HIV-MDR TB co infection in India

D. Behera
Director
LRS Institute of TB & Respiratory Diseases
New Delhi
Introduction

• Human immunodeficiency virus (HIV) multi-drug resistant TB (MDR-TB), and extensive drug resistant tuberculosis (XDR-TB) have emerged as threats to TB control.

• Given the dynamic interplay between HIV and TB, it is not surprising that MDR-TB has complicated the picture

• However, the association between MDR-TB and HIV infection has not yet been fully investigated.
HIV-MDR TB

- HIV and MDR-TB are an even deadlier combination

- > 50% of HIV- MDR-TB patients in Peru died within two months of diagnosis

- Studies with longer follow up observed death rates ranging from 72 to 89%

    - Am J Trop Med Hyg
  
    - Trop Med Int Health
HIV-MDR TB

• A study in the UK estimated that MDR-TB patients who are immune-compromised are nine times more likely to die than those not immune-compromised

In a XDR-TB outbreak in South Africa, 98% of co-infected patients died with median survival time of 16 days from XDR-TB diagnosis.

HIV-MDR TB

• HIV infection has been associated with MDR-TB outbreaks in institutional settings, such as hospitals and prisons

• It remains less clear whether HIV infection is also associated with MDR-TB in community settings


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Thailand survey

- In Thailand as part of a sentinel surveillance system, data was collected prospectively about pulmonary TB cases treated in public clinics.

- Results: HIV is common among MDR-TB patients, but is not an independent risk factor for MDR-TB.

- Populations at high risk for HIV—young adults, men, injection drug users—should be prioritized for drug susceptibility testing.

Suchindran S, Brouwer ES, Van Rie A et al - 2009

- conducted a systematic review and meta-analysis to summarize the evidence on the association between HIV infection and MDR-TB
- 32 eligible studies
Results:

• No clear association was found between MDR-TB and HIV infection across time and geographic locations.

• MDR-TB prevalence ratios comparing MDR-TB prevalence by HIV status, ranged from 0.21 to 41.45

• Assessment by geographical region or study period did not reveal noticeable patterns.

• The summary prevalence ratios for acquired and primary MDR-TB were 1.17 (95% CI 0.86, 1.6) and 2.72 (95% CI 2.03, 3.66), respectively.


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Conclusions:

- Could not demonstrate an overall association between MDR-TB and HIV or acquired MDR-TB and HIV
- Results suggested that HIV infection is associated with primary MDR-TB.

• Future well-designed studies and surveillance in all regions of the world are needed to better clarify the relationship between HIV infection and MDR-TB

Treatment of HIV with MDR TB

- Can safely co-administer:
  - Usual second line ATT
  - Nevirapine based first line ART regimen

- Case fatality rates are reported to be high in patients with HIV - MDR TB

Sputum examination for 1000 patients:

- 618 patients (61.8%) culture positive
- 495 (49.5%) had drug resistant tubercule bacilli, to one or more drugs
- 339 (33.9%) of these were MDR TB bacilli
- Sero-positivity in MDR TB was 4.42%
- 245 (24.5%) – Resistant one or more reserve drugs (ET, K/O)


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**Total No.** | **25 (HIV & New TB)**
---|---
Resistance to |
• INH | 92%
• Rifampicin | 65%
• SM | 81%
• EMB | 77%
• Second Line Drugs | 50-100%

Sputum and Blood samples

?Methodology

?Standardized lab
## Table
Mycobacterial drug susceptibility pattern in patients with HIV and pulmonary tuberculosis

<table>
<thead>
<tr>
<th></th>
<th>New n (%)</th>
<th>Previously treated n (%)</th>
<th>Total n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients tested</td>
<td>167 (100.0)</td>
<td>37 (100.0)</td>
<td>204 (100.0)</td>
</tr>
<tr>
<td>Sensitive to all drugs</td>
<td>141 (84.4)</td>
<td>23 (62.2)</td>
<td>164 (80.4)</td>
</tr>
<tr>
<td>Drug resistance</td>
<td>26 (15.6)</td>
<td>14 (37.8)</td>
<td>40 (19.6)</td>
</tr>
<tr>
<td>Any resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>22 (13.2)</td>
<td>10 (27.0)</td>
<td>32 (15.7)</td>
</tr>
<tr>
<td>R</td>
<td>7 (4.2)</td>
<td>7 (18.9)</td>
<td>14 (6.9)</td>
</tr>
<tr>
<td>E</td>
<td>4 (2.4)</td>
<td>1 (2.7)</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>S</td>
<td>13 (7.8)</td>
<td>4 (10.8)</td>
<td>17 (8.3)</td>
</tr>
<tr>
<td>Mono resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>8 (4.8)</td>
<td>4 (10.8)</td>
<td>12 (5.9)</td>
</tr>
<tr>
<td>R</td>
<td>0 (0.0)</td>
<td>2 (5.4)</td>
<td>2 (1.0)</td>
</tr>
<tr>
<td>S</td>
<td>4 (2.4)</td>
<td>2 (5.4)</td>
<td>6 (2.9)</td>
</tr>
<tr>
<td>Multidrug resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>4 (2.4)</td>
<td>4 (10.8)</td>
<td>8 (3.9)</td>
</tr>
<tr>
<td>HR±E±S</td>
<td>7 (4.2)</td>
<td>5 (13.5)</td>
<td>12 (5.9)</td>
</tr>
<tr>
<td>Other patterns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS</td>
<td>6 (3.6)</td>
<td>1 (2.7)</td>
<td>7 (3.4)</td>
</tr>
<tr>
<td>HSE</td>
<td>1 (0.6)</td>
<td>0 (0.0)</td>
<td>1 (0.5)</td>
</tr>
</tbody>
</table>

New patients = nil or <1 month prior chemotherapy; previously treated = previously treated for >1 month.
HIV = human immunodeficiency virus; H = isoniazid; R = rifampicin; E = ethambutol; S = streptomycin.
Study from NARI, Pune –

- 30 isolates from HIV infected patients,
- 10 per cent were resistant to isoniazid (H),
- 6.6 per cent to streptomycin (S),
- 6.6 per cent to ethambutol (E) and
- 10 per cent were multi drug resistant (MDR).

- Of the 40 *M. tuberculosis* isolates from HIV negative only 2.5 per cent isolates were MDR

Fifty-four full-blown AIDS patients suspected of having HIV-tuberculosis co-infection

Out of the 54 patients, M. tuberculosis was isolated from 24 (44.4%).

Twelve (50%) isolates of these had resistance to first-line drugs,

Four (33.33%) were also resistant to second-line drugs.

All four patients, in whom XDR M. tuberculosis was isolated, died within 2.6 months of diagnosis.

High rate of extensively drug-resistant tuberculosis in Indian AIDS patients.


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Data from Delhi  \textbf{(Sharma et al, IJMR 2011)}

- A total of 218 cases of sputum-positive pulmonary tuberculosis
- 41 cases had negative mycobacterial cultures
- DST was carried out in 177 cases.
- Mean age of the patients was 27.8 ± 10.2 yr;
- 59 patients (27\%) were female
- All patients tested negative for HIV infection
- Out of 177 cases, two cases of MDR-TB were detected (1.1\%)
<table>
<thead>
<tr>
<th>Location</th>
<th>Period of study</th>
<th>No. of isolates</th>
<th>MDR-TB (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangalore</td>
<td>1980s</td>
<td>436</td>
<td>1.1</td>
</tr>
<tr>
<td>Wardha</td>
<td>1982-1989</td>
<td>323</td>
<td>5.3</td>
</tr>
<tr>
<td>North Arcot</td>
<td>1985-1989</td>
<td>2779</td>
<td>1.6</td>
</tr>
<tr>
<td>Pondicherry</td>
<td>1985-1991</td>
<td>1841</td>
<td>0.8</td>
</tr>
<tr>
<td>Kolar</td>
<td>1987-1989</td>
<td>292</td>
<td>3.4</td>
</tr>
<tr>
<td>Jaipur</td>
<td>1989-1991</td>
<td>1009</td>
<td>0.9</td>
</tr>
<tr>
<td>New Delhi</td>
<td>1990-1991</td>
<td>324</td>
<td>0.6</td>
</tr>
<tr>
<td>Pune</td>
<td>1992-1993</td>
<td>473</td>
<td>1.0</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>1997</td>
<td>384</td>
<td>3.4</td>
</tr>
<tr>
<td>North Arcot</td>
<td>1999</td>
<td>282</td>
<td>2.8</td>
</tr>
<tr>
<td>Lucknow</td>
<td>2000-2002</td>
<td>318</td>
<td>13.2</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>2001-2003</td>
<td>714</td>
<td>0.14</td>
</tr>
<tr>
<td>Ernakulam</td>
<td>2004</td>
<td>305</td>
<td>2.0</td>
</tr>
<tr>
<td>Gujarat</td>
<td>-</td>
<td>1571</td>
<td>2.4</td>
</tr>
<tr>
<td>Mumbai</td>
<td>2004-2007</td>
<td>493</td>
<td>24.0</td>
</tr>
<tr>
<td>Present study</td>
<td>2008-2009</td>
<td>177</td>
<td>1.1</td>
</tr>
</tbody>
</table>
# HIV Among MDR-TB Patients in 2009 (2011 MDR progress report)

<table>
<thead>
<tr>
<th>Country</th>
<th>% of MDR-TB patients living with HIV/AIDS</th>
<th>Odds of HIV-positive TB patient having MDR-TB over odds of HIV-negative TB patient having MDR-TB</th>
<th>Source of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ukraine</td>
<td>23.8</td>
<td>1.5(1.1-2.0)</td>
<td>2006 Survey</td>
</tr>
<tr>
<td>Republic of Maldova</td>
<td>9.7</td>
<td>2.0 (1.4-2.9)</td>
<td>2009 routine Surveillance</td>
</tr>
<tr>
<td>Latvia</td>
<td>24.6</td>
<td>1.9(0.9-3.5)</td>
<td>2008 routine Surveillance</td>
</tr>
<tr>
<td>Estonia</td>
<td>7.2</td>
<td>0.8(0.2-2.1)</td>
<td>2009 routine Surveillance</td>
</tr>
</tbody>
</table>
• Contrary to Eastern European Study, in India did not demonstrate any association between HIV and MDR TB
• DR Survey of Andhra Pradesh (2009) – No association
• Decision of lab committee – all future DRSs should capture HIV status
• With implementation of ‘routine referral of TB patients for HIV testing’
• Effort to capture this data
• No HIV +ve in 126 MDR patients  \textit{(Singla et al, Int J TUBERC Lung Dis, 2009)}
### HIV and TB drug resistance – No association!

<table>
<thead>
<tr>
<th>HIV status</th>
<th>Pan sensitive</th>
<th>Any resistance</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>131 (69.3%)</td>
<td>40 (21.2%)</td>
<td>18</td>
<td>189</td>
</tr>
<tr>
<td>Negative</td>
<td>1152 (69.9%)</td>
<td>335 (20.3%)</td>
<td>161</td>
<td>1648</td>
</tr>
<tr>
<td>Unknown</td>
<td>608 (71%)</td>
<td>170 (19.9%)</td>
<td>78</td>
<td>856</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1891</strong></td>
<td><strong>545</strong></td>
<td><strong>257</strong></td>
<td><strong>2693</strong></td>
</tr>
</tbody>
</table>

Source - AP DRS
<table>
<thead>
<tr>
<th>Study</th>
<th>Setting</th>
<th>No. of MDR cases</th>
<th>No. Of HIV +ve</th>
<th>Prevalence of XDR-TB (%)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas et al, 2007</td>
<td>Field trial, Chennai</td>
<td>66</td>
<td>Not reported</td>
<td>1(1.5)</td>
<td>IJT, 2007</td>
</tr>
<tr>
<td>Sharma et al, 2009</td>
<td>AIIMS, New Delhi, tertiary care hospital</td>
<td>211</td>
<td>All HIV-negative</td>
<td>5(2.4)</td>
<td>IJMR, 2009</td>
</tr>
<tr>
<td>Ramchandran et al, 2009</td>
<td>Gujrat, Field study</td>
<td>216</td>
<td>Not reported</td>
<td>7(3.1)</td>
<td>IJTLD, 2009</td>
</tr>
<tr>
<td>Myneedu et al, 2011</td>
<td>LRS Institute</td>
<td>223</td>
<td>Not reported</td>
<td>45( 20.17)</td>
<td>IJT, 2011</td>
</tr>
</tbody>
</table>
HIV-associated TB disease in India

- Total population of 1.21 billion
- 400 million+ TB infected
- 1.9 million new TB cases
- ≥0.9 million TB/HIV co-infected
- ~2.27 million HIV-infected
- 4.85% TB cases HIV-infected (~95,240 cases)

1.9 million new cases per year → But TB epidemic in India is being primarily driven by the 399 million TB infected non-HIV infected pool
National estimate of HIV seroprevalence among tuberculosis patients in India


*Office of the World Health Organization Representative to India, New Delhi. †Central Tuberculosis Division, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, New Delhi, India; ‡Consultant, Geneva, Switzerland; §National AIDS Control Organization, Ministry of Health and Family Welfare, Government of India, New Delhi, India

SUMMARY

The national estimate for human immunodeficiency virus (HIV) prevalence among tuberculosis (TB) patients in India has previously been estimated indirectly from global data. To derive an improved national estimate from local data, we correlated district-level HIV surveillance data from antenatal clinics and TB diagnostic centres, and applied this correlation to state-level HIV prevalence estimates for the antenatal population. We estimate that among the 1.96 million incident TB cases in 2007, 4.85% (95% CI 4.12–5.73) or 95,240 (95% CI 80,730–112,478) were HIV-infected. With these estimates from local data, the national programme can better plan TB–HIV collaborative activities and monitor efforts to detect HIV infection in this large population.

KEY WORDS: HIV; tuberculosis; surveillance; India
Proportion of Registered TB patients who are HIV+, 1q10

Highly Variable!!
## RNTCP: HIV status among TB patients registered for DOTS
### 1Q-2Q 2009 Karnataka State

<table>
<thead>
<tr>
<th>District</th>
<th>Total TB patients registered for DOTS</th>
<th>No. known to be tested for HIV (%)</th>
<th>Of the number tested for HIV, no. known to be HIV infected (%)</th>
<th>Minimum % HIV positive among registered TB patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAGALKOT</td>
<td>1114</td>
<td>913</td>
<td>423</td>
<td>46%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38%</td>
</tr>
<tr>
<td>BELGAUM</td>
<td>2544</td>
<td>1812</td>
<td>493</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19%</td>
</tr>
<tr>
<td>BIJAPUR</td>
<td>1135</td>
<td>790</td>
<td>340</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>DHARWAD</td>
<td>931</td>
<td>612</td>
<td>116</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12%</td>
</tr>
<tr>
<td>GADAG</td>
<td>530</td>
<td>332</td>
<td>54</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>HAVERI</td>
<td>750</td>
<td>577</td>
<td>67</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>UTTARA_KANNADA</td>
<td>646</td>
<td>359</td>
<td>54</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>BIDAR</td>
<td>856</td>
<td>649</td>
<td>66</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>BELLARY</td>
<td>1528</td>
<td>1075</td>
<td>133</td>
<td>12%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9%</td>
</tr>
<tr>
<td>GULBARGA</td>
<td>1922</td>
<td>959</td>
<td>152</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8%</td>
</tr>
<tr>
<td>KOPPAL</td>
<td>877</td>
<td>757</td>
<td>134</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>RAICHUR</td>
<td>1456</td>
<td>1193</td>
<td>187</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13%</td>
</tr>
<tr>
<td>KARNATAKA</td>
<td>34165</td>
<td>24246</td>
<td>3977</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12%</td>
</tr>
</tbody>
</table>

Source: Central TB Division, 2009
TB-HIV activities in India

- TB-HIV collaboration began in 2001
  - Joint training
  - Intensified case finding at ICTCs
  - HIV testing of TB patients with HIV risk factors

- 2004: Scale up of activities to ICTCs in 8 States

- 2006: Scale-up of activities to 14 states

- 2007: Piloted CPT & Routine Referral of TB patients for HIV testing (5 Districts)

- 2008: National Framework for Collaborative TB-HIV activities
Intensified Case Finding - TB suspects referred from ICTC for evaluation, 2005-2008

> 8 fold increase in referrals

Source: Monthly reports from ICTCs collated and reported by respective State AIDS Control Societies
TB-HIV Collaboration: Future Plans

- Phased expansion of Intensified TB/HIV package, to cover the entire country by 2012
- Initiation of IPT pilots
- Development of operational guidelines for Airborne Infection Control
- Replacement of rifampicin with rifabutin for HIV positive TB patients on 2nd line ART
- Development of training manual on TB/HIV for ART Centre Staff
- Development of training material (i.e. simplified manuals) for low HIV prevalence states
TB-HIV Interaction in India

• India has the highest burden of TB, and a high burden of HIV in the world
• Most TB is among persons without HIV; magnitude variable
• HIV may slow down TB control efforts in India
  • Particularly efforts to reduce mortality
• Enormous need for improved TB-HIV programme collaboration
Currently 11 states implementing (TN, AP, KA, MH, PD, GA, MZ, MN, NG, GU, DL)
Launched in 7 states (AS, WB, OR, KE, RJ, PN, CH) in 2009
Rolled out in 11 states in 2010 (HR, UK, HP, JH, CG, TR, ArP, ME, SI, MP, UP)

- Intensified TB-HIV package - Nationwide coverage by 2012
Trends in Number (%) of registered TB patients with known HIV status, 4q08-2q10

Number of Registered TB Patients

Unknown HIV status
Known HIV status

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Unknown HIV Status</th>
<th>Known HIV Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>4q08</td>
<td>34%</td>
<td></td>
</tr>
<tr>
<td>1q09</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>2q09</td>
<td>54%</td>
<td></td>
</tr>
<tr>
<td>3q09</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>4q09</td>
<td>62%</td>
<td></td>
</tr>
<tr>
<td>1q10</td>
<td>66%</td>
<td></td>
</tr>
<tr>
<td>2q10</td>
<td>61%</td>
<td></td>
</tr>
</tbody>
</table>
Number (%) of HIV+ TB patients receiving ART during TB treatment, 4q08-2q09

By quarter of TB registration

- 4q08: 41%
- 1q09: 43%
- 2q09: 47%

Number of HIV+TB patients receiving ART

% of HIV+TB patients receiving ART
Trends in Number of TB suspects referred from ICTC to RNTCP 2006–2010 (June)
Trends in TB case detection from ICTC to RNTCP referrals, 2006–2010 (June)

- No. TB cases diagnosed from ICTC referrals
- % of TB cases put on DOTS
Next Steps – 2010-15

- Intensified TB/HIV package - Nationwide coverage by 2012
  - Provider-initiated HIV testing for all TB patients
  - Immediate and accountable linkage of HIV-infected TB patients to NACP for HIV care and treatment
- Intensified TB case finding and reporting – Consolidation in all HIV care settings
- Completed clinical and operational research on IPT for TB/HIV with policy decisions
- Implementation of airborne infection control measures
- HIV Surveillance among TB suspects at some sentinel sites
- RCT among HIV-infected TB patients comparing daily v/s intermittent regimens
HIV and MDR TB in India

- 5% of MDR TB cases
- ~ 5,000 cases of MDR with HIV +ve
- Diagnostic issues
- Treatment issues
- Cure rates
- To ensure MDR TB Treatment + ART + CPT
- Within the System
- Completion issues
- Drug reactions
Challenges
Challenges in diagnosis of MDR TB...

- Delay in establishment of accredited state level laboratories due to a host of reasons

- Sub-optimal functioning of the accredited labs
  - Non-availability of trained manpower
    - Dedicated regular staff in addition to the contractual posts
  - Uninterrupted power supply

- Diagnostic delay with conventional method (3-4 months turn around time)

- Special requirements for introduction of newer rapid diagnostics- laboratory infrastructure and training
Treatment Challenges

- Long duration, toxic, expensive treatment
  - ~2,100 $ per patient course
- Daily ambulatory DOT
  - 6-9 months of injectables
- Availability of DOTS-Plus in-patient sites (1 per 10 million population)
- Extensive training, supervision and monitoring needed at all levels
- Ensuring treatment adherence and timely follow up
- Uninterrupted supply of second line drugs
Infection Control

• **Problem**
  - Infection control considered synonymous with waste management
  - Lack of National guidelines on Airborne Infection control in context of TB
  - Overcrowding/lack of space at health facilities
  - Lack of awareness and commitment of hospital administrators

• **Steps taken**
  - National Airborne Infection Control Committee constituted
  - “National guidelines for airborne infection control” for all healthcare facilities developed and pilot tested
  - Provision of support to upgrade IC measures at
    - DOTS-Plus site indoor facilities
    - Intermediate Reference laboratories
  - Collaboration with AIDS control programme to ensure IC measures at ICTCs and ART centres
  - Encouraging Medical Colleges (through NTF, ZTF and STF mechanism) to develop and implement infection control measures
Targets for Introduction of Tests, leading to sustainable adoption

**Abbreviations**
- CRI: Colorimetric redox indicator assay
- DST: Drug Susceptibility Test
- LED: Light-emitting diode
- LPA: Line probe assay
- LTBI: Latent TB Infection
- MODS: Microscopic observation drug-susceptibility
- NAAT: Nucleic Acid Amplification Test
- NRA: Nitrate reductase assay
- POC: Point of Care

* Manual NAAT: technology for MTB Drug Susceptibility Testing
** Manual NAAT: technology for MTB detection at the Peripheral Lab
*** Manual NAAT: technology for MTB detection at the Community Health Care Level

**Technologies in boxes:** endorsed by WHO
Future Plan

Levels of the health system:
- National Reference Level
- District & Sub-district Level
- Community Level

Diagnostic needs:
- Surveillance
- Reference methods
- Network Supervision

Case finding:
- In-patient care

Primary care:
- Point-of-care (POC) technology

What FIND is doing:
- [Images]
BRINGING CUTTING-EDGE TESTS CLOSER TO PATIENTS

- A self-contained and fully automated diagnostic test that detects both TB and rifampicin resistance within 100 minutes
- with minimal bio-safety requirements.

The Xpert® MTB/RIF is a cartridge-based nucleic amplification test (NAAT) that integrates sputum processing, DNA extraction and amplification, TB and MDR-TB diagnosis.

- In December 2010, WHO endorsed this new rapid test
- Potential to triple the number of MDR-TB cases detected worldwide
- price reductions based on demand/volumes are effected quickly.
- To date, more than 75 countries have taken concrete steps
A small panel of *M.tb* proteins show a strong, statistically confirmed association with active TB.

The complete genome sequence of the best-characterized strain of *Mycobacterium tuberculosis* (*M.tb*), H37Rv, (Cole et al. in 1998.)

Reactivity of the immunoproteome
Kunnath-Velayudhan et al. PNAS 2010; 107(33):14703–08
I. IMPLEMENTATION
1. DOTS Expansion and enhancement
2. Drug Resistant TB
3. TB/HIV
4. Laboratory Strengthening

II. RESEARCH AND DEVELOPMENT
1. Fundamental research
2. Newer Diagnostics
3. New drugs
4. New Vaccines
5. Operational research
NEVER GIVE UP
Go over, go under, go around, or go through.
But never give up.