Multiplexed POC System for HIV and Co-Infection Serodiagnosis

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mBio Diagnostics, Inc.

HIV Diagnostics Conference
March 24, 2010
Orlando, FL
Background

• mBio Diagnostics, Inc., Boulder CO
• Collaboration with UCSD
  • Drs. Schooley and Benson
• Point-of-care (POC); low-cost, instrumented tests
  – Global health focus

• MAJOR THEMES
  – Multiplexed assay panels at point of care
  – Rapid test workflow & cost with lab quality output
mBio SnapEsi™ System

- Fluorescence immunoassays
- Digital and quantitative
- Designing for CLIA-waiver

Address limitations of visually read rapid tests

- Interpretation
- Training; QA/QC
- Connectivity
Multiplexed Serology Assay

Planar waveguide with custom surface chemistry

20 to 30 feature microarray
Multiplexed Serology Assay

- Low density microarray in fluidic channel
  - Printed antigen spots
  - Sample and procedural controls
- Detect antibodies in serum, plasma, blood

Planar Waveguide with Custom Surface Chemistry

- Control Spot (e.g. anti-human IgG)
- HIV Antigen (e.g., gp41)
- T. pallidum Antigen (e.g., p17 core)
Multiplexed Serology Assay

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![Diagram of multiplexed serology assay](image)
Multiplexed Serology Assay

- Fluorescence imaging detection
- Patent-protected planar waveguide design
- Robust, reproducible illumination at very low cost

Planar Waveguide with Custom Surface Chemistry

- Control Spot (e.g. anti-human IgG)
- HIV Antigen (e.g., gp41)
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mBio SnapEsi™ System
Low Cost Fluorescence Imaging

DISPOSABLE CARTRIDGE
Sample Inlet
Assay surface

Diode Laser
INSTRUMENT
Patent-protected optical configuration
CAMERA
SnapEsi™ HIV-1/Syphilis Workflow

- 5 to 10 microliter sample
- Total assay time ~25 min
- Batch processing; one operator:
  - 16 cartridges in parallel
  - 60 to 80 per shift
- Read window: 10 min to hours
## SnapEsi™ Ab Reactivity Output

### Pathogen Status

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Status</th>
<th>Antibody Reactivity</th>
<th>Signal / Cutoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>POSITIVE</td>
<td>gp41</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gp120</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p24</td>
<td>7.8</td>
</tr>
<tr>
<td>T. pallidum</td>
<td>NEGATIVE</td>
<td>p47</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p17</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TmpA</td>
<td>0.0</td>
</tr>
<tr>
<td>Control</td>
<td>Good Test</td>
<td>Anti-Hu IgG</td>
<td>4.1</td>
</tr>
</tbody>
</table>

**Image:**
- Visual representation of the SnapEsi™ device and test results.

**Legend:**
- HIV-1 (HIV-1)
- Syphilis (Treponemal)
- Controls

**Result:**
- **HIV:** Positive (gp41, gp120, p24)
- **T. pallidum:** Negative (p47, p17, TmpA)
- **Control:** Good Test (Anti-Hu IgG)
HIV-1 / Syphilis Combination Assay

Sample 1

Sample 2

Sample 3
HIV-1 / Syphilis Combination Assay

**Sample 1**
- Non-Reactive

**Sample 2**
- HIV-1 Reactive
- Trep Reactive

**Sample 3**
- Trep Reactive
Example Data Output

**Treponemal Ab Reactive Sample**

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Status</th>
<th>Antibody Reactivity</th>
<th>Signal / Cutoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV</td>
<td>NEGATIVE</td>
<td>gp41 0.0</td>
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<td></td>
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<td>gp120 0.1</td>
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<td></td>
<td></td>
<td>p24 0.0</td>
<td></td>
</tr>
<tr>
<td>T. pallidum</td>
<td>POSITIVE</td>
<td>p47 5.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>p17 3.7</td>
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</tr>
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<td></td>
<td></td>
<td>TmpA 8.8</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>Good Test</td>
<td>Anti-Hu IgG 6.1</td>
<td></td>
</tr>
</tbody>
</table>
HIV-1/Syphilis Clinical Sample Results

- Serum Samples from University of California San Diego Clinical Micro Lab (Siemens ADVIA Centaur analyzer)
- Commercial controls (including negatives)
  - Sensitivity and Specificity based on same dataset used to establish cutoffs

<table>
<thead>
<tr>
<th>HIV</th>
<th>n = 170</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Pos</td>
<td>54</td>
</tr>
<tr>
<td>False Neg*</td>
<td>1</td>
</tr>
<tr>
<td>False Pos</td>
<td>115</td>
</tr>
<tr>
<td>True Neg</td>
<td>0</td>
</tr>
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</table>

- Sensitivity: 98.2%
- Specificity: 100.0%

*Also negative on OraQuick®
# HIV-1 Seroconversion Panel

## PATH (Seattle, WA) Evaluation Result

<table>
<thead>
<tr>
<th>Sample</th>
<th>Days since 1st bleed</th>
<th>mBio SnapEsi™ Result</th>
<th>mBio SnapEsi™ s/co</th>
<th>Abbott EIA Result</th>
<th>Abbott EIA s/co</th>
<th>Maxim Western Blot Result</th>
<th>Maxim Western Blot s/co</th>
<th>Siemens Advia Centaur Result</th>
<th>Siemens Advia Centaur s/co</th>
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</thead>
<tbody>
<tr>
<td>PRB956-01</td>
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<td>NEG</td>
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<td>PRB965-02</td>
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<td>NEG</td>
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<td>0.1</td>
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<td>PRB965-03</td>
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<td>NEG</td>
<td>0.2</td>
<td>NEG</td>
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<tr>
<td>PRB965-04</td>
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<td>IND</td>
<td>&gt;50</td>
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<tr>
<td>PRB965-05</td>
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<td>POS</td>
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<td>POS</td>
<td>&gt;50</td>
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<td>PRB965-06</td>
<td>21</td>
<td>POS</td>
<td>7.6</td>
<td>POS</td>
<td>&gt;50</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**PATH Result**

**Package Insert Data**
mBio SnapEsi Syphilis (*Treponemal*)
Clinical Serum Sample Results

*T. pallidum* Positives
- 46 confirmed *Trep*-positive (TPPA)
- 45 SnapEsi POS; one indeterminate
- 97.8% Sensitivity

RPR Negatives
- 111 RPR negatives
- 108 SnapEsi *Trep* NEG
- 3 SnapEsi POS are likely resolved/treated infection
SnapEsi™ Syphilis T/NT  
(Treponemal / Nontreponemal)

• Preliminary quantitative anti-cardiolipin results

Anti-cardiolipin assay in same array as anti-\textit{T. pall} assay

Dashed line is signal for pooled normal human serum.
mBio Development Pipeline: Quantitative Antigen Detection & Panel Expansion

- Hepatitis B Surface Antigen (HBsAg)
- HIV-1 p24 direct antigen detection
- HIV-2 serology
- Hepatitis C serology
Summary

• Simple, low-cost fluorescence imaging system with disposable assay cartridge
• mBio focus: HIV, coinfection, global health apps

• MAJOR THEMES
  – Multiplexed assay panels at point of care
  – Rapid test workflow & cost with lab quality output
Acknowledgements - Collaborators

Clinical Collaborators:

Dr. Robert Schooley (UCSD)
Dr. Constance Benson (UCSD)
Dr. Sharon Reed (UCSD)

- Dr. Emilia Noormahomed (Mozambique)
- Dr. Roberto Badaro (Brazil)

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Planar Waveguide Technology

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- Dr. Frances Ligler (Naval Research Lab)
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