



ANNUAL IMPACT REPORT





TABLE OF CONTENTS

1	Introduction	3			
	Message from the CEO	4			
	Delft's Impact 2021 at a glance	5			
	COVID-19 Pandemic Response	9			
	Voice from our partners	10			
	About Delft Imaging	11			
2	Operating with Integrity	12			
	Our Path to Healthcare Impact	14			
	Our Approach	15			
	Delft Imaging as a Social Enterprise	18			
	Global Partnerships	23			
	Data Protection, Privacy & Security	24			
	Service & Training	25			
3	Case Study: Delft's Solutions for Impacts	27			
	Delft's Solutions for TB Programs	28			
	TB Active Case Finding:	29			
	• Nigeria, Uganda				
	• Pakistan, Indonesia				
	TB Screening for high-risk populations:	31			
	• Zambia, Malawi				
	• Nigeria, Pakistan				
	Migrant Screening & Prevalence Survey:	33			
	• Thailand, South Africa & Zambia				
	CAD4TB Effectiveness, Bi-Directional	34			
	TB & COVID-19 Screening:				
	• Nigeria				
4	Policy & Scientific Evaluation	36			
	WHO's Guidelines & Technical Specifications	37			
	Scientific Publications 2021	39			
5	Innovations for Social Change	41			
	TB Screening Optimisation per setting	42			
	BabyChecker	43			
6	Co-Creation	44			
	Co-Creation	45			
	The Team	46			
	Acknowledgements	48			



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1 Introduction





MESSAGE FROM THE CEO

At Delft Imaging, we see ourselves as a social enterprise; a company that is – above anything – focused on impact. But this raises the question: what does it mean to strive for impact? For us, it means that impact always comes first. **As a company, we need to be profitable, but it is not the reason we exist – profit is not what drives us, impact is.** Because of this belief, we invest with a long-term view on research and development of solutions that we believe should exist for the impact they will have, not for the revenue they may potentially generate.

For example, we had invested numerous years in our artificial intelligence (AI) solution for tuberculosis detection (CAD4TB) before its potential started to be recognised by others. Yet, we continued to pioneer its development because we believed in the major impact that this AI-driven solution could have in the fight against tuberculosis. That is why for us one of the key milestones of 2021 was to see the World Health Organization recognising its same potential for impact and endorsing CAD for tuberculosis screening and triage; something that once started with our initial research. With that same approach, we continue to invest greatly in the development of a new AI-powered solution that is designed to make pregnancies safer in low-resource settings: BabyChecker, which is set to be rolled out in 2022.

At the end of the day, it is the results that matter; not just the results that we are able to achieve as a company, but collectively as a global community. That is why we also never chose to patent or otherwise shield any of our solutions. That way, others may also be inspired by the solutions we develop, and those types of solutions can benefit the most people, the quickest.

Still, our ability to be impactful can only be determined through measurement and transparency. That is why we are proud to present to you our Annual Impact Report of 2021; A well-measured and transparent account of our major milestones and impact achieved this past year. The report features our strides towards social- and environmental impact, but also discusses vital topics like data protection and privacy and leading scientific research.

The credits, however, do not just belong to us. We warmly thank our clients and our partners whose efforts are interwoven throughout the report, and who share our quest of ending health inequity.

Sincerely yours,

Guido Geerts

President & CEO, Delft Imaging





AT A GLANCE DELFT'S IMPACT 2021



9.6

million+ people

Screened by CAD4TB

Adding 2.4 million+ screening in 2021



34

Countries

Utilized Delft's solutions

Adding to a total of 74 countries globally



95%

of Delft Portable X-Rays

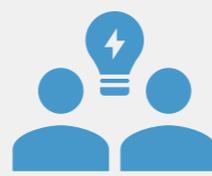
Powered by Clean Energy



150+

Professionals

From 10+ countries trained by the Delft Team



1,100+

Professionals

Gained knowledge of AI & digital tools for TB



96%

Technical Enquiries

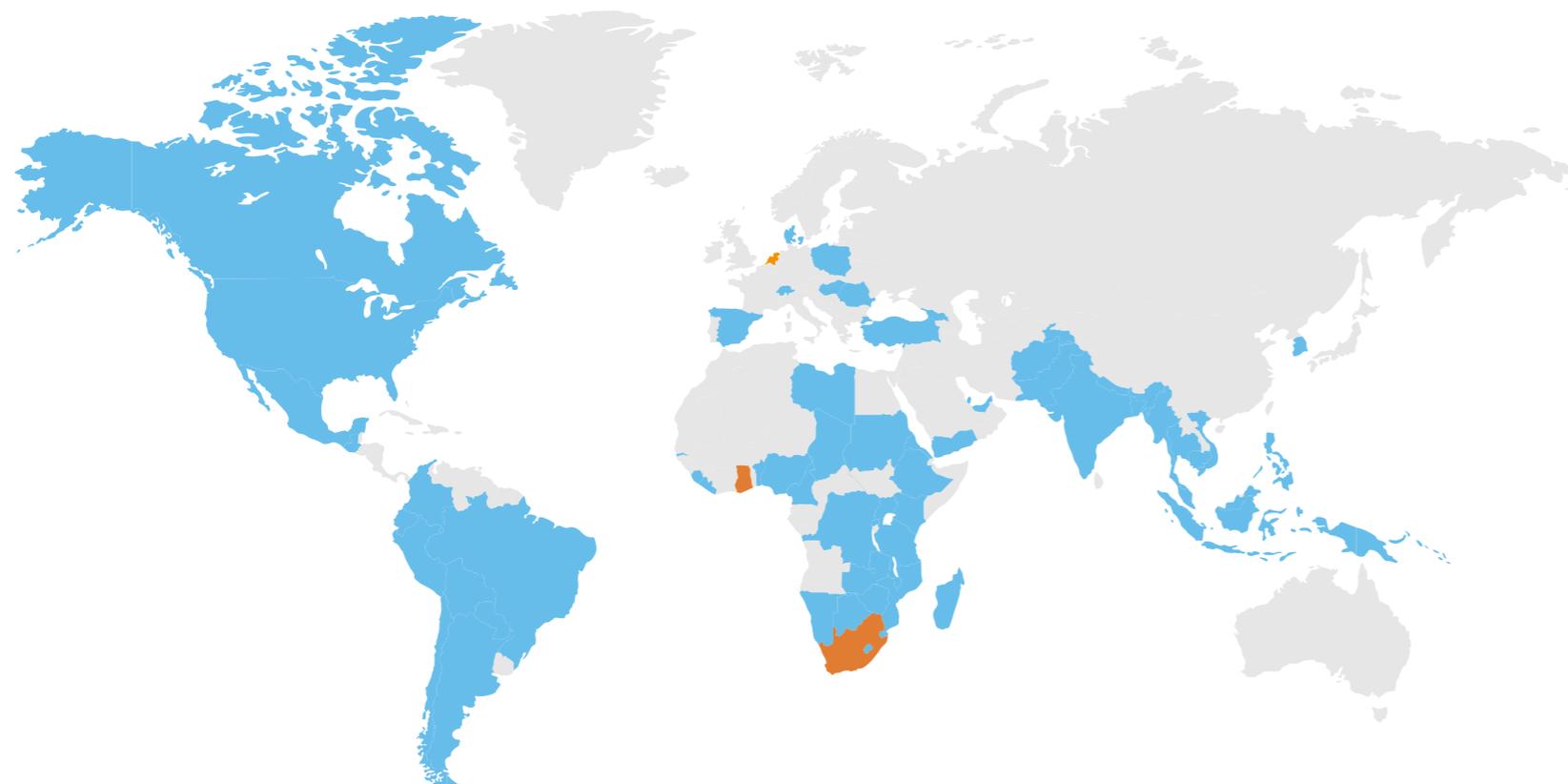
Resolved within an average of 1 day

DRIVING IMPACT

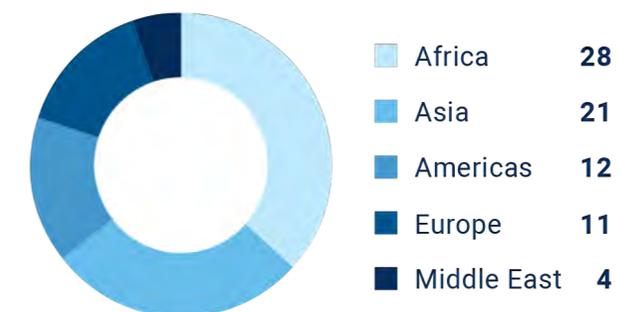




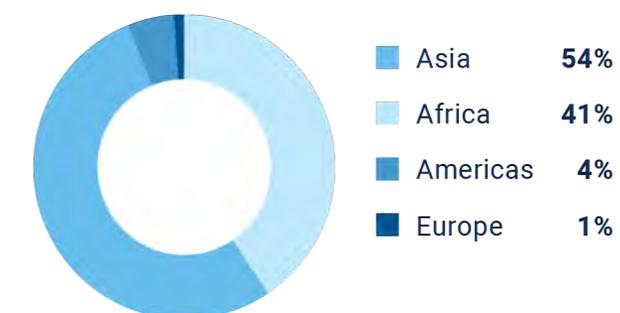
WHERE WE MAKE IMPACT



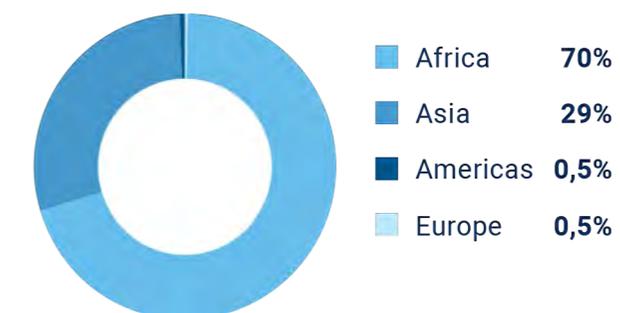
To date, Delt Imaging's digital screening solutions are used in 76 countries, including in the COVID-19 pandemic response. Delt Imaging's HQ in the Netherlands and regional offices in Ghana and South Africa continuously support our clients' operations worldwide, which increasingly combine in-person and web-based services to further increase optimization and improve the user experience.



Delt's Users by Regions
Total of 76 countries



CAD4TB
Users percentage by regions



Digital X-rays
Users percentage by regions





IMPACT ON TB SCREENING YIELD & EFFICIENCY



9.6 million+ TB screenings with CAD4TB

Delft Imaging's innovative Tuberculosis (TB) screening solutions slash screening cost and make TB services more accessible, accurate, efficient and effective. Digital X-ray systems and CAD4TB/AI enable data-driven active TB case-finding programs.



DAILY SCREENING THROUGHPUT

2.5 x higher

With CAD4TB in comparison to screening without

MURPHY ET AL.
NATURE SCIENTIFIC REPORTS, 2020



COST PER SCREEN

50% lower

With CAD4TB in comparison to screening without

MURPHY ET AL.
NATURE SCIENTIFIC REPORTS, 2020



TB & DIABETES

High accuracy

With CAD4TB as a TB screening triage among people living with diabetes

HABIB ET AL.
NATURE SCIENTIFIC REPORTS, 2020



CASES DETECTED

22% more

With CAD4TB being used as a second CXR reader

PHILIPSEN ET AL.
IJTLD, 2019



XPRT TESTS USED

75% saving

With CAD4TB at a sensitivity 79.7%. More than 50% saving at a sensitivity above 90%

QIN ET AL.
THE LANCET DIGITAL HEALTH, 2021



TB & HIV

Added-value

CAD4TB with universal HIV screening increased timelines and completeness of HIV/TB diagnosis

MACPHERSON ET AL.
PLOS MEDICINE, 2021





OPERATIONS SUMMARY 2021



SUCCESSFUL PROJECT DELIVERY WORLDWIDE

- Implemented 50+ projects globally
- Supported clients and TB programs with our innovative solutions



ENHANCED PERFORMANCE & SERVICES

- Released CAD4TB7 with enhanced performance and cardiomegaly analysis
- Introduced CAD4TB platform with SAM as a new functionality



INNOVATION

- Pre-launched BabyChecker to support the timely detection of risky pregnancies



GLOBAL RECOGNITIONS

- CAD4TB endorsed by WHO
- Best in the World in 2021 in the B-Corp. service category



EXPANDING PARTNERSHIPS

- New partnership with the [Global Drug Facility \(GDF\)](#) in the Stop TB Partnership
- Delft Imaging joined [the UN Global Compact](#)



Florent Geerts
Business Unit Director



Mohammed Harbiye
Business Unit Director

“ COVID-19, not ignoring the enormous negative impact it has had around the world, has also shown the tremendous potential of when organisations around the world work together. The amount of funding that was sourced, the extent of scientific research that was published and the innovation in medical solutions that came forward – and all of that with the incredible speed we have seen. Globally, we need to continue that spirit of cooperation in our global efforts to screen for TB as well so that TB may also see the same level of funding, the same level of pioneering research and the same level of innovation in medical solutions and, also there, at the same speed we have seen as with COVID-19.





COVID-19 PANDEMIC RESPONSE

Supporting collective action with novel CAD/AI software

In response to the COVID-19 pandemic, Delft Imaging supported Ministries of Health and healthcare facilities worldwide by leveraging our extensive experience and proven CAD system for TB screening. In collaboration with our sister company [Thirona](#) and various leading hospitals, we rapidly developed [CAD4COVID](#) for triaging and to make better clinical decisions for COVID-19 cases in resource-constrained settings and high-burden locations. To support the pandemic response, we made CAD4COVID available **free-of-charge**.

-  **CAD4COVID-XRAY** Development **in 2 weeks** (March 2020)
-  **CAD4COVID-CT** Development **in 4 weeks**
-  **Class II CE certification** in 2.5 months
-  **Secured various funding** to scale globally
-  **CAD4COVID** available with **240+ installations** and available in **40+ countries**

This initiative was supported by the Dutch Entrepreneurial Development Bank (FMO), the Netherlands Enterprise Agency (RVO), DeveloPPP / GIZ, Open Road Alliance, and the Philips Foundation. To date, CAD4COVID is available through 240+ installations at health facilities in 40+ countries to triage COVID-19 cases for better clinical pathway decisions.

Moreover, as the pandemic continues to have a devastating impact on the global health system, our collective fight to end TB by 2030 has been jeopardised. Therefore, [bi-directional screening/testing](#) for TB and COVID-19, along with using digital X-rays with CAD software is a novel way to combat both infectious diseases. Our [CAD4TB](#) is a significant part of our approach to the bi-directional screening pertaining to CAD4COVID.



28,000+
people
Screened with
CAD4COVID



240+
installations
Benefited from
CAD4COVID



49
countries
Supported by
CAD4COVID





VOICE FROM OUR PARTNERS

Delft Light & CAD4TB reaching the hard-to-reach



Dr. Bethrand Odume
Executive Director
KNCV TB Foundation, Nigeria

“ Delft Light Backpack (DLB) has helped to improve TB diagnosis amongst the hard-to-reach population in Nigeria. KNCV TB Foundation Nigeria in 2020 got a DLB back pack on loan from Delft Imaging for a six months pilot. Between October to September 2021, 15,653 clients were screened, 194 TB cases diagnosed and 190 enrolled on treatment. DLB improved access to TB diagnosis at reduced cost of X-ray services, transportation time and other associated cost for TB services.

The lessons learnt from the pilot project informed the ongoing deployment of 10 DLB in Nigeria through the USAID funded new tools project in Nigeria.

CAD4TB solves geographical gap in remote screenings



Dr. Lituhayu B. Putri
National Program Manager,
Fullerton Health Foundation,
Indonesia

“ CAD4TB can reduce the time consumed in the TB-Screening process and provide early screening tools in a less than one minute-process, helping us to decide whether the patient needs to have the further confirmatory test or not.

Delft Imaging can provide CAD4TB in an offline mode: it has solved our geographical gap in the remote screenings. The technology allows easy implementation, and the offline solution helps us comply with the government regulations and keep medical data confidential.





ABOUT DELFT IMAGING

Delft Imaging was founded in 2002. However, our roots in diagnostic imaging go all the way back to the beginning of the 20th century, when the first Dutch radiology equipment factory (ENRAF) was founded. Over the decades that followed, we accumulated worldwide expertise in medical imaging and remain committed to providing reliable diagnostic solutions to emerging countries, with a focus on TB and the use of artificial intelligence (AI).

Since our founding, we have implemented projects in 76 countries. With over 1,000 installations using our radiology equipment and software, we are proud to say that we have facilitated the screening of over 9 million people for TB.

Delft's products and services include Computer-Aided Detection software to automatically detect TB (CAD4TB), turn-key diagnostic centres, easy-to-use X-ray equipment and all-in-one mobile clinics that are designed to be taken into remote and difficult-to-reach areas for on-site healthcare services.

Delft Imaging has collaborative partnerships with Canon Medical Systems, Oldelft Benelux and Thirona. Delft Imaging's headquarter is located in 's-Hertogenbosch, the Netherlands, and its training and technical support office is located in Accra, Ghana. In addition, we regularly participate in public and private partnerships with international and local NGOs as well as knowledge institutes.

Visit www.delft.care to learn more about us.

2021 → **Over 9 million people screened with CAD4TB**

2020 → 240+ installations with CAD4COVID AI during the pandemic

2018 → Branch office for S. Africa in Johannesburg

2016 → Branch office for W. & E. Africa in Accra

2012 → Delft Imaging Systems B.V.

2012 → Canon acquires Delft Diagnostic Imaging

2003 → Delft Imaging Systems, Part of Delft Diagnostic Imaging

1990 → Delft Instruments

1985 → Oldelft

1939 → De Oude Delft

1925 → ENRAF (Eerste Nederlandse Röntgen Apparaten Fabriek)

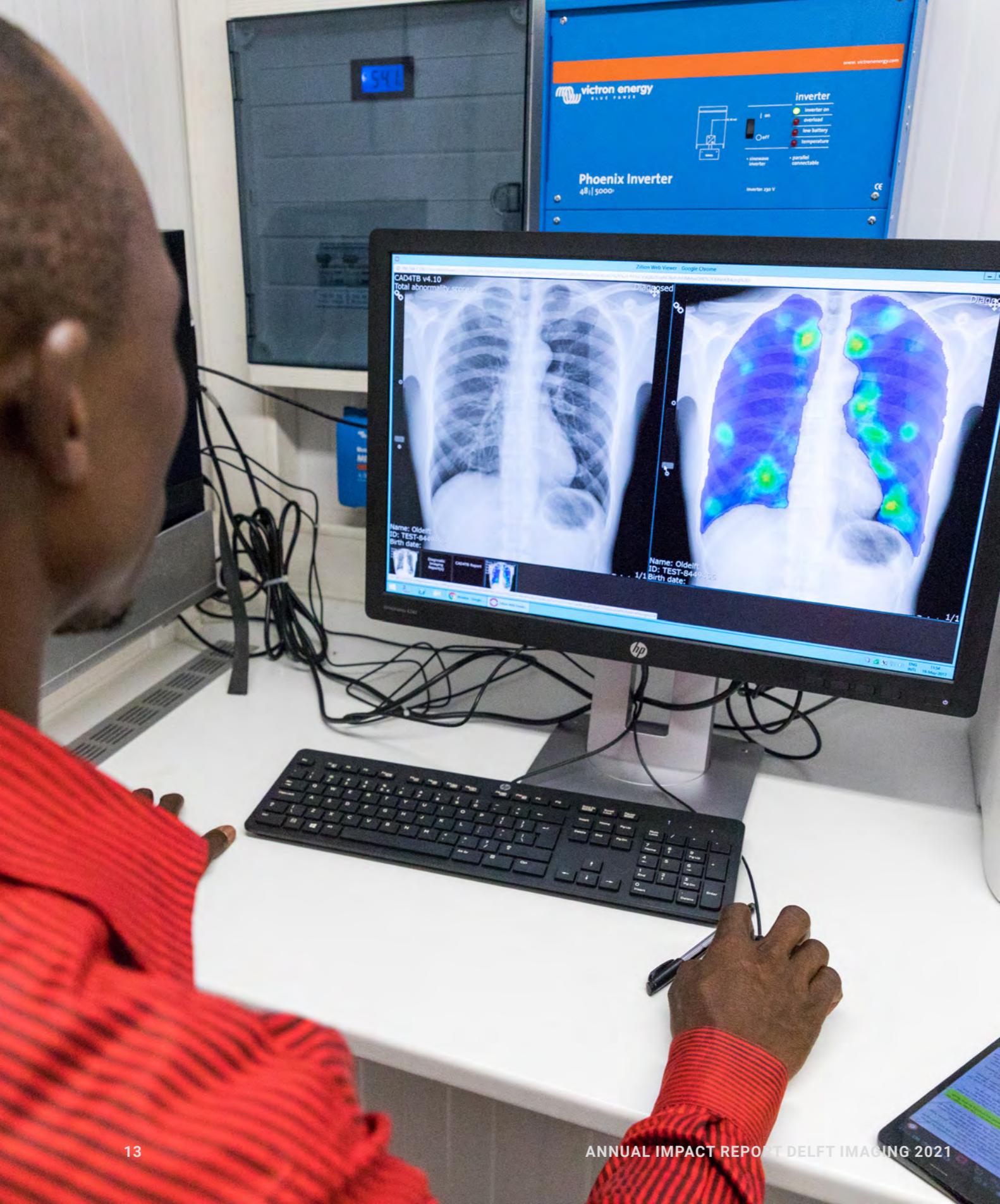


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2 Operating

with integrity





DELFT IMAGING MISSION

Delft Imaging is committed to developing and delivering unique solutions that respond to the specific needs of key and vulnerable populations around the globe. We focus strongly on providing affordable and innovative diagnostic imaging solutions and Artificial Intelligence (AI) that are key to strengthening health systems worldwide.





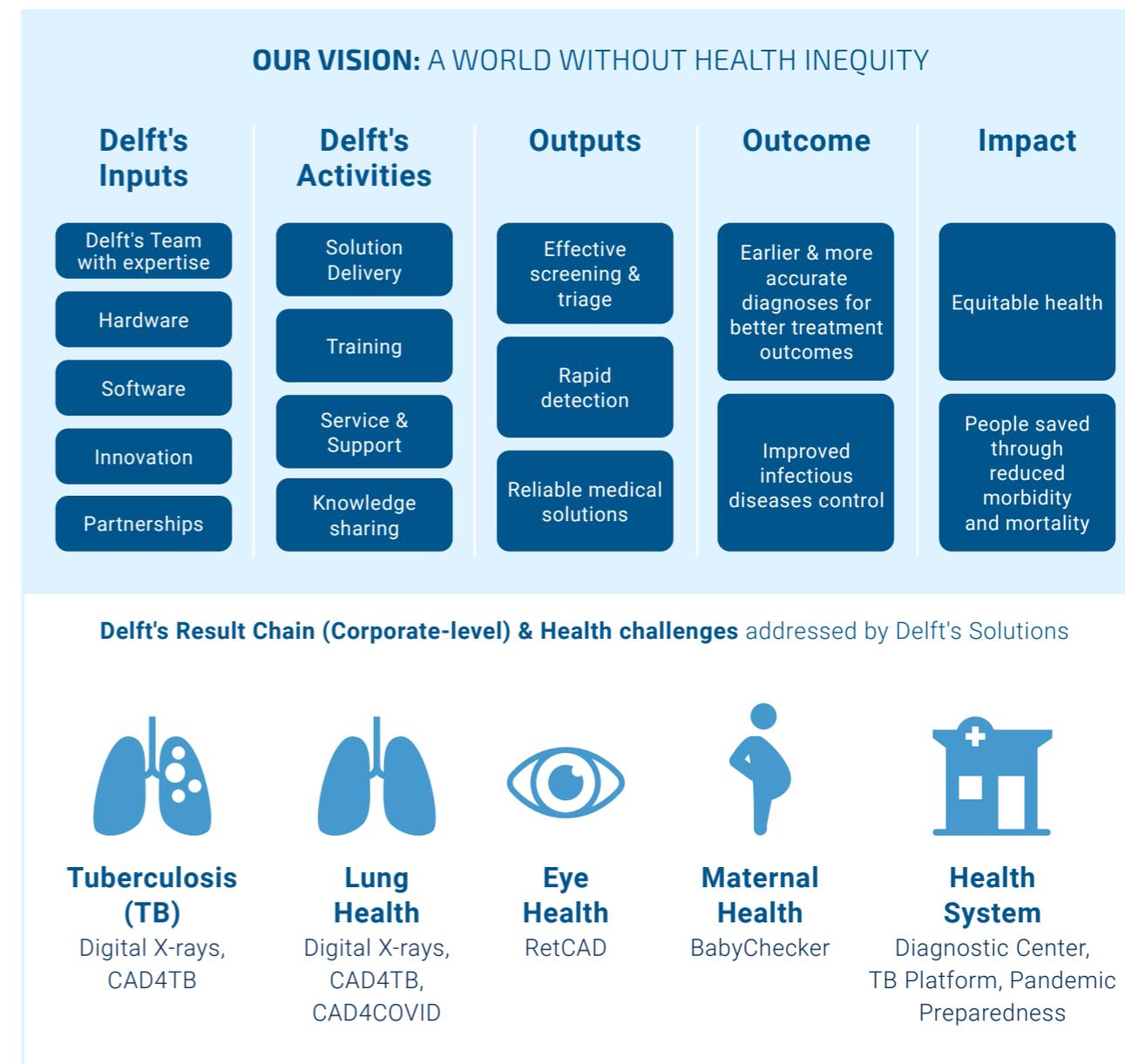
OUR PATH TO **HEALTHCARE IMPACT**

We envision a world in which everyone can benefit from the modern worldwide advances in the healthcare field. Delft Imaging is specifically dedicated to improving people's quality of life by means of affordable and easy to use diagnostic imaging solutions aided by AI.

It is this vision that drives our commitment to develop and deliver unique health innovations that respond to the specific needs of key and vulnerable populations worldwide.

Delft Imaging specifically focuses on lung health with a specialisation in TB, eye health and maternal health. Our solutions strengthen the health system in general with multi-functional imaging systems and CAD/AI software.

Through our intensive cooperation with medical specialists and practitioners around the world, we have developed a deep understanding of their practical needs. This has resulted in a demand-driven social enterprise that develops and supplies solutions and services that truly respond to diagnostic requirements.





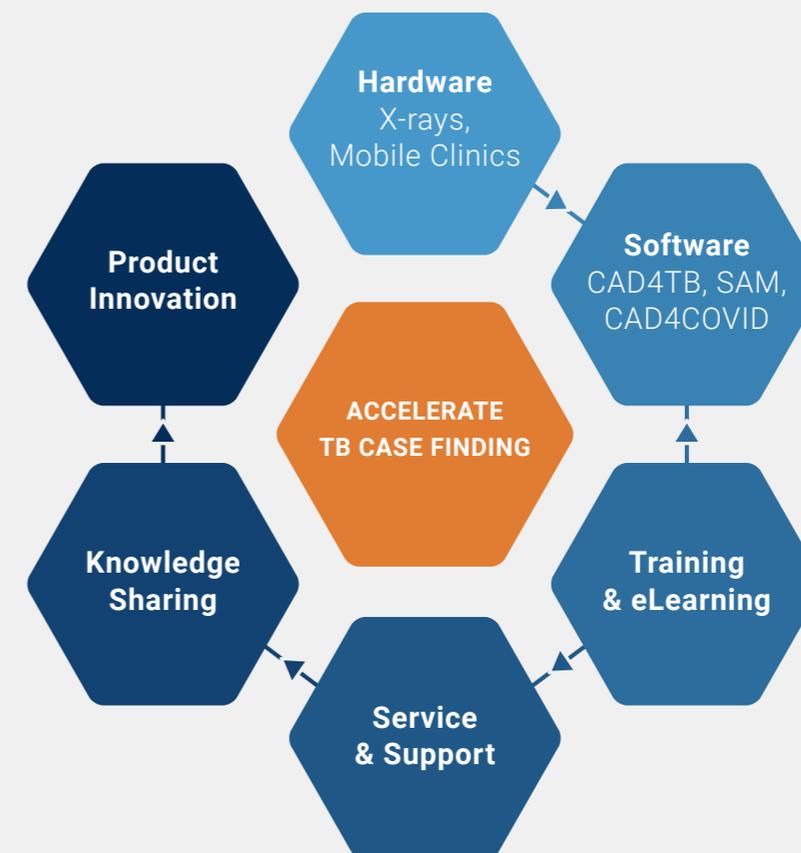
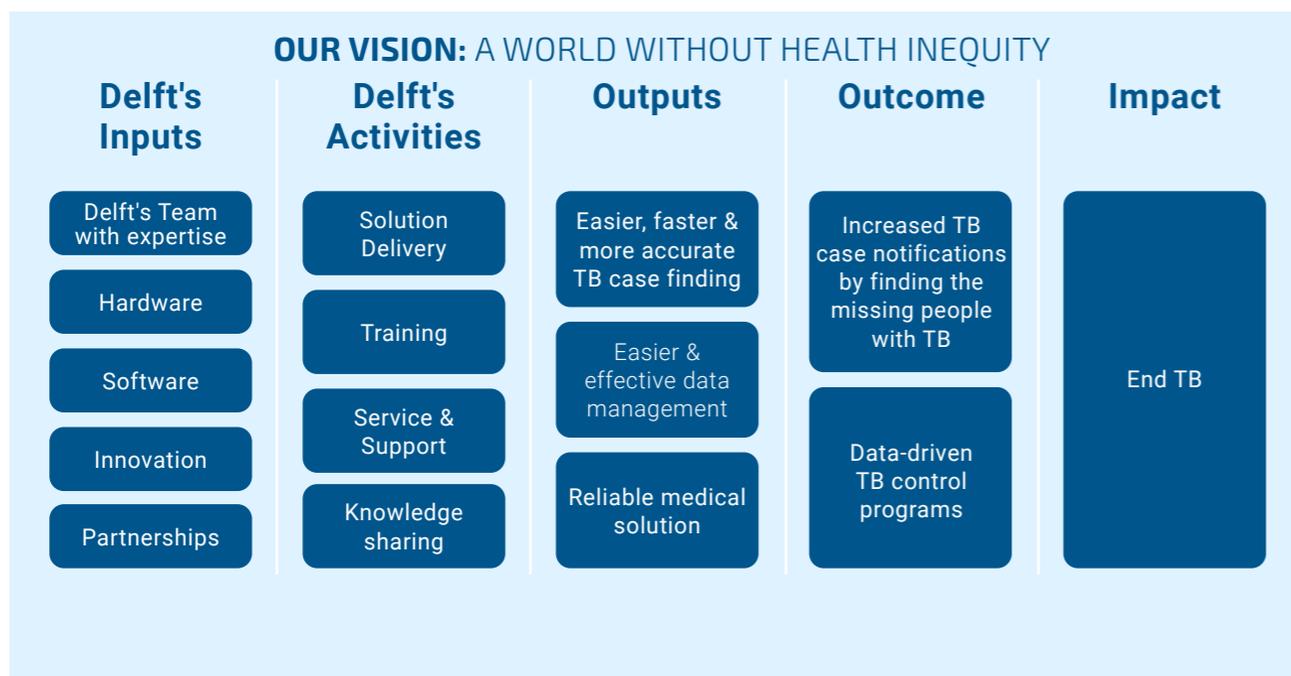
OUR APPROACH TO END TB

Tuberculosis (TB) is the world’s deadliest infectious disease after COVID-19 and is a global health security threat. According to the WHO Global Tuberculosis Report 2021, there were 1.5 million deaths from TB, surpassing both HIV and malaria combined in deaths, and 10 million people fell ill with TB in 2020. Moreover, millions of people are “missed” each year by health systems so they do not get the TB treatment and care they need and deserve. To achieve the global TB targets of the SDGs and the WHO’s End TB Strategy targets, innovative solutions that are affordable, rapid, accurate and easy to implement in resource-constrained settings are essential.

To respond to the challenges, we support our clients with:

- [CAD4TB/AI software](#) for TB detection and Data Management Platform
- [Digital X-ray systems](#) (from ultra-portable to stationary)
- [OneStopTB Mobile Clinics](#)
- [Technical training](#) and [Service & Maintenance](#)

Our operating model ensures customers’ smooth and uninterrupted utilization of our solutions. We support TB programs to enable case detection with unprecedented speed and ease.





OUR APPROACH TO MAKE PREGNANCIES SAFER

Globally, 830 women die during pregnancy and childbirth every day. Sub-Saharan Africa and Southern Asia account for approximately 86% of the estimated global maternal deaths. Fortunately, many of these deaths are preventable. The WHO recommends ultrasound to assess gestational age, identify the number of fetuses, fetal presentation, and placenta localisation to reduce risks and improve a woman's pregnancy experience.

Despite the well-known benefits, ultrasound is not available in many rural and remote areas in low-resource settings for two main reasons:

1. Ultrasound is too expensive
2. A trained clinician is required

Even with the latest innovations in portable ultrasound that have reduced the cost of ultrasound from \$50,000 to a few thousands, a trained clinician is still required. In cooperation with various stakeholders, we leveraged our decade of expertise in AI medical imaging to tackle these challenges. In countries like Malawi, where there is an estimate of 5 obstetric gynecologists for a population of 14 million people, we must employ task-shifting and empower community-health workers. This is where AI plays an important role.

To make ultrasound available for those who need it the most, Delft Imaging is introducing [BabyChecker](#), a smartphone-based ultrasound designed to make pregnancies safer in low-resource settings. BabyChecker is powered by AI to support the timely detection of risky pregnancies by community health workers.

Through the [6-sweep obstetric protocol](#), the ultrasound images are acquired and analysed by the BabyChecker AI installed as a mobile application. Training untrained users requires a maximum of 1 hour. BabyChecker can operate without Internet access.



[See the video](#)

REFERENCE

<https://www.paho.org/en/topics/maternal-health>

<https://www.who.int/publications/i/item/WHO-RHR-18.01>

<https://www.med.unc.edu/obgyn/unc-ob-gyn-in-malawi/>

<https://www.frontiersin.org/articles/10.3389/frai.2021.553987/pdf>

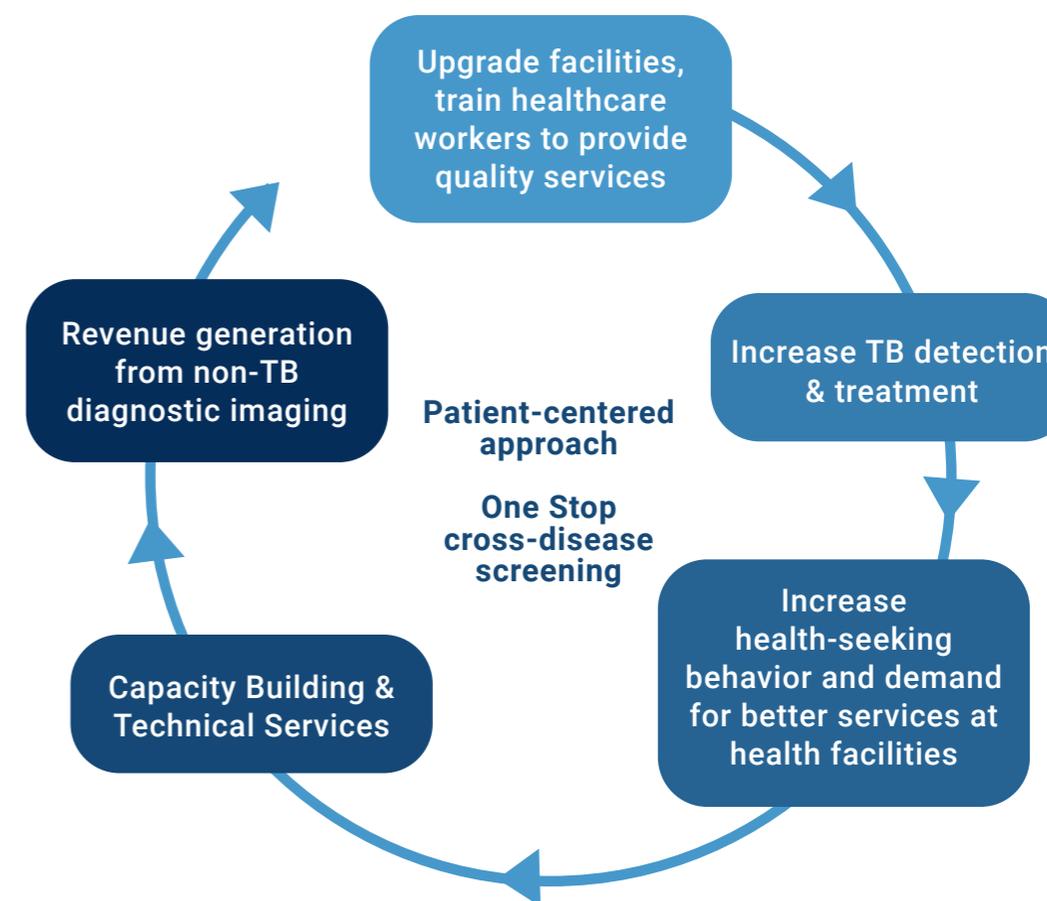
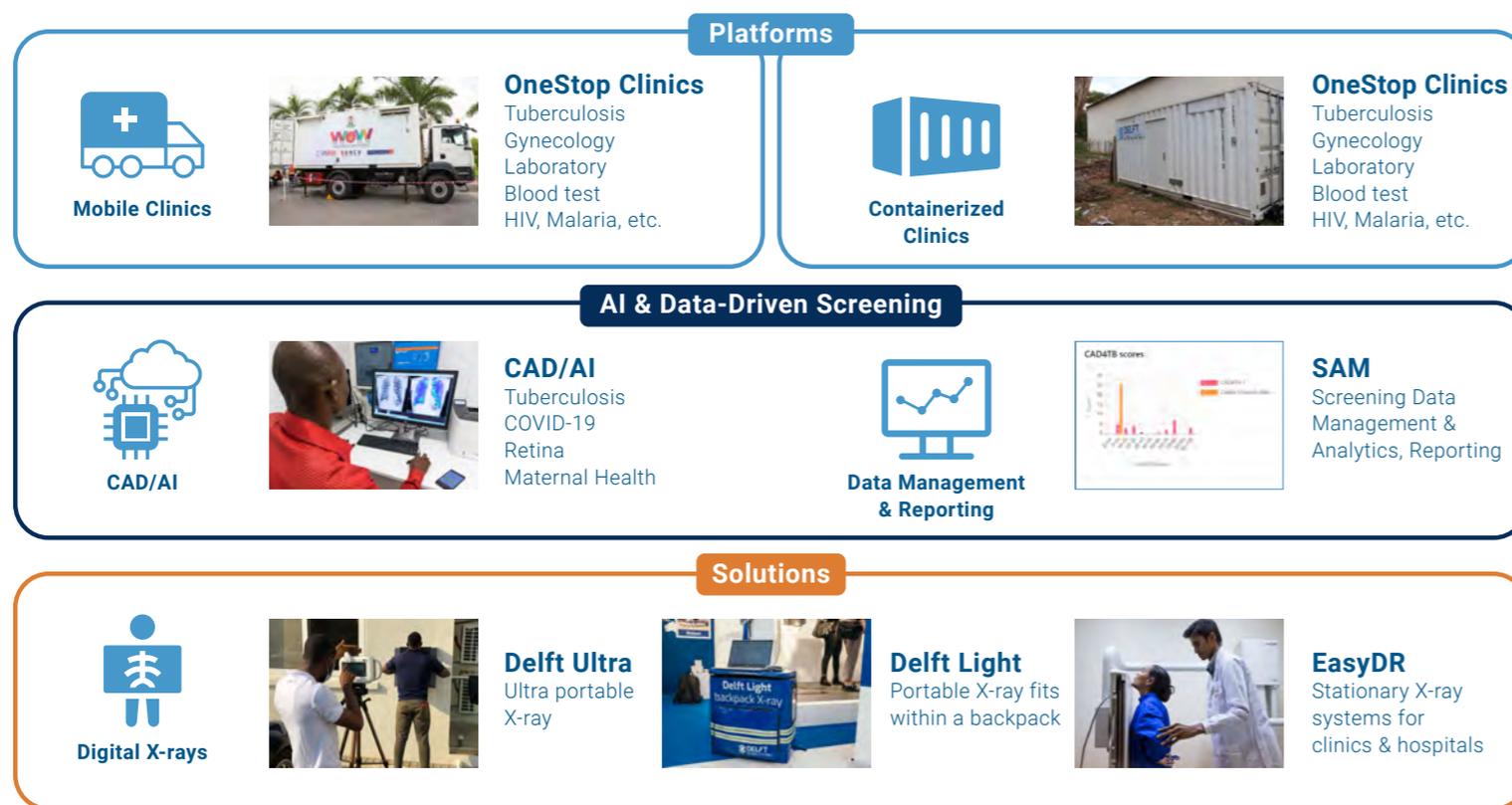
<https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10139/101390V/A-step-towards-measuring-the-fetal-head-circumference-with-the/10.1117/12.2253671.full?SSO=1>





OUR APPROACH TO STRENGTHEN HEALTH SYSTEMS

In addition to eliminating TB, it is critical to address other health burdens. Innovative digital technologies can strengthen health systems and contribute to the prevention, timely diagnosis and treatment of multiple diseases reliably and with cost-effectiveness. As the innovator of One-Stop services with turn-key solar powered platforms, our expertise in diagnostic imaging, AI and data management as well as point-of-care testing and laboratory services can be combined for deployment depending on the disease burdens of given countries. Multi-functional diagnostic imaging also enables health facilities to generate recurring revenues from non-TB patients, further strengthening the sustainability of the health systems.





DELFT IMAGING AS A SOCIAL ENTERPRISE

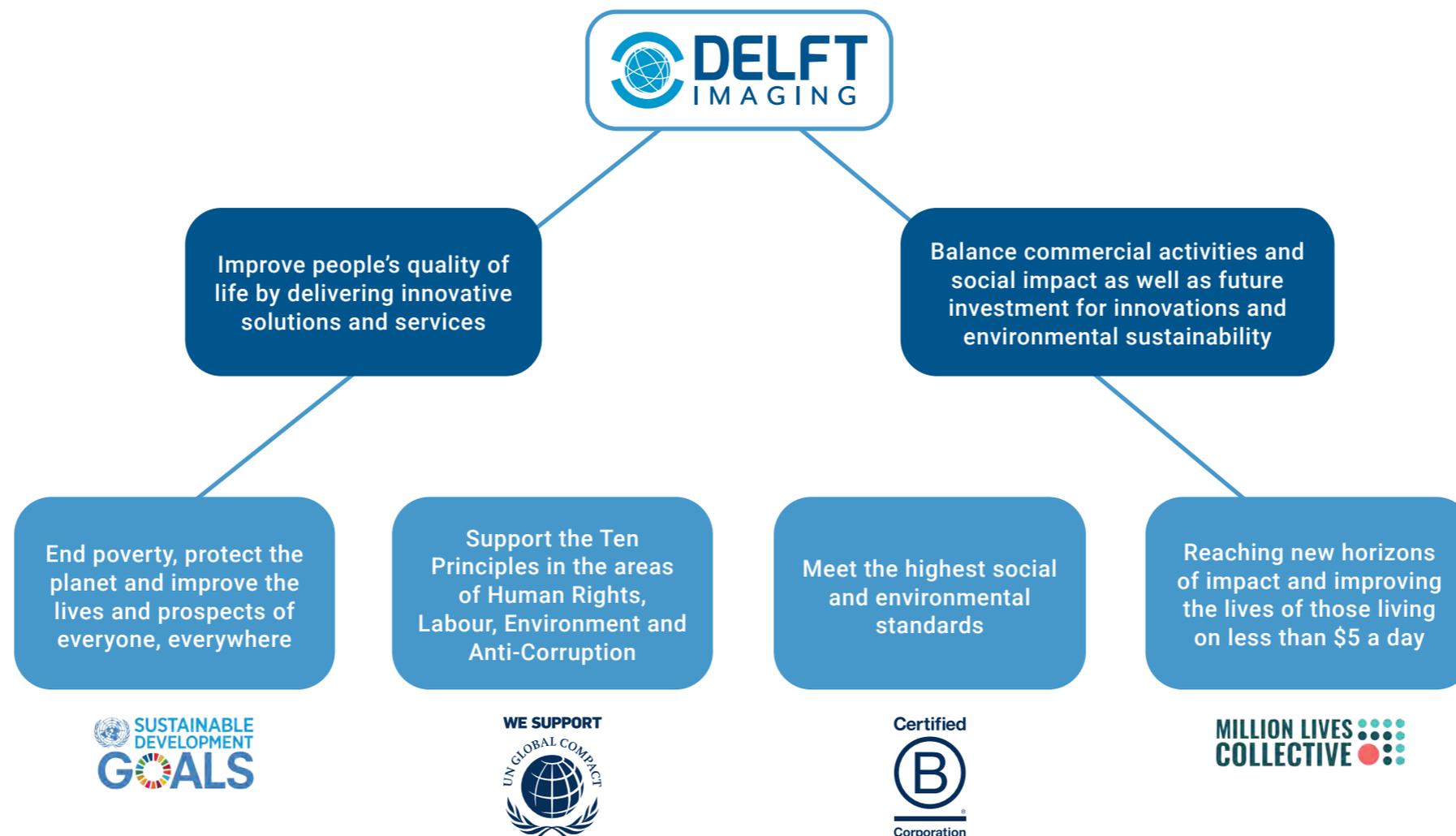




DELFT IMAGING AS A SOCIAL ENTERPRISE

Delft Imaging is a social enterprise: aiming to balance commercial activities and social impact. Our innovative solutions respond to pressing healthcare needs of key and vulnerable populations worldwide. Ultimately, we want to contribute to achieving social change: a world without health inequity.

Therefore, Delft Imaging meets various international standards and actively supports social initiatives. We are committed to the United Nations' Sustainable Development Goals (SDGs) and the United Nations Global Compact. Additionally, since 2020 Delft Imaging has been a B-Corp certified company and a vanguard member of the Million Lives Collective with our CAD4TB. We incorporate the values and principles of these initiatives into our company's mission as well as day-to-day operations.





UN SUSTAINABLE DEVELOPMENT GOALS & GLOBAL COMPACT

To create a better world for people and the planet by 2030, the United Nations set the 17 Sustainable Development Goals (SDGs). Delft Imaging aims to promote these SDGs with our core activities and projects. Additionally, we participate in [the UN Global Compact](#), the world's largest corporate sustainability initiative to align ourselves with the Ten principles on human rights, labour, environment, and anti-corruption.



GOAL 1 With our integrated TB solutions, we aim to support earlier detection of TB and prevent catastrophic costs of treatment.



GOAL 9 With our integrated TB solutions, we support human well-being with quality, reliability and sustainability while ensuring affordability and equitable access for all.



GOAL 3 With our medical innovations, we aim to provide access to innovative healthcare for everyone worldwide and contribute to ending TB epidemics by 2030.



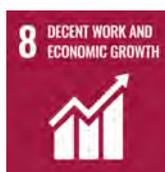
GOAL 10 We design our medical solutions to reach key and vulnerable populations including those in rural and remote areas in low-resource settings as well as migrant populations.



GOAL 7 Our solar panels provide electrical energy for our OneStopTB mobile clinics and portable digital X-rays (Delft Light and Delft Ultra), ensuring sustainable operation with clean energy.



GOAL 17 We create partnerships with public and private institutions, universities and local health care providers. Additionally, we set up the Delft Foundation to partner with and support others that promote the SDGs that we believe in, especially Goal 4 (quality education) and Goal 5 (gender equality).



GOAL 8 With our integrated TB solutions, we aim to support earlier detection of TB and prevent the spread of the disease among people in households, communities and workplaces, ensuring continuous participation in economic activities.



We are committed to delivering our solutions in a responsible and sustainable manner. For more information, please visit [Delft Imaging Systems | UN Global Compact](#).





CERTIFIED B CORPORATION

Since 2020, Delft Imaging has been a B Corp. certified company that balances purpose and profit. The B Corp. Certification provides legitimacy and credibility to our business as a social enterprise, but more importantly, it gives direction towards the areas where we can further improve.

In 2021, Delft Imaging was recognised as Best for the World 2021 in the service category. This means that out of 4,000 certified B Corporations worldwide, we are among the top 5% B Corps. who set standards to serve our customers and offer products and services that support the greater good.

Please visit bcorporation.net/directory/delft-imaging for more details.



MILLION LIVES COLLECTIVE

The Million Lives Collective is an initiative that recognises and raises awareness of innovators and social entrepreneurs that are making a significant impact by addressing global development challenges. The initiative is supported by leading bilateral agencies, multilateral organizations and foundations.

The Million Lives Collective celebrates innovators and social entrepreneurs who are reaching new horizons of impact and improving the lives of those living on less than \$5 a day.

Since 2020, Delft Imaging has been a Vanguard member of the Million Lives Collective, **receiving recognition that CAD4TB has directly impacted 1 million clients.** For more information, please visit www.millionlives.co.

6 million+ people
living under \$5/day
Screened by CAD4TB





COMMUNITY ENGAGEMENT

Delft Community

As a leading supplier of digital solutions for TB programs, we share user perspectives and insights among our existing and prospective customers as well as key stakeholders. To do this, we organise Delft Community and Live Webinar series to discuss the benefits and challenges of using Delft's solutions for actual use on the ground in various settings. These online learning platforms serve as a place where participants can actively engage and exchange their practical experience and knowledge to further improve TB screening and increase its impact.



130+
TB professionals

Joined the Delft Community



1,100+
TB professionals

Gained knowledge on AI & digital tools for TB screening



Delft Foundation

In 2021, the Delft Foundation supported the Elidiaries Foundation's Bundle of Pages (BOP) project to build and equip local libraries with over 300 books & stationery in three Ghanaian schools. This contribution also enabled the creation of literacy clubs serving about 2,000 students.



2,000+
school children

Gained access to literacy clubs



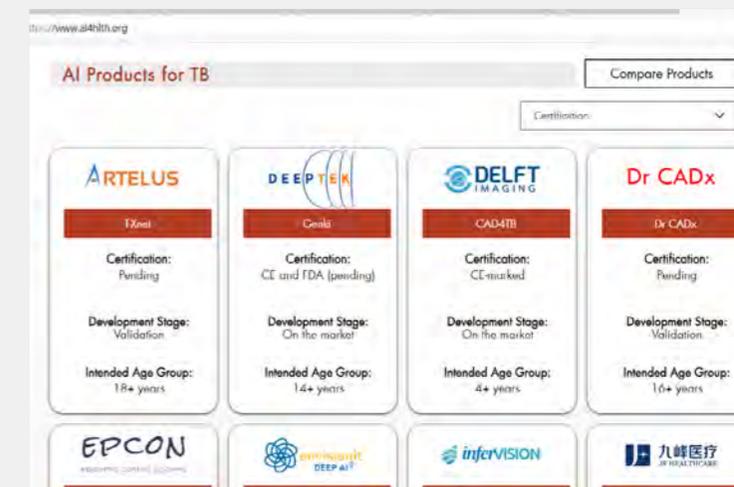
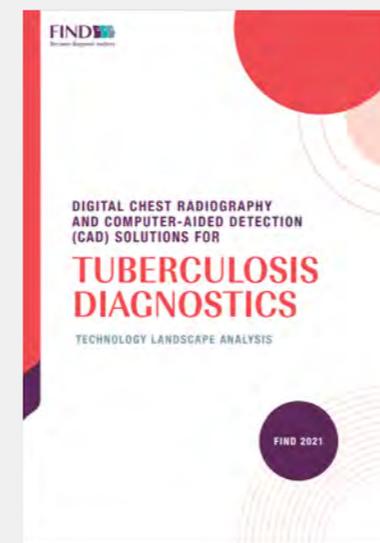


GLOBAL PARTNERSHIPS

A core reason we are able to carry out our work is our partnerships with other organizations. In 2021, Delft Imaging:

- Formalized a new partnership with [the Global Drug Facility \(GDF\)](#) under the Stop TB Partnership. Through this partnership, we offer Delft Light (ultra-portable digital X-rays) and CAD4TB (perpetual license) via [the GDF diagnostic catalogue](#)
- Maintained a long-term agreement with UNOPS for mobile clinics available at [UN Web Buy Plus](#), a global e-Commerce solution
- Officially joined [the United Nations \(UN\) Global Compact](#)
- Continued to be a member of [the Stop TB Partnership's Private Sector Constituency](#)
- Continued to be a long-standing member of the UNION

Delft's solutions feature in leading technical publications. In 2021, this included [Technology Landscape Analysis by FIND](#) for Digital Chest Radiography and the CAD Solution for TB Diagnostics and [Screening and Triage for TB using Computer-Aided Detection \(CAD\) Technology and Ultra-portable X-Ray Systems: A Practical Guide](#) by the Stop TB Partnership. Additionally, Delft Imaging and CAD4TB is listed on [the AI4HLTH platform](#) developed by the Stop TB Partnership and FIND, which provides an extensive overview of available CAD products. Finally, **CAD4TB is among the 2021 WHO recommended CAD software for TB screening and triage**, see [page 37](#) for more details.





TRUST IN **DATA PROTECTION, PRIVACY AND SECURITY**

We understand that data protection, privacy and security are critical for donors, users and beneficiaries, especially when using digital technologies which process and store patients' data. As a company based in the Netherlands, we strictly adhere to the European Union (EU) laws on data privacy and security and are transparent with our clients in accordance with the below points:



Data Ownership

National programs and implementators who use CAD4TB maintain full ownership at all times of any data collected using Delft's digital X-ray systems, CAD4TB (both online and offline) and related platforms.



Confidentiality

Information and data shared with, or processed by Delft's solutions remain confidential.



Restricted Data Use

- We use data only for clearly specified and agreed upon purposes.
- We do not use data for our product development unless agreed to with written consent.



Data Anonymization

Data that is uploaded to the CAD4TB platform can be anonymized with the click of a button.



Data Processing

- We are GDPR (General Data Protection Regulation) compliant and ensure data protection and security.
- Entering into a data process agreement (DPA) is our standard procedure.





SERVICE & TRAINING

Delft Imaging has a support centre for questions or issues about the use of the delivered solutions or warranty. Delft Imaging Ghana provides training, installation and maintenance services globally and assists customers with smooth and uninterrupted operations. **Delft Imaging Ghana is ISO9001:2015 certified.**

In addition, we work with a variety of highly capable and dependable service partners in various countries throughout Africa and Asia to ensure that support is always available

SERVICE HIGHLIGHTS 2021



96% of technical enquiries

resolved within avg of 1 day



< 7 hrs to resolve IT Issues

on avg

TRAINING HIGHLIGHTS 2021



150+ professionals

trained by the Delft Team



10+ countries

received training



“ I enjoyed the interaction between the facilitators and participants, and the simplicity of the communication.

“ I mostly enjoyed the practical aspect of the training.

	EXCELLENT	VERY GOOD	GOOD
Overall Satisfaction	74%	19%	7%
Relevance & Helpfulness	77%	13%	10%
Realisation of learning objectives	55%	32%	10%
Effectiveness for practical purposes	45%	26%	29%
Quality of trainer presentations	52%	35%	13%
Engagement & interaction	68%	26%	6%
Organisation & planning	48%	39%	13%

Evaluation Results Delft Light & CAD4TB Training. Nigeria, 2021

	EXCELLENT	VERY GOOD	GOOD
How satisfied are you with the overall service?	67%	33%	-
How satisfied are you with the overall performance?	69%	25%	2%
How relevant and helpful do you think our visit was for our job/organization?	76%	24%	-

Evaluation results digital X-ray periodic maintenance. Ghana, 2021







3 Case study

Delft's solutions for impact

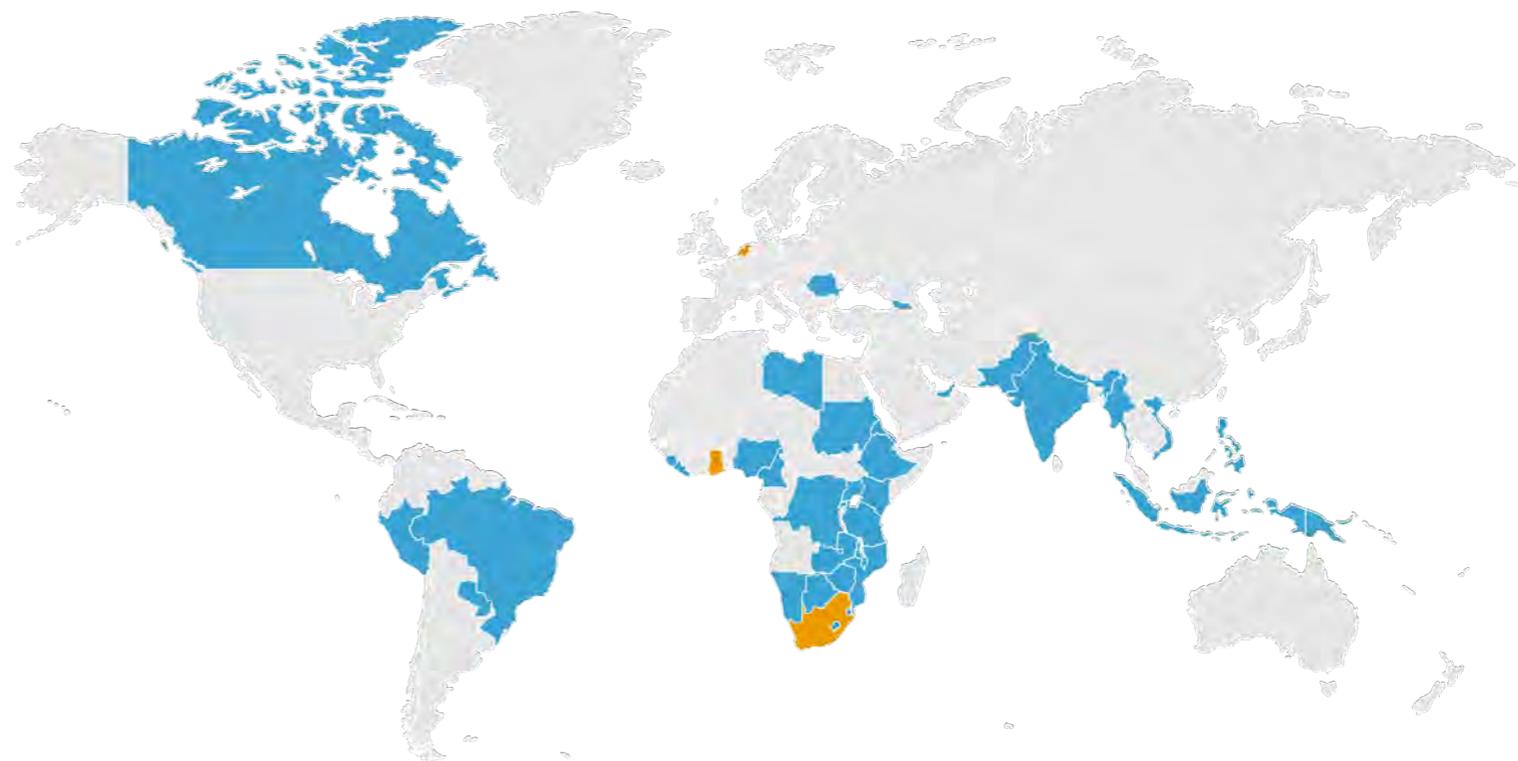




DELFT'S SOLUTIONS FOR TB PROGRAMS

In 2021, following the WHO's recommendations for the use of chest X-ray and CAD software for systematic screening for TB, we saw a tremendous effort globally to spearhead the utilisation of portable digital X-ray systems and CAD for TB screening. The inclusion of Delft Light and CAD4TB in [the Diagnostics Catalogue of the Global Drug Facility of the Stop TB Partnership](#) further supported access to and deployment of these tools worldwide.

Delft Imaging would like to thank all these organisations for supporting the development and helping to pioneer these innovative solutions. We are fully committed to showing the potential of portable X-ray systems and CAD4TB.



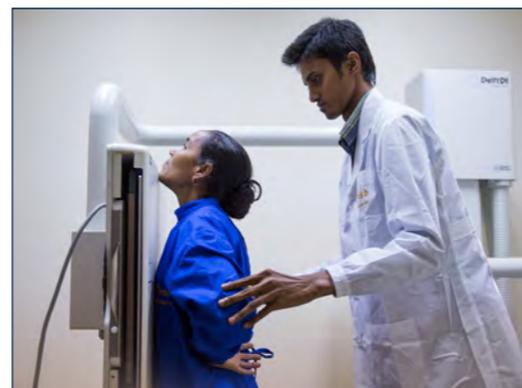
- 01. Delft Ultra
- 02. Delft Light
- 03. EasyDR
- 04. OneStopTB Mobile Clinic
- 05. CAD4TB AI Software



01



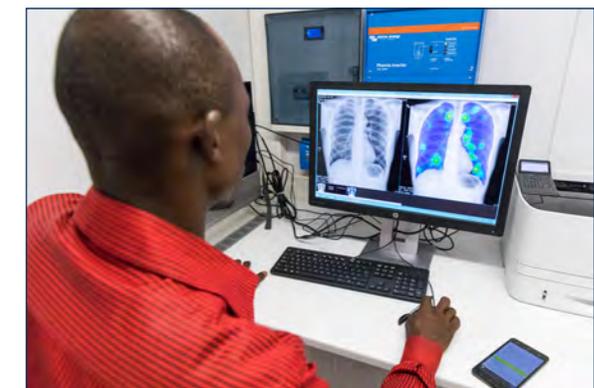
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03



04



05





TB ACTIVE CASE FINDING

Community-Based TB Active Case Finding with Delft Light & CAD4TB



- Community-based TB ACF in hard-to-reach areas in Nigeria Delta Region.
- In 4 months, 6,232 people (Children 4+ years and adults) with TB symptoms were enrolled, 6,218 were screened, and 778 were identified as presumptive TB (CAD4TB Score of ≥ 60). 757 cases were evaluated by Xpert and 70 cases were diagnosed with TB.
- Number Needed to Screen (NNS) with this approach was more favorable than intervention with WoW mobile clinic.
- **Active case finding with Delft Light and CAD4TB can be more effective in finding missing TB cases**, especially among the underserved hard-to-reach population in rural communities.

REFERENCE The 52nd UNION conference "Optimizing community TB Active Case Finding (ACF) using the Delft Light Backpack (DLB): Preliminary results from a 6-month pilot in Nigeria", Odume et al., KNCV Nigeria.

Health facility & Community screening with Delft Light & CAD4TB



- TB case finding at health facilities serving for high TB burden districts and for community outreach in TB hotspots and populations with high risk of TB.
- At health facilities (June 2020 to May 2021), 1,308 individuals were screened with X-ray, 281 (21%) had abnormal X-ray, 241 (86%) were tested by GeneXpert, and 35 (14%) were confirmed with TB (72% males, 51% HIV positive, 54% TB contacts).
- At community settings (in March 2021), 1,403 clients were screened with X-ray. 189 (13.5%) had abnormal X-ray and were tested by GeneXpert, and 12 (6.3%) were confirmed to have TB.
- **"TB screening using mobile digital X-ray has higher yield of TB when used at health facilities**, compared to community setting, especially among PLHIV and TB contact."

REFERENCE The 52nd UNION conference "Optimizing use of mobile digital X-ray with CAD4TB among populations at increased risk for TB to increase Tuberculosis case detection in Uganda", Dr. Aldo Burua, the National Tuberculosis and Leprosy Program, Uganda.





TB ACTIVE CASE FINDING

Active case finding using Mobile Van with **CAD4TB**



- Active case finding (ACF) was conducted at community outreach camps to find missing TB cases.
- 78,885 individuals visited camps. 62,656 (79%) were screened with digital X-rays, 12,661 were identified as presumptive TB cases (CAD4TB score ≥ 70) and tested with Xpert.
- Those having a CAD4TB score between 50 and 70 were clinically evaluated by a doctor.
- 1,187 were bacteriologically positive, 1,627 were clinically diagnosed, 62 were EP and 37 were detected as having RR-TB.
- **ACF intervention is an effective strategy to find missing TB cases in hard-to-reach areas and enables early TB diagnosis.**

REFERENCE The 52nd UNION conference "Implementation of an active case-finding intervention by using mobile vans equipped with digital X-rays and Gene Xpert machines to reach the missing TB cases in Pakistan" Sidra Azmat Mercy Corps, Pakistan, Merch Corps.

Mercy corps' experience with cad4tb" Dr. Tahir, Mercy Corps Pakistan, presented at Delft Imaging's Webinar on 30th June 2021.

CAD4TB for Mass and Remote TB Screening



- CXR screening with AI increases the quality and sensitivity of screening and allows for the use of the GeneXpert test only in CAD presumptive cases. The diagnostic costs are reduced as well as the workload of the machine so that it could also be used for COVID cases.
- 65% of radiologists agreed with the CAD4TB outcome declaring that a population with a CAD4TB score ≥ 60 is abnormal (suspected TB). For patients with a CAD4TBscore < 60 , 98% of radiologists agreed with the CAD4TB outcome that these cases are normal.
- **"The CAD4TB is in line with the radiologists' expertise and has good sensitivity in high-risk TB populations".**

REFERENCE "Utilization of CAD4TB for Mass and Remote TB Screening in Indonesia", Dr Lituhayu B. Putri, Fullerton Health Indonesia, presented at Delft Imaging's Webinar on 14th October 2021.





TB SCREENING FOR HIGH-RISK POPULATIONS

Intensified TB case finding with **OneStopTB Mobile Clinic (MOST)**



Eradicate TB Project

- Intensified TB case finding in province with highest TB burden in Zambia.
- MOST deployed for screening at 30 TB hotspots.
- **TB notification increased by 49%** through introduction of the mobile clinic.
- **“Use of the MOST clinic is making a significant contribution to TB case notifications** in the Copperbelt Province in Zambia. Scaling up the MOST clinic innovation to other provinces could help close the gap between notified TB patients and estimated incidence”.

REFERENCE The 52nd UNION conference “Intensified TB case finding in Copperbelt Province, Zambia: Contribution of Mobile One-Stop TB Clinic”, Onety Hanyuma, PATH Zambia.

Find missing cases of TB in high-risk populations with **OneStopTB Mobile Clinic**



- Mass TB screening exercise at congested bus terminal.
- Between July and October 2020, 2,005 people were screened, 307 (15.3%) were identified as presumptive TB cases, and 22 (7.1%) were confirmed to have TB. 10 (45.5%) of the 22 TB cases were biologically confirmed and 12 (54.5%) were diagnosed through chest X-rays.
- **Systematic screening using the OneStopTB Mobile Clinic can improve TB case notification.**
- Such screening exercises should be conducted routinely to further improve TB case notification and it is recommended that it be expanded into other towns.

REFERENCE The 52nd UNION conference “Mobile van TB screening at Blantyre Bus Station, Blantyre City, Malawi”, K. E. Mkalira, Malawi National TB Control Programme.





TB SCREENING FOR HIGH-RISK POPULATIONS

Prison screening with OneStopTB Mobile Clinic



- TB case finding at Kano Central Correctional Center in a high-risk setting for transmission of TB.
- OneStop TB Mobile Clinic (WoW: Wellness on Wheels) deployed to screen inmates.
- 1,967 (98%) were screened with X-rays using CAD4TB, 92 (5%) presumptive TB cases (CAD4TB score ≥ 60 and/or symptomatic), 21 TB cases diagnosed.
- **23% TB case yield.**
- Intervention was highly effective and significantly increased TB case finding in a short period of time (21 TB cases identified over 2 weeks while only 7 cases were found over the previous year).

REFERENCE The 52nd UNION conference "Report of an outbreak of Tuberculosis in Kano Central Correctional Center, Kano, Nigeria", Tukur et al., KNCV Nigeria.

Active case finding at prison with CAD4TB



PROCESS INDICATORS	TOTAL	
	N	%
(A) X-ray Screening	20,557	-
(B) Presumptive (B/A)	1,964	10
(C) Samples Collected (C/B)	1,804	92
(D) Diagnosed Cases (C/A)	104	0,5
(D1) MTB+ve (RIF+ included) (D1/D)	71	68
(D2) RIF+ (D2/D1)	3	4
(D3) Clinically Diagnosed (D3/D)	33	34
(E) Prevalence of TB (D/A) *100,00	506	

Figure 1 - Cumulative TB Case Finding Cascade at Prison Facilities

- Systematic screening in prison setting using CAD4TB with portable X-ray system.
- 20,557 inmates were screened and 1,964 (10%) were identified as presumptive TB cases with a CAD4TB score ≥ 70 and/or as being symptomatic.
- TB prevalence at prisons is around 1.8 times higher than the estimated national prevalence.
- TB screening is necessary at prisons as part of routine practice and use of technology enables mass screening and higher yields of MTB cases, reducing transmission.

REFERENCE The 52nd UNION conference "Active case-finding using artificial intelligence in prison facilities in Karachi, Quetta and Peshawar, Pakistan", Maniar et al., Indus Hospital and Health Network.





MIGRANT SCREENING

Using **Delft Light & CAD4TB**



- Screening migrants in the border area of Thailand–Myanmar, target population with difficulties visiting local hospitals.
- 1,318 Myanmar migrant farm workers were screened with CAD4TB (end of 2019 until middle of 2021). 17% (226) were presumptive TB cases due to abnormal CXR and/or positive symptoms. Presumptive TB cases led to sputum microscopy and GeneXpert test.
- 12% (165 participants) had abnormal CXR findings and 12% (16) of those were diagnosed with TB. Among them, 13 had smear negative pulmonary TB and the other 3 were positive. For the 16 participants with a TB diagnosis, the median CAD4TB score was 70 and 14 had a score above 50. Non-TB participants had a CAD4TB score median of 43. 10 out of 16 people were asymptomatic.

REFERENCE “Field TB screening of migrants living in Thailand-Myanmar Border Area with CAD4TB”, Dr Banyar M., SMRU (Shoklo Malaria Research Unit) presented at Delft Imaging’s Webinar on 14th October 2021.

PREVALENCE SURVEY

Using the **OneStopTB Mobile Clinic**



- TB Prevalence Survey in urban and peri-urban areas with high HIV prevalence.
- A mobile field site was set up in each community together with the OneStop TB Mobile Clinic equipped with digital X-rays, CAD4TB (with Cloud) and laboratory (GeneXpert).
- “Digital X-rays provided excellent image quality... also, an advantage was that using the CAD enabled to peak non-TB abnormalities”.
- Thanks to the lab installed in the truck, results were ready within 24 hours; no need for sputum sample transportation to external sites.

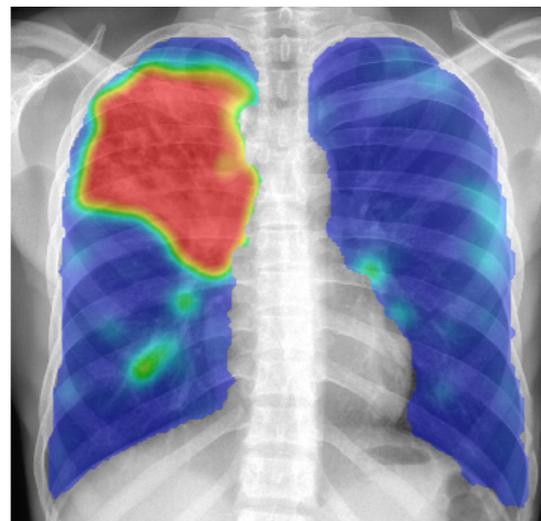
REFERENCE “Practical considerations for conducting a TB Prevalence Survey using the OneStop TB platform in Zambia and South Africa”, Chali Wapamesa & Michael Burnett, TREAT Study, presented at Delft Imaging’s Webinar on 14th October 2021.





CAD4TB EFFECTIVENESS

CAD4TB to reduce false negatives from GeneXpert test



- WoW truck (OneStopTB Mobile Clinic with EasyDR X-ray, CAD4TB, GeneXpert)
- Focused on high CAD4TB scores (≥ 80 while cut-off score is 56) though negative on Xpert test. CXRs were further evaluated by radiologists and clinicians.
- 485 symptomatic cases with Xpert were negative though CAD4TB scores were ≥ 80 , and 307 (63%) were clinically diagnosed with TB.
- These cases contributed 60% of TB cases diagnosed by the WoW truck between August 2020 and March 2021, and 100% of them showed reduced TB-associated symptoms within weeks of starting TB drug treatment.
- **CAD4TB can contribute to reducing false negatives from bacteriological tests.**

REFERENCE "The 52nd UNION conference "Using Artificial Intelligence to Improve diagnosis of TB on the Wellness on Wheels (Wow): Streamlining Clinical diagnosis with the use of CAD4TB Scores", Tukur et al., KNCV Nigeria.

BI-DIRECTIONAL TB & COVID-19 SCREENING

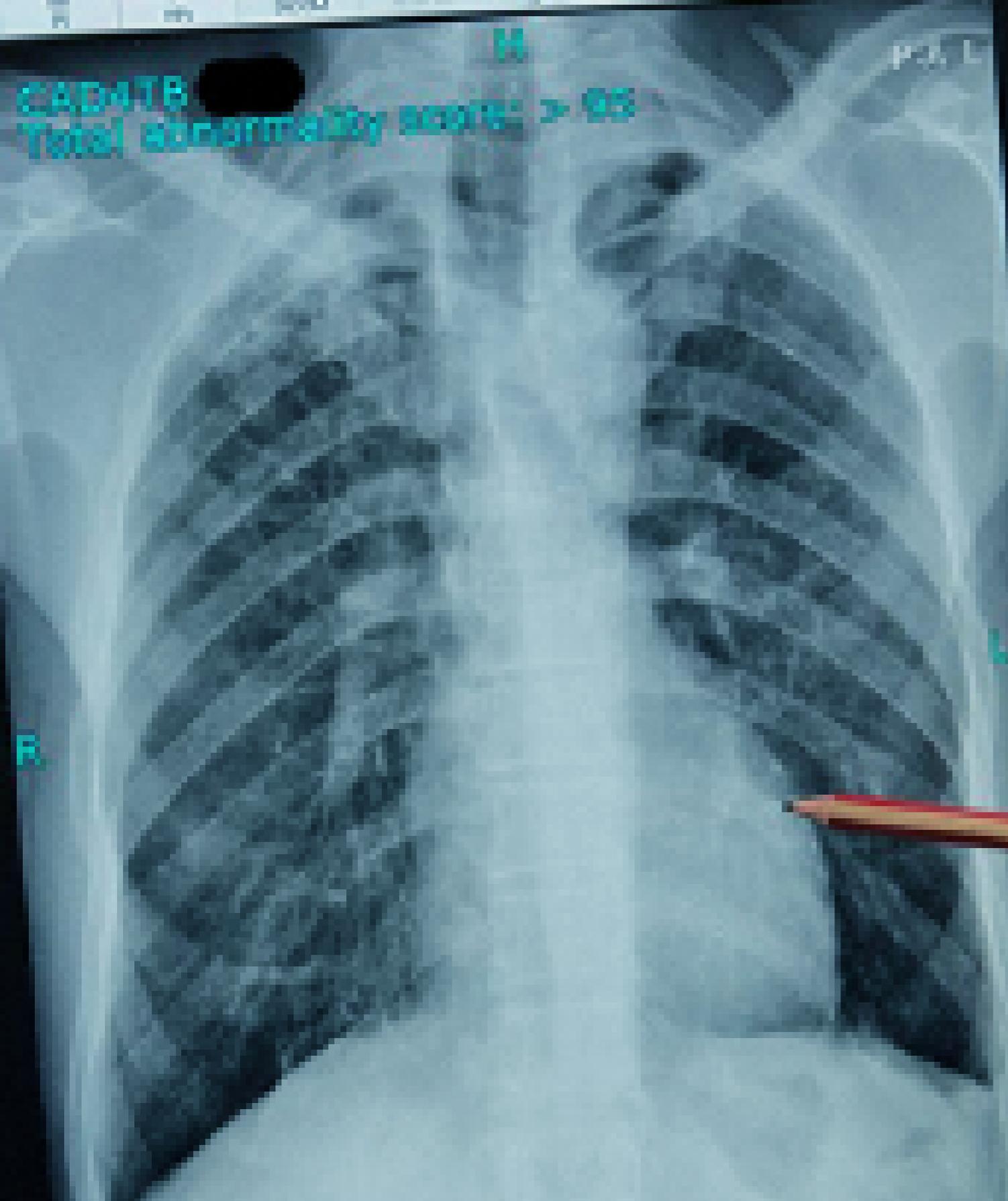
Bi-directional screening with OneStopTB Mobile Clinic & CAD4TB



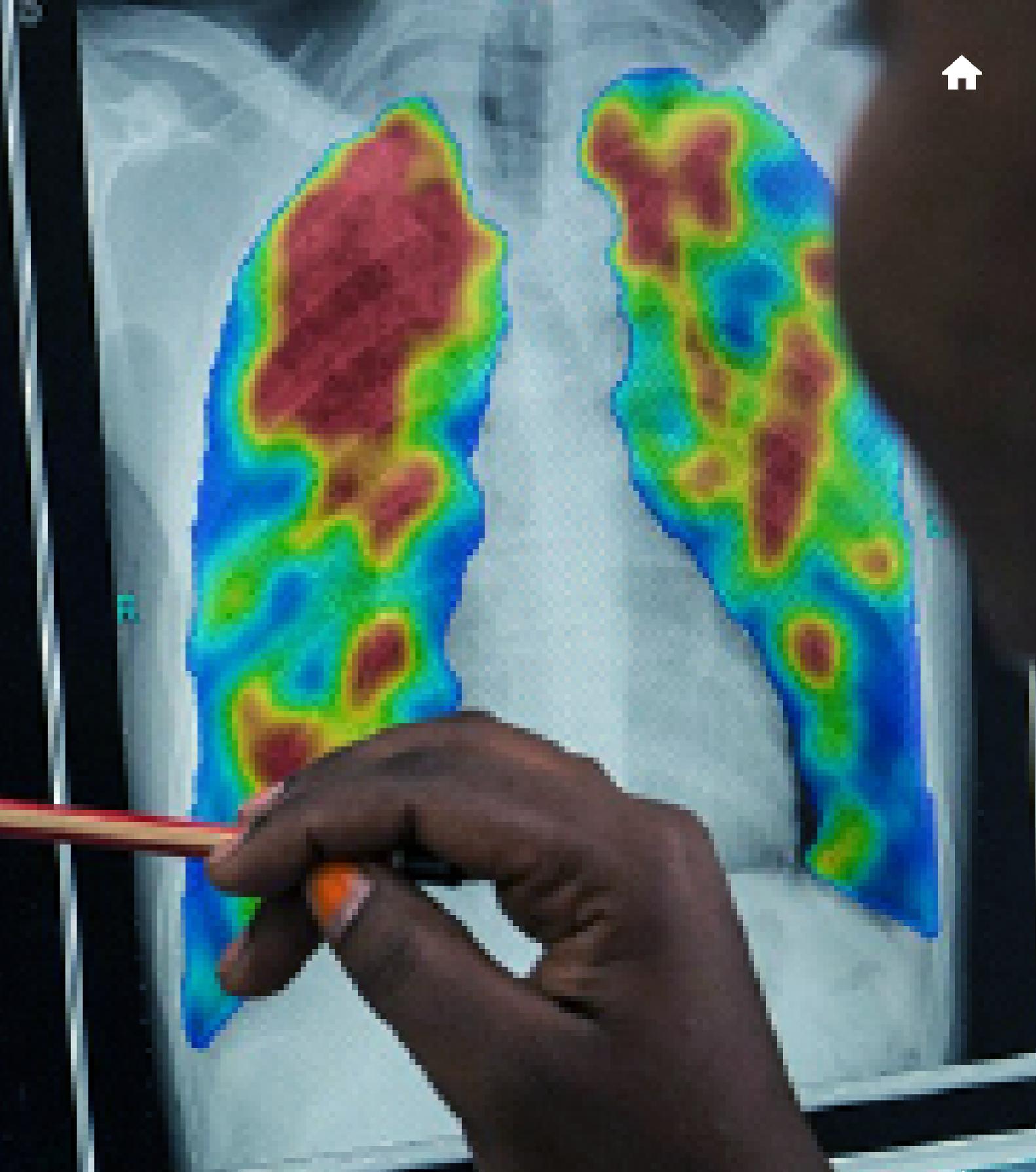
- Integrated testing using a "WoW" truck (OneStopTB Mobile Clinic with EasyDR X-ray, CAD4TB, GeneXpert) was selected for the [WHO case study](#).
- From June to July 2020, 1,931 persons enrolled and 1,928 (99.8%) were screened using CAD4TB X-rays. 83 presumptive TB cases were identified; 11 (13%) cases of TB were diagnosed with GeneXpert. Among the persons screened, 1,252 nasopharyngeal swabs were collected and tested for SARS COV-2 and all were screened for HIV.
- 183 (15%) COVID-19 and 12 (1.0%) HIV cases were diagnosed. The COVID-19/HIV co-infection rate was 0.5% and COVID/TB co-infection rate was 0%.
- **The community integrated platform provided access to early diagnosis and a linkage to treatment for TB and COVID-19.**

REFERENCE "Using cad in bi-directional screening", dr bethrand odume (kncv nigeria) presented at delft imaging's webinar on 30th june 2021. Gidado et al., "[Early experience in implementation of an integrated covid-19 and tb community-based active case finding in nigeria](#)", researchgate, october 2020.





CAD4TB
Total abnormality score: > 95



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4 Policy & Scientific Evaluation





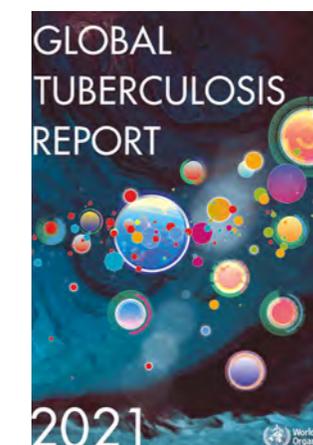
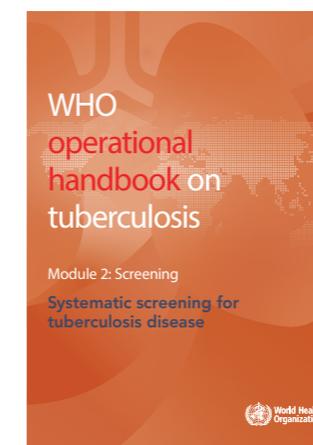
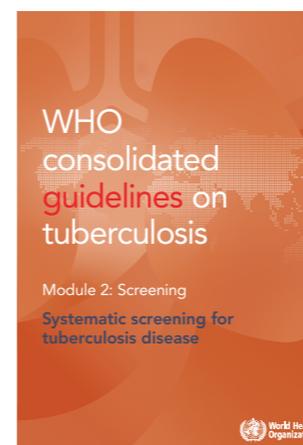
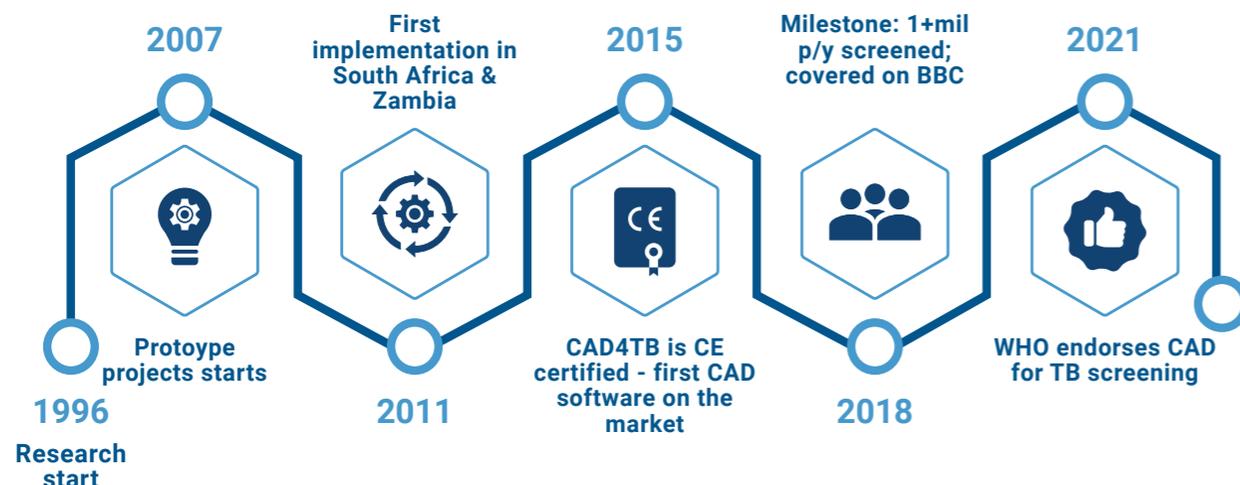
CAD4TB ENDORSEMENT BY THE WORLD HEALTH ORGANIZATION

Recommendations to use CAD for TB screening and triage

Delft Imaging is the pioneer of CAD (Computer-Aided Detection) for TB, having close partnerships with the Diagnostic Image Analysis Group (DIAG) of Radboud University Medical Center and our sister company Thirona. Initial research started in 1996 and commenced with prototype projects in 2007, which subsequently led to the first field implementation in South Africa and Zambia in 2011.

CAD4TB had been used to screen over 9 million people in 40+ countries globally by the end of 2021.

In March 2021, the WHO announced an update of its consolidated guidelines on tuberculosis Module 2: [Systematic screening for TB guidelines](#). The update states for the first time that “among individuals aged 15 years and older in populations in which TB screening is recommended, **CAD software programmes may be used in place of human readers for interpreting digital chest X-rays for screening and triage for TB disease**”. CAD4TB is one of the three products included in the technical evaluation. The guidelines are accompanied by the [Operational handbook](#) on TB (Module 2) with further details for selecting and using CAD for screening in TB programs as CAD offers a promising solution for high TB burden countries. The WHO’s [Global Tuberculosis Report 2021](#) has a dedicated chapter on TB research and innovation, and **CAD4TB is listed as the CAD technologies endorsed by the WHO.**



CALL FOR THE USE OF IMAGING TECHNOLOGIES FOR TB SCREENING

New technical specifications for portable X-ray systems

The Chest X-ray (CXR) is recognised as an essential tool for early detection of TB and is fundamental to achieving the targets set out in the WHO's End TB Strategy. Thus, recommendations for CXR for TB detection are included in [several WHO policies](#). In the recently updated [Systematic screening for TB guidelines](#), it states “CXR was found to be a sensitive screening tool that has an important role in the early detection of TB in children and adults who are at higher risk of TB, as well as potential to reduce the population burden of TB diseases when combined with early treatment”.

In order to bring not only TB screening but also detection of other pathologies and conditions like trauma and pneumonia closer to people and communities, the WHO and International Atomic Energy Agency (IAEA) jointly published [technical specifications for portable digital radiography system](#) in August 2021.

The document supports users with decision-making regarding the selection, incorporation, allocation and use of portable X-ray systems. Delft Imaging continues to drive innovation in its portable X-ray systems like Delft Light and Delft Ultra to ensure that TB screening can be facilitated in even the remotest areas.



Portable digital radiography systems

Delft Ultra and Delft Light



CAD4TB SCIENTIFIC PUBLICATIONS IN 2021

CAD4TB has been validated by 50+ scientific publications in highly respected journals. In 2021, eleven new publications which feature CAD4TB became available, including studies on TB/HIV in Malawi, high-risk groups with TB in Romania, rural settings in South Africa and community-based screening in Pakistan as well as a performance evaluations of CAD software.

THE LANCET Digital Health

Bangladesh

“ CAD4TB performs significantly better than human readers. CAD4TB met the WHO’s TPP at 90% sensitivity.

[Read article](#)

medRxiv THE PREPRINT SERVER FOR HEALTH SCIENCES

Kenya

“ CAD4TB is an accurate tool for community-based TB screening for prevalence survey in Kenya. CAD4TB 6 met the optimal WHO TPP (Target Product Profile).

[Read article](#)

scientific reports

Vietnam

“ CAD4TB and two other software solutions are identified as excellent alternatives to human CXR interpretation, performing on par with the Expert Reader and significantly better than the Intermediate Reader.

[Read article](#)

CAD4TB Evaluation from Vietnam

“ CAD4TB 7 performed significantly better than v6. CAD4TB 7 outperformed both expert and intermediate readers.

“ ...the software performs significantly better than an Expert Reader in our setting and would be a valuable decision support tool for TB screening initiatives.

READER	CUT-OFF SCORE	SENSITIVITY	SPECIFICITY
Expert reader	N/A	97.2% (94.4-98.9)	25.3% (23.5-27.3)
CAD4TB v6	55	97.6% (94.9-99.1)	13.4% (12.0-15.0)
CAD4TB v7	46.74	97.2% (94.4-98.9)	35.3% (33.2-37.5)
Intermediate reader	N/A	90.1% (85.8-93.5)	29.9% (27.9-31.9)
CAD4TB v6	64	90.9 (86.7-94.1)	30.6% (28.6-32.6)
CAD4TB v7	61.88	90.1% (85.5-93.5)	56.6% (54.5-58.7)

Results Comparison with human readers

REFERENCE: The 52nd UNION conference; “Results from an independent field evaluation of CAD4TB software versions in Viet Nam”. Thang Dao, Friends for International Tuberculosis Relief (FIT), Vietnam





CAD4TB SCIENTIFIC PUBLICATIONS IN 2021



Malawi

“ In Malawi, Digital CXR using CAD4TB with universal HIV screening significantly improved the timelines and completeness of HIV and TB diagnosis.

[Read article](#)

npj | digital medicine

South Africa

“ In a community-based multi-disease screening survey in an HIV-endemic rural area, CAD4TB achieved comparable sensitivity and specificity to the radiologist. HIV serostatus did not impact CAD4TB’s performance.

[Read article](#)



Pakistan

“ Community-based screening with innovative activities, comprising sensitive screening and diagnostic tools, including a digital X-ray and CAD4TB, effectively improves TB case detection.

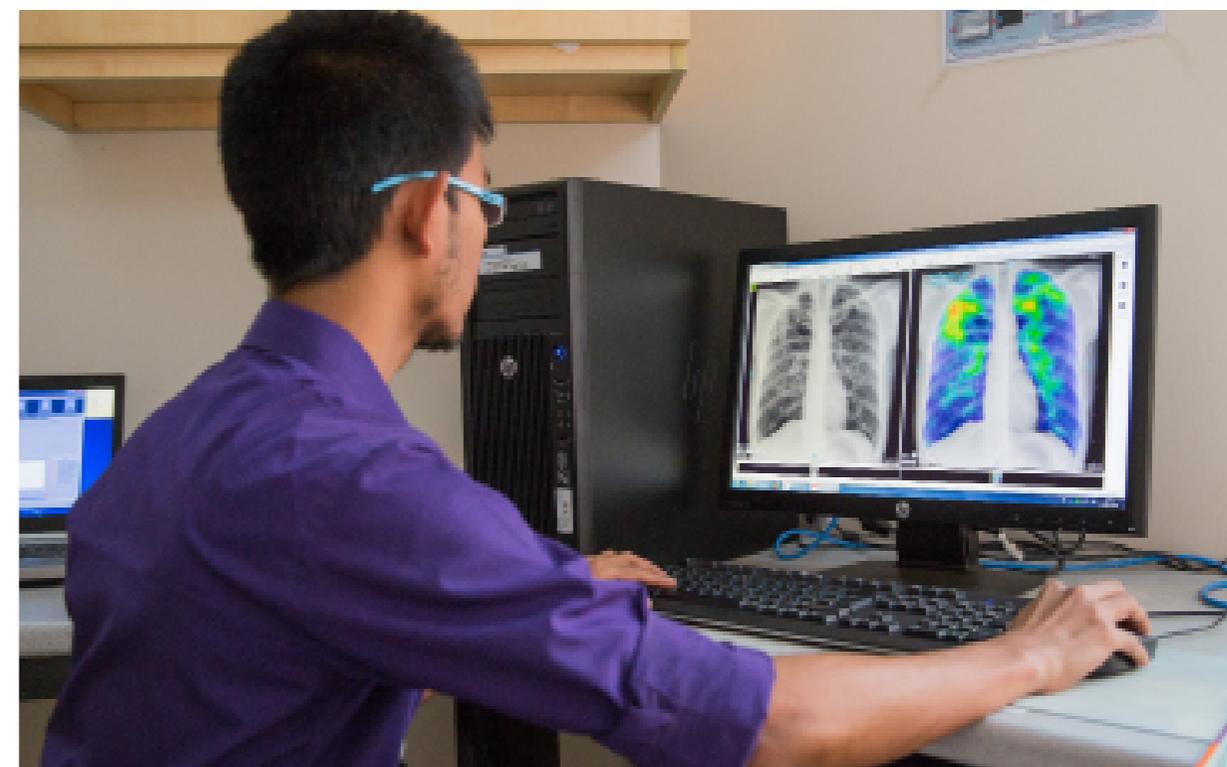
[Read article](#)



Romania

“ The combined use of mobile X-rays and CAD4TB to identify TB among high-risk groups to improve early TB diagnosis can deliver a major contribution to TB control in Romania.

[Read article](#)



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5 Innovations for social change

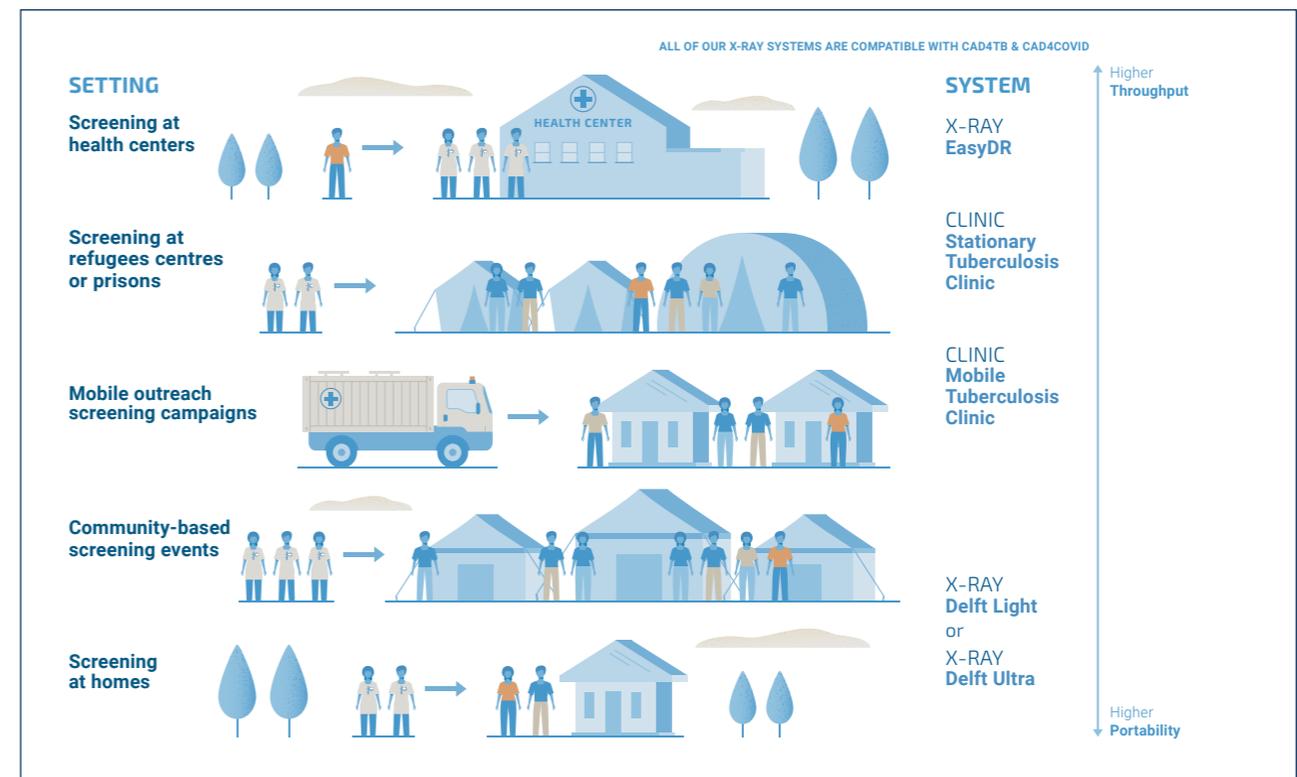




TB SCREENING OPTIMISATION BASED ON SETTINGS

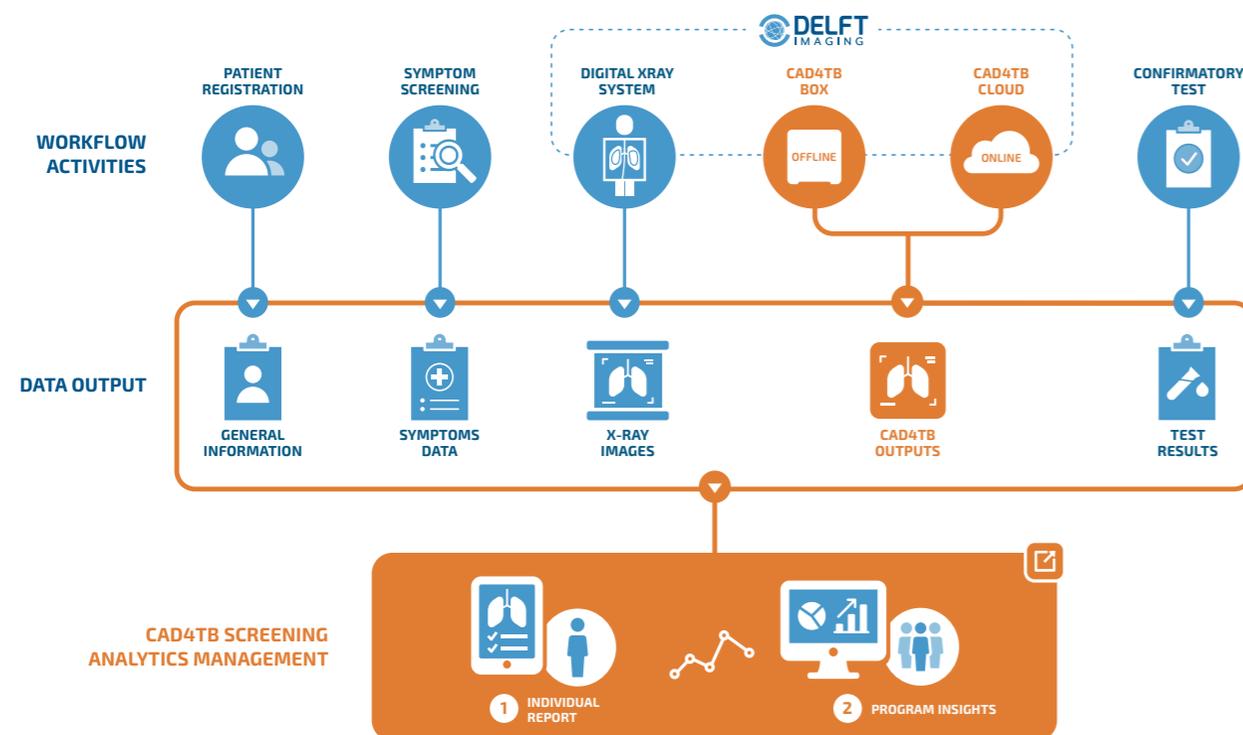
CAD4TB platform with SAM FUNCTIONALITIES

Moving from paper-based to digitalised data management using one platform is key to further making the TB screening process efficient. Therefore, we have introduced the CAD4TB Platform with SAM (Screening-Analytics-Management) functionalities as an add-on to the CAD4TB 7 software. SAM contributes to data quality and integrity, and prevents data fragmentation. It also enables data access from multiple locations. SAM can provide connectivity with other data systems at a national level, serving as the first data entry point by health workers at the community-level and ensuring that national TB Programs can access aggregated data and dashboards.



Additionally, to find the missing people with TB and start prompt TB treatment, it is critical to bring TB services closer to people. Therefore in 2021, Delft Imaging introduced [Delft Ultra](#), a wireless, ultra-portable digital X-ray system which weighs just under 7kg and is compatible with CAD4TB software.

We support TB programs with a variety of portable and stationary X-ray systems (Delft Ultra, Delft Light, and EasyDR) and [OneStop Mobile Clinics](#) that can be customised.



BABYCHECKER

Smartphone-based ultrasound for safer pregnancies

In 2021, Delft Imaging pre-launched BabyChecker, a smartphone-based ultrasound designed to make pregnancies safer in low-resource settings. BabyChecker is powered by AI to support the timely detection of risky pregnancies by community health workers.

Through 6-sweeps across the abdomen, ultrasound images are acquired by the user within 2 minutes and analysed within 2 seconds by the mobile application. The mobile application uses AI to detect various factors that could determine potential risks. Users with no prior experience or knowledge in ultrasound can use BabyChecker within a 1-hour training.

BabyChecker's mobile application and AI operates without internet.

THE KEY INNOVATIONS

- 1. Portability** by connecting a low-cost CE-certified probe to a smartphone and charging the smartphone through solar energy.
- 2. Accessibility** by leveraging AI, simplifying the training and targeting untrained users.

In the past few years, BabyChecker has travelled to Ethiopia, Ghana and Sierra Leone, thanks to collaborators including Radboud UMC, Ministry of Health of Ethiopia, and the Lion Heart Foundation. It has been a thrilling journey to see BabyChecker perform in the most remote and resource-constrained settings. An important outcome from our research project in Sierra Leone with Lion Heart Medical Centre, consists that an untrained user can use BabyChecker within 1-hour of training, whereas training users with a standard ultrasound is usually a lengthy and costly process.





6 Co-Creation



INNOVATIONS & CO-CREATION

“ TB programs need greater resources and innovative approaches to recover from devastating disruptions caused by the COVID-19 pandemic, leading to significantly reduced TB case notifications in most high burden countries. Delft Imaging will continue to deliver our digital X-rays, CAD4TB platform and mobile clinics to our clients to support TB programs and accelerate earlier TB case finding.

To continue demand-driven innovations, your views do matter to us. We would like to hear from you on how to best co-create next generation digital screening solutions and strengthen data-driven TB programs, to eliminate TB and achieve health equity for all.

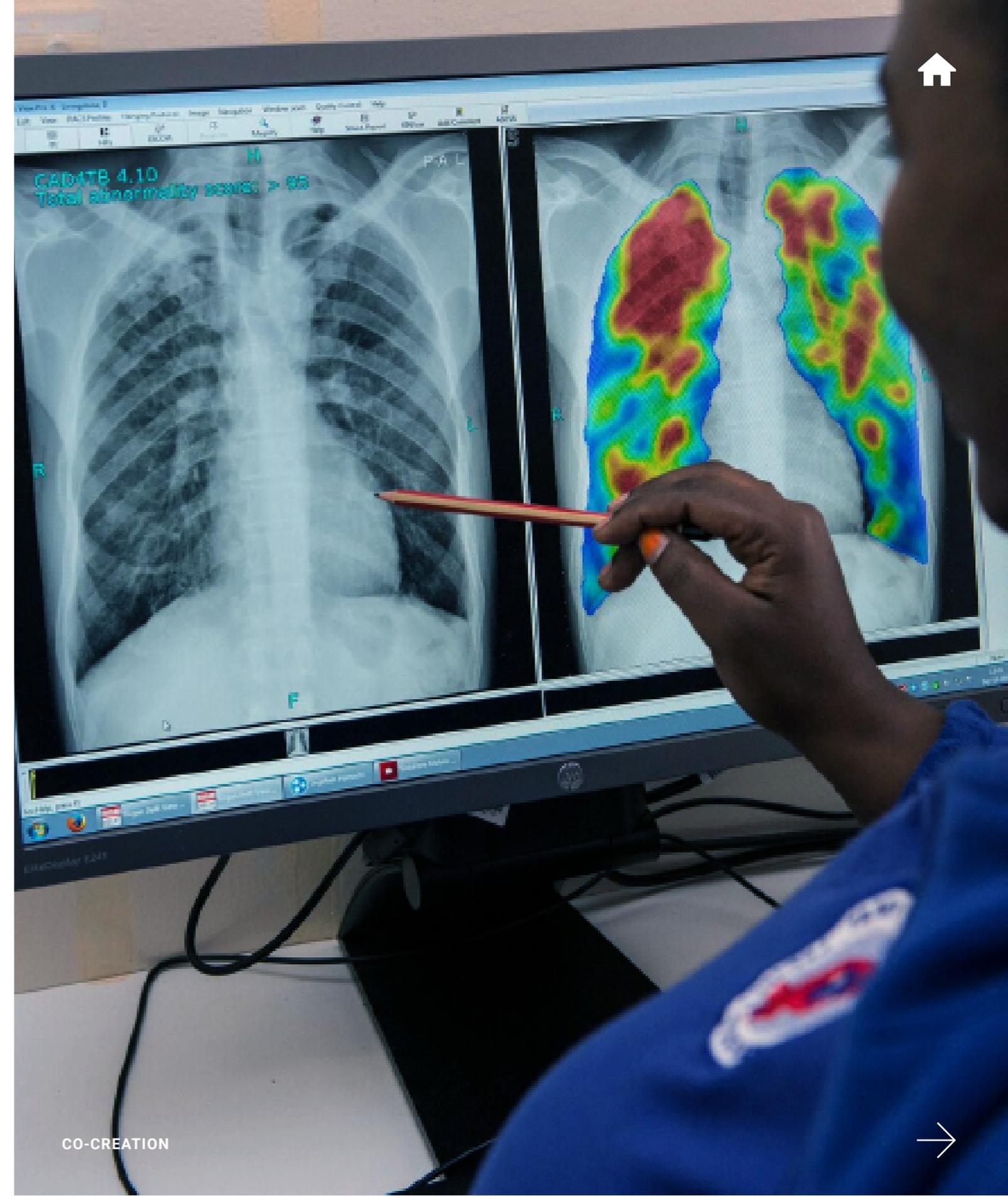
Please send your ideas and feedback to us so we can continue creating meaningful solutions.

Contact: aalhafez@delft.care

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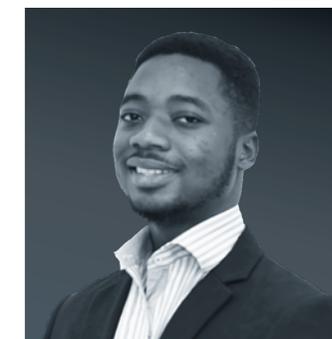
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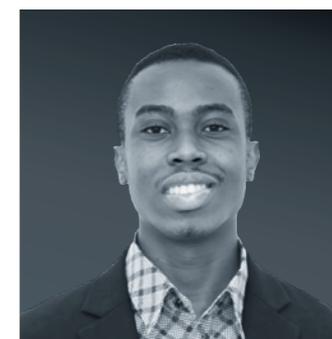
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Delft Imaging is an enterprise of various backgrounds, cultures, and experiences: this cultivates greater creativity, wider perspectives and more cultural knowledge. As a diverse team, we strongly value building relationships based on mutual respect.

We are happy to communicate with you in:
Dutch, Arabic, English, French, Greek, Hindi, Indonesian, Japanese, Persian and Turkish.



ACKNOWLEDGEMENTS

This report has been prepared by Delft Imaging with contributions from our clients and partners. It is also based on research and analysis of publicly available information.

The Delft Imaging Team is grateful to its partners for sharing their experiences at Delft's live webinar series in 2021, and which are featured in the case study section of this report. Special appreciation (including but not limited to) : Fullerton Health Indonesia, KNCV Nigeria, Mercy Corps Pakistan, the National Tuberculosis and Leprosy Program (Uganda), Shoklo Malaria Research Unit (Thailand), the TREST Study South Africa and Zambia.

Finally, we express our gratitude to all who choose Delft Imaging as a trusted partner to support TB projects and programmes.

The Delft Imaging Team





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