Millennium Development Goals and Child Survival: does Antimicrobial Resistance matter?

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Why do the MDGs matter?

It’s the world’s poor who die earlier

(Graphs showing data related to TB deaths, AIDS deaths, Maternal deaths, Under-Five deaths, and Underweight children, categorized by Global income quartiles.)

Global income quartiles:
- Poorest 25%
- 2nd poorest 25%
- 2nd richest 25%
- Richest 25%
Child deaths

SASI Group and M. Newman 2006
Affordable drugs
Physician Density

SASI Group and M. Newman 2006
Major causes of child deaths
Newborn infections, pneumonia and diarrhea account for almost 40% of all child deaths globally.
The issue of “access” versus “excess”
Antibiotics for pneumonia among children under 5 years according to wealth quintiles

4 districts, Tanzania, 1999

Schellenberg JA et al., Lancet 2003;
Diarrhea Treatment (Rural Sindh 2007)

- ORS
- ZINCOL
- IV Infusion
- Antibiotics
- Anti-diarrheals

Jan-Mar: ORS 46.1
April-June: ORS 53.1
July - Sept: ORS 54.6
Oct - Dec: ORS 56.8

Jan-Mar: ZINCOL 0
April-June: ZINCOL 0
July - Sept: ZINCOL 3.2
Oct - Dec: ZINCOL 4.5

Jan-Mar: IV Infusion 0
April-June: IV Infusion 0
July - Sept: IV Infusion 0
Oct - Dec: IV Infusion 0

Jan-Mar: Antibiotics 32
April-June: Antibiotics 29.5
July - Sept: Antibiotics 25.6
Oct - Dec: Antibiotics 29.5

Jan-Mar: Anti-diarrheals 23.7
April-June: Anti-diarrheals 27.3
July - Sept: Anti-diarrheals 30
Oct - Dec: Anti-diarrheals 22.7
Slipping in and out of care!

Median national coverage levels for 19 Countdown interventions and approaches, most recent estimates since 2000.

Bhutta et al, Lancet 2010
Bacterial Diarrhea and Antimicrobial resistance
Diarrhea deaths

- Some reduction in diarrhea mortality; plateaued at ~1.34 million deaths annually
- Diarrhea incidence has not changed
- Two thirds of diarrhea admissions are NOT related to Rotavirus diarrhea
Antimicrobial Susceptibility of *Shigella* (n=560)  
Mirzapur (Rural), Bangladesh
Dhaka Hospital (ICDDR,B) Surveillance
Antimicrobial Susceptibility of *Shigella*

![Bar chart showing antimicrobial susceptibility of Shigella](chart.png)
### Case Fatality Rates in Hospitalized Childhood Diarrhea

<table>
<thead>
<tr>
<th>Organism</th>
<th>Case Fatality Rate %</th>
<th>Resistant</th>
<th>Sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESCHERICHIA COLI (EP)</td>
<td>1.3%</td>
<td>0.4%</td>
<td></td>
</tr>
<tr>
<td>SALMONELLA ENTERITIDES</td>
<td>2.5%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>VIBRIO CHOLERAE</td>
<td>0.1%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>SHIGELLA</td>
<td>2.4%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>CAMPYLOBACTER JEJUNI</td>
<td>1.6%</td>
<td>0.9%</td>
<td></td>
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</tbody>
</table>
Pakistan Floods
a slow-motion Tsunami

<table>
<thead>
<tr>
<th>Province</th>
<th>Deaths</th>
<th>Injured</th>
<th>Houses Damaged</th>
<th>Population Affected</th>
<th>Damaged Schools</th>
<th>Schools as Shelters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balochistan</td>
<td>48</td>
<td>58</td>
<td>75,261</td>
<td>1,060,162</td>
<td>917</td>
<td>434.00</td>
</tr>
<tr>
<td>Khyber Pakhtunkhwa</td>
<td>1,121</td>
<td>1,165</td>
<td>152,655</td>
<td>4,315,309</td>
<td>913</td>
<td>786.00</td>
</tr>
<tr>
<td>Punjab</td>
<td>103</td>
<td>350</td>
<td>50,000</td>
<td>8,250,000</td>
<td>4,497</td>
<td>3,404.00</td>
</tr>
<tr>
<td>Sindh</td>
<td>141</td>
<td>840</td>
<td>410,510</td>
<td>4,158,160</td>
<td>4,039</td>
<td>1,471.00</td>
</tr>
<tr>
<td>AJK</td>
<td>71</td>
<td>87</td>
<td>7,069</td>
<td>255,900</td>
<td>389</td>
<td>NA</td>
</tr>
</tbody>
</table>

Dadu and Joti towns are under threat as floodwaters continue to move southwards into Dadu district.

400,000 people are believed to have moved to higher ground on the outskirts of Makli town.
Cholera Outbreak in Khairpur (Aug 15-Sept 5 ongoing)

- 80,000 diarrhea cases in the area

- 50% of all severe acute watery diarrhea (> 2500 referred cases)

- Over two thirds of those referred required

- Low case fatality due to excellent management by the University team (high input of workers & logistics)
AMR in Vibrio cholera (Pakistan)

Cholera screening studies carried out in Khairpur (Aug 24 – Aug 31, 2010)
Resistance pattern of *V. cholerae* O1 in Dhaka and Matlab by Month

![Graph showing resistance pattern of *V. cholerae* O1 in Dhaka and Matlab by Month. The graph displays the percentage of resistance over time for different strains (Ogawa and Inaba) in Dhaka and Matlab. The x-axis represents the months from September to March, and the y-axis represents the percentage resistant. The data shows a significant increase in resistance from September 2004 to March 2005 for both Dhaka and Matlab.]
Neonatal sepsis and Antimicrobial resistance: does it matter?
AKUMC profile

• Tertiary care facility

• Maternal and newborn services initiated in 1987

• Currently ~5000 high risk births annually and a catchment population of 40,000 births

• Fully staffed neonatal unit & microbiology services & Electronic records
Antimicrobial prescribing patterns
<table>
<thead>
<tr>
<th>Organism</th>
<th>Susceptibility</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resist</td>
<td>Sensitive</td>
<td></td>
</tr>
<tr>
<td>STAPHYLOCOCCUS AUREUS</td>
<td>15.4 %</td>
<td>3.5 %</td>
<td></td>
</tr>
<tr>
<td>KLEBSIELLA</td>
<td>22.8 %</td>
<td>16.1 %</td>
<td></td>
</tr>
<tr>
<td>ENTEROBACTER</td>
<td>28.0 %</td>
<td>21.6 %</td>
<td></td>
</tr>
<tr>
<td>ACINETOBACTER &amp; PSEUDOMONAS</td>
<td>42.7 %</td>
<td>14.0 %</td>
<td></td>
</tr>
<tr>
<td>ESCHERICHIA COLI</td>
<td>44.0 %</td>
<td>26.7 %</td>
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</tbody>
</table>

Case Fatality Rates (Neonatal sepsis)
Model predicted 368,000 neonatal deaths due to sepsis in South Asia (cf WHO projections of 385,000 deaths)
Conclusions (1)

• The contribution of AMR to major causes of newborn and under 5 bacterial infections and mortality is grossly under-estimated and possibly increasing.

• Crude estimates indicate that an excess 96,000 (~26%, range 16-37%) neonatal infection deaths occur due to AMR infections in South Asia alone.

• Conservative estimates based on etiological fractions indicate that treating these infections alone with appropriate second line antibiotics would cost in excess of $110 million (at bulk purchase costs, excluding delivery systems).
Conclusions (2)

• AMR poses one of the most important challenges to health systems globally, especially in developing countries

• This has enormous implications for the development of appropriate evidence-based treatment regimen & preventive strategies

• A balance of appropriate and timely access as well as regulation of antibiotic use in primary care settings, is needed ….. at scale

• RATIONAL antibiotic use and RATIONING of use