DISEASE SURVEILLANCE, EMERGENCY PREPAREDNESS, AND OUTBREAK RESPONSE IN EASTERN AND SOUTHERN AFRICA:

A Situational Assessment and Five-Year Action Plan for the Africa CDC Strengthening Regional Public Health Institutions and Capacity for Surveillance and Response Program

18 March 2021

KWPF KOREA-WORLD BANK PARTNERSHIP FACILITY
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African Union
AFRICA CDC Centres for Disease Control and Prevention
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Acknowledgements

This publication was commissioned by the World Bank with financing from the Korea-World Bank Partnership Facility (KWPF) - Grant Number: TF0A8447. The report was drafted by a consortium of firms, including the African Society for Laboratory Medicine (ASLM) and IQVIA, under the direction of the World Bank. Patricia Geli (Senior Economist, Task Team Leader) led the preparation process with support from Musonda Rosemary Sunkutu (Senior Public Health Nutrition Specialist), Roman Tesfaye (Senior Operations Officer), John Bosco Makumba (Senior Operations Officer). The key principal investigators from the African Society for Laboratory Medicine (ASLM) include Pascale Ondoa (Director of Science and New Initiatives,), Marguerite Massinga (Senior Laboratory Advisor, African Society of Laboratory Medicine) and from IQVIA include Deepak Batra (Principal – Public Health, Africa and Middle East), Hemant Chaudhry (Head, Public Health Research), Dr. Tura Boru (Technical Expert), Dr. Debarghya Dasgupta (Consultant), Aneesha Ahluwalia (Consultant), Pallavi Dani (Consultant). Sean Lothrop (Consultant) edited the report.

The teams would like to thank World Bank Practice Manager Ernest Massiah for general guidance; Son Nam Nguyen, Miriam Schneidman, Inaam Ul Haq for providing comments and suggestions; Abeyah A. Al-Omair for overall support; Eleni Albejo, Kidist Kebebe Demissie, Shafali Rajora, and Wisdom E. Mulenga for providing administrative support; Paul Jacob Robyn, Wubedel Dereje Alemu and Zelalem Yilma Debebe for mission support; and to Sulzhan Bali (Health Specialist, World Bank) for support through the concept stage. Anju Sharma (Senior Program Officer) and Daksha Shakya (Operations Officer) at the KWPF Secretariat, as well as members of the Korean government, were instrumental in sustaining the exchange of information between the teams and other stakeholders despite the extremely challenging circumstances created by the pandemic.

The Africa CDC provided overall support during the preparation of the report and facilitated the knowledge-collection process. The report benefited from the perspectives, advice, and expertise offered by Dr. John N. Nkengasong (Director, Africa CDC), Dr. Ahmed Ouma (Deputy Director, Africa CDC), Dr. Mohammed Abdulaziz (Head of Division, Disease Control and Prevention, Africa CDC). The teams would like to express their sincere gratitude to Theresa Madubuko (Programme Management Officer, Africa CDC), Mahlet Kifle Habtemariam (Principal Program Officer, Africa CDC), Dr. Raji Tajudeen (Head, Division of Public Health Institutes and Research, Africa CDC), Thaddee Niyoyitungira (Africa CDC), Dr. Nafiisah Chotun (Public Health Volunteer, Africa CDC), Laura Ambe (Administrative Officer, Africa CDC), Dr. Achamyelesh Kifle Debela (Coordinator, Eastern Africa RCC), Addis Mhiraf (Communication Officer, Eastern Africa RCC), Hiwot Moges (Public Health Volunteer, Eastern Africa RCC), Dr. Rick Lul Pout (Coordinator, Southern Africa RCC), Dr. Talkmore Maruti (Biosafety and Biosecurity, Southern Africa RCC) for their endless patience and valuable insights into the situational analysis. The Ethiopia Public Health Institute and the Zambia National Public Health Institute were key institutional partners, and vital support was provided by Dr. Ebba Abate (Director General, EPHI), Dr. Victor Mukonka (Director, ZNPHI), Dr. Kunda Musonda (Head of Laboratory Systems and Network, ZNPHI), Dr. Adisu Kebede (Focal/Acting Director, Laboratory Capacity Building, EPHI), Alemnesh H. Mirkuzie (EPHI), Dr. Gonfa Ayana (EPHI). Finally, valuable feedback was provided by representatives of international agencies, institutions, and other stakeholders, including the EMLA, the European CDC, WHO Country Offices, AFENET, and the US CDC Country Missions to Ethiopia and Zambia.

Contents

Abbreviations and Acronyms

Abbreviations	Expanded Form
AFENET	African Field Epidemiology Network
AFI	Acute Febrile Illness
AFP	Acute Febrile Paralysis
Africa CDC	Africa Centres for Disease Control and Prevention
AFRICHOL	African Cholera Surveillance Network
AFTCOR	Africa Taskforce for Corona Virus
AMR	Antimicrobial Resistance
AMU	Antimicrobial Use
ANISE	African Network for Influenza Surveillance and Epidemiology
ART	Antiretroviral Therapy
ASA	Advisory Services and Analytics
ASLM	African Society for Laboratory Medicine
AST	Antimicrobial Susceptibility Testing
AU	African Union
AUC	African Union Commission
BSL	Biosafety Level
CBS	Case-Based Surveillance
CDDEP	Center for Disease Dynamics, Economics, and Policy
CLSI	Clinical and Laboratory Standards Institute
CORDS	Connecting Organizations for Regional Disease Surveillance
COVID-19	Coronavirus Disease
DHIS	District Health Information Software
EAC	East African Community
EAIDSNET	East Africa Integrated Disease Surveillance Network
EAPHLN	East Africa Public Health Laboratory Networking Project
EBS	Event Based Surveillance
ECHO	Extension for Community Healthcare Outcomes
ECSA-HC	East, Central and Southern Africa Health Community
EID	Emerging Infectious Disease
EPHI	Ethiopia Public Health Institute
EQA	External Quality Assessment
EUCAST	European Committee on Antimicrobial Susceptibility Testing
EVD	Ebola Virus Disease
EWARN	Early Warning, Alert and Response Network
FAO	Food and Agriculture Organization
FELTP	Field Epidemiology and Laboratory Training Programme
FETP	Field Epidemiology Training Programme
GARP	Global Antibiotic Resistance Partnership
GISRS	Global Influenza Surveillance and Response System
GLASS	Global Antimicrobial Resistance Surveillance System
GMRLN	Global Measles and Rubella Laboratory Network
GPLN	Global Polio Laboratory Network
GRLN	Global Rotavirus Laboratory Network

GYFN	Global Yellow Fever Network
HANMAT	Horn of Africa Network for Monitoring Antimalarial Treatment
HIV	Human Immunodeficiency Viruses
IBAR	Inter-African Bureau for Animal Resources
IBS	Indicator Based Surveillance
IDSR	Integrated Disease Surveillance and Response
IEC	Information Education and Communication
IHR	International Health Regulations
JEE	Joint External Evaluation
KWPF	Korea-World Bank Partnership Facility
LabCoP	Laboratory Systems Strengthening Community of Practice
LabMaP	Laboratory Mapping Program
LIMS	Laboratory Information Management System
MERS	Middle East Respiratory Syndrome
MTaPS	Medicines, Technologies, and Pharmaceuticals Services
NAMRS	National AMR Surveillance
NAP	National Action Plan
NDMC	National Data Management Center
netSPEAR	Network for Surveillance of Pneumococcal Disease in the East Africa Region
NHPI	National Public Health Institute
NLSP	National Laboratory Strategic Plan
NPHL	National Public Health Laboratory
NRL	National Reference Laboratory
PACT	Partnerships for Accelerated COVID-19 Testing
PANVAC	Pan-African Veterinary Vaccine Centre
PCR	Polymerase Chain Reaction
PHEM	Public Health Emergency Management
PHEOC	Public Health Emergency Operations Center
PPP	Public-Private Partnership
RCC	Regional Coordinating Center
RISNLET	Regional Integrated Surveillance and Laboratory Network
SACIDS	Southern African Center for Infectious Disease Surveillance
SANAS	South African National Accreditation Service
SARS	Severe Acute Respiratory Syndrome
SLIPTA	Stepwise Laboratory Improvement Process Towards Accreditation
SLMTA	Strengthening Laboratory Management Toward Accreditation
SORMAS	Surveillance Outbreak Response Management & Analysis System
SPAR	State Parties Annual Report
TB	Tuberculosis
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNECA	United Nations Economic Commissions for Africa
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization
ZNPHI	Zambia National Public Health Institute

Executive Summary

The Role of the Africa CDC's Regional Integrated Surveillance and Laboratory Network (RISLNET) in Mitigating the Transnational Threat of Infectious Disease

The mounting human and economic toll of COVID-19 has brought the challenge of regional disease surveillance and control to the forefront of the policy discourse around global public health. This report was commissioned in 2019, several months before the first cases of COVID-19 were identified. The rapid global spread of the virus over the following year prompted the team to adapt its analytical approach to reflect the evolving reality on the ground. The report's findings identify the medium- and long-term investments necessary to build a comprehensive framework for monitoring, containing, and addressing infectious disease outbreaks. African countries have battled many outbreaks in the past, including several devastating Ebola virus disease epidemics and the recurrent ravages of cholera, yellow fever, and meningitis, among others. These outbreaks compound the persistent burden of endemic diseases such as malaria, typhoid, and HIV. However, the damage inflicted by the COVID-19 pandemic and ensuing economic crisis exceeds all modern disease outbreaks in terms of the scope, extent, and persistence of its effects, which could undo decades of gains in public health and poverty reduction in countries across the region.

The African continent is more integrated than ever before, with free trade across countries and open borders allowing the large-scale movement of people and goods; but while greater connectivity creates new economic opportunities, it also heightens the risk posed by communicable diseases. The worldwide spread of COVID-19 starkly illustrates how the undetected transmission of pathogens across borders can transform a local disease outbreak into a regional health emergency or even global crisis. The Africa Centres for Disease Control and Prevention (Africa CDC), which is the apex body for regional cooperation on disease control and prevention in Africa, has played a crucial role during the ongoing pandemic. The Africa CDC established the Africa Taskforce for Corona Virus (AFTCOR) in cooperation with the African Union Commission and the WHO. Under the Africa Joint Continental Strategy for COVID-19, the AFTCOR and the Africa CDC's Incident Management System moved swiftly to implement a continent-wide approach to combatting the virus, working in close coordination with the Africa CDC's Regional Collaborating Centers (RCCs) and the national public health institutions (NHPIs) of African Union (AU) member states. The AFTCOR and the RCCs provided technical guidance and policy recommendations, supported the deployment of on-site technical assistance, and coordinated with stakeholders to align strategies and exchange information on best practices.

The Regional Integrated Surveillance and Laboratory Network (RISLNET) was envisaged as a network of networks that would coordinate and connect the continent's analytical, surveillance, and emergency-response assets. RISLNET is designed to leverage economies of scale and institutional complementarities to strengthen disease prevention, rapid detection, and response capacity across African sub-regions. Under the One Health approach, RISLNET aims to facilitate close collaboration among national public health institutions (NPHIs), academic institutions, private and public laboratories, centers of excellence, non-governmental and civil society organizations, and veterinary services to address regional challenges such as antimicrobial resistance (AMR), pandemic preparedness, and rapid disease detection and response. One RISLNET is planned for each RCC region: Central Africa, Eastern Africa, Northern Africa, Southern Africa, and Western Africa. The Central Africa RISLNET is currently active, and the others are in the process of being established.

The World Bank, with financial support from the Korea-World Bank Group Partnership Facility, is providing Advisory Services and Analytics (ASA) to support the operationalization of the Africa CDC through knowledge transfer, technical assistance, and institutional capacity-building. The knowledge products generated through World Bank engagement will inform the activities of the Africa CDC, AU member states, and development partners as they work to enhance infectious disease control systems across the continent, and they will provide the analytical underpinnings for the World Bank's Africa CDC Regional Investment Financing Program. This report presents a situational analysis of laboratories and disease-surveillance networks, AMR surveillance systems, human resources and capacity-building needs, emergency-response capabilities, and the role of the private sector in disease surveillance, prevention, and control in the Eastern Africa and Southern Africa RCCs. The Eastern Africa RCC is headquartered in Kenya, and member states include Ethiopia, Somalia, South Sudan, and Uganda. The Southern Africa RCC is headquartered in Zambia, and member states include Malawi, Mozambique, South Africa, and Zimbabwe. The member states described in this report are samples, and both RCCs encompass additional countries that are not included in the analysis.

Findings

Existing laboratory networks have strengthened clinical and analytical capabilities at the country level while fostering cross-border collaboration, providing compelling proof of concept for RISLNET. Through the East Africa Public Health Laboratory Networking Project (EAPHLN), health authorities in Kenya, Uganda, Tanzania, Rwanda, and Burundi have developed a network of 40 well-equipped public health laboratories with trained personnel and robust diagnostic and surveillance capacity. The EAPHLN has significantly increased cross-border outbreak preparedness and response while enhancing the impact of national-level facilities, and it has played a crucial role in combatting the regional spread of COVID-19. In addition, about 187 laboratories connected through the WHO's Global Influenza Surveillance and Response System (GISRS) were involved in COVID-19 testing during the initial phases of the pandemic. The African Network for Influenza Surveillance and Epidemiology (ANISE) brought together more than 30 African countries through a unified surveillance and testing platform. However, the existing laboratory networks do not cover all diseases or all countries, leaving ample scope for RISLNET to incorporate these networks into a comprehensive framework for disease surveillance and response.

RCC member states vary widely in terms of strategic planning, laboratory capabilities, human resources, and surveillance and reporting mechanisms. States with limited institutional capacity, including Malawi, Mozambique, and Somalia, have not developed laboratory-specific strategic plans, while higher-capacity states such as Uganda and Zambia lack well-defined procedures to monitor the implementation of their plans. Across countries, laboratory personnel often lack the knowledge and skills necessary to adhere to biosafety guidelines, and such guidelines tend to be either unimplemented or legally unenforceable. Ethiopia, Kenya, Uganda, South Africa, and Zimbabwe have relatively strong specimen-referral mechanisms that include satellite-based vehicle tracking, hub-and-spoke models, and public-private partnerships. South Africa is a regional leader in quality control, with a wide range of tests covered under its external quality assessment (EQA) programs, but EQA coverage in other countries is limited. Most states have laboratory testing capabilities for endemic diseases such as cholera, diarrhea, measles, malaria, and HIV, but only South Africa and Zambia have the capabilities to perform all 12 laboratory confirmation tests for the priority diseases defined by WHO guidelines. The RCC member states still lack a comprehensive platform for integrating epidemiological data with laboratory data.

All countries are working to develop their capacity to address AMR, but progress has been uneven, and there are no standardized protocols for antimicrobial susceptibility testing (AST). Kenya and Uganda have begun developing the laboratory capacity to monitor and control AMR, but AST capabilities in Somalia, South Sudan, and Mozambique remain inadequate. Somalia and South Sudan have yet to develop national strategies for AMR surveillance, and countries that have AMR strategies face implementation challenges. Financing for AMR programming is limited, and the establishment of multi-sectoral governance and coordinating agencies is incomplete. Very few laboratories that have AST capabilities have enrolled in the WHO's Global AMR Surveillance System (GLASS), and only a minority of the enrolled laboratories are reporting data to GLASS.

Ethiopia, Kenya, Uganda, South Africa, and Zambia have well-functioning indicator-based surveillance (IBS) systems, and event-based surveillance (EBS) systems are operational in South Africa and Uganda, but EBS implementation is insufficient in all other countries. Infrastructure gaps, limited internet connectivity, and absence of clear policies and legislation weaken reporting, and despite the availability of electronic data platforms, empirical analysis is limited at the national and sub-national levels. Most states rely on paper-based reporting. The use of Laboratory Information Management System (LIMS) software is limited, and the renewal of licenses is donor-dependent.

Comprehensive multi-sectoral and multi-hazard risk assessments have yet to be conducted. The fight against COVID-19 has revealed significant gaps in national and regional defenses against the spread of infection. Supply chain management is a major weakness in most countries, risk assessments are inconsistent, and emergency-response capabilities vary substantially. However, regional collaboration is improving, and Ethiopia has participated in several emergency-management situations in neighboring Kenya and Somalia.

Recommendations

1. ***Operationalize RISLNET in the Eastern and Southern Africa regions within the next 12 months.*** The Africa CDC and the RCCs can facilitate RISLNET operationalization by: (i) conducting outreach to RCC member states and highlighting the benefits offered by RISLNET; (ii) addressing RCC funding and staffing issues; and (iii) establishing a governance framework for RISLNET in collaboration with RCC member states. The experience of implementing RISLNET Central Africa yields important lessons for the Eastern and Southern RCCs. The Central Africa RISLNET was operationalized through a collaborative process that secured buy-in from member states, and its implementation was guided by a well-defined organizational structure with clear financial and operational guidelines. A laboratory-mapping exercise raised awareness of the benefits of participating in RISLNET among regional laboratories, further consolidating stakeholder support.

2. ***Strengthen regional and continental laboratory networks by analyzing laboratory capabilities and creating standardized guidelines for building staff capacity in diagnostics and strategic planning.*** Countries that have not yet prepared comprehensive laboratory maps could leverage the mapping exercises conducted in Ethiopia and Zambia with support from the respective NPHIs. Utilizing the LABNET scorecard would yield a standardized analysis of laboratory capacity, and the laboratory maps can be used to provide targeted capacity-building support to expand diagnostic testing. AST protocols should be harmonized across RCC member states, and RISLNET and the respective NPHIs must ensure that each member state develops appropriate biosafety and biosecurity guidelines. The Africa CDC should help countries replicate the success of regional leaders in quality management, and the Africa CDC and RISLNET should jointly coordinate with external quality assessment (EQA) centers to expand the range of tests covered by EQA. The Africa CDC should lead the expansion of EQA programming at the continental level.

3. ***Build institutional and staff capacity in the areas of testing, quality control, biosafety, specimen referral, and information management.*** The African Society for Laboratory Medicine (ASLM) offers training sessions on disease diagnostics and AMR microbiology through its Extension for Community Healthcare Outcomes (ECHO) platform, and RISLNET should support ECHO-based training activities. Using South Africa as a model, RISLNET and the NPHIs should build the quality-control capabilities of regional laboratories. In the area of biosafety, states with limited institutional capacity can learn from the experience of Uganda and South Africa, which have well-defined biosafety systems, national reference laboratories (NRLs), and standard operating procedures for specimen-tracking. RISLNET and the NPHIs must ensure that each member state develops biosafety and biosecurity guidelines for specimen referrals and transportation, and the strategies used by Ethiopia, Uganda, South Africa, and Zimbabwe should be expanded to other countries. South Africa has established a standardized LIMS across all laboratories, and its experience should inform the implementation of LIMS by NPHIs with support from RISLNET. Priority activities include: (i) developing memorandums of understanding (MoUs) between countries and protocols to facilitate sample referral; (ii) aligning RISLNET with ongoing Africa CDC initiatives around biosafety; (iii) leveraging international grants to strengthen quality management; and (iv) standardizing NPHI training packages and delivering cascading trainings to national staff.

4. ***Enhance national, regional, and continental disease-surveillance networks by enabling the adoption of a unified electronic data platform while building data-reporting and analytical capacity.*** Through regional collaboration, RISLNET can expand existing surveillance networks to include additional diseases and countries. Mozambique, Zimbabwe, and Malawi must strengthen adherence to the International Disease Surveillance and Response (IDSR) Guidelines to improve data reporting and site coverage, and the NPHIs should lead this process in their respective countries. The second iteration of the District Health Information System (DHIS2) has been implemented in Kenya, Uganda, Zambia, Mozambique, and Zimbabwe, but in states with limited institutional capacity, NPHIs should promote the uptake of the DHIS2. RISLNET and the NPHIs should facilitate capacity-building sessions on advanced data analysis, assist in developing AMR surveillance action plans in Somalia and South Sudan, and sensitize key stakeholders to the importance of timely and complete reporting. The implementation of event- and indicator-based surveillance systems must be harmonized across RCC member states, and paper-based reporting must be comprehensively replaced by LIMS. Establishing uniform surveillance mechanisms and digital reporting systems are prerequisites for creating an interconnected platform to enable RCC member states to share data on infectious disease risks, outbreaks, and countermeasures.

5. ***Develop multi-sectoral, multi-hazard preparedness and response plans, and conduct regular simulation exercises at all levels.*** The Public Health Emergency Operations Centers (PHEOCs) in each member state require multi-hazard, multi-sectoral preparedness and response plans to ensure their effective functioning. However, few countries have

developed such plans, and Malawi, Somalia, and South Sudan lack well-defined PHEOC guidelines. Using Uganda's preparedness and response plan and Ethiopia's PHEOC guidelines as models, the Africa CDC should lead the development of plans and guidelines across both regions. Enabling joint risk assessments and ensuring effective coordination and communication between national and subnational PHEOCs requires establishing standard communication procedures at the subnational level, including clearly defined triggers for specific actions. RISLNET and the NPHIs should assist in establishing dedicated hotlines for reporting emergencies, and conduct exercises, drills, and risk assessments at the subnational level to test awareness and build capacity among PHEOC staff. Meanwhile, the Africa CDC can leverage WHO resources to create a standardized training package for NPHIs and hold regional and continental training sessions.

Context

The COVID-19 pandemic has inflicted a staggering toll in human lives and wrought unprecedented economic damage, abruptly refocusing the world's attention on the extreme risks posed by infectious disease. For decades, as death rates from communicable diseases fell across developed and emerging economies, health authorities in much of the world shifted focus to the chronic conditions and noncommunicable diseases associated with economic prosperity. The relative success of the global response to the deadly 2009 H1N1 influenza outbreak further consolidated the conventional wisdom that infectious disease was a dwindling residual risk to which the world's advanced economies were already largely immune. Then, in late 2019, the emergence of a novel coronavirus strain in Wuhan, China tragically revealed the extent of the threat posed by the undetected transmission of pathogens across borders and the shockingly limited protections afforded by the wealth, administrative sophistication, or biomedical resources of individual nations. In this context, the establishment of regional disease-surveillance and response networks has taken on a new urgency, and the global recognition that a pandemic risk anywhere is a threat everywhere has elevated the profile of institutions dedicated to countering this threat at the continental level.

Even before the emergence of COVID-19, infectious diseases were the leading cause of death in Africa, and the continent has one of the highest rates of communicable, neonatal, maternal, and nutritional diseases in the world. In April 2020, the World Health Organization (WHO) reported 98 ongoing outbreaks and 11 humanitarian crises across different regions of Africa, with major reported outbreaks including COVID-19, measles, cholera, chikungunya, dengue, Ebola virus disease (EVD), and monkey pox. Over the last decade, the prevalence of communicable diseases has continued to decline across much of the world, but in Africa the probability of a pandemic has risen from 3-10 percent to 26-65 percent.[1] As Africa becomes more densely integrated, the large-scale movement of people and goods across borders is intensifying these risks, and local disease outbreaks threaten to evolve into regional epidemics or global pandemics. Meanwhile, African countries face additional dangers due to: (i) the increasing threat from zoonotic diseases as the proximity of humans and animals intensifies, (ii) the influence of climate change on disease transmission, especially for vector- and waterborne diseases, and (iii) antimicrobial resistance (AMR) for diseases such as cholera, dysentery, typhoid, meningitis, gonorrhea, tuberculosis (TB), malaria, and HIV.[1] The devastating 2013-16 West African EVD outbreak provided a tragic demonstration of the severity of these risks and affirmed the need for a continental public health institution to build the capacity of all African Union (AU) member states to effectively prevent, detect, assess, and respond to disease outbreaks.

Faced with the urgent need to combat present and future epidemics, the African Union (AU) member states accelerated the establishment of the Africa Centres for Disease Control and Prevention (Africa CDC). The Africa CDC was the first public health agency mandated to harmonize infectious disease surveillance and control among all AU member states. The Africa CDC has greatly strengthened the continental response to the ongoing pandemic, but COVID-19 is still expected to have far-reaching consequences across the African healthcare landscape. As of July 14, 2020, the continent had reported 612,586 confirmed cases of COVID-19 and 13,519 deaths, representing just 2.2 percent of global COVID-19 mortality.[2] According to United Nations Economic Commissions for Africa (UNECA), the economic shock of the pandemic reduced the continent's average GDP growth rate from a pre-crisis projection of 3.2 percent to just 1.8 percent.[3] Without a robust and harmonized response, the COVID-19 pandemic could reverse a decade or more of progress in improving public health and reducing poverty.

In addition to its economic impact, the COVID-19 pandemic threatens to exacerbate other serious health challenges. By consuming scarce medical resources and discouraging potential patients from seeking care, the pandemic could cause a steep rise in the incidence of other infectious diseases such as HIV, malaria, and TB, as well as a sharp drop in immunization coverage and deteriorating maternal and child health indicators due to reduced access to pre- and postnatal care. At the institutional level, the disruption of supply chains and the demoralization of overworked healthcare staff could negatively affect the quality of health services. A modelling group convened by the World Health Organization and UNAIDS estimated that a six-month disruption in the supply of antiretroviral therapy (ART) due to the pandemic could cause 500,000 additional deaths in Sub-Saharan Africa over 2020-21. Similar models have also estimated that the general disruption in health services due to COVID-19 could result in a total of 769,000 malaria deaths in Sub-Saharan Africa in 2020, roughly twice the number of deaths recorded in 2018.

The Africa CDC: Structure and Mandate

In 2017, the Africa CDC was launched with the mission to "strengthen Africa's public health institutions' capacities, capabilities, and partnerships to detect and respond quickly and effectively to disease threats and outbreaks based on science, policy, and data-driven interventions and programs."[4] The Africa CDC operates under the authority of the AU and is primarily financed from the AU's Union Budget. Other sources of funding include voluntary contributions from

[1] Ndihokubwayo JB et al. Antimicrobial resistance in the African Region: Issues, challenges and actions proposed
[2] Africa CDC #COVID19 update in Africa (As of 13 July 2020, 2:30 am East Africa Time) accessed at https://africacdc.org/covid-19/
[3] UNECA report – COVID-19 in Africa: Protecting Lives and Economies
[4] http://www.africacdc.org/vision-mission-values

member states, development partners, the private sector, and other sources in accordance with AU rules. The Africa CDC's three-tiered administrative structure includes: (i) the Africa CDC Secretariat headquartered Addis Ababa; (ii) five Regional Collaborating Centers (RCCs) based in Egypt, Gabon, Kenya, Nigeria, and Zambia; (iii) national public health institutions (NHPIs) in all 55 AU member states; and (iv) partners, including universities, private firms, non-governmental organizations (NGOs), and multilateral institutions, which provide technical assistance, training, supplies, financing, and other forms of support.[5] In addition to the Secretariat, the Africa CDC's leadership includes a Governing Board and an Advisory and Technical Council.[6]

The RCCs coordinate regional public health initiatives among their member states in consultation with headquarters. Three RCCs have been established: the Southern Africa RCC based in Zambia; the Eastern Africa RCC based in Kenya; and the Central Africa RCC based in Gabon. The Western African RCC based in Nigeria is in the process of being created, and the consultative process around the Northern Africa RCC based in Egypt is ongoing.[7] The Eastern Africa RCC member states include Kenya, Ethiopia, Somalia, South Sudan, and Uganda, along with other regional countries. The Southern Africa RCC member states include Malawi, Mozambique, South Africa, and Zimbabwe, as well as others. The member states analyzed in this report are samples, and both RCCs encompass additional countries that are not included in the analysis. The RCCs are staffed by personnel on secondment from host-country health ministries, NPHIs, and the Africa CDC. The standard RCC staff complement includes a Coordinator, a Deputy Coordinator, one Cluster Head and one Technical Lead for each functional pillar defined by the Africa CDC. RCCs are funded by the AU through the Africa CDC, but host countries also bear a portion of the cost, especially for personnel, office space, and other operational expenses.

The core functions of the RCCs include:[8]

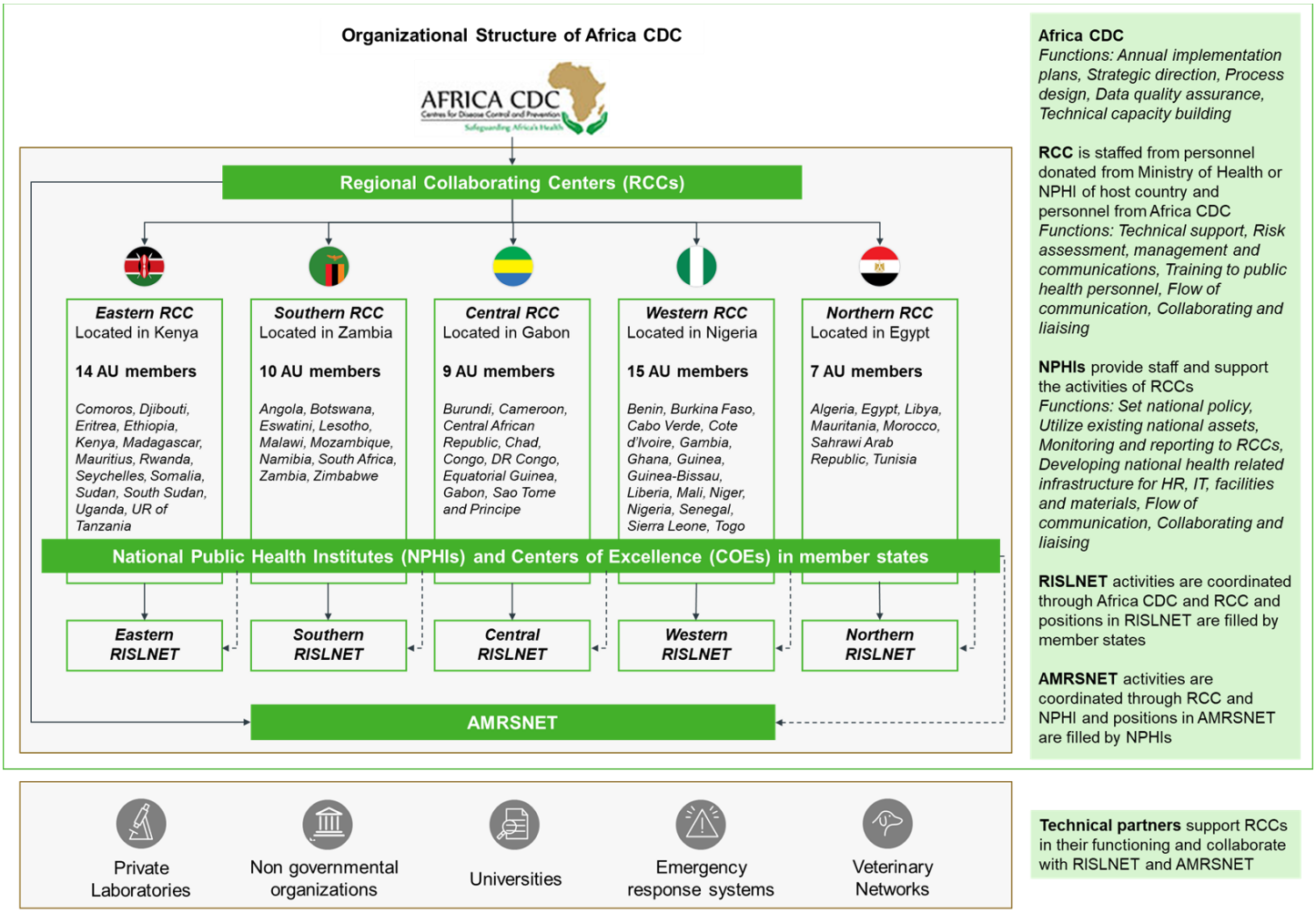
1. **Providing technical support to member states** as they pursue the strategic objectives of the five functional pillars of the Africa CDC: (i) workforce development, (ii) partnerships, (iii) innovation, (iv) financing, and (v) leadership and management.
2. **Strengthening core capacities of member states** in disease surveillance, laboratory facilities and networks, information systems, emergency preparedness and response, and health research.
3. **Promoting collaboration among member states** in responding to infectious disease outbreaks and other health emergencies.
4. **Offering training** to public health personnel in member states; **enabling communication** among member states, RCCs, and the Africa CDC Secretariat; and **establishing focal-point offices** within national health ministries to enable active collaboration among member states within each region.

The Africa CDC plans to establish two cross-border networks for strengthening disease control at the continental level: (i) the Regional Integrated Surveillance and Laboratory Networks (RISLNET) and (ii) the Antimicrobial Resistance (AMR) Program.

1. **RISLNET is an integrated platform for regional surveillance and laboratory systems, emergency preparedness, disease prevention, epidemic control and response, and health research managed by the RCCs.** RISLNET integrates existing networks, programs, institutions, and initiatives under the One Health approach, and its goal is to optimize the use of limited resources. RISLNET is aligned with the objectives of the AU's *Regional Integration and Cooperation Assistance Strategy for Africa for FY18-23*, which calls for concerted action on transnational priorities, including disease surveillance, prevention, and control. Each RCC will have a RISLNET, and the Central Africa RISLNET is already operational.

2. **The AMR program[9] is a cross-border network that will enable health institutions and experts to coordinate AMR surveillance and control activities in Africa while also providing a platform for high-level policy engagement.** Hosted by the AU, AMR Program members will include NPHIs, and the platform's activities will be implemented by the RCCs in collaboration with NPHIs and other organizations. The AMR Program will link the WHO's Global AMR Surveillance System (GLASS) and other initiatives, national health ministries, the AU's Inter-African Bureau for Animal Resources (AU-IBAR), the AU's Pan-African Veterinary Vaccine Centre (AU-PANVAC), the UN Food and Agriculture Organization FAO), and other development partners and NGOs.

[5] Africa CDC Strategy Plan 2017-2021
[6] Statute of the Africa CDC
[7] Primary stakeholder interviews
[8] Africa CDC Strategic Plan 2017-2021
[9] This program was formerly known as the Antimicrobial Resistance Surveillance Networks (AMRSNET).



The Africa CDC has played a critical role in Africa's response to the COVID-19 pandemic. On February 5, 2020, the Africa CDC, in cooperation with the African Union Commission (AUC) and the WHO, established the Africa Taskforce for Corona Virus (AFTCOR). AFTCOR has six workstreams: (a) laboratory diagnosis and subtyping, (b) surveillance, including screening at points of entry and cross-border activities, (c) infection prevention and control in healthcare facilities, (d) clinical management of people with severe COVID-19, (e) risk communication, and (f) supply-chain management and stockpiles. AFTCOR and the Africa CDC's Incident Management System implemented the Africa Joint Continental Strategy for the COVID-19 Outbreak in close coordination with RCCs and member-state NPHIs. AFTCOR and the RCCs provided technical guidance and policy recommendations, supported deployment of SMEs for on-site technical assistance, and coordinated with stakeholders to align on strategies and exchange information on best practices.[10] At the beginning of February 2020, only two laboratories in two AU countries (Senegal and South Africa) were capable of performing COVID-19 tests, but by March 2020 at least 43 laboratories[11] in 43 AU countries had been trained in COVID-19 diagnosis. In addition, health staff in 22 AU member states were trained in infection-prevention and control measures, and the Africa CDC trained health ministry staff from 26 countries in public information management and other subjects.

The COVID-19 pandemic has highlighted the importance of establishing an institutional framework for cross-country collaboration in response to public health emergencies, especially in resource-constrained environments. Effective disease detection and control requires clinical identification, laboratory testing, an effective public health response, cross-country information sharing, and the coordinated utilization of scarce resources and capabilities. RISLNET's objectives[12] are to: (i) ensure that each member state has the capacity to rapidly detect, investigate, respond to, and control disease outbreaks; (ii) strengthen operational and technological communications and build mutual trust among countries; (iii) leverage the capacity and assets of existing regional health networks; (iv) catalyze the introduction and uptake of new technologies and healthcare systems; (v) develop new competencies among frontline healthcare personnel, including training in applied epidemiology, bioinformatics, laboratory methods, and surveillance; and (vi) support the advancement and harmonization of laboratory and surveillance policies among member states.

[10] Africa Joint Continental Strategy Report for the COVID-19 Outbreak
[11] COVID-19 in Africa: A Call for Coordinated Governance, Improved, Health Structures, and Better Data. Mo Ibrahim Foundation
[12] https://africacdc.org/rislnet/

Objectives of this Report

This report is designed to identify opportunities to strengthen regional disease-monitoring and control capabilities in Eastern and Southern Africa. The report presents a situational analysis of existing laboratory and surveillance networks, AMR monitoring systems, and emergency response mechanisms, as well as an assessment of cross-cutting areas such as human resources, information exchange, and private-sector participation. The report is designed to address five key research questions:

- What norms and protocols currently exist regarding laboratory, surveillance, and emergency-response systems at the national and regional levels?
- To what extent do countries in Eastern and Southern Africa comply with defined norms around laboratory operations, disease-surveillance systems, and emergency-response mechanisms?
- What opportunities are available to countries in Eastern and Southern Africa in cross-cutting areas such as health policy, human resources (HR) management, data sharing, information technology (IT), and private-sector participation?
- How can more-developed RCC member states build the capacity of their less-developed peers?
- What existing laboratory, disease-monitoring, and AMR-surveillance networks can RISLNET leverage to achieve the objectives envisaged by the Africa CDC?

The answers to these five questions form the basis for an action plan for operationalizing the Eastern and Southern Africa RISLNET. This plan includes measures to be implemented at the country level to fill identified gaps in the existing institutional and policy framework, as well as measures to be implemented at the regional level, including health-related outreach efforts, the integration of existing health networks, and the coordinated use of public health assets.

Study Methodology

This study used a mix of primary and secondary research. The team conducted 25 interviews with key informants in Ethiopia and Zambia, as well as stakeholders from the Africa CDC, NPHIs, private sector organizations, the WHO, the World Bank, USAID, and other international institutions and donor agencies using a structured interview guide. The team also corresponded with RISLNET-related staff at the Central Africa RCC, the Eastern Africa RCC, and the Southern Africa RCC via telephone and email. The team held five focus-group discussions (three in Ethiopia and two in Zambia) using a structured discussion guide. In addition to gathering information from primary sources, the team conducted a literature review of scientific journals; electronic databases such as PubMed; official reports such as the Joint External Evaluation (JEE), the WHO State Parties Annual Report (SPAR), and African Society for Laboratory Medicine (ASLM) laboratory-mapping reports; and documents on AMR, including Fleming Fund reports. The JEE yielded an assessment of country-level compliance with International Health Regulations (IHR) core capacities. Finally, the team conducted desktop simulation exercises in collaboration with the Ethiopia Public Health Institute (EPHI) to test public health emergency response capabilities at the national and subnational levels. The five countries selected to represent each region were chosen based on their diversity: they encompass states with varying levels of institutional capacity, economies at different developmental stages, as well as countries that have been affected by conflict, instability, and violence.

Operationalizing RISLNET in Eastern and Southern Africa

Establishing a fully functional RISLNET involves:

- *Prerequisites*, including a functional RCC with a defined workplan, adequate funding and staffing, a governance framework, and a formal agreement by member states participating in RISLNET to enable the sharing of data and public health assets.
- *Institutional infrastructure*, including a national laboratory network across member states to detect diseases and monitor treatments, a national-level surveillance network to analyze health trends, and a national level emergency-response system capable of addressing outbreaks and epidemics.
- *Cross-cutting components*, including a trained national health workforce, the necessary IT platforms and databases, and buy-in from the private sector and other stakeholders.

1. Prerequisites

Area	Status in Eastern RCC	Status in Southern RCC	Lessons from Central African RISLNET
Functional RCCs	▪ The RCC is functional, but there is no five-year action plan, staffing is inadequate, and the RCC is facing funding issues.	▪ The RCC is functional, but standard operating procedures (SOPs) are in the draft stage, and staffing and funding is inadequate.	▪ The Central Africa RCC prioritized operationalizing all RCC pillars before launching a RISLNET initiative, as RISLNET relies on the RCC for staffing and establishing links with NPHIs and governments of member states.
RISLNET governance framework	▪ A framework has not yet been defined, as stakeholder outreach could not be conducted.	▪ A framework has not yet been defined, as discussions around the formation of RISLNET have not reached this level.	▪ Develop a governance framework in collaboration with member states and launch a consultative process that incorporates a wide range of stakeholders. ▪ Reinforce the governance framework with a sound organizational structure that clearly defines functions, responsibilities, and SOPs. ▪ Ensure that member states understand how RISLNET will function and its role in coordinating a regional public health response.
Formal agreement by member states to participate in RISLNET	▪ Stakeholders from all member states have not yet been engaged in the process of creating an agreement due to the disruptions caused by COVID-19.	▪ Member states have indicated their agreement in principle to participate in RISLNET but have expressed concerns regarding the details of data-sharing arrangements.	▪ A consultative process highlighting the requirements and benefits of participating in RISLNET among member states can help create buy-in prior to the establishment of RISLNET. ▪ Establishing RISLNET through an implementing partner can facilitate multi-stakeholder coordination.

2. Institutional Infrastructure

Area	Status in Eastern RCC	Status in Southern RCC	Lessons from Central African RISLNET
Laboratory networks	▪ Laboratory mapping is at an advanced stage in Ethiopia. ▪ ASLM LabMaP is conducting laboratory mapping in Uganda, and	▪ Public health assets have been mapped in Zimbabwe, Malawi, and Zambia.	▪ Comprehensive laboratory mapping in all countries is essential to enable regional laboratory integration. ASLM LabMaP performed a comprehensive mapping exercise that helped build

	the Kenyan Association of Public Health Laboratories is mapping laboratories in Kenya. ▪ The RCC has built a consensus among member states around the need to create a laboratory network. ▪ Individual disease-specific referral networks exist but are not integrated.	▪ Individual disease-specific referral networks exist but are not integrated.	consensus among laboratories on the benefits of participating in RISLNET. ▪ RISLNET can be launched with an initial network of one reference laboratory in each member state rather than waiting for more laboratories to join the system prior to operationalization. ▪ RISLNET should develop a template and guidance for NLSPs for countries to customize and finalize.
Disease surveillance	▪ Some member states are unwilling to share surveillance data, which could prevent the effective functioning of RISLNET. ▪ A data-sharing framework exists within the EAPHLN, which can be leveraged to expand data sharing among member states.[13] • Various countries are members of surveillance networks for vaccine-preventable diseases such as WHO's Global Polio Laboratory Network (GPLN), Global Rotavirus Laboratory Network (GRLN), Global Measles and Rubella Laboratory Network (GMRLN), Global Yellow Fever Network (GYFN), the African Network for Influenza Surveillance and Epidemiology (ANISE), and the Global Influenza Surveillance and Response System (GISRS).	▪ Surveillance data are not shared across the region. ▪ Information-sharing and cooperation between countries occurs on an ad hoc basis. ▪ Various countries are members of surveillance networks for vaccine-preventable diseases, such as the WHO's GPLN, GRLN, GMRLN, GYFN, ANISE, and GISRS.	• The Central Africa RISLNET has not yet made significant progress on surveillance, as this is a year-two activity.
Emergency response	▪ Ethiopia has participated in several emergency-management situations in neighboring states such as Kenya and Somalia. ▪ Uganda sent about 20 cadres of health workers to help contain the 2013-16 EVD outbreak by supporting clinical management, coordination, surveillance, laboratory work, and social mobilization. ▪ During the COVID-19 pandemic, RCC member states have shared information with each other, and representatives have	▪ South Africa has training agreements in place with the Southern African Development Community and the Wits Health Consortium, and the country is a member of the Global Outbreak Alert and Response Network. It deployed public health and medical personnel during the 2013-26 EVD outbreak through an MoU signed with the AU.	▪ The Central Africa RISLNET has not made significant progress in this area, but planned activities include preparing SOPs for emergency preparedness and response at the regional level, including risk assessments, early-warning systems, and protocols for the flow of information and the allocation of crisis-management responsibilities.

[13] https://au.int/sites/default/files/documents/32386-doc-01_africa_cdc_group_3.pdf

	expressed interest in expanding the exchange of laboratory data to enable electronic tracking of COVID-19 patients.	▪ There is no regional emergency-response system, but member states share capabilities and staff on an ad hoc basis. ▪ Member states plan to begin sharing important health information on a regular basis.	

3. Cross Cutting Areas

Area	Status in Eastern RCC	Status in Southern RCC	Lessons from Central African RISLNET
Human resources	▪ A lack of adequate RCC staff could prevent the establishment of RISLNET. Currently, the RCC is staffed by just five personnel. ▪ The ECHO platform is used to share knowledge and best practices. ▪ Limited staff capacity to analyze and process data inhibits evidence-based decision making.	▪ Staffing challenges at the RCC may prevent the establishment of RISLNET. The RCC has no full-time technical personnel and is staffed by an Interim Coordinator and three fellows on short-term secondment from the Africa CDC. ▪ The ECHO platform is being used for cross-border collaboration and the discussion of public health issues. ▪ Limited staff capacity to analyze and process data inhibits evidence-based decision making.	▪ Adequate staffing at the RCC level is necessary to operationalize RISLNET. ▪ An ongoing process of capability building is necessary to ensure that staff in network entities have the skills required to achieve the goals of RISLNET.
IT platforms and databases	▪ No interconnected platform allows for sharing raw disease data across member states. ▪ Some countries use information management systems such as DHIS-2. Ethiopia uses the Polytech, Smartcare, and Sota laboratory-information systems, and the LabWare system is used in Kenya.	▪ No interconnected platform allows for sharing raw disease data across member states, but country-level aggregate reports are shared with the RCC. ▪ Some countries use information-management systems such as DHIS-2. The DisaLab laboratory-information system is used in Zambia, and the TrakCare system is used in South Africa. ▪ IT infrastructure (e.g., cloud servers, data centers, etc.) is insufficient.	▪ Providing a knowledge-management platform can foster collaboration and encourage open communication between member states. The Central Africa RCC is using the ECHO platform for this purpose. ▪ Creating a platform for member states to share laboratory and surveillance data is planned for year two but has yet to be initiated.
Private-sector participation	▪ There is no protocol for incentivizing private-sector participation, enabling the private sector to share data securely, or allowing private firms to access the regional network.	▪ There is no protocol for incentivizing private-sector participation, enabling the private sector to share data securely, or allowing private firms to access the regional network.	▪ Data security is a serious concern among potential private-sector partners that may discourage them from participating in RISLNET.

Lessons Learned from the Implementation of RISLNET in Central Africa

A participatory process can help create an atmosphere of collaboration and transparency. The governance framework for the Central African RISLNET was drafted through an interactive workshop attended by government officials from member states and representatives from the UN FAO, the US CDC, the ASLM, the Pandora-ALERT network, and the WHO Special Program for Research and Training in Tropical Diseases. The stakeholders approved a final draft of the governance framework specifying RISLNET's organizational structure, roles and responsibilities, internal decision-making processes, funding sources, and operational guidelines.[14]

RISLNET requires a clear organizational structure and consistent guidelines for member states. The Central Africa RISLNET consists of: (i) a General Assembly made up of representatives from all member states; (ii) a Steering Committee composed of ten members from the disease-surveillance team, ten from the laboratory-services team, five from the animal-health team, and five from participating universities, NGOs, and other partners; (iii) a Bureau composed of the President, Vice President, Secretary General, Assistant Secretary General and Treasurer; and (iv) six technical working groups consisting of 60 members covering the One Health approach, AMR monitoring systems, laboratory networks, IT systems, NHPIs, and research and development (R&D). The organizational framework also includes operational details around number and type of regular meetings, and the process for decision-making including quorum required. Sources of funding for RISLNET include the Africa CDC via the RCC, as well as possible contributions from individuals, development partners, and the private sector.

Promulgating uniform guidelines is a key function of RISNLET. The Central Africa RISLNET has developed various process documents for RCC member states, including (i) a Framework Sample Transport System for RISLNET; (ii) national laboratory strategic plans (NLSPs) for the nine RCC member states; (iii) Guidelines for Antimicrobial Resistance Testing; (iv) Guidelines for Point of Care Testing; (v) a Quality Manual for Laboratory Testing; (vi) Guidelines for Laboratory Biosafety and Biosecurity; and (vii) Guidelines for Equipment Maintenance and Calibration.

Establishing the Central Africa RISLNET required a minimum of one reference laboratory in each member state, with the plan that at the end of five years, at least 50 percent of these laboratories should have received five-star accreditation. Currently, 10 laboratories are part of the network: one reference laboratory in each of the nine member states and a regional laboratory BSL-3 laboratory in Gabon. Seven laboratories in seven countries have been enrolled into ISO 15189 and the WHO accreditation process. Incentives for member states to participate in RISLNET include training exercises, accreditation support, and access to equipment.

Establishing a referral system is crucial, as not all member states will have the capability to build, staff, and operate a BSL-3 or BSL-4 laboratory. The transportation of specimens from Republic of Congo to Gabon takes place although a formalized referral system, which has yet to be expanded to all RISLNET member states.[15] A laboratory-management information system has been installed at four laboratories in four countries. Its objective is to accelerate the availability of results to support clinical decision making.

Staff training is a long-term collaborative process. A total of 247 personnel have been trained in multiple disciplines, including quality management, laboratory information systems, equipment maintenance and calibration, laboratory accreditation, and external quality assessments. Trainings on quality assurance and external quality assessment were conducted in Bujumbura, Burundi and Libreville, Gabon, and a workshop on laboratory accreditation for biologists, laboratory managers, and laboratory technicians was held in N'Djamena, Chad. A meeting to develop a template for NLSPs and achieve compliance with IHR was also held, and member states share aggregated reports on the ECHO platform on a weekly basis. Representatives of member states discuss current challenges faced and deliberate on approaches, best practices, and potential solutions. The latest ECHO sessions have focused on sharing information about COVID-19 and related issues such as testing capacity and contact tracing.

[14] Africa CDC TODAY, December 2018, Issue 02 accessed at https://africacdc.org/download/africa-cdc-newsletter-december-2018/
[15] Africa CDC TODAY, March 2020, Issue 7 accessed at https://africacdc.org/download/africa-cdc-newsletter-quarter-1-2020/

Laboratory Capabilities and Networks

Creating an integrated network of laboratory systems, surveillance mechanisms, and national health infrastructure

Laboratory networks have long played a critical role in disease identification, detection, reporting, and tracking. Laboratory networks and enhanced diagnostic capacity are essential components of the national and regional efforts to comply with IHR and build strong IDSR systems.[16] During the COVID-19 pandemic, networked laboratories have supported disease surveillance by identifying pathogens and sharing the information in real time. Laboratory networks harness country-level health systems and institutions to advance shared regional goals. Pooling scarce resources is critical to overcome weaknesses in diagnostics, surveillance, reporting, strategic planning, and human resources at the national level.[17] The ongoing COVID-19 pandemic has highlighted the value of laboratory networks, several of which have proven instrumental in addressing the local spread of the disease.

The five EAPHLN[18] member countries—Kenya, Uganda, Tanzania, Rwanda, and Burundi—are integrated into a network of 40 well-equipped public health laboratories with trained personnel and enhanced diagnostic and surveillance capacity. Cross-border access to hospital laboratories has improved service quality among vulnerable groups and strengthened regional outbreak preparedness. The networked laboratories have benefited from the latest molecular diagnostic technologies, including those used for COVID-19 testing, shortening turnaround times and enhancing accuracy.

During the initial phases of the pandemic, approximately 85 percent of over 220 NPHLs testing for COVID-19 globally were associated with GISRS, which enabled information-sharing and rapid capacity development among participating states. Similarly, ANISE has connected more than 30 countries across Africa on a single platform to discuss and build their surveillance and testing capabilities. Global health agencies like the WHO have released guidelines on leveraging existing national influenza surveillance systems and public health laboratories for epidemiological and virologic surveillance of COVID-19. The Africa CDC has also leveraged its partnerships and collaborations with public health institutions and centers of excellence to enhance COVID-19 testing and build the capacity of laboratory professionals.

The COVID-19 pandemic has revealed critical gaps in country-level laboratory capabilities across Africa. Quality control, supply-chain management, and workforce supervision have proven especially challenging in a context where a limited number of laboratories must test not only for COVID-19 but also for a wide range of other priority diseases. Moreover, the dependency of national laboratories on external suppliers significantly slowed the expansion of COVID-19 testing. Despite the Africa CDC's efforts to address these challenges, substantial gaps remain. National health authorities lack a comprehensive assessment of their diagnostic capabilities, and existing health databases are inadequate. Finally, quality-control policies must be implemented at all tiers of national health systems, not just in central reference laboratories, and diagnostic capacity must be built among subnational facilities.[19]

A national-level assessment of laboratory capabilities in Eastern and Southern Africa reveals the uneven but potentially complementary resources of RCC member states. In the Eastern RCC, EAPHLN labs can serve as the backbone of a regional laboratory and surveillance network. The 32 EAPHLN labs include a central reference laboratory in each country and satellite laboratories, most near international borders. Uganda's national reference laboratory can support AMR detection and surveillance across the Eastern RCC, and states with limited institutional capacity can access priority disease and AMR pathogen testing capabilities from neighboring countries. In the Southern RCC, South Africa's existing laboratory systems and capabilities can support neighboring countries as they develop their diagnostic capacity, and testing at the national reference laboratory can be extended to diseases other than TB. Regional EQA centers established in South Africa and Zimbabwe can enhance the quality of diagnostic systems in other regional countries, including states with limited institutional capacity, which can access priority disease and AMR pathogen testing from neighboring countries.

The following matrix compares the capacity of national health systems against WHO standards. The assessment encompasses national strategic plans; laboratory quality management; quality-control policies; supply-chain management; biosecurity and biosafety; diagnostic networks; specimen referral; testing of priority diseases; LIMS reporting; AMR detection; and adherence to AST guidelines. Green represents "existing capacity," yellow represents "partial capacity," and orange represents "little or no capacity."

[16] Schneidman et al (2017) Building Cross-Country Networks for Laboratory Capacity and Improvement Clin Lab Med 38 (2018) 119–130
[17] Africa CDC Strategic Plan 2017-2021
[18] https://blogs.worldbank.org/health/investing-medical-laboratory-networks-will-covid-19-coronavirus-be-wake-call
[19] Ondoa et al. (2020) COVID-19 testing in Africa: lessons learnt

Eastern Africa RCC[20,21,22,23]

Functions	Requirement	Ethiopia	Kenya	Uganda	Somalia	South Sudan
Legislations, Policies and Guidelines						
National strategic plans	*NLSP in place*	National Laboratory System Master Plan and EPHI Strategic Plan 2015-2020	NPHLS Strategic Plan 2016-2020	NHLS Strategic Plan 2016-2020	No national level strategic plans in place	Strategic plan in place
Laboratory quality control	*SOPs and quality-control standards in place*	Adheres to WHO SLIPTA guidelines for achieving international ISO-15189 accreditation. Of 109 regional and hospital labs enrolled in SLIPTA, 21 received one-star recognition, 12 received two stars, 7 received three stars, and two received four stars	Follows WHO SLIPTA and ISO guidelines for accreditation. Of 37 laboratories audited under SLIPTA, 7, 5, 7, 13, and 5 received 0, 1, 2, 3, and 4 stars, respectively	Follows WHO SLIPTA guidelines for laboratory accreditation. Of 82 laboratories audited under SLIPTA, 2, 7, 21, 40, and 12 received 0, 1, 2, 3, and 4 stars, respectively	No laboratory quality standards available	National laboratories refer to foreign national or regional accreditation bodies and WHO SLIPTA guidelines
National quality policy	*National quality-control policy in place*	Government agency tasked with developing a quality-control policy	National quality-control policy in place	National quality-control policy in place	No	No
Supply-chain management	*Supply-chain management plans available*	Part of laboratory plan	Part of laboratory plan	Part of laboratory plan	No	No
Biosecurity and biosafety	*Comprehensive national guidelines in place*	National biosafety guidelines in place	National biosafety guidelines in place	National biosafety guidelines in place	No	No
Collect						
Diagnostic network	*Tiered structure of laboratory network in place*	Four-tiered structure from facility to national level encompassing 4,023 laboratories	Three-tiered network from primary level to specialized reference laboratories encompassing 4,026 facilities	Tiered testing structure in place	Regional and district hospital laboratories in each state and national reference laboratory	Peripheral facility-based laboratories with main reference laboratory system at NPHL
Specimen referral network	*Transportation of specimens from 80% of facilities to national level*	Transportation from over 80% of facilities	Transportation from less than 50% of facilities	Transportation from 50%-80% of facilities	Transportation from less than 50% of facilities	Transportation from less than 50% of facilities

[20] Primary research & Stakeholder consultations
[21] Country JEE Reports
[22] WHO SPAR Reports
[23] WHO GLASS Reports

Confirm						
Testing of priority diseases defined by IDSR	*Laboratory confirmation tests performed for priority diseases*[24]	All tests except one	All tests except one	All tests except one	Four out of 12 total tests	Six out of 10 core tests

Report						
Laboratory information management	*LIMS established and standardized*	Multiple LIMS systems implemented in 28 facilities	Partial LIMS implementation in tertiary facilities[25]	Largely paper-based reporting and no LIMS established[26]	No LIMS established	No LIMS established; paper-based and electronic reporting used
AMR Detection						
AST guidelines	*Standardized guidelines and protocols in place*	Clinical and Laboratory Standards Institute (CLSI) guidelines in place	CLSI guidelines in place	No standardized guidelines	No standardized guidelines	No standardized guidelines

Southern Africa[27]

Functions	Requirement	Zambia	South Africa	Zimbabwe	Malawi	Mozambique
Legislation, Policies and Guidelines						
National policy and guidelines	*NLSP in place*	National Biomedical Laboratory Strategic Plan 2018-2022	National Strategic Plan 2016-2020	Policy documents define the responsibilities of laboratories at each tier	No strategic plan specific to laboratories	No strategic plans specific to laboratories
Laboratory quality control	*SOPs and quality-control standards in place*	Follows WHO SLIPTA checklist and ISO 15189; of the four laboratories audited under SLIPTA, 2, 1, and 1 received 2, 4, and 5 stars, respectively	Follows internal and ISO standards; of 31 laboratories audited under SLIPTA, 9, 8, 8, and 6 received 2, 3, 4, and 5 stars, respectively	Follows standard guidelines; of 35 laboratories audited under SLIPTA, 4, 7, 9, 10, and 5 received 0, 1, 2, 3, and 4 stars, respectively	Follows SLIPTA protocols; of 19 laboratories audited under SLIPTA, 3, 10, 4, and 2 received 1, 2, 3, and 4 stars, respectively	Follows SLMTA guidelines; of 41 laboratories audited, 2, 11, 16, 11, and 1 received 0, 1, 2, 3, and 4 stars, respectively
National quality control	*National quality-control policy in place*	No national policy, only laboratory-specific guidelines	National policy in place	National policy in place	National policy in place	A coordinating agency has been established
Supply-chain management	*Supply-chain management plans available*	Part of laboratory plan	Standard procedures and policies in place	Part of laboratory plan	No	No

[24] Sourced from key informants and different secondary sources
[25] ASLM Conference Paper on BLIS-Kenya and I-Tech Website
[26] Uganda National Health Laboratory Services Policy II (2016)
[27] Primary research & Stakeholder consultations; Country JEE Reports; WHO SPAR Reports; WHO GLASS Reports; MoH Websites; National Action Plans and National Strategic Plans; Sembajwe et al. (2018) Implementation of a Laboratory Information System in Zimbabwe Online Journal of Public Health Informatics * ISSN 1947-2579 * http://ojphi.org * 10(1):46, 2018

Biosecurity and Biosafety	*Comprehensive national level policies in place*	National guidelines and SOPs in place	National guidelines scattered across ministries	Laboratory safety manual in place	No	National guidelines in place

Collect						
Diagnostic network	*Tiered laboratory network in place*	Four-tiered structure linking 359 laboratories	Four-tiered structure	Three-tiered structure linking 78 laboratories	Four-tiered structure linking 367 laboratories	Tiered structure in place
Specimen referral network	*Transportation of specimens from 80% of facilities to the national level*	Transportation from less than 50% of facilities	Transportation from over 80% of facilities	Transportation from over 80% of facilities	Transportation from less than 50% of facilities	Transportation from 50%-80% of facilities

Confirm						
Testing of priority diseases defined by IDSR	*Laboratory confirmation tests performed*[28]	All tests conducted	All tests conducted	All tests conducted except one	All tests conducted except one	All tests conducted except one

Report						
Laboratory information management	*LIMS established and standardized*	LIMS established in four central-level laboratories; paper-based systems and hybrid systems still in use and not standardized	More than 270 public-sector NHLS labs networked through LIMS	LIMS implemented in six regional laboratories	Mostly paper-based data management	LIMS in place at reference laboratories and several clinical laboratories
AMR Detection						
AST guidelines	*Standardized guidelines and protocols in place*	CLSI guidelines in place	CLSI and European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines in place	CLSI guidelines in place	EUCAST guidelines in place	CLSI guidelines in place

**Specimen referral network for priority diseases.*

Note: This assessment is largely based on national-level findings. In addition to performing diagnostics, the national reference laboratories offer specialized services, formulate SOPs and guidelines, monitor the implementation of standards, provide disease intelligence to underpin public health interventions; offer advice and mentorship; and maintain quality-assurance and information-management systems. The description of laboratory capacities refers to laboratory systems at the national level.

[28] This information was sourced from key informants and various secondary sources.

a) Laboratory Testing for Priority Diseases[29]

Ethiopia: A 2018 laboratory-mapping exercise by EPHI, the Africa CDC, and ASLM examined 126 laboratories and found that more than 20 (16 percent) had the capacity to test for HIV, TB, cholera, hepatitis B, and bacterial meningitis. However, only 12 conducted viral-load testing, and only the Ethiopian NPHI performed EVD testing. Moreover, none of the 13 regional laboratories had diagnostic capacity for hemorrhagic fevers such as Rift Valley fever, dengue, chikungunya, or Congo-Crimean fever. Point-of-care diagnostics for priority diseases such as HIV, TB, gonorrhea, and malaria are being used, including new technologies like GeneXpert for TB. A clinical bacteriology and mycology laboratory has been established in Ethiopia's national reference laboratory for AMR. Out of 126 laboratories surveyed by ASLM, 23 perform AST for common bacterial infections, and 33 perform AST for TB.[10] Real-time reverse transcription polymerase chain reaction (rRT-PCR) COVID-19 testing capability has been developed by 61 facilities, including the NPHI, Armauer Hansen Research Institute, the Ethiopian Biotechnology Institute, International Clinical Laboratories, the Tigray Health Research Institute, the Amhara Public Health Institute, the Adama Public Health Research and Referral Laboratory, Arsi University laboratory, and Jigjiga University Laboratory.[10] Real-time reverse transcription polymerase chain reaction (rRT-PCR) COVID-19 testing capability has been developed by 61 facilities, including the NPHI, Armauer Hansen Research Institute, the Ethiopian Biotechnology Institute, International Clinical Laboratories, the Tigray Health Research Institute, the Amhara Public Health Institute, the Adama Public Health Research and Referral Laboratory, Arsi University laboratory, and Jigjiga University Laboratory. The COVID-19 laboratory testing network is jointly led and coordinated by the National Laboratories Capacity Building Directorate and the NPHI's Influenza Reference Laboratory. The NPHI also leads 10 national and 10 subnational reference laboratories that test for priority diseases. With these diagnostic capabilities, the Ethiopian NPHI has the potential to become a regional center of excellence capable of testing for priority diseases that emerge in neighboring countries.

Kenya: A 2020 laboratory-mapping report found that Kenya has 4,086 laboratories at various levels of the health system. The NPHLS has been strengthened significantly, and its facilities have been upgraded with advanced infrastructure, technologies, staff training, and information and communication systems. The NPHLS hosts national reference laboratories for HIV, TB, influenza, and microbiology. The Kenya Medical Research Institute houses national reference laboratories for polio, measles, and viral hemorrhagic fever, including the US CDC-supported laboratory for testing samples of unknown etiology for multiple pathogens. Kenya also has six satellite public health laboratories that are part of EAPHLN. Kenya has expanded its COVID-19 testing capacity, and 35 laboratories (30 public and five private) currently conduct COVID-19 PCR testing through existing platform technologies like GeneXpert. A COVID-19 laboratory testing network has been established and is coordinated by the national influenza laboratory at NPHLS.

Uganda: Well-established NRLs include the Uganda Virus Research Institute, the National Tuberculosis Reference Laboratory, and the Central Public Health Laboratories. Laboratory capabilities have also been strengthened under the EAPHLN project. The Uganda Tuberculosis Reference Laboratory is part of the WHO's Supranational Reference Laboratory network and provides specialized services and technical assistance to 20 African countries. The country's laboratory services also play a major role in addressing crucial gaps in emerging diseases like EVD. Uganda is currently testing for COVID-19 through PCR tests, as well as rapid antigen and antibody tests.

Zambia: A 2018 laboratory-mapping survey of 18 public and private laboratories conducted by the Zambia NPHI in collaboration with the Africa CDC and ASLM found that three laboratories (17 percent) had testing capabilities for bacterial meningitis, HIV (PCR), viral-load testing, and cholera. Three laboratories also conducted tests for EVD, Rift Valley fever, dengue, chikungunya, and Congo-Crimean fever. Polio testing capacities have been extensively mapped, and eight laboratories[30] perform AST. The designated laboratories for COVID-19 diagnostics are the Tropical Diseases Research Centre and the University Teaching Hospital Virology Laboratory, a WHO-certified national influenza center. Zambia is utilizing real-time PCR testing for COVID-19, and some antibody tests (IgM and IgG) have been conducted. The laboratory system is supported by the University Teaching Hospital's National Chest Disease Laboratories. However, of the country's 2,900 healthcare facilities, only about 359 have some form of laboratory support. There is no dedicated laboratory system for public health authorities, which instead rely on the clinical laboratory system, and 316 of the country's 359 laboratories perform only basic microscopy. To establish itself as a regional center of excellence, the Zambian NPHI will have to overcome these challenges.

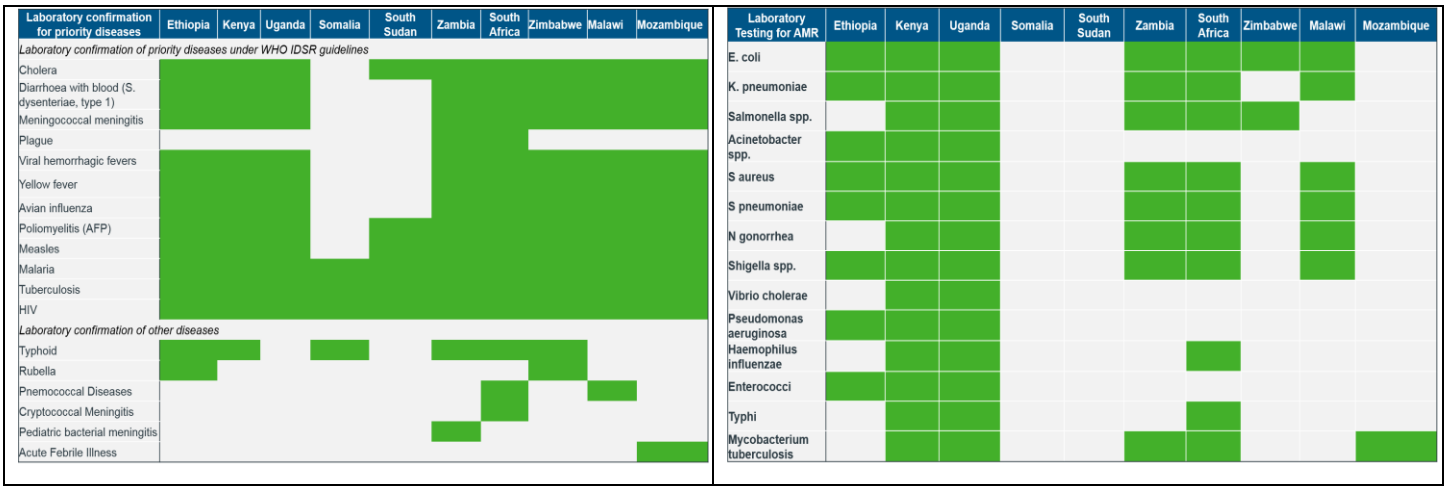
"We also have a network of public clinical labs dotted around the country which are connected to health facilities through a tiered system (Zambia has nearly 3000 health facilities) and roughly around 10 percent of these facilities have labs associated to them. Unfortunately, Zambia does not have a dedicated public health laboratory and

[29]Nkengasong et al (2018) Laboratory medicine in Africa since 2008: then, now, and the future www.thelancet.com/infection Published online July 3, 2018 http://dx.doi.org/10.1016/S1473-3099(18)30120-8

[30] Primary Research Report – Ethiopia and Zambia, 2019

currently relies on the clinical labs which are primarily earmarked to support patient management ***– Head of Laboratory Networks, Zambia NPHI***

South Africa: South Africa has an advanced laboratory system with leading diagnostic centers such as the National Institute of Communicable Diseases. There are 10 national, 17 provincial, 42 regional, and over 150 district laboratories, as well as three large private laboratories and a BSL-4 laboratory. About 50 laboratories perform AST. South Africa is a continental leader in COVID-19 testing, which is performed by both public and private laboratories. There are six testing sites and 60 mobile testing facilities. The tables below illustrate the availability of laboratory confirmation tests for the priority diseases defined in the WHO's IDSR and for AMR pathogens.[31]



The WHO has encouraged collaboration and sharing of currently existing molecular diagnostics platforms to support COVID-19 response.[32] Two commonly used molecular technologies for HIV and TB have received WHO emergency-use listing for COVD-19 diagnosis. Many countries have well-developed testing capabilities for TB and HIV, including Kenya, which has a 76 percent utilization rate of molecular platforms in 10 viral load and early infant diagnosis testing laboratories.[33] Similarly, Zimbabwe had about 135 GeneXpert platforms[34] in more than 100 public health facilities in 2017, which were utilized for TB testing. A study by Doctors without Borders found that GeneXpert capacity was underutilized and could be leveraged to support integrated testing. A pilot for integrated TB and HIV testing in four sites in Zimbabwe showed an increase in the utilization rate from 41 to 55 percent with no adverse impact on TB testing.[35]

International organizations and private partners are helping to expand COVID-19 testing. Partnerships for Accelerated COVID-19 Testing (PACT) is an initiative by the AU and Africa CDC designed to test 10 million people for COVID-19 within four months, provide training to member states and laboratory technicians, support continent-wide pooled procurement, and facilitate the deployment of one million community health workers for contract tracing. PACT has three components—diagnosis, contact tracing, and treatment—and it plans to engage with the private sector to achieve its goals.[36,37] Public-private partnerships (PPPs) for COVID-19 testing have already yielded significant results. Ethiopia and Kenya increased their testing capacity after the multinational biomedical firm Abbott agreed to reconfigure its closed platform to accommodate COVID-19 testing. Academic and animal health laboratories were also enlisted in the effort to expand COVI-19 testing. In Kenya, private laboratories were authorized to test for COVID-19 and participated in a sample-split testing EQA scheme. Private laboratories are also part of the COVID-19 PCR testing laboratory network. In addition to bolstering testing capacity, the integration of private laboratories can offer sample-referral routes in countries with less-developed testing facilities. However, private-sector regulations are not yet clearly defined in national laboratory plans and policies.

"The private sector can help with reporting of disease incidences and signs of potential outbreak but none of them report regularly. The district levels can also be pushed to further engage the private sector for better collection of data. There are also plans to include private hospitals in upcoming trainings." **- Head of Surveillance, ZNPHI**

[31] This information is sourced from key informants and secondary sources. The list may not be exhaustive.
[32] https://africacdc.org/video/maintaining-hiv-tb-testing-in-the-context-of-covid-19/
[33] https://aslm.org/wp-content/uploads/2019/06/VL-overview-of-in-kenya.pdf
[34] https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0193577
[35] https://aslm.org/wp-content/uploads/2019/11/Integrated-Testing-for-TB-and-HIV-Zimbabwe_Eng_digital.pdf
[36] https://aslm.org/wp-content/uploads/2020/05/PACT-Accelerating-Testing-in-Africa-vFinal.pdf
[37] https://au.int/en/pressreleases/20200603/african-union-rolls-out-partnership-accelerate-covid-19-testing

Despite the evolving laboratory capabilities of many countries in Eastern and Southern Africa, persistent gaps and challenges must be addressed to enable successful regional integration. Countries that lack a comprehensive laboratory mapping exercise are unaware of their diagnostic capacity, but regional integration will enable these countries to reduce the fiscal and administrative costs of laboratory mapping by leveraging existing tools and resources.

Stakeholder discussions and secondary data sources reveal that not all countries undertake all tests for priority diseases that require laboratory confirmation under IDSR guidelines. For example, Somalia's COVID-19 testing capacity is limited to a few locations in Mogadishu, Hargeisa, and Garowe. Limited COVID-19 testing facilities, combined with a lack of isolation and treatment facilities, limits contact tracing and case testing. South Sudan has only one laboratory that tests for COVID-19, and it lacks essential supplies and staff. Turnaround times for test results are long, and testing is limited to symptomatic patients. Zimbabwe is currently conducting PCR tests for COVID-19 at two facilities in Harare and Bulawayo. In Malawi, testing is limited to three hospitals in the northern region, Blantyre, and Lilongwe. In Mozambique, only the National Health Institute Laboratory in Marracuene, on the outskirts of Maputo, performs COVID-19 tests. Across Africa, a lack of information about national diagnostic capabilities has hindered the COVID-19 response effort. Regional integration will support countries in mapping and understanding their laboratory capacity and resources and provide an enabling environment to address current and future outbreaks.

Clear guidelines and policies are essential for well-functioning laboratory systems. Countries must develop NLSPs that reflect the WHO IDSR guidelines for national laboratory functions. States with limited institutional capacity, such as Somalia, South Sudan, Malawi, and Mozambique, have yet to formulate their NLSPs. RISLNET should support the development of these plans by NPHIs or national-level laboratory systems. Uganda and South Africa have undertaken important biosafety and biosecurity initiatives. Uganda's NRLs provide mentoring support to other laboratories and help build the specimen-transportation capacity of laboratory personnel. The authorities have created a multi-sectoral biosafety committee, elaborated pathogen-control mechanisms with SOPs and manuals, and a national specimen transport and referral network. Public Health Emergency Operations Centers (PHEOCs) track specimens at each transportation point and level. Similarly, South Africa has a comprehensive legislative framework for biosecurity and biosafety, with well-defined monitoring mechanisms supported by national associations and committees, and the South African National Accreditation Service (SANAS) performs biosafety audits and quality assurance for individual laboratories. However, Somalia, South Sudan, and Malawi have not developed comprehensive biosafety guidelines, and clear biosecurity guidelines are unavailable in most countries. Kenya and Uganda have drafted biosecurity laws but have yet to implement them.

The implementation of biosafety guidelines at the laboratory level continues to pose a serious challenge in many countries. In Ethiopia, biosafety and biosecurity guidelines and regulations have been developed and are awaiting endorsement, but laboratory personnel have limited capacity to implement these guidelines, which are not legally binding. Kenya was among the first countries to pilot a new assessment tool developed last year by ASLM, the US CDC, the Global Fund and the Integrated Diagnostics Consortium to assist with identifying gaps and creating awareness of best practices for waste management processes in VL and EID molecular testing laboratories.[38] During stakeholder consultations, biosafety and biosecurity were identified as an important area for capacity building, and RISLNET can support countries in developing these guidelines.

Although countries in both regions are working to develop their AMR and AST capabilities, there are currently no standardized protocols or guidelines for AST testing. Some states have little or no capacity for AST testing, and the lack of guidelines, limited availability of laboratory supplies funding, and logistical challenges hinder AST testing in countries across Southern and Eastern Africa.[39] Stakeholders have recognized AMR and AST testing as critical areas for capacity building. The AMR program, along with ongoing support from other partners, will help to address these challenges by harmonizing AMR guidelines and strengthening supply-chain management. Regional integration is also critical to leverage the more advanced capabilities of regional leaders to assist neighboring states that have limited laboratory capacity.

b) Specimen Referral Systems

Ethiopia: Ethiopia uses designated vehicles for sample transportation, which are tracked by global positioning systems, and adheres to specific guidelines for cold chains, triple packaging, and other elements of safe sample transportation. However, 2018 laboratory-mapping survey found that 29 percent of Ethiopian laboratories used postal services and professional couriers for sample transportation. The Ethiopian NPHI will play a critical role in elaborating the guidelines and SOPs for specimen referral and transportation, both within Ethiopia and across the Eastern Africa RCC. The NPHI will also lead the creation of PPPs and help establish the regulatory framework for private-sector engagement. The SOPs and guidelines developed in Ethiopia can be adopted by other countries in the region.

"EPHI has very good experience with Ethiopian postal system to provide HIV specimens referrals. Sample referral network was based on proximity, tracking is done but is paper based and specimens transport is GPS monitored.

[38] https://aslm.org/wp-content/uploads/2020/05/LabCoP-Mar-2020-Newsletter-A4.pdf?x11001
[39] Terms of Reference for Request for Proposals Fleming Fund Country Grant to Kenya RFP/CG1/Kenya

Standard transport system with biosafety and biosecurity facilities exists. Concerns are how can dangerous pathogens be transported during outbreaks and emergencies?" – ***Laboratory Focal Point, EPHI***

Kenya: Kenya has a well-established nationwide laboratory specimen referral network for selected pathogens, including COVID-19, Acute Febrile Paralysis (AFP), measles, viral hemorrhagic fevers, HIV, and TB. Kenya utilizes a mixed model for sample transportation that includes G4S national contracted couriers, motorcycle couriers, and couriers contracted by country partners. For viral-load testing, 66 percent of facilities that are close to testing laboratories send plasma samples, whereas 34 percent of remote facilities send dried blood spots.

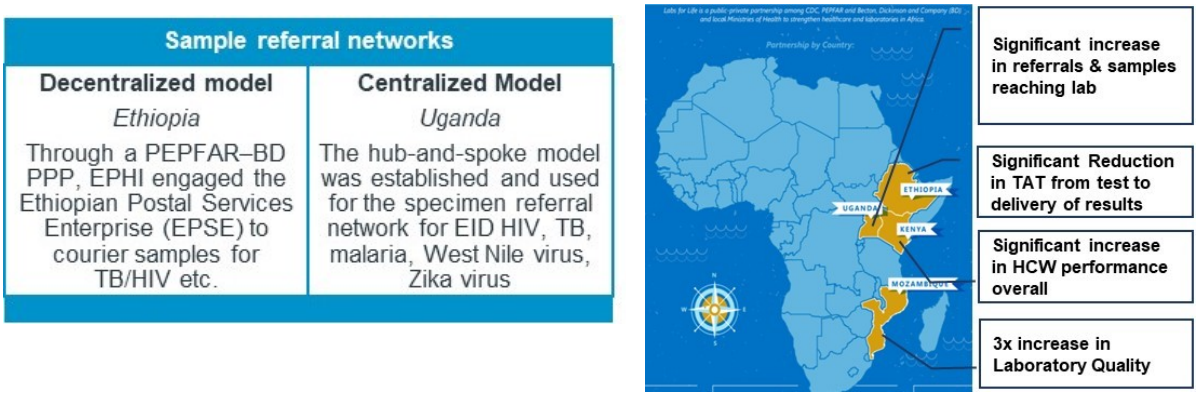
South Africa: South Africa has established a functional, nationwide specimen referral system.

Zambia: In Zambia, there are well-established mechanisms for specimen referral in HIV. For example, under the President's Emergency Plan for AIDS Relief (PEPFAR) project implemented by the US government, 3,000 facilities have been linked to 200 sample-collection hubs and 24 HIV viral-load testing sites. Specimens are collected from mortuaries, health facilities, and the community and transported through a new emergency courier system for inter-provincial referral to eight testing laboratories. Meanwhile, the preexisting sample referral system is being expanded to include inter-provincial referral.[40]

Zimbabwe: Zimbabwe has adopted an integrated sample transportation system utilizing motorcycles, which is intended to streamline the country's existing system. Using a hub-and-spoke model, a mapping exercise has been performed for health facilities using GPS coordinates. An operational framework has been created and is slated to be operationalized by January 2020 with financing from the Global Fund.[41] MoUs have been signed with neighboring countries to enable cross-border collaboration. The East, Central and Southern Africa Health Community (ECSA-HC) has been instrumental in developing cross-border collaborations by strengthening laboratories and extending support to member states.

Malawi: Malawi has activated eleven laboratories for COVID-19 testing and 66 laboratory personnel have been trained in RT-PCR testing. Specimens are collected at the homes of suspected cases by District Rapid Response Team and transported to testing laboratories in ambulances/ utility vehicles. Riders for Health personnel have also been oriented on specimen transportation. [42]

The figure below illustrates the referral and transportation system used by "Labs for Life," a PEPFAR PPP.[43]



Specimen referral networks are not integrated and operate in isolated silos organized around individual programs and diseases. In Kenya, Zambia, and South Sudan, specimen referral networks are in place for programs targeting TB, HIV, viral hemorrhagic fevers, Acute Febrile Paralysis (AFP), and measles. These parallel networks increase the overall cost of the system, and leveraging the existing specimen referral networks for diseases like HIV could enable countries to quickly scale up their specimen referral capacity for multiple priority diseases. Creating efficient referral mechanisms in a single country can enable other countries to replicate those mechanisms and scale them for cross-border collaboration and regional integration. However, limited human resources are a longer-term challenge, and stakeholder interviews highlighted the importance of training staff in specimen referral and transportation.

RISLNET can play an important role in strengthening specimen referral systems in public health laboratories and networks. The Africa CDC and the RCC can provide oversight and coordinate country-level activities, including high-level engagement with policymakers, in-country coordination, and resource mobilization, and they can assist national health ministries, NRLs, and NPHIs in developing action plans for improving sample transportation systems based on identified gaps. National authorities will be responsible for mapping laboratory capabilities and creating a workforce-development plan

[40] https://aslm.org/resource/covid-19-echo-session-14-specimen-referral-systems-for-sars-cov-2-testing/
[41] https://aslm.org/wp-content/uploads/2019/11/Zimbabwe-IDC-presentation-1.pdf
[42] https://aslm.org/wp-content/uploads/2020/07/1594185240-Country-SRS-Overviews.pdf
[43] Importance of Public-Private Partnerships: Strengthening Laboratory Medicine Systems and Clinical Practice in Africa Article in The Journal of Infectious Diseases · Ritu Shrivastava Centers for Disease Control and Prevention et al April 2016 DOI: 10.1093/infdis/jiv574

for sample transportation. Developing these capabilities in each country in the region will be a difficult process, and leveraging cross-border collaboration could facilitate capacity-building while covering gaps in national referral frameworks.

c) Laboratory Quality Management

Most RCC member states follow specific guidelines for ensuring laboratory quality and have national EQA programs in place. In South Africa, EQA programs cover a wide range of tests, but EQA coverage is limited in other countries. For example, in Ethiopia, EQA programs do not fully cover all priority diseases, though the country has robust systems for hematology, clinical chemistry, blood banking, parasitology and bacteriology testing. All RCC member states except Somalia follow SLIPTA/SLMTA or other quality-control guidelines for laboratory services and accreditation.

Ethiopia: In Ethiopia, five national reference laboratories have achieved accreditation to ISO standards by the National Accreditation Office, while another five are improving laboratory quality control as part of SLIPTA/SLMTA initiatives. Ethiopia has been a member of the African Accreditation Cooperation for the last three years and has established the Ethiopia National Accreditation Office. The NRL supports subnational laboratories with biosafety certification, equipment calibration, and preventive maintenance services by providing access to skilled biomedical engineers. The Medical and Health Science Training Institution also provides support for licensing and certification. The Ethiopian NPHI has the potential to emerge as a regional center of excellence, and the country's NRLs can provide EQA to laboratories in other countries in the region, along with mentorship and support.

Kenya: Kenya has more than 10 ISO 15189 accredited laboratories, including a microbiology NRL, an HIV NRL, and an influenza NRL based at NPHLS. Laboratories in Kenya are accredited through the Kenya National Accreditation Service, as well as SANAS and the College of American Pathologists. Most Kenyan laboratories also participate in SLIPTA's stepwise accreditation process. Kenya's COVID-19 PCR testing laboratories participate in a split-sample testing EQA program run by the influenza NRL. Licensing of laboratories and personnel is the responsibility of the Kenya Medical Laboratory Technicians and Technologist Board, which conducts routine inspections to determine if laboratories follow its guidelines and if personnel are qualified to practice. However, compliance with quality standards is voluntary, and the licensing process for government laboratories is lax.

Uganda: Under EAPHLN, Uganda is playing an important role in regional quality assurance and accreditation. Organizations like the ASLM have been instrumental in enabling countries to scale up the implementation of the SLIPTA program. As part of regional peer audit mechanisms established through EAPHLN, certified assessors trained by ASLM conduct annual assessments of laboratories in neighboring countries.

Zambia: Three Zambian laboratories and the Tropical Disease Research Centre have been accredited by the Southern African Development Community Accreditation Services in ISO 15189. Zambia has a council of health professionals, and the licensing of laboratories is mandatory.

Zimbabwe and South Africa: Zimbabwe and South Africa host two regional centers of excellence for quality assurance. SANAS is the accreditation body for both countries, and the quality of laboratory systems is monitored by the Medical Laboratory and Clinical Scientist Council.

Zambia, South Africa, and Zimbabwe had established regulations for private laboratories, but the private sector is less well-regulated in other countries. Zambia, South Africa, and Zimbabwe oversee the registration of health professionals and the licensing and accreditation of private laboratories. However, a World Bank study in Ethiopia found that the regulatory framework was outdated, and its implementation was uneven, though both were gradually improving. The study also identified a lack of political commitment and policy gaps in the areas of facility licensing, human-resources certification and licensing, the accreditation of private medical training institutes, and PPP authority and capacity. In South Africa, the licensing and accreditation of private laboratories is not mandatory.

Important advances in laboratory accreditation notwithstanding, the harmonization of quality system guidelines will be essential to facilitate integration. Moreover, the experience of COVID-19 testing has demonstrated that subnational quality controls must be strengthened, especially since introducing new tests during an outbreak can be highly challenging.[44] EQA in COVID-19 testing may be performed through rechecking or retesting in a different laboratory. NRLS can also provide remote monitoring and supervision for laboratories performing COVID-19 tests. Health authorities must implement quality-control policies for all tiers of the national laboratory network, not solely for central-level laboratories.

RISLNET can leverage the high-quality laboratory infrastructure and centers of excellence already present in both regions. Drawing on lessons from the implementation of the EAPHLN project in Uganda, RISLNET can help laboratories adhere to international quality-control standards such as SLIPTA/SLMTA and provide standardized guidelines for achieving ISO 15189 accreditation. The limited and uneven implementation of quality-control policies is a major constraint, and one that RISLNET is uniquely positioned to address. Some countries have not developed formal quality-control policies for laboratories, while others have yet to establish agencies tasked with implementing those policies. In some cases, national policies are not aligned with ISO 15189 accreditation, and domestic laboratory accreditation and quality control are limited

[44] https://aslm.org/wp-content/uploads/2020/05/Assuring-quality-test-results-short-version-pdf.pdf

to laboratory-level strategic plans. Regional integration will allow for the harmonization of quality-control processes around international accreditation standards. SOPs and guidelines will have to be developed to support the harmonization process, and RISLNET, the Africa CDC, and the RCCs, will have to build national capacity for SLIPTA/SLMTA implementation.

d) Laboratory Information Management System (LIMS)

Ethiopia: In Ethiopia, 28 regional and hospital laboratories use a standardized LIMS to share data with the Ethiopian NPHI: 26 laboratories use Comp Pro Med's Polytech LIMS, which is supported by the US CDC, while two others use Smartcare and Sota. The NPHI, in collaboration with the Clinton Health Access Initiative (CHAI), has developed dedicated databases for HIV viral-load testing and early infant diagnosis at the NPHI's HIV NRL, and another 18 molecular-testing laboratories across the country transfer testing data to the NPHI's Central Data Center in real time. Plans are in place to expand this system to encompass other priority diseases such as TB, malaria, and Acute Febrile Paralysis (AFP). Ethiopia has adopted DHIS2 as its national health management information system, and efforts are underway to integrate laboratory data captured by a suitable and interoperable LIMS into the DHIS2 platform. A 2018 laboratory-mapping survey found that 86 laboratories (68 percent of the total surveyed) were not connected to an information platform, and more than 80 percent of public health and clinical laboratories lacked access to LIMS.

"In Ethiopia, surveillance and laboratories are networked and institutionalized within the NPHI. Being institutionalized could mean more efficiency and coordination. Ethiopia can potentially support the RCC in Kenya through the Ethiopian NPHI, which has comprehensive facilities."– **Focal Point, EPHI**

Kenya: In Kenya, NPHLS reference laboratories Kenya Medical Research Institute reference laboratories use Labware LIMS. LabWare's mobile technology is being used to streamline the COVID-19 patient registration and sample collection process as part of field-based specimen collection and COVID-19 testing operations. COVID-19 laboratory data are integrated with surveillance data managed by Kenya Electronic Medical Records under the national PHEOC. A case-based surveillance system exists for priority diseases, including measles, polio, yellow fever, viral hemorrhagic fevers, and HIV, and information is reported to Kenya Electronic Medical Records and then entered in aggregate form in the DHIS2. There is no regulatory framework for patient protection or data privacy

South Africa: The South African NHLS consists of more than 270 sites representing around 80 percent of pathology data in the country. It uses the TrakCare Laboratory Information System,[45] as do the National Institute of Communicable Diseases and National Institute of Occupational Health Laboratories. The system captures laboratory, financial, and staffing information, as well as national-level survey data on disease prevalence and district-level health information that can be used to conduct disease surveillance, identify gaps in coverage, and report the results of interventions.

Zambia: DisaLab software is being used to collect laboratory-related information, with funding from the US CDC and PEPFAR. Currently, this LIMS is being used in four viral-load testing facilities and five tertiary hospitals. The software has an annual subscription fee, which is paid by donors, while the Zambian authorities have control over LIMS operations and access to the data. To ensure sustainability, donors are paying for permanent software licenses for some facilities and training members of the Ministry of Health on software use and maintenance. However, there has been no financial commitment from the Ministry of Health, and thus the LIMS remains donor-dependent. There is no clear regulatory framework for data protection and privacy.

Kenya, Uganda, Zambia, Zimbabwe, Mozambique, South Africa, and Malawi have implemented DHIS2 at the national level, either completely or partially. Though laboratory data do not flow into the DHIS2 directly, the aggregated data from case-based surveillance are available. However, LIMS suffer from weaknesses in supply-chain management, integration with health information management systems, internal data management, and reporting. Inadequate human resources also hinder the implementation of LIMS. By strengthening regional communication and leveraging economies of scale in data management, RISLNET can help the RCC member states overcome these constraints. Networking regional laboratories using standardized platforms or data-sharing mechanisms can enable domestic and international data sharing. With support from RISLNET, the DHIS2 can be customized to capture and report case-based surveillance and laboratory data across countries in each region.

e) Supply Chain Management

Supply-chain management for laboratories has been identified as a priority in NLSPs, but inefficiencies exist both at the regional and country levels. Frequent shortages of laboratory supplies have been observed in many RCC member states. In Ethiopia, the procurement agency faces challenges in bulk procurement that disrupt the supply chain, and the 2018 laboratory-mapping survey found that 17 percent of surveyed laboratories did not have adequate storage for reagents and supplies. Frequent stockouts of reagents and media have also been observed in Zambia at the subnational level. To

[45] https://aslm.org/wp-content/uploads/2019/11/Wendy-Stevens-NHLS-data-strategy_-IDC-2019_3.11.pdf

emerge as regional hubs, NPHIs in both the countries will have to develop their capacity to forecast laboratory needs and address supply-chain management challenges. The COVID-19 pandemic has highlighted the difficulty of accessing diagnostic products during an ongoing crisis due to export restrictions, unreliable product quality, and long delivery times.[46]

RISLNET can help resolve these challenges through targeted capacity-building in systematic forecasting and quantification. Capacity-building programs in these and related areas should be led by the Africa CDC and the RCCs. Regional integration will also facilitate the Africa CDC's strategic interventions in pooled procurement and centralized purchasing and storage. Finally, a coordinated approach to supply-chain management will help standardize laboratory commodities and ensure the procurement of quality products.

f) Human Resources

Limited human resources has been identified as a major challenge, and many health systems face an inadequate supply both of trained professionals and of specific skills. Laboratory professionals are among the most neglected cadres of skilled workers in African health systems. In many cases, they work in poorly equipped and unsafe facilities, and they often have limited opportunities for training or career advancement. At the national level, the NLSPs of Ethiopia and Zambia have highlighted human resources as one of the key focus areas, yet both countries face shortages of laboratory staff. In Ethiopia, medical laboratory professionals make up about 4 percent of the total health workforce.[47] There are fewer than two biomedical engineers at the district level, as opposed to the three to eight prescribed by WHO staffing norms, and both countries have fewer than one microbiologist per laboratory. At the national level, the Ethiopia NPHI houses NRLs that have the capacity to conduct advanced diagnostic tests, but stakeholder consultations and human-resource data reveal that Ethiopia must overcome the shortage of laboratory professionals to become a regional center of excellence in diagnostics.

Though national laboratory plans have emphasized recruitment and provided clear job descriptions and career pathways for laboratory professionals, countries still struggle to attract and retain skilled workers. For example, more than 50 percent of laboratory professional positions in Zambia's public sector are vacant. Laboratory work is not considered a critical profession, and the training and recruitment of new personnel is limited. Country-level strategic plans emphasize hiring from the private sector, but they do not provide clear guidelines and regulations for private laboratory staff. High attrition and migration rates further attenuate the supply of laboratory professionals, and migration is an especially acute problem in conflict-affected states such as Somalia and South Sudan.

Number of Laboratory Professionals in Ethiopia and Zambia by Category, 2020

Categories	Ethiopia	Zambia
Medical/clinical Laboratory personnel	9468	1800
Microbiologists	126	18
Biomedical Engineers	485	-
Source: Zambian and Ethiopian Ministries of Health		

Average Annual Throughput of Institutes Offering Laboratory Courses in Zambia, 2019-2020

Courses	Intake/Admissions	Output
Diploma	90	45
Degree	70	65
Masters	15	10
Source: Zambia NPHI		

While managing human resources is a national-level challenge, RISLNET can facilitate the process by providing standard norms and guidelines for laboratory professionals. Capacity-building in personnel recruitment and retention could be included in the NLSPs supported by RISLNET. The Africa CDC can advocate for the adoption of WHO staffing norms by the RCCs and their member states, though implementation will remain within the purview of country-level stakeholders. Kenya has developed guidelines on the number of laboratory staff required at each tier and cadre and defined career pathways for laboratory professionals under the Public Service Commission; these standards can be replicated by other countries in both RCCs.

International institutions offer technical training for laboratory professionals. The ASLM has partnered with the US CDC to train RCC member states on COVID-19 biosafety guidelines, including the packaging and transportation of specimens.[48] These trainings are provided via the ECHO platform. ASLM has also partnered with the Africa CDC and other organizations to offer virtual trainings, information, and technical assistance related to COVID-19. As of September 2020, a total of 22 sessions involving 681 participants had been conducted on topics including testing instrumentation, troubleshooting, serological tests, and PCR. These training sessions are being continually added and updated, and they demonstrate the usefulness of the ECHO platform to strengthen laboratory capacity during an ongoing outbreak. Additional ECHO sessions have highlighted the importance of decentralizing testing and integrating it with existing services to improve diagnostic capacity. The Global Fund also offers technical guidance and tools for sustainable healthcare waste management.

[46] https://aslm.org/wp-content/uploads/2020/05/supply-chain_covid-19_ACDC.pdf
[47] HRH directorate, MOH, Ethiopia
[48] https://aslm.org/wp-content/uploads/2020/10/LabCoP-Sep-2020-Newsletter-A4-1.pdf?x11001

Many leadership programs are offered at the facility level, but no training is currently available on the skills required to manage multi-tiered national laboratory networks. To address this gap, ASLM is working with the WHO, Africa CDC, APHL, Columbia University, and other partners to create training courses on optimizing laboratory networks.

RISLNET could leverage several continental and regional capacity-building initiatives to expand the diagnostic skills of personnel in RCC member states. For example, the US CDC, ASLM, the American Society for Clinical Pathology, and the American Society for Microbiology reviewed the pre-service curriculum of medical laboratory training programs in various PEPFAR-supported countries of Eastern Africa, including RCC member states Kenya and Ethiopia, in an effort to improve and standardize their content. Kenya introduced the Field Epidemiology and Laboratory Training Programme (FELTP) in 2004. FELTP has now expanded to almost all countries in Eastern and Southern Africa, but all FELTP programs are members of the African Field Epidemiology Network based in Kampala. FELTP aims to build the capacity of laboratory professionals through competency-based applied epidemiology and public health laboratory management training. The fellowship program trains cadres of human- and animal-health professionals together and has greatly improved the relationship especially between human and animal health departments in line with the One Health approach.

The Africa CDC's Institute of Workforce Development has identified priority areas for building the capacity of laboratory professionals. The Africa CDC is working with ASLM to enhance AMR-related competencies, and ASLM provides laboratory mentorship and quality-assurance support to RCC member states and other countries. Additional capacity-buildings networks and centers include the African Field Epidemiology Network, the Mériux Foundation, the Supranational Reference Laboratory Networks, the Southern African Center for Infectious Disease Surveillance (SACIDS), the African Centre for Integrated Laboratory Training, that have been leading trainings for laboratory professionals. Under the ECSA-HC and EAPHLN, the Tanzanian government leads training-of-trainers and capacity-building programs.

The Africa CDC has undertaken trainings for laboratory professionals to improve COVID-19 testing. The Africa CDC's AFTCOR initiative has been instrumental in developing capacities for the African Union member states to scale up COVID-19 testing capacity. The AFTCOR collaborated with several institutes like South African National Institute for Infectious Diseases, the Institute Pasteur of Dakar, and the West African Health Organization to train staff from reference laboratories in the molecular detection of SARS-CoV-2. The Africa CDC Pathogen Genomics Intelligence Institute, which is also part of the joint continental COVID-19 strategy, provides training and resources to 16 AU member states and aims to generate up to 2,500 SARS-CoV-2 whole-genome sequences for submission to the Global Initiative on Sharing All Influenza Data platform. ASLM has also played a key role in training national staff on both basic and specialized COVID-19 testing. These trainings have highlighted supply-chain gaps, and the experience of South Korea underscores the necessity of establishing a well-functioning specimen referral and transportation system.

The private healthcare firm Becton Dickinson formed the "Labs for Life" PPP with PEPFAR, while Siemens Healthineers established the "Stronger Together" PPP with the US CDC. These PPPs are designed to strengthen laboratory systems in Ethiopia, Kenya, Tanzania, Uganda, and Zambia by providing training in resource-constrained settings via e-learning the virtual education platform PEPconnect.[49] The African Regional Collaborative for Laboratory Technologists has worked with Roche-PEPFAR to provide training on HIV viral-load testing to nurse leaders from 17 Sub-Saharan African countries, and another PPP with Roche Diagnostics focuses on improving early infant diagnosis and viral-load monitoring.[50]

An uneven distribution of staff may further strain the available human resources. The skewed distribution of laboratory professionals toward major cities and away from more remote areas has been observed across African countries, including Ethiopia and Zambia. While incentive schemes have attempted to attract health workers to underserved regions, they rarely cover laboratory professionals. For example, the Zambian Ministry of Health created the Health Workers Retention Scheme and other performance-based incentives, but these programs do not cover laboratory professionals. In Ethiopia, the laboratory plan mentions staff retention and incentives as one of its strategic areas, but it lacks a clear action plan. Similar challenges have been identified in Kenya and Uganda. In addition to a lack of targeted incentives, poor working environments and the unavailability of suitable accommodation in rural areas have been identified as key challenges affecting the distribution of laboratory professionals.

Most RCC member states lack critical information on the human resources involved in disease identification, detection, analysis and response. Regional integration through RISLNET could support workforce development while also mapping the distribution of human resources at the national and regional level. Creating a reporting system and database could enable health authorities to track the evolution of human resources in real time. As it supports countries in developing national strategic plans, RISLNET can provide training in professional incentive systems and staff retention policies.

[49] https://www.businesswire.com/news/home/20140922005881/en/New-Public-Private-Partnership-E-Learning-Fight-HIVAIDS; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6339398/; https://aslm.org/resource/pepfar-hiv-rapid-testing-continuous-quality-improvement/; "Innovative Public-Private Partnerships for Global Laboratory System Strengthening to Accelerate Epidemic Control", US CDC

[50] https://aslm.org/wp-content/uploads/2019/11/LabCoP-July-2019-Newsletter-1.pdf?x11001

Maps of Existing Regional Laboratory Networks

East Africa Public Health Laboratory Networking Project (EAPHLN)

TB, other communicable diseases

- **41 labs across 5 countries** for diagnosis and surveillance of communicable diseases.
- It links NRLs and district (county) level laboratories through knowledge sharing and joint activities.

WHO TB Supranational Reference Laboratory (SRL) Network

TB Diagnostics and Laboratory Strengthening

- Network of **32 global SRLs including 1 in Uganda**
- **4 National CoE including 1 in South Africa.**
- Coordinate with National Reference Labs and National TB Programs for TB drug resistance surveillance, capacity building.

WHO Global Rotavirus Laboratory Network (GRLN)

Rotavirus

- Network of 1 global reference lab in US
- 9 **regional reference labs including 1 in South Africa**
- 69 national labs and 187 site labs globally for rotavirus surveillance and detection

Invasive Bacterial Vaccine-preventable Diseases (IB-VPD)

Pediatric Bacterial meningitis

- Network of 1 global reference lab in US.
- **9 regional reference labs** and 26 national labs and 88 site labs globally for IB-VPD surveillance and detection.

WHO Global Polio Laboratory Network(GPLN)

Polio Surveillance & Immunization

- 16 WHO accredited polio labs (92 globally) incl. **1 regional reference lab in South Africa** for conducting surveillance, research and immunization activities.

Global Measles and Rubella Laboratory Network(GMRLN)

Measles, Rubella

- **49 laboratories in 44 countries** in Africa.
- Network provides Accreditation Program, EQA and training to labs.

Global Yellow Fever Network

Yellow Fever

- **21 labs in Africa with UVRI, Uganda**
- As **WHO regional reference lab** to provide confirmatory testing for suspected outbreaks; quality control for national labs.

WHO Global Influenza Surveillance and Response System (GISRS)

Influenza

- Network of 143 institutes across 113 member states globally.
- Includes national influenza centers, WHO collaborating center, H5 reference labs.
- Covers the cost of shipping specimens to WHO CC and provide EQA.

African Cholera Surveillance Network (AFRICHOL)

Cholera Surveillance

- Aims to strengthen surveillance, laboratory confirmation and capacity building for cholera.
- NICD, South Africa participating for lab quality control and genotyping.

African Network for Influenza Surveillance and Epidemiology (ANISE)

Influenza

- **More than 260 members from more than 30 countries**
- To improve detection, case management, control, prevention of influenza

Several ongoing initiatives are designed to strengthen laboratory staff capacity across the region.

- The WHO's **Human Papilloma Virus Laboratory Network** links one regional reference laboratory in South Africa with two emerging laboratories in Uganda and Kenya.
- The **Southern African Tuberculosis and Health Systems Support Project** assists Lesotho, Malawi, Mozambique and Zambia in building disease-surveillance and laboratory capacities through regional coordination, policy advocacy, and operational research. The project has four centers of excellence for multi-drug-resistant TB, integrated disease surveillance, TB management, and occupational health.
- The **Fleming Fund** helps lower-middle-income countries address AMR through grants, global projects, and professional fellowship programs. Fleming Fund grants to 24 countries,[51] including Kenya, Uganda, Zambia, Zimbabwe, and Malawi, support improvements in laboratory infrastructure, transportation, logistics, staff trainings, IT systems, equipment maintenance, One Health surveillance protocols, quality control, data sharing, and biosafety and biosecurity.
- The ASLM's laboratory-mapping tool **LabMaP** aims to improve the functionality of national and regional laboratory networks by sharing existing resources and increasing diagnostic testing capacity.
- The **Laboratory Systems Strengthening Community of Practice (LabCoP)** platform enables the sharing of information and best practices for viral load scale-up and laboratory strengthening in partnership with the ECHO project.[52] LabCoP also provides facility-level guidelines for biosafety, sample packing, and shipment.[53] The LabCoP guidelines highlight the importance of EQA and provide tools for COVID-19 proficiency testing.[54]
- **ASLM** has developed comprehensive guidelines and best practices for sample transportation and quality management. Its sample-transportation guidebook highlights key aspects of different models and describes best practices for supply-chain management, viral-load supply planning, the use of dried blood spot tests in remote areas, etc.[55] ASLM prescribes the use of third-party evaluations and sample verification at national reference laboratories or WHO laboratories.
- ASLM and the Association of Public Health Laboratories have jointly developed the **LABNET** scorecard to measure the performance of national laboratory networks. ASLM also supports the implementation of the WHO's **SLIPTA** program.[56]
- The Foundation for Innovative New Diagnostics and Becton Dickinson are jointly developing and piloting an **AMR Scorecard for Laboratory Quality Improvement.**[57]
- **GERMS-SA**, a network of public and private clinical microbiology laboratories in South Africa, has formed an active laboratory-based surveillance program.

Strengths and Weaknesses of the EAPHLN

The EAPHLN was launched by the World Bank with five participating countries, Burundi, Kenya, Rwanda, Tanzania and Uganda, and a regional steering committee composed of representatives from ECSA-HC and the East African Community. Key activities include improvements in quality assurance and progress toward accreditation through participation in SLIPTA/SLMTA, and 94 percent of participating facilities have attained at least three out of five stars, far above the 9 percent recorded at the project's inception. Moreover, nearly 40 percent of participating facilities have reached the gold standard of international accreditation. Regional peer auditing mechanisms were introduced under which certified assessors conducted annual peer assessments of laboratories in neighboring countries to promote knowledge sharing, encourage transparency, and generate cost savings. The EAPHLN has supported the rollout and testing of new TB diagnostics, such as GeneXpert, to improve access to more accurate testing for underserved populations in cross-border areas. The ECSA-HC has developed frameworks for cross-border collaboration to improve disease surveillance and outbreak response, and participating facilities have also been upgraded to better cope with outbreaks.

An assessment of EAPHLN labs in 2016 cited limited demand from physicians for microbiology cultures. The assessment also highlighted AST as among the causes of the underutilization of resources. Limited demand has also been attributed to the length of time required to obtain results, which is at least two days, as well as limited trust in results and limited laboratory capacity for blood cultures. Almost all blood cultures were processed in Ugandan laboratories, as few other facilities have this capability.

[51] https://www.flemingfund.org/about-us/investment-areas/
[52] https://aslm.org/
[53] https://aslm.org/wp-content/uploads/2020/10/BookletLabCoPCookbook5-2020-10-08-WebQuality-A4.pdf?x11001
[54] https://aslm.org/wp-content/uploads/2020/10/BookletLabCoPCookbook5-2020-10-08-WebQuality-A4.pdf?x11001
[55] https://aslm.org/wp-content/uploads/2019/11/BookletLabCoPCookbook1-2018-07-20-Web.pdf?x11001
[56] https://au.int/sites/default/files/documents/32386-doc-4._presentation_acdc_labnet_p_ondoa.pdf
[57] https://www.bd.com/en-us/company/news-and-media/bd-blog/bd-partners-with-global-organizations-to-support-diagnostic-testing-for-amr

Infectious Disease and AMR Surveillance

Leveraging Regional Integration to Improve Surveillance

Disease surveillance plays a critical role in early detection and mitigation of public health threats through the systematic collection, analysis, and interpretation of health-related data. National surveillance systems help countries monitor and evaluate emerging patterns and trends of diseases, and this information can be used to develop targeted interventions to address outbreaks and prevent potential epidemics. The Africa Regional Strategy for Integrated Disease Surveillance and Response (IDSR) has set ambitious targets, including 90 percent coverage of IDSR at the national level. The IDSR strategy has encouraged investment in national surveillance systems, but progress has varied across countries. With increasing cross-border outbreaks, it is imperative to support countries with inadequate surveillance systems in detecting and responding to public health threats. This, in turn, will help in maintaining national and subsequently regional health security. Regional integration provides an opportunity for countries to strengthen their capacities by accessing assets and best practices in the region. There are existing disease-surveillance networks with cross border mandates, which help in ensuring cross-border coordination, data sharing and reporting, conducting joint simulation exercises, trainings and capacity building, operational research, and knowledge exchange. National disease surveillance systems and regional surveillance networks are providing critical support to countries in tackling the COVID-19 pandemic, and the Africa CDC has formulated a mechanism for reporting national statistics at the regional level, which are then consolidated at the continent level to track disease trends.

Several regional surveillance networks are engaged in addressing the COVID-19 pandemic. The Africa CDC, SACIDS and East African Integrated Disease Surveillance Network (EAIDSNet) have collaborated on COVID-19 surveillance and diagnosis in countries considered to be at especially high risk. The partnership is built on existing systems for monitoring influenza-like illnesses and severe acute respiratory infections. EAIDSNet member countries hold regular discussions on coordinating surveillance across borders to slow the transmission of COVID-19. Member countries have established the EAC Regional Electronic Cargo and Drivers Tracking System,[58] which will provide information directly to designated laboratories. The WHO has adapted existing mobile-phone applications developed for disease surveillance and outbreak response to be deployed during the COVID-19 pandemic, and over 100 disease-surveillance officers in Zimbabwe are using these tools for case investigation and contact tracing. The SACIDS Foundation for OneHealth has collaborated with the Africa CDC to develop a COVID-19 surveillance manual for training community health workers, and SACIDS and EAIDSNet partner institutions have begun sequencing complete SARS-Cov-2 genomes to identify transmission patterns. Further regional integration under RISLNET could magnify the positive impact of recent improvements in national and regional surveillance systems.

This chapter examines the effectiveness of existing norms and guidelines in the context of country-level infectious disease and AMR surveillance systems. It analyzes cross-cutting areas, including legislative and policy frameworks, human resources, IT systems, and private-sector participation, and it presents a map of regional surveillance networks that can be leveraged by RISLNET. The analysis presented in the chapter also incorporates feedback from RCC member states on the prospective benefits of RISLNET, especially for countries with limited institutional capacity.

The following tables describe the extent to which RCC member states adhere to the WHO's technical guidelines of the IDSR. These guidelines list priority diseases, and each country can adapt the guidelines to suit its local epidemiological situation, needs, and health system. Similarly, WHO GLASS lists priority AMR pathogens for surveillance, including E. coli, K. pneumoniae, salmonella spp., acinetobacter spp., S aureus, S pneumoniae, N gonorrhea, shigella spp. isolated from clinical specimens. Table 1 shows priority infectious diseases, and Table 2 shows priority AMR diseases. The matrix that follows the tables maps the status of national surveillance systems against the core IDSR functions and activities described in the 2019 WHO Technical Guidelines for IDSR in the Africa region. Green represents "full adherence," yellow represents "partial adherence," and orange represents "little or no adherence." The gaps identified in this exercise are detailed in the subsequent section, which also identifies assets that RISLNET can leverage to strengthen national disease-surveillance capabilities.

[58] https://www.eac.int/press-releases/147-health/1736-eac-partner-states-adopt-the-eac-regional-electronic-cargo-and-drivers-tracking-system

Table 1: IDSR Priority Diseases by Country

(infectious diseases only)

Sno		Priority Diseases	Ethiopia	Kenya	Uganda	Somalia	South Sudan	Zambia*	South Africa	Zimbabwe	Malawi	Mozambique
1	Vaccine Preventable Diseases	Avian Human Influenza										
2		Cholera										
3		Dengue										
4		Diptheria										
5		Hepatitis (B)										
6		Malaria										
7		Measles										
8		Meningococcal Meningitis										
9		Neonatal Tetanus										
10		Pandemic Influenza A (H1N1)										
11		Pertussis (Whooping cough)										
12		Poliomyelitis										
13		Pneumonia										
14		Rabies										
15		Smallpox										
16		Tuberculosis										
17		Typhoid fever										
18		Yellow fever										
19	Syndromes	Acute Flaccid Paralysis (AFP)										
20		Acute jaundice syndrome										
21		Diarrhoea										
22		Febrile Syndrome/ Relapsing fever										
23		Haemolytic uraemic syndrome										
24		Meningitis Syndrome										
25		Severe acute respiratory syndrome (SARS)										
26		Severe acute respiratory Illness (SARI)										
27		Viral haemorrhagic fever (VHF)*										
28	Other Diseases	Acute rheumatic fever										
29		Anthrax										
30		Botulism										
31		Brucellosis										
32		Chikungunya										
33		Dracunculiasis / Guinea worm										
34		Dysentery (Diarrhoea with blood)										
35		HIV/AIDS, New AIDS Cases										
36		Kala Azar (Leishmaniasis)										
37		Legionellosis										
38		Leprosy										
39		Listeriosis										
40		Lymphatic Filariasis (Elephantiasis)										
41		Onchocerciasis										
42		Plague										
43		Schistosomiasis										
44		STIs										
45		Trypanosomiaisis										
46		Typhus										

Table 2: Surveillance of Priority AMR Pathogens by Country

AMR Pathogens	Ethiopia	Kenya	Uganda	Zambia	South Africa	Zimbabwe	Malawi	Mozambique
E. coli								
K. pneumoniae								
Salmonella spp.								
Acinetobacter spp.								
S aureus								
S pneumoniae								
N gonorrhea								
Shigella spp.								
Vibrio cholerae								
Pseudomonas aeruginosa								
Haemophilus influenzae								
Enterococci								
Typhi								
Mycobacterium tuberculosis								

*Ebola, Marburg, Rift Valley, Lassa, Crimean Congo, West Nile Fever

Immediate Reporting (Same day)

Weekly or Monthly Reporting

Eastern Africa

Area	Requirements	Ethiopia[59]	Kenya	Uganda[60]	Somalia[61]	South Sudan[62]
2.2.1 Case/ Condition/ Event Identification						
National IDSR policies and guidelines	*IDSR guidelines developed; laws incorporate IHR*	Guidelines developed; legislative framework incorporates IHR	Guidelines developed; standalone laws incorporate IHR	Guidelines developed; legislation being revised to incorporate IHR	Guidelines not developed; limited IHR legislation	Guidelines developed; limited IHR legislation
Indicator-based surveillance (infectious diseases only)	*Priority diseases*	20	30	24	12	25
	IBS systems exist at all levels; at least three syndromes surveilled	IBS system in place; non-standardized surveillance of at least five syndromes	IBS system in place; non-standardized surveillance of at least six syndromes	IBS system in place; non-standardized surveillance of at least five syndromes	IBS not fully functional; partial surveillance of four syndromes	IBS not fully functional, EWARN being used; partial surveillance of at least five syndromes
Event- and community-based surveillance	*EBS and CBS at all levels via both formal and informal channels*	EBS not fully functional; CBS being piloted (toll-free number, rumor logbook used)	EBS being scaled up; CBS being piloted (media and rumor reports used)	Well-functioning EBS and CBS in place (anonymous reports, toll-free number used)	EBS not fully functional (not systematic or integrated into regular reporting)	EBS not fully functional (information collected only through formal reporting channels)
2.2.2. Case/ Condition/ Event Reporting						
Data aggregation and timely reporting	*IDSR bulletin disseminated with at least 80% timeliness and completeness*[63]	Bulletin disseminated with 85%[3] timeliness and completeness	Bulletin disseminated with 70% completeness	Bulletin disseminated with 69% timeliness and 70% completeness	No bulletin disseminated (50% of health services delivered in facilities with no reporting)	Bulletin disseminated with 39% timeliness and 57% completeness
Incorporation of laboratory reporting	*Laboratory data integrated into surveillance*	Data not integrated	Laboratory data shared weekly but not integrated with DHIS2	Data not integrated	Data not integrated	Data not integrated
2.2.3. Case/ Condition/ Event Analysis and Interpretation						
Data analysis	*Regular data analysis and validation*	Regular data analysis at national and regional levels,	Regular data analysis at national level and validation through DHIS2	Regular data analysis at district and national levels, but no regular data validation	No standard system for data collection, analysis, or validation	Analysis via EWARS, but no regular validation

[59] IQVIA Primary Research; JEE Reports; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5619923/
[60] https://www.panafrican-med-journal.com/content/series/27/4/5/full/
[61] http://www.emro.who.int/somalia/news/somalia-rolls-out-ewarn-as-surveillance-for-covid-19-increases.html
[62] South Sudan IDSR Epidemiological Weekly Bulletin, December 2019
[63] Africa Regional Strategy for Integrated Disease Surveillance and Response, 2020–2030

		but no regular data validation				

2.2.4. AMR National Action Plan						
National action plan	*Plan developed*	Yes	Yes	Yes	Developed but not approved	No
Surveillance system	*Pathogens surveilled*	7	5	3	--	--

2.2.5. AMR[64] Surveillance						
National AMR surveillance	*Sites enrolled (excluding NRL)*	9 laboratories (target of 16 by 2020)[65]	4 laboratories[66]	At least 5 laboratories (target of 14 by 2023)[67]	Surveillance for TB only (World Vision program)	No routine surveillance
WHO GLASS enrollment and WHONET reporting	*Sentinel sites and laboratories*	4 sites, 4 laboratories, 1 NRL	4 sites, 1 laboratory, 1 NRL	22 sites, 2 laboratories, 1 NRL	0	0
	Sites reporting	0	0	2	-	-

Southern Africa

Area	Requirement	Zambia[68]	South Africa[3,69]	Zimbabwe	Malawi	Mozambique
2.2.1 Case/ Condition/ Event Identification						
National IDSR policies and guidelines	*IDSR guidelines developed; laws incorporate IHR*	Guidelines developed; legislation being revised for IHR, and NPHI bill drafted	National guidelines developed; IHR legislation drafted but not enacted	WHO IDSR guidelines used; IHR laws limited; public health bill awaiting approval	Guidelines developed; legislation must be updated to incorporate IHR	Guidelines developed; no laws specifically address IHR
Indicator-based surveillance (infectious diseases only)	*Priority diseases*	11**	29	18	17	13
	IBS systems exist at all levels; at least three syndromes surveilled	IBS in place for public, faith-based, and military facilities, and at least three syndromes surveilled	IBS in place, and at least five syndromes surveilled	IBS in place with ad hoc data collection; at least three syndromes surveilled	IBS in place, but no systematic weekly reporting; limited syndromic surveillance, with pilots ongoing	IBS poorly implemented, with underreporting of data and limited coverage; four syndromes surveilled

[64] GLASS Early Implementation Report 2018
[65] The Surveillance of Antimicrobial Resistance Using Public Health Laboratory-Based Sentinel Sites in Ethiopia 2016–2020
[66] https://www.cdc.gov/drugresistance/solutions-initiative/stories/surveillance-in-Kenya-Senegal.html#:~:text=The%20MoH%20and%20the%20National,Kitale%2C%20Malindi%2C%20and%20Machakos.
[67] First Fleming Fund Country Grant to Uganda, Terms of Reference, 2018; AMR National Action Plan Uganda, 2018-2023
**These include only immediately notifiable diseases
[68] https://twitter.com/ZMPublicHealth/status/1128959889085276160
[69] https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-015-2117-3

Event- and community-based surveillance	*EBS and CBS at all levels via both formal and informal channels*	EBS not fully functional; rollout in process, with electronic IBS system being deployed	Well-functioning EBS and CBS in place (media streaming, toll-free number used)	EBS not fully functional (unsystematic use of rumor and media reports)	EBS in place, but CBS data collection unsystematic	EBS in place but CBS not fully functional (rumor logbook not used)

2.2.2. Case/ Condition/ Event Reporting						
Data aggregation and timely reporting	*IDSR bulletin disseminated with at least 80% timeliness and completeness*	Bulletin disseminated with 80%[70] completeness (paper based)	IDSR bulletin not disseminated;[71] similar bulletin for notifiable medical conditions disseminated with 64%[72] completeness	IDSR bulletin not disseminated; similar bulletin disseminated with 90% timeliness and 90% completeness	IDSR bulletin not disseminated; similar bulletin disseminated with 60% timeliness and 40% completeness	IDSR bulletin not disseminated; similar bulletin disseminated with 52% timeliness and 92% completeness
Incorporation of laboratory reporting	*Laboratory data integrated into surveillance*	Data not integrated (ad hoc data-sharing mechanisms used)	Data not integrated	Data not integrated	Data not integrated	Data not integrated

2.2.3. Case/ Condition/ Event Analysis and Interpretation						
Data analysis	*Data analysis and validation*	Regular analysis at national level; validation system in place	Regular analysis at national level; validation system in place	Regular analysis at national level; validation via DHIS2	Ad hoc analysis only	Data analysis at national level; weak validation system in place

2.2.4. AMR National Action Plan						
National action plan	*Plan developed*	Yes	Yes	Yes	Yes	Yes[73]
Surveillance system	*Pathogens surveilled*	11	6	2	9	1

2.2.5. AMR Surveillance						
National AMR surveillance	*Sites enrolled (excluding NRL)*	4 hospital laboratories enrolled,[74] 3 more identified	About 50 laboratories enrolled in GERMS-SA Network	9 laboratories enrolled	At least 7 laboratories enrolled[75]	AMR sentinel surveillance in place for meningitis, enteric diseases, and TB
WHO GLASS enrollment and WHONET reporting	*Sentinel sites and laboratories*	1 site, 0 laboratories, 1 NRL	31 sites, 50 laboratories, 1 NRL	2 sites, 5 laboratories, 1 NRL	4 sites, 2 laboratories, 1 NRL	1 sites, 2 laboratories, 1 NRL
	Sites reporting	1	31		2	

[70] IDSR Surveillance Report ZNPHI, 25 November-1 December 2019
[71] WHO IDSR Bulletin, 2016
[72] https://www.sciencedirect.com/science/article/pii/S1201971217300905
[73] https://cddep.org/blog/posts/weekly-digest-jan-18-19/
[74] First Fleming Fund Country Grant to Zambia, Terms of Reference, 2019
[75] Fleming Fund Grant to Malawi, Terms of Reference, 2019

a) Case, Condition, and Event Identification

Effective indicator-based surveillance (IBS) systems have been established in Ethiopia, Kenya, Uganda, South Africa, and Zambia. These systems include surveillance for vaccine-preventable diseases. Event-based surveillance (EBS) systems are well established in South Africa and Uganda, where multiple formal and informal channels are used for EBS. EBS training is ongoing in most districts in Zambia, supported by community engagement and outreach. For priority diseases such as TB, electronic case-based surveillance (CBS) systems have been established in South Africa, Mozambique, and Uganda. Paper-based surveillance systems are in place in Zambia, Zimbabwe, Ethiopia, South Sudan, and Malawi.[76] As of 2019, Ethiopia and Zimbabwe were implementing case-based surveillance for HIV infections, while all countries except Somalia were planning to implement case-based HIV surveillance.[77] All countries are following international norms for conducting syndromic surveillance for at least three diseases, albeit with varying capacity levels.

Surveillance systems have also been activated for COVID-19. In South Africa, the National Institute of Communicable Diseases has enhanced its three sentinel syndromic surveillance programs for influenza-like illnesses and pneumonia to detect SARS-CoV-2 and monitor the COVID-19 pandemic. Similarly, Kenya upgraded eight acute febrile illness (AFI) sentinel surveillance sites for SARS-CoV-2 detection and is increasing the number of sentinel sites to 22 with support from the US CDC.

Most Eastern and Southern RCC member states still require stronger EBS systems. Multiple reporting channels, both formal and informal, need to be established. In addition, standalone surveillance systems for HIV, TB, and malaria must be integrated and expanded to encompass other priority diseases. Moreover, disease-specific surveillance systems are currently dependent on donors. Regional integration through RISLNET can help countries expand the range of diseases under surveillance while providing a sustainable source of funding. Countries that are currently not part of any surveillance networks and have less-developed domestic surveillance systems stand to gain the most from regional integration.

b) Case, Condition, and Event Reporting

In Uganda and Kenya, electronic reporting tools are in place, and an electronic IDSR is being used for reporting and data sharing. Kenya adopted an electronic reporting system for COVID-19 that links laboratory and surveillance data to the national PHEOC. South Africa and South Sudan are both using mobile technology to enable real-time data reporting—the former through a smartphone application and the latter through a pilot SMS system. In the absence of a functioning routine surveillance system, South Sudan's web-based, mobile-application linked Early Warning, Alert and Response Network (EWARN) has been able to detect and prevent epidemics in drought-affected districts, camps for internally displaced people, and inaccessible districts. Kenya, Uganda, Zambia, Mozambique, and Zimbabwe have implemented the DHIS2 at the national level in cases where aggregated surveillance data are available. In Zambia, DHIS2 reporting has been implemented in five pilot districts.

Inadequate data sharing by laboratories is a major challenge. In South Africa, all healthcare providers are required to report important medical conditions to the local authorities, who in turn report them to the district, provincial, and national levels. However, there are no legal provisions requiring laboratories to notify the authorities when communicable diseases are detected. To ensure data protection, the Kenya RCC allows only the Communications Officer to receive bulletins directly from lower levels. The Communications Officer then shares them with the EBS Analyst, who in turn shares them with the Africa CDC Headquarters. Similarly, the Ethiopia NPHI has an internal policy for managing health-related data, and the Ethiopian government has drafted a national data-sharing policy.

Although the private sector is well positioned to facilitate the early detection of outbreaks and conduct routine monitoring of disease trends, its current role in disease surveillance and control programs is minimal. The private sector's contribution to health information systems is marginal and largely voluntary, which leads to the misrepresentation and underestimation of disease burdens. Legal instruments, policies, and platforms must be created to improve private-sector participation in public health surveillance. In Nigeria, engagement with private stakeholders has strengthened the government's integrated disease surveillance and response mechanisms by increasing data reporting by private health facilities, which improves data management and enables more informed decisions.[78] Nigeria's experience can provide a template for other countries to formally engage the private sector in disease surveillance and response.

Limited infrastructure, incomplete reporting, and the absence of clear policies and legislation weaken the efficiency of public health networks across all RCC member states. Frequent power outages and limited internet connectivity hinder data sharing from the subnational level to the local level. In Ethiopia, data is currently shared through both paper-based reporting and email; the latter, though more efficient in principle, is in practice highly vulnerable to power outages

[76] https://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/meetings/tf7_background_1_strengthen_notification.pdf?ua=1-
[77] https://www.cdc.gov/mmwr/volumes/68/wr/mm6847a2.htm#T1_down
[78] https://www.afro.who.int/news/engagement-private-sector-stakeholders-strengthening-disease-surveillance-and-response-yields

and internet service interruptions. Mobile phones are also used for reporting data, but similar challenges affect phone connectivity, which can contribute to delayed data reporting. While the electronic surveillance system has improved the timeliness of reporting in most countries, even when implemented at higher administrative levels, accurate, comprehensive, and complete data reporting remains limited. For example, TB reporting by most countries with a national TB database is either incomplete or inaccurate, with cases typically underreported. Paper-based reporting systems are most common in remote areas, where transporting paper records can be especially difficult. In addition, a lack of standardization and/or harmonization of data and processes between DHIS2 and LIMS often prevents the integration of multiple data systems, as indicators and reference data (e.g., facility names or codes, product data, regimen lists, reporting processes, indicator definitions, etc.) are inconsistent.

c) Case/ Condition/ Event Analysis and Interpretation

Most countries conduct regular data analysis and validation at the national level, and some do so through electronic platforms such as DHIS2. The Ethiopian NPHI, in collaboration with DAI Global Health[79] and the Ministry of Health, has established a National Data Management Center (NDMC) to serve as a central hub for surveillance information. The NMDC captures data from research institutions and health facilities, which is shared weekly through bulletins.[80] Despite the availability of electronic platforms that can aggregate data at the national level, data analysis and use remain limited. Little data analysis is performed at the subnational level due to an inadequate supply of computers and data analysts, particularly in states with limited institutional capacity. Even at the national level, many countries lack the human resources to conduct advanced data analysis and prepare visualizations. Ethiopia's NDMC compiles surveillance data and information from multiple projects, but no analysis is currently being performed at the central level, and key informant interviews suggest that the Ethiopian NPHI has limited capacity to conduct national-level analysis based on NDMC data. In Zambia, an acute shortage of frontline surveillance professionals at the subnational level must be overcome in order for the country to establish itself as a regional hub for data collection and analysis.

Regional integration through RISLNET can play an integral role in developing these data reporting and analysis capabilities. During the COVID-19 pandemic, the Africa CDC has assisted member states in strengthening their surveillance and contact-tracing abilities by training health workers and ministry staff on best practices and by disseminating tools for data collection, reporting, and analysis. Through RISLNET, the Africa CDC can play a similar role in building capacity for disease reporting, surveillance, and data analysis.

d) AMR National Action Plan

The Center for Disease Dynamics, Economics, and Policy (CDDEP), the Global Antibiotic Resistance Partnership (GARP), USAID, the Medicines, Technologies, and Pharmaceuticals (MTaPS) program, and the ReACT programs have collaborated with Kenya, Uganda, Ethiopia, Zambia, South Africa, Zimbabwe, Malawi, and Mozambique to develop national AMR policies and implement AMR action plans. However, to create effective regional AMR surveillance mechanisms, country-level gaps and challenges must be addressed. Somalia and South Sudan have yet to develop national action plans for AMR. Zimbabwe and Malawi have created yearly operational plans, but their implementation is incomplete, and Malawi's plan faces significant financial challenges. Mozambique, Somalia, and South Sudan have not yet established the multi-sectoral governance structures and coordinating agencies necessary for AMR.

e) AMR Surveillance

AMR surveillance data must be reported in national AMR systems and/or WHONET, an open-source software platform designed to capture AMR data. The WHO supports countries in consolidating their AMR surveillance data by enrolling surveillance sites in GLASS and enabling data reporting via WHONET. All ten RCC member states except Somalia and South Sudan have sentinel surveillance sites and have enrolled in WHO GLASS. However, reporting is largely paper-based, and the use of multiple reporting platforms has been reported in some cases, and no reporting in others. South Africa has prepared a consolidated AMR surveillance report for the public and private sectors, and the relevant data are also reported in GLASS and the CDDEP Resistance Map project, enabling them to inform decision-making at the national level.

Low enrollment rates are another critical AMR surveillance challenge. In Ethiopia, Kenya, Zambia, Zimbabwe, and Malawi, very few laboratories with AST capacity have enrolled in GLASS. Even in enrolled countries, very few sites report data to GLASS: in 2019, only 93 sentinel sites in Africa reported data to GLASS. Furthermore, the multiple laboratory information systems, such as DISALAB, WHONET and paper-based systems, currently in use should be integrated to ensure timely data reporting. Regional integration through RISLNET can play an important role in strengthening AMR surveillance, and the Africa CDC's AMR program can assist countries in developing national action plans, promote the enrollment of surveillance sites, and advocate for the use of electronic data-reporting tools. RCC member states can also leverage regional best practices for surveillance systems, data management, policies, and guidelines, as well as the tools developed by other countries in the region for data reporting and analysis.

[79] https://www.dai.com/news/dai-and-ephi-to-collaborate-on-health-data-management-center-in-ethiopia
[80] Ethiopia JEE Report 2016

f) Human Resources

Uganda is the only country in which the number of health professionals with core surveillance and epidemiology competencies meets the WHO target of one trained field epidemiologist or equivalent per 200,000 people.[81] Even in Ethiopia, where the NPHI is to serve as a center of excellence for disease detection and response in East Africa, the number of epidemiologists falls short of WHO norms. As per JEE findings, Uganda's robust FETP program and the master's and clinical epidemiology modules provided by private and public sectors enable it to maintain enough epidemiologists to meet the WHO target. South Africa has developed an occupational framework for epidemiology and a roadmap for creating a multidisciplinary public health workforce with well-defined, cadre-appropriate competencies in epidemiology, surveillance, and public health leadership to fill its human resource gaps. During the COVID-19 pandemic, Somalia utilized frontline health workers from its polio program in surveillance and response efforts. Key barriers to enhancing human resource capacity include: (i) a lack of tracking or mapping of non-clinical care personnel such as epidemiologists and biostatisticians, (ii) inadequate guidelines for developing human resources and for building surge capacity to respond to public health emergencies, (iii) high attrition rates, especially in remote or unstable regions, and (iv) a lack of established positions or dedicated roles for epidemiologists in public health institutions.

Per the WHO's Africa Regional Strategy for IDSR 2020-2030, 85% of member states had initiated IDSR training at the district level in 2018. The table below shows the status of IDSR implementation in selected countries. Green represents "full implementation," yellow represents "partial implementation," and orange represents "little or no implementation."

Eastern Africa RCC Member States	Total Number of Districts	Share of Districts with IDSR Training, 2015-17 (%)	Southern Africa RCC Member States	Total Number of Districts	Share of Districts with IDSR Training, 2015-17 (%)
Ethiopia	904	50-89	Zambia	105	50-89
Kenya	301	50-89	South Africa	52	50-89
Uganda	116	>90	Zimbabwe	63	50-89
Somalia	NA	--	Malawi	29	<50
South Sudan	80	>90	Mozambique	159	<50

As per JEE findings, Ethiopia, Kenya, Uganda, and South Africa have well-established FETPs or other applied epidemiology training programs. Somalia and South Sudan have no capacity to provide such trainings, but they can benefit from twinning arrangements with successful FETPs in other countries; for example, Kenya's FETP supported trainees from South Sudan for several years until the graduates of the program returned and initiated frontline epidemiology training program in their own country. Zambia has established a FETP, but study findings show that frontline workers have limited knowledge of surveillance and reporting tools, and surveillance has been identified as a priority area for capacity building, especially passive surveillance and EBS. FETP participants in Uganda and Ethiopia have been involved in COVID-19 coordination activities, screening, and active surveillance at international airports and other points of entry.

The Africa CDC and partner institutions have conducted trainings for experts across Africa on disease surveillance and related functions, including COVID-19 prevention and control. The Africa CDC, the WHO, the International Civil Aviation Organization, and the African Field Epidemiology Network (AFENET) organized training on enhanced surveillance at points of entry for 80 participants from 18 African countries. The Africa CDC also collaborated with the WHO to train analysts on EBS using an open-source epidemic intelligence platform, and it worked with the US CDC to train experts from 20 countries on EBS for COVID-19. Other key capacity-building networks include AFENET, the Africa Centre Of Excellence for Infectious Diseases, SACIDS, and EAIDSNet.

While national-level surveillance capacity appears adequate, gaps are evident in the distribution of surveillance personnel at the provincial, district, and facility levels. Rural areas have less capacity than urban centers. Primary research in Zambia has revealed a limited number of trained epidemiologists and biostatisticians at the subnational level. Incentive schemes for staff retention, such as the Zambian Health Workers Retention Scheme, typically exclude public health specialists such as epidemiologists and surveillance officers, and studies have shown that the effectiveness of such policies is limited, as they do not address challenges involving living and working conditions, especially in rural areas.

Mapping of Existing Regional Surveillance Networks

a) Disease Surveillance Networks

EAIDSNet is part of the Connecting Organizations for Regional Disease Surveillance (CORDS) program, which aims to harness innovations in science and technology to detect, identify, and monitor infectious diseases of humans and animals. CORDS covers Kenya, Rwanda, South Sudan, Uganda, and Tanzania and is supported by EAPHLN, and the Eastern Africa RCC is overseeing surveillance, risk assessment, and testing. SACIDS is also a part of the CORDS

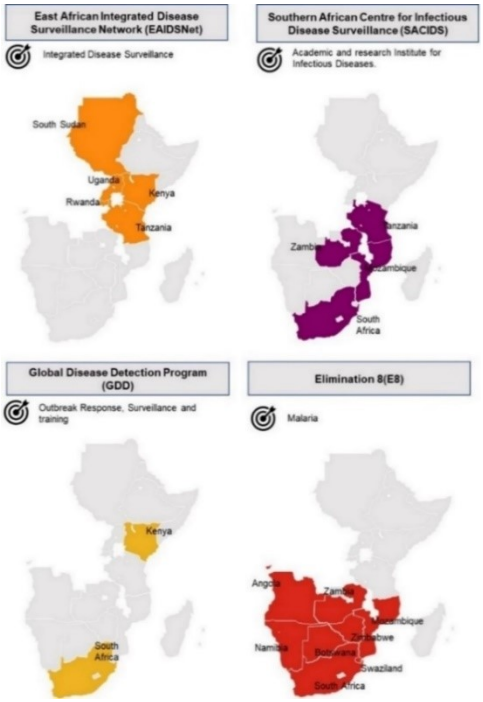
[81] WHO Technical Framework in Support of IHR Monitoring and Evaluation (2005)

program and covers Southern Africa RCC member states such as Mozambique, South Africa, Zambia, and Tanzania. SACIDS provides health research and training through a national surveillance center in each country, and its regional institutional base is in Tanzania. SACIDS has partnered with the Africa CDC for COVID-19 diagnosis and surveillance, and the two institutions will implement joint activities via the AFTCOR surveillance and laboratory working groups.

SACIDS is collaborating with EAIDSNet to pilot a One Health-based mobile technology approach to disease surveillance with funding from the Rockefeller Foundation. The project operates in Tanzania, Zambia, and Burundi. Pilots have shown that an effective and sustainable mobile technology-based system requires: (i) participatory epidemiological approaches; (ii) form-based reporting; and (iii) resident IT expertise for programming, local support, and training.[82] SACIDS and EAIDSNET have launched the Enhancing Community-Based Disease Outbreak Detection and Response in East and Southern Africa project,[83] which is aimed at creating mobile and participatory surveillance tools. The Africa CDC, SACIDS and EAIDSNet have also collaborated on COVID-19 surveillance and diagnosis in selected countries considered to be at especially high risk.

E8 for Malaria elimination is a network of 50 mobile malaria posts (public, non-profit, private) and surveillance teams for surveillance, diagnosis and case management, vector control, community engagement, research and DHIS2 reporting. E8 for Malaria is active in Angola, Botswana, Swaziland, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe, among others. Data is reported through the Elimination 8 Regional Surveillance database (ERSD), built by Akros, which leveraged its experience in developing DHIS2 databases to design a country-specific system.[84]

The Global Disease Detection program operates ten state-of-the-art centers in Kenya, South Africa, and elsewhere. The program responds to high-profile public health emergencies by assisting with surveillance, outbreak detection and response, laboratory capacity-building, and zoonotic disease research. In Kenya, the program runs a robust population-based surveillance system with centers in Nairobi's Kibera informal settlement and in Siaya County in Western Kenya. The program also runs a facility-based sentinel surveillance system for AFI, MERS-COV, and Zika virus, among others. Eight AFI sentinel sites in Kenya are currently used for COVID-19 surveillance.



An analysis of vaccine-preventable disease surveillance in Africa found robust networks for TB, rotavirus, measles, malaria, meningitis, cholera, Acute Febrile Paralysis (AFP), and yellow fever. In many countries, the number of diseases surveilled rose from four to at least 15[85] between 2000 and 2018. The AU's goal for 2030 is to expand or strengthen the surveillance networks for more than 22 diseases, including dengue fever,[86] typhoid fever, rabies, and influenza.

The various databases and tools being used for data reporting and analysis by different surveillance networks should be harmonized at the regional level. For example, the GISRS network uses FluNet, a global web-based tool for influenza virologic surveillance. The GMRLN uses the MeaNS and RubeNS databases. [87] The African Cholera Surveillance Network (AFRICHOL) has developed its own database.

b) AMR Surveillance Networks

- The **Horn of Africa Network for Monitoring Antimalarial Treatment (HANMAT)** is a USAID-funded network linking six countries, including Somalia, Ethiopia, and South Sudan.[88.]
- The **Network for Surveillance of Pneumococcal Disease in the East Africa Region (netSPEAR)** established by WHO AFRO aims to strengthen Hib–pediatric bacterial meningitis surveillance in Kenya, Tanzania, Ethiopia, Uganda, and other African countries.
- **The Typhoid Fever Surveillance in Africa Program** aims to standardize multi-country surveillance of typhoid fever and invasive non-typhoidal salmonella. The program has surveillance sites in Burkina Faso, Ethiopia, Ghana, Guinea-Bissau, Kenya, Madagascar, Senegal, South Africa, Sudan, and Tanzania. The program provides a biannual training on blood culture for AST at its surveillance sites.

[82] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3557954/
[83] http://endingpandemics.org/wp-content/uploads/2017/04/EP_DODRES_CaseStudy.pdf
[84] https://akros.com/elimination-8-regional-surveillance-database-ersd/
[85] https://www.afro.who.int/sites/default/files/2019-11/VPD_Surv_Brochure_Final_20190918_WEB.pdf
[86] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4193177/
[87]https://www.who.int/immunization/monitoring_surveillance/burden/laboratory/MR_labnet_Recommendations_2016.pdf?ua=1
[88] Report on Antimicrobial Resistance in Low- and Middle-Income Countries by Wellcome, Trust IDDO, WWARN, 2016

- **GISRS** is a network of 15 participating national influenza centers across Africa, which collect specimens, carry out diagnostics using WHO-provided reagents, and monitor antiviral drug resistance in seasonal influenza viruses.[89]
- Pfizer's **Antimicrobial Testing Leadership and Surveillance program**[90] monitors the resistance of pathogens across more than 73 countries and shares data on AMR Register, an open-access data platform created by the Open Data Institute and Wellcome Trust.

c) Research, Capacity-Building, and Other Support for AMR Surveillance Networks

- The **Plasmodium Diversity Network Africa** is a research network dedicated to eliminating malaria in Sub-Saharan Africa that investigates parasite genetic diversity and drug resistance. The MRC Centre for Genomics and Global Health is helping to establish the network in 15 African countries, including South Africa, Kenya, Mozambique, Ethiopia, Tanzania and others.
- The **Mapping Antimicrobial Resistance and Antimicrobial Use Partnership** collects and shares historical data on AMR and AMU in 14 African countries. The partnership was created by a consortium of the ASLM, CDDEP, IQVIA, the Africa CDC, ECSA, the West African Health Organization, and InSTEDD, with financing from the Fleming Fund.
- The **CDDEP Resistance Map** is a web-based collection of data-visualization tools that allow interactive exploration of AMR and antibiotic-use trends in countries including Kenya, Malawi, South Africa, Zambia, and Zimbabwe.
- The **Global Research on Anti-Microbial Resistance**, financed by the Fleming Fund, aims to generate accurate and timely estimates of trends in AMR that can inform treatment guidelines, decision-making, and research agendas, detect emerging problems, underpin global strategies, and facilitate the assessment of interventions over time.

Potential Challenges to Regional Surveillance Networks

An evaluation of SACIDS[91] revealed several key challenges involved in establishing and maintaining an effective regional disease surveillance network. These include:

- ***Limited data sharing***. SACIDS does not possess a platform on which data could be shared among project partners in a standardized format that would reduce the risk of duplication, and no formal institutional arrangements to support systematic data and information sharing have been created.
- ***Uneven funding and resources***. The distribution of resources and activities across member states is unequal. Under the centralized structure of SACIDS, all funding goes to the Secretariat and Executive Director based in Tanzania. Decentralizing activities and funding would allow for greater country-level resource management.
- ***Weak governance arrangements***. The top-down management structures at the regional and national levels undermine programmatic governance. Currently, a single person acts as coordinator between SACIDS and its consortium partners in different countries, and junior staff and local communities are only marginally involved in decision making.
- ***Limited operational efficiency***. At the regional level, delays are reported in implementing project activities and obtaining the necessary inputs due to process inefficiencies and unclear lines of command.

Sharing data across countries is a common challenge when tackling regional disease outbreaks. Primary research in Ethiopia indicates that there is currently no platform for sharing data with other countries. Zambia has signed a cross-border surveillance agreement with the Democratic Republic of Congo, Tanzania, Mozambique, Zimbabwe, and Malawi, but this agreement includes no mandate for data-sharing. Data sharing currently occurs primarily within each surveillance network and not across regional networks. EAIDSNet member countries, including Kenya, Rwanda, South Sudan, Uganda, and Tanzania, have set up the EAC Regional Electronic Cargo and Drivers Tracking System, which connects directly to designated laboratories and is used for sharing data. E8 for Malaria uses custom software for data reporting within the network. However, existing MoUs can be leveraged to support cross-border collaboration on disease surveillance. These include: (i) the East African Community's One Stop Border Posts Act of 2016, which governs border operations, including surveillance within five countries in the EAC region, (ii) agreements between Kenya and Namibia (2009), Ethiopia (2016), Botswana (2011), and Israel (2016) on technical cooperation in public health; and (iii) an agreement between Kenya and the AU to enable health volunteers to provide support to the Ebola Outbreak in West Africa mission in 2014.

[89] http://www.influenzacentre.org/centre_GISRS.htm
[90] https://accesstomedicinefoundation.org/amr-benchmark/best-practices/first-company-to-share-raw-amr-surveillance-data
[91] A One Health Evaluation of The Southern African Centre for Infectious Disease Surveillance, 2018

Emergency Response Mechanisms

Public health emergencies such as the COVID-19 pandemic, the 2013-16 West Africa EVD outbreak, and the 2009 Influenza A pandemic can strain, overwhelm, or severely damage public health systems in affected countries. The COVID-19 pandemic provides an opportunity to test the efficacy of national and regional emergency response mechanisms, including risk assessments, early warning systems, response team deployment, and risk communication. In line with RISLNET's vision for regional integration, ECSA-HC has been established as an intergovernmental body tasked with facilitating collaboration in the health sector, providing regional oversight, and supporting knowledge-sharing. The ECSA-HC's cross-border response framework provides a new governance structure to enable regional collaboration on outbreak management through integrated plans, multi-country electronic reporting systems, enhanced laboratory confirmation, and capacity-building initiatives.[92]

The Africa CDC's COVID-19 Task Force is working with the WHO to improve community engagement, screening at points of entry, infection prevention and control in healthcare facilities, the clinical management of people with severe infections, and risk communication. After developing an Incident Action Plan and technical guidelines for COVID-19, the Africa CDC activated its emergency operations center and incident management system on January 27, 2020. The Africa CDC has begun providing weekly updates on the status of pandemic control, launched capacity-building initiatives, and is creating a central stockpile for equipment and supplies to manage the outbreak.[93] The RCC member states also activated their PHEOCs to coordinate preparedness and response activities. Training sessions have been organized to equip rapid response teams with the necessary knowledge and skills for case management and contact tracing, specimen collection, and the investigation of rumor alerts.

Most African countries moved swiftly to implement interventions designed to minimize the spread of the pandemic, but underlying weaknesses in their health systems have complicated the response effort. Countries across Africa already face the challenge of managing a heavy infectious disease burden, coping with increasing rates of non-communicable diseases, and addressing the chronic problem of malnutrition. With an average of just 0.2 physicians and 1.8 hospital beds per thousand people, Africa's existing health infrastructure had very little surge capacity. Many countries faced a dearth of essential supplies and equipment, such as sample-collection kits, PCR test kits, personal protective equipment, ventilators, and pharmaceuticals, due to their dependence on external suppliers, and only a few laboratories had the capability to diagnose COVID-19 at the beginning of the pandemic. A UNDP assessment found deficiencies in the pandemic preparedness of Zambia, Uganda, Malawi, and Zimbabwe, and among the countries included in this report, only South Africa was deemed adequately prepared. Ethiopia reported supply-chain challenges and a lack of facilities for disease management.[94]

This chapter assesses country-level emergency preparedness and response capabilities vis-à-vis international norms and guidelines. It identifies strengths that countries can leverage to support regional integration, as well as challenges to building effective regional networks, and it examines national policies and legislation, human resources, private-sector engagement, and other cross-cutting issues. The analysis incorporates perspectives from states with limited institutional capacity on how to maximize the benefits of regional integration. The most relevant international standards for public health emergency preparedness in Africa are the WHO's IDSR guidelines and IHR benchmarks, which can be adapted to suit individual country contexts. The following matrix presents a mapping exercise of national emergency preparedness and response capabilities against the WHO guidelines for Africa. Green represents "adequate capacity," yellow represents "partial capacity," and orange represents "little or no capacity."

[92] Schneidman et al (2017) Building Cross-Country Networks for Laboratory Capacity and Improvement Clin Lab Med 38 (2018) 119–130
[93] Policy Brief: Impact of COVID-19 in Africa, United Nations (2020)
[94] Lucero-Prisno, D.E., Adebisi, Y.A. & Lin, X. Current efforts and challenges facing responses to 2019-nCoV in Africa. glob health res policy 5, 21 (2020). https://doi.org/10.1186/s41256-020-00148-1

Assessment of National Emergency Preparedness and Response Capabilities in Eastern and Southern Africa against WHO AFRO IDSR Guidelines[95] and WHO IHR Benchmarks[96]

Eastern Africa[97]

Area	Requirement	Ethiopia	Kenya	Uganda	Somalia	South Sudan
Legislation, Policies, and Guidelines						
National policy and guidelines	*National multi-hazard emergency preparedness and response plan in place*	Emergency preparedness and response plan in place	Draft plan for disaster risk management developed	National multi-hazard emergency preparedness and response plan in place	No plan in place	No plan in place
Risk communication	*National risk communication plan in place*	No national plan in place; communications included in disease-specific plans	No national plan in place; communications included in disease-specific plans	Addressed in national preparedness and response plan	No formal risk communication plan in place	No formal plan but part of disease-specific emergency response plans
Preparedness						
Strategic risk assessments	*Risk assessments conducted and resources mapped*	National-level risk assessment conducted for priority diseases, but no comprehensive risk mapping	Disease-specific risk mapping and human resources mapping, but no consolidated risk assessment for all emergencies	Risk assessment carried out, but no comprehensive resource mapping for identified risks	No comprehensive risk assessment or resource mapping	National risk assessment completed, but no comprehensive resource mapping
Response						
Emergency response operations	*PHEOC established; guidelines and SOPs in place*	PHEOC in place with plans and procedures	PHEOC in place with SOPs	PHEOC in place with handbook and SOPs	No PHEOC in place	PHEOC in place but no well-defined SOPs in place
Emergency exercises	*Emergency exercises management program in place*	Exercises conducted	Exercises conducted	Exercises conducted	No simulations or structured exercises	Exercises conducted
Communications						
Risk communication	*Risk communication systems in place*	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place	Informal systems available	Dedicated mechanisms and structures in place

[95] WHO IDSR Technical guidelines (2019)
[96] WHO BENCHMARKS for International Health Regulations (IHR) Capacities (2019)
[97] Primary research & stakeholder consultations; WHO JEE Reports; MoH sources; PHEOC guidelines for countries

Southern Africa[98]

Functions	Requirement	Zambia	South Africa	Zimbabwe	Malawi	Mozambique
Legislation, Policies, and Guidelines						
National policy and guidelines	*National multi-hazard emergency preparedness and response plan in place*	Public health emergency preparedness and response plan drafted	Disease-specific plans in place, but no comprehensive plan	Multi-hazard public health emergency preparedness and response plan in place	No comprehensive plan in place	No plan in place
Risk communication	*National risk communication plan in place*	No formal plan in place, but risk communications integrated into disaster management plan	No formal plan, but risk communications integrated into disease-specific emergency and response plans	No plan in place	Risk communications included in national health communication strategy for 2015-2020	No comprehensive plan, but disease-specific plans in place
Preparedness						
Strategic risk assessments	*Risk assessments conducted and resources mapped*	National risk assessments conducted annually, but no resource mapping	Risk assessments conducted, but no resource mapping or response planning	Not conducted	Risk assessment conducted in 2018, but no comprehensive resource mapping	Risk assessment, risk mapping, and risk management activities undertaken
Respond						
Emergency response	*PHEOC established; PHEOC guidelines and SOPs in place*	PHEOC established and guidelines in place	PHEOC established and SOPs in place	PHEOC established and national guidelines in place	No fully functional PHEOC established	PHEOC established and procedures and plans in place
Emergency exercises	*Emergency exercises management program in place*	Exercises conducted	Exercises conducted	Exercises conducted	Exercises conducted on an ad hoc basis	Exercises conducted
Communicate						
Risk communications	*Risk communication systems in place*	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place	Dedicated mechanisms and structures in place

[98] Primary research and stakeholder consultations; WHO JEE Country Reports; MoH sources; PHEOC guidelines

Strategic Risk Assessments

Risk assessments vary by country, but only Mozambique adheres to WHO guidelines. In Ethiopia, national-level risk assessments are conducted biannually, but subnational level vulnerability and risk analysis and mapping exercises have been conducted for only three of ten regions. Uganda has conducted risk assessments at the national and subnational levels. Zambia has conducted a nationwide vulnerability and risk analysis to develop emergency plans, but funding challenges limit emergency preparedness and coordination at the subnational level. South Sudan is using strategic assessment tools for risk prioritization to classify diseases and categorize risk. The country carried out a national risk assessment in July 2017 and classified the risks posed by diseases and other hazards as high, moderate, low, or very low. Malawi has developed a national emergency risk profile based on strategic multi-hazard emergency risk assessments, the most recent of which was conducted in 2018 by the Department of Disaster Management Affairs. Profiles are reviewed and updated annually to reflect emerging threats or changing risks. In Somalia, risk assessments are conducted by international agencies, but they are fragmented, partial, and not effectively disseminated. Moreover, risk assessments tend to be driven by project-related interests, not objective criteria. The WHO and UNICEF have conducted risk assessments and evaluations in Somalia, but the public health department will need to assume a greater leadership role going forward.

"Appropriate structures have been put in place to address JEE weaknesses. In 2018, we developed and finalized NAPHS addressing all 13 core capacities and 19 technical areas for implementation of IHR. This document awaits launch from the Health Minister. We have also conducted a nation-wide vulnerability and risk analysis and mapping exercise upon which the All-Hazards Emergency Preparedness and Response plan is built. We are currently developing documents related to PHEOC, emergency preparedness, recovery and IHR." – ***Head of Emergency Preparedness and Response, Zambia NPHI***

Regional integration through RISLNET can promote comprehensive risk assessment and resource mapping to inform emergency preparedness and response plans. As in other areas, regional collaboration on risk assessment will be especially beneficial for states with limited institutional capacity. Leveraging existing national systems, such as Kenya's Human Resource Information System, can facilitate resource mapping across both RCC regions. Existing strategic assessment tools for risk prioritization can also be adapted by other countries once the necessary formal agreements have been established.

Emergency Response Operations

Ethiopia: In Ethiopia, a national PHEOC has been operational since 2017. There are 10 regional centers, of which seven have been activated over the past year. Ethiopia has participated in several emergency management situations in neighboring states such as Kenya and Somalia. However, frequent power outages and limited PHEOC infrastructure hinder disease reporting and monitoring. To mount an effective response against COVID-19, the Ethiopian NPHI has strengthened coordination between the Risk Communication and Community Awareness section of the national PHEOC, the Community Awareness Branch of the national Emergency Coordination Center, and the UN Communication Group. The PHEOC was activated on January 27, 2020 to deal with potential domestic outbreaks of COVID-19, and 24-hour toll-free call centers were established at the national and subnational levels for rumor collection and public outreach. A Rapid Response Team was established to investigate and verify rumors. Technology startups are using 3D printing to develop face shields and ventilator valves, and IT volunteers are working with the government to develop tools for contact tracing, information campaigns, and data collection. Ethiopian Airlines has refurbished 31 ventilators for the Ministry of Health and is set to begin producing ventilators with international partners. Despite the active engagement of the private sector, the lack of a regulatory-frameworks public-private collaboration remains a challenge. Regional integration can provide a platform for networking and partnerships, while Ethiopia can leverage its national and subnational PHEOCs, health infrastructure, and human resources to support emergency-response operations in neighboring countries with limited institutional capacity.

Kenya: As described in the laboratory section, the capacities of the Kenyan NPHL have been strengthened to support outbreak response. Other institutions, including the Kenya Medical Research Institute, are also supporting emergency management. A national-level PHEOC was established in 2015 with support from the WHO, the US CDC, PEPFAR and other partners. The PHEOC has been activated several times for domestic outbreaks of cholera and Rift Valley fever, as well as for the 2013-16 EVD outbreak in West Africa and the global COVID-19 pandemic. An incident-management system, multi-agency national task force, and rapid-response teams are in place to coordinate response efforts. Real-time information is gathered through hotlines, media monitoring, and established DHIS2 systems.

Uganda: Uganda's emergency-response capabilities were tested during the West African EVD outbreak. As the virus ravaged Guinea, Liberia, Nigeria, and Sierra Leone, Uganda sent about 20 cadres of health workers to support clinical management, coordination, surveillance, laboratory testing, and social mobilization. In 2018, the PHEOC and a national task force for public health emergencies coordinated EVD preparedness under the authority of the Ministry of Health. The national task force formed an incident-management team and a national rapid-response team to support the activation of district-level task forces and rapid-response teams, jointly assessed EVD preparedness in 30 designated high-risk districts.

These activities were characterized by successful multi-sectoral coordination. As of mid-2019 there had been no confirmed cases of EVD in Uganda, and the country continued to make significant and verifiable progress in EVD preparedness. In addition, FETP graduates and participants in the Uganda Public Health Fellowship program are part of the national rapid response team for COVID-19. With support from AFENET, the PHEOC has conducted COVID-19 training-of-trainers sessions aimed at equipping epidemiologists with the knowledge and skills necessary to activate the subnational rapid-response teams.

Zambia: A national PHEOC is operational at the Zambia NPHI, and there are plans to create at least one subnational PHEOC in each of the country's ten provinces. The national PHEOC was activated on January 30, 2020 in response to the COVID-19 outbreak. Public health specialists serve as incident commanders and are deployed in subdistricts of Lusaka to coordinate daily activities with the field teams. For the Zambian NHPI to become a regional center of excellence, the capacity of the PHEOC must be further enhanced. For example, hotline services for rumor verification and public outreach have yet to be established. However, the authorities have prepared an All-Hazards Emergency Preparedness and Response Plan based on a national risk assessment, and specific preparedness and response plans for cholera, anthrax, and bacterial diarrheal diseases have been developed and are awaiting validation. A COVID-19 contingency plan was finalized and continues to be regularly updated as the outbreak evolves.

South Africa: The South African PHEOC is located at the National Institute of Communicable Diseases and receives the necessary data to conduct regular event-based surveillance. The center has an established hotline, but it is available only for consulting with experts and not for reporting incidents or alerts. A National Health Operations Center at the Department of Health is responsible for coordinating the response to public health emergencies.

Somalia and Malawi lack functional PHEOCs and will need to access external technical assistance and other forms of support via regional collaboration. While establishing fully functional PHEOCs in every country will be a long-term task, regional integration can accelerate the process. For example, Zambia's PHEOC guidelines for specific diseases and Uganda's PHEOC handbook can serve as templates for countries that lack well-defined PHEOC SOPs, such as Somalia and South Sudan. Similarly, a regional network with clear governance structures, mandates, and agreements will support the cross-country utilization of laboratory facilities and the deployment rapid-response teams during public health emergencies. For example, Kenya and Uganda have rapid-response teams trained by FELTP that can be readily deployed across the region. Similarly, Somalia can leverage Ethiopia's PHEOC capabilities, rapid-response teams, and FETP-trained experts. Zambia has created an emergency management training program to support the national health system, and cadres trained by the program can be deployed in neighboring countries if necessary.

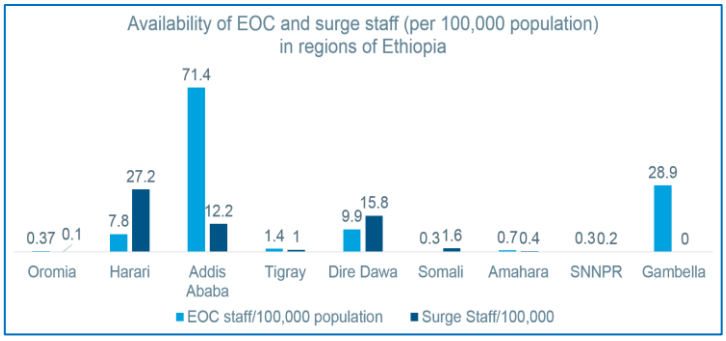
Countries in both regions have developed disease-specific emergency response plans. Ethiopia has emergency preparedness and response plans for EVD, cholera, measles, meningitis, and MERS-CoV, as well as subnational plans for three regions in which risk assessments have been undertaken. South Sudan has plans for EVD, malaria, measles, cholera, hepatitis E, and meningitis. Zimbabwe has guidelines for typhoid, yellow fever, cholera, rabies, and anthrax, along with preparedness plans for EVD and pandemic influenza. Kenya, Uganda, Malawi, and Zimbabwe have drafted specific plans for COVID-19. As part of the regional integration process, Ethiopia and Zambia are well-positioned to assist other countries in preparing both general and disease-specific preparedness plans.

Many countries have formed agreements allowing cross-country collaboration during public health emergencies. Zambia has MoUs in place with Malawi, Mozambique, Tanzania, and Zimbabwe that allow the sharing of data and resources during disease outbreaks, and these agreements have been invoked to send emergency resources to Malawi and Zimbabwe. Similarly, Uganda has agreed to provide emergency support other countries under the WHO regional resolution that formed the Africa Public Health Emergency Fund. South Africa has also played an important role during outbreaks by deploying rapid-response teams to other countries during public health emergencies through a MoU signed with the AU in 2016 to support the response to the West African EVD outbreak. However, the cross-country use of laboratory systems and satellite laboratories in border areas will require additional bilateral or multilateral agreements.

Many countries lack the human resources necessary to carry out emergency response activities. Countries across Africa face shortages of skilled staff for emergency response activities, and the novel nature of the COVID-19 virus limited the information available to frontline workers early in the pandemic. Moreover, the distribution of existing staff is often highly uneven. The figures below show the number of permanent staff members in Ethiopia's national and regional PHEOCs, revealing a total absence of surge capacity at the subnational level.[99] In Zambia, the national PHEOC has just 15 staff members, and even fewer staff are available at the subnational level. For these countries to establish themselves as regional centers of excellence, human resource constraints will have to be addressed.

[99] Ethiopia NPHI, 2020

Region	Number of permanent staff employed	Number of surge staff available
Oromia	14	4
Harari	2	7
BG	6	No
Addis Ababa	257(RHB),10,288 (All)	44 (RHB)
Tigray	7	5
DireDawa	5	8
Somali	2	10
Amhara	16	8
SNNPR	7	4
Gambella	14	0



Its unbalanced distribution of health staff notwithstanding, Ethiopia has created dedicated teams to manage emergency response operations and provide surge support. During the COVID-19 pandemic, the authorities identified specialized staff to manage and coordinate the health situation, and the government has been conducting tabletop simulation exercises, drills, and trainings in risk communication and other guidelines. The table at right shows the subject of the trainings conducted at the regional- and national-level PHEOCs. The WHO facilitated the COVID-19 tabletop simulation exercise to evaluate the country's preparedness to manage a potential COVID-19 outbreak. Based on the weaknesses identified during the simulations, plans were drawn up to further strengthen COVID-19 response capacity.

Region	PHEM guidelines training conducted	EOC SOP training conducted	PPE training given
Oromia	✓	✓	✓
Harari	✓	✗	✗
BG	✓	–	✗
Addis Ababa	✓	✗	✗
Tigray	✓	✗	✗
DireDawa	✗	✓	✗
Somali	✓	✓	✗
Amhara	✓	✗	✗
SNNPR	✓	✗	✗
Gambella	✓	✗	✗

The Zambian health authorities have held trainings in emergency medicine, risk assessment, and incident management. Public health specialists trained by the FETP are leading the COVID-19 response in Zambia in collaboration with the Ministry of Health, the NPHI, domestic universities, and other public health agencies. The incident-management system also includes FETP-trained experts involved in response activities, and the FETP plans to conduct a series of localized trainings for rapid-response teams.

Kenya and Uganda have built their capacity to manage outbreaks. As discussed in the previous sections, Kenya's Field Epidemiology and Laboratory Training Program has been a pioneer in specialized field epidemiology in the region. A pool of epidemiologists at the Ministry of Health's Disease Surveillance and Response Unit and FELTP is available to respond to public health emergencies, and rapid-response teams are ready to provide surge capacity during public health emergencies, both domestic and regional. In addition to managing suspected cases of COVID-19, FELTP residents have been deployed to Jomo Kenyatta International Airport and are evaluating preparedness and response capacity at other major points of entry. The Africa CDC is also coordinating trainings in COVID-19 response measures and risk-communication in partnership with the Ministry of Health.

South Sudan and Zimbabwe are also conducting specialized trainings for COVID-19. With support from the WHO and the Red Cross, trainings have been conducted in South Sudan on reporting COVID-19 deaths and updating the PHEOC database, and on issues around case management, community engagement, supply-chain management, patient screening, isolation, contact tracing, and the use of personal protective equipment. Some of these trainings are facilitated by the Africa CDC, which has also conducted COVID-19 risk communication trainings in 27 countries. Capacity-building networks such as the Emergency Communication Network and AFENET have organized trainings in emergency response and outbreak management. Abbott and the Abbott Fund are supporting the efforts of the African Federation for Emergency Medicine to provide 2,000 frontline emergency professionals in 26 African countries with the technology to disseminate knowledge and share solutions on COVID-19 care.

Some countries have successfully leveraged regional and international support to mobilize resources in response to COVD-19. In addition to the cross-border deployment of country-level teams, the WHO has deployed emergency medical teams in Ethiopia and Zambia to address staffing shortages. The Africa CDC has also helped address the shortage of emergency response personnel by establishing the African Health Volunteers Corps, which includes epidemiologists, laboratory scientists, communications professionals, logisticians, data managers, physicians, and social scientists who can be swiftly deployed in emergency situations. While ensuring an adequate supply of human resources is ultimately a country-level challenge, regional bodies like the Africa CDC or WHO AFRO can facilitate the process by providing clearly defined staffing norms for countries to adapt and incorporate into their emergency response plans.

Risk Communication

In Ethiopia, outbreaks are reported to the WHO country office within 24 hours, and an IHR focal point is available for reporting and communication. The designated channels for a coordinated response are available at the national level and include clear guidelines and a communication hierarchy. Spokespersons from the Ministry of Health and the NPHI have been identified, and the latter publishes weekly COVID-19 bulletins that highlight the activities of the PHEOC. A risk-communication and community engagement strategy for COVID-19 has been developed to disseminate appropriate and timely messages to government stakeholders and the public. Press statements and dashboard updates are produced on a regular basis. Videos on how to make a mask at home have been produced, as have audio and video messages on home care. Recorded video spots for psychosocial support have been created in collaboration with Save the Children and UNICEF. Messages regarding the correct use of facemasks have been delivered via various social media channels, and the Facebook challenges #betenegn and #IAmAtHome have been launched to encourage community participation. Media scanning and monitoring are being conducted on daily basis, and the "talk-walker" social media monitoring platform deployed by UNICEF provides COVID-19-related alerts. Message guides and key messages are communicated for Easter, Ramadan, and other holidays to ensure compliance with public health measures.[100] However, these initiatives are concentrated at the national level, and the coordination of subnational response efforts requires additional strengthening.

In Zambia, a subcommittee of the National Epidemic Preparedness and Prevention Committee has been established to define risk-communication activities. The response effort is coordinated on an ad hoc basis, with the Zambian NPHI taking the lead, and protocols for multi-sectoral collaboration have yet to be defined. The country has been publishing daily situational reports on COVID-19 since February 13, 2020. Social outreach efforts are underway to integrate concerns, questions, and issues raised by members of the public into risk communication activities. A standard COVID-19 messaging document has been drafted and was pending approval as of July 20, 2020. Community radio stations are being utilized for communication, and IEC materials are being distributed. In Lusaka Province, 50 media personnel have received training in public announcements protocols, and community meetings have been held with 43 local chiefs in the Southern, Central, Luapula, and Copperbelt Provinces.

While most of the analyzed RCC member states have integrated risk-communication plans into their emergency response plans, no formalized national risk communication plans are in place. Somalia, however, lacks any formalized plan or system for risk communication. During primary consultations with national stakeholders in multiple countries, risk assessments and risk communications were identified as key areas for capacity building. Regional integration can enable RCC member states to formulate regional and even continental communications strategies that can easily be adopted by countries with no established risk communication plans. Meanwhile, the Africa CDC should continue to organize risk communication trainings in collaboration with the RCCs. Once Ethiopia and Zambia have become established regional hubs for disease surveillance and outbreak preparedness, the expertise they developed during the COVID-19 pandemic can be leveraged to consolidate regional risk communication plans and systems.

[100] COVID-19 Pandemic Preparedness and Response in Ethiopia weekly bulletin

Recommendations and Action Plan[101]

Operationalize RISLNET

Inadequate funding and staff among RCCs are key obstacles to the establishment of RISLNET. While the Eastern Africa and Southern Africa RCCs are functional, both suffer from a lack of financing and human resources, which impacts their ability to perform their core functions. Advocacy efforts and outreach to member state governments together with demonstrated benefits of RISLNET is needed to increase funding for RISLNET, which is crucial for its functioning. In addition to providing adequate staffing and financing, member states must jointly develop the governance and organizational structure of RISLNET and sign formal agreements to enable the sharing of data and public health assets.

Action Plan

- **The Africa CDC should raise awareness of the benefits of RISLNET among member states.** Highlighting the institution's successful experience coordinating a regional response to the COVID-19 pandemic could provide a compelling basis for advocacy at the government level. The Africa CDC should liaise with key stakeholders, health ministries and NPHIs to form a robust consensus around the importance of operationalizing RISLNET and begin the process of forming agreements between member states to allow the sharing of data and other public health assets. The RCCs can provide on-the-ground support to facilitate these consultations, which can be held at the regional and continental levels over the coming year.
- **The RCCs should prepare costed plans and submit them to the Africa CDC.** The Africa CDC can then present these requirements to member states to inform budgetary earmarks and the allocation of staff or other resources for the operationalization of RISLNET. The draft requirements should include annual budget targets, as well as itemized cost components of RCC operations. They can be prepared and submitted at the regional level over the coming year.
- **The RCCs should work with member states to establish the policy and institutional arrangements necessary to operationalize RISLNET in their respective regions.** The RCCs must collaborate closely with key stakeholders to define a RISLNET framework that sets forth a clear organizational structure, positions and staffing requirements, roles and responsibilities, and activity plans. The Africa CDC should organize workshops for member states to validate and formally adopt the RISLNET draft governance framework, discuss implementation strategies, and develop work plans around a common set of regional objectives. These activities can be implemented at the regional level over the coming year.

Complete Laboratory-Mapping Exercises at the National, Regional, and Continental Levels

Many RCC member states have yet to complete comprehensive laboratory-mapping exercises. These countries lack either the funding, technical capabilities, or experience necessary to conduct laboratory-mapping exercises. Inadequate information on laboratory locations, testing throughput capacity, relative complexity level, quality-assurance mechanisms, or other key elements of the laboratory system complicates efforts to improve the functionality of national and regional laboratory networks by sharing assets, increasing diagnostic testing capacity, or expanding surveillance coverage. The laboratory-mapping exercises conducted in Ethiopia and Zambia can provide useful examples for countries in both regions.

Action Plan

- **The Africa CDC should encourage all member states to prioritize laboratory-mapping exercises.** The Ethiopian and Zambian NPHIs can directly assist member states by sharing their tools and experience, while ASLM can supply the latest model regulations, guides, and other relevant information. The Africa CDC can establish laboratory mapping as a critical onboarding activity for all member states and ensure that RCCs have access to the ASLM LabMaP tool and international best practices. The Labnet Scorecard, which covers nine core capabilities of laboratory networks, can be used to obtain baseline information on network functions, guide interventions, and monitor progress. Funding for this activity could be obtained from the national budgets of member states or from multilateral institutions.

Establish National Laboratory Strategic Plans in All RCC Member States

NLSPs are critical to create the common minimum standards for laboratory operations necessary to provide a sound basis for regional integration. Creating a comprehensive regional laboratory network requires robust, harmonized systems across RCC member states. Somalia, Malawi, and Mozambique have not developed NLSPs due to gaps in administrative capacity and expertise, and the NLSPs developed by Uganda, Kenya, and Zambia lack annual implementation plans. The NLSPs created by Ethiopia and South Africa can serve as templates to define similar strategies and corresponding annual operational plans in other countries.

[101] All recommendations are for one to three years unless stated otherwise.

Action Plan

- **The NPHIs should lead the NLSP development process at the country level, while RISLNET should share templates, sample plans, tools, and guidelines and provide direct technical assistance to member states.** The resulting plans should include provisions for a tiered laboratory system, standardized testing, uniform quality management systems, physical biosecurity, financing arrangements, data management, and specimen transportation. Each NLSP should have a year-by-year action plan with defined outcomes and targets. The process of drafting NLSPs can be completed at the national level.

Build the Testing Capacity of National Laboratories

Of the countries included in this report, only South Africa and Zambia perform all 12 laboratory confirmation tests for the priority diseases defined by WHO IDSR guidelines. Expanding these core tests to all RCC member states will require enhancing the diagnostic testing capacity of laboratory networks. Limited workforce skills are a major constraint on laboratory diagnostics, including AMR testing, across countries. Ethiopia and Zambia face shortages of laboratory staff, and the uneven distribution of laboratory workers weakens testing at the subnational level. As effective capacity-building efforts require a sound assessment of existing assets and capabilities, the completion of the laboratory-mapping exercises is a prerequisite for the actions described below.

Action Plan

- **Based on the laboratory-mapping exercise completed in each country, the NHPIs should engage with individual laboratories to increase their capability to perform additional disease-specific confirmatory tests.** The NPHIs should define a standard testing package for each level of the healthcare system, with special emphasis on point-of-care testing and diagnostic network optimization, while RISLNET should facilitate knowledge-exchange and capacity-building initiatives. To maintain continuous testing capacity, RISLNET should partner with RCC member states to develop asset-maintenance programs to prevent breakdowns in vital diagnostic equipment. Ensuring that all countries have the capacity to perform all 12 laboratory confirmatory tests will take an estimated three to five years.
- **The Africa CDC should organize pooled procurement of laboratory supplies.** Malawi, South Sudan, and Somalia have little capacity to conduct AST, due in part to frequent shortages of testing supplies, including blood for culture-media preparation, control organisms, and microbiology supplies among other inputs. Other countries also face frequent stockouts of reagents for the 12 laboratory confirmatory tests for priority diseases. To address this challenge, lessons can be drawn from various COVID-19 pooled-procurement initiatives and from the Southern African Development Community pooled procurement mechanism for essential medicines and health commodities. The Africa Medical Supplies Platform, which has been utilized for pooled procurement during the COVID-19 pandemic, can provide a single platform for aggregation, quota management, payment facilitation, logistics and transportation, enabling equitable and efficient access to critical diagnostic reagents and AST supplies. Central warehouses for testing supplies should be established at the regional level based on the regional distribution centers established by Supply Chain Management Systems and Imperial Health Sciences to provide HIV-related commodities in Africa. To support AST testing, countries should source animal blood from in-country veterinary farms or prepare blood agar plates at NRLs or regional centers. These activities can be implemented at the national and regional levels over the next three to five years.
- **To address the widespread shortage of skilled laboratory staff, RISLNET should partner with WHO, ASLM, and other relevant organizations to conduct ECHO sessions on specific disease diagnostics and basic AMR diagnostic microbiology.** These sessions should focus on laboratory methods for detection and confirmation of national priority diseases, as well as AMR. RISLNET can leverage regional and continental capacity-building initiatives like FELTP that train human and animal health professionals together as part of the One Health approach. The Africa CDC's Institute of Workforce Development, in collaboration with ASLM, can utilize the Siemens/PEPFAR PPP model to provide trainings in resource-constrained settings via online platforms. Training sessions can be organized and conducted at the national level.

Develop and Promulgate Uniform Standards for Quality Control and Management

Laboratory guidelines, AST protocols, and other quality-control standards are not harmonized across countries. Ethiopia, Mozambique, Kenya, and Zambia use CLSI, while Malawi uses EUCAST, and South Africa uses both. Uganda, South Sudan, and Somalia have not defined any standardized protocols at national level. South Africa has successfully implemented laboratory quality management standards and has 5-star laboratories rated by SLMTA and SLIPTA. Malawi and Mozambique have adopted SLIPTA to promote laboratory accreditation, while Somalia has no guidelines on laboratory quality management. Of the countries examined in this report, only South Africa's EQA system monitors testing of all the priority diseases identified by WHO ISDR guidelines, and in most countries EQA is restricted to vertical programs for specific diseases. Somalia, South Sudan, and Malawi have no biosafety guidelines, which complicates specimen transportation while exposing laboratory personnel and the public to infectious diseases. Meanwhile, other countries struggle to implement their biosafety guidelines due to limited capacity of laboratory personnel. Defining uniform standards for quality

management, including accreditation, EQA, and biosafety, is necessary to harmonize test procedures, outcomes, and result interpretation across regions.

Action Plan

- **The AU's AMR program (formerly known as the AMRSNET) should take a lead role in harmonizing AST protocols across RCC member states.** NPHIs should support the implementation of harmonized protocols at the country level. The RCCs can play a vital role in assisting countries that have not defined their protocols by disseminating templates, tools, and guidelines prepared by the AMR program and by sharing knowledge from neighboring countries.
- **RISLNET and the respective NPHIs should ensure that each member state develops appropriate biosafety and biosecurity guidelines.** These guidelines are necessary for effective referral system and safe specimen transportation. They should comprise management responsibility, practices for handling and transporting specimens, hazardous waste, hygiene, personal protective equipment, containment of high-risk pathogens, laboratory biosafety levels, occupational health, disinfection and sterilization, bio-risk assessments, emergency preparedness, waste management, and biosecurity plans**.** Uganda and South Africa are regional leaders in biosafety, and their experience can help create, standardize, and strengthen biosafety standards across countries. Similarly, Kenya, Uganda and Ethiopia have drafted biosecurity laws that could serve as regional templates. RISLNET can play a key role in sharing knowledge, tools, and templates across member states, as well as providing technical assistance to support the drafting and implementation process. These activities can be carried out at the national and regional levels.
- **The Africa CDC can help countries replicate the success of regional leaders in quality management.** For example, South Africa has created an internal accreditation agency, SANAS, to verify the quality of testing services. The Ethiopian National Accreditation Office promotes the implementation of international laboratory quality standards and accreditation. Uganda also has well-defined standards for laboratory quality management that can be utilized as templates for other countries in the region. These activities can be implemented at the country level.
- **RISLNET and the Ethiopian NPHI should assist Somalia in developing standards for laboratory quality management.** These standards should encompass personnel requirements, safety, equipment requirements, and information management, inter alia. They should reflect the limited capacity both of Somalia's health authorities and of laboratory personnel.
- **The Africa CDC and RISLNET should coordinate with EQA centers to expand the range of tests covered by providing access to essential infrastructure and building the capacity of EQA staff.** Improving the quality of laboratory services requires regular EQA by the NRLs or by regional EQA centers, such as those established in South Africa and Zimbabwe. EQA must be expanded beyond the assessments provided by the WHO to increase coverage and empower the national reference bacteriology laboratories providing these services. A Fleming Fund External Quality Assessment-Africa (EQAFRICA) regional grant could be utilized to expand the provision of EQA services by NRLs in both regions.
- **The Africa CDC, with assistance from South Africa's National Institute for Communicable Diseases and ASLM, should lead the expansion of EQA programming at the continental level.** RISLNET can support the development of national policies and regulations to promote the uptake of EQA programs as part of routine laboratory quality management at the regional level, while the NPHIs can provide country-level support.

Strengthen Regional Health Systems and Capabilities

Beyond laboratory management, RCC member states across both regions face serious deficiencies in referral systems, transportation and logistics, and information management. Specimen referral and transportation mechanisms are inadequate in Kenya, Zambia, Somalia, South Sudan, and Malawi. South Sudan and Somalia still use paper-based reporting for laboratory information, and the implementation of LIMS on other countries has been uneven. The limited availability of IT infrastructure is a cross-cutting challenge.

Action Plan

- **By forming partnerships to promote knowledge exchange at the regional level, RISLNET can help expand the use of innovative models for sample referral and transportation.** Ethiopia, Uganda, South Africa, and Zimbabwe have strengthened their specimen referral and transportation system by creating PPPs and broadening HIV-specific referral systems to encompass other diseases. RISLNET could assist other countries in developing similar strategies. Other PPP models for transporting bacterial isolates and clinical specimens, such as Riders for Health and International Clinical Laboratories, could also be introduced into new country contexts. The Ethiopian NPHI's partnership with the Ethiopian Postal Service Enterprise to enable integrated specimen transportation for HIV and TB testing within the national laboratory network could be adopted by other countries, as could Uganda's hub-and-spoke model for specimen collection and Zambia's HIV sample referral network. The Africa CDC can also partner with academic and research organizations to pilot studies on specimen transportation in remote areas. These activities can be undertaken over the next three to five years.

- **The NPHIs should lead the implementation, standardization, and adoption of LIMS in respective countries, and RISLNET can support this process by identifying proven solutions that can be adopted by each RCC member state.** For example, South Africa has established standardized LIMS across all laboratories, and its successful experience can serve as an example to other countries in the region. The Africa CDC can negotiate prices for the bulk purchase of software licenses or secure sustained donor funding to support LIMS implementation.

Improve Existing Regional Surveillance Networks

No single regional disease network encompasses all RCC member states in either Eastern or Southern Africa. The absence of an integrated regional network creates gaps and inefficiencies in disease surveillance, weakening the protections afforded by even the most sophisticated national surveillance systems. At the national level, the incomplete adoption of international standards for laboratory networks undermines data collection and reporting. DHIS2 has been implemented at the national level in Kenya, Uganda, Zambia, Mozambique, and Zimbabwe, but the system has been only partially implemented in Malawi and South Africa, and its implementation in South Sudan and Somalia is negligible. Mozambique, Zimbabwe, and Malawi need to strengthen adherence to IDSR guidelines to improve data reporting and site coverage. Moreover, the persistence of paper-based reporting, especially in states with limited institutional capacity, inhibits the standardization of reporting tools and platforms.

Action Plan

- **The Africa CDC and RISLNET should advocate that existing diseases surveillance networks be expanded to include multiple diseases that are not covered under any surveillance networks.** These existing networks include the Global Invasive Bacterial Vaccine-Preventable (IB-VPD) Diseases Surveillance Network, GMRLN, AFRICHOL, GISRS, and ANISE. Similarly, regional surveillance networks should be expanded to encompass countries that are not currently included under any surveillance network. RISLNET can also assist member states by compiling standard protocols for collecting, reporting, analyzing, and disseminating disease data.
- **The NPHIs should lead the implementation of IDSR guidelines in their respective countries, while RISLNET can analyze cross-country experiences and facilitate knowledge exchange.** The Africa CDC should raise awareness among all member states of the importance of fully implementing IDSR guidelines. Meanwhile, the RCCs should assist national authorities in leveraging the expanded capacity developed during the COVID-19 response to improve routine disease surveillance.
- **RISLNET should encourage the NPHIs to support the full implementation of DHIS2 in their respective countries, but over the long term the Africa CDC should advocate for the adoption of a core LIMS.** Although DHIS2 lacks the functionality of a LIMS, it is still an effective mechanism for collecting surveillance data and could serve as an interim arrangement while countries are transitioning to LIMS. RISLNET should support this transition through capacity-building and the sharing of knowledge and best practices. These two activities—supporting the adoption of DHIS2 and facilitating the transition to a core LIMS—can be implemented over the next one to five years.
- **RISLNET and the NPHIs should sensitize key stakeholders on the importance of timely and complete data reporting.** RISLNET and the NPHIs can organize capacity-building sessions for relevant staff on data reporting formats, definitions, sources, and interpretation. RISLNET could also facilitate additional capacity-building sessions organized by AFENET, ASLM, and academic partners targeting data analysts, frontline workers, and district surveillance officers, which would focus on auditing the quality of surveillance data.
- **RISLNET, in collaboration with the NPHIs, should facilitate capacity-building sessions for surveillance staff on advance data analysis and visualizations.** In all member countries, capabilities to analyze data and use it to make informed decisions is limited at the subnational level. RISLNET can leverage existing technical programs, such as the UN's Operational Satellite Applications Program, which offer training in geospatial information, satellite data/imagery analysis, and integrated navigation and geo-positioning. RISLNET can also consolidate lessons from the SORMAS initiative implemented in Nigeria and Ghana.
- **To address the acute shortage of field epidemiologists and surveillance staff at the subnational level across both regions, RISLNET and the NPHIs should organize capacity-building exercises in surveillance activities.** RISLNET should also facilitate trainings for community-based health workers, health extension workers, and frontline workers offered by WHO AFRO, AFENET, and other organizations on active case finding, timely reporting, and innovative reporting mechanisms.

Build National and Regional AMR Surveillance Capacity

AMR surveillance capacity varies widely across RCC member states. Somalia and South Sudan lack national AMR action plans, and no sites in either country are enrolled in the National AMR Surveillance (NAMRS) platform or WHO GLASS. Malawi and Mozambique have national AMR action plans, but a lack of financing and poorly defined governance structures limit their implementation. Very few sentinel sites in either region are reporting data to NAMRS, and in countries where such reporting takes place, it is often inconsistent, as some sites report to NAMRS or to WHO GLASS or to both. A

dearth of AMR information at the national, regional, and continental levels inhibits the ability of health authorities to adopt appropriate measures to coordinate, integrate, and implement surveillance plans across both regions.

Action Plan

- **The Africa CDC's AMR Program and the NPHIs should ensure that each member state develops its National AMR Action Plan.** The AMR Program should share templates, sample plans, tools, and guidelines with the NPHIs and provide technical assistance to enable them to develop and implement their respective plans.
- **The AMR Program can also advocate for replacing paper-based systems with electronic reporting and data-sharing systems to enable real-time case reporting**. The AMR Program should collaborate with the NPHIs to upgrade surveillance and data-reporting protocols, especially for frontline health workers and surveillance officers, by leveraging existing training programs offered by WHONET, AFENET, and other organizations.
- **The AMR Program should draw on the findings of the laboratory-mapping exercises to design strategies for enrolling existing and potential sentinel sites in surveillance platforms such as WHO GLASS or NAMRS.** The NPHIs should coordinate the enrollment of laboratories with AST capacity into GLASS and enable the monitoring of data at all levels.

Enhance Emergency Response Operations

Most countries in the Eastern and Southern African RCCs lack multi-hazard and multi-sectoral preparedness and response plans, which inhibits their capacity to mount a timely and efficient response to emergencies. However, Uganda has developed a sound preparedness and response plan that can serve as a positive example for other countries in both regions. Similarly, Ethiopia's well-defined PHEOC guidelines—including SOPs at the national and subnational levels, an effective incident management system, clear lines of reporting, and a structure for emergency response at all levels—can provide a template for the development of similar guidelines in Malawi, Somalia, and South Sudan. Even in countries with robust PHEOC guidelines, the inconsistent adoption of reporting protocols creates communications challenges at the subnational level. These issues are often compounded by operational challenges, such as the lack of a dedicated hotline for reporting emergencies, limited IT resources, and insufficient staff capacity at the subnational level. These gaps in emergency preparedness, coordination, and communication between the subnational and national levels significantly impact the ability of health authorities to respond to emergency situations.

Action Plan

- **The Africa CDC should advocate for member states to develop multi-hazard, multi-sectoral preparedness and response plans and PHEOC guidelines.** RISLNET can share templates, sample plans, and lessons learned from Uganda's multi-hazard emergency plan and Ethiopia's PHEOC guidelines and provide technical assistance to help other countries develop similar plans. RISLNET should also review national emergency management plans and PHEOC guidelines to ensure their consistency and completeness.
- **The NPHIs should promote and conduct functional exercises, simulations, and full-scale drills and risk assessment at the subnational level to continually test the preparedness of PHEOC staff.** WHO resources can be utilized to conduct these exercises, and RISLNET can draw on the experience of FETP to train surge staff on incident management systems, the use of personal protective equipment, and the implementation of public health emergency management guidelines.
- **The Africa CDC should build on its partnerships with global institutions such as the Korea Disease Control and Prevention Agency, Korea Trust Fund, China CDC, European CDC, and US CDC to expand the availability of technical expertise focusing on future potential investments and twinning arrangements.** The Africa CDC can also leverage existing arrangements between individual NPHIs and international organizations, such as the Ethiopian NPHI's partnership with the US CDC to implement the PHEM Fellowship Program.

RISLNET, in collaboration with the NPHIs, should facilitate capacity-building sessions for emergency response personnel. Regional integration can assist countries in creating staffing norms and guidelines for their emergency response plans and help cover staff shortages through cross-border collaboration. RISLNET can leverage national and regional capacity-building networks, such as the Emergency Communication Network and AFENET, to conduct trainings in emergency management and response. Kenya, Uganda, Ethiopia, South Africa, and Zambia have trained highly capable field epidemiologists and laboratory professionals, and their experience can inform the design of similar training programs in other countries.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