Community-based Typhoid Vaccination Program in New Delhi, India

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Typhoid Fever

• Major public health problem in developing world, if left untreated- 30% mortality
• High Migrants load (unprotected vulnerable cohort) settling in slums
• Evidence of higher occurrence of culture positive Typhoid in 2-5 years children in slum
• Occurrence of typhoid was 44% in < 5 years.
• Total Expected Annual Losses/cost for each individual 5 times higher in child 2-5 yrs against those 5-19yrs
Typhoid Fever in Delhi

Typhoid fever in children aged less than 5 years

Anju Sinha, Sunil Sazawal, Ramesh Kumar, Seema Sood, Vankadara P Reddaiah, Bir Singh, Malla Rao, Abdolla Naficy, John D Clemens, Maharaj K Bhan

<table>
<thead>
<tr>
<th>Age at follow-up (years)</th>
<th>Total follow-up (years)</th>
<th>Culture-confirmed cases (n)</th>
<th>Typhoid incidence* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5</td>
<td>1027</td>
<td>28</td>
<td>27.3 (17.2 to 37.4)</td>
</tr>
<tr>
<td>0–1</td>
<td>166</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>&gt;1–2</td>
<td>202</td>
<td>5</td>
<td>24.8 (3.1 to 46.5)</td>
</tr>
<tr>
<td>&gt;2–3</td>
<td>213</td>
<td>11</td>
<td>51.6 (21.1 to 82.2)</td>
</tr>
<tr>
<td>&gt;3–4</td>
<td>225</td>
<td>5</td>
<td>22.2 (2.7 to 41.7)</td>
</tr>
<tr>
<td>&gt;4–5</td>
<td>221</td>
<td>7</td>
<td>31.7 (8.2 to 55.2)</td>
</tr>
<tr>
<td>Over 5–19</td>
<td>2743</td>
<td>32</td>
<td>11.7 (7.9 to 15.7)</td>
</tr>
<tr>
<td>≥5–12</td>
<td>1579</td>
<td>22</td>
<td>13.9 (8.1 to 19.8)</td>
</tr>
<tr>
<td>&gt;12–19</td>
<td>1164</td>
<td>10</td>
<td>8.6 (3.3 to 13.9)</td>
</tr>
<tr>
<td>Over 19–40</td>
<td>2684</td>
<td>3</td>
<td>1.1 (−0.1 to 2.4)</td>
</tr>
<tr>
<td>Total</td>
<td>6454</td>
<td>63</td>
<td>9.8 (7.4 to 12.2)</td>
</tr>
</tbody>
</table>

*Incidence per 1000 person-years.

Table 1: Age-specific incidence of culture-confirmed typhoid detected by active surveillance over a 1-year period in urban Delhi
Typhoid Vaccination in Delhi

• Assured sustained Financial Resource
• Experience of successful Polio Program, Prior Experience MMR & Hepatitis B an advantage
• Strong political and bureaucratic commitment, relatively better performing system with adequate reach of services.
Delhi Health System’s strength

- 600 fixed health facilities
  - Twice weekly at peripheral facilities
  - Once a week out-reach in underserved/un-served
- State & Regional Cold Chain adequate
- Training facility adequate
- Grand Total of sessions = 135,888 annually
- Total Reported Annual Antigens administered = 24,35,000
- Average Session vaccination rate= 17.92 per session

Recommendation:
- Integration in EPI feasible at no extra cost
Delhi’s Vaccination Program

• State Government began the program in 2004 targeting 2-5 year olds
• 300,000 - 325,000 children are vaccinated each year
• Vaccine procured locally at public sector price (~USD 0.50) from their own budget
Evaluating the Program

• Recommendations from Typhoid meeting in 2009
  – Strengthen surveillance system
  – Evaluate Immunization Coverage
  – Evaluate impact of the vaccination from retrospective data of major hospitals
  – Conduct immunological assessment
  – Assess the cost of the program
LAST 5 YEARS TYPHOID COVERAGE REPORT OF MCW UNITS OF COMBINED MCD

Typhoid coverage

- **2007-08**: 61480
- **2008-09**: 84594
- **2009-10**: 53265
- **2010-11**: 80805
- **2011-12**: 76958

- **Y-axis**: 0 to 100000
- **X-axis**: 2007-08 to 2011-12
Post Introduction Research

• Prospective study carried out on 250 children between 6 months to 5 years of age (at a medical college)
  – to determine sero-prevalence (baseline) of anti Vi antibodies and
  – to measure sero-response

• Fifty children each were enrolled
  – between 6 to 12 months of age (Group A),
  – between 1- 2 years of age (Group B),
  – between 2-3 years of age (Group C),
  – between 3-4 years of age (Group D) and
  – between 4-5 years of age (Group E).

• Anti-Vi antibody baseline titres were determined in all children.
Results

- Mean pre-vaccination antibody titre of 0.321 – 0.333 micro gram/ml.
- Mean Post-vaccination antibody 1.825 – 2.349 micro gram/ml.
- More than four fold rise in antibody titre seen in all.
- The pre and post vaccination titre statistically significant (p<0.001).
- Mean percentage rise in antibodies ranged 106.07% - 204.38%
Post introduction research

• There were no significant adverse reactions following vaccination.
• The study highlights very low prevalence of baseline anti Vi antibodies in children between 6 months and less than 5 years of age.
• Shows high immunogenicity and safety of Typhoid Vi polysaccharide vaccine in children 2-5 years of age.
Hospital wise typhoid cases from Apr.-Dec.2012(<5 Year)

- Shi Balaji Action Medical Institute: 43
- Acharya Shree Bhikshu Hospital: 62
- Maharaja Agrasen Hospital: 39
- Guru Gobind Singh Hospital: 25
- Maharishi Valmiki Hospital: 67
- Mata Chanan Devi Apollo Hospital: 9
- Indraprastha Apollo Hospital: 85
- Bhagwan Mahavir Hospital: 40
- Kalawati Saran Children's Hospital: 122
- Pt. Madan Mohan Malaviya Hospital: 9
- ESI Hospital, Okhla Industrial area: 2
- Tirath Ram Shah Hospital: 10
- A & U Tibbia college & Hospital: 5
- Sardar Vallabhbhai Patel Hospital: 5

Serological +
Blood C
Hospital wise typhoid cases from Apr.-Dec.2012 (5-10 Years)

- Shi Balaji Action Medical Institute: 104 cases
- Acharya Shree Bhikshu Hospital: 50 cases
- Maharaja Agrasen Hospital: 45 cases
- Gobind Singh Hospital: 76 cases
- Maharishi Valmiki Hospital: 25 cases
- Mata Chanan Devi Hospital: 7 cases
- Indraprastha Apollo Hospital: 204 cases
- Bhagwan Mahavir Hospital: 3 cases
- Maharaja Agrasen Children’s Hospital: 44 cases
- Pt. Madan Mohan Malaviya Hospital: 0 cases
- ESI Hospital, Okhla Industrial Area: 0 cases
- Sardar Vallabhbhai Patel Hospital: 0 cases
- Tirath Ram Shah Hospital: 10 cases
- A & U Tibbia College & Hospital: 0 cases

Legend:
- Purple bar: Serological +
- Red bar: Blood C
Typhoid cases comparison in major hospital (2008-2010)

- VMMC & Safdarjang Hospital
  - 2008: 548
  - 2009: 87
  - 2010: 29

- KSCH
  - 2008: 193
  - 2009: 42
  - 2010: 4

- RML Hospital
  - 2008: 209
  - 2009: 151
  - 2010: 31

- AIIMS
  - 2008: 6
  - 2009: 0
  - 2010: 0

- Sanjay Gandhi Hospital
  - 2008: 237
  - 2009: 6
  - 2010: 0
Acharya Shree Bhikshu Hospital (2011-12)

IPD Cases aged <5 yrs
IPD Cases aged 5-10 yrs
Estimated Financial Burden of the Disease

<table>
<thead>
<tr>
<th>Private cost</th>
<th>Non-patient cost</th>
<th>Mean total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>INR 1,732</td>
<td>INR 1,865</td>
<td>INR 3,597</td>
</tr>
</tbody>
</table>

- Mean total cost if hospitalized: INR 18,131
- Mean total cost if not hospitalized: INR 2,111

- Total Expected Annual Losses/cost for each individual 5 times higher in child 2-5 yrs against those 5-19yrs
Estimation of Financial saving & Implication during last 4 yrs (till March, 2009)

Input data:
- 10 lacs (1,000,000) children vaccinated
- Protection from Vi vaccine: 70%
- Incidence of typhoid: 9.7/1,000/yr
- Cost of illness (inpatient): INR 18,131 / blood culture confirmed typhoid
- Cost of illness (outpatient): INR 2,111 / blood culture confirmed typhoid
- Inpatient to Outpatient ratio: 2 / 8

<table>
<thead>
<tr>
<th></th>
<th>Population at risk</th>
<th>Cases in 4 years</th>
<th>Cases averted</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Vaccine</td>
<td>1,000,000</td>
<td>11,600</td>
<td></td>
</tr>
<tr>
<td>With Vaccine</td>
<td>300,000</td>
<td>3,480</td>
<td>8,120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Inpatient cost</th>
<th>Outpatient cost</th>
<th>Total cost saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of illness</td>
<td>INR 98,487,592</td>
<td>INR 45,867,808</td>
<td>INR 144,355,400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Vaccines (INR 30 ea.)</th>
<th>IEC cost (INR 500,000/yr)</th>
<th>Total cost used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of program</td>
<td>INR 30,000,000</td>
<td>INR 2,000,000</td>
<td>INR 32,000,000</td>
</tr>
</tbody>
</table>
Future Perspectives

• Continue current surveillance efforts

• Further studies:
  – Community based KAP
  – Community based follow up (stool culture) 3 months and 12 months after discharge to find out carrier status/ incidence

• Develop and Advocate for Vaccination Policy for children>5 years & adolescents in Delhi and beyond