Does Screening and Contact Tracing for Tuberculosis Make Sense?

Rencontre Genevoise de Pneumologie

HUG, mercredi 29 avril 2009

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Incident cases of tuberculosis emerge unpredictably from the population prevalently infected with *M tuberculosis*

Population including persons with and without infection with *M tuberculosis*
Where does \textit{M. tuberculosis} spread? 
The Community Infection Ratio

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Community</th>
<th>Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (denominator)</td>
<td>157</td>
<td>224</td>
</tr>
<tr>
<td>Infected (numerator)</td>
<td>709</td>
<td>374</td>
</tr>
<tr>
<td>Prevalence (p)</td>
<td>0.22</td>
<td>0.60</td>
</tr>
<tr>
<td>1-prevalence (q)</td>
<td>0.78</td>
<td>0.40</td>
</tr>
<tr>
<td>p/q</td>
<td>0.24</td>
<td>1.50</td>
</tr>
<tr>
<td>p/q_{comm} / p/q_{contacts}</td>
<td>0.19 (Cl: 0.15-0.25)</td>
<td></td>
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</tbody>
</table>


The community infection ratio with \textit{M tuberculosis}

Sensitivity of Direct Sputum Smear Examination in Identifying Pulmonary Tuberculosis and Transmitters

Fraction of cases / infected

Cases of pulmonary tuberculosis

Fraction due to smear-neg cases

Fraction due to smear-pos cases

Infected contacts < 15 yr

Calculated from data from:

Prevalence of Infection Among Childhood Contacts <5yr by Characteristic of Bacteriologically Confirmed Source

Per cent infected

Cough + Sputum +: 490/1,012
Cough + Sputum -: 71/286
Cough - Sputum -: 24/244

Risk of Infection Given Exposure: Largely Exogenous Factors

\[ \text{Particles} \times \frac{\text{Volume}}{\text{Exposure time}} \]

- Particles: Production of infectious droplet nuclei
- Volume: Volume of air and ventilation
- Exposure time: Time of inhaling air with droplet nuclei

Risk of Infection Among Contacts as a Function of the Proximity of Contact
Denominators and numerators…

_Whose contacts should be considered?_
- All pulmonary cases? – likely inefficient
- All smear-positive cases:
  Problem: what is “smear-positive”? 

_Which contacts are at risk of infection?_
- Critical: duration of exposure

_Which contacts are at particular risk of disease given infection?_
- Age and immunosuppression are the principle considerations

The “Stone-in-the-Pond” Principle

Simplified after data from:
Veen J. Tuber Lung Dis 1992;73:73-6
The Dutch Supermarket Approach

Secondary Cases of Tuberculosis Among Contacts, by Proximity and Smear Grade in Index Case, Finland, 1984-88


A simplified view of a problem: Tuberculin skin test versus IGRAs

Both tests measure the wrong thing, but IGRAs do it more specifically

An immunologic response to mycobacterial antigens acquired in the past does not equate currently live bacilli ready to cause disease (BCG!)
The choice between IGRA types

<table>
<thead>
<tr>
<th></th>
<th>I don’t want to be bothered with complexities</th>
<th>It’s the lymphocytes, stupid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Smart</td>
<td>Not so smart</td>
</tr>
<tr>
<td>Simple</td>
<td>Not available</td>
<td>Available</td>
</tr>
<tr>
<td>Not so simple</td>
<td>Available</td>
<td>Not a chance</td>
</tr>
</tbody>
</table>

A rational strategy that will never be heeded?

- Examine first only household contacts of direct (not BAL) sputum smear-positive cases, aged less than some cut-off age
- Calculate prevalence of “infected”
- If critical prevalence threshold exceeded only, examine other close contacts
- Examine contacts of all pulmonary cases aged <5yrs
How to determine a cut-off of critical prevalence?

- Depends on the predictive value of a positive test result (test-type dependent – poorer for tuberculin test with increasing age)
- UK chose 10 per cent
- Compile your own data and then revise cut-off based on data
- Break all rules only with children under age of 5 years as long as they live in the household – overkill might be justified

A cold epidemiologic view of reality?

- Contact tracing and testing is an inefficient rollback and containment strategy: the damage has been done and cannot be identified efficiently
- Preventive therapy is a nice theoretical concept, but the tests available do not identify the right people
- Regard contact tracing and preventive therapy strictly as an individual measure to contain the worst damage: children under age of 5 years living in the same household as a potential source of transmission
- Accept the deficiencies of operation damage control and live with it, you cannot compensate it justifiably by extending contact tracing