THE INTRODUCING NEW TOOLS PROJECT (iNTP)

Using New Tools to Find Missing People with TB: Implementing Ultra-portable X-ray and Computer-aided Detection (CAD) Software in Kenya

The ultra-portable digital X-ray system set up and the patient positioned for examination

Country in Focus: Kenya

Background

Kenya is among the 30 high TB burden countries. In 2022, an estimated 128,000 people fell ill with TB in Kenya, but only 69% of these were diagnosed and reported.[1]

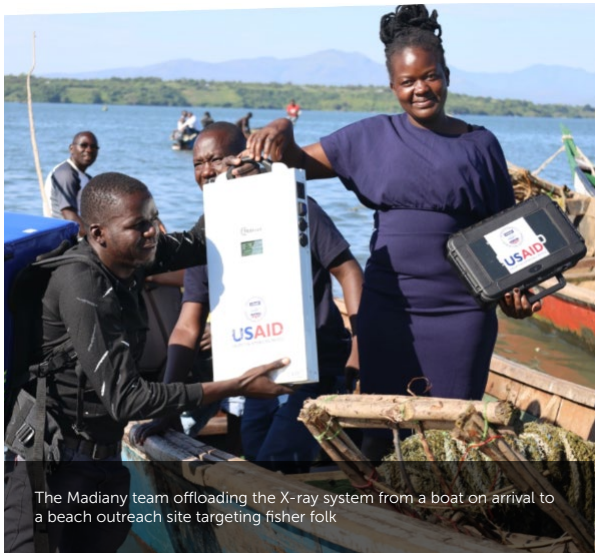
This gap in detection and reporting poses a significant public health concern, as untreated TB can lead to ongoing transmission and significant morbidity and mortality. To address this urgent need, innovative tools including ultra-portable digital X-ray systems with artificial intelligence-powered software for the computer-aided detection (CAD) of TB are advocated for by the Stop TB Partnership's Global Plan to End TB.[2] The use of these tools could significantly improve TB detection and care in Kenya, leading to better health outcomes for affected individuals and reduced transmission in the community.

Chest X-ray is one of the most sensitive tools for TB screening, capable of detecting both symptomatic and asymptomatic cases. However, its use can be hindered

[1] World Health Organization. Global TB Report 2023. Available from: https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2023

[2] 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

Continue reading...



The Madiany team offloading the X-ray system from a boat on arrival to a beach outreach site targeting fisher folk

by variability in interpretation and a shortage of skilled radiologists in high-burden countries. These issues can lead to missed diagnoses and delayed treatment. The use of CAD software to detect TB-related abnormalities can significantly improve the accuracy and consistency of screening results. Additionally, the miniaturisation of digital X-ray technology into a portable form allows for TB screening services to be delivered to remote and hard-to-reach areas, increasing access to care and improving health outcomes for affected individuals.

As part of the United States Agency for International Development (USAID) funded *introducing New Tools Project* (iNTP), the Stop TB Partnership has been supporting the Kenya National Tuberculosis, Leprosy and Lung Disease Program (NTLD-P) alongside the USAID supported Tuberculosis Accelerated Response and Care II (TB ARC II) activity implemented by Centre for Health Solutions - Kenya (CHS), to roll out eight ultra-portable X-ray systems with CAD software across seven counties: Kisumu, Kitui, Meru, Mombasa, Nairobi, Siaya and Turkana.

Implementation of Ultra-portable X-ray and CAD in Kenya under the iNTP

Under the iNTP, the Kenya NTLD-P selected the Delft Light backpack system with CAD4TB version 7 software, with a perpetual licence and a full training, maintenance and support package of 4 years, provided by Stop TB Partnership's Global Drug Facility (GDF) with USAID funding. The products were supplied at prices negotiated by GDF. Prior to implementation, weekly calls between the NTLD-P, CHS and Stop TB were organised to assist with project planning, including advising on screening algorithms for different use cases. In June 2022, the manufacturer, Delft, delivered training for radiographers, radiologists, TB coordinators and clinicians, in close collaboration with the Stop TB Partnership, USAID, CHS and the USAID Infectious Disease Detection and Surveillance project. Screening activities commenced shortly afterwards in July.

TB screening has been conducted in both facility and community settings, utilizing the ultra-portable nature of the X-ray systems to conduct outreach visits in hard-to-reach areas as well as in identified hotspots in the 7 counties. Screening sites were strategically chosen to target high-risk populations, including those with a high TB/HIV burden, urban slums, immigrant and refugee populations and chest clinic referrals. Two different screening algorithms were put in place depending on the site and its workload.

Figure 1: *Map of Kenya with stars indicating the seven counties where ultra-portable X-ray and CAD systems have been deployed.*

Source: Based on United Nations Map

Continue reading...

1. At high-volume sites, individuals have undergone a symptom screen, with those screening positive receiving a chest X-ray examination. At most sites, those with scores above the threshold score of 60 were sent for a follow-on confirmatory laboratory test, with some sites opting to evaluate, using the confirmatory lab test, all those with a CAD score of 40 and above. All images with scores of 40 and above were additionally reviewed by a radiologist.

2. At low-volume sites, a 'screening for all' algorithm was used, where all individuals received both an X-ray and a symptom screen. Those with symptoms and/or a score above the threshold were then referred for confirmatory testing. In some sites, Truenat tests, also provided under the iNTP, were provided at the point-of-care as the confirmatory laboratory test. As with images from high-volume sites, all images with scores of 40 and above were also reviewed by a radiologist.

The NTLD-P, in collaboration with CHS, has supported implementation of activities in the eight sites through technical visits, both at facility and at outreach sites, aimed at providing facility-wide sensitisations, mentorship and to assess implementation issues.

Radiation safety assessments of the 8 implementing sites were conducted and recommendations made, and later adopted, to ensure the safety of the operators, patients as well as members of the public. To guide with the planning of future community screening outreach activities, a similar assessment was conducted during an outreach activity in Mombasa county. Further to this, monthly dosimetry reading has been done to monitor radiation exposure risks to the operators.

Project Impact

The project has demonstrated the promising potential of ultra-portable X-ray with CAD at both the facility and community levels in a high TB burden country. The intervention has focused on at-risk populations and conducted outreach visits to help detect missing people with TB and provide access to the care they need.

As of June 2023, the implementation partners have screened over 33,000 people in Kenya using these ultra-portable X-ray systems with CAD. Out of these, 2,662 had an abnormal X-ray determined by CAD, and a total of 1,386 people were diagnosed with TB.

33,000+
total individuals successfully screened

~8%
displayed abnormal chest X-ray results

1,386
individuals were diagnosed with TB

A radiographer is reviewing a chest X-ray based on the immediate interpretation of CAD4TB, Mutuati Sub-county Hospital, Meru county.

Continue reading...

Lessons Learned

The nature of implementing a new technology comes with a range of challenges. In Kenya, one of the most significant of these was ensuring that these ultra-portable X-ray systems complied with the country's radiation safety regulations. Stop TB facilitated meetings with the country implementers, the Delft team and subject matter experts from MSF to decide on the best way forward to address the country's radiation safety requirements. While the systems comply with radiation exposures within both international and national limits, the Kenyan Nuclear Radiation Authority (KNRA) undertook a further assessment and mandated that three lead aprons be available per unit and that a lead screen be utilized. After an assessment was conducted by the Christian Health Association of Kenya (CHAK), a KNRA certified provider, Stop TB held meetings to disseminate the findings to all stakeholders. Following the meetings, Stop TB also aided the implementing teams with gathering quotations from suppliers for the additional accessories that were listed as requirements by the KNRA.

In order to comply with the KNRA requirements for carrying out community screening, multiple lead aprons and lead screens were required. However, these were not included in the ultra-portable X-ray system provided by GDF, due to their added weight. The implementing partner managed to source and procure the additional accessories from local suppliers in order to comply with the requirements, with help from the Stop TB Partnership and its partners. This demonstrates the need to take into account both local and international regulations and guidelines in the roll out of new technology.

Another issue facing Kenya in implementing ultra-portable X-ray systems and CAD was the appropriate capturing of data. While the CAD4TB system came with its own in-built data fields, these did not fully capture the information the NTLD-P required. In addition, this was a stand alone system not integrated into the NTLD-P TIBU patient management system. The Stop TB Partnership facilitated collaboration with the manufacturer Delft to customise the data fields in CAD4TB. The NTLD-P and CHS IT team were then able to integrate this into the Tibulims connectivity dashboard, through support of the iNTP, to ensure that data from the entire cascade of care, from screening to lab results could be accessed on one central platform.

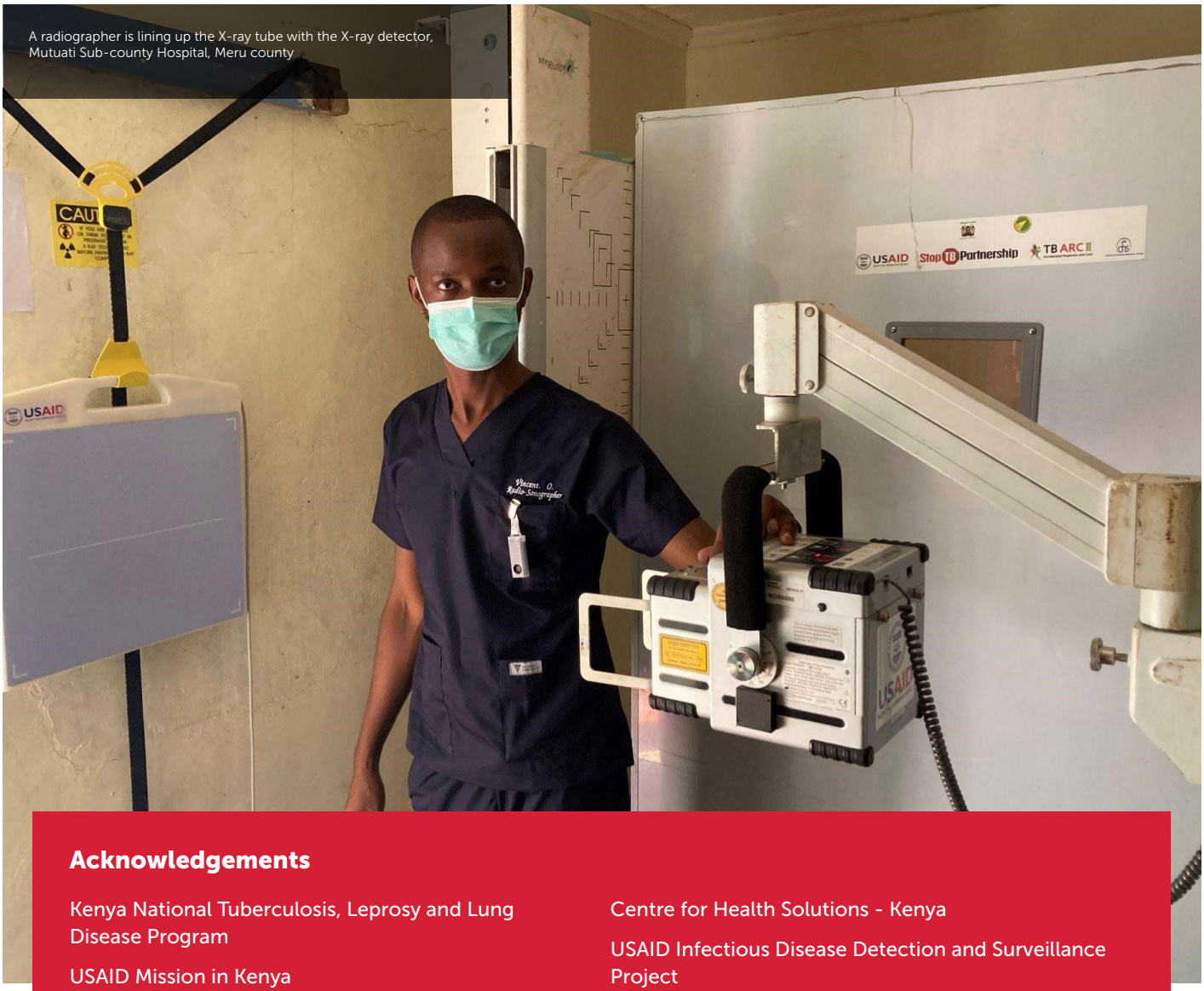
Additionally, prior to the roll-out of digital X-ray screening using CAD, an in-country national sub-committee spearheaded by the NTLD-P was formed. This committee was instrumental in collaboratively planning and overseeing the compliance, safety and local adaptation of the project activities thereby demonstrating the need for inclusion of all stakeholders (national and county programs, nuclear authority, radiologists, radiographers and partners) early on.

A radiographer based in Jomvu, Mombasa donning a lead apron and thyroid shield for radiation safety.

Continue reading...

Looking Forward

Kenya continues to roll out the ultra-portable X-ray systems with CAD under the iNTP and has plans to continue community outreach events as well as facility-based screening to reach more people and provide access to the care they need. The NTLD-P is seeking to procure additional digital X-ray systems with CAD software to scale up use in other areas of the country, as the iNTP has demonstrated the significant potential of these new tools.



A radiographer is lining up the X-ray tube with the X-ray detector, Mutuati Sub-county Hospital, Meru county

Acknowledgements

Kenya National Tuberculosis, Leprosy and Lung Disease Program

USAID Mission in Kenya

Centre for Health Solutions - Kenya

USAID Infectious Disease Detection and Surveillance Project

Disclaimer: *The findings in this publication are those of the authors and do not necessarily represent the views of the U.S. Agency for International Development or the U.S. Government.*

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

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