National Enteric Surveillance Program (NESP)

ANNUAL SUMMARY 2014

PROTECTING CANADIANS FROM ILLNESS

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NATIONAL ENTERIC SURVEILLANCE PROGRAM (NESP)

ANNUAL SUMMARY 2014

INCLUDING SEROVAR AND PHAGE TYPE TABLES FOR 2014, NESP AND NML

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

&

Provincial Public Health Laboratories

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Executive Summary

The National Enteric Surveillance Program (NESP) is designed to detect and respond to multi-jurisdictional outbreaks and to integrate with national and international efforts to monitor and limit the spread of enteric diseases. This is achieved through weekly analysis and reporting of laboratory-confirmed isolations of enteric pathogens in Canada, including bacterial, viral and parasitic pathogens. Within Canada's multi-tiered surveillance systems for enteric diseases, NESP provides the first level of characterization – primarily species and serovar. These data are used as early warning signals, and are also critical to, and integrated with, downstream surveillance at the molecular and strain level (e.g., PulseNet Canada). This document is an annual summary of data submitted to NESP by provincial microbiology laboratories in 2014. For some pathogens reported to NESP, it is important to note that the isolates are only a subset of laboratory isolations within the province/territory and therefore may not reflect the incidence of disease reported through provincial and national notifiable disease surveillance systems.

In 2014, *Salmonella* continued to be the most common pathogen reported to NESP, with *S*. Enteritidis being the most common serovar. *S.* Enteritidis was reported nearly five times as often as any other serovar in 2014, and there was a 65% increase in the number of reported isolates of *S*. Enteritidis from 2013 to 2014. In contrast, *S*. Heidelberg rates have returned to baseline since a spike in 2012. The number of isolates of Vero-toxigenic (VTEC) *E. coli* O157 decreased between 2006 and 2010, with a slight increase into 2011, leaving the last three years to be relatively stable. Interestingly, the reporting of non-O157:H7 isolates to NESP is increasing with more specific subtyping information available. A total of 133 isolates of *Listeria monocytogenes* were reported to NESP in 2014. Lastly, after a subsequent drop in the number of reported isolates of *Shigella* spp. in 2013, reporting has slightly increased.

This report includes reference tables with a complete list of species and serovar data reported to NESP and phage types of isolates reported in 2014 at the National Microbiology Laboratory (NML).

This report also summarizes the extra-intestinal isolation sites and travel-associated infections reported through NESP. Although travel history is largely under-reported in NESP, 270 enteric infections (1.7% of all cases reported to NESP) were identified as associated with international travel. Similar to 2013, *Salmonella* infections were the most common, followed by parasites

among travel-associated infections. Travel to the Caribbean (22%) and Asia (18%) were the most frequent destinations identified by travellers with travel-associated enteric infections.

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Introduction

The National Enteric Surveillance Program (NESP) is designed to detect and respond to multi-jurisdictional outbreaks and to integrate with national and international efforts to monitor and limit the spread of enteric diseases. This is achieved through 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[1], NESP supports the real-time detection and response to emerging and priority diseases. Within Canada's multi-tiered surveillance systems for enteric diseases, NESP provides the first, and most timely, level of characterization, primarily species and serovar. These data are used as early warning signals, and are also critical to and integrated with downstream surveillance at the molecular and strain level (e.g., PulseNet Canada).

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 serovar information on enteric microorganisms isolated from human patients. Data are submitted to NML either directly or using a web-based application (webNESP) hosted on the Canadian Network for Public Health Intelligence (CNPHI). Compilation and analysis weekly data is conducted jointly between NML and the Centre for Foodborne, Environmental and Zoonotic Infectious Diseases (CFEZID) and a weekly report is distributed. 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, webNESP allows partners to perform real-time data analysis, examine trends and display their data. PulseNet Canada uses these data in conjunction with laboratory DNA fingerprinting data determined by pulsed-field gel electrophoresis (PFGE) and other molecular or genomic data to detect disease clusters and outbreaks. The resulting data analyses are also shared on CNPHI between provincial public health microbiology laboratories, the Canadian Food Inspection Agency (CFIA), Health Canada (HC), PHAC and provincial/territorial epidemiologists. Notably, the coordinated assessment of laboratory evidence collected through these two complementary laboratory

[1] PulseNet Canada, National Microbiology Laboratory, Public Health Agency of Canada: https://www.nml-lnm.gc.ca/index-eng.htm

surveillance networks allows for the interpretation of clinical microbiological evidence during multi-jurisdictional epidemiologic investigations, as described in the Food-borne Illness Outbreak Response Protocol (FIORP)[2].

This annual report is a summary of the weekly data collected from all provincial public health microbiology laboratories, for the purpose of analyzing long-term trends in the incidence of enteric pathogens in Canada. 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 changes in reported trends. Additional details are provided in the "Limitations" at the end of this section,

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 Epidemiology Division within the Centre for Communicable Diseases and Infection Control (CCDIC) at PHAC. These data may be more reliable indicators of total numbers of annual illnesses; however CNDSS is not designed to provide timely information required for cluster or outbreak detection. These two surveillance systems (CNDSS and NESP) are complementary in providing both epidemiological and laboratory results; however discrepancies between them do exist. A comparison of national case counts and incidence rates for enteric, food and waterborne diseases is included (Appendix 1).

Data Collection, Analysis and Dissemination:

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 (and serovar, where appropriate) of the enteric pathogen. Weekly results from each provincial public health laboratory are summarized onto a NESP report form. The 'report week' for NESP spans each 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

[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

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 (i.e., the total number of each organism in the province) and do not contain any patient identifiers, locators, or other private information. NESP partners endeavor to include only the number of isolates from new cases identified at the laboratory that week, or updates to previously reported numbers. To avoid duplication, the provincial laboratories attempt to identify multiple, repeat, or follow-up specimens from the same individual, and 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 the expected baseline. The cumulative Poisson probability between the reported case count and the retrospective 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/territory, and multiple stakeholders at the federal level. The reports may be shared with other public health professionals who have an operational need to have this information, 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. 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 further public health investigation of potential outbreaks or to inform the activities of downstream surveillance systems such as PulseNet Canada.

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 *Escherichia 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 minimize this occurrence. 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, and case counts reported to NESP may not be representative of the actual final number of cases associated with 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, including the Outbreak Summaries Surveillance system.

Isolates Reported By Major Organism Group

A total of 16,151 enteric pathogens were reported to NESP in 2014. The number of cases reported per province and territory for each major organism group is shown in Table 1. For bacterial pathogens, the isolates were grouped by genus, whereas parasites and viruses were each grouped respectively. A complete list of all organisms reported to NESP by province and territory in 2014 is shown in Appendix 2.

The most frequently reported enteric pathogen in 2014 was *Salmonella*, followed by enteric viruses (Norovirus, Hepatitis A, Rotavirus and Adenovirus) and enteric parasites (*Giardia*, *Cryptosporidium*, *Entamoeba histolytica*/*dispar* and *Cyclospora*) (Table 1). As mentioned previously, this does not reflect national incidence rates but rather testing and reporting practices within the provincial laboratories.

Table 1. Number of isolates reported to NESP by major organism group per province/territory, 2014

GROUP	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL	% OF TOTAL ISOLATES REPORTED
Campylobacter[1]	436	273	138	93	161	197	200	99	42	37	.	.	.	1676	10.4
E. coli[2]	124	206	36	40	123	84	3	9	10	8	.	.	.	643	4.0
Listeria	18	10	2	3	45	46	3	4	1	1	.	.	.	133	0.8
Salmonella	1231	1008	184	250	3207	1443	185	213	34	89	.	3	4	7851	48.6
Shigella	136	88	15	32	275	120	4	7	3	1	.	.	.	681	4.2
Vibrio	39	19	1	.	4	12	2	3	1	.	1	.	.	82	0.5
Yersinia	78	47	25	.	124	59	4	1	.	2	1	.	.	341	2.1
Parasites[1]	214	6	121	204	631	360	102	114	15	24	20	.	.	1811	11.2
Viruses[1]	393	271	188	119	912	534	171	149	85	110	.	1	.	2933	18.2
Total	**2669**	**1928**	**710**	**741**	**5482**	**2855**	**674**	**599**	**191**	**272**	**22**	**4**	**4**	**16151**	**100**

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

[2] *E. coli* includes O157 serovars (458 cases), non-O157 serovars (151 cases), and non-typed VTEC (34 cases).

National incidence rates of the major organism groups over the last six years are shown in Tables 2a and 2b. Rates (per 100,000) are based on the number of isolates reported to NESP each year. Isolates of organisms such as *E. coli* O157, *Listeria monocytogenes*, *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 the organisms that are routinely reported to NESP are shown in Table 3. Five-year trends (2010-2014) in the national incidence rate for *Salmonella*, *Shigella* and *E. coli* O157 compared to the previous 5-year baseline (2005-2009) are shown in Figure 1. Since *Listeria monocytogenes* was added to NESP in July 2010, there is currently not enough data to provide this type of trend analysis.

Campylobacter, enteric parasites (*Giardia, Cryptosporidium, Entamoeba histolytica/dispar* and *Cyclospora*) and enteric viruses (Norovirus, Rotavirus and Adenovirus), as previously mentioned, are not routinely reported to the provincial or central reference laboratories (Table 2b

and Appendix 1). Therefore, NESP incidence rates are not presented for these pathogens as they are difficult to interpret and changes may not reflect actual changes in disease rates.

Table 2a. Annual national totals and rates (per 100,000) for major organism groups routinely reported to NESP, 2009-2014[1]

Group	2009		2010		2011		2012		2013		2014	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate
E. coli O157[2]	529	1.57	405	1.19	481	1.40	486	1.39	470	1.33	458	1.28
Listeria[3]	.	.	.	.	132	0.38	124	0.36	117	0.33	133	0.37
Salmonella	6084	18.02	7254	21.25	6806	19.74	6980	20.01	6270	17.77	7851	22.00
Shigella	631	1.87	739	2.17	861	2.50	988	2.83	621	1.76	681	1.91

[1]Rates calculated using the population estimates for Canada as of October 1 for years 2009 to 2014 as reported by Statistics Canada.

[2]Only cases of *E. coli* O157 are included in this table; additional details about *E. coli* non-O157 are outlined in the *E. coli* section of this report.

[3]Reporting of *Listeria monocytogenes* to NESP began in July 2010.

Table 2b. Annual national totals and rates (per 100,000) for major organism groups under-reported to NESP, 2009-2014[1]

Group	2009		2010		2011		2012		2013		2014	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate	Total	Rate
Campylobacter	1751	5.19	1837	5.38	1938	5.62	1994	5.72	1866	5.29	1676	4.70
Vibrio	47	0.14	51	0.15	47	0.14	61	0.17	48	0.14	82	0.23
Yersinia	382	1.13	341	1.00	381	1.11	322	0.92	278	0.79	341	0.96
Parasites	1570	4.65	1585	4.64	1190	3.45	1320	3.78	1665	4.72	1811	5.08
Viruses	3184	9.43	4662	13.66	4441	12.88	4523	12.97	4058	11.50	2933	8.22

[1]Rates calculated using the population estimates for Canada as of October 1 for years 2009 to 2014 as reported by Statistics Canada.

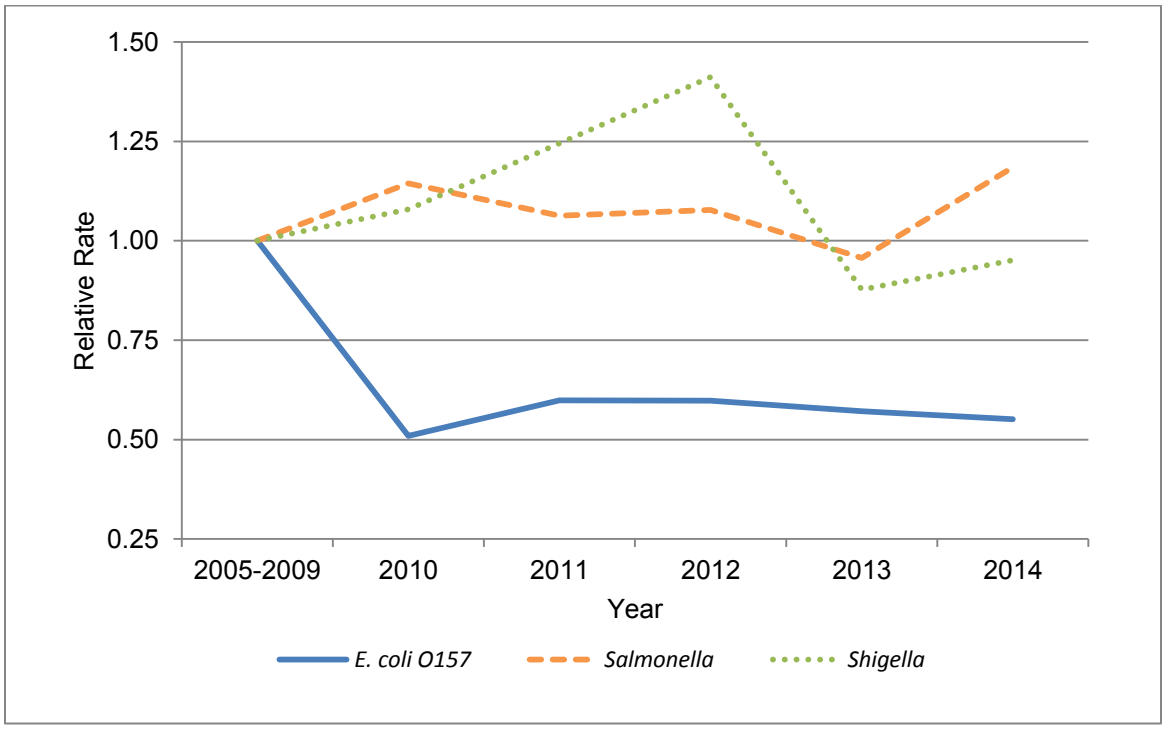
Table 3. Rates (per 100,000) per province/territory for select major organism groups routinely reported to NESP, 2014[1]

GROUP	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU
E. coli O157[2]	1.18	4.49	0.36	1.71	0.84	0.64	0.40	0.95	6.14	0.19	.	.	.
Listeria	0.39	0.24	0.18	0.23	0.33	0.56	0.40	0.42	0.68	0.19	.	.	.
Salmonella	26.39	24.31	16.33	19.46	23.36	17.52	24.50	22.57	23.21	16.83	.	6.80	11.03
Shigella	2.92	2.12	1.33	2.49	2.00	1.46	0.53	0.74	2.05	0.19	.	.	.

[1]Rates calculated using preliminary post-censal population estimates for the provinces and territories as of October 1, 2015 from Statistics Canada.

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

Figure 1. Relative national incidence rates[1] of lab-confirmed cases of *Salmonella*, *Shigella* and *E. coli* O157 reported to NESP by year, 2010-2014

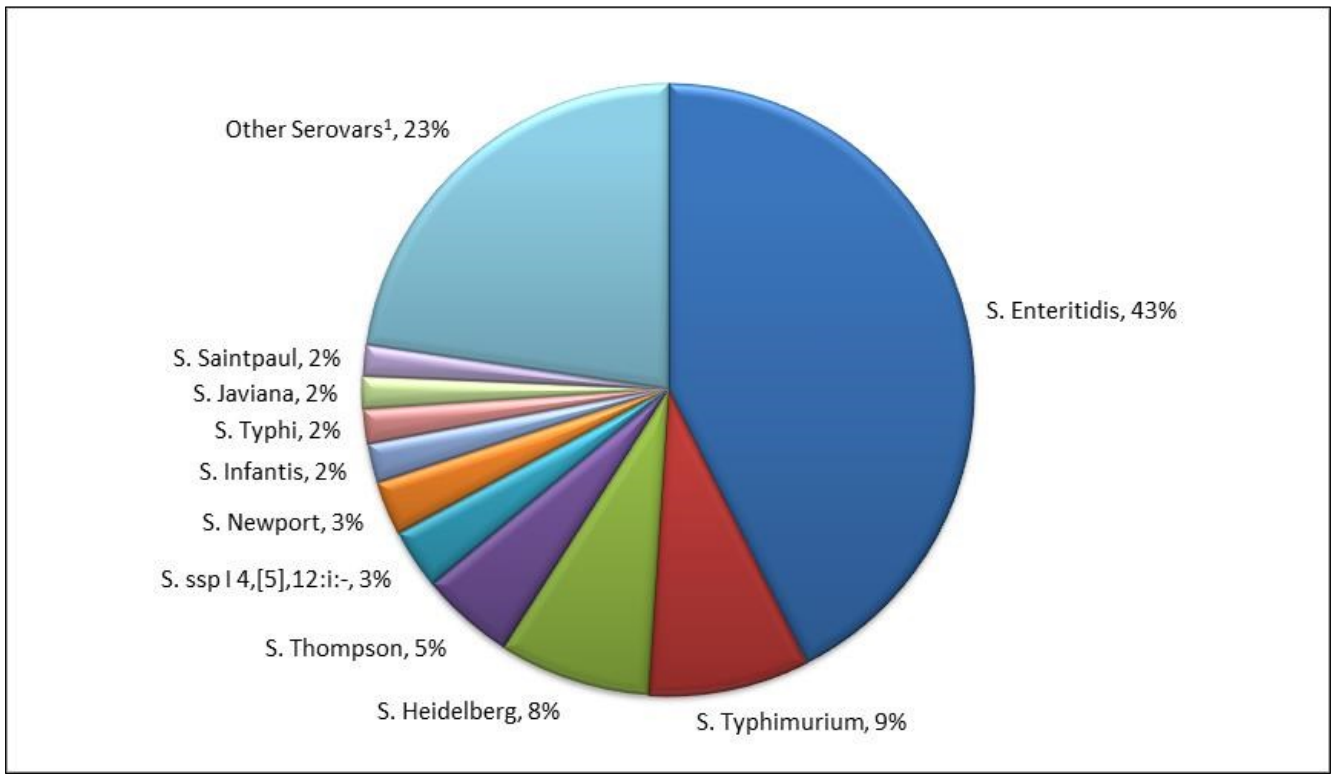


[1]Rates are compared to the 2005-2009 5-year baseline period.

Salmonella

A total of 7,851 *Salmonella* isolates and 244 different serovars were reported to NESP in 2014. The 10 most commonly reported *Salmonella* serovars accounted for 77% of the total *Salmonella* infections reported (Figure 2). 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 2014 is presented in Appendix 2.

Figure 2. Proportion of *Salmonella* serovars as reported to NESP, 2014 (n=7,851)



[1] Other serovars (1,780 isolates) were divided among 233 serovars and 10 isolates were reported as unspecified *Salmonella* species.

S. Enteritidis, *S*. Typhimurium, and *S*. Heidelberg remain the top three most commonly reported *Salmonella* serovars in NESP. This observation has been unchanged since the beginning of NESP; however, the ranking between the top three has shifted from year to year. In 2012 it was noted that for the first time in eight years there were more reports of *S.* Heidelberg than *S.* Typhimurium. In comparison, *S.* Typhimurium has moved back to being the second most commonly reported in 2014 behind *S.* Enteritidis. The provincial distribution of the ten most commonly reported *Salmonella* serovars in 2014 is highlighted in Table 4. The ten most

commonly reported *Salmonella* serovars in 2014 are compared to the top ten reported serovars in the previous five years in Table 5. As a comparison, the serovars that have dropped in ranking but have previously been identified in the top 10 within the past five years are included at the bottom of the table.

Table 4. Number of isolates reported to NESP per province and territory of the ten most commonly reported *Salmonella* serovars nationally, 2014

Serovar	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL	% of *Salmonella* Total
Enteritidis	629	494	84	99	1225	507	100	128	21	48	.	1	1	3337	43
Typhimurium	77	94	15	19	307	134	10	8	3	3	.	.	1	671	9
Heidelberg	32	38	9	13	289	195	20	18	.	13	.	.	1	628	8
Thompson	10	10	.	3	210	124	12	13	1	9	.	.	.	392	5
ssp I 4,[5],12:i:-	36	48	16	3	96	43	7	2	.	.	.	.	.	251	3
Newport	34	11	6	7	89	60	9	6	1	1	.	.	.	224	3
Infantis	25	12	1	11	74	35	2	1	1	2	.	.	.	164	2
Typhi	31	20	2	1	77	8	.	1	.	.	.	.	.	140	2
Javiana	24	16	4	7	56	19	2	3	2	.	.	.	.	133	2
Saintpaul	28	28	.	5	40	25	1	2	1	1	.	.	.	131	2
Top Ten Total	926	771	137	168	2463	1150	163	182	30	77	0	1	3	6071	77

Table 5. National total counts (overall rank) for the ten most commonly reported *Salmonella* serovars as reported to NESP, 2009-2014

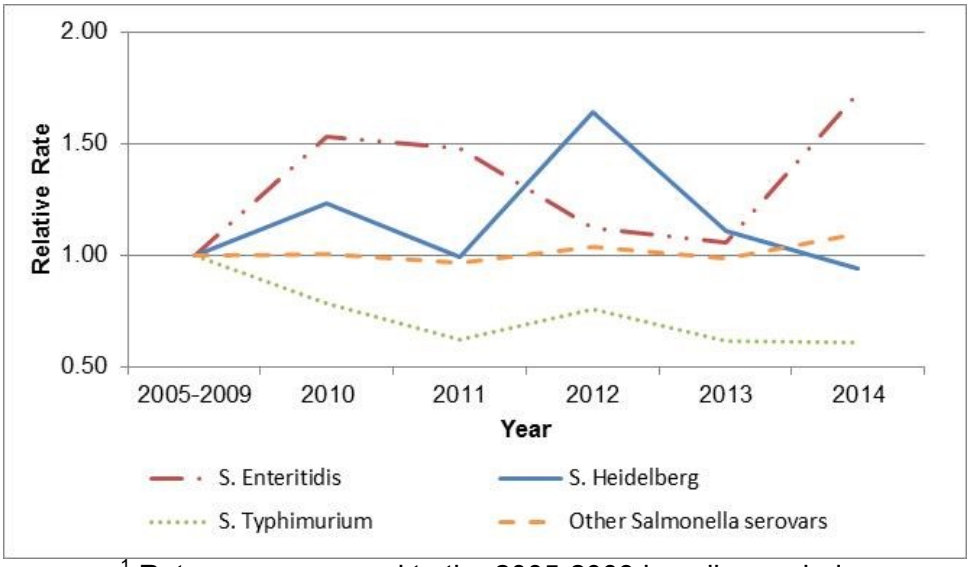
Serovar	2009	2010	2011	2012	2013	2014
Enteritidis	1955 (1)	2828 (1)	2763 (1)	2117 (1)	2019 (1)	3337 (1)
Typhimurium	777 (2)	827 (2)	661 (2)	814 (3)	668 (3)	671 (2)
Heidelberg	665 (3)	787 (3)	641 (3)	1071 (2)	733 (2)	628 (3)
Thompson	99	107 (7)	118 (8)	265 (5)	149 (6)	392 (4)
ssp I 4,[5],12:i:-	271 (4)	278 (4)	218 (4)	281 (4)	299 (4)	251 (5)
Newport	133 (6)	146 (6)	195 (6)	153 (7)	189 (5)	224 (6)
Infantis	110 (8)	106 (8)	185 (7)	184 (6)	116 (8)	164 (7)
Typhi	164 (5)	180 (5)	196 (5)	144 (8)	134 (7)	140 (8)
Javiana	102 (9)	90	77	87	113 (9)	133 (9)
Saintpaul	130 (7)	88	101 (9)	94	91 (10)	131 (10)
Hadar	100 (10)	95 (10)	75	70	73	61
Paratyphi A	92	91	94 (10)	79	73	64
Oranienburg	53	104 (9)	52	55	64	81
ssp I 4,[5],12:b:-	75	90	62	108 (9)	59	40
Braenderup	69	73	78	98 (10)	57	71

The reporting of *S*. Thompson infections during 2014 achieved its highest ranking in comparison to previous years. This is primarily due to a large multi-provincial outbreak of *S.* Thompson (highly concentrated in a single province), which was initially triggered by weekly NESP data. Several multi-provincial increases in specific *Salmonella* serovars were also noted in NESP in 2014. These increases were flagged in 23 NESP Weekly Reports as the "Topic of the Week" highlighting various *Salmonella* serovars (Typhimurium, Schwarzengrund, Enteritidis, Newport, Thompson, Litchfield, Bovismorbificans, Virchow, ssp I 4,[5],12:i:-, Infantis, Muenchen, and Javiana).

Salmonella Enteritidis, *Salmonella* Typhimurium, and *Salmonella* Heidelberg

In 2014, 3,337 isolates of *S.* Enteritidis were reported to NESP and reflects approximately 43% of all *Salmonella* isolates reported. Increased counts were noted in 2010, 2011 and again in 2014. (Table 5; Figure 3). After an observed increase in the number of *S.* Heidelberg infections reported in 2012 (above the baseline period (2005-2009), there was a subsequent decrease (and return to baseline) in cases reported to NESP in 2014. There has been a decline in the incidence of *S.* Typhimurium, while the incidence rate of all other *Salmonella* serovars combined from 2013 to 2014 compared to the 2005-2009 baseline period remained relatively unchanged (Figure 3).

Figure 3. Relative incidence rates[1] of *S.* Enteritidis, *S.* Heidelberg, *S.* Typhimurium and other *Salmonella* serovars reported to NESP by Year, 2010-2014



[1] Rates are compared to the 2005-2009 baseline period.

For most other serovars of *Salmonella*, PFGE is relied upon to differentiate among isolates and to identify case clusters, which is done through PulseNet Canada. For *S.* Enteritidis and *S.* Heidelberg, however, PFGE does not provide optimal discrimination. For these serovars, phage typing is useful for detecting trends and potential case clusters. When used in conjunction with PulseNet Canada molecular data, phage types can facilitate cluster detection and outbreak response, but on their own they also provide insight into overall trends among these frequently occurring serovars.

The numbers of reported isolates for the most common phage types reported by the NML in 2014 are shown in Figure 4 compared to the number of isolates of that phage type reported in the past five years. In 2014 there was an increase in the top four most commonly reported *S.* Enteritidis phage types: 8, 13, 13a, and 64. Phage type 64 has been continuing to increase since 2011, whereas after being stable from 2012 to 2013, phage types 13 and 13a have begun to increase once again. A steep increase in phage type 8 has occurred. Of the top four *S.* Typhimurium phage types, phage type 10 has been slowly increasing up until 2014 where a slight decrease in reported isolates has been observed. After a high level of reporting in 2009, *S.* Typhimurium phage type 108 sharply diminished in 2010 with a spike occurring again in 2012 to a more recent decline in 2014. *S.* Heidelberg phage type 19 is still on the decline after a major increase in reporting observed in 2012. The top four *S.* Enteritidis, top four *S.* Typhimurium and top two *S.* Heidelberg phage types account for 71%, 37%, and 59% of the all

phage types reported for each serovar by the NML in 2014, respectively (Figure 5). All *Salmonella* phage types reported by the NML in 2014 are listed in Appendix 3. It is important to note that phage types are not analyzed in NESP on a weekly basis, as PulseNet Canada utilizes molecular methods to differentiate subtypes in real-time. Phage type data have been used to identify long-term trends, to inform PulseNet Canada surveillance and outbreak response activities, and for provincial-level activities. It is expected that phage typing will eventually be phased out in the near- to mid-term as molecular and genomic methods are implemented.

Figure 4. Number of isolates reported to NML for the four most common phage types of a) *S.* Enteritidis and b) *S.* Typhimurium and the two most common phage types for c) *S.* Heidelberg, 2009-2014

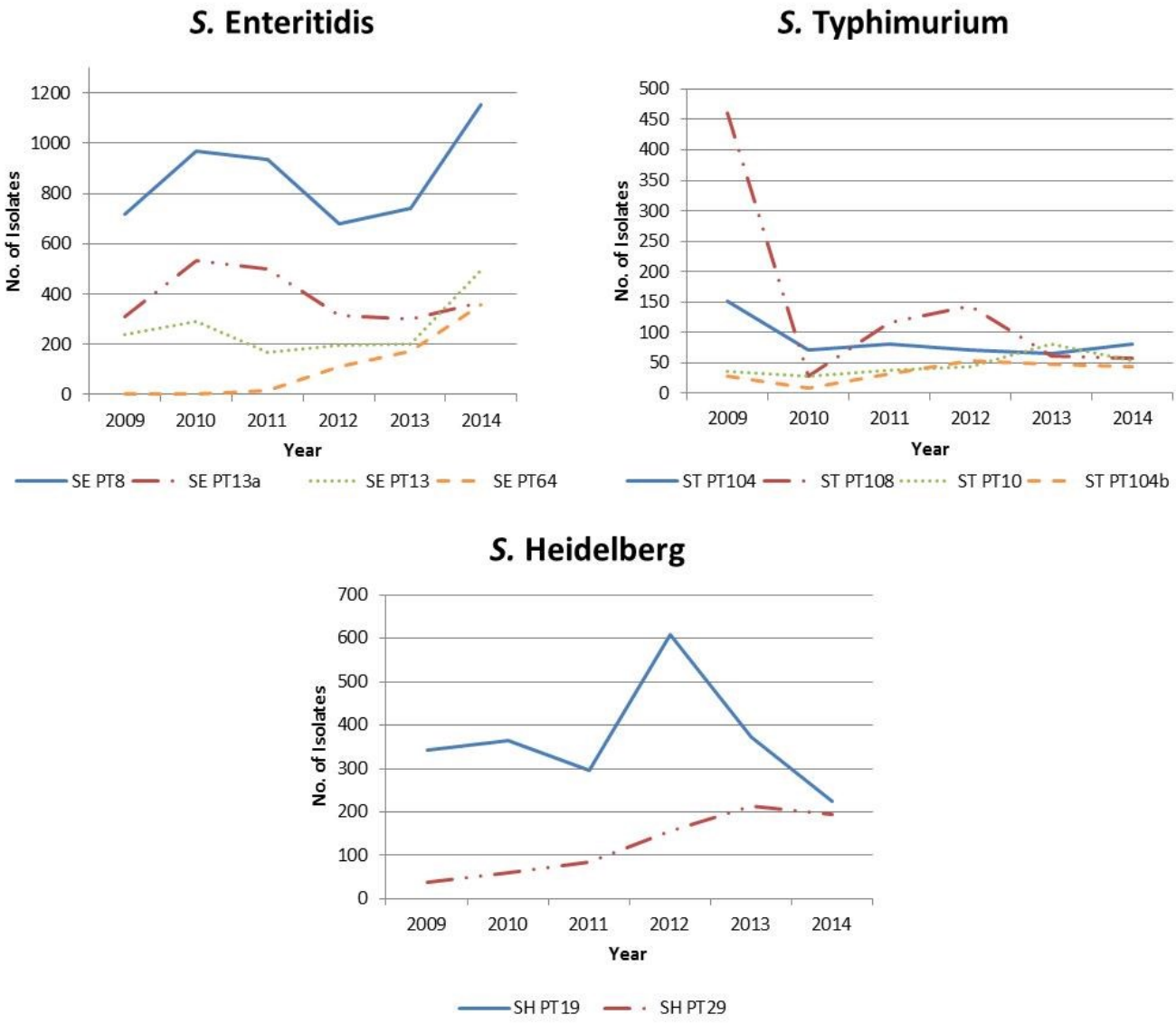
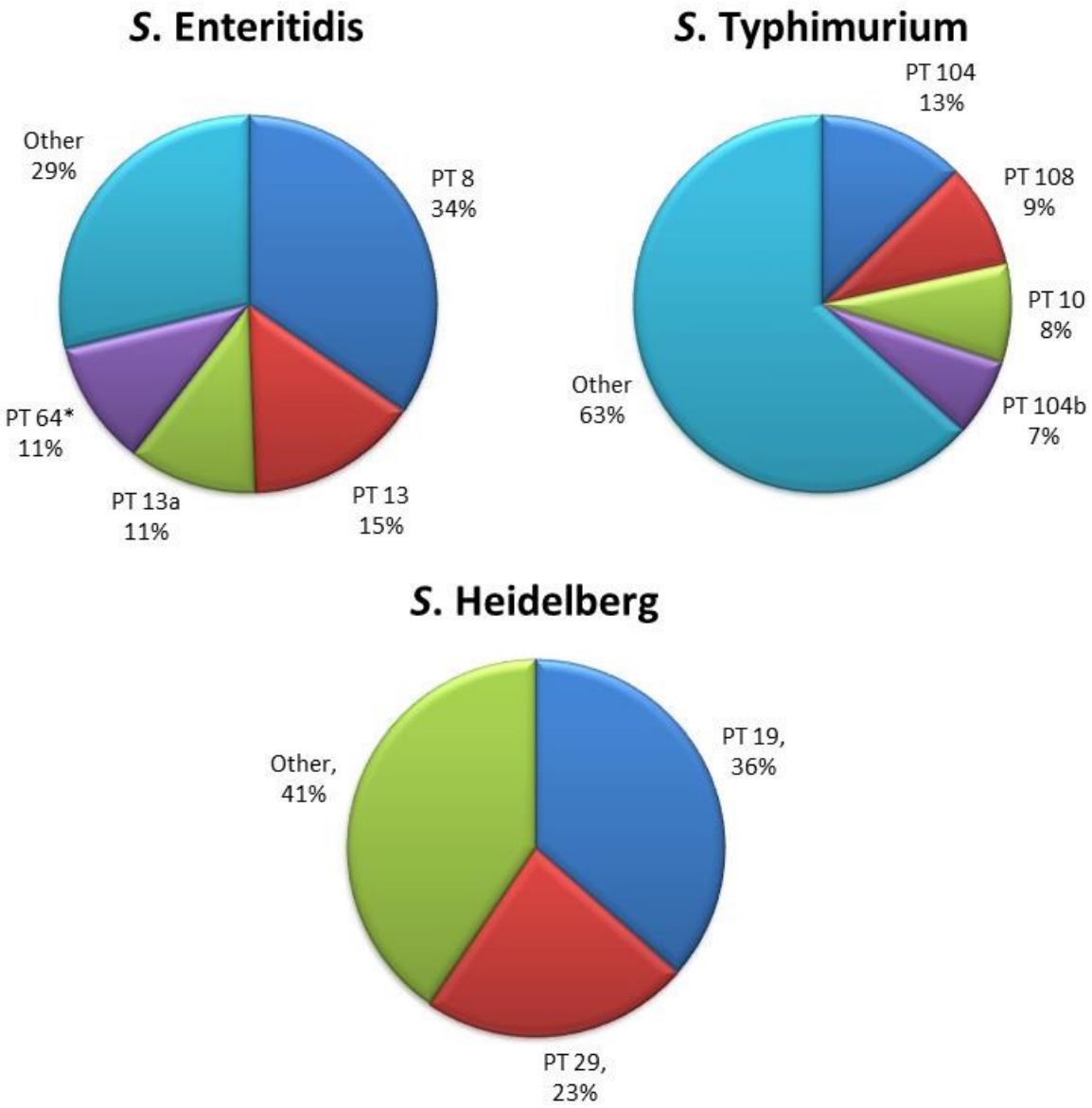


Figure 5. Distribution of phage types reported to the NML for *S.* Enteritidis, *S.* Typhimurium and *S.* Heidelberg in 2014



*PT64 was previously known as ATEN-16

Escherichia coli

NESP observed a significant decline in reported cases of verotoxigenic *E. coli* (VTEC) O157 between 2006 and 2010 (Figure 6). With a slight increase from 2010 to 2011, the overall incidence rates for the following years remained relatively consistent (1.40 cases per 100,000 in 2011, 1.39 cases per 100,000 in 2012, 1.33 cases per 100,000 in 2013, and 1.28 cases per 100,000 in 2014).

The national incidence rate of *E. coli* non-O157 reported to NESP increased from 0.12 cases/100,000 in 2008 to 0.52 cases/100,000 in 2014 (Figure 6). It should be noted that *E. coli* non-O157 are reported less consistently than *E. coli* O157 to NESP by the provincial laboratories (as many are not identified or sent to provincial laboratories) and that the specific serovar of an *E. coli* non-O157 isolate is not always reported or available. Incidence rate trends of *E. coli* non-O157 serovars and *E.coli* non-typed VTEC are illustrated in Figure 7. An increasing trend of reporting specific serovar information for *E. coli* non-O157 isolates to NESP has been noted, likely as result of increased recognition of the importance of non-O157 VTEC in food safety and therefore a response in testing practices by some provincial laboratories. In 2014 there were 129 isolates reported, compared to 85 in 2013, and 43 in 2012. The top three most commonly reported non-O157 serovars to NESP are: *E. coli* O26:H11 (24 isolates), *E. coli* O111:H Nonmotile (20 isolates), and *E. coli* O121:H19 (15 isolates). All *E. coli* serovar data reported to NESP is listed in Appendix 2. Serovar information is also available for the confirmed non-O157 VTEC isolates sent to the NML in 2014 (Appendix 4).

Figure 6. Incidence rate of *E. coli* O157 VTEC and *E. coli* non-O157 serovars (including un-typed organisms) reported to NESP, 2005-2014

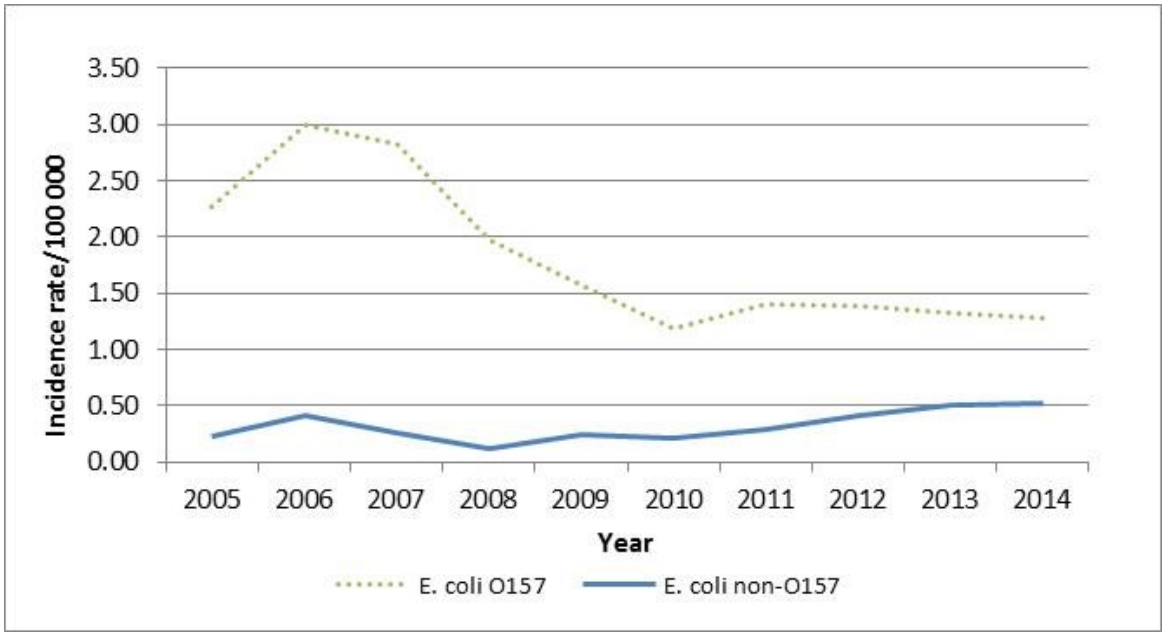
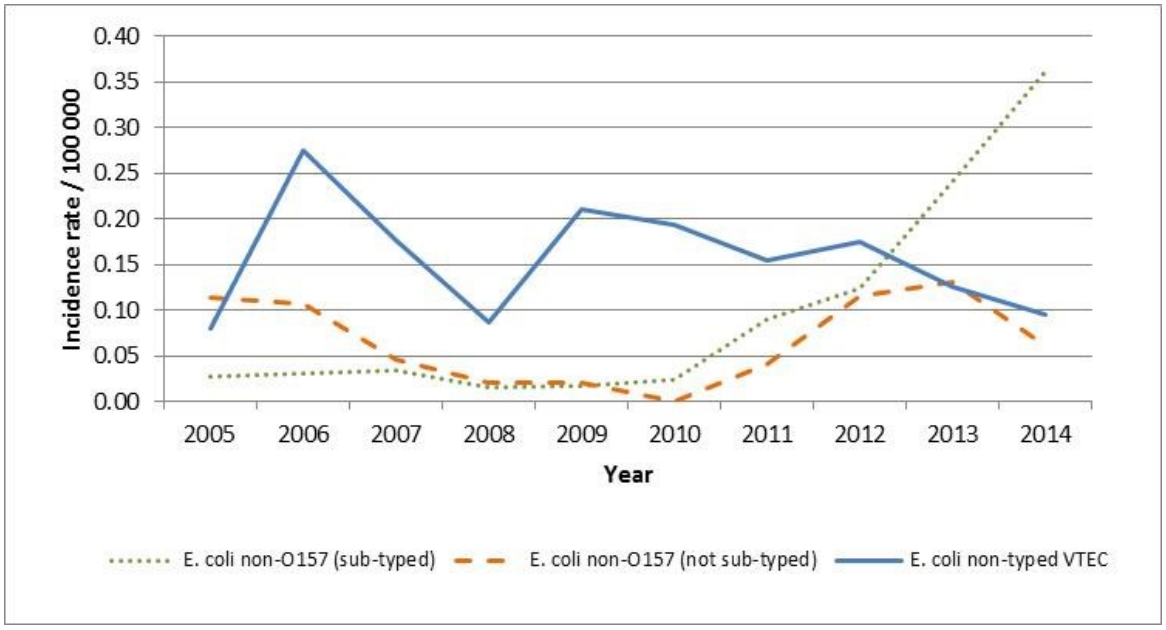


Figure 7. Incidence rate of *E. coli* non-O157 serovars and *E. coli* non-typed VTEC reported to NESP, 2005-2014



E. coli non-O157 (sub-typed) refers to isolates where a specific serovar was reported.

E. coli non-O157 (not sub-typed) refers to isolates that were reported as *E. coli* non-O157 but no specific serovar was reported.

E. coli non-typed VTEC refers to any non-typed *E. coli* (could be O157 or non-O157).

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. A total of 133 isolates were reported in 2014 with a median of three isolates reported nationally per week, and the provincial and territorial distribution of these isolates is highlighted in Table 1. The incidence rate of *L. monocytogenes* from 2011 to 2013 has dropped slightly from 0.38 to 0.33 cases per 100,000, respectively. However, from 2013 to 2014 the incidence rates returned to 0.37 cases per 100,000. The results of serotyping performed by the NML in 2014 are outlined in Table 6 (note: this will be the last year the NESP report includes *L. monocytogenes* serovars – as this test was discontinued in 2015).

Table 6. Serovar of *L. monocytogenes* isolates reported to the National Microbiology Laboratory by province, 2014[1]

Serovar	BC	AB	SK	MB	ON	QC[2]	NB	PE	NS	NL	Total
1/2a	6	5	-	1	10	-	-	-	2	1	25
1/2b	-	-	-	-	5	-	-	-	-	-	5
4a	-	-	-	-	2	-	-	-	-	-	2
4b	1	5	1	2	30	-	3	2	2	1	47
4d	-	-	1	-	1	-	-	-	-	-	2
Total *L. monocytogenes*	7	10	2	3	48	-	3	2	4	2	81

[1]This data includes only isolates collected from extra-intestinal collections site and excludes 'unknown' collection sites. Isolates from animals, food and the environment are excluded as well as multiple isolates collected from the same case.

[2] Quebec does not submit *L. monocytogenes* isolates for serotype testing to NML

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 cerebrospinal fluid are still the most common sites reported.

Table 7. Collection site of *L. monocytogenes* isolates as reported to NESP, 2014

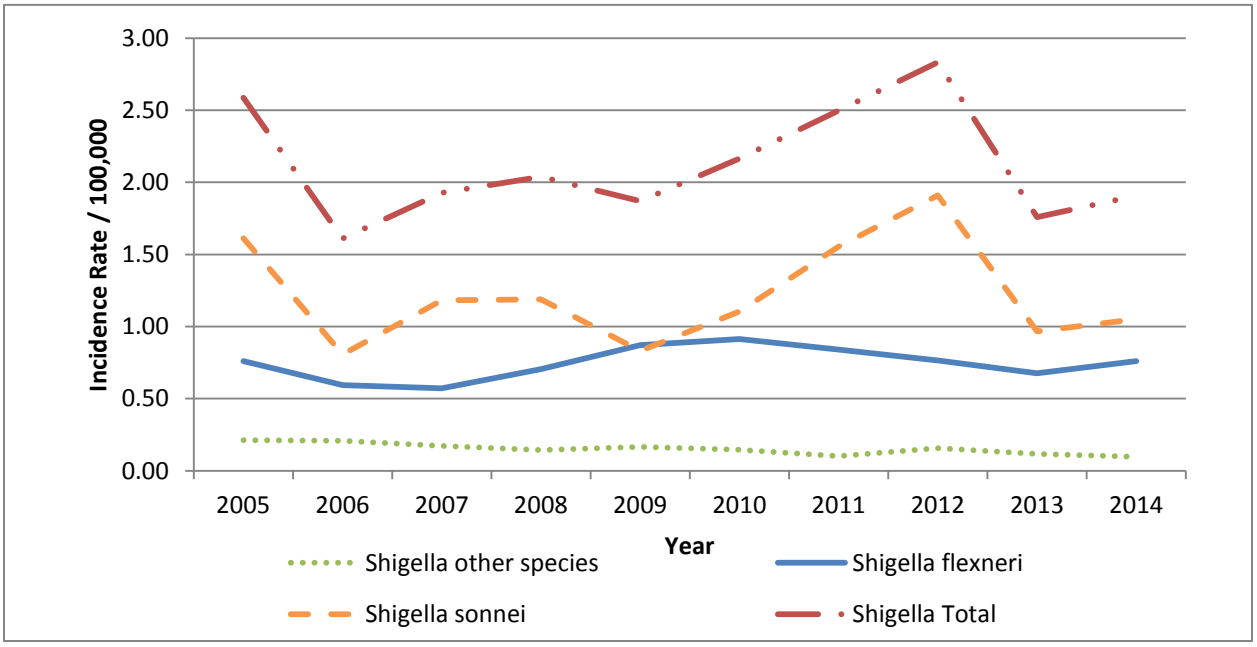
Site	No. Isolates	Percent (%)
Blood	108	81.2%
Cerebrospinal fluid	17	12.8%
Other tissue or fluid[1]	8	6.0%
Total	133	-

[1]Joint fluid (2), placenta, abdominal fluid, intra-cranial fluid, urine, amniotic fluid, gall bladder

Shigella

In 2014, 681 *Shigella* isolates were reported to NESP, with approximately half being *Shigella sonnei* (n=375). After a sharp decline in cases reported between 2012 and 2013, there was a slight increase in the overall reporting of *Shigella* infections in 2014 (1.75 cases per 100,000 in 2013 to 1.91 cases per 100,000 in 2014).

Figure 8. Incidence rate of *Shigella* species reported to NESP, 2005-2014



Hepatitis A

In July 2012, the list of organisms included in NESP was expanded to include Hepatitis A. This addition was designed to provide timely national surveillance of Hepatitis A for multi-jurisdictional outbreak detection. The data in this report represents the second complete year of data collection on Hepatitis A, and the number of isolates reported by each province/territory is highlighted in Table 8 and Appendix 2. There were 208 cases (incidence rate of 0.58 cases per 100,000 population) reported to NESP in 2014.

It is important to note that there are multiple streams for reporting Hepatitis A cases to NESP. In provinces where Hepatitis A testing is done primarily by private or hospital laboratories, a weekly count of the number of cases is provided by the provincial/territorial ministry of health. In other provinces where testing is conducted at the provincial laboratory, the cases are routinely reported to NESP similar to the other organisms under surveillance. The timeliness of reporting will depend, in part, on whether the data is reported via the provincial laboratory or epidemiology arm of public health.

Table 8. Number of Hepatitis A isolates reported to NESP by Province and Territory, 2014

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL
Hepatitis A	21	27	17	8	83	46	-	3	-	3	-	-	-	208

Isolates Collected from Extra-intestinal Isolation Sites

Isolation of an organism from a sterile site may reflect more severe illness and an increased likelihood to seek treatment and submit a specimen for testing. The number of isolates collected from extra-intestinal sites (excluding *L. monocytogenes*) reported to NESP in 2014 is outlined in Table 9. Although information regarding extra-intestinal isolation sites is collected by NESP, these data are not consistently reported to provincial laboratories and therefore may not be adequately represented in the NESP report.

Table 9. Number of isolates collected from extra-intestinal sites as reported to NESP, 2014

Organism	Blood	Urine	Other[1]	Total/Overall	Percent (%)
Campylobacter	**38**	**0**	**2**	**40/1676**	**2.4**
fetus ssp *fetus*	15		1	16/44	36.4
jejuni	20			20/1214	1.6
Other species[2]	3		1		
E. coli		**1**		**1/643**	**0.2**
E. coli O157:H7		1		1/400	0.3
Salmonella serovar	**333**	**204**	**40**	**577/7851**	**7.3**
Agona	2	3	1	6/78	7.7
Anatum	1	2		3/27	11.1
Bovismorbificans	1		2	3/34	8.8
Braenderup		3		3/71	4.2
Brandenburg	3	1	1	5/24	20.8
Chester	2	1		3/19	15.8
Derby	1	2		3/28	10.7
Dublin	6	1		7/19	36.8
Eastbourne	2			2/21	9.5
Ebrie	1		1	2/5	40.0
Enteritidis	100	49	15	164/3337	4.9
Hadar	1	5		6/61	9.8
Hartford	1	3		4/45	8.9
Heidelberg	42	21	5	68/628	10.8
Infantis	1	4	1	6/164	3.7
Javiana	5	7		12/133	9.0
Kentucky	1	2		3/30	10.0
Litchfield		2		2/27	7.4
Mbandaka		1	1	2/25	8.0
Montevideo	2	4		6/31	19.4
Muenchen	1	8		9/81	11.1
Newport	5	8		13/224	5.8
Ohio	1	1		2/5	40.0
Oranienburg	7	8	1	16/81	19.8
Panama	4	1		5/31	16.1
Paratyphi A	31	1		32/64	50.0
Poona	2			2/21	9.5
Reading	2			2/19	10.5
Saintpaul	6	3	1	10/131	7.6
Schwarzengrund	7	3		10/59	16.9
Senftenberg		8		8/35	22.9

Organism	Blood	Urine	Other[1]	Total/Overall	Percent (%)
Tennessee		1	1	2/10	20.0
Thompson	10	5	1	16/392	4.1
Typhi	51			51/140	36.4
Typhimurium	13	11	4	28/671	4.2
Virchow	5		1	6/26	23.1
ssp I	1	1		2/13	15.4
ssp I 4,[5],12:i:-	3	3		6/251	2.4
ssp I 6,7,[14]:c:-			2	2/2	100.0
ssp I 9,12:-:-	1	1		2/5	40.0
ssp I Rough-O:-:-		5		5/11	45.5
Other serovars[3]	11	25	2		
***Shigella* species**	**3**		**1**	**4/681**	**0.6**
flexneri 3			1	1/15	6.7
flexneri 3b	1			1/23	4.3
flexneri	1			1/18	5.6
sonnei	1			1/375	0.3
***Vibrio* species**			**4**	**4/82**	**4.9**
alginolyticus			2	2/6	33.3
cholerae			1	1/1	100.0
parahaemolyticus			1	1/50	2.0
***Yersinia* species**	**1**		**2**	**3/341**	**0.9**
enterocolitica	1		2	3/302	1.0
Total	375	204	49	**629**	

[1] Other sites include: **Abscess:** *S.* Enteritidis (1), *S.* Mbandaka (1), *S.* Virchow (1); **Abdominal fluid:** *S.* Heidelberg (1), *S.* Enteritidis (1), *S.* Agona (1), *C. curvus* (1); **Abdominal pus:** *S.* Enteritidis (1); **Aorta:** *S.* ssp I 6,7,[14]:c:- (1); **Biliary fluid:** *S.* Thompson (1); **Biopsy – unknown:** *S.* Enteritidis (1), *S.* Newport (1); **Biopsy – lung:** *S.* Enteritidis (1); **Biopsy – terminal ileum:** *S.* Sandiego (1); **Bronchoalveolar lavage:** *S.* Typhimurium (1); **Colon biopsy:** *S.* Brandenburg (1); **Elbow:** *S.* Ebrie (1); **Foot:** *V. alginolyticus* (1); **Hip puncture:** *C. fetus* ssp *fetus* (1); **Hip swab:** *S.* Oranienburg (1); **Joint fluid:** *S.* Enteritidis (1); **Left vertebral fluid:** *S.* Heidelberg (1); **Leg:** *S.* Saintpaul (1), *S.* ssp I 6,7,[14]:c:- (1); **Lung cavity fluid:** *S.* Enteritidis (1), **Pancreatic pseudocyst:** *S.* Enteritidis (1), **Peri-anal abscess:** *S.* Enteritidis (1); **Pleural fluid:** *S.* Enteritidis (1), *S.* Typhimurium (1); **Scrotum:** *S.* Enteritidis (1), **Serum:** *S.* Infantis (1), **Sputum:** *S.* Heidelberg (1); **Tissue - unknown:** *S.* Enteritidis (1), *S.* Heidelberg (1); **Tissue - micotic aortic aneurysm**: *S.* Enteritidis (1); **Toe:** *V. cholerae*; **Wound:** *S.* Bovismorbificans (2), *S.* Enteritidis (2), *S.* Heidelberg (1), *S.* Typhimurium (2), *S.* ssp I O-:l,z13,l,z28:e,n,z15 (1), *V.* alginolyticus (1), *V. parahaemolyticus* (1), *Y. enterocolitica* (2).

[2] Other species of *Campylobacter* include those where only a single isolate from an extra-intestinal source was reported: *C. curvus*, *C. jejuni/coli*, *C. lari,* and *C.* sp.

[3] Other *Salmonella* serovars include those where only a single isolate from an extra-intestinal source was reported: *S*. Alachua, *S*. Amsterdam, *S*. Apapa, *S*. Arechavaleta, *S*. Bonariensis, *S*. Bradford, *S*. Bredeney, *S*. Chailey, *S*. Cotham, *S*. Give, *S*. Haifa, *S*. Kiambu, *S*. Livingstone, *S*. Meleagridis, *S*. Michigan, *S*. Muenster, *S*. Orientalis, *S*. Paratyphi B var. Java, *S*. Rissen, *S*. Sandiego, *S*. Stanley, *S*. Telelkebir, *S*. Uganda, *S*. Urbana, *S*. Weltevreden, *S.* ssp I (multiple), and *S.* ssp IIIb (multiple).

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 270 cases of enteric infection recorded through NESP were reported in foreign travelers or new immigrants arriving in Canada (Table 10 & Table 11). This represents only 1.7% of all pathogens reported to NESP in 2014. The Caribbean and Asia were the most frequently identified regions and were associated with 22% (60 cases) and 18% (48 cases) of travel-acquired infections, respectively. The Caribbean and Central America are popular winter destinations for Canadians and represent 38% of the travel-acquired infections reported.

Table 10. Number of infections by geographical region as reported to NESP, 2014

Geographic Region	No. of Cases (%)
Caribbean	60 (22.3)
Asia	48 (17.8)
Central America	42 (15.6)
Africa	38 (14.1)
South America	12 (4.5)
North America	8 (3.0)
Europe	5 (1.9)
Oceania	4 (1.5)
Multiple regions	12 (4.5)
Destination not identified	41 (15.2)
Total	**270**

Salmonellosis was the most commonly reported travel-related infection, accounting for 35% of travel associated cases reported to NESP in 2014. Parasitic infections were also frequently reported (29% of travel cases), specifically Giardiasis, which alone accounted for 19% of all travel associated infections. Information on countries of travel was not available for 15% of travel-associated infections

There were two cases of *Vibrio cholerae* O1 reported to NESP in 2014, one with travel to India and the other with travel to Cuba during their exposure period.

Table 11. Number of travel-acquired infections reported to NESP by organism, 2014

Organism	No. of Cases (% of total travel)	% of Pathogen Total	Country or Region (number of cases >1)[1]
***Campylobacter* species**	**38 (14.1%)**	**2.3**	
coli	3	1.8	Mexico, Multiple destinations (2) (India, Nepal, Bangladesh)
jejuni	11	0.9	Africa, Dominican Republic, Fiji, Greece, Mexico (2), Multiple destinations (2) (Mexico, Dominican Republic, Asia), Nepal, Pakistan, Tahiti
jejuni/coli	24	24.0	Africa, China, Cuba (2), Dominican Republic (2), Italy, Jamaica, Japan, Kenya, Mexico, Peru (2), Tanzania, Turkey, Unknown (7), USA
***Salmonella enterica* subsp. *enterica* serovars**	**93 (34.6%)**	**1.2**	
Enteritidis	44	1.3	Cuba (21), Dominican Republic (5), India, Mexico (14), Multiple destinations (3) (Cuba, Mexico, China)
Javiana	3	2.3	Cuba (3)
Mbandaka	2	8.0	Dominican Republic (2)
Newport	3	1.3	Cuba, Mexico (2)
Paratyphi A	2	3.1	India, Pakistan
Saintpaul	3	2.3	Brazil, USA, Jamaica
ssp I 4,[5],12:i:-	3	1.2	Lebanon (2), Mexico
Typhi	9	6.4	India (8), Pakistan (1)
Typhimurium	6	0.9	Mexico (3), Multiple destinations (Mexico, Cuba)
Other serovars[2]	18		Cuba (5), Ecuador, Europe, Jamaica, Lebanon, Mexico (4), Multiple destinations (Cambodia and Vietnam), Pakistan, Philippines (3)

Organism	No. of Cases (% of total travel)	% of Pathogen Total	Country or Region (number of cases >1)[1]
***Shigella* species**	**17 (6.3%)**	**2.5**	
dysenteriae 2	2	40.0	Dominican Republic (2)
flexneri[3]	6	4.1	India (2), Multiple destinations (2) (Vietnam, Cambodia, Laos, Mexico, India, Chile, Bolivia, Peru, and Colombia), Saudi Arabia, Somalia
sonnei	9	2.4	Cuba, Dominican Republic, India, Mexico (3), Thailand, USA
***Vibrio* species**	**2 (0.7%)**	**2.4**	
cholerae O1	1	100.0	India
cholerae O1 Ogawa	1	100.0	Cuba
***Yersinia* species**	**3 (1.1%)**	**0.9**	
enterocolitica	2	0.7	Cuba (2)
intermedia	1	7.1	Mexico
Parasites	**77 (28.6%)**	**4.3**	
Cryptosporidium	3	0.7	Cuba, Dominican Republic, Unknown
Cyclospora	1	3.6	Mexico
Entamoeba histolytica/dispar	23	4.2	Africa (2), Colombia (2), Congo (2), Cuba, Ecuador (2), Eritrea, India, Iran, Mozambique, Spain, Uganda, Unknown (8)
Giardia	50	6.1	Africa, Bhutan, Colombia, Congo (3), Costa Rica, Iraq, Jamaica, Kenya (3), Middle east, Morocco, Nepal, New Zealand, Republic of Cameroon (2), Rwanda (4), Somalia, Sudan, Tanzania, Unknown (23)
Viruses	**40 (14.9%)**	**1.4**	
Hepatitis A	39	18.8	Africa (2), Algeria, Bangladesh, Chad, China, Cuba, Dominican Republic, El Salvador, Ethiopia (2), Europe, Fiji, Guatemala, Haiti, Honduras, India (4), Mexico (4), Morocco (2), Multiple destinations (Singapore, Istanbul, Philippines, and Dubai), Nicaragua, Pakistan (3), Peru (1), Philippines (2), Tanzania, Unknown, USA (3)
Rotavirus	1	0.2	Cuba
Total	**270**	**1.7**	

[1] Where more than one case reported travel to a country or region, the number of travelers is indicated in brackets.

[2] Other serovars includes the *Salmonella* serovars that were reported as travel-associated by a single case including: *S.* Anatum, *S.* Berta, *S.* Blockley, *S.* Bredeney, *S.* Concord, *S.* Derby, *S.*

Hadar, *S.* Havana, *S.* Javiana, *S.* Newport, *S.* Oranienburg, *S.* Paratyphi B var. Java, *S.* Singapore, *S.* ssp I Rough-O:e,h:1,5, *S.* Uganda and *S.* Virchow.

[3] *S. flexneri* category includes *S. flexneri* 6*, S. flexneri* 1b*, S. flexneri* 2a*, and S. flexneri* 3a.

Summary

Since its inception in 1997, NESP has developed a robust database of information pertaining to laboratory-confirmed isolations of enteric pathogens in Canada. With the ongoing collaboration of federal, provincial and territorial laboratory and epidemiological partners, NESP is used for its ability to detect and support multi-jurisdictional outbreaks, to flag anomalies for further investigation, and to identify long-term trends in enteric disease nationally. Key findings in 2014 include *S*. Enteritidis, *S*. Typhimurium, and *S*. Heidelberg remaining the top three most commonly reported *Salmonella* serovars. However, of note was a significant increase in *S*. Enteritidis from 2013 to 2014 with *S.* Enteritidis representing 43% of all *Salmonella* isolates reported in 2014 compared to 32% in 2013. In 2014 there was also a continued stable incidence rate of *E. coli* O157 since its major decline in 2011. Finally, in 2014, there was an observed ongoing increase in testing and reporting procedures for *E. coli* non-O157 reflecting, at least in part, greater awareness and knowledge of clinically significant *E. coli* serovars other than *E. coli* O157.

Going forward, it is expected NESP data will continue to be relied upon as a method to support the real-time detection and response to emerging and priority diseases, to provide early warning signals to support public health action, and to identify long-term trends and integrate with national and international efforts to monitor and limit the spread of enteric diseases.

Questions and correspondence may be forwarded via email to NML.Enterics@phac-aspc.gc.ca

Appendix 1. Comparison of national totals, incidence per 100,000 and proportion captured between the Canadian Notifiable Disease Surveillance System (CNDSS) and NESP for enteric, food and waterborne diseases, 2013

Enteric, Food and Waterborne Diseases	Canadian Notifiable Disease Surveillance System (CNDSS)[1]		National Enteric Surveillance Program (NESP)		% of CNDSS cases captured in NESP (NESP isolations / CNDSS cases[5])
2013	N	Rate per 100,000	N	Rate per 100,000	
Botulism	5	0.01	-	-	N/A
Campylobacteriosis[2]	10232	29.13	1866	-	18.2
Cholera	1	< 0.01	1	< 0.01	100.0
Cryptosporidiosis[2]	830	2.36	341	-	41.1
Cyclosporiasis[2,3]	146	0.42	17	-	11.6
Giardiasis[2]	3788	10.79	779	-	20.6
Hepatitis A	212	0.60	217	0.61	102.4
Invasive Listeriosis	128	0.36	117	0.33	91.4
Paralytic Shellfish Poisoning[4]	0	0.00	-	-	N/A
Salmonellosis	6171	17.57	6270	17.77	101.6
Shigellosis	682	1.94	621	1.76	91.1
Typhoid	124	0.35	133	0.38	107.3
Verotoxigenic *Escherichia coli* Infection	631	1.80	647	1.83	102.5

[1]NU did not report on any of these diseases in 2013. The population of the territory has been removed for rate calculation.

[2]*Campylobacter* and parasites *(Cryptosporidium, Cyclospora* and *Giardia)* are not routinely reported to provincial or central reference laboratories and are greatly under-represented in NESP; therefore no rate was calculated for NESP.

[3]NB did not report on Cyclosporiasis in 2013. The population of these provinces have been removed for rate calculation.

[4]MB, NB, NT, ON, and SK did not report on Paralytic Shellfish Poisoning in 2013. The population of these provinces and territory have been removed for rate calculation.

[5]Cases reported through the CNDSS and laboratory-confirmed isolations through NESP have not been linked, this is the degree of concurrence represented as a percentage of NESP isolations compared to the case count reported by the CNDSS. Percentages greater than 100 likely reflect cases with more than one isolate.

Appendix 2. Species and serovar data reported to NESP by province and territory, 2014

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
Campylobacter														
coli	52	16	14	5	24	43	2		6	1				163
concisus						1								1
curvus						1								1
fetus ssp *fetus*	3	1			8	32								44
jejuni	350	248	119	88	114	99	134		30	32				1214
jejuni/coli								97		3				100
lari	4	2	1		3	7	1		4					22
rectus						2								2
upsaliensis	24	6	3		12	12	1		2					60
urealyticus	1													1
Campylobacter sp	2		1				62	2		1				68
Total *Campylobacter*	**436**	**273**	**138**	**93**	**161**	**197**	**200**	**99**	**42**	**37**	**0**	**0**	**0**	**1676**
Escherichia coli														
O5:H Nonmotile		2	1			1								4
O13:H Undetermined						1								1
O26:H11	8	8	8											24
O26:H Nonmotile	1	1	3			1								6
O41:H2	1													1
O43:H2	1													1
O49:NM			1											1
O52:H45					2	4								6
O75:H21	1													1
O77:H45	1													1
O80:H14			1											1
O96:-:-			1											1
O98:H Nonmotile					1									1
O103	1													1
O103:H2	2				2	1								5
O103:H21			1											1
O111				1										1
O111:H Nonmotile	12	5		1	1	1								20
O112ab:H Nonmotile	1													1
O117:H7	4													4
O118:H Undetermined	1		1											2
O121	1													1
O121:H1	1		1											2
O121:H9	1													1
O121:H19	6	2	6			1								15
O126:H8	1													1
O127:VT-				1										1
O128:- VT-				1										1
O128ab:H2						1								1
O145:H19			1											1
O145:H25						1								1
O145:H Nonmotile			1											1
O146:H Nonmotile						1								1

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
O156:H19			1											1
O157			4	20						1				25
O157:H7	51	178		2	102	48	3	7	9					400
O157:H16		1												1
O157:H Nonmotile	4	7			14	5		2						32
O172:H16			1											1
O182:H Undetermined			1											1
O182:H19			1											1
O186:H2	3		2											5
O186:H Nonmotile		1												1
O-Rough:H Undetermined	2													2
O-Rough:H1	1													1
O-Rough:H2		1												1
O-Rough:H7	1													1
O-Rough:H16						1								1
O-Rough:H45					1	1								2
Inactive									1					1
Non-O157 VTEC	4			11						7				22
Non-Typed VTEC	14			3		16								33
Total *E. coli*	**124**	**206**	**36**	**40**	**123**	**84**	**3**	**9**	**10**	**8**	**0**	**0**	**0**	**643**
Listeria														
monocytogenes	18	10	2	3	45	46	3	4	1	1				133
***Salmonella enterica* serovars**														
Aarhus	1													1
Aberdeen				1	3									4
Abony		1			1									2
Adelaide		1			1									2
Agona	15	15	2		33	10	2	1						78
Ajiobo	1													1
Alachua	1				1	1								3
Albany	4		1		4									9
Altona					3									3
Amager	1													1
Amsterdam			1		1									2
Anatum	5	4	1		14	2	1							27
Apapa					1	2								3
Arechavaleta	1				7			1						9
Bardo					6									6
Bareilly	4	3	1	1	7									16
Benin					1									1
Berta					5				1					6
Bispebjerg	1													1
Blockley					2	1								3
Bonariensis	1	1			4									6
Bovismorbificans	6	3			13	12								34
Bradford		1												1
Braenderup	6	10	2	2	22	25	1	2		1				71
Brandenburg	4	6		5	4	4	1							24
Brazil						1								1

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
Bredeney	1	1			2									4
Carrau	1													1
Cerro		1			1									2
Chailey		1												1
Chester	2		1		9	7								19
Choleraesuis						2								2
Colindale		1												1
Corvallis	5	2	1	1	11	1								21
Cotham	2	1			4									7
Cubana					2									2
Daytona	6													6
Derby		2			16	10								28
Drogana					1									1
Dublin	3	2			5	9								19
Durban					1									1
Ealing		1												1
Eastbourne					13	6		2						21
Ebrie	3				2									5
Edinburg					2									2
Emek		1			2									3
Enteritidis	629	494	84	99	1225	507	100	128	21	48		1	1	3337
Fairfield					1									1
Florida						1								1
Fresno	1													1
Gaminara					1									1
Gatuni					1	1								2
Give	4	1			4	2	1							12
Goettingen			1		2									3
Goverdhan	2				1									3
Hadar	8	2	2	14	20	9	1	1		3		1		61
Haifa	1	2	1		3	1								8
Hannover					1									1
Hartford	6	5	1		31	2								45
Havana	1				4	2								7
Heidelberg	32	38	9	13	289	195	20	18		13			1	628
Herston						1								1
Holcomb					1									1
Hvittingfoss	1	1		1	9								1	13
Idikan					1									1
Indiana					3	2								5
Infantis	25	12	1	11	74	35	2	1	1	2				164
Inverness					1									1
Irumu	1	1			2									4
Isangi					2									2
Istanbul		1												1
Javiana	24	16	4	7	56	19	2	3	2					133
Johannesburg					1	1								2
Kedougou		1			1									2
Kentucky	7	2			15	6								30
Kiambu	2	3	1	3	11	2								22

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
Kintambo					3	1								4
Kirkee					1									1
Kisarawe					1									1
Kottbus		1			1	2								4
Kouka					1									1
Lagos					2									2
Larochelle					1	3								4
Lattenkamp	1				1									2
Litchfield	2			5	13	5	1			1				27
Liverpool	2				1									3
Livingstone	1	1			2									4
Lomalinda		2			2									4
London	2				3	1								6
Manhattan	3	2		5	14	3								27
Mbandaka	4	5			11	3	1	1						25
Meleagridis	2													2
Miami		1			2	5								8
Michigan	1	1												2
Mikawasima					1									1
Minnesota	1	1	1			1								4
Mississippi		1	3	1	3	2		1						11
Monschaui	1					1								2
Montevideo	5	6	2	1	10	7								31
Muenchen	5	6	1	4	43	17	1	3		1				81
Muenster	1				2	3								6
Napoli		1			1	1								3
Nessziona						4		1						5
Newport	34	11	6	7	89	60	9	6	1	1				224
Norwich					1	1								2
Nottingham		1												1
Ohio		1		2		2								5
Okatie					1	1								2
Oranienburg	16	10	2	3	33	13	2	2						81
Ordonez	1													1
Orientalis	1													1
Oslo	4	3			3	1								11
Othmarschen	1				1									2
Overschie					1									1
Oxford						1								1
Panama	2	6			19	4								31
Paratyphi A	19	10	1	2	27	4		1						64
Paratyphi B	4			2	1	1								8
Paratyphi B var. Java	15	12	3		18	8								56
Pensacola		1												1
Pomona		3		1	3	2								9
Poona	3	4			8	4	1			1				21
Potsdam	1	1												2
Praha					1									1
Putten					1									1
Reading	6	6	2		4							1		19

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
Richmond	1				2									3
Rissen	4	1			4	1								10
Rubislaw	3				2									5
Ruiru						1								1
Saintpaul	28	28		5	40	25	1	2	1	1				131
Sandiego	3	3	1	1	5	3								16
Schwarzengrund	9	7	6	1	25	9	1			1				59
Senftenberg	5	5	3	2	10	2	1	5	1	1				35
Seremban					1									1
Singapore	1				2	1								4
Solt					1									1
Stanley	28	6	3	4	27	3		1						72
Stanleyville						1								1
Takoradi					1									1
Tallahassee					1									1
Tarshyne					1									1
Telelkebir		2	1											3
Tennessee	2		1		6	1								10
Thompson	10	10		3	210	124	12	13	1	9				392
Tornow					1									1
Typhi	31	20	2	1	77	8		1						140
Typhimurium	77	94	15	19	307	134	10	8	3	3			1	671
Uganda	1	1		2	3	4	1	1						13
Urbana		1				2								3
Virchow	3	7			9	5	1	1						26
Wangata						1								1
Weltevreden	7	7		1	4	2								21
Worthington	1	1		1	1									4
species				6				1		3				10
ssp I	1			9				1	2					13
ssp I 1,3,19:-:-							1	1						2
ssp I 2,12:-:-					1									1
ssp I 3,15,34:l,z13,z28:1,7						1								1
ssp I 4,12:-:-						1								1
ssp I 4,[5],12,27:-:1,2		1												1
ssp I 4,[5],12:-:-		1			1									2
ssp I 4,[5],12:-:1,2						1								1
ssp I 4,[5],12:b:-		4			30	6								40
ssp I 4,[5],12:d:-	1													1
ssp I 4,[5],12:e,h:-						1								1
ssp I 4,[5],12:i:-	36	48	16	3	96	43	7	2						251
ssp I 4,[5],12:r:-						1								1
ssp I 6,7,[14]:-:1,2		1												1
ssp I 6,7,[14]:b:-		1												1
ssp I 6,7,[14]:c:-		2												2
ssp I 6,7,[14]:k:-		2												2
ssp I 6,7:-:-					1									1
ssp I 6,7:c:-					1									1
ssp I 6,7:d:-	1													1
ssp I 6,7:e,h:-	1				1			1						3

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
ssp I 6,7:k:-	1				1									2
ssp I 6,7:r:-					2									2
ssp I 6,7:y:-	1													1
ssp I 6,8:-:1,5	1													1
ssp I 6,8:d:-	1													1
ssp I 6,8:e,h:-	1				1									2
ssp I 6,8:r:-						2								2
ssp I 9,12:-:-					1	4								5
ssp I 9,12:-:1,5	1	5			3	1	1	3						14
ssp I 9,12:l,z28:-					2									2
ssp I 13,23:b:-					2		1							3
ssp I 13,23:z:-					1									1
ssp I 16:l,v:-					1									1
ssp I 50:y:-		1				1								2
ssp I O-:l,z13,l,z28:e,n,z15						1								1
ssp I O19:d:-	1													1
ssp I O50:-:-						1								1
ssp I Rough-O:-:-	1	2			6	2								11
ssp I Rough-O:-:1,5						1								1
ssp I Rough-O:-:1,6						1								1
ssp I Rough-O:b:l,w						1								1
ssp I Rough-O:d:1,2		1			2									3
ssp I Rough-O:e,h:-					1									1
ssp I Rough-O:g,m:-		1					1							2
ssp I Rough-O:i:-					1									1
ssp I Rough-O:k:-						1								1
ssp I Rough-O:k:1,5					1									1
ssp I Rough-O:m,t:-			1											1
ssp I Rough-O:r:1,2	1													1
ssp I Rough-O:z10:-	2													2
ssp I Rough-O:z4,z23:-					1									1
ssp I Rough-O:z:-					1									1
ssp I Rough-O:z:l,w	1													1
ssp II 4,12:g,m,t:-					1									1
ssp II 6,7:z4,z23:-		1												1
ssp II 42:z29:-	1													1
ssp II 43:g,z62:e,n,x					1									1
ssp II 47:b:1,5					1									1
ssp II 58:l,z13,z28:z6	1													1
ssp IIIa 21:g,z51:-					1									1
ssp IIIa 41:z4,z23:-		3			1	1								5
ssp IIIa 47:z4,z23:-	1													1
ssp IIIa 53:z4,z23:-						1								1
ssp IIIb	1			1										2
ssp IIIb 16:z10:e,n,x,z15	1													1
ssp IIIb 38:k:1,5,7		1												1
ssp IIIb 47:k:z35					1									1
ssp IIIb 48:i:z:[z72]		1												1

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
ssp IIIb 50:k:z					1									1
ssp IIIb 50:l,v:z35					1									1
ssp IIIb 50:r:z53	1													1
ssp IIIb 53:-:-					1									1
ssp IIIb 53:z10:z					1									1
ssp IIIb 53:z10:z35		1			1									2
ssp IIIb 60:r:e,n,x,z15	1													1
ssp IIIb 61:-:1,5,7						2								2
ssp IIIb 61:i:z							1							1
ssp IIIb 61:l,v:1,5,7:[z57]		1												1
ssp IIIb 65:z52:z		1												1
ssp IIIb Rough-O:l,v:z					1									1
ssp IV						1								1
ssp IV 6,7:z4,z23:-					1									1
ssp IV 16:z4,z32:-					1									1
ssp IV 44:z4,z23:-	1													1
ssp IV 45:g,z51:-						1								1
ssp IV 48:g,z51:-	1													1
ssp IV 50:g,z51:-		2												2
ssp IV 50:z4,z32:-					1									1
Total *Salmonella*	**1231**	**1008**	**184**	**250**	**3207**	**1443**	**185**	**213**	**34**	**89**	**0**	**3**	**4**	**7851**
***Shigella* species**														
boydii				2						1				3
boydii 1	1				1									2
boydii 2					3	1								4
boydii 4					3									3
boydii 8	1													1
boydii 10	2	1			2									5
boydii 11					1									1
boydii 12	1													1
boydii 14	2													2
boydii 19	2													2
boydii 20	1													1
dysenteriae 2	3				2									5
dysenteriae 4					2									2
dysenteriae 16	2													2
flexneri 1	11													11
flexneri 1a						1								1
flexneri 1b	1	4			8	2		1						16
flexneri 2	13													13
flexneri 2a	1	8			17	6			1					33
flexneri 2b					4									4
flexneri 3	15													15
flexneri 3a	4	2			42	33								81
flexneri 3b	3	1			12	5		2						23
flexneri 3c					1									1
flexneri 4	2					1								3
flexneri 4a		2			5									7
flexneri 4c					1									1
flexneri 5b	2													2

NESP 2014	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT[1]	NT	NU	Total
flexneri 6	7	4			5	1								17
flexneri 6 Hertfordshire					2									2
flexneri			4	12		1	1							18
flexneri Prov. SH-104	5	1			4									10
flexneri var. X	6	1			2									9
flexneri var. Y		1			1	1		1						4
sonnei	50	63	11	18	157	68	3	3	2					375
Shigella sp	1													1
Total *Shigella*	**136**	**88**	**15**	**32**	**275**	**120**	**4**	**7**	**3**	**1**	**0**	**0**	**0**	**681**
Vibrio														
albensis						1								1
alginolyticus		1			1	3		1						6
cholerae		1												1
cholerae O1	1													1
cholerae O1 Ogawa						1								1
cholerae non-O1/O139	2	1	1		2	5	1		1		1			14
fluvialis	2	2						1						5
furnissii						1								1
hollisae	1													1
parahaemolyticus	33	14			1		1	1						50
Vibrio sp						1								1
Total *Vibrio*	**39**	**19**	**1**	**0**	**4**	**12**	**2**	**3**	**1**	**0**	**1**	**0**	**0**	**82**
***Yersinia* species**														
bercovieri						2								2
enterocolitica	63	39	18		124	50	4	1		2	1			302
frederiksenii	11	2	4			2								19
intermedia	1	6	3			4								14
kristensenii						1								1
pseudotuberculosis	3													3
Total *Yersinia*	**78**	**47**	**25**	**0**	**124**	**59**	**4**	**1**	**0**	**2**	**1**	**0**	**0**	**341**
Parasites														
Cryptosporidium	18	2	26	94	225	3	15	25	6	4	1			419
Cyclospora				5	22			1						28
Entamoeba histolytica/dispar	137		16	30	91	257	4	2			9			546
Giardia	59	4	79	75	293	100	83	86	9	20	10			818
Total Parasites	**214**	**6**	**121**	**204**	**631**	**360**	**102**	**114**	**15**	**24**	**20**	**0**	**0**	**1811**
Viruses														
Adenovirus	9	5		24	58			2						98
Astrovirus		2												2
Enterovirus				17						3				20
Hepatitis A	21	27	17	8	83	46		3		3				208
Norovirus	353	229	146	53	638	488	40	105	75	52		1		2180
Rotavirus	10	8	25	17	133		131	39	10	52				425
Total Viruses	**393**	**271**	**188**	**119**	**912**	**534**	**171**	**149**	**85**	**110**	**0**	**1**	**0**	**2933**

[1] In the Yukon bacterial case counts (including *Campylobacter*, *E. coli*, *Salmonella* and *Shigella*) are frequently reported through British Columbia, and are therefore not representative of the province.

Appendix 3. Phage types of isolates submitted to the NML, 2014[1]

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Escherichia coli												
***E. coli* O157:H7**	1					1	1					2
	2	1	5		4	21	2		1	1		35
	4	1	2			11	3	1				18
	8	1	4			12	18					35
	14	3	17	1	1	9	5		1			37
	21					1						1
	24					1						1
	31		1				1					2
	32	1	3	1		2						7
	33					1						1
	34		1		1	3	1		1	1		8
	42					1						1
	49		1		1	5	1					8
	54					3			2			5
	70					1						1
	74		1			1	1					3
	77					1						1
	95				1							1
	14a	7	141	1	10	38	12	2	2	7		220
	14c					1						1
	14d					1						1
	32a	1		1		3	1					6
	ATEC-04						1					1
	ATEC-09					3						3
	ATEC-12					1						1
	ATEC-13					1						1
	ATEC-15		1									1
	ATEC-16					1						1
	ATEC-17					2						2
	ATEC-19					2						2
	ATEC-20					1						1
	Untypable						1					1
	Subtotal	**15**	**177**	**4**	**18**	**128**	**48**	**3**	**7**	**9**	**0**	**409**
***E. coli* O157:HNM**	4						1		1			2
	8	1				7	3				1	12
	14								1			1
	31		1									1
	32						1					1
	33					1						1
	54					1						1
	70					1						1
	14a		6									6
	14c	1				2						3
	ATEC-18					1						1
	Subtotal	**2**	**7**	**0**	**0**	**13**	**5**	**0**	**2**	**0**	**1**	**30**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Salmonella												
***S. enterica* ssp *enterica* (I) 4,[5],12:b:-**	3b					1						1
	3b var 2					1						1
	ATPB-01					1						1
	ATPB-05					7	1					8
	ATPB-07					3	1					4
	ATPB-09					1						1
	Battersea					2	1					3
	Dundee					1	1					2
	Dundee var 1		1									1
	Stirling						1					1
	Untypable	2	4	1		2	1					10
	Subtotal	**2**	**5**	**1**	**0**	**19**	**6**	**0**	**0**	**0**	**0**	**33**
***S. enterica* ssp *enterica* (I) 4,[5],12:i:-**	27						3					3
	35						4					4
	41					2	1					3
	51		1									1
	120	1				1	3					5
	151		1									1
	166					1						1
	178	1										1
	186	1				2						3
	191		1	4	3	6	3		1	1		19
	192					1						1
	193	12	17	5	4	39	17	1				95
	195					1						1
	104a						1					1
	104b		2			1						3
	191a		7	1			1		1			10
	193a					2						2
	ATTM-04	1	2	1							1	5
	ATTM-100			1								1
	ATTM-11		1									1
	ATTM-115		1									1
	ATTM-116		7	1		1						9
	ATTM-117					1						1
	ATTM-120			1								1
	ATTM-123							5				5
	ATTM-125					1						1
	ATTM-131			2								2
	ATTM-135	1										1
	ATTM-139					1						1
	ATTM-149					2						2
	ATTM-40					1						1
	ATTM-78					1						1
	ATTM-82				2	2						4

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	ATTM-86					2						2
	ATTM-92						1					1
	ATTM-97						1					1
	ATTM-98		1									1
	ATTM-99		1			2						3
	U291	1	4		3	13	5					26
	U302					1	1					2
	U311		1				1	1				3
	Untypable					1						1
	UT1		1			2	1					4
	UT2					1						1
	UT6		1									1
	UT7					1						1
	Subtotal	**18**	**49**	**16**	**12**	**89**	**43**	**7**	**2**	**1**	**1**	**238**
***S. enterica* ssp *enterica* (I) O Rough:i:1,2**	Untypable						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
***S.* Enteritidis**	1	24	12	6	4	88	42	1	6		1	184
	2	2	2	1	1	16	4					26
	3		1			3						4
	4	5	5			13	4					27
	6					2	1					3
	7	1										1
	8	197	146	27	36	441	160	47	59	10	32	1155
	13	161	44	5	5	175	69	13	17	4	4	497
	18	4	7			3						14
	19	1				1	2					4
	21	4	1	1	2	8	1				1	18
	22	2	4			15	5	1	1			28
	23	3	2			1	1					7
	26	1										1
	29		1									1
	31	1										1
	34		51				1	1			1	54
	35	36	44	9	6	64	26	6	4	1	5	201
	37								1			1
	38	2										2
	41	1										1
	43	1	1				2				1	5
	47						3					3
	51	7				7	3		1			18
	52					1						1
	53					1						1
	55						1					1
	56		1									1
	59			2		1						3
	63	8	4		1	37	15					65

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	64	13	38	10	13	172	66	15	24	4	3	358
	11b					1						1
	13a	123	101	13	16	78	31	5	2			369
	14b	5				5	1					11
	14c						1					1
	15a					2	2					4
	1a					1	1					2
	1b	5		1		7	2	4			1	20
	21c	4	2			1	3					10
	29a						2					2
	4b	2	2			2	1		1			8
	5a						2					2
	5b	5	6	1	8	46	23	1	8	1		99
	6a	8	7	1	2	10	5					33
	7a	1			1							2
	9a					3	1					4
	9b	1					1					2
	ATEN-01					3	1					4
	ATEN-02	1				2	1		1			5
	ATEN-03		1									1
	ATEN-05	1					1					2
	ATEN-07	1										1
	ATEN-12					2	1					3
	ATEN-15	1				1						2
	ATEN-17	1										1
	ATEN-31					1						1
	ATEN-34					1			1			2
	ATEN-39					1						1
	ATEN-40		1						1			2
	ATEN-41					1						1
	ATEN-46	1										1
	ATEN-47		1									1
	ATEN-48	1										1
	ATEN-49	1				1						2
	ATEN-50	1	3	1		4						9
	ATEN-51		1		1	1						3
	ATEN-52					1						1
	ATEN-53					5	2		1			8
	ATEN-54							1				1
	ATEN-55	1					2					3
	ATEN-56		1									1
	ATEN-57				1	2						3
	ATEN-58	1										1
	ATEN-59					1						1
	ATEN-60									1		1
	ATEN-61					1						1
	ATEN-62					1						1

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Non-Viable				2	1						3
	Untypable	3	1	3	1	2	8				1	19
	Subtotal	**642**	**491**	**81**	**100**	**1237**	**498**	**95**	**128**	**21**	**50**	**3343**
***S.* Hadar**	2					6	3		1		1	11
	5	2			12							14
	10				1	1						2
	11	1						1			1	3
	18		1									1
	33				4							4
	47		2	1								3
	56	1				1						2
	ATHR-03					1						1
	Subtotal	**4**	**3**	**1**	**17**	**9**	**3**	**1**	**1**	**0**	**2**	**41**
***S.* Heidelberg**	1					1						1
	2	1	1			2	4	1				9
	4						1					1
	5		1			11	3					15
	9		1		2	1						4
	10	1	1			22	5		2		1	32
	11	1			1							2
	17						3				1	4
	18	1	2			6	1					10
	19	10	12	7	5	109	63	6	4		9	225
	22	1				1	1					3
	24					6						6
	26		2			3	5		4			14
	29	10	10		1	57	58	3	3			142
	32		1	1	1	2	11	1			1	18
	37					1						1
	39				1	1	1					3
	40					1	2					3
	41	4	3			14	3		1			25
	44						1					1
	47						1				1	2
	51						4	1				5
	52					2	1					3
	53					1	4					5
	54					2	1					3
	55					2						2
	57					1						1
	58		2			3	4					9
	19a			1		10	4	5	3			23
	19b					1						1
	19c					1						1
	29a					1	3					4
	40a				1	3						4
	6a					1	1					2

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	ATHE-01					1						1
	ATHE-02					1						1
	ATHE-04					1						1
	ATHE-05							1				1
	ATHE-06					1						1
	ATHE-08					1		1				2
	ATHE-16						1					1
	ATHE-18					2						2
	ATHE-21					1	1					2
	ATHE-23						1					1
	ATHE-24					1						1
	ATHE-25						1					1
	ATHE-26					1						1
	ATHE-28	5										5
	ATHE-29					1						1
	ATHE-30					1						1
	ATHE-31						1					1
	ATHE-32						2					2
	ATHE-34					1						1
	ATHE-35						1					1
	ATHE-36					1						1
	ATHE-37		1									1
	ATHE-38					1						1
	ATHE-39								1			1
	Non-viable					1						1
	Subtotal	**34**	**37**	**9**	**12**	**282**	**193**	**19**	**18**	**0**	**13**	**617**
***S.* Infantis**	1		1		1	1						3
	3		1		2	2	2					7
	4	1	2		1	15	5				1	25
	6	1				2				1		4
	7	5	7			22	5	2			1	42
	8	2			1		1					4
	9					2			1			3
	12					1						1
	13	1				4	2					7
	24						1					1
	26					1	1					2
	Untypable		1		5							6
	Subtotal	**10**	**12**	**0**	**10**	**50**	**17**	**2**	**1**	**1**	**2**	**105**
***S.* Newport**	1					3	1					4
	2	2				2	5	2				11
	3			1			3	1				5
	4					2						2
	5	1	1				1					3
	6					1						1
	9	1	3		3	15	8	2	1		1	34
	10	3				2	18	1				24

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	11						3					3
	13	1	1			10	3	2		1		18
	14					2	2					4
	15					4	1		1			6
	16				1	1		1				3
	14a	1			1	1	1					4
	14b	2	2	1		7	2					14
	17a		1			2			1			4
	1a	1				1						2
	ATNP-01					1	3					4
	ATNP-02	1	1	1		2						5
	ATNP-05					1						1
	ATNP-06						1					1
	ATNP-07	4	1			10	4					19
	ATNP-11					1						1
	ATNP-14	1										1
	ATNP-18	1				2			1			4
	ATNP-19						1					1
	ATNP-20			1								1
	ATNP-21	1				2						3
	ATNP-22				1	2	1					4
	ATNP-23					5			1			6
	ATNP-24			1		2						3
	ATNP-25					1						1
	ATNP-26					1						1
	ATNP-27					1						1
	Subtotal	**20**	**10**	**5**	**6**	**84**	**58**	**9**	**5**	**1**	**1**	**199**
***S.* Oranienburg**	1			1	1	8	6				1	17
	2		1									1
	6	3			1	4	3	2				13
	8	2	3	1		1	2					9
	11		1			1			1			3
	12		1				1					2
	15		1		1	3						5
	ATOR-01	4										4
	ATOR-06		2									2
	ATOR-10					2						2
	ATOR-12		1									1
	ATOR-13		1									1
	ATOR-14	1										1
	ATOR-15					1						1
	ATOR-16								1			1
	ATOR-17					1	1					2
	ATOR-18						1					1
	ATOR-19					1						1
	Subtotal	**10**	**11**	**2**	**3**	**22**	**14**	**2**	**2**	**0**	**1**	**67**
***S.* Panama**	A	1	2			4						7

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	ATPA-04					1						1
	ATPA-05					1						1
	ATPA-06		1									1
	G		1			1						2
	H	1					1					2
	Untypable		1			1						2
	Subtotal	**2**	**5**	**0**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**16**
***S.* Paratyphi B**	ATPB-01	2										2
	ATPB-07	1			1							2
	ATPB-08						1					1
	ATPB-10						1					1
	Battersea					1						1
	Sterling		1									1
	Worksop		1		1							2
	Subtotal	**3**	**2**	**0**	**2**	**1**	**2**	**0**	**0**	**0**	**0**	**10**
***S.* Paratyphi B var. Java**	1 var 2					2						2
	1 var 6					1						1
	3b var 7	1										1
	ATPB-03						1					1
	ATPB-07	4	2	1		1	3					11
	ATPB-11					1						1
	ATPB-12					1						1
	ATPB-13					1						1
	Battersea		3	1		1	2					7
	Untypable						1					1
	Worksop		2									2
	Subtotal	**5**	**7**	**2**	**0**	**8**	**7**	**0**	**0**	**0**	**0**	**29**
***S.* Thompson**	1	2	6		2	159	71	11	9	1	8	269
	2					7	3					10
	3					1						1
	5						1					1
	14					2		1	2			5
	25					4	2					6
	26					1						1
	ATTH-02					3						3
	ATTH-03					2			1			3
	ATTH-04		2			6	3					11
	ATTH-05					7						7
	ATTH-09		1		1	1						3
	ATTH-10		1			1						2
	ATTH-11	1					1					2
	ATTH-12					1						1
	Untypable						1					1
	Subtotal	**3**	**10**	**0**	**3**	**195**	**82**	**12**	**12**	**1**	**8**	**326**
***S.* Typhi**	28					4						4
	35	1				2						3
	53						2					2

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	A	2	5			2						9
	D2				1							1
	DVS	1	3			2						6
	E1	17	3			29	2					51
	E2					1						1
	E9 var	2	2			9	1					14
	E9var					1						1
	J1		1			1						2
	M1						1					1
	Non-viable	1										1
	T					2						2
	Untypable	6	2	1		12			1			22
	UVS	6	4			8						18
	UVS I+IV	8		1		6	1					16
	Subtotal	**44**	**20**	**2**	**1**	**79**	**7**	**0**	**1**	**0**	**0**	**154**
***S.* Typhimurium**	1	5	3		1	8	1					18
	2	1	2		1	6	2	1	1			14
	3		1									1
	8		1			5				1		7
	9				1							1
	10	3	2		5	37	6				1	54
	11		1									1
	12	3	1		1	13	5					23
	21					1	2					3
	22					1	1					2
	35		1			2	2					5
	39		1				1					2
	40						2					2
	41	1	4	1	1	8	1		1			17
	46					2						2
	66		2			4	2					8
	69					4	1					5
	75	1										1
	93	1							1			2
	99		4			1	1	1				7
	104	8	37	9	2	14	8	1	2			81
	105					1						1
	107					1						1
	108	2	4		2	45	3		1	1		58
	110					1						1
	116	1				1						2
	120	2	2		1	1	2	2				10
	125					1						1
	132		1				6					7
	135	1	1			4	2					8
	136					2						2
	137		1									1

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	141					1						1
	160	1					1					2
	161					1						1
	170					1						1
	177						1					1
	179		1			1						2
	186						2					2
	191					1	2					3
	193	3	7		1	9	13				1	34
	195		1	1		2	2					6
	208					1	3					4
	104a					5	7					12
	104b			1	3	23	15				1	43
	110b					1	2					3
	15a	3	1									4
	179 var		1				2					3
	193a	1				1	1					3
	2a				1							1
	46a						1					1
	66a						1					1
	ATTM-04					1						1
	ATTM-101							1				1
	ATTM-102									1		1
	ATTM-103					1						1
	ATTM-104		1			1						2
	ATTM-106					1						1
	ATTM-107							1				1
	ATTM-108		1									1
	ATTM-109	1	1			5	2		2			11
	ATTM-110					1						1
	ATTM-111					3						3
	ATTM-112					1						1
	ATTM-113					1						1
	ATTM-114		1									1
	ATTM-118					1						1
	ATTM-119					1						1
	ATTM-12		1			4						5
	ATTM-121				1							1
	ATTM-122						1					1
	ATTM-124						1					1
	ATTM-126					1						1
	ATTM-127					1	1					2
	ATTM-128				1	1						2
	ATTM-129					1						1
	ATTM-13					1						1
	ATTM-130					1						1
	ATTM-132					1						1

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	ATTM-133	1										1
	ATTM-134					1						1
	ATTM-136					1						1
	ATTM-137					1						1
	ATTM-138	1										1
	ATTM-140					3						3
	ATTM-141					7	1					8
	ATTM-142					3						3
	ATTM-143					1						1
	ATTM-144					1						1
	ATTM-145						1					1
	ATTM-146					2						2
	ATTM-147						2					2
	ATTM-148					1						1
	ATTM-15						1					1
	ATTM-150					1						1
	ATTM-151						1					1
	ATTM-152					1						1
	ATTM-154					1						1
	ATTM-155					1						1
	ATTM-156	1					1					2
	ATTM-16					1						1
	ATTM-20					1						1
	ATTM-22						1					1
	ATTM-24				1							1
	ATTM-66					1						1
	ATTM-78					1						1
	ATTM-82					2						2
	ATTM-83				1							1
	ATTM-84	1										1
	ATTM-85	1										1
	ATTM-87					1						1
	ATTM-88					2						2
	ATTM-89		1									1
	ATTM-90					1						1
	ATTM-91					1						1
	ATTM-93					1						1
	ATTM-94					1						1
	ATTM-95	1										1
	ATTM-96	1					1					2
	U284						1					1
	U291					1						1
	U297		1									1
	U302	1	1			13	12	1				28
	U303						1					1
	U310				1		1					2
	U312					1	1					2

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Untypable	1	4			5	1					11
	UT 5		1									1
	UT1	1		1		5	1					8
	UT2					1						1
	UT4					1						1
	UT5		4	1								5
	UT6					1						1
	UT7					1						1
	Subtotal	**48**	**97**	**14**	**25**	**305**	**133**	**8**	**8**	**3**	**3**	**644**
Shigella												
***Shigella boydii* 1**	9					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
***Shigella boydii* 10**	15		1									1
	ATSB-04					1						1
	Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
***Shigella boydii* 11**	18					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
***Shigella boydii* 18**	12				1							1
	Subtotal	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
***Shigella boydii* 19**	12	1										1
	2	1										1
	3	1				1						2
	Subtotal	**3**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**4**
***Shigella boydii* 2**	13					1						1
	6					1						1
	ATSB-03					1						1
	Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
***Shigella boydii* 20**	3	1										1
	Subtotal	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
***Shigella boydii* 4**	13					3						3
	ATSB-01					1						1
	Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**
Shigella sonnei	1		38	5	1	111	1	2	3	1		162
	2		2			1						3
	4		1	1								2
	7		2			4						6
	9					5						5
	10								1			1
	11					1						1
	15		2			2						4
	19					1						1
	1a			1		1						2
	ATSS-03					2						2
	ATSS-10					1						1
	ATSS-11					2						2
	ATSS-12			1								1
	ATSS-13					5				1		6

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	ATSS-14			1								1
	ATSS-15					3						3
	ATSS-16					1						1
	ATSS-17		1			2						3
	ATSS-18					1						1
	ATSS-19					1						1
	ATSS-20		1									1
	ATSS-21		15	1		3						19
	ATSS-22		1	1								2
	ATSS-23		1									1
	ATSS-24					2						2
	ATSS-25					1						1
	Subtotal	**0**	**64**	**11**	**1**	**150**	**1**	**2**	**4**	**2**	**0**	**235**
Total		**866**	**1008**	**148**	**211**	**2690**	**1119**	**160**	**191**	**39**	**82**	**6514**

[1]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.

Appendix 4. Non-O157 serovars of verotoxigenic *E. coli* tested by the NML, 2014[1]

Serovar	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
O1:H Nonmotile									1		1
O1:H Undetermined					1						1
O2:H Nonmotile						2			1		3
O2:H6				1							1
O2:H40						1					1
O4:H1						1					1
O5:H Nonmotile		2	1			1					4
O6:H Nonmotile					1						1
O8:H Undetermined			1								1
O8:H10			1								1
O8:H19			3		1						4
O9:H Undetermined			1								1
O9:H10			1								1
O11:H Nonmotile			1								1
O11:H21			1								1
O13:H Undetermined						1					1
O15:H12			1								1
O15:H45							1				1
O18ac:H1									1		1
O18ac:H7									1		1
O18ac:H31					2						2
O21:H Nonmotile		1									1
O21:H25						1					1
O25:H Undetermined					1						1
O25:H1									1		1
O25:H4	1	1			1	1					4
O26:H Nonmotile	1	2	3	1		1				1	9
O26:H11	9	8	8	4						2	31
O28ab:H Nonmotile					1						1
O28ac:H Nonmotile					2						2
O28ac:H21			2								2
O29:H Nonmotile									1		1
O33:H Undetermined									1		1
O37:H10			1								1
O38:H21			1								1
O41:H2	3										3
O43:H2	1										1
O45:H12			1								1
O48:H23					1						1
O49:H Nonmotile			1								1
O52:H45					2	4					6
O62:H17			1								1
O69:H Nonmotile										1	1
O71:H Nonmotile					1						1

Serovar	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
O71:H8										1	1
O73:H1			1								1
O74:H Nonmotile		1									1
O75:H21	1										1
O77:H45	1										1
O80:H14			1								1
O81:H Nonmotile					1	1					2
O81:H14				1							1
O84:H Nonmotile	1										1
O86:H18					1						1
O91:H10			1								1
O96:H Nonmotile			1								1
O98:H Nonmotile					1						1
O99:H6									1		1
O103:H2	2			1	2	1					6
O103:H21			1								1
O105:H8			1								1
O107:H Undetermined						1					1
O110:H Nonmotile			2								2
O110:H19			1								1
O111:H Nonmotile	13	5		3	1	1					23
O111:H8				1							1
O112ab:H Nonmotile	1										1
O112ab:H2	1										1
O117:H Nonmotile			1								1
O117:H2						1					1
O117:H7	6										6
O117:H32			1								1
O118:H Undetermined	1										1
O118:H16	1										1
O121:H1	2		1								3
O121:H19	8	3	7	3		1		1		2	25
O124:H Nonmotile					4						4
O126:H8	1										1
O128ab:H2						1					1
O132:H34					1						1
O134:H1			1								1
O136:H Nonmotile					1						1
O141ac:H10					1						1
O145:H Nonmotile		1	1	1							3
O145:H19			1								1
O145:H25						1					1
O146:H Nonmotile						1					1
O153:H2							1				1
O156:H19			1								1
O156:H7			1								1
O164:H Nonmotile					1						1

Serovar	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
O165:H4			1								1
O166:H15					1						1
O168:H21			1								1
O171:H16			1								1
O172:H Nonmotile	1										1
O172:H16			1								1
O174:H Undetermined	1										1
O174:H16			1								1
O174:H19			1								1
O175:H28		1									1
O179:H8			1								1
O181:H Undetermined	1										1
O181:H16	1										1
O181:H4			2								2
O182:H Undetermined			1								1
O182:H19			1								1
O183:H19			1								1
O184:H12			1								1
O186:H Nonmotile		1									1
O186:H2	3		2								5
O Rough:H 7	1										1
O Rough:H Nonmotile		1			2	2			2		7
O Rough:H Undetermined	2		1		1						4
O Rough:H1	1						1		2		4
O Rough:H10			1						1		2
O Rough:H12			1								1
O Rough:H15						1					1
O Rough:H16						1					1
O Rough:H19			1								1
O Rough:H2		1									1
O Rough:H45					1	1					2
O Rough:H8			2								2
O Untypable:H 34					1						1
Total *E.coli*	**65**	**28**	**74**	**16**	**34**	**27**	**3**	**1**	**13**	**7**	**268**

[1]Inclusive of only those isolates where both serovar 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.