Digital Health and COVID-19 in Africa: Unlocking the Potential of Digital Innovation to Improve Healthcare Delivery

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POLICY BRIEF

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1. Introduction

The COVID-19 pandemic had a significant impact on the public health systems across Africa and caused enormous fiscal strains as governments have limited resources to meet the spending needs associated with response and discovery efforts. According to WHO's Coronavirus (COVID-19) Dashboard[1], there have been over 9.3 million cases of COVID-19 in Africa and over 174,000 deaths from early 2020 to the end of September 2022. Although these numbers are low compared to other regions, African countries still lag in vaccination rates.

In addition to the direct impacts, COVID-19 is also disrupting critical health services in Africa and undermining years of progress in fighting other diseases, such as HIV, Tuberculosis, and malaria. The focus on COVID-19 at medical facilities reduced access to standard healthcare services, as some facilities were overwhelmed with treating COVID-19 patients; and patients refrained from visiting their doctors for fear of contracting COVID-19. The inability to reach healthcare facilities and receive medical support due to disruptions in public transportation and stay-at-home orders also presented a challenge.[2]

In coping with these challenges, medical professionals and facilities worldwide adopted telehealth appointments to facilitate access to care and utilized big data and machine learning tools for COVID-related contact tracing and prevention. The pandemic has provided an unprecedented opportunity for African countries to harness the potential of digitalization and technological innovation to strengthen their public health systems with a forward-looking approach and improve the well-being of their citizens against future outbreaks.

Against this backdrop, the UN Office of the Special Adviser on Africa (OSAA) has produced this policy brief to discuss the challenges and opportunities in digitalizing Africa's public health systems. This document summarizes the key areas of digital innovation implemented by African countries, prominent country examples, case studies, and recommendations on future priority policy actions.

# 2. Impact of COVID-19 on Africa's Public Health

The COVID-19 pandemic has highlighted – and exacerbated – the gaps in public health systems in African countries. Prior the pandemic, Sub-Saharan Africa had on average 0.2 doctors per thousand people, compared to 0.9 in South Asia and 3 in Latin America and the Caribbean (countries in the European Union averaged around 5 doctors).[3] Many people in rural and disadvantaged areas lived hours away from essential healthcare services, which, combined with the loss of healthcare workers to COVID-19 and the disruption to transport systems due to lockdowns, have put enormous pressure on Africa's already fragile healthcare systems.

As of the end of September 2022, there are 9.3 million cases of COVID-19 in Africa and over 174,000 deaths. These numbers are low compared to other regions, as seen in Figure 1, with

Africa accounting for about 1.5% of all global cases, compared to the developed regions (e.g., Europe 41.3%) and other developing regions (e.g., Southeast Asia 9.8%). However, African countries have suffered socioeconomic repercussions because, unlike advanced economies, African governments do not have sufficient fiscal space to boost employment and support households and businesses most affected by the pandemic.

The lack of financial resources is coupled with a slow vaccination rate across Africa (Figure 1). Only 21% of the continent's population have been fully vaccinated (primary series) as of September 2022, and a mere 2.3% have been boosted. This reflects a significant gap in the ability to vaccinate populations compared to developed (e.g., 64% and 30% in Europe) and developing regions (e.g., 67% and 16% in Southeast Asia).[4]

FIGURE 1. AFRICA HAS FEWER COVID-19 INFECTIONS THAN OTHER REGIONS BUT LAGS BEHIND IN VACCINATION
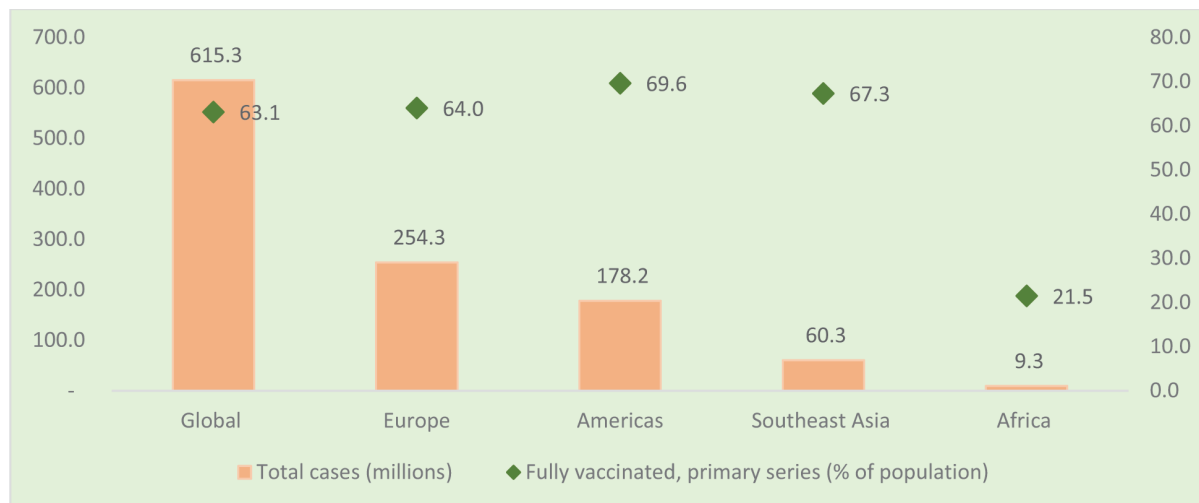
Source: WHO Coronavirus (COVID-19) Dashboard

3. Global Strategy on Digital Health

SDG Goal 9 on *"Industries, Innovation and Infrastructure"* highlights the importance of increasing access to information and communications technology (ICT), striving to provide universal and affordable access to the Internet in least-developed countries".[5] COVID-19 further highlights the crucial role of ICT in this increasingly connected world. The sudden global shock has accelerated the adoption of digital tools across healthcare and other sectors, ranging from digital health services, teleworking and video conferencing systems to e-learning and online education.

In coping with these challenges, medical professionals and facilities worldwide adopted telemedicine appointments to facilitate access to healthcare and utilized big data and machine learning tools for COVID-19-related contact tracing and prevention. The pandemic has provided an unprecedented opportunity to harness the potential of digital technology to accelerate the achievement of SDG 3 on "Health and Well-being".

Digitalization was a priority in global public health long before the emergence of COVID-19. As early as 2005, the World Health Assembly, through its resolution WHA58.28 on eHealth, urged Member States "to consider drawing up a long-term strategic plan for developing and implementing eHealth services…to develop the infrastructure for information and communication technologies for health…to promote equitable, affordable, and universal access to their benefits." In May 2018, the World Health Assembly adopted its resolution WHA71.7 on digital health, in which it requested the Director-General to develop a global strategy on digital health. WHO's Global Strategy on Digital Health 2020-2025 was developed through a consultative process and endorsed by the 73rd World Health Assembly in decision WHA73(28) (2020).[6]

The Global Strategy on Digital Health identifies four strategic objectives to provide guidance and coordination on global digital health transformation while harnessing the interconnectedness between initiatives and stakeholders. The implementation framework in Figure 2 summarizes the proposed policy and actions as well as the desired impact while emphasizing the need for countries to implement appropriate digital technologies in accordance with their public health contexts. The four strategic objectives at the global level are:

1. Promote global collaboration and advance the transfer of knowledge on digital health;

2. Advance the implementation of national digital health strategies;

3. Strengthen governance for digital health at global, regional and national levels;

4. Advocate people-centred health systems that are enabled by digital health.

The adoption of digital technology in developing countries, including Africa, brings about short- and long-term benefits in public health and beyond. Through digital tools and capacity building, countries can improve the effectiveness, efficiency, and quality of their health facilities and health system performance. Using digital records and big data allows for patient tracking and increased safety, aggregation of health data for disease management and prevention, and providing more

up-to-date information for policymakers. The scaling-up of basic health services through digital platforms also helps countries advance towards universal healthcare coverage.

The COVID-19 outbreak led to the development of many new digital healthcare platforms and the scaling-up of existing solutions. Some of these tools and interventions are telemedicine to improve access in hard-to-reach areas; e-learning for healthcare professionals; improvement of health information systems such as electronic health records; use of big data for rapid information gathering and processing; and use of artificial intelligence (AI) to detect infection trends and areas of outbreaks. In the next section, we provide a few examples of the digital health solutions deployed in African countries during COVID-19 and their impact on the delivery of healthcare services.

FIGURE 2. IMPLEMENTATION FRAMEWORK OF THE ACTION PLAN
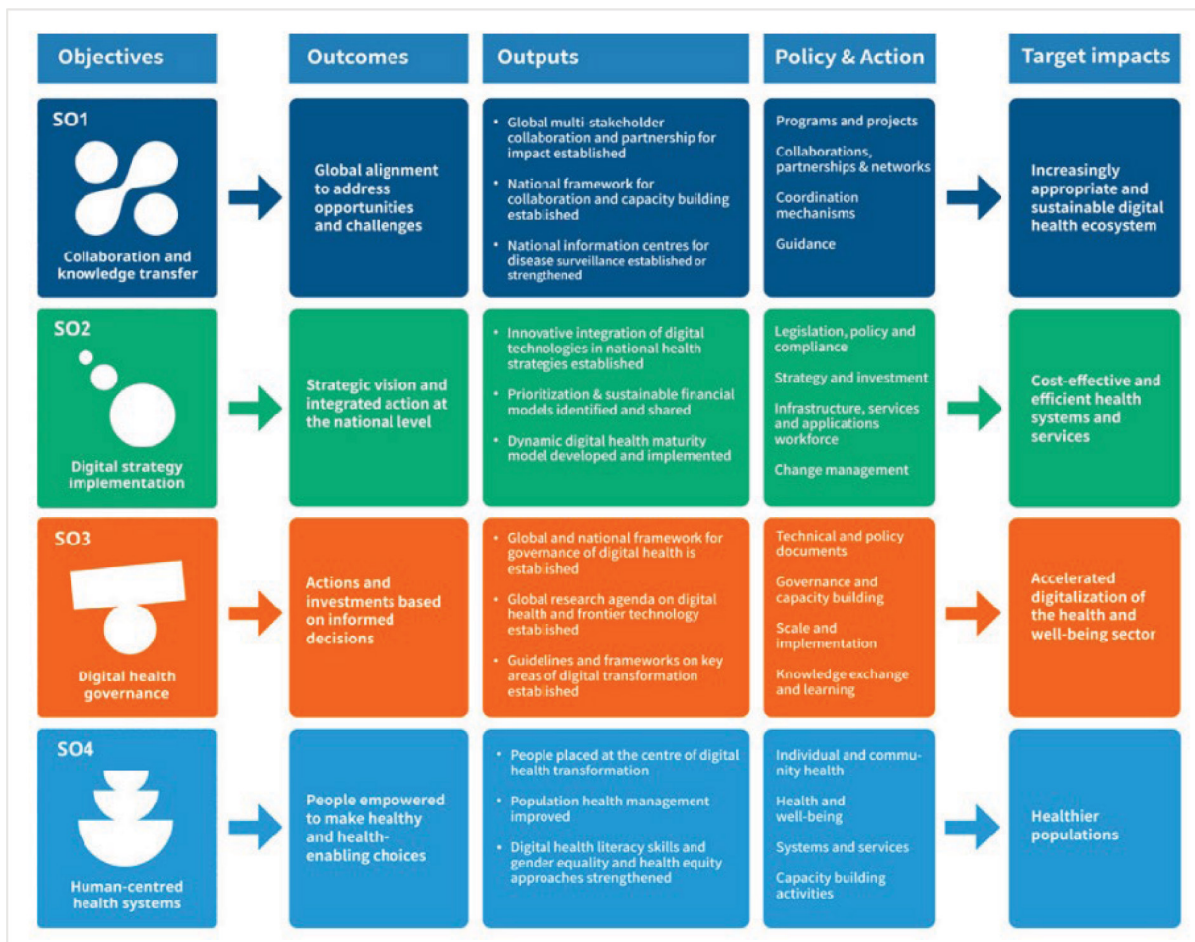
Source: WHO. Global strategy on digital health 2020-2025.

4. Examples of Digital Health Innovation in Africa in response to the COVID-19

Africa's health systems face several challenges, including the lack of qualified doctors and nurses; ill equipped laboratories and hospitals; the long distances people in rural areas need to travel to access health care; the lack of emergency services; and the inadequacy of financial resources.

The importance of innovative solutions in the health field cannot be overstated in a region with the world's largest burden of disease and the most severe shortage of healthcare professionals.[7] The technological innovation that explores the power of digitalization holds the potential of leapfrogging existing barriers to strengthen African healthcare in a short period of time. This section provides some prominent examples of digital health interventions across Africa in the wake of COVID-19.

COMMCARE IN BURKINA FASO: RAPIDLY DEPLOYED COVID-19 MODULES ENABLED BY DIGITAL TOOLS SCALED OVER A DECADE[8]

In 2010, Burkina Faso's Ministry of Health (MOH) in collaboration with the Swiss organization "Terres des hommes (Tdh)" introduced a digital solution to improve the healthcare of children under five at the primary health care (PHC) level, the Integrated e-Diagnostic Approach (IeDA), which is hosted on the Commcare platform. The tablet-based app provides health workers with enhanced decision support and is a digital job aid for the Integrated Management of Childhood Illnesses (IMCI) strategy to reduce child mortality.

Over a decade after its introduction, the project was scaled up to more than 1,700 rural PHC facilities with 6,300 health workers using the app. It was already used by health workers at 67% of the country's PHC facilities when the first cases of COVID-19 were reported in Burkina Faso in 2020.

The app's wide usage enabled the MOH and Tdh to rapidly adapt the platform for the pandemic by introducing three COVID-19 modules, which were quickly deployed to health workers within three weeks. Box 1 provides details on the three modules and their implementation.

This illustrates how a government-led digital healthcare initiative with strong digital foundations and large scale can be improved quickly and effectively to meet emerging public health needs. The key factors quoted as driving CommCare's success include existing scale and knowledge of healthcare workers across the country; key champions within MOH and good partnerships between the government and partner organizations; building a solution from the ground up to benefit the end user from day one; as well as the decision to leverage an existing platform which allowed the government to focus on scale at a time of crisis rather than developing something new.

VAXIGLOBAL IN ZIMBABWE: USING BIOMETRIC DATA TO VERIFY VACCINE DELIVERY

Countries in Africa have made tremendous progress towards increasing access to immunizations and eradicating vaccine-preventable diseases in recent decades. Immunization is estimated to save 4 million lives annually in the continent. However, vaccine fraud is prevalent, and verification of vaccination status is hindered by low adoption rate of smartphones, incomplete or inconsisent ID systems and medical records, as well as spotty internet connection in many countries.[9] The gap between vaccines and administrative data often made it hard to estimate vaccination outreach and effectiveness.

One of the three winners of the 2021 Kofi Annan Award for Innovation in Africa, VaxiGlobal is a Harare-based organization that is leading the way in safe and reliable vaccination certification in Africa. Since their launch in 2019, the team has built relationships with the MOH in Zimbabwe, Botswana, Zambia, DRC and Nigeria and WHO Africa. [10]

VaxiGlobal works with governments and NGOs during NGO-sponsored mass immunization campaigns to collect vaccination metrics data, assess progress towards immunization targets, and help identify gaps in vaccination campaigns. It operates in a three-step system:

1. First patients are enrolled at a clinic using facial recognition AI technology;

2. Then health workers create a digital certificate that's biometrically linked to the patient after the vaccine is administered. The certificate is automatically uploaded onto a secure cloud when internet is available;

3. Verifiers can then scan a patient's face or QR code to pull their digital vaccination records from the cloud whenever necessary.[11]

The contactless biometrics system bypasses the challenges of inconsistent medical records or absence of national ID systems in African countries. And the mobile application is designed to be able to upload and download data synchronously to enable both online and offline functionality.

In addition to local vaccination campaigns, VaxiGlobal works with laboratories in Zimbabwe and Zambia, technology companies, and airlines to build a digital verification system for travellers' immunization, when the surge of COVID-19 infection led to a thriving black market for counterfeit immunization certificates. A decentralized online record keeping system built on blockchain technology safely stores vaccination data that cannot be tampered with. The travellers are able to get a QR code on a mobile app or on paper which can be instantly verified by border authorities.[12] This effort helps to greatly reduce counterfeit travel vaccination certificates and facilitate cross-country travel in Africa during a global pandemic.

BABYL IN RWANDA: PUBLIC-PRIVATE COLLABORATION TO EXPAND TELEMEDICINE ACCESS

Rwanda is not without the common challenges in public health experienced by many African countries, namely a low doctor-patient ratio (1.3 doctors per 10,000 population compared to a global average of 15.1) and a highly rural population (over 60% live in rural areas).[13]

Nevertheless, Rwanda is fast becoming a digital health success story, driven by an enabling environment created by the government, reliable IT infrastructure, broadband connection reaching more than 90% of the population, and targeted digital tools capacity building for healthcare workers.[14] The country's health insurance system ensures 90 percent of coverage for basic healthcare services, enabling wide adoption of telehealth consultations.[15]

Babyl, a subsidiary of the UK-based digital health company, embarked on a 10-year partnership with the government of Rwanda in 2020 to give every person over the age of 12 access to digital healthcare. Every appointment is paid for through the government's health insurance scheme Mutuelle de Santé.[16] Babyl allows patients to access telehealth services via text or voice – including booking appointments, conducting consultations with doctors or nurses, and receiving prescriptions and lab test codes – making it available even to those without a smartphone or data plans.[17] Since its launch in 2016, over 30% of Rwanda's adult population has been registered, with over 1.2 million consultations that have taken place.[18]

Rwanda's only 4G LTE wholesaler company KTRN partnered with Babyl during the pandemic by donating smartphones to Babyl and healthcare centres that use Babyl, to help expand digital healthcare across the country through the government's #ConnectRwanda initiative.[19]

In late 2021, Babyl launched its AI powered triage tool which collects information about patients' symptoms and provide insights to help choose the correct triage path. This proved to be a powerful tool during COVID-19 allowing for symptom surveillance and data visualization. The solution has been customized for the Rwanda text and accounts for local language, epidemiology, culture and health system pathways.[20]

TURN.IO IN SOUTH AFRICA: FIRST-EVER WHATSAPP HEALTH ALERT FOR UP-TO-DATE INFORMATION ON COVID-19

At the onset of COVID-19 in early 2020, WHO partnered with South African organization Praekelt. org using its behavioural chat platform – Turn. io – to launch WHO's first-ever free, automated 24-hour WhatsApp Health Alert to provide secure, up-to-date information on COVID-19 and avoid misinformation. It was developed in March 2002 for South Africa's national health department and reached almost one million users in just days.[21] Credible information was provided to people on common symptoms, latest infection figures, to treatment methods.[22]

The platform took only one week to launch thanks to an effective multilateral partnership: Turn.io provided the technology and developed the content together with the WHO; WhatsApp offered a team of engineers and leveraged its huge user base (around 2 billion active users) to promote the service; and Amazon Web Services volunteered its large-scale hosting services. The quick implementation was also attributed to a simple initial design prioritizing the content the population needed to know the most. This way, the solution met the countries' communication needs and freed ministries of health in developing countries to respond to urgent healthcare needs.[23]

Today, WHO's Health Alert for COVID-19 is available in over 20 languages and has reached over 14.7 million people worldwide. Although the impact of the services is yet to be measured, WHO Director-General Tedros Adhanom Ghebreyesus has praised the innovation for paving the way for more governments to partner with services with a wide user base like WhatsApp to provide health information to millions of people. Ghebreyesus said, "Digital technology gives us an unprecedented opportunity for vital health information to go viral and spread faster than the pandemic, helping us save lives and protect the vulnerable".[24]

GEROCARE IN NIGERIA: SUBSCRIPTION-BASED MEDICAL CARE FOR THE ELDERLY

In Nigeria, many elderly people experience various ailments, yet neither the state nor their families can manage the situation adequately. GeroCare solves the absence of structured medical care for this underserved segment of the population and improves their quality of living by providing subscription-based services.[25]

Individuals can register patient details and make payments through the GeroCare app. Afterwards, patients are matched with a doctor who is in close proximity for monthly medical visits. Family members of the patient receive regular updates on the health status of the patient and can pay for any tests or drugs via the app for direct delivery.[26]

During the pandemic GeroCare helped fill the service delivery gap by providing affordable home visits, on-demand doctor visits, and telemedicine to the elderly with reduced risk of contracting COVID-19.[27] GeroCare already serves 160,000 elderly people in 52 cities across Nigeria. It is now aiming to integrate insurers and financial partners into their solution.[28]

M-TIBA IN KENYA: SMART HEALTH PAYMENT PLATFORM LOWERING COVID-19 TRANSMISSION

Mobile money platforms such as M-Pesa were widely used in Kenya before the pandemic. The government loosened restrictions and lowered mobile money transfer fees to encourage the use

of mobile money transactions to reduce risk of transmission.[29]

Capitalizing on the mobile money revolution, Kenya start-up Carepay (est. 2015) created M-Tiba, a smart health payment distribution system, in partnership with PharmAccess Foundation and Safaricom. M-Tiba allows patients to use credits on their phones to pay for healthcare treatment. The mobile phone-based system uses SMS texts rather than 3G or 4G, enabling wider access for the poor. Moreover, a patient's information including symptoms and prescriptions is collected anonymously after each doctor's visit, allowing for real time capture of diagnoses and detection of public health trends.[30]

Federal and county governments can use that data to determine where COVID-19 cases are concentrated and prepare for an outbreak. Carepay can notify users about an outbreak in a given area via SMS notifications. The app can also disseminate critical information regarding precautionary measures and social distancing rules, curfews, and quarantine requirements.[31]

To date M-Tiba has connected more than 4.5 million users and 1,200 healthcare providers to the platform. Over 715,000 treatment claims have been handled by the platform, with over 1,140,000 medical payment transactions. M-Tiba is now the preferred health payment platform for the government, retail, and private health sector, contributing to the drive towards universal health coverage in Kenya. Carepay also operates in Nigeria and Tanzania.

UNITED AI ALLIANCE: STRENGTHENING DATA SCIENCE CAPACITY IN 10 AFRICAN COUNTRIES[32]

The United AI Alliance is a public-private initiative led by UNECA, the Global Partnership for Sustainable Development Data, and Nvidia to provide data science workstations and AI education to African governments and developer communities.

The initiative targets national statistical offices, which handle data that inform economic policies, healthcare decisions, and census data, with the aim to support data analytics and decision-making in public health, population affairs, climate change, etc. The project pilots in ten African countries - Ghana, Kenya, Rwanda, Senegal, Sierra Leone, Guinea, Mali, Nigeria, Somalia and Togo – and will subsequently roll out in Southeast Asia and Latin America.

Given the huge infrastructure gaps in data science across African nations, this public-private collaboration will provide the necessary infrastructure and expertise required for African countries to harness the benefits of the data revolution. In the context of COVID-19, better public health data, for example, can help countries track real-time infection rates, detect hotpots, and target response efforts.

There are a large number of digital health tools and interventions from African countries that cannot be included in this policy brief. Table 1 below summarizes some of these innovations across different subregions.

TABLE 1. OTHER DIGITAL HEALTH INNOVATIONS IN AFRICA IN RESPONSE TO COVID-19

Country	Partner Organization/Company	Description of digital health tools
Nigeria	SORMAS	Quickly scaled existing disease surveillance platform.
Uganda	SmartHealth	Mobile app supported healthcare workers in pandemic response and primary care.
Kenya	Project ECHO	Telemonitoring model supports case-based learning on broad health topics.
Rwanda	WelTel	Remote monitoring via text messaging improves workflows and adherence.
Benin	REMA	An app that connects medical students, general practitioners, specialists and physicians to enable collaboration and support better decision-making.
Benin	KEA	A mobile-enabled digital health solution that allows patients to create a unique digital health identity (ID) that holds their emergency medical information and medical history.
Liberia	mHero	A two-way, mobile phone-based communication system that connects ministries of health and health workers to help coordinate COVID-19 response.
Ghana, Rwanda	Zipline	High-speed drones are being used to deliver vital packages to clinics and hospitals over 85km in Ghana and Rwanda.
Zimbabwe	RapidPro	Scaling-up RapidPro system to collect high-frequency nutrition data of 9 selected indicators in the prioritized 25 districts across all the country's provinces to monitor the nutrition situation during the pandemic.

Source: Source: WHO Regional Office for Africa. 2020. COVID-19 African Innovation Compendium. McKinsey & Company. Unlocking digital healthcare in lower- and middle-income countries. November 2021. GSMA. 2021. Health Systems, Digital Health and COVID-19: Insights from Bangladesh, Myanmar, Pakistan, Benin, Nigeria and Rwanda..

5. Enablers and challenges for healthcare digitalization in Africa

It is evident from the range of innovations provided above that Africa is fast coming a breeding ground for the digital health revolution. For African countries to fully capitalize on the power of digitalization to strengthen access to basic health care, disease prevention and management, as well as convenient health payment systems, it is important to identify the enablers and opportunities that lie within the African context, as well as the challenges that need to be addressed by decision makers and global players.

ENABLING ENVIRONMENT FOR DIGITAL HEALTHCARE SOLUTIONS

INCREASING SMARTPHONE PENETRATION AND MOBILE MONEY ADOPTION

One major factor that facilitates of the adoption of digital health applications in Africa is the wide use of smartphones. Across Sub-Saharan Africa smartphones account for 44% of total mobile connections in 2019, projected to reach 65% in 2025. It is estimated that SSA will have nearly 700 million smartphone connections by 2025, accelerated by an increasing amount of low-cost devices and smartphone financing schemes. The three biggest markets in 2025 will be Nigeria (154 million), South Africa (73 million), and Kenya (47 million). There will be higher rate of smartphone penetration in all subregions, with the SADC and ECOWAS economies leading the growth (Figure 3).[33]

Africa also is leading the charge in the mobile money revolution. In 2020, Sub-Saharan Africa accounts for nearly half of all registered mobile money accounts globally with 548 million registered users (Figure 4a), and more than 60% of mobile money transaction values (Figure 4b). East Africa alone accounts for half of the African mobile money market, as seen in Figure 5, with 293 million registered accounts (52%), followed by West Africa (198 million, or 35%).[34]

The examples of Babyl in Rwanda, Turn.io in South Africa, and M-Tiba in Kenya illustrate the importance of mobile phone access for the development and large-scale deployment of digital health solutions across Africa during COVID-19, even in the absence of an internet connection. Despite these promising developments, real-life challenges prevent access by the most vulnerable population, such as the gender gap and rural-urban divide in access to financial services. [35]

YOUNG TECH-SAVVY DEMOGRAPHIC

The growing smartphone and mobile money penetration is complemented by a youthful African population. People between the age of 0 and 14

account for 42% of the total population in SSA.[36] The young generation is knowledgeable in technology and more likely to use smartphones. They are ready to move from traditional communication in healthcare towards (smart) phone-based communication. Their ability to absorb digital technology fast will enable them to take advantage of the latest digital solutions and obtain the health benefits from the spur of digital health tools[37], potentially leading to greater health and better human development achievement in the younger generation.

FIGURE 3. GROWING SMART PHONE PENETRATION AND MOBILE MONEY USE IN SUB-SAHARAN AFRICA
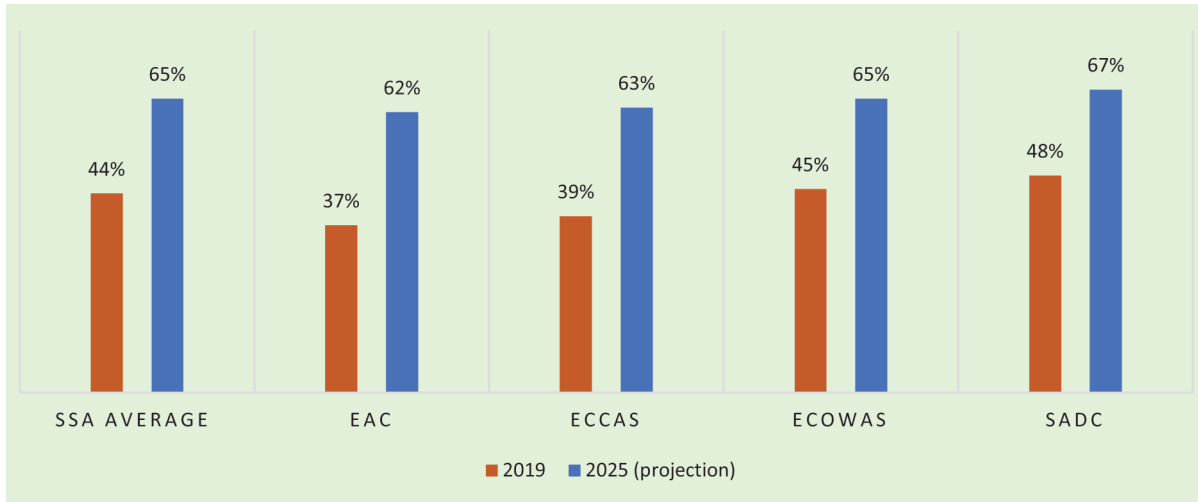
Source: GSMA. The Mobile Economy Sub-Saharan Africa 2020, page 16.

FIGURE 4. GLOBAL OVERVIEW OF MOBILE MONEY USE IN 2020
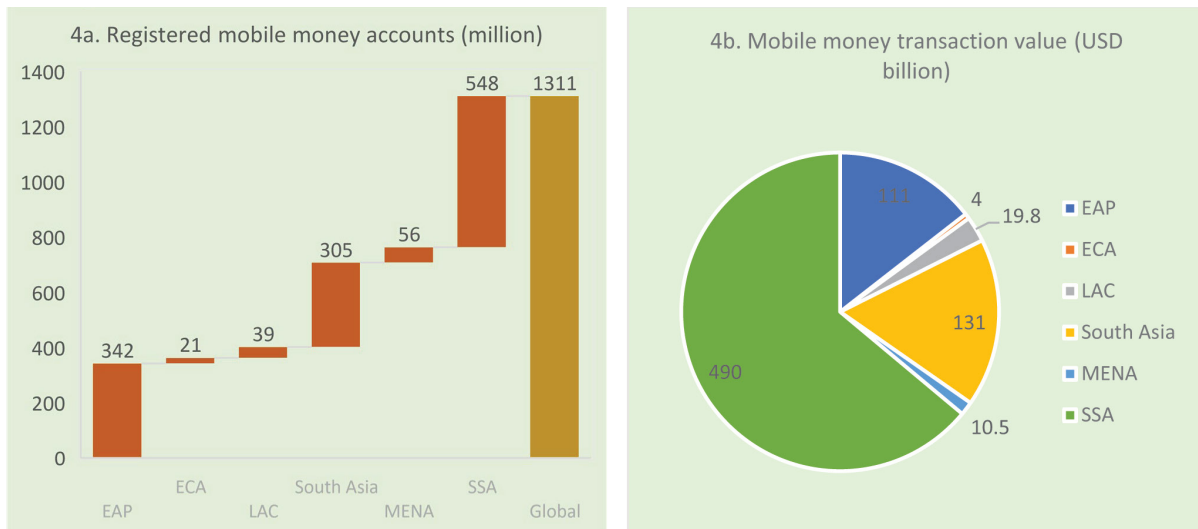
Source: GSMA. State of the Industry Report on Mobile Money 2021, page 8.

FIGURE 5. DISTRIBUTION OF REGISTERED MOBILE MONEY ACCOUNTS IN AFRICAN SUBREGIONS

East Africa , 52%　　West Africa , 35%　　Central Africa, 8%　　North Africa, 2%　　Southern Africa, 2%

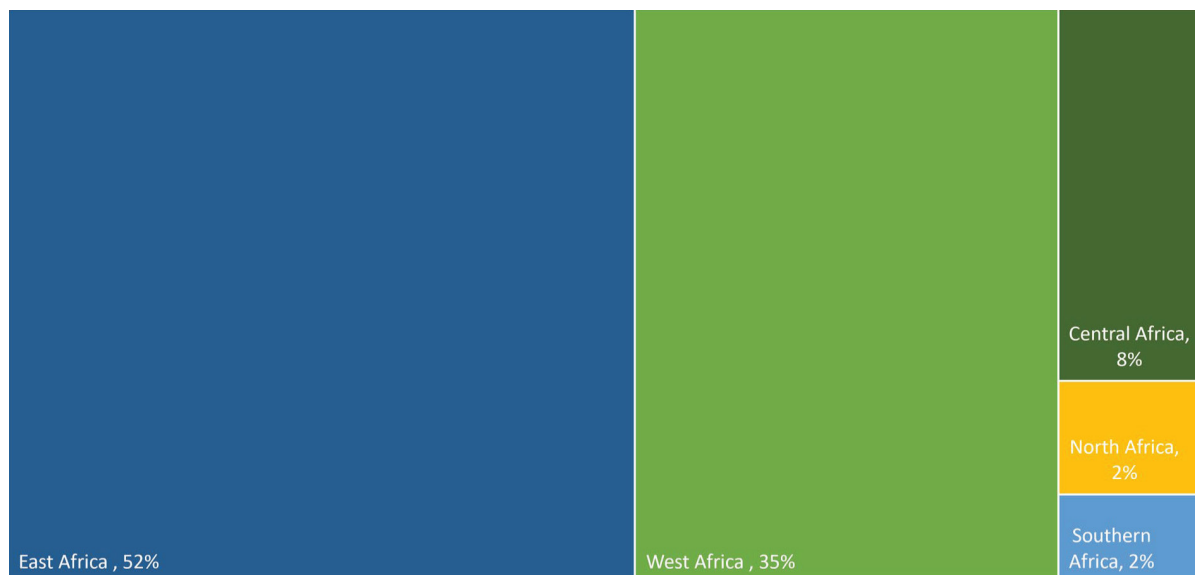Source: GSMA. State of the Industry Report on Mobile Money 2021, page 9.

LEADERSHIP AND GOVERNANCE IN DIGITAL INNOVATION

Governments are on the forefront of the digital health trend across Africa and have demonstrated dynamic leadership. Leadership and governance was named "the most important enabler for countries advancing their digital healthcare system" in McKinsey's 2021 report on "Unlocking digital healthcare in lower- and middle-income countries". Governments need to create an enabling environment to advance digital health.[38]

In Burkina Faso, the government led the development of the CommCare app in order to improve basic health care for children and supported the rapid deployment of COVID-19 modules. In Kenya, the government has long supported the development of mobile money technology and further instructed telecommunications companies to lower the fees of mobile money transfers to encourage mobile transactions instead of paper money in order to reduce the risk of COVID-19 transmission.

CHALLENGES TO HARNESSING DIGITAL HEALTH INNOVATION

Alongside strengthening the enabling factors for digital health activities, individual barriers to adopting digital health interventions in Africa are important to address by national governments, the private sector, and the international community.

LIMITED ACCESS TO ELECTRICITY

Many in Africa have limited access to electricity which hinders the adoption of most digital technology. As of 2020, only 48.4% of all population in Sub-Saharan Africa has access to electricity (Figure 6), with a distinctive contrast between urban population (78.3%) and rural population (28.7%). Some African countries are well electrified such as the Seychelles (100%), Mauritius (99.7%) and Gabon (91.6%), yet in other countries only a minority share of population have electricity access, such as Chad (11.1%), Malawi (14.9%), and DRC (19.1%).[39]

FIGURE 6. ACCESS TO ELECTRICITY AND INTERNET POSES A SIGNIFICANT CHALLENGE TO SUB-SAHARAN AFRICA
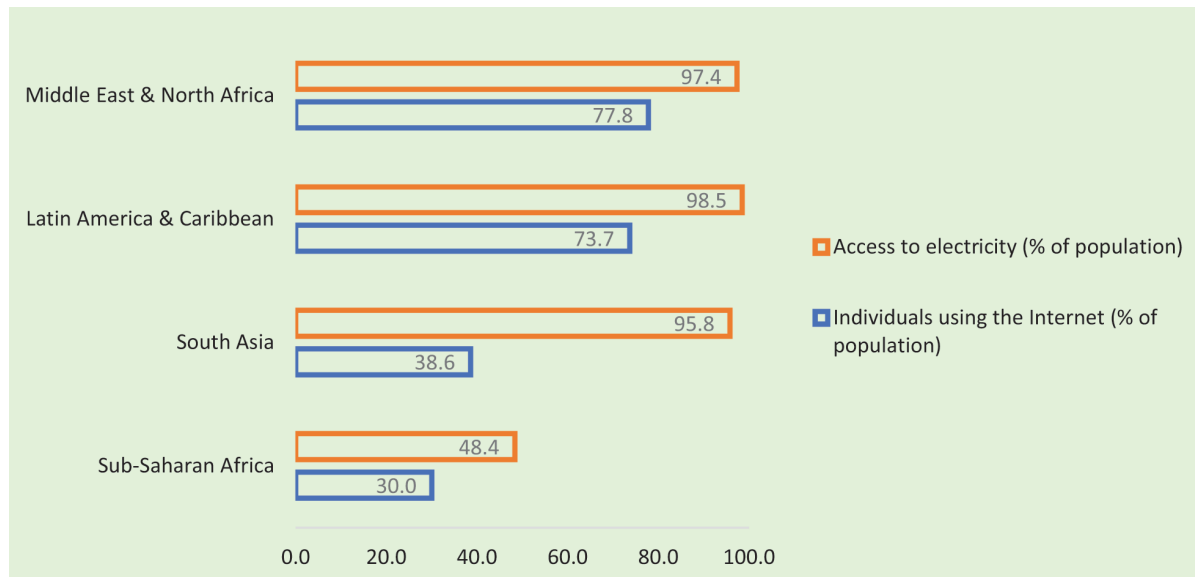
Source: World Development Indicators. Data are for 2020.

LOW INTERNET CONNECTIVITY AT COSTLY PRICES

Another barrier is the shortage of high-speed internet connections across the continent. Internet penetration is at about 30% in 2020, and only 6 in every 1000 people have a fixed broadband connection lagging behind other developing regions (Figure 6).[40]

Reports have shown that Africa has the most expensive internet charges in the world. The Alliance for Affordable Internet (A4AI) defines affordability of 1GB of mobile broadband data as costing less than 2% of average monthly income, yet the average across African stands at 7.12%, making it too expensive for all but the wealthiest few. While internet is affordable in some countries such as Egypt and Mauritius (0.5% and 0.59% of average earnings), citizens in Chad, DRC, and CAR must pay more than 20%. Equatorial Guinea has the world's most expensive mobile data at $49.67 per gigabyte.[41]
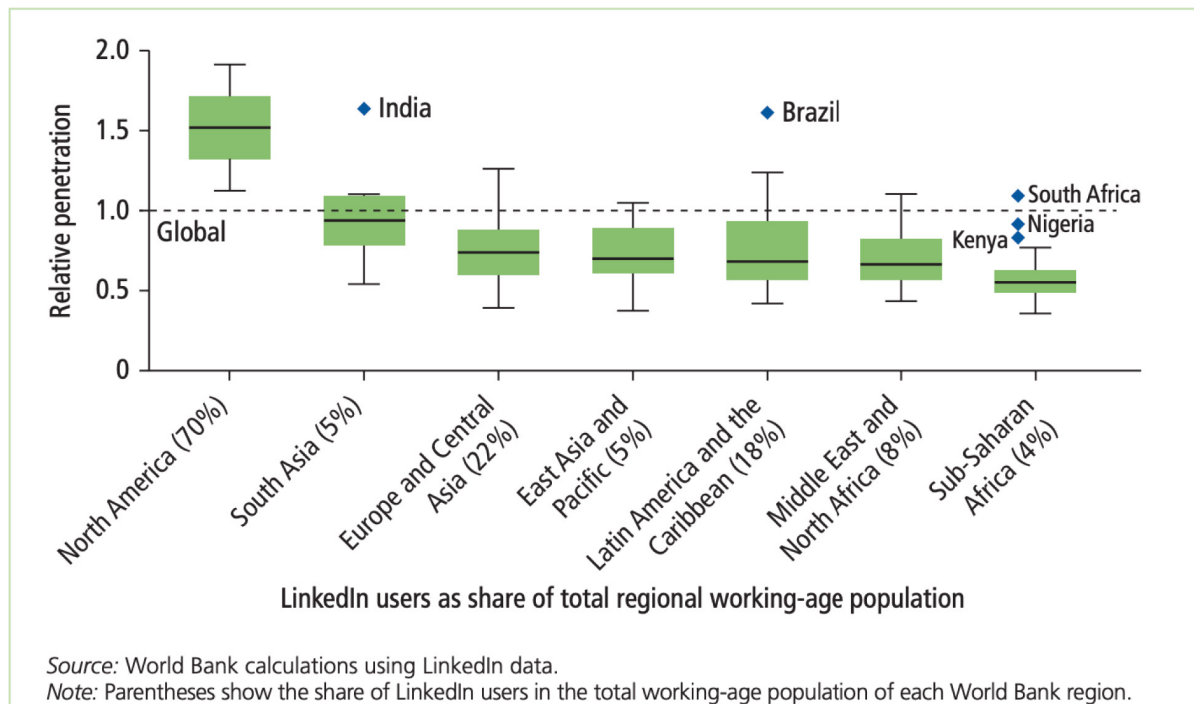
The COVID-19 outbreak has made e-learning and remote work the new normal and highlighted the importance of internet connectivity for work and education today. Despite the rapidly growing smartphone penetration across the continent, many are not online due to the high cost and patchy availability of internet access. A combination of poor infrastructure and monopoly control of telecommunication operators are cited as leading causes; therefore, the governments need to put in place legislations that compel the telcos to make the investment required to lower cost of high-speed internet, including through incentives such as reducing permit fees, lowering tax rates on mobile money revenues, and allowing the companies to save on operational expenses by using government-funded infrastructure.[42]

LOW DIGITAL LITERACY

In addition to the lack of access to digital devices and connectivity, low digital literacy in many African countries hamper people's ability to make use of technology (SMS or apps) to obtain necessary health information, leading many to go to unqualified doctors or healers.[43]

FIGURE 7. DIGITAL SKILLS IN SUB-SAHARAN AFRICA LOWER THAN OTHER REGIONS

LinkedIn users as share of total regional working-age population

Source: World Bank calculations using LinkedIn data.
Note: Parentheses show the share of LinkedIn users in the total working-age population of each World Bank region.

Source: Choi, Jieun, Mark A. Dutz, and Zainab Usman, eds. 2020. The Future of Work in Africa: Harnessing the Potential of Digital Technologies for All.

The World Bank's Future of Work in Africa 2020 report shows the underdeveloped digital skills in Sub-Saharan Africa. Self-reported data on Linkedin users from 27 countries in the region were used to analyze the penetration of digital skills, which revealed that digital skill adoption in SSA is the lowest in the world (Figure 7). Comparison of specific digital skills between countries in SSA and Europe with similar ratios of LinkedIn users as a share of the labor force revealed that African countries with better mobile phone coverage and internet access reported higher levels of digital literary, web development, and mobile application development, while they still fall behind in more advanced skills, e.g. artificial intelligence, scientific computing, and human-computer interaction.[44]

In order to foster digital skills and close the gap between Africa and the rest of the world, higher access to electricity and internet are essential.

In the meanwhile, there needs to be an emphasis on the quality of education to prepare youths in Africa for the skills needed in the modern labour market.

UNDERDEVELOPED DIGITAL INFRASTRUCTURE

One underlying factor that affects the access to electricity and internet and digital literacy discussed above is the quality of digital infrastructure. Reliable IT infrastructure, internet backbone, broadband, mobile telecom and digital communication suits, and data systems and networks provide the basis for digital activities. For example, Rwanda enjoys 90% of broadband infrastructure coverage and 75% mobile phone penetration, which contributes to the country's higher level of digital readiness and its digital healthcare success. A key element of the digital infrastructure for public health is to build integrated systems

and platforms that allows for interoperability and real-time data exchange.

Governments in Africa need to invest in not only digital infrastructure, but also build capacity of healthcare workers to utilize digital health tools. For example, Senegal deployed the eVaccin project when COVID-19 hit to identify and digitally capture vulnerable people with underlying conditions in order to prioritize them in the vaccine rollout. The digital infrastructure underpinning the vaccine registry enabled Senegal to become the first country in Africa to provide vaccination QR codes to its citizens.[45]

The joint WHO-ITU partnership launched in 2017, eHealth Africa Initiative46, aims to facilitate the adoption of ICTs to transform national health systems. The focus is on equipping countries with the necessary ICT foundations, building digital infrastructure, and foster digital skills of healthcare professionals. The initiative brings public-private partnership to increase the resilience of the health system.

6. Conclusion and policy recommendations

The COVID-19 pandemic has prompted the development of many new digital healthcare tools and platforms and the scale-up of existing solutions. As the region with the largest burden of disease and most severe shortage of healthcare professionals, Africa can greatly benefit from innovative solutions in digital health and transcend existing barriers to strengthen their public health in a short period of time. The adoption of digital technology can improve the effectiveness, efficiency, and quality of Africa's health facilities and health system performance.

Despite significant challenges to Africa's health systems, there have been a great number of digital health solutions and interventions before and during COVID-19. A wide range of innovations have spurred on the African continent in areas of telemedicine, subscription-based medical care, smart health payment systems, biometric-based vaccine verification, health alert messaging systems, the integration of COVID-19 related modules into existing solution at scale, as well as capacity building for healthcare workers, etc.

The breadth of digital health innovation across Africa has been enabled by effective leadership and governance, a relatively young population who are eager to use modern technology, growing rates of mobile phone penetration, and wide usage of mobile money. Yet barriers still remain that prevent African countries from fully capitalizing on the power of digitalization to improve health outcomes and human capital development. Some of the key challenges are lack of electricity and internet access, inadequate digital skills and literacy, and poor digital infrastructure.

To make digital health flourish within Africa, the governments need to create an enabling environment that is driven by African needs and firmly anchored within the local context. Below are some recommendations for priority actions that governments can undertake to advance digital health and the achievement of SDGs.

Build a clear forward-looking national digital health strategy. Governments in Africa need to establish a forward-looking national strategy that demonstrates their commitment to improving digital health. The strategy needs to outline the weaknesses in a country's healthcare system, highlight enablers for the development and scale-up of digital innovations for public health, underline specific objectives at the national and subnational levels, and identify priority areas and use cases to support and scale based on a clear understanding of population needs. 41 of 54 African countries already have national digital health strategies and architectures, which shows that governments in the region see enormous opportunities within digital health.[47]

Create a solid governance framework for the digital health ecosystem. Based on the national strategy, a set of relevant policies, legislation,

and regulations need to be established to build a strong regulatory environment that ensures quality care, patient data protection, interoperability of applications and data systems, and safe and reliable data sharing and exchange.

Establish dedicated units responsible for the efforts around digital health. Within the Ministry or Department of ICT, this may include a specialized unit that orchestrates the delivery of the digital health strategy and coordinates digital health activities at the national and sub-national levels and another specialized unit to manage digital health data aggregation and exchange among governments, healthcare providers, technology providers, insurers, and other stakeholders.

Invest in energy to improve electricity access. Less than half of the population in Sub-Saharan Africa has reliable access to electricity, which poses a severe challenge for the wide-scale adoption of digital health interventions in the region. Governments must invest their resources in expanding energy access and accelerating renewable energy generation to electrify the nation.

Strengthen digital infrastructure. At the centre of a digital health ecosystem needs to be a strong foundation of digital infrastructure. Lack of access to electricity and a stable Internet connection, especially in rural areas, hinder the penetration of digital healthcare in Africa. Governments nmustprioritize investment in IT infrastructure, internet backbone, broadband, mobile telecom and digital communication suits, and data systems and networks. A key element of the digital infrastructure for public health is to build integrated systems and platforms that allow for interoperability and real-time data exchange.

Prioritize education to promote digital literacy. Africa has a youthful population who are eager technology and smartphone users, yet the continent suffers from low digital literacy compared to other regions. Governments must prioritize digital education in their curricula to fully capitalize on the demographic dividend and the youth's ability to absorb digital knowledge. Although there has been increased skill development in digital literacy, web development, and mobile application development, African countries fall behind in more advanced skills. By enabling the youth to use and develop digital health tools, countries will equip the next generation of the workforce with digital skills and improve human development achievements.

Develop mechanisms for sustainable financing of the digital health system. To build sustainable digital health systems, governments in Africa must not rely solely on donor funding. A dedicated portion of the government budget may be allocated to deliver the national digital health strategy, jointly managed by the Ministry of Health and ICT. More importantly, there have been many examples of successful public-private partnerships to create digital health solutions in Africa, e.g., Babyl in Rwanda and the United AI Alliance initiative. As the private sector wields more innovative and financial power and can develop tools and applications more efficiently, governments should prioritize public-private partnerships to help finance digital health efforts and, in the meantime, improve the ease of doing business conditions in the country to attract additional private sector investment.

Leverage collaboration with digital solution providers. In settings where African governments and NGOs are ill-equipped to build and deploy digital health solutions on their own, technology innovators have a critical role as they have the expertise and experience and can evaluate how to integrate the interventions with government systems. Strong partnerships between governments and digital solution providers can help drive scale.[48]

Foster partnerships with key global players. Last but not least, key international organizations such as the UN and WHO can provide a platform for

information exchange and peer learning because of their convening power. WHO, as the leading specialized agency in international public health, is able to provide guidance on the development and delivery of national digital health strategies and unify data privacy standards and exchange across countries. Moreover, the UN and WHO can provide targeted capacity-building programs to help strengthen the digital skills of healthcare professionals in African countries.

7. Notes

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