The Epidemiology and Burden of Pneumococcal Disease

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World Health Organization
Diseases caused by *Streptococcus pneumoniae* (Pneumococcus)

- Febrile bacteraemia
- Meningitis
- Arthritis
- Peritonitis
- Osteomyelitis

Pneumonia

Sinusitis

Otitis

NP carriage

Invasive pneumococcal disease
NP colonization occurs earlier in lower socioeconomic settings

Surveillance for laboratory confirmed disease only provides part of the picture.

Culture positive Spn disease identified by surveillance for invasive disease.

Additional cases preventable with vaccination.
Incidence of IPD

Incidence < 2 years

Invasive Pneumococcal Disease Rates, by Age, USA 1997

Available at: www.cdc.gov/ncidod/dbmd/abcs/survreports/spneu98.pdf.
Age distribution of pneumococcal meningitis cases
(Bangladesh, India)

Pneumococcus is a significant cause of bacterial meningitis

In low-income countries about 45% of people with pneumococcal meningitis die, compared to 29% with Hib meningitis and 8% with meningococcal meningitis.

Proportion of meningitis caused by pneumococcus

Proportion of CSF specimens positive for *S. pneumoniae*, culture, latex or Binax ICT, children <5 y.o.

- **Bangladesh (n=356)**: 21.6%
- **Pakistan (n=274)**: 17.2%
- **Burkina Faso (n=121)**: 17.4%
- **Kenya (n=66)**: 16.2%
- **Nigeria (n=37)**: 16.2%

**Region**
- **Asia**
- **Africa**
Serotypes causing IPD in India, Nepal & Sri Lanka
(n = 735)

Data for the period of 2005-2013
Differences in serotype prevalence between India, Nepal & Sri Lanka

INDIA

NEPAL

SRI LANKA
Figure: Distribution of Meningitis and Non-meningitis Cases with Their Vaccine Coverage (2007-2013)

Non-meningitis (N= 105)
(Meningitis (N=336)

PCV-10 Coverage

Meningitis  44%
Non-Meningitis 47%
Overall  45%

Source: S K Saha, personal communication
All Countries (India, Nepal, Sri Lanka) by Year

<table>
<thead>
<tr>
<th></th>
<th>2005-2009</th>
<th>2010-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>11.3</td>
<td>14.7</td>
</tr>
<tr>
<td>PCV7</td>
<td>7.6</td>
<td>16.9</td>
</tr>
<tr>
<td>19F</td>
<td>10.7</td>
<td>9.0</td>
</tr>
<tr>
<td>23F</td>
<td>5.6</td>
<td>3.1</td>
</tr>
<tr>
<td>9A/V</td>
<td>3.1</td>
<td>3.4</td>
</tr>
<tr>
<td>18A/B/C/F</td>
<td>1.5</td>
<td>2.8</td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>1.7</td>
</tr>
<tr>
<td>1</td>
<td>18.7</td>
<td>11.9</td>
</tr>
<tr>
<td>PCV10</td>
<td>7.3</td>
<td>7.9</td>
</tr>
<tr>
<td>5</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>7A/F</td>
<td>2.4</td>
<td>2.8</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>1.7</td>
</tr>
<tr>
<td>PCV13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVT</td>
<td>25.4</td>
<td>20.9</td>
</tr>
</tbody>
</table>

% Vaccine Type

Vaccine Types: PCV7, PCV10, PCV13, NVT
Figure: PCV-10 Coverage for IPD Cases in Bangladesh, 2007 - 2013

PCV-10 Coverage

- Meningitis: 44%
- Non-Meningitis: 47%
- Overall: 45%

Source: Samir Saha
### Incidence of pneumonia

<table>
<thead>
<tr>
<th>Outcome and age range (months)</th>
<th>India (cases per 1000 child-years)</th>
<th>Neighboring countries (per 1000)</th>
<th>Developing countries globally (per 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALRI 0-59</td>
<td>290, 370</td>
<td>510</td>
<td>290</td>
</tr>
<tr>
<td>ALRI 1-59</td>
<td></td>
<td>310</td>
<td></td>
</tr>
<tr>
<td>Severe ALRI 0-59</td>
<td></td>
<td>50</td>
<td>20</td>
</tr>
<tr>
<td>Severe ALRI 1-59</td>
<td></td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>Severe ALRI 2-59</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Severe ALRI 0-35</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe ALRI 1-23</td>
<td>27, 31, 79</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
S. pneumoniae—The Most Common Cause of Bacterial Pneumonia

% of bacterial isolates

<table>
<thead>
<tr>
<th>Location</th>
<th>S. pneumoniae</th>
<th>H. influenzae</th>
<th>Other bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papua New Guinea</td>
<td>40%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>The Gambia (2)</td>
<td>50%</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>Zimbabwe (3)</td>
<td>30%</td>
<td>10%</td>
<td>60%</td>
</tr>
<tr>
<td>The Gambia (4)</td>
<td>50%</td>
<td>20%</td>
<td>30%</td>
</tr>
</tbody>
</table>

3Ikeogu MO. Arch Dis Child. 1989; 64(8):1207.
# Lung aspirate studies from S Asia

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>N</th>
<th>No. pos</th>
<th>S pneumo</th>
<th>H inf</th>
<th>S aureus</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinha</td>
<td>1966</td>
<td>25</td>
<td>11</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hughes</td>
<td>1966</td>
<td>17</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hughes</td>
<td>1969</td>
<td>18</td>
<td>7</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Kalra</td>
<td>1981</td>
<td>70</td>
<td>36</td>
<td>18</td>
<td>2</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Tewari</td>
<td>1991</td>
<td>100</td>
<td>50</td>
<td>5</td>
<td>0</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Prakash</td>
<td>1996</td>
<td>35</td>
<td>17</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Patwari</td>
<td>1996</td>
<td>12</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td><strong>All studies</strong></td>
<td><strong>1966-96</strong></td>
<td><strong>277</strong></td>
<td><strong>132 (48%)</strong></td>
<td><strong>36 (13%)</strong></td>
<td><strong>21 (8%)</strong></td>
<td><strong>36 (13%)</strong></td>
<td><strong>44 (16%)</strong></td>
</tr>
</tbody>
</table>

Source: Vuori-Holopainen E, Peltola H. CID 2001

Included older children
Proportion of pneumonia attributable to pneumococcus, based on vaccine impact data

Clinical Pneumonia
NCKP
South Africa
Gambia
Philippines
Severe Pneumonia
NCKP
South Africa
Gambia
Philippines
CXR+ Pneumonia
NCKP
South Africa
Gambia
Philippines

8% 21% 33%
Causes of death in children, 2010

Liu et al. Lancet 2012
Pneumonia mortality trends, SEAR

Liu et al. Lancet 2012
### Etiology - bacterial “probe” studies

<table>
<thead>
<tr>
<th>Country and age range (months)</th>
<th>Study design</th>
<th>Outcome measure</th>
<th>Outcome-specific mortality reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>India 0-47</td>
<td>Case-control, village randomized</td>
<td>Fatal pneumonia</td>
<td>54%</td>
</tr>
<tr>
<td>Pakistan 0-59</td>
<td>Observational, community based</td>
<td>Fatal ALRI</td>
<td>55%</td>
</tr>
<tr>
<td>Pakistan 0-59</td>
<td>Observational, hospital based</td>
<td>ARI case fatality</td>
<td>51%</td>
</tr>
<tr>
<td>Bangladesh 0-23</td>
<td>Case-control, village randomized</td>
<td>Fatal pneumonia</td>
<td>54%</td>
</tr>
<tr>
<td>Nepal 0-59</td>
<td>Observational, community based</td>
<td>Fatal ARI</td>
<td>69%</td>
</tr>
</tbody>
</table>

**Bacterial pneumonia has a proportionally greater contribution to pneumonia deaths**
# Estimates of pneumococcal deaths

*(WHO, 2008 unofficial)*

<table>
<thead>
<tr>
<th>Country</th>
<th>Pneumococcal deaths</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pneumonia</td>
<td>Meningitis</td>
<td>NPNM</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>7165</td>
<td>1311</td>
<td>371</td>
<td>8846</td>
<td></td>
</tr>
<tr>
<td>Bhutan</td>
<td>82</td>
<td>7</td>
<td>2</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>73292</td>
<td>9850</td>
<td>2786</td>
<td>85928</td>
<td></td>
</tr>
<tr>
<td>Maldives</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>1378</td>
<td>278</td>
<td>79</td>
<td>1735</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>18799</td>
<td>1595</td>
<td>451</td>
<td>20845</td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>133</td>
<td>10</td>
<td>10</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100854</td>
<td>13054</td>
<td>3701</td>
<td>117609</td>
<td></td>
</tr>
</tbody>
</table>
Top 10 high burden countries
Population size vs mortality rate

Feb/08 analysis
Summary

- Pneumococcus is an important cause of serious disease in children, especially pneumonia and meningitis.

- Establishing pneumococcal etiology of childhood pneumonia is a challenge and limits the ability to get a direct estimation of burden of disease.

- Synthesis of available data shows that pneumococcal disease is an important cause of childhood morbidity and mortality worldwide, as well as in South Asia.

- No reason to suspect that the epidemiology of pneumococcal disease in South Asia is different from that in other countries with similar socio-economic & mortality profile.
thank you
EXTRA SLIDES
IPD serotypes, India (2005-213) (n=349)

Data for the period of 2005-2013
IPD serotypes, Nepal (2005-13) (n=210)

Data for the period of 2005-2013
IPD serotypes, Sri Lanka (2005-13) (n=176)

Data for the period of 2005-2013
India by Year

% Vaccine Type

Year | PCV7 | PCV10 | PCV13 | NVT
--- | --- | --- | --- | ---
14 | 7.4 | 7.8 | 3.1 | 3.3
9 | 2.2 | 3.9 | 1.9 | 1.9
18 | 2.6 | 3.9 | 1.9 | 1.9
23 | 1.3 | 1.9 | 3.5 | 3.5
19 | 1.3 | 1.9 | 3.5 | 3.5
6 | 1.3 | 1.9 | 3.5 | 3.5
4 | 1.3 | 1.9 | 3.5 | 3.5
1 | 35.8 | 33.3 | 12.6 | 11.8
5 | 9.1 | 11.8 | 4.3 | 3.5
7 | 2.5 | 2.5 | 2.5 | 2.5
3 | 5.9 | 8.2 | 5.9 | 8.2
19 | 29.9 | 25.2 | 23.5 | 20.0

Nepal by Year

Data for the period of 2005-2013

- PCV7
- 14
- 9A/V
- 18A/B/C/F
- 23F
- 19F
- 6A/B/C/D
- 4
- 1
- PCV10
- 5
- 7A/F
- 3
- PCV13
- 19A
- NVT

- 2005-2009
- 2010-2013
Sri Lanka by Year

Data for the period of 2005-2013