Epidemiology of Pediatric Tuberculosis (TB) in North America

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The findings and conclusions in this presentation are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention.
Overview and Objectives

- **Risk factors for TB**
  - TB in a child is a sentinel public health event

- **Recent pediatric TB data from Canada, Mexico, and the United States**
  - Similarities and differences compared with adult TB data

- **Programmatic and clinical implications**
“Any program designed to control or eliminate tuberculosis must focus great effort on children, because they are the future reservoir for the disease...children are important public health markers...because they represent ongoing transmission”

EPIDEMIOLOGY OF PEDIATRIC TB
Global Epidemiology of Pediatric TB

- TB disease in a person < 15 years old

- Greater burden among children in low resource settings
  - Low resource: children account for 15–20% of all TB cases
  - High resource: children account for 2–7% of all TB cases

- Estimated 490,000 TB episodes in 2011
  - 64,000 deaths

Establishing a new post-2015 strategy

Proposed three pillars

- Innovative TB Care
- Bold policies and supportive systems
- Intensified research and innovation

Surveillance, Monitoring and Evaluation

WHO and Partners Support to countries

- Protection and promotion of human rights and equity
- Community, civil society and private sector engagement
- Government Stewardship and Country Adaptation

Post-2015 vision for new TB strategy and targets
Pediatric TB Risk Groups

- Contacts of a known TB case
- Recently infected
- Racial and ethnic minority populations
- Foreign-born
- Poverty; homelessness; congregate settings
- Immunosuppressed
- Younger age
## Age Specific Risk for Developing TB Disease

<table>
<thead>
<tr>
<th>Age</th>
<th>Risk of disease following primary infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 year</td>
<td>Pulmonary disease 30-40%</td>
</tr>
<tr>
<td></td>
<td>TBM* or miliary disease 10-20%</td>
</tr>
<tr>
<td>1-2 years</td>
<td>Pulmonary disease 10-20%</td>
</tr>
<tr>
<td></td>
<td>TBM or miliary disease 2-5%</td>
</tr>
<tr>
<td>2-5 years</td>
<td>Pulmonary disease 5%</td>
</tr>
<tr>
<td></td>
<td>TBM or miliary disease 0.5%</td>
</tr>
<tr>
<td>5-10 years</td>
<td>Pulmonary disease 2%</td>
</tr>
<tr>
<td></td>
<td>TBM or miliary disease &lt;0.5%</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>Pulmonary disease 10-20%</td>
</tr>
<tr>
<td></td>
<td>TBM or miliary disease &lt;0.5%</td>
</tr>
</tbody>
</table>

*TBM = tuberculous meningitis

## World Health Organization 2011 TB Data

<table>
<thead>
<tr>
<th></th>
<th>Canada</th>
<th>Mexico</th>
<th>United States (US)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated incidence (per 100,000)</td>
<td>4.5</td>
<td>23.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Incident new cases</td>
<td>1,332</td>
<td>18,986</td>
<td>10,521</td>
</tr>
<tr>
<td>Total cases &lt; 15 years</td>
<td>74</td>
<td>886</td>
<td>572</td>
</tr>
<tr>
<td>Proportion pediatric TB</td>
<td>5.6%</td>
<td>4.7%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Proportion of all children smear-positive</td>
<td>6.8%</td>
<td>29.8%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>

WHO Global TB Report 2012
SIMILARITIES TO ADULT TB
TB Case Rates by Age Group — US, 1993–2011

## Top Five Countries of Origin for TB Cases with Foreign Birth — US, 2008–2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Children &lt; 18</th>
<th>All persons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 2,648 (%)</td>
<td>N = 21,292 (%)</td>
</tr>
<tr>
<td>Mexico</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Philippines</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Burma</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Viet Nam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Winston et al. Pediatrics 2012:e1425  
CDC. Reported Tuberculosis in the United States, 2011
Epidemiology of Pediatric TB — Canada

- 1,577 new and re-treatment TB cases in 2010
  - 4.6 cases/100,000
  - Nunavut 304.0 cases/100,000

- 77 cases in children < 15 years (4.9% of total)

<table>
<thead>
<tr>
<th>Year</th>
<th>&lt;1 year</th>
<th>1-4 years</th>
<th>5-14 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2.4</td>
<td>1.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Case rate per 100,000</td>
<td>875.0</td>
<td>140.8</td>
<td>29.3</td>
</tr>
<tr>
<td>Highest case rate per 100,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lowest case rate per 100,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Pediatric TB — Canada, 2000–2010

Cases per 100,000

Age Group (years)

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010

<1 1-4 5-14 15 - 24 All ages

Public Health Agency of Canada: Tuberculosis in Canada 2010 — Pre-Release
Epidemiology of Pediatric TB — Mexico

- **18,848 total cases in 2010**
  - 16.8 cases/100,000

- **917 cases in children <15 years (4.9% of total)**

<table>
<thead>
<tr>
<th>Year</th>
<th>0-4 years</th>
<th>5-9 years</th>
<th>10-14 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>2.9</td>
<td>2.4</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Case rate per 100,000

SINAVE/DGE/SALUD/Perfil Epidemiológico de Tuberculosis en México 2010
TB Case Rate by Age Group — Mexico, 2010

SINAVE/DGE/SALUD/Perfil Epidemiológico de Tuberculosis en México 2010
DIFFERENCES IN PEDIATRIC AND ADULT TB
Native Birth vs. Foreign Birth


- 66% of all Canadian TB cases in 2010 were foreign-born
  - 69% of <17 with TB in Ontario (1999–2002)
  - 18% of <15 with TB in Canada (2001)
  - 45% of <18 with TB in Children’s Hospital of Eastern Ontario (1998-2008)


**Age < 1**  n=1,697

- Laboratory Confirmed: 51%
- Clinical Case: 25%
- Provider Diagnosis: 24%

**Age 1–4**  n=8,616

- Laboratory Confirmed: 53%
- Clinical Case: 27%
- Provider Diagnosis: 20%

**Age 5–9**  n=3,991

- Laboratory Confirmed: 59%
- Clinical Case: 26%
- Provider Diagnosis: 15%

**Age 10–14**  n=3,198

- Laboratory Confirmed: 45%
- Clinical Case: 18%
- Provider Diagnosis: 37%

Percent of Pediatric TB Cases by Age and Site of Disease — US, 1993–2008

Age < 1 n=1,697
- Lymphatic: 7.8%
- Meningeal: 7.6%
- Pulmonary: 75.3%
- Extrapulmonary: 14.5%
- Both: 10.2%

Age 1–4 n=8,616
- Lymphatic: 19.3%
- Meningeal: 3.8%
- Pulmonary: 71.9%
- Extrapulmonary: 7.3%

Age 5–9 n=3,991
- Lymphatic: 22.2%
- Meningeal: 1.5%
- Pulmonary: 69.9%
- Extrapulmonary: 4.6%

Age 10–14 n=3,198
- Lymphatic: 19.4%
- Meningeal: 1.8%
- Pulmonary: 66.9%
- Extrapulmonary: 5.9%

TB Case Rates by Age Group and Sex

US, 2011

Mexico, 2010

Canada, 2007


SUNA/DOGE/SALUD/Perfil Epidemiológico de Tuberculosis en México 2010

Children Have Better Treatment Outcomes

- **Treatment completion**
  - 90% vs. 76%

- **Lower mortality**
  - 1% vs. 13% US-born
  - <1% vs. 5% foreign-born

PROGRAMMATIC AND CLINICAL IMPLICATIONS
Parent or Guardian Country of Birth for US-Born Pediatric TB Patients <18, 2009–2010

- United States 35%
- Mexico 29%
- Guatemala 5%
- India 4%
- Vietnam 3%
- Honduras 3%
- El Salvador 3%
- Other 18%

65% of parents or guardians non-US-born

Winston et al. Pediatrics 2012:e1425
Opportunities to Recognize Pediatric TB

- **25% (188 of 765) US-born children**
  - Did NOT have foreign-born parent AND
  - Did NOT live outside US

- **7% (7 of 95) Canadian-born children**
  - Did NOT have foreign-born parent AND
  - Were not Status Indian or Métis

Winston et al. Pediatrics 2012:e1425
### Reasons Evaluated for TB Disease among Children < 18 years by Nativity — US, 2009–2010

<table>
<thead>
<tr>
<th>Reason</th>
<th>US-born (n = 1,162)</th>
<th>Foreign-born (n = 518)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB Symptoms</td>
<td>29%</td>
<td>33%</td>
</tr>
<tr>
<td>Contact Investigation</td>
<td>32%</td>
<td>8%</td>
</tr>
<tr>
<td>Targeted Testing (if other reason not appropriate)</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Immigration Exam</td>
<td>Not applicable</td>
<td>8%</td>
</tr>
<tr>
<td>Abnormal Chest Radiograph (incidental)</td>
<td>15%</td>
<td>22%</td>
</tr>
<tr>
<td>Other*</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Missing/Unknown</td>
<td>19%</td>
<td>20%</td>
</tr>
</tbody>
</table>

*Other = Incidental laboratory result for evaluation other than TB, employment/administrative testing

Winston et al. Pediatrics 2012:e1425
### Reasons Evaluated for TB Disease among Children < 17 years — Ontario, 1999–2002

<table>
<thead>
<tr>
<th>Reason</th>
<th>n</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB Symptoms</td>
<td>78</td>
<td>(64.5)</td>
</tr>
<tr>
<td>Contact Investigation</td>
<td>25</td>
<td>(20.7)</td>
</tr>
<tr>
<td>Immigration Screening</td>
<td>5</td>
<td>(4.1 )</td>
</tr>
<tr>
<td>Postmortem</td>
<td>1</td>
<td>(0.8 )</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>(4.1 )</td>
</tr>
<tr>
<td>Unknown</td>
<td>7</td>
<td>(5.8 )</td>
</tr>
</tbody>
</table>

N = 121

Think TB! ^
Pediatric
Summary

- Think about pediatric TB as a sentinel event

- Think about TB in context of local epidemiology
  - Think about TB in high-risk children
  - Think about TB in seemingly “low-risk” children
Acknowledgements

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  - Heather Menzies
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