

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
 - EFSA. 2010. "Application of systematic review methodology to food and feed safety assessment to support decision making: EFSA Guidance for those carrying out systematic reviews." *EFSA J.* 8(6): 1637.
- Issues:
 - study evaluation criteria appropriate to epidemiological studies
 - adoption of appropriate research reporting standards
 - Vandembroucke et al. 2007. "Strengthening Reporting of Observational Studies in Epidemiology (STROBE)." *Epidemiology* 18(6): 805-835.

Meta-Analysis

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

- Food Safety Applications:
 - Dominques, AR, Pires, SM, HalasaT, and Hald T. 2011. "Source attribution of human salmonellosis using meta-analysis of case-control studies of sporadic infections." *Epidemiolo. Infect.* 8:1-11.

- Issues:
 - Depends on having enough primary research available
 - Research reporting standards
 - Stroup et al. 2000. "Meta-analysis of Observational Studies in Epidemiology: a Proposal for Reporting." *JAMA* 83(15): 2008-2012.

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
 - US EPA. 2011. *Expert Elicitation White Paper*

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

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

Use Expert Attribution

<i>Campylobacter</i>	120	1712	3307	0.91	Expert
<i>Cryptosporidium</i>	4	1152	3622	1.64	
<i>Toxoplasma</i>	0	--	2706	2.02	Neither
<i>Yersinia</i>	5	11909	562	1.38	

Source: Batz, Hoffmann and Morris. *Forthcoming*. Ranking the Disease Burden of Fourteen Pathogens in Food Sources in the United States Using Attribution Data from Outbreak Investigations and Expert Elicitation. *J. of Food Protection*.

New Directions: Time Series Analysis

United States
Department
of Agriculture



Economic
Research
Service

On the Accuracy of Nielsen Homescan Data

Economic
Research
Report
Number 69

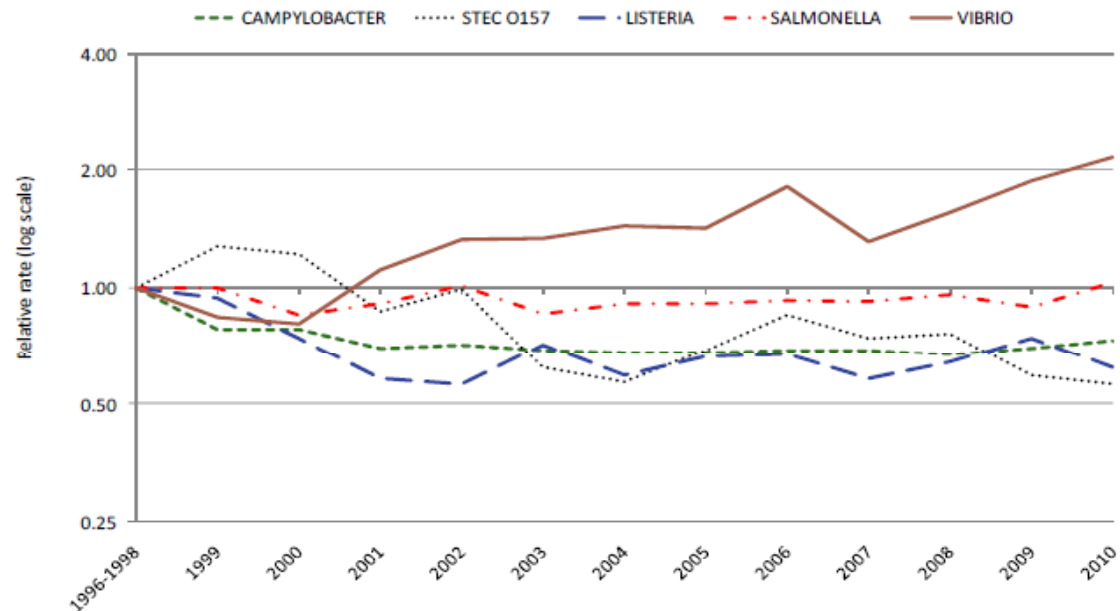
December 2008

Liran Einav
Ephraim Leibtag
Aviv Nevo

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*



*Shiga toxin-producing *Escherichia coli*

*The position of each line indicates the relative change in the incidence of that pathogen compared with 1996–1998. The actual incidences of these infections cannot be determined from this graph. 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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Further Reading: Systematic Reviews

□ Guidance:

- EFSA. 2010. "Application of systematic review methodology to food and feed safety assessment to support decision making: EFSA Guidance for those carrying out systematic reviews." *EFSA J.* 8(6): 1637.
- Vandembroucke et al. 2007. "Strengthening Reporting of Observational Studies in Epidemiology (STROBE)." *Epidemiology* 18(6): 805-835.
- Dickersin, K. 2002. "Systematic reviews in epidemiology: why are we so far behind?" *Internatl. J. Epi.* 31:6-12

□ Applications:

- Sargeant, JN et al. 2006. Methodological Quality Assessment of Review Articles Evaluating Interventions to Improve Microbial Food Safety. *Foodborne Path. And Disease* 3(4) 447-456.
- Guerin, MT et al.. 2010. The change in prevalence of *Campylobacter* on chicken carcasses during processing: a systematic review. *Poult Sci.* 89(5):1070-1084.
- Furst, T et al. 2011. Global burden of human food-borne trematodiasis: a systematic review and meta-analysis. *Lancet Infectious Disease*. DOI: 10.1016/S1473-3099(11)70294-8.

Further Reading: Meta-analysis

□ Guidance:

- Stroup et al. 2000. "Meta-analysis of Observational Studies in Epidemiology: a Proposal for Reporting." *JAMA* 83(15): 2008-2012.

□ Meta-analysis applications:

- Gonzales Barron, U et al. 2008. A meta-analysis study of the effect of chilling on prevalence of *Salmonella* on Pig Carcasses. *J. of Food Prot.* 71(7): 1330-1337.
- Dominques, AR et al. 2011. "Source attribution of human salmonellosis using meta-analysis of case-control studies of sporadic infections." *Epidemiolo. Infect.* 8:1-11.
- Dominques, AR et al. 2012. "Source attribution of human campylobacteriosis using meta-analysis of case-control studies of sporadic infections." *Epidemiolo. Infect.* 8:1-11.

Further Reading: Expert elicitation

□ Guidance:

- EPA, 2011. Expert Elicitation Task Force White Paper

□ Applications:

- Van der Fels-Klerz, HJ et al. 2005 A Structured Expert Judgment Study for a model of Campylobacter Transmission during Brioler-Chicken Processing. *Risk Anal.* 25(1): 109-124.
- Hoffmann, SA et al. 2007. Using Expert Elicitation to Link Foodborne Illnesses in the United States to Foods. *J. Food Protection* 70(5):1220-9
- Havelaar, AH et al. 2008. Attribution of Foodborne Pathogens Using Structured Expert Elicitation. *Foodborne Pathogens and Disease* 5(5): 649-659.
- Davidson, VJ et al. 2011. Food-Specific Attribution of Selected Gastrointestinal Illnesses: Estimates from a Canadian Expert Elicitation Survey. *Foodborne Pathogens and Disease* 8(9) 983-955.
- Hoelzer, K et al. 2011. Structured Expert Elicitation about *Listeria monocytogenes* Cross-Contamination in the Environment of Retail Deli Operations in the United States. *Risk Anal.* 10: 1539-. DOI: 10.1111/j.1539-6924.2011.01729.x