2018

Short Report

C-EnterNet

Canada's National Integrated Enteric Pathogen Surveillance System

Public Health Agency of Canada
Agence de la santé publique du Canada

Canada

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Introduction

C-EnterNet is an integrated enteric pathogen surveillance system based on a sentinel site surveillance model collecting information on both cases of infectious gastrointestinal illness and sources of exposure within defined communities. C-EnterNet's primary objectives are to detect changes in trends in human enteric disease and levels of pathogen exposure from food, animal and water sources in a defined population; and to strengthen source attribution efforts in Canada by determining statistically significant risk factors for enteric illness.

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In 2010, C-EnterNet implemented a second sentinel site in part of the Fraser Valley in the lower mainland of British Columbia, in partnership with the Fraser Health Authority (FHA). The communities of Burnaby, Abbotsford and Chilliwack comprise the sentinel site within the Fraser Health Region. In this region, active surveillance of enteric pathogens is performed in the retail sampling of bagged leafy greens, and enhanced human disease surveillance is performed in collaboration with FHA and the BCCDC Public Health Microbiology and Reference Laboratory. In the first sentinel site, C-EnterNet continues its strong partnership with the Region of Waterloo Public Health within the Regional Municipality of Waterloo, Ontario and the Ontario Agency for Health Protection and Promotion's Toronto Public Health Laboratory where enhanced surveillance of human cases of enteric disease in the community is performed. In parallel, active surveillance of enteric pathogens is performed in water, food and on farms.

The purpose of this report is to present the preliminary findings from the 2010 surveillance year in both sentinel sites. Note that C-EnterNet data need to be considered in the context of two sentinel sites, thus major conclusions cannot yet be extrapolated nationally.[1] This report will be followed by the Long Report, which will include more extensive analyses of temporal trends and subtyping information for an integrated perspective on enteric disease from exposure to illness for 2010.

For further information about the C-EnterNet program or sampling methodologies, please refer to our website (http://www.phac-aspc.gc.ca/c-enternet/index-eng.php).

[1] C-EnterNet is designed to have five sites encompassing about 10% of the Canadian population

Human Case Summary

The enhanced human disease surveillance component of C-EnterNet has been fully implemented in two sentinel sites: Sentinel Site 1 (SS1) in the Region of Waterloo (ROW) and Sentinel Site 2 (SS2) in the FHA. The C-EnterNet program was officially launched in the FHA in April 2010; therefore, results presented here only include partial year data. Historical data from 2000-2009 have been included, for both sentinel sites, to show trends in disease over time (Figure 1). These counts include all cases (endemic, travel and outbreak) and were obtained from the sentinel sites.

In 2010, campylobacteriosis, salmonellosis and giardiasis were the most common enteric diseases in C-EnterNet's sentinel sites, with rates of 29.5/100,000, 26.0/100,000 and 14.2/100,000, respectively (Table 1). Overall, the number of endemic, travel- and outbreak-related cases reported in SS1 in 2010 were higher than that reported in 2009. In SS1, the incidence rate of campylobacteriosis, especially travel-associated infections, was higher in 2010 than 2009. The incidence rate of endemic salmonellosis has increased in both sentinel sites over the last couple of years, with SS2 steadily increasing since 2006 (Figure 1).

Travel continues to be an important factor in the burden of enteric disease. In 2010, 30% and 23% of all cases of enteric disease were associated with travel outside of Canada, in SS1 and SS2 respectively. In both sentinel sites, the travel-related proportion of cases, compared with endemic cases, was highest for cyclosporiasis (100% in both SS1 and SS2), shigellosis (83% (SS1) and 33% (SS2)) and cryptosporidosis (43% (SS1) and 60% (SS2)).

Human Case Summary (cont.)

Table 1: Disease-specific case counts and annual incidence rates in Sentinel Sites 1 and 2 in 2010 compared to 2009, and 2008 National Notifiable Disease incidence rates.

		2009				2010				2008
		Sentinel Site 1 (ROW)		Sentinel Site 2 (FHA)		Sentinel Site 1 (ROW)		Sentinel Site 2 (FHA) (Apr - Dec 2010)		National Totals[b]
		# of Cases	Incidence Rate (per 100,000 person-years)	# of Cases	Incidence Rate (per 100,000 person-years)	# of Cases	Incidence Rate (per 100,000 person-years)	# of Cases	Incidence Rate[a] (per 100,000 person-years)	Incidence Rate (per 100,000 person-years)
Total	**Endemic**	278		462		296		223		
	Travel	113				132		72		
	Outbreak[d]	0				8		8		
Amoebiasis	**Total**	27	5.2			26	4.9			--
	Endemic	13	2.5			12	2.3			
	Travel	14	2.7			14	2.7			
Campylobacteriosis	**Total**	118	22.8	184	41.5	144	27.3	112	33.0	28.4
	Endemic	99	19.1			112	21.3	89	26.2	
	Travel	19	3.7			32	6.1	23	6.8	
Cryptosporidiosis	**Total**	20	3.9	14	3.2	23	4.4	5	1.5	2.4
	Endemic	17	3.3			13	2.5	2	0.6	
	Travel	3	0.6			10	1.9	3	0.9	
Cyclosporiasis	**Total**	4	0.8	8	1.8	1	0.2	3	0.9	0.5
	Endemic	0	0.0			0	0.0	0	0.0	
	Travel	4	0.8			1	0.2	3	0.9	
Giardiasis	**Total**	72	13.9	57	12.9	78	14.8	45	13.3	12.7
	Endemic	40	7.7			50	9.5	37	10.9	
	Travel	32	6.2			28	5.3	8	2.4	
Listeriosis	**Total**	1	0.2	1	0.2	1	0.2	2	0.6	0.78[c]
	Endemic	1	0.2			1	0.2	2	0.6	
Salmonellosis	**Total**	117	22.6	129	29.1	129	24.5	96	28.3	18.2
	Endemic	82	15.8			82	15.6	56	16.5	
	Travel	35	6.8			39	7.4	32	9.4	
	Outbreak	0	0.0			8	1.5	8	2.4	
Shigellosis	**Total**	8	1.5	23	5.2	6	1.1	6	1.8	2.3
	Endemic	7	1.4			1	0.2	4	1.2	
	Travel	1	0.2			5	1.0	2	0.6	
Verotoxigenic *E. coli* (VTEC)	**Total**	10	1.9	22	5.0	12	2.2	10	2.9	2.3
	Endemic	10	1.9			12	2.2	9	2.7	
	Travel	0	0.0			0	0.0	1	0.3	
Yersiniosis	**Total**	8	1.5	24	5.4	8	1.5	24	7.1	--
	Endemic	7	1.4			7	1.3	24	7.1	
	Travel	1	0.2			1	0.2	0	0.0	

[a] Adjusted for partial year data

[b] Notifiable Disease Surveillance System, Surveillance and Epidemiology Division, Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada (2008)

[c] Listeria Research Laboratory and Listeriosis Reference Service, Food Directorate, Bureau of Microbial Hazards, Health Canada

[d] If outbreak is not indicated, there were no outbreaks that occurred

Human Case Summary (cont.)

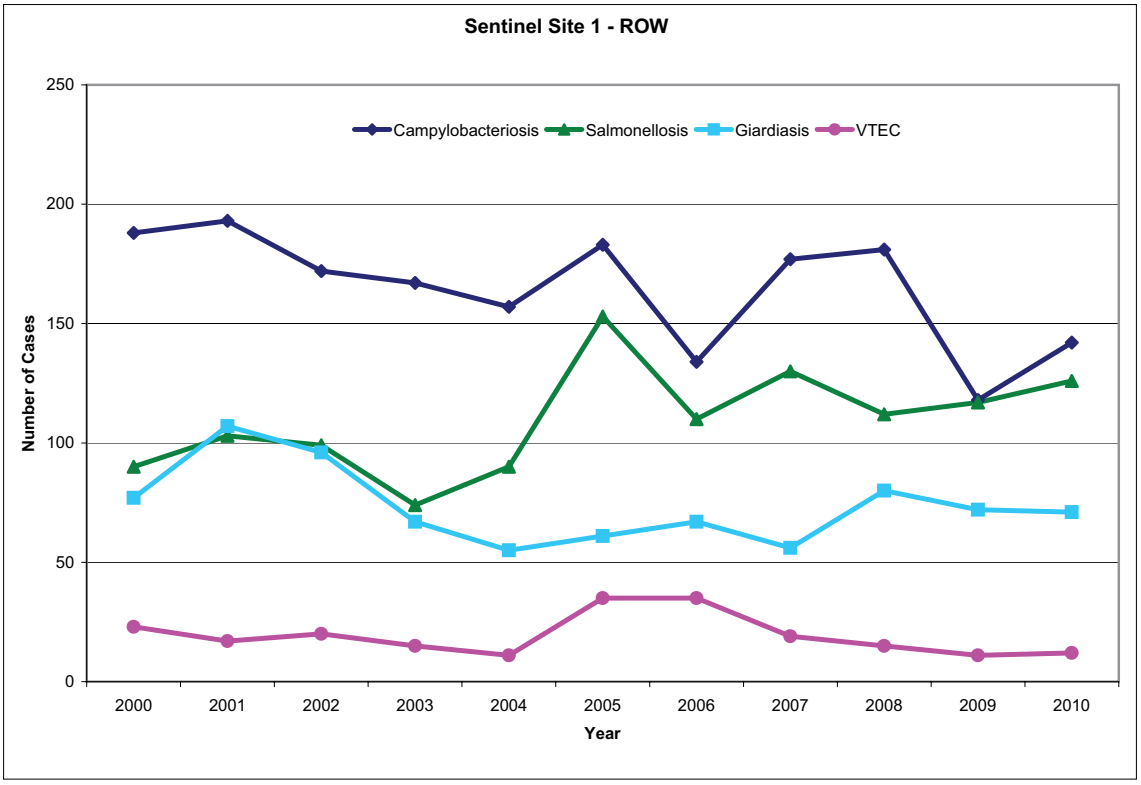
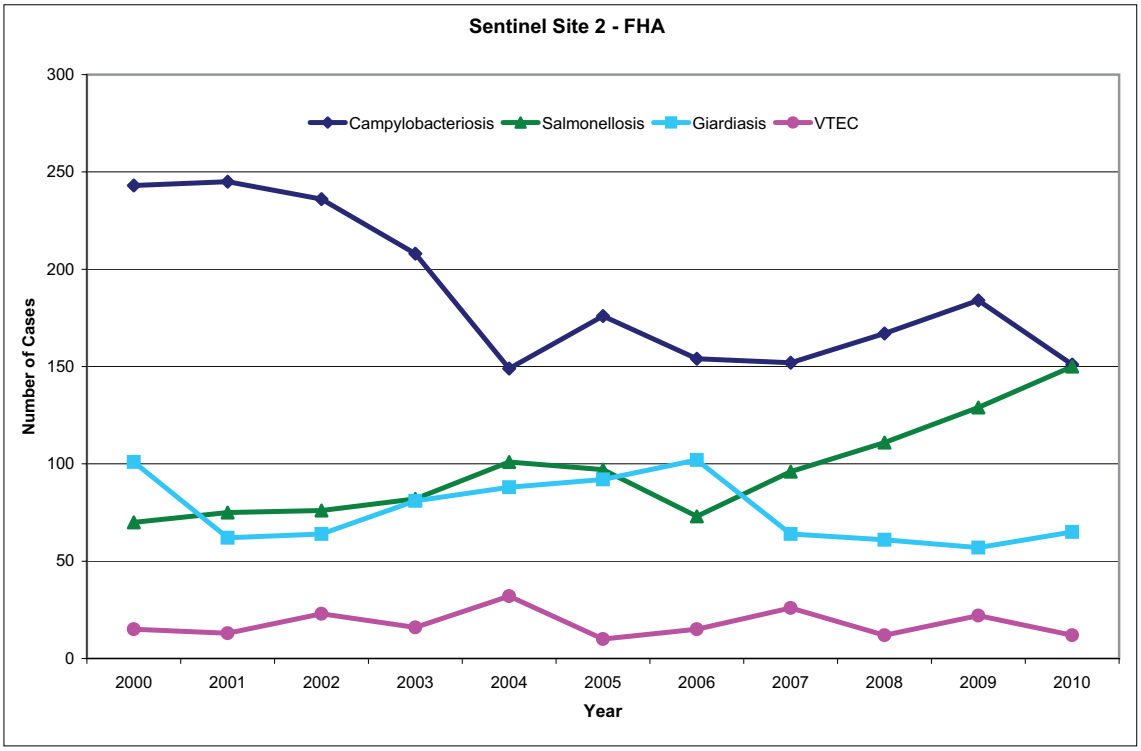


Figure 1: Temporal trends of campylobacteriosis, salmonellosis, giardiasis and verotoxigenic *E. coli* (VTEC) from Sentinel Sites 1 and 2, 2000 to 2010

Human Case Summary (cont.)



Note: Total enteric disease includes endemic, travel and outbreak cases

In 2010, a total of eight outbreak-associated cases were reported in SS1 compared to the previous year when no cases were reported. All eight outbreak-associated cases were *Salmonella* cases. SS2 also reported eight outbreak-associated enteric disease cases in 2010, all of which were *Salmonella* cases.

Retail component

Retail meat continues to be an important exposure source for enteric pathogens. Sampling at the retail level represents consumer exposure close to consumption, but prior to food handling and preparation. Since mid-2005, C-EnterNet has systematically sampled fresh raw pork, chicken and beef from randomly selected grocery stores within SS1 on a weekly basis. In 2010, the significant changes in prevalence trends compared to the previous surveillance year included a decrease in *Campylobacter* on retail chicken, an increase in *Yersinia* on retail pork and an increase of VTEC on ground beef. The latter two are most likely due to alterations of laboratory isolation methods. In June 2009, the *Yersinia* culture method was modified to increase test sensitivity, which resulted in a statistically significant increase in *Yersinia* levels (3% in 2008 to 30% in 2009 and 82% in 2010). By July 2010, testing for *Yersinia* on retail pork was discontinued given that less than 1% of *Yersinia* recovered was pathogenic to humans. In January 2010, the VTEC isolation method was modified to increase test sensitivity resulting in a significant increase of VTEC prevalence on ground beef (Table 2). The significant decrease in *Campylobacter* prevalence on skin-off chicken breast cannot be attributed to a sampling or laboratory methodology change and therefore may represent a true decrease in occurrence on this commodity.

Table 2: Pathogen detection on retail meat in Sentinel Site 1, 2009 and 2010, percent positive (number positive)

	2009			2010		
	Pork (n= 200)	Chicken (n=200)	Beef (n=200)	Pork (n=197)	Chicken (n=197)	Beef (n=197)
Campylobacter	1% (1)	46% (92)	1% (1)	2% (3)	36 % (70)	1% (1)
Salmonella	2% (3)	29% (57)	1% (1)	2% (3)	29% (57)	1% (1)
VTEC	0% (0)	0% (0)	1% (1)	0% (0)	0% (0)	6% (12)
Yersinia (non-pathogenic)	30% (60)	Not tested	Not tested	82% (86)[d]	Not tested	Not tested
Listeria monocytogenes	10% (16)[a]	19% (31)[b]	12% (20)[c]	8% (15)	14% (27)	12% (23)

Cell shaded in yellow represents significant changes from 2009 to 2010 (Fisher's Exact Test, P-value ≤ 0.05)

Cells shaded in green represent significant changes from 2009 to 2010, most likely due to laboratory method changes

[a] n=163 [b] n=165 [c] n=164 [d] n=105, *Yersinia* testing on pork stopped in July 2010

Note: 2010 results are preliminary

Retail Component (cont.)

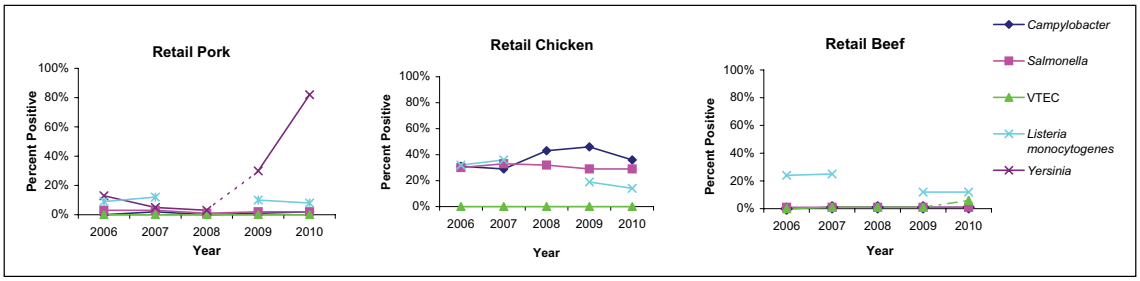


Figure 2: Yearly distribution of pathogen contamination on retail meat in Sentinel Site 1, 2006 to 2010

Note: Dashed lines indicate a laboratory or sampling method change

Table 3: Pathogen detection on bagged leafy greens in Sentinel Sites 1 and 2, 2009 and 2010

Pathogen Detection on Leafy Greens	2009[a] (n=376)		2010 (n= 574[d])	
	Culture % (# positive)	PCR % (# positive)	Culture % (# positive)	PCR % (# positive)
Campylobacter	0% (0)	N/T	0% (0)[e]	N/T
Salmonella	0% (0)	N/T	0% (0)[f]	N/T
E. coli Verotoxin	N/T	0% (0)	N/T	0% (0)[e]
Generic *E. coli*	3% (11)[b]	N/T	1% (2)[g]	N/T
Listeria monocytogenes	1% (5)	N/T	1% (9)	N/T
Shigella	0% (0)[c]	0.3% (1)	N/T	0% (0)[e]
Cryptosporidium	N/T	9% (32)	N/T	0% (0)
Giardia	N/T	2% (9)	N/T	3% (15)
Cyclospora	N/T	2% (9)	N/T	0% (0)
Norovirus	N/T	5% (19)	N/T	0.5% (3)
Rotavirus	N/T	0.3% (1)	N/T	0% (0)

Cells shaded in yellow represent significant changes from 2009 to 2010 (Fisher's Exact Test, P-value ≤ 0.05)

[a] Testing from April to December 2009

[b] 348 generic *E. coli* results available

[c] Culture only performed on the single PCR positive

[d] Combined sentinel site result

[e] n=98 [f] n=168 [g] n=140 N/T = Not Tested

Note: 2010 results are preliminary

Retail Component (cont.)

In 2010, detection of pathogens on bagged leafy greens continued but most bacterial testing was discontinued in March due to low yields (Table 3). Parasite, virus and *Listeria monocytogenes* testing continued. In addition, sampling expanded to include bagged leafy greens from the second sentinel site. In 2010, there was a statistically significant reduction in prevalence of *Cryptosporidium*, *Cyclospora* and Norovirus, although there were no changes in laboratory protocols. *Listeria monocytogenes* was detected on nine samples by culture method. Generic *E. coli* was detected on a single sample; however testing was stopped in March. Among parasites, *Giardia* was detected by PCR in 15 samples of which five were confirmed by microscopy. Norovirus was detected by PCR on three samples and no Rotavirus was detected. Differences in prevalences between sentinel sites will be explored in the 2010 Long Report.

Agriculture Component

Detection of enteric pathogens on farms represents an environmental exposure source. In 2010, in SS1 four commodity groups (dairy, beef, swine, and broiler chickens) were sampled. Each month two to three farms per commodity were enrolled and visited for a total of 30 farms per commodity per year. Three fresh pooled manure samples from different age groups of animals and one stored manure sample were collected at each visit. No on-farm sampling occurred in SS2.

Results are presented at the sample level and at the farm level to account for within-farm similarities. Of the farms sampled for each commodity in 2010, 23/30 swine farms, 27/30 dairy farms, 26/30 beef farms and 25/30 poultry farms had also been previously sampled in 2009.

In 2010, the prevalence of *Salmonella* increased significantly on broiler chicken farms at the sample level, but not at the farm level. No other significant changes were noted.

E. coli O157:H7 was detected on both dairy and beef operations and on a single swine operation. On the swine operation, the positive finding was from a manure pit sample. Given that this operation also included sheep and horses, the source of the O157:H7 cannot be determined.

In July 2010, *Yersinia* testing on the dairy, beef and poultry operations was initiated, with no positive findings.

Agriculture Component (cont.)

Table 4: Pathogen detection from individual manure samples in Sentinel Site 1, 2009 and 2010, percent positive (number positive)

Sample Prevalence	2009				2010			
	Swine (120 samples)	Dairy (120 samples)	Beef (120 samples)	Broiler Chickens (120 samples)	Swine (120 samples)	Dairy (120 samples)	Beef (119 samples)	Broiler Chickens (120 samples)
Campylobacter	80% (96)	80% (96)	79% (95)	5% (6)	83% (100)	75% (89)	78% (93)	6% (7)
Salmonella	34% (41)	18% (22)	13% (15)	31% (37)	24% (29)	13% (15)	13% (15)	63% (75)
E. coli O157:H7	3% (4)	6% (7)	9% (11)	0% (0)	1% (1)	6% (7)	13% (15)	0% (0)
Yersinia	2% (2)	Not tested	Not tested	Not tested	3% (4)	0% (0)[a]	0% (0)[a]	0% (0)[b]

Cell shaded in yellow represents significant changes from 2009 to 2010 (Fisher's Exact Test, P-value ≤ 0.05)

[a] number samples tested=67 [b] number samples tested=68

Note: 2010 results are preliminary

Table 5: Pathogen detection at the farm level in Sentinel Site 1, 2009 and 2010, percent positive (number positive)

Farm Prevalence	2009				2010			
	Swine (30 farms)	Dairy (30 farms)	Beef (30 farms)	Broiler Chickens (30 farms)	Swine (30 farms)	Dairy (30 farms)	Beef (30 farms)	Broiler Chickens (30 farms)
Campylobacter	100% (30)	100% (30)	100% (30)	7% (2)	100% (30)	100% (30)	100% (30)	7% (2)
Salmonella	67% (20)	27% (8)	27% (8)	53% (16)	60% (18)	20% (6)	23% (7)	77% (23)
E. coli O157:H7	7% (2)	17% (5)	20% (6)	0% (0)	3% (1)	20% (6)	30% (9)	0% (0)
Yersinia	7% (2)	Not tested	Not tested	Not tested	13% (4)	0% (0)[a]	0% (0)[a]	0% (0)[a]

[a] 17 farms tested in 2010

Note: 2010 results are preliminary

Agriculture Component (cont.)

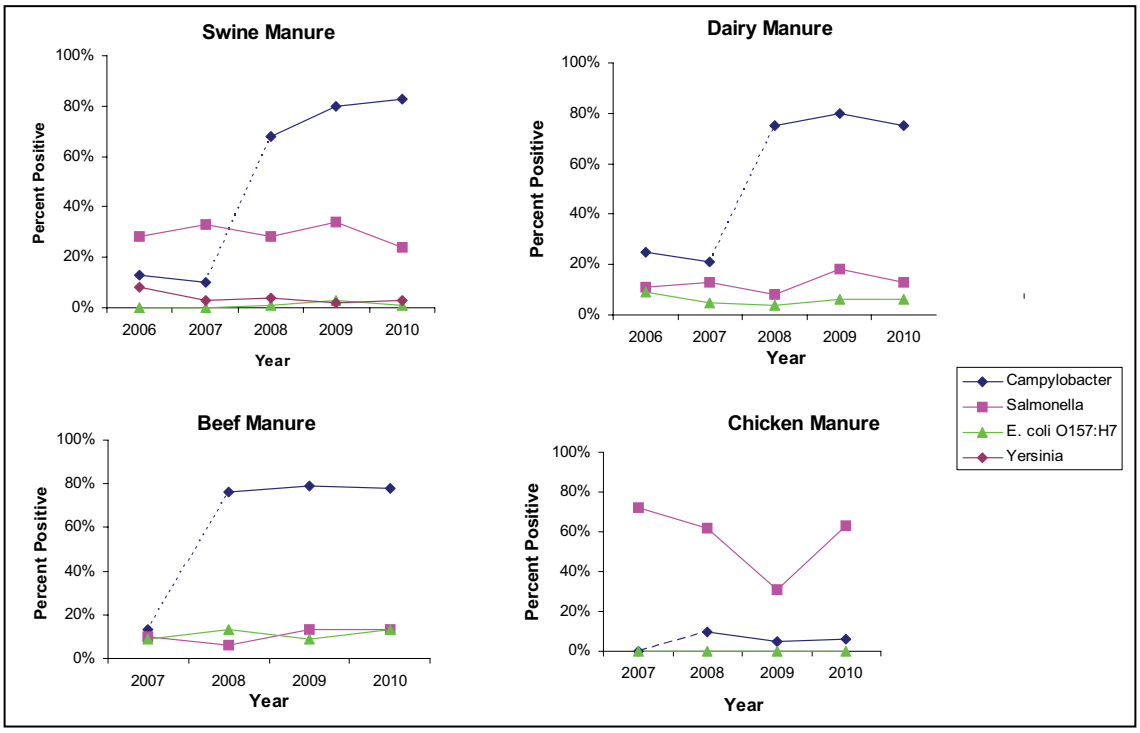


Figure 3: Pathogen detection (sample level) from manure samples in Sentinel Site 1, 2006 to 2010

Note: Dashed lines indicate a laboratory or sampling method change

Water Component

During 2010, surveillance in SS1 along the Grand River watershed continued at the same five sampling locations, demonstrating the continued collaboration with the Ontario Ministry of the Environment and, as in previous years, the laboratories involved in the pathogen detection analyses.

The data illustrate consistent trends from year to year at the five sampling locations within the watershed. Further molecular typing will help to elucidate if the strains we are detecting are also remaining consistent.

The proportion of samples positive for *Yersinia* in the Grand has been significantly affected by laboratory protocol changes, starting in 2008, when a change in the service laboratory was made. The method was then modified in 2009 to enhance the sensitivity, and molecular pre-screening method was used, which again increased the sensitivity. However, in July of 2010, *Yersinia* sampling was discontinued. This decision was made because a human-pathogenic strain had yet to be identified in five years of surveillance on the river. And, improvements to the method had significantly increased the laboratory costs of *Yersinia* from water samples, yet the public health significance of the data does not warrant continued surveillance.

Water Component (cont.)

Table 6: Pathogen detection in untreated surface water in Sentinel Site 1, 2009 and 2010

	2010					
	All Sites	A	B	C	D	E
Campylobacter	23% (21/93)	30% (6/20)	33% (7/21)	22% (4/22)	18% (4/22)	0% (0/12)
Salmonella	28% (27/94)	25% (5/20)	24% (5/21)	6% (1/18)	32% (7/22)	69% (9/13)
E. coli O157:H7	0% (0/94)	0% (0/20)	0% (0/21)	0% (0/18)	0% (0/22)	0% (0/13)
Yersinia [a]	76% (32/42)	89% (8/9)	91% (10/11)	71% (5/7)	73% (8/11)	25% (1/4)
Cryptosporidium [b]	92% (11/12)	---	---	---	92% (11/12)	---
Giardia [b]	100% (12/12)	---	---	---	100% (12/12)	---

	2009					
	All Sites	A	B	C	D	E
Campylobacter	21% (24/112)	13% (3/23)	25% (6/24)	36% (8/22)	29% (7/24)	0% (0/19)
Salmonella	25% (28/112)	17% (4/23)	17% (4/24)	27% (6/22)	29% (7/24)	37% (7/19)
E. coli O157:H7	0% (0/112)	0% (0/23)	0% (0/24)	0% (0/22)	0% (0/24)	0% (0/19)
Yersinia	44% (49/112)	48% (11/23)	46% (11/24)	50% (11/22)	33% (8/24)	42% (8/19)
Cryptosporidium [b]	80% (8/10)	---	---	---	80% (8/10)	---
Giardia [b]	100% (10/10)	---	---	---	100% (10/10)	---

Sample Site Legend:
A - Canagagigue Creek
B - Conestogo River
C - Upper Grand River
D - Grand River, near drinking water intake
E - Grand River, near one waste water treatment plant effluent

Cell shaded in yellow represents significant changes from 2009 to 2010 (Fisher's Exact Test P-value ≤ 0.05)

[a] Stopped *Yersinia* testing in July, 2010

[b] By microscopy, not culture method

Water Component (cont.)

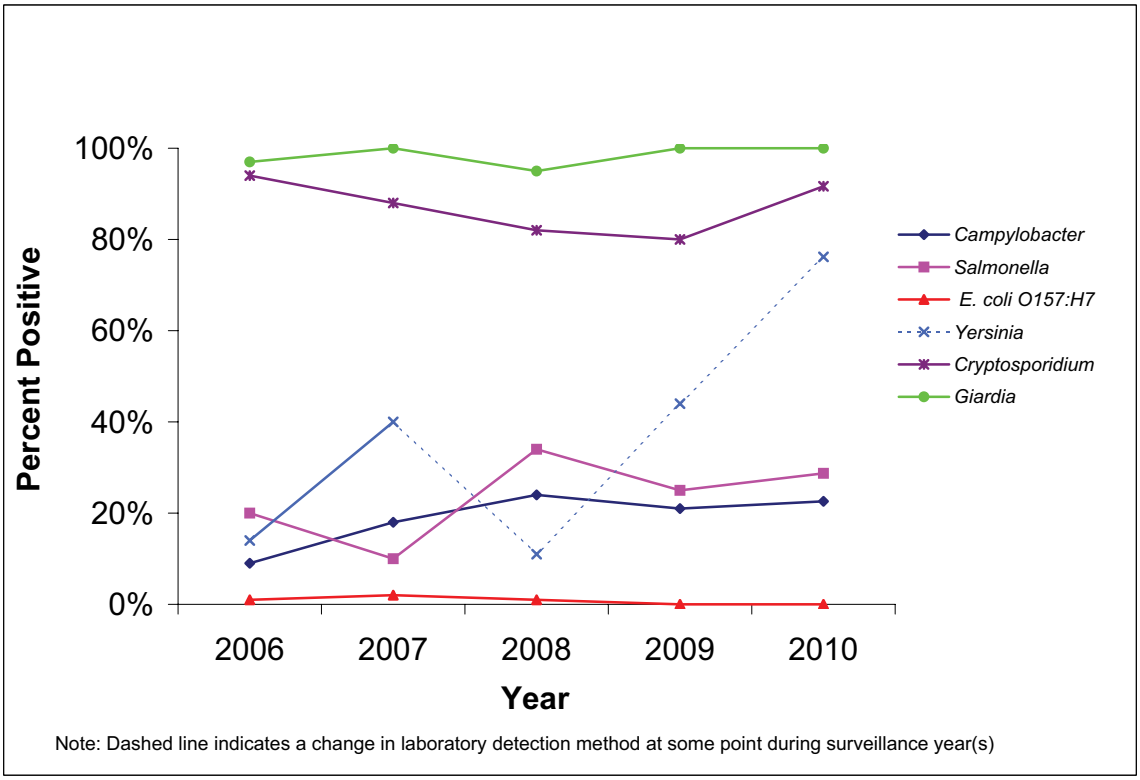


Figure 4: Proportion of positive untreated surface water samples tested in Sentinel Site 1 between 2006 and 2010 for selected enteric pathogens