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Monitoring Foodborne Diseases and Retail Meats



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CMSA Technical Symposium 2008

Niagara Falls, Ontario

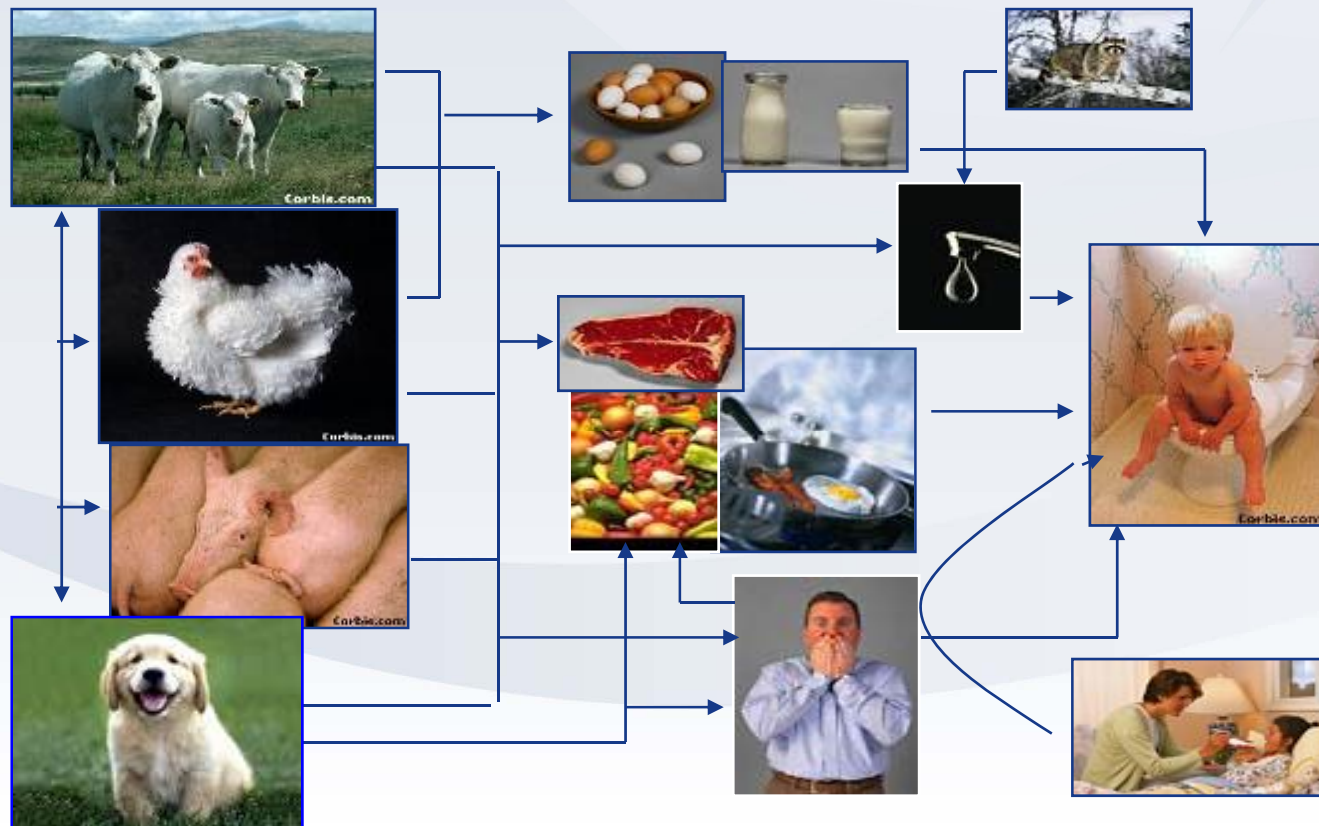
May 8, 2008

Outline

- Sentinel Surveillance
- Meat Sampling
- Results from pilot site Surveillance
 - *Trends*
 - *Salmonella*
 - *Campylobacter*
 - *VTEC*
- Looking Ahead

Background for C-EnterNet

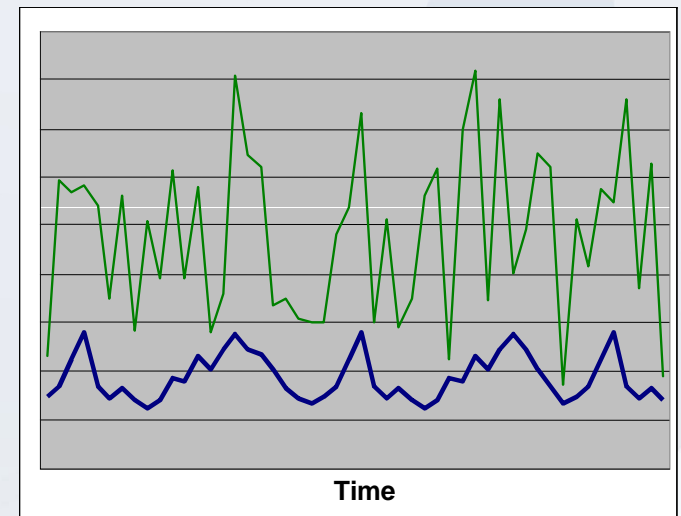
- Enteric illness is complex with multiple sources, pathways and exposures
- Requires an *integrated system for enteric disease surveillance*



Objectives of C-EnterNet

1. Detect changes in trends of

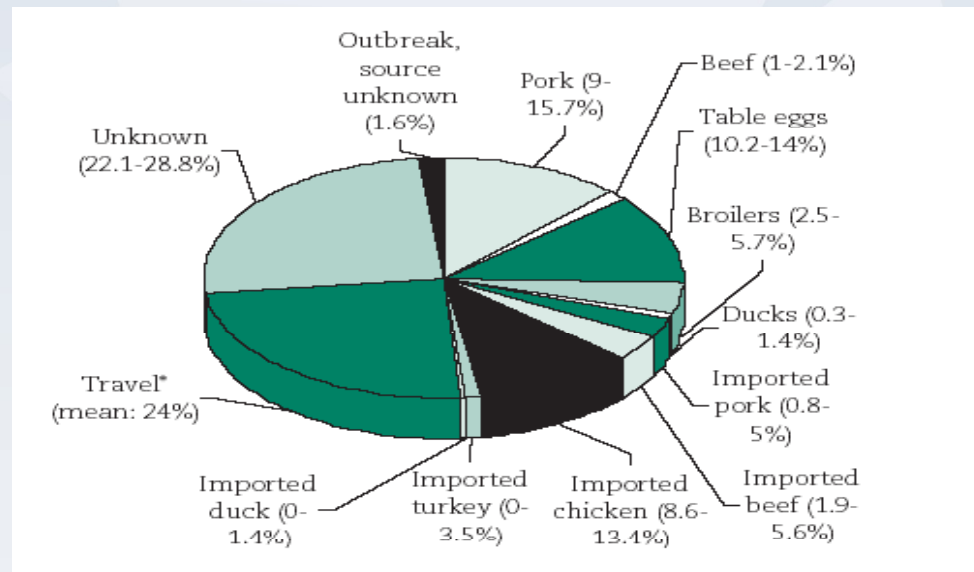
- human enteric disease incidence
- pathogen exposure levels from food, animal and water sources



Objectives of C-EnterNet

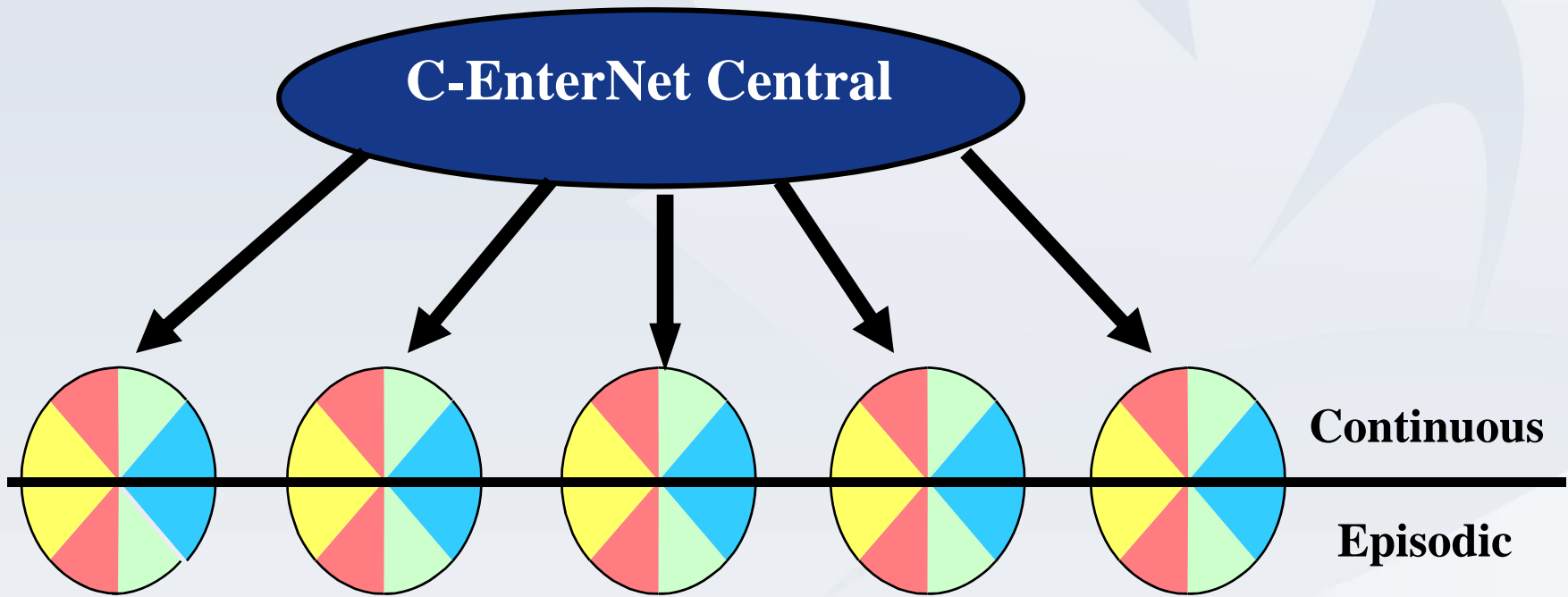
2. Source attribution (proportion of human cases due to water, food, animal contact)

Example: Estimated source attribution of human salmonellosis in Denmark (Danish Zoonosis Center 2005 Annual Report)



3. Enhance analysis, interpretation and reporting of **laboratory and epidemiological** data for public health, water, and agri-food in the private and public sectors

Framework



Yellow	Human
Red	Food
Green	On-farm
Blue	Water

Pilot Sentinel Site: Region of Waterloo, Ontario



508,000 residents
1,400 farms
225,800 acres

Retail food stores:
40 large and
50 small/markets



85%- municipal water system
15% - Private wells

65% livestock
Farms: Dairy, Beef, Pig and Chicken farms



C-EnterNet Exposure Assessment



Human case information
and enhanced risk factor information
collected through standardized
questionnaires



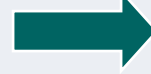
Enhanced
Lab
Testing



Meat sampling
•raw pork chops
•ground beef
•chicken breasts



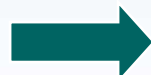
Enhanced
Lab
Testing



Animal / Farm sampling
•Beef Dairy
•Swine Poultry



Enhanced
Lab
Testing



Surface Water testing
•5 sites
•Physical parameters
and pathogens



Enhanced
Lab
Testing

Laboratory - Target Pathogens

- *Salmonella* spp.
 - *Campylobacter*
 - *E. coli* O157
 - *Shigella* spp.
 - *Yersinia enterocolitica*
 - *Giardia*
 - *Cryptosporidium*
 - *Cyclospora*
 - *Listeria monocytogenes*
- Speciation
 - Serotyping
 - Phagetyping
 - AMR
 - PFGE
 - Genotyping

Retail Meat Sampling

- Does our sampling reflect meat purchasing trends?
 - Evaluated through a survey in the sentinel site



Meat purchasing by store type

- 76% large chain grocery stores
- Remainder- butcher shops, farmers market etc
- Supports C-EnterNet's 3 large store : 1 small store

Retail Meat Sampling

Are we selecting the appropriate meat samples?

- ground beef and pork chops cuts frequently consumed
- chicken breast with skin-on consumed by 13% of those eating chicken
- Skinless chicken breast- 87%

Food Item	Total %	95% CI
Beef	51.1	(48.9, 53.2)
Ground beef ^a	70.1	(67.3, 72.9)
Extra lean ^b	28.4	(25.1, 31.7)
Lean ^b	47.9	(44.2, 51.5)
Medium ^b	19.4	(16.5, 22.3)
Regular ^b	4.4	(2.9, 5.9)
Average amount of ground beef purchased in pounds	3.03 lbs	(2.8, 3.2)
Chicken	59.6	(57.4, 61.7)
Chicken breast ^c	70.0	(67.4, 72.6)
Skin on ^d	13.1	(10.8, 15.3)
Skin off ^d	87.0	(84.7, 89.2)
Average number of chicken breasts purchased	5.9	(5.6, 6.2)
Pork	41.9	(39.7, 44.0)
Pork chops ^e	49.4	(46.1, 52.8)
Average number of pork chops purchased	5.3	(5.0, 5.6)

Retail Meat Sampling

Episodic study: skin-on versus skin-off chicken breasts

	Skin-on	Skin-off
<i>Campylobacter</i> (p =0.02)	29% (55/187)	42%(55/131)
<i>Salmonella</i>	33% (61/187)	31% (40/131)

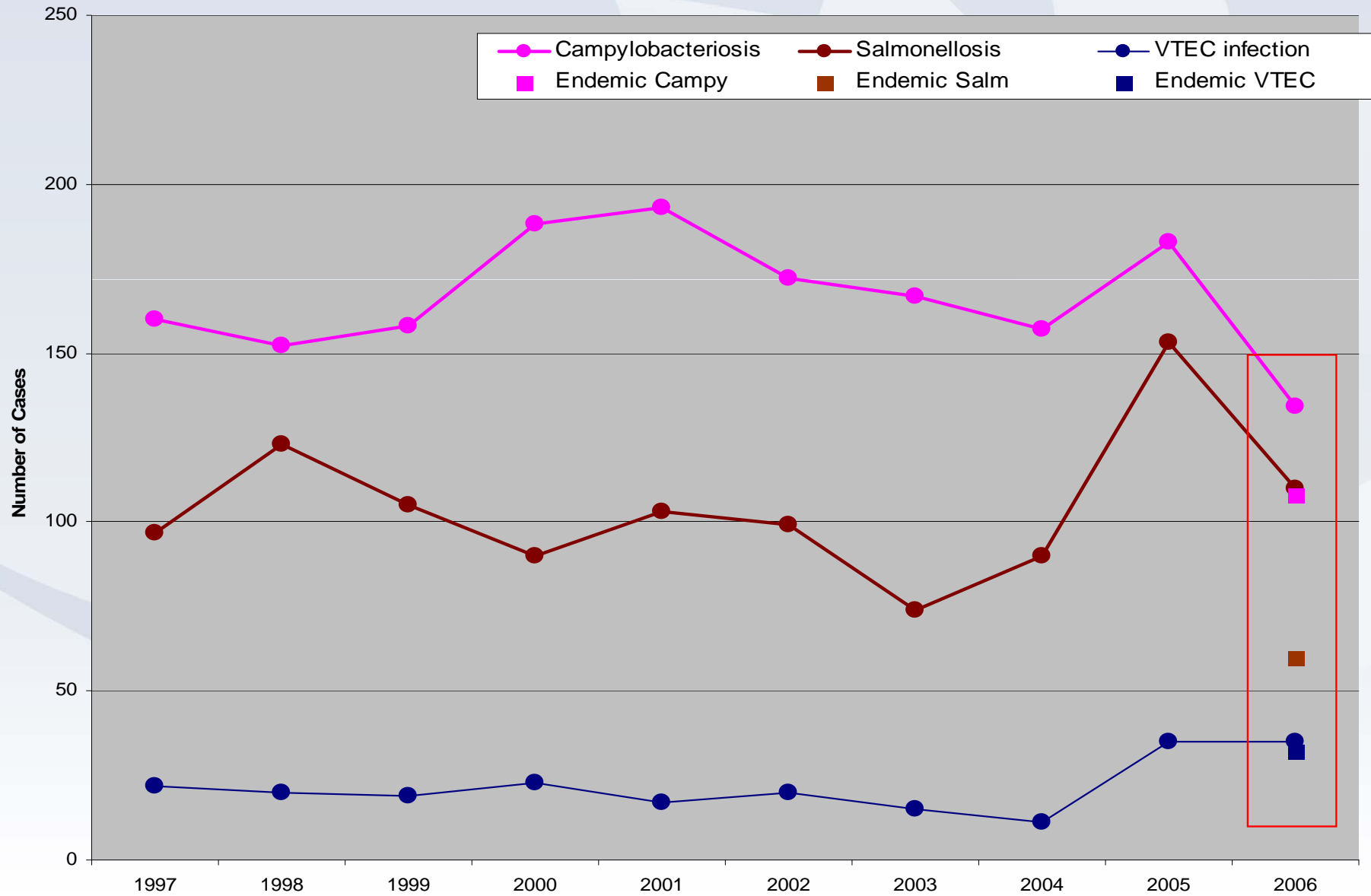


Skin-on Chicken Breast, n=61	
<i>Salmonella</i> Serotype	Number of isolates (Percent)
KENTUCKY	28 (45%)
HEIDELBERG	16 (26%)
HADAR	5 (8%)
TYPHIMURIUM	3 (5%)
ENTERITIDIS	3 (5%)
Other (<2 isolates)	6 (10%)

Skin-off Chicken Breast, n=40	
<i>Salmonella</i> Serotype	Number of isolates (Percent)
KENTUCKY	20 (50%)
HEIDELBERG	10 (25%)
ENTERITIDIS	2 (5%)
Other (<2 isolates)	7 (18%)
Not tested	1 (3%)

Human Cases

10 year Trend for Human Cases



Diseases and Travel

C-EnterNet data: from Pilot Sentinel Site 2006

	Not Travel-associated	Travel-associated	% Travel
Campylobacter	108	26	19%
Salmonella	62	48	44%
E. coli O157:H7	34	1	3%
Total*	289	131	31%

* All reportable enteric diseases

Campylobacter

Campylobacter

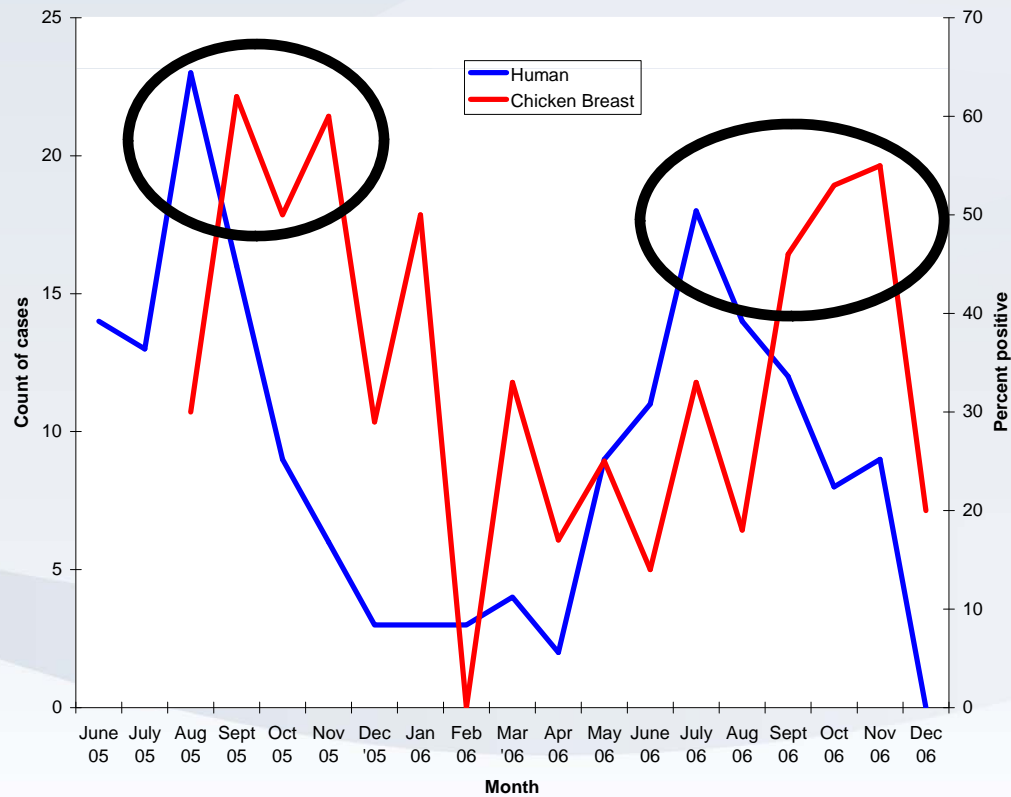
	Human	Retail Food			Food Animals (Manure)		Untreated Surface Water	
	Endemic Cases	Pork	Chicken	Beef	Swine	Dairy Cattle	Grand River	
Detection		Pork chop	Skin-on breast	Ground beef	30 Farms	45 Farms	5 sample points on Grand River	
# tested	Unknown	140 ^a	145 ^a	139 ^a	120 ^a	179 ^a	140 ^a	140 ^b
# positive	108 ^a	0	45	0	15 (12 farms)	44 (27 farms)	13	78
% positive		0%	31%	0%	13%	25%	9%	56%
Subtyping								
# subtyped	106		45		15	44	12 ^c	0
<i>C. coli</i>	2 2%		5		6	6	1	
<i>C. jejuni</i>	103 97%		40		0	23	2	
<i>C. lari</i>	1 1%		0		0	0	10	
Other					9	15		

^a Culture method.

^b Molecular method (16S rRNA).

^c Two serotypes were detected in 1 sample

Campylobacter Seasonality



Significant elevation in retail chicken in fall (Sept, Oct, Nov) $p < 0.05$

Travel and AMR

Antimicrobial resistance of *Campylobacter* from Human Cases

Species	Class	Number of isolates	Nalidixic acid	Ciprofloxacin	Azythromycin
<i>C. jejuni</i>	Travel	9	4 (44%)	2 (22%)	0
	Endemic	60	4 (7%)	4 (7%)	0
<i>C. coli</i>	Travel	4	3 (75%)	3 (75%)	2 (50%)
	Endemic	3	0	0	1 (33%)

Campylobacter Summary

- *C. jejuni* was the predominant species in human cases, retail chicken meat and pooled dairy manure samples
- The summer peak in human cases precedes the observed elevations in the retail samples
- Epidemiological risk factors from questionnaire
 - Eating in a restaurant
 - Private well for drinking water
 - Household contact with dogs
 - Unpasteurized milk?

Salmonella

	Human	Retail Food			Food Animals (Manure)		Untreated Surface Water	
	Endemic Cases	Pork	Chicken	Beef	Swine	Dairy Cattle	Grand River	
		Pork chop	Skin-on breast	Ground beef			5 sampling points on river	
Detection					30 Farms	45 Farms		
# tested	Unknown	140 ^a	145 ^a	139 ^a	120 ^a	179 ^a	140 ^a	140 ^b
# positive	60 ^a	4	43	1	33	20	28	24
% positive		3%	30%	1%	28%	11%	20%	17%
Subtyping								
# subtyped	60	4	43	1	33	20	32^c	
Typhimurium ^{d,e}	3							
Typhimurium DT104 ^d	2				7 (4 farms)	1	1	
Typhimurium DT104a ^d			1		1			
Typhimurium DT104b ^d	1				1			
Typhimurium 1 ^d	2							
Typhimurium 2 ^d	1							
Typhimurium 10	1							
Typhimurium 15 ^d					1			
Typhimurium 41 ^d							1	
Typhimurium 69 ^d							1	
Typhimurium U302 ^d					3 (2 farms)			
Typhimurium UT1 ^d					1			
Typhimurium 108	2							
Typhimurium 120	1							
Typhimurium 151					1			
Typhimurium 169 ^d			1					
Typhimurium 170	1							
Typhimurium 193 ^d					1		1	
Typhimurium Untypable ^d	1					1		
Enteritidis	2							
Enteritidis PT13	9		5					
Enteritidis PT4a	1							
Enteritidis PT8	2							
Heidelberg	4		6				2	
Newport	3						2	
Branderup	2							
Oranienberg	2							
Senftenberg	2							
Untypable	2							
Agona	1				2 (2 farms)	2 (1 farm)		
Derby	1				5 (3 farms)			
Hadar	1		1			1		
Infantis	1		1		4 (3 farms)		1	
Saintpaul	1					1		
Schwarzengrund	1	1	2					
Tennessee	1				1			
Thompson	1	2				1	5	
I:4,5,12:b:-	1						2	
Brandenburg					2 (2 farms)		1	
Kentucky		1	20			12 (6 farms)	5	
Kiambu			2				2	
London					2 (2 farms)			
Orion var. 15+34+				1				
Other ^f	7		4		1	1	8	

^a Culture method.

^b

Salmonella Enteritidis PFGE

	Human		Retail
	Non-travel*	Travel	Chicken
Enteritidis			
# samples with PFGE results	14	18	5
SENXAI.0001		11 (2)	
SENXAI.0002	1	1	
SENXAI.0003	2		
SENXAI.0004		1	
SENXAI.0038	9 (2)		5
SENXAI.0079		1	
SENXAI.0093		1	
SENXAI.0123		1	

Salmonella Summary

- *Salmonella* Typhimurium
 - Top serotype in endemic human cases (none travel-associated)
 - Found on swine farms, dairy farms and in untreated surface water
 - Rarely in meats
 - The two most frequent PFGE patterns detected in pooled swine manure samples were also detected in human cases.
- *Salmonella* Enteritidis
 - Second serotype in endemic human cases (more are travel-related)
 - Found in retail chicken meat samples.
 - PT13 cases had identical PFGE patterns (SENXA1.0038)
- *Salmonella* Kentucky
 - Most common serotype from chicken meat, dairy cattle, and untreated surface water
 - Rarely found in human case
- Epidemiological risk factors
 - Travel
 - Reptiles

Verotoxigenic *E. coli*

	Human	Retail Food			Food Animals (Manure)		Untreated Surface Water	
	Endemic Cases	Pork	Chicken	Beef	Swine	Dairy Cattle	Grand River	
Detection		Pork chop	Skin-on breast	Ground beef	(30 farms)	(45 farms)	5 sample points on Grand River	
# tested	Unknown	140 ^a	145 ^a	139 ^a	120 ^a	179 ^a	120 ^a	140 ^b
VTEC		0	0	0				
O157 (non-H7)					8 (6 farms)	7 (7 farms)	1	
O157:H7	32				0	16 (13 farms)	1	35

^a Culture method.

^b Molecular method.

E. coli O157:H7	Human		Food Animals (Manure)	Untreated Surface Water
	Endemic Cases	Travel	Dairy Cattle	Grand River
# of samples with PFGE results	30	1	16 ^a	1 ^a
ECXAI.0001	5			
ECXAI.0007	1			
ECXAI.0008	2			
ECXAI.0017	3			
ECXAI.0063	1			
ECXAI.0247	1			
ECXAI.0262	9			
ECXAI.0309	1			
ECXAI.1248	1			
ECXAI.1477	1			
ECXAI.1478	1			
ECXAI.1501	1			
ECXAI.1526	1			
ECXAI.1537	1			
ECXAI.1578	1			
ECXAI.0052		1		
ECXAI.0006			3	
ECXA1.0023			1	
ECXA1.1175			1	
ECXA1.1267			1	
ECXAI.1611			3	
ECXAI.1612			3	
ECXAI.1613			2	
ECXAI.1614			1	
ECXA1.1687			6	
ECXA1.1688			1	
ECXA1.1689			1	
ECXA1.1690			4	
ECXA1.1691			1	
ECXA1.1692			2	
ECXA1.1694			2	
ECXAI.1556				4
ECXAI.1557				1

^aMultiple isolates per positive sample (i.e. 16 positive dairy manure samples yielded 32 isolates; 1 untreated water sample yielded 5 isolates).

Verotoxigenic *E. coli* Summary

- *E. coli* O157:H7 appears to be a domestically acquired infection
- Not found in sampled meats in 2006
- Pathogenic strains of *E. coli* were detected in pooled dairy manure samples and untreated surface water
 - PFGE subtyping revealed no identical patterns between the human cases and non-human isolates
- Epidemiological risk factors
 - Swimming in lake
 - Attending BBQ
 - Contact with household pet
 - Meat from butcher shop
 - More likely to be urban residents
(more likely to be rural residents 2005)

Reports

- Results 2005/2006 (1st 12 months)
- Results 2006 (1st complete calendar year)
- Results 2007
 - Short Report
 - Detailed Report

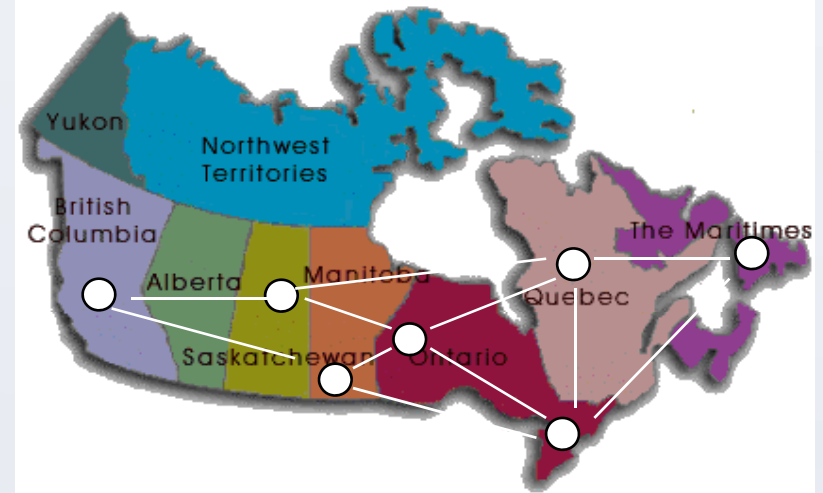
<http://www.phac-aspc.gc.ca/c-enternet/index-eng.php>

<http://www.phac-aspc.gc.ca/c-enternet/index-fra.php>



Looking Ahead

- Expansion to 5 sites
 - National representation
 - Trends and risk factors
- Utilize infrastructure to:
 - Link with climate change activities
 - Targeted surveillance for additional pathogens
 - Targeted surveillance for other sources
- Source attribution reports



A thank you to our partners...



Thank You

C-EnterNet Contact Information

Website:

<http://www.phac-aspc.gc.ca/c-enternet/index-eng.php>

<http://www.phac-aspc.gc.ca/c-enternet/index-fra.php>

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