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Viewpoint

Commentary title: COVID-19 research, Africa, and global health

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Commentary

While the world is struggling to cope with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic – according to the World Health Organization (WHO) about 70 million infections and 1.6 million deaths have been reported as of December 13, 2020,[1] its socio-economic effects are being felt globally, with a disproportionate impact on the poor, those lacking access to functioning health systems, and those living in regions with inadequate public health leadership. In Africa, far less coronavirus disease 2019 (COVID-19) cases have been observed than projected, i.e. 1.6 million cases and 36,000 deaths.[1] While not epidemiologically proven, possible contributors to this low burden could be Africa's youthful populationand prior exposure to other coronaviruses.[2] Of note, many countries took measures such as early lockdown and strict travel restrictions. South Africa implemented an 8-stage response starting with testing preparedness before any case detection and the declaration of a national state of disaster only ten days after the first South African patient was diagnosed.[3]

Unfortunately, colonialism and persistent systemic racism, in which many health inequities are rooted, continue to manifest in Africa in response to the COVID-19 global threat. In April 2020, two French doctors, in a televised discussion on COVID-19 vaccine trials, suggested that trials should be done in Africa because "there are no masks, no treatment, nor intensive care",[4] implying that substandard and/or exploitative research would be permissible. The significant outrage, including legal complaints and public discussion following these remarks, emphasized the danger of such perception and highlighted the contributions of sound research being conducted in Africa.[4] The WHO Director-General has referred to the presumption of lack of African research infrastructure as a "hangover from a colonial mentality", and declared that "racist remarks that shall not be tolerated when the world needs solidarity".[5] In Science, Bekker and Mizrahi have stressed that Africa is "key to the response to outbreaks of emerging and re-emerging pathogens" and that excluding it from research "will be a life-threatening mistake".[6] For example, many HIV antiretroviral drugs used were tested in Sub-Saharan Africa and were "found to be lifesaving for people with advanced AIDS".[6] International partnerships involving African researchers and community advocates and, first and foremost, patients to combat global infectious diseases have contributed significantly to clinical and implementation research, and have provided substantial data that we would not have gained otherwise.

Investment in clinical research and research capacity-building in

Abbreviation: ANRS, the French National Agency for Research on AIDS; ART, Antiretroviral Therapy; CAPRISA, Centre for the AIDS Programme of Research in South Africa; CRS, Clinical Research Site; EVD, Ebola Virus Disease; HIV, Human Immunodeficiency Syndrome; HPTN, HIV Prevention Trials Network; IPT, Isoniazid Preventive Therapy; LA, long-acting; MAb114, single human monoclonal antibody derived from an Ebola survivor; PrEP, Pre-Exposure Prophylaxis; RNA, Ribonucleic Acid; REGN-EB3, a co-formulated mixture of three human IgG1 monoclonal antibodies; rVSV, recombinant vesicular stomatitis virus; Tasp, Treatment as prevention; TB, Tuberculosis; WHO, World Health Organization; ZMapp, a triple monoclonal antibody agent against Ebola glycoproteins.

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Africa has paid off many times over. Just now, the global health community is celebrating the positive opinion from the European Medicines Agency under Article 58 and, in cooperation with the WHO, to market a new HIV prevention intervention for women – the dapivirine vaginal ring outside the EU. This is based on studies done in Kenya, Malawi, Rwanda, South Africa, Tanzania, Uganda, and Zimbabwe.[7–10] Over the years, Africa has developed its public health infrastructure, including the establishment of national biosafety level 3 and level 4 laboratories, the Africa Centre for Disease Control and Prevention, and public health institutions that have tremendously advanced the continent's research capabilities.[11] The existence and continuous further development of infrastructure are critical in responding to outbreaks, such as the Ebola epidemic in West Africa, and leveraging local resources are just as critical for containing SARS-CoV-2. Numerous rigorous studies in Africa have contributed immensely to global health, resulting in significant advancement of human health, such as the development of treatments and vaccines against emerging and re-emerging infectious diseases. A detailed but non-exhaustive list of studies is included in Table 1. Meanwhile, established networks from these global health studies have been used as platforms for COVID-19 vaccine trials such as the Pfizer/BioNTech and Astra Zeneca/Oxford ChAdOxl-S candidates which are being tested in Africa showing efficacy ranging from 70 to 95%.[12]

Although these networks can serve as a platform for COVID-19 vaccine trials, imbalances remain and need to be fixed. The global community should support Africa to leverage every opportunity to scale up African research capacity, facilitate African investigators' intellectual contributions and further strengthen the regulatory capacity on the continent to ensure timely approval of efficacious and safe new medical interventions and equitable post-trial access to treatments and vaccines. Establishing a rigorous research and development infrastructure and increasing regional manufacturing capacity for diagnostics, rigorous surveillance, and data analysis would be the first steps for preventing deleterious outcomes in the future.

Impressive as they are, research results per se are not the only form of return on investment. Embedding clinical research into at-risk communities is a key and necessary step to transition from research to implementation and access. Scientifically and ethically sound research throughout all the stages of the research cycle (basic, translational, clinical, socio-behavioral, and implementation research) lays the groundwork for more equitable health outcomes. Community input

Table 1
Studies conducted in Africa.

N	Author	Year	Title	Area	Global Health Benefit and Sites/Networks
1	Jared Baeten	2016	Use of a vaginal ring containing dapivirine for HIV-1 prevention in women[10]	HIV prevention	Use of dapivirine vaginal ring for HIV prevention in women. MTN sites: Malawi, Uganda, South Africa, Zimbabwe sites.
2	Linda Gail Bekker	2020	Safety and tolerability of injectable rilpivirine LA in HPTN 076: A phase 2 HIV pre-exposure prophylaxis study in women[17]	HIV, PrEP	Rilpivirine in African was safe, acceptable and well tolerated. HPTN sites: Emavundleni Clinical CRS in Cape Town, South Africa, Spilhaus CRS in Harare, Zimbabwe and others.
3	Malungu S, Dodd	2019	A randomized, controlled trial of Ebola virus disease therapeutics[18]	Ebola, treatment	Superiority of MAb114 and REGN-EB3 over ZMapp in treating EVD. Site: Democratic Republic of Congo.
4	Joseph Makhema	2019	Universal testing, expanded treatment, and incidence of HIV infection in Botswana[19]	HIV, prevention	Increased population level viral load suppression through expanded HIV testing, linkage to care, and ART coverage. Site: Botswana.
5	Gibrilla F. Deen	2017	Ebola RNA persistence in semen of Ebola virus disease survivors. Final report[20]	Ebola molecular	Long-term presence of Ebola virus RNA in semen. Sites: Sierra Leone.
6	Linda Gail Bekker	2018	Daily and non-daily pre-exposure prophylaxis in African women (HPTN 067/ADAPT Cape Town Trial): a randomized, open-label, phase 2 trial[21]	HIV, PrEP	Increased coverage, adherence, and drug concentration with daily PrEP over time driven or event driven PrEP use. Sites: HPTN Emavundleni Prevention Centre, Cape Town, South Africa.
7	Salim S. Abdool Karim	2011	Integration of antiretroviral therapy with tuberculosis treatment [22]	TB treatment	Optimization of ART initiation in HIV-TB coinfection. CAPRISA site: South Africa.
8	Quarraisha Abdool Karim	2010	Effectiveness and safety of tenofovir gel, an antiretroviral microbicide, for the prevention of HIV Infection in women[23]	HIVprevention	Tenofovir gel reduced HIV acquisition by 39%. Subsequent studies proved that innate immune activation and genital inflammation have a major role in HIV transmission. CAPRISA sites: Urban and rural KwaZulu-Natal, South Africa.
9	Sodiomon B Sirima	2016	Artemether-lumefantrine fixed-dose combinations for treatment of uncomplicated plasmodium Falciparum Malaria in children younger than 5 years in sub-Saharan Africa: a randomized, multicenter, phase 4 trial[24]	Malaria, Treatment	Safety and effectiveness of Artesunate-mefloquine for treating children under five years-old with uncomplicated malaria. Sites: Tanzania, Burkina Faso, and Kenya.
10	Jared Baeten	2012	Antiretroviral prophylaxis for HIV prevention in heterosexual men and women[25]	HIV, PrEP	Use of Truvada for PrEP in women and men. Sites: Kenya and Uganda.
11	Myron S Cohen	2016	Antiretroviral therapy for the prevention of HIV-1 transmission[26]	HIV, TasP	Informed domestic and international guidelines, including WHO HIV guidelines for test-and-treat. HPTN African sites: Malawi, Zimbabwe, South Africa, Botswana, Kenya.
12	Bertran Auvert	2005	Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 trial[27]	HIV, prevention	Addition of male medical circumcision strategy for HIV prevention. ANRS. Sites: Johannesburg, South Africa.
13	Raphael J Landovitz	2018	Safety, tolerability, and pharmacokinetics of long-acting injectable cabotegravir in low-risk HIV-uninfected individuals: HPTN 077, a phase 2a randomized controlled trial[28]	HIV, PrEP	Sets the stage for injectable PrEP phase 3 trials. HPTN sites in Malawi plus others.
14	Ana Maria Henao-Restrepo	2016	Efficacy and effectiveness of an rVSV-vectored vaccine in preventing Ebola virus disease: final results from the Guinea ring vaccination, open-label, cluster-randomized trial[29]	Ebola, vaccine	Introduction of vaccine against Ebola virus disease. Sites: Guinea, and Sierra Leone.
15	The TEMPRANO ANRS 12136 Study Group	2015	A trial of early antiretrovirals and isoniazid preventive therapy in Africa[30]	TBtreatment	Lower rates of severe illness in immediate ART and 6 months of IPT than deferred ART and no IPT. ANRS site: Ivory Coast.
16	Catharina C. Boehme	2010	Rapid molecular detection of tuberculosis and rifampin resistance[31]	TBmolecular	Less than 2 h minimal hands-on time for the detection of TB and rifampicin resistance. Site: South Africa.

through ongoing dialogue and deliberation raises awareness about the gaps in health, the potential solutions and, most importantly, health as a human right. The community's voice in balancing benefits and risks for new healthcare products is essential. The community should be integral to the identification of research problems and the research process and not just an end-user. It is imperative to build the foundations of trust through systematic efforts such as an authentic investment in communities and early community engagement for full return on investment.[13]

Building on such community investment, the global community should support efficient knowledge transfer from local science to local policy, recognizing that science needs to move from silos to inter and trans disciplinary approaches. Activities, such as the United States President's Emergency Plan for AIDS Relief (PEPFAR) and multilateral programs such as the WHO's Prequalification Program and the Global Fund, demonstrate the value of data-driven approaches for the implementation of new treatments to counter existing epidemics, such as HIV – a seamless back and forth between implementation research and practice. In May 2020, the National Institute of Health, (NIH) announced the $58 million program for Harnessing Data Science for Health Discovery and Innovation in Africa, which is expected to impact on health outcomes in the region and around the world, including in the United States. Further similar types of programs in this respect are fundedby the European Union and other national and supranational organizations.

It is equally crucial that the externally funded research leads to African ownership. The majority of African countries have developed and are implementing eHealth strategies at remarkable speed, having the potential to expedite universal health coverage implementation and advance the Sustainable Development Goals.[14] Such innovation makes Sub-Saharan Africa an attractive partner for the Global North. John Nkengasong, a Cameroonian virologist and Director of the Africa Centres for Disease Control and Prevention, recently wrote that Africa needs "solidarity both across the world and within the continent … If Africa loses, the world loses".[15] Solidarity should include increased transfer of ownership from externally funded research.

In conclusion, the research potential in Africa is very promising. Africans have done extensive work in emerging infectious diseases, including HIV/AIDS, malaria, tuberculosis, Ebola and now COVID-19. As Gaius Plinius once said, "*Ex Africa semper aliquid novi*"(there is always something new from Africa). Through continued support, engagement, and collaboration with a strong emphasis on capacity building, ethical considerations, and equitable partnerships,[16] advancing research in Africa will continue to impact global health.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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