C-EnterNet

Short

REPORT

2007

Canada

To promote and protect the health of Canadians through leadership,
partnership, innovation and action in public health.

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Introduction

C-EnterNet is a multi-partner surveillance initiative facilitated by the Public Health Agency of Canada and funded primarily through Agriculture and Agri-Food Canada through the 2003-2008 Agricultural Policy Framework. C-EnterNet is based on a sentinel surveillance model to collect information on both cases of illness and sources of exposure within defined communities—an approach that would not be possible on a broader scale.

C-EnterNet's pilot 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. Four additional sites are planned to better estimate the burden of enteric disease in Canada in future years.

One of C-EnterNet's primary objectives is 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. To-date, C-EnterNet data need to be considered in the context of the pilot nature of this program. This report provides a summary of data from a pilot sentinel site and two sampling years, thus major conclusions cannot yet be extrapolated nationally.

New for the 2007 sampling year, C-EnterNet is releasing a short report of preliminary findings, to 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. The purpose of the short report is to present the main findings from the 2007 surveillance year in Sentinel Site 1 in a timely manner.

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

		2007		2006		Average 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)	(1990 - 2004)†
Total	Endemic	327		285		
	Travel	142		131		
	Outbreak	4		4		
Amoebiasis	Total		6.44		3.66	5.35
	Endemic	16	3.22	12	2.44	
	Travel	16	3.22	6	1.22	
Campylobacteriosis	Total		35.82		27.23	49.69
	Endemic	132	26.56	108	21.95	
	Travel	46	9.26	26	5.28	
Cryptosporidiosis	Total		3.82		4.27	2.98
	Endemic	12	2.41	15	3.05	
	Travel	7	1.41	6	1.22	
Cyclospora	Total		0.60		0.00	0.70
	Endemic	2	0.40	0	0.00	
	Travel	1	0.20	0	0.00	
Giardiasis	Total		10.26		13.61	31.87
	Endemic	28	5.63	35	7.11	
	Travel	22	4.43	32	6.50	
	Outbreak	1	0.20	0	0.00	
Listeriosis	Total		0.20		0.00	0.19
	Endemic	1	0.20	0	0.00	
	Travel	0	0.00	0	0.00	
Hepatitis A	Total		1.41		2.44	2.72
	Endemic	7	1.41	4	0.81	
	Travel	0	0.00	8	1.63	
Salmonellosis	Total		26.16		22.36	25.97
	Endemic	96	19.32	60	12.19	
	Travel	33	6.64	48	9.76	
	Outbreak	1	0.20	2	0.41	
Shigellosis	Total		2.21		1.22	2.83
	Endemic	2	0.40	3	0.61	
	Travel	9	1.81	3	0.61	
Verotoxigenic E. Coli (VTEC)	Total		3.82		7.11	5.86
	Endemic	14	2.82	32	6.50	
	Travel	3	0.60	1	0.20	
	Outbreak	2	0.40	2	0.41	
Yersiniosis	Total		4.43		3.45	3.11
	Endemic	17	3.42	16	3.25	
	Travel	5	1.01	1	0.20	

Cells shaded in yellow represent significant changes from 2006 to 2007(Mid-P Exact Test = 0.05)

* The Mid-P exact test can be considered as an alternative to the Fisher's exact test, as an approximation to the randomized test. Only half of the probability of the observed event is counted, therefore the mid-p value is always less than or equal to the conventional p-value.[1]

† Keegan, V. The epidemiology of enteric disease in C-EnterNet's pilot site, Waterloo, Ontario, 1990-2004. MSc thesis, University of Guelph, Guelph, ON; 2006.

[1] Lawal, H.B. Categorical Data Analysis with SAS and SPSS Applications. London: Lawrence Erlbaum, 2003.

C-EnterNet's human enteric samples are 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 improved 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[21].

In 2007, of the 473 reported cases of 11 bacterial, viral and parasitic enteric diseases in the Region of Waterloo, campylobacteriosis, salmonellosis and giardiasis were most common. One case of listeriosis and three cases of cyclosporiasis were reported in 2007, compared to 2006, where no cases of either disease were reported. Endemic VTEC infections decreased significantly from 2006 to 2007 and the total incidence rate is lower than historical levels reported in the Region of Waterloo. Endemic salmonellosis increased significantly since last year, but the total incidence rate of salmonellosis in 2007 is consistent with historical levels. The rates of campylobacteriosis and giardiasis have decreased in 2007 compared to historical levels. However, the rate of yersiniosis appears to be increasing from the past seventeen-year period.

Travel continues to be a significant factor in the burden of enteric disease. In 2007, 30% of all cases of enteric disease were associated with travel outside of Canada. There were no travel-related hepatitis A cases this year compared to the previous year (8 cases, of which the majority had reported travelling to Asia). The incidence of travel-related cases of campylobacteriosis significantly increased from 2006 to 2007, and the majority of cases in both years had reported travelling to Mexico or the Caribbean region. Similarly, the incidence of travel-related cases of amoebiasis significantly increased in 2007 compared to 2006, where the majority of cases in 2007 had reported travelling to Asia, Mexico and the Caribbean region compared to 2006, where all cases had reported travelling to Asia.

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

Retail Component

	2007			2006		
	Pork, n=187	**Chicken, n=187**	**Beef, n=187**	**Pork, n=140**	**Chicken, n=145**	**Beef, n=139**
Campylobacter	2% (3)	29% (55)	1% (1)	0%	31% (45)	0%
Salmonella	3% (6)	33% (61)	1% (1)	3% (4)	30% (43)	1% (1)
VTEC	0%	0%	1% (2)	0%	0%	0%
Yersinia spp	5% (9)	Not tested	Not tested	13% (18)	Not tested	Not tested
Listeria monocytogenes	12% (22)*	36% (68)*	25% (46)*	9% (12)	32% (46)	24% (33)

Cells shaded in yellow represent significant changes from 2006 to 2007(Exact Fisher Test alpha=0.05)

Retail meat continues to be a stable and significant exposure source for enteric pathogens. Since mid-2005, C-EnterNet has systematically sampled fresh raw pork, chicken and beef from randomly selected grocery stores within the sentinel site on a weekly basis. In 2007, the levels of pathogen contamination on retail raw meat were quite similar to what was found in 2006, with the exception of a decrease in *Yersinia* contamination on pork. Raw chicken remains the commodity most frequently contaminated with *Salmonella* and *Campylobacter*. Unlike 2006, Verotoxogenic *E. coli* was detected on 2 ground beef samples in 2007.

Agriculture Component

Sample prevalence	2007				2006	
	Swine	**Dairy**	**Beef**	**Broiler chickens**	**Swine**	**Dairy**
	120 samples	112 samples	80 samples	36 samples	120 samples	179 samples
Campylobacter	10% (12)	21% (23)	13% (10)	0%	13% (15)	25% (44)
Salmonella	33% (40)	13% (14)	10% (8)	72% (26)	28% (33)	11% (20)
E. coli O157:H7	0%	5% (6)	9% (7)	0%	0%	9% (16)
Yersinia spp	3% (4)	Not tested	Not tested	Not tested	8% (10)	Not tested
Listeria monocytogenes	Not tested	Not tested	64% (51)	3% (1)	3% (1)	9% (15)

Farm prevalence	2007				2006	
	Swine	**Dairy**	**Beef**	**Broiler chickens**	**Swine**	**Dairy**
	30 farms	28 farms	21 farms	9 farms	30 farms	45 farms
Campylobacter	40% (12)	40% (11)	33% (7)	0%	40% (12)	60% (27)
Salmonella	60% (18)	21% (6)	14% (3)	89% (8)	60% (18)	22% (10)
E. coli O157:H7	0%	21% (6)	24% (5)	0%	0%	29% (13)
Yersinia spp	13% (4)	Not tested	Not tested	Not tested	30% (9)	Not tested
Listeria monocytogenes	Not tested	Not tested	95% (20)	1% (1)	3% (1)	9% (15)

Detection of enteric pathogens on farms represents an environmental exposure source. C-EnterNet on-farm sampling began in 2005 with the enrolment and sampling of swine operations in Sentinel Site 1. Sampling on dairy operations started in early 2006, beef sampling was initiated in February 2007 and broiler chicken farm sampling started in October 2007. 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 fresh pooled manure from 3 age groups of animals and stored manure.

Results are presented at the sample level and at the farm level, to account for within-farm similarities. In 2007, the same 30 swine farms were enrolled and sampled as in 2006. In contrast, 10 of the 45 dairy farms from 2006 were re-sampled in 2007. No significant differences were found between 2006 and 2007 at the farm level.

Salmonella was most frequently detected on swine and broiler chicken farms (at the farm and sample level). *Campylobacter* was frequently detected (at both the farm and sample level) in swine, dairy and beef farms, though has not been detected to-date on the broiler chicken farms. *E. coli* O157:H7 was detected on both dairy and beef farms.

Water Component

Culture Method

	2007						2006					
	All Sites	A	B	C	D	E	All Sites	A	B	C	D	E
Campylobacter	20% (26/135)	26% (7/27)	11% (3/27)	41% (11/27)	19% (5/27)	0% (0/27)	9% (13/140)	18% (5/28)	4% (1/28)	14% (4/28)	11% (3/28)	0% (0/28)
Salmonella	10% (13/135)	4% (1/27)	7% (2/27)	7% (2/27)	4% (1/27)	26% (7/27)	20% (28/140)	21% (6/28)	21% (6/28)	18% (5/28)	29% (8/28)	11% (3/28)
E. coli O157:H7	2% (3/135)	7% (2/27)	0% (0/27)	0% (0/27)	0% (0/27)	4% (1/27)	1% (1/124)	0% (0/24)	0% (0/24)	4% (1/24)	0% (0/24)	0% (0/24)
Yersinia spp	40% (54/135)	37% (10/27)	37% (10/27)	56% (15/27)	30% (8/27)	41% (11/27)	14% (15/105)	19% (4/21)	19% (4/21)	14% (3/21)	10% (2/21)	10% (2/21)
Cryptosporidium	85% (35/41)	100% (3/3)	100% (3/3)	67% (2/3)	80% (22/27)	100% (5/5)	94% (33/35)	—	—	100% (3/3)	93% (27/29)	100% (3/3)
Giardia	100% (41/41)	100% (3/3)	100% (3/3)	100% (2/2)	100% (27/27)	100% (5/5)	97% (34/35)	—	—	67% (2/3)	93% (27/29)	100% (3/3)

Molecular Method

	2007						2006					
	All Sites	A	B	C	D	E	All Sites	A	B	C	D	E
Campylobacter	93% (100/108)	100% (21/21)	86% (18/21)	91% (20/22)	95% (21/22)	86% (19/22)	56% (78/140)	75% (21/28)	32% (9/28)	71% (20/28)	43% (12/28)	57% (16/28)
Salmonella	36% (43/119)	17% (4/24)	43% (10/23)	29% (7/24)	29% (7/24)	58% (14/24)	17% (24/140)	18% (5/28)	18% (5/28)	7% (2/28)	14% (4/28)	29% (8/28)
E. coli O157:H7	25% (30/119)	13% (3/24)	9% (2/23)	8% (2/24)	25% (6/24)	67% (16/24)	25% (35/140)	32% (9/28)	7% (2/28)	11% (3/28)	14% (4/28)	61% (17/28)
Yersinia spp [a]	59% (46/78)	69% (11/16)	47% (7/15)	69% (11/16)	86% (12/14)	29% (5/17)	39% (54/140)	50% (14/28)	25% (7/28)	50% (14/28)	25% (7/28)	43% (12/28)

Cells shaded in yellow represent significant changes from 2006 to 2007 (Exact Fisher Test alpha = 0.05)

[a] — incomplete data, some samples being retested

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

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Water Component – *continued*

Since 2005, five sites along the Grand River have been sampled for exposure surveillance within the C-EnterNet sentinel site, to understand the dynamics of pathogen levels in the environment and the transmission of enteric pathogens from both point and non-point sources within the watershed. After two full years of sampling, we have separated the results based on sample collection point.

Campylobacter and *Yersinia* prevalence (by culture) increased in 2007, though *Salmonella* prevalence (by culture) decreased. Pathogenic *E.coli* detection (by both culture and molecular methods) in river samples continues to be low, and it is still unclear if this is due to low levels or inadequate methodology (or a combination of both). While detection of *Yersinia* increased in 2007, to-date no human pathogenic strains of *Y. enterocolitica* have been detected in the river. *Cryptosporidium* and *Giardia* are consistently being detected at all five sample points in the river and is thus an important consideration for water treatment plant operators in the watershed.

Conversely, molecular-based detection of *Salmonella* spp. and *Yersinia* spp. increased in 2007. There are no distinct differences between the five sample sites when evaluating the culture results, although molecular results suggest that one point (E) consistently has higher levels of *Campylobacter*, *Salmonella* and pathogenic *E. coli*. Because molecular detection does not differentiate between viable and non-viable cells, we are likely detecting both live and dead cells. Parallel culture and molecular testing helps to highlight the potential public health risks from environmental matrices that are traditionally difficult to monitor.