

National Enteric Surveillance Program (NESP)

ANNUAL SUMMARY 2011

**Including Serotype and Phage Type Tables for
2011, NESP and NML**

**The National Microbiology Laboratory (NML) and
Centre for Food-borne, Environmental and Zoonotic Infectious
Diseases (CFEZID), Public Health Agency of Canada**

And

Provincial Public Health Microbiology Laboratories



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Executive Summary

The National Enteric Surveillance Program (NESP) is designed to provide weekly analysis and reporting for laboratory-confirmed isolations of enteric pathogens in Canada, including bacterial, viral and parasitic pathogens. This is an annual summary of data submitted to NESP by provincial/territorial microbiology laboratories in 2011. It is important to note that for some of the pathogens the isolates reported in NESP is only a subset of laboratory isolations within the province and may not reflect the incidence of disease either provincially or nationally.

There were no notable changes in the NESP program or data collection processes in 2011. *Salmonella* continued to be the most common pathogen reported to NESP in 2011, with *S. Enteritidis* being the most common serovar. The number of *E. coli* O157 isolates reported showed a significant decline over the past 5 years. There were slight increases in the number of *Shigella sonnei* and *E. coli* O157 cases reported in 2011 compared to the previous year.

The report includes reference tables with a complete list of species and serotype data reported to NESP and phage types of isolates reported in 2011 at the National Microbiology Laboratory (NML).

This report also summarizes the extra-intestinal isolation sites and travel-associated infections reported through NESP. The majority of enteric pathogens reported, with the exception of *L. monocytogenes*, were isolated from faecal matter. However, a considerable number of bacterial pathogens were isolated from extra-intestinal sites, the most common sites reported being blood and urine. For *L. monocytogenes*, NESP only collects data on isolates from sterile sites, consistent with the national case definition. Although travel history is largely under-reported in NESP, 189 enteric infections were identified as associated with international travel. Parasitic infections were the most common followed by salmonellosis. The Caribbean was the most frequent destination identified by travellers with travel-associated enteric infections.

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Introduction

The National Enteric Surveillance Program (NESP) is designed to provide timely analysis and reporting for laboratory-confirmed isolations of enteric pathogens in Canada, including bacterial, viral and parasitic pathogens. In collaboration with related programs such as PulseNet Canada, NESP supports the real-time detection and response to emerging and priority diseases, and is integrated with international efforts to monitor and limit the spread of pathogenic micro-organisms.

NESP is based on the collection of weekly aggregate laboratory data from across Canada, as submitted by the provincial public health microbiology laboratories to the National Microbiology Laboratory (NML) at the Public Health Agency of Canada (PHAC). Laboratories submit genus, species and serotype information on enteric microorganisms isolated from human patients. Data are submitted to the NML either directly or using a web-based application through the Canadian Network for Public Health Intelligence (CNPHI). Compilation and analysis of these weekly data is conducted jointly between the NML and the Centre for Food-borne, Environmental and Zoonotic Infectious Diseases (CFEZID) and a weekly report is produced. The report alerts provincial/territorial and federal partners to significant increases in the number of cases of enteric illness. To support communication of laboratory surveillance findings, the on-line webNESP application of CNPHI allows partners to perform real-time data analysis, trending and display of their data. PulseNet¹ Canada then utilizes these data in conjunction with laboratory DNA fingerprint data to detect disease clusters and outbreaks, and the resulting data analyses are shared on CNPHI's Canadian Laboratory Surveillance Network (CLSN) between provincial public health microbiology laboratories, the Canadian Food Inspection Agency, Health Canada, and PHAC. Notably, the coordinated assessment of laboratory evidence collected through these two complementary laboratory surveillance networks allows for the interpretation of clinical microbiological evidence during multi-jurisdictional epidemiologic investigations, as prescribed in the *Food-borne Illness Outbreak Response Protocol* (FIORP)².

This annual report is a summary of the weekly data from all provincial public health microbiology laboratories, and is being produced so that longer term national trends on the incidence of enteric pathogens in Canada can be analyzed. For some organisms the number of isolates reported to NESP is only **a subset of laboratory isolations within the province and may not reflect the incidence of disease either provincially or nationally**. However, within each disease group, the data may indicate event-related changes in reported trends.

¹ PulseNet Canada, National Microbiology Laboratory, Public Health Agency of Canada: <http://www.nml-lnm.gc.ca/Pulsenet/index-eng.htm>

² Food-borne Illness Outbreak Response Protocol (FIORP) 2010: To guide a multi-jurisdictional response. Public Health Agency of Canada: <http://www.phac-aspc.gc.ca/zoono/fiorp-pritioa/index-eng.php>

The Canadian Notifiable Diseases Surveillance System (CNDSS) receives data that are collected on a mandatory basis by local health units, forwarded to provincial/territorial health authorities and collated by the Surveillance and Risk Assessment Division, Centre for Communicable Diseases and Infection Control, PHAC. These data may be more reliable for total number of illnesses however the CNDSS is not designed to provide timely information required for cluster or outbreak detection. These surveillance systems are complementary in providing both epidemiological and laboratory results; however discrepancies between them do exist.

Data Collection and Analysis:

Provincial public health laboratories receive isolates (or specimens) with accompanying submission forms. Laboratory personnel at each provincial laboratory perform appropriate tests to confirm the identification or subtyping of the enteric pathogen. Weekly results are summarized onto a NESP report form. The 'report week' for NESP is Sunday to Saturday and is based on the date the laboratory test was completed. The completed NESP report form is faxed or e-mailed to the NML as soon as possible and no later than the second day after a weekend or holiday. An exception to this reporting scheme occurs when the isolate must be sent to another laboratory for completion of the identification. In this case, the isolate is reported at the level of typing or identification attained (e.g. *Salmonella* sp.) for the week in which it was sent to the reference laboratory. The NESP record is then updated when the final identification is received from the reference laboratory (e.g. report in week 35 that one *Salmonella* sp. reported in week 33 has been confirmed as *S. Anatum*). This updated information is submitted with the next weekly NESP report form.

All data sent to NESP are aggregate and anonymous. NESP partners endeavour to include only the number of isolates from new cases identified at the laboratory that week or updates to previously reported numbers. The provincial laboratory will attempt to identify multiple, repeat or follow-up specimens from the same individual and will consider all identical isolates from the same patient that are collected over a 3-month period as a single case.

With respect to data analysis, NESP uses an algorithm to determine whether case counts are significantly higher than expected. The cumulative Poisson probability between the reported case count and the 5-year median value is used to determine statistical significance.

The NESP Weekly Report is sent to all provincial laboratories, at least one epidemiologist or Medical Officer of Health in each province and multiple stakeholders at the federal level. The reports may be shared with other public health professionals, but are not for public distribution. There is no required response by public health professionals to the events or statistical elevations noted in the reports.

Although there is no mandatory response for provincial or local public health authorities, these reports aim to provide useful and timely information for those responsible for public health action, and they have been used by PHAC, in collaboration with public health partners in provinces, to trigger public health action including OICCs.

Limitations:

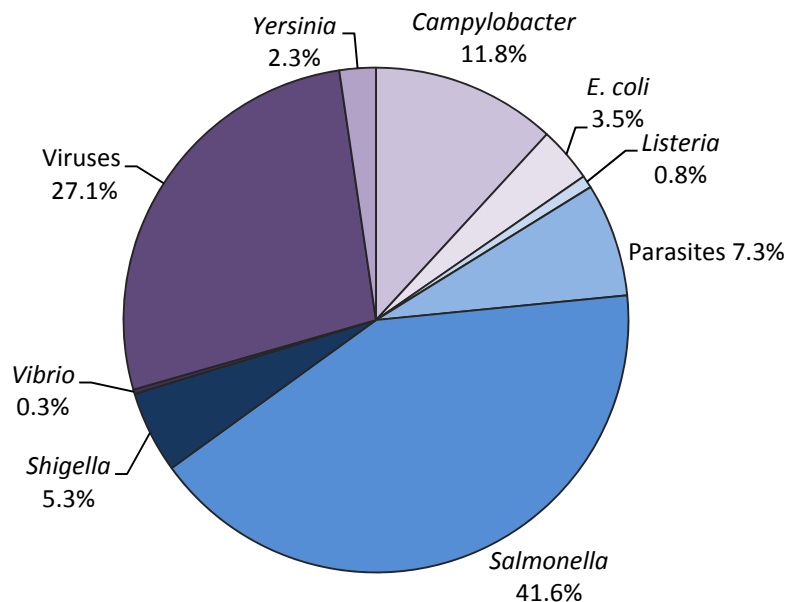
It should be noted that there are some inherent limitations of these data. Not all specimens/isolates are referred from the regional and local laboratories to the provincial public health laboratories and therefore the provincial reports and NESP data may be an under-representation of the true incidence of disease in Canada. For example, *Campylobacter* isolates are not routinely forwarded to provincial or central reference laboratories for further testing beyond genus/species characterizations and are therefore greatly under-represented in NESP. However, *Salmonella* and *E. coli* O157 isolates captured by NESP are more representative of the true incidence of disease in Canada, as the number of cases reported to CNDSS and isolates reported to NESP show a high degree of concurrence for both diseases. In some cases, there may be over-reporting of organisms in NESP due to reporting of multiple specimens from a single patient, but efforts are made to keep this to a minimum. Information regarding extra-intestinal isolation sites, foreign travel, and outbreaks and case clusters are not routinely or consistently reported to NESP from all laboratories and therefore any interpretation should be considered with caution. Outbreaks and clusters reported to NESP do not represent all enteric illness outbreaks identified nationally nor are the case counts reported to NESP representative of the actual final number of cases that may have been associated with the outbreaks and clusters. Therefore, details regarding outbreaks and case clusters are not included in this report; these are more accurately tracked within PulseNet Canada or through other systems.

Isolates Reported by Major Organism Group

NESP collects information on several bacterial, viral and parasitic enteric pathogens. The most frequent enteric pathogens reported in 2011 were *Salmonella* spp. followed by the enteric viruses (Norovirus, Rotavirus and Adenovirus) and *Campylobacter* spp. (Figure 1). As mentioned previously, this does not reflect national incidence rates but rather testing and reporting practices within the provincial laboratories.

A total of 16 378 enteric pathogens were reported to NESP in 2011. The number of cases reported per province and territory for each major organism group is shown in Table 1. A complete list of all organisms reported per province and territory is in Appendix 1.

Figure 1. Proportion of isolates reported to NESP attributed to each major organism group, 2011 (n=16,378)*



**Campylobacter*, Parasitic (*Giardia*, *Cryptosporidium*, *Entamoeba histolytica/dispar* and *Cyclospora*) and viral infections (Norovirus, Rotavirus and Adenovirus) are not routinely reported to the provincial or central reference laboratories and are greatly under-represented in NESP.

Table 1. Number of isolates reported to NESP by major organism group per Province/Territory, 2011

Group	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>Campylobacter</i> *	489	334	181	147	310	131	167	86	36	52	1	2	2	1938
<i>E. coli</i> [†]	92	73	7	58	227	77	7	17	16	5		1		580
<i>Listeria</i>	17	2		4	55	46	3	5						132
Parasites*	195	29	112	119	278	223	98	73	15	48				1190
<i>Salmonella</i>	1158	960	183	213	2739	1081	156	179	22	69	7	14	28	6809
<i>Shigella</i>	158	209	120	35	240	83	3	12						860
<i>Vibrio</i>	14	8	1	1	7	8	5	1	2					47
Viruses*	473	453	568	154	1383	744	273	142	161	85		4	1	4441
<i>Yersinia</i>	68	55	28	9	195	21	5							381
Total	2664	2123	1200	740	5434	2414	717	515	252	259	8	21	31	16378

**Campylobacter*, Parasitic (*Giardia*, *Cryptosporidium*, *Entamoeba histolytica/dispar* and *Cyclospora*) and viral infections (Norovirus, Rotavirus and Adenovirus) are not routinely reported to the provincial or central reference laboratories and are greatly under-represented in NESP.

[†]*E. coli* includes O157 serotype (482 cases) and non-O157 or non-typed serotypes (98 cases).

National incidence rates of the major organism groups over the last six years are shown in Table 2.

Rates are based on the number of isolates reported to NESP each year. Due to the nature of NESP reporting practices, the number of isolates reported for some pathogens are considered to be an underestimate of the true number of isolates; this is especially true for *Campylobacter*, parasites and enteric viruses. As a result, NESP incidence rates for these pathogens are difficult to interpret and changes in these rates may not be due to actual changes in disease rates.

Table 2. Annual national totals and rates (per 100,000) for major organism groups reported to NESP, 2006 to 2011[†]

Group	2006		2007		2008		2009		2010		2011	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate
<i>Campylobacter</i> *	1958	5.99	1959	5.93	1614	4.83	1751	5.17	1837	5.36	1938	5.60
<i>E. coli</i> O157 [‡]	978	2.99	934	2.83	661	1.98	529	1.56	404	1.18	482	1.39
<i>Listeria</i>											132	0.38
Parasites*	1705	5.22	1678	5.08	1783	5.33	1570	4.64	1585	4.63	1190	3.44
<i>Salmonella</i>	5724	17.51	6419	19.42	6351	18.99	6084	17.97	7251	21.17	6809	19.68
<i>Shigella</i>	526	1.61	636	1.92	680	2.03	631	1.86	739	2.16	860	2.49
<i>Vibrio</i>	43	0.13	37	0.11	39	0.12	47	0.14	51	0.15	47	0.14
Viruses*	4057	12.41	4657	14.09	3248	9.71	3184	9.40	4662	13.61	4441	12.83
<i>Yersinia</i>	578	1.77	488	1.48	414	1.24	382	1.13	341	1.00	381	1.10
Total	15569		16808		14790		14178		16870		16280	

[†]Rates calculated using the population estimates for Canada as of July 1 for years 2006 to 2011 as reported by Statistics Canada.

**Campylobacter*, Parasitic (*Giardia*, *Cryptosporidium*, *Entamoeba histolytica/dispar* and *Cyclospora*) and viral infections (Norovirus, Rotavirus and Adenovirus) are not routinely reported to the provincial or central reference laboratories and are greatly under-represented in NESP.

[‡]Only cases of *E. coli* O157 are included in this table, as *E. coli* non-O157 is not consistently reported by provinces.

Conversely, isolates of organisms such as *E. coli* O157, *Listeria*, *Salmonella* and *Shigella* are routinely forwarded to provincial microbiology laboratories, and as such NESP incidence rates are considered to be reflective of true incidence rates for these pathogens. The provincial and territorial incidence rates for these organisms are shown in Table 3. Five-year trends in the national incidence rate for *Salmonella*, *Shigella* and *E. coli* O157 are shown in Figure 2.

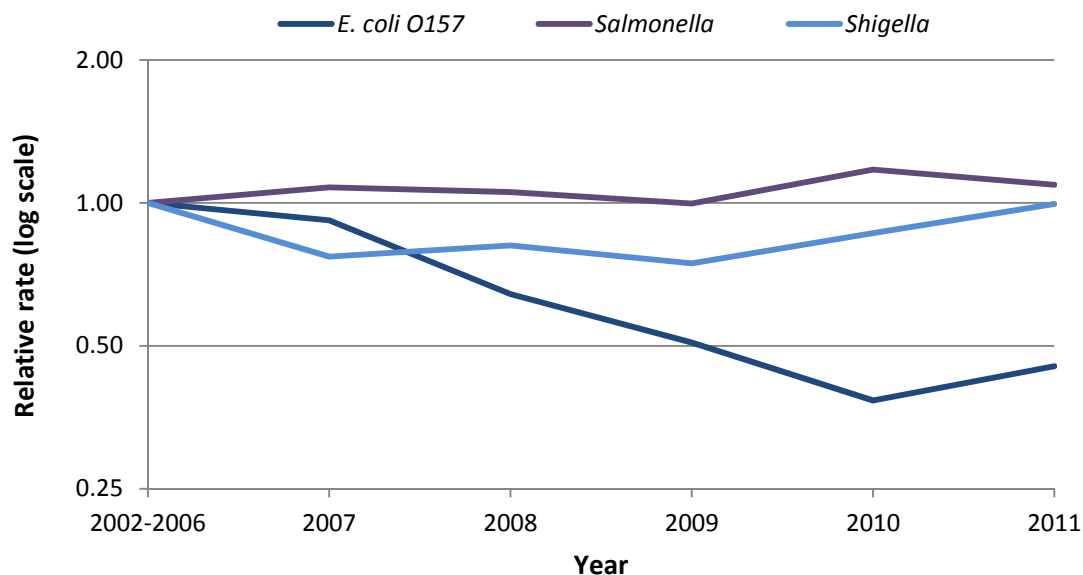
Table 3. Rates (per 100,000) per province/territory for select major organism groups reported to NESP, 2011[†]

Group	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Nat'l
<i>E. coli</i> O157	0.89	1.90	0.66	2.07	1.62	0.91	0.93	1.80	10.95	0.78	-	2.30	-	1.39
<i>Listeria</i>	0.37	0.05	-	0.32	0.41	0.57	0.40	0.53	-	-	-	-	-	0.38
<i>Salmonella</i>	25.22	25.27	17.21	16.98	20.41	13.51	20.64	18.91	15.05	13.50	20.06	32.20	84.01	19.68
<i>Shigella</i>	3.44	5.50	11.28	2.79	1.79	1.04	0.40	1.27	-	-	-	-	-	2.49

[†]Rates calculated using updated postcensal population estimates for Canada, the provinces and the territories as of July 1, 2011 from Statistics Canada.

[‡]Only cases of *E. coli* O157 are included in this table, as *E. coli* non-O157 are not consistently reported by provinces

Figure 2. Relative national incidence rates* of lab-confirmed cases of *Salmonella*, *Shigella* and *E. coli* O157 reported to NESP by year, 2007 to 2011

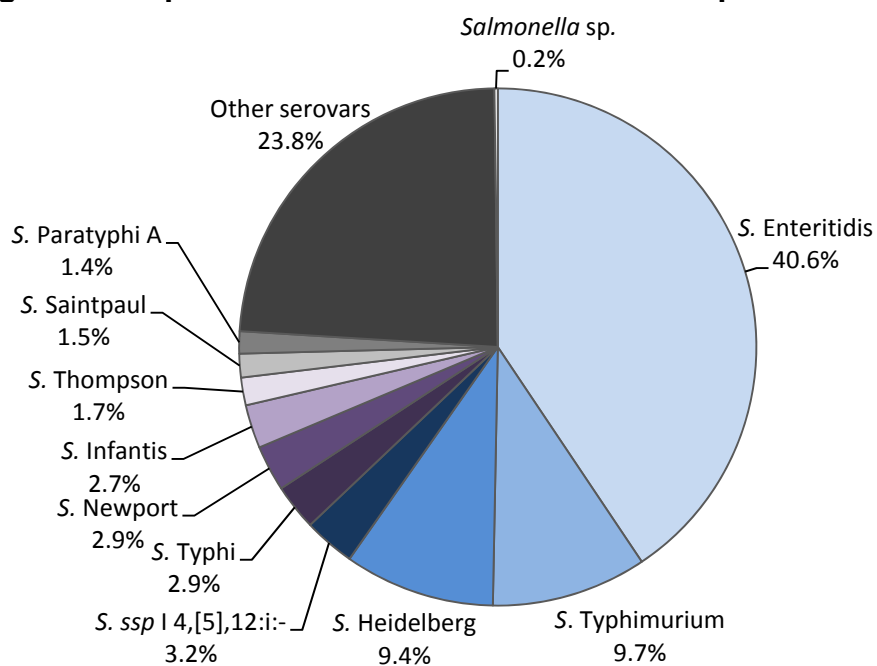


*rates are compared to the 2002-2006 baseline period

Salmonella

A total of 6809 *Salmonella* isolates and 247 different serovars were reported to NESP in 2011. The 10 most commonly reported *Salmonella* serovars accounted for 76% of the total *Salmonella* infections reported (Figure 3). The total numbers of isolates identified in each province and territory of the 10 most commonly reported *Salmonella* serovars nationally are listed in Table 4, while a full list of the number of *Salmonella* serovars reported to NESP by each province and territory in 2011 is presented in Appendix 1.

Figure 3. Proportion of *Salmonella* serovars as reported to NESP, 2011 (n=6809)



*Other serovars (1636 isolates) were divided among 236 serovars and 14 isolates were reported as unspecified *Salmonella* species.

Table 4. Number of isolates reported to NESP per province and territory of the ten most commonly reported *Salmonella* serovars nationally, 2011

Serovar	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YK	NT	NU	Total
Enteritidis	588	493	70	74	933	408	48	15	93	26	2	4	10	2764
Typhimurium	79	79	23	18	295	133	16	-	7	9	2	-	-	661
Heidelberg	51	48	11	24	271	143	41	3	22	15	-	7	5	641
ssp I 4,[5],12:i:-	26	52	15	13	62	46	3	-	-	-	-	-	1	218
Typhi	40	16	3	12	104	18	-	-	-	3	-	-	-	196
Newport	16	20	2	3	102	42	3	-	5	2	-	-	-	195
Infantis	33	14	4	4	80	26	16	-	6	.	-	2	-	185
Thompson	6	6	2	1	88	11	-	1	2	1	-	-	-	118
Saintpaul	12	15	4	7	34	14	1	-	3	-	-	-	11	101
Paratyphi A	30	9	1	2	48	3	-	-	1	-	-	-	-	94
Top Ten Total	881	752	135	158	2017	844	128	19	139	56	4	13	27	5173

The ranking among the three most commonly reported *Salmonella* serovars remained unchanged from the previous seven years, with *S. Enteritidis* being the most frequently reported, followed by *S. Typhimurium* and *S. Heidelberg* (Table 5).

In 2011, several multi-provincial increases in specific *Salmonella* serovars were noted in NESP. These increases were often highlighted as the topic of the week in the weekly NESP report and serve as a trigger for further follow-up which may lead to the detection of multi-jurisdictional outbreaks. For example, multi-jurisdictional increases in *S. Kingabwa* and *S. Newport* noted in NESP lead to the activation of an Outbreak Investigation Co-ordinating Committee (OICC), as described in FIORP, to facilitate federal and provincial collaboration in investigating the outbreaks. The Outbreak Management Division of PHAC led and coordinated these investigations.

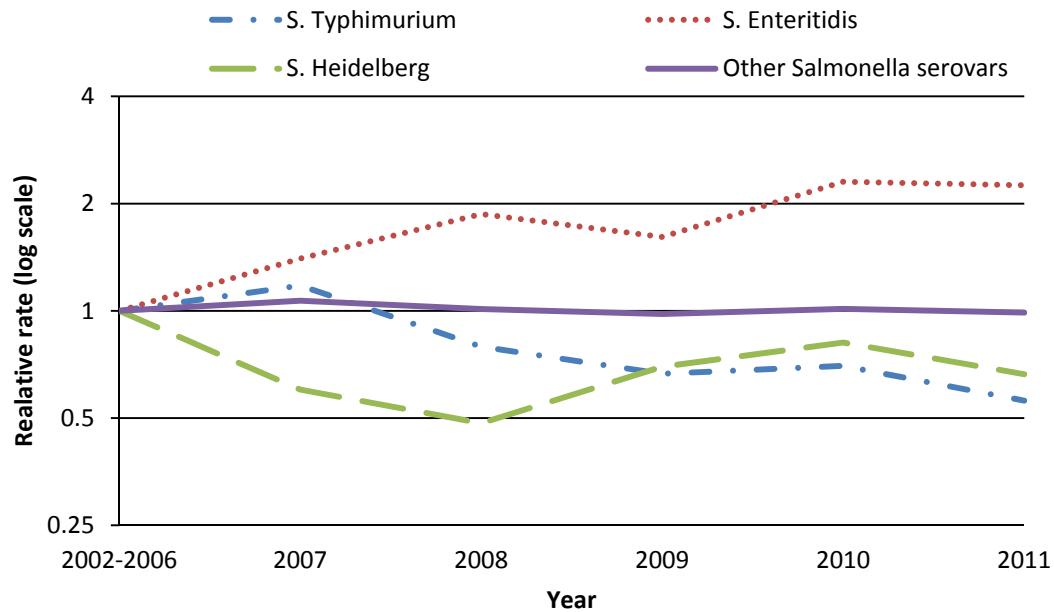
Table 5. National totals (overall rank) for the ten most commonly reported *Salmonella* serovars as reported to NESP, 2005 to 2011

Species	2006	2007	2008	2009	2010	2011
Enteritidis	1338 (1)	1661 (1)	2239 (1)	1955 (1)	2827 (1)	2764 (1)
Typhimurium	998 (2)	1341 (2)	914 (2)	777 (2)	827 (2)	661 (2)
Heidelberg	696 (3)	560 (3)	456 (3)	665 (3)	787 (3)	641 (3)
ssp I 4,[5],12:i:-	109 (9)	184 (4)	180 (6)	271 (4)	278 (4)	218 (4)
Typhi	177 (4)	158 (6)	192 (4)	164 (5)	180 (5)	196 (5)
Newport	145 (7)	142 (9)	185 (5)	133 (6)	146 (6)	195 (6)
Infantis	81	131 (10)	119 (8)	110 (8)	106 (8)	185 (7)
Thompson	171 (5)	173 (5)	130 (7)	99	107 (7)	118 (8)
Saintpaul	166 (6)	123	92	130 (7)	88	101 (9)
Paratyphi A	132 (8)	94	109 (10)	92	91	94 (10)
Oranienburg	67	145 (7)	45	53	104 (9)	52
Hadar	107 (10)	144 (8)	113 (9)	100 (10)	95 (10)	75
Javiana	49	49	66	102 (9)	90	77

Continued Prevalence of *S. Enteritidis*

In 2011, 2764 *S. Enteritidis* isolates were reported to NESP, a slight decrease over the previous year. However, *S. Enteritidis* remained the most prevalent cause of human salmonellosis in Canada representing approximately 41% of all human *Salmonella* isolates reported in 2011. The proportion of salmonellosis cases attributed to *S. Enteritidis* has been steadily increasing over time (with the exception of 2011 where it remained similar to 2010) The incidence rate doubled from the baseline period (2002-2006) to 2011 (Figure 4) whereas the incidence of *S. Typhimurium* and *S. Heidelberg* decreased over the same time period. The continual increase in the rate of *S. Enteritidis* infections in numerous provinces has prompted investigations and enhanced surveillance activities in many provinces in collaboration with animal health and food safety partners.

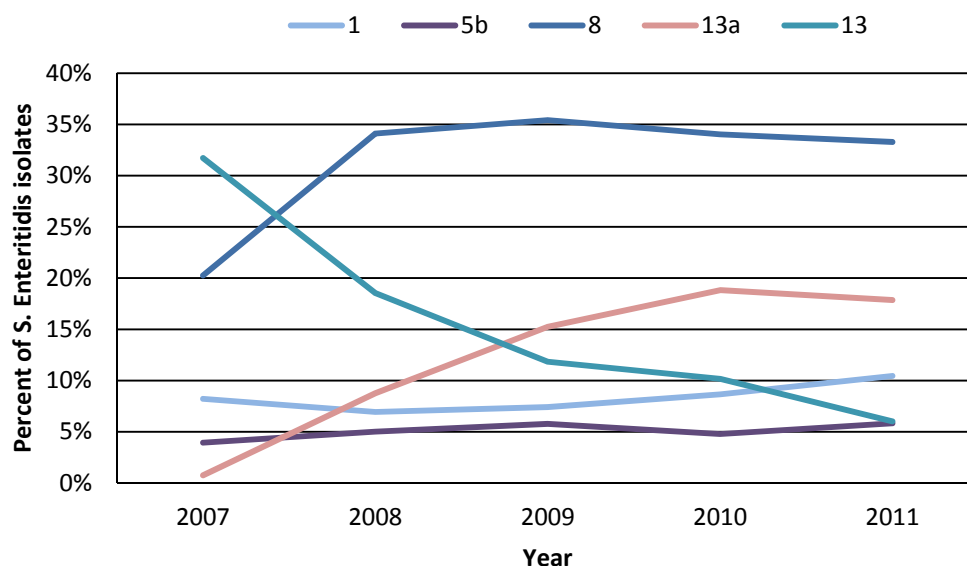
Figure 4. Relative incidence rates* of *S. Enteritidis*, *S. Heidelberg*, *S. Typhimurium* and other *Salmonella* serovars reported to NESP by year, 2007 to 2011



*rates are compared to the 2002-2006 baseline period

Phage typing is commonly used to detect changing trends in *S. Enteritidis*. The last five years has seen the emergence of phage type 13a and an increase in phage type 8 (Figure 5). A complete list of all *Salmonella* phage types reported by NML in 2011 are listed in Appendix 2.

Figure 5. Proportion of *S. Enteritidis* isolates reported for the five most common phage types of *S. Enteritidis*, 2007 to 2011

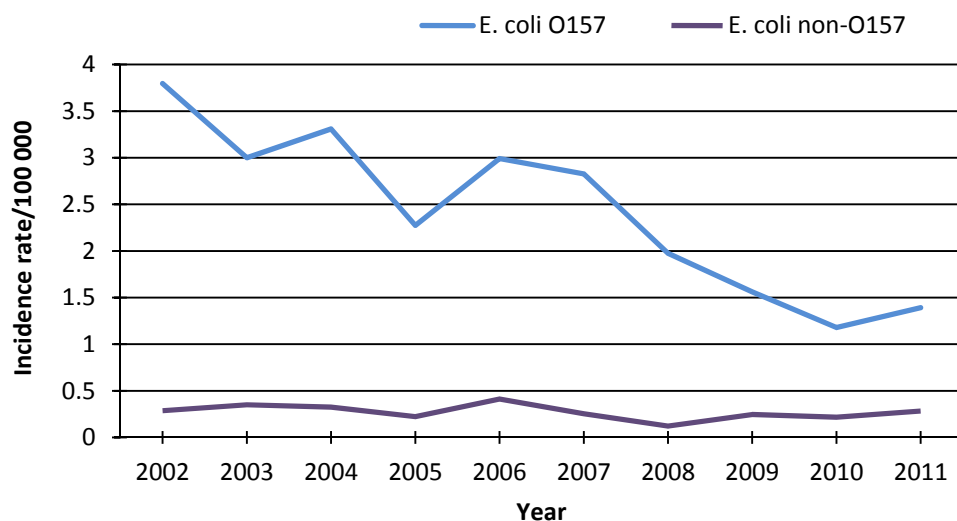


E. coli

One significant trend observed in NESP is the decline in cases of *E. coli* O157 VTEC (Figure 6). The incidence rate has decreased from 3.00 cases per 100 000 in 2006 to 1.18 cases per 100 000 in 2010; the incidence rate increased slightly to 1.39 in 2011. The increase observed in 2011, may be partially attributed to 4 multi-jurisdictional outbreaks, with a total of 30 cases, collaboratively investigated by federal and provincial partners through an activated OICC as described in FIORP. The Outbreak Management Division of PHAC lead and coordinated these investigations. For three out of the four *E. coli* OICC a food product was identified associated with illness, these items were veal liver, walnuts and hazelnuts. There were also several provincial *E. coli* O157 outbreaks in 2011.

The national incidence rate of *E. coli* non-O157 reported to NESP has shown little change over the past ten years (0.12/100 000 to 0.41/100 000). It should be noted that *E. coli* non-O157 are reported less consistently than *E. coli* O157 to NESP by the provincial laboratories and that the specific serotype of *E. coli* non-O157 isolates is not often reported. The limited *E. coli* serotype data available through NESP are presented in Appendix 1, however, serotype information is also available for the confirmed non-O157, Shiga toxin-producing isolates sent to the NML in 2011 (Appendix 3).

Figure 6. Incidence rate of *E. coli* O157 VTEC and *E. coli* non-O157 (including untyped organisms) serotypes reported to NESP, 2002 to 2011



Listeria monocytogenes

In July 2010, the list of organisms included in NESP was expanded to include *L. monocytogenes*. This addition was designed to provide increased national surveillance of invasive listeriosis. This year, 2011, represents the first full calendar year of data collection on invasive listeriosis (Figure 7). A total of 132 isolates were reported in 2011 with a median of 2 isolates reported nationally per week, although there may be seasonal variation in the distribution of *L. monocytogenes*. This is consistent with case data provided by provincial ministries of health from previous years, which indicate that 100 to 140 cases would be expected nationally per year. The breakdown of the total isolates reported by each province/territory is shown in Table 1. Serotyping is performed on *L. monocytogenes* isolates sent to the NML, Table 6 has a summary of the serotypes identified in 2011.

Figure 7. Number of isolates of invasive *L. monocytogenes* reported to NESP per month, 2011

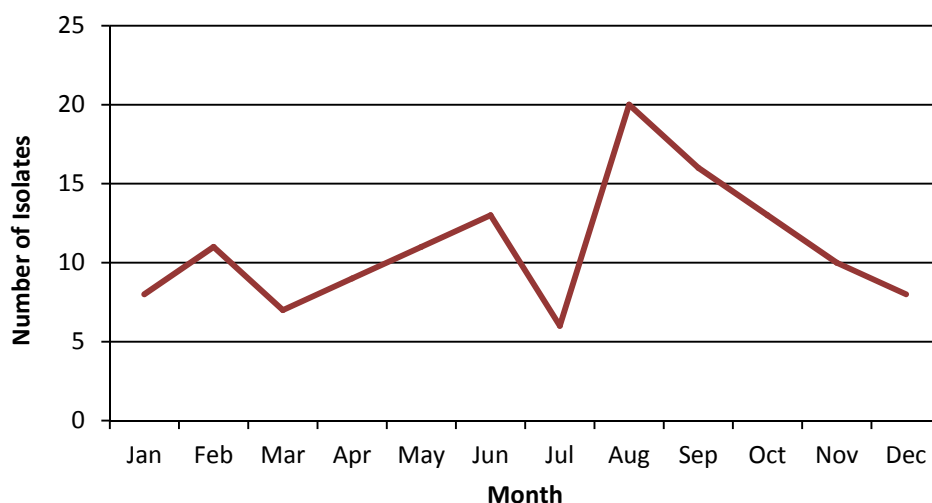


Table 6. Serotype of *L. monocytogenes* isolates reported in 2011, National Microbiology Laboratory.

Serotype	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
1/2a	9	1	-	4	14	-	3	-	3	-	34
1/2b	-	-	-	-	6	-	-	-	-	-	6
1/2c	-	-	-	-	1	-	-	-	-	-	1
4a	-	-	-	-	1	-	-	-	1	-	2
4b	8	1	-	1	26	-	1	-	1	-	38
4e	-	-	-	-	1	-	-	-	-	-	1
Untypable	1	-	-	-	1	-	-	-	-	-	2
Total <i>L. monocytogenes</i>	18	2	-	5	50	-	4	-	5	-	84

According to the case definition for invasive listeriosis, only isolates obtained from a normally sterile site or placental/fetal tissues should be reported to NESP. Therefore, unlike the other enteric organisms included in NESP, all *L. monocytogenes* isolates are from extra-intestinal sites. The isolation sites of *L. monocytogenes* reported to NESP are shown in Table 7. Blood and CSF were the most common sites reported.

Table 7. Collection site of *L. monocytogenes* isolates as reported to NESP, 2011

Site	No. Isolates	Percent (%)
Blood*	98	74.2
CSF	13	9.8
Joint fluid [‡]	5	3.8
Other tissue or fluid [†]	5	3.8
Unknown site	11	8.3
Total	132	

*Includes one case where both blood and CSF tested positive for *L. monocytogenes*

[‡]Includes knee fluid (3), hip fluid (1), tibia membrane (1)

[†]Includes ascitic fluid (1), peritoneal fluid (1), breast tissue (1), thoracic tissue (1), and pleural fluid (1)

Isolates Collected from Extra-intestinal Isolation Sites

The number of isolates collected from extra-intestinal sites excluding *L. monocytogenes*, reported to NESP in 2011 is shown in Table 8. Although information regarding extra-intestinal isolation sites is collected by NESP, these data are not consistently reported to provincial or central reference labs. Isolation of an organism from a sterile site may reflect more severe illness and an increased likelihood to seek treatment and be tested.

The organisms that had the highest percentage of cases isolated from an extra-intestinal site were *C. fetus*, *S. Paratyphi A* and *S. Typhi*, all of which were most frequently isolated from blood.

Table 8. Total isolates collected from extra-intestinal isolation sites as reported to NESP in 2010

Organism	Blood	Urine	Other*	Total/Overall	Percent (%)
<i>Campylobacter</i>	25		1	26/1938	1.34
<i>C. fetus</i>	11			11/21	52.38
<i>C. jejuni</i>	9		1	10/1489	0.67
Other species	5				
<i>E. coli</i>		1	1	2/578	0.35
<i>E. coli</i> O157		1	1	2/482	0.59
<i>Salmonella</i>	287	121	22	430/6809	6.32
<i>S. Braenderup</i>	1	1	1	3/78	3.85
<i>S. Enteritidis</i>	63	37	11	111/2764	4.02
<i>S. Hadar</i>		2		2/75	2.67
<i>S. Heidelberg</i>	40	18	1	59/641	9.20
<i>S. Infantis</i>	2			2/185	1.08
<i>S. Javiana</i>	2	2		4/77	5.19
<i>S. Montevideo</i>		2		2/45	4.44
<i>S. Newport</i>	4	2		6/195	3.08
<i>S. Oranienburg</i>	7	1	1	9/52	17.31
<i>S. Panama</i>	5			5/35	14.29
<i>S. Paratyphi A</i>	37	1	1	39/94	41.49
<i>S. Saintpaul</i>	3	2		5/101	4.95
<i>S. ssp</i> I 4,5,12:b:-	1	1		2/62	3.23
<i>S. ssp</i> I 4,5,12:i:-	5	1	1	7/218	3.21
<i>S. Thompson</i>	3			3/118	2.54
<i>S. Typhi</i>	65	1		66/196	33.67
<i>S. Typhimurium</i>	12	6	2	20/661	3.03
Other serovars	34	39	4		
<i>S. ssp</i> IIIb		4		4/22	18.18
<i>S. ssp</i> IV	3	1		4/22	18.18
<i>Shigella</i>	3	3		6/850	0.71
<i>Shigella flexneri</i>	1				
<i>Shigella flexneri</i> 3a	2				
<i>Shigella sonnei</i>		3		5/535	0.56
<i>Vibrio</i>	2			2/47	4.26
<i>V. cholerae</i> non-O1	1				
<i>Vibrio</i> sp.	1				
Viruses			1		
Norovirus			1	1/2715	0.04
<i>Yersinia</i>	2		1	3/381	0.79
<i>Y. enterocolitica</i>	2		1	3/331	0.91
Total	319	125	26	470	

*Other sites include: Abscess: *S. Braenderup* (1), *S. Enteritidis* (1), *S. Typhimurium* (1); Articular liquid: *S. Enteritidis* (1); Emesis: Norovirus (1); Expectorate: *S. Heidelberg* (1). Gall bladder fluid: *S. Brandenburg* (1); Gall bladder tissue: *S. Paratyphi A* (1); Hip fluid: *S. Enteritidis* (1); Knee: *S. Enteritidis* (1); Pus: *S. Enteritidis* (1), *S. Give* (1), *S. ssp* I 4,5,12:i:- (1), *Y. enterocolitica* (1); Sternum: *S. Enteritidis* (1); Sputum: *E. coli* O157:H7 (1); Subdural hole: *S.*

Oranienburg (1); Synovial fluid: *C. jejuni* (1); Wound: *S. Adelaide* (1), *S. Enteritidis* (5), *S. ssp* I 6,7:c:- (1), *S. Typhimurium* (1).

Travel-Associated Infections

Although foreign travel is an important risk factor for gastro-intestinal illness, this information is rarely reported to provincial laboratories and is therefore greatly under-represented in NESP.

A total of 189 cases of enteric infection recorded through NESP were reported in foreign travelers or new immigrants arriving in Canada (Table 9 & Table 10). The Caribbean was the most common region identified associated with 25% of travel-acquired infections (47 cases). Mexico and the Caribbean are popular winter destinations for Canadians, combined, these 2 regions represent 33% of the travel-acquired infections reported.

Table 9. Number of infections by region/country of origin as reported to NESP, 2011

Geographic Region	No. of Cases (%)
Caribbean	47 (25%)
Asia	34 (18%)
Africa	33 (17%)
Mexico	16 (8%)
Europe	14 (7%)
South & Central America	11 (6%)
Other Destinations (Including multiple regions)	6 (3%)
Unknown	28 (15%)
Total	189

Parasitic infections were the most common travel-related infection, accounting for 37% of travel associated cases reported through NESP. *Giardia* alone accounted for a quarter (25%) of all travel cases. Salmonellosis was the second most common travel related infection with 34% of travel related cases.

There was an increase in the number of Cholera cases reported to NESP in 2011; 9 cases were reported compared with 0-4 cases in previous years. The majority of these cases (67%) reported travel to Haiti or the Dominican Republic where there has been a large ongoing outbreak of Cholera since 2010.

Table 10. Number of travel-acquired infections reported to NESP by organism, 2011

Organism	No. of Cases (% of total)	Country (No. > 1)
<i>Campylobacter</i>	32 (17%)	
<i>C. coli</i>	1	Peru
<i>C. jejuni</i>	16	Africa, Asia, China, Dominican Republic, India, Lebanon, Mexico (4), Portugal, Switzerland, United Kingdom, and multiple destinations (Switzerland and Hungary), (Switzerland and Italy) and (Central America, South America and Middle East)
<i>C. jejuni/coli</i>	15	Africa (3), Argentina, Costa Rica, Dominican Republic (2), Europe, India, Israel, Peru, multiple destinations (Scotland and Ireland) and unknown destinations(3)
<i>E. coli</i>	2 (1%)	
<i>E. coli</i> O104:H4	1	Germany
<i>E. coli</i> O157:NM	1	Europe
Parasites	69 (37%)	
<i>Cryptosporidium</i>	2	Cuba and Malta
<i>Entamoeba histolytica/dispar</i>	19	Asia (3), Cuba, Eritrea (2), Haiti, India, Mexico, Nepal, Pakistan (2), Peru, USA and unknown destinations (5)
<i>Giardia</i>	48	Afghanistan, Brazil, Bhutan (2), Colombia, Congo (5), Costa Rica, East Africa, Ethiopia (6), India (2), Mexico (2), Nepal, Pakistan, Somalia (5), Tanzania (2), multiple destinations (India, Thailand, Taiwan) and unknown destinations (16)
<i>Salmonella</i>	64 (34%)	
<i>S. Braenderup</i>	2	Netherlands and Tanzania
<i>S. Concord</i>	2	Africa and Ethiopia
<i>S. Enteritidis</i>	35	Cayman Island, Cuba (8), Dominican Republic (7), Indonesia, Jamaica (6), Mexico (5), Portugal, Thailand, multiple destinations (Italy and Greece) and (Tanzania and Kenya) and unknown destinations (3)
<i>S. Paratyphi A</i>	2	India and unknown destination
<i>S. Saintpaul</i>	2	Jamaica (2)
<i>S. Senftenberg</i>	2	Cuba and Dominican Republic
<i>S. Typhimurium</i>	2	Saudi Arabia and Trinidad
<i>S. Virchow</i>	2	Africa and Hong Kong
Other (14 serovars)	15	Cuba, Dominican Republic (2), Europe, India, Indonesia, Jamaica (2), Mexico (3), Pakistan, Sudan, Thailand and multiple destinations (St. Thomas, St. Martin and British Virgin Islands)
<i>Shigella</i>	11 (6%)	
<i>Shigella boydii</i>	1	Mexico
<i>Shigella flexneri</i>	4	India (2), Sudan and multiple destinations (Italy, Greece, Turkey and USA)
<i>Shigella sonnei</i>	6	Brazil, Caribbean, Central America, India (2) and South America
<i>Vibrio</i>	9 (5%)	
<i>V. cholerae</i> O1	1	India
<i>V. cholerae</i> O1 Ogawa	8	Bangladesh, Dominican Republic, Haiti (5) and multiple destinations (Brazil & Angola)
<i>Yersinia</i>	2 (1%)	
<i>Y. enterocolitica</i>	2	Cuba and Vietnam
Total	189	

Appendix 1. Species and Serotype data reported to NESP by province and territory, 2011

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>Campylobacter</i>														
<i>C. coli</i>	41	12	17	9	87	33	5		1					205
<i>C. fetus</i> ssp <i>fetus</i>	2	3			2	13		1						21
<i>C. helveticus</i>		1												1
<i>C. hyointestinalis</i>		1			1									2
<i>C. jejuni</i>	429	306	156	136	194	76	111		33	45		1	2	1489
<i>C. jejuni/coli</i>				1				84	1	4				90
<i>C. lanienae</i>					1									1
<i>C. lari</i>	2	1	2		5	5			1			1		17
<i>C. upsaliensis</i>	14	10	6		20	1					1			52
<i>Campylobacter</i> sp	1			1		3	51	1		3				60
Total <i>Campylobacter</i>	489	334	181	147	310	131	167	86	36	52	1	2	2	1938
<i>Escherichia coli</i>														
<i>E. coli</i> O26				1										1
<i>E. coli</i> O26:H11	1	1		1										3
<i>E. coli</i> O45:H2						1								1
<i>E. coli</i> O49:NM					1									1
<i>E. coli</i> O55:H7					1									1
<i>E. coli</i> O91:NM					1									1
<i>E. coli</i> O103:H2	1				1									2
<i>E. coli</i> O103:H21						1								1
<i>E. coli</i> O103:H25					1									1
<i>E. coli</i> O104:H4					1									1
<i>E. coli</i> O108:H11				1										1
<i>E. coli</i> O111				1										1
<i>E. coli</i> O111 VT-				1										1
<i>E. coli</i> O111:NM	2													2
<i>E. coli</i> O121:H19	2			5										7
<i>E. coli</i> O145:NM					1									1
<i>E. coli</i> O153										1				1
<i>E. coli</i> O156:H25	1													1
<i>E. coli</i> O157	41	71	7	26	217	73	7	17	16	4		1		480
<i>E. coli</i> O157:H16					1									1
<i>E. coli</i> O157:H25		1												1
<i>E. coli</i> O177:NM						1								1
<i>E. coli</i> O-Rough:H45					1	1								2
<i>E. coli</i> Non-O157 VTEC *	2			11	1									14
<i>E. coli</i> Non-Typed VTEC	42			11										53
Total <i>E. coli</i>	92	73	7	58	227	77	7	17	16	5	0	1	0	580
* see appendix 3 for related information														
<i>Listeria</i>														
<i>L. monocytogenes</i>	17	2	0	4	55	46	3	5	0	0	0	0	0	132
Parasites														
<i>Cryptosporidium</i>	6	12	9	13	29	2	29	9	2	2				113
<i>Cyclospora</i>	2		1	2	6									11

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>Entamoeba histolytica/dispar</i>	116	6	14	17	131	140	1	9						434
<i>Giardia</i>	71	11	88	87	112	81	68	55	13	46				632
Total Parasites	195	29	112	119	278	223	98	73	15	48	0	0	0	1190
Salmonella														
S. Aarhus	1													1
S. Aberdeen					3									3
S. Adelaide		1			1	1								3
S. Agama		1												1
S. Agbeni	8				1									9
S. Ago					2									2
S. Agodi	1													1
S. Agona	16	16	4	2	26	5	2	3						74
S. Alachua	1			1	6									8
S. Albany	5	2		1										8
S. Altona	1				2									3
S. Amsterdam		1	1											2
S. Anatum	11	3		1	15	2								32
S. Apapa					1	1								2
S. Arechavaleta					2	1								3
S. Baildon					1									1
S. Bardo					1									1
S. Bareilly	7	4	2	6	15	1		1						36
S. Beaudesert	1				1									2
S. Berta		2			25	2								29
S. Blockley		5			3	3								11
S. Bonariensis						1								1
S. Bovismorbificans				2	5	1	1							9
S. Braenderup	4	10	2	1	38	21		1	1					78
S. Brandenburg	4	2	1	2	4	2				2				17
S. Bredeney					1		1	1						3
S. Brijbhumi		1												1
S. Brunei					1									1
S. Bsilla						1								1
S. Carrau					1									1
S. Cerro	1				1	2								4
S. Chester	1	1		1	5	1								9
S. Coeln					1									1
S. Colindale	1													1
S. Concord			1	3	2		1	1						8
S. Corvallis	8	6			6	1								21
S. Cotham		2												2
S. Cubana					1									1
S. Cuckmere						2								2
S. Dahra					3									3
S. Daytona	3													3
S. Derby	2				6	4		1			1			14
S. Dublin					1	7								8
S. Durban					3									3

Species/Serotype Data 2011

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
S. Durham		2			1									3
S. Ealing					4									4
S. Eastbourne					11	3								14
S. Ebrie		1			1									2
S. Elizabethville					1									1
S. Elomrane						1								1
S. Emek					2									2
S. Enteritidis	588	493	70	74	933	408	48	93	15	26	2	4	10	2764
S. Essen	1													1
S. Florida		1												1
S. Fluntern					1									1
S. Galiema						1								1
S. Gaminara	1				4	1	1							7
S. Garba					1									1
S. Gatuni					3	3			1					7
S. Give	1	1		1	3	2	1							9
S. Glostrup	2													2
S. Goldcoast					1									1
S. Guildford		1												1
S. Haardt					1									1
S. Hadar	10	14	4	1	36	10								75
S. Haifa		1			2			1						4
S. Hartford	1			1	16	2								20
S. Havana	2				1	1								4
S. Heidelberg	51	48	11	24	271	143	41	22	3	15		7	5	641
S. Herston					1									1
S. Hindmarsh		1												1
S. Holcomb					2									2
S. Hvittingfoss	2	1		1	6			1						11
S. Indiana	1		1		2	2	1							7
S. Infantis	33	14	4	4	80	26	16	6				2		185
S. Istanbul					2									2
S. Jangwani						1								1
S. Javiana	12	9	2	3	29	16	3	2		1				77
S. Johannesburg	1													1
S. Kalamu						1								1
S. Kapemba					1									1
S. Kedougou	2			1										3
S. Kentucky	6			1	9	1				1				18
S. Kiambu	3	2	2	1	11									19
S. Kingabwa	1	1				2								4
S. Kintambo					1									1
S. Koketime						1								1
S. Kokomlemle	2													2
S. Kottbus					1									1
S. Larochelle	1													1
S. Lexington	2				1									3
S. Litchfield	1	1	1	1	11	8	1			1				25
S. Lomalinda			1											1
S. Lomita						1								1

Species/Serotype Data 2011

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
S. London					1									1
S. Madelia					2									2
S. Manhattan			1		1	3								5
S. Mbandaka	9	4			5	2	1							21
S. Meleagridis		1												1
S. Miami	4	2				1								7
S. Mikawasima						1								1
S. Minnesota	1			1	3	2	1							8
S. Mississippi	2	2	1		5	1								11
S. Mkamba				1										1
S. Molade					1									1
S. Monschau					3									3
S. Montevideo	11	4	1	1	18	5	2	2			1			45
S. Mountpleasant						1								1
S. Muenchen	13	3	2	5	25	7	2	4						61
S. Muenster	3	1			4	1								9
S. Mundonobo	1													1
S. Naestved					1									1
S. Nchanga					1									1
S. Nessziona				1	4									5
S. Newport	16	20	2	3	102	42	3	5		2				195
S. Nima					3									3
S. Norwich					1									1
S. Oakland										1				1
S. Odozi						1								1
S. Ohio					2									2
S. Onderstepoort					1									1
S. Onireke					1									1
S. Oranienburg	11	9	4	2	21	4	1							52
S. Orion	1													1
S. Oslo	1				3									4
S. Othmarschen					1									1
S. Ouakam		1												1
S. Panama	8	8	1		8	9				1				35
S. Paratyphi A	30	9	1	2	48	3		1						94
S. Paratyphi B	2	1	1	2	3	2	1			1				13
S. Paratyphi B var Java	17	4	5		18	6								50
S. Pomona						1								1
S. Poona	1	4			8	3								16
S. Potsdam	1	1												2
S. Praha						1								1
S. Presov						2								2
S. Reading	1				2	1								4
S. Richmond	2				2									4
S. Rissen	3	2			3	1								9
S. Rubislaw	1													1
S. Ruiru								1						1
S. Saarbruecken						1								1
S. Saintpaul	12	15	4	7	34	14	1	3					11	101

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
S. Salford					1									1
S. San Diego	1	2			11	4					1	1		20
S. Schwarzengrund	4	3			4	1	1			1			1	15
S. Senegal	1		1											2
S. Senftenberg	4	1	3		10	4		4						26
S. Singapore	1	1			5									7
S. Stanley	15	7		1	29	8								60
S. Stanleyville	1				2	1								4
S. Sundsvall		1												1
S. Telekebir					2	1								3
S. Tennessee	2	1			14									17
S. Thompson	6	6	2	1	88	11		2	1	1				118
S. Tornow					1									1
S. Typhi	40	16	3	12	104	18				3				196
S. Typhimurium	79	79	23	18	295	133	16	7		9	2			661
S. Uganda		3			8	2								13
S. Urbana					1	1		1						3
S. Vejle					1									1
S. Virchow	7	3		1	14	1	1			1				28
S. Wagenia		1												1
S. Wandsworth					1	1								2
S. Weltevreden	5	2	1	1	14									23
S. Wien					1									1
S. Wilhelmsburg					1									1
S. Worthington	1					1								2
S. Zanzibar	1					1								2
S. ssp l -:b:1,2						1								1
S. ssp l 1,3,19:z:-					1									1
S. ssp l 13,22:-:-					1									1
S. ssp l 13,23:b:-			1			1								2
S. ssp l 16:l,v:-	1													1
S. ssp l 3,10:-:1,5		1												1
S. ssp l 3,15:-:-					1									1
S. ssp l 4,[5],12:-:-	1			1	5	1								8
S. ssp l 4,[5],12:-:1,2					3	2								5
S. ssp l 4,[5],12:b:-		7			42	13								62
S. ssp l 4,[5],12:d:-		1												1
S. ssp l 4,[5],12:e,h:-					2									2
S. ssp l 4,[5],12:i:-	26	52	15	13	62	46	3						1	218
S. ssp l 4,[5],12:l,v:-					1									1
S. ssp l 45:g,m,s,e,n,x		1												1
S. ssp l 47:z4,z23:-					1									1
S. ssp l 6,7:-:-					1									1
S. ssp l 6,7:c:-					1	2	1							4
S. ssp l 6,7:k:-						1								1
S. ssp l 6,7:r:-		2		1	3									6
S. ssp l 6,8:-:-		1			1									2
S. ssp l 6,8:-:1,5						1								1
S. ssp l 6,8:e,h:-					1									1
S. ssp l 6,8:r:-						1								1

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>S. ssp</i> I 8,20:-:-					1									1
<i>S. ssp</i> I 9,12:-:-	1	2			4									7
<i>S. ssp</i> I 9,12:-:1,5	1	5				2		1						9
<i>S. ssp</i> I Rough-O:-:-		1			6	2								9
<i>S. ssp</i> I Rough-O:-:1,2						1								1
<i>S. ssp</i> I Rough-O:-:1,5		1												1
<i>S. ssp</i> I Rough-O:b:-			1											1
<i>S. ssp</i> I Rough-O:d:-		1												1
<i>S. ssp</i> I Rough-O:d:1,2					1									1
<i>S. ssp</i> I Rough-O:e,h:1,2			1											1
<i>S. ssp</i> I Rough-O:g,m,s:-		1												1
<i>S. ssp</i> I Rough-O:g,m:-				1	1									2
<i>S. ssp</i> I Rough-O:i:-		1												1
<i>S. ssp</i> I Rough-O:i:1,2		1			3									4
<i>S. ssp</i> I Rough-O:r:-		1			1									2
<i>S. ssp</i> I Rough-O:untypable				1	3	3								7
<i>S. ssp</i> I Rough-O:z10:e,n,x		1			1									2
<i>Salmonella ssp</i> I					1			8	1	1				11
<i>S. ssp</i> II 40:c:e,n,x,z15						1								1
<i>S. ssp</i> II 42:b:e,n,x,z15		1												1
<i>S. ssp</i> II 48:d:z6					1									1
<i>S. ssp</i> II 6,7:m,t:-			1											1
<i>S. ssp</i> II Rough-O:c:-		1												1
<i>S. ssp</i> IIIa 41:z4,z23:-	1				1									2
<i>S. ssp</i> IIIa 48:g,z51:-		1												1
<i>Salmonella ssp</i> IIIa										1				1
<i>S. ssp</i> IIIb 16:z10:e,n,x,z15	1													1
<i>S. ssp</i> IIIb 47:k:z35		1												1
<i>S. ssp</i> IIIb 48:k:z53						1								1
<i>S. ssp</i> IIIb 48:z4,z24:-		1												1
<i>S. ssp</i> IIIb 48:z52:z	1							1						2
<i>S. ssp</i> IIIb 50:k:z		2			1									3
<i>S. ssp</i> IIIb 53:z10:z35						1								1
<i>S. ssp</i> IIIb 58:z10:e,n,x,z15	1													1
<i>S. ssp</i> IIIb 61:-:1,5,7		2												2
<i>S. ssp</i> IIIb 61:c:1,5,7					1									1
<i>S. ssp</i> IIIb 61:c:z35					1									1
<i>S. ssp</i> IIIb 61:k:1,5	1													1
<i>S. ssp</i> IIIb 61:l,v:1,5	1													1
<i>S. ssp</i> IIIb 61:z52:z53	1													1
<i>S. ssp</i> IIIb 65:k:-						1								1
<i>S. ssp</i> IIIb 65:z10:e,n,x,z15						1								1
<i>S. ssp</i> IIIb OR:-:-					1									1

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>S. ssp</i> IIIb Rough-O:z10:e,n,x,z					1									1
<i>Salmonella ssp</i> IV								1						1
<i>S. ssp</i> IV 43:z36,z38:-		1												1
<i>S. ssp</i> IV 44:z4,z23:-	2	2			2									6
<i>S. ssp</i> IV 44:z4,z24:-					1									1
<i>S. ssp</i> IV 44:z4,z32:-					1									1
<i>S. ssp</i> IV 45:g,z51:-			1											1
<i>S. ssp</i> IV 48:g,z51:-		2		1	2									5
<i>S. ssp</i> IV 50:g,z51:-					1	3								4
<i>S. ssp</i> IV 50:z4,z23:-					1									1
<i>S. ssp</i> IV Rough-O:z4,z23:-		1												1
<i>Salmonella sp.</i>				3			5	5		1				14
Total <i>Salmonella</i>	1158	960	183	213	2739	1081	156	179	22	69	7	14	28	6809
<i>Shigella</i>														
<i>Sh. boydii</i>		1		2										3
<i>Sh. boydii</i> 1					1									1
<i>Sh. boydii</i> 2	1				5									6
<i>Sh. boydii</i> 4					2	1								3
<i>Sh. boydii</i> 8	1					1								2
<i>Sh. boydii</i> 10					2									2
<i>Sh. boydii</i> 12	1													1
<i>Sh. boydii</i> 13					1									1
<i>Sh. boydii</i> 14	1													1
<i>Sh. boydii</i> 20	1	1			1									3
<i>Sh. dysenteriae</i> 2	1	1												2
<i>Sh. dysenteriae</i> 4	1													1
<i>Sh. dysenteriae</i> 5					1									1
<i>Sh. dysenteriae</i> 6	1													1
<i>Sh. dysenteriae</i> 9	2				1									3
<i>Sh. dysenteriae</i> 12	1													1
<i>Sh. dysenteriae</i> 16						3								3
<i>Sh. flexneri</i>	1	1	3	9				3						17
<i>Sh. flexneri</i> 1	17	7												24
<i>Sh. flexneri</i> 1a					4									4
<i>Sh. flexneri</i> 1b					42	9								51
<i>Sh. flexneri</i> 2	16	9												25
<i>Sh. flexneri</i> 2a					36	5								41
<i>Sh. flexneri</i> 3	15	5												20
<i>Sh. flexneri</i> 3a					5	18								23
<i>Sh. flexneri</i> 3b					5	4								9
<i>Sh. flexneri</i> 4	4	4												8
<i>Sh. flexneri</i> 4a					3	2								5
<i>Sh. flexneri</i> 4c					1									1
<i>Sh. flexneri</i> 6	8	2			13									23
<i>Sh. flexneri</i> Prov SH-101					1									1

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
<i>Sh. flexneri</i> Prov SH-104	13	4			7	2								26
<i>Sh. flexneri</i> var X					1									1
<i>Sh. flexneri</i> var Y	2	2			5	2								11
<i>Sh. sonnei</i>	71	172	117	24	103	36	3	9						535
Total <i>Shigella</i>	158	209	120	35	240	83	3	12	0	0	0	0	0	860
<i>Vibrio</i>														
<i>V. alginolyticus</i>	1				1				1					3
<i>V. cholerae</i>							1							1
<i>V. cholerae</i> O1	1													1
<i>V. cholerae</i> O1 Ogawa		2				6								8
<i>V. cholerae</i> O75		1												1
<i>V. cholerae</i> non-O1				1										1
<i>V. cholerae</i> non-O1/O139	1	1			2	2	1							7
<i>V. fluvialis</i>	1													1
<i>V. mimicus</i>		1												1
<i>V. parahaemolyticus</i>	10	3	1		4		2		1					21
<i>Vibrio</i> sp.							1	1						2
Total <i>Vibrio</i>	14	8	1	1	7	8	5	1	2	0	0	0	0	47
Viruses														
Adenovirus	37			27	72			1						137
Astrovirus					2									2
Enterovirus				14										14
Norovirus	318	380	300	70	589	744	104	127	27	52		4		2715
Rotavirus	118	73	268	43	720		169	14	134	33			1	1573
Total Viruses	473	453	568	154	1383	744	273	142	161	85	0	4	1	4441
<i>Yersinia</i>														
<i>Y. enterocolitica</i>	35	51	23	3	195	19	5							331
<i>Y. frederiksenii</i>	31	1	1											33
<i>Y. intermedia</i>	2	2	2											6
<i>Y. kristensenii</i>			2											2
<i>Y. pseudotuberculosis</i>		1												1
<i>Yersinia</i> sp.				6		2								8
Total <i>Yersinia</i>	68	55	28	9	195	21	5	0	0	0	0	0	0	381
Total	2664	2123	1200	740	5434	2414	717	515	252	259	8	21	31	16378

Appendix 2. Phage types of isolates submitted to NML*, 2011

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
<i>Escherichia coli</i>												
<i>E. coli</i> O157:H7	2		1			7			2	1		11
	4	1	3		1	18	18	2			1	44
	8		1			7	6					14
	10				1	1						2
	14		10	1	1	19	4		1			36
	14a	12	40	3	15	115	26	3	9	12	2	237
	14c		4			5						9
	14d					2						2
	21					1	2					3
	24								1			1
	31		2									2
	32		2	1								3
	32a	2	1			4						7
	33		1			1						2
	34	1				1	3		1			6
	48						1					1
	49		2			1	1					4
	51					1						1
	54	2	2		1	5	4			1		15
	68					1						1
	70					1						1
	73					2						2
	91					1						1
	Atypical	2	1			7	4		2			16
	Subtotal	20	70	5	19	200	69	5	16	14	3	421
<i>E. coli</i> O157:NM	2	1										1
	4					1						1
	8		1	2	1	15	1			1		21
	14		1					1				2
	14a							1		1		2
	54				2							2
	Atypical				1	2					2	5
	Subtotal	1	2	2	4	18	1	2	0	2	2	34
Total <i>E. coli</i>		21	72	7	23	218	70	7	16	16	5	455
<i>Salmonella</i>												
<i>S. Enteritidis</i>	1	27	17	3	3	151	67	8	3	12	3	294
	1b	10	6	1		10		1		2		30
	2	6	12	1	1	6	4				2	32
	3		1			2	14					17
	3a					1						1
	4	14	7	1	1	17	5			1		46

* These values include isolates submitted to the NML for research purposes and may also include a small number of strains that represent multiple isolates from the same patient.

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
	4b	2					1					3
	5a	1					1					2
	5b	11	17	2	2	83	31	6		10	2	164
	6	2	5			2	5	1				15
	6a	19	11			11	4	1		1		47
	7				1							1
	7a	2	3	1	3	10	4					23
	8	239	198	17	26	283	100	18	8	34	13	936
	11b	3	2	1		1	1					8
	12	1				1	1	1				4
	13	32	39	2	9	55	23		2	6	1	169
	13a	122	80	27	11	164	80	6		10	2	502
	14b	2	3			3	1					9
	14c					1						1
	15a	1	1			1						3
	18					1						1
	19		2			1						3
	20		1				1					2
	21	4	4		4	6	5			1	1	25
	21c	1	2			24	1			1		29
	22	2	1	1		17	1			1		23
	23	2	2	1	2	4	1				1	13
	29		2			1						3
	29a		2	2		1				1		6
	33	1										1
	34	1	48	1		1						51
	34a	1										1
	35	1	1				1					3
	37					1						1
	38					1						1
	41	6	4	3		3						16
	42					1						1
	43		1			1						2
	47					1						1
	51	13	3	1		9	3	5	1	5		40
	53					2	2					4
	55		2			2						4
	57					1						1
	911	1			1							2
	Atypical	57	32	4	8	65	42	2	1	8	1	220
	Untypable	21	10		2	9	9			1		52
	Subtotal	605	519	69	74	954	408	49	15	94	26	2813
S. Hadar	1					1						1
	2		3			11	3					17
	5		1									1
	10		3			6	1					10
	11		1	3	1	2						7
	14			1		2						3
	17					2						2

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
	18		1									1
	21					1						1
	33					2						2
	46		1									1
	47	1	5									6
	56					3						3
	Atypical	1										1
	Untypable					2						2
	Subtotal	2	15	4	1	32	4	0	0	0	0	58
S. Heidelberg	1	1										1
	2		7	1	1	6	2					17
	4				1	3		1				5
	5			1	1	3						5
	6						1					1
	6a					1					2	3
	8						1					1
	10		2			8	3					13
	11				2	1		2				5
	16					1						1
	17					1	1					2
	18	2				1						3
	19	14	28	3	14	143	66	14		11	4	297
	19a						4					4
	19b		1			1		1				3
	20					1	1					2
	22		1				2					3
	24								3			3
	25				1	3				2		6
	26		1			2	3	4				10
	26a						1	9				10
	29	8	9	3	3	75	39	9		4	6	156
	29a			1		1	1				1	4
	32					1	1					2
	32b		2									2
	35					1	3			1		5
	36							1				1
	37						1					1
	40					1						1
	41		4	2	2	8	2			1	1	20
	42		1				2					3
	47					1	1				1	3
	51									1		1
	52					2						2
	53					1		2		1		4
	54	2				1						3
	58					14	2					16
	59					1						1
	Atypical		4			4	6		1			15
	Subtotal	27	60	11	25	286	143	43	4	21	15	635

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
S. Infantis	1		1			1						2
	3		2			11	5					18
	4	3			1	12		15		1		32
	7	9	10	3	2	27	10	1		3		65
	9	1	1	1		1						4
	11					4	1			1		6
	12	1										1
	13		2			1						3
	22	1										1
	26					5				1		6
	27						1					1
	Subtotal	15	16	4	3	62	17	16	0	6	0	139
S. Newport	1	1		1		8	13	1				24
	2	2	2			13	3				1	21
	3				1	5	3			1		10
	4					5	1					6
	6	1										1
	7					1						1
	8					1	1					2
	9	2	1		2	23	4	1		3		36
	10					3						3
	11	1				3	1					5
	13	1				2	2					5
	13a						1					1
	14		1			4	2					7
	14a	2	1			1	1					5
	14b	1	4			6						11
	14c		1				1					2
	15					6	5					11
	16					1						1
	17		2									2
	17a	1				3	3				1	8
	17c	1	2			2	1					6
	Atypical	2	6	1		14	2			1		26
	Subtotal	15	20	2	3	101	44	2	0	5	2	194
S. Oranienburg	1			1								1
	6	1	1	2		4	1					9
	11	3	2	1		2	1					9
	12		2		2							4
	13					1		1				2
	15						1					1
	Atypical	4	4			6						14
	Subtotal	8	9	4	2	13	3	1	0	0	0	40
S. Panama	A		2			1	3					6
	G	1	2	1			1					5
	H		1									1

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
	Untypable	1	2									3
	Atypical		1			2	1					4
	Subtotal	2	8	1	0	3	5	0	0	0	0	19
S. Paratyphi B	Battersea				1		1	1				3
	Dundee						1					1
	Dundee var 2					1	1					2
	Atypical	1	2	1	1		1					6
	Subtotal	1	2	1	2	1	4	1	0	0	0	12
S. Paratyphi B var. Java	3b var 2						1					1
	3b var 7						1					1
	Battersea		1	1		1	4					7
	Dundee		1				1					2
	Dundee var. 2					1						1
	Workshop	3	2	2		2	1					10
	Atypical			1		4	2				1	8
	Subtotal	3	4	4	0	8	10	0	0	0	1	30
S. Thompson	1		3	1		57	5	2		1		69
	2	1				4						5
	3	1	1			9			1			12
	13						1					1
	14				1	2					1	4
	25		1			2	1					4
	Atypical		1	1		10				1		13
	Untypable					1						1
	Subtotal	2	6	2	1	85	7	2	1	2	1	109
S. Typhi	11	1										1
	28				2		1					3
	35	1				1						2
	40				1	1						2
	46					1						1
	A	1				1	4					6
	D1	2	1			1	1					5
	D2	1				1						2
	DVS					4	1					5
	E1	20	7		6	25	3				2	63
	E9					1						1
	E9 var	10	5	2		31	2				1	51
	E14	1	1			3						5
	J1				1							1
	Untypable	1				17	4					22
	UVS					5						5
	UVS I+IV	7		1	1	11	2					22
	Untypable		2									2
	Subtotal	45	16	3	11	103	18	0	0	0	3	199

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
S. Typhimurium	1	1				9	8					18
	2		5	4		3	9	1				22
	3 aerogenic					3	1					4
	9						1					1
	10		4			21	10	2		1		38
	12					2	3			1		6
	12a			1								1
	15a		1									1
	20					4	1					5
	21		1									1
	22		1			2	2	1			1	7
	29						1					1
	35						2					2
	36					1						1
	39	1										1
	40		1			2	2			1		6
	41		4	3		7	1	1				16
	49b						1					1
	56						1					1
	64	1										1
	69					5		1				6
	75 var					18	2					20
	80						1					1
	82					1						1
	87						1					1
	99		3			4	2	3				12
	104	11	25	3	3	29	10					81
	104a		1			4	5			1		11
	104b		2		3	21	3				2	31
	105					6						6
	107					1	1			1		3
	108	2	4	1	1	68	35	4			2	117
	110b					1	1					2
	116					1						1
	120		1	1		1	1	1				5
	125	1										1
	135					1						1
	146					1						1
	151	1				2						3
	153					1						1
	160					2						2
	164						1					1
	166						3					3
	175					1						1
	179					1						1
	179 var		2			2						4
	181			1								1
	191					1						1
	193	3				6	1			1		11
	195	1	1									2

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
	208	1	5	2	1	4	3					16
	U284	2										2
	U285		1									1
	U302			1	1	10	5					17
	U310						1					1
	U320					1						1
	UT1	2	2		3	5	1	1			1	15
	UT2		6	1		2	1					10
	UT3			1								1
	UT5	4	1			3	1					9
	UT6					4						4
	Atypical	6	11	4	8	49	22	2		1		103
	Untypable		2			2	2				1	7
	Subtotal	37	84	23	20	312	146	17	0	7	7	653
S. ssp (I) 4,[5],12:b:-	Battersea					2	2					4
	Dundee var 1					1						1
	Dundee var. 2					4						4
	Atypical					12	3					15
	Untypable	4	6			2	2					14
	Subtotal	4	6	0	0	21	7	0	0	0	0	38
S. ssp (I) 4,[5],12:i:-	3 aerogenic						1					1
	12		2									2
	29						1					1
	35						10					10
	39		1									1
	41		2	1		4	1					8
	51									1		1
	94					1						1
	120	1				1	1					3
	151						1					1
	179						1					1
	191	2	5	5	9	6	1	1		3		32
	191a	2	23	2			1					28
	193	4	5	1		4	3				1	18
	U287		1	1		1						2
	U291		3	2	1	7	9	1		1		24
	U302	1					2					3
	U311	1				2						3
	UT1		1			1	3					5
	UT2						1					1
	UT7	1	1				1	1		1		5
	Atypical	3	12	4	2	6	2			1		30
	Untypable					2	1					3
	Subtotal	15	56	15	12	35	40	3	0	7	1	184
Total Salmonella		781	821	143	154	2016	856	134	20	142	56	5123

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
<i>Shigella</i>												
<i>Shigella boydii</i> 1	9		1									1
<i>Shigella boydii</i> 4	13				1							1
<i>Shigella boydii</i> 12	Untypable				1							1
<i>Shigella boydii</i> 20	3	1	1			1						3
Total <i>Shigella boydii</i>		1	2	0	2	1	0	0	0	0	0	6
<i>Shigella sonnei</i>	1		152	119	2	51		1		7		332
	4					1						1
	7					3						3
	9		2							2		4
	10		2			1						3
	15		1			1						2
	18			1								1
	19		10					2				12
	Atypical		6			5						11
	Subtotal	0	173	120	2	62	0	3	0	9	0	369
Total <i>Shigella</i>		1	175	120	4	63	0	3	0	9	0	375
Total Organisms		803	1068	270	181	2297	926	144	36	167	61	5953

Appendix 3. Non-O157 serotypes of Shiga toxin-producing *E. coli* tested by the NML*, 2011

Serotype	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	Total
<i>Escherichia coli</i>											
<i>E. coli</i> O6:H Nonmotile	3										3
<i>E. coli</i> O8:H9				1							1
<i>E. coli</i> O23:H Nonmotile	1										1
<i>E. coli</i> O26:H7	1										1
<i>E. coli</i> O26:H11	5	1		4	1						11
<i>E. coli</i> O26:H21				3	1						4
<i>E. coli</i> O26:H Nonmotile				3	1						4
<i>E. coli</i> O45:H2					1	1					2
<i>E. coli</i> O49:H Nonmotile					1						1
<i>E. coli</i> O55:H7					1						1
<i>E. coli</i> O69:H11				1							1
<i>E. coli</i> O71:H11	2										2
<i>E. coli</i> O91:H Nonmotile					1						1
<i>E. coli</i> O103:H2	2			1	5						8
<i>E. coli</i> O103:H21				2		1					3
<i>E. coli</i> O103:H25	1				1						2
<i>E. coli</i> O103:H Nonmotile				1							1
<i>E. coli</i> O104:H4					1						1
<i>E. coli</i> O108:H11				1							1
<i>E. coli</i> O111				1							1
<i>E. coli</i> O111:H Nonmotile	2			3	1						6
<i>E. coli</i> O117:K1:H7	1										1
<i>E. coli</i> O118:H16	1										1
<i>E. coli</i> O121:H1				2							2
<i>E. coli</i> O121:H19	3			8							11
<i>E. coli</i> O123:H2	1			1							2
<i>E. coli</i> O145:H Nonmotile					1						1
<i>E. coli</i> O153:H2										1	1
<i>E. coli</i> O156:H25	1										1
<i>E. coli</i> O177:H Nonmotile	1					1					2
<i>E. coli</i> O182:H48	1										2
<i>E. coli</i> O181:H16					1						1
<i>E. coli</i> O183:H21	1										0
<i>E. coli</i> O Rough:H2	1										1
<i>E. coli</i> O Rough:K1:H6				1							1
<i>E. coli</i> O Rough:H21				1	1						2
<i>E. coli</i> O Rough:H45					2	1					3
<i>E. coli</i> O Rough:H Nonmotile		1									1
Total non-O157 Isolates	28	2		34	20	4				1	89

*Inclusive of only those isolates where both serotype and toxin testing data were available. These data are not representative of national incidence, as not all human-clinical Shiga toxin-producing *E. coli* are sent to the NML for these reference service tests.