

Original Article

Innovative Healthcare Technologies in Otorhinolaryngological Practice in Sub-Saharan Africa: Strategies for Accelerated Uptake

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ABSTRACT

Healthcare innovations are geared towards greater patient comfort, improved diagnosis and better treatment outcomes. Otorhinolaryngology (ORL) has witnessed many technological innovations become a core aspect of daily practice. Sub-Saharan Africa is currently lagging behind the rest of the world in both development and uptake of innovative health technologies. This paper aims to examine these innovations in otorhinolaryngology as well as the challenges and routes to their timely deployment in Sub-Saharan Africa (SSA). A literature review was conducted on papers retrieved from Google scholar and Pubmed. Several factors have hampered practitioners in SSA from fully leveraging new technologies. By applying political, legal, economic, educational and scientific strategies these practitioners may adopt safe, effective, home-grown adaptations of emerging technologies for accelerated uptake.

Keywords: Healthcare, Innovation, mHealth, Otorhinolaryngology, Technology

INTRODUCTION

The use of technology in healthcare has come to stay. Technological advances have helped to make healthcare more accessible, faster and safer with improved treatment outcomes.¹ The sub-specialty of Otorhinolaryngology (ORL) especially lends itself to the application of technological aids as it involves working in orifices which are often dark and difficult to assess. It also involves working within bones which contain many vital neurovascular structures tightly packed together as well as surgery in the cosmetically important regions of the face, head and neck. In its raw form, most major ORL surgeries

often have life-changing cosmetic and functional consequences. With advances in technology however, ORL surgeries have become less radical, more precise and safer with improved and better functional and cosmetic results. Many technological innovations have become part of routine ORL practice.^{2,3} For example nasendoscopy is now a routine part of nasal examination and endoscopic sinus surgery has largely taken over many of the indications for open sino-nasal surgeries. In the same vein, the use of the surgical microscope is the standard of care for virtually all ear and throat surgeries.³ There is hardly any part in the head and neck region which will not benefit from the use of technological advances in tackling pathology. There is also an ever growing body of innovative

technology within the sub-specialty; the growing field of endoscopic ear surgery compared to the microscopic surgeries to which we are accustomed is one such example. These innovative technologies are not restricted to the operating room but span from surgical training, to patient evaluation, diagnosis, treatment and follow-up.

Sub-Saharan Africa refers to the part of Africa that lies south of the Sahara and consists of 46 of the 52 countries on the continent of Africa. It encompasses Central, West, East and Southern Africa, with Nigeria being its most populous nation. Studies have shown a poor uptake of new health technology in SSA.⁴ SSA has the lowest rate of mobile health (mHealth) adoption in the world even though they inarguably have the most need for it.⁴ Why is this so and what can be done to change it? This paper is aimed at trying to answer these questions.

MATERIALS AND METHODS

A non-systematic search of literature was carried out using Google scholar and PubMed. The search was carried out using the keywords: healthcare, technology, otolaryngology, innovation and Africa. A total of 30 publications were included in this review.

RESULTS

The rise of wearable technology offers clinicians the opportunity for remote ambulatory measurement of patient parameters for better assessment and follow-up.⁵ It may obviate the need for traditional in-hospital testing for example the need for an overnight stay in a sleep lab in the assessment of obstructive sleep apnoea. Measures like heart rate, blood pressure, oxygen saturation and ECG may be measured and evaluated with a smartwatch thereby increasing the patient's comfort and reducing the cost needed to set-up these expensive facilities. It also obviates the cost of transportation to the health facility.

Familiarity with the anatomy of the temporal bone and head and neck is considered a critical part of the training of an ENT surgeon requiring extensive practice of temporal

bone and head and neck dissection in the temporal bone laboratory. In recent times, medical schools around the world have had limited supply of cadaver heads from which temporal bones and other structures can be harvested for trainee dissection.⁵ In response to this the use of virtual reality (VR) in simulating these structures have been found to be useful. While not without its problems the use of VR may enable surgeons in training to have remote access to the temporal bone laboratory/dissecting room round the clock allowing multiple dissection sessions at his/her convenience.⁵ Arguably, there remains a need for dissection of real temporal bones/tissue as learning the feel of the bones and dealing with normal variations in the anatomy are critical to subsequent operative success. Similar VR simulations may be used by surgeons in preparation for surgical procedures.⁶

Clinical decision support systems such as IBM's Watson and other less advanced models also lend themselves to use in ORL.^{5,7} These Artificial Intelligence (AI) tools operate based on millions of published research and treatment guidelines. They are programmed to evaluate patient data and suggest the best management plan for a patient to doctors.^{5,7} These systems have recorded varying levels of success in different settings with different pathologies, but are especially useful in cancer patients with multiple morbidities and in the future may replace inter-disciplinary clinical conferences often required for management planning in these patients.⁷

In Sub-Saharan Africa (SSA), we face a dual problem of shortage of healthcare providers due to inadequate production as well as a high rate of health worker migration out of the region. In Kenya, there are 1.2 otolaryngologists and 0.12 audiologists/million people.⁸ As at 2015 there were only 170 ENT surgeons in Nigeria, 13 Audiologists and 4 Speech therapists representing 1 otolaryngologist per million people.⁹ This shortage is consistent across all countries in SSA. In addition these professionals are concentrated in large urban cities with poor penetration into the rural areas where most of the population live.^{3,11} It is imperative therefore to adopt technological innovations that improve access to the services these people provide in

an efficient and cost effective manner.¹¹ The use of mobile technology in tele-audiology has been successfully used in Kenya and South Africa and represents such adoption.^{8,9,10} Much has been said about the low level of exposure to ORL in undergraduate medical training such that fresh medical school graduates have limited clinical skill in the recognition and treatment of ORL conditions; as we know many ENT emergencies are unforgiving requiring intervention in minutes.¹² This is further amplified by the poorly developed emergency health service in the region. From the foregoing, the adoption of mHealth and telemedicine would seem imperative. With a high level of mobile phone and internet penetration even in very rural areas the basic infrastructure for this appears to be well laid.

The emergence of robotic surgery using such haptic systems such as the Da Vinci robot for Transoral Robotic Surgery (TORS) in oropharyngeal carcinoma has the potential to make surgeries faster and safer with minimal incisions.^{3,13} Robotic assisted procedures continue to grow in number now including Total laryngectomy, thyroidectomy and skull base surgeries among others.¹³ Algorithms based on a patient's CT scan or MRI scan can be designed to prevent injury to vital structures while drilling the temporal bone/skull base.⁶ Some systems prevent the surgeon's drill from going within a certain distance of specified structures improving the safety of the procedure. In spite of their advantages these systems are very expensive and in order to use them surgeons need to train which represents an additional cost.

The growing field of 3-D printing also holds multiple possibilities for ORL practice. For training, 3-D models have been found to be very useful simulators for practice in paranasal sinus, skull base and temporal bone surgery.¹⁴ It has also become very useful in the production of prostheses such as auricular prostheses and hearing aids. In fact, most hearing aid shells are now 3-D printed worldwide.¹⁴ 3-D bioprinting is now being studied as an alternative to harvested cartilage for surgical management of long segment tracheal replacement and other surgeries

requiring cartilage grafts.¹⁴ It has also been used successfully in the printing of bio-resorbable nasal septal implants in septal surgeries.¹⁵ There exists the possibility of bio-printing of whole or part of organs for transplantation. Within the fields of 3-D printing and tissue engineering there are endless possibilities with the potential to maintain function following major ORL surgery.

In the mobile technology space, multiple applications (apps) have been developed to cater to a variety of ORL conditions.⁵ These apps are available on both Google and Apple stores for android and iOS operating systems and many are for free.¹⁷ These apps could potentially be used in the management of patients if properly evaluated and validated.^{5,17} These apps generally have low level of physician participation and the clinical utility of many of them are not proven and so they are not routinely used in clinical care of patients.¹⁷

Like the apps described above, many technological innovations are not translated into clinical practice due to failure when tried in a clinical environment.^{18,19} This is especially sad as the entire aim of developing healthcare technologies is for them to be used failing which it's just a huge waste of resources. Sometimes there are difficulties with integrating a technological solution into the health system. As health systems differ from country to country, technological solutions that work effectively in one system may fail in another.²⁰ There is also the problem of usability with many technological designs found to be difficult to use by healthcare providers in practice which potentially causes patient harm.²¹

It has been stated that in spite of their many benefits, ultimately the utility and hence the value of any healthcare technology lies in its acceptance and use by healthcare providers. Historically, healthcare providers have been noted to resist change of time-tested methods in medical practice. It was reported that Daniel Fahrenheit faced great resistance when he first introduced his temperature sensor in a tube. Many physicians of his day argued that nothing could assess temperature better than a physician's hand.²²

DISCUSSION

The barriers to uptake of innovative surgical technologies in SSA may be traced to a number of factors. First of which is a lack of finance and infrastructure to support these technologies.^{1,11} Many countries in SSA have a relatively small healthcare budget. This makes it difficult for health institutions to acquire cutting edge technological equipment for use. In the same vein, application of cheaper technology is hampered by poor infrastructure such as power failure, and poor internet connectivity.^{4,11} There is a need for advocacy for governments in SSA to increase healthcare spending. Practitioners in the region should be encouraged to continue to synthesize local modifications of existing technologies to suit scant resources and environment. Such modifications of existing technologies include PEEK which allows a simple mobile phone to be used in screening for eye disease currently being used in Kenya.¹⁹

There is also a severe shortage of skilled manpower to install, use and maintain relevant equipment when they are acquired.^{1,11,23} Many equipment have to be transported back to their countries of manufacture for routine maintenance and/or calibration greatly increasing the cost of owning such equipment. An NIH funded project in Nigeria, Ghana and South Africa which trained biomedical engineering technicians (BMET) in selected pilot hospitals found that hospitals with BMET that they had trained had 35% less out-of service equipment than those without these staff.²³ Biomedical engineering modules may also be introduced into the undergraduate medical training curriculum either as compulsory modules, elective modules or intercalated degrees.⁵ This will help spur clinically relevant healthcare technological innovations which are suited for the local healthcare system within available resources and reduce the waste associated with failure at clinical translation in the face of scant resources. This is probably of particular interest in ORL which is relatively under represented in innovative technologies emerging from the region due to limited exposure of many undergraduates and health workers to the sub-specialty.

Lack of ethical and legal framework surrounding the use of these new technologies has led to extreme caution in their adoption and use by healthcare practitioners.^{1,11} Infact younger doctors in Nigeria have been shown to be more resistant to adoption of mHealth and telemedicine than older more experienced doctors.¹⁶ This would seem counterintuitive as the younger doctors are more tech-savvy and familiarity with digital tools is associated with faster uptake of innovative technologies.¹ Fear of litigation could be a major part of this restraint.¹¹ It has been suggested that AI decision support systems be given legal personhood such that when errors are made due to erroneously generated management plans the system is held liable rather than the practitioner.⁷ In the same vein, another group of authors suggest the formation of 'app boards' consisting of ORL practitioners to evaluate and validate ORL related apps to allow their integration into clinical practice while reducing the risk of treatment failure and legal problems.¹⁷ Such predictability will allow appropriate insurance cover for liability, decrease liability for the practitioner and increase uptake of these technologies.⁷ A clearly defined legal and ethical framework set out by regulatory and constitutional bodies may encourage faster development in this area.¹¹ National and regional guidelines for telemedicine and e-professionalism will also encourage its uptake without fear of legal consequences.

Uncoordinated efforts with multiple pilots in varying areas across the continent, some of them repetitive with minimal potential for wider replication have been the norm.¹¹ This leads to waste of resources as well as slows the integration of these technological interventions into the healthcare system. National and regional plans for the implementation of eHealth should be drawn up as seen in US, UK, Canada and Japan and other countries.¹¹ It is also necessary for healthcare providers to be carried along in such planning to ensure success of the programmes.¹

CONCLUSION

In order to engage healthcare innovation for improved patient care, modern ORL practitioners in SSA need to be both creative and strategic in the face of deficient infrastructure, scant resources and lack of legal and regulatory guidance.

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