EXPERT VOICES

Investing in Africa's scientific future

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Africa bears a disproportionate burden of infectious diseases, accounting for a substantial percentage of global cases. Malaria, HIV/AIDS, tuberculosis, cholera, Ebola, Lassa fever, and other tropical diseases, such as dengue and chikungunya, have had a profound impact on morbidity and mortality. Various factors contribute to the higher prevalence and incidence of infectious diseases in Africa, including socioeconomic challenges, limited access to health care, inadequate sanitation and hygiene infrastructure, climate-related factors, and endemicity of certain diseases in specific regions. A skilled workforce is crucial to addressing these challenges. Unfortunately, many countries in Africa often lack the required resources, and aspiring scientists frequently seek educational and career opportunities abroad, leading to a substantial loss of talent and expertise from the continent. This talent migration, referred to as "brain drain," exacerbates the existing training gaps and hampers the sustainability of research within Africa.

During the COVID-19 pandemic, considerable resources were invested to enable African countries to directly monitor genetic changes of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) without relying on international assistance. In particular, the Africa Centres for Disease Control and Prevention (CDC) and World Health Organization, through the Africa Pathogen Genomics Initiative (Africa PGI), invested in increasing the capacity of African countries by providing equipment, reagents, and training. These investments resulted in an exponential increase in the number of SARS-CoV-2 genome sequences produced in Africa. Remarkably, whereas it took 375 days to produce the first 10,000 African SARS-CoV-2 genomes, it took only 87 days to produce the next 10,000 and just 24 days to produce an additional 10,000. Currently, 54 African countries have the capacity to conduct genome sequencing, and these countries have collectively contributed almost 200,000 genomic sequences from Africa, with South Africa contributing about a third of the sequences. Although this is only a fraction of the 16 million SARS-CoV-2 genomes publicly available, the monitoring of SARS-CoV-2 genetic changes in Africa played an important role in shaping the global scientific response to the pandemic and enabled the identification of several variants of interest and five variants of concern to date, two of which, Beta and Omicron, were identified by scientists from Africa. This success highlights the potential for genomics to help revolutionize disease control and prevention in Africa.

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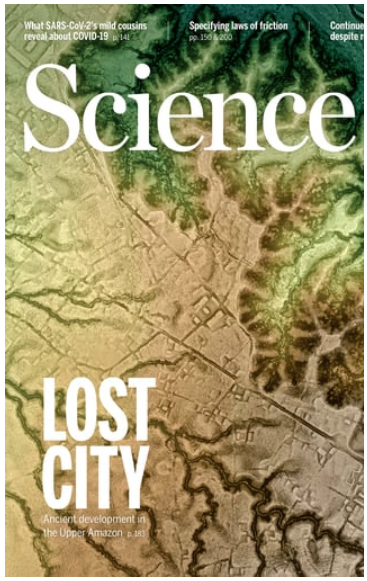

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As the COVID-19 pandemic recedes, it will be important to redirect resources on the continent to quickly and effectively characterize other pathogens. One of the main lessons from the COVID-19 pandemic is that pathogens do not respect borders and can quickly spread globally. The 2022–2023 outbreak of mpox across the world, including in regions that have not historically reported cases, is a prime example. Therefore, it is necessary to build on the investments already made and use genomics, clinical trial capabilities, and vaccine development as catalysts for responding to other ongoing and future epidemics, particularly those previously neglected, such as tuberculosis and mpox, and those affected by climate change, such as dengue, chikungunya, cholera, and malaria.

The need to build genomics capacity in Africa while simultaneously retaining skilled personnel is critical for several reasons. The substantial infectious disease burden in Africa is likely to worsen as the impacts of climate change become apparent. A recent review revealed that climate change has the potential to amplify more than 50% of known human pathogens. Genomic sequencing could be harnessed to elucidate the origin, genetic diversity, transmission patterns, and evolution of these pathogens. Strengthening capacity in genomics will enable researchers and health care professionals in Africa to generate region-specific data and knowledge that is crucial for understanding disease dynamics and developing targeted interventions, including the evaluation and development of diagnostics, therapeutics, and vaccines to improve public health outcomes.

There is also the need to invest and expand scientific expertise in Africa, as the continent is witnessing a demographic shift, characterized by a rapidly growing population of people between the ages of 15 and 24 (dubbed a "youth bulge"). Almost 60% of Africa's population is under the age of 25, making it the youngest population in the world; and young Africans (15 to 24 years of age) are predicted to constitute 42% of the world's youth population by 2030. Educating young people and developing their interest in scientific research may equip them with the abilities to overcome Africa's challenges, which will be crucial for reaping the benefits of the demographic dividend.

Despite Africa carrying 25% of the global burden of disease, African-led research has contributed less than 1% of the scientific literature. This discrepancy further highlights the urgent need to build capacity in science to address the unequal distribution of research efforts and ensure that scientists from Africa have equitable opportunities to contribute and lead in Africa. Additionally, building local capacity in genomics and bioinformatics analysis enhances the ability of Africa to conduct in-depth investigations into ongoing health problems and identify potential local solutions, such as the development of Lassa fever diagnostics by African researchers. Furthermore, retaining skilled personnel is vital for sustainable development and growth within the health care and research sectors of Africa. Ultimately, building capacity and retaining skilled personnel will empower Africa to take ownership of its health care challenges, drive innovation, and improve health outcomes for its populations.

There are already many laudable genomics and bioinformatics training programs in Africa that can be expanded, such as H3ABioNet, which has provided training to 1420 individuals from 29 African countries through bioinformatics and data analysis cour-

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ses. In 2021, a new fellowship program was launched, the Genomics Africa fellowship program, which, with support from multiple funders, has provided short-, medium-, and long-term fellowships to more than 440 individuals from 42 African countries in the three specialized genomics facilities of the Africa PGI in Kenya, Nigeria, and South Africa. Importantly, this fellowship program ensures that fellows return to their country of origin and receive ongoing support in the form of protocols and reagents to characterize new pathogens in their country. Recent examples of the success of this program in leveraging previous investment include the characterization of novel strains of cholera in Malawi and the establishment of sequencing capabilities in West Africa to characterize dengue and chikungunya. It will be important to strengthen this fellowship program, along with the other bioinformatics and data analysis programs, to ensure that investments in equipment and training are not jeopardized.

Increasing capacity in Africa to not only sequence pathogens but also analyze the data in real time and make this information available for diagnostics, therapeutics, and vaccine development will surely have a multiplier effect that benefits future efforts to tackle emergent pathogens. It will also benefit the world because pathogens respect no borders.

Investing in Africa's genomics future is an imperative not just for the continent's health but for global health security as well. By empowering African scientists and building strong genomics infrastructure, we can collectively mitigate the impact of infectious diseases and pave the way for a healthier future for all.

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