALLIANCE FOR AFRICA IN ORGANISING THE ETHIOPIAN RESIDENTS DAY

MISS KOHILA VANI SIGAMONEY, MR. HENRY WYNN JONES, MR. ANTHONY CLAYSON
The Northwest Orthopaedic and Trauma Alliance for Africa (NOTAA) was established in September 2016 with the aim to bring together skills and expertise of orthopaedic healthcare professionals to improve trauma services in Africa. So far efforts in this direction have been concentrated in Ethiopia and Malawi with four trips to Ethiopia and funding of equipment in Malawi.

As the team is a multidisciplinary one, there are also orthopaedic trainees (registrars) who are involved. It was apparent during the first two trips to Ethiopia that the orthopaedic trainees in Ethiopia wanted help with carrying out quality improvement projects like audits and research. NOTAA’S trips to Ethiopia were generally for a period of around ten days. This was not enough time for a handful of UK orthopaedic trainees to help and train Ethiopian trainees in audits and research.

In the UK, carrying out research and audit projects is seen as an essential aspect of training towards a lifelong career in trauma and orthopaedic surgery. There is a growing passion amongst these trainees to be involved in overseas research projects.

NOTAA considered the needs of both the UK and Ethiopian trainees and came up with an idea for research collaboration and “Residents Day”. The Residents Day is when research work performed as a collaboration between UK trainees and Ethiopian Residents is showcased. Here, technology plays a game changing factor in the success of Residents Day. Two Residents Days, both successful, have been held so far, one in November 2017 and another in June 2018. The organisation of the day takes place a few months before a dedicated trip by NOTAA to Ethiopia.

Interests and further participation for the Residents Day is sought with the help of Mr. Saqib Noor’s “Viber journal Club”. “Viber” is a smartphone, internet-based, messaging application that is free to use and is widely used by the Ethiopian trainees to communicate. On the Viber journal Club, Interested Ethiopian and UK trainees are matched and then communicate through e-mail and work on projects together.

Trainees do not meet in person (unless they are part of the visiting team) but still manage to help each other and learn. Simultaneously, the Ethiopian trainees may be anywhere in the country for their
training and may not be able to travel to where Residents Day is held. However, if they can still attend, they are asked to participate in oral presentations and if they cannot, their work is presented as a poster presentation. In the last Residents Day held in Addis Ababa, these research collaborations were presented as e-posters with the help of simple tools such as a projector and a laptop. Competing residents and trainees are judged by a team and prizes awarded on the same day.

This innovative method of research collaboration and presentation levies no fees on residents or trainees, neither to participate nor to present. A feedback done to evaluate the effectiveness of this collaboration showed that Ethiopian residents found it to be an extremely useful tool and will be interested in introducing it into their curriculum. The work from the Residents Day can later be presented by both group of participants and have been approved by both Training Programme Directors. For example, the Ethiopian trainees submitted their work to the Ethiopian Society of Orthopaedic Traumatology Annual meeting and this was then published in the meeting booklet.

The Residents Day solely runs on the power of technology and communication. Despite its later success, when it was first held in Hawassa in November 2017, there were communication issues. The internet was not always available for connection and therefore some trainees could not get in touch with the UK partners, thereby struggling in collaboration. Ethiopia itself is developing with technology still in its infancy. Collaborations like these can pave the way for innovative training and teaching models in future.

These models can consequentially help reduce the knowledge and skills gap between trainees from HICs and LMICs. In addition to trainees helping residents, there is a reverse benefit to trainees receiving exposure to global surgery and the practice of surgery in different countries. Its economically feasible aspect with minimal logistics and resources needed raises its value as a training and collaboration model for low-resources settings. NOTAA is looking forward to organising further similar research collaboration and presentations in Ethiopia and other countries and for it to be successful, we need a balanced combination of collaboration and communication with the right intention and strong resolution.

Miss Kohila Vani Sigamoney, a trainee in the UK can be contacted via email: kohilavani_sigamoney@yahoo.com
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Digitalizing and Distributing Essential Clinical Knowledge In Zimbabwe

THE ESSENTIAL DRUGS AND MEDICINES LIST IN ZIMBABWE HAS BEEN TRANSFORMED INTO AN ONLINE PLATFORM.

MICHAEL DERA AND DR. TAFADZWA LIBERTY NYEVE EXPLAIN HOW THEY DID IT.
An introduction to EDLIZ

EDLIZ is the official handbook for essential drugs and medicines in Zimbabwe. It is has been printed and distributed to healthcare professionals in Zimbabwe for many years and is now in its 7th edition.

The Idea to build a digital EDLIZ

Our motivation for making a digital version of the guidelines were simple. They are the go-to reference for the prescription of medicines and drugs in the country and are used by practitioners every day. By improving the accessibility of the guidelines, we felt we would make a meaningful contribution to making the work of medical professionals easier.

Building EDLIZ

To find the best solution in terms of developing the application, we had to consider the environment. While internet connectivity continues to improve, a large part of the population lives in rural areas were there is no connectivity. A significant number of medical professionals serve in such areas. While we may not have the best connectivity, we do have a high mobile penetration rate. Medical professionals in the country are generally higher income earners and would have internet enabled mobile devices. We wanted to make a solution that could be accessible on mobile devices but was not vulnerable to intermittent data connections.

EDLIZ the Progressive Web Application

We decided to develop EDLIZ as a PWA (Progressive Web Application). The main advantage of developing it in this way was that we could simultaneously target all devices that had a browser and had internet access. The PWA approach also solved the challenge of professionals who may find themselves working in areas with unreliable internet connection. After first use of the digital format, the application will keep a cached version of the guidelines on the mobile device. This cached version provides reliable access where internet access may be intermittent. When a user does have access to the internet, the application will check for updates to the guidelines and update the cache to the latest version.

Developing EDLIZ

Over a period of more than a year we worked on converting the guidelines from the PDF format that they were in into HTML and CSS. We would meet when Dr. Nyeve was not on-call and when I was done with work, which would typically be at night and write code.

We spent several late nights working on it throughout the year whenever an opportunity afforded us. Dr. Nyeve also brilliantly committed to learning HTML so that he could actively participate in writing the code. Over that time, we wrote in excess of 20,000 lines of code while converting the format.
Open Source

Because of growing commitments elsewhere and the fact that Dr. Nyeve had to relocate to work at another hospital, we decided that it was best to open source the project so that we could let other developers participate in the development of the project. Following the decision, I shared the work on the project on Twitter. The response was amazing. Developing EDLIZ as a PWA had another great advantage. EDLIZ is built in HTML, CSS and JavaScript. The three are widely known languages for application development which has made it easier for developers to contribute to the project.

Road Map

We will be actively working on the repository that is on GitHub with community of Open Source developers it has already attracted. The goal is to progressively add feature to the application that will make it better and more convenient to use.

Consensus

Until we shared and Open sourced the project on the 15th December 2018, not many people knew the project was going on at all with the exception of a few friends of Dr Nyeve’s and I (which was just about as much consensus as we got before we started the work).

Perhaps the best form of consensus came after we shared the project, a tweet from myself (@michaelder) generated over 600 engagements primarily from people in the medical field. The responses were encouraging.
Funding

The project had been entirely funded by Dr. Nyeve and I for the year of development prior to us sharing it publicly. The main direct cost being cloud hosting and build tools.

Institutional Support/Barriers

There is a lot of red tape when it comes to decisions and for a while we were had to talk to a lot of different offices. Having gone through the multiple office what we got was that we could go ahead and digitilise the guidelines on the provision that we were not doing so for commercial purposes (to then sell the app). This process was made a lot easier because we were not requesting any funding to back the project.

Feedback

So the application is a pre-release and we have started to accept feedback from users. One of the reason we did share it was so that we know what features to prioritise. Its also worth noting the support we have received from other developers since putting the source code in a public repo on GitHub. We have received 8 stars on GitHub, 3 pulls requests, 1 fork, 2 issues filed and we had one developer porting the application to the Android and putting it on the Google Play Store.

About the authors

Dr Tafadzwa Liberty Nyeve is a medical doctor who loves making use of technology to enhance the quality of healthcare. Michael Dera is a software developer who is passionate about using open source software to solve problems.

For further information, Michael can be contacted via Twitter: @michaeldera
My Voice of Hope

HENANG KWASAU

HENANG IS FROM KADUNA, NORTHERN NIGERIA. SHE DESCRIBES HER INTERNATIONAL JOURNEY THROUGH MEDICAL TRAINING, INCLUDING WITNESSING THE EBOLA OUTBREAK IN SIERRA LEONE AND HER NEW MOTIVATION TO NOW PURSUE A FUTURE SURGICAL CAREER.
My journey towards medical training began excitedly with entrance into Bingham University in Karu, Nigeria. I was part of just the second set of admissions into the medical school programme. At the time, the university had not been granted full accreditation by the Nigerian Medical and Dental Council but we were hopeful that it would soon be fully verified. However, after three years, it became clear that there was to be no transition into clinical placements because full accreditation had still not been granted by the council. Furthermore, there was no clear timeline of when this may happen.

So I sadly packed my bags and went home to my parents. Although Bingham University was eventually granted full accreditation a few years after I left, at the time I was not ready to sit and wait for the unknown.

Reapplying to other Nigerian government universities would have meant resitting my premedical years which would have been difficult. Someone working with my father suggested that I try applying to the University of Sierra Leone (affiliated to Kings College, London), so I reached out to his in-law who was living in the country at the time and started the application process.

I travelled to Sierra Leone for the first time in pursuit of admission into the medical school even though I had no idea what to expect. I assumed that it would not be so different from Nigeria since it is also a country in West Africa.

Amazingly, I got direct entry, enrolling in a six year medical school programme. I had to commute by bus to a remotely located campus where classes for basic sciences are held. By the third year, I started taking classes at Connaught Hospital which is situated in the heart of Freetown.
I had to learn Krio which is the language that originated from the slaves that were returned to Freetown after the slave trade ended. The majority of Sierra Leoneans are only fluent in this form of creole.

I discovered that bread and rice were the staple food of the nation and in no time I had gotten accustomed to eating cassava leaves and potato leaves.

Freetown being a peninsula, is surrounded by beautiful beaches. I visited Aberdeen beach, Tokeh beach, Bureh beach and Number 2 beach. Most college raves took place at the beach. During my time in Freetown, I joined a college club called The Essence Club which is somewhat a sorority that engages in charity, youth empowerment and most importantly building lifelong friendships. I also joined a charity organisation called We Are The World.

In as much as Sierra Leone is not nearly as developed as Nigeria, I got international exposure that I probably would not have gotten if I were in Nigeria.

It is a country that depends greatly on foreign aid and there are various NGOs that work with medical students.

On several occasions, I got the opportunity of working for WHO as an independent monitor on the Expanded Programme on Immunisation (EPI). The Ebola virus exposed the wide breach of Infection Prevention and Control (IPC) protocol which resulted in the demise of two of my lecturers, Dr. Victor Willoughby and Dr. Sheik Umar Khan as well as junior doctors, nurses and other health workers.

I learned about a medical summer school at University of Manchester called Doctors Academy and attended in 2014, in the heat of the Ebola virus outbreak. It was a wonderful experience to interact with medical students and junior doctors from all over the world. It awakened in me a need to be at par with my colleagues around the world, as the saying goes “Think globally, act locally”.

In 2016, I did my electives at SHEBA Academic Medical Center (Tel Hashomer), a government hospital in Israel. It is the largest hospital in the Middle East.
It was an inspiring experience that catapulted me into the realm of interventional radiology and robotic surgery, I’d seen nothing like it before. I’ve always known that I would like to deal with children because apart from their small size, they don’t lie. In my high school yearbook, in the future ambition column I wrote “Paediatrician”. But when I got into clinicals, I found surgery to be very interesting. The same procedure is different in every individual. When I told my father, he said there’s a specialty called Paediatric Surgery. I had my mind made up at that moment.

Though it’s a sub speciality of surgery and takes many years of training, my mind is made up that this is the path I am willing to tread. There’s a huge knowledge gap in Africa and training here will not provide the platform for acquiring all the skills required to be a world class surgeon. Currently, I am in the process of taking the PLAB and registering in the General Medical Council (GMC) as a licensed medical doctor so that I can continue my training in the UK.

"I believe that in order to give my best to my country, I have to train under ideal conditions and acquire the skills and knowledge that will enable me to reach my full potential."

Henang would like to acknowledge and thank The Kings Sierra Leone Partnership, which was instrumental in her learning process.

Henang can be contacted on Twitter/Instagram @NaijaVoodooDoll and via email henangshamie@yahoo.com
MINIMALLY INVASIVE
GLOBAL SURGERY

NEJRA SELAK AND AMILA ŠABIĆ
Minimally invasive surgery (MIS) as a surgical approach has drastically increased in popularity in the last two decades (1). Continual advancements in this technology has seen greater innovation and ultimately greater solutions to surgical issues (2). This is perhaps most apparent in the role this technology plays in the process of improving surgical treatment in low and middle-income countries (LMICs) (2).

Today, MIS is the preferred treatment for a large number of surgical conditions in high-income countries (HICs), (4) but with minimal adoption in LMICs (5), where the surgical management of diseases is a major unmet need (2), these techniques are seldom used. Specific advantages of MIS in resource-limited settings of LMICs are multiple. Those relating directly to the surgery include smaller incisions with a resulting lower risk of infection in areas where clean water is not available, and decreased blood loss and a subsequent decreased need for blood transfusions in areas where blood banks are limited. Benefits can also be seen regarding the healthcare system as exemplified by earlier discharges and shorter hospital stays, and ultimately lower bed utilisation which increases inpatient capacity for patients with common and benign diseases to receive the appropriate surgical care (6). This increased patient turnover also affects positively the resident training due to the potential for a higher number and frequency of surgical cases (6). Moreover, benefits have also been shown at the family level, as quicker return to work minimises losses and improves earnings for financially unstable families (4).

Laparoscopy has also shown to be cost-effective when used as a diagnostic procedure, and is most applicable in LMIC. An example of this is the area of Southwestern Nigeria which only had six CT scanners and three MRI scanners available in 2012 for a population of 15 million. Laparoscopy subsequently became the modality for diagnosis of intra-abdominal malignancies (2). A second example of this application has been reported in India, where the technology was successfully used for the evaluation of abdominal tuberculosis, peritoneal pathology and abdominal trauma (2).

The most quoted reason for the slow adoption of MIS in LMICs is the lack of resources (5) necessary for initial set up and maintenance of laparoscopic surgical equipment (2). These costs impact patients too, as laparoscopy might is not always covered by health insurance in some countries, unlike open procedures (4). This problem can be overcome with adaptive modifications which lower costs, thus making it affordable for local population. Obafemi Awolowo University Teaching Hospital in Western Nigeria and Health Science University of Mongolia have successfully implemented laparoscopy with these efforts (7,8). This was achieved by investing in reusable instruments designed to last over 3 years, however life spans of up to 18 years have been reported as well (3). Other factors include the use of alternative materials to replace disposable items. Exemplifying this are the use of reusable tube drapes replace disposable camera covers and surgical gloves or condoms replace the extraction bags (7,8). Specific examples include the use of consumables as retrieval bags, however this is only for highly inflamed and purulent appendices, while those less inflamed are ligated and extracted via a port (8). Techniques which do not require specific materials are implemented utilising the most cost effective resources. This is seen in the use of sutures instead of clips for surgical incision closure (7,8). Another strategy involves combining readily available equipment in order to achieve the same effect as the lacking instrument. In this way, a harmonic scalpel is replaced with clips and diathermy for dissections and hemostasis (8). Hospitals in Mongolia found the solution for the latter problem in loaning each other their available instruments (7).
A potential solution to this issue could be the donation of medical equipment to resource-poor facilities and sites. There are several international organizations working on donations of medical equipment, such as ‘THET’, ‘Project C.U.R.E.’, ‘HUMATEM’ and ‘REMEDY’, amongst others (10). Together with the WHO, they help to provide guidance and support for countries deficient in resources (9). A prime example of this is REMEDY, who in the last 12 years has donated more than 50 tons of equipment (11).

A positive example of a successfully established laparoscopy service in limited-resource settings is in Mongolia (12). Laparoscopy was introduced here in 1994, and by 2005 it was still only used for 2% of cholecystectomies. As the benefits of this approach were then recognized, in addition to the surgical needs of the population particularly concerning gastrointestinal diseases, a joint collaboration between Mongolian Ministry of Health, non-governmental and foreign organisations and health care leaders was formed in early 2000 with the aim of developing a sustainable teaching and infrastructural model. Through this initiative laparoscopic surgery was widely re-introduced in the country with 61% of cholecystectomies in urban settings, and 55% in rural areas, being performed by a laparoscopic approach by 2013. Another positive effect of the established plan is that all of the trained surgeons during this period stayed in Mongolia, thus preventing the migration of skilled health care workers (12).

The Future of MIS

Although, technological advancements are commonly associated with HICs, introducing LMICs to innovative approaches such as laparo-endoscopic single-site surgery (LESS), natural orifice transluminal endoscopic surgery (NOTES) and robotic-assisted surgery, plays an important role in the implementation of MIS in LMICs as well.

LESS refers to an even less-invasive procedure which involves a single umbilical or extra–umbilical skin incision through which surgical tools are inserted to create a stable platform for performing major surgery (3). Similarly to MIS, a smaller incision causes less trauma for the abdominal wall and thereby less pain (3). This procedure has proved to be feasible in resource-limited settings such are rural areas in India, where performing appendectomies via single-incision technique has been reported (13). The procedure is carried without gas inflation and requires fewer disposable materials, both of which lower costs. Additionally, it is possible to combine the approach with regional anaesthesia, which is less expensive than general anaesthesia (13).

In 2018, an affordable laparoscopic camera system (ALCS) was designed, whereby the laparoscopic telescope is coupled with the camera of a low-price smartphone (14).
The primary objective of this development was to design an ALCS as a backup option in the case of a temporary failure of the laparoscopic vision cart or for contemporary use in another operation (14). The ALCS may also provide an easier method for a surgeon and assistant to practice on various dry laboratory models (14). Another example of MIS-related innovation is a project of Bass Connections, who developed a low-cost, reusable and maintenance-free laparoscope prototype. This group aims for the device to become available in the next two years in LMICs (15). The design process of the instrument is particularly reassuring as surgeons from Uganda are directly involved as they will be the end users of the product (15).

Minimizing the gap

MIS is a fast-developing field in medicine that brings many new advantages for patients. In addition to the obvious technical challenge that surgeons encounter when using the technology in the initial stages, one of the greatest challenges for MIS is its global implementation. Particularly, making it affordable to patients in different healthcare systems. Ultimately, the benefits of the future technological developments in the MIS, as well in medicine in general are worthless if they do not meet those they are made for.

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