WFPI
World Federation of Pediatric Imaging

**EXECUTIVE SUMMARY**

# DETECTING TUBERCULOSIS IN CHILDREN THROUGH IMPROVED DIAGNOSTIC IMAGING
# 2013 - 2017

**PROJECT LOCATION:** Selected sites and health systems in high-burden tuberculosis areas in Africa and Asia including South Africa (Khayelitsha, Western Cape), Liberia (Monrovia), India (Bangalore), Haiti (Port-au-Prince) and and partner tele-reading sites in Malawi, CAR, Tajikistan and Cambodia.

**PROJECT SUMMARY:**

Tuberculosis (TB) is a major health problem worldwide. The latest World Health Organization (WHO) figures indicate that in 2010 there were 8.8 million incident cases of TB, with about 13% of cases occurring among people living with human immunodeficiency virus (HIV). In 2010 there were 1.1 million deaths from tuberculosis among HIV-negative people and an additional 350 000 deaths from HIV-associated tuberculosis. In addition, the global emergence of multi drug-resistant tuberculosis, extensively drug-resistant tuberculosis, and more recently, totally drug-resistant tuberculosis presents a formidable challenge to tuberculosis control, especially in Eastern Europe, Asia, and sub–Saharan Africa. The WHO Tuberculosis Program indicates that current trends in the epidemic will continue unless effective control is achieved, resulting in 3,5 million new cases of tuberculosis over the next decade and at least 90 000 patients dying.

The WHO's global TB data include age breakdowns only for smear-positive TB cases among children. These represent only a subset of the burden of disease due to TB (about 8%). Based on age-specific estimates made in 2000, the global burden of TB among children under age 15 is 884,019 cases (11 percent of total cases). **Approximately, 15– 20% of all TB cases in sub-Saharan Africa are in children**, who act as future reservoirs for the disease. The consequences of undiagnosed, untreated tuberculosis in young children are substantial and exacerbated due to the rapid progression to disseminated tuberculosis. Childhood tuberculosis is often associated with high mortality.

Children do not present to their clinic with TB but rather with respiratory and/or constitutional symptoms, which renders differentiation of TB from other diseases a significant challenge. It is not feasible to start and maintain TB treatment on all children presenting with symptoms without some proof of disease. Yet the diagnosis of pediatric pulmonary TB – the most common in children - is difficult because children do not produce sputum for examination, testing and culture and TB diagnosis lacks accurate rapid point-of-care diagnostic tests. This complicates the usual diagnostic techniques, including new innovations such as gene Xpert, which is extremely useful in adult diagnosis but still requires a sample for testing and therefore remains only 75% sensitive in children. It is thus widely acknowledged that there is a critical need for improvement in pediatric TB diagnostic tools. **Meanwhile, more emphasis and attention is required for optimal usage of currently available diagnostics to improve active tuberculosis case detection rates.**

The chest X-ray is an important part of the clinical assessment for intrathoracic tuberculosis in children. There are significant differences in clinical and radiological findings between adults and children, as well as important epidemiological variations in high-burden settings that will affect the predictive value of any

criteria. The presence of lymphadenopathy on chest X-ray is frequently used for diagnosing pulmonary tuberculosis in children, particularly in the setting of a clinical suspicion of tuberculosis. Furthermore, the detection of pulmonary complications which may require additional treatment - effusion, empyema, cavitation, pneumothorax and diaphragmatic paresis - is supported by chest radiography, as is the effort to exclude TB before the institution of antiretroviral therapy for HIV-AIDS so to avoid the development of Immune Reconstitution inflammatory Syndrome.

Chest X-rays are not without their own limitations, including the imparting of a radiation dose to the patient. In addition, they can be expensive and not always readily available where needed. Radiography is subject to variable quality in technique. The unreliability of radiographic interpretation with significant inter-observer variation has caused some clinicians to refute the usefulness of performing chest radiographs in children for the diagnosis and management in children with respiratory symptoms and suspected TB as well as those with HIV.

Nonetheless the conversion of existing X-ray facilities to digital machines is possible through the use of digital cassettes and cassette readers i.e. computed radiography. This obviates the need of a dark room and developing consumables and furthermore allows for e-referrals across the Internet to be read almost instantly by readers at another location. Furthermore, digital imaging allows for a much larger margin for error when performing radiographs as the radiologists interpreting can adjust the brightness and contrast [windowing] to improve visualization [post-processing]. This has transformed the potential of radiologists to assist in the diagnosis of conditions such as tuberculosis from a distance.

**PROJECT RATIONALE**

The WFPI will support the **conversion of existing facilities to digital**, with operator guidelines including recommendations on **radiation safety**. The larger margin of error when performing radiographs also opens the way for non-radiographers to perform the radiographs ('**task shifting**'). While radiologists in low resource settings are still being identified and trained (the WFPI also assists with **radiologist and clinician training** in HIV-AIDS/TB pediatric imaging), local X-ray operators can send their images to expert readers in other countries (**tele-reading**) for second opinions offered on a volunteer basis to support diagnosis, detect complications, monitor treatment and diagnose other conditions presenting in a similar fashion to TB. This may be termed '**patient-shifting**' rather than 'task-shifting', and at **low cost**. In this scenario, the X-ray machine and user become the point-of-care.

The long-term operational aim: build a low cost, ultimately sustainable model for reproduction in other project sites.

The expense of imaging services availability at the point-of-care will remain an issue. However, the WFPI does not propose the installation of imaging equipment at every point-of-care but limits its scope of action to supporting existing facilities' conversion to digital so as to facilitate volunteer reporting. Thereafter it will **utilize its TB focus as a gateway to wider pediatric imaging support**, tele-reading for any pediatric cases requiring second opinions from its project sites and optimizing its TB training, education and industry reach to cover wider pediatric imaging needs. It will thereby demonstrate that even though medical imaging is expensive, it remains important for diagnosing all respiratory conditions, monitoring response to therapy and detecting complications. Diagnosis of tuberculosis is just one of the possible uses.

In support of its field action, the WFPI can help re-position pediatric imaging on the TB diagnostics map, working upwards from the point-of-care.

- ⇒ Its clinicians facilitate **contacts with industry**; WFPI members work in the world's most advanced imaging centers thus representing significant industry pull, and WFPI has alliances with radiological societies funding equipment donations;
- ⇒ Its members participate in **national and international forums** on child healthcare, TB and child

imaging safety; they will draw on project experience to feed into guidelines and recommendations;

⇒ Its academic membership base facilitates **research and publication** - the WFPI's founding societies produce a journal: "Pediatric Imaging", [publisher: Springers];

⇒ Through its membership network, the WFPI has worldwide access to healthcare **congresses and courses**. These will similarly be harnessed as platforms to teach and share progress made and raise awareness.

Constituted of all the major pediatric imaging societies worldwide, the WFPI has some unique characteristics underpinning this project rationale:

- Existing 'on the ground' pediatric radiology tele-reading for developing countries (**proven track record**);
- Use of **expert pediatric radiologists from major centers around the globe** as tele-readers;
- A **unified approach to X-ray diagnosis of pediatric TB** – equipment, X-ray operators, radiograph reading - using current expert knowledge based on research in the field;
- **Dedicated educationalists** from major international institutions available for on-site training;
- A **website** (www.wfpiweb.org) offering online pediatric imaging training and educational content;
- **Alliances** with adult radiology societies world wide;
- **Partnerships** with not-for-profit organizations on the frontline of low resource medical aid.

**OPERATIONAL STRATEGY**

General objective

- Impacting on the diagnosis of tuberculosis in children using radiography in low resource settings.

Expected outcomes

1. The quality of pediatric TB images made is improved;
2. Resource allocation in terms of imaging HR is promoted and radiologists and clinicians receive training & education in pediatric HIV-AIDS/TB imaging;
3. Digital technology is harnessed to secure interim pediatric imaging expert second opinions with a particular focus on HIV-AIDS/TB;
4. Multi-centre research, publication and participation in global health forums take place so as to maintain momentum for the improved detection of pediatric TB.