EXECUTIVE SUMMARY

ASSESSMENT OF DIAGNOSTIC GAPS AND RELEVANT DIGITAL HEALTH SOLUTIONS IN NIGERIA

INTRODUCTION

This assessment identifies the priority diagnostic gaps and the relevant digital health solutions to address those gaps in Nigeria. The findings are based on interviews with 14 in country experts that included government, implementing partners, patient advocates and digital health solution vendors, and desk research. Diagnostic gaps were identified within the context of disease burden and the diagnostic patient pathway, inclusive of pre-point of care (pre-POC) stages of health information seeking and early care-seeking, and point of care (POC) stages at the facility level, consisting of screening, diagnosis, linkage to treatment and treatment monitoring. The diagnostic gaps were prioritized based on their direct impact on patient outcomes, stakeholder feedback, and the extent to which the gap affects multiple stages in the patient pathway. Relevant digital health solutions and the barriers and enablers of their scale were identified based on a broad landscaping and stakeholder feedback.

COUNTRY CONTEXT

Nigeria is a lower-middle income country in West Africa, representing both the largest country, with 195 million people, and the largest economy in Africa. Continuously high fertility rates maintain a young and rapidly urbanizing demographic, with 42% of people under the age of 15 and half of Nigerians residing in urban areas, up from 34% in 2000. Despite Nigeria's economic gains, the increasing population demands in a low-resource environment have contributed to a high poverty rate of 40%[1] and an average life expectancy of 54 years, among the worst in the world.[2]

Although primary health care (PHC) is a growing priority for the Ministry of Health (MOH), it is significantly resource-constrained and local private-sector providers play a critical role in delivery of basic health services. Healthcare is delivered through a decentralized governance model, which can result in fragmentation of decision-making and increases the complexity of scaling national initiatives. PHC service availability is led by the public sector, which represents almost 80% of all PHC facilities in Nigeria. PHC facilities are managed by Local Government Areas (LGAs) with support from state governments and the National Primary Healthcare Development Agency (NPHCDA) and are most commonly staffed with community health extension workers (CHEWs), midwives and/or nurse midwives.[3] However, nearly 70% of the population access the private sector as their first point of call for health services.[4,5,6] Most of the rural poor cohort of Nigerians have limited access to formal health services and are served by private proprietary and patent medicine vendors (PPMVs). PPMVs are drug-retail outlets that have good geographic density across a network of 200 000 to 400 000 outlets.[7]

Nigeria's healthcare system is underfunded, with 0.53% of GDP spent on public health services, representing less than half of typical healthcare expenditure in other low- and middle-income countries and sub-Saharan Africa.[2] Although the National Health Insurance Scheme was launched in 2003 to support universal health coverage, less than 5% of the population is insured6 and 77% of health expenditure is out of pocket, frequently pushing Nigerian households further into poverty.[2] In the government's National Strategic Health Development Plan for 2018 to 2022, the stated priority is to strengthen the PHC system, ensuring universal access to affordable essential healthcare and decreasing the number of deaths from preventable causes.[8]

DIAGNOSTIC GAPS IN THE CONTEXT OF DISEASE BURDEN

Nigeria's disease burden is dominated by maternal, newborn and child health (MNCH) and infectious diseases, with a growing burden of non-communicable diseases (NCDs). Around 68% of all deaths in Nigeria are from the combined categories of communicable, maternal, neonatal and nutritional diseases, and the top five causes of morbidity and mortality are lower respiratory infections, neonatal disorders, HIV/AIDS, malaria and diarrhoea. Although NCDs are not as prevalent as infectious diseases, they still account for a third of deaths.[9] Rapid population growth, urbanization, lifestyle transition, and air pollution have contributed to the growing burden of NCDs in Nigeria. It was also highlighted that Nigeria's response to outbreaks and/or global threats such as Ebola, COVID-19 and antimicrobial resistance reveal significant diagnostic gaps.

Despite numerous interventions, Nigeria is struggling to reduce its high MNCH mortality rates, demonstrating gaps in antenatal and newborn screening, and in the effective diagnosis of childhood illnesses such as pneumonia and diarrhoea. The country still experiences 20% of all global maternal deaths, has under-five mortality that is five times greater than set out in the Sustainable Development Goals and has the highest neonatal mortality rate in sub-Saharan Africa.[2,10]

Nigeria is a leading contributor to the global disease burden for HIV, malaria and tuberculosis (TB) and gaps in identifying cases of these infections have persisted.[11,12] A third of HIV and TB infections are not identified and the government's efforts to improve malaria testing have fallen short.[13]

MOH, donor and implementing partner priorities are aligned with infectious disease and MNCH burden statistics, but the increasing prevalence of NCDs has not translated into domestic or donor funding. This has left a growing need to provide education, diagnostics and care for key NCDs, such as cardiovascular disease, diabetes and cancers. However, providing quality care for NCDs in a low-resource environment is expensive and challenging, demonstrated by the lack of diagnostics tools, equipment and specialists in the public or private sector in Nigeria.

DIAGNOSTIC GAPS IN THE PATIENT PATHWAY

Pre-point of care (pre-POC) stages were stated as fundamental and significant barriers to driving demand for diagnostic services. These barriers cause patients to delay engagement with the health system until they are seriously ill, as their efforts in seeking care are costly in time and money, and often unfruitful.

THE HIGH-PRIORITY PRE-POC GAPS ARE:

01 **Lack of access to accurate, timely and trusted information.** People often seek health information from sources that they trust, including family, friends and informal providers such as religious leaders or traditional healers.[7,14] However, these sources are not always reliable sources of health advice and often provide misinformation. CHEWs and PPMVs are better positioned to provide accurate and accessible health information, but there appears to be significant variation and/or limitations in their ability to provide accurate information due to insufficient training or support.[15,16]

02 **Low perception of health service quality, leading to reduced patient trust.** Patients have low confidence in being able to obtain quality health services from the public sector, based on previous poor patient experiences. This is reflected in patient-facing concerns such as long wait times, creating a cycle of avoidance in seeking diagnosis and care.

03 **High out-of-pocket costs for health services and transport.** Financial constraints are a significant barrier to seeking care in rural areas. Patient preference for the private sector, low insurance coverage and transport/administrative fees (for both public and private sector) result in high out-of-pocket expenses. Patient fees are disproportionately high compared with consumers' ability to pay, with the average cost of a public PHC visit ranging from US$2.30 to US$8.00, which is onerous for the 73% of Nigerians who live on less than US$2.00 a day.[16]

"Cost in particular is a key barrier to decision to seek care. People will rather do self-medication based on presenting symptoms e.g. someone might prefer to just buy paracetamol for a fever than spend extra money getting a test done".

– Implementing Partner, Nigeria

The root cause of Nigeria's diagnostic gaps are health system capacity gaps, which prevent access to basic diagnostics at the POC. The nation's burgeoning population and low budget allocation to health has stretched available health resources. This results in poorly equipped PHC facilities and laboratories that mainly refer patients to secondary and tertiary level facilities for diagnostics and care, especially in rural areas.

THE HIGH-PRIORITY POC GAPS ARE:

01 **Poor physical infrastructure and power supply.** Significant gaps in infrastructure, such as the absence of electricity and essential general equipment, serve as a key barrier to service provision. Allocation of available public resources is reported to favour provision of treatment over improving diagnostic capacity. For example, laboratory facilities in rural areas were indicated as not available or severely under-equipped.

02 **Inadequate availability and capacity of HCWs.** Nigeria experiences understaffed, overburdened and under-trained CHEW and HCW teams at PHC. Nigeria has 20 HCWs (doctors, nurses, midwives) per 10 000 people, less than half of the World Health Organization's recommended minimum of 44.5 per 10 000 people.[17] Additionally, HCWs often lack the knowledge and skills to deliver quality screening or diagnosis. One study noted that only 37% of all cases were correctly diagnosed by participating HCWs across a number of high-burden diseases in Nigeria.[3] Additionally, laboratory staff are often overburdened, and face operational delays and limited mentorship. Although PPMVs are the first point of call for many patients, they often demonstrate low disease awareness and do not always have the skills to perform basic screening and diagnosis, as per MOH guidelines.[18]

"We don't have enough lab scientists to do these tests. [We] need to expand the workforce that can do the tests".

– Implementing Partner and Laboratory Director, Nigeria

Laboratory staff in Nigeria are often overburdened, with limited mentorship which can cause delays in delivering test results.

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03 **Insufficient availability of diagnostic tests and equipment.** A lack of supply chain management expertise or ownership, combined with oft-neglected attention to diagnostic commodities, results in frequent stock-outs of rapid diagnostic tests, basic equipment and laboratory reagents, especially at the last-mile PHC facilities.[19,20,21,22,23]

"Most people didn't know much about supply chain. There are huge knowledge gap on supply chain management to expiries and wrong procurement of commodities".

– Implementing Partner, Laboratory SCM Expert, Nigeria

04 **Lack of interoperability between information management systems and/or applications.** Access to diagnostic results is dependent on building interoperability solutions between the laboratory information management systems, diagnostic devices, data sets from other programmes, electronic medical record systems and other in-field digital health solutions, such as short message service (SMS) printers or unstructured supplementary service data (USSD) codes for sample tracking and returning results. Although an ongoing effort, this has been challenging to coordinate and fragmented donor activities have created parallel systems, without a common standard approach to interoperability.

Finally, although not deemed a comparably high priority gap, it is worth highlighting that utilization of data tends to be restricted to reporting purposes, with limited evidence of use for clinical or programmatic decision-making. Parallel reporting of many streams of data, without any coordination at district level, results in paper-based repositories of unused data at LGA, state and central level and does not optimize the data collected for decision making, especially for frontline HCWs.

RELEVANT DIGITAL HEALTH SOLUTIONS

Digital health solutions can help address several of the identified high-priority gaps, as summarized further below. The following recommendations take into account Nigeria's moderate digital maturity level, which is in line with the average digital maturity of the sub-Saharan African region. Nigeria has a positive enabling environment for digital intervention in health, from a strategy and policy standpoint.[24,25,26]

BARRIERS TO SCALE

Scaling digital health interventions faces challenges from the poor digital infrastructure in rural areas, limited lower-level ICT user skills and difficulty in transitioning ownership of solutions to the MOH, due to fragmented governance and budget and technical capacity constraints. Additionally, fragmented and donor-dependent financing results in parallel systems that are not compliant to the same programmatic and/or technical standards, creating silos.

ENABLERS OF SCALE

There is opportunity to support the MOH in providing appropriate guidelines or evaluation stage gates for implementation of digital solutions for diagnostics, in a way that specifically considers the constraints of the government and Nigeria's digital maturity trends. Selected digital solutions for MOH investment should prioritize those that ensure interoperability with other systems and integration with existing workflows, connect to a unique patient identifier, is built with simple, configurable and modular design that demonstrates scalability in low-resource environments, illustrate a roadmap to sustainable financing and generates value for its end-users by addressing their key pain-points.

"We design for a low data environment [so that] even with a smartphone, users can switch to a lower data or a feature phone view".

– Digital Solution Vendor, Nigeria

It is with this context that these recommendations are made.

DISEASE FOCUS

Based on the diagnostic gaps observed from a disease-specific lens, digital health solutions can help close TB case detection gaps (especially in the private sector); increase uptake of malaria testing; improve access and quality of integrated antenatal screening; increase diagnosis of childhood illnesses, specifically pneumonia and diarrhoea; and build awareness, routine screening and diagnosis for NCDs, particularly for cardiovascular diseases and its major drivers, diabetes and hypertension. It is noted that increasing demand screening and diagnostics is most effective when treatment is adequately available in country, which is not currently the case for certain NCDs like cancer.

PATIENT PATHWAY:

01 **Pre-POC: improving access to accurate, timely and trusted information to increase efficient care-seeking.** Solutions that address pre-POC diagnostic gaps by targeting patients with accurate and relevant health information via basic mobile phone features via short message service (SMS) messaging, unstructured supplementary service data (USSD) codes, WhatsApp and social media like Facebook would help address the considerable need for health education and drive demand for diagnostic services. These solutions should be championed by trusted patient influencers, such as CHEWs, PPMVs and/or traditional and religious leaders and could be valuable to improve patients' knowledge of early symptoms of diseases with high prevalence (e.g. TB) or to increase aware-ness of NCDs, thereby promoting early care-seeking for diagnosis. Patient resonance and reach could be expanded by combining tailored messaging with a basic symptom tracker/self-screening module and geo-mapping to provide guidance on what action to take next, based on the patient's budget, location and health needs, could act as a holistic platform for patients.

"Patients are eager to be supported. There is a need for these [digital] products. Patients need and want this support. It is up to us to figure out how to provide in a way that meets their needs".

– Digital Solution Vendor, Nigeria

02 **POC: improving existing capacity of frontline PPMVs and CHEWs to increase the quality of screening and diagnosis and strengthen referral, especially in rural areas.**

Solutions that address POC diagnostic gaps related to quality of care are best targeted to PPMVs, CHEWs and other HCWs at lower level PHC facilities. Multiple mobile applications that provide clinical decision support through job aids, screening and diagnosis workflows, and case management tools have been implemented in Nigeria, especially for TB, and could be expanded to aid in screening and diagnosis for other neglected or new health areas.

03 **POC: increasing the availability of key diagnostic commodities and equipment to improve access to POC diagnostics, especially in rural areas.**

Solutions that address POC diagnostic gaps around availability of commodities and equipment are best targeted to HCWs and state or LGA-level health system supply chain personnel. These could include simple digital job aids and automated tools to improve rational ordering or stock inventory management. Additionally, the Nigeria Health Logistics Management Information System (NHLMIS) includes both drugs and diagnostics, but the focus on diagnostic commodities within its implementation could be explored with the MOH as to potential diagnostic-specific gaps, and how to improve visibility of warehouse and facility inventory metrics to accelerate responses to low diagnostic commodity stock levels or expiry risk.

Digital solutions can improve existing capacity of frontline health workers, increasing the quality of screening and diagnosis and strengthening referral, especially in rural areas.

04 **POC: bringing screening and diagnostics closer to the patient through telemedicine and mobile digital diagnostics will improve access to accurate diagnosis.**

Solutions that overcome topography and health infrastructure barriers can reach patients where they are and improve access to accurate diagnosis. These solutions should be targeted to HCWs as holistic clinical decision support initiatives and could include provider-to-provider telemedicine and mobile vehicles with a combination of artificial intelligence-powered software, telemedicine, and connectivity solutions to provide rapid diagnosis and referral. Significant support is needed to design these solutions in a cost-effective way, with financial and operational commitment to the longer timelines required for expansion.

05 **POC: bringing focus to disease prevention and screening to identify health risks, diagnose disease and target intervention earlier.**

Mobile digital solutions that leverage geo-localization to facilitate individual case identification, contact tracing, and targeted alerts to individuals and the government enables real-time surveillance of on-going disease burden and speeds up the response and management of unanticipated outbreaks. Additionally, digital solutions that are tailored to support the integration and/or bundling of basic tests, provide an opportunity for the early identification of at-risk patients and faster intervention.

06 **POC: supporting central, state, LGA-level and frontline HCWs to utilize data more effectively for decision-making.**

Supporting the development of interoperability standards and solution integration guidelines, and accelerating connectivity between the disease specific laboratory information management systems to the POC devices, NHLMIS, DHIS2 and/or the central National Data Repository would enable more integrated and side-by-side utilization of data, in a patient-centric way. Leveraging existing functionality of implemented digital systems or building configurable extensions can enable central and district-level HCWs, including laboratory staff, to use visual data summaries in an actionable way for programmatic intervention.

Overall, digital health tools will be necessary to optimize the use of limited resources in Nigeria and increase access to quality diagnostic services at the lower levels. Looking forward, the MOH's leadership in advocating the use of technology in health and its increasing focus on strengthening PHC services via the NPHCDA, combined with the spotlight on diagnostics from COVID-19, positions Nigeria well for a digital health transformation where it's needed the most - at the frontlines of service delivery.

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