Application of Implementation Science to TB Evaluation: A Case Study from Uganda

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Advanced TB Diagnostics Research Course
July 9, 2014
Implementation Science

- The **study of methods or strategies** to promote uptake of research findings into routine clinical practice

- NOT simply the validation of evidence-based practices or interventions in “real world” settings

- Implementation depends on behavior of key stakeholders
  - Improving uptake requires changing behavior
  - To change behavior, it helps to understand determinants of current behavior and how behavior changes.
Reasons for Low TB Case Detection

• Cases are being diagnosed but not reported

• Cases are not presenting to TB diagnostic centers

• Cases seek care but are not diagnosed
  – Low sensitivity of microscopy (30-70%)
  – Poor quality of TB evaluation
TB Evaluation Guidelines

- **Standard 2**: All persons with unexplained cough of at least 2 weeks’ duration should be evaluated for TB

- **Standard 3**: All persons who require TB evaluation should be referred for sputum-based microbiologic testing

- **Standard 3**: All persons referred for sputum microscopy should have at least 2 smears examined

- **Standard 8**: Smear-positive patients should be prescribed anti-TB therapy
TB GOAL study

TB Guideline Observation and Adherence in Low-income countries

Study Objectives

• To assess the quality of TB evaluation

• To identify modifiable barriers to TB evaluation

• To develop and test a theory-driven intervention to improve TB evaluation
Study setting

- Network of 6 government health centers
- Partners
  - Uganda Ministry of Health
  - Makerere University
  - UCSF
- Electronic data collection (>100,000 patients/year)
### Patient Record Form

<table>
<thead>
<tr>
<th>Date</th>
<th>OPD Number</th>
<th>Patient's Last Name</th>
<th>First Name</th>
<th>New admission C/D</th>
<th>CNI No</th>
</tr>
</thead>
</table>

**History & Exam Findings**

- Date: [__] / [__] / [__]
- Cough History: [__] (Yes) [__] (No)
- Weight: [__] kg
- Age: [__]
- Gender: [__] (Male) [__] (Female)
- [__] (Unknown)

**Test Results**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV Test</td>
<td>[__]</td>
</tr>
<tr>
<td>CD4 Count</td>
<td>[__]</td>
</tr>
</tbody>
</table>

**TB Exams**

- Chest X-ray: [__] (Positive) [__] (Negative)
- TB PPD: [__] (Positive) [__] (Negative)
- TB Test: [__] (Positive) [__] (Negative)

**TB Diagnoses**

- Tuberculosis: [__] (Yes) [__] (No)
- HIV: [__] (Positive) [__] (Negative)
- Other Infectious Diseases: [__] (Yes) [__] (No)

**TB Medications**

- [__] Category: [__] (Yes) [__] (No)
- [__] Drug: [__] (Yes) [__] (No)
- [__] Other: [__] (Yes) [__] (No)

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*Note: The form contains sections for patient demographics, cough history, TB exams, TB diagnoses, and TB medications. Each section includes various input fields for medical information.*
ISTC Quality Indicators

TB Evaluation Flow Diagram with Quality Indicators

Total Episodes of Care

Cough >= 2 weeks?

Sputum AFB Ordered?

Sputum AFB Completed?

>= 1 Positive

>= 2 Negatives

AFB Smear-Positive

TB Treatment?

Indicator Number

1

2

3

Summary

ISTC-adherent care
Objective 1: “Define quality gap”

<table>
<thead>
<tr>
<th>Q1 2009 (14,852 patients → 365 with cough &gt;2 weeks)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1: Referred for TB testing</td>
<td>21%</td>
</tr>
<tr>
<td>Standard 2: Completed TB testing (if referred)</td>
<td>71%</td>
</tr>
<tr>
<td>Standard 3: Treated for TB (if smear-positive)</td>
<td>73%</td>
</tr>
<tr>
<td>ISTC-adherent care</td>
<td>11%</td>
</tr>
</tbody>
</table>

ISTC, International Standards for TB Care

Davis JL, AJRCCM 2011
Objective 2: “Understand quality gap”

- Conceptual Model: Theory of Planned Behavior

- Knowledge/skills
- Attitudes
- Social Norms
- Self-efficacy

\[ \text{Intention to Follow ISTC} \rightarrow \text{ISTC Adherence} \rightarrow \text{Case Detection and Treatment} \]

Health System Factors
- Physical Resources
- Material Resources

- Data collection
  - Key informant interviews
  - Field Observation

- Analysis
  - Transcribe interviews and field notes
  - Apply standard coding scheme to identify recurring themes
Health system barriers to TB evaluation

Clinic-level
- Poor infection control
- Limited private space
- Variable leadership

NTP-level
- Inconsistent oversight
- Stock-outs of reagents and drugs
## Provider-level barriers to TB evaluation

<table>
<thead>
<tr>
<th>PRECEDE framework</th>
<th>Recurring themes</th>
</tr>
</thead>
</table>
| **Predisposing factors**   | - Low motivation of staff  
- Inconsistent training of staff  

*Some of us are trained, but some new staff are not trained.* |
| **Enabling Factors**       | - Workload faced by lab staff  
- Multi-day sputum collection and evaluation  

*When they have a cough for more than 2 weeks they are sent to the lab. But the problem is they get the first sample and sometimes, actually most times they don’t bring the second sample.* |
| **Reinforcing Factors**    | - Limited capacity for patient follow-up  
- Lack of communication and coordination between staff  

*...actually at times we have met but we don’t meet [regularly], only when we realize there is a problem that’s when we communicate and say why is this happening, then we try to rectify.* |
Objective 3: “Improve quality gap”: Theory-informed intervention

- Evidence review
- Stakeholder consultation
- Feasibility

**Predisposing factors**
- ISTC training
- Refresher microscopy training

**Enabling factors**
- Same-day LED FM

**Reinforcing factors**
- Performance feedback

**Flowchart**

- Intention to Follow ISTC
- ISTC Adherence
- Case Detection and Treatment

**Factors**
- Knowledge
- Skills
- Attitudes
- Social Norms
- Self-efficacy
Intervention details: Performance feedback

• Goals
  – Facilitate training/continuous quality improvement

• Report card provided to each site monthly
  – PLAN: Identify plans to improve performance
  – DO: Implement plans
  – STUDY: Review updated report card
  – ACT: Refine or change performance improvement plans
Intervention details: Same-day LED FM

• Goals
  – Facilitate same-day TB evaluation and treatment
  – Reduce laboratory workload/patient waiting time

• 5-day training at each health center
  – FM staining
  – Use of LED fluorescence microscope (PrimoStar iLED)
  – Identification of AFB: practice and proficiency testing
  – Re-organization of work flow
Evaluation of intervention components

• ISTC/Refresher Microscopy training
  • Before-and-after study assessing trend over time

• Same-day LED FM and Performance feedback
  • Interrupted time series study
Impact of ISTC/Microscopy training - 1

**ISTC-adherent care**

- Indicator 1: Referred for TB exams
  - p=0.005
- Indicator 2: Completed TB exams
  - p=0.85
- Indicator 3: Treated if AFB-positive
  - p=0.02

**Impact of ISTC/Microscopy training**

- Indicator 1: Referred for TB exams
  - p=0.01
- Indicator 2: Completed TB exams
  - p=0.85
- Indicator 3: Treated if AFB-positive
  - p=0.02
Impact of ISTC/Microscopy training - 2

• High yield of smear examination (13-21%)

• Modest improvements → 3.5-fold increase in TB case detection (7 to 25 cases/quarter)
Impact of performance feedback - 1

Proportion receiving ISTC-adherent care

![Graph showing the proportion of ISTC-adherent care over months since intervention introduction. The graph indicates an increase in the adjusted probability of ISTC-adherent care after the introduction of the intervention.](image)
## Impact of performance feedback - 2

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Performance Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre N=838</td>
</tr>
<tr>
<td>Received ISTC-adherent care</td>
<td>52%</td>
</tr>
<tr>
<td></td>
<td>( +8 to +23)</td>
</tr>
<tr>
<td>Referred for sputum examination</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td>(-7 to +27)</td>
</tr>
<tr>
<td>Completed sputum examination</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>(-8 to +27)</td>
</tr>
<tr>
<td>Initiated treatment if smear-positive</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td>(-3 to +30)</td>
</tr>
</tbody>
</table>
## Impact of same-day LED FM

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Pre N=907</th>
<th>Post N=1043</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received ISTC-adherent care</td>
<td>58%</td>
<td>75%</td>
<td>+17% (+1 to +33)</td>
</tr>
<tr>
<td>Referred for sputum examination</td>
<td>78%</td>
<td>78%</td>
<td>+0.3% (-1 to +7)</td>
</tr>
<tr>
<td>Completed sputum examination</td>
<td>75%</td>
<td>96%</td>
<td>+21% (+4 to +38%)</td>
</tr>
<tr>
<td>Initiated treatment if smear-positive</td>
<td>86%</td>
<td>98%</td>
<td>+12% (-2 to +28%)</td>
</tr>
</tbody>
</table>
Summary

• Guideline implementation requires changing provider behavior

• A behavioral perspective may be helpful to inform barrier assessment and intervention choice

• Same-day microscopy and performance feedback are feasible and complement ISTC training

• Improving the quality of TB evaluation has a large impact on case detection
Acknowledgements

UCSF/Curry International TB Center
Phil Hopewell
Luke Davis
Grant Dorsey
Cecily Miller
Lelia Chaisson

UCSF/Dept. of Epi and Biostatistics
Margaret Handley
Eric Vittinghoff

Makerere University
Achilles Katamba
Moses Kamya
Geoff Lavoy
Irene Ayakaka
Priscilla Haguma
Emma Ochom
Irene Kinera

Uganda MoH/NTLP
Francis Adatu
Frank Mugabe
Moses Joloba
Level IV HC staff

Funding: NIH/NIAID; UCSF Nina Ireland Program in Lung Health