

REPORT SUMMARY

ASSESSMENT OF DIAGNOSTIC GAPS AND RELEVANT DIGITAL HEALTH SOLUTIONS

SUMMARY FINDINGS FROM PERU, INDIA, NIGERIA AND UGANDA

OVERVIEW AND METHODOLOGY

This first-of-its-kind report prioritizes diagnostic gaps across four diverse countries – Peru, India, Nigeria and Uganda – and identifies both new and existing digital health solutions that can address those gaps to improve healthcare service delivery.

The assessment was conducted via primary and secondary research in Peru, India, Nigeria and Uganda. It included 500 mobile phone surveys conducted via interactive voice response (IVR) with patients from India and Peru, and 63 interviews with global and in-country experts representing patient advocacy groups, government, implementing partners, public health advisors, funders, digital health experts and digital solution vendors. These were supplemented by a desk review of public health publications and digital health solution landscapes. To note, this assessment's scope and findings are intended to be broad and general in nature and any specific topics could be explored further, depending on interest.

This assessment was conducted during March to July 2020, coinciding with the COVID-19 pandemic and stakeholders provided feedback against this backdrop.

This report aims to take a **PATIENT-FOCUSED PERSPECTIVE**, with findings framed by the following distinguishing elements:

01 A patient pathway approach, defined from the point at which health information and early care are sought (i.e. prior to the patient accessing a point of care, referred to here as “pre-POC”), to POC screening and clinical assessment, accurate diagnosis, linkage to treatment and treatment monitoring.

02 Exploration of the earlier stages of the patient journey are reflected by:

- The inclusion of the pre-POC stages, which allows the assessment to take a broader approach in the understanding of diagnostic delivery, compared with the traditional cascade of care definition.
- POC stages are focused in scope to the levels of the healthcare system that patients interact with first and deliver primary healthcare (PHC) services.

FOCUS COUNTRY CONTEXT

Peru, India, Nigeria and Uganda were selected to reflect their diverse income classifications, demographics, socioeconomics, culture, geography and healthcare system structures. Additionally, they span low-to-moderate digital health maturity levels, based on country assessments drawn from the [Global Digital Health Index](#) and the [Network Readiness Index](#).¹

The four countries illustrate varying epidemiological patterns. Non-communicable diseases (NCDs) drive mortality and morbidity rates in Peru and India, causing 70% and 63% of deaths, and 66% and 56% of disability-

adjusted life years, respectively. To note, tuberculosis (TB) remains a major concern in both countries, with high multidrug-resistant TB rates. Infectious diseases (HIV/AIDS, malaria and TB) and maternal, newborn, and child health (MNCH)-related conditions dominate the disease burden in Nigeria and Uganda. Similar to other sub-Saharan African countries, morbidity and mortality from NCDs has risen in Nigeria and Uganda, driving an increase in related disability-adjusted life years by 42% and 54%, respectively, and caused nearly a third of deaths in 2017 in both countries.²

HIGH-PRIORITY GAPS FROM A DISEASE LENS

Despite differences in disease burden patterns across the four focus countries, similarities emerged in the highest priority disease-focused gaps with neglected diagnostic needs:

01 **The rising NCD burden is recognized but remains largely unaddressed, necessitating a dynamic shift in the focus of government and partner resources.** While NCDs represent a serious and growing health need, funding and programmatic interventions continue to prioritize the 'big three' infectious diseases (HIV/AIDS, malaria, TB) and MNCH related conditions. This has left a widening gap to strengthen the continuum of care for key NCDs with increasing prevalence and mortality, namely cardiovascular diseases, chronic respiratory conditions and cancers.² Early diagnosis and management of hypertension and diabetes was highlighted as key to improving cardiovascular disease outcomes. Across all four countries, fundamental barriers to NCD response are observed as low disease awareness, a lack of preventative and routine screening measures and inconsistent availability of basic diagnostic services at PHC level.

02 **To manage the growing threats of antimicrobial resistance (AMR) and disease outbreaks, progress needs to be accelerated towards establishing a nationwide, routine and integrated disease surveillance system.** In India, routine disease surveillance was observed as a high-priority gap overall; in Peru, Nigeria and Uganda, the existing national systems can be strengthened by stronger inclusion of NCDs and AMR monitoring. The development of an integrated diagnostics network that reaches last-mile facilities was deemed an essential building block to enable routine surveillance reporting and timely programmatic intervention. COVID-19 has amplified challenges in effectively tracing and tracking patients' risk, diagnosis and case status in real time, regardless of the type of healthcare provider they access.

03 **Achievement of the TB elimination target by 2035 is significantly hampered by insufficient early detection of missing³ cases at community and PHC level.** In 2018, India and Nigeria alone drove 37% of the 3 million missing TB cases globally.⁴ Experts noted that key gaps to ramp up diagnosis are greater disease and drug resistance awareness, and the need for simple POC diagnostic solutions at PHC facility level.

1 The Network Readiness Index 2019 is released by the World Information Technology and Services Alliance (WITSA), previously facilitated by The World Economic Forum. The Global Digital Health Index is facilitated by HealthEnabled and a consortium of global health partners.

2 [Country Profiles: Peru, India, Nigeria, Uganda, Measuring what matters](#). Institute for Health Metrics and Evaluation (IHME), 2017.

3 Gap between number of new cases reported and the estimated number of incident cases.

4 [Global Tuberculosis Report](#), WHO, 2019.



PRE-POC: HIGH-PRIORITY GAPS IN THE PATIENT PATHWAY

Significant gaps were identified in the pre-POC stages of the patient pathway: health information seeking and early care-seeking. This negatively impacts patient demand, trust and engagement with diagnostic services in the health system, with consequences for long-term health outcomes.

Early-stage gaps identified include low awareness of high-burden diseases and their symptoms and limited access to accurate timely and trusted information to guide when and where to seek care. Patients struggle to recognize symptoms and seek diagnosis early.

The pre-POC stages represent fundamental gaps in the patient pathway overall, especially consequential for NCDs, AMR, outbreaks and persisting infectious diseases like TB.

- **Gaps in the pre-POC stages of the patient pathway are more critical in the context of NCDs, as they can have the greatest repercussions for patient outcomes.** Patients prioritize diagnosis when symptoms arise, but NCDs are often asymptomatic in their early stages and patients present in late stage with a significantly higher risk of adverse health outcomes, along with potentially catastrophic cost.
- **Appropriate case detection, management and monitoring of high-burden diseases is restricted when early stages of the patient pathway contain gaps.** For example, in the field of TB, a lack of robust mechanisms to disseminate targeted health information quickly fails to empower patients to ask questions, identify symptoms and seek out screening and diagnosis.

Patients seeking health information have few sources that are trusted and well equipped to provide such information, especially in rural areas. While community healthcare workers (CHWs) are well positioned to provide health information, they are often under-resourced and overburdened, limiting their impact. Although patients indicated that family, friends, traditional healers, religious leaders and local and/or informal providers are trusted and accessible, they are not always reliable sources of health advice.

Perceived quality, accessibility and affordability of health services are the key factors that patients consider when seeking care. Patients in the four countries seek primary care predominantly in the private sector first, due to perceived low quality of public health services. However, the standard of care remains variable in the private sector and the required out-of-pocket spend on health, ranging from 28% in Peru to 77% in Nigeria of current health expenditure,⁵ deters patients from seeking early or further care.

⁵ [World Development Indicators Open Data](#), The World Bank, 2017



Health extension workers train community representatives who act as health advocates, sharing information and acting as a bridge between community and health system.

POC: HIGH-PRIORITY GAPS IN THE PATIENT PATHWAY

The key gaps identified in the POC stages of the patient pathway were most attributable to challenges in health system capacity, governance and data management and use. Overall, bringing screening and diagnosis closer to the patient, especially in rural areas was deemed as the highest priority need to expand access to diagnostic services.

Lack of access to high-quality testing services at PHC facilities, especially in rural areas, impacts accuracy of diagnosis, patient satisfaction and patient retention.

- Local delivery of testing services across the four focus countries is challenged by poor physical infrastructure and power, neglected focus on building diagnostic capacity by governments in the form of laboratory infrastructure, sufficient laboratory staff and supply chain personnel, insufficient availability of essential diagnostic commodities and equipment, shortage of healthcare workers (HCWs), underutilization of POC diagnostic tools, weak referral systems and long waiting times for sample collection and test results.
- Where services are available, patients often expressed low confidence in HCWs' ability to provide a clear diagnosis and next steps. This is driven by inadequate HCW training, poor HCW compliance to testing protocols and suboptimal quality of diagnostic tests or equipment.
- These gaps disproportionately affect rural communities, where primary HCWs are overburdened, health facilities are stretched, and quality-assured laboratories are few and far between. For example, in India and Uganda, 70–75% of the population resides in rural areas, but only 30% of the health workforce serve the rural community.

Especially in India and Peru, a fragmented health system both between and within the public and private sectors, and siloed service delivery puts continuity of care at risk.

- Multiple health centre or laboratory visits across difficult terrain, incomplete or misplaced medical records and a lack of provider-to-provider communication increase the likelihood of delays in testing, unnecessary repeat testing, and patients opting out and/or reverting to unqualified self-testing or self-treatment. In an effort to quickly resolve their health concerns and/or minimize costs, patients may skip screening and diagnosis to directly access treatment.
- The absence of a standard of care and clear referral network across public and private sector facilities and laboratories often results in inaccurate diagnosis and poor or no linkage to appropriate treatment and monitoring.



Malaria samples being prepared for testing in the Peruvian Amazon.

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Across countries, there is emerging recognition of the value of preventative screening in PHC and the need to implement broad-spectrum screening tests and diagnostics as the starting point for the diagnostic pathway.

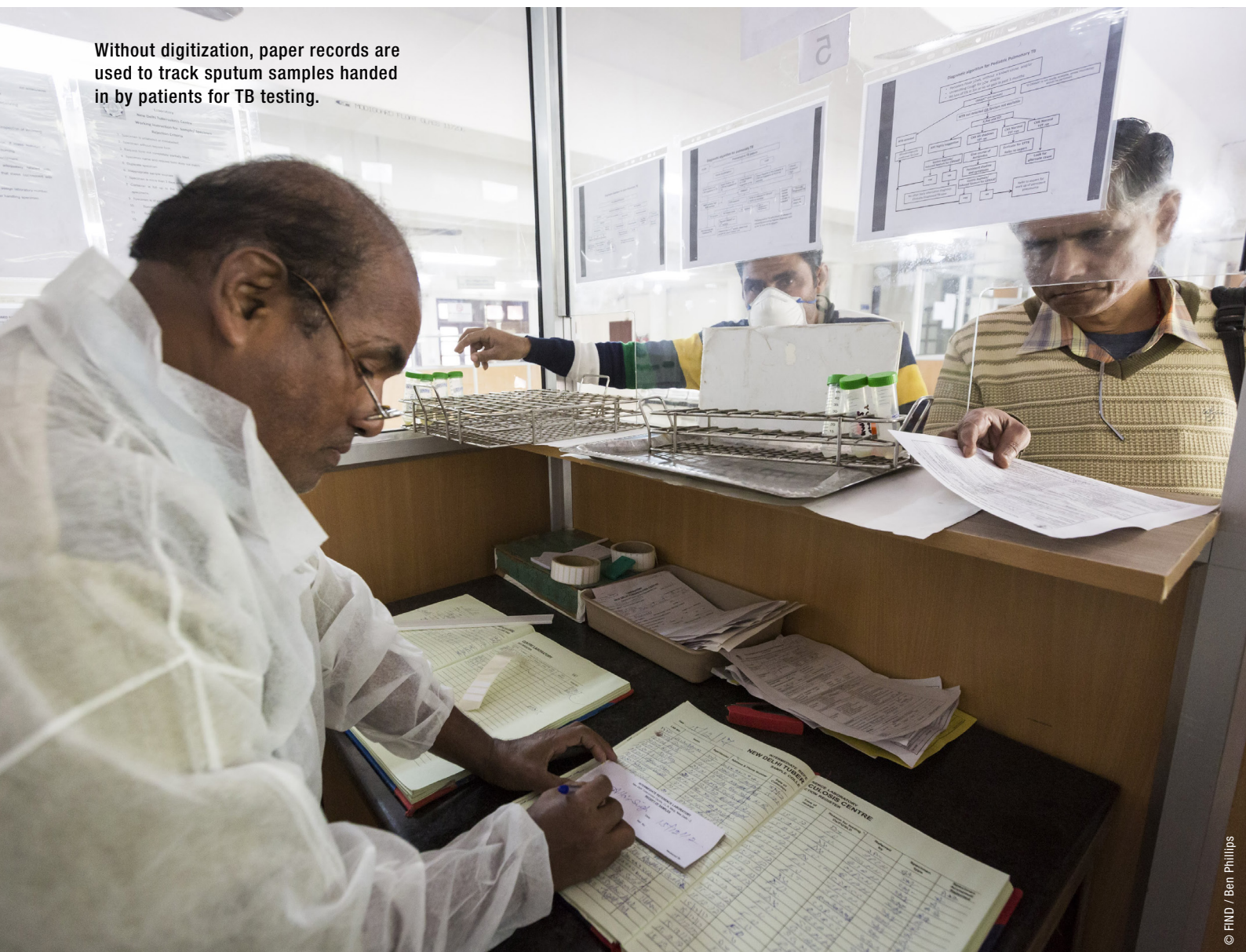
- PHC has been practically designed to provide acute and disease-focused services – for example, for infectious disease testing and MNCH services – versus delivering a routine and patient-centric package of services. This transition is important to address the shifting disease burden and prioritize NCD screening and referral services.

Diagnostic data management and use for patient benefit is **CONSTRAINED BY THE FOLLOWING HIGH PRIORITY GAPS:**

A lack of interoperability between various diagnostic devices, systems and applications is the highest priority gap identified to enable an environment for more effective data utilization and is the key barrier to establishing connected diagnostics networks. The difficulty of integrating systems between programmes and providers was emphasized across all focus countries and is primarily due to absence of common interoperability standards, appropriate data privacy laws and the fragmentation and non standardization of diagnostic devices and information communication technology solutions. While interoperability standards exist at a global level, they lack local adaptation, guidance and enforcement at a ministry of health level or by other regulatory agents, and cross-stakeholder collaboration for their implementation.

Health data is not sufficiently utilized by CHWs, HCWs and health system managers for clinical or programmatic decision-making. At the facility level, paper-based data collection is prioritized for reporting and rarely used by frontline HCWs for decision-making to better direct diagnostic needs or leverage previously collected information. This results in time-consuming data collection processes for HCWs and data entry staff, reduced data quality, repeat testing for patients, ill-informed clinical decision-making and ultimately, poorer quality services. At the central level, underutilization of cross-disease diagnostic data fails to inform timely programmatic decision-making and intervention, especially for proactive identification of disease hotspots and service delivery risks.

Without digitization, paper records are used to track sputum samples handed in by patients for TB testing.



RELEVANT DIGITAL HEALTH SOLUTIONS

Technology can help bridge inequity in access to diagnostic and care services, with a significant benefit to poor, underserved and remote populations. Bringing screening and diagnosis closer to the patient is imperative to improve health outcomes, and should focus on digital health solutions that target the first ‘port of call’ for the patient, such as the frontline community or PHC healthcare worker, the local private provider or the patient directly, to maximize direct impact.

Both scaled and emergent high-potential digital health solutions were identified across the four focus countries. Many of these digital health solutions have been designed to address gaps related to MNCH, TB and HIV, which reflects the significant investment in these disease areas over the last decade. However, most of these digital solutions are applicable across other disease areas and there is opportunity to use lessons learned and established platforms to tackle the neglected areas such as NCDs, AMR, outbreaks and other growing health needs.

Overall, THE FOLLOWING PRIORITIES FOR THE DIGITAL HEALTH AGENDA WERE IDENTIFIED to address key diagnostic gaps across Peru, India, Nigeria and Uganda:

01

ENGAGE PATIENTS WITH HEALTH KNOWLEDGE TO EMPOWER THEM AND DRIVE DEMAND FOR QUALITY CARE

To drive demand for screening and diagnosis, additional focus is needed earlier in the patient pathway to empower the patient and their trusted influencers to build health knowledge and engage in more efficient care-seeking.

Digital health solutions targeted at patients and advocated by trusted influencers, such as CHWs, community leaders and local private providers, can improve patient access to accurate and relevant health information. To maximize impact, they should be developed through the lens of the patient pathway, with linkage to PHC service delivery points.

- Digital health solutions targeting patients early in the pathway may include targeted delivery of information through direct text, audio or video messaging and widespread use of popular instant messaging and social media platforms.
- Mobile health apps with tailored health information, self-screening assessments and/or health service geo-mapping can help patients identify when, where and how to seek care, based on their location, insurance access and need.
- Ensuring digital tools are developed with simple user-centred design, are available in the local language and provide relevant messaging with a holistic health lens is critical to their success.

02

EMPOWER HCWS IN DELIVERING MORE ACCURATE AND EFFICIENT DIAGNOSIS CLOSER TO THE POC TO BUILD TRUST IN THE PATIENT-PROVIDER RELATIONSHIP

Strengthening the patient-provider relationship emerged as a significant need to encourage patient care-seeking behaviour. Digital tools that improve the speed, quality and engagement of HCWs at lower health facility level is critical to motivating patients to seek diagnosis and continue to engage with the health system.

Digital health solutions can enhance HCW knowledge and skills, bolstering their confidence to carry out testing and expand health workforce capacity, especially in rural areas.

- In addition to HCWs at PHC facilities, targeting digital tools to trusted sources of health information closer to the patient, such as CHWs, local health providers and religious or traditional community leaders increases patient uptake, relieves overburdened HCWs and drives patient demand for health services.

Digital health solutions that provide clinical decision support to HCWs (in the community, at PHC and in the local private sector) can help HCWs work with greater efficiency and improve the quality of care. Such solutions could include job aids for protocol compliance, web-based remote training, provider-to-provider telemedicine, automated screening tools and artificial intelligence-led diagnostic applications connected to smart devices.

- In particular, tools based on artificial intelligence or predictive analytics can be used to anticipate and trigger interventions for high-risk issues via functions like patient risk stratification, case triaging and commodity stock-out warnings before they happen.
- Holistic solutions that utilize middleware solutions for data connectivity and connect to software applications on mobile, tablet or computer (such as POC diagnostic devices like thermometers, blood pressure cuffs, glucometers, oximeters, portable ultrasounds), have proven to be promising, although scaling up is required.
- To bring value to HCWs, solutions need to be: integrated into existing workflows; functional within the available infrastructure; designed to address the users' pain points; suitable to their digital literacy levels; based on the use cases at the different levels of the health system value chain; and committed to addressing in-field implementation challenges in a timely manner. Otherwise, technology is often seen as an added burden to HCWs, consuming time instead of saving it.

03

SHIFT FOCUS TO DISEASE PREVENTION AND SCREENING TO IDENTIFY HEALTH RISKS, DIAGNOSE DISEASES AND TARGET INDIVIDUAL AND COMMUNITY-LEVEL INTERVENTION EARLIER

Digital solutions that enable preventative, routine and integrated screening for multiple diseases at PHC would support the transition from a disease-centric to patient-centric health system approach.

- Digital solutions tailored to support the integration and/or bundling of basic tests, especially for diseases with high co-morbidity (e.g. TB and diabetes), provide an opportunity for the early identification of at-risk patients and faster intervention.
- The ability to leverage digital health solutions successfully across disease areas is observed to be highly dependent on the extent of alignment of policies, processes and implementation planning between different disease programmes within the government.

Digital solutions that facilitate individual case identification, contact tracing and targeted alerts to individuals and government enables real-time surveillance of ongoing disease burden, and speeds up the response and management of unanticipated outbreaks.

04

ENABLE CONNECTED DIAGNOSTIC SYSTEMS, BETTER USE OF DATA FOR DECISION-MAKING AND PERSONALIZATION OF HEALTHCARE THROUGH INTEROPERABILITY

As mentioned, interoperability is the keystone required to bring different data sources together to create insight and predictions that lead to actions that benefit patients.

- Strong guidance on interoperability standards and accepted workarounds for existing systems and devices are required to improve the consumption and utilization of data and should be components of the national strategies for digital health. Connectivity solutions that enable the transmission of data between different laboratory, logistics and/or electronic medical record information management systems, along with unique patient identifiers, will help improve national-level disease surveillance, utilization of data for targeted health interventions, individual patient care and supply chain logistics.
- Improving interoperability between systems and devices will also facilitate more cost-effective bundling of POC diagnostic devices and biometric monitors together to create simple-to-use and broader diagnostic screening and management capabilities.

05

ESTABLISH APPROPRIATE EVALUATION STANDARDS AND STAGE GATES FOR IMPLEMENTATION OF DIGITAL DIAGNOSTICS IN COUNTRY

Applicable across focus countries, the evaluation, regulatory and implementation pathway frameworks for digital diagnostic tools and platforms can be developed or strengthened.

- These frameworks and standards can help inform governments and partner investments in a prioritized and smaller pool of scalable digital health solutions that demonstrate programmatic impact and a greater likelihood of being financed sustainably. It is important to ensure that a country-led process of validating digital tools is in place to ensure that they meet the requirements set out in frameworks and standards.
- Ongoing operational costs should be budgeted for at the outset, including training, hardware, maintenance, transport costs, management HR, server capacity etc.
- Selected solutions should focus on ensuring interoperability with other systems, prioritizing designs that are simple, adaptable and scalable in low-resource environments and that demonstrate value for the end-users.

OVERALL, THERE IS OPPORTUNITY FOR DIAGNOSTIC SERVICES TO LEAD THE DIGITAL HEALTH REVOLUTION

As mobile penetration and information communication technology literacy continues to grow in Peru, India, Nigeria and Uganda, scale-up of digital health tools will be necessary to optimize these nations' limited resources, tackle the growing inequity of healthcare access and strengthen the availability of quality diagnostics at PHC level. Although these countries are at different points of progress, there is a shared vision of investing in strong diagnostic data systems, and implementing a cross-disease national platform and an analytical layer to enable functions such as disease surveillance and targeted programmatic intervention.

Governments, donors and implementing partners alike are collaborating at a previously unprecedented pace in the fight against COVID-19, and with the intensified focus on building diagnostic and data management capabilities across multiple platforms, there is optimism that this effort will translate to long-term change. Building on momentum from this current spotlight on testing and accelerating digital intervention where it is needed most – at the frontlines of service delivery – there is a unique opportunity to inform the active and evolving digital health ecosystems of these countries and set them up for success.

ACRONYMS, ABBREVIATIONS AND DEFINITIONS

AMR:	Antimicrobial resistance	NCD:	Non-communicable disease
CHW:	Community health worker	PHC:	Primary healthcare
HCW:	Healthcare worker	POC:	Point of care
MNCH:	Maternal, neonatal and child health	TB:	Tuberculosis

For more information and examples of specific digital health solutions that address diagnostic gaps, please contact FIND at digitalhealth@finddx.org