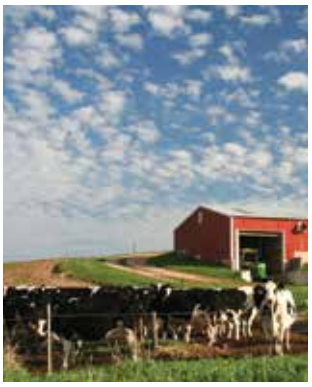
2012
SHORT REPORT

FOODNET CANADA
CANADA'S NATIONAL INTEGRATED ENTERIC PATHOGEN SURVEILLANCE SYSTEM





PROTECTING CANADIANS FROM ILLNESS

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FoodNet Canada acknowledges the significant investments made by our partners in both sentinel sites, our provincial and federal government agency colleagues and academic and industry collaborators who help to make this program a continued success.

INTRODUCTION

FoodNet Canada is an integrated enteric pathogen surveillance system based on a sentinel site surveillance model that collects information on both cases of infectious gastrointestinal illness and sources of exposure within defined communities. These data are analyzed to assist in determining what food and other sources are making Canadians ill and to accurately track disease over time. FoodNet Canada'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, strengthen source attribution efforts in Canada by determining significant exposure factors for enteric illness, and assess the effectiveness of food safety programs and targeted interventions.

FoodNet Canada currently has two sentinel sites in operation: the Region of Waterloo Public Health in Ontario since 2005, and the Fraser Health Authority of lower mainland British Columbia since 2010. In each sentinel site, enhanced human disease surveillance is performed in parallel with active surveillance of enteric pathogens in various exposure sources.

The purpose of this report is to present the preliminary findings from the 2012 surveillance year in both sentinel sites. Note that FoodNet Canada 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 a comprehensive annual 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 further information about the FoodNet Canada program or sampling methodologies, please refer to our website: www.phac-aspc.gc.ca/foodnetcanada/index-eng.php.

HUMAN CASE SUMMARY

The enhanced human disease surveillance component of FoodNet Canada is fully implemented in two sentinel sites: in the Region of Waterloo, Ontario (ON) site and in the Fraser Health Authority, British Columbia (BC) site.

In 2012, campylobacteriosis, salmonellosis and giardiasis were the most commonly reported enteric diseases in FoodNet Canada's sentinel sites (Table 1). Overall, the total number of endemic enteric cases reported in the ON and BC sites in 2012 was lower than that reported in 2011. The incidence rate of sporadic, endemic cryptosporidiosis decreased in the ON site from 2011 to 2012. The incidence rate of total salmonellosis cases decreased in the BC site from 2011 to 2012, due to fewer reported outbreak and endemic cases (travel cases did not have an impact).

Travel continues to be an important factor in the burden of enteric disease. In 2012, over 30% of all cases of enteric disease were associated with travel outside of Canada, in both the ON and BC sites. In both sentinel sites, all investigated cyclosporiasis cases were travel-related. The proportion of travel-related cases, compared to sporadic endemic cases, was higher for yersiniosis (60%) and cryptosporidiosis (58%) in the ON site and for shigellosis (58%) in the BC site.

In 2012, a total of 13 outbreak-associated cases were reported in the ON and BC site. There were 10 *E. coli* O157:H7 outbreak-associated cases and three *Salmonella* cases.

[1] FoodNet Canada is designed to have five sites encompassing about 10% of the Canadian population.

TABLE 1: Disease-specific case counts and annual incidence rates in the ON and BC sites in 2012 compared to 2011, and 2011 National Notifiable Disease incidence rates

		ON Site				BC Site				National[b]
		2011[†]		2012		2011[†]		2012		2011
		# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	Incidence Rate[a]
Entamoeba[c]	Total	25	4.70	36	6.68	36	7.84	39	8.50	—
	Endemic[d]	19	3.57	19	3.53					
	Travel[e]	6	1.13	11	2.04					
	LTF[g]	0	0	6	1.11					
Campylobacteriosis	Total	163	30.66	146	27.09	177	38.51	171	36.97	27.39
	Endemic	103	19.37	101	18.74	107	23.28	115	24.87	
	Travel	37	6.96	27	5.01	45	9.79	34	7.35	
	LTF	23	4.33	18	3.34	25	5.44	22	4.76	
Cryptosporidiosis	Total	23	4.33	13	2.41	6	1.31	11	2.38	1.70
	Endemic	20	3.76	5	0.93***	3	0.65	6	1.30	
	Travel	2	0.38	7	1.30	3	0.65	2	0.43	
	LTF	1	0.19	1	0.19	0	0	3	0.65	
Cyclosporiasis	Total	2	0.38	3	0.56	3	0.65	1	0.22	0.41
	Endemic	1	0.19	0	0	0	0	0	0	
	Travel	1	0.19	2	0.37	3	0.65	1	0.22	
	LTF	0	0	1	0.19	0	0	0	0	
Giardiasis	Total	60	11.28	60	11.13	61	13.27	57	12.32	11.03
	Endemic	33	6.21	30	5.57	29	6.31	24	5.19	
	Travel	19	3.57	25	4.64	18	3.92	22	4.76	
	LTF	8	1.50	5	0.93	14	3.05	11	2.38	
Listeriosis	Total	0	0	1	0.19	1	0.22	2	0.43	0.41
	Endemic	0	0	1	0.19	1	0.22	1	0.22	
	Travel	0	0	0	0	0	0	1	0.22	
	LTF	0	0	0	0	0	0	0	0	
Salmonellosis	Total	111	20.88	119	22.08	137	29.81	102	22.05**	19.06
	Endemic	59	11.10	65	12.06	78	16.97	56	12.11*	
	Travel	39	7.33	39	7.24	36	7.83	36	7.78	
	Outbreak[f]	0	0	1	0.19	11	2.39	2	0.43**	
	LTF	13	2.45	14	2.60	12	2.61	8	1.73	
Shigellosis	Total	6	1.13	7	1.30	18	3.92	13	2.81	3.07
	Endemic	1	0.19	3	0.56	4	0.87	5	1.08	
	Travel	4	0.75	3	0.56	13	2.83	7	1.51	
	LTF	1	0.19	1	0.19	1	0.22	1	0.22	
Verotoxigenic *E. coli* (VTEC)	Total	14	2.63	23	4.27	15	3.26	9	1.95	1.85
	Endemic	13	2.45	13	2.41	13	2.83	7	1.51	
	Travel	1	0.19	1	0.19	2	0.44	1	0.22	
	Outbreak	0	0	9	1.67	0	0	1	0.22	
	LTF	0	0	0	0	0	0	0	0	

		ON Site				BC Site				National[b]
		2011[†]		2012		2011[†]		2012		2011
		# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	# of cases	Incidence Rate[a]	Incidence Rate[a]
Yersiniosis	**Total**	8	1.50	5	0.93	23	5.00	22	4.76	—
	Endemic	4	0.75	2	0.37	16	3.48	14	3.03	
	Travel	4	0.75	3	0.56	3	0.65	2	0.43	
	LTF	0	0	0	0	4	0.87	6	1.30	
Total	**Endemic**	**253**		**239**		**251**		**228**		
	Travel	**113**		**118**		**123**		**106**		
	Outbreak	**0**		**10**		**11**		**3**		
	LTF	**46**		**46**		**56**		**51**		

[a] Incidence rate is measured as the number of new cases / 100,000 person-years.

[b] Canadian Notifiable Disease Surveillance System (CNDSS), Surveillance and Epidemiology Division, Centre for Communicable Diseases and Infection Control, PHAC (2012).

[c] Entamoeba is reported as Entamoeba histolytica/dispar.

[d] Endemic cases include reported cases of infection that occur sporadically within the sentinel site. Cases that are lost to follow-up are also included with the endemic cases.

[e] Travel-related cases include individuals that have travelled outside of Canada in the relevant time frame before onset of illness.

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

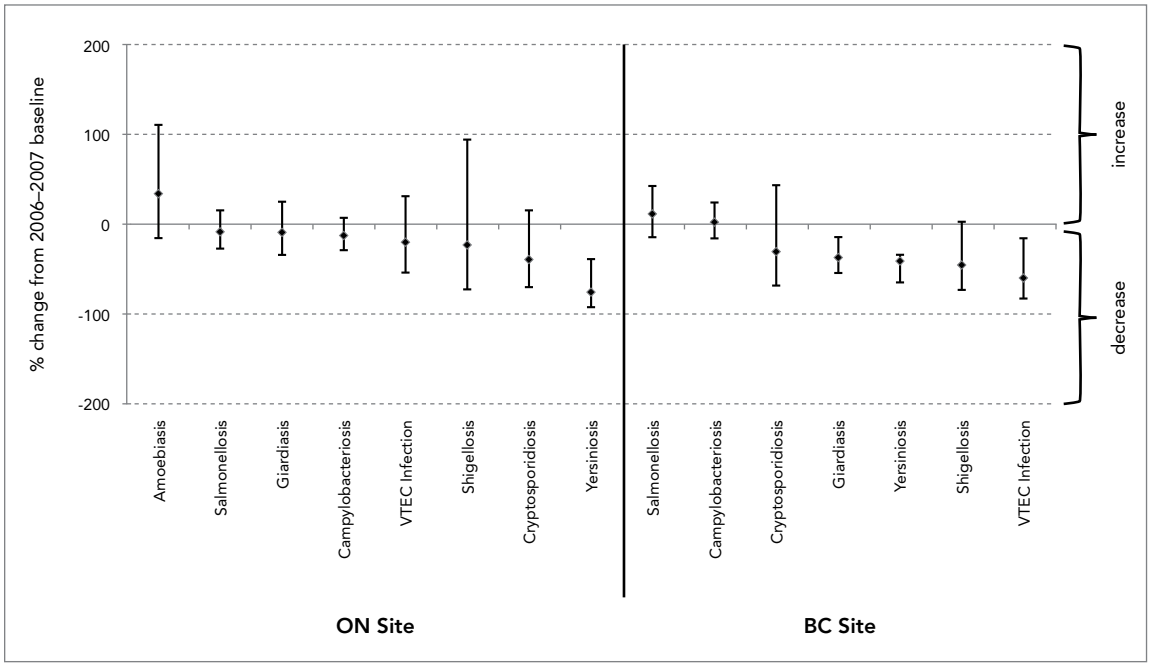
[g] Lost To Follow-up (LTF) includes cases that could not be followed-up with an interview.

[†] Reference group

[***] $P \leq 0.01$, [**] $0.01 < P \leq 0.05$, [*] $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

It is also important to monitor longer-term disease trends over time . The data include all cases (endemic, travel, outbreak and those lost to follow-up). In general, there has been a decreasing trend in overall disease from 2006–2007 to 2012 (Figure 1). In both the ON and BC sites, the incidence rate of yersiniosis showed a statistically significant decrease (76% in the ON site and 41% in the BC site) in 2012 compared to the 2006–2007 rates. In the BC site, the incidence rate of VTEC infections showed a statistically significant decrease of 60% in 2012. The incidence rate was also lower for giardiasis (37% decrease) in 2012 (Figure 1).

FIGURE 1: Estimated percent change (with 95% confidence interval) in annual incidence rates of all reportable enteric disease cases in the ON and BC sites in 2012, compared to the average annual incidence rate during 2006–2007, by pathogen



Note: Changes are not statistically significant if zero is within the estimate's 95% confidence interval; changes are statistically significant if zero is not within the confidence interval. Baseline 2006–2007 data from the BC site was provided by the Fraser Health Authority.

RETAIL COMPONENT

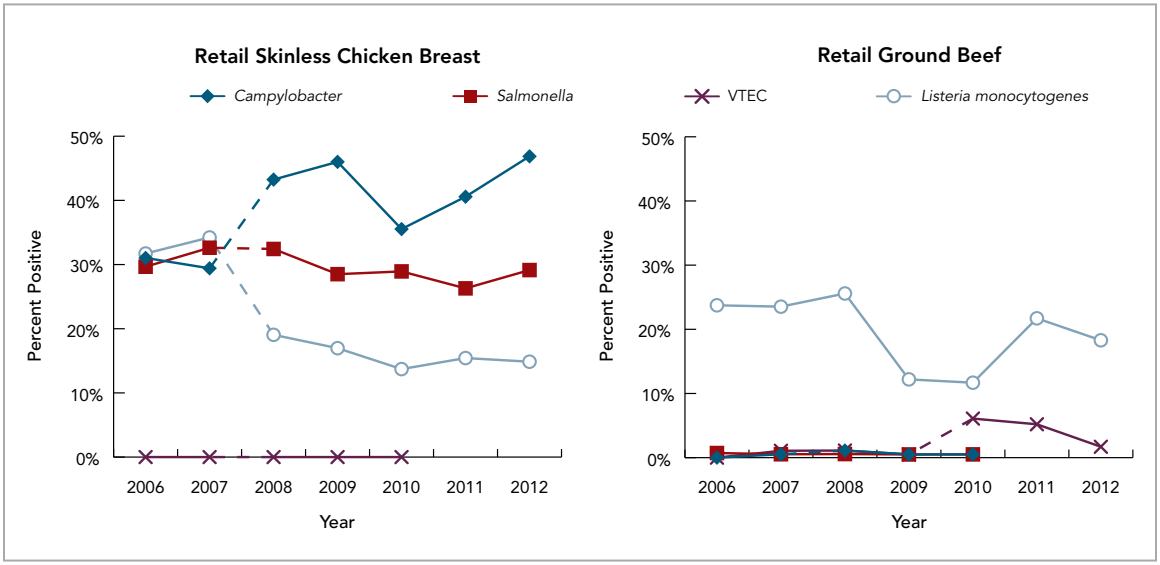
Retail food continues to be an important human exposure source for enteric pathogens. Core surveillance activities monitor retail chicken and beef for major pathogens every year. Targeted surveillance focuses on select items that have high chances of human exposure and may differ from year to year.

Core Surveillance Activities

ONTARIO SITE

Since mid-2005, FoodNet Canada has systematically sampled fresh raw pork, chicken breasts and ground beef from randomly selected grocery stores within the ON site on a weekly basis. After being detected at lower rates on retail beef in 2009 and 2010, *Listeria monocytogenes* returned in 2011 to prevalence levels previously seen before the decrease. (Table 2, Figure 2). VTEC levels on ground beef decreased in 2012 (1.7%, 3/175) compared with 2011 (5.2%, 9/173). *Campylobacter* levels on skinless chicken breasts decreased in 2010 from 2009, though returned in 2012 to prevalence levels seen before the decline.

FIGURE 2: Yearly distribution of pathogen contamination on retail meat in the ON site, 2006 to 2012



Note: Dashed lines indicate a laboratory or sampling method change. Chicken breast samples with skin were tested in 2006 and 2007. Starting in 2008, skinless chicken breast samples were tested. Pork chops were not sampled in 2011 or 2012. *Campylobacter* and *Salmonella* testing were also stopped on ground beef, beginning in 2011.

TABLE 2: Pathogen detection on retail meat in the ON site, 2011 and 2012

Pathogen detection on retail meat	Skinless Chicken Breast		Ground Beef	
	2011† (n = 175)	2012 (n = 175)	2011† (n = 175)	2012 (n = 175)
	percent positive (number positive)			
Campylobacter	41% (71)	47% (82)	.	.
Salmonella	26% (46)	29% (51)	.	.
VTEC	.	.	5.2% (9)[a]	1.7% (3)*
Listeria monocytogenes	15% (27)	15% (26)	22% (38)	18% (32)

. Not tested

[a] 173 samples tested for VTEC

† Reference group

*** P ≤ 0.01, ** 0.01 < P ≤ 0.05, * 0.05 < P ≤ 0.1 indicate statistically significant estimates compared to the reference group (Fisher's exact test)

BRITISH COLUMBIA SITE

In January 2011, core retail sampling was initiated in the BC site with identical sampling and laboratory procedures as in the ON site (Table 3). Year to year trend analysis indicates that the prevalence of *Salmonella* decreased by 13 percentage points to 23% (41 out of 175) in 2012. VTEC rates held at the same level from 2011 to 2012.

TABLE 3: Pathogen detection on retail meat in the BC site, 2011 and 2012

Pathogen detection on retail meat	Skinless Chicken Breast		Ground Beef	
	2011†	2012	2011†	2012
	percent positive (number positive/number tested)			
Campylobacter	49% (83/171)	51% (88/174)	.	.
Salmonella	36% (63/175)	23% (41/175)**	.	.
VTEC	.	.	1.8% (3/164)	1.7% (3/174)
Listeria monocytogenes	46% (81/175)	49% (86/175)	13% (22/174)	17% (30/174)

. Not tested

† Reference group

*** P ≤ 0.01, ** 0.01 < P ≤ 0.05, * 0.05 < P ≤ 0.1 indicate statistically significant estimates compared to the reference group (Fisher's exact test)

Targeted Retail Surveillance

POULTRY

A targeted retail poultry study, started in 2011, was conducted from January to December in both sites (Table 4 and 5). At each store visit, in addition to core retail meat sampling, ground chicken, ground turkey and uncooked frozen chicken nugget samples were also collected. Ground turkey sampling was discontinued in 2012.

Rates of *Campylobacter*, *Salmonella* and *Listeria* found on frozen chicken nuggets sampled in the Ontario site were stable from 2011 to 2012. On ground chicken, *Salmonella* was more common in 2012 (66%) than in 2011 (52%). There was also evidence that the prevalence rates of *Listeria* found on ground chicken decreased between 2011 and 2012. For the British Columbia site, *Salmonella* was found somewhat less often on ground chicken over the same time period.

TABLE 4: Pathogen detection on ground chicken, ground turkey and frozen chicken nuggets in the ON site, 2011 to 2012

Pathogen detection on retail meat	Ground Chicken		Ground Turkey		Frozen Chicken Nuggets	
	2011[†] (n = 158)	2012 (n = 144)	2011[†] (n = 155)	2012	2011[†] (n = 212)	2012 (n = 144)
	percent positive (number positive)					
Campylobacter	13% (21)	20% (29)[a]	16% (25)	.	1.4% (3)	0% (0/29)[b]
Salmonella	52% (82)	66% (95)**	23% (35)	.	43% (91)	41% (59)
Listeria monocytogenes	46% (73)	35% (51)*	32% (50)	.	20% (42)	20% (29)

. Not tested

[a] n=142

[b] Testing ended in March 2012

[†] Reference group

[***] P ≤ 0.01, [**] 0.01 < P ≤ 0.05, [*] 0.05 < P ≤ 0.1 indicate statistically significant estimates compared to the reference group (Fisher's exact test)

TABLE 5: Pathogen detection on ground chicken, ground turkey and frozen chicken nuggets in the BC site, 2011 to 2012

Pathogen detection on retail meat	Ground Chicken		Ground Turkey		Frozen Chicken Nuggets	
	2011[†] (n = 96)	2012 (n = 117)	2011[†] (n = 96)	2012	2011[†] (n = 94)	2012 (n = 117)
	percent positive (number positive)					
Campylobacter	68% (65)	56% (66)	44% (42)	.	0% (0)	0% (0/24)[a]
Salmonella	76% (73)	65% (76)*	26% (25)	.	47% (44)	45% (53)
Listeria monocytogenes	42% (40)	40% (47)	41% (39)	.	23% (22)	20%(23)

. Not tested

[a] Testing ended in March 2012

[†] Reference group

[***] P ≤ 0.01, ** 0.01 < P ≤ 0.05, * 0.05 < P ≤ 0.1 indicate statistically significant estimates compared to the reference group (Fisher's exact test)

PRODUCE

In 2012, a study to detect viruses and parasites on herbs at the retail level was conducted (Table 6). From January to November, a variety of herb types were collected in both sentinel sites. In the ON site, 299 samples were collected (50 domestic, 249 imported); in the BC site, 299 samples were also collected (83 domestic, 216 imported).

Giardia was the most frequently detected parasite, by PCR methods, in both sentinel sites. *Cyclospora* and *Cryptosporidium* were not detected in samples from either site (Table 6). The samples were also tested for two viruses—Norovirus and Rotavirus. Norovirus was detected on 2.3% (7/298) of samples in the ON site, and on 0.33% (1/299) of samples in the BC site. Since the viability of the pathogens could not be determined with the PCR test, the potential risk is unknown.

The small number of domestic samples collected made meaningful comparisons to imported products difficult. Statistical comparisons did not show a significant difference between domestic versus imported for these pathogens (Table 7).

TABLE 6: PCR-based pathogen detection on herbs in the ON and BC sites, 2012

Pathogen Detection on Herbs[a]	ON Site[†] (n = 299)	BC Site (n = 299)
	percent positive (number positive)	
Cryptosporidium	0% (0)	0% (0)
Giardia	1.3% (4)	0.67% (2)
Cyclospora	0% (0)	0% (0)
Norovirus	2.3% (7)[b]	0.33% (1)**
Rotavirus	0% (0)[b]	0% (0)

[a] 1 Arugula, 71 basil, 6 bay, 47 chives, 59 cilantro, 1 coriander, 62 dill, 1 fenugreek, 1 lemon grass, 7 marjoram, 52 mint, 45 oregano, 93 parsley, 36 rosemary, 43 sage, 16 savoury, 3 sorrel, 21 tarragon, 34 thyme, and 2 unidentified herbs. Samples testing positive for *Giardia*—ON (1 cilantro, 2 rosemary, 1 tarragon), BC (1 cilantro, 1 parsley); Norovirus—ON (1 basil, 2 chives, 3 dill, 1 parsley), BC (1 basil)

[b] n = 298

[†] Reference group

[***] $P \leq 0.01$, [**] $0.01 < P \leq 0.05$, [*] $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

TABLE 7: Pathogen detection by PCR on herbs in the ON and BC sites, imported versus domestic, 2012

Pathogen Detection on Herbs	Imported (n = 465)[†]	Domestic (n = 133)
	percent positive (number positive)	
Cryptosporidium	0% (0)	0% (0)
Giardia	1.3% (6)	0% (0)
Cyclospora	0% (0)	0% (0)
Norovirus	1.7% (8)	0% (0)
Rotavirus	0% (0)[a]	0% (0)

[a] n = 464

[†] reference group

[***] $P \leq 0.01$, [**] $0.01 < P \leq 0.05$, [*] $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

AGRICULTURE COMPONENT

Farms are possible environmental and food chain exposure sources and so are monitored for their levels of enteric pathogens. In 2011 in the ON site, four commodity groups (dairy, beef, swine, and broiler chickens) were sampled for four pathogens (*Campylobacter*, *Salmonella*, *E. coli* O157:H7 and *Yersinia*). In 2012, swine sampling was discontinued. As well in 2012, testing for *Yersinia* was stopped due to low detection rates in previous years. Farms are sampled throughout the year by visiting and enrolling two or three farms per commodity per month 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 bovine and swine visit. Broiler flocks were sampled within one week of transport for slaughter. No on-farm sampling occurred in the BC site in 2012, though sampling in 2013 is expected for some commodities. Results are presented at the sample level and at the farm level to account for within-farm differences (some pathogens may be found at different prevalence rates within each farm and this may impact any comparisons based only on their sample-level results).

In 2012, the prevalence of *E. coli* O157:H7 increased in dairy operations at the sample level. However, a change in laboratory testing methods for *E. coli* O157:H7 was also implemented in 2012 and may explain this difference. Though four additional farms were found positive for *E. coli* O157:H7, the increase at the farm level was not statistically significant. No other statistically significant changes were noted (Tables 8 and 9).

TABLE 8: Pathogen detection from individual manure samples in the ON site, 2011 and 2012

Sample Prevalence	Swine		Dairy		Beef		Broiler Chickens	
	2011† (n = 120)	2012 (n = 120)	2011† (n = 120)	2012 (n = 120)	2011† (n = 120)	2012 (n = 120)	2011† (n = 120)	2012 (n = 120)
	percent positive (number positive)							
Campylobacter	85% (102)	.	80% (96)	78% (93)	82% (98)	73% (88)	10% (12)	8.3% (10)
Salmonella	34% (41)	.	13% (16)	5.8% (7)*	9.2% (11)	8.3% (10)	61% (73)	58% (69)
E. coli O157:H7[a]	0% (0)	.	2.5% (3)	12% (14)***	3.3% (4)	8.3% (10)	0% (0)	0% (0)
Yersinia	0% (0)	.	0% (0)	.	0% (0)	.	0% (0)	.

. Not tested

[a] Differences in prevalence rates between 2011 and 2012 should be interpreted with caution as lab methods used to detect *E. coli* O157:H7 changed in 2012.

† Reference group

*** $P \leq 0.01$, ** $0.01 < P \leq 0.05$, * $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

TABLE 9: Pathogen detection at the farm level in the ON site, 2011 and 2012

Farm Prevalence	Swine		Dairy		Beef		Broiler Chickens	
	2011† (30 farms)	2012 (30 farms)	2011† (30 farms)	2012 (30 farms)	2011† (30 farms)	2012 (30 farms)	2011† (30 farms)	2012 (30 farms)
	percent positive (number positive)							
Campylobacter	100% (30)	.	97% (29)	97% (29)	100% (30)	97% (29)	13% (4)	10% (3)
Salmonella	57% (17)	.	27% (8)	20% (6)	20% (6)	17% (5)	80% (24)	67% (20)
E. coli O157:H7[a]	0% (0)	.	10% (3)	27% (8)	6.7% (2)	17% (5)	0% (0)	0% (0)
Yersinia	0% (0)	.	0% (0)	.	0% (0)	.	0% (0)	.

. Not tested

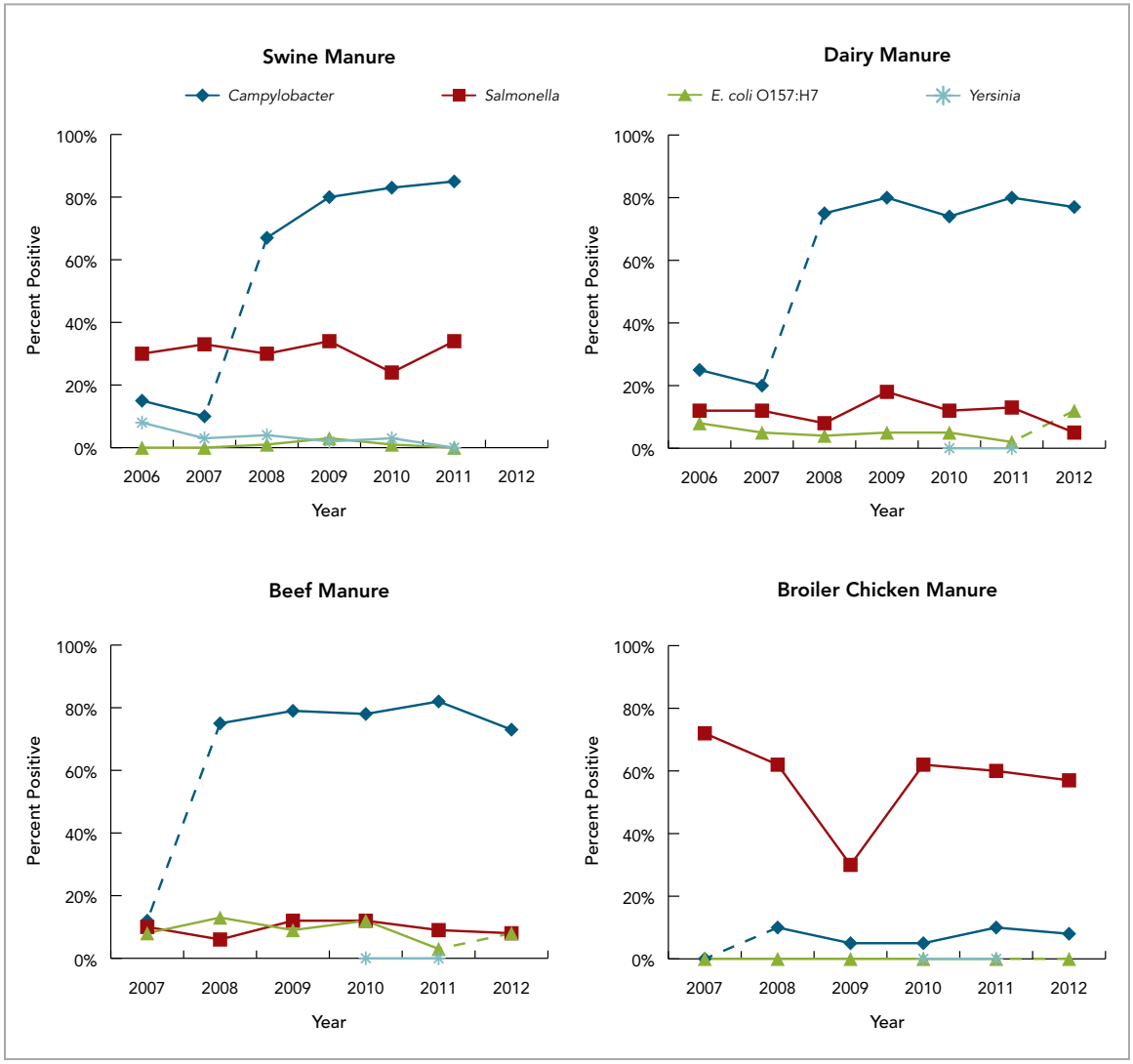
[a] Differences in prevalence rates between 2011 and 2012 should be interpreted with caution as lab methods used to detect *E. coli* O157:H7 changed in 2012.

† Reference group

*** $P \leq 0.01$, ** $0.01 < P \leq 0.05$, * $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

Prevalence detection rates have remained relatively stable from 2006 to 2012 for the four pathogens (Figure 3). *Salmonella* was found on approximately 62% of broiler chicken manure samples from 2007 to 2012, except in 2009 when it briefly dropped to about half that value (31%).

FIGURE 3: Pathogen detection (sample level) from manure samples in the ON site, 2006 to 2012



Note: Dashed lines indicate a laboratory or sampling method change.

WATER COMPONENT

Untreated Surface Water

During 2012, surveillance in the ON site along the Grand River watershed continued at the same five sampling locations. During the summer months (June-September), sampling was re-directed to three beach locations to assess the load of pathogens at local swimming venues. These data are presented separately from the routine surveillance results of untreated surface water from the Grand River.

The 2012 ON site data continue to illustrate consistent trends from year to year at the five sampling locations of untreated surface water within the watershed for many of the target pathogens (Figure 4).

For the ON sentinel site, a decrease was noted in the prevalence of *Campylobacter* detection from 34% (29/85) in 2011 to 14% (11/76) in 2012. This was largely due to decreases at two Grand River sample locations—one near a drinking water intake and the other near a waste water treatment plant (Table 10).

Recreational Water

Recreational water sampling targeted seven beaches in the two sentinel sites between June and September. Beach locations were chosen to reflect local freshwater swimming areas that can be accessed by sentinel site residents. The beach testing in the ON and BC sites illustrate that all pathogens were detected at least some of the time, though sample sizes are small. *Campylobacter* was detected at a lower prevalence in 2012 (4.5%, 2/44) compared to 2011 (18%, 12/66) for summary results representing both sites. It was largely due to drops at the ON site beaches.

TABLE 10: Pathogen detection in untreated surface water (ON), and in recreational water (ON and BC), 2011 and 2012

	Summary			
	Untreated Surface Water (5 locations, ON)		Recreational Beaches (7 locations, ON and BC)	
	2011[†]	2012	2011[†]	2012
Campylobacter	34% (29/85)	14% (11/76)***	18% (12/66)	4.5% (2/44)**
Salmonella	39% (34/87)	34% (32/94)	8.3% (2/24)[a]	8.3% (2/24)[a]
Verotoxigenic *E. coli*	38% (30/78)	40% (37/93)	24% (5/21)[a]	8.3% (2/24)[a]
Cryptosporidium	.	.	48% (10/21)	42% (13/31)
Giardia	.	.	57% (12/21)	48% (15/31)

Untreated Surface Water (ON)					
	A	B	C	D	E
2012					
Campylobacter	14% (2/14)	36% (5/14)	21% (3/14)	5.6% (1/18)**	0% (0/16)**
Salmonella	19% (3/16)	25% (4/16)	25% (4/16)	21% (5/24)	73% (16/22)
Verotoxigenic *E. coli*	38% (6/16)	19% (3/16)	13% (2/16)	25% (6/24)	95% (20/21)
Cryptosporidium	.	.	.	100% (2/2)	50% (2/4)
Giardia	.	.	.	100% (2/2)	100% (4/4)
2011[†]					
Campylobacter	29% (5/17)	44% (7/16)	15% (2/13)	42% (10/24)	33% (5/15)
Salmonella	12% (2/17)	50% (8/16)	31% (4/13)	32% (8/25)	75% (12/16)
Verotoxigenic *E. coli*	33% (5/15)	27% (4/15)	18% (2/11)	32% (7/22)	80% (12/15)
Cryptosporidium	.	.	.	100% (6/6)	.
Giardia	.	.	.	100% (6/6)	.

Recreational Beaches, 2012							
	ON Site			BC Site			
	Elora Gorge	Laurel Creek	Shade Mills	Albert Dyck Lake	Entrance Bay	Barnet Marine Park	Maple Bay
Campylobacter	25% (1/4)	0% (0/4)	25% (1/4)	0% (0/8)	0% (0/8)	0% (0/8)	0% (0/8)
Salmonella	13% (1/8)	0% (0/8)	13% (1/8)	25% (2/8)	0% (0/8)	0% (0/8)	0% (0/8)
Verotoxigenic *E. coli*	25% (2/8)	0% (0/8)	0% (0/8)	13% (1/8)	13% (1/8)	0% (0/8)	0% (0/8)
Cryptosporidium	75% (3/4)	100% (4/4)	100% (4/4)	0% (0/4)	0% (0/5)	20% (1/5)	20% (1/5)
Giardia	100% (4/4)	50% (2/4)	100% (4/4)	75% (3/4)	20% (1/5)	20% (1/5)	0% (0/5)

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

Note: the method used to detect *Cryptosporidium* and *Giardia* was microscopy.

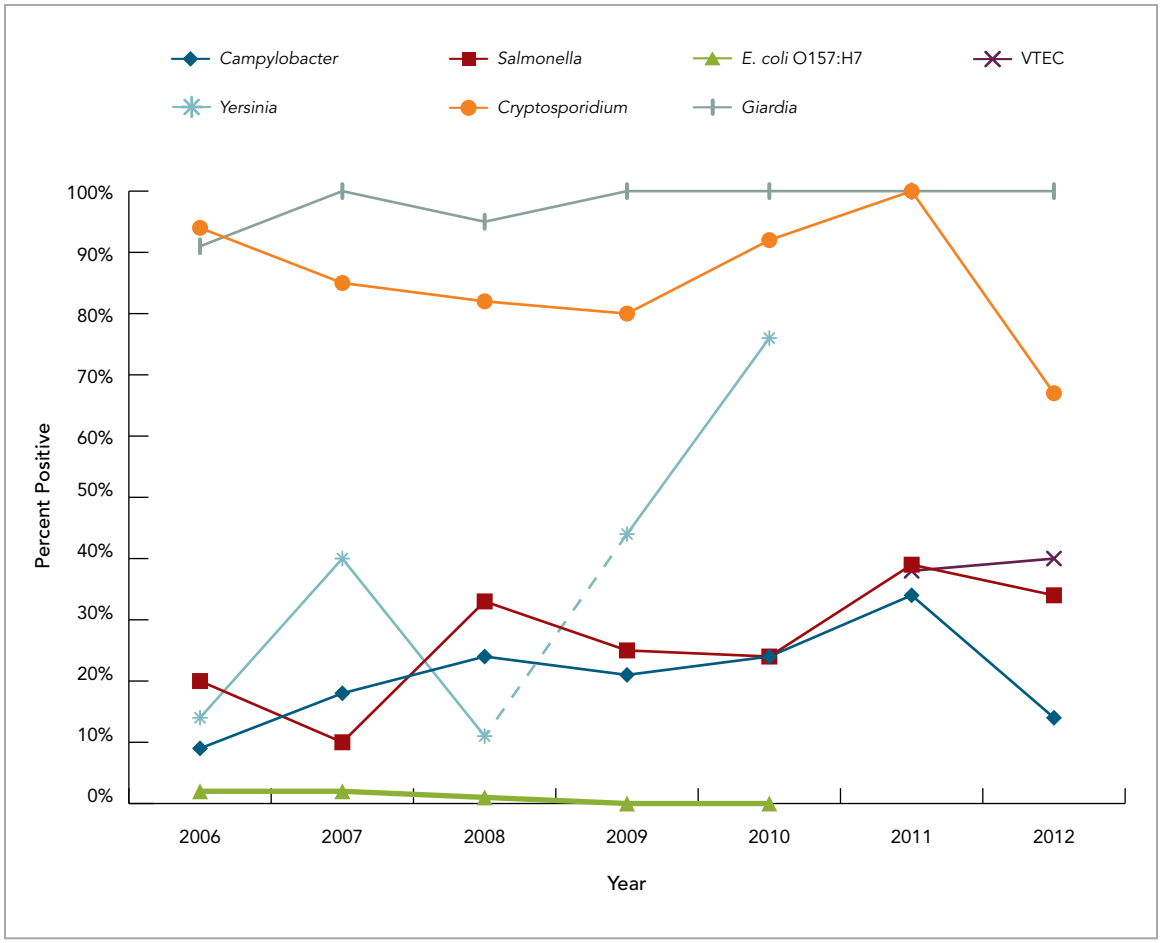
. Not tested, or insufficient data

[a] ON site only (allows year-to-year comparability since the pathogens were not tested in 2011 in BC).

[†] Reference group

[***] $P \leq 0.01$, [**] $0.01 < P \leq 0.05$, [*] $0.05 < P \leq 0.1$ indicate statistically significant estimates compared to the reference group (Fisher's exact test)

FIGURE 4: Proportion of positive untreated surface water (non-beach) samples tested in the ON site between 2006 and 2012 for select enteric pathogens



Note: Dashed lines indicate a change in laboratory detection method at some point during surveillance year(s).
Yersinia not tested after 2010.

SUMMARY

Following seven years of integrated surveillance, some general trends in exposures and diseases have been observed. These findings provide current information for consideration in the development of food safety policies in Canada.

At the farm level, it is relatively common to find enteric human pathogens in food-producing farm animal manure. For example, *Campylobacter* has been detected consistently in dairy, beef and swine manure though rarely in broiler chicken manure (Figure 3). *Salmonella* was commonly detected in broiler chicken farms and on swine manure.

Results also demonstrate that these pathogens, as well as verotoxigenic *E. coli*, are found in the surface waters (which are untreated) of the Ontario sentinel site (Figure 4), in both urban and rural sections of the watershed, and at local freshwater beaches. *Cryptosporidium* and *Giardia* were also found in a number of these areas. These results demonstrate that contact with the environment is a likely exposure route for human cases. However, this exposure route is still secondary to the food-borne route of transmission.

Retail level surveillance results from FoodNet Canada indicate that *Salmonella*, *Campylobacter* and *Listeria monocytogenes* are frequently found on retail chicken breasts (Figure 2) and in some cases more frequently on processed poultry products (Table 4). These could be potential areas of focus for food safety interventions.

Parasitic and viral pathogens were also detected on retail fresh herbs (all positives were imported). Though the viability/infectivity of these pathogens could not be determined with the PCR testing methods used, the test does indicate that viable pathogens could be on these products, suggesting that further monitoring is warranted.

In the human component, FoodNet Canada reports that both *Salmonella* and *Campylobacter* infections are consistently the top two bacterial pathogens causing human illness and that their rates of endemic infection remained elevated again in 2012 (Table 1). These results are in-line with the possible exposures observed from retail and environmental sources.