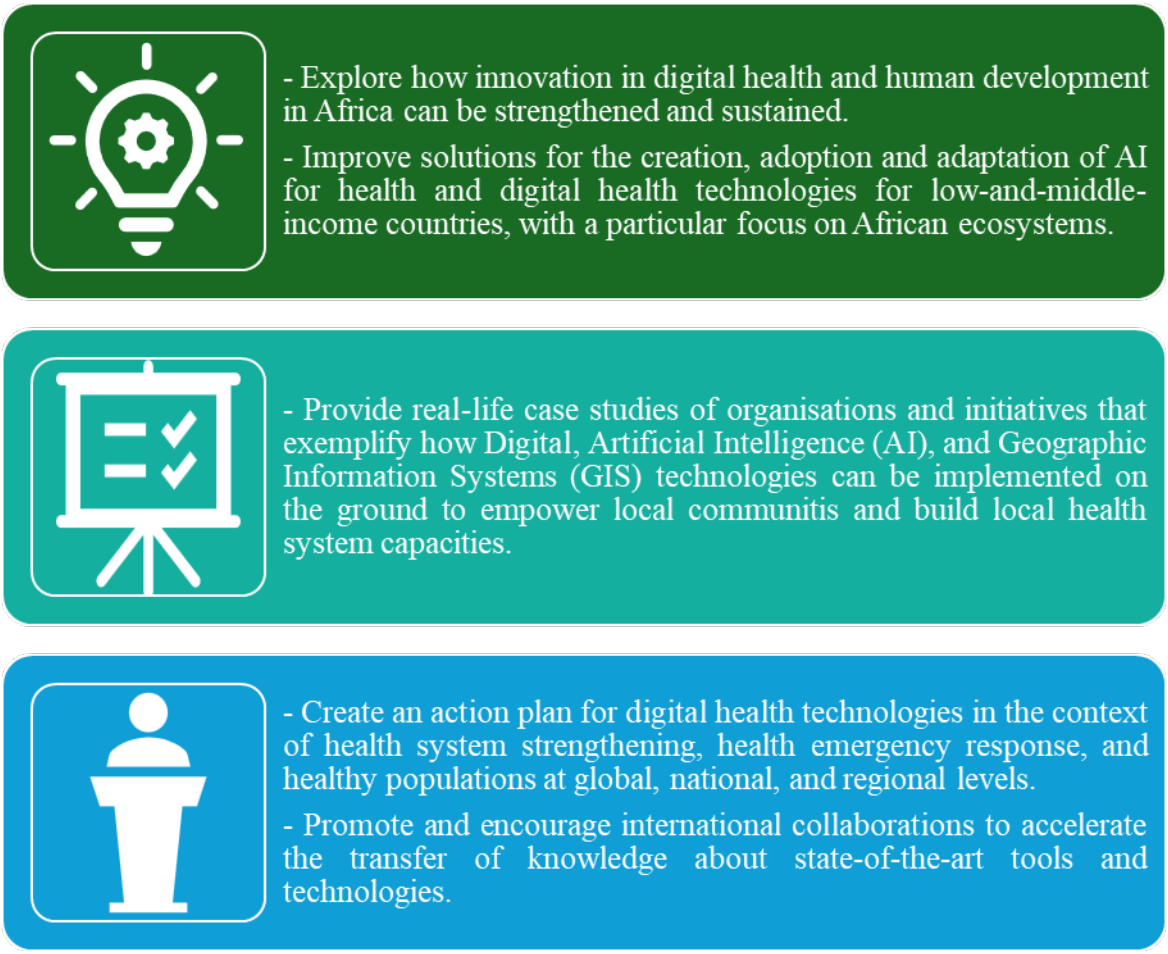
AI and Digital Innovation for Health and Human Development in Africa: From Ideas to Impact

EXECUTIVE SUMMARY

This report is based on a workshop gathering in Doula, Cameroon, organised by the ITU-WHO Focus Group of AI for Health in collaboration with True-Spec-Africa, and the Republic of Cameroon Minister of Posts and Telecommunications, with support of the Global Health Policy Partnership. Participation was sought from practitioners in the fields of digital health, AI, and machine learning, especially those working in Cameroon or part of the Cameroon AI-for-health diaspora: regulators; entrepreneurs; engineers; academic researchers; policymakers, government and civil society experts. Participation was open to anyone from the 193 country members of the International Telecommunication Union.

Table 1: The main goals of the workshop



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ACRONYMS

AI	Artificial Intelligence
AI4H	Artificial Intelligence for Health
CDC	Centres for Disease Control and Prevention
DALY	Disability Adjusted Life Year
FG-AI4H	Focus Group on AI for Health
GDPR	General Data Protection Regulation
GI-AI4H	Global Initiative on AI for Health
GIS	Geographic Information System
HICs	High Income Countries
HSS	Health Systems Strengthening
HSU	Health Systems Unit
ICT	Information and Communication Technology
IoT	Internet of Things
ITU	International Telecommunication Union
LMICs	Low-and-Middle-Income Countries
NCDs	Non-Communicable Diseases
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
TG	Topic Group
UHC	Universal Health Coverage
UN	United Nations
UTAUT	The Unified Theory of Acceptance and Use of Technology
WG-CO	Working Group Collaborations and Outreach
WHO	World Health Organization

1. INTRODUCTION

Artificial intelligence (AI) and digital health technologies have begun to impact health and healthcare globally. These technologies offer huge potential to better understand and manage complex disease mechanisms, develop better drugs and vaccines, help health professionals and policy makers to identify outbreaks faster, improve medical diagnosis, enhance the accuracy and use of electronic health records, manage and reduce the costs of health care, prevent poor health outcomes in populations, and much more. However, High-Income Countries (HICs) and Low-and-Middle-Income Countries (LMICs) have highly variable access to resources and different needs. LMIC health systems encounter major challenges due to poverty, shortages of healthcare workers exacerbated by skill drain, and the highly variable quality of medical resources and systems.[1] These new technologies might help LMICs overcome obstacles by building more cost-effective systems, empowering their research communities, and promoting sustainable development to ensure healthy lives. However, to achieve this, a context-sensitive plan is needed to design, step by step, strategic, innovative, ethical, equitable, accessible, affordable, and multidisciplinary solutions using these new tools.

In the face of rapid technological advances, acceleration in the quality of health for everyone wherever they live in the world will need a space where global health experts can share, explore, evaluate, and adapt each new development. The International Telecommunication Union, the UN's specialized agency for information and communication technologies (ICTs), is the oldest agency in the UN Family. The World Health Organization, the UN's specialized agency for health, directs worldwide efforts to connect nations, partners, and programmes to improve health, including by expanding universal health coverage (UHC). Both organizations collaborated to establish the Focus Group on Artificial Intelligence for Health (FG-AI4H) vested with the task of creating a standardized assessment platform for the evaluation of AI-based tools for health. The FG-AI4H has been organizing meetings since September 2018, growing a vibrant global community of practice, and shaping future directions.[2] The Global Health Policy Partnership

gathers experts with diverse backgrounds from across the world, balanced between HICs and LMICs, to engage in in-depth discussions of health challenges and proposed solutions. The partnership supported the Working Group on Collaborations and Outreach (WG-CO) of the ITU / WHO Focus Group on AI4H to produce this workshop and report.

1.1. Groups and Organisations joining the Workshop

1.2. Chairs and Speakers

H.E. Minette Libom Likeng
Minister, Posts and Telecommunications Cameroon

Thomas Wiegand
Chairman, ITU/WHO FG-AI4H; Executive Director, Fraunhofer Heinrich Hertz Institute

Sarah Agbor
Africa Union Commissioner for Human Resources, Science and Technology

Andrew Farlow
University of Oxford and Global Health Policy Partnership

Simao Campos
Counsellor for ITU/WHO FG-AI4H and ITU-T Study Group

Franck Verzefe
Chief Executive Officer, TrueSpec Africa

Darlington Akogo
Founder and Chief Executive Officer, minoHealth AI Labs

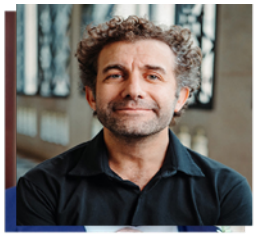
Bastiaan Quast, Data Scientist and Machine Learning Researcher, ITU

Terrence Beteck Epie
International Health and Tropical Medicine, University of Oxford

Brenda Tanyi
International Health and Tropical Medicine, University of Oxford

Deogratias Mzurikwao
AI Sector Lead, Villgro Africa

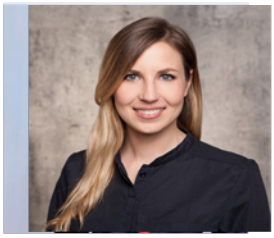
Sunny Ibeneme
Digital Health Specialist, UNICEF



Daniel Opoku
Research Fellow, AI in Medicine Lab, Berlin University of Technology

Yunusa M. Garba
Founder, AiMedicare and Algorizmi Health

Guisilla Dedino
Service Manager, National Health System UK



Eva Weicken
Chief Medical Officer, Fraunhofer Heinrich Hertz Institute

Karim Lekadir
Director, AI in Medicine Lab, University of Barcelona

Marc Lecoultre
Head of Architecture Board, Swisscom Digital Services

Ngwashi Christabel
Founder MT-7AM Health

Simien Nchinda Ngek Ekongefevin
University of Oxford

Robert Beyer
Co-Founder and Executive Chairman Villgro Africa

Benjamin Sarcodie
University of Ghana Medical School

Judy Wawira
Winship Cancer Institute, Emory University

Conrad Tankau
Founder, Global Innovation and Creativity Space

Ahmed Ahidjo
University of Maiduguri Teaching Hospital

Markus Wenzel
Senior Scientist, Fraunhofer Heinrich Hertz Institute

Jawa Zabah Muhammad
Sultan Qaboos University Hospital

1.3. Cameroon Workshop Agenda

Session 1: Opening remarks and keynote addresses (09:00 - 10:40)

- Franck Verzefé, TrueSpec-Africa, Cameroon
- Thomas Wiegand, Chair ITU/WHO FG-AI4H & Fraunhofer HHI, Germany: "Introduction to the ITU/WHO Focus Group on AI for Health"
- H.E Minette Libom Likeng, Minister of Posts and Telecommunications of Cameroon
- Andrew Farlow, University of Oxford, UK and Global Health Policy Partnership:
  "FG-AI4H WG - Collaborations and Outreach"
- Sarah Agbor Africa Union Commissioner for Technology:
  "Research and education in Africa"

Session 2: Health system strengthening, infectious disease, outbreaks, health finance to support Universal Health Coverage (11:00-12:20)

Moderators: Robert Beyer, Villgro Africa, Deogratias Mzurikwao, Tanzania

- Sunny Ibeneme, Nigeria: "Health system strengthening for UHC: Building a Shared Vision"
- Daniel Opoku, Ghana: "Management of non-communicable diseases outbreaks, and pandemic prevention"
- Terrence Beteck Epie, Cameroon: "Epidemic and HIV drug control - A Digital Tool for Blood Donation in Cameroon: A Failed Implementation"
- Panel Discussion

Session 3: Innovation, entrepreneurial support, education (13:30 - 14:30)

Moderators: Robert Beyer, Villgro Africa, and Deogratias Mzurikwao, Tanzania

- Christabel Ngwashi, Cameroon: "Digital innovation in conflict zones"
- Guisilla Dedino, Cameroon: "Digital innovation in times of conflict and for trauma"
- Deogratias Mzurikwao, Tanzania: "Entrepreneurial support for impact – Harnessing the Power of AI for Africa's Development"
- Brenda Tanyi: "Funding mechanisms for m-health interventions for maternal health"
- Karim Lekadir, Director AI in Medicine Lab, University of Barcelona, Spain: "Inclusive Artificial Intelligence for Accessible Medical Imaging Across Resource-Limited Settings"

- Panel Discussion

Session 4: Telemedicine, medicines, non-communicable diseases (15:00 - 16:10)

Moderators: Markus Wenzel, FG-AI4H WG-O & Fraunhofer HHI, Germany & Eva Weicken, Co-Chair WG Clinical evaluation & operations; Fraunhofer HHI, Germany

- Yunusa M. Garba, Uganda: "Telemedicine - AiMedicare"
- Sintieh Ekongefeyin: "Non-communicable diseases (NCDs) and Digital Health"
- Conrad Tankou: "Breast and cervical cancer" –"Advancing health equity in Africa through technology"
- Jawa Zabah Muhammad, Sultan Qaboos University Hospital, Oman: "Nuclear medicine in Africa"
- Panel Discussion

Session 5: Radiology (16:10 - 18:15)

Moderator: Darlington Akogo, MinoHealth AI Labs & FG-AI4H TG AI for Radiology, Ghana

- Ahmed Ahidjo, University of Maiduguri Teaching Hospital, Nigeria: "Radiology in Africa"
- Benjamin Sarkodie, University of Ghana Medical School: "Challenges Facing Radiology in Africa"
- Judy Wawira, Emory University, USA: "Challenges Facing AI in Radiology"
- Darlington Akogo, MinoHealth AI Labs & FG-AI4H TG AI for Radiology, Ghana: "Opportunities in AI for Radiology"
- Panel Discussion

Closing Remarks(18:15)

- Andrew Farlow, University of Oxford, UK and Global Health Policy Partnership

1.4. Writing and Research Team

Selin Girgin

Derya Şahin

Humayra Bashir

Andrew Farlow

2. PERSPECTIVES

- **Challenges to implementing and accelerating AI applications** in global digital health.
  To name a few: going beyond 'pilotitis', ensuring platforms are efficient and cost-saving, tackling technology trust issues/lack of understanding of AI, lack of understanding of ethical issues, optimising internet/network for local populations, ensuring local and context-sensitive innovation, enabling Universal Health Coverage for all regardless of wealth level or location, rural vs urban equity, harnessing the demographic dividend.

- Shaping the WHO/ITU/WIPO Global Initiative Ecosystem.
  Developing, implementing, and scaling up of **new hackathon/challenge structures** for tackling globally relevant health problems with FG-AI4H **standards and software**, in collaboration with governments, communities, and other stakeholders.

- Advancing a **novel and expanded investment framework**. The fast-growing area of AI and digital health technologies presents an opportunity to create novel global economic accounting rules and frameworks that better account for value of health and human development.

- Improving the **sustainability of digital and AI initiatives**, especially coming from low-resource settings by achieving a better balance between the private and public sectors. This includes **health system strengthening** for **UHC** and building **health-resilient societies**, including against pandemics and in conflict zones.

- Supporting efforts for developing stronger **research, education, technology, and innovative environments in Africa**.

- Focusing on **human-centered design and local "intelligence"** such that health systems are continuously learning and improving, and innovation in digital health becomes a natural outgrowth of lessons learnt from patient care, leading

to the rapid adoption of findings and improved quality of outcomes, all under local control.

- Encouraging **collaborations and global initiatives** on AI for health. Determining strategic approaches for future goals and defining and refining the three main pillars of the GI-AI4H: Enablement, Facilitation, and Implementation.

2.1. Challenges to Implementing and Accelerating AI Applications in Global Digital Health

Digital health and AI tools are evolving rapidly, but there are significant challenges and risks associated with their implementation and global scale-up. During the workshop some of these challenges were explored including equitable, efficient, and cost-effective data management, evaluation, research capacity, bias, trust, and ethical issues.

One major obstacle is the quality and quantity of data used to train and validate models and keep them up to date and an equitable health-data infrastructure to support this function. The Covid-19 pandemic demonstrated that up-to-date data needs to be shared with local and international partners to define, determine, and manage infectious disease threats. The FAIR Principles have created standard guidelines and common understandings around gathering, analysing, and managing data. To facilitate international collaborations; data should be Findable, Accessible, Interoperable, and Reusable.[3]

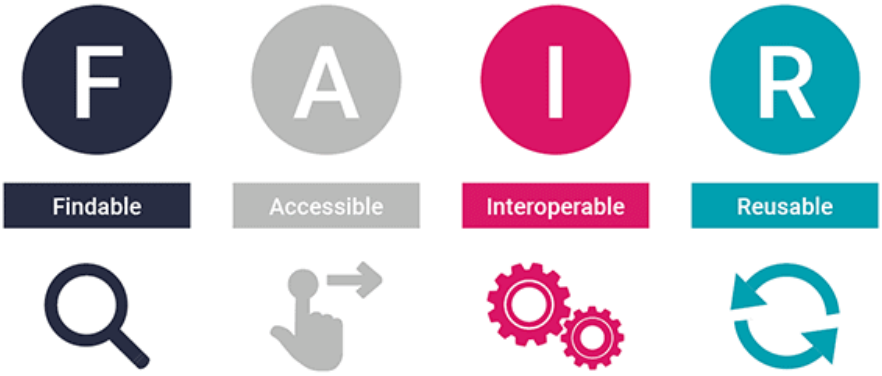


Figure 1: The FAIR Principles

Trust is essential for any health technology. AI and machine learning (ML) models and the circumstances where they are implemented can be highly complex. The models — whether they are data-driven ML models (e.g., artificial neural networks) or knowledge-based AI models (e.g., expert systems) — can be applied in a range of use cases such as diagnostics, forecasting, triage, image segmentation, electronic health records, and many others. Data privacy for models has also raised cybercrime concerns around the world, as patient data might be misused and lead to discrimination. Therefore, it must be ensured that all these AI/ML models are accurate, robust, transparent, free from bias, plausible, safe in practice, and hence trustworthy.

2.2. Contributing to the AI4H Ecosystem

The goal of the ITU/WHO Focus Group on AI for Health (FG-AI4H) was to boost AI for health in line with the WHO's Global Strategy on Digital Health and the United Nation's Sustainable Development Goals.

Figure 2: The ITU/WHO FG-AI4H

The FG-AI4H identified, promoted, co-developed, and evaluated AI innovations in close collaboration with partners around the globe,[4] increasingly with a focus on implementation that would lead to sustainable impact and benefit.

The ITU/WHO Focus Group Ecosystem, being incorporated within the Global Initiative on AI for Health, centres on:

- The creation of guidance documents & standards for AI4 in health;
- Open-source software for AI auditing, benchmarking, data annotation, and assessment platform;
- Global applicability and implementation of these standards.

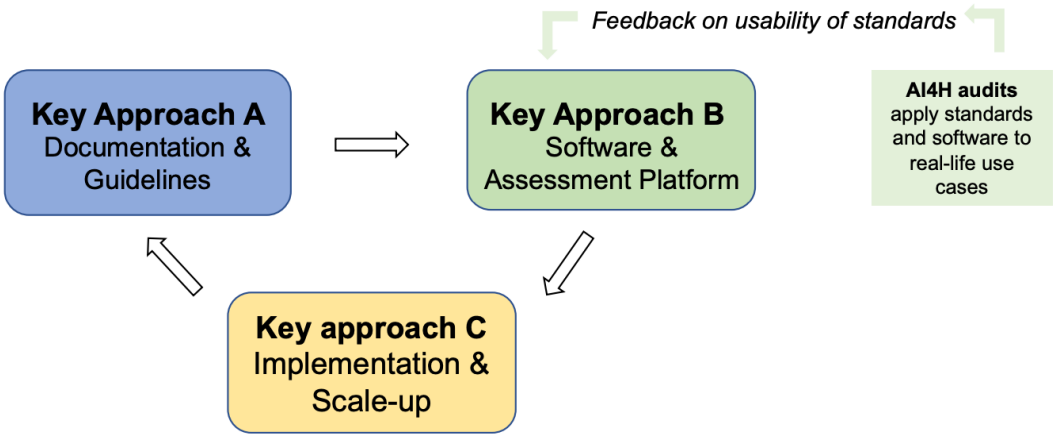
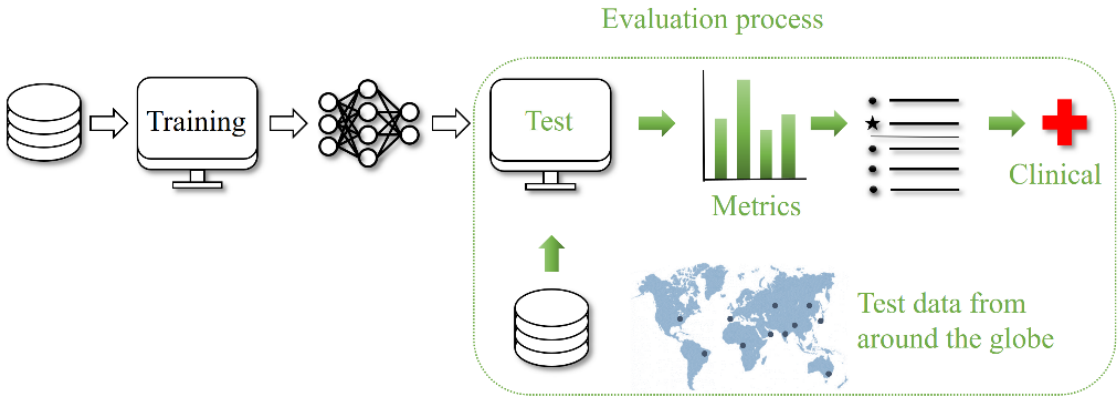


Figure 3: Strategic workflow of key approaches in the ITU/WHO Focus Group Ecosystem

The ITU/WHO FG-AI4H established 24 Topic Groups (TGs) which explored specific health domains having potential AI/ML applications, such as radiology, tuberculosis, antimicrobial resistance, and cardiovascular disease management.[4] Seven Working Groups (WGs) addressed cross-cutting themes which influence specific aspects of AI health applications that WGs developed a framework for clinical evaluation of AI systems, highlighted ethical considerations, and encouraged collaborations and outreach.

An open-code initiatives focused on the improvement of open-source software tools (data acquisition, storage, annotation, prediction, assessment, and reporting packages) and provision of an end-to-end benchmarking platform based on



standardized test procedures and metrics using high-quality, representative, and undisclosed test data.

Figure 4: Independent model validation with standard procedures on separate test data and subsequent clinical evaluation

This approach complemented in-house or local technical tests and subsequent clinical trials. It did not put test subjects at risk, could be repeated in the case of model/software updates, and could be based on large amounts of high-quality test data from different sources and sites. In addition, releasing new benchmarking data sets drives the R&D community and can serve as an incentive to shift R&D resources to areas of high health priority.

AI auditing involves developers, regulators, medical professionals. AI auditing by FG-AI4H:

- Permits the identification & definition of methods for data & AI evaluation.
- Enables best practices for AI auditing and quality control along the entire AI life cycle.
- Facilitates the verification and validation of technical/clinical/regulatory/ethical requirements for AI.

"Only five percent of solutions, which aim to tackle challenges to globally relevant health problems by using the FG-AI4H standards and software, have been developed after gatherings like this workshop. We need to close the solution development gap." The WG-CO proposed novel challenge structures for closing the solution development gap:

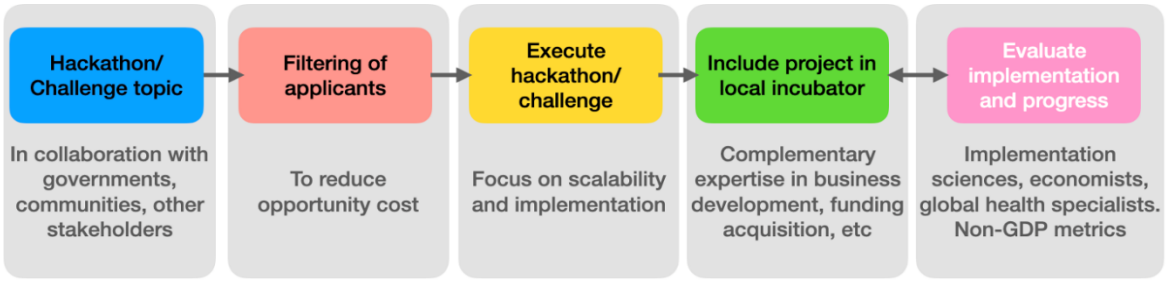


Figure 5: The venture building strategy focused on global health challenges

Digital health innovations in low-resource settings require more than good ideas: they need to be supported with a venture-building strategy for effective implementation. To sustain long-term impact, new hackathon/challenge structures, complementary business opportunities, and funding mechanisms working in collaboration with communities, stakeholders, and governments are required.

2.3. Advancing a Novel and Expanded Investment Framework

Creating and deploying AI and digital technologies requires resources, and some focus needs to be put on investment frameworks, funding methods, and markets. A new and expanded investment framework was proposed by the Working Group – Collaborations and Outreach incorporating:

- Company (entrepreneur, business model, financials)
- Competitive landscape (e.g., barriers to entry)
- Market (size, growth, potential and timing)
- Diligence (competitive advantage, exit and risk)
- Impact on the population (health outcomes in Disability Adjusted Life Years (DALYs) averted, equity, access, effect on the society and environment).

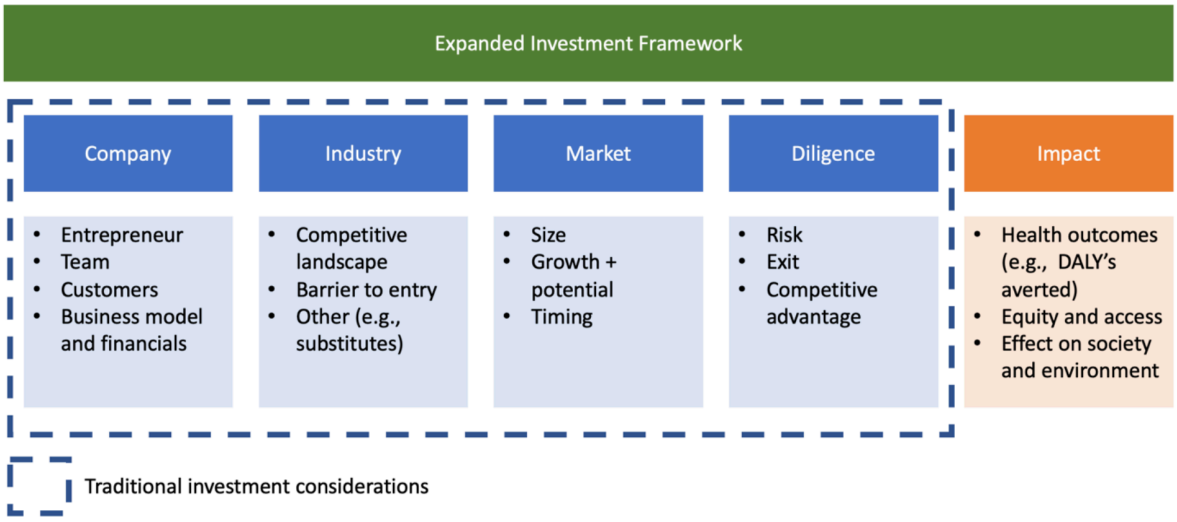


Figure 6: An expanded investment framework,[5] a specific form of impact investing that incorporates health outcomes along with other outcomes (such as impact on the environment).

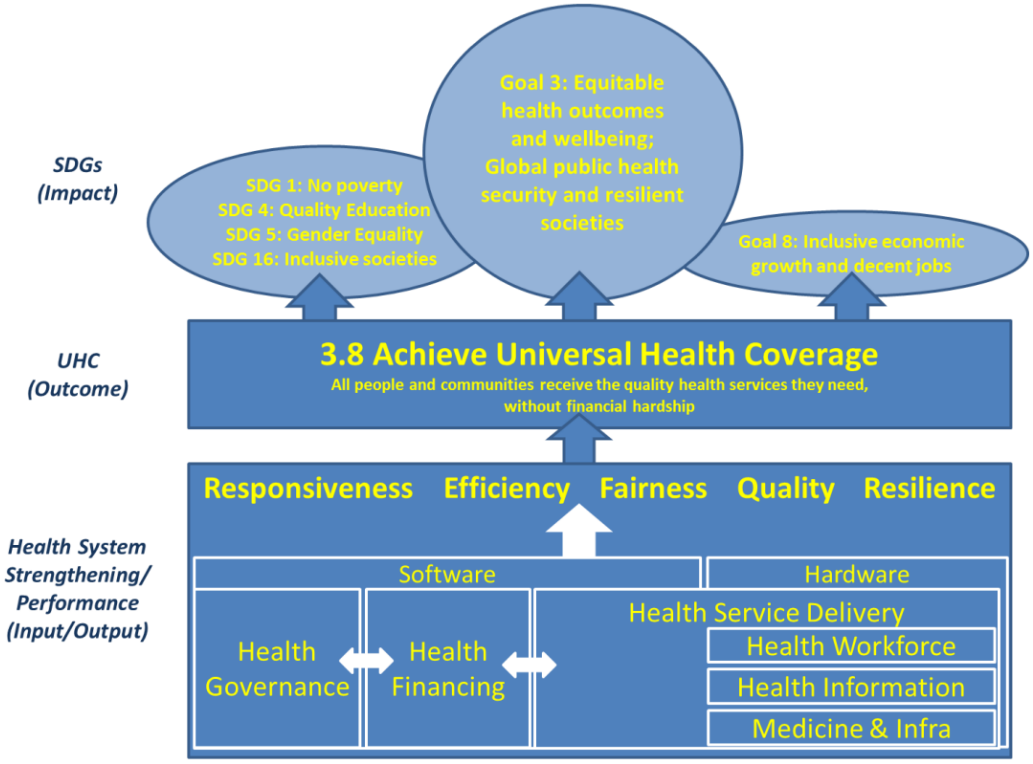
2.4. Improving the Sustainability of Digital and AI Initiatives in the context of Universal Health Coverage

Nearly every workshop in the series has identified sustainability as a major limiting factor. A long-term funding strategy is a requirement to support initiatives for technical experiments and capacity strengthening.

The goal is to permanently make systems function better, not just apply temporary solutions. Permanent health system strengthening (HSS) which promotes Universal Health Coverage (UHC) requires clarity and consensus on both desired goals and policy entry points.[6] UNICEF enumerates five dimensions of health system performance as its HSS focus (Figure 8):

- Fairness in access and financing
- Quality
- Responsiveness
- Efficiency
- Resilience

UHC requires going beyond proving that solutions are "economically viable". Traditional approaches to demonstrating value, and modes of reimbursement, pricing, and financing are often barriers to implementation, and are also in need of



pragmatic innovation.

Figure 7: Achieving the Universal Health Coverage by implementing the Sustainable Development Goals (SDGs) and building a shared mission

Policy entry points for HSS to promote UHC towards improved health system performance require domestic and global action in three areas: service delivery; financing; and governance.

Service delivery is the primary interface between the health system and the population. Scaling up front-line health workers, making organizational innovations, enhancing healthcare quality, and ensuring patient safety are key considerations for HSS.

Health financing arrangements determine the ability of health systems to respond to health needs, spread financial risks, and operate efficiently and equitably. Strengthening all health financing functions particularly in LMICs is necessary to enhance the resilience of health systems. Domestic and global resource mobilization are fundamental steps towards UHC for health financing.

"As digital health and AI leaders, we need to think about not only getting a grant but about how we can provide a sustainable level of service once grant funding has ended."

Robust governance is a crucial foundation for all health systems. UHC will require collective action across countries to make health systems the business of everybody through multisectoral coordination, including the private and public sectors.

2.5. Supporting Efforts for Developing Better Research, Education, Technology, and Innovative Environments in Africa

Developing technological solutions that address global challenges is not enough. It is critical to support efforts to improve the installation of these state-of-the-art technologies in diverse communities and to pay particular attention to regulation of policies.

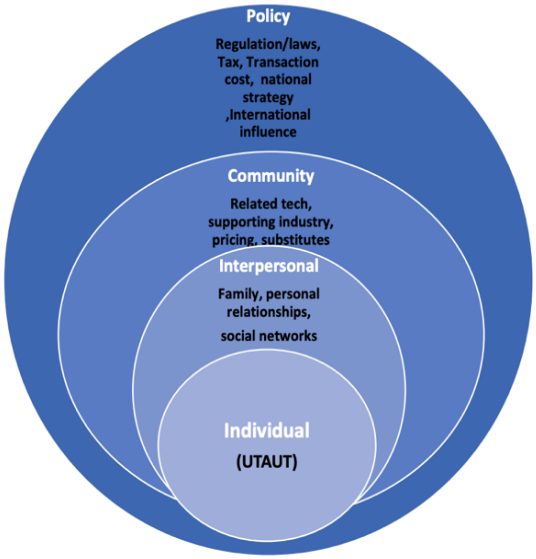


Figure 8: Adoption of digital technologies with a socio-ecological model. The Unified Theory of Acceptance and Use of a Technology (UTAUT) explores the acceptance of technology through the effects of individual, interpersonal, community, and policy factors.[7]

The Minister of Posts and Telecommunications of Cameroon, H.E. Minette Libom Likeng, noted that integration of digital technologies into a system will not be spontaneous. It will need some centralised decisions in terms of standards, regulations, policies, and pricing, and that a socio-ecological model must frame all.

"We must keep up with this evolution and transform our modes of production by increasing the digital content in the various sectors of activity. This is true of e-learning in education, telemedicine in health, e-administration in the public sector, and e-commerce in sales. The developing digital society will not wait for laggards."

President of Cameroon, Paul Biya, quoted by Minister of Posts and Telecommunications of Cameroon, H.E. Minette Libom Likeng

The former Africa Union Commissioner for Human Resources, Science, and Technology, Sarah Agbor, promoted research and education in all Africa "to raise many more brilliant minds, and stimulate initiatives for innovation in AI and digital health". Specifically, she encouraged youth empowerment and participation in the education of AI across the African continent and highlighted the need for inter-African international cooperations.

"Our Research needs to leave the shelves to the tables. There must be synergy between the academia and the technology industry."

The former Africa Union Commissioner for Human Resources, Science, and Technology, Sarah Agbor

Figure 9: Primary objectives of Agenda 2063 Africa[8]

Sarah Agbor highlighted "Agenda 2063", Africa's blueprint and master plan for transforming Africa to a high standard of living with advanced technology, science, education, and innovation.

2.6. Focusing on Human-Centred Design of AI and Digital Health and Local Delivery

Digital health and AI tools (app-based or otherwise) should be compatible with local health system workflows, respond to local priorities, be well-designed, and be sustainable.

Improving health data in health care centers in LMICs will mean building local "intelligence" in terms of skills, organising people to meaningfully use such data, investment in local data infrastructure and data centres, and encouraging local

health systems to continuously learn and improve. Discovery in AI and digital health, as in any other area of medical intervention, can then become a natural outgrowth of patient care, leading to more rapid adoption of findings, and improved quality and outcomes. Often, good innovations are not being used because of constraints elsewhere in the system or within society. To understand why this is so, the group indicated the need to focus on health system implementation science and tackling those constraints so that proven effective interventions can be matched with local knowledge on how to deliver them. Such research requires a multi-disciplinary system lens, one that looks also at unintended consequences of innovations on broader systems and different stakeholders.

"To achieve success; technology should be created in collaboration with local partners and suited to their specific demands and health system constraints."

The design of digital health tools needs to be human-centered. Most digital health innovations fail after they have been developed, not because they are technically deficient but because they do not fit workflows or help those providing, or receiving, care in their day-to-day activities. Such tools have no value to users even if they have a logical value for the system. They solved the problems outsiders imagined, not the problems insiders knew existed. Perspectives shaped predominantly by academic approaches may not fully reflect local context and on-the-ground realities, which are often much better understood by local practitioners and innovators with years of experience in those settings.

Tackling "pilotitis," as the WG-CO explained, is the ability to go beyond endless piloting of interventions demonstrating efficacy in only very small and targeted population samples. This requires the right research networks, and embedded long-term collaborations. It was noted that creating and bringing together a rich multidisciplinary group allows policy makers, service providers, local innovators, and patients in routine settings to become partners in a digital-health and AI learning enterprise. This was discussed as the most fruitful way to encourage the creation, adoption, and adaptation of AI in healthcare within African ecosystems, while strengthening and sustaining innovation in digital health and human development in Africa.

2.7. Encouraging Collaborations and Global Initiatives on AI for Health

Interoperability is one of the key issues confronting the global health community and its expanding digital health and AI solution ecosystem. Coordinated action is needed to achieve interoperability in the global health ecosystem – because individual actors cannot force compatibility with one another – and ongoing communication among diverse communities to enhance the "innovation umbrella" of AI for health.[9] This will enable funders and investors to get a better understanding of how they can assist both HICs and LMICs after having dialogued with experts in these domains from within both.

For this purpose, the WG-CO and the ITU/WHO FG-AI4H have been organising workshops and webinars – so far more than 20 international webinars and 5 workshops –with a growing number of local partners.

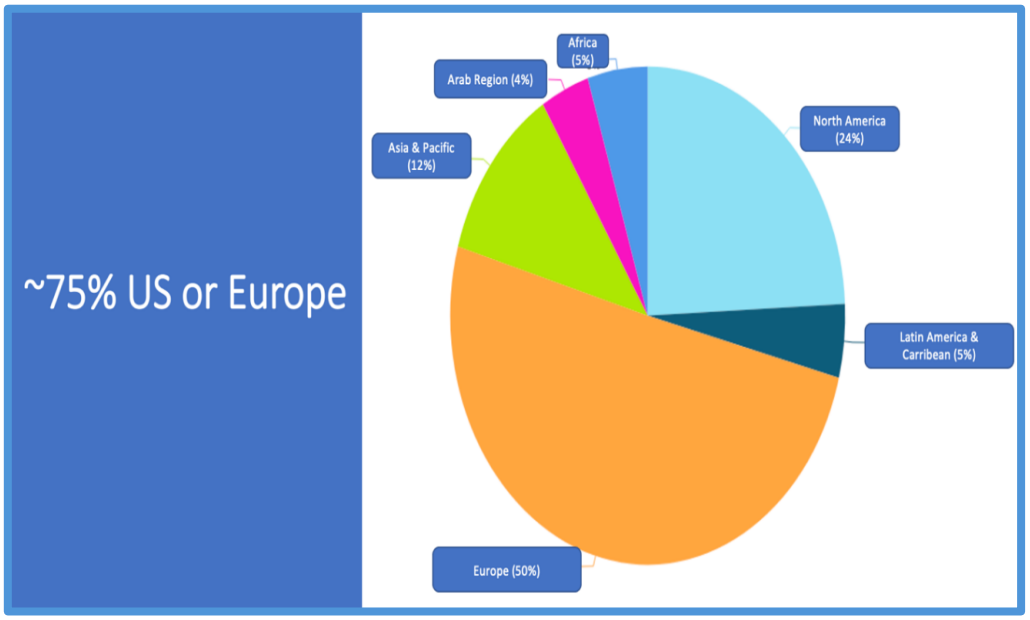
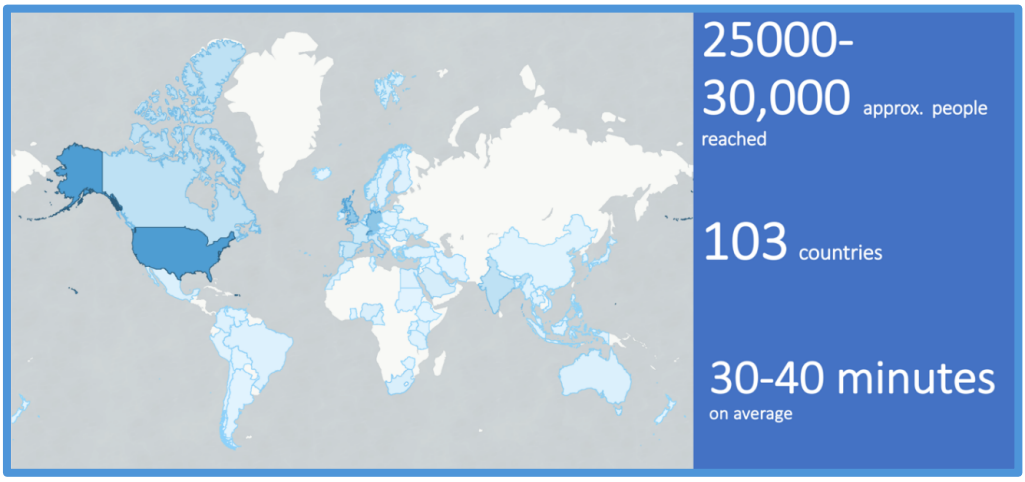


Figure 10: The statistical information and diagram about the attendance of AI4H webinars

The Collaborations and Outreach working group has created reports on the "State of Digital Tools in Africa", "Catalyzing Innovation in Global Health" and "Equitable Data Sharing" and further reports, documents, and publications are forthcoming.



The future goal and strategic approach of these collaborations, in particular the new Global Initiative on AI for Health, are:

Figure 11: The Enablement, Facilitation, and Implementation Pillars of the Global Initiative on Artificial Intelligence for Health (GI-AI4H).

Enablement Pillar: The Enablement Pillar serves as the foundation for AI4H solutions by delivering a suite of standards, guidance documents, governance materials, and policies. These are to be officially published by key international bodies, each contributing from their areas of expertise. The ITU is responsible for technical specifications and reports built upon past FG-AI4H deliverables. The WHO contributes by providing regulatory and ethics guidance specific to AI in health contexts, including specialized guidance for tuberculosis (TB) and sexual and reproductive health and rights (SRHR), along with implementation guidelines for AI systems in health.

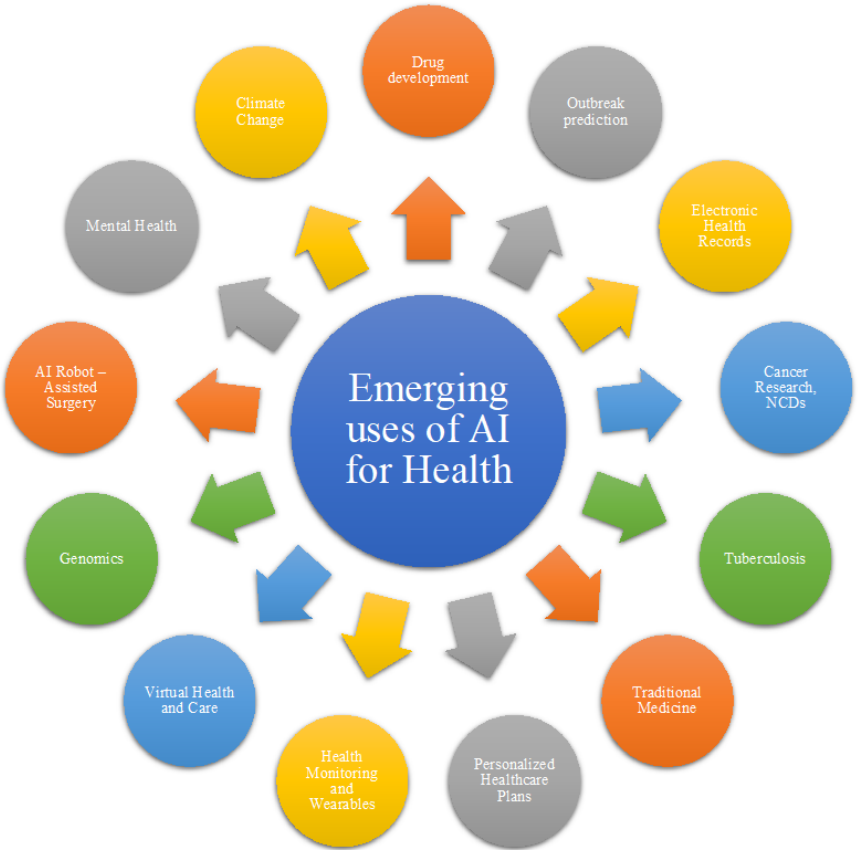


Figure 12: WHO's approach on emerging uses of AI for Health[1]. This comprehensive approach ensures that AI4H is internationally recognized and involved in various disciplines.

Facilitation Pillar: The Facilitation Pillar is instrumental in the practical implementation of AI4H, providing a multifaceted support system to bridge the gap between foundational principles and real-world applications. It involves collaboration with facilitation groups –including public health agencies, academic and research institutions, AI agencies, regulators, investors, and industry stakeholders – to guide and accelerate the adoption of AI4H. This pillar leverages an Open Code Initiative to translate established standards and guidelines into software solutions, ensuring compliance and ease of integration. Furthermore, an Innovation Factory will play a crucial role in connecting funding sources, such as of foundations and venture capital funds, with AI4H implementers, facilitating the transition from concept to operation. This comprehensive support will lead to the development of critical components for AI4H projects, including efficient data management, clinical evaluation processes, regulatory compliance mechanisms, intellectual property considerations, and cost-effectiveness assessments. These

components ensure that AI4H projects are not only technically sound but also viable and ready for integration into health systems.

Implementation Pillar: The Implementation Pillar is critical for the deployment of AI4H solutions on a sustainable, large-scale level – nationally or regionally. It offers comprehensive support through various channels:

- Facilitation and implementation groups that guide rollout processes.
- The Innovation Factory that connects funders with AI4H implementers.
- Country-specific implementation programs that tailor AI4H deployment strategies to local needs.
- Workshops for developers and country-specific entities to ensure skill development and readiness.

For countries and hospitals, this pillar aids in establishing acceptance criteria for AI4H technologies to ensure smooth integration. For implementers, it ensures the creation of detailed scale-up plans, financial models for the deployment lifecycle, processes for securing ethics approvals, addressing legal aspects such as contracts and permissions, and crafting both execution and evaluation plans. These comprehensive steps ensure that AI4H initiatives are effectively translated from concept to practice, with a focus on sustainability and adherence to regulatory, ethical, and financial considerations.

3. CASE STUDIES

3. CASE STUDIES

A range of AI and digital health projects were presented during the Cameroon meeting, with an especially strong body of work created by Cameroon colleagues. Future meetings will offer opportunities for numerous additional organizations and innovators to present and promote their achievements to a wider audience and to learn, modify, and spread good AI solutions with others.

3.1. TrueSpec-Africa, Cameroon – Using AI to Determine the Genuity of Medication

Millions of individuals throughout the world are exposed to a high risk of illness or death from taking poor-quality or substandard medications to prevent or treat various diseases. Existing drug testing devices are offered at a high price and are not affordable in many LMICs. TrueSpec Africa is a healthtech company focused on developing novel solutions to difficult problems impacting populations and industries around the world. It has developed a low-cost portable device that utilizes AI to allow hospitals, pharmacies, pharmaceutical laboratories, quality control centers, warehouses, and buyers and sellers to determine in less than 10 seconds whether a drug is genuine.

Figure 13: The TrueSpec Device

TrueSpec involves a Nano-scanner using near infrared (NIR) spectral methods for rapid, reagent-free, and preparation-free drug testing to detect the quality of a drug. The NIR spectral method is an analytical technique for quick determination and characterization of materials.

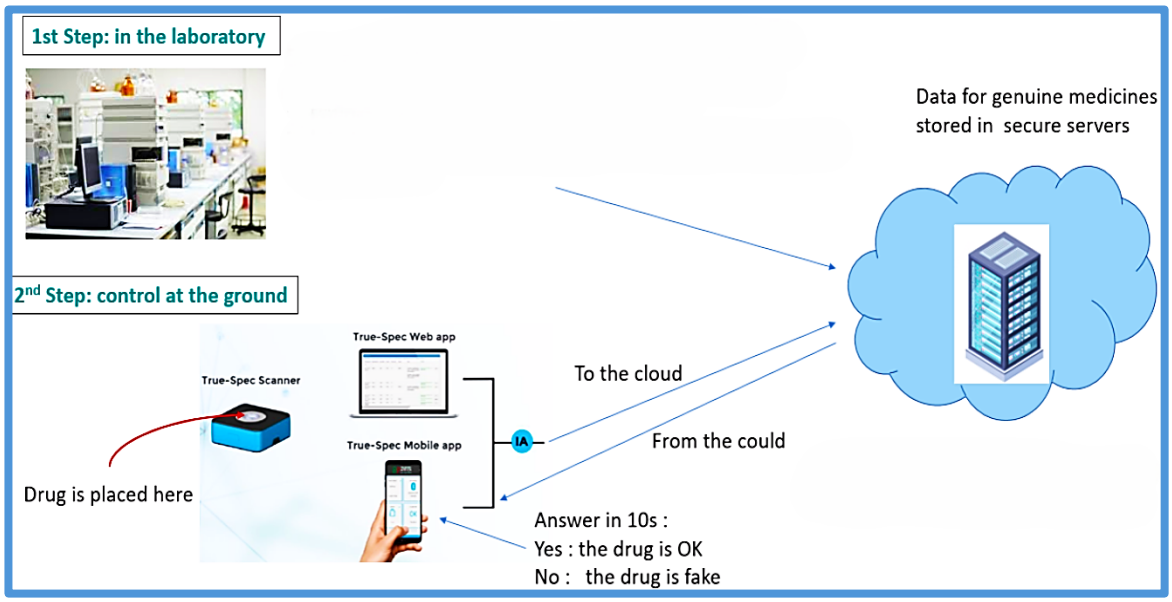


Figure 14: The principle of near infrared drug analysis on the ground

The NIR spectral data are processed by AI and then transferred to a secure server. This AI-based technology is used to match drug data collected on the ground to datasets characterising genuine medicines stored on secure servers in the cloud.

TrueSpec builds a database by systematically analysing genuine medicines using NIR methods and comparing the output data with the standard references. The creation of this database has been made possible by the contributions of several universities, professors, researchers, and young pharmacists in Africa.

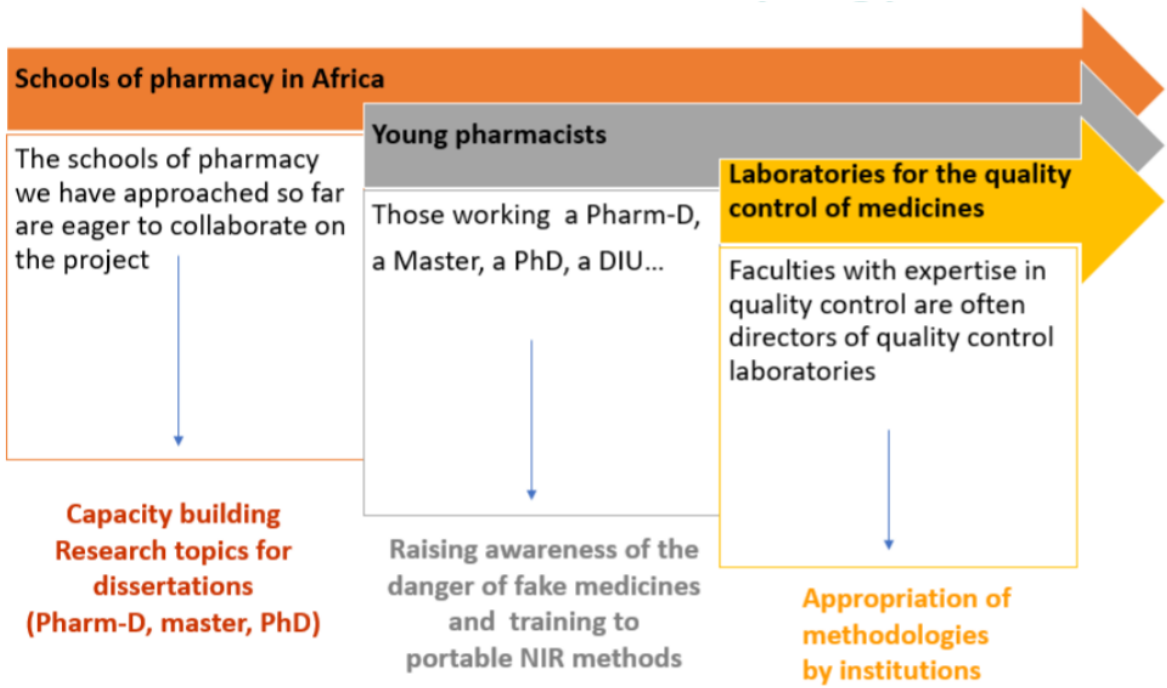


Figure 15: Building the drug data base

Frank Verzefe from Cameroon, Chief Executive Officer and founder of TrueSpec Africa, emphasized that various regions in Africa such as Dakar, Kigali, Gaborone, Limpopo, and Antananarivo have been involved in the creation of the database.

The goal is to protect people through improving the ability of national drug regulators to secure the drug supply chain and reduce mortality due to substandard and falsified drugs in Africa and around the world. This can be accomplished by providing a platform as a service tool to drug regulators for their use in real time for multiple purposes, such as checking, monitoring, and reporting drug quality. One of TrueSpec Africa's future goals is to equip every school with mobile NIRs TrueSpec devices and train teachers and students in the use of new drug analysis technologies.

3.2. Villgro Africa – Entrepreneurial Support for Impact

Villgro Africa was established in 2015 (as Villgro Kenya) to serve a nascent global health innovation ecosystem on the African continent. The sector choice was informed by the lack of focused support in health, life sciences, agriculture, education, research, and innovation.

Over the most recent 7 years, Villgro Africa has supported over 50 innovators, investing more than $2.1 million in companies that have gone on to unlock over $20 million in follow-on funding with activities that touch millions of lives in Africa.

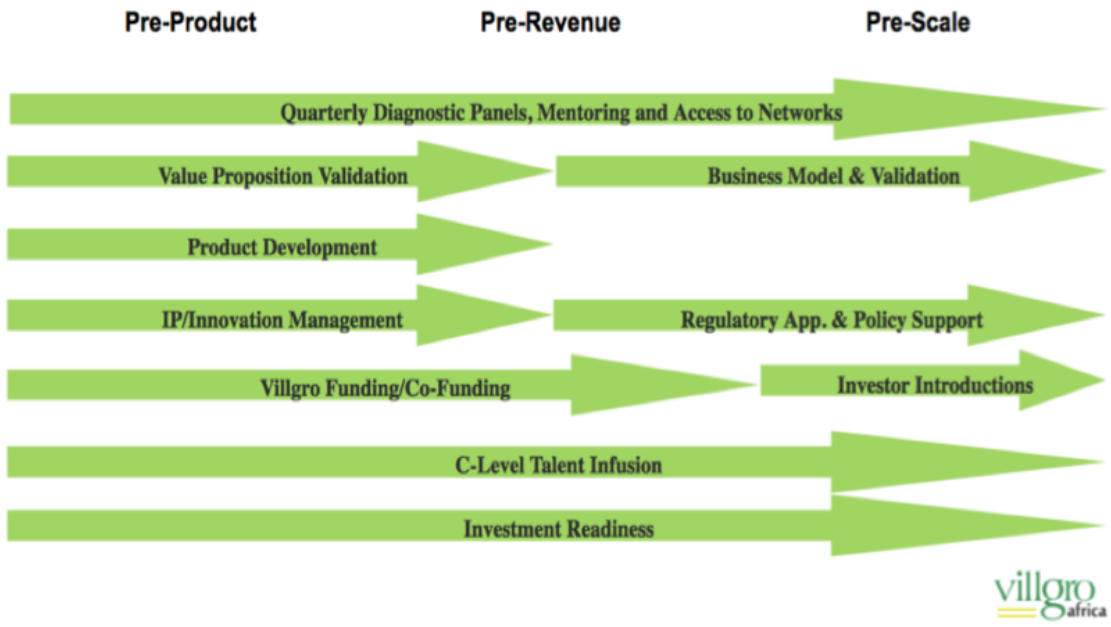


Figure 16: Villgro Africa's Support Model

Villgro Africa funding partners include the Argidius Foundation, Lemelson Foundation, IDRC, AI4D, USAID, Grand Challenges Canada, Saving Lives@Birth, Johnson & Johnson Impact Ventures, Villgro Innovations Foundation (India), Villgro USA & Villgro Philippines, among others.

In March 2021, Villgro Africa launched a pan-African call for innovations entitled "Harnessing the Power of AI for Africa's Development". Their mission is to assist entrepreneurs to turn creative ideas into successful businesses.

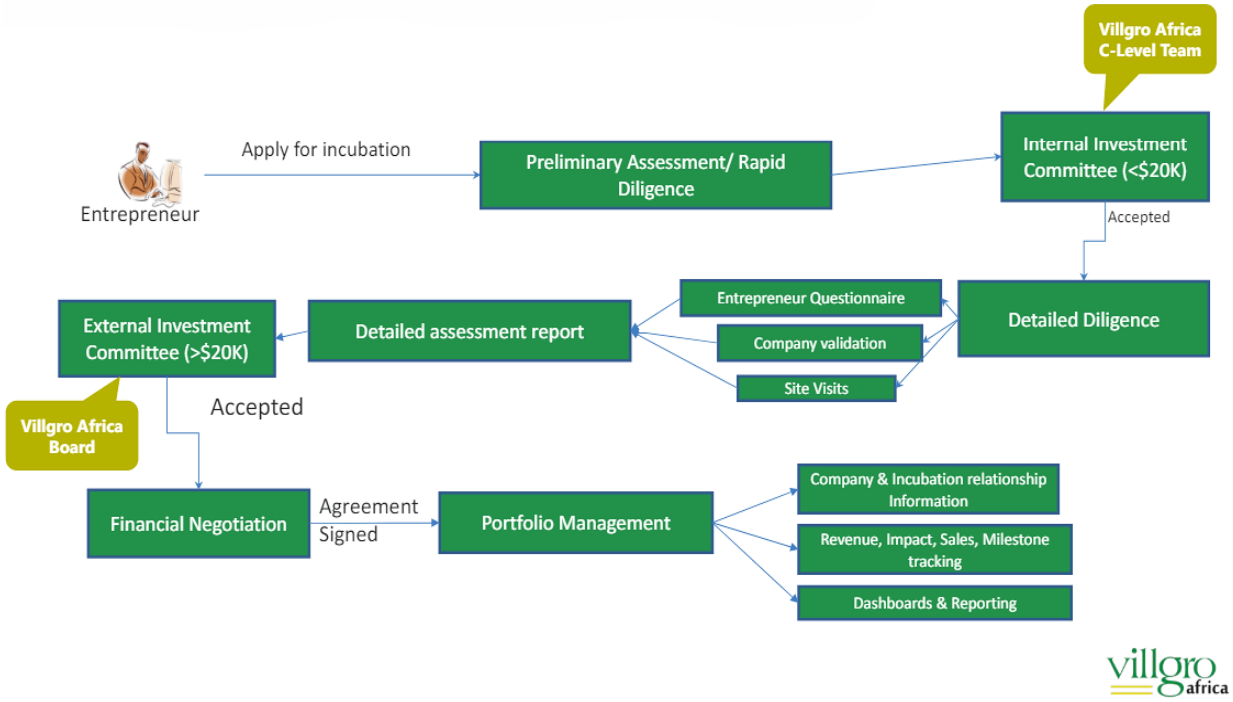


Figure 17: Example of a typical Villgro Africa deal workflow

Villgro Africa offers advisory support and mentorship to institutions to help them set up tech transfer offices with innovator-friendly policies.

Of the multiple successful innovations, digital and AI tools have been utilised to tackle health problems including malaria, childhood jaundice, and critical care.

3.3. Donate for life Africa – HIV Control

Blood demand in Sub-Saharan Africa is approximately 18 million units per year, but only 6 million units are donated, a donation rate of 4.6 per 1000 people.[11] Every year, 25% of maternal deaths are attributed to lack of blood for transfusion. The need for blood keeps growing since the number of patients with end-stage renal failure, cancer, HIV/AIDS and other related conditions continues to increase. For example, 5-10% of HIV/AIDS infections in Africa occur from unsafe transfusions. The Centers for Disease Control (CDC) stated in 2015 that only 50,000 of the 400,000 units of blood that were needed in Cameroon were given, representing an 80% shortfall.[11] Additionally, the lack of connectivity between the blood banks and the

lack of public motivation towards blood donation have been influencing, in self-reinforcing fashion, this low rate of donation. There is a significant requirement to both facilitate access to blood and also raise awareness in the population of the need to donate. To provide a practical, sustainable solution, Dr. Terrence Beteck Epie created an application, a digital tool, "Donate4Life", for blood donation in Cameroon.

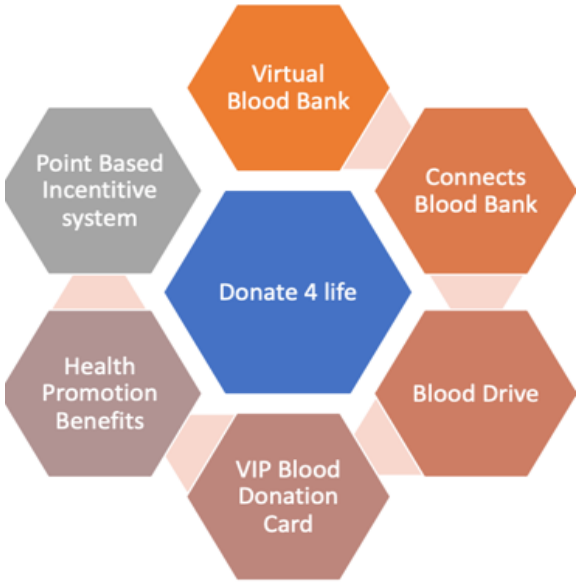


Figure 18: Donate4Life's Approach

"Real joy comes from reaching out to those you don't know. Why not join Donate4Life Africa to make a difference and save lives? All it takes is an app."

Founder of Donate4Life, Cameroonian Dr. Terrence Beteck Epie

This app connects hospitals, blood banks, healthcare facilities, blood donors, and those in need of blood in Cameroon. This platform also aims to educate the young generation on the need for blood donation and to help them learn about their HIV status at the same time by giving a donation. If a person donates their blood, the app offers a donation card which a person can use to benefit from express services at the partner's healthcare facilities.

3.4. Mother's Matter App – mHealth Interventions for Maternal Health

Every year, globally more than 550,000 women die due to pregnancy-related complications, most of them living in LMICs.[12] Fifty percent (50%) of the worldwide estimate of maternal deaths occur in sub-Saharan Africa.[12] With respect to the Integrated African Health Observatory (iAHO) report; the whole African Region accounted for 69% of all worldwide maternal mortality in 2020. The maternal mortality ratio (MMR), "the ratio of the number of maternal fatalities during a given period per 100,000 live births during the same time period," was estimated at 531 deaths per 100,000 live births.[13] MMR is higher in women who live in poorer communities, and there are huge disparities between high-income and low-and-middle-income countries. Specifically, socioeconomic factors in LMICs have been correlated with this situation due to a lack of trained medical professionals, a shortage of facilities and equipment, poverty, and a poor education system.

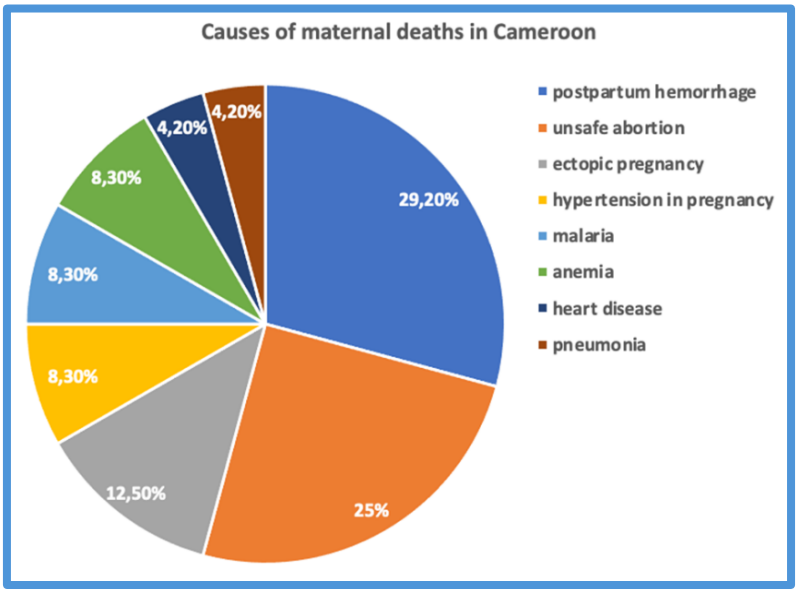


Figure 19: Causes of Maternal Deaths at the University Centre Hospital in Yaoundé, Cameroon from 2006 to 2010. Haemorrhage is the leading cause of maternal mortalities in Cameroon.[12]

The doctor-patient ratio in Cameroon is 1:50,000, seriously out of line with the WHO global standard of 1:10,000 patients. On top of socioeconomic factors, there

are many medical-related causes of maternal death such as haemorrhage, anaemia, hypertension, pneumonia, and malaria.

Yet, all these socioeconomic and health causes associated with maternal mortality can be reduced. Mother's Matter is an app, founded by Cameroonian Dr. Brenda Tanyi, being developed to provide accessible and affordable online and offline training and support materials for key medical practitioners to assist in reducing maternal mortality in Cameroon.

Figure 20: Mother's Matter App

It aims to create a digital education programme and make materials available through an app on smartphones and tablets. The platform includes accredited courses, short-video tutorials, and reviews with gamification features that enable online discussion forums between health professionals.

3.5. MedAccess – Non-Communicable Diseases and Digital Health Education

Noncommunicable diseases (NCDs), such as cardiovascular diseases, cancers, chronic respiratory disorders, and diabetes are the main causes of death around the world. MEDACCESS is a digital health initiative, founded by Cameroonian Dr. Sintieh Nchinda Ngek Ekongefeyin, to:

- Provide verified NCD awareness information to at least 1 million Cameroonians by 2030;
- Support at least a million Cameroonians in leading healthier lifestyles;
- Detect, diagnose, and provide long-term support to at least a thousand people living with and/or at risk of NCDs;
- Ensure 98% of patients diagnosed have personalized follow-up and can get access to drugs and support for adherence.

The project phases include social media, local media, and community campaigns to reach out to a broad range of populations and to ensure health education tips. This platform holds great potential to raise awareness amongst the general population.

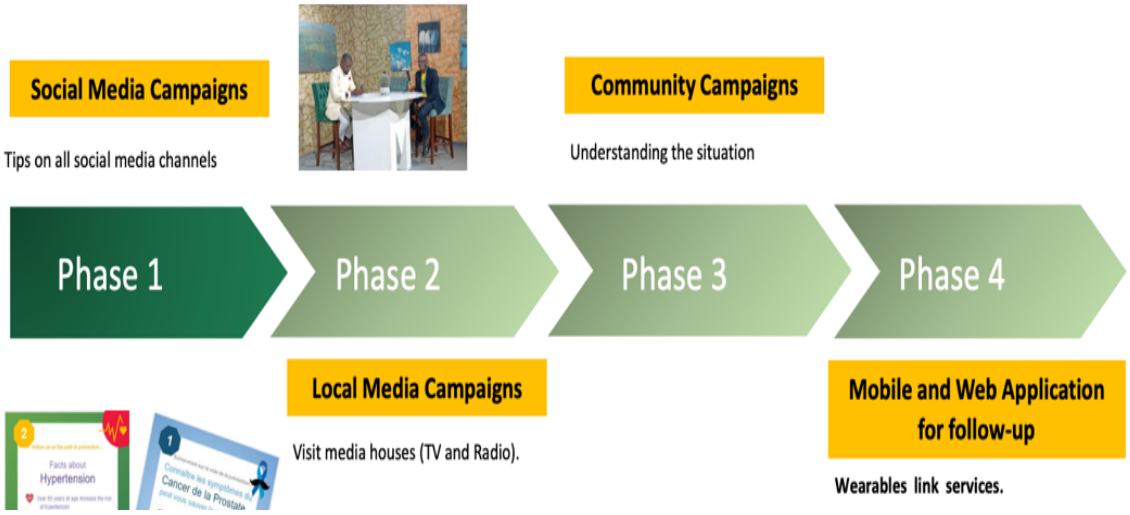


Figure 21: The Project Phases of MedAccess

3.6. AI in Medicine Lab – Inclusive AI for Accessible Medical Imaging Across Resource-Limited Settings

The director of the Barcelona Artificial Intelligence in Medicine Lab, Professor Karim Lekadir, talked about the strategies they have been developing to attain inclusive Artificial Intelligence for Medical Imaging in Low-Resource Settings: The Medical Image Computing & Computer Assisted Intervention International Society (MICCAI), and the African Network for Artificial Intelligence in Biomedical

Imaging (AFRICAI). These networks hold annual meetings which include workshops, tutorials, challenges, mentorship, and publication forums.

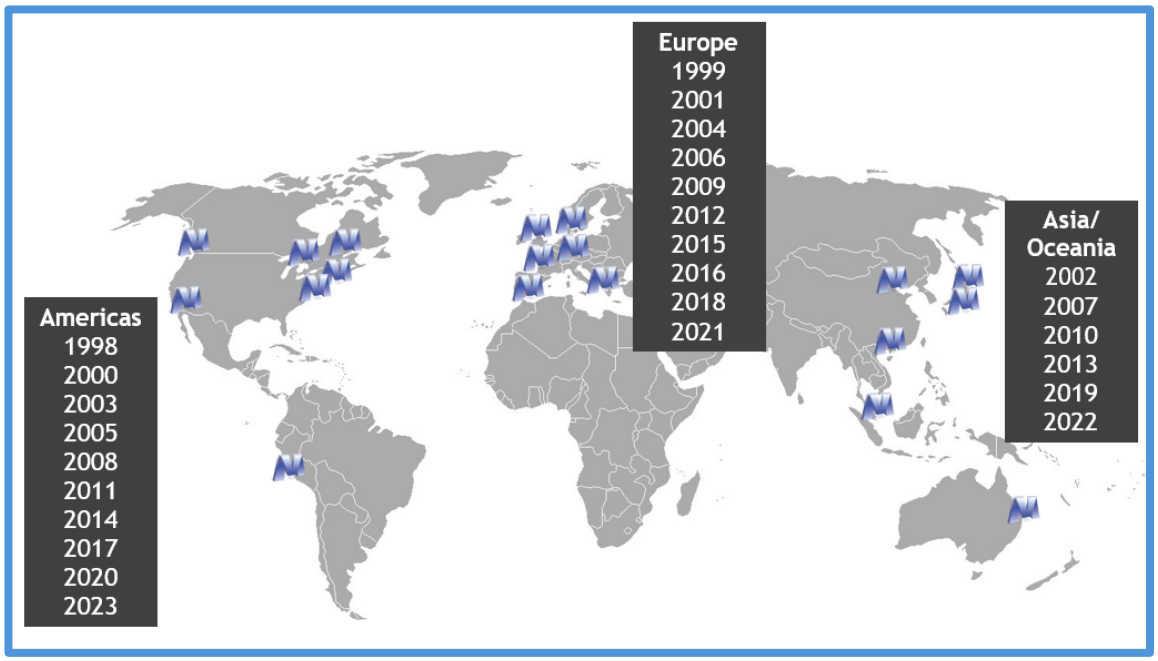


Figure 22: Locations of the MICCAI society organizations since 1998

The MICCAI society has existed since 1998, organising and planning conferences pretty much everywhere on the American continent, in Asia, in Europe, and in Australia but not yet in Africa. A group of colleagues in MICCAI are working with African colleagues to organise the first MICCAI conference in Africa, in Marrakech, Morocco, in October 2024. Their action plan leads to the creation of the African Network for AI in Biomedical Image in Africa. AFRICAI was established in 2020 and has more than 500 members from about 30 countries including academicians, clinicians, innovators, and students.

The purpose of the AFRICAI network is to promote research and real-world applications across the African continent with the aim of facilitating the quantification of complex datasets, accelerating the improvement of AI solutions, and expanding accessible medical imaging in LMICs.

AIMIX, Inclusive Artificial Intelligence for Accessible Medical Imaging Across Resource-Limited Settings, is one of their primary initiatives to advance AI in medical imaging, develop scientific frameworks, and provide accessible obstetric ultrasound screening in resource-limited rural settings. The Aimix Project aims to provide a collaborative strategy
on "How to build AI tools for areas with no "Big Data" by:

- Combining African and non-African data,
- Combining high-end and low-cost data,
- Combining general ethical considerations and local contexts.

This strategy is based on integrative-adaptive learning such that the neural network is adjusted for optimal performance in African settings.

As an example, a low-cost AI-powered ultrasound device can help midwives perform pregnancy screening in villages.[14]

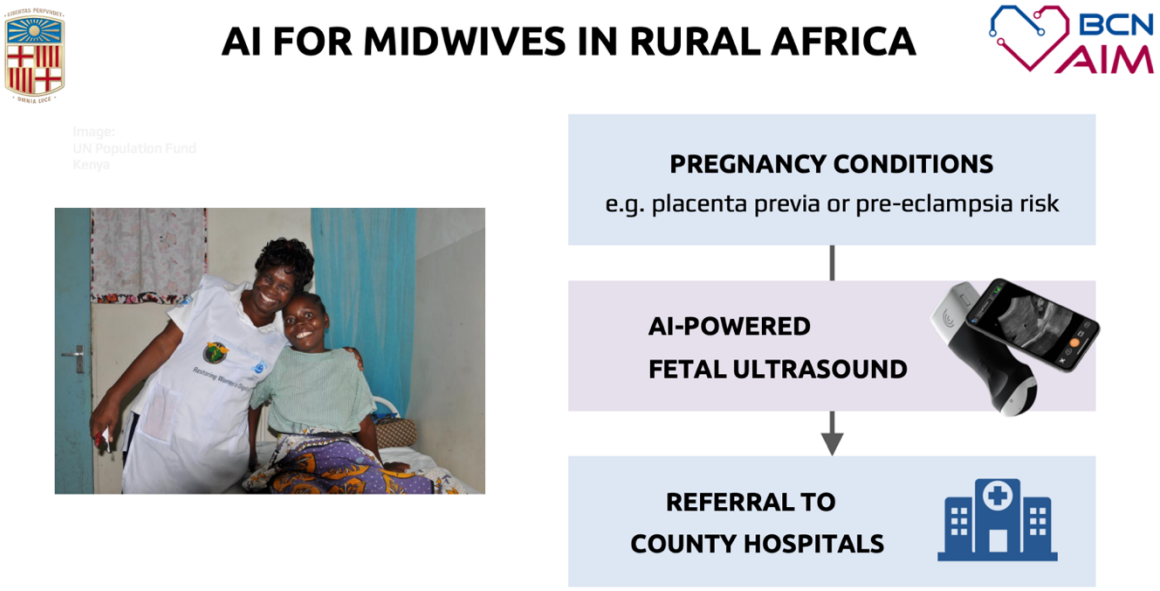


Figure 23: AI tool used for midwives in rural Africa

The director of BCN-AIM, Professor Karim Lekadir, mentioned the challenges faced for imaging AI development and deployment in low-resource settings. However, there are opportunities to develop smart solutions based on AI that can be realistically implemented and affordable in low-resource settings. Overall, inclusive AI allows the combining of data, expertise, resources, and disciplines to solve unmet clinical needs using new approaches.

3.7. AIMedicare – Telemedicine

AIMedicare, an app-based initiative, unites telemedicine, artificial intelligence, the Internet of Medical Things (IoMT), big data health analytics, and blockchain

technology to ensure patients of personalized and secure healthcare solutions. By merging these various properties into a single app, patients can connect to experts remotely, monitor their vitals, be responsible for their own medical records, and rapidly orient themselves to the right treatment at the right time.

Figure 24: The IMedicare App

The AIMedicare wearable devices measure blood pressure, blood oxygen, heart rate, ECG, and heart rate variability; additionally, they can monitor sleep and get active GPS locations.

Figure 25: AIMedicare Wearable Device

The founder of AIMedicare, Yunusa M. Garba from Nigeria, explained that this system was built based on African data. Their goal is to expand their data collection

with international collaborations, including universities, clinics, and service providers to build a more comprehensive system.

3.8. GICMED – Advancing Health Equity Through Screening Technology

There are over 400,000 annual deaths recorded in Sub-Saharan Africa (SSA) due to inadequate access to screening and diagnosis services, absence of required diagnostic equipment, and lack of qualified medical specialists.[15] Global Innovation and Creativity Space (GIC Space) is a healthtech start-up founded by Conrad Tankau from Cameroon in 2018. GIC Space has created GICMED, proprietary technology that can screen, diagnose and treat cervical and breast cancer in women. GICMED aims to ensure cutting-edge, accessible, and cost-effective technology to ease cancer screening procedures in remote, poor, and rural areas of SSA.

The GICMED technology includes a smartphone digital microscopy system, a smart speculum device, a simple fine needle aspirate biopsy device, a telemedicine platform, and an e-learning and training platform. The C-Spec device is an example of the tech innovation that GICMED brings to assist in easy and efficient workflow and to foster health equity in LMICs.

Figure 26: The C-Spec Device

The founder of GICMED, Conrad Tankau, had witnessed the pains of women living in Cameroon and Sub-Saharan Africa as a medical doctor and was motivated to build this healthtech based on his own experiences in rural areas. The goal is to widely operate not only in Cameroon and SSA but also in LMICs.

3.9. Challenges and Opportunities in Radiology – MinoHealth AI Labs

Radiology is one of the Topic Groups of the ITU/WHO FG-AI4H. Radiology uses imaging technology such as X-Rays, Mammograms, Ultrasound, PET (positron emission tomography) scans, MRI (magnetic resonance imaging) scans, and CT (computed tomography) scans. A simple radiological process can provide rapid clinical results and reduce the mortality rate, especially with early detection. The fundamental challenge is lack of radiologists around the world. There are various radiology specialities such as musculoskeletal, chest, breast, paediatric, emergency, vascular and interventional radiology.

The advances of AI, big data, and machine learning have enabled novel solutions in radiology. However, these solutions face major challenges, especially in Africa and LMICs, including:

- Infrastructural deficits (roads, water, etc.);
- Long travel times to access radiology services;
- Lack of security;
- Lack of imaging equipment;
  (There is less than one CT scanner per million inhabitants in LMICs compared with almost forty scanners per million inhabitants in HICs. The gap is even wider for MRI and nuclear medicine equipment.[16])
- Lack of funding;
- Electricity/power cuts;
- Huge workforce shortages affecting radiologists, radiographers, and medical physicists;
  (1.9 vs. 97.9 radiologists per million inhabitants in LMICs and HICs respectively.[17] This is, in part, driven by the high cost of training.)
- Long duration of training impacting in especially subspecialty training;

(The radiology sub-specialties require particular training programmes, services, and practices.)

- Demand from Western countries training trained staff away from LMICs;
- Unavailability of skilled technicians with mastery of IT and AI innovation;
- Inadequate Africanizing/domesticating software.

The Radiology Topic Group is focused on tackling these challenges, benchmarking AI radiological systems, and developing global standards for diverse AI applications. Several of the workshop speakers are current members of the topic group, such as Darlington Akogo from Ghana, Founder and CEO of MinoHealth AI Labs, and Benjamin Dabo Sarkodie from Ghana, Head of Radiology & Interventional Radiologist, Euracare Diagnostic Center.

MinoHealth AI Labs and Runmila AI Institute in Ghana were running digital and AI hackathons for various medical conditions with local public health stakeholders prior to the outbreak of SARS-CoV-2. They began to mobilise in response to COVID-19. One early problem was that, while African data was beginning to appear in global trackers and portals, there was a scarcity of aggregated COVID-19 data in Africa. They assembled a team from throughout Africa to collect and make available online data from their countries, and began analysing and forecasting patterns and dynamics. When COVID-19 appeared in Africa, the number of cases was initially negligible, and there was a sense in some quarters that Africa's young population would be protected from the worst affects. Despite a lacklustre approach in the early days, the Ghana digital and AI group demonstrated the exponential risk. After the Africa CDC and WHO started building the tracker, the Ghana group shifted its attention to using medical images and CT scans to detect damage related to COVID-19 and other diseases.

MinoHealth AI Labs investigates the use of AI in healthcare, including radiology, infectious diseases, malaria, tuberculosis, COVID-19, and focuses on automatic radiological analysis for medical diagnosis, prognosis, and forecasts.

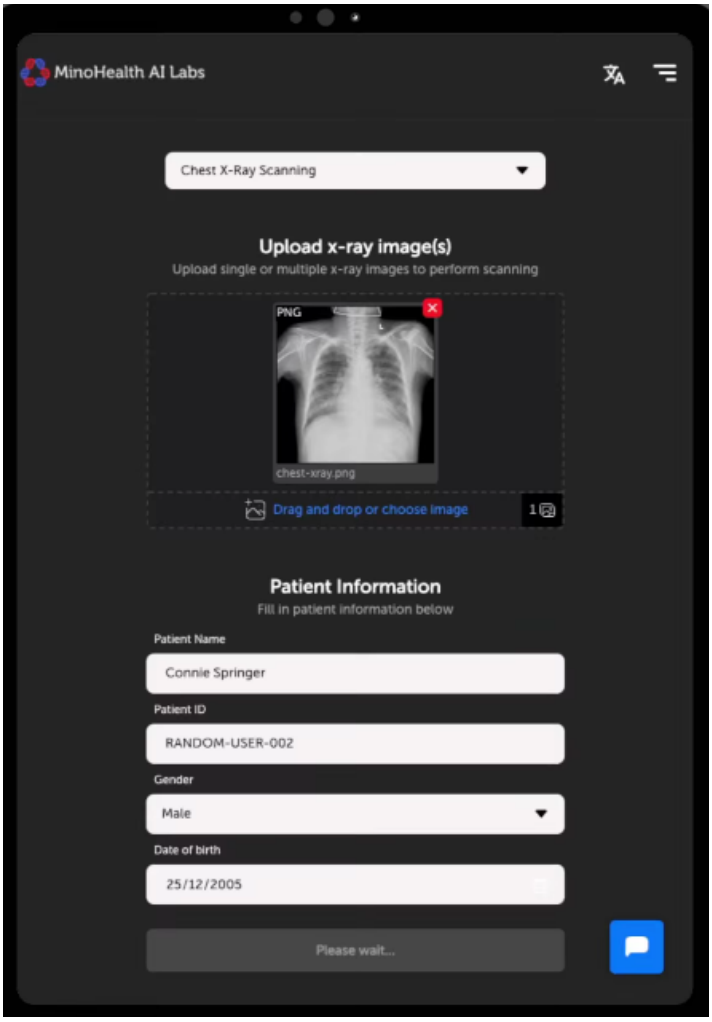


Figure 27: The MinoHealth AI Labs system

They created AI systems for automated diagnostics of 14 chest conditions involving pneumonia, fibrosis, hernia, pleural effusion, cardiomegaly with chest X-rays, and breast cancer with mammograms. To use the MinoHealth AI Labs system, patients first fill out an AI form. Then patients upload their medical images to the system. MinoHealth AI analyses the medical image and shares diagnostic results. With this platform, diagnostic radiology can be completed in under 1 minute using a high-performance AI framework. Most importantly, this system costs only $2 US dollars per diagnosis, which makes it much more affordable to everyone, especially in Africa and LMICs.

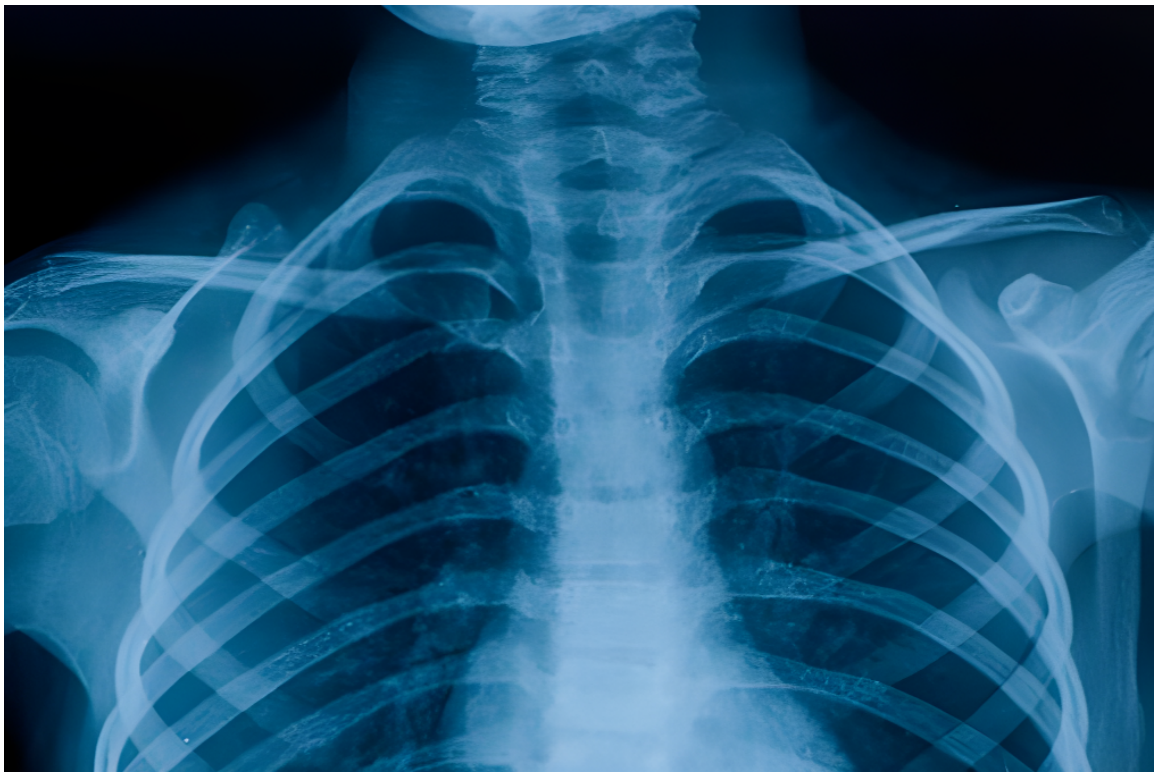


Figure 28: Chest X-ray image

The purposes of MinoHealth Labs are to assist health facilities, ensure quality healthcare, reduce the workload on existing clinicians, and allow early detection and intervention for various diseases. Additionally, MinoHealth AI Labs tries to improve and implement AI solutions in numerous fields in biomedical research, consisting of biotechnology, oncology, neuroscience, epidemiology, and regenerative medicine.

4. CONCLUSIONS

AI and digital health technologies have great potential for overcoming significant global health and development challenges. However, if critical concerns such as standardisation, sustainability, and data sharing are not addressed strategically and promptly, progress will be slowed. The use of AI and digital tools to improve human health should be guided by common regulatory principles that ensure interventions are equitably distributed, and easily operated by end-users. Supporting initiatives to improve implementation science and encourage multisectoral collaborations are essential for achieving increased awareness globally.

Many more communities and learning groups must be established to promote the exchange of concepts, information, and creativity throughout various industries and countries. These learning groups are especially important for dealing with issues that may impact the scaling up of practical, valid, and effective technological solutions in LMICs. Developers need to be designing cost-effective, human-centered, and accessible innovations. Policymakers need to consider more data-driven decision-making as well as investments in digital health and AI tools and data architecture to support better health. Lastly, the future of healthcare is digital, and global action plans should be determined to advance health system strengthening at regional, national, and international levels.

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