Implementing CAD and Ultra-Portable X-ray in Nigeria

KNCV TB FOUNDATION NIGERIA AND IHVN NIGERIA

Presentation Outline

- Role of implementing partners in iNTP Project
- Program planning (training & product cost)
- Screening algorithm
- Using CAD4TB in the field
- Threshold score selection
- Using the ultra-portable X-ray system
- Ultra-portable X-ray system image quality
- Interoperability with health information systems
- Results so far
- Lessons learned - CAD
- Lessons learned – Ultra-portable X-ray
- Insight into Fiji films FDR Xair
- Experience with the X-ray and CAD vendor
- Scaling up
- What would you do differently next time?
- Challenges
- Experience with Delft service support
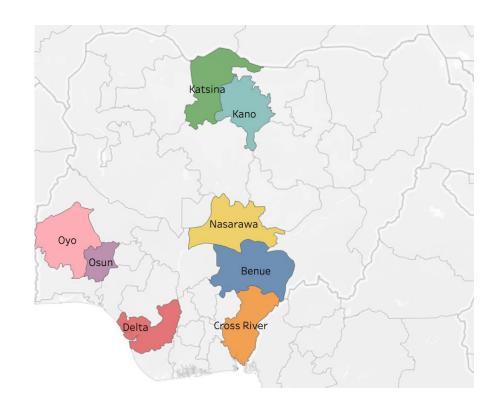- Success stories

Role of implementing partner in iNTP Project

- 10 Portable digital Xray systems with CAD received as part of the New Tools project to support NTP with TB diagnostics

- Implemented in-country through 2 USAID IPs – KNCV Nigeria and IHVN Nigeria with overall leadership and coordination of the NTP

- Distributed to 8 states (Kano, Katsina, Benue, Nasarawa, Cross River, Delta, Osun and Oyo)

Program planning 1

- Engagement of NTP and Stakeholders for integration of Portable Digital Xray with CAD into National guidelines (May – Oct 2021)
  - Engagement of NTBLCP leadership and TB stakeholders
  - Development of implementation road map
  - Integration of the use of the Digital Xray with CAD as a screening tool into the Guidelines for Community TB and National TB guidelines.
  - Customs clearance & local radiation authority approval
  - Adaptation of Portable Digital Xray training materials
  - Country-wide sensitization and awareness creation for stakeholders

Program planning 2

- What steps were taken, and decisions made prior to screening starting?
    - Identification of high TB burden communities and target populations using the hotspot analytics- EWORS (KNCV) and EPCON (IHVN) and TB epidemiological data in collaboration with the State TB programs
    - Community stakeholder's engagement e.g Advocacy visits to LGA chairman, head of prisons, refugee camps in collaboration with TB LGA supervisor etc
    - Selection of proper site to ensure radiation safety and good working space for infection prevention control (IPC)

Program planning - training

- Trainings and Installation (Nov. 2021)
  - STOP TB/IDDS Centralized training on use of PDX and CAD. Participants included program managers from NTP, STP, IPs + End Users (Radiographers and Data clerks)
  - Equipment/technical training by DELFT (Installation, configuration and set-up)
  - Refresher trainings (virtual)

- Mentoring visits (Ongoing)
  - Visit to field sites
  - Equipment functionality status, adherence to guidance on Use, Safety and screening Algorithm

Program planning - product costs

- **Total cost of the 10 PDX with CAD and warranty is $1,222,637 covering items below:**

- Delft Light Full kit (with accessories)

- Delft Light Full Kit Installation and Training

- Delft Light Full kit Warranty Extension 3 years

- CAD4TB box

- CAD4TB Installation and Training

- CAD4TB Support and Maintenance Extension 3 years

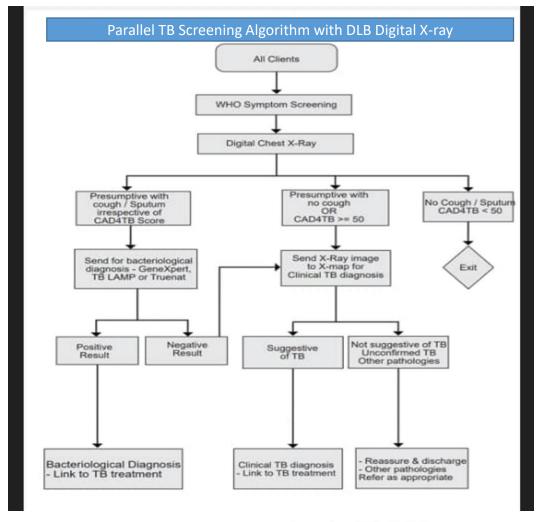- CAD4TB Software Perpetual License 15-month Support & Maintenance

Screening algorithm

- Parallel screening algorithm with CAD and W4SS adapted from NTP by KNCV

- Patients with CAD4TB 50+ and patients identified as presumptive using W4SS are referred for either GXP, Truenat testing

- Presumptive TB who are negative on GXP/Truenat or who are unable to produce sputum will have their x-rays and symptoms sent to the radiologist -uploaded to XMAP (KNCV) for radiologists' interpretation

- All identified TB patients either bacteriological or x-ray (clinical TB cases) are linked to treatment through the LGA TBLS or DOT officers

Parallel TB Screening Algorithm with DLB Digital X-ray

Using CAD4TB in the field

- CAD4TB is used both online and offline

- CAD4TB box is connected to the router then CSDI laptop and to

  detector

- The CAD data is stored on the cloud

Threshold score selection

- The operational threshold is CAD4TB score 50+ given by the manufacturer for this version – version 7

- The threshold is maintained to give time for data generation from ongoing screening activities in the field which will then inform review

- The threshold for WoW truck and piloted DLB is retained at 60 as they use CAD4TB v6 which will provide a comparable data for analysis in deciding a new threshold

- Preliminary data has shown some TB cases detected even below that CAD4TB 50

- A robust data from the implementation being collected using the modified NTP presumptive TB register

- A more local threshold would be decided after 6 months of implementation after review of these data

Using the ultra-portable X-ray system

- Screening occurs 5 days a week in target populations like community hotspots, prisons, refugee camps, IDP camps, HTRC, markets, health facilities and outdoor settings etc

- Standard radiation safety precautions are adhered, lead jacket, ensuring no one is 5 meters behind the detector, exposing with a string rather than button on the machine and wearing of dosimeter badge

- Any person who has done Xray less than 6 months prior are not eligible

- Pregnant women are not eligible

Ultra-portable X-ray system image quality

- The image quality is very good
- The quality is comparable to the X-ray in the wow truck and other stationary digital x-ray,
- The radiologists reviewing the X-rays are happy with the images
- An apt description: *"DLB, image resolution at its best"*

Interoperability with health information systems

- All information of presumptive and diagnosed TB patients are shared and harmonized with the state TB program, hence there's information flow from implementers like KNCV and IHVN to the health facilities through the TBLs where patients are enrolled on treatment up to the NTP

- Recently KNCV adapted the NTP presumptive register into an electronic version that will be made available to the stakeholders, this tool can easily be linked to HIS

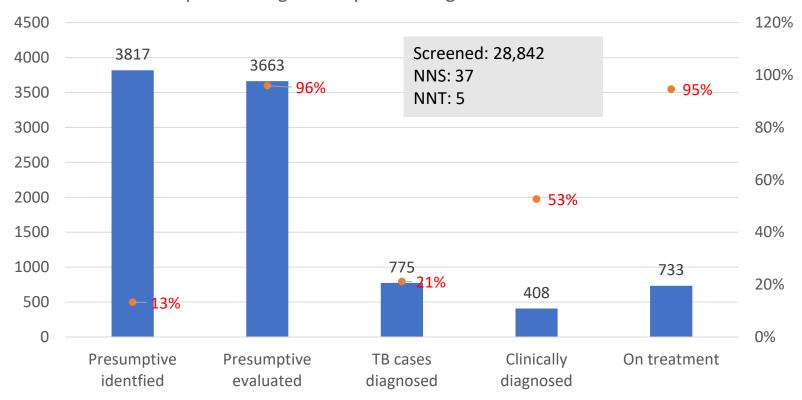- No further customization of CAD4TB was required

National Results: Dec 2021 – March 2022

Ultra-portable digital X-ray results Nigeria: Dec 2021 -Mar 2022

Screened: 28,842
NNS: 37
NNT: 5

Chart data:
- Presumptive identfied: 3817, 13%
- Presumptive evaluated: 3663, 96%
- TB cases diagnosed: 775, 21%
- Clinically diagnosed: 408, 53%
- On treatment: 733, 95%

USAID
FROM THE AMERICAN PEOPLE

Results

- KNCV Nigeria
- 7 DLBs (one of the DLB has been for more than 2months)
- Results- Dec 2021-March 2022:
  - Screened: 23,347
  - Presumptive identified: 2,772 (12%)
  - Presumptive tested: 2,772 (100%)
  - TB cases diagnosed: 544 (20%) (Bact.156, Clinical .388)
  - TB cases started on Tx: 539 (99%)

Results 2

- IHVN
- 3 DLBs Results- January-March 2022:
  - Screened: 5,495
  - Presumptive identified: 1,045 (19%)
  - Presumptive tested: 891 (85%)
  - TB cases diagnosed: 231 (26%) Bact.211, Clinical.20)
  - TB cases started on Tx: 194 (84%)

Lessons learned-CAD

- Gathering robust data that will inform review of threshold is ongoing

- Adoption of E-presumptive register could ease the link with HIS, this document contains CAD score with complete information of all the presumptive TB clients

- Being able to operate both offline and online has made it possible for DLB to be deployed to HTRC without mobile network and internet connectivity

- Robust system for x-ray reporting XMAP has been developed and for the first time to handle very large quantity of X-ray, this will also help provide comparative data between CAD and human readers

The XMAP digital x-ray reporting app

– Real time reporting to optimize clinical diagnosis

XMAP dashboard as @ 4/27/22 – 2,361 requests and 2,360 reports

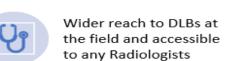Automated process for digital x-ray reporting

Drastic reduction in TAT for reporting

Accurate tracking of reports

Wider reach to DLBs at the field and accessible to any Radiologists

Seamless and very easy to use

In built quality assurance system

XMAP — RESULTS YOU CAN TRUST

a.org !
XMap Dashboard

2361 Total Requests

2360 Total Reports

7 Today's Suggestive of TB

28 Today's Not Suggestive of TB

18 Week's Suggestive of TB

37 Week's Not Suggestive of TB

235 Month's Suggestive of TB

364 Month's Not Suggestive of TB

Quality assurance and quality control

There are two major areas of quality assurance for CXR: the quality of CXR imaging and the quality of CXR reading

WHO has not defined formal procedures for internal or external quality assessment of CXR interpretation for TB screening and detection

1. Tracking concordance of x-ray reports by radiologist

- Suggestive : 70%
- Not suggestive : 68%

2. Monitoring the proportion of clinically diagnosed cases out of all TB cases can serve as an indicator of diagnostic quality

- Consistently above set bench-mark

3. Comparing laboratory results with CXR results can help to improve the quality of radiological screening and diagnosis

- Range : 67 % to 100%

Lessons learnt- Ultra portable x-ray

- The image quality has been commended by our radiologists

- The use of epidemiological tools and data to guide targeting of populations for screening. Targeting special populations and vulnerable groups like prisons, Hard-to-Reach Areas, IDPs, Refugees shows good returns

- Systems put in prompt reporting and follow up of challenges from the field - Creation of a WhatsApp group and Weekly report from the teams aided monitoring and timely response to challenges.

- Engagement of community gatekeepers and mobilization necessary for successful screening programs

- Introduction of the XMAP app by KNCV to support real time linkage to a radiologist for Xray reporting significantly improved clinical diagnosis.

- Coupling the Portable Xray_CAD systems with point-of-care field molecular diagnostic tools (Truenat, TB LAMP platforms) results in faster diagnosis and enrollment on treatment. E.g. WTBD outreach in Abuja yielded 3 bacteriological Tb cases in the field 5 from clinical review.

Experience with the X-ray and CAD vendor

- Easy accessibility to the virtual technical support – Whatsapp platform, service support forms.

- Provided refresher course to support field staff with equipment use.

- Time difference with Ghana sometimes results in delayed TAT for technical challenges experienced in the morning at the beginning of field work.

- Delayed response and turn around time for spare parts replacements - spare parts are not available in country and manufacturer needs to send same down before repairs e.g laptop charger had to be requested all the way from Netherlands

- Some technical glitches like connectivity challenges have been recurrent as these are not completely resolved each time due to absence of a service support center in Nigeria. This is despite the number of machines being used in-country.

Scaling up

- Close collaboration with NTP translated to ease of country preparation and roll-out

- National webinar on introduction and use of Digital CXR_CAD created awareness among clinicians and stakeholders on benefits of the new tool.

- Implementation experience from the KNCV Pilot DLB and WoW truck. Presence of Technical staff with who were familiar with DLB equipment system and its operationalization aided quick roll out– WoW Truck and Pilot DLB experience.

- Engaging field staff with selected attributes to aid smooth roll-out:
  - Basic IT skill/experience helped with easy linkage to service support providers and trouble shooting;
  - Data clerk – staff with prior field/facility experience with the project to ensure proper documentation using the R&R tools

What would you do differently next time?

- What advice would you have for your peers preparing for X-ray/CAD implementation in their countries?

  - Ensure all stakeholders are involved from the beginning of implementation while ensuring ownership and close collaboration with NTP.

  - Ensure early commencement of process for authorization of use by the National radiation authority

  - Need for widespread sensitization and awareness creation to introduce the use of Digital CXR_CAD and the benefits of the new tool.

  - Leverage on whatever country experience is available on use of digital CXR with AI to ensure smooth roll-out.

  - Ensure biomedical and IT staff are part of the training to support technical issues that may arise on the field.

  - Engage DELFT/service support to have in-country technical staff and spares available at the start of the project for quick TAT for replacements

Challenges

- **Program Implementation/Operational**
  - Capital intensive and resource heavy implementation
    - Logistics of moving the tool especially in hard-to-reach areas
    - Advocacy, communication and social mobilization for acceptability of DLB
    - Resources limiting initial plan to couple the DLB systems with the Truenat machine for real time point-of-care diagnosis in the community/Hard-to-reach areas
  - Weight of equipment to be carried
  - Time to mount and dismount the equipment makes it difficult to work in multiple location/day

Challenges

- **Technical/Equipment**
    - Connectivity glitches and challenges between the different components of the DLB is a frequent occurrence. This often slows down field work and demoralizes staff
    - CAD4TB Boxes for all 10 systems had to be changed almost immediately post-installation due to cross-cutting technical issues observed. A few CAD4TB boxes still presenting some issues
    - The generator battery and solar panel challenge was a common experience from pilot DLB, we have had a recurrence of one episode/report with new tools
    - Absence of a DELFT support office in Nigeria delays response time to complaints and increases equipment downtime.
    - Lack of additional laptops for the DLB Assistants considering the shell mode being installed by Delft on the laptops

Experience with the DELFT Service support

- Easy accessibility to the virtual technical support – WhatsApp platform, service support forms

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DELFT Service Request form

Delft Imaging

Welcome! You can raise a request for Delft Imaging using the options provided.

What can we help you with?

🔧 **Support Request**

Email confirmation to *

Summary *

Short description of issue

Product Category *

Please mention the Delft Imaging product, eg - Delft Light or CAD4TB, etc

Component ID *

Please mention issue component's serial number, eg - THI-CTB-xxxxx or MOBxxxx etc

Country

Country

Project

Description

Detailed description of issue

WhatsApp contact *

Please include country code

Priority

Low

Attachment

Drag and drop files, paste screenshots, or browse

Browse

Screenshots of errors, products etc can be uploaded

Send   Cancel

Asks from Stop TB/DELFT Imaging

- Critical need for a service center in Nigeria with technical staff and ample number of equipment spares for prompt resolution of technical challenges and ongoing field support.

- DELFT to improve technical design of system components to reduce episodes of connectivity challenges and make them sturdier (including the mobisun).

- DELFT to improve structural design to reduce weight of equipment and improve ease of set-up and dismount.

- A global sim card for router needed for easy connectivity

Sustainability plan

- Strengthen integration of the DLB into the existing health systems and activities, without creating a parallel structure

- Buy-in by the NTP anticipated and possibility of funding through GF and government for scale up

- In-country service centre for prompt resolution of challenges and replacement of faulty equipment – in the pipeline by DELF

- Regular refresher trainings for DLB field staff

SUSTAINABILITY

Insight into Fujifilm's FDR Xair Implementation

- Introduction
  - Battery powered; CAD enabled Ultra-portable Digital X-ray
  - The **qXR** CAD software analyze X-ray image within seconds
  - Fully charged Battery can take more than 100 images
  - Available on GDF catalog

- Implementation Steps
  - After completion of Procured/shipped/cleared in Dec, 2021
  - Two Days Training of end users and Program Staff in Jan. 2022
  - The machine was deployed to the field on 16/01/2022 for ACF in rural communities which are mostly hard to reach areas base on EPCON predictions

- Experience with Manufacturer
  - We have excellent work relationship with Fujifilm Nigeria staff and Fujifilm international staff

The Xair Story…

- ## What Stand-out
  - The machine has never pick up a single fault since deployment
  - The ability of the machine to work in locations with mobile network

- ## Data so far…

# of clients screened for TB	# presumed to have TB	Total # evaluated for TB	# diagnosed with TB	# Bacteriologically Diagnosed	# clinically diagnosed	NNT	NNS
1,375	234	187	44	30	14	4	31

- ## Challenges
  - Implementation of PDX driven outreaches are capital intensive

Preparing a Client for Exposure with Xair

Nigeria free of tuberculosis!

Success Stories 1

- DLB was used for an outreach in a primary school in Aiyedire LGA

- 112 people screened, 24 presumptive were identified while 6 cases were diagnosed, including 3 (50%) childhood cases (NNT 4; NNS 18)

- The yield from interventions with DLB have greatly improved and some of these cases would have been missed with symptomatic screening
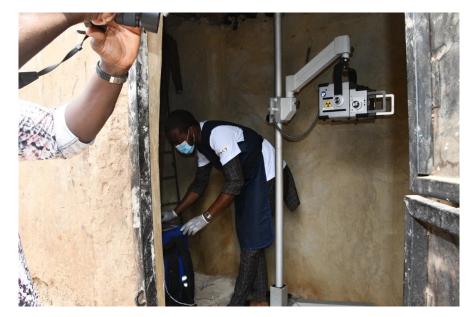
Success Stories 2

- DLB and TB Lamp were used for an outreach during the WTBD in Mabushi Abuja

- 41 people screened, 11 presumptives were identified and tested during the outreach which yielded 3 Bacteriological TB cases

- 5 more TB cases were later identified during clinical review using the XMAP

- Coupling DLB and TB Lamp equipment was key to on-the-spot Tb diagnosis

- All 8 cases have been enrolled on treatment

Success Stories 3

- DLB was deployed across all the 11 prisons in Katsina state from Jan 7th-Feb 23rd, 2022

- 2,795 people screened, 172 presumptives were identified and tested

- 57 more TB cases were identified and 56 enrolled on Tb treatment

- 34 of the Tb cases were bacteriologically diagnosed

DLB in pictures....Delta and Benue State

Ongoing screening in Ndokwa East LGA, Delta State

Ongoing screening at an IDP camp in Benue State

DLB in pictures....Osun State

Ongoing screening in a primary school at Ile-Ogbo, Osun State

Setting up DLB at Agberire community, Osun State

DLB in pictures….Kano State

Ongoing screening at a primary school in Kano State

Screening an inmate at a correctional facility in Kano State

DLB in pictures....Oyo State

Setting up in Akinyele LGA, Oyo State

Outreach with DLB in Oyo West LGA, Oyo State

OFFICIAL HAND OVER OF NEW TOOLS TO NTBLCP

Thank you