An Introduction to
Childhood Tuberculosis
Kim Smith, MD, MPH
August 10, 2012

Kim Smith, MD, MPH has the following disclosures to make:

• No conflict of interests
• No relevant financial relationships with any commercial companies pertaining to this educational activity
Childhood Tuberculosis

Kim Connelly Smith
MD, MPH

OUTLINE
• Stages of tuberculosis
• Differences of disease in children and adults
• Diagnostic challenges of pediatric TB
• Treatment of TB in children
• Clinical cases
Stages of Tuberculosis

Exposure to Contagious Adult with Pulmonary Disease

Household contacts 20-30%

Latent TB Infection LTBI

5-10%

Risk varies by age 5-50%

Adult Active TB Disease

Child Active TB Disease
### Percent Risk of Disease by Age

<table>
<thead>
<tr>
<th>Age at Infection</th>
<th>Risk of Active TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth – 1 year*</td>
<td>43%</td>
</tr>
<tr>
<td>1 – 5 years*</td>
<td>24%</td>
</tr>
<tr>
<td>6 – 10 years*</td>
<td>2%</td>
</tr>
<tr>
<td>11 – 15 years*</td>
<td>16%</td>
</tr>
<tr>
<td>Healthy Adults</td>
<td>5-10% lifetime risk</td>
</tr>
<tr>
<td>HIV Infected Adults+</td>
<td>30-50% lifetime</td>
</tr>
</tbody>
</table>

*Miller, Tuberculosis in Children
Little Brown, Boston, 1963
WHO, 2004

### Risk of Progression to TB Disease by Age

<table>
<thead>
<tr>
<th>Age @ primary infection</th>
<th>Risk of Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth-12months</td>
<td>Disease 50%</td>
</tr>
<tr>
<td></td>
<td>Pulmonary Dis 30-40%</td>
</tr>
<tr>
<td></td>
<td>Miliary or TBM 10-20%</td>
</tr>
<tr>
<td>1-2 years</td>
<td>Disease 20-25%</td>
</tr>
<tr>
<td></td>
<td>Pulmonary Dis 75%</td>
</tr>
<tr>
<td></td>
<td>Miliary or TBM 2-5%</td>
</tr>
</tbody>
</table>

Marais BJ. *Int J Tuberc Lung Dis* 2004;8:392-402
### TREATMENT OF TUBERCULOSIS IN CHILDREN

#### Stages of TB Skin Test or IGRA

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Skin Test or IGRA</th>
<th>CXR</th>
<th>SXs</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household contact with adult with active pulmonary disease</td>
<td>Negative</td>
<td>Normal</td>
<td>None</td>
<td>Meds: INH Duration: 8-10 weeks Repeat skin test: 8-10 wks after exp if positive ≥ 5mm, see LTBI</td>
</tr>
</tbody>
</table>

#### Latent TB infection (LTBI)

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Skin Test or IGRA</th>
<th>CXR</th>
<th>SXs</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>Normal</td>
<td>None</td>
<td>None</td>
<td>Meds: INH Duration: INH 9 mo or for INH resistant LTBI, RIF 6 mo</td>
</tr>
</tbody>
</table>

#### Disease

<table>
<thead>
<tr>
<th>Disease</th>
<th>Skin Test or IGRA</th>
<th>CXR</th>
<th>SXs</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary and extrapulmonary (except disseminated disease and meningitis, see below)</td>
<td>90% positive</td>
<td>Abnormal</td>
<td>+/-</td>
<td>Meds: INH, RIF, PZA (consider EMB or an aminoglycoside) Duration: 6 mo total, Stop PZA after 2 mo, continue INH &amp; RIF for susceptible disease</td>
</tr>
<tr>
<td>Disseminated including miliary, bone/joint and multi-site disease</td>
<td>TST may be negative early in disseminated TB, most positive by end of treatment</td>
<td>+/-</td>
<td>Yes</td>
<td>Meds: INH, RIF, PZA and EMB or an aminoglycoside Duration: 9-12 mo total Stop PZA and EMB or aminoglycoside after 2 mo for susceptible disease</td>
</tr>
<tr>
<td>Meningitis</td>
<td>Often negative early in meningitis and miliary disease 90% positive by end of tx</td>
<td>+/-</td>
<td>Yes</td>
<td>Meds: INH, RIF, PZA and an aminoglycoside or EMB or Ethionamide daily for 2 mo, then INH and RIF for 7-10 mo Duration: 9-12 mo total for drug susceptible disease Steroids recommended for first 1-2 mo for meningitis</td>
</tr>
</tbody>
</table>

### Pediatric Tuberculosis Treatment Table

<table>
<thead>
<tr>
<th>Pediatric Tuberculosis Treatment Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stages of TB</strong></td>
</tr>
<tr>
<td>Exposure</td>
</tr>
<tr>
<td>Latent TB infection (LTBI)</td>
</tr>
<tr>
<td>Disease</td>
</tr>
<tr>
<td>Disease</td>
</tr>
<tr>
<td>Disease</td>
</tr>
</tbody>
</table>

### Daycare Exposure

- **Daycare Exposure**

  - Children aged 4 years of age and younger who have had household contact with an adult with active pulmonary disease.
  - Negative skin test or IGRA.
  - No symptoms (SXs).
  - Treatment: INH for 8-10 weeks. Repeat skin test or IGRA in 8-10 weeks.
  - Repeat skin test or IGRA if positive ≥ 5mm. See LTBI if positive.

- **Latent TB Infection (LTBI)**
  - Positive skin test or IGRA.
  - No symptoms (SXs).
  - Treatment: INH for 9 months or RIF for INH-resistant LTBI.

- **Disease**
  - Pulmonary and extrapulmonary (except disseminated disease and meningitis).
  - 90% positive skin test or IGRA.
  - Abnormal CXR.
  - +/- symptoms.
  - Treatment: INH, RIF, PZA (consider EMB or an aminoglycoside).
  - Duration: 6 months total, stop PZA after 2 months, continue INH & RIF for susceptible disease.

  - Disseminated, including miliary, bone/joint, and multi-site disease.
  - TST may be negative early in disseminated TB, most positive by end of treatment.
  - +/- symptoms.
  - Treatment: INH, RIF, PZA, and EMB or an aminoglycoside.
  - Duration: 9-12 months total, stop PZA and EMB or aminoglycoside after 2 months for susceptible disease.

  - Meningitis.
  - Often negative early in meningitis and miliary disease.
  - 90% positive by end of treatment.
  - +/- symptoms.
  - Treatment: INH, RIF, PZA, and an aminoglycoside or EMB or Ethionamide daily for 2 months, then INH and RIF for 7-10 months.
  - Duration: 9-12 months total for drug susceptible disease.
  - Steroids recommended for the first 1-2 months for meningitis.

### Conclusion

- Treatment guidelines for tuberculosis in children include skin test or IGRA, CXR, SXs, and appropriate medication regimens based on exposure and disease severity.
- Early detection and treatment are crucial to prevent the progression of tuberculosis.
- Monitoring through repeat skin tests or IGRA is important to ensure effective treatment and prevent the development of active disease.
Daycare Exposure

- Index case, teacher assistant with AFB smear positive pulmonary disease and cough for 6 weeks
- 135 children < 4 years of age, plus adult staff members exposed

Smith, KC. *Southern Medical Journal* 93(9):877-880, 2000

Daycare Exposure Management

- Who is at risk?
  - Children and staff

- Who needs TST?
  - Everyone with significant contact with source case

- Who needs CXR?
  - All children less than 4 years of age even if TST negative
  - Any contacts with positive TST (>5mm)

- Who needs treatment?
  - LTBI (positive TST >5mm and normal CXR) INH for 9 months
  - Exposed children less than 4 years of age need INH window prophylaxis for 8-10 weeks

- Follow up?
  - Repeat TST 8-10 weeks after exposure
  - If negative and contact broken, stop INH prophylaxis
Window Prophylaxis

- **Exposure**
  - Household contact with contagious person
  - Usually ≥ 4 hours of contact
  - Teen or adult with pulmonary TB disease
- **Window period for TST conversion**
  - 8-10 weeks
- If CXR and physical exam normal
  - INH prophylaxis recommended:
    - For children <4 yrs of age
    - Prevention of disease during window period
- Repeat TST 8-10 wks after exposure
- May stop INH if 2nd TST negative <5mm and contact broken

Preventable Case
Pediatric TB Case a Missed Opportunity

**15 mo old**
- 10 days fussiness & decreased appetite
- 3 days inability to walk or sit up
- CSF: 96 WBC (NL <7), 72% Lymphs, 198 Protein (NL <45), Glucose 8
- Source case: mother of child
- Diagnosis: TB Meningitis

**Family history**
- Mom with pulmonary TB diagnosed 5 mo earlier on appropriate treatment
- Dad diagnosed with LTBI on INH
- Baby initial TST 0mm @ 10 months of age
  - no CXR
  - no treatment
  - lost to follow up

TB Meningitis
Treatment and Clinical Course

- 12 months RIPE therapy
- Steroids for 1-2 month with 2-3 week taper
  - decreases CNS inflammation
- Fever common for first month, symptoms may initially worsen followed by gradual improvement
- Possible complications
  - Seizures
  - Hydrocephalus
  - CNS tuberculoma, stroke, MR, CP
  - Mortality may be 100% if not diagnosed and treated
- This case was potentially preventable if treated with window prophylaxis when parent diagnosed
Differences In Adult and Pediatric TB

- Occurs years after primary infection
- Typical of adult disease
- Occasionally seen in teens
- Often cavitary disease
- High numbers of organisms (AFB +)
- Usually symptomatic and contagious

Reactivation Disease
Primary Disease

- Typical of childhood TB
- Usually not cavitary
- Classic x-ray:
  - Hilar lymphadenopathy with or without pulmonary infiltrates
  - Miliary infiltrates
- Low numbers of organisms
  - AFB smears negative in 95% of pedi cases
  - Culture negative in 60% of cases
- Most children <12 yrs not contagious
- Often asymptomatic (50%)
Pediatric Case
TB Disease

Father
- Cavitary pulmonary disease
- AFB smear positive
- Pansusceptible TB

9 year old son
- Contact investigation TST 5 mm
- Healthy kid with no symptoms
- Initial CXR with small pleural effusion
- No treatment started
- What was the diagnosis at this point?
Treatment and Follow up

- 6 weeks later
  - Fever
  - Respiratory difficulty
  - Worsening CXR

- What went wrong?

- What treatment recommended?
Adult TB Disease

- Pulmonary: 85%
- Extrapulmonary: 15%

Adult Extrapulmonary TB Disease (15%)

- Lymphatic: 25%
- Pleural: 23%
- GU: 16%
- Other: 13%
- Bone/Joint: 10%
- Miliary: 9%
- Meningeal: 4%

CDC
Pediatric TB Disease

- 75% Pulmonary
- 25% Extrapulmonary

Extrapulmonary TB Disease in Children (25%)

- 67% Lymphatic
- 14% Meningeal
- 5% Miliary
- 5% Other
- 4% Bone/Joint
- 6% Pleural

CDC
Symptoms of TB Disease in Children

- Cough and/or respiratory distress
- Pulmonary findings on examination
- Lymphadenopathy or lymphadenitis
- S/Sx of meningitis including seizures
- Persistent fever (FUO)
- Weight loss or failure to thrive
- Unlike adults, up to 50% of children with TB disease may have no symptoms

*Feigin & Cherry, Text of Pedi ID*
Unique Challenges of TB in Children

- More difficult diagnosis
- Nonspecific signs and symptoms
- Fewer mycobacteria
- Fewer positive bacteriologic tests
- Increases risk of progression to disease
- Higher risk of extrapulmonary and TB meningitis

Diagnosis for TB in Children

- **Gold Standard** –
  Positive TB Culture

  OR, **Clinical Diagnosis**:

  - Abnormal CXR, laboratory, or physical examination consistent with TB **AND**

  1 or more of the following:
  
  - Positive tuberculin skin test
  - Contagious adult source case identified
  - Clinical course consistent with TB disease, or
  - Improvement on TB therapy
Diagnostic Triad for TB Disease in Children

- Abnormal CXR and/or physical exam
- Positive TST or IGRA
- Infectious adult source case identified

AFB smears and Cultures in Children and Infants

- AFB smear usually negative
  - In 95% of patients <12 years of age
- Low yield on TB culture
  - Only 40% positive in children 1-12 yrs of age with pulm TB
- Obtaining cultures from children with pulmonary TB
  - Early morning gastric aspirates (x3)
  - Broncho alveolar lavage (BAL)
  - Induced sputum
- Infants with pulmonary TB
  - 60-70% cultures pos
### Gastric Aspirates

- Inpatient procedure
- Overnight fasting
- Lavage with NS
- Collected in morning x3
- Inpatient costs substantial
- AFB smear yield: minimal
- AFB Culture yield: 20-50%

**Lancet. 2005;365:130**

### Induced Sputum

- Outpatient procedure
- 2-3h fasting period
- Pretreatment:
  - Nebulized salmeterol and saline
  - Chest physiotherapy (CPT)
  - Nasopharynx suctioned
- One specimen sufficient
- Minimal costs
Clinical Case
Cervical Lymphadenopathy

- 8 yr old with cervical lymphadenopathy
- **History:**
  - LAN for 3 months
  - PMHx: Healthy
  - BCG vaccine at birth
  - TB skin test 10 mm
- **Physical Exam:**
  - 3 cm anterior cervical LAN
  - 1.5 cm supraclavicular LAN
- **CXR:**
  - Hilar LAN, no infiltrates
- Is this TB disease?
- What else could it be?
Hilar & Cervical Lymphadenopathy

**Differential Dx**
- Tuberculosis
- Non TB mycobacteria (NTM)
- Lymphoma/Leukemia
- HIV
- Other causes

**Diagnostic tests**
- Biopsy (FNA or surgical for culture and path)
- Interferon $\gamma$ Blood test for TB infection

---

**Results**

- **Fine needle aspirate of node:**
  - Pathology: lymphoma, no TB by culture or microscopy

- **Interferon $\gamma$ Blood test for TB**
  - Positive
  - Diagnostic for latent TB infection or disease

- **Diagnoses:**
  - LTBI
  - AND
  - Hodgkin’s Lymphoma

- **Treatment:**
  - Chemotherapy for lymphoma AND
  - INH daily for 9 months for LTBI
  - consider prolonged treatment during immunosuppression
**IGRAs in Children**

- **Sensitivity**
  - Variable 60-90%
- **Highly specific**
  - Specificity 90-95%
  - Eliminates false positives from BCG or most other mycobacteria
- Single visit required
- Helpful (preferred) in BCG vaccinated patients
- Children <5 years of age
  - Not FDA approved in this age due to limited data
  - Consider either test (IGRA or TST) positive in high risk patients
- May save costs by reducing false positives

**QuantiFERON TB Meta Analysis in Children**

- Systematic review and meta analysis of QFT for diagnosing LTBI and TB disease in children – 20 of 68 studies used
- Conclusions:
  - LTBI: QFT has higher specificity compared to TST
  - Disease: Sensitivity of QFT was no different from the TST
  - Lower QFT sensitivity was found in high-burden settings (55%) compared with low burden settings (70%)

Machingaidze et al. PIDJ 2011; 30: epub
TABLE 2. Studies Comparing the Sensitivity of QFT With That of TST in the Diagnosis of Active TB Disease (All Cases) in Children

<table>
<thead>
<tr>
<th>Author, Year*</th>
<th>Test Type</th>
<th>TB Burden</th>
<th>Age (yr)</th>
<th>Sample Size</th>
<th>No. TB Cases</th>
<th>TST Cutoff (mm)</th>
<th>Sensitivity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okada et al.14 2008</td>
<td>QFT-G</td>
<td>High</td>
<td>&lt;5</td>
<td>195</td>
<td>19</td>
<td>10</td>
<td>79%</td>
</tr>
<tr>
<td>Dogra et al.11 2006</td>
<td>QFT-G IT</td>
<td>High</td>
<td>1–12</td>
<td>165</td>
<td>8</td>
<td>10</td>
<td>63%</td>
</tr>
<tr>
<td>Bianchi et al.13 2009</td>
<td>QFT-G IT</td>
<td>Low</td>
<td>&lt;10</td>
<td>326</td>
<td>15</td>
<td>10</td>
<td>56%</td>
</tr>
<tr>
<td>Haustein et al.12 2009</td>
<td>QFT-G IT</td>
<td>Low</td>
<td>&lt;10</td>
<td>327</td>
<td>27</td>
<td>6</td>
<td>73%</td>
</tr>
<tr>
<td>Bramford et al.14 2009</td>
<td>QFT-G IT</td>
<td>Low</td>
<td>&lt;16</td>
<td>333</td>
<td>195</td>
<td>15</td>
<td>55%</td>
</tr>
<tr>
<td>Kampmann et al.15 2009</td>
<td>QFT-G IT</td>
<td>Low</td>
<td>&lt;16</td>
<td>309</td>
<td>63</td>
<td>15</td>
<td>60%</td>
</tr>
</tbody>
</table>

*Year of publication.
QFT indicates Quantiferon; TST, tuberculin skin test; TB, tuberculosis; QFT-G, Quantiferon Gold; QFT-G IT, Quantiferon Gold In-Tube.

Machingaidze et al. PIDJ 2011; 30: epub
Skin Test in Foreign Born

- 6 year old with positive TST for school entry
- Born in Asia
- BCG history
  - Vaccinated at birth
  - BCG scar present
- TST measures 12mm

CXR Normal

- How do you interpret the skin test?
- Is this BCG effect or LTBI?
- What tests may help?
Algorithm for TB Testing in Children

TST Preferred, IGRA Acceptable

- Children < 5 years of age
  Note: most experts would not use an IGRA to detect TB infection in a child < 2 years of age

IGRA preferred, TST acceptable

- Children > 4 yrs of age who have had BCG vaccine
- Children > 4 years of age who are unlikely to return for TST reading
What to do with Discordant IGRA and TST Results?

- Consider either test positive
  - If disease is suspected
  - If patient is at high risk for progression to disease (infants or immune compromised)

- For healthy patients without risk factors
  - Choose the more specific test (IGRA)

Monitoring Children on TB Treatment

- Risk of toxicity low
- Monitor clinical signs
  - Regular clinical visits (4-6 wks)
  - Patient education
- Routine blood work not necessary unless
  - Symptoms
  - Risk factors for toxicity
  - Taking other toxic drugs
- Monitor and reinforce adherence
  - Pill counts
  - Pharmacy records
- When to follow up CXR’s
  - Clinical change
  - End of therapy
  - Normal CXR not required to end therapy
- Completion of therapy certificate
Management of TB Medication Reactions

- Hepatotoxicity
- Medication refusal in children
  - Crush tablets, medication sandwich
- Vitamin B6
  - Breastfed infants, teens & picky eaters
- Going back to school
  - Children <12 yrs of age are not contagious

Central Nervous System TB Drug Penetration

<table>
<thead>
<tr>
<th>Drug</th>
<th>CNS Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isoniazid</td>
<td>Good</td>
</tr>
<tr>
<td>Rifampin</td>
<td>Inflamed meninges only</td>
</tr>
<tr>
<td>PZA</td>
<td>Good</td>
</tr>
<tr>
<td>Ethambutol</td>
<td>Inflamed meninges only</td>
</tr>
<tr>
<td>Ethionamide</td>
<td>Good</td>
</tr>
<tr>
<td>Aminoglycosides</td>
<td>Inflamed meninges only</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>Good except Cipro poor</td>
</tr>
</tbody>
</table>
Ethambutol in Children

- Risk of optic neuritis:
  - Visual acuity
  - Color perception
  - Visual field perception
  - Dose related
  - Usually reversible
  - Risk around 1-3% in adults
  - Risk in children about the same

- EMB probably safe in children
  - Monitor vision on treatment
  - Infants - VEP

Table 2. Studies that have specifically sought optical toxicity in children treated with Ethambutol

<table>
<thead>
<tr>
<th>Reference</th>
<th>Patients (n)</th>
<th>Age range</th>
<th>Method of evaluation</th>
<th>Length of follow up (months)</th>
<th>Number with toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>47</td>
<td>3-13 years</td>
<td>Visual evoked responses</td>
<td>15-18 24-48</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>36</td>
<td>4 months to 16 years</td>
<td>Acuity/field/colour</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Fox*</td>
<td>45</td>
<td>1-15 years</td>
<td>Acuity/field/colour</td>
<td>9-18 6</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>30</td>
<td>4-5 years</td>
<td>Acuity/field/colour</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>27</td>
<td>5-15 years</td>
<td>Acuity/field/colour</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>6</td>
<td>9-16 years</td>
<td>Computerised visual field examination</td>
<td>12-36 9</td>
<td>0</td>
</tr>
</tbody>
</table>

Fluoroquinolones in Children

- Initial animal studies:
  - Problems with growing cartilage in puppies
  - Initial clinical trials in children were not done
- Some children have been treated without problems:
  - CF, chronic UTI, shigellosis and TB
- Probably safe in children:
  - Some case series and RCT with good results
  - Germany study: 2030 patients treated, 31 (1.5%) with self-resolving arthralgia*
- Not indicated for routine infections in children
- Consider risk benefit
- Monitor clinically for joint and tendon problems (reported in adult patients)


---

Comparison of Side Effects with Ciprofloxacin vs Ceftazidime/Tobramycin in Children

<table>
<thead>
<tr>
<th>Event</th>
<th>Ciprofloxacin N = 67 (%)</th>
<th>Ceftazidime/Tobramycin N = 62 (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any</td>
<td>52 (78)</td>
<td>43 (69)</td>
<td>0.288</td>
</tr>
<tr>
<td>Abnormal liver function tests</td>
<td>17 (25)</td>
<td>13 (21)</td>
<td>0.554</td>
</tr>
<tr>
<td>Injection</td>
<td>16 (24)</td>
<td>5 (8)</td>
<td>0.015</td>
</tr>
<tr>
<td>Injection site pain</td>
<td>13 (19)</td>
<td>7 (11)</td>
<td>0.203</td>
</tr>
<tr>
<td>Rash</td>
<td>10 (15)</td>
<td>5 (8)</td>
<td>0.225</td>
</tr>
<tr>
<td>Rash</td>
<td>7 (10)</td>
<td>1 (2)</td>
<td>0.063</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>11 (16)</td>
<td>4 (6)</td>
<td>0.078</td>
</tr>
<tr>
<td>Central nervous system, any</td>
<td>1 (1)</td>
<td>6 (10)</td>
<td>0.055</td>
</tr>
<tr>
<td>Respiratory, any</td>
<td>7 (10)</td>
<td>3 (5)</td>
<td>0.328</td>
</tr>
<tr>
<td>Musculoskeletal, any</td>
<td>15 (22)</td>
<td>13 (21)</td>
<td>0.845</td>
</tr>
<tr>
<td>Joint Disorder</td>
<td>8 (12)</td>
<td>10 (16)</td>
<td>0.493</td>
</tr>
<tr>
<td>Arthralgia</td>
<td>7 (10)</td>
<td>7 (11)</td>
<td>0.878</td>
</tr>
<tr>
<td>Arthritis</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Leg cramps</td>
<td>0 (0)</td>
<td>1 (2)</td>
<td>0.481</td>
</tr>
<tr>
<td>Myalgia</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Aminoglycocides

- **Administration**
  - IV or IM
  - Consider central line
  - Home health or clinic administration
  - Usually given for 6-12 months with MDR-TB or some non-TB mycobacterial diseases

- **Monitor**
  - Blood levels
  - Renal function
  - Hearing

**Summary**

- TB medications are well tolerated in children
- Education of family important
- Regular clinical monitoring recommended
  - Laboratory test if symptoms
- Adverse events are rare and usually reversible
- DOT standard of care for disease
Prevention of TB Disease in Children

- Contact Investigation
- INH Window Prophylaxis
- Treatment of LTBI
Questions