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Brief Communication

COVID-19 two years on: Four fundamental lessons to curb future pandemics in Africa

Abebaw Fekadu[1,2,3], Eyasu Makonnen[1,4], Aschalew Abayneh[5] , Yimtubezinash Woldeamanuel[1,6] , Asrat Hailu[1, 6], Girmay Medhin [1,7] , Anteneh Belete[1,8], Mirutse Giday [1,7], Getnet Yimer[9] , Haregewein Assefa[10], Mitike Molla[11], Tassew Woldehanna[12]

[1]Addis Ababa University, Center for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa), Addis Ababa, Ethiopia
[2] Brighton and Sussex Medical School, Global Health and Infection Department, Brighton, UK
[3]WHO collaborating center for Mental Health research and capacity building, department of Psychiatry, School of Medicine, College of Health sciences, Addis Ababa University, Addis Ababa, Ethiopia
[4]Addis Ababa University, College of Health Sciences, Department of Pharmacology and Clinical Pharmacy, Addis Ababa, Ethiopia
[5]Ethiopian Public Health Institute, Ministry of Health, Addis Ababa, Ethiopia
[6] Addis Ababa University, College of Health Sciences, Department of Microbiology, Parasitology, Immunology and Pathology, Addis Ababa, Ethiopia.
[7] Aklilu Lemma Institute of Pathobiology, Addis Ababa University, Addis Ababa, Ethiopia.
[8]Addis Ababa University, College of Health Sciences, Department of Pharmaceutics and Social Pharmacy, Addis Ababa, Ethiopia
[9]University of Pennsylvania, Department of Genetics, Center for Global Genomics & Health Equity, Philadelphia, United States
[10]Addis Ababa University
[11]Addis Ababa University, College of Health Sciences, School of Public health, Addis Ababa, Ethiopia
[12]Addis Ababa University, Department of Economics, Addis Ababa, Ethiopia

Corresponding author*: abebaw.fekadu@aau.edu.et

Abstract
Background: COVID-19 is one of the major pandemics of the past 100 years. We reflect on the key lessons from the COVID-19 pandemic for deflecting similar threats in Africa.
Results: We describe four fundamental lessons. (1) The need for capable and empowered national/regional knowledge translation centers to synthesize and translate rapidly evolving evidence during pandemics to inform policy and practice. (2) Importance of harnessing the power of global partnerships: Pandemics, as shown during COVID-19, attract global partnerships. Thus, mechanisms should be devised to use partnerships to control or mitigate consequences of pandemics. (3) Urgency of improving the innovation ecosystem drastically: The unprecedented drive for innovations during pandemics requires flexible and robust systems to absorb them. (4) Need for producing critical medical supplies within country: The extreme dependence of Africa on imports constitutes an existential threat for Africa and must be addressed as a priority.
Conclusion: Building world class knowledge translation units, medical discovery capabilities and harnessing innovations and partnerships should be part of the critical foundation of a secure and prosperous Africa that can confidently tackle future pandemics.

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Background

Four major pandemics of the past 100 years have taken the lives of close to 100 million people globally. The Spanish flu, with nearly 50 million deaths, remains the leading cause of pandemic related mortality (1). To date, over 6.5 million people have died from the Corona Virus Disease 2019 (COVID-19) pandemic (2). The economic impact of the pandemic has been immediate, deep, persistent, and more pronounced in emerging economies (3). Unlike previous pandemics that took up to 10 years to become global, COVID-19 had made its way around the world within three months of the first report of the disease. Aware of what was coming, many African countries took drastic actions. In fact, African countries can be proud of their collective response. Their implementation of public health control measures was unprecedented. Recognising the health system challenges, they focused on enhancing service provision. They engaged in continental and international frameworks to keep the pandemic at bay. In Ethiopia, COVID-19 was just one of the many problems the country was facing. But COVID-19 received the full attention of the nation with coordination at the highest level of political leadership. The Ministry of Health led from the front putting into use the extensive diaspora network and effective communication strategy. The Ethiopian Public Health Institute was strengthened to lead the control effort. Diagnostic capacity was scaled up rapidly. When vaccines were produced, Ethiopia negotiated access to these vaccines. These are all monumental achievements and will serve as important inputs for preventing or controlling future pandemics. However, the public response in many developed countries was lukewarm, and global leadership was 'absent' (4). The Independent Panel for Pandemic Preparedness and Response lamented the flagging political commitment to end the pandemic and prevent another. It particularly noted that the extremely slow pace will not bring about the required transformative changes (4).

Albert Camus, the French Algerian novelist in his novel, the Plague, aptly captures the public sentiment displayed during COVID-19 (5):

> *"A pestilence isn't a thing made to man's measure; therefore we tell ourselves that pestilence is a mere bogy of the mind, a bad dream that will pass away. But it doesn't always pass away and, from one bad dream to another, it is men who pass away, and the humanists first of all, because they haven't taken their precautions."*

Camus also captures the slow and timid leadership response (especially in high income countries): *"The only hope was that the outbreak would die a natural death; it certainly wouldn't be arrested by the measures the authorities had so far devised"* This inconsistent public and leadership response in the current pandemic, along with the severe global inequity, formed the basis for an unrelenting pandemic.

Monkey pox, an endemic disease in some parts of Africa, has been recently declared a "Public Health Emergency of International Concern" by the World Health Organization as it spread relatively quickly across 75 countries and territories infecting over 16,000 people (6).

Despite its endemicity in Africa for half a century, virtually all reports of recent cases have come from outside of Africa (7), undoubtedly a function of the familiar poor diagnostic capability in Africa. Financially and technologically advanced countries are now in a hurry to hoard the little available vaccine (8, 9). Africa remains woefully unprepared. We have not learnt from the lessons of previous pandemics or the still unabated COVID-19 pandemic. Therefore, it seems right to stop and ask: What should Africa learn from this pandemic for deflecting or surviving another pandemic? While the typical recommendations focus on early detection through surveillance, modelling of transmission and spread, communication and development of therapies (10-12), there are unique lessons from the current pandemic to help Africa protect its people from another pandemic largely on its own terms and resources (13).

Thus, we put forward four key suggestions based on the lessons we learned through active participation in the prevention, and control of the disease for over two years. First, it is critical to be serious in generating and managing new knowledge. Second, institutional and national systems have to be in place to harness the opportunities of partnerships. Third, the essential culture and ecosystems must be in place to absorb and benefit from inevitable innovations created during times of crisis. Finally, Africa should have the key human, infrastructure and system capabilities to produce all its essential drugs, vaccines and diagnostics domestically. We provide more details below based on our experience in participating in the national and regional response, knowledge translation, global partnerships, and medical discovery initiatives.

Harnessing knowledge to track pandemics and inform policy and practice

When the COVID-19 pandemic started nearly three years ago, there was little knowledge about the disease. The global quest to understand the origins and nature of the disease, its cause, treatment and prevention opportunities was instant. This pursuit resulted in an overwhelming amount of knowledge of unconfirmed veracity. During the first two years of the pandemic, over half a million papers were published in peer reviewed journals, with about half generated in the first year [Figure 1]. Standards for peer review were virtually suspended. Approvals for medicines were accelerated and occurred under intense political pressure. It was suggested that the extreme clinical concerns warranted dropping the normal standards and that patients should be allowed to use drugs not approved by the appropriate regulatory authorities. This was believed to reflect the recommendations of the then president to try unproven treatments for COVID-19 (14, 15)The interest to repurpose old drugs (e.g., using well established drugs like chloroquine for COVID-19), and the recommendation to use traditional medicines

(e.g., herbal tonic endorsed by the president of Madagascar (16)) increased significantly despite the lack of clear evidence. The extreme panic and lockdown led to substantial economic losses and pressure on the health system. While major contribution has been made by regional and national institutions, such as the Africa CDC and the Ethiopian Public Health Institute in describing the spread of the disease, making sense of the overwhelming data in the public domain and to use it to inform policy and practice remained a major challenge. Aware of this clear gap, the Addis Ababa University's Centre for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa) established a knowledge synthesis team to verify and harness the knowledge that was being generated (17). The team collated all critical new knowledge relevant to the nature of the disease, diagnosis, treatment and control from reputable sources and forwarded it to the Ministry of Health, initially daily, in a structure that the team felt was easy to comprehend. However, the team was only assembled to address the obvious gap without sufficient mandate or authority to influence policy direction even in issues as basic as 'universal' face coverings.

Therefore, it seems critical to establish sufficient number of highly specialized knowledge translation units with sufficient expertise and mandate that work along health ministries. These units should provide continuous and actionable health security intelligence to a national office tasked with pandemic preparedness and response. There should also be clear path of accountability. Perhaps no pandemic will command similar interest as COVID-19 had partly because of the exhausting enthusiasm it caused. However, knowledge translation units that generate and track new knowledge are likely to be even more important for conditions that may emerge 'under the radar' and lead to very serious public health consequences.

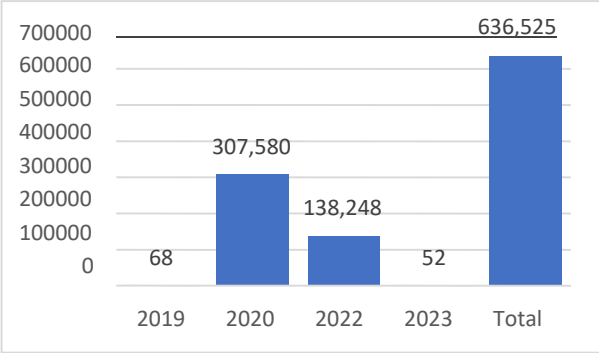

Figure 1. Publications by Year since start of the COVID-19 pandemic

[Source: WHO. COVID-19. Global literature on coronavirus disease (16)].

Harnessing the power of partnership

The relevance of global partnerships to assist low-income countries to achieve the sustainable development goals [1, 2] was heightened during the COVID-19 pandemic. For example, the Solidarity trial, described as "unprecedented international collaboration", had engaged 2000 researchers from 52 countries (19). Within few months of the pandemic, a global research coalition was formed by individuals from 98 countries and 900 organizations, including the Addis Ababa University, to bring together expertise and capabilities to accelerate the implementation of COVID-19 clinical trials in resource limited countries (20). An international collaboration, which also included Addis Ababa University and various hospitals in Ethiopia, worked on a UV-C Cabinet to support reuse of N95 respirators (21). The initial collaboration environment was also conducive in many organizations (22). However, these partnerships did not provide the transformative platform required to address the pandemic or produce sustainable impact.

First, these partnerships were very transient engendered by the immediate need of knowledge generation or short-term business and philanthropic interests, without lasting relationship or impact envisaged. Second, most African countries had limited capacity for developing or marketing high impact innovations, while potential partners from high-income countries were interested identifying marketing destination (23).

Third, countries where most of the innovation happened were not willing to share critical knowledge and resources required to make these innovations in low-income countries. This was shown clearly in the discussions about waiver of intellectual property protection for covid-19 vaccines (24).

"Building back better" through partnership requires a new model of partnership. An example is the "Partnership Maturity Model", a values-driven partnership growth model (25). At the core of this model is equity and mutual benefit with dedication of partners to long-term and sustainable relationship. While partnerships have great potential for rebuilding a better and safer Africa, these partnerships must be built to last on values such as equity, choice, freedom, and agency. Preventing and surviving another pandemic requires countries and institutions to invest and carefully engage in such partnerships. Better engagement mechanisms with the African diaspora and private business has to be devised.

Harnessing the potential of innovation

The pandemic has accelerated innovation meaningfully as major crises tend to do (26). The primary beneficiary of the innovation drive was the healthcare system, both as a solution and business proposition. New diagnostics, vaccines and repurposed drugs were developed and marketed in ultra-short time. Countries with ready expertise, infrastructure, and mature innovation system benefited most from the opportunity.

African countries were engaged in some documented innovation activities, including "virus-testing robots, contact-tracing apps, non-invasive testing kits, foot-operated hand-washing stations, oxygen machines, drone medicine delivery service, genome sequencing, [Artificial Intelligence] AI-powered healthcare chat-bots" (27). There was also major interest in innovative solutions in Ethiopia. The former Ministry of Science and Higher Education of Ethiopia organized numerous exhibitions of products, with all national universities actively engaged. Nevertheless, with all the 'dust' of excitement and chaos settled, there is no clear evidence that these innovations and the enthusiasm have led to significant and sustainable impact. While challenges abound, two critical barriers to innovation and impact deserve mention. First, low expectation of universities: While universities are critical for innovation and, even the achievement of the Sustainable Development Goals (28), the low expectation of African Universities (29) is antithetical to their mission of generating transformative knowledge and innovation that can address emerging threats or bring about sustainable impact. Without the right expectation and leadership, universities cannot be valued and receive the right investment, governance and accountability systems that underpin their purpose. Policies and engagements with universities need to change drastically. Whether acknowledged or not, Ethiopia's transformation requires drastic re-invigoration and accountability of all its higher education institutions. The private colleges and universities have played an important role in terms of increasing access to higher education although concerns of quality are raised (30). These private institutions must also be part of the solution. Ethiopian universities have led many of the national political changes of the past half century. They now should be the drivers of national transformation through innovation. Solomon Nwaka, one of the major advocates of African innovation, emphasizes the point that investment should be on innovation rather than on education arguing that innovation itself will force the education system to change (31). The indicator of impact would then be the number of innovations rather than the number of graduates. We illustrate this in Figure 2, extending the link of innovation to overall societal wellbeing.

One of the most critical barriers to impactful partnership was perhaps the lack of a mature and facilitative innovation ecosystem. Despite a considerable number of innovations during COVID-19, there is no evidence that any national system has kept a useful inventory of the innovations or the innovators. Bright innovators have not been given ongoing support for bigger purposes. There is no clear evidence that Ethiopia, or Africa more broadly, has benefited directly from the potential of innovation that came about because of the pandemic. Africa has to improve its innovation ecosystem not only for the next pandemic, but to address its perennial development challenges as well.

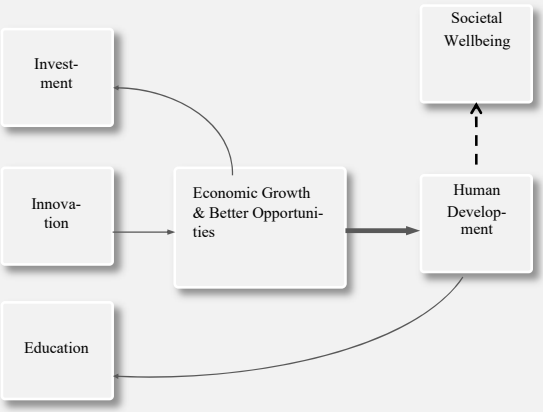

Figure 2 The investment-for-innovation paradigm for economic growth and better pandemic control opportunities

Medical discovery and development capabilities

Africa's main threat in any new pandemic is its absolute dependence on import for the supply of its essential medicines. The United Nations Economic Commission for Africa (UNECA) estimates that Africa imports about 94% of its pharmaceutical and medicinal supplies from outside the continent at an annual cost of $16 billion (32). All in all, there are only 600 pharmaceutical manufacturing plants in Africa, just 5% of India's (33), and only capable of handling downstream processes. Only 1% of the vaccines Africa needs are produced within Africa, while consuming 25% of the global vaccine supply (34). Diagnostic production capability is similarly low. In Ethiopia, the plan to "… increase the contributions of local manufacturers in supplying EPSA [Ethiopian Pharmaceutical Supply Agency] to 60% are far behind 2020 targets" (35).

Approaches to develop non-African solutions to perpetual African health problems, such as the Product Development Partnerships (PDPs) have failed. For example, in a period spanning 30 years, while over 1500 new molecular entities have been developed, only 21 of these were for diseases of poverty, including TB (36). The recent establishment of the Africa Medicines Agency is a step in the right direction. Similarly, the Partnerships for African Vaccine Manufacturing (PAVM), the African Medicines Regulatory Harmonization (AMRH) and African Vaccine Regulatory Forum (AVREF) are important initiatives for improving access to medicines. However, for Africa to produce its essential medicines within its boundaries requires a lot more. Multiple inter-related capabilities must be built — medical discovery and development expertise, transformation of the academic environment, medical discovery infrastructure, investment in basic sciences, clinical development

and regulatory capabilities, quality assurance, fully functional industries with Good Manufacturing Practice standards, full engagement of the private sector, and government leadership. The current technology transfer and funding mechanisms have to be drastically restructured (36). A land-locked country with a large population, such as Ethiopia, must commit to produce its essential medicines, including those required to respond to any public health emergencies within its territories. This makes not only public health sense but is also needed for effective economic growth and national security (Figure 3)

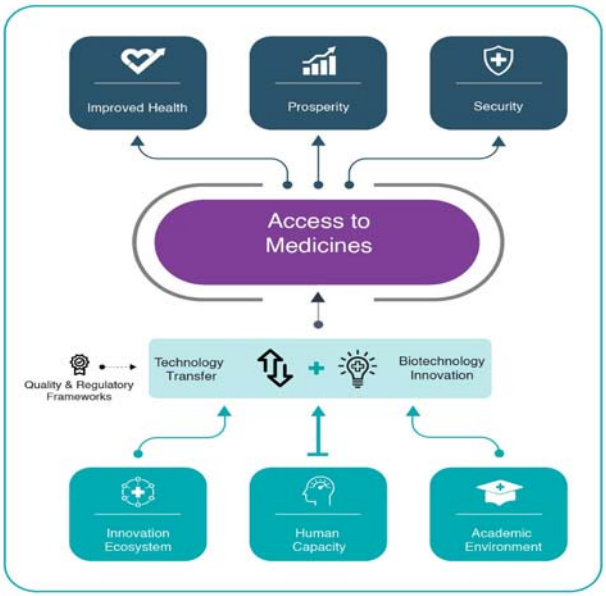

Figure 3 :Required inputs for improving access to medicines and potential impact

Conclusion

Albert Camus astutely predicts the future of pandemics: *"Everybody knows that pestilences have a way of recurring in the world; yet somehow we find it hard to believe in [the] ones that crash down on our heads from a blue sky. There have been as many plagues as wars in history; yet always plagues and wars take people equally by surprise."* There is a high likelihood that Camus will be right again. The commitment of the international community to act on its expressed desire of ensuring equal access to essential drugs, diagnostics and vaccines during pandemics has been very low. Africa must have the essential capabilities that would allow it to engage with any health threats on its own terms and resources. At the core of this, freedom is the capacity of researchers within Africa to conduct fundamental therapeutic discovery and development research.

Funders and African governments should create new mechanisms to support local technology innovations, including medical discovery capabilities. These local capabilities will have major transformative impact that goes far beyond the prevention or control of pandemics.

Such local capabilities will open the opportunity to use the untapped knowledge and biodiversity of Africa to address not only the perpetual health challenges of the continent but also assist in finding solutions for global health challenges such as cancer.

While the potential of partnerships is obvious, new models of partnerships in the current highly competitive global environment are needed to encourage congressive relationships.

Abbrevations /Acronomys

COVID 19: Coronavirus Disease 2019
AI: Artificial Intelligence
AMRH: the African Medicines Regulatory Harmonization
AVREF: African Vaccine Regulatory Forum
CDT-Africa: Centre for Innovative Drug Development and **Therapeutic Trials for Africa**
PAVM: Partnerships for African Vaccine Manufacturing
PDPs: Product Development Partnerships
UNECA: United Nations Economic Commission for Africa

Declarations

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Not applicable

Consent for publication:

Not applicable

Availability of data and material:

Not applicable

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The authors declare that they have no competing interests.

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Supplementary Material:

None

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