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Whitepaper

EasyDR:

The impact of a multipurpose X-ray system for TB screening and beyond

Contents

Preface

This white paper supports the Ministries of Health (MoH) and National Tuberculosis Programs (NTP) in selecting, incorporating, and implementing multipurpose stationary X-ray systems for TB screening and triage and general radiographic examinations, particularly in resource-constrained settings. The document outlines the technical information and case study of EasyDR, a digital X-ray system based on the World Health Imaging Systems (WHIS-RAD). This document aims to guide the selection of optimal digital X-ray systems based on the clinical needs, local infrastructure, operational environments, human resources, and budgets/total cost of ownership.

About us

Delft Imaging is a B-Corp-certified social enterprise headquartered in the Netherlands with regional offices in Africa and Asia. We are committed to supporting the eradication of tuberculosis by promoting health equity through innovations. We provide reliable and sustainable AI-powered diagnostic imaging solutions in emerging countries.

As a total solution provider for TB screening, we offer integrated digital X-rays and AI-powered CAD solutions, as well as one-stop training, technical support services, and project management.
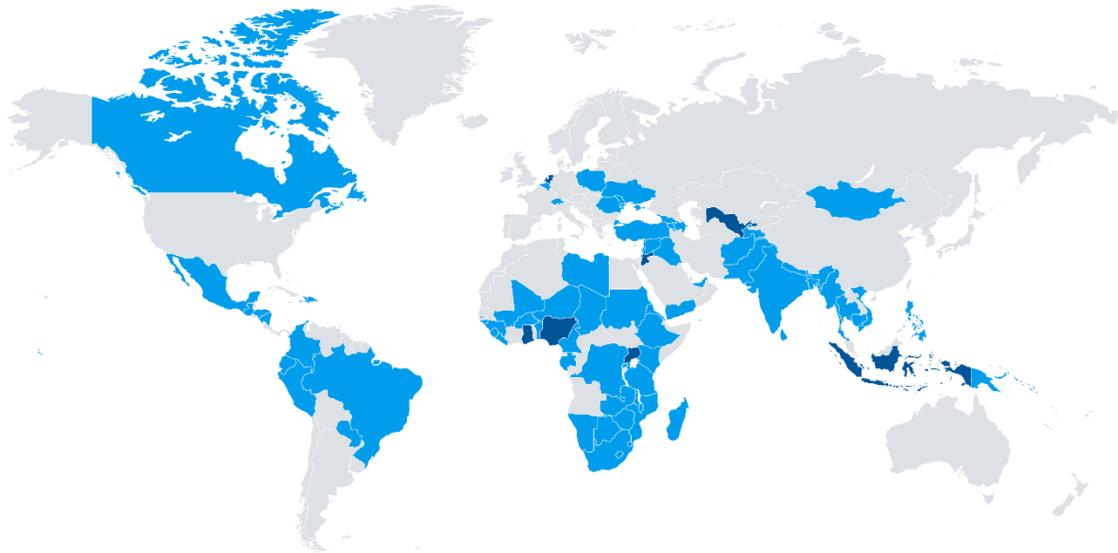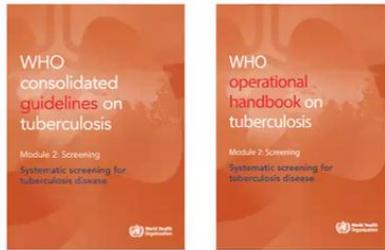

Delft Imaging has implemented TB projects in over 85 countries. With 2,500+ installations of radiology systems and CAD4TB, we are proud to say that we have facilitated the TB screening of over 32 million people globally.

1 Introduction

1.1 The value of digital X-rays and AI for TB and health systems strengthening

"

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.

WHO consolidated guidelines on tuberculosis Module 2: Screening

Chest X-ray (CXR) plays a critical role in the early detection of TB. It is fundamental to achieving the targets outlined in the WHO End TB Strategy and consolidated guidelines on TB [i]. Strategic documents from key stakeholders highlight the importance of CXR. The Global Fund Strategy (2023-2028)[ii] and the TB Information Note[iii] underline the role of digital X-rays in early and accurate TB diagnosis, with an emphasis on finding missing people with TB and prioritizing screening interventions. Recent plans include scaling up systematic screening for TB using more sensitive CXRs and CAD software.

Additionally, the value of X-rays in integrated, multi-disease screening and diagnosis is also emphasized within the broader framework of respiratory care and case management services in the context of Resilient and Sustainable Systems for Health, Community System Strengthening, and Pandemic Preparedness.[iv]

The Stop TB Partnership's Global Plan to End TB 2023-2030[v] underlines the importance of leveraging modern technologies. Solutions such as CXRs with CAD improve rapid TB detection and expand early diagnosis, even in sub-clinical stages. The plan underscores the excellent value of digital CXRs for pulmonary TB screening in combination with confirmatory tests, especially in populations with high TB rates.

The USAID's Global TB Strategy 2023-2030[vi] aims to maximize TB detection across all age groups by increasing access to new technologies, such as portable digital X-rays with AI. In low-resource settings where radiology and imaging services are limited, artificial intelligence (AI) enabled CAD software can significantly improve how we practice medical imaging and holds great promise. Despite some challenges to its successful deployment in clinical practice, Delft Imaging has gained considerable experience deploying cutting-edge yet simple-to-use technology in low-resource settings. We have successfully facilitated TB screening and triage of over 32 million people globally.
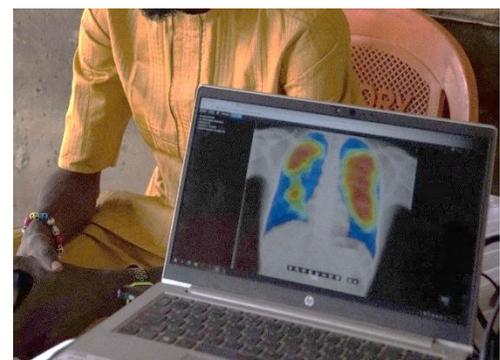
CAD4TB in Nigeria

1.2   WHO's World Health Imaging System for Radiology (WHIS-RAD)

In 1995, the World Health Organization (WHO) released the **Technical Specifications for the World Health Imaging System for Radiology** (WHIS-RAD) for a multifunctional X-ray. According to WHO, the WHIS-RAD is "intended for use in primary care and at first-level referral hospitals. It is especially suited for use in small rural hospitals and large health care centres, but serves well also in X-ray departments of large hospitals, especially as a first-choice unit for examinations using a horizontal X-ray beam.[vii]"

The guiding principles for the WHO-specified radiographic unit have been:

1. The X-ray image quality must be excellent.
2. The equipment must be safe for patients and personnel.
3. The equipment must be easy to install and use.
4. The equipment must be usable even when the electrical mains supply is unreliable.
5. Equipment maintenance should be minimal.

Furthermore, the WHO released the Consumer Guide to Purchase X-ray Equipment.[viii] It states that **the X-ray equipment of choice at the first referral level is the WHIS-RAD unit**. The WHIS-RAD system allows increased accuracy, reproducibility, and less radiation dose to patients and personnel than with any other X-ray unit.

> "
>
> *The WHIS-RAD unit is the only X-ray unit needed at a primary health care centre or in a small hospital at the first referral level. Any other X-ray unit, which does not meet the WHIS-RAD specifications would be a questionable investment".*
>
> **WHO's Consumer guide for the purchase of X-ray equipment**

The WHO Manual of diagnostic imaging: radiographic technique and projections[ix] is designed for the use of multipurpose X-ray systems that comply with WHIS-RAD. The manual also includes technical specifications for the WHIS-RAD equipment. The guidelines cover various important aspects such as maintenance, radiation protection, and patient care.
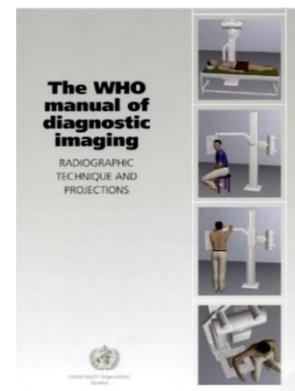
2   EasyDR

EasyDR is a multipurpose stationary X-ray system designed in accordance with the WHIS-RAD. It is ideal for chest imaging and general radiographic examinations. Compact, easy to install, and durable, the EasyDR can be installed in small X-ray rooms, mobile vehicles, or containerized clinics. These features make it highly beneficial for deployable field requirements.

The system supports a wide range of examinations across all body positions, including erect, supine, prone, decubitus, oblique, and lateral. It can accommodate nearly all radiographic needs at the primary care level and up to 95% of exams at district hospitals. Proving its reliability in various settings globally, the EasyDR can perform **over 300 exposures per day**.

The EasyDR is designed according to the WHIS-RAD and exceeds the WHO technical requirements. For instance, it was designed with a fixed SID of 145 cm, motorized up/down and rotation movement, and a fully integrated X-ray system (single console operation). These features mitigate potential points of failure, ultimately reducing the risk of system downtime and lowering maintenance expenses.

(Top left) EasyDR in X-ray room in Bangladesh
(Top right) EasyDR in a containerized clinic in Ghana
(Bottom) EasyDR in X-ray room in Sierra Leone

2.1   Advantages of the EasyDR

➢ **Meet the WHO WHIS-RAD specifications:**
Provides high-quality images and is reliable, user-friendly, and safe to operate when appropriate safety measures are followed..

➢ **Multifunctional:**
The U-arm can be positioned vertically and horizontally, enabling all X-ray examinations at primary healthcare clinics and 95% at district hospitals.

➢ **Robust and easy to install:**
The system can be installed in one day, and can be installed in small X-ray rooms, containers, trucks, or vans; ideal for remote areas.

➢ **Easy to operate:**
Relatively little experience is needed for the output of high-quality images with the Automatic Exposure Control and an automatically aligned detector and X-ray beam.

➢ **Powered by solar energy**:
The integrated power pack enables continuous operation in case of grid power failures.

The EasyDR is equipped with Canon's trusted flat panel detector and imaging software. Its single-tile CXDI detector ensures high sensitivity for optimal image quality at a low patient dose. The system includes Automatic Exposure Control (AEC), which adjusts exposure parameters to improve image consistency while supporting radiation safety for patients and healthcare workers. The Canon CXDI-NE imaging software, integrated with the X-ray generator, ensures high-resolution imaging at the lowest practical dose.

Delft Imaging was the first provider of solar-powered digital X-ray systems. The EasyDR power supply uses single-phase 220V to facilitate solar power packs and electricity spike protection. The solar power packs support service availability, stability, and financial sustainability. No carbon fuels are required to operate our X-ray solutions. This contributes to operational cost savings and CO_2 emissions reduction.

(Left) Solar-powered EasyDR in a containerized clinic in Ghana
(Right) Solar-powered Mobile clinic (Wellness on Wheel) in Nigeria

2.2 Service & maintenance

The EasyDR offers ease of use, high maintainability, and uptime. The system's minimalist designs fully benefit from the latest digital imaging technology and comprise a few moving parts. The EasyDR's maintainability is high in case of system failure: built-in test equipment and software can identify the faulty component. In case of failure, these components can be replaced on-site. No "break and fix" maintenance services are required, allowing for rapid repair and higher uptime.

First-line

Local hospital engineers and technicians can perform basic troubleshooting, reset systems, replace fuses or bulbs, and conduct routine cleaning and calibration following initial training.

Second-line

In-country biomedical engineers or IT professionals trained by Delft Imaging can replace X-ray tubes and motors, calibrate systems, and manage software installation.

Third-line

For complex issues, Delft Imaging's global support team, including more than 20 certified engineers, provides remote diagnostics and onsite service. Most systems can be monitored remotely, allowing early intervention and real-time performance tracking.

2.3 Capacity building

Healthcare technology is developing rapidly, with new models of medical equipment appearing almost every year. In order to warrant uptime and system usability, health professionals need to operate this new range of digital medical equipment effectively. Several on-site and remote training programs are available and integral to every 'digital X-ray project'. Furthermore, e-learning modules of several key system components are available free of charge.

3   Considerations to select optimal X-ray systems

Chest X-ray (CXR) is critical for the early TB detection. It is essential to achieving the targets outlined in the WHO End TB Strategy. Moreover, it is a crucial component of resilient and sustainable systems for health and future pandemic preparedness.

A range of stationary digital X-ray systems is available for multipurpose screening. Each system offers distinct strengths and benefits, along with important considerations such as operational features, environments, human resources, maintenance, and total cost of ownership. Below are key considerations to guide the decision-making process:

➤   The programmatic goal and the facility's intended use

It is vital to understand the programmatic goal and the health facility's needs to determine the optimal X-ray. When selecting an X-ray system, carefully consider the target number of screens in a specific screening strategy. For instance, the expected daily throughput of the sites can be categorized based on the level of throughput: e.g., low (50 exposures per day), medium (200 exposures per day), or high (over 300 exposures per day). Additionally, there is a trade-off between portability, daily throughput, and the coverage of radiological exams.

The EasyDR is a multipurpose stationary X-ray system suitable for primary health clinics and district/regional hospitals. The robust system can perform high throughput (over 300 exams per day) and allow 95% of all radiological exams. The EasyDR is also a proven digital X-ray system that can be installed in a mobile clinic or a van (OneStopTB clinic), enabling deployment in hard-to-reach areas.

➤   Space requirements

Consider the physical space where the stationary X-ray system will be installed and comply with any relevant national regulatory requirements. In comparison to other stationary X-ray systems, EasyDR is compact and simple. It can be effortlessly assembled and installed within a compact area, such as a single block on the X-ray room floor. Its versatility allows for assembly even in limited spaces, making it suitable for installation in mobile vehicles or containers with restricted room.

➤   Installation & operation settings

Generally, robust X-ray systems require installation considerations. But the EasyDR system comes as a single component. Therefore, installation is simple and only takes one day to complete. The EasyDR uses single-phase 230 VAC, and when external power sources are unstable, a solar power pack can be used to power the system.

➤   Environments

Even though the EasyDR is robust and durable, environmental factors such as temperature and humidity should be considered.

➢ Human resources

Limited human resources can be a significant challenge in resource-constrained settings, as there may be a shortage of qualified radiographers, healthcare professionals, X-ray technicians, and IT staff.

Operating an EasyDR is simple and easy for radiographers since relatively little experience is required to produce high-quality images. This is thanks to the Automatic Exposure Control with an automatically aligned detector and X-ray source. It helps to assure optimal imaging geometry and eliminates the negative influences of variable distance and angulation, contributing to fewer exposures for a sufficient X-ray image.

➢ Capacity building & training

Healthcare professionals must receive appropriate training on how to operate and maintain the system safely and effectively and minimize radiation exposure. Therefore, training and capacity building are key for both the theoretical and practical aspects of digital X-ray systems. The EasyDR requires a basic level of radiology knowledge.

Radiologists may not be required on-site when CAD software is used for TB screening and triage.

➢ Support and maintenance

For optimal system uptime and seamless operation, a supplier should offer a high-standard maintenance contract or extended warranty service agreement, in collaboration with a trained local service partner in the country. It is critical that the maintenance strategy, including inspection, corrective, and preventive maintenance, is in place.

➢ Budget and the total cost of ownership

The costs of X-ray systems vary greatly depending on the modalities. Thus, it is vital to select a system that meets the needs and is value for money.

When selecting and budgeting X-ray systems (with/without CAD), the total cost of ownership (TCO) and economics per screen are critical considerations. The TCO means the total amount of all direct and indirect costs related to the procurement, distribution and operation of a diagnostic product. The implementers are advised to consider the TCO of the equipment, including capital expenditure of the equipment, training/installation costs, the useful life of the equipment, necessary consumables, and maintenance costs. This includes training, maintenance and service costs as part of the TCO is advised.

4 Case study: Ghana

Various X-ray specialists recognize the EasyDR as well-designed for sustained operations in resource-constrained settings. Its rapidly growing installed base, new clients, and repeat orders from TB programs confirm its reliability. The following case study demonstrates the EasyDR's reliability for continuous operations and diagnostic impact, especially in resource-constrained settings.

Ghana ORIO project: Acceleration of TB case detection

In February 2016, the Ghanaian government approved one of the largest eHealth projects in Africa to date: "Acceleration of Tuberculosis Case Detection in Ghana". The project aimed to support the early detection of pulmonary TB, deliver diagnostic testing efficiently and affordably, and strengthen the Ghanaian health systems.

With the support of the Dutch Government's ORIO facility, Delft Imaging executed the project, including system installation, project management, training, and maintenance. We installed 52 EasyDR multipurpose X-ray systems across Ghana, all equipped with CAD4TB and teleradiology interlinked to a central database and diagnostic viewing station.

Most systems were installed by the end of 2017, and the remainder were installed in 2018 or later. Over 400 health professionals have since participated in the capacity-building program.

The project includes a two-year initial warranty period, followed by a five-year operations and maintenance period. Service and support comprise corrective maintenance and periodic planned preventive maintenance of all EasyDR X-ray systems (including other existing systems), CAD4TB, and viewing stations.

Project summary
- 52 X-ray systems across Ghana, all using CAD4TB software and teleradiology:
  - 30 EasyDR in containers
  - 20 EasyDR in X-ray rooms
  - 2 EasyDR in OneStopTB clinics
- Capacity building, including radiographer training.
- A total of seven years of service & maintenance support.
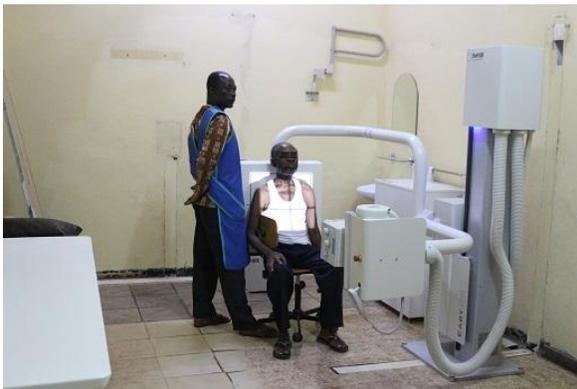- Also used for the COVID-19 Pandemic.

The project was featured in BBC World News (2017)

*DIGITAL INNOVATION TO REDUCE THE SPREAD OF TB IN GHANA.*

EasyDR and Containerized clinic


EasyDR in an X-ray room and CAD4TB

4.1   Performance overview

Most EasyDR were installed at the end of 2017 and started operating in 2018. The annual total screen volume trends show that the screen volume has increased steadily. This trend strongly suggests that the EasyDR systems have been operating continuously, and clients have actively used the X-ray systems.
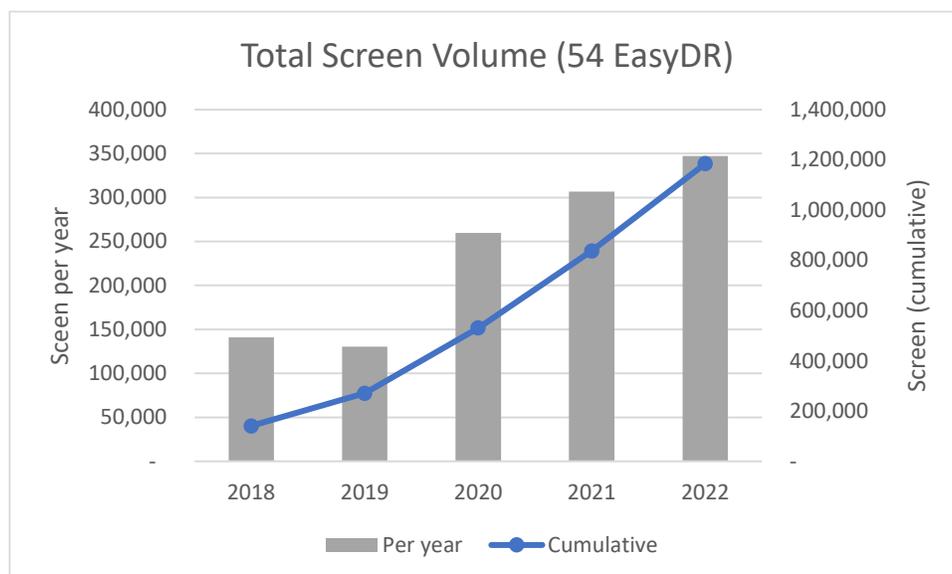
4.2 Corrective maintenance

Corrective maintenance addresses both technical and IT/application issues. Technical maintenance covers EasyDR-related issues, and IT/Application issues include network-related issues, software and licenses, Canon-related applications, and the printer. Delft engineers resolve issues either remotely or on-site. In the past three years, on average, there were more IT/Application-related inquiries (73%) than technical-related inquiries (27%).
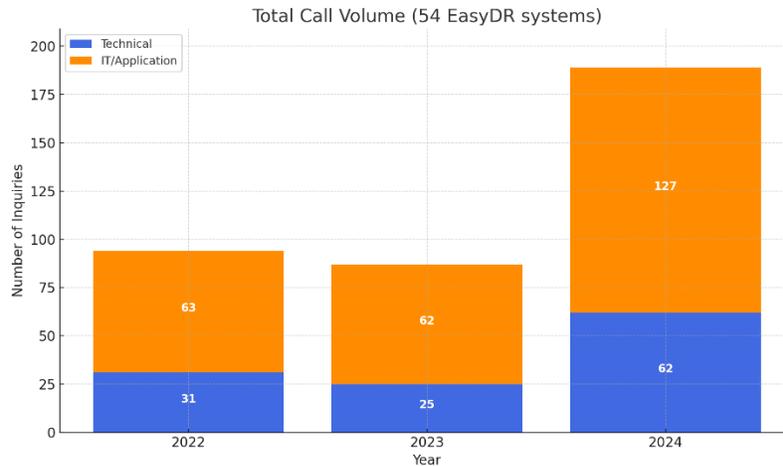
Frequency of inquiries
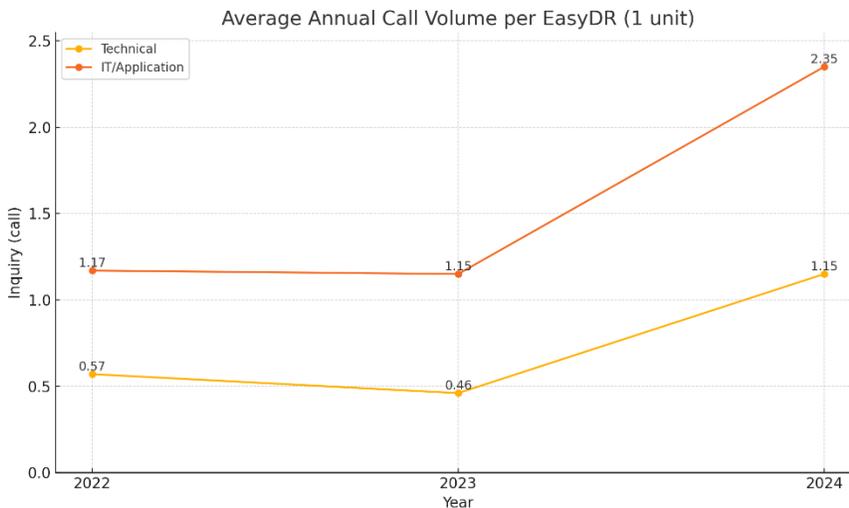
1.55 calls/year
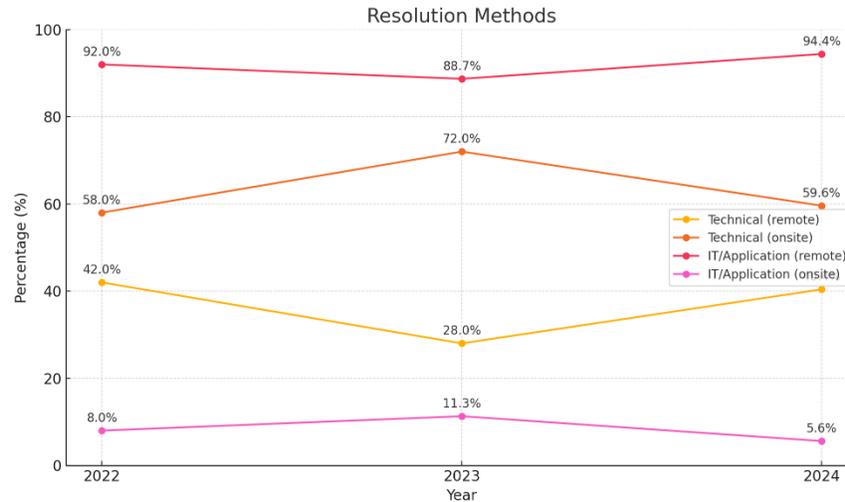For IT/Application issues (3yrs ave.)

0.24 calls/year
For technical issues (3yrs ave.)

From 2022 to 2024, there were an average of 84 inquiries for IT/Application yearly for the 54 units of EasyDR (2022: 63 calls, 2023: 62 calls, 2024: 127 calls). This indicates that, on average, 1.55 calls were for IT/Applications per EasyDR system annually. Meanwhile, on average, there were 13 technical inquiries per year for the 54 units of EasyDR (2022: 31 calls, 2023: 25 calls, 2024: 62 calls). This means that, on average, 0.24 calls were for technical issues per EasyDR system annually. **These meagre numbers confirm that the EasyDR is reliable for continuous operation with minimal technical issues.**

Resolution methods

In the past three years, most IT/Application issues were resolved remotely (2022: 92%, 2023: 88.7%, 2024: 94.4%). Meanwhile, most of the technical inquiries were resolved by on-site support (2022: 58%, 2023: 72%, 2024: 59.6%).

Resolution time

In 2022, the average resolution time for IT/Application issues was within a working day, and the average resolution period for technical issues was within two working days. When the resolution took longer, it was primarily due to spare parts (e.g., batteries) that needed shipping from outside Ghana. The issues were resolved immediately once the spare parts were available.

< 4 hours
To resolve IT/Application issues

< 2 days
To resolve technical issues

4.3   Planned preventive maintenance

The Delft Imaging Ghana team and the Clinical Engineering Department of Ghana Health Service (GHS) conduct annual on-site maintenance visits at all sites. The maintenance is carried out in accordance with a protocol approved by GHS. This includes mechanical inspection, software version verification, electrical inspection, dose measurement, X-ray field alignment, system calibrations (tube and detector), and image quality tests. For the containerized systems, an additional maintenance protocol covers solar panels, the battery pack, and the container itself.

Additionally, an annual on-site capacity-building program is provided for engineers and IT staff from the Ministry of Health and GHS. Different key themes are applied each year to ensure that the daily operations and maintenance of the EasyDR, as well as the use of communication systems, are done effectively. The training sessions also invite local hospital engineers, radiographers, IT staff,

and regional engineers to ensure that practical knowledge and new updates or features are well-informed. These on-site sessions facilitate knowledge and skill transfer among health professionals and contribute to the continued patronage of the EasyDR.
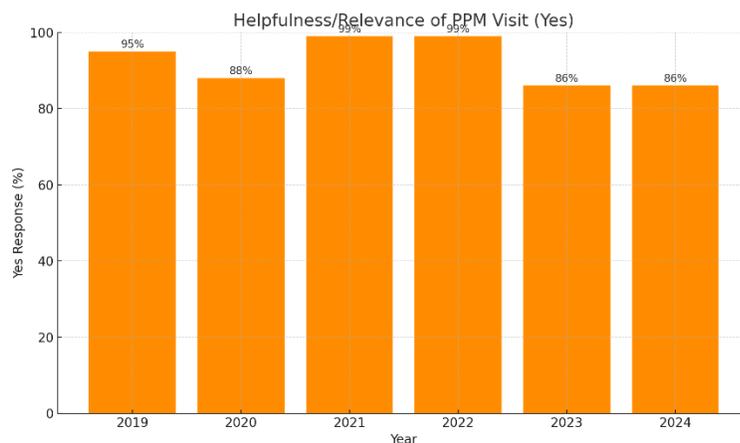
4.4 Client survey

During the planned preventive maintenance visits between 2019 and 2025, the Delft Imaging team in Ghana conducted customer surveys. The average response rate was 48%. In most years, respondents were radiographers, engineers, medical superintendents, IT officers, and administrators, among others.

The survey results show that clients remain satisfied with EasyDR's performance (93% of Excellent and Good on average). Additionally, most clients find the planned preventive maintenance at their facilities extremely relevant and helpful in carrying out their operations (92% positive on average).
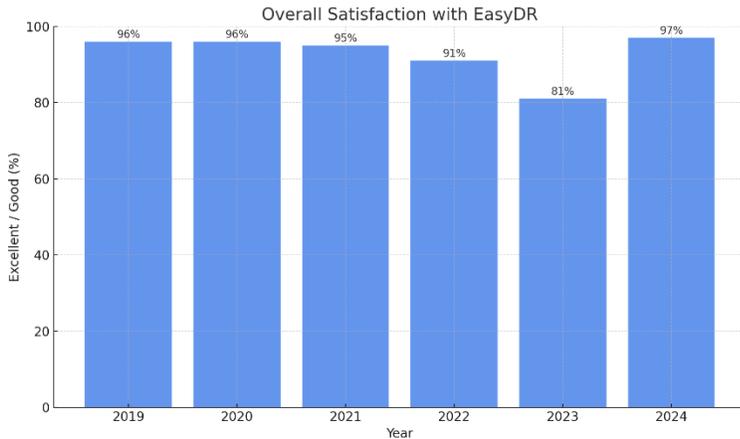
93%
Excellent/Good
satisfaction with EasyDR

92%
Clients found the
helpfulness/ relevance
of PPM

Survey questions & findings (2019-2022 on average)

Question	Finding
How satisfied are you with the overall service?	98% Excellent and Good - satisfaction with the service.
How satisfied are you with the overall performance of the EasyDR?	95% of Excellent and Good: satisfaction with the EasyDR.
How relevant and helpful is our visit for your job/organization?	96% found PPM as very important.
Were you adequately informed about our visit?	89% affirmed being adequately informed.
Did we inform you in time about our visit?	88% affirmed receiving timely communication.
Did our engineers report on the specified day as planned?	83% assented to good planning & communication.
Did you have problems with the machine before our visit?	24% affirmed having issues before PPM.
Did the engineers successfully answer all your questions?	99% confirmed satisfaction with how issues were addressed.
Did our engineers report what they did?	94% Affirm the accuracy of the PPM report.
What do customers say they like about Delft Imaging Ghana?	Many rated "professionalism" followed by "promptness" and "communication."

(Left) Kumasi South Government Hospital
(Right) Client interview at Wechiau Government Hospital

4.5   Voices of Partners

We conducted a customer survey during the PPM for 2023 and received the following feedback:

The EasyDR system has made working easier. I can work faster and reduce patient waiting times.

Before we got the EasyDR system, the hospital had an analogue X-ray system. Having the EasyDR system was, therefore, very impactful. Image quality and resultant radiological diagnoses have greatly improved.

Frederick Damptey, Senior Radiographer
Kumasi South Hospital

The EasyDR X-ray system has benefited the community and other adjoining communities mostly in the diagnosis of TB screening in real-time.

Vincent Anafo, **Junior Radiographer**
Bolgatanga Regional Hospital

The EasyDR makes work faster and easier with regard to attending to patients and clients.

Mohammed Atif Sidik, X-ray Operator
Wa West District Hospital

Easy detection of TB cases which has encouraged rapid response of the facility.

Cornelius Botchway, Clinical Engineering Manager
Effiduase Government Hospital

The EasyDR X-ray is helping the community and the hospital. TB cases are now treated in our facility.

Joshua Omega, X-ray Technician
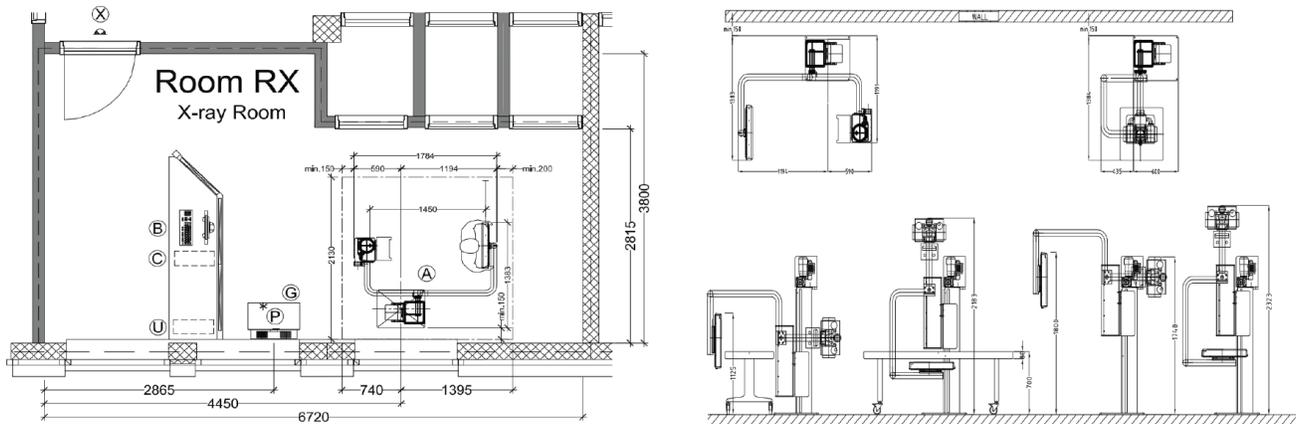**Akatsi District Hospital**

5 Conclusion

This whitepaper outlines the technical information of the EasyDR, a multipurpose stationary digital X-ray system based on the World Health Imaging Systems (WHIS-RAD). It offers guidance on selecting the most suitable system based on the clinical needs, local infrastructure, operational environments, human resources, and budget or total cost of ownership.

The advantages of the EasyDR are highlighted:

➢ **Meet the WHO WHIS-RAD specifications:**
Provides high-quality images, safe to use, reliable, and easy & simple to learn and operate.

➢ **Multifunctional:**
The U-arm can be positioned both vertically and horizontally, enabling all X-ray examinations at primary healthcare clinics and 95% at district hospitals.

➢ **Robust and easy to install:**
Installation takes only one day, and can be done in a small X-ray room, containers, trucks, or vans to be deployed in hard-to-reach areas.

➢ **Easy to operate:**
Minimal experience is needed to produce high-quality images thanks to the Automatic Exposure Control and automatic alignment of the detector and X-ray beam.

➢ **Proven solar-powered X-ray**:
An integrated power pack enables continuous operation during grid power failures.

The Ghana case study showcased the successful deployment of 54 units of EasyDR installations across the country. Despite such a large-scale implementation, including in remote areas, the performance overview shows that support & service by Delft Imaging Ghana help ensure EasyDR's continuous operation with minimal technical challenges. Furthermore, the Planned Preventive Maintenance and periodic capacity building confirm high maintainability, uptime, and constant patronage from the clients. The EasyDR systems contribute to a strong diagnostic impact on TB case findings, other general health examinations, as well as the pandemic response, leading to a more robust health system in Ghana. Additionally, the client surveys show that users have been pleased with EasyDR's ease of use, high performance, effectiveness in TB detection, and its role in improving the quality of health services.

Annex: EasyDR technical specifications

EasyDR	Specification
	EasyDR (SID 145cm, chest screening and multipurpose system) Includes: • Canon CXDI-401G (GOS detector) • Canon CXDI-NE/RD software + control unit (PC) incl. generator integration • Mini-console + exposure switch • Operator display, 17" touch screen • Manual 3 knob collimation with LED (top/bottom separate knob) • Grid Unit 10:1 140cm 52 l/cm (removable) • Automatic Exposure Control (three field) • X-ray tube 150 kV, 300 kHU • Radiographic Generator 50kW/150kV Energy Assist* • HS-cable, 8 meter • Motorized movement (up/down and rotation) *Capacitor Assist generator, Single Phase 214VAC -/13%, 16A low power consumption.

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ix Sandström, Staffan, Ostensen, Harald, Pettersson, Holger, Akerman, K & World Health Organization. (2003). The WHO manual of diagnostic imaging: radiographic technique and projections / Staffan Sandström ; editors: Harald Ostensen, Holger Pettersson ; in collaboration with K. Akerman ... [et al.]. https://apps.who.int/iris/handle/10665/42720