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Medicine Security in Sub-Saharan Africa: Improving Access to Drugs Via Utilization of Novel Technologies.

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ABSTRACT

Background: Providing all citizens with fair and equitable access to healthcare remains one of the most challenging issues facing most African countries today. The health indices of the Sub-Saharan Africa show how much it is lacking in managing and properly funding its health sector. The rates of maternal and newborn mortality continue to be the highest and the lowest life expectancy on a global scale. Millions of Africans continue to perish from diseases that are treatable and avoidable, including such as viral diarrhea and malaria. In the last few decades, novel drug delivery technologies have emerged and evolved into various drug delivery systems with various drug release mechanisms. This has altered the way individuals now access medications. Presently, several creative approaches, based on partnerships, intellectual property, and technology are used to stimulate innovation, promote healthcare delivery, and reduce global health disparities. The purpose of this study is to review the Medicine Security in Sub-Saharan Africa and proffer recommendations on how access to drugs can be improved via utilization of novel technologies.

Method: A review of the Medicine Security in Sub-Saharan Africa was focused on underlining novel technologies that will improve access to drug.

Result: Recommendations were suggested to improve drug access via novel technologies in Sub-Saharan Africa.

Conclusion: Making sure that patients have timely and affordable access to safe and effective medicines, stimulating innovation by providing incentives for research that will lead to innovative medicines that effectively target real therapeutic needs, and safeguarding sustainability by developing the mechanisms to purchase these medicines at affordable prices in order to protect the sustainability of pharmaceutical budgets are essential to improving access to drugs within Sub-Saharan Africa.

1. Introduction:

To ensure drug security, measures are put in place to guarantee that quality, safe and efficacious medicines are produced by facilities that meet the right Quality Management standards and, that the integrity of such medicines is not compromised during their distribution along the supply chain from the manufacturers down to the consumers [1]. The requirement of national drug security is embedded in our national drug policy, which is to make an adequate supply of drugs that are effective, affordable, safe, and of good quality available to the Nigerian populace always; to ensure the reasonable use of such drugs; and to encourage continued local production of such drugs. One of the objectives of the Sustainable Development Goal - SDG goal number 3 - is Universal

Health Coverage, access to quality essential healthcare services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all [1]. Without access to medicines, Africans are susceptible to the three big killer diseases on the continent: malaria, tuberculosis, and HIV/AIDS. In 2015, about 1.6 million Africans died of malaria, tuberculosis, and HIV-related illnesses [6]. These diseases can be prevented or treated with timely access to appropriate and affordable medicines, vaccines, and other health services [2]. 70-90% of drugs available in Sub-Sahara Africa are imported with less than 2% being locally produced [3]. The implication of this is that many sick patients will be unable to access quality drugs as foreign products are quite expensive and the locally affordable ones are inaccessible [2]. To achieve medicine security, communities need: 1) Medicine Accessibility 2) Medicine Availability 3) Medicine Affordability 4) Medicine Acceptability [4]. Technology has become an integral part of medicine today and with proper utilization, can help increase efficiency, improve quality of drug, reduce costs and save lives.

2. Challenges of medicine security in the Sub-Saharan Africa

Inability to access drugs each year, contributes to millions of deaths and untold suffering in Africa and a major cause of this is that most medicines are not manufactured locally[2]. To produce medicines, a country must abide by the Current Good Manufacturing Practices (CGMP) standards[5]. To assure the safety and efficacy of drug products, facilities and equipment that are in good condition, properly maintained and calibrated must be present, also fully trained qualified employees must also be available acting as consultants in drug product analysis and quality assurance[6]. These features are lacked in so many African countries, as a result, it is usually hard for them to meet the CGMP standards. Another challenge is that many African countries do not have the technical, financial, or human resources required for high-scale drug production and as a result, rely heavily on importation of drugs [3]. This in effect, affects the supply chain making it long and not timely hence scarcity. In cases, such as the COVID-19 pandemic, most developing countries especially in Africa suffered in availability of essential medications and active pharmaceutical ingredients (API) due to the restricted movements and supply of these medications by countries that are actively involved in drug production[7]. Also, this over reliance, is seen to affect prices of drugs, making them very expensive and almost impossible for the masses to afford. Added to these are the poor transportation systems, a lack of storage facilities for pharmaceutical products and lack of skilled and well-paid medical personnel[8]. Another major challenge is that most countries in Africa lack the facilities needed to train medical practitioners and specialists, hence there is a limited number of people they can train/ graduate at a time. As a result, the workload on these practitioners become too unbearable and burdensome. In Nigeria for example, we have one doctor to almost 20,000 people. Studies have also shown that "Not less than 10 per cent of doctors produced in the country over the last 10 years have migrated to other countries in the quest for greener pasture"[8]. The payment in Nigeria compared with standard of living is not encouraging. Furthermore, inadequate budgetary allocations to healthcare, poor leadership and management in health care are also seen to affect the medicine security in sub-Saharan Africa.

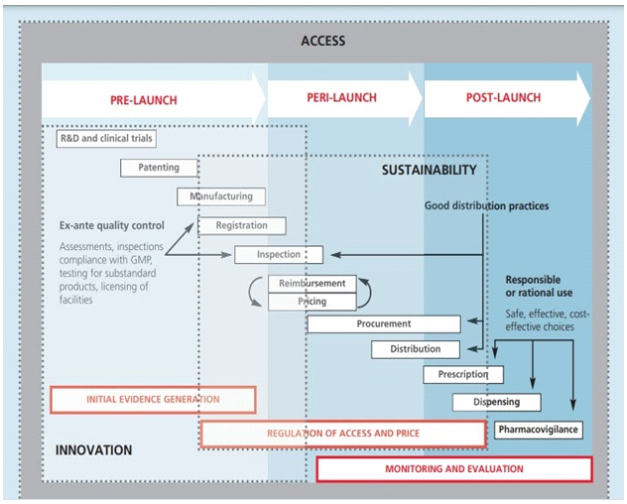

Figure 1: Diagram showing how access to drugs can be improved (culled from Dimitra et al[9])

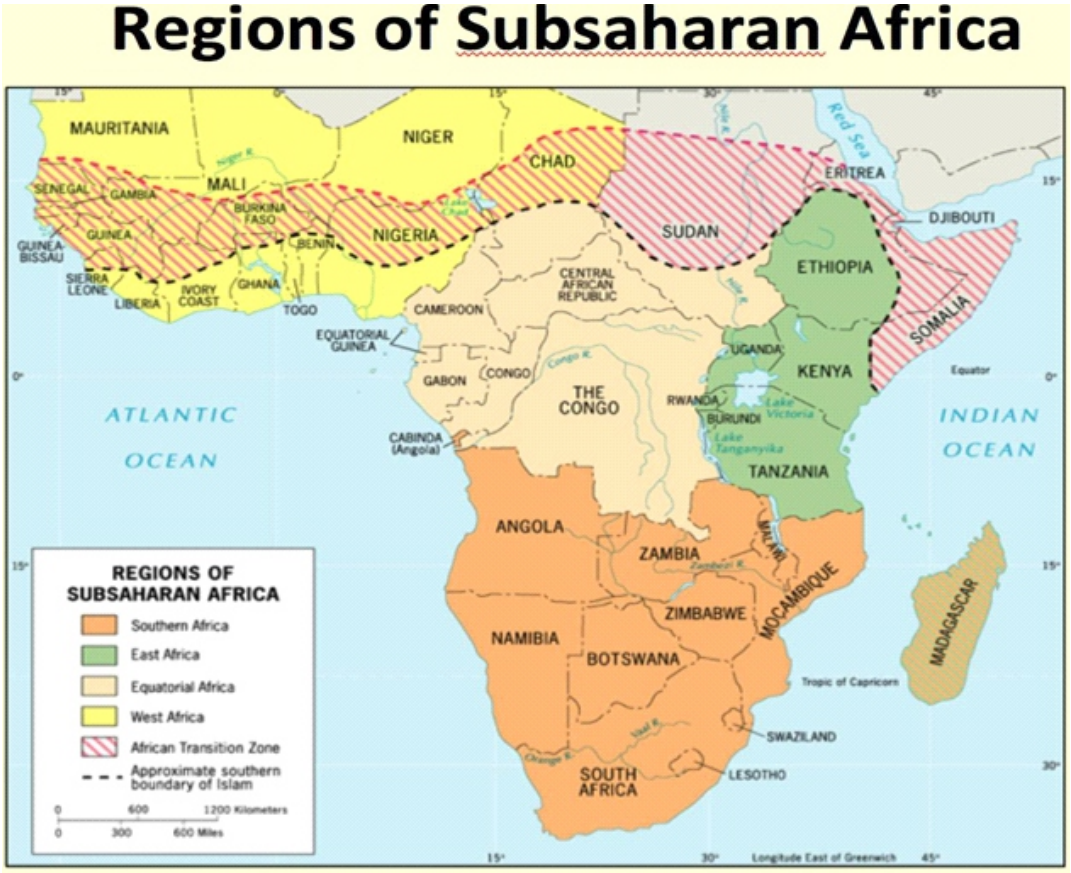

Figure 2: Diagram showing the various countries in the Sub-Saharan Africa. Culled from: Sub Saharan Africa growth to rise 3.1 percent in 2018 - report - Eagle Online[10]

1. Improving access to drugs via utilization of novel technology.

Novel technologies in health used to improve access to medicines include the following:

3.1 The use of drones to deliver blood in some east African countries

According to the World Health Organization (WHO), about 295,000 women died globally from mostly preventable causes related to pregnancy and childbirth in 2017, with roughly two-thirds of these deaths taking place in sub-Saharan Africa[11]. This was greatly due to the poor road infrastructure which makes road-based delivery very difficult, preventing patients from getting their medications on time. In a bid to combat this setback, a California-based startup called Zipline started using drones to deliver blood to remote villages in East Africa[12]. Since 2011, Zipline has been working with the government of 'Rwanda' to deliver blood supplies to about 21 regional hospitals. Launching more than 50 drones daily for on-demand deliveries[12]. The blood sent by the drone is often used for post-birth blood loss and to treat malaria-induced anemia. Also, doctors can treat patients in regional hospitals with blood plasma and platelets to promote clotting. Doctors can request blood on demand, by calling or placing orders online, and it generally arrives within 30 minutes. The drones gauge wind speed and direction when releasing a package, with its own parachute, so that it falls in a dedicated area. Round trips are 150 kilometers or less, and each drone makes a single drop before returning to the distribution centre. One of the biggest challenges has been navigating deliveries through mountain passes or during storm[12].

The project has been a roaring success and is gaining enough recognition across the globe. Zipline is in talks with interested parties in other African countries too, such as Ghana, and Nigeria[12]. In 2021, Nigeria's Kaduna Government collaborated with Zipline to assist in delivering covid-19 Vaccines[13]. This emergency drone delivery has aided fast delivery of not just only vaccines, but blood, protective equipment to front line workers, and

other life-saving medicinal products such as Oxytocin, used during pregnancy to induce labor to local clinics and hospitals that urgently needs them. Delivery of other medications which pose life-threatening risks to the population can also be maximized using these drones, Such as HIV medications, Antimalarials, Anti-hypertensive to areas where they are inaccessible. This drone delivery technology could also be utilized in providing essential medications to patients in their homes rather than in a hospital setting[14]. This can greatly reduce the margin in deaths caused by these big killer diseases in Africa.

3.2 The impact of local manufacturing on access to medicines in Nigeria

Most pharmaceutical companies in Nigeria deal mostly with secondary and tertiary production, that is they depend entirely on the primary industries for their drug's API and excipient raw material for production[6]. Companies such as Swiss Pharma Limited Nigeria, Fidson Pharmaceuticals, Emzor Pharmaceuticals, are examples of pharmaceutical companies in Nigeria that has demonstrated an acceptable level of compliance with WHO GMP standard and are manufacturing locally[15].

Essential medications such as Anti-malarials, Anti-infectives, Anti-diabetics, Anti-hypertensives, Vitamins, Antihelminthics, Antitussives are being produced locally by these companies[15]. This has to some extent reduced the cost of some essential medicines as compared to drugs that are being imported and has also increased availability as well as accessibility to these drugs. Although these businesses are faced with issues such as; unfair government regulations, a lack of productive R&D due to inadequate funding from public and private sources, and unfair competition from foreign firms and multinational corporations, the government can play a big role in encouraging these companies and helping them thrive and compete favorably by developing infrastructures such as good roads, stable electricity, creating stable and working policies, supplying security, creating an enabling environment, and expanding the money and capital markets for simple access to medium- and long-term funds[6].

3.3 Nigeria as a hub for medicine security in the African sub region

Nigeria continues to be the major pharmaceutical producer in West Africa, providing more than 65 percent of the medications required to treat diseases that affect both Nigerians and the rest of the West African region[16]. Treatments for sickle cell disease, antiretrovirals, analgesics, and antimalarial medications are a few of the available products produced in the country[16]. However, there remains a research and development gap (R&D) and without proper funding, the industry won't grow as it should. In this regard, organizations like the Nigerian Institute for Pharmaceutical Research and Production (NIPRD), which is statutorily tasked with the development of medications, vaccines, herbal remedies, and other products, must receive enough funding[17]. To close this gap, the NIPRD strategically plans to do this by encouraging local production of excipients, pharmaceutical inputs, high-quality medicines, and other innovative interventions for the sector through carefully cultivated partnerships with institutions, Nigerian and international universities, and funding agencies. With respect to this, NIPRD has partnered with Bloom Public Health, a partnership that will make it easier for other African countries to work together to help NIPRD take the lead in the field of pharmaceutical quality. It will also operate as its technical partner for accessing and implementing donor-funded activities[17]. Additionally, in order to create an ecosystem that provides the needed infrastructure and support for research and development in Pharmaceutical Manufacturing, the Association of Industrial Pharmacists of Nigeria (NAIP), initiated a Pharmaceutical Manufacturing Park project for which a hundred hectares parcel of land has been allocated by the Ebonyi State Government. This project is the first of its kind in West Africa and is hoped to boost significantly the availability and accessibility of quality medicines in Africa[18,19].

Significantly, the benefits of strengthening Nigeria's health research capabilities will not only benefit its own citizens, but also those of other smaller sub-Saharan nations who have comparable problems with the security of their supply of pharmaceuticals. Rather than relying on imported goods with a longer supply chain, more expense, and a higher chance of fabricated, counterfeit, and subpar pharmaceutical products. Nigeria can act as a center for producing a range of essential medications that may be shipped to these nations. Another thing to note is the impact of our shortage on locally produced pharmaceuticals, Due to this shortage, Nigeria and other African nations currently spend at least $14 billion importing goods[20]. But with this development, the nation as well as other sub-Saharan countries will benefit greatly by saving themselves the cost of having to import these pharmaceuticals, this will in return boost economic growth, health status and life expectancy of its citizens [21].

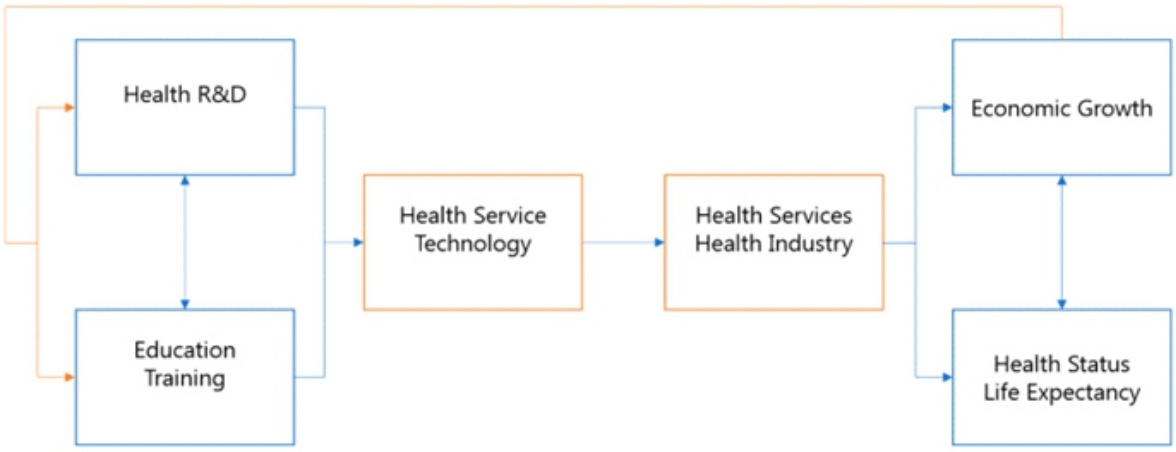

Figure 3: A diagram showing the benefits of investing in Research and Development. (Ahmad et al; 2020).

3.4 The use of novel technologies in drug manufacturing

Drug shortages are possible when manufacturing difficulties emerge in drug production plants. Manufacturing and quality difficulties account for 65 percent of all medicine shortages[22]. This highlights the requirement for a secure and trustworthy medicine supply chain. Sadly, many of these shortages have harmed people suffering from critical illnesses such as cancer, life-threatening infections, and acute malnutrition. They cause delays and prohibit patients from receiving care, leaving doctors with no choice but to prescribe less effective treatments[22].

Many pharmaceutical firms in sub-Saharan Africa have been working hard to help the nation's pharmaceutical industry develop, moving beyond the production of tertiary goods like the

packaging of already manufactured medications to the primary and secondary production of the medicines themselves. In Nigeria for example, Emzor Pharmaceuticals, which is a Pan-African pharmaceutical production and distribution company well known for its top-notch ISO and NAFDAC accredited manufacturing facilities, is one of these businesses. One of its equipment include- H-vac system- a heating, ventilation, and air conditioning system used to maintain the clean room in sterile as well as non-sterile manufacturing[23]. This facility is essential in making sure that an industry produces high-quality pharmaceutical items. Other equipment includes tableting machines, tablet coating machines, soft gel encapsulating machines, capsule filling machines[24]. These upgraded pharmaceutical machines will ensure the public always have access to high-quality pharmaceuticals, facilitate and accelerate overall production, lessen our over-dependence on pharmaceuticals from foreign countries, which in return will benefit the country's economy by generating more income and creating more jobs in the country.

3.5 Use of smart phones app to improve access to drugs

Patients put their faith in their healthcare providers above all other stakeholders to help them manage their health conditions. They rely on their knowledge before beginning treatment, which can be aggravating, especially when they have to wait in line to see the doctor for consultation and then again to see the pharmacist for the drugs to be dispensed. Therefore, in order to improve medication access and adherence, there is a need for technology assistance[25].

Technology advancements have resulted in promising consumer self-care options. Medical technologies have been used in numerous healthcare delivery contexts in recent years, and they have shown the ability to enhance outcomes and lower costs. Patients can use smartphone, electronic device, and internet applications to help them make complex health-care decisions. Portable and wireless diagnostic devices can capture and communicate valuable health data such as cholesterol levels, blood pressure, and blood glucose control measures to consumers and

physicians via direct entry into electronic health records (EHRs) to inform and optimize treatment. As these consumer-oriented medical technologies continue to evolve, patients will have improved tools to facilitate the safe and effective use of pharmaceuticals[26].

Examples of such app that are in use in Nigeria include:

- **Advantage Health Africa®**- A health solution company that makes drugs available to patients nationwide, including those living in very remote regions, by aggregating pharmacies and drug stores on an internet platform called myMedicine.com and mypharmacy.com. providing last mile delivery service within the 774 local government areas in Nigeria. The delivery service is made possible through collaboration with the Nigerian Postal service, a government owned parastatal that provide mail logistics nationwide. Currently MyMedicines® app allows consumers to order for their medications, buy now and pay later and is servicing up to 3,000 clients per month and mypharmacy.com has 45 partner franchise pharmacies in the country[27]. This initiative not only help to ensure that genuine drugs are being delivered to patients' worldwide, but it also bridges the gap of accessibility and affordability in the health sector.
- **Smart Health® App**-This App aims to provide accurate baseline information on HIV/AIDS, TB and Malaria. Currently, the app is available in Tanzania, Nigeria, Kenya, South Africa, Angola, Ghana, and Senegal[28].
- **Safer mom®-** It addresses the high maternal and infant mortality crises in Nigeria, by delivering vital health information to new and expectant mothers using interactive, personalized and low cost mobile technologies, including SMS, voice calls in local languages[29].
- **Omomi®**- Helps parents keep their children healthy by enabling them easily monitor their children's health. Parents can track their child's immunization status, manage diarrhea at home with interactive DIY platform and access to speak to doctors as well as other parents. It also provides a fun and very educating quiz which gives parents simple health education knowledge[29].
- **Find-a-med®-** Helps users find the closest health and medical centers around them with turn-by-turn directions to the centers has launched in Nigeria. Find-A-Med uses your location either via the web or mobile to find the nearest hospital, clinic, pharmacy, dental care, eye care, therapy, laboratory, etc[29].
- **Kangpe®**- Here, you ask real doctors your health questions. Get Answers Under 10 Minutes. Find a doctor and book an appointment[29].
- Other apps include- **Hello doctor®, Momconnect®, Matibabu®, MedAfrica®, Kids First Aid®** amongst others[28].

3.6 The use of telemedicine to improve access to medications in the sub-Saharan Africa

Telemedicine is "the use of electronic information and telecommunication technologies to support and promote long-distance clinical health care, patient and professional health-related education, public health and health administration[30]. Telecommunications include: the use of Telephone, WhatsApp, SMS (short message services), Skype, video call, virtual platforms. Clear instructions, management and follow-up can be done via phone calls, SMS and video calls, reducing the number of hospital visits by patients and long ques of waiting for a consultation from the doctors. This can improve and quicken the access of essential medications to patients. As we saw during the lockdown, using this system improved access to mental healthcare despite lockdowns, made mental health services easier and faster, and maximized scarce mental health resources[31]. There was also reduced hospital visits for patients that ingested poison by giving clear management instructions and successfully monitoring toxicology trends over the telephone and via virtual online platforms[32].

During the pandemic, the use of telemedicine in sub-Sahara Africa was very much utilized. We saw benefits such as continuing medical service provision, connecting relatives with loved ones in quarantine, education and awareness of mental health issues, and toxicovigilance and infection control[33]. However, there were also some

limitations which included-cost of usage, lack of digital and technical skills among users and health care professionals. Therefore, in order for telemedicine to be used effectively in Sub-Saharan Africa, it is critical to minimize digital barriers by enhancing digital infrastructure, access, and cost. Authorities should zero-rate telemedicine services and establish partnerships sponsored by the authorities to narrow the digital gap and enable universal access to digital care. In addition, for effective telemedicine acceptance and utilization, a deliberate effort to boosting digital literacy and awareness is required. There is also a need to empower and develop the technical skills of many healthcare professionals in Sub-Saharan Africa, as well as create more awareness initiatives for optimal use of accessible telemedicine services[33].

3.7 The use of mobile phones to check the authenticity of drugs.

One of the tenets of medicine security is the ability of a drug to be universally acceptable and genuine. This means the ability of a drug to be free from adulteration, contamination, falsified labels/claims and meet the specified standard according to the CGMP[34,5]. To identify substandard and falsified medical products, NAFDAC implemented the MOBILE AUTHENTICATION SERVICE (MAS) scheme as one of its anticounterfeiting tactics in 2010. They did this by using Scratch codes and short messaging service (SMS) to enable customers confirm the legitimacy of medications at the point of purchase; so, the patient scratches a panel on the goods to reveal a special, single-use PIN (placing the power of spotting counterfeit in the hands of consumers). The consumer receives a response in the form of a text message (SMS) indicating if the product is either real or suspected to be a fake after sending the PIN toll-free to a short number using any of the GSM operators. Currently, holders of certificate of registration can access MAS technology from the following MAS providers: PharmaSecure, Sproxil, Savante, UBQ-t/Kezzler, M-Pedigree[35].

This scheme has been used so far to confirm the authenticity of drugs such as Anti-malarials (for example-Lonart) and Antibiotics (for example-Ciprotab) both the ones imported and the ones manufactured in Nigeria[35]. This can be extended to other classes of drugs, to ensure the eradication of fake and substandard drugs and to ensure that people get genuine, effective drugs that will produce the right therapeutic outcome.

There is a need to put in place a robust infrastructure for simple access to pharmaceuticals, particularly at hospitals-both primary, secondary, and tertiary health centers. In order to achieve this, the hospital's infrastructure must support the seven areas of excellence- patient experience, effectiveness, efficiency, timeliness, safety, equity, and sustainability. The constructed environment, as well as supporting aspects such as equipment, access, information technology (IT), systems and processes, sustainability initiatives, and personnel, are all included in infrastructure[36].

3.8 Improved medical science infrastructure

One effective strategy to increase drug availability and ensure that health care services is accessed by all, and health infrastructures are being utilized is by investing in our National Health Insurance schemes. Health insurance schemes in most sub-Saharan countries are still in their infancy stage with little to no strategy on how it can be maximized to benefit the health status of its citizens. An example of a health insurance scheme that has succeeded in widening access to health services is Rwanda's subsidized health insurance scheme*, Mutuelle,* launched in 2004. This scheme was reformed in 2011 to introduce stratified premiums linked to income, with the poorest households receiving free coverage, a model that other African countries can learn from and customize to their needs[37].

Another way of improving in our medical facilities particularly in hospital settings, is to use fully integrated information technology systems such as computers with up-to-date software, this will ensure that patients, caregivers, and health professionals have access to the information they need, when they need. This information may include patients' files and medical records[36].

4. Conclusion

Africa faces numerous obstacles that hinder its population from receiving an appropriate supply of effective, inexpensive, safe, and high-quality medications. As a result, the government must reprioritize its citizens' health care demands to appropriate adequate funds and form successful partnerships with established private parties to develop novel approaches to increase medicine accessibility, acceptability, affordability and availability. The employment of novel technologies such as medical drones, infrastructural development-particularly in the manufacturing sector, and information technology are all critical in assuring Medicine security.

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