Adding Tools to the Toolbox

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Making the Most of What We Have

- **Research Synthesis**
  - Provide rigorous means of integrating existing primary research

- **Time Series Analysis**
  - an experiment with FoodNet and HomeScan consumption data
Research Synthesis Methods

- Systematic Reviews
- Meta-Analysis
- Expert Elicitation

Contributions:
- Means of providing new attribution estimates
- Means of evaluating data quality
Systematic Review: What is it?

- A literature review, but ...
  - Explicit objectives with clear study inclusion criteria (improves transparency)
  - Systematic, documented searches (reduces selection bias, increases transparency)
  - Defined study quality criteria (reduces bias)
  - Consistent evaluation of available information in literature (data, outcomes, study quality)
Systematic Review: Uses and Issues

- **Uses:** to guide practice decisions
  - Developed to inform evidence-based medical practice guidelines
  - Can be used alone or as the basis for a meta-analysis

- **Food Safety applications:**
  - European Food Safety Authority panels are required to consider use in official reviews

- **Issues:**
  - study evaluation criteria appropriate to epidemiological studies
  - adoption of appropriate research reporting standards
Meta-Analysis

- **What is it:** statistical synthesis of results from multiple studies
  - Statistically combines reported results
  - Reanalysis of underlying data

- **Food Safety Applications:**

- **Issues:**
  - Depends on having enough primary research available
  - Research reporting standards
Expert Elicitation

What is it: a set of methods for systematically eliciting and evaluating expert judgment

Uses:
- To fill data gaps
- To characterize uncertainty about existing information

Issues:
- Choosing method appropriate to purpose
- Recognizing usefulness in evaluating data quality
Expert Elicitation Food Attribution

Applications

- estimate attribution to point of consumption for multiple pathogens at the national level:
  - U.S. (Hoffmann et al. 2007), Netherlands (Havelaar et al. 2008), Canada (Davidson et al. 2011), New Zealand (Lake 2006)

- WHO, Global Burden of Disease to estimate % foodborne, and to fill gaps in % foodborne and attribution to point of consumption in WHO regions
  - Cooke and Hoffmann

- Estimate contamination in supply chain
  - Hoelzer et al. 2011, Van der Fels-Klerz et al. 2005
Consider all the evidence …
## Use Outbreak Attribution

<table>
<thead>
<tr>
<th></th>
<th>Number of Outbreaks</th>
<th>Incidence / Outbreak Cases</th>
<th>Sum of Squared Expert/Outbreak Difference</th>
<th>Expert estimates mean st. dev.</th>
<th>Case Control Studies Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cyclospora</strong></td>
<td>14</td>
<td>87</td>
<td>62</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td><strong>E. Coli O157</strong></td>
<td>143</td>
<td>132</td>
<td>20</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td><strong>Listeria</strong></td>
<td>20</td>
<td>55</td>
<td>827</td>
<td>0.96</td>
<td></td>
</tr>
<tr>
<td><strong>Norovirus</strong></td>
<td>1125</td>
<td>555</td>
<td>701</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td><strong>Salmonella</strong></td>
<td>621</td>
<td>296</td>
<td>218</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td><strong>Shigella</strong></td>
<td>41</td>
<td>256</td>
<td>1198</td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td><strong>Vibrio</strong></td>
<td>59</td>
<td>780</td>
<td>9</td>
<td>0.25</td>
<td></td>
</tr>
</tbody>
</table>

## Use Expert Attribution

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Campylobacter</strong></td>
<td>120</td>
<td>1712</td>
<td>3307</td>
<td>0.91</td>
<td>Expert</td>
</tr>
<tr>
<td><strong>Cryptosporidium</strong></td>
<td>4</td>
<td>1152</td>
<td>3622</td>
<td>1.64</td>
<td></td>
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<tr>
<td><strong>Toxoplasma</strong></td>
<td>0</td>
<td>--</td>
<td>2706</td>
<td>2.02</td>
<td>Neither</td>
</tr>
<tr>
<td><strong>Yersinia</strong></td>
<td>5</td>
<td>11909</td>
<td>562</td>
<td>1.38</td>
<td></td>
</tr>
</tbody>
</table>

New Directions: Time Series Analysis

- **FoodNet**
  1995 to now

- **HomeScan**
  1998 to now

Figure 2. Relative rates of laboratory-confirmed infections with *Campylobacter*, *STEC O157*, *Listeria*, *Salmonella*, and *Vibrio* compared with 1996–1998 rates, by year. FoodNet 1996–2010

*Note: Data for 2010 are preliminary.*
Two Experiments:

- **U.S.:** *Campylobacter* and STEC O157 (CDC, ERS, UC Berkeley)
  - FoodNet attribution of domestically-acquired sporadic STEC O157 illnesses to food commodities consumed at home. Dana Cole (CDC), Sandy Hoffmann and Jessica Todd (ERS) and Peter Berck (U.C. Berkeley with ERS funding)

- **U.K.:** *Campylobacter* (Universities of Manchester, Liverpool, Lancaster, New Castle and U. of East Anglia with Research Council funding)
  - Sources, Seasonality, Transmission and Control: *Campylobacter* and human behaviour in a changing environment. PI: Dan Rigby, U. of Manchester, UK. A 5 year project, starting in 2012, funded by MRC/NERC/ESRC/BBSRC. Joint with universities of Liverpool, Lancaster, Newcastle and U East Anglia
Bottom Line: Better data is needed, but we also need to make the most of what we have.

- Systematic reviews and meta-analysis
  - becoming central to EFSA analysis and decision making
  - discussion needed on adapting methods to epidemiology
    - Harvard Center for Risk Analysis (Lisa Robinson & Jim Hammitt)
    - Iowa State U., School of Vet. Medicine (Annette O’Connor)

- Expert elicitation
  - multiple methods ... use what’s appropriate to need
  - use for data quality evaluation as well as “filling gaps”

- Time Series Analysis ... stay tuned, it may provide another alternative.
Thank you!

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For more information, see http://www.ers.usda.gov
Further Reading: Systematic Reviews

Guidance:
- Dickersin, K. 2002. “Systematic reviews in epidemiology: why are we so far behind?” *Internat. J. Epi.* **31:**6-12

Applications:
Further Reading: Meta-analysis

- **Guidance:**

- **Meta-analysis applications:**
Further Reading: Expert elicitation

**Guidance:**

**Applications:**