Epidemiology of TB and Diagnostic Delays

Onn Min Kon
TB Clinics
St Mary’s and Hammersmith Hospitals
What happens after ‘infection’

- May heal spontaneously
- May develop active disease
  - over weeks and months
  - ‘primary’ TB
- Contained and dormant
  - may reactivate later if debilitated or immunocompromised
  - ‘post-primary’ TB

Lifetime cumulative risk after ‘infection’ - 10-15%
(1.5% first year/ 5-10% five years)
Spread of *M. tuberculosis* – the causative bacillus of TB

1/5 Londoners died of TB in early 19th C
TB rates in London, 1982-2010

- **London**: The rate has been increasing from 1982 to 2010, reaching a peak around 2004 and then declining slightly until 2010.
- **England and Wales**: The rate has been relatively stable with a slight increase from 1982 to 2010.
TB incidence in Western Europe, 2009

Collaborative TB Strategy - Consultation
Trends in the annual number of cases of tuberculosis in England compared with the USA. Dotted lines show projected numbers, assuming present annual percentage change continues for 2 more years. (Based on data from Public Health England (UK) and the Centre for Disease Control and Prevention (USA). (Zenner et al 2013)
Three-year average TB rates by local authority district, England, 2012-2014

Tuberculosis rate (per 100,000)

- 0.0-4.9
- 5.0-9.9
- 10.0-14.9
- 15.0-24.9
- 25.0-39.9
- 40.0-69.9
- >70.0

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Source: Enhanced Tuberculosis Surveillance (ETS), Office for National Statistics (ONS)
Data extracted: March 2015.
The TB Control Boards (TBCBs) are aligned with PHEC boundaries other than North East and the Yorkshire and the Humber PHECs, which together form the North East, Yorkshire and Humber TBCB, and the South East and South West PHECs, which together form the South East and South West TBCB.

Number of TB case notifications by TB control board*, England, 2014

* The TB Control Boards (TBCBs) are aligned with PHEC boundaries other than North East and the Yorkshire and the Humber PHECs, which together form the North East, Yorkshire and Humber TBCB, and the South East and South West PHECs, which together form the South East and South West TBCB.

TB burden

- Highest TB burden control board
- Lowest TB burden control board

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Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015.

Tuberculosis in England: 2015 report
TB case notifications and rates by PHE Centre, England, 2014

Source: Enhanced Tuberculosis Surveillance (ETS), Office for National Statistics (ONS)
Data extracted: March 2015.
TB case notifications and rates by place of birth, England, 2000-2014

Source: Enhanced Tuberculosis Surveillance (ETS), Labour Force Survey (LFS)
Data extracted: March 2015.
TB case notifications and rates by age group and place of birth, England, 2014

Age group (years)

- UK born
- Non-UK born
- Rate in UK born
- Rate in Non-UK Born

95% CI (too narrow to be visible)
95% CI

Source: Enhanced Tuberculosis Surveillance (ETS), Labour Force Survey (LFS)
Data extracted: March 2015.

Tuberculosis in England: 2015 report
## Country of birth and time from UK entry to TB notification, England, 2014

<table>
<thead>
<tr>
<th>Country of birth</th>
<th>Number of cases</th>
<th>Percentage of cases (%)</th>
<th>Median time in years since entry to UK (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>1,774</td>
<td>28.2</td>
<td>-</td>
</tr>
<tr>
<td>India</td>
<td>1,288</td>
<td>20.5</td>
<td>7 (3 - 14)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>791</td>
<td>12.6</td>
<td>10 (3 - 25)</td>
</tr>
<tr>
<td>Somalia</td>
<td>230</td>
<td>3.7</td>
<td>10 (3 - 14)</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>207</td>
<td>3.3</td>
<td>8 (4 - 19)</td>
</tr>
<tr>
<td>Nepal</td>
<td>168</td>
<td>2.7</td>
<td>4 (3 - 9)</td>
</tr>
<tr>
<td>Nigeria</td>
<td>118</td>
<td>1.9</td>
<td>7 (2 - 17)</td>
</tr>
<tr>
<td>Philippines</td>
<td>111</td>
<td>1.8</td>
<td>9 (4 - 13)</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>107</td>
<td>1.7</td>
<td>11 (9 - 12)</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>96</td>
<td>1.5</td>
<td>8 (4 - 13)</td>
</tr>
<tr>
<td>Romania</td>
<td>88</td>
<td>1.4</td>
<td>1 (0 - 6)</td>
</tr>
<tr>
<td>Eritrea</td>
<td>83</td>
<td>1.3</td>
<td>3 (0 - 8)</td>
</tr>
<tr>
<td>Kenya</td>
<td>81</td>
<td>1.3</td>
<td>19 (8 - 41)</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>78</td>
<td>1.2</td>
<td>11 (4 - 15)</td>
</tr>
<tr>
<td>Poland</td>
<td>70</td>
<td>1.1</td>
<td>6 (2 - 8)</td>
</tr>
<tr>
<td>Others (each &lt;1%)</td>
<td>1,007</td>
<td>15.8</td>
<td>8 (3 - 16)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,297</strong></td>
<td><strong>100.0</strong></td>
<td><strong>9 (3 - 20)</strong></td>
</tr>
</tbody>
</table>

* Where country of birth was known

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Trend in TB case notifications for top five countries of birth* of non-UK born cases, England, 2005-2014

* Five most frequent countries of birth in 2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Time between entry to the UK & TB notification for non-UK born cases by year, England, 2005-2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015.
TB case notifications and rates
by place of birth and ethnic group, England, 2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015

Tuberculosis in England: 2015 report
Trend of TB case notifications by age group and ethnic group* in UK born cases, England, 2000-2014

* Cases with Black-Caribbean, Black-African, Black-Other, Indian, Pakistani, Bangladeshi, Chinese and Mixed/Other ethnic groups were grouped as 'non-White'.

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015

Tuberculosis in England: 2015 report
TB case notifications by site of disease, England, 2014

<table>
<thead>
<tr>
<th>Site of disease*</th>
<th>Number of cases</th>
<th>Percentage**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary</td>
<td>3,434</td>
<td>52.9</td>
</tr>
<tr>
<td>Extra-thoracic lymph nodes</td>
<td>1,445</td>
<td>22.3</td>
</tr>
<tr>
<td>Intra-thoracic lymph nodes</td>
<td>863</td>
<td>13.3</td>
</tr>
<tr>
<td>Unknown extra-pulmonary</td>
<td>638</td>
<td>9.8</td>
</tr>
<tr>
<td>Pleural</td>
<td>566</td>
<td>8.7</td>
</tr>
<tr>
<td>Other extra-pulmonary</td>
<td>504</td>
<td>7.8</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>368</td>
<td>5.7</td>
</tr>
<tr>
<td>Bone – spine</td>
<td>310</td>
<td>4.8</td>
</tr>
<tr>
<td>Miliary</td>
<td>179</td>
<td>2.8</td>
</tr>
<tr>
<td>Bone – not spine</td>
<td>168</td>
<td>2.6</td>
</tr>
<tr>
<td>CNS – meningitis</td>
<td>148</td>
<td>2.3</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>129</td>
<td>2.0</td>
</tr>
<tr>
<td>CNS – other</td>
<td>99</td>
<td>1.5</td>
</tr>
<tr>
<td>Cryptic disseminated</td>
<td>39</td>
<td>0.6</td>
</tr>
<tr>
<td>Laryngeal</td>
<td>16</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* With or without disease at another site
** Total percentage exceeds 100% due to disease at more than one site
CNS - Central Nervous System

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Rate of TB in UK born children (0-14 years old), England, 2000-2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
## Number and proportion of cases with unique and clustered MIRU-VNTR strain types, England, 2010-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Notified cases</th>
<th>Culture confirmed cases</th>
<th>Strain typed cases (≥23 loci)</th>
<th>Unique cases</th>
<th>Clustered cases *</th>
<th>New clusters (per year) **</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>2010</td>
<td>7,677</td>
<td>4,609</td>
<td>3,229</td>
<td>1,391</td>
<td>1,838</td>
<td>56.9</td>
</tr>
<tr>
<td>2011</td>
<td>8,276</td>
<td>5,029</td>
<td>4,267</td>
<td>1,846</td>
<td>2,421</td>
<td>56.7</td>
</tr>
<tr>
<td>2012</td>
<td>8,086</td>
<td>4,895</td>
<td>4,301</td>
<td>1,754</td>
<td>2,547</td>
<td>59.2</td>
</tr>
<tr>
<td>2013</td>
<td>7,257</td>
<td>4,390</td>
<td>3,656</td>
<td>1,526</td>
<td>2,130</td>
<td>58.3</td>
</tr>
<tr>
<td>2014</td>
<td>6,520</td>
<td>3,914</td>
<td>3,319</td>
<td>1,512</td>
<td>1,807</td>
<td>54.4</td>
</tr>
<tr>
<td>Total</td>
<td>37,816</td>
<td>22,837</td>
<td>18,772</td>
<td>8,029</td>
<td>10,743</td>
<td>57.2</td>
</tr>
</tbody>
</table>

* Clustered in time period (2010-2014), clustered cases notified in year
** A new cluster forms at the point when a second case is notified with the same MIRU-VNTR strain type as an existing case

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Proportion of MIRU-VNTR clusters by size, England, 2010-2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Number and proportion of pulmonary TB cases by delay from symptom onset to treatment start, England, 2011-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>0-2 months</th>
<th></th>
<th>2-4 months</th>
<th></th>
<th></th>
<th>&gt;4 months</th>
<th></th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1,317</td>
<td>45.0</td>
<td>856</td>
<td>29.3</td>
<td>753</td>
<td>25.7</td>
<td>2,926</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>1,369</td>
<td>44.0</td>
<td>925</td>
<td>29.8</td>
<td>814</td>
<td>26.2</td>
<td>3,108</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>1,222</td>
<td>41.2</td>
<td>900</td>
<td>30.4</td>
<td>841</td>
<td>28.4</td>
<td>2,963</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>1,137</td>
<td>39.5</td>
<td>868</td>
<td>30.2</td>
<td>870</td>
<td>30.3</td>
<td>2,875</td>
<td></td>
</tr>
</tbody>
</table>

* The number of pulmonary cases with time between onset of symptoms to start of TB treatment available, excluding those diagnosed post-mortem and those that were known to not start treatment.

Tuberculosis in England: 2015 report

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Proportion of pulmonary cases with a delay from symptom onset to treatment start of >4 months by age group, England, 2011-2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Proportion of cases with a delay from symptom onset to treatment start by place of birth, England, 2011-2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
TB outcome at 12 months for drug sensitive cases with expected treatment duration <12 months*, England, 2013

- Treatment completed: 84.8%
- Died: 1.5%
- Lost to follow-up: 5.1%
- Still on treatment: 3.7%
- Treatment stopped: 0.9%
- Not evaluated**: n = 6,422

* Excludes initial and amplified to rifampicin resistant TB and MDR-TB cases and MDR-TB treated cases and those with CNS, spinal, miliary or cryptic disseminated TB
** Not evaluated includes missing, unknown and transferred out

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Treatment completion at 12 months for drug sensitive TB cases with expected treatment duration <12 months*, England, 2004-2013

* Excludes initial and amplified to rifampicin resistant TB and MDR-TB cases and MDR-TB treated cases and those with CNS, spinal, miliary or cryptic disseminated TB

Tuberculosis in England: 2015 report

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Last recorded TB outcome for drug sensitive cohort with CNS, spinal, miliary or cryptic disseminated* TB, England, 2013

- Treatment completed: 67.1%
- Died: 4.0%
- Lost to follow-up: 0.8%
- Still on treatment: 13.4%
- Treatment stopped: 5.7%
- Not evaluated**: 8.9%

n = 751

* Excludes initial and amplified to rifampicin resistant TB and MDR-TB cases and MDR-TB treatment cases and only includes drug sensitive TB cases with CNS, spinal, military or cryptic disseminated TB

** Not evaluated includes missing, unknown and transferred out

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015

Tuberculosis in England: 2015 report
Number and proportion of TB cases with initial drug resistance, England, 2005-2014

* Culture confirmed cases with DST results for at least isoniazid and rifampicin resistant to isoniazid without MDR-TB
** Culture confirmed cases with DST results for at least isoniazid and rifampicin resistant to rifampicin, including those with MDR-TB

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
### Number and proportion of TB cases with drug resistance by age group, England, 2014

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Resistant to isoniazid without MDR-TB cases*</th>
<th>MDR/RR-TB cases**</th>
<th>Total cases#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>0-4</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>5-14</td>
<td>2</td>
<td>4.3</td>
<td>0</td>
</tr>
<tr>
<td>15-24</td>
<td>31</td>
<td>5.6</td>
<td>9</td>
</tr>
<tr>
<td>25-34</td>
<td>62</td>
<td>5.7</td>
<td>24$</td>
</tr>
<tr>
<td>35-44</td>
<td>51</td>
<td>6.8</td>
<td>11$</td>
</tr>
<tr>
<td>45-54</td>
<td>33</td>
<td>6.3</td>
<td>7</td>
</tr>
<tr>
<td>55-64</td>
<td>20</td>
<td>5.9</td>
<td>4</td>
</tr>
<tr>
<td>65+</td>
<td>16</td>
<td>2.8</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>215</td>
<td>5.5</td>
<td>56</td>
</tr>
</tbody>
</table>

* Culture confirmed cases with DST results for at least isoniazid and rifampicin who are resistant to isoniazid without MDR-TB
** Culture confirmed cases with DST results for at least isoniazid and rifampicin who are resistant to rifampicin, including those with MDR-TB
# All culture confirmed cases with DST results for at least isoniazid and rifampicin
$ Three cases aged 25-34 and one case aged 35-44 were resistant to rifampicin without MDR-TB

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015

Tuberculosis in England: 2015 report
Most frequent countries of birth of TB cases with drug resistance, England, 2014

<table>
<thead>
<tr>
<th>Country of birth*</th>
<th>Total cases**</th>
<th>Resistant to isoniazid without MDR-TB cases #</th>
<th>MDR/RR-TB cases$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>UK</td>
<td>987</td>
<td>52</td>
<td>5.4</td>
</tr>
<tr>
<td>India</td>
<td>780</td>
<td>40</td>
<td>5.1</td>
</tr>
<tr>
<td>Pakistan</td>
<td>469</td>
<td>27</td>
<td>5.8</td>
</tr>
<tr>
<td>Somalia</td>
<td>129</td>
<td>10</td>
<td>7.8</td>
</tr>
<tr>
<td>Philippines</td>
<td>75</td>
<td>7</td>
<td>9.3</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>59</td>
<td>7</td>
<td>11.9</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>107</td>
<td>7</td>
<td>6.5</td>
</tr>
<tr>
<td>Nepal</td>
<td>113</td>
<td>6</td>
<td>5.3</td>
</tr>
<tr>
<td>Lithuania</td>
<td>46</td>
<td>5</td>
<td>10.9</td>
</tr>
<tr>
<td>Eritrea</td>
<td>53</td>
<td>5</td>
<td>9.4</td>
</tr>
<tr>
<td>Nigeria</td>
<td>81</td>
<td>4</td>
<td>4.9</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>69</td>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>27</td>
<td>1</td>
<td>3.7</td>
</tr>
<tr>
<td>Latvia</td>
<td>15</td>
<td>1</td>
<td>6.7</td>
</tr>
</tbody>
</table>

* Top 14 countries of birth for cases resistant to isoniazid without MDR and MDR/RR-TB cases in 2014.
** Culture confirmed cases with DST results for at least isoniazid and rifampicin
# Culture confirmed cases with DST results for at least isoniazid and rifampicin who are resistant to isoniazid without MDR-TB
$ Culture confirmed cases with DST results for at least isoniazid and rifampicin who are resistant to rifampicin, including those with MDR-TB
^ Two cases from Nigeria and one case from India were resistant to rifampicin without MDR-TB

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
TB outcome at 24 months for drug resistant cohort, England, 2012*

- Treatment completed: 56.4%
- Died: 3.2%
- Lost to follow up: 9.6%
- Still on treatment: 5.3%
- Treatment stopped: 6.4%
- Not evaluated**: 1.1%

n = 94

Last recorded TB outcome for entire drug resistant cohort, England, 2012*

- Treatment completed: 74.5%

n = 94

* Includes initial and amplified MDR/RR-TB and MDR-TB treatment cases only
** Not evaluated includes missing, unknown and transferred out

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015

Tuberculosis in England: 2015 report
Treatment completion for drug resistant TB cases, England, 2004-2012*

* Includes initial and amplified MDR/RR-TB and MDR-TB treatment cases only
Data labels display the number of cases completing treatment

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Proportion of TB cases with a social risk factor by place of birth, England, 2014

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Last recorded TB outcome for entire drug sensitive cohort by social risk factor*, England, 2013

**At least one social risk factor**
- Treatment completed: 78.2%
- Died: 2.7%
- Lost to follow-up: 3.6%
- Still on treatment: 8.0%
- Treatment stopped: 5.4%
- Not evaluated**: 2.1%

n = 523

**No social risk factor**
- Treatment completed: 89.3%
- Died: 0.7%
- Lost to follow-up: 3.0%
- Still on treatment: 3.2%
- Treatment stopped: 1.3%
- Not evaluated**: 2.6%

n = 5,225

* Excludes initial and amplified to rifampicin resistant TB and MDR-TB cases and MDR-TB treated cases and those with CNS, spinal, miliary or cryptic disseminated TB
** Not evaluated includes missing, unknown and transferred out

Source: Enhanced Tuberculosis Surveillance (ETS)
Data extracted: March 2015
Summary

• Clinical suspicion key
  – ‘great mimicker’
  – epidemiology more sensitive than symptoms (or plain CXR)

• Epidemiology - young non UK born versus caucasian elderly UK born

• Pulmonary/ extrapulmonary presentations – chest radiology

• Radiology ‘normal’ symptomatic cases need assessing

• Refer to local TB clinic

• Latent TB screening
  – Contact screening
  – New Entrant Screening