2009

Short Report

C-EnterNet

Canada's National Integrated Enteric Pathogen Surveillance System

Canada

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Introduction

C-EnterNet is a multi-partner, integrated surveillance initiative facilitated by the Public Health Agency of Canada. C-EnterNet is based on a sentinel site surveillance model to collect information on both cases of infectious gastrointestinal illness and sources of exposure within defined communities—an approach that would not be possible on a broader scale.

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C-EnterNet's sentinel site—the Regional Municipality of Waterloo, Ontario—is a community of approximately 500,000 residents, has a mix of both urban and rural areas and demonstrates innovation in public health and water conservation and treatment. Within this site, active surveillance of enteric pathogens is performed in water, food and on farms, and enhanced human disease surveillance is performed in collaboration with public health partners. Beginning in 2010, C-EnterNet will partner with the Fraser Health Authority and expand to its second sentinel site in part of the Fraser Valley in the lower mainland of British Columbia.

C-EnterNet's primary objectives are to detect changes in trends in human enteric disease and in 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.

The purpose of this report is to present the main preliminary findings from the 2009 surveillance year in Sentinel Site 1. New in 2009, C-EnterNet's routine retail sampling program expanded to include the testing of bagged leafy greens and the preliminary findings are presented. Note that C-EnterNet data need to be considered in the context of the sentinel nature of this program, thus major conclusions cannot yet be extrapolated nationally. This report will be followed by a long report, which will include more extensive analyses of temporal trends and subtyping information for an integrated perspective on enteric disease from exposure to source for 2009.

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).

Human Case Summary

Table 1: Disease-specific annual incidence rates in Sentinel Site 1
in 2009 compared to 2008

		2008		2009	
		# of Cases	Incidence Rate (per 100,000 person-years)	# of Cases	Incidence Rate (per 100,000 person-years)
Total	Endemic	322		279	
	Travel	118		113	
	Outbreak	33		0	
Amoebiasis	Total	30	5.98	27	5.21
	Endemic	19	3.79	13	2.51
	Travel	11	2.19	14	2.70
Campylobacteriosis	Total	181	36.07	118	22.76
	Endemic	123	24.51	99	19.10
	Travel	32	6.38	19	3.66
	Outbreak	26	5.18	0	0.00
Cryptosporidiosis	Total	17	3.39	20	3.86
	Endemic	15	2.99	17	3.28
	Travel	2	0.40	3	0.58
Cyclosporiasis	Total	3	0.60	4	0.77
	Endemic	1	0.20	0	0.00
	Travel	2	0.40	4	0.77
Giardiasis	Total	80	15.94	72	13.89
	Endemic	48	9.57	40	7.72
	Travel	32	6.38	32	6.17
Hepatitis A	Total	2	0.40	6	1.16
	Endemic	1	0.20	2	0.39
	Travel	1	0.20	4	0.77
Listeriosis	Total	6	1.20	1	0.19
	Endemic	3	0.60	1	0.19
	Travel	0	0.00	0	0.00
	Outbreak	3	0.60	0	0.00
Salmonellosis	Total	112	22.32	117	22.57
	Endemic	82	16.34	82	15.82
	Travel	28	5.58	35	6.75
	Outbreak	2	0.40	0	0.00
Shigellosis	Total	6	1.20	8	1.54
	Endemic	1	0.20	7	1.35
	Travel	5	1.00	1	0.19
Verotoxigenic *E. coli* (VTEC)	Total	15	2.99	11	2.12
	Endemic	14	2.79	11	2.12
	Travel	0	0.00	0	0.00
	Outbreak	1	0.20	0	0.00
Yersiniosis	Total	10	1.99	8	1.54
	Endemic	7	1.39	7	1.35
	Travel	3	0.60	1	0.19

Cells shaded in yellow represent significant changes from 2008 to 2009 (Fisher's Exact Test, P-value ≤ 0.05)

Figure 1: Temporal trends of the three most frequent enteric diseases, and total bacterial, viral and parasitic enteric diseases from Sentinel Site 1, 1990 to 2009

Note: Total enteric disease includes endemic, travel and outbreak cases.
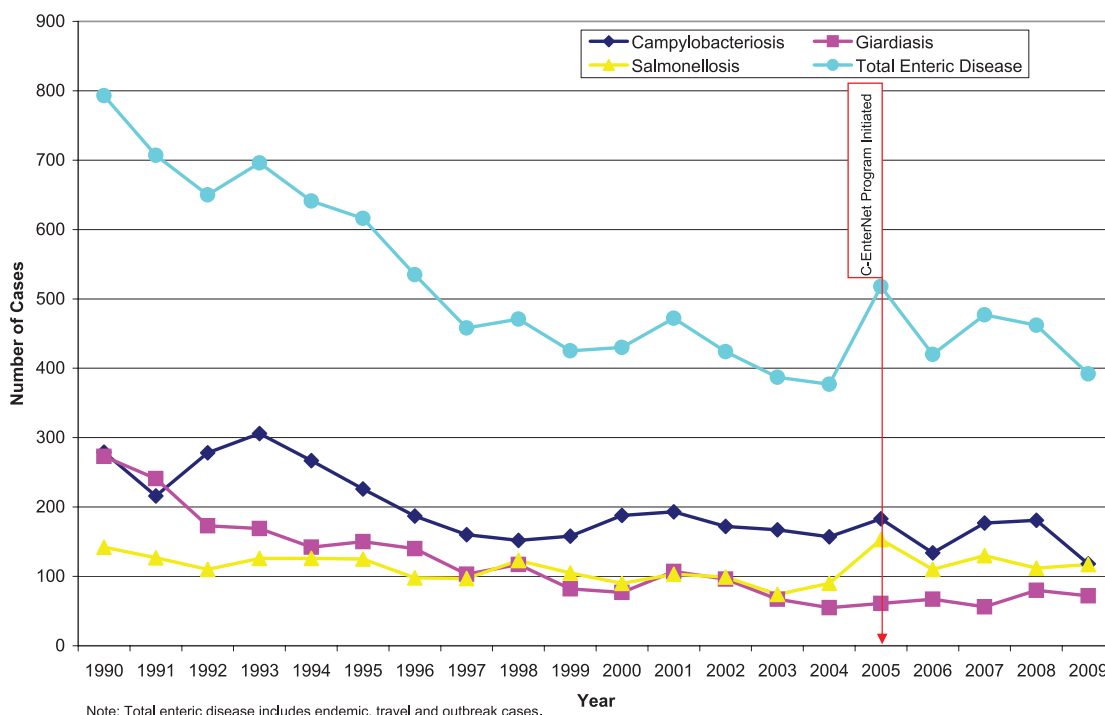
C-EnterNet's human enteric information is collected through the existing passive surveillance system in Ontario. This system has been enhanced by C-EnterNet through the collection of epidemiological and microbiological data for the human cases by using an enhanced standardized questionnaire for sporadic enteric disease cases and by performing advanced subtyping analyses on human stool samples.

The burden of enteric disease continues to be significant in the Region of Waterloo. It must be noted that under-reporting continues to complicate these measures, not only in Sentinel Site 1 but also across Canada. It has been estimated that for every case of acute gastroenteritis that is counted through public health surveillance, there are 313 cases in the community that go unmeasured[1].

In 2009, of the 392 reported cases of 11 bacterial, viral and parasitic enteric diseases captured in the Region of Waterloo (Table 1), campylobacteriosis, salmonellosis and giardiasis were most common, accounting for 78% of those cases (Figure 1). Overall, the number of endemic cases reported in 2009 were lower than that reported in 2008. Campylobacteriosis decreased significantly (p-value<0.05) in 2009 compared to 2008, with lower reported endemic, travel- and outbreak-related cases than the previous year. The incidence rate of endemic salmonellosis remains consistently high over the last couple of years. The incidence rate of endemic shigellosis was higher in 2009 than 2008, while endemic giardiasis was lower.

[1] Majowicz et al., 2005. Estimating the under-reporting rate for infectious gastrointestinal illness in Ontario. Canadian Journal of Public Health 96 (3):178-81

Travel continues to be an important factor in the burden of enteric disease. In 2009, 29% of all cases of enteric disease were associated with travel outside of Canada. The travel-related proportion of cases, compared with endemic, was highest for cyclosporiasis (100%), Hepatitis A (67%) and amoebiasis (52%). Travel-related campylobacteriosis, giardiasis and salmonellosis showed the highest number of reported cases in 2009. The majority of travel-related *Campylobacter* cases had reported travelling to Europe (5/19) and the Americas (4/19). The majority of travel-related *Giardia* cases had reported travelling to Asia (17/32), and the majority of travel-related *Salmonella* cases had reported travelling to the Americas (20/35), of which 60% (12/20) were infected with *S. Enteritidis*. Travel-related shigellosis decreased from the previous year with only 1 case reported in 2009, while the number of travel-related salmonellosis increased. There were no travel-associated VTEC infections reported in 2009, indicating that *E. coli* O157:H7 may be a domestically acquired infection.

There were no outbreak-associated enteric disease cases reported within Sentinel Site 1 in 2009 compared to 2008 which reported a total of 32 outbreak-associated cases.

Retail Component

Table 2: Pathogen detection on retail meat, 2008-2009

| | 2008 | | | 2009 | | |
	Pork (n=178)	Chicken (n=185)	Beef (n=180)	Pork (n= 200)	Chicken (n=200)	Beef (n=200)
Campylobacter	0% (0)	43% (80)	1% (2)	1% (1)	46% (92)	1% (1)
Salmonella	1% (1)	32% (60)	1% (1)	2% (3)	29% (57)	1% (1)
VTEC	0% (0)	0% (0)	1% (2)	0% (0)	0% (0)	1% (1)
Yersinia spp.	3% (6)	Not tested	Not tested	30% (60)	Not tested	Not tested
Listeria monocytogenes	Not tested	Not tested	Not tested	10% (16)[a]	19% (31)[b]	12% (20)[c]

Cells shaded in yellow represent significant changes from 2008 to 2009 (Fisher's Exact Test, P-value ≤ 0.05)

[a] n=163   [b] n=165   [c] n=164

Note: 2009 results are preliminary

Retail Component (cont.)

Figure 2: Yearly distribution of pathogen contamination on retail meat, 2006-2009
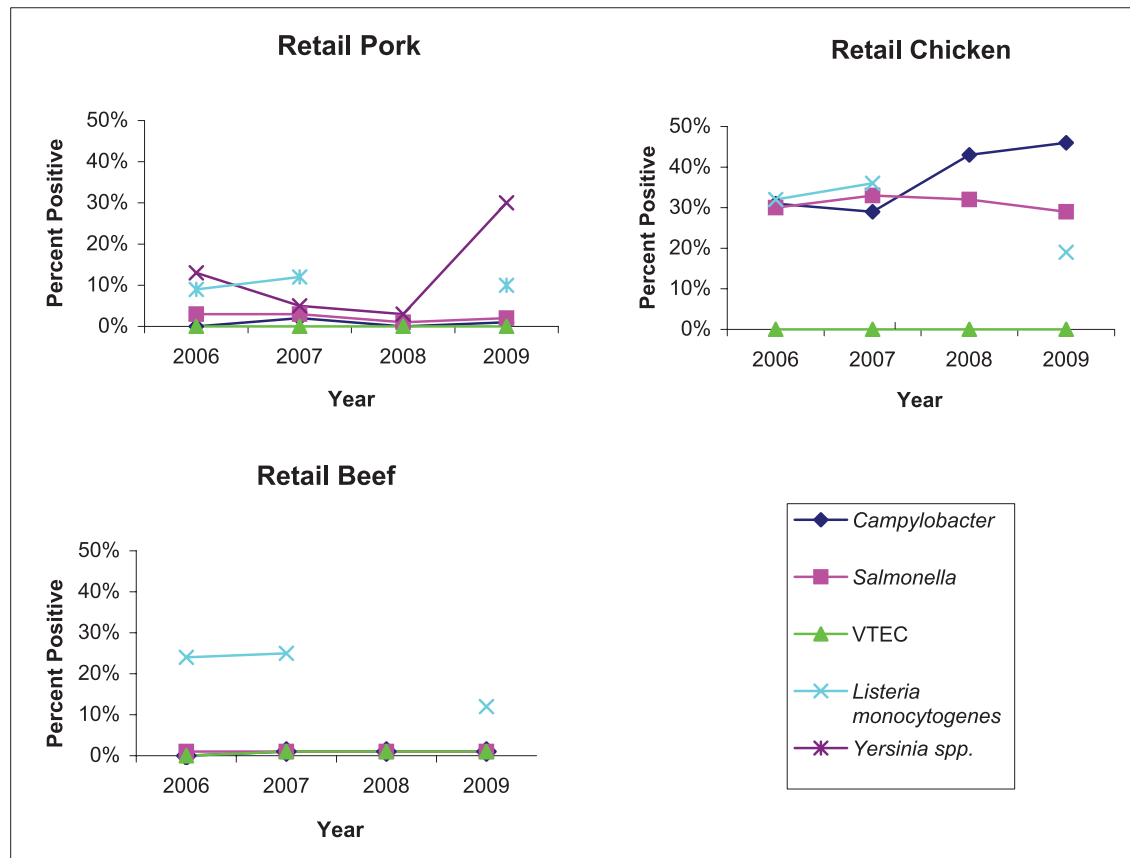
Retail meat continues to be an important exposure source for enteric pathogens. Sampling at the retail level represents consumer exposure close to consumption, but prior to food handling and preparation. Since mid-2005, C-EnterNet has systematically sampled fresh raw pork, chicken and beef from randomly selected grocery stores within Sentinel Site 1 on a weekly basis. In 2009, the levels of pathogen contamination on retail raw meat were similar to 2008 levels, with the exception of *Yersinia* spp. on retail pork. In June 2009, the *Yersinia* spp. culture method was modified to increase test sensitivity, which resulted in a statistically significant increase in *Yersinia* spp. levels (3% in 2008 to 30% in 2009). Raw chicken remains the commodity most frequently contaminated with *Salmonella* and *Campylobacter*. In 2009, as in 2008, the presence of verotoxogenic *E. coli* remains low with only 1 ground beef sample testing positive. The prevalence of *Campylobacter* increased significantly (p-value<0.05) in 2008 in chicken compared to 2007 and 2006 (Figure 2). However, this increase corresponds to the change in the type of chicken breast sampled from skin-on in 2006-2007 to skin-off in 2008.

Table 3: Pathogen detection on leafy greens in 2009

Pathogen detection on leafy greens in 2009[a] (n=376)		
	Culture % (# positive)	PCR % (# positive)
Campylobacter	0% (0)	N/T
Salmonella	0% (0)	N/T
E. coli Verotoxin	N/T	0% (0)
Generic *E. coli*	3% (11)[b]	N/T
Listeria monocytogenes	1% (3)	N/T
Shigella	0% (0)[c]	0.3% (1)
Cryptosporidium	N/T	9% (33)
Giardia	N/T	2% (9)
Cyclospora	N/T	2% (9)
Norovirus	N/T	5% (19)
Rotavirus	N/T	0.3% (1)

[a] Testing from April to December 2009

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

[c] Culture only performed on the single PCR positive

N/T = Not Tested

Note: 2009 results are preliminary

In April 2009, C-EnterNet's routine retail sampling program expanded to include the testing of bagged leafy greens. Each week 14 samples were collected from 4 to 5 randomly selected grocery stores within the sentinel site for a total of 376 samples in 2009. Samples were shipped to the Bureau of Microbial Hazards, Health Canada for pathogen testing. *Listeria monocytogenes* was detected on 3 samples by culture and *Shigella* on 1 sample by PCR. Generic *E. coli* was detected on 11 samples with a mean log of 1.5 CFU/g. No other bacteria were detected. Among parasites detected by PCR, *Cryptosporidium* was the most frequently detected (33 samples) while *Giardia* and *Cyclospora* were detected on 9 samples each. By microscopy, *Cryptosporidium*, *Giardia*, and *Cyclospora* were found on 24, 1 and 5 samples, respectively. Norovirus was detected by PCR on 19 samples and Rotavirus on 1 sample.

Agriculture Component

Table 4: Pathogen detection from individual manure samples in 2008 and 2009

Sample Prevalence	2008				2009			
	Swine (111 samples)	Dairy (112 samples)	Beef (112 samples)	Broiler Chickens (100 samples)	Swine (120 samples)	Dairy (120 samples)	Beef (120 samples)	Broiler Chickens (120 samples)
Campylobacter	68% (76)	75% (84)	76% (85)	10% (10)	80% (96)	80% (96)	79% (95)	5% (6)
Salmonella	28% (31)	8% (9)	6% (7)	62% (62)	34% (41)	18% (22)	13% (15)	31% (37)
E. coli O157:H7	1% (1)	4% (4)[a]	13% (14)[a]	0% (0)[b]	3% (4)	6% (7)	9% (11)	0% (0)
Yersinia spp.	4% (4)	Not tested	Not tested	Not tested	2% (2)	Not tested	Not tested	Not tested
Listeria monocytogenes	Not tested	Not tested	64% (23)[c]	8% (7)[d]	Not tested	Not tested	Not tested	Not tested

Cells shaded in yellow represent significant changes from 2008 to 2009 (Fisher's Exact Test, P-value ≤ 0.05)

[a] 8 samples not tested for *E. coli* O157:H7 (N=104)   [b] 4 samples not tested for *E. coli* O157:H7 (N=96)   [c] N=36   [d] N=88

Note: 2009 results are preliminary

Table 5: Pathogen detection at the farm level in 2008 and 2009

Farm Prevalence	2008				2009			
	Swine (30 farms)	Dairy (28 farms)	Beef (28 farms)	Broiler Chickens (25 farms)	Swine (30 farms)	Dairy (30 farms)	Beef (30 farms)	Broiler Chickens (30 farms)
Campylobacter	93% (28)	93% (26)	96% (27)	12% (3)	100% (30)	100% (30)	100% (30)	7% (2)
Salmonella	60% (18)	18% (5)	11% (3)	76% (19)	67% (20)	27% (8)	27% (8)	53% (16)
E. coli O157:H7	3% (1)	12% (3)[a]	31% (8)[a]	0% (0)[b]	7% (2)	17% (5)	20% (6)	0% (0)
Yersinia spp.	13% (4)	Not tested	Not tested	Not tested	7% (2)	Not tested	Not tested	Not tested
Listeria monocytogenes	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested	Not tested

[a] 2 farms not tested for *E. coli* O157:H7 (N=26)   [b] 1 farm not tested for *E. coli* O157:H7 (N=24)

Note: 2009 results are preliminary

Detection of enteric pathogens on farms represents an environmental exposure source. In 2009, 4 commodity groups (dairy, beef, swine, and broiler chickens) were sampled. Each month 2-3 farms per commodity are enrolled and visited for a total of 30 farms per commodity per year. The visit involves the administration of a short management survey and sampling of 3 fresh pooled manure samples from different age groups of animals and 1 stored manure sample.

Results are presented at the sample level and at the farm level to account for within-farm similarities. Of the 30 farms sampled for each commodity in 2009, 23 swine, 14 beef, 14 dairy and 16 poultry farms had also been sampled in 2008.

Agriculture Component (cont.)

Salmonella was most frequently detected in swine and broiler chickens (at the farm and sample level). In 2009, the prevalence of *Salmonella* increased significantly on dairy farms and decreased significantly on broiler chicken farms at the sample level, but not at the farm level.

Campylobacter was frequently detected (at both the farm and sample level) in swine, dairy and beef farms, and was detected on 2 broiler chicken operations. In Figure 3, the prevalence of *Campylobacter* increased significantly (p-value<0.05) in swine, dairy and beef at the farm level in 2008 compared to 2007 and 2006, and is most likely due to the implementation of a more sensitive laboratory methodology at the beginning of 2008, rather than a true prevalence increase.

E. coli O157:H7 was detected on both dairy and beef operations and on 2 swine operations, 1 of which also had beef cattle.

Figure 3: Pathogen detection (sample level) from manure samples in 2006–2009

Water Component

Table 6: Pathogen detection in untreated surface water in Sentinel Site 1, 2008-2009

	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 spp	44% (49/112)	48% (11/23)	46% (11/24)	50% (11/22)	33% (8/24)	42% (8/19)
Cryptosporidium[a]	80% (8/10)	---	---	---	80% (8/10)	---
Giardia[a]	100% (10/10)	---	---	---	100% (10/10)	---

|	2008					
	All Sites	A	B	C	D	E
Campylobacter	24% (24/100)	24% (5/21)	24% (5/21)	28% (5/18)	41% (9/22)	0% (0/18)
Salmonella	34% (34/100)	62% (13/21)	33% (7/21)	11% (2/18)	18% (4/22)	44% (8/18)
E. coli O157:H7	1% (1/100)	0% (0/21)	5% (1/21)	0% (0/18)	0% (0/22)	0% (0/18)
Yersinia spp	11% (11/100)	10% (2/21)	10% (2/21)	17% (3/18)	14% (3/22)	6% (1/18)
Cryptosporidium[a]	82% (18/22)	100% (2/2)	50% (1/2)	0% (0/1)	87% (13/15)	100% (2/2)
Giardia[a]	95% (21/22)	100% (2/2)	100% (2/2)	100% (1/1)	93% (14/15)	100% (2/2)

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

Note: Cells shaded in yellow represent significant changes from 2008 to 2009 (Fisher's Exact Test P-value ≤ 0.05)

[a] By microscopy, not culture method

Water Component (cont.)

Figure 4: Proportion of positive untreated surface water samples tested by culture method in Sentinel Site 1 between 2006 to 2009 for selected enteric pathogens
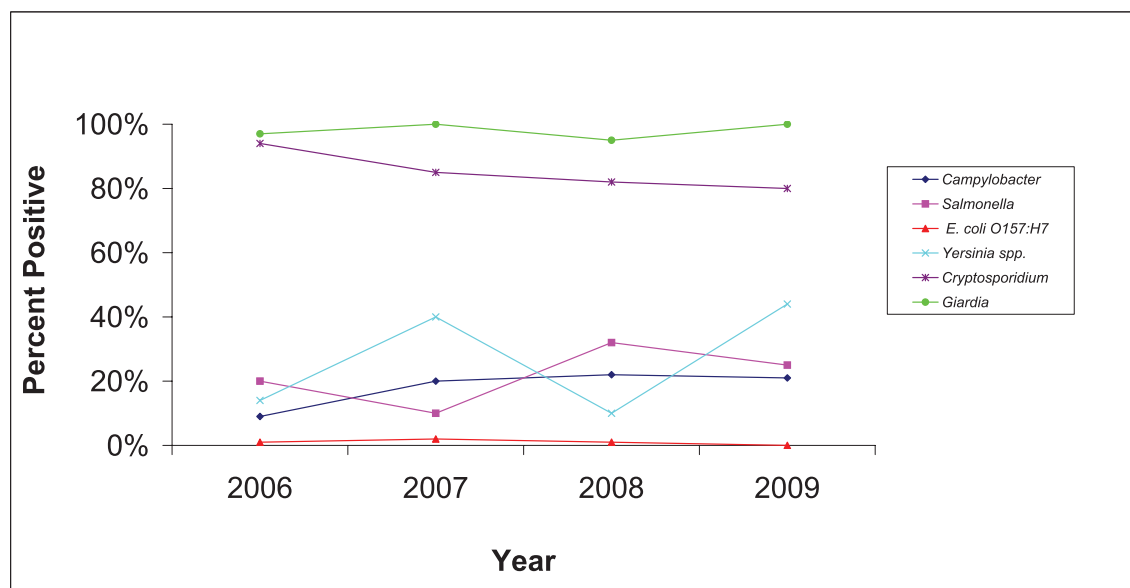
Watershed surveillance has been ongoing along the Grand River at 5 sampling locations since early 2005. A rich database of pathogen occurrence has been compiled for the past 4 surveillance years, to reflect the temporal and spatial variability of enteric pathogens in the surface waters in Sentinel Site 1.

As in 2008, only culture-based and microscopy detection methods were used. In 2008, the change in detection laboratory had an effect on pathogen recovery from the surface water samples. This is reflected in the significant difference between *Yersinia* spp. prevalence in 2008 versus 2009. By 2009, the method had been optimized at the new laboratory and detection returned to the 40% level, as observed in 2007.

All other pathogen prevalence levels remained consistent with previous surveillance years. Two sampling months were missed for the parasite detection during a start-up delay with the new detection laboratory.