Establishing Regional Centers of Excellence: Capacity Assessment of Fully-Established National Public Health Institutes in Africa

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Abstract

Introduction: By linking key components of public health functions such as surveillance, laboratory capacity, emergency response, communications, and public health research, NPHIs shorten the response time to public health emergency response and provides focused and centralized leadership and coordination mechanism for public health.

Objective: The main objective of the assessment was to describe the capacities of fully established NPHIs and identify potential Centres of Excellence for Health Information System, Emergency Response Coordination, Workforce Development and Public Health Research in each geographic regions of Africa.

Method: We assessed capacity of 12 fully established NPHIs in Africa from May to August 2023 using a tool focused on Corporate Governance, Health Information Management System, Public Health Workforce Development, Public Health Emergency Response Coordination and Public Health Research.

Result: The assessment findings showed that NPHIs of DRC, Ethiopia, Liberia, Burkina Faso, South Africa, and Mozambique scored 71%, 93%, 91%, 90%, 91.3%, 88.4% for Health Information Management System; Burundi, Rwanda, Burkina Faso, Nigeria, Mozambique, and South Africa scored 71%, 90%, 86%, 81%, 90.5%, and 85.7% for Work Force Development; Burundi, Ethiopia, Liberia, Burkina Faso, South Africa and Mozambique scored 67%, 94%, 98%, 92%, 78.4%, and 70.6% for Emergency Response coordination; and Burundi, Ethiopia, Rwanda, Liberia, Morocco, South Africa, and Mozambique scored 92%, 92%, 92%100%,100%, 91.7%, and 91.7% for Public Health Research respectively. The mean score of the potential regional centers of excellence at 95% CI is 87% [72-102], 84.5% [67,101], 70.6% [27,140] and 91.7% [89,99] for Health Information Management System, Workforce Development, Emergency Response Coordination, and Public Health Research respectively.

Conclusion: The most common challenges all NPHIs faced include inadequate infrastructure and resources to carry out their mandates, fragmented health information systems, dependence on external funding for programmes, high staff turnover, and lack of career development plans. Addressing these challenges require sustained political commitment, increased funding for public health, improved infrastructure, and resources, strengthened partnerships and collaborations, and the development of effective policies and strategies to support the functions of NPHIs.

Keywords: NPHI, CoE, Africa CDC

Introduction

Success in building strong health systems in Africa requires countries to have strong public health institutions. National Public Health Institutes (NPHIs) increase outbreak detection and emergency response efficiency by bringing similar functions together into one organization and removing redundancy and organizational barriers [1,2]. By linking key components of public health functions such as surveillance, laboratory capacity, emergency response, communications, and public health research, NPHIs shorten the response time to public health emergency response and provides focused and centralized leadership and coordination mechanism for public health.

As a specialized institution of the African Union (AU) [3], Africa CDC supports Member States in improving the health of their citizens through prevention, detection, and response to endemic and epidemic diseases. In its 2023-2027 Strategic Plan, the Africa CDC commits to supporting the establishment and strengthening of National Public Health Institutes and improving evidence-based decision-making and practice [4]. NPHIs are featured as one of the pillars of the Africa CDC Strategic Plan. They will also act as core agencies in Member States to implement the other pillars (Surveillance and disease Intelligence, Emergency Preparedness and Response, Information Systems, Laboratory Systems and Networks, Research, and Health Promotion and Disease control) and to help achieve the AU's development goals (Agenda 2063) [5]. Furthermore, the African Union Heads of State and Government, in September 2022 called for a new Public Health Order in the Continent. The New Public Health Order for Africa has five key elements: strengthen continental, regional and national public health institutions; strengthen public health workforce; expanded manufacturing for vaccines, diagnostics and therapeutics; enhanced domestic financing; and, respectful and action-oriented partnership [6]. The Africa CDC provides strategic support to Member States (MS) to strengthen their individual and collective health security by establishing and strengthening the National Public Health Institutes within their jurisdictions. NPHIs enable MS to comply with the International Health Regulations (IHR, 2005) and advance the Global Health Security Agenda (GHSA) by consolidating and organizing core functions. NPHIs provide leadership and a home for coordinating IHR activities, support national accountability for the GHSA, and strengthen the overall health system.

To help establish the landscape of NPHIs in the continent, the Africa CDC conducted a desk review assessment in 2022. Data generated revealed that 19(35%) of the 55 Member States had established NPHIs, 21 (38%) were in the establishment phase and 15(27%) had no NPHIs and were not in the establishment phase. Member States with fully established NPHIs were Algeria, Angola, Burkina Faso, Burundi, Cape Verde, Ethiopia, Guinea, Guinea Bissau, Kenya, Liberia, Libya, Morocco, Nigeria, Somalia, Rwanda, Uganda, Mozambique, South Africa and Zambia.

The assessment results also revealed that the fully established NPHIs had both areas of strength and weaknesses in the core competencies of NPHIs. This finding informed a plan by Africa CDC to establish Centres of Excellence in each region to support other NPHIs within the regions to build their national capacities for early detection and prompt response to public health threats. Africa CDC assessed the capacities of fully established and functional NPHIs to identify the potential regional Centres of Excellence. The areas assessment for the Centres of Excellence focused on corporate governance, Health Information Systems, Emergency Response Coordination, Workforce Development and Public Health Research.

Public Health Workforce development is a crucial component of any public health institution. The availability of a competent and qualified workforce makes an institution a centre of excellence in its field. Workforce development improves health outcomes by enhancing public health workers' training, skills, and performance that are critical to the effective and efficient function of the organization or system [7]. A competent and fit-for-purpose workforce is essential to delivering public health services, including emergency response, disease surveillance, research, laboratory investigation and other critical public health functions nationally [8]. In the public health context, emergency response activities can vary widely but generally include coordinating public health response functions; collecting, integrating, and analyzing epidemiologic, laboratory testing, and other data; sharing information with key stakeholders and partners; developing and disseminating guidance, emergency risk communication messages, and other recommendations to targeted audiences or at-risk populations; coordinating the implementation of control measures such as the distribution and dispensing of appropriate medical countermeasures for the effective management of complex health events [9]. Coordination and communication are core capacities that any public health institute should have at all times and for responding to public health emergencies of national and international concerns [10]. Achieving evidence-based decision-making is achieved by building individuals' skills and competencies and taking action in multiple levels of organizations [11-16]. To strengthen health research in Africa, The African Academy of Sciences (AAS) recommends empowering African-based researchers, providing quality training and career development opportunities and, effective information exchange and collaboration, long-term investment from international donors and increasing funding commitments from African governments and philanthropies is needed to realize a critical mass of local capacity and to create and sustain world-class research hubs that will be conducive

to address Africa's intractable health challenges [17]. The ability of health agencies to collect, analyze, and make effective use of health information is critical to the success of health agency functions. Public health decision-making requires intensive information management to organize responses to health threats and develop effective health education and promotion [18]. Africa's recent commitment to free movement of its people in the continent, open skies for airlines, and free trade agreements further makes data sharing more imperative for cross border surveillance and disease intelligence. Health data is essential to determine a health problem's magnitude, monitor trends over time, and provide information and a basis for decision-making. The source of health data can be notifiable diseases, laboratory specimens, vital records, sentinel surveillance, disease registries, periodic surveys, special studies, administrative data systems, etc. Data and information management is necessary because it is needed for good record-keeping and documentation, program evaluation, and to support valid inference.

Materials and Methods

a. Selection criteria:

Following the desk review conducted in 2022, all Member states NPHIs were reviewed for establishment and functionality. Only those that reported full establishment with legal mandate and were operational were considered for site assessment.

b. NPHIs Assessed:

- Central Africa: Burundi, Democratic Republic of Congo
- East Africa: Ethiopia, Rwanda, Uganda
- North Africa: Morocco,
- Southern Africa: Mozambique, South Africa, and Zambia
- West Africa: Burkina Faso, Liberia, Nigeria

c. Period of assessment:

Assessments were conducted from May 2023 - August 2023.

d. Assessment Tool:

An assessment tool was developed taking into consideration other assessment tools for NPHI and health security. These tools included the Africa CDC scorecard for NPHI assessment and monitoring scorecard, the IANPHI staged development tool, and the JEE. The draft tool was shared with Africa CDC staff and NPHI consultants for comment and review. We shared the final assessment tool together with a concept note and agenda with the NPHIs selected for the assessment for their preparation.

e. Assessment

The assessments were conducted using the tool that focused on Corporate Governance and the following four programmatic, functional areas: Health Information Management System; Public Health Workforce Development; Public Health Emergency Response Coordination and Public Health Research. In each Programmatic functional area, the assessment focused on eliciting information on a specific number of critical points.

Areas assessed were scored as follows: **Advanced** (fully operational with up-to-date evidence) - 3 Points; **Developing** (operational however, still missing some functional steps) - 2 Points; **Basic** (presence of understanding of requirement) - 1 Point; **No Capacity** (no evidence of the requirement in place)- 0 Point. Each programmatic area assessed was scored against a maximum: Corporate Governance, 12; Health Information Management System, 69; Public Health Workforce Development, 42; Public Health Emergency Response Coordination, 51; and Public Health Research, 24. The maximum expected total score from the Assessment is 198(66x3).

The study participants were identified on 29th April 2023. The focused group discussions were conducted in Ethiopia, Zambia, Mozambique, Burkina Faso, Uganda, Liberia, South Africa, Rwanda, Nigeria, Morocco, Democratic Republic of Congo, and Burundi from 9-11 May, 10-12 May, 12-14 June, 23-24 May, 28-31 May, 5-7 June, 7-8 June, 12-14 June, 13-15 June,, 2-4 August, 7-8 August and 28-29 August 2023 respectively.

f. Capacity areas assessed

The assessment results focused on the following 5 critical areas as discuss below:

Corporate Governance: NPHIs are expected to show an accountability system, change management processes, and internal and external audit findings to ensure continuous quality improvement. This was done assuming their legal documents were available and allowed for transparent operation.

Health information system: The NPHIs are expected to have at least an up-to-date Health Information System (HIS) policy, strategic plan, conduct population-based disease surveillance of the nationally notifiable diseases linked to an interoperable electronic reporting system. The NPHIs should conduct data analysis and prepare a weekly epidemiological bulletin.

Public health workforce development: The effective functionality of the NPHIs depends on a robust workforce development strategy which includes a public health workforce development plan, continuous professional development program, a national database of health workers and an FETP in place in the country.

Public health emergency response and coordination:

Risk assessments, contingency plans, communication plans, standard guidelines and SOPs, response coordination mechanisms, and training are key elements for effective and efficient public health emergency response and coordination at all levels. Equally, a dedicated human resource, regular budget, simulation exercises, medical countermeasures, and After-Action Review (AAR) are essential for optimal emergency response and coordination.

Public health research: Public health research is a key pillar in examining health determinants influencing population health. Some essential requirements for effective public health research include the availability of operational research guidelines, an aligned research agenda to national priorities, communication and dissemination of research findings in scientific journals, and collaboration with relevant national and international research institutions.

g. Data Analysis

After collecting the performance scores for each programmatic area, the capacity for each NPHI was calculated against the maximum score for each programmatic area and the result given in percentage. The scores for the programmatic areas were used to guide the identification of potential Centers of Excellence for the respective programmatic areas. The NPHI with the highest percentage score in each programmatic area was considered the potential candidate to be a Center of Excellence for that program area, considering geographic location and, language representation and the population size the NPHI serves. A 95% Confidence Interval was calculated using the formula Confidence Interval $(CI) = X + Z(S/\sqrt{n})$, where X represents sample mean, Z the z value from the normal standard distribution, S represents Standard deviation, and n represents sample size.

h. Ethical considerations

A concept note that specifies the objectives and purpose of the assessment together with an assessment checklist were shared with the participants of the study to seek an informed consent before the assessment was conducted. Data collection was conducted after obtaining oral consent from participants to be part of the assessment and information was gathered through an open discussion with all the participants. In addition, the completed assessment checklist was shared with all the participants to confirm the information provided was correctly captured and approved by the participants.

Results and Discussion

a. Central Africa Region

Corporate Governance: The results in Table 1 show that the Burundi National Public Health Institute (INSP Burundi) scored 92% and Democratic Republic of Congo National Public Health Institute (INSP RDC) scored 8%.

The INSP Burundi has an institutional strategic plan with clearly defined objectives. There are periodic performance reports with clear indicators for monitoring and mobilizing resources. The INSP Burundi is audited regularly, and the reports are available. Change management plan is being developed and the process has been initiated internally as the institution's mandate is expanding.

Health Information System: INSP DRC scored 71% and INSP Burundi 57% (Table 1). INSP DRC has a 4-year strategic plan for health information (2021-2023) and health information system management policy. The INSP DRC also has SOPs for digital health and data management. The digital platform currently in use within the health system includes DHIS2 and EWARs to capture surveillance data.

Public Health Workforce Development: INSP Burundi scored 71% and INSP RDC 45%). All the staff in the INSP Burundi sign annual performance contracts informed by institutional strategies and plans with their direct supervisors. The institute conducts monthly performance evaluations and has a career development plan for its staff. The INSP Burundi has an accredited FETP.

Public Health Emergency Response Coordination: INSP Burundi scored 67% and INSP RDC 25% (Table 1). INSP Burundi is part of the national commission for emergencies and natural disasters and collaboratively conducts vulnerability assessment and risk mapping frequently. Burundi has a functional Emergency Operation Center (EOC) at national level hosted at the Ministry of Health. The INSP Burundi has trained surge staff for emergency deployment and regularly carry out simulation exercises. Contingency plans are regularly revised and updated.

Public Health Research: INSP Burundi scored 92% and INSP RDC 42% (Table 1).

Table 1: Programmatic Assessment Summary for selected NPHIs of the Central Africa region

Areas assessed	INSP Burundi	INSP RDC
Corporate Governance	11(92%)	1(8%)
Health Information System	39(57%)	49(71%)
Public Health Workforce Development	30(71%)	19(45%)
Public Health Emergency Response Coordination	34(67%)	13(25%)
Public Health Research	22(92%)	10(42%)

The INSP Burundi has established an institutional strategic plan for research. There exists a research directorate in the INSP Burundi. The institute's research agenda aligns with the national health priorities for Burundi. Scientific research is disseminated through scientific journals.

b. Eastern Africa Region

Corporate governance: Rwanda Bio Medical Center (RBC) scored (100%), followed by Ethiopian Public Health Institute (EPHI) (92%) and Uganda National Institute of Public Health (UNIPH) (50%). RBC has an Institutional Strategic Plan (2023-2027) that clearly defines priority projects and activities and strategies for mobilizing resources to fund the projects. The Plan also has provisions for ensuring monitoring and evaluation systems for the effective and efficient implementation of the set goals and objectives. The Center is audited annually by the Office of Auditor General and different External Audit Groups. RBC has a merger of 14 vertical programs with effective internal change management.

Health Information System: EPHI scored 93%, RBC 90% and UNIPH 71% (Table 2). Ethiopia has an Information Communication Technology (ICT) policy and a Digital Health Strategy. The EPHI has developed a customized strategy at the institutional level and a dedicated ICT and information communication Directorate has been established within the Institute. EPHI also has a digital health guideline for implementing the data management strategic areas. Digital platform currently in use within the health system includes DHIS2 to capture surveillance data. The Health Management Information System has covered eighty-five percent (85%) of the health facilities, and the surveillance data's average completeness is 90%. Interactive voice record system is established at national level with the hotline to provide information on the prioritized health threats with 5 different languages and the hotline also works 24/7 to collect adverse events, alerts and provide information. To ensure Information security policies are constantly updated to address new threats and incorporate new technologies, a national data security policy is prepared by the Ministry of Information Technology customized at institutional level.

Public Health Workforce Development: RBC scored 90%, EPHI 83% and UNIPH 74% (Table 2). In RBC, both government and contractual staff propose and sign annual performance contracts informed by institutional strategies and plans. Moreover, quarterly performance appraisal is conducted for both government and contractual staff. The RBC develops a capacity-building plan on an annual basis. There is an updated national digital database with all health workers in Rwanda at different levels. The RBC has a list of 75 trained AVoHC SURGE members ready to be deployed in and outside the country.

Public health Emergency Response and Coordination: EPHI scored 94%, RBC 86% and UNIPH 80%. EPHI, in coordination with other agencies conducts vulnerability assessment and risk mapping annually. Following the assessment, Scenario-Based Emergency Preparedness and Response Plans are developed. The findings of the assessment are used to procure emergency drugs and supply using the government budget at national level. The EPHI has a functional Emergency Operation Center (EOC) at a national level and 12 sub-national institutions which are completely aligned and network with the national PHEOC. A simulation exercise is conducted on a yearly basis with the engagement of WHO Afro and country offices, Africa CDC, and other relevant stakeholders and partners. EPHI participates in regional and international partnership platforms through the Intergovernmental Authorities for Development (IGAD) platform.

Public Health Research: EPHI and RBC scored 92% and 71%, respectively (Table 2). EPHI has prioritized research agendas on Public Health and Nutrition emanated from the Health Sector Transformation Plan (HSTP) and based on identified public health problems. Priority agendas are documented in its legal framework and periodical strategic plans of the institute are regularly reviewed and updated. EPHI has its own standardized Scientific Ethical Review Office and accredited Institutional Review Board (IRB) for peer-reviewing and reviewing research proposals, guidelines for evaluation and monitoring of executed research projects out comes through technical reports and published peer reviewed journals including Journal of Health and Nutrition which is edited and published bi-annually by EPHI to reach end users.

It has a well-established research evidence system of research knowledge translation mechanism that produces evidence briefs, policy briefs and dialogue reports to be utilized by policy makers when formulating policy directions for program interventions and evaluations.

Rwanda has a National Health Research Agenda that is updated regularly. The research agenda development is coordinated by the RBC's Research Innovation and Data Science (RIDS). The Ministry of Health has a Health Sector Research Policy that guides all research activities within the sector. A guidance on the flow of approval of the research is available and shared with stakeholders. Rwanda has a National Ethics Committee that reviews, approves and monitors all Health research activities. The research agenda is developed based on the national health priorities highlighted in the Sector Strategic Plan. A platform for dissemination named Rwanda Public Health Bulletin is published on a quarterly basis.

c. Western Africa Region

Corporate governance: (Table 3) The Nigeria Centre for Disease Control (NCDC) scored 100%, National Public Health Institute of Liberia (NPHIL) and National Public Health Institute of Burkina Faso (INSP Burkina Faso) both scored 92%.

The NCDC has internal guidelines, policy documents (best practice manual, financial regulations, and public

Table 2: Programmatic Assessment Summary for selected NPHIs of the Eastern Africa region

Areas assessed	EPHI	UNIPH	RBC
Corporate Governance	11(92%)	6(50%)	12(100%)
Health Information Management System	64(93%)	49(71%)	62(90%)
Public Health Workforce Development	35(83%)	31(74%)	38(90%)
Public Health Emergency Response Coordination	48(94%)	41(80%)	44(86%)
Public Health Research	22(92%)	17(71%)	22(92%)

service rules), financial reports, and external (Government and private) and internal audit reports. It has an onboarding and offboarding succession plan, a recruitment plan, a unit in charge of workforce development and staff performance evaluation.

Burkina Faso scored 92%. However, from discussions and observations during the assessment, Burkina Faso still needs more time to operationalize their guidelines for effective governance fully.

Health Information System: NPHIL scored 91%, INSP Burkina Faso 90% and NCDC 86% (Table 3). NPHIL and INSP Burkina Faso have established an interoperable information system. The health information system in Burkina Faso is hosted in the MoH and the INSP Burkina Faso has real-time access.

Public Health Workforce Development: INSP Burkina Faso scored 86%, NCDC 81%, and NPHIL 76%. The score for INSP Burkina Faso is high because they participate in the universities providing FETP training but not that the INSP Burkina Faso leads the training. Nigeria NCD has a well-established program for workforce development offering all the 3 levels of FETP, working in collaborations with other national and international universities providing opportunities for internship etc. The evidence of the workforce development success of the Nigeria NDC is seen in the number of staff of Nigeria CDC that have joined international organizations such as WHO and Africa CDC. NPHIL and INSP Burkina Faso still need support to strengthen workforce development.

Public Health Emergency Response Coordination: NPHIL scored 98%, INSP Burkina Faso 92%, and NCDC 86% (Table 3). The NPHIL conducted vulnerability assessment and risk mapping, needs assessment at points of entry, and shared the findings with the relevant stakeholders in the past two years. The institute has a national action plan for health security, case management guidelines for infectious diseases such as Ebola, Lassa fever, COVID-19, and Cholera. A risk communication system is in place with all the guidelines and Standard Operating Procedures (SOPs). One health platform is operational at national and subnational levels with multi-hazard emergency plans and SOPs. The emergency preparedness plan's guidelines to activate surge staff are well documented, especially during outbreaks. The country has functional national and 15 sub-national Public Health Emergency Operation Centers (PHEOC) with dedicated trained staff. The PHEOC conducts annual simulation exercises and participates in regional simulation exercises. The PHEOC can respond to large-scale emergencies as well as multiple emergencies. The PHEOC responded to 29 disease outbreaks in 2022.

Public Health Research: NPHIL scored 100%, NCDC 96% and INSP Burkina Faso 96% (Table 3). NPHIL has a unit for research. It has a 5-year Research Agenda (2021 – 2025). The research unit participates in research meetings, journal clubs, training in research techniques and manuscript writing. The research agenda is aligned to the national disease priority. NPHIL also collaborates with national and international organizations to conduct research and organize scientific conferences. NPHIL carries out periodic evaluation of the implementation of the research agenda.

Table 3: Programmatic Assessment Summary for selected NPHIs of the Western Africa region

Areas assessed	NPHIL	NCDC	INSP Burkina Faso
Corporate Governance	11 (92%)	12 (100%)	11 (92%)
Health Information System	63 (91%)	56 (86%)	62 (90%)
Public Health Workforce Development	32 (76%)	34 (81)	36 (86%)
Public Health Emergency Response Coordination	50 (98%)	44 (86%)	47 (92%)
Public Health Research	24 (100%)	23 (96%)	23 (96%)

d. Northern Africa Region

The assessment exercise in the Northern African Region was not completed within the given period due to delayed responses from member states. Only Institute Pasteur de Maroc (IPM) from the Kingdom of Morocco participated in the current exercise. The Africa CDC intends to complete this evaluation for the northern region soon. The Institute Pasteur de Maroc (IPM), National Institute of Hygiene and the Directorate of Epidemiology and Disease Control of MoH collectively perform various NPHI functions in Morocco. The main roles for the IPM are research and laboratory diagnosis.

Corporate governance: Institute Pasteur Morocco (IPM) scored 100% (Table 4).

The IPM is legally established by decree (No. 176-66) and

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Table 4: Programmatic Assessment Summary for IPM

Areas assessed	IPM (Morocco)
Corporate Governance	12 (100%)
Public Health Research	24 (100%)

the institute implements a performance-based management system annually. Bi-weekly management meetings are also held to monitor the project implementations and quarterly staff meetings. The institute conducts internal and external audits.

Public health research: IPM scored 100% for public health research (Table 4). The IPM has a unit for research with operationalized guidelines. Research priorities are updated annually and in line with national priorities. The institute also carries out public health research programs in collaboration with both public and private universities, other research centers in the country, pharmaceutical companies', network of public health institutes such as IANPHI, and international organizations like the Africa CDC. Research findings from the IPM have informed policy development in the country. The research findings are disseminated to MoH and funders depending on the specific agreement. The research findings are also published in international journals

e. Southern Africa Region

Corporate Governance: All NPHIs scored 92% (Table 5). The Instituto Nacional de Saúde (INS), National Institute of Communicable Diseases (NICD) and the Zambia National Public Health Institute (ZNPHI) are established and functioning through legal frameworks in line with the laws of their respective countries. The legal instruments establishing these institutions gives them autonomy to decision-making, human resource management (recruitment, retention, discipline, motivation, pension for staff), financial autonomy including direct treasury allocation, disbursement, internal and external audits and procurement processes.

The NICD is also accredited and certified to ISO 17025, ISO15189 and ISO 9001, internationally recognized quality management systems. The ZNPHI maintains a Risk Register for recording potential and identified risk as part of best financial risk management and accountability practices. All institutions generate audited financial statements annually in line with good corporate governance practices, including 5-year Strategic Plans.

Health Information System: NICD scored 91.3%, INS 88.4%, and ZNPHI 69.6% (Table 5). The NICD Health Information system is aligned with the National Legislative and Governance Framework of South Africa, the National Department of Health and the National Health Laboratory Service. The specific Surveillance Strategy is being developed within the context of the National Health Normative Standards Framework for Interoperability in eHealth in South Africa 2014 and the National Digital Health Strategy for South Africa 2019-2024.

The National Laboratory Information System (TRAKCARE) provides a list of public facilities updated regularly as and when new health facilities are registered. Private facilities are added via the Notifiable Medical Conditions platform. The master facility list, national data dictionary, and a district health information system provide additional information. All public health facilities are represented in the NICD Health Management System and 80% of private facilities are being included in the Surveillance Data Warehouse. The surveillance system is equipped with a fully secure interoperable electronic tool for public health surveillance and across sectors (animal and environmental health).

Public Health Workforce Development: the INS scored 90.5%, NICD 85.7% and ZNPHI 69% (Table 5). At the INS, the National Directorate for Training and Communication in Health publishes the Annual Plan for Short Duration Courses. INS has an accredited 3-tier FETP program. The INS is part of the Network of NPHIs of Portuguese-speaking countries and regularly collaborates with other LUSOPHONE countries on workforce capacity development. The 2023-2027 Strategic Human Resource Development Plan has been developed and is set to be operational by the second semester of 2023. Similar to the INS, the NICD also offers national, regional and international in-service and professional training courses. Also, the South African FETP, established in 2006, was accredited by TEPHINET in 2018 and accepts regional participants, specifically from Botswana, Lesotho, Eswatini, Zimbabwe and Malawi.

Public Health Emergency Response Coordination: the NICD scored 78.4%, ZNPHI 76.5%, and INS 70.6% (Table 5). The NICD has a national EOC which is fully established and functioning. The Western Cape provincial (sub-national) EOC is also established while the other 8 provinces are setting theirs. Simulation exercises are conducted regularly. The team conducts After-Action-Review (AAR) post emergency responses at the national level. The NICD collaborates with Port Health to monitor and notify medical evacuation cases. An electronic alert notification system is in place.

Public Health Research: both the INS and NICD scored 91.7%, while ZNPHI scored 33.3% (Table 5). The NICD research agenda is based on national priorities set by the NDoH and produced after a series of consultative processes with stakeholders. Furthermore, the NICD has a Research Office to consolidate research activities across the institute and provide support and guidance to external research funders. Currently, the NICD communicates the research findings monthly. The NICD has a scientific journal called the "Science Focus".

The INS collaborates with the National Directorate for Health Research and Wellbeing and the Directorate for Health Surveys and Observation. Dissemination of findings is done through national and international fora. The INS has a scientific journal called the "Revista Moçambicana de Ciências e Saúde" (RMCS), which produces approximately 40 indexed publications annually and will host the Lusophone NPHI conference in 2023.

The mean score of the potential regional centers of excellence at 95% CI for Health Information Management System, Workforce Development, Emergency Response Coordination, and Public Health Research is 87% [72-102], 84.5% [67,101], 70.6% [27,140] and 91.7% [89,99] respectively. (Table 6)

Table 5: Programmatic Assessment Summary for selected NPHIs of the Southern Africa region

Areas assessed	INS (Mozambique)	NICD (South Africa)	ZNPHI (Zambia)
Corporate Governance	11(92%)	11(92%)	11(92%)
Health Information Management System	61(88.4%)	63(91.3%)	48(69.6%)
Public Health Workforce Development	38(90.5%)	36(85.7%)	29(69%)
Public Health Emergency Response Coordination	36 (70.6%)	40(78.4%)	39(76.5%)
Public Health Research	22(91.7%)	22(91.7%)	8(33.3%)

Table 6: Average scores of potential regional Centers of Excellence for the selected programmatic areas

Variable	Health Information Management System	Workforce Development	Emergency Response Coordination	Public Health Research
Total Score	524.7	504.2	500	168
Sample size	6	6	6	7
Average score	87	84	70.6	91.7
Standard Deviation	40	43	146	15
Standard Error	7	7.2	24.36	2.08
Margin of error	3	3.6	12.18	1.04
95% CI	[72,102]	[67,101]	[27,140]	[89,99]
Confidence Interval(CI)= $X \pm Z(S/\sqrt{n})$				
X= Sample mean, Z= Z value from the normal standard distribution, S=Standard deviation, n= population size				

Conclusion

Based on the assessment scores, and taking into consideration geographic location and language factors, and the population they serve, the NPHIs that relatively demonstrated advanced capacity in each region were DRC, Ethiopia, Nigeria, Morocco, and South Africa for Health Information System; Burundi, Rwanda, Burkina Faso and Nigeria, Morocco, Mozambique and South Africa for Public Health Workforce Development; Burundi, Ethiopia, Liberia, Morocco, and South Africa for public health emergency response coordination; and Burundi, Ethiopia, Liberia, Morocco, and South Africa for Public Health Research from Central, East, West, North, and Southern Africa regions respectively. These NPHIs can serve as a regional Centers of Excellence for the programmatic areas identified with additional support from Africa CDC and other partners.

The most common challenges all NPHIs face include inadequate infrastructure and resources for interoperable electronic reporting systems and fragmented health information systems, inadequate government funding and dependence on external funding for NPHI programmatic activities, weak coordination mechanisms between national, sub-national government institutions and partner organizations, high staff turnover and lack of career development plans and frequent top NPHI leadership change affecting program continuity.

Addressing these challenges require sustained political commitment, increased funding for public health, improved infrastructure and resources, strengthened partnerships and collaborations, and the development of effective policies and strategies to support the functions of NPHIs. Moreover, NPHIs need to develop career development plan and

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continuous professional development programs to address staff attrition.

Declarations:

Ethics approval and consent to participate

Ethical approval was obtained from the Public Health Institutes and Research Division of the Africa CDC to conduct the assessment. Informed consent was obtained from the study participants, and the data was collected through a focused group discussion, document verification and site visits.

Consent for publication

Our manuscript does not include information or images that could lead to the identification of a study participant; therefore, consent for publication is not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author based on reasonable requests. NPHIs that participated in this study must consent to make the data publicly available.

Competing interests

The authors declare that they have no competing interests.

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Authors' Contributions

Haftom Taame Desta designed and planned the study, took the lead in analyzing the results and writing the manuscript. Raji Tajudeen, Fai Karl, Howard Nyika, Grace Merekaje, Joshua Obasanya, Killian Songwe, Emmanuel Idigbe, and Placido Cardoso contributed to the design and implementation of the study, the analysis of the results and the writing of the manuscript. Nicaise Ndembi, Ngashi Ngongo, and Jean Kaseya contributed to the writing of the manuscript. All authors provided critical feedback and helped shape the manuscript.

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