AFIDEP
African Institute for Development Policy

HealthTech
Promoting dialogue and action on health technologies in Africa

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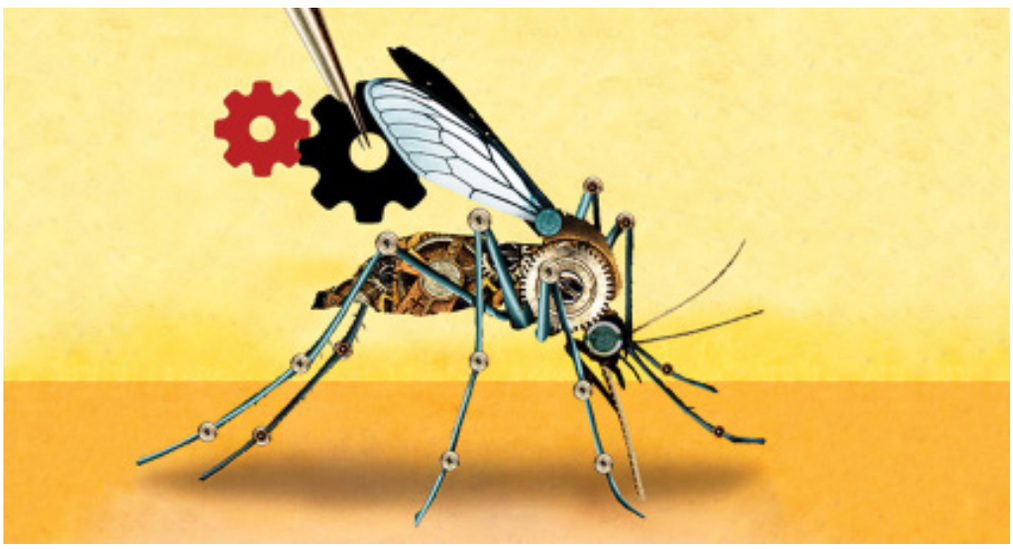
FACTSHEET



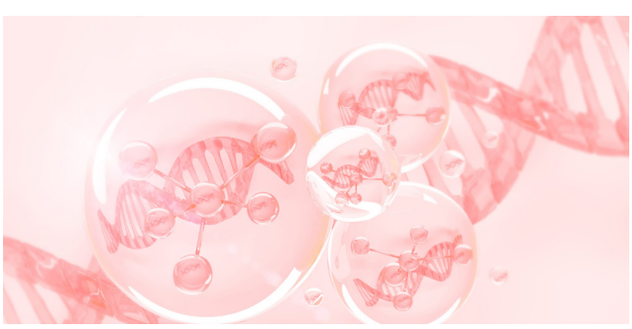
The Development of Emerging Health Technologies in Africa

The African Institute for Development Policy (AFIDEP) established the Platform for Dialogue and Action on Health Technologies in Africa (Health Tech Platform) to facilitate informed, objective, transparent, open and balanced discussions on the development and use of emerging health technologies to address key health challenges in sub-Saharan Africa (SSA).

The emerging health technologies of focus are those prioritised by the African Union as technologies with the potential to radically change the trajectory of health on the continent. The technologies include genome editing, specifically gene drives for malaria control and elimination; artificial intelligence; drones for improved health; and microgrids in healthcare, among others.

The development and testing of health technologies in Africa are often undermined by an interaction of various factors including:

- Opposition to the development of some of the technologies, for instance gene drives.
- Limited African voices and engagement in the development of these technologies.
- Limited knowledge among many Africans of these technologies.
- Low priority and inadequate investments by African governments in the development of these technologies.



1 Gene drives for malaria control and elimination

A gene drive is a process in which an organism is engineered to bias the inheritance of desired traits from parent to offspring through sexual reproduction. Genes usually have a 50/50 chance of being inherited, but the gene drive increases the chance to almost 100%. This effect allows the desired traits to spread rapidly through the population over the course of generations.

The 2021 World Malaria Report highlighted the need for new tools and innovations to complement the current strategies for fighting malaria, citing that no single tool available today will eliminate the disease (World Health Organization, 2021). This makes the development and testing of new tools with the potential to eliminate malaria urgent.

Two types of gene drives are being explored. The first is to produce and deploy gene drive mosquitoes that will suppress the reproductive system of the malaria-transmitting mosquitoes and eventually lead to the population's elimination from their environment. The second is to produce and deploy gene drive mosquitoes that resist infection from the malaria parasite. The gene drive mosquitoes will spread the foreign genes to future generations, eventually resulting in the elimination of malaria-transmitting mosquitoes (APET, 2018a).

Currently, gene drives have only been tested in large-scale laboratory experiments. This means it will be a couple of years before field-testing is conducted in Africa that will generate the evidence needed to tell whether this tool will or will not control and eliminate malaria.

Ongoing work and actors

There is notable ongoing preparatory work that will facilitate the future testing of gene drive mosquitoes. The technology is being explored in Burkina Faso, Mali, Uganda, Tanzania, Cape Verde, Ghana, Comoros, and Sao Tome and Principe.

African Union/AUDA-NEPAD

The African Union (AU) has committed to investing in gene drive technology development and regulation for the control and elimination of malaria on the continent, and its development agency AUDA-NEPAD established the Integrated Vector Management (IVM) Programme to help achieve this goal (African Union Development Agency-NEPAD, 2020). AUDA-NEPAD's work targets policymakers, regulators and scientists by conducting outreach activities and strengthening regulatory frameworks needed to test gene drives on the continent.

Pan-African Mosquito Control Association (PAMCA)

The organisation is an African member-based professional body that brings together stakeholders in vector-borne disease control to adopt best practices for controlling and eliminating these diseases in Africa and worldwide. PAMCA conducts training for African scientists, and strengthens regional collaborations and partnerships between scientists, regulators, public health professionals, academics, policymakers, students, media practitioners, and civil society actors.

African Genetic Biocontrol Consortium

The Consortium provides a platform to support African influence on the development of genetic biocontrol technologies through technical capacity strengthening, knowledge exchange and deliberation among African experts and institutions.

FNIH's GeneConvene Global Collaborative

The US-based initiative supports capacity-building interventions to ensure an improved understanding of best practices and to facilitate informed decision-making in the development of genetic biocontrol technologies aimed at improving public health. It organises webinars and other online events on topical scientific, regulatory, policy and ethical issues, and runs the GeneConvene Virtual Institute, an open online source of information about gene drives and genetic biocontrol.

2 Drones for improved health

The use of drones in healthcare includes delivering life-saving medical supplies, dispersing organisms for biological control, and surveying dangerous locations. Across Africa, the inadequate road and communication infrastructure, particularly in rural areas have been notable barriers to healthcare delivery, and evidence indicates that drone application in health can contribute immensely towards improved outcomes.

Ongoing work and actors

Pilot projects on drones in Africa have largely focused on the use of these unmanned aerial vehicles (UAVs) to facilitate the speedy delivery of medical supplies and medications to areas that are remote or hard to reach, while some have focused on their use for malaria control and elimination.

Gavi, the Vaccine, Zipline and UPS

In 2016, Rwandan President Paul Kagame launched the world's first national drone delivery service to reduce the time taken to deliver life-saving medical supplies and vaccines to regions where health facilities are spaced out across mountainous terrains. The drone delivery service is in partnership with UPS, Gavi, the Vaccine Alliance and Zipline (Gavi, the Vaccine Alliance, 2016).

In 2019, Ghana launched the world's largest vaccine drone delivery network, also in partnership with UPS, Gavi, the Vaccine Alliance and Zipline (Gavi, the Vaccine Alliance, 2019). In 2020, the country distributed COVID-19 vaccines to healthcare facilities using Zipline drones (Muñoz, 2021).

MoH Malawi

Since 2016, Malawi's Ministry of Health, along with the United Nations Children's Fund (UNICEF) and the NGO VillageReach, has worked to use drones to deliver maternal health supplies and to optimise the country's health supply chain (Knoblauch et al., 2019; VillageReach, n.d.).

MoH Senegal

In 2017, Senegal's Ministry of Health, in collaboration with the NGO PATH, began to assess how drones can transform the health supply chain system, focusing on their usefulness, health impact and cost-effectiveness (Knoblauch et al., 2019). A project is now being implemented in Foundiougne district, Fatick region – where its island geography has isolated health facilities – to deliver essential drugs and collect medical samples.

Government of Botswana

The Drones for Health project in Botswana was launched in May 2021 as a collaboration between the country's Ministry of Health and Wellness and Ministry of Tertiary Education, Research, Science and Technology; the Botswana International University of Science and Technology (BIUST); the United Nations Population Fund (UNFPA); and Dutch drone company Avy, to deliver maternal health supplies and commodities such as obstetric care drugs, with the aim of reducing preventable maternal deaths (UNFPA, 2021; Avy, n.d.).

African Drone and Data Academy and Malawi-Liverpool-Wellcome Trust

In Malawi, researchers working with the African Drone and Data Academy and Malawi-Liverpool-Wellcome Trust are exploring drones to map mosquito larval habitats for larviciding, as a complementary intervention to existing strategies (i.e. insecticide-treated nets and indoor residual spraying of insecticides) in the fight against malaria (Pensulo, 2022). In a study on the use of drones for larviciding an irrigated rice agro-ecosystem in Zanzibar, Tanzania, Mukabana et al. (2022) concluded that the technology, alongside the anti-mosquito film sprayed on water surfaces where malaria vectors breed, offers a promising and cost-effective method of area-wide larval source management. This technology has not been extensively used for malaria control on the continent.

African Leaders Malaria Alliance (ALMA), Kenya

In 2021, the president of the Republic of Kenya, Uhuru Kenyatta, who was serving as the Chair of the African Leaders Malaria Alliance (ALMA), flagged off the use of drones in the larviciding of mosquito habitats in the country (Saya, 2021).

3 Artificial intelligence

Artificial intelligence (AI) is concerned with the use of smart machines to perform tasks typically ascribed to human intelligence, and includes the automation of decision-making, problem-solving, and learning activities. A United States Agency for International Development (USAID) report highlights four areas where artificial intelligence might play an active role in healthcare, namely, population health; individual health; health systems; pharmaceuticals and medical technology (USAID, 2019).

Ongoing work and actors

Scientists and innovators are currently exploring AI tools and applications for the diagnosis and treatment of different kinds of cancer, as well as to maximize the impact of interventions aimed at controlling malaria.

PapsAI

In Uganda, scientists developed the PapsAI platform that is powered by AI technology to provide affordable diagnostic

tools for cervical cancer, thereby reducing barriers to life-saving healthcare. WHO Africa (n.d.) identified the founder of PapsAI as one of Africa's prominent health innovators.

Insightiv Technologies

The Rwandan startup uses AI to help increase access to radiology services in the country by enabling the remote analysis of medical images (Kuteesa, 2022). The startup won the inaugural HealthTech Hub Africa competition supported by the Novartis Foundation (MIT PKG Center, n.d.).

minoHealth AI Labs

The Ghanaian startup uses AI for the automated diagnosis, forecast and prognosis of a number of diseases. Its research lab studies the application of AI technology in the treatment of diseases. The Founder and CEO is the Lead for the Topic Group on Artificial Intelligence for Radiology under the United Nations International Telecommunication Union and WHO Focus Group on AI for Health (ITU, n.d.).

Zzapp

The Jerusalem-based company leverages AI to identify malaria transmission hotspots by analysing satellite images and topographical maps. In doing so, it helps prioritise areas for the execution of strategies to control and eliminate malaria.

4 Genome editing

Genome editing, also known as gene editing or genome engineering, refers to various scientific techniques that enable changes to an organism's DNA (Fridovich-Keil, n.d.). At specific sites in the genome, these technologies allow for the addition, removal, or modification of genetic material. There are several genome editing techniques that have been developed. Among these techniques, CRISPR-Cas9, which stands for clustered regularly interspaced short palindromic repeats, is more highly regarded for its greater precision and efficiency.

The potential to improve human health is enormous. It may alter DNA sequences that are sources of diseases, or help prevent genetic disorders. Genome editing is being explored to treat cancer, blood disorders, blindness, HIV/AIDS, cystic fibrosis, muscular dystrophy, Huntington's disease and COVID-19, among others (Fernández, 2021).

Ongoing work and actors

Work on genome editing in Africa includes a focus on high-burden diseases; the mapping of gene sequences that are responsible for diseases specific to people of African descent; as well as building the technical capacity of Africans in this area of research.

University of the Witwatersrand, Johannesburg

Research is ongoing at the South African university on the use of CRISPR-Cas9 and other gene editing techniques to cure hepatitis B, HIV, tuberculosis and cancer (Amato, 2019).

The African Computational Genomics (TACG) Research Group

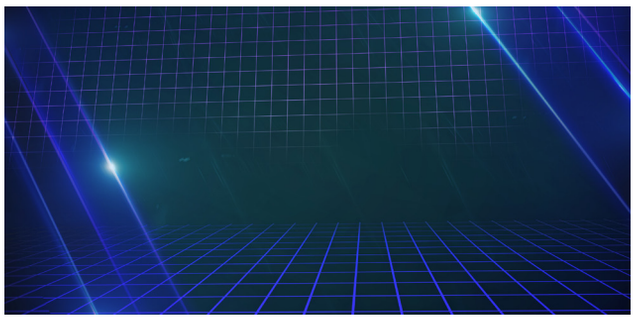
To identify the genes responsible for non-communicable diseases, the research group at the Medical Research Council/Uganda Virus Research Institute and London School of Hygiene and Tropical Medicine, UK is analysing enormous amounts of genomic data. Their goal is to prevent and treat illnesses in which people of African descent are more susceptible.

Malaria Genomic Epidemiology Network (MalariaGEN)

MalariaGEN provides a data resource platform to help understand the genomic variation and evolution of mosquito populations in response to malaria intervention efforts such as insecticides. This knowledge would help guide the development of new tools for malaria control and elimination.

African Centre of Excellence for Genomics of Infectious Diseases (ACEGID)

Founded in 2014, the Nigeria-based ACEGID is producing African genomics scientists to close the skills gap on the continent, and contribute to the effective containment and control of highly infectious diseases such as Lassa fever, Ebola, and COVID-19.



5 Microgrids in healthcare

A systematic review revealed that reliable electricity access in healthcare facilities is a critical issue that must be addressed for the delivery of quality care in sub-Saharan Africa (Adair-Rohani, 2013). Microgrid technology may provide the solution. A microgrid is a self-sufficient energy system which relies mainly on renewable energy sources such as wind and solar, harnessing their power to provide energy to a discrete geographic locale, such as a college campus, hospital complex, or business centre.

The African Union High-Level Panel on Emerging Technologies (APET) has recommended that member states harness microgrid technology for their socio-economic transformation, including for health (APET, 2018b).

Ongoing work and actors

The use of microgrids in healthcare is still in its infancy, however, work is ongoing to expand the use of this technology to provide the much-needed electrical power in the health sector.

Power Africa

The US presidential initiative has so far provided US$3 million in grants for off-grid electrification of over 200 health facilities (USAID, n.d.). This is a priority area for the initiative, and Power Africa and USAID aim to power 10,000 remote facilities in the region.

Multilateral Energy Compact for Health Facility Electrification

At the United Nations High-level Dialogue in 2021, Power Africa, the international organisation Sustainable Energy for All, and twelve other organisations launched the Energy Compact to electrify 25,000 health facilities by 2025 (SEforALL, 2021).

Issues in the development, testing and deployment of emerging health technologies

Lack of specific legal and regulatory frameworks

Most countries in Africa lack the requisite frameworks to facilitate the development and deployment of EHTs.

For gene drive technology, there is a lack of biotechnology legal and regulatory frameworks to guide its field-testing, presenting a significant hurdle towards its complete realisation. Therefore, efforts should be made to engage and support African governments to develop and pass the required frameworks necessary for the planned testing of the technology for malaria control and elimination. There is also a need to develop principles, criteria and standards for the use of gene editing techniques.

The deployment of drones faces the hurdle of lacking frameworks specific to their use in healthcare. While most countries in sub-Saharan Africa have regulations governing unmanned aerial vehicles (UAVs), none of these regulations are specific to using drones in healthcare, such as to deliver medical supplies. Regulators such as National Civil Aviation Authorities are to liaise with the necessary stakeholders in developing or amending existing regulations to encourage the use of drones in healthcare, as well as in harmonising policies for a continent-wide framework to address cross-border use.

Countries also need to amend regulations and policies to facilitate the use of microgrids in healthcare, for instance, distribution for sale is not allowed in some countries. Amendments could focus, among other things, on sustainable tariff structures, monitoring schemes, cross-border interconnection, investment laws, and public-private partnerships.

African countries often lack comprehensive privacy and data protection laws, and this hinders the proper development of artificial intelligence in the continent; thus there is a need for countries to address this policy gap. The inconsistent regulation regarding its application across jurisdictions also needs to be addressed.

Low levels of awareness and knowledge among key stakeholders

Given the relative novelty of some emerging health technologies, key stakeholders may have little to no knowledge about them. These stakeholders include political leaders; policymakers in government ministries, departments and agencies; media practitioners; and communities likely to benefit from the technology if proven effective and safe. For gene drive technology and artificial intelligence, many key stakeholders in government are currently not contributing to their ongoing development, as such, much of the technology development process is driven by researchers or the private sector. All key stakeholders in Africa must be involved in the ongoing process to ensure EHTs address the needs and contexts of target beneficiaries.

Lack of acceptance of certain technologies

Opposition to biotechnology is not new, as this has been witnessed for many years in the agricultural sector. In many parts of Africa, genetically modified crops still do not receive much support. Similarly, there is well-organised opposition to testing gene drives in Africa for malaria control and elimination. Since the technology has not yet being field-tested, the opposition is mainly driven by concerns around the potential risks of this technology to humans and the environment, which have not yet been proven.

Limited technical capacity and investments

Another critical issue for Africa is the limited technical capacity in the continent. The poor data collection and storage in African countries, for instance, impacts the ability to use AI tools. For gene drives, it is urgent to invest in developing capacity so that local experts can play a key role in driving the research and other efforts around its testing and deployment if it is proven effective and safe. There is also a need to drive research and investments to help scale up the use of microgrids in healthcare. For all the EHTs, there is a need to strengthen the internal capacity of various stakeholders to enable better understanding of the technologies, thereby contributing to informed decision-making.

Need for African governments to mainstream proven technologies in healthcare

To fully realise the potential of technologies such as drones and microgrids, African governments need to put in place policies and procedures and make investments to mainstream their use in the health sector. Governments can also facilitate collaborations with the agriculture, transportation, energy, education, water and sanitation sectors to help guide their use in health.

Gaps in media reporting on emerging health technologies

For African governments to prioritise the development and use of emerging health technologies, the media is best placed to facilitate public discussions and debates. Key among the media's role is to share information that empowers the various stakeholders to address their fears concerning emerging health technologies. However, there is a glaring gap in the media's capacity to effectively report on emerging health technologies in an informed, objective, and balanced manner.

Emerging health technologies in Africa

Emerging Technology	Description	Diseases	Countries currently involved	Policy gaps/issues
Gene drives for malaria control and elimination	– Malaria mosquitoes are engineered to resist infection with *Plasmodium* parasites or to produce non-viable offspring – This way, malaria control is achieved through mosquito population replacement or suppression, respectively	Malaria	Burkina Faso, Uganda, Ghana, Mali, Cape Verde, Tanzania, Sao Tome and Principe, Comoros	– No regulatory framework – Increased awareness and capacity building needed
Drones for improved health	– Medical providers often use drones to deliver healthcare items from one point to another – Drones are highly useful in this scenario because they can fly quickly and efficiently between different points and overcome terrain challenges – Drones can also be used for the dispersal of biocontrol organisms	General healthcare	Rwanda, Ghana, Malawi, Kenya, Senegal, Botswana, Tanzania	– Inadequacy of national UAV regulations – Need for a continent-wide regulatory framework – Need to harmonise policies across countries and regions
Microgrids in healthcare	– A microgrid is a self-sufficient energy system that serves a discrete geographic footprint, such as a college campus, hospital complex, or business centre – Microgrids mainly rely on renewable energy sources e.g. solar and wind.	General healthcare	Senegal, Madagascar, Nigeria, Togo, Zambia, Rwanda, Lesotho, Ghana, Mozambique, Malawi	– Distribution for sale not allowed in some countries – Mediocrity of energy-supporting policies and institutions – Capacity building needed – Energy policies and strategies fail to properly address issues such as planning for basic demands, energy security, sustainability, power sector capacity management, environmental protection and end-user protection through workable tariff settings and monitoring schemes
Genome editing	– Genome editing, or genome engineering, or gene editing, is a type of genetic engineering in which DNA is inserted, deleted, modified or replaced in the genome of a living organism	Cancer, blood disorders, blindness, HIV/AIDS, cystic fibrosis, muscular dystrophy, Huntington's disease, hepatitis B, tuberculosis, COVID-19	South Africa, Uganda, Nigeria	– Need for principles, criteria and standards – Capacity building needed
Artificial intelligence	– Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence	Malaria and general healthcare	Sao Tome and Principe, Zambia, Tanzania, Uganda, Ghana	– Uncertain regulatory and policy environments given many low- and middle-income country (LMIC) governments lack the resources and technological capabilities to create consistent policies – Lack of consistent regulations for the use of AI tools by various actors and AI providers, particularly for those used outside of health facilities. This challenge is not only about regulations differing across countries or regions, but also that there is a lack of clear regulation on AI tools in a given jurisdiction – Weak health systems in LMICs, with limited means of collecting or storing digital health data, could inhibit the use of AI tools where they may be most needed

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AFIDEP
African Institute for Development Policy

Kenya Office
6th Floor (Block A), Westcom Point Building,
Mahiga Mairu Avenue, Off Waiyaki Way, Westlands
P.O. Box 14688-00800, Nairobi, Kenya
Phone: +254 20 203 9510 | +254 716 002 059

Malawi Office
3rd Floor, Public Service Pension Fund Building,
Presidential Way, City Centre,
P.O. Box 31024, Lilongwe 3, Malawi
Phone: +265 995 495 143 , Email: info@afidep.org

African Institute for Development Policy
@Afidep
@htp_Africa
African Institute for Development Policy
AFIDEP
afidep_org