Current WHO methods used to estimate TB burden in children and women

Global Task Force on TB Impact Measurement
3rd meeting of TB estimates subgroup
Glion-sur-Montreux, 1 April 2015

Babis Sismanidis
sismanidisc@who.int
Outline

• TB disease burden estimates in children
  – A brief history of events
  – Incidence
  – Mortality
  – Prevalence

• TB disease burden estimates in women
  – Incidence
  – Mortality
TB DISEASE BURDEN ESTIMATES IN CHILDREN A BRIEF HISTORY OF EVENTS
What makes paediatric TB disease burden estimates problematic?

- Lack of gold-standard, point-of-care, diagnostic tool (difficulties with case definitions)
- Neglect of recording and reporting of the "non-infectious" childhood TB cases
- Scarcity of robust, nationwide data on children
Paediatric TB disease burden: past, present, future

Call to action for childhood TB
Paediatric TB disease burden: past, present, future

Call to action for childhood TB

1st set of estimates

Feb-11  Dec-11  Sep-12  Jul-13  May-14  Feb-15  Dec-15
Paediatric TB disease burden: past, present, future

Call to action for childhood TB

1st set of estimates

Start of STEP-TB

Feb-11 Dec-11 Sep-12 Jul-13 May-14 Feb-15 Dec-15
Paediatric TB disease burden: past, present, future

Start of STEP-TB

Global consultation on estimates

Call to action for childhood TB

1st set of estimates

Feb-11  Dec-11  Sep-12  Jul-13  May-14  Feb-15  Dec-15
Global Consultation on Paediatric Tuberculosis: Disease Burden Estimation and Quantification of Its Drug Market

25-26 September, 2013

Hosted by the Speeding Treatments to End Paediatric Tuberculosis (STEP-TB) Project
Sponsored by USAID and UNITAID

Objectives

1. To review available data and **highlight gaps**
2. To **review analytical methods** and epidemiological indicators
3. To **define and prioritise specific actions** that can be taken by TB Alliance, WHO, and other participating organizations
4. To **catalyse efforts to strengthen routine surveillance** and promote consensus in disease burden estimation
Paediatric TB disease burden: past, present, future

Start of STEP-TB

Global consultation on estimates

Call to action for childhood TB

1st set of estimates

Updated estimates

Feb-11 Dec-11 Sep-12 Jul-13 May-14 Feb-15 Dec-15
Paediatric TB disease burden: past, present, future

Call to action for childhood TB

Start of STEP-TB

Publication of new estimation attempts

Global consultation on estimates

1st set of estimates

Updated estimates

Feb-11  Dec-11  Sep-12  Jul-13  May-14  Feb-15  Dec-15
Independent attempts to estimate TB incidence

Incidence of multidrug-resistant tuberculosis disease in children: systematic review and global estimates

Helen E Jenkins, Arielle W Tolman, Courtney M Yuen, Jonathan B Parr, Salmaan Keshavjee, Carlos M Pérez-Vélez, Marcello Pagano, Mercedes C Becerra, *Ted Cohen*

Burden of childhood tuberculosis in 22 high-burden countries: a mathematical modelling study

Peter J Dodd, Elizabeth Gardiner, Renia Coghlan, James A Seddon

Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013

Christopher J L Murray*, Katrina F Ortblad, Caterina Guinovart, Stephen S Lim, Timothy M Wolock, D Allen Roberts, Emily A Dansereau, Nick
Heterogeneous findings, many data gaps
Paediatric TB disease burden: past, present, future

**Call to action for childhood TB**

- **Start of STEP-TB**
- **Inventory study workshop**
- **Publication of new estimation attempts**
- **Global consultation on estimates**
- **1st set of estimates**
- **Updated estimates**

Feb-11, Dec-11, Sep-12, Jul-13, May-14, Feb-15, Dec-15
Getting to TB incidence

- Incident cases
  - Under-diagnosed
  - Under-reported

TB case notifications known to the NTP

(Mind the) gap
Design and protocol development workshop: TB inventory studies to measure under-reporting of TB cases

24-26 September, 2014

Objectives

1. To explain and promote the role and value of inventory studies to TB care and control

2. To explain (i) major alternative study design & (ii) key issues concerning the implementation and analysis of inventory studies

3. To facilitate the development of a draft protocol outline for a TB inventory study
## Summary of key decisions, timelines and requirements

<table>
<thead>
<tr>
<th></th>
<th>China</th>
<th>Indonesia</th>
<th>Pakistan</th>
<th>Philippines</th>
<th>Thailand</th>
<th>Viet Nam</th>
</tr>
</thead>
</table>
| **Case definitions** | Bact-conf (all ages) | • All-form TB  
• Bact-conf  
• Children | Children | • All-form TB  
• Bact-conf  
• Children | • All-form TB  
• Bact-conf  
• Children | • All-form TB  
• Bact-conf  
• Children |
| **Timelines**    | • Q1 2015  
• Q4 2015 | • Q4 2014  
• Q4 2015 | • Q4 2014  
• Q4 2015 | • Q2 2015  
• Q4 2016 | • Q4 2014  
• Q4 2015 | • Q4 2014  
• Q4 2015 |
| **Protocol Study end** | • TA  
• Funding | • TA  
• Funding | • TA  
• Funding | • TA  
• Funding | • TA  
• Funding | • TA  
• Funding |
| **Support required** |                              |                                |                                |                                  |                                            |                                            |
Paediatric TB disease burden: past, present, future

Call to action for childhood TB

Start of STEP-TB

Inventory study workshop

Publication of new estimation attempts

Global consultation on estimates

1st set of estimates

Updated estimates

Updated estimates

Feb-11 Dec-11 Sep-12 Jul-13 May-14 Feb-15 Dec-15
TB DISEASE BURDEN ESTIMATES IN CHILDREN INCIDENCE
Age disaggregated case notifications

<table>
<thead>
<tr>
<th>Table B2.2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New TB case notifications in 2012, by case type and age disaggregation</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total notifications</td>
</tr>
<tr>
<td>Countries disaggregating by age</td>
</tr>
<tr>
<td>Countries not disaggregating by age</td>
</tr>
<tr>
<td>(% total notifications disaggregated)</td>
</tr>
<tr>
<td>Number of countries that reported notifications disaggregated by age (number of HBCs)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total childhood notifications from countries disaggregating by age</td>
</tr>
<tr>
<td>Total estimated childhood notifications among all countries</td>
</tr>
</tbody>
</table>

<sup>a</sup> This includes reported cases for whom smear results were unknown or not done.

<sup>b</sup> An additional nine countries reported zero TB cases for 2012 and three countries had not reported data to WHO by July 2013.
Availability of age disaggregated data (2000)
Availability of age disaggregated data (2011)
Availability of age disaggregated data (2013)
**Incidence (notifications) (2013)**

\[ r = \frac{I_{0-14}}{I_{15+}} \quad (1) \]

\[ I = I_{0-14} + I_{15+} \quad (2) \]

**Table:**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r )</td>
<td>Ratio of incident TB children:adults ( \approx ) ratio of the number of new and relapse case notifications in children:adults</td>
</tr>
<tr>
<td>( I )</td>
<td>Estimated number of incident TB cases</td>
</tr>
<tr>
<td>( I_{0-14} )</td>
<td>Estimated number of incident TB cases in children</td>
</tr>
<tr>
<td>( I_{15+} )</td>
<td>Estimated number of incident TB cases in adults</td>
</tr>
</tbody>
</table>
Incidence (notifications) (cont.)

- Model-based regional estimates from country-level dataset (n=217)
- Uncertainty propagated through operations between RVs

500 000 (400 000 – 600 000) incident TB cases
Incidence (notifications) limitations

– Assume CDR for children same as for adults, due to lack of national data (inventory studies)
– Uncertainty not fully propagated (multiple imputation)
– Assume 0 cases among case type unknown and re-treatments
Combining results of independent estimation approaches

Method 1 (notifications)
Method 2 (mathematical model)
Ensemble 550,000 (470,000 – 640,000)
Ensemble - principles

Incidence distributed Beta, \( I_i \sim B(a_i + 1, b_i + 1) \)

Two estimates \( I_1 \) and \( I_2 \), so that

\[
Prob(x = TB) = \int_0^1 x \cdot B(a_i + 1, b_i + 1) \, dx = \frac{a_i + 1}{a_i + b_i + 2}
\]

Let \( c = \sum a_i \) and \( d = \sum b_i \)

Combined estimate

\[
Prob(x = TB) = \frac{c + 1}{c + d + 2}
\]

\[
Var = \frac{(c + 1)(d + 1)}{(c + d + 2)^2(c + d + 3)}
\]
TB DISEASE BURDEN ESTIMATES IN CHILDREN MORTALITY
Mortality data source (2013)

Countries (in orange) for which TB mortality is estimated using measurements from vital registration systems (n=124) and/or mortality surveys (n=2, India and Viet Nam)

* VR data from South Africa and Zimbabwe are not used due to miscoding of HIV as TB deaths
TB mortality, HIV-negative (2013)

$$d_a = \frac{d}{cov(1-g)} \quad (1)$$

$$r = \frac{M_{0-14}}{M_{15+}} \quad (2)$$

$$M = c M_{0-14} + (1 - c) M_{15+} \quad (3)$$

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$d$</td>
<td>Number of TB deaths from VR</td>
</tr>
<tr>
<td>$cov$</td>
<td>VR system coverage</td>
</tr>
<tr>
<td>$g$</td>
<td>VR system ill-defined causes</td>
</tr>
<tr>
<td>$r$</td>
<td>Ratio of mortality rates (children/adults)</td>
</tr>
<tr>
<td>$M$</td>
<td>Rate of TB mortality (HIV-negative), all ages</td>
</tr>
<tr>
<td>$M_{0-14}$</td>
<td>Rate of TB mortality (HIV-negative), 0-14 years</td>
</tr>
<tr>
<td>$M_{15+}$</td>
<td>Rate of TB mortality (HIV-negative), 15 years +</td>
</tr>
<tr>
<td>$c$</td>
<td>Proportion of children in the general population</td>
</tr>
</tbody>
</table>
TB mortality, HIV-negative (cont.)

From (2) and (3):

\[ M_{0-14} = \frac{M}{c + \frac{1 - c}{r}} \]

<table>
<thead>
<tr>
<th>country</th>
<th>da_014</th>
<th>da_15+</th>
<th>e_pop_014</th>
<th>e_pop_15+</th>
<th>r</th>
<th>c</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>40</td>
<td>4790</td>
<td>48269216</td>
<td>152092704</td>
<td>.026</td>
<td>.24</td>
<td>1</td>
</tr>
<tr>
<td>Nigeria</td>
<td>.</td>
<td>.</td>
<td>76920032</td>
<td>96695304</td>
<td>.</td>
<td>.44</td>
<td>49</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>31</td>
<td>22887</td>
<td>22554586</td>
<td>120279096</td>
<td>.007</td>
<td>.16</td>
<td>1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TB mortality, HIV-negative (cont.)

- Use imputation step to estimate global and regional $r$’s
- Imputation model (from a set of existing covariates) for country-level dataset (n=217)
- Combine multiply imputed datasets [pweight=e_pop_num] for global and regional $r$’s
- Uncertainty propagated through operations between RVs and imputation

80 000 (64 000 – 97 000) TB deaths (HIV-negative)
7% of total 1 100 000 TB deaths (HIV-negative)
Mortality *limitations*

- All countries used in ecological model are middle to high income
- Possible under-estimation due to miscoding of TB deaths (e.g. pneumonia, malnutrition, HIV/AIDS)
- No estimates for TB mortality in HIV-negative children (*ratio of age-disaggregated AIDS deaths? Spectrum?*)
TB DISEASE BURDEN ESTIMATES IN CHILDREN PREVALENCE
Field operations
(100-200 participants/day
5-7 days/cluster)

- Census collection
- Group instructions to participants
- Reception and interview screening
- Chest X-ray screening
- Chest X-ray reading
- Sputum specimen collection for those screened positive
- Result for all and exit
# National prevalence surveys for pulmonary TB that included children in the past

## Surveys in the 2000s

- Heterogeneous age groups, difficult to pool
- 20-29% of the sample size to detect 1-4% S+ and 2-7% B+ cases

<table>
<thead>
<tr>
<th>NATIONAL SURVEYS*</th>
<th>Age group</th>
<th>Participants N (%1)</th>
<th>S+2 cases N (%1)</th>
<th>S+2 rate per 100,000</th>
<th>B+3 cases N (%1)</th>
<th>B+3 rate per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>China 1990</td>
<td>0-14</td>
<td>401,997 (28)</td>
<td>30 (2)</td>
<td>7</td>
<td>51 (2)</td>
<td>13</td>
</tr>
<tr>
<td>China 2000**</td>
<td>0-14</td>
<td>89,295 (24)</td>
<td>6 (1)</td>
<td>7</td>
<td>11 (2)</td>
<td>12</td>
</tr>
<tr>
<td>Cambodia 2002**</td>
<td>10-14</td>
<td>4,591 (21)</td>
<td>3 (4)</td>
<td>65</td>
<td>4 (1)</td>
<td>87</td>
</tr>
<tr>
<td>Philippines 1997</td>
<td>10-19</td>
<td>4,989 (31)</td>
<td>6 (9)</td>
<td>120</td>
<td>18 (10)</td>
<td>361</td>
</tr>
<tr>
<td>Philippines 2007</td>
<td>10-19</td>
<td>6,728 (29)</td>
<td>1 (2)</td>
<td>15</td>
<td>11 (7)</td>
<td>163</td>
</tr>
<tr>
<td>Republic of Korea 1990</td>
<td>5-19</td>
<td>16,468 (34)</td>
<td>2 (3)</td>
<td>12</td>
<td>5 (4)</td>
<td>30</td>
</tr>
<tr>
<td>Republic of Korea 1995</td>
<td>5-19</td>
<td>19,005 (29)</td>
<td>1 (2)</td>
<td>5</td>
<td>2 (1)</td>
<td>11</td>
</tr>
</tbody>
</table>

* Pulmonary TB with CXR screening; ** Additional symptoms screening;  
  1 Over total survey population; 2 Smear-positive; 3 Bacteriologically-confirmed (smear and/or culture positive)
### Why not include children in prevalence surveys of PTB?

<table>
<thead>
<tr>
<th>Item</th>
<th>Current design</th>
<th>Adding children</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevalence estimate</strong></td>
<td>Bacteriologically-confirmed TB among 15+ in the general population</td>
<td>- A more accurate estimate among the total population</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Still imprecise estimate of prevalence among children</td>
</tr>
<tr>
<td><strong>Sample size</strong></td>
<td>Typically about 50,000-70,000</td>
<td>- 20% increase if 10+ included</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 60-100% increase if 0-14 included</td>
</tr>
<tr>
<td><strong>Screening algorithm</strong></td>
<td>CXR and symptoms</td>
<td>- CXR unsafe to deliver in thousands of healthy children</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No reliable test for infection</td>
</tr>
<tr>
<td><strong>Confirmation of TB</strong></td>
<td>Sputum smear microscopy and culture (with supporting CXR evidence)</td>
<td>- Invasive and uncomfortable diagnostic procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Referral hospital for follow-up diagnosis and treatment required</td>
</tr>
<tr>
<td><strong>Budget</strong></td>
<td>- USD 1-2 million in Asia</td>
<td>- Prolonged cluster operations</td>
</tr>
<tr>
<td></td>
<td>- USD 2-4 million in Africa</td>
<td>- Inclusion of pediatrician</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Larger sample size</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Additional equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Referral hospital incidentals and transportation</td>
</tr>
</tbody>
</table>
Prevalence next steps

• Data source does not exist at global level

• With current tools the WHO Global Task Force on TB Impact Measurement does not recommend the inclusion of children in nationwide prevalence surveys of pulmonary TB

• No disease burden estimate of paediatric TB prevalence is currently produced

• Global sentinel sites for stand-alone prevalence surveys among children?

• Use a deterministic model with data from contact tracing studies instead
Paediatric TB disease burden: past, present, future

Start of STEP-TB

Inventory study workshop

Publication of new estimation attempts

Global consultation on estimates

Call to action for childhood TB

1\textsuperscript{st} set of estimates

Updated estimates

Updated estimates

Feb-11 Dec-11 Sep-12 Jul-13 May-14 Feb-15 Dec-15
STEP TB – Key expected results

- **TB incidence**
  - Results form inventory studies
  - Global and regional estimates
  - Disaggregated by HIV-status
  - Disaggregated by MDR-TB status

- **TB mortality**
  - Global and regional estimates
  - Disaggregated by HIV-status

- **Data gaps**
  - Set priorities in empirical studies that could most improve precision of model-based estimates
TB DISEASE BURDEN ESTIMATES IN WOMEN INCIDENCE
TB incidence (2013)

\[ r = \frac{I_w}{I_m} \]  \hspace{1cm} \text{(1)}

\[ I = I_w + I_m \]  \hspace{1cm} \text{(2)}

\[ I_w = \frac{I}{1 + \frac{1}{r}} \]  \hspace{1cm} \text{(1), (2)}

<table>
<thead>
<tr>
<th>( r )</th>
<th>Ratio of incident TB (15+) women:men ≈ ratio of the number of new and relapse case notifications in women:men</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I )</td>
<td>Estimated number of incident TB, 15 + \</td>
</tr>
<tr>
<td>( I_w )</td>
<td>Estimated number of incident TB, 15 +, women \</td>
</tr>
<tr>
<td>( I_m )</td>
<td>Estimated number of incident TB, 15 +, men \</td>
</tr>
</tbody>
</table>
TB incidence (cont.)

- Combine country level to provide regional estimates
- Uncertainty propagated from operations between RVs

<table>
<thead>
<tr>
<th>WHO REGION</th>
<th>NUMBER OF TB CASE NOTIFICATIONS AMONG WOMEN</th>
<th>ESTIMATED TB INCIDENCE AMONG WOMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BEST ESTIMATE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCERTAINTY INTERVAL</td>
</tr>
<tr>
<td>AFR</td>
<td>390 808</td>
<td>990 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>880 000–1 100 000</td>
</tr>
<tr>
<td>AMR</td>
<td>73 905</td>
<td>100 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96 000–110 000</td>
</tr>
<tr>
<td>EMR</td>
<td>180 917</td>
<td>330 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>270 000–390 000</td>
</tr>
<tr>
<td>EUR</td>
<td>84 508</td>
<td>120 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>110 000–130 000</td>
</tr>
<tr>
<td>SEAR</td>
<td>234 190</td>
<td>1 300 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 200 000–1 400 000</td>
</tr>
<tr>
<td>WPR</td>
<td>346 537</td>
<td>510 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>480 000–530 000</td>
</tr>
<tr>
<td>Global</td>
<td>1 310 865</td>
<td>3 300 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 200 000–3 500 000</td>
</tr>
</tbody>
</table>
TB DISEASE BURDEN ESTIMATES IN WOMEN MORTALITY
TB mortality, HIV-negative (2013)

\[ d_a = \frac{d}{\text{cov}(1-g)} \quad (1) \]

\[ r = \frac{M_m}{M_w} \quad (2) \]

\[ M = M_w + M_m \quad (3) \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( d )</td>
<td>Number of TB deaths from VR</td>
</tr>
<tr>
<td>( \text{cov} )</td>
<td>VR system coverage</td>
</tr>
<tr>
<td>( g )</td>
<td>VR system ill-defined causes</td>
</tr>
<tr>
<td>( r )</td>
<td>Ratio of adjusted number of male:female TB deaths ( (d_{am}/d_{aw}) )</td>
</tr>
<tr>
<td>( M_w )</td>
<td>Estimated number of TB deaths (HIV-), 15 +, women</td>
</tr>
<tr>
<td>( M_m )</td>
<td>Estimated number of TB deaths (HIV-), 15 +, men</td>
</tr>
<tr>
<td>( M )</td>
<td>Estimated number of TB deaths (HIV-), 15 +</td>
</tr>
</tbody>
</table>
TB mortality, HIV-negative (cont.)

- Imputation model for country-level dataset (n=217)
- Combine multiply imputed datasets for regional r’s
- Uncertainty propagated from operations between RVs and multiple imputation

<table>
<thead>
<tr>
<th>Region</th>
<th>BEST ESTIMATE</th>
<th>UNCERTAINTY INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFR</td>
<td>110 000</td>
<td>79 000–130 000</td>
</tr>
<tr>
<td>AMR</td>
<td>4 300</td>
<td>3 600–5 000</td>
</tr>
<tr>
<td>EMR</td>
<td>44 000</td>
<td>33 000–54 000</td>
</tr>
<tr>
<td>EUR</td>
<td>11 000</td>
<td>10 000–11 000</td>
</tr>
<tr>
<td>SEAR</td>
<td>130 000</td>
<td>100 000–170 000</td>
</tr>
<tr>
<td>WPR</td>
<td>36 000</td>
<td>33 000–39 000</td>
</tr>
<tr>
<td>Global</td>
<td>330 000</td>
<td>290 000–380 000</td>
</tr>
</tbody>
</table>
TB mortality, HIV-positive (2013)

\[ r = \frac{M_m}{M_w} \quad (1) \]

\[ M = M_w + M_m \quad (2) \]

\[ M_w = \frac{M}{1+r} \]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r )</td>
<td>Ratio of number of all AIDS deaths in men:women ( \approx ) ratio of number of TB AIDS deaths in men:women</td>
</tr>
<tr>
<td>( M )</td>
<td>Estimated number of TB deaths (HIV+), 15 +</td>
</tr>
<tr>
<td>( M_w )</td>
<td>Estimated number of TB deaths (HIV+), 15 +, women</td>
</tr>
<tr>
<td>( M_m )</td>
<td>Estimated number of TB deaths (HIV+), 15 +, men</td>
</tr>
</tbody>
</table>
TB mortality, HIV-positive (cont.)

- Combine country level to provide regional estimates
- Uncertainty propagated from operations between RVs

<table>
<thead>
<tr>
<th>Region</th>
<th>HIV-POSITIVE</th>
<th>BEST ESTIMATE</th>
<th>UNCERTAINTY INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFR</td>
<td></td>
<td>160 000</td>
<td>140 000–190 000</td>
</tr>
<tr>
<td>AMR</td>
<td></td>
<td>2 100</td>
<td>1 900–2 300</td>
</tr>
<tr>
<td>EMR</td>
<td></td>
<td>990</td>
<td>840–1 200</td>
</tr>
<tr>
<td>EUR</td>
<td></td>
<td>990</td>
<td>850–1 100</td>
</tr>
<tr>
<td>SEAR</td>
<td></td>
<td>17 000</td>
<td>14 000–20 000</td>
</tr>
<tr>
<td>WPR</td>
<td></td>
<td>1 200</td>
<td>1 000–1 400</td>
</tr>
<tr>
<td>Global</td>
<td></td>
<td>180 000</td>
<td>160 000–210 000</td>
</tr>
</tbody>
</table>
Questions to the group?

1. Are there suggestions for modifications to the statistical approach for estimation of childhood TB incidence that would improve the appeal of this approach?

2. Are there suggestions for modifications to the statistical approach for estimation of childhood TB mortality that would improve the appeal of this approach?

3. Are there any suggestions for expansion of the statistical approach that will allow disaggregation of incidence and mortality estimates by HIV status?
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Bill & Melinda Gates Foundation

Centers for Disease Control and Prevention

ECDC

London School of Hygiene & Tropical Medicine

The Global Fund

To Fight AIDS, Tuberculosis and Malaria

Harvard

USAID

From the American People