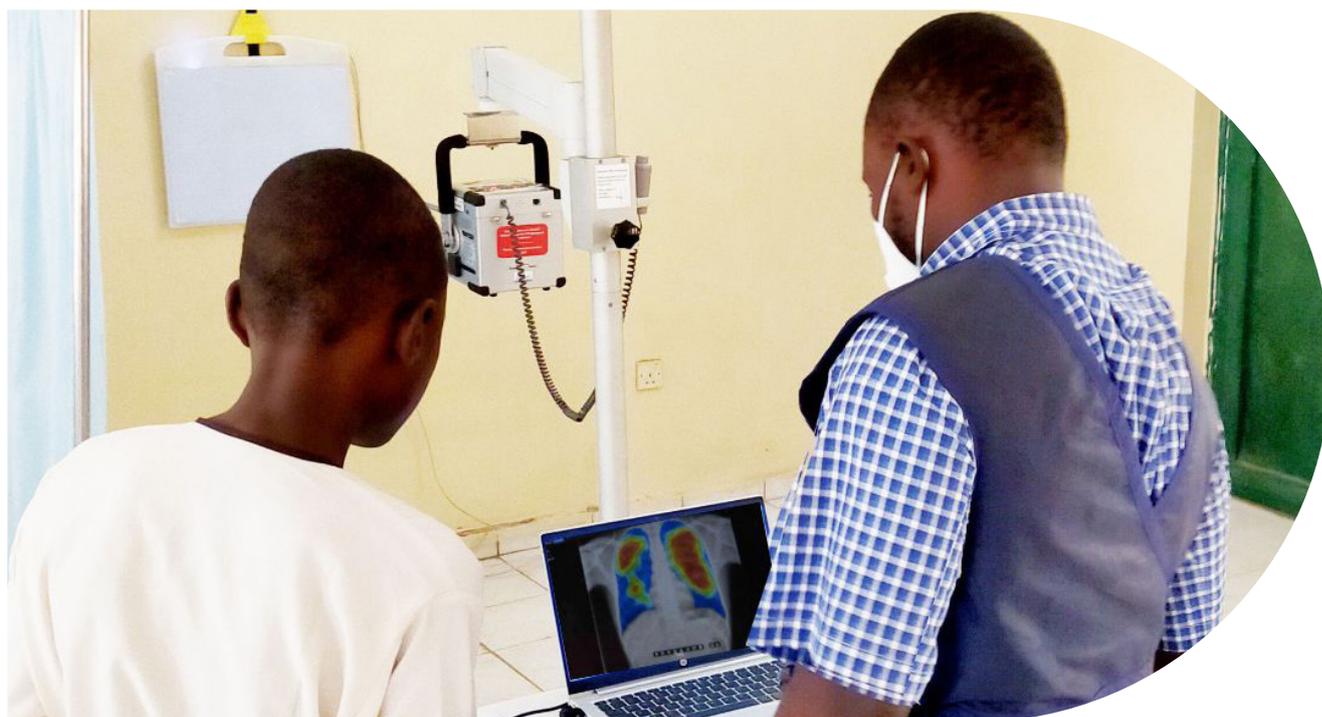


THE INTRODUCING NEW TOOLS PROJECT (iNTP)

## Innovative TB Screening Tools: The Roll-Out of Ultra-Portable Digital X-Ray and Computer-Aided Detection Software in Nigeria



### Background

Of the 30 high-TB burden countries, Nigeria ranks 6th in the world and 1st in Africa, with an estimated TB incidence of 467,000 in 2021. However, according to estimates by the World Health Organization (WHO), almost half of these people with TB went without a diagnosis or were not accounted for in national data.<sup>1</sup>

The Global Plan to End TB advocates for the use of innovative tools to find these missing people with TB.<sup>2</sup> Chest X-ray (CXR) alongside software for the computer-aided detection (CAD) of TB is one such tool. Chest X-ray is one of the most sensitive tools for screening TB, yet its use is hampered by inter- and intra-reader variability and lack of skilled radiologists. CAD can overcome these limitations, and provide accurate, rapid results, by utilising artificial intelligence (AI) to read X-rays and indicate whether a patient should be referred for confirmatory testing through the generation of an abnormality score.

<sup>1</sup> World Health Organization. Global TB Report 2022. Available from: <https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2022>

<sup>2</sup> Stop TB Partnership. The Global Plan to End TB 2023-2030. Available from: <https://www.stoptb.org/global-plan-to-end-tb/global-plan-to-end-tb-2023-2030>

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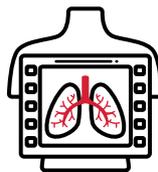
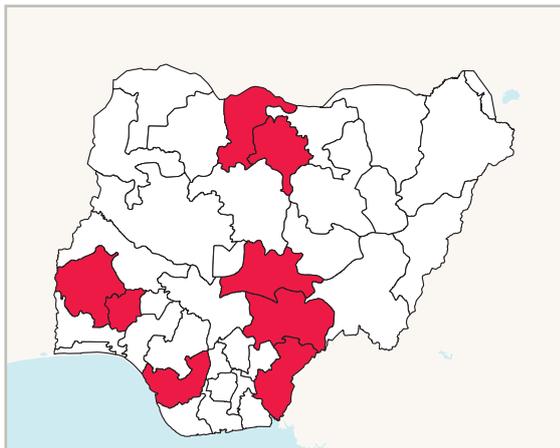
**Stop TB Partnership**

**KNCV**  
NIGERIA

**INSTITUTE OF HUMAN  
VIROLOGY, NIGERIA**



**NATIONAL TUBERCULOSIS & LEPROSY  
CONTROL PROGRAMME (NTBLCP)**  
Federal Ministry of Health



**10 ultra-portable X-ray units** with CAD software are being used across eight states



**Individuals with a CAD score over 50** were referred to confirmatory testing

The use of CAD, coupled with advances in making digital X-ray systems increasingly lightweight and portable, makes screening for TB feasible even in remote locations and hard-to-reach areas.

This technology has the potential to be game-changing in detecting more cases of TB in high-burden countries, such as Nigeria, with a [pilot implementation project](#) by KNCV Tuberculosis Foundation Nigeria in 2020, showing a high prevalence of TB among participants in hard-to-reach populations in the Niger Delta region.<sup>3</sup>

As part of the United States Agency for International Development (USAID) funded [introducing New Tools Project \(iNTP\)](#), the Stop TB Partnership has supported the National Tuberculosis & Leprosy Control Programme (NTBLCP) and implementing partners [KNCV Tuberculosis Foundation Nigeria](#) and [Institute of Human Virology Nigeria \(IHVN\)](#) in the **largest scale roll-out of ultra-portable digital X-ray and CAD to screen for TB in Nigeria**. Altogether, 10 ultra-portable X-ray units with CAD software are being used across eight states: Benue, Cross River, Delta, Kano, Katsina, Nasarawa, Osun, and Oyo.

## Implementation of CAD and X-ray in Nigeria under the iNTP

As part of the groundwork for screening, implementing partners - KNCV Nigeria and IHVN - built relationships with national and community stakeholders to develop an implementation roadmap and integrate the use of digital X-ray with CAD as a screening tool into the national TB guidelines and the guidelines for community TB. Products at a pre-negotiated reduced price were selected from the Stop TB's Global Drug Facility (GDF) catalog, with Nigeria opting for the Delft Light with CAD4TB version 7 package. This came with a perpetual software licence, as well as a full training and maintenance and support package of 4 years.

Implementation in Nigeria officially kicked off with a Webinar for Country Sensitization on 25 October 2021. Stop TB, together with USAID's [Infectious Disease Detection and Surveillance \(IDDS\) Project](#) and Delft Imaging, delivered a 5-day training programme to 33 radiographers, data clerks, IT officers and other healthcare workers from all across Nigeria in November. Slides and an implementation guide developed by Stop TB can be found [here](#).

All screening activities in Nigeria have been conducted in community settings, utilizing the ultra-portable nature of the X-ray machines to bring care closer to where people are, and reaching those who may not usually have access to such services. High TB-burden sites were chosen to conduct screening visits, in collaboration with local and national stakeholders, using epidemiological and AI-powered hotspot analytics with KNCV Nigeria using Early Warning Outbreak Recognition System (EWORS) analytics and IHVN using Epcor AI technology. Target populations include high-risk groups such as refugees, internally displaced people, and prisoners, as well as hard-to-reach communities.

Prior to screening events, implementing teams generated interest in the intervention in innovative ways, such as using town criers and jingles to attract attention, as well as screening important members of the community first to build trust. During screening campaigns, each individual received a chest X-ray, and if they had a CAD score over the threshold of 50 or any TB symptoms, a sputum sample was taken for confirmatory testing. In some cases, testing was done at the point-of-care, making use of Truenat instruments, also provided through the Project. In other cases, rapport was built with the nearest laboratories for processing samples and efficient sample transportation logistics were put in place. Individuals with confirmed TB were initiated on treatment through local Directly Observed Therapy (DOT) centres as soon as possible.

<sup>3</sup> Odume, B et al. "Portable digital X-ray for TB pre-diagnosis screening in rural communities in Nigeria". Public health action vol. 12,2 (2022): 85-89. doi:10.5588/pha.21.0079Odume et al. 2020.

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# 130,000+

individuals screened by iNTP  
implementing partners

# 10%

detected with abnormal CXR

# 3,200+

people diagnosed with TB  
through this intervention

## Project Impact

This project has demonstrated the potential of ultra-portable X-ray with CAD in a high TB burden country. As the intervention has been concentrated in hard-to-reach areas and high-risk populations, the project has made care accessible for thousands of people, who otherwise may be missed. When used in conjunction with Truenat tests and linked to local DOT centres, the entire care cascade from screening to diagnostics to treatment has been brought exactly to the people who need them.

Since the beginning of implementation in Nigeria, **the iNTP implementing partners from KNCV Nigeria and IHVN have screened over 130,000 individuals** with over 13,000 detected with an abnormal CXR. **Over 3,200 people have been diagnosed with TB through this intervention.**



## Lessons Learned

As this was the first large-scale roll-out of this technology in Nigeria, during the early stages of implementation, the country faced multiple equipment and support difficulties, including issues with connectivity between the system components as well as malfunctions of X-ray generators and solar panels.

These equipment challenges, along with the long turnaround time for replacements, caused delays in the initial implementation process. Despite these setbacks, the Nigeria team was able to work with the manufacturer, Delft, to resolve these issues. Over time, the manufacturer gradually increased local support and set up storage of spare parts in the country, while also making improvements to the product in the latest upgrades. As a result, there has been a decrease in equipment issues and less interruption of screening campaigns. These challenges highlight the importance of the presence of local support and spare parts availability as well as contingency planning and proactive maintenance to ensure successful adoption of new technologies. Finally, Delft's willingness to collaborate and improve their products based on our field feedback has been invaluable in providing a positive user experience in our project in Nigeria and other countries, demonstrating their commitment to helping to improve TB screening campaigns globally.

The implementing teams have also shared their early experiences, lessons learned, and advice with other implementers through the [Stop TB Focus Group for AI-Based Imaging for TB](#).

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## Looking Ahead

The implementing teams from KNCV Nigeria and IHVN will continue to use these 10 ultra-portable X-ray systems with CAD to detect more people with TB in high-burden areas.

The positive impact of this project shows the potential of scaling up these technologies further across the country. Currently, the implementing teams are working to document and evaluate their experiences further through

operational research to aid this scale-up in different states and sites in Nigeria and share lessons learned with other implementers to ensure more and more people with TB are found and treated. Meanwhile, the National TB programme is in the process of upscaling the use of portable digital X-rays with CAD, with the deployment of more than 300 machines nationwide to enable active case finding in hard-to-reach areas and among key populations at the sub-national level.



### Acknowledgements

KNCV Tuberculosis Foundation Nigeria

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USAID Mission, Nigeria

Infectious Disease Detection and Surveillance (IDDS) Project

*Photos courtesy of Austin Ihesie of the USAID Mission, Nigeria and Zhi Zhen Qin of the Stop TB Partnership*

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For more information on the introducing New Tools Project, visit:

<https://www.stoptb.org/accelerate-tb-innovations/introducing-new-tools-project>