ONE WORLD TB SUMMIT VARANASI 2023

Stop TB Partnership hosted by UNOPS

Making the 'Impossible- Possible' for people affected by Tuberculosis

Stop TB Partnership 36 Board Meeting

Varanasi- India

India TB Innovators' Spectacle

For the People Of the World

25 March 2023

Making the 'Impossible- Possible' for people affected by TB

STP Board Session: Making the 'Impossible-Possible' for people affected by TB- **25th March 2023: 16.30 to 18.45**

This Session showcase TB innovations in the recent years from India that has potential to influence the TB care in the world. The session showcase the key roles private sector innovators and partnerships have played, the facilitators and other actors contributed to promote these innovations. The session ran as modified panel discussion with short presentations showing the innovation with additional comments from facilitators for these innovations in the country.

Disclaimer:

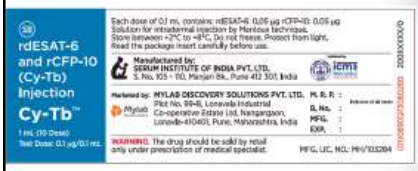
This booklet is intended only as a reminder of the presentations in the session and Stop TB Partnership Secretariate does not endorse the views expressed by presenters or the data presented. Secretariate has taken all possible care to include TB innovations from India in the last 2 years available to us while preparing this session.

-Stop TB Partnership Secretariate***.***

Prevention
New Latent TB Test

Latent Tb Testing
Finding missing millions

- 40% of Indians live with latent Tb. Must be prevented from Tb.
- We need a test which is fast, accurate, and cost effective in detecting Latent TB
- Cy-Tb is the the perfect solutions to this problem



1/4TH OF THE WORLD'S POPULATIONS HAS LATENT TB.

	TST	IGRA	Mylab Serum C-Tb Test
Accuracy	Low Accuracy. Problem of False Positives	High Accuracy	High Accuracy
Cost	Low	Very High	Low
Ease of Use	Easy	Difficult	Easy
Patient Linkage	Not Available	Not Available	Available with Mylab SmartPatch
Field Use	Possible	Not Possible	Possible
LMIC Applicability	Yes	No	Yes

Latent Tb Testing
Cy-Tb- A Unique Solution

Mylab and Serum have come together to create a unique CY-Tb solution which is **Fast, Accurate**, and **Cost Effective**

CLINICAL TRIAL SUMMARY

- Cy-Tb test results correlate with exposure to M. tuberculosis
- Cy-Tb and QFT have similar positivity rates
- Safety profile of Cy-Tb is comparable to PPD
- Excellent diagnostic performance in children, adolescents and adults
- Cy-Tb deliver IGRA like performance in the field using a universal 5 mm cut off

Latent Tb Testing
Tb-Connect App and Patch (Under Evaluation)

Prevention
New TB Vaccines

rBCG

rBCG: Why rBCG?

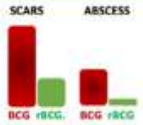
r-BCG is an excellent solution as it not only has more benefits compared to BCG but also a better safety profile and has lesser implementation challenges for the government.

Immunity in Revaccination — **Comprehensive Immunity**

rBCG provides a more targeted immune response compared to BCG. Its mode of action facilitates CD8 T cell stimulation; a key feature for effective anti-TB responses. Also, CD4 T-cell mediated immunity is greatly improved. Combined, these features achieve a strong anti-TB response.

Safety in Revaccination — **Much Safer**

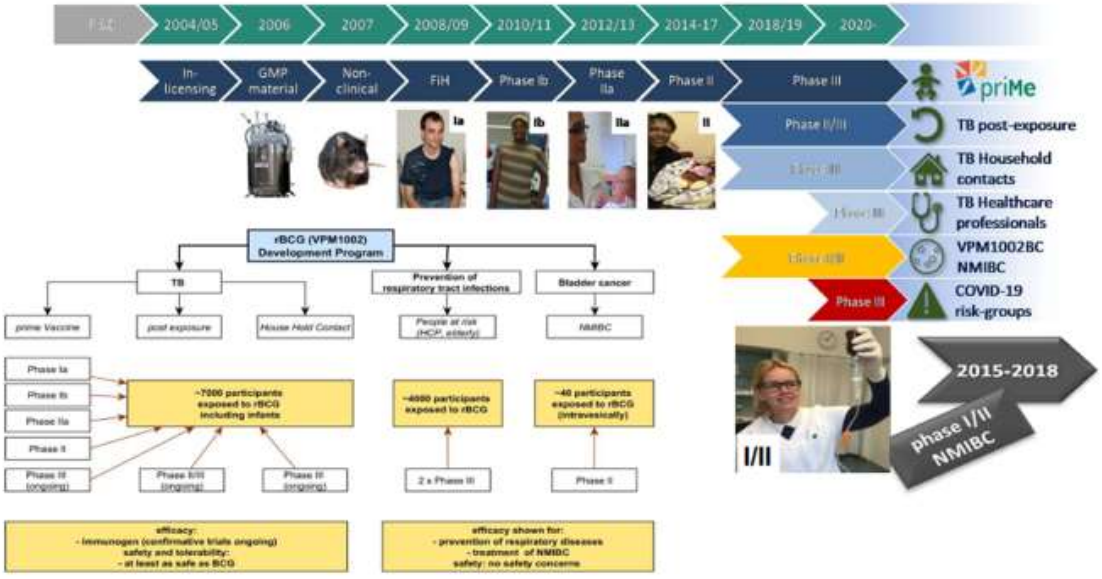
rBCG causes significantly less scaring (**20.8% vs. 74%** in BCG), ulceration (**<0.1% vs. 14%** in BCG) and abscess formation (**1.6% vs. 22%** in BCG). Also, it has faster clearance which leads to much shorter persistence times and thus reduces reduced risk for BCGosis.



Use in special Populations — **HIV+ Children Suitable**

Phase II trial showed no difference in HIV-exposed or HIV-unexposed babies could be seen in terms of safety and tolerability when rBCG was administered.

rBCG: Clinical Development Roadmap



Prevention
New TB Vaccines

Mycobacterium W- MIP
Fast growing , Non pathogenic mycobacteria

- **Mycobacterium W**
  - Activates macrophage – TLR2 (BCG no role of TLR2)
  - Shares antigens with M. Tb
  - Provides protection against BCG sensitive as well as BCG resistant strains
  - Adaptive immune response
    - Induces Th1 Type of response in Lungs
    - effector as well as memory T cell response
    - M.tb Antigen Specific Memory Recall Response
    - Upregulation of costimulatory molecules CD40,CD80 and CD86

- **Mycobacterium W**
  - Enhances Innate immune response
    - M1 macrophages through TLR2
    - Increases adaptive NK cells and reduces inhibitory NK cells
  - Better protection by intranasal route of administration
  - Enhances BCG induced immunity and confers higher protection

Mycobacterium W
- Kills intracellular organisms
- Synergistic with chemotherapy

Approved product - Killed Mycobacterium W (BCG-live)

1

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Mycobacterium W- MIP

- **Tuberculin conversion - Tuberculin negative in HIV+**
- **Protection against TB – Long lasting**
- **Improves CD4 count in HIV**
- **0.1 ml intradermal (Like BCG)**
- **Safe- No systemic side effects**
- **Protection against other viral/bacterial organisms also**

- **Faster sputum conversion – Pulmonary tuberculosis (Irrespective of drug sensitivity)**

2

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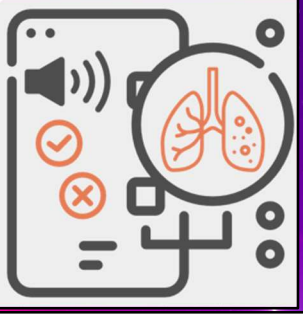
Screening

AI solution for elicited cough/ sounds to improve TB screening

WADHWANI AI

Cough Against TB

AI-POWERED PULMONARY TB SCREENING USING COUGH SOUNDS



THE PROBLEM

In India, **1.8 out of every 2.8** tuberculosis (TB) cases prevalent in the community are missed by the public health system.

Moreover, an estimated **63.6% cases do not seek care in spite of having TB symptoms**, further widening the gap.

OUR AI-POWERED SOLUTION

The Central TB Division (CTD), in partnership with the USAID-supported TRACE-TB Project, led by Wadhwani AI, is developing an innovative AI-powered solution to identify presumptive pulmonary tuberculosis cases.

The AI model that drives this screening tool utilises **cough sound data**, along with symptoms and comorbidities for pulmonary TB, to enable the early detection and treatment of TB in health facility settings.

- An easy-to-use, non-invasive, no cost, point-of-care screening test
- A highly sensitive screening test for pulmonary tuberculosis in high-burden health facilities.

Source: National Tuberculosis Prevalence Survey in India, 2021

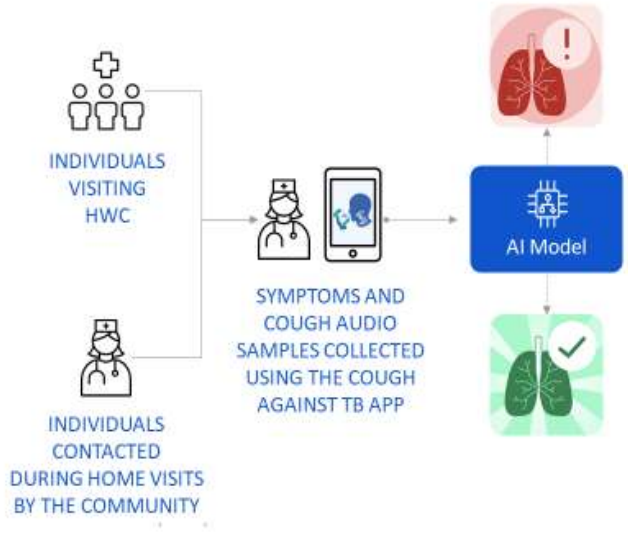
COUGH AGAINST TB

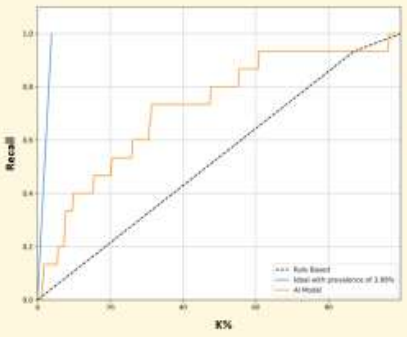
VALUE PROPOSITION FOR THE NATIONAL TUBERCULOSIS ELIMINATION PROGRAM (NTEP)

Identifying more presumptive individuals who are likely to have pulmonary TB.

Higher precision in identifying presumptive cases resulting in TB diagnosis.

SOLUTION DEPLOYMENT SETTINGS: HEALTH AND WELLNESS CENTRES





AI MODEL VS. RULE-BASED (7 SYMPTOMS) SCREENING

Our AI model detects more actual cases of TB than rule-based methods while accounting for variations in testing capacities of health infrastructure across geographies, serving to increase the efficiency of healthcare workers.

K = 20 (n = 386)					
7S	Pr +	Pr –	AI	Pr +	Pr –
Tr +	4	11	Tr +	7	8
Tr –	19	298	Tr –	16	301

7S: Sn 26.67% Sp 80.32%
AI: Sn 46.67% Sp 81.18%

K = 30 (n = 386)					
7S	Pr +	Pr –	AI	Pr +	Pr –
Tr +	5	10	Tr +	9	6
Tr –	111	260	Tr –	107	264

7S: Sn 33.33% Sp 70.08%
AI: Sn 60.00% Sp 71.16%

K = 40 (n = 386)					
7S	Pr +	Pr –	AI	Pr +	Pr –
Tr +	7	8	Tr +	12	4
Tr –	187	224	Tr –	181	228

7S: Sn 46.67% Sp 60.38%
AI: Sn 73.33% Sp 61.46%

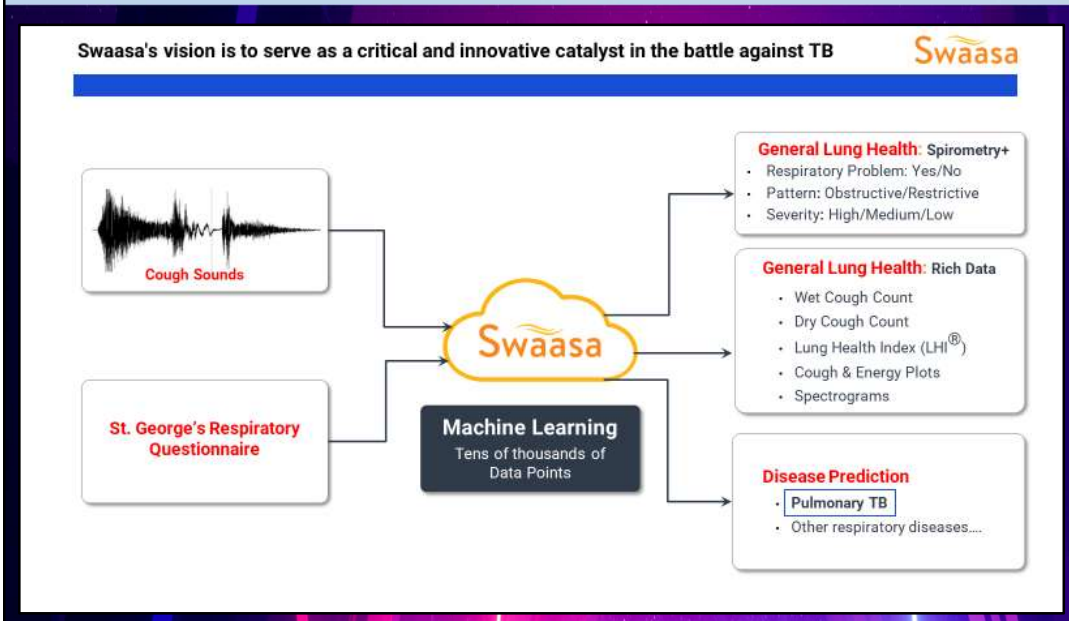
K = 50 (n = 386)					
7S	Pr +	Pr –	AI	Pr +	Pr –
Tr +	8	6	Tr +	12	3
Tr –	183	187	Tr –	181	190

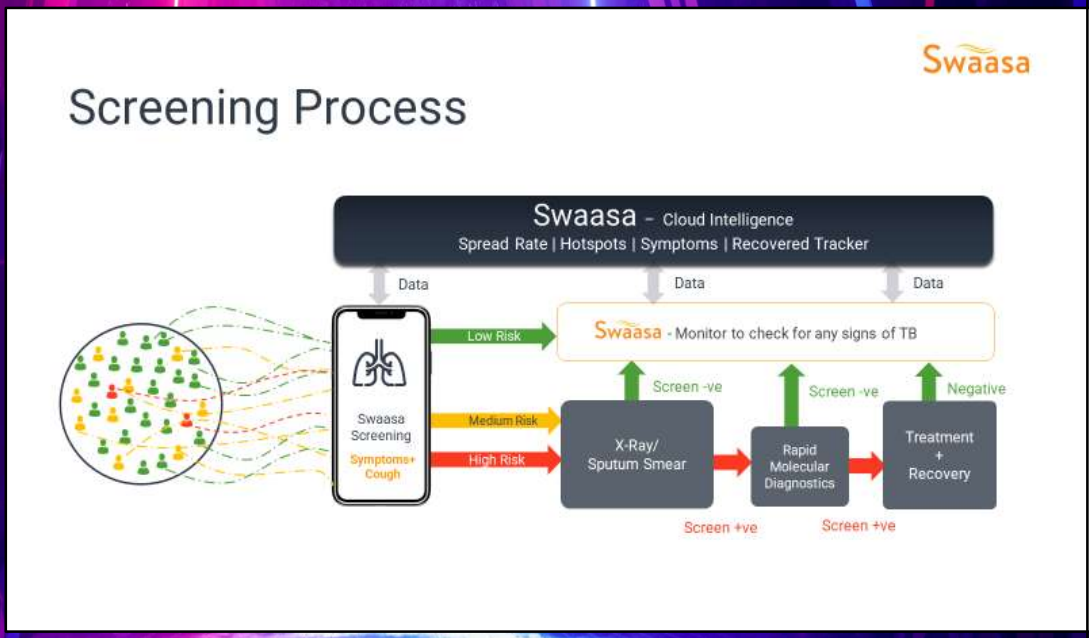
7S: Sn 60.00% Sp 50.40%
AI: Sn 80.00% Sp 51.21%

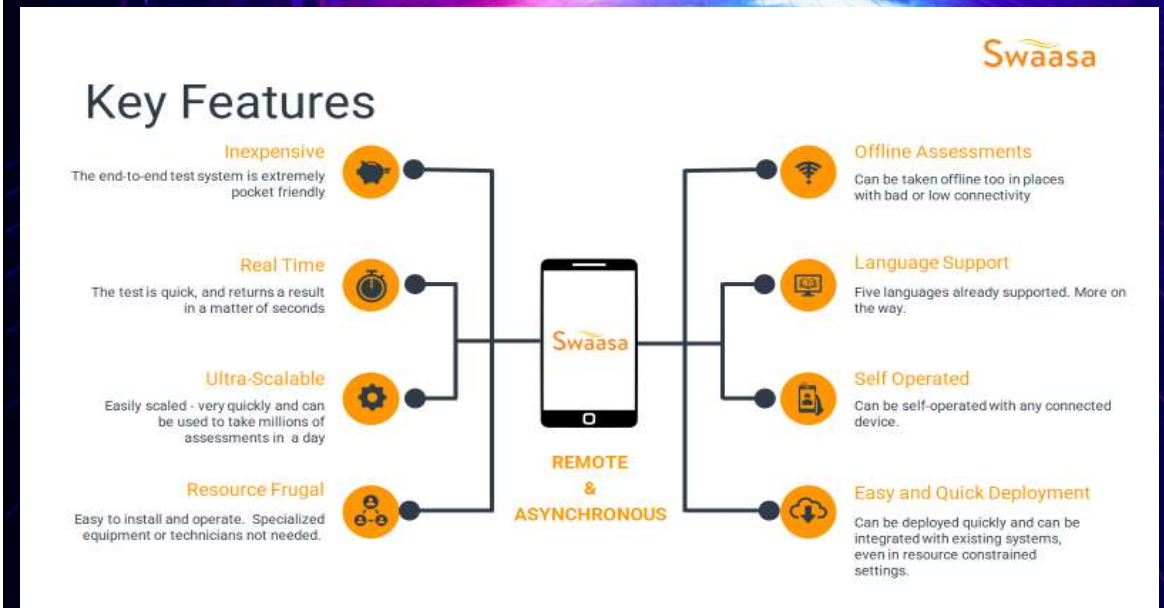
Pulmonary tuberculosis prevalence in the test dataset = 3.89%

Screening

AI solution for elicited cough/ sounds to improve TB screening







Screening

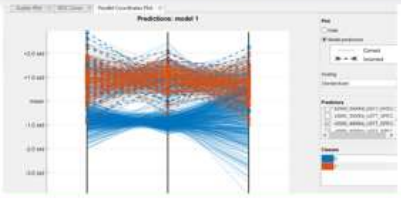
AI solution for elicited cough/ sounds to improve TB screening

Docturnal
Simply Health

- Connectivity and Infrastructure Agnostic
- Explainable AI | Real Time | HI fidelity Cough Sounds
- Bidirectional Screening (Pulmonary TB, Pneumonia/Covid19)
- Community & Home based screening

Clinical Trials: Tuberculosis - CTRI/2019/02/017672

Docturnal
Simply Health



Covid19 (PCR as Reference standard – preclinical validation)

Sensitivity	Specificity	PPV	NPV
92%	96%	97%	88 %

Location	Total(n)	Reference Std	Sensitivity	Specificity
NH	500	CXR, Microscopy, Consultation	80%	92%
Gadwal	126	CXR	59%	60%
Warangal	39	CBNAAT	83%	Disrupted
SR	545	CXR	90%	95%

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AI/ML Workflow

Docturnal
Simply Health

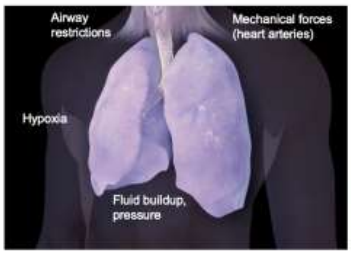
19

Screening

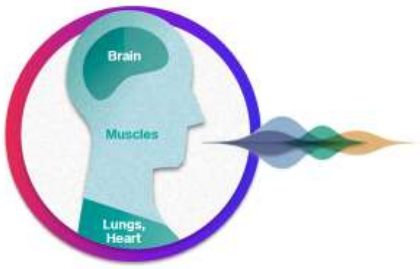
AI solution for elicited cough/ sounds to improve TB screening

Sonde is digital health company developing vocal biomarker technology with a foundation in speech processing, clinical research, and machine learning

Health Changes Lead to Changes in Physiology...



... Which Alter Voice Acoustic Features & Their Temporal Coordination



Major Acoustic Feature Categories

- **Prosody** (Intonation, tempo, dynamics)
- **System** (Vocal Tract Movements and Coordination)
- **Source** (Vocal Fold Dynamics)

Disciplines involved:
Audio Signal Processing – Speech Production and Speech Pathology – Clinical Research – Machine Learning
Presentation by: Dr. Manoj Jain MD MPH – Emory University, Atlanta USA

J Med Internet Res (https://doi.org/10.2196/44410)

Respiratory-Responsive Vocal Biomarker (RRVB) as a "Vital Sign"

Discovery

~3,000 research subjects across India with asthma diagnosis, 6 sec "ahh" recordings, multiple native languages

Matched healthy subjects, no disease diagnosis

Weighted sums of select voice acoustic features fed into logistic regression model perform robustly across training and validation data

Preliminary asthma detection model, indication that >70% sens/spec feasible

Development

- **Refine model to improve robustness and generalizability**
- **Test model with new/holdout asthma recordings and other respiratory disease recordings**

Disease	# Patients	Sensitivity	Specificity	Odds Ratio
Asthma	576	66%	69%	4.32
COPD	625	77%	73%	9.05
Persistent Cough	814	55%	72%	3.14
Interstitial Lung Disease	98	65%	68%	3.95

Respiratory Responsive Vocal Biomarker (RRVB) model with broad utility

Validation

Registered clinical trial – COVID Detection

- **155 COVID-19 positive**
- **147 COVID-19 negative, symptomatic patients**
- **187 healthy controls**

Montefiore · Brigham and Women's Hospital · UC San Diego Health System

- **No adjustments to RRVB model**
- **Achieved primary endpoint: 73% sensitivity, 63% specificity, p-value <0.0001**
- **Also detected 2/3 of COVID+ subjects with no respiratory symptoms**

RRVB model can detect new disease in new setting and maintain performance

Sonde Health is building a new class of digital biomarker which require a foundation of technology, data resources, collaborators, and commercial partners

Mobile rapid & scalable R&D tools and products

+ API / web integrations

1,000,000+ health-labeled voice samples

80,000+ individual speakers speaking 10+ languages

20 health conditions with 1,000+ subjects

Select R&D partners

Montefiore · MIT · Yale University · Royal Papworth Hospital NHS · UMassMemorial · UNSW · GN · Tesla · Biogen · Harvard University · Brigham and Women's Hospital · Stanford University · Massachusetts General Hospital · UC San Diego Health System · University of Cambridge · Einstein · Novartis

AI based Chest X-Ray Interpretation

qure.ai

Qure.ai offers AI powered radiology interpretation solutions

At Qure.ai, our mission is to
make healthcare more affordable and accessible using the power of deep learning

- Multiple FDA and CE clearances. Cleared for clinical use in 85+ countries
- Technology Recommended by WHO
- Impact 10 million lives annually
- 1000+ sites, 10,000+ Clinician users
- 50+ publications
- Large training data sets and repository of +1Bn images

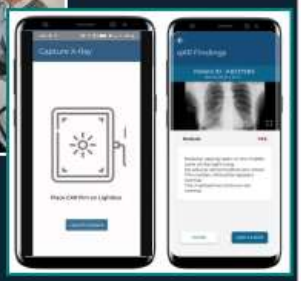
Our vision: Impact 1 Billion+ lives through our solutions

qure.ai

Analog CXR systems are still prevalent in Indian health system particularly in rural and resource constraint geographies

Product Innovation

Collaboration with India Health Fund



Qure was awarded the **India Health Fund grant** in December 2019.

Key Outcomes:

- Development of qXR software for processing CXR film images through training of the algorithm
- Development of qTrack smartphone application
- Scaling up of Analog AI deployments across the country

72 Hospitals	14 States	~ 53K individuals screened	~ 33K analog scans	~ 17K TB presumptive	Avg. time for sputum collection ~1 day

Surveillance setting : AI enabled Incidental Screening of CXRs in the hospitals (MCGM)

Deployment Innovation

Collaboration with Stop TB

~ 100K individuals screened

9 MCGM Hospitals

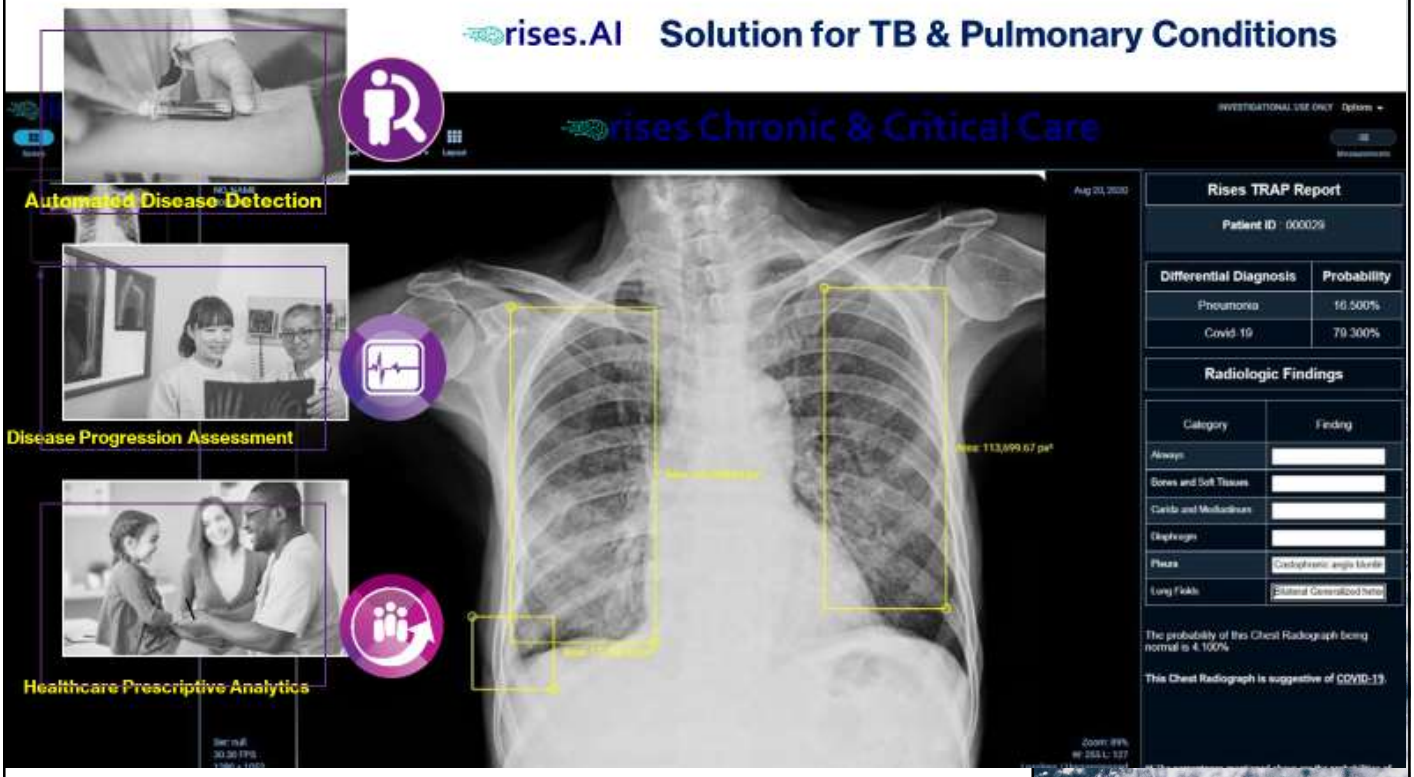
PATIENT-ENTRY ON CONSOLE → X-RAY TAKEN → qXR FLAGS CXR as TB PRESUMPTIVE – NOTIFICATION TO THE TB STAFF → SPOT SPUTUM COLLECTION (Patient immediately contacted to provide sputum) → CB-NAAT TESTING → REVIEW & FOLLOW-UP

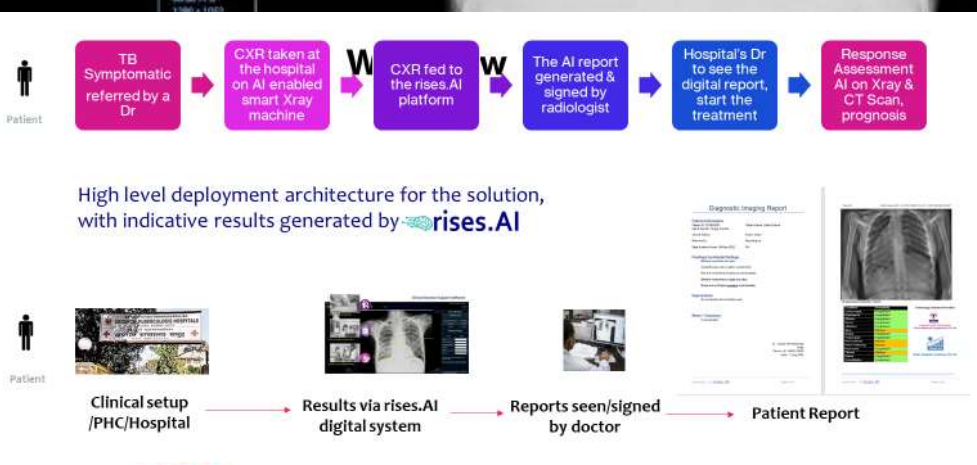
All of this happens within a single day

35% of confirmed TB cases were detected incidentally i.e., were part of a non-TB pathway

AI based Chest X-Ray Interpretation

rises.AI Solution for TB & Pulmonary Conditions





rises.AI Automatic Detection Benefits & Performance

Rises end to end solution has 3 major parts

- Xray machine (portable etc., if needed)
- Medical Software for remote care
- rises.AI platform-based algorithm

Feedback captured for various aspects, Sample of 10K patients

- including the clinicians sees the reports/digital, doctors using it,, Xray technicians & health care professionals.
- from 4 Hospitals - Govt & Private / PHCs, from different cohorts

Overall clinical accuracy seen is > 95% ie usable AI assistant.

Insights

- during TB treatment, better understanding and prediction of the disease spread

Accuracies

- predictions beforehand for reduce the side effects, better planning & optimization of treatment protocol

Optimization

- radiographs Xray CT based AI system solution, remote care, cost effective

Abnormalities	ROC AUC Latest Model	F1 Score Latest Model
Atelectasis	88.85	39.80
Cadiomegaly	88.46	45.16
Consolidation	84.35	42.35
Edema	94.91	48.00
Effusion	90.14	55.36
Emphysema	94.17	43.07
Fibrosis	83.15	25.90
Hernia	95.66	50.39
Infiltration	92.56	49.33
Mass	91.91	37.20
Nodule	88.17	29.67
Pleural Thickening	89.10	55.65
Pneumonia	90.94	43.50
Pneumothorax	91.67	36.84
Tuberculosis	97.6	94.0

AI based Chest X-Ray Interpretation

Genki –Solution for Xray Chest AI Based Public Health Screening

Public health screening solution designed for "Tuberculosis" screening and other chest conditions like pneumonia (covid 19 and other community acquired), cardiomegaly, pleural pathology, lung mass and lung nodules.

Solution Design Objectives: Designed to ensure active intervention and augmenting public health screening methodology to ensure faster TB elimination.

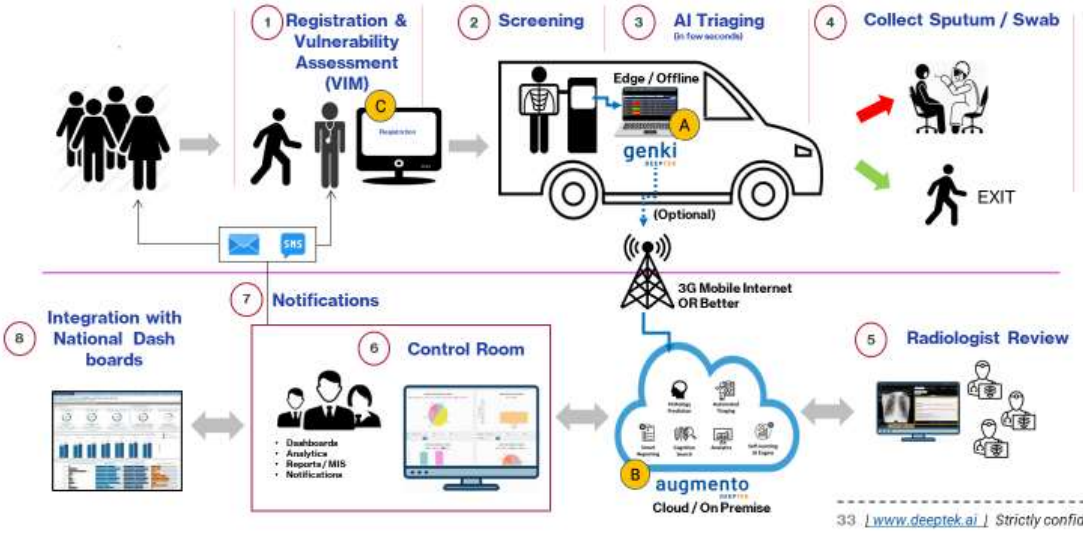
Working Model: "offline" called Genki Edge or "online" mode called Augmento Hub.

Deployment Types: Embedded within x-ray machine, hand held x-ray devices or can work on a standard configuration laptop assigned to an x-ray machine.

Image Type: AI assisted reading for Computed radiography (CR) and Digital Radiography (DR) images of any make and manufacture following Dicom standards. Available as adult only or pediatric module.

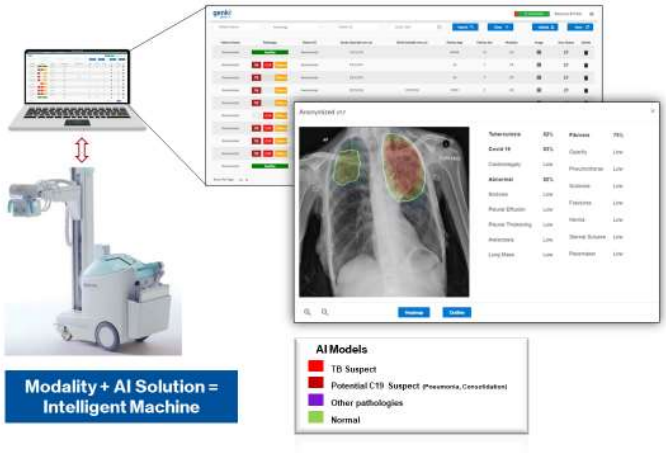
Solution Design : Designed to be 1. embedded in Xray machine or stand alone offline, 2. supported with a scalable cloud solution 3. Patient Registration Platform and an 4. AI Bot for Mobile.

Genki: End to End Solution for Public Health Screening



Automatic Sync

Genki Edge: The Offline Embedded or stand alone Solution for Chest X Rays



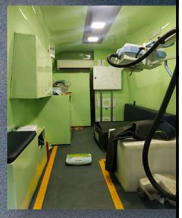
Modality + AI Solution = Intelligent Machine

What is Genki Edge?

- Offline Solution with AI
- Instant triaging (<1 Min)
- Portable + Battery backup
- Auto backup when online

Features of Genki Edge:

- Smart and Easy Worklist
- Smart Triaging
- Smart Pathology Prediction
- Smart Notifications
- 20+ pathologies



Screening

Hand-held X-Ray machines

X-Ray Screening can reach every part of the country now.
Camps / Remote villages / At home / In Ambulances / In PHC / In District Hospitals

MINE 2 Handheld Xray system

- Generator weighs **only 1.8 Kg**
- Can be carried to remote areas in a backpack
  - Total weight **<8KG vs 30+KG** of conventional machines
- **Over 100 Images can be taken on one charge**
  - not dependent on electricity.

- **AI can help to triage TB symptomatics** / Other respiratory ailments.
- **At least 50X – 1000X less radiation** than conventional X-Ray – Safe for subjects – especially infants and operator.
- Very high image quality – **comparable to Gold Standard in ICMR comparison.**

Mine 2 X-Ray system deployed in remote villages for TB screening
Feasibility study done by by ICMR & Labindia / Lipomic.

- ICMR guidance and efforts were Instrumental in proving the efficacy and utility of the system.
- Double Blinded comparison study with Gold Standard X-Ray systems.
- System efficacy validated.
- Effective planning and execution of feasibility study in Sheopur district – highest TB prevalence in India.
- Units travelled several miles to remote villages every day from 3 base stations - Extreme weather conditions
- ~10000 subjects screened
- Mine 2IN is now made in India under tech transfer agreement with OTOM.

Who is using this?

- ICMR has done the comparison of this handheld Xray with Gold Standard machines.
- ICMR has deployed multiple units of this Handheld Xray at Sheopur District in MP for feasibility study.
- All India Institute of Medical Sciences will be using it for Trauma cases.
- State TB units are now deploying this unit for community screening.
- TB Research project underway at a government hospital.
- South Korea for Covid screening, StopTB, for TB screening in other countries
- NGOs & ICMR associates have deployed these Handheld X-Rays for TB diagnosis in India.
- Knee clinics for in camp screening and diagnosis.
- Private Doctors are using this Handheld Xray for taking the images of all anatomies.

Screening

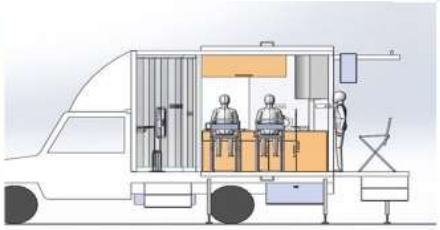
Hand-held X-Ray machines

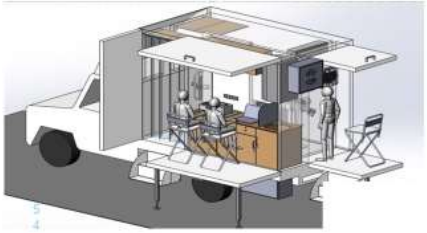
ULTRAMOBILE TB SCREENING

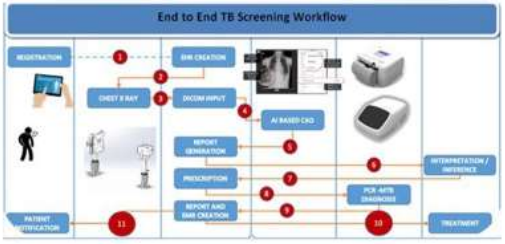
molbio

Prognosys

Model	PRORAD ATLAS*
W	140 W
kV	70 kV
mA	2.2 mA
mAs	0.5 – 6.5 mAs
Weight	3.0 kgs







The Real Work Of The Technology Innovation

passion to lead
EPSILON

Portable High frequency X Ray Solution

Salient Features:

- 2.4 KW HF Generator
- Easy to carry 13.5 Kg weight
- 16 -35 mA
- 40-100 KV
- Compact and Light weight
- Battery operated(Optional)
- Ideal for Home care/Camps

DR ► C-Arm ► X-Ray ► OPG ► LED View Box

www.epsilonhealthcare.com

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passion to lead
EPSILON

The Real Work Of The Technology Innovation

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DR ► C-Arm ► X-Ray ► OPG ► LED View Box

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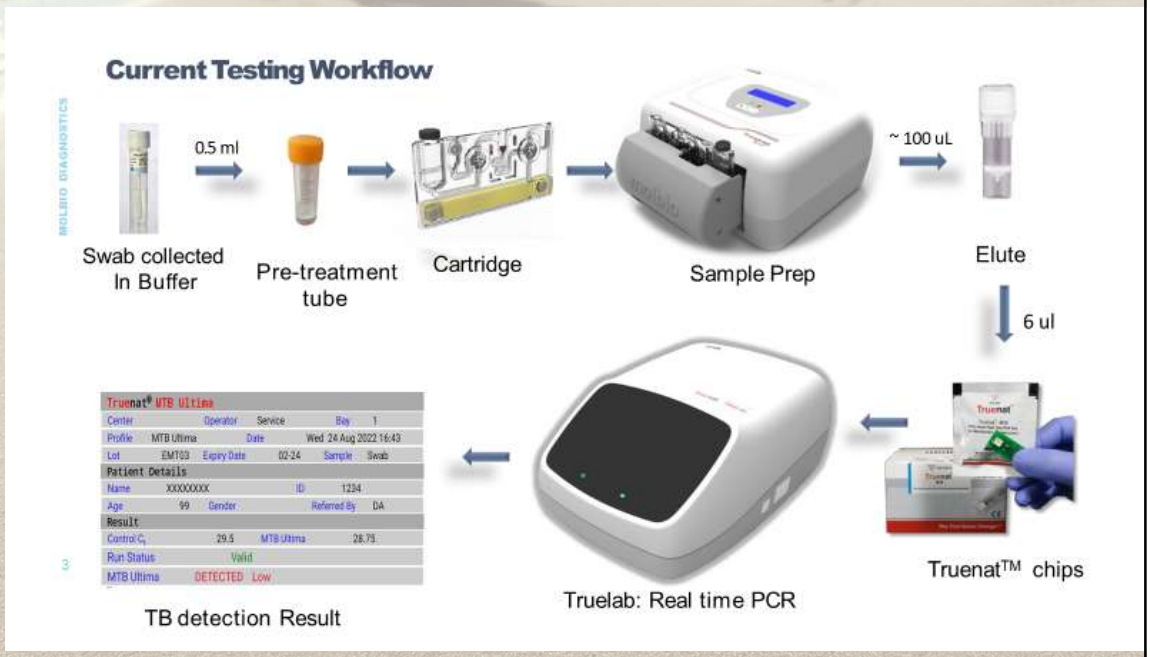
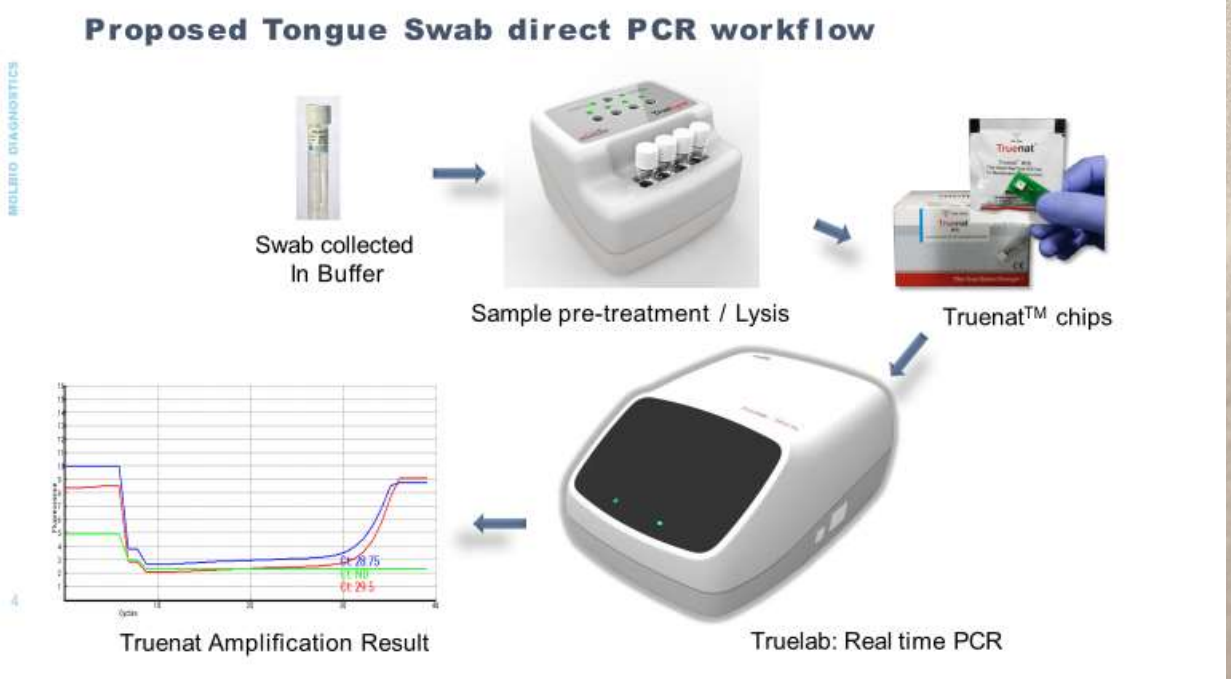
Screening/Testing/ SMART COMBO

TONGUE SWAB + ULTRA SENSITIVE TB DETECTION

- Molbio's Truenat platform
  - rapid, portable, battery operated, fully automated point-of-care Real-Time Polymerase PCR
  - extensively deployed in Point of Care and resource limited settings.
- Improved sensitivity MTB test - Truenat MTB Ultima, which use two multicopy genes
- Early evaluation results combining Truenat MTB Ultima with Tongue swab as sample type has shown promising results.
- We are currently working on standardizing protocols for direct detection of TB with minimal sample processing to achieve faster sample to result for mass screening.





Screening/Testing/ SMART COMBO

Integrated solution for TB Mukt Bharat

Molecular real-time PCR for TB with simultaneous confirmatory detection of Rifampicin and INH resistant TB. Best suited for India's needs

MAKE IN INDIA

India's fastest TB test (40 minutes)

Validated by ICMR with high sensitivity and specificity

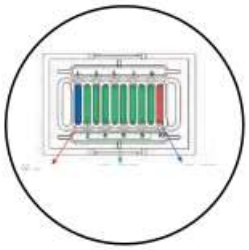
Mobile diagnostics
No AC required
No calibration required

Comprehensive TB Testing

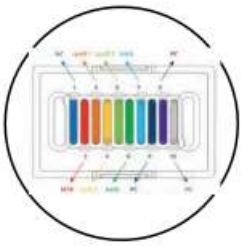
1. A portable molecular diagnostics device capable of accurate testing in POC and remote setting; up to 8 samples in a single run
2. Also available in a quadruple version for higher volume testing; up to 32 samples in a single run
3. Both version use chip-based Tata MD Check KshayANTH MDR TB (RIF+INH) Kit and KshayANTH MTB Kit that provides rapid, test for TB confirmation and management

Battery operated POC Device

Quadruple version



Tata MD Check KshayANTH MTB Kit



Tata MD Check KshayANTH MDR TB (RIF+INH) Kit

Approved by CDSCO Validated at India's premier research institutes

icmr NIRT

Laboratory Evaluation at NIRT, Chennai

500 well-characterized MTB samples evaluated comprising of:

- 195 MTB negative samples
- 305 MTB positive samples: 129 positive for Rifampicin resistance and 173 positive for INH resistance

Result:

TATA MD KshayANTH MTB : Sensitivity 100% and Specificity 100%.

TATA MD KshayANTH MDR TB (Rif+INH) :

- Rifampicin Sensitivity 91.47%, Rifampicin Specificity 90.85%
- INH Sensitivity 87.35%, INH Specificity 85%

Thane Municipal Corporation
Rajiv Gandhi Medical College
Chhatrapati Shivaji Maharaj Hospital

Field Validation at Chhatrapati Shivaji Maharaj Hospital, Thane

Prospective clinical trial comprising of 313 patients

- 65 MTB negative patients
- 248 MTB positive patients: 26 positive for Rifampicin resistance and 27 positive for INH resistance

Result:

TATA MD KshayANTH MTB : Sensitivity 98.5% and Specificity 100%.

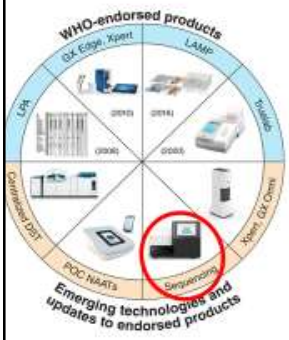
TATA MD KshayANTH MDR TB (Rif+INH) :

- Rifampicin Sensitivity 96%, Rifampicin Specificity 100%
- INH Sensitivity 96.30%, INH Specificity 100%

Precision Medicine in TB Genomic Sequencing

Drug-resistant tuberculosis detection using targeted genomics

miBiome Targeted panel for DRTB



Cheaper, faster, better...

- Addresses Indian Market need and affordability
- Designed using "Catalogue of mutations in *Mycobacterium tuberculosis complex* and their association with drug resistance by WHO, 2021"
- Covers ~300 Mutations
  - 15 drugs
  - 2 multiplexed assay pools per sample
- TAT ~ 2 weeks
- Drugs include Rifampicin, Isoniazid, Pyrazinamide, Ethambutol, Streptomycin, Levofloxacin, Moxifloxacin, Kanamycin, Amikacin, Capreomycin, Ethionamide, Delamanid, Linezolid, Bedaquiline and Clofazimin
- Specificity for TB bacillus taken into account during *in-silico* designing

DOI: https://doi.org/10.1128/JCM.01582-19

Proof of concept study (19 WGS blind samples)

Concordance with WGS samples (for 13 drugs) > 80%

Concordance study with DST samples: Initiated

Partner	IDT platform	Illumina	miBiome
Sample preparation	DNA extraction	Multiplex PCR	NGS sequencing	Data analysis

TAT: 2 weeks

Precision Medicine in TB Genomic Sequencing

FocusTB
Towards a TB free world

TGS for Complete Profiling of Tuberculosis

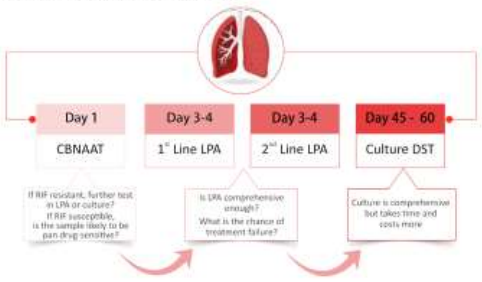
Tuberculosis Genome Sequencing

An initiative by Thyrocare — The Trust. The Truth.

Powered by

Challenge of Tuberculosis

- A rising proportion of new tuberculosis (TB) cases are already resistant to rifampicin and isoniazid, the key first- line drugs.[1]
- **Universal drug susceptibility testing (DST)** is required to identify drug resistant (DR) TB patients in endemic areas, rather than screening only previously-treated individuals.[2]
- The current path to diagnosis and treatment of TB patients carries a burden of time and cost leading to patients suffering from treatment delays and side effects of empirical therapy.[3,4]



CBNAAT: Cartridge-based nucleic acid amplification test; LPA: Line probe assay; DST: Drug sensitivity test

Without TGS 60 days of vague outcome; the mean duration for treatment initiation in TB care takes an average of 65 days for new and retreatment cases.[1] shortening this time with TGS for diagnosis can help put patients on the right treatment path early.

TGS as a comprehensive single-test solution for TB[2,3]

TB Whole genome sequencing is proving complete comprehensive single test solution of tuberculosis. TGS provides an opportunity to treat with ideal antibiotics without wasting time.

Where can TGS fit in the diagnostic pathway?

Sputum Smear /CBNAAT (Day 1) → 1st Line LPA (Day 2) → TGS (Day 14)

14-day cumulated time to diagnosis of DR-TB

Sputum Smear /CBNAAT (Day 1) → 1st Line LPA fail (Day 2) → 2nd Line LPA fail (Day 5) → TGS (Day 18)

18-day cumulated time to diagnosis of DR-TB

Sputum Smear /CBNAAT (Day 1) → TGS (Day 12)

12-day cumulated time to diagnosis of TB in critical re-treatment and HIV comorbid cases

TGS is based on the same Whole Genome Sequencing technology.

TGS-based comprehensive screening

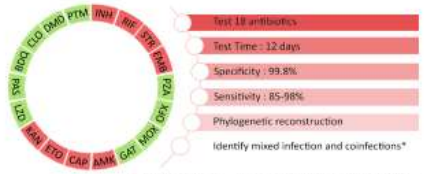
- Complete DST profile
- Mixed infections and heteroresistance
- Individualized treatment
- Rapid results

TGS can help guide individualized treatment as well as inform public health measures. Such approaches have already been successfully implemented for clinical diagnosis in general patients across several countries.[2,4]

TGS: All-in-one genomic analysis[2,5]

- TGS has been optimized by analyzing >10,000 TB genomes and >300 clinical isolates.
- Antibiogram profile of TGS is far superior than combination of all tuberculosis diagnostics methods (Indivivualised or combined).
- It gives simple and precise results with the advantage of a rapid turn-around-time.
- Being an evidence-based profiling, the analysis gives results based on the latest available information that is regularly updated.

TGS assessment profile



*Coinfections detected on samples where direct from sputum processing is undertaken

	TGS test	Culture DST	CBNAAT	LPA
Antibiotic coverage	18 antibiotics	13-15 antibiotics	1 antibiotic	Targeted mutations for 1st line or 2nd line group of antibiotics under LPA
TAT	As early as 12 days	2-8 weeks	24 hrs	3-4 days
Cost	INR 6000/-	INR 10,000 -15,000/-	INR 2000/- *	INR 4000/-*
Other information	Strain identification Mixed infection Coinfection			

TAT: Turn-around-time; DST: Drug sensitivity test; CBNAAT: Cartridge-based nucleic acid amplification test; LPA: Line probe assay ; * - IRNOT rates

What do guidelines say?

Global as well as Indian authorities such as the World Health Organization and the National TB Elimination Programme have evaluated and indicated the promise of NGS-based approaches.[1,3]

Whole Genome Sequencing is a widely recommended assessment method for tuberculosis with the potential to be implemented for general patient use even in high burden countries such as India. TGS is a complete spectrum of existing antibiotics; (which can cover newly introduced too) solution that produces an accurate and clinically relevant report as early as 12 days.

References

1. Meehan CJ, Goig GA, Kohl TA, et al. Whole genome sequencing of Mycobacterium tuberculosis: Current standards and open issues. Nat Rev Microbiol. 2019;17(9):533-545.
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3. Mistry N, Rangan S, Dholakia Y, et al. Durations and delays in care-seeking, diagnosis and treatment initiation in uncomplicated pulmonary tuberculosis patients in Mumbai, India. PLoS One. 2016 Mar 28;11(3):e0152287. doi: 10.1371/journal.pone.0152287.
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8. Chatterjee A, Nilgiriwala K, Saranath D, Rodrigues C, Mistry N. Whole genome sequencing of clinical strains of Mycobacterium tuberculosis from Mumbai, India: A potential tool for determining drug-resistance and strain lineage. Tuberculosis (Edinb). 2017;107:63-72.

PROCESSED AT : FOCUS TB — Towards a TB free world — Powered by Thyrocare — The Trust. The Truth.

NAME : MR DUMMY
REFERRED BY : DR ABC
TEST ASKED : TS WHOLE GENOME SEQUENCING
HOME COLLECTION : 13 HOSPITAL HANUMAN MANDIR NEAR - 400004

TGS GENOME ANALYSIS REPORT

CLINICAL SUMMARY

Mycobacterium tuberculosis detected : Detected
Coverage : 389.54
Lineage : EAI
Proportion of Genome covered : 1.00
Genomic DST Profile : Drug-Resistant tuberculosis (DR-TB)

DRUG SUSCEPTIBILITY PROFILE

FIRST LINE

Drug	Interpretation
Isoniazid (INH)	Resistant*
Rifampicin (RMP)	Sensitive**
Ethambutol (EMB)	Sensitive**

GROUP A

Drug	Interpretation
Ofloxacin (OFX)	Resistant*
Moxifloxacin (MOX)	Resistant*
Gatifloxacin (GAT)	Resistant*
Linezolid (LZD)	Sensitive**
Bedaquiline (BDQ)	Resistant*

GROUP B

Drug	Interpretation
Clofazimine (CLO)	Resistant*

GROUP C

Drug	Interpretation
Streptomycin (SM)	Sensitive**
Pyrazinamide (PZA)	Sensitive**
Amikacin (AMK)	Sensitive**
Delaminid (DMD)	Sensitive**

OTHERS

Drug	Interpretation
Capreomycin (CAP)	Sensitive**
Ethionamide (ETO)	Resistant*
Kanamycin (KAN)	Sensitive**
Para-aminosalicylic acid (PAS)	Sensitive**
Pretomanid (PTM)	Sensitive**

* Refer to mutation table
** No mutation detected, expert consultation advised

FocusTB — Towards a TB free world — Powered by Thyrocare — The Trust. The Truth.

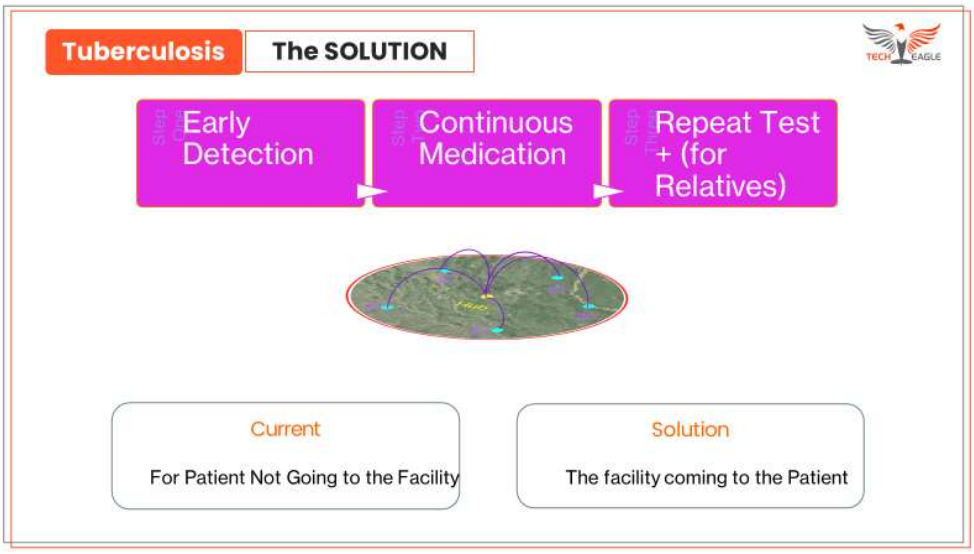
MUTATION TABLE

Position	Ref Allele	Alternate Allele	Type	Frequency	Coverage	Substitution	Gene Symbol	Gene Name	Drug	PMID	High Confidence SNP
7581	G	T	SNP	57.86	436	Asp94Tyr (gac/Tac)	Rv0006	gyrA	FQ	21562102	yes
778991	T	C	SNP	33.18	428	Val1Ala (gtg/gCg)	Rv0678	-	BDQ;CFZ	24590481; 26555934; 26045528	no
1674481	T	G	SNP	53.22	342	Ser94Ala (tcg/Gcg)	Rv1484	inhA	INH;ETH	24055765	yes

GENOME SEQUENCING SUMMARY

Library type: 150x2 paired end	Library Date: 10-10-2022	Library QC: Pass
Genome Sequencer: NovaSeq6000	Run Date: 13-10-2022	Machine/ Flow cell ID: A01580-HW27NDSX3
Application: OmegaTB v2.0.1	Application Run By: HAPL	QC Check: Pass

SMART Logistic networks with Drones



SMART Logistic networks with Drones

SKYE AIR

Introduction

Skye Air is Asia's largest leading SaaS based dorne logistics company with widespread operations delivering for leading Health care, e-commerce, quick-commerce, tech and agri-commodity players.

FLIGHTS	Clients	Delivery	Skye Tunel
4500+	20+	1.3 Mn Packets	150+

The overall vision of Skye Air Mobility is to **Transform, build and operate** a futuristic solution to help mankind. To create a **faster, smarter environment friendly** air mobility solution.

Aster · SUNZO · SWIGGY · BLUE DART DHL · Apollo HOSPITALS · Redcliffe labs · SRL Diagnostics · Pathkind Labs

SKYE AIR

Himachal Pradesh & Uttarakhand - NHM TB Drugs Delivery

Skye Air Mobility has an immersive drone delivery model to optimize the current healthcare logistics within Himachal Pradesh & Uttarakhand. Skye Air started the immersive delivery plan to enable deliveries from District CMS & Blood Banks to PHCs, CHCs, Blood Storage Units and further from PHCs/CHCs to Distribution Central & Diagnostic laboratories. Delivery model divides the entire healthcare logistic within a district in 4 zones namely:

- **Zone 1** - Pickup Zone 1 (CMS/DH/Blood Bank/VCS)
- **Zone 2** - Drop Zone 1 (PHC/CHC/BSU)
- **Zone 3** - Pickup Zone 2 (PHC/CHC)
- **Zone 4** - Drop Zone (Distribution Center)

SKYE AIR

SKYEZONE

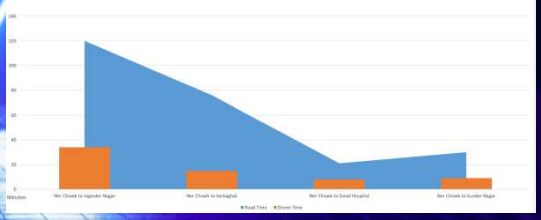
User Name

Password

Login

SKYE AIR

Road Vs Drone Delivery



SKYE AIR

Pros of Drone Delivery

- At Scale, Drones can **save up to 20% of cost** compared to current hectic and non efficient way of logistics.
- This would result in **70% increase in efficiency**, Minimum that to no involvement of man, in turn reducing human error.
- TAT can be **reduced by 30%** and above
- No restrictions on working hours.
- Significant reduction in cost per delivery at scale
- Direct connectivity
- 100% Customer satisfaction
- Enabling same day and instant delivery on time for time sensitive and emergency TB Drugs and vaccines.

Taking TB Care to Community

BD SANKALP- *A Pledge to Fight TB Together*

A catalytic effort to support National TB Elimination Program (NTEP) to further strengthen TB detection and management

Key Interventions of the Project

Active Case Finding (ACF)
Covering every household in the project area to identify presumptive TB cases.

Capacity Building
Building community volunteers and outreach workers' capacity on TB identification, treatment initiation and adherence.

Provider Engagement
Engage with pharmacists and registered medical practitioners

Bringing TB Diagnostics Closer
A Mobile Medical Van, equipped with X-ray, CBNAAT, and AI assisted tele-radiology capabilities

Treatment and Adherence for TB positive patients
Follow-up with TB positive patients and their contacts through the entire care cascade

Information, Education and Communication
Community awareness programs about early detection, seeking timely help, and reducing stigma.

Active Case Finding

- Intensified door to door ACF through a digital mobile app
- Geo-spatial mapping
- QR code-based identification of every house

Diagnosis through Chest X ray and NAAT

- Presumptive TB cases undergo Chest X ray & CBNAAT as per NTEP guidelines
- AI assisted Teleradiology innovation including Radiologist's review
- TAT ~20-25 minutes

BD

BD SANKALP- *A Pledge to Fight TB Together*

Sustainable

- Deep stakeholder engagement & regular feedback
- Integration with local community
- Local resources leveraged, employed & digital upskilling
- Standardized awareness /training for best practice adoption and reduced stigma
- Robust M/E framework
- Facilitating timely management, adherence & arresting further transmission

Innovative

- Digitized ACF questionnaire
- Real Time Tracking Dashboard
- AI assisted Teleradiology
- Assured and Integrated data confidentiality
- Geo-spatial mapping

A senior citizen being assisted for CXR

Scalable

- Digitized ACF questionnaire
- Customized Mobile van
- Robust M/E framework
- Digital innovations
- IEC materials including an animation video
- Replicable and effective project model

Equitable

- Holistic coverage with special focus on vulnerable populations
- Diagnostics access through a mobile van closer to the homes

BD

BD SANKALP- *A Pledge to Fight TB Together*

Key Impact Metrices (4th Aug 2022-10th March 2023)

Last Updated: 10 March 2023

Individuals screened
1,07,974 across 30,612 households

Presumptive identified
2,353

Diagnosed with TB
118
Treatment completed: 19
Treatment ongoing: 99

Patient preparation for CXR | CBNAAT test in progress | ACF through mobile app

BD

Taking TB Care to Community

Indo-Japan Private Sector Collaboration for Mobile Diagnostic Van with Onboard X-Ray AI and RMDs (FujiFilm India/Molbio/Qure AI)

FUJIFILM Value from Innovation

Enabling Tuberculosis Screening in Every Corner of the country

NEVER STOP

World Health Organization

New Guideline: Screening with Chest X-Ray Images + AI Assist

FDR Xair

Compact and lightweight Portable X-ray system (Weight 3.5kg)

3.5kg

#1 global market share*

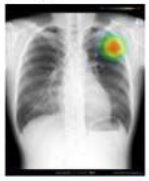
Digital X-ray diagnostic imaging equipment

High Sensitivity Detector technology

Mobile console

*Signify data

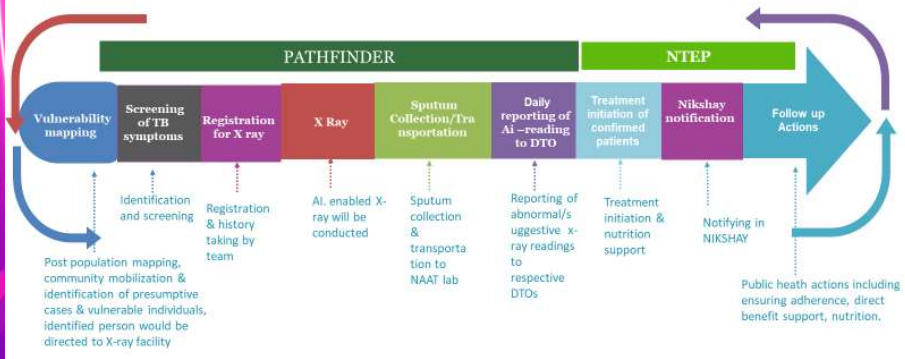
QURE AI-powered diagnostic support



FUJIFILM Value from Innovation

NEVER STOP

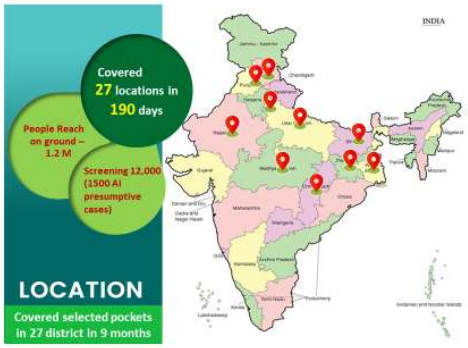
CASCADING CARE FLOW DIAGRAM: MOBILE X-RAY SCREENING



FUJIFILM Value from Innovation

MOBILE SCREENING INITIATIVE FOR TB (Phase I)

NEVER STOP



117 new TB patients were identified !!

FUJIFILM Value from Innovation

MOBILE SCREENING INITIATIVE FOR TB (Phase II)

NEVER STOP

Project Geography

The program will be implemented in high priority pockets in six districts of Assam and one each in Gujrat and Kerala.

- Tea Tribe of Assam (*Symptomatic Screening 1,50,000*)
- Industrial Workers of Kutch (*Symptomatic Screening 1,00,000*)
- Tribal Population of Wayanad (*Symptomatic Screening 1,00,000*)

Nutrition Support

- Three districts namely Sivasagar (Assam), Wayanad (Kerala) & Kutch (Gujrat) will be adopted for nutrition support (in addition to screening exercise) for six months under the program.
- More than 5800 packets of food basics such ground almonds, kidney beans, green lentils, skinned chickpeas, and mustard/coconut oil will be distributed.

Community led TB Response

INNOVATIONS

to engage TB Champions

Empowering women

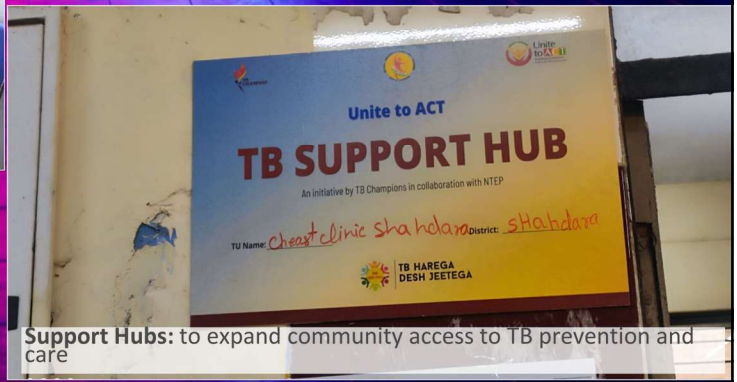
as community health mentors through an IVRS-based platform

Communications training:

Skill development for TB Champions to become effective communicators

Providing person-centred support: through tele counselling to people with TB in Bihar during the COVID-19 pandemic

Community Accountability Framework-to identify any gaps in quality of care and services provided to PwTB



Support Hubs: to expand community access to TB prevention and care

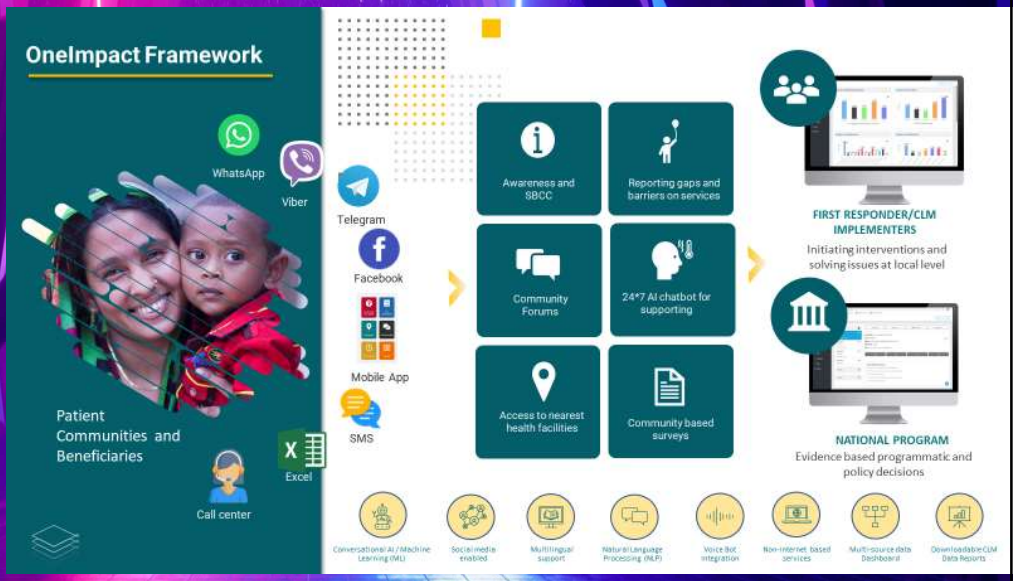
Community led TB Response

TB Mitra CLM platform for TB communities

TB Mitra, a unique mobile-based application for TB-affected communities supported by USAID and National TB Program of India as the key CLM intervention.

The platform was fully adopted and rolled out nationally by India with complete integration with the national TB surveillance system NIKSHAY.

OneImpact Framework



Dure' Global Partnerships and Footprint

Dure's is working with more then 50 global partners spread across 40+ countries with over 200+ project experience

Data Driven Actions to End TB

AI solution for ppredicting lost to follow up and death

THE PROBLEM

Despite an increase in efforts to curb non-adherence to TB treatment regimens, the number of TB patients who were lost to follow-up (LFU) in 2021 was over 4% of the total incidence.

Besides facing a higher risk of developing and amplifying drug-resistant TB, LFU patients may face outcomes such as mortality (5% of total) due to inadequate care at the onset of treatment.

OUR AI-POWERED SOLUTION

We are developing a solution for the early identification of TB patients at risk of LFU, and adverse outcomes such as mortality, at the onset of treatment initiation, to facilitate timely and effective care measures for high-risk patients.

The AI model employs an ensemble of models trained using Ni-kshay data, corresponding to treatment outcomes for half a million TB patients across India.

- Transforming the nature of the adherence system from reactive to proactive.
- Empowering health staff with effective decision for differentiated care.

Source: National Tuberculosis Prevalence Survey in India, 2021

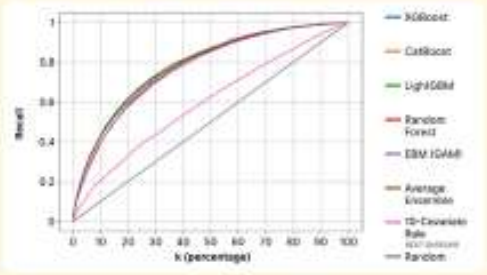
LFU AND MORTALITY PREDICTION VALUE PROPOSITION FOR THE NATIONAL TUBERCULOSIS ELIMINATION PROGRAM (NTEP)

Predicting the risk of non-adherence and mortality at the very beginning of the TB cascade of care.

Enabling effective field interventions that work towards reducing adverse outcomes for TB patients.

SOLUTION OVERVIEW: LFU AND MORTALITY PREDICTION

AI MODEL VS. RULE-BASED (10 COVARIATES) PREDICTION



Recall@k vs. k curve for our best models shows a **significant lift in performance** over all values of k (the target percentage).

The Facilitators

India Health Fund : Design and Purpose

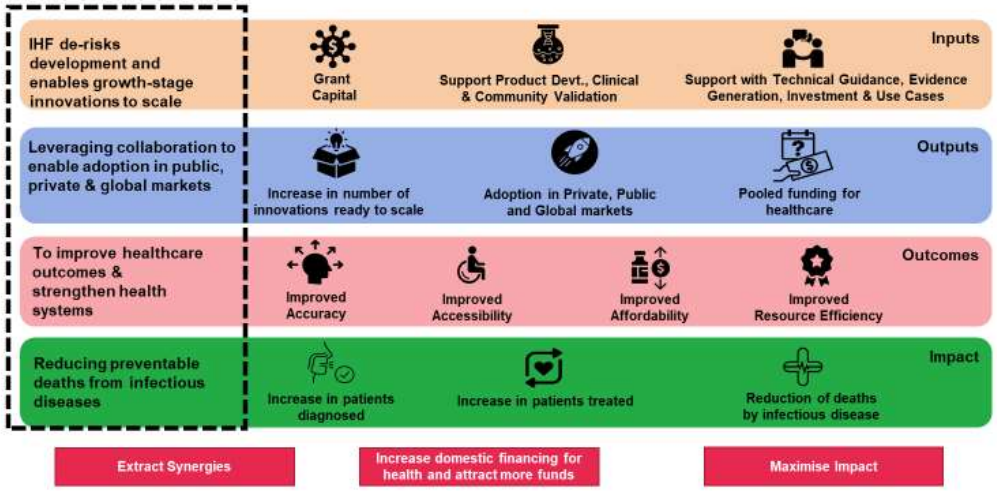
TATA TRUSTS

THE GLOBAL FUND

INDIA HEALTH FUND
A TATA TRUSTS INITIATIVE

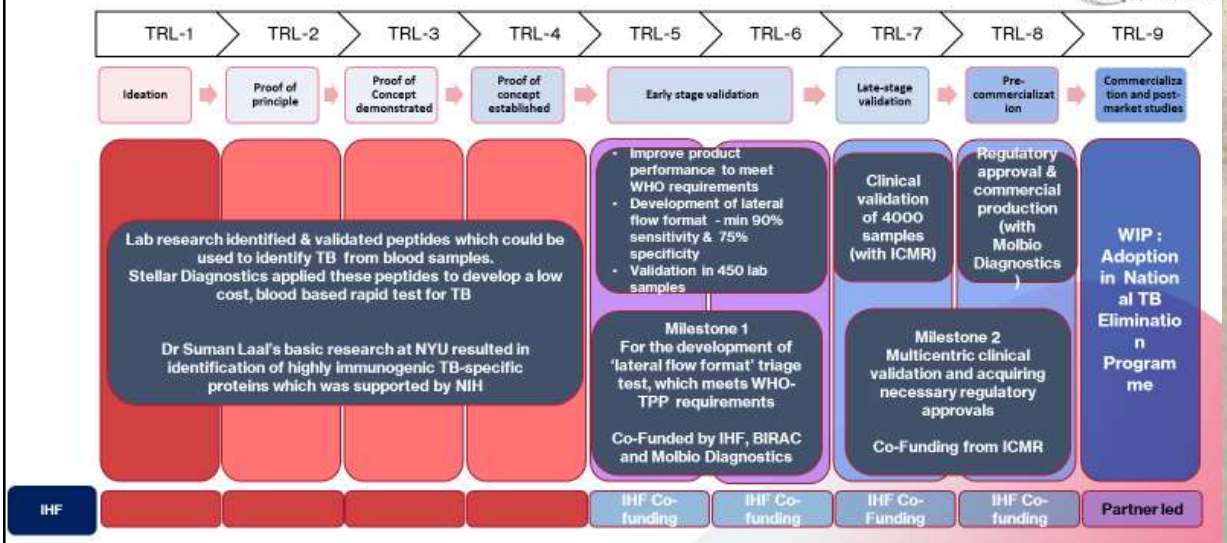
- Designed by Tata Trusts in collaboration with The Global Fund to Fight TB and malaria
- Create a pooled mechanism for health financing in India to end infectious diseases & other public health threats
- Enable agility & innovation by supporting programmes & projects which develop:
  - *New products or strategies to address infectious diseases*
  - *Innovative business models, partnerships or financing mechanisms to significantly scale up solutions*

IHF's theory of change links de-risking innovation development with strengthening health systems

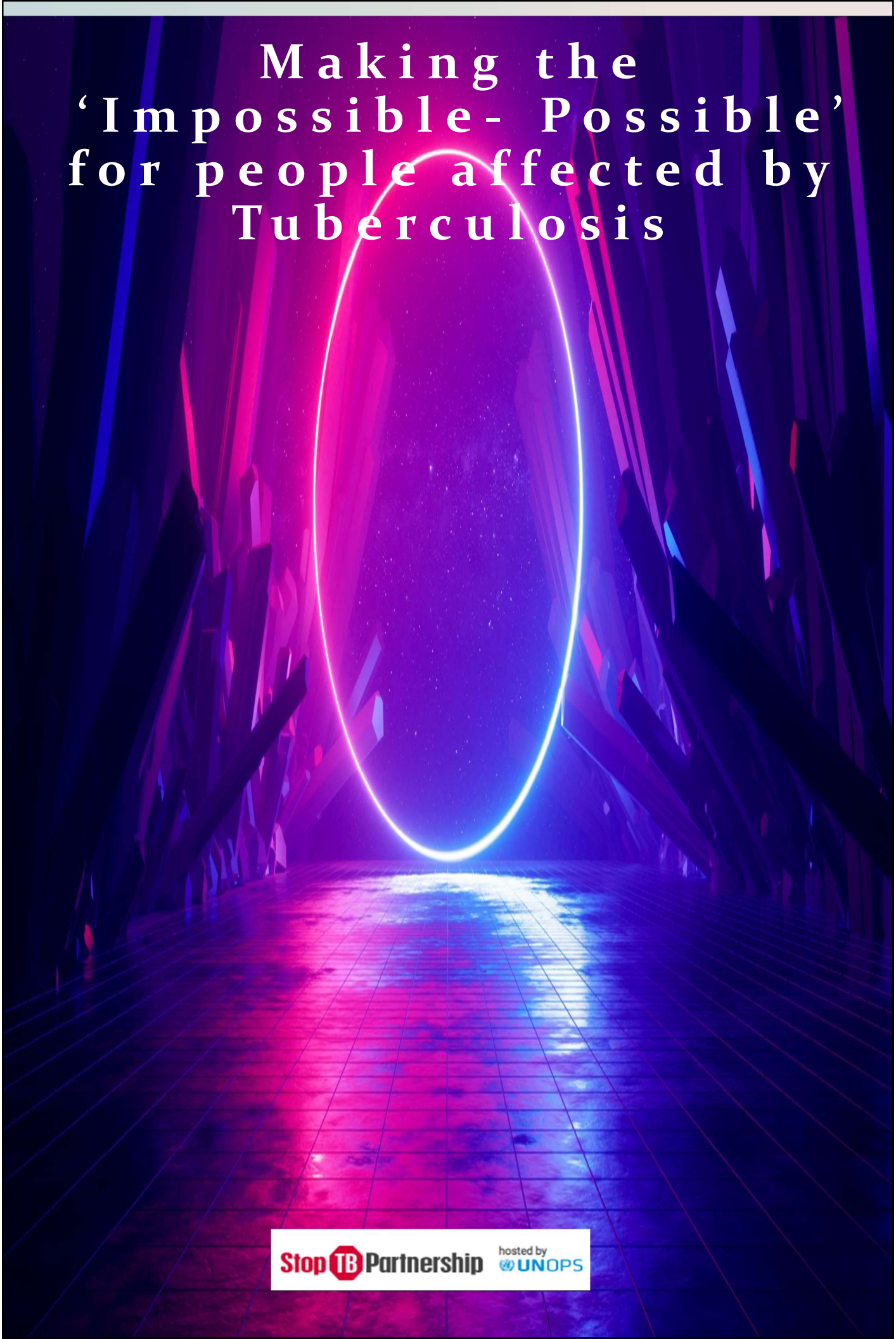


Diagnostics: Stellar Diagnostics – a first-of-its-kind rapid test for TB

Stellar



Making the ‘Impossible- Possible’ for people affected by Tuberculosis



Stop TB Partnership hosted by UNOPS