SCREENING COAL MINERS IN RURAL PAKISTAN USING ARTIFICIAL INTELLIGENCE AND ULTRA-PORTABLE X-RAY

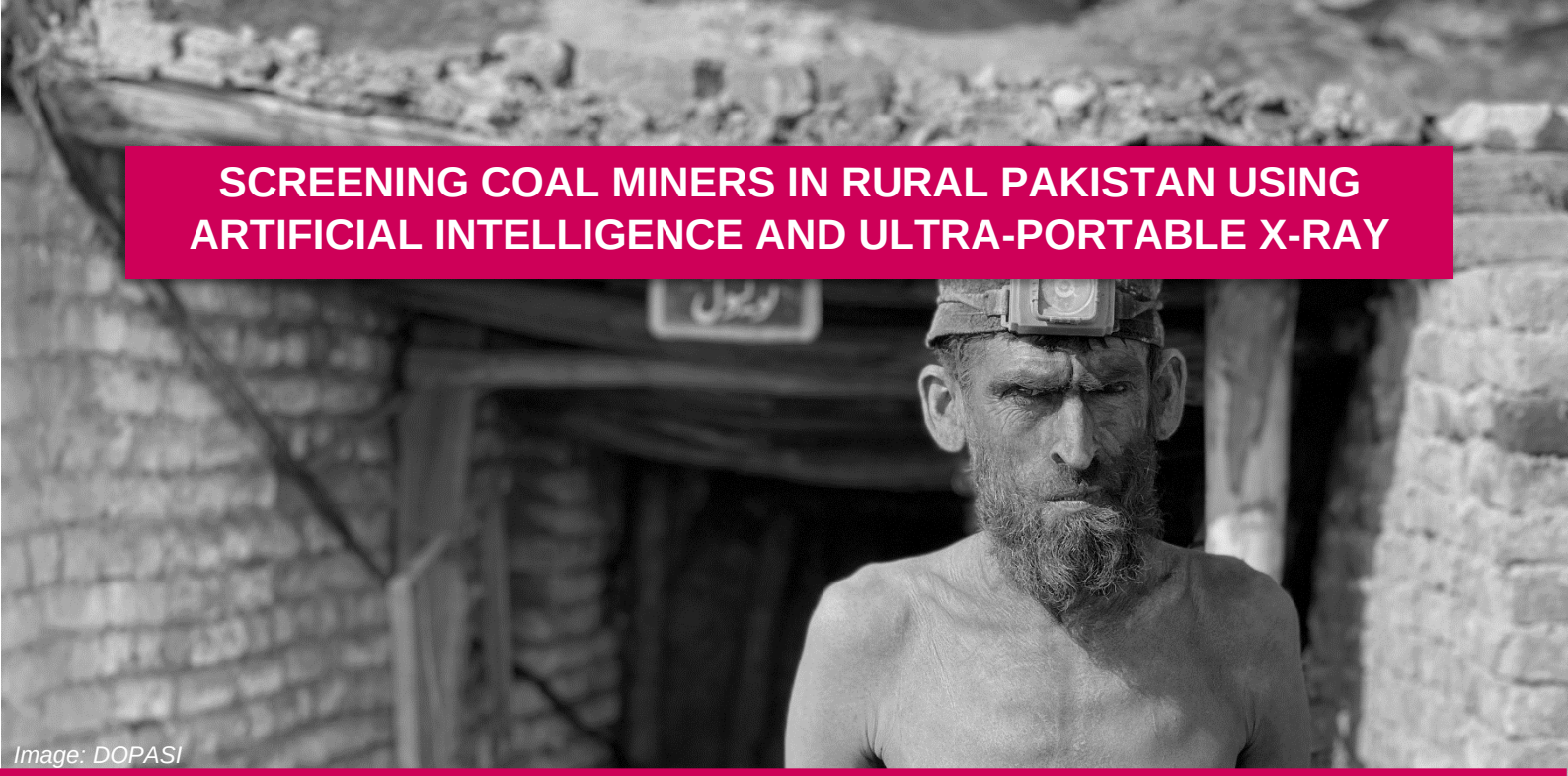


Image: DOPASI

PROJECT OVERVIEW

Khyber Pakhtunkhwa, Punjab, Sindh provinces, Pakistan

April 2019– August 2021

Lunit INSIGHT CXR (Lunit)

DOPASI Foundation

AI INTERVENTION

With an estimated 573,000 cases of tuberculosis (TB) in 2020 and accounting for over 5% of the global TB burden, Pakistan has one of the highest rates of disease globally.[1] Miners face a high risk of TB disease because of their exposure to silica, and poor working and living conditions.[2,3] Mining is prominent in Pakistan, as it has the fourth highest coal deposits in South and Central Asia –185 billion tonnes. However, the industry is poorly regulated and **fails to protect workers from occupational risks such as disease**.[4,5] This is compounded by the fact that miners occupy remote regions (as much as 40km away from the nearest health facility), move between districts, and are daily workers, making their access to health care in Pakistan virtually **non-existent**. Crucially, the scale of the TB epidemic in these communities is largely unknown.

To address these urgent gaps, TB REACH supported DOPASI to screen miners, their families, and communities for TB in Balochistan district. However, after realizing that sick miners frequently returned home to other districts, this project was scaled up to cover the additional districts of Khyber Pakhtunkhwa, Punjab and Sindh thought to collectively house 80% of Pakistan's mining population.

TB REACH facilitated DOPASI to deploy **innovative screening tools** – artificial intelligence (AI) (Lunit INSIGHT CXR) and an ultra-portable X-ray machine (Fujifilm Xair) – to aid in the scale-up and accelerate screening efforts.

Screening in rural communities using the ultra-portable X-ray. Image: DOPASI

Traversing difficult mountainous terrain, DOPASI held TB screening camps in mining communities. Accessing these locations would not have been possible without the ultra-portable X-ray system, which is **smaller, lighter weight, battery-powered**, and **emits less radiation** than its predecessors. Two different types of screening camps were organized: one using a verbal questionnaire to identify people showing signs and symptoms of TB, and the other using screening through ultra-portable X-ray and AI.

Anyone attending a chest X-ray screening camp received an X-ray read by AI, and the result was used to determine who would receive diagnostic testing through a sensitive molecular (Xpert) test or be submitted for clinical diagnosis. If individuals were diagnosed with TB, their close contacts were also screened, and the project provided treatment support to all those diagnosed.

> ***"MOST DOCOTORS, PULMONOLOGISTS AND RADIOLOGISTS CAN'T TRAVEL TO MINING AREAS. HAVING AI ON HAND ENABLED US TO HAVE A COMPREHENSIVE SOLUTION ON THE SPOT AND IT'S COST EFFECTIVE."***
>
> **– KINZ-UL-EMAN**
> **PROJECT LEAD, DOPASI**

Ultra-portable X-ray screening started in April 2019 and continued until August 2021 in the districts of Khyber Pakhtunkhwa, Punjab and Sindh. Camps using the state-of-the-art X-ray tool were attended by up to 100 people and held every other day. During the project, **117 digital X-ray screening camps** have been conducted.

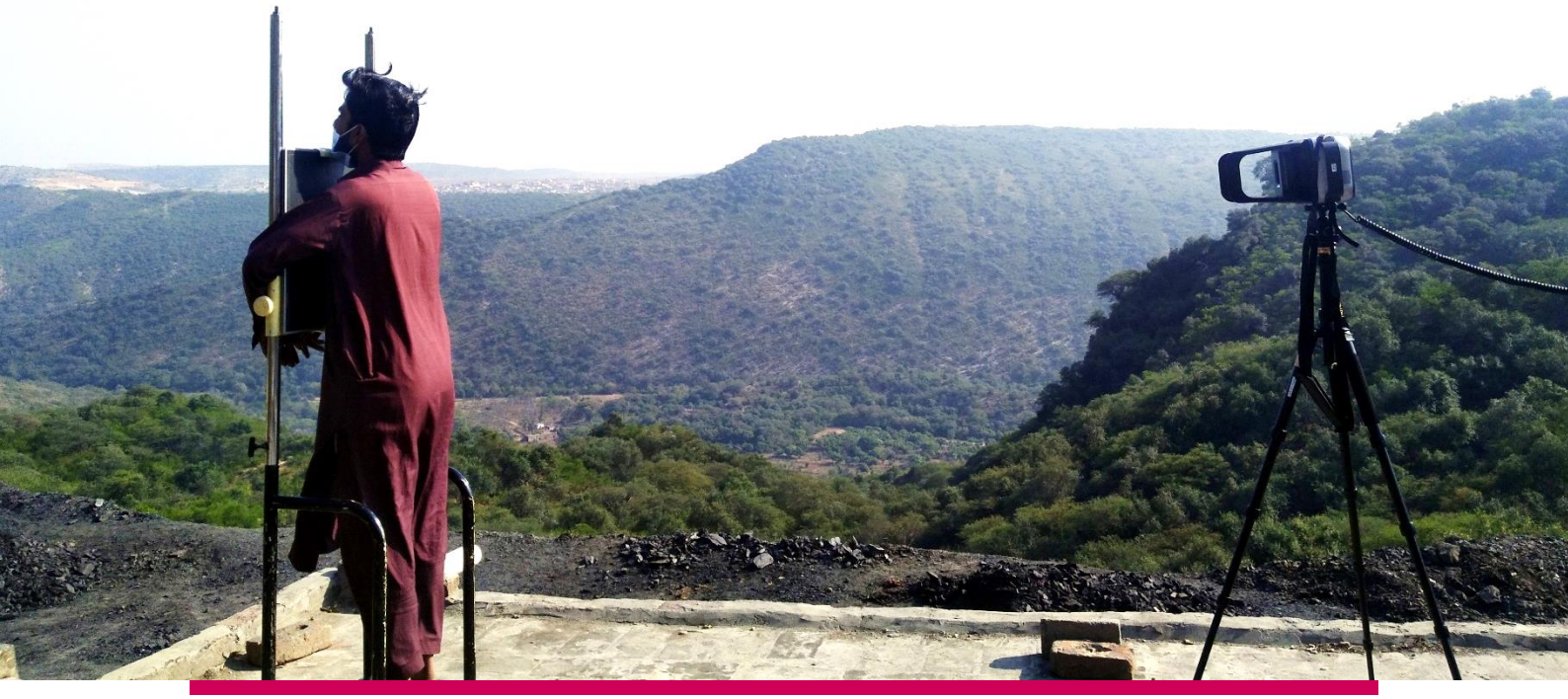
The project weathered the storm of COVID-19, which caused the suspension of activities and made people more hesitant to attend screening camps. However, DOPASI seized the opportunity to begin testing AI to screen for both TB and COVID-19 in selected health facilities, **setting a global precedent for co-screening for these diseases**.

PROJECT IMPACT

- ✓ **150,242 miners and their families screened for TB in total, 12,495 of which were screened using X-ray**
- ✓ **429 people provided with TB treatment**
- ✓ **77.5% increase in TB detection in project areas**
- ✓ **1,509 people screened for COVID-19 using AI**
- ✓ **316 people screened in one day at a mega-screening camp**

Despite occasional faults and a low battery capacity, Pakistani radiologists warmly received the new ultra-portable X-ray equipment, remarking that **image quality was equal to trusted, non-portable counterparts**. AI and ultra-portable X-ray enabled provision of TB care in a key, yet underserved population. DOPASI advocates on behalf of miners, highlighting the significant consequences of occupational hazards for health, and pushing for mine owners and regulatory authorities to take greater responsibility. The project also hopes that the screening strategy will be expanded nationally, warning that **if this opportunity is missed, this impoverished population will suffer from the lack of these services for a long time to come**.

> ***THE PORTABILITY, THE OUTREACH, THE ACCESS TO SERVICES FOR A VULNERABLE POPULATION, THAT IS THE BEST THING I CAN THINK OF.***
>
> **– KINZ-UL-EMAN,**
> **PROJECT LEAD, DOPASI**



REFERENCES

1. Global tuberculosis report 2021. Geneva: World Health Organization; 2021 (https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-2021, accessed 5 November 2021).

2. Key populations brief – miners. Geneva: Stop TB Partnership; 2016 (https://stoptb.org/assets/documents/resources/publications/acsm/kp_miners_spreads.pdf, accessed 22 December 2021).

3. Ross MH, Murray J. Occupational respiratory disease in mining. Occup Med (Lond). 2004;54:304–10. doi:10.1093/occmed/kqh073.

4. World energy resources: coal. London: World Energy Council; 2013 (https://www.worldenergy.org/assets/images/imported/2013/10/WER_2013_1_Coal.pdf, accessed 22 December 2021).

5. Death in mines: a report on coal mines in Balochistan. Islamabad: National Commission for Human Rights, Government of Pakistan; 2019 (https://nchr.gov.pk/wp-content/uploads/2019/01/Coal-Mines-in-Balochistan.pdf, accessed 22 December 2021).

ABOUT THIS DOCUMENT

This document is one of a series spotlighting the experiences of these early implementers when using artificial intelligence (AI) / computer-aided detection (CAD), to highlight the added value of CAD for TB programmes and inspire prospective implementers to innovate. Funding of this project was provided by the Stop TB Partnership's TB REACH initiative, launched in 2010 by Global Affairs Canada. In 2012, TB REACH first worked with implementing partners to pilot CAD software. Since then, it has implemented 3 different CAD products in 13 different countries in Sub-Saharan Africa, Latin America, Eastern Europe, and South and South-East Asia.