Foodborne diseases:
an ongoing global challenge

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Outline

• WHO estimates of the global burden of foodborne disease
• Regional differences in foodborne disease
• Foods involved in foodborne disease transmission
• Implications for food safety management
• Conclusions
Why did WHO estimate the global burden of foodborne disease?

- Foodborne diseases (FBD) outbreaks and contamination events are highly visible, but true burden is invisible
- FBD cause considerable morbidity and mortality
- Full extent of FBD not documented
- FBD not a risk factor in studies on global burden of disease
- Attention to food safety reduces food loss
- Poverty reduction requires access to markets

“If it is not safe, it is not food”  
(Markus Lipp, FAO)

Challenges in estimating the global burden of FBD

- FBD are complex: numerous hazards, numerous health outcomes, effects on different time scales
- Food is not the only transmission pathway of many food-related hazards
- Limited data availability
Metrics to estimate the global burden of foodborne disease

- Incidence
- Deaths
- Disability Adjusted Life Years
  - DALYs = YLDs + YLLs
  - Equivalent to one health life year

Global burden of foodborne disease, 2010

<table>
<thead>
<tr>
<th>Hazard group</th>
<th>Foodborne illnesses (millions)</th>
<th>Foodborne deaths (thousands)</th>
<th>Foodborne DALYs (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>600</td>
<td>420</td>
<td>33</td>
</tr>
<tr>
<td>Diarrheal</td>
<td>549</td>
<td>230</td>
<td>18</td>
</tr>
<tr>
<td>Invasive</td>
<td>36</td>
<td>117</td>
<td>8</td>
</tr>
<tr>
<td>Helminths</td>
<td>13</td>
<td>45</td>
<td>6</td>
</tr>
<tr>
<td>Chemicals</td>
<td>0.2</td>
<td>19</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Havelaar et al., PLOS Med 2015;13:57-64
Most frequent causes of global food safety risks:

- Foodborne illnesses: norovirus, *Campylobacter* spp.
- Foodborne deaths: non-typhoidal *Salmonella enterica*, *Salmonella Typhi*, *Taenia solium*, hepatitis A virus, aflatoxin

Global findings:

- Annually, 1 out of 10 people in the world suffer from foodborne disease
- Diarrheal diseases are the most common causes of illness (550 million cases) and death (230,000 deaths)
- Of these, non-typhoidal *Salmonella enterica* causes 60,000 deaths
- Diarrheal diseases cause more than half of global foodborne DALYs
Regional differences

- Africa and South-East Asia have the highest incidence of foodborne diseases and the highest death rates among all ages, including children under five.
- Lowest burden in North America, Europe and Australia, New Zealand and Japan.
- Marked differences in the contribution of different agents between regions.
- Typhoid fever, foodborne cholera and diarrhea caused by pathogenic *E. coli* are much more common in low income countries.
- Fish-borne parasites are of concern in Southeast Asia.

Sub regions are defined on the basis of child and adult mortality.
Regional differences in foodborne disease

<table>
<thead>
<tr>
<th>Metric (per 100,000)</th>
<th>Global average</th>
<th>AMR A (North America)</th>
<th>EUR A (Western Europe)</th>
<th>WPR A (Australia, New Zealand, Japan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>8,729</td>
<td>2,577</td>
<td>2,431</td>
<td>2,798</td>
</tr>
<tr>
<td>Deaths</td>
<td>6</td>
<td>0.4</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>DALYs</td>
<td>477</td>
<td>35</td>
<td>41</td>
<td>36</td>
</tr>
</tbody>
</table>

Foodborne disease in Western Europe and North America

- High income countries have largely controlled foodborne deaths
- Foodborne disease incidence in these regions is only 3-4 fold lower than the global average
- Main causes of foodborne disease burden in these regions are non-typhoidal *S. enterica*, *Campylobacter* spp., *Toxoplasma gondii*, norovirus and *Listeria monocytogenes*
- Incidence of foodborne disease due to norovirus in these regions is similar to the global average, but incidence of deaths is much lower
Which foods are implicated in transmission of priority pathogens?

- Food attribution is complex and data-intensive
- Key methods and data sources
  - Outbreaks
  - Microbial subtyping
  - Case-control studies
  - Structured expert judgment
- Different methods may give different results
  - Different points of attribution: reservoir, pathway, risk factor
  - Limited data result in uncertainty

Attribution based on outbreak data (US)

Interagency Food Safety Analytics Collaboration (IFSAC), 2015
Attribution based on case-control studies

\textit{(T. gondii, US)}

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Odds ratio</th>
<th>Attributable risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or more kittens</td>
<td>28</td>
<td>10%</td>
</tr>
<tr>
<td>Eat raw ground lamb</td>
<td>8.4</td>
<td>20%</td>
</tr>
<tr>
<td>Eat raw ground beef</td>
<td>6.7</td>
<td>7%</td>
</tr>
<tr>
<td>Drink raw goat’s milk</td>
<td>5.1</td>
<td>4%</td>
</tr>
<tr>
<td>Work with meat</td>
<td>3.2</td>
<td>5%</td>
</tr>
<tr>
<td>Eat raw shellfish</td>
<td>2.2</td>
<td>16%</td>
</tr>
<tr>
<td>Eat local meat products</td>
<td>2.0</td>
<td>22%</td>
</tr>
</tbody>
</table>

Jones et al., Clin Inf Dis 2009;49:878-884

**Attribution - summary**

- Attribution is complex and data-demanding
- Different methods answer different questions and provide different answers
- Attribution differs between pathogens and between countries for one pathogen
- All food groups contribute to the burden of foodborne disease
- Meats, eggs, produce and seafood cause the highest burden
- WHO will publish comprehensive global estimates in 2017
### Foodborne disease outbreaks - USA

<table>
<thead>
<tr>
<th></th>
<th>Outbreaks</th>
<th>Illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Totals 2011-2014</strong></td>
<td>3314</td>
<td>55718</td>
</tr>
<tr>
<td>Attributed to single food category</td>
<td>798 (25%)</td>
<td>14706 (26%)</td>
</tr>
<tr>
<td>Aquatic animals</td>
<td>234</td>
<td>1544</td>
</tr>
<tr>
<td>Land animals</td>
<td>322</td>
<td>7117</td>
</tr>
<tr>
<td>beef</td>
<td>48</td>
<td>798</td>
</tr>
<tr>
<td>pork</td>
<td>47</td>
<td>1347</td>
</tr>
<tr>
<td>poultry</td>
<td>112</td>
<td>3625</td>
</tr>
<tr>
<td>Plants</td>
<td>225</td>
<td>5809</td>
</tr>
<tr>
<td>fruits</td>
<td>65</td>
<td>2261</td>
</tr>
<tr>
<td>vegetables</td>
<td>102</td>
<td>2747</td>
</tr>
<tr>
<td>grains and beans</td>
<td>36</td>
<td>576</td>
</tr>
</tbody>
</table>

### Foodborne disease outbreaks – EU 2014

Strong evidence outbreaks by food vehicle

- Mixed food: 18.2%
- Eggs and egg products: 12.8%
- Milk and dairy products: 9.3%
- Sweets and chocolate: 6.3%
- Fish and fish products: 6.3%
- Other foodstuffs: 6.3%
- Other or mixed meat and products thereof: 4.9%
- Fruit, berries and juices and other products thereof: 4.4%
- Bakery products: 4.3%
- Broiler meat (Gallus gallus) and products thereof: 3.6%
- Veal, lambs and products thereof: 3.2%
- Buffet meals: 2.7%
- Water: 2.5%
- Other: 1.5%

\( N=592 \)
Litigation

- During the past twenty years, Bill Marler has become the most prominent and powerful food-safety attorney in the country. ... His law firm, on the twenty-eighth floor of a Seattle office building, has filed hundreds of lawsuits against many of the largest food producers in the world. By his estimate, he has won more than six hundred million dollars in verdicts and settlements ....
- Mike Taylor, the highest-ranking food-safety official at the F.D.A., called litigation such as Marler’s “a central element of accountability.”

http://www.newyorker.com/magazine/2015/02/02/bug-system

Foodborne diseases: the state of play

- Foodborne diseases continue to impact the health of consumers and viability of businesses
- The greatest burden is in developing countries
- Developed countries have made major steps towards controlling foodborne deaths but less so for illnesses
- All food chains are involved in transmitting disease, particularly foods of animal origin, produce and seafood
Implications for food safety management

- Food safety management needs to be a core activity of every food business operation
- Priority hazards differ between regions and between products
- Global food chains are vulnerable to a greater diversity of hazards
- Changing consumption patterns (mild processing) and increasing vulnerable populations increase risks
- Priority setting and risk-based safety management are crucial to maximize impact

Acknowledgments

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