TESTING & SURVEILLANCE

DRC
SENEGAL
NIGERIA
UGANDA

TESTING AND SURVEILLANCE: CROSS-COUNTRY SYNTHESIS

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INTRODUCTION

ONE OF THE MOST CRITICAL ASPECTS OF COVID-19 RESPONSE IS SURVEILLANCE—THE SYSTEMATIC collection, analysis, and interpretation of data to identify cases, map and explain the disease's spread, and shape the development of interventions to contain the epidemic.[1]

To inform the development of sustainable testing and surveillance systems for future disease preparedness, this project aimed to identify and explain the testing and surveillance strategies adopted by four low- and lower-middle-income countries in sub-Saharan Africa: the Democratic Republic of the Congo (DRC), Nigeria, Senegal, and Uganda. The research has been led by partners at the Makerere University School of Public Health in collaboration with the University of Kinshasa, Université Cheikh Anta Diop, and the University of Ibadan and was supported and funded by the Bill & Melinda Gates Foundation Africa Team and by Gates Ventures.

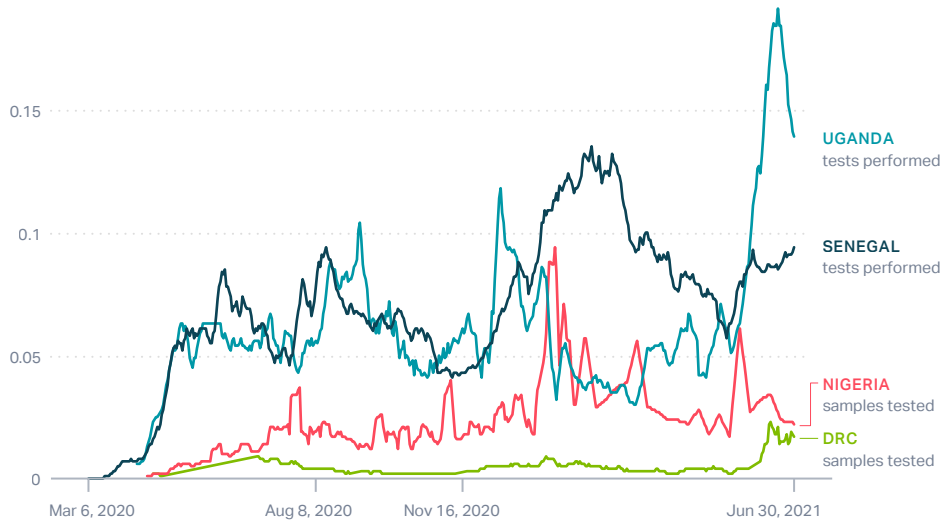
This cross-country synthesis presents high-level strategies, lessons, and challenges that emerged from the research, which readers can explore further in the detailed case studies coming soon. These findings are relevant for policy makers, funders, and nongovernmental leaders seeking to understand how governments and implementers have introduced, adapted, and scaled testing and surveillance in the context of COVID-19. They can also inform the development of sustainable testing and surveillance systems for future pandemic preparedness and response.

FIGURE 1

Daily COVID-19 tests per thousand people

Our World in Data

The figures are given as a rolling 7-day average. Comparisons across countries are affected by differences intesting policies and reporting methods.



Data source: Official data collated by Our World in Data

HOW WERE THESE COUNTRIES PERFORMING BEFORE THE PANDEMIC?

THE FOUR COUNTRIES INCLUDED IN THE STUDY WERE SELECTED BECAUSE:

- They demonstrated variation in their COVID-19 responses, both in terms of the scope and intensity of nonpharmaceutical interventions and in their outcomes.
- They had historical experience in managing epidemics of global concern, such as yellow fever, Ebola virus disease, and Marburg virus disease.
- Existing partnerships between local research institutions and government offices eased access to COVID-19 and other health systems data and enabled the translation of research findings to evidence-based policy and practice.
- The mixture of Francophone (the DRC and Senegal) and Anglophone (Nigeria and Uganda) countries enhances South-to-South cross-learning networks and communities of practice.

FIGURE 2

Pre-pandemic health context in the Democratic Republic of the Congo (DRC), Nigeria, Senegal, and Uganda

	DRC	NIGERIA	SENEGAL	UGANDA
Population	85 million	206 million	17 million	46 million
Life expectancy from birth (Japan and Singapore have longest, about 85 years)	65.1 years	64.3 years	68.5 years	66.2 years
Universal Health Care effective coverage index (0-100)	45	38	50	53
DTP3 coverage in children in 2019	57%	57%	93%	93%
In-facility births	85%	49%	84%	79%
Maternal mortality ratio (SDG 3.1 is 140/100,000 by 2030)	345 per 100,000 live births	233 per 100,000 live births	379 per 100,000 live births	133 per 100,000 live births
Doctors, nurses, midwives per capita. Benchmark is 4.45 to achieve universal health coverage	1.2 : 1000	1.6 : 1000	0.4 : 1000	1.4 : 1000
Total Health Expenditure per capita (% of GDP). Benchmark in health financing is $86/person or 5% of GDP to achieve universal health coverage	**$23** 4.9%	**$86** 3.9%	**$74** 5.2%	**$53** 7.1%
Out of pocket health expenditure (% of total health expenditure)	**$8** per capita 33%	**$61** per capita 71%	**$33** per capita 44%	**$18** per capita 33%

Data Sources: Various

WHAT HAS BEEN THE PANDEMIC EXPERIENCE IN CASE COUNTRIES?

ON FEBRUARY 27, 2020, NIGERIA WAS ONE OF THE FIRST COUNTRIES IN AFRICA TO REPORT ITS FIRST CASE of COVID-19. Just days later, on March 2, Senegal reported its first case in a traveler arriving from France. Uganda and the DRC identified their first cases later in March.

Like many other African countries, these four experienced a relatively mild first wave of the pandemic (through July 2020). A second wave of cases and deaths followed between November 2020 and February 2021, except in the DRC where the reported burden remained low. Until June 2021, Senegal had the most cases and deaths per capita among the countries profiled; that month, Uganda began suffering a massive wave of infections and deaths.

Compared with other parts of the world, COVID-19 has not been as severe in the WHO Africa Region. Although it is home to about 14 percent of the world's population, the region has accounted for only about 2 percent of *reported* cases and deaths. (It is worthy to note that reporting gaps exist in cases and deaths across the world, and they are particularly acute in sub-Saharan Africa due to limited existing infectious disease and mortality surveillance systems.)

Test positivity, or the proportion of COVID-19 tests that are positive, can be used as a marker to indicate how widespread infection is and whether sufficient testing is being done. WHO suggests that a positivity rate of less than 5 percent is one indicator that a country has the spread of COVID-19 under control. At certain points in time, especially during the second wave between November 2020 and February 2021, all four countries' test-positivity rates were greater than 10 percent, much higher than the WHO benchmark of 5 percent,[2] suggesting a substantial undetected burden of COVID-19.

In Europe and North America, most adults who were willing and able to receive a COVID-19 vaccine have already done so. Now the world is focusing its attention on disparities in vaccine access. Only about 2.7 percent of people in Africa had received at least one dose of the COVID-19 vaccine as of July 1, 2021, compared with more than 40.0 percent in North America and Europe.

Summary of reported cases and deaths due to COVID-19 through July 1, 2021

LOCATION	REPORTED CASES	REPORTED DEATHS	POPULATION	CASES PER MILLION	DEATHS PER MILLION
World	182,600,000	3,960,000	7,737,500,000	23,400	507.7
Africa	5,550,000	143,700	1,099,600,000	4,140	107.2
 *DRC*	41,400	933	87,700,000	470	10.6
 *Nigeria*	167,700	2,121	214,800,000	780	9.9
 *Senegal*	43,300	1,168	15,100,000	2,860	77.1
 *Uganda*	81,000	1,061	41,100,000	1,970	25.8

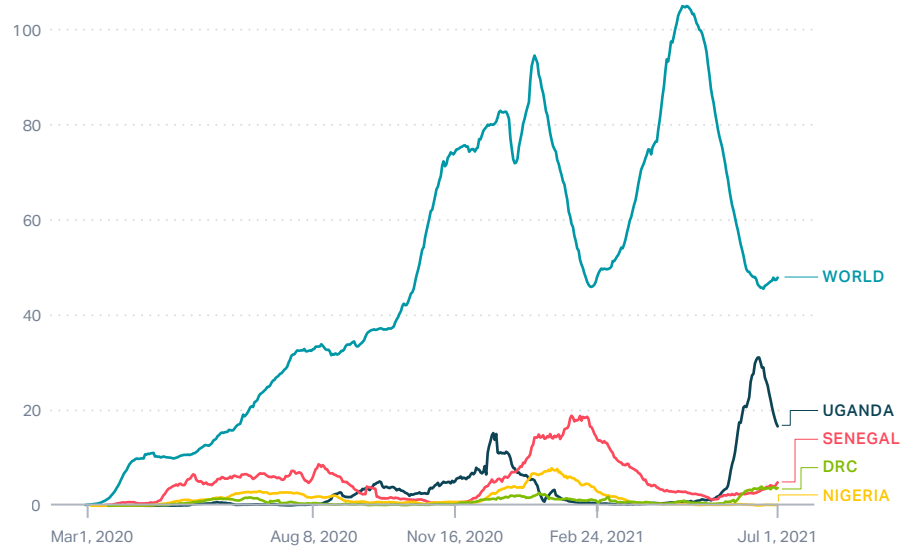
Data source: Various

FIGURE 4

Daily new confirmed COVID-19 cases per million people

Our World in Data

7-day rolling average. The number of tests divided by the number of confirmed cases. Comparisons across countries are affected by differences in testing policies and reporting methods.



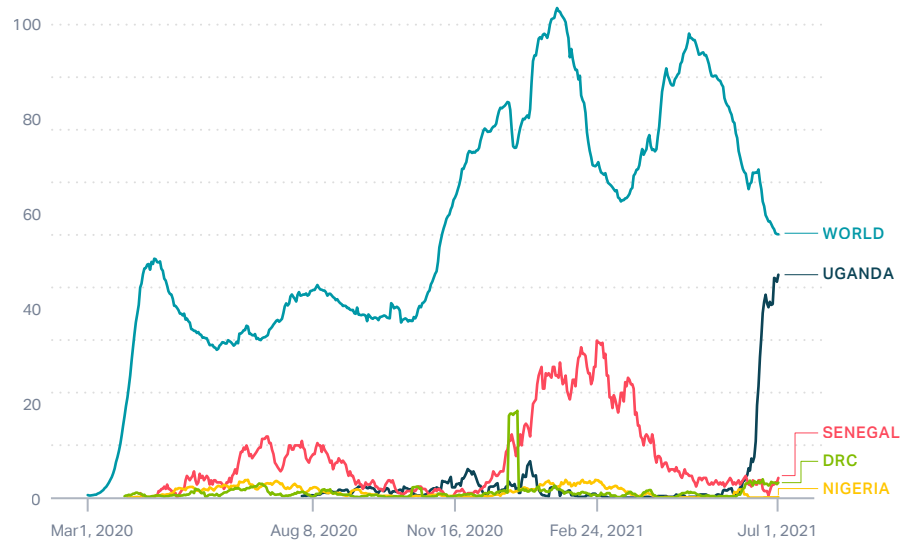
Data source: Johns Hopkins University CSSE COVID-19 Data

FIGURE 5

Daily new confirmed COVID-19 deaths per million people

Our World in Data

7-day rolling average. Due to varying protocols and challenges in the attribution of the cause of death, the number of confirmed deaths may not accurately represent the true number of deaths caused by COVID-19.



Data source: Johns Hopkins University CSSE COVID-19 Data

WHAT WERE THE KEY STRENGTHS, CHALLENGES, AND LEARNINGS BY COUNTRY?

FIGURE 6

Executive Summary of Findings by Country

COUNTRY	STRENGTHS	CHALLENGES	KEY LEARNINGS
 *DRC*	» Mass testing strategy at epicenter and early RDT adoption » Continued capacity growth and decentralization throughout the pandemic » Leveraged existing surveillance systems » Multisectoral engagement across levels of the government	» Limited access to testing sites and lim-ited supply of testing kits » Inadequate funding and resources to manage multiple out-breaks » Heavily paper-based surveillance system	» Task-shifting to community health workers for contact tracing » Develop hotline for case reporting
 *Nigeria*	» Increased testing access & TAT through decentralization » Leveraged pre-existing SORMAS software and DHIS2 » Strong central coordination to avoid duplication and proactive response before first case was recorded	» Low demand, in part from misinformation » Difficulty in collecting test results » Poor use of data to guide decision making at subnational level and some states faced coordination issues	» Leverage experience & systems from past outbreaks » Adopt tech solutions that integrate disparate information systems
 *Senegal*	» Leveraged existing PCR and GeneXpert capacity, as well as the local production of RDTs » Strong collaboration between universities and academic institutes » Existing surveillance structures and information systems repurposed	» Community stigma and misinformation influenced demand » Multiple reporting applications and mechanisms made coordination difficult » Under-detection of cases and variants	» Leverage government leadership for national communication strategies » Enhance multisectoral partnerships to boost capacity and innovation
 *Uganda*	» Leveraged existing laboratory capacity and transport network, including capacity built for other diseases (e.g. HIV) » Strong surveillance system already on alert from Ebola » Strong central coordination structures with leadership buy-in » Partnerships with academics and private sector institutions	» Inadequate testing supplies and funding » Overreliance on donor funding and foreign supplies » Long turnaround times and limited number of sample collection sites » Limited resources for district coordination	» Rapid response and proactive action » Coordination within lab networks » Initiate community surveys » Leverage available funding for innovation

Data source: Various

While the importance of surveillance efforts has long been understood and accurate tests for COVID-19 have been available since January 2020, challenges can occur at each step of the testing value chain (see Topic Page for more detail). The following strengths, challenges, and learnings emerged from the research in the DRC, Nigeria, Senegal, and Uganda. These findings can be leveraged to shape recommendations for COVID-19 response and future pandemic preparedness, as well as to strengthen health systems in general.

The findings are categorized according to the testing, surveillance, and public health action framework here.

WHAT WERE THE KEY STRENGTHS AND CHALLENGES IN TESTING AND SURVEILLANCE DURING THE FIRST 15 MONTHS OF THE COVID-19 PANDEMIC?

TESTING

Strengths

» Because of their long experience with infectious disease surveillance, the four countries could **leverage existing testing and sample-transport capacities** as they ramped up their COVID-19 response. An example is the repurposing of the GeneXpert rapid nucleic acid amplification test, typically used to diagnose tuberculosis, for COVID-19 testing.

» To improve testing turnaround time, the countries explored the **adoption of rapid diagnostic tests**, where they were available. Early in the pandemic, innovators in Senegal aimed to improve access to rapid testing by developing and piloting a low-cost rapid diagnostic test.

» The four countries were able to **adopt or develop digital platforms** to support sample tracking and result reporting. For example, Uganda was already in the process of piloting a sample-tracking system whose rollout was expedited due to COVID-19.

» All four countries leveraged **private partnerships** for testing supply procurement. Additionally, coordination with private labs was essential to scaling test capacity.

Challenges

» Test positivity rates were often high during the pandemic, indicating that there was **insufficient testing** and that the testing strategies that were in effect left many cases undetected. This was validated by serological surveys in Nigeria, Senegal, and Uganda in 2020, which found much higher prevalence of past infection than previously reported.

» The four countries showed **major gaps in testing access and affordability**, with some facilities unable to offer tests or pricing tests beyond many citizens' means.

» The **supply of test kits, personal protective equipment (PPE), and sample-collection materials was limited and inconsistent** across the countries, and the increased demand from the pandemic strained global and local supply chains. Even when funding was available, competing in the global market was a challenge. For example, the lack of reverse transcription polymerase chain reaction testing supplies pushed the DRC to rely on unapproved rapid diagnostic tests.

» The **quality of tests and laboratories varied** from site to site, within and between countries. For example, Uganda reported different results from different labs for the same sample. In the DRC, 14 of the 26 provinces did not have the required laboratory capacity, meaning that samples had to be shipped to Kinshasa. At the time of study, rapid diagnostic tests were still not accurate enough for use beyond screening and triage of symptomatic cases.

» Misinformation on testing and COVID-19 in general contributed to **stigma** in Nigeria and Senegal which may have influenced the number of people seeking tests. Coupled with a lack of access to testing facilities for many people (in rural areas, for example), all four countries experienced **limited demand for testing**.

» Most countries faced challenges in getting turnaround time for results within the recommended 24- to 48-hour window. **Slow turnaround times** (e.g. two to three weeks in the DRC) limited the utility of the tests they were able to perform.

SURVEILLANCE

Strengths

» In part because of their experience with surveillance for other endemic diseases, each country **leveraged an existing system of national labs and expertise** as they ramped up their COVID-19 response. For example, Uganda's community surveillance officers had experience with Ebola outbreaks. In Nigeria, the Surveillance, Outbreak Response Management and Analysis System (SORMAS) tool , originally designed for Ebola, was repurposed for COVID-19.

» Each country **used preexisting databases and electronic systems** to speed up reporting, enable the use of dashboards, and integrate data between health information systems. For example, Senegal used the District Health Information Software 2 (DHIS2) with support from the University of Oslo to capture and visualize COVID-19 data and the DRC used the Early Warning, Alert and Response System.

» The countries **supplemented weak diagnostic testing systems with other surveillance methods** to gain a more robust understanding of the true COVID-19 burden. For example, serological surveys were conducted in Nigeria, Senegal, and Uganda to better understand the prevalence of COVID-19.

Challenges

» Even with additional surveillance capacity, **cases have been underdetected and underreported** across the countries throughout the COVID-19 pandemic. **Postmortem surveillance** is a potential method of gauging case numbers, but at the time of study, a dearth of resources has limited the effective use of postmortem surveillance in the four countries studied.

» Although this is improving, at the time of study, the countries had **limited capacity for routine genotyping and genetic sequencing,** making it difficult for officials to track the emergence and spread of new variants.

» The countries **showed limited decentralized surveillance capacity** at district and state levels, delaying decision making and creating gaps in data analysis and action planning.

COORDINATION AND STRATEGY

Strengths

» The countries **leveraged preexisting structures at the national level** that included representatives across sectors and stakeholders, such as academics, World Health Organization representatives, and implementing nongovernmental organizations.

» To increase testing capacity and speed up testing supply procurement, the countries **built robust partnerships with national, regional, and local stakeholders**. For example, academic labs were leveraged to increase testing capacity in Uganda and the Africa Centres for Disease Control and Prevention and the African Union provided support for testing procurement.

» The countries **initiated early response actions** before their first COVID-19 case was identified.

» The countries put in place **dynamic, data-responsive strategies** and consistently updated policy guidelines for public health action accordingly. For example, the four countries revised testing strategies when researchers discovered that cases were no longer contagious after ten days.

Challenges

» Health systems struggled to organize and coordinate **complex chains of communication** within and between parallel and overlapping task forces and other administrative bodies (such as Uganda's testing and point-of-entry surveillance task forces).

- Travel testing requirements, including the timeframe of negative test results required, were misaligned from one country to another, causing issues for those crossing the border (such as between Kenya and Uganda).
- The private sector has played an important role in contributing to testing and surveillance capacity in all countries, but early on there was **limited regulation of private-sector pricing and quality** resulting in access and reliability issues.

WHAT ARE THE RECOMMENDATIONS FOR TESTING AND SURVEILLANCE?

MOVING FORWARD—TO LATER PHASES OF THE COVID-19 PANDEMIC, FUTURE PANDEMICS, AND THE future of health systems in general—countries and regional bodies can take several actions to better prepare for the next major disease outbreak. In particular, they can continue to invest in data systems and set up regional mechanisms for supply procurement, disease surveillance, and the validation of test results.

FOR COVID-19

- **Refine and address gaps in coordination, especially at the subnational level:** Addressing subnational coordination gaps in resource mobilization, policy development, and guideline development will minimize duplication of efforts, improve efficiency, clarify public risk-communication activities, and ensure the timely adoption of changes in strategies or guidelines.
- **Adopt testing strategies that reflect the true burden of COVID-19:** Focus on risk-based testing that targets travelers, symptomatic people, high-risk contacts, health workers, and vulnerable people. Additional sources of data—such as mortality surveillance, community surveys, and testing of all contacts of confirmed cases—could help identify asymptomatic cases, interrupt transmission, give a better sense of the true burden of disease, and guide future planning (including vaccine preparedness).
- **Deploy mobile labs in hard-to-reach areas and at points of entry:** These labs improve access to testing and turnaround time. They could become an integral part of the health care system and could be deployed to localized outbreaks, such as in prisons or schools.
- **Expand demand for and use of testing services by addressing stigma and misinformation:** Countries that reported underutilization of testing services even where they existed, such as Nigeria and Senegal, attributed this to stigma and misinformation. In general, where there was concentrated community engagement and clear, regular, targeted risk communication, demand for COVID-19 testing was not an issue.
- **Use effective alert-management systems to identify community outbreaks:** Effective alert-management systems, such as toll-free community call centers, support case finding and contact tracing, especially during periods of low community transmission.

FOR FUTURE PANDEMICS

- **Establish testing and surveillance structures that are familiar and quick to stand up:** Early planning and preparedness strategies (for example, intensive testing and surveillance with contact tracing and quarantine at points of entry) contributed to the early containment of COVID-19 in these countries. Maintaining preparedness and acting fast across all levels of operation may slow or even stop future pandemics.

- **Invest in surge capacity:** At the onset of the pandemic, all countries had some existing surge capacity—lab testing systems that were eventually overwhelmed, trained epidemiologists, and some dedicated (but limited) funds for outbreak response management and supplies such as PPE. Though government contributions played an important role, the four case countries were reliant on funding for COVID-19 testing reagents and supplies from donors. Countries need to further invest in reserve financial and human resources as well as infection prevention and control materials for detection and response. Investment in polymerase chain reaction testing capacity may facilitate multiple-disease pathogen testing, or multiplexing, in the future.
- **Strengthen surveillance capacity at the subnational, decentralized level:** The countries' preexisting surveillance systems were built to respond to localized epidemics via a central-level response team that would deploy rapid response teams to the site of an outbreak. Subnational structures had never been activated into full response on their own, and countries were unprepared for simultaneous outbreak response in more than one place. Funding for subnational epidemic-response priorities—adequately trained surveillance officers, human resources and equipment for data analysis and use, contact tracing and testing, and regional surveillance structures such as regional emergency operation centers in Senegal, provincial emergency operation centers in the DRC, and state emergency operation centers in Nigeria—would be a step toward building decentralized surveillance capacities across districts and regions.
- **Engage global institutions in procuring and ensuring equal access to supplies:** Even where funds were available for procurement of testing supplies and PPE, the countries had limited access to testing reagents and supplies, since manufacturers gave priority to higher-income countries. In many cases, top leadership had to intervene: Uganda's leadership contacted suppliers of polymerase chain reaction equipment directly to facilitate procurement for mobile labs at points of entry. Initiatives such as the Partnership to Accelerate COVID-19 Testing and organizations such as the Africa Centres for Disease Control and Prevention and the Global Fund to Fight AIDS, Tuberculosis and Malaria were instrumental in improving access to supplies on the global market.
- **Establish mechanisms for clear communication and leadership engagement:** All countries had political engagement at the highest level. Regular media messages reflected this top-down commitment to raising awareness about the COVID-19 pandemic via risk communication.

FOR THE HEALTH SYSTEM

- **Ensure data access and availability for public health decision making:** In all countries, regularly reported data enabled policy makers to make informed decisions. The establishment of databases and dashboards accessible to key stakeholders that linked surveillance with testing improved communication and efficiency but was typically limited to the national level. Although countries made efforts to decentralize these data-sharing dashboards, data flow to the regional and local levels was inconsistent and could be better streamlined in the future.
- **Invest in health worker human resources to build capacity for public health actions like contact tracing:** Countries did not have enough pandemic responders—such as contact tracers, laboratory technicians, and sample collectors—to meet demand. They can and did rapidly train, repurpose, and deploy community health workers and health facility-based health workers, but these structures require strengthening for preparedness and rapid response, as well as adequate PPE and other supplies.
- **Strengthen partnerships with the private sector and clarify its role in pandemic response:** Countries need to optimize public-private partnerships in several areas, including the provision of health services and the manufacture of health products and PPE. It is particularly important to build local capacity for manufacturing diagnostics and other supplies.

» **Improve supply chain management, including use of pooled procurement at a regional level:** Supply chain challenges affected the availability of testing supplies and PPE. Due to the rapid spread of the novel coronavirus and the huge volume of supplies needed for infection prevention and control around the globe, the need for strong supply chain mechanisms is more urgent than ever. Pooled procurement of commodities worked well for the Global Fund and could be consolidated at a regional level to support future pandemics.

CONCLUSION

FOLLOWING THE FIRST CASES OF COVID-19 ON THE AFRICAN CONTINENT IN FEBRUARY AND MARCH 2022, the DRC, Nigeria, Senegal, and Uganda demonstrated prompt public health response; instituted national policies, strategies, and plans aligned with World Health Organization guidance; and modified these strategies as local epidemics evolved.

In the initial phases of the pandemic, all four countries were able to leverage preexisting capacities in testing and surveillance. Resource constraints continued to be a challenge for the implementation of these strategies. Moving forward, recommended approaches such as those described above can help stem the further spread of COVID-19 while enhancing readiness for future disease outbreaks.

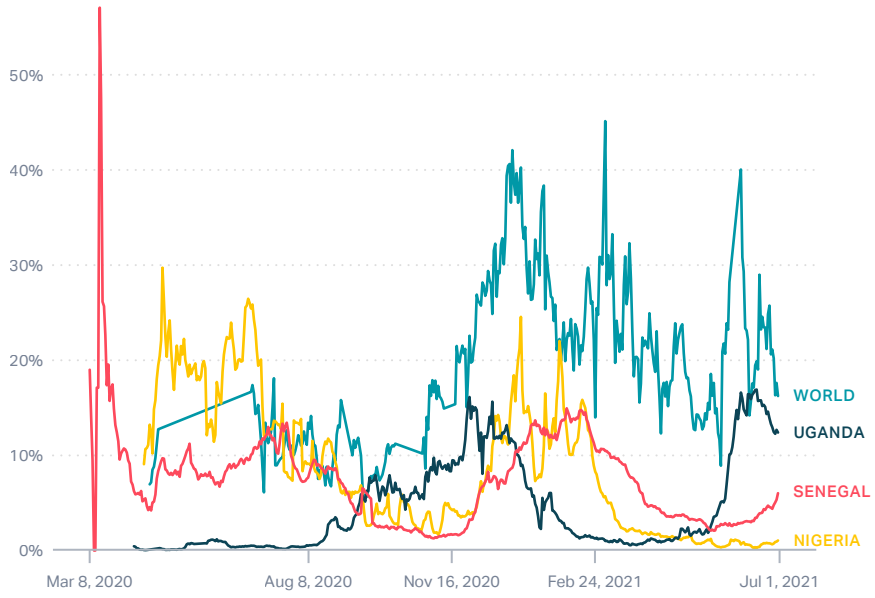
Note: At the time of publication (August 2021), the African continent was in the midst of the third and deadliest wave of COVID-19. How these recommendations have been implemented, adapted, challenged, or scaled to quell the spread of the Delta variant in the DRC, Nigeria, Senegal, and Uganda is still being understood.

FIGURE 7

The share of COVID-19 tests that are positive

Our World in Data

7-day rolling average. Comparisons across countries are affected by differences in testing policies and reporting methods.



Data source: Official data collated by Our World in Data

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