National Enteric Surveillance Program (NESP)

ANNUAL SUMMARY 2019

PROTECTING CANADIANS FROM ILLNESS

Public Health Agency of Canada
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NATIONAL ENTERIC SURVEILLANCE PROGRAM (NESP)

ANNUAL SUMMARY 2019

INCLUDING SEROTYPE TABLES FOR 2019, 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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Newfoundland and Labrador Department of Health and Community Services
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Northwest Territories Department Health and Social Services
Nunavut Health and Social Services

Overview

The National Enteric Surveillance Program (NESP) is a collaborative program between the Public Health Agency of Canada (PHAC) and the Provincial Public Health Laboratories. Through NESP, weekly analysis and reporting is conducted for 14 different organisms causing enteric illness, including 10 which are nationally notifiable. The data derived from this surveillance system supports detection of multi-provincial clusters and outbreaks, guides public health interventions, and are designed to integrate with national and international efforts to limit the transmission of enteric diseases.

In 2019, a total of 15,142 isolate results were reported; a decrease from the average number of notifications received in the previous five years (15,541). *Salmonella* spp*.* continues to be the most common organism identified with 6,350 notifications provided in 2019, representing 42% of all isolates reported. As in previous years, *Salmonella* Enteritidis (50.87%) and *S.* Typhimurium (12.57%), remain the top two serotypes of all *Salmonella* reported to NESP in 2019. This is the first year *S.* ssp I, 4,[5],12:i:- (6.64%) was one of the top three *Salmonella* serotypes reported to NESP. Collectively, these three serotypes represent 70% of all *Salmonella* serotypes identified.

The incidence rate of shiga toxigenic *Escherichia coli* (STEC) O157 remained stable since 2010, with 1.06 cases per 100,000 population reported in 2019. An increase in the incidence rate of non-O157 isolates was observed in 2019 (2.5 cases per 100,000 population) compared to 2018 (1.42 cases per 100,000 population). This is the third consecutive year where more non-O157 isolates were reported than O157 isolates.

The incidence rate of invasive listeriosis in 2019 (0.46 per 100,000 population) is similar to what has been seen in the past 5 years. Over the 7-year period Hepatitis A has been under national surveillance, the highest incidence was reported to the program in 2019 (1.55 cases per 100,000 population). As in previous years, *Shigella sonnei* constituted the majority of *Shigella* species reported in 2019, representing 55% of all *Shigella* reported. Trends for all other *Shigella* species have remained unchanged over the past 20 years, with a slight increase in overall incidence rate reported in 2019.

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Information to the reader on the National Enteric Surveillance Program (NESP)

In Canada, the surveillance of enteric diseases is conducted through NESP and the Canadian Notifiable Diseases Surveillance System (CNDSS)[a]. NESP is jointly administered by PHAC's National Microbiology Laboratory (NML) and the Centre for Foodborne, Environmental and Zoonotic Infectious Diseases (CFEZID). Since 1997, weekly analysis and reporting on laboratory-confirmed cases of enteric illness submitted by the Provincial Public Health Laboratories has been conducted through NESP.

NESP provides the first and most timely level of characterization (primarily species and serotype) of data critical to, and integrated with, other surveillance programs. Monitoring aggregated data allows for the rapid evaluation and response to enteric illness outbreaks. In addition, the data allows for the description of trends in pathogen subtypes and in the incidence of nationally notifiable enteric pathogens. CNDSS receives data that are collected by local health units, which is forwarded to provincial/territorial health authorities and collated by the Centre for Communicable Diseases and Infection Control (CCDIC). These data may be more representative 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. Due to the reporting protocols and requirements, CNDSS is a more reliable source of information in terms of total number of illnesses, while NESP data are more current and responsive to trends. A comparison of national case counts and incidence rates for enteric diseases is included (Appendix 1).

NESP is also highly complementary to another laboratory-based surveillance system, PulseNet Canada[b]. Also administered by PHAC, PulseNet Canada collects high resolution data in real-time on cases of enteric diseases for the purpose of outbreak detection and response. Due to the additional testing performed (molecular or genomic subtyping), there are differences in

[a] Canadian Notifiable Diseases Surveillance System, Public Health Agency of Canada: https://diseases.canada.ca/notifiable/
[b] PulseNet Canada, National Microbiology Laboratory, Public Health Agency of Canada: https://www.nml-lnm.gc.ca/index-eng.htm

turnaround time compared to weekly NESP data. Further, PulseNet Canada surveillance is conducted only for a subset of the organisms that are tracked by NESP.

Data Collection

Isolates (or specimens) are submitted to provincial public health microbiology laboratories for testing and/or confirmation of the enteric pathogen. On a weekly basis, each provincial public health laboratory summarizes the number of enteric microorganisms isolated from human patients. The information details the genus, species and serotype (where appropriate). The 'report week' for NESP spans the period from Sunday to Saturday and is based on the date the laboratory test was completed, except for in Alberta, where it is based on the date received. Data are submitted to NML either directly (faxing or emailing), or by entering the data via the web-based application (webNESP) hosted on the Canadian Network for Public Health Intelligence (CNPHI). The information is submitted 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.* Banana"). This updated information is submitted with the next weekly NESP report form.

All data submitted are aggregated by province and pathogen and do not contain any patient identifiers, locators, or other confidential 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 three month period as a single case.

Data collected for surveillance purposes are increasingly being generated using whole genome sequencing instead of by classical microbiological methods. Most of the data collected by NESP, however, can be derived from whole genome sequence data *in silico* (e.g., species identification, serotype), ensuring that the over two decades of data used for NESP analyses will remain compatible with surveillance in the genomics era. Starting in 2018, portions of the data collected and analyzed by NESP will have been generated via whole genome sequencing.

Data Analysis and Dissemination

Data analysis is conducted weekly by using an algorithm to determine if the current week case counts are significantly higher than the expected baseline. Statistical significance is based on the cumulative Poisson probability between the reported case count and the retrospective five-year median.

Results from the weekly analysis included in the "NESP Weekly Report" are disseminated to all provincial laboratories, at least one epidemiologist or Medical Officer of Health in each province/territory and multiple stakeholders at the federal level. Protocol allows sharing of the reports with other public health professionals who have an operational need to have this information, although, the weekly reports are not intended for public distribution. No response is required by public health professionals to the statistical elevations noted in the reports. The aim is to provide useful and timely information for those responsible for public health action.

In addition to the NESP Weekly Reports, partners can perform real-time data analysis, examine trends and display the data for their respective jurisdictions within webNESP. PulseNet Canada uses these data in conjunction with laboratory DNA fingerprinting data determined by pulsed-field gel electrophoresis (PFGE) and other molecular/genomic data to detect disease clusters and outbreaks. The resulting data analyses are also shared on CNPHI with 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 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)[c].

Limitations

It should be noted that there are some inherent limitations of these data. For some organisms, the number of isolates reported is a subset of laboratory isolations and may not reflect the incidence of disease at the provincial or national level. For example, *Campylobacter* isolates are not routinely forwarded to provincial or central reference laboratories for further testing beyond

[c] 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

genus/species characterizations, and are therefore greatly under-represented in NESP. By contrast, *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. 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 and foreign travel are not consistently reported to NESP from all laboratories and therefore any interpretation should be considered with caution.

Questions and correspondence may be forwarded via email to:

PHAC.NESP-PNSME.ASPC@canada.ca

Laboratory-confirmed Isolate Counts & Incidence Rates

In 2019, provincial laboratories reported the results of 15,142 isolates of enteric pathogens to NESP, a decrease from the average number of notifications in the previous five years (15,541). The most frequently reported enteric pathogen group was *Salmonella*, followed by enteric viruses (Norovirus, Hepatitis A, Rotavirus and Adenovirus), and *Campylobacter* (Table 1). Organism isolate counts reported by province and territory in 2019 can be found in Appendix 2.

Table 1. Number of isolates reported to NESP by major organism group per province or territory, 2019

GROUP	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL	% OF TOTAL ISOLATES REPORTED
Salmonella	959	759	175	237	2578	1156	166	144	16	152	1	7	0	6350	41.94
Viruses[1]	425	167	168	267	889	59	107	93	75	405	0	1	0	2656	17.54
Campylobacter[1]	39	337	170	94	123	327	238	110	35	191	0	0	0	1664	10.99
Parasites[1]	259	13	119	135	670	49	124	136	16	100	18	0	0	1639	10.82
E. coli[2]	128	349	77	53	227	204	9	7	6	399	2	1	0	1462	9.66
Shigella	167	99	13	16	253	255	7	4	0	12	1	0	0	827	5.46
Yersinia	73	38	13	2	161	23	4	0	0	3	1	0	0	318	2.10
Listeria	15	10	5	7	75	54	5	2	0	1	0	0	0	174	1.15
Vibrio	23	7	1	0	5	6	7	2	1	0	0	0	0	52	0.34
Total	2088	1779	741	811	4981	2133	667	498	149	1263	23	9	0	15142	100.00

[1]*Campylobacter*, parasitic (*Giardia*, *Cryptosporidium*, *Entamoeba histolytica*/*dispar* and *Cyclospora*), and viral (Norovirus, Rotavirus and Adenovirus) isolates are not routinely forwarded to the provincial or central reference laboratories and are greatly under-represented in NESP.
[2]*E. coli* includes O157 serotypes (397 cases), non-O157 serotypes (595 cases), CIDT positive for STX/STEC (139 isolates), and non-typed STEC (331 cases).

Annual national incidence rates for the groups of enteric pathogens reported to NESP between 2014 and 2019 are shown in Table 2 and Appendix 1. Isolates of *E. coli* O157, *Listeria monocytogenes*, *Salmonella* and *Shigella* are routinely forwarded to provincial microbiology laboratories, while isolates for *Campylobacter, Yersinia,* enteric parasites (*Giardia, Cryptosporidium, Entamoeba histolytica/dispar* and *Cyclospora*) and enteric viruses (Norovirus, Rotavirus and Adenovirus) are not routinely reported to the provincial or central reference laboratories. As such, NESP incidence rates are considered to be reflective of the true incidence rate for those routinely reported pathogens enabling the calculation of provincial and territorial incidence rates as shown in Table 3.

Table 2. Annual national totals and rates (per 100,000 population) for enteric pathogens and organism groups reported to NESP, 2014-2019

GROUP	2014		2015		2016		2017		2018		2019	
	Total	Rate[1]	Total	Rate[1]	Total	Rate[1]	Total	Rate[1]	Total	Rate[1]	Total	Rate[1]
E. coli O157	458	1.29	379	1.06	415	1.15	348	0.95	426	1.15	397	1.06
E. coli non-O157[2]	151	0.43	229	0.64	205	0.57	361	0.99	580	1.57	926	2.46
Listeria	133	0.38	125	0.35	191	0.53	109	0.30	150	0.40	174	0.46
Salmonella	7850	22.15	7717	21.61	7816	21.65	7313	20.01	7300	19.70	6350	16.90
Shigella	681	1.92	739	2.07	807	2.23	699	1.91	784	2.12	827	2.20
Campylobacter	1676	4.73	1514	4.24	1378	3.81	1287	3.52	1333	3.60	1664	4.43
Vibrio	82	0.23	85	0.24	44	0.12	54	0.15	67	0.18	52	0.14
Yersinia	341	0.96	383	1.07	353	0.98	387	1.06	404	1.09	318	0.85
Parasites	1811	5.11	1845	5.17	1921	5.32	1679	4.59	1675	4.52	1639	4.36
Viruses	2934	8.28	3075	8.61	2295	6.36	2600	7.12	2303	6.21	2656	7.06

[1]Rates calculated using the population estimates on July 1st as reported by Statistics Canada – Table 17-10-0005-01
[2]*E. coli* non-O157 is not consistently reported by provinces and territories.

Table 3. Annual rates[1] (per 100,000 population) of infection per province and territory for select groups of pathogens routinely reported to NESP, 2019

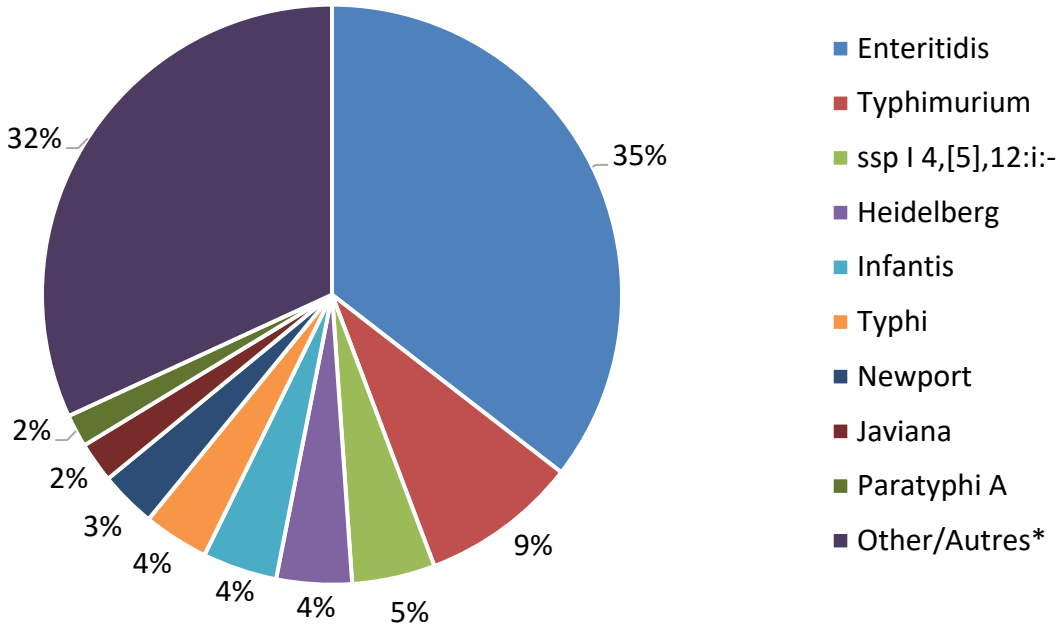
GROUP	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU
E. coli O157	0.71	2.17	0.51	1.83	1.06	0.59	0.90	0.62	3.19	2.49	0	0	0
E. coli non-O157[2]	1.50	5.83	6.05	2.04	0.50	0.41	0.26	0.10	0.64	72.48	2.45	2.23	0
Listeria	0.30	0.23	0.43	0.51	0.51	0.64	0.64	0.21	0	0.19	0	0	0
Salmonella	18.91	17.39	14.90	17.31	17.70	13.62	21.37	14.82	10.19	29.14	2.45	15.62	0
Shigella	3.29	2.29	1.11	1.17	1.74	3.01	0.90	0.41	0	2.30	2.45	0	0

[1]Rates calculated using the population estimates on July 1st as reported by Statistics Canada – Table 17-10-0005-01
[2]*E. coli* non-O157 is not consistently reported by provinces and territories.

Salmonella

A total of 6,350 *Salmonella* isolates representing 203 serotypes were reported in 2019. *Salmonella* Enteritidis accounted for 35% of all human salmonellosis, and together with the nine remaining most common serotypes (Figure 1), they constituted 68% of all *Salmonella* infections reported. National, provincial and territorial case counts for *Salmonella* reported in 2019 are shown in Table 4 and Appendix 2.

Figure 1. Proportion of *Salmonella* serotypes causing human illness as reported to NESP, 2019 (n=6,350)



*Other serotypes (2,024 isolates) were divided among 194 serotypes and 140 isolates were reported as unspecified *Salmonella* species.

Table 4. Number of isolates reported to NESP per province and territory for the ten most commonly reported *Salmonella* serotypes, 2019

GROUP	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL	% of *Salmonella* total
Enteritidis	437	264	77	71	829	415	74	65	13	6	1	2	0	2254	50.87
Typhimurium	36	61	18	21	281	102	19	16	2	1	0	0	0	557	12.57
ssp I 4,[5],12:i:-	43	21	6	8	114	95	3	4	0	0	0	0	0	294	6.64
Heidelberg	8	27	6	5	102	81	20	16	1	1	0	0	0	267	6.03
Infantis	27	27	2	17	118	57	6	5	3	0	0	2	0	264	5.96
Typhi	45	29	3	11	127	15	1	1	0	0	0	0	0	232	5.24
Newport	34	36	8	10	77	28	3	4	0	0	0	0	0	200	4.51
Javiana	22	15	1	4	55	39	5	2	0	0	0	0	0	143	3.23
Paratyphi A	34	24	4	1	47	6	0	0	0	0	0	0	0	116	2.62
Oranienburg	7	9	8	7	46	25	0	2	0	0	0	0	0	104	2.35
Total	693	513	133	155	1796	863	131	115	19	8	1	4	0	4431	100.00

Compared to the average number of *Salmonella* notifications received between 2014 and 2018 (7,599 cases), there was a 17.9% decrease observed in 2019 (6,350) (Figure 2). While *S.* Enteritidis remained the most common serotype over this time period, changes were observed among the other most commonly reported *Salmonella* serotypes (Table 5).

Figure 2. Annual counts between 2010 and 2019 for the top five *Salmonella* serotypes reported to NESP in 2019

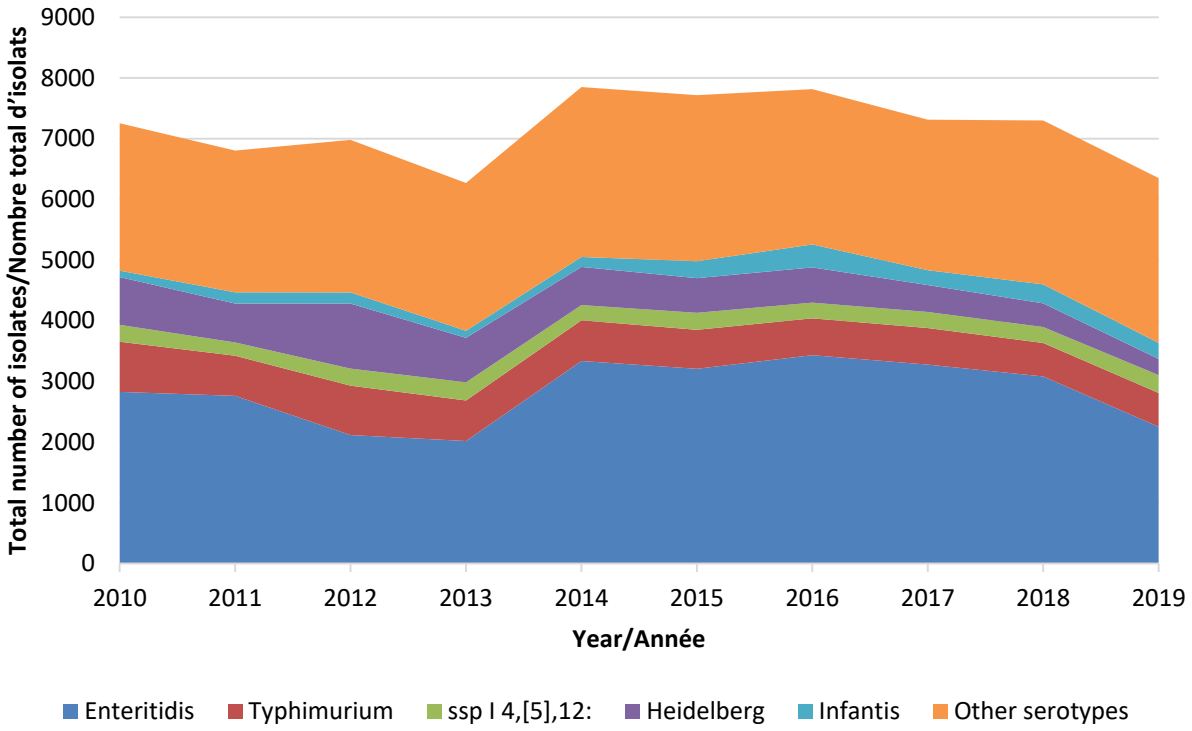


Table 5. National total counts (overall rank) for the ten most commonly reported *Salmonella* serotypes to NESP, 2014-2019

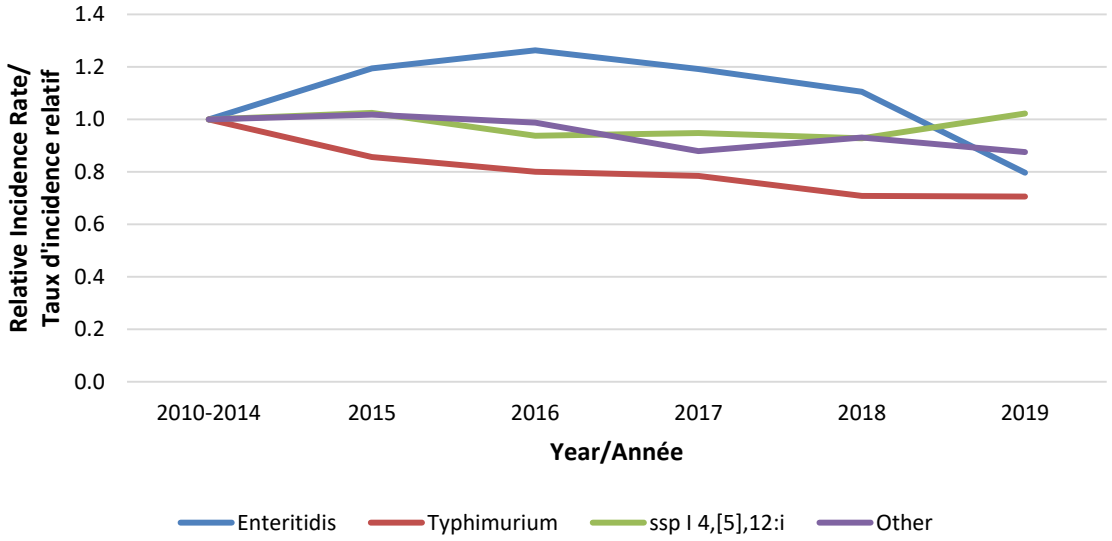
Serotypes	2014	2015	2016	2017	2018	2019	Average no. of isolates (2014-2018)
Enteritidis	3337	3209	3433	3278	3083	2254	3268
Typhimurium	671	642	607	602	551	557	615
ssp I 4,[5],12:i:-	251	280	259	265	263	294	264
Heidelberg	628	571	580	444	390	267	523
Infantis	164	279	378	244	313	264	276
Typhi	140	121	136	181	198	232	155
Newport	224	235	198	143	192	200	198
Javiana	133	136	114	111	118	143	122
Paratyphi A	64	77	62	62	56	116	64
Oranienburg	81	68	61	53	113	104	75
Thompson	392	311	290	135	148	98	255
Braenderup	71	123	81	145	127	101	109
Agona	78	63	120	103	125	125	98
Saintpaul	131	108	70	87	87	99	97

In May 2017, PulseNet Canada began performing WGS on all *Salmonella* isolates submitted for routine laboratory-based surveillance, providing high discriminatory genomic subtype data for outbreak detection and response. The potential impacts of this change on NESP data collection and analysis are currently under assessment.

Salmonella Enteritidis

In 2019, 2,254 isolates of *S.* Enteritidis, 35% of all *Salmonella* submissions, were reported to NESP. The incidence rate observed in 2019 was 7.4% lower (6.0 cases per 100,000 population) relative to the 2010-2014 baseline period (7.5 cases per 100,000 population). A decrease in incidence can be seen from 2016-2018 (Figure 3).

Figure 3. Relative incidence rates[1] of *S.* Enteritidis, *S.* Typhimurium, *S.* ssp I 4,[5],12:i:-, and other *Salmonella* serotype reported to NESP by Year, 2015-2019 compared to the 2010-2014 baseline period



[1] Rates are compared to the 2010-2014 baseline period.

Salmonella Typhimurium

Compared to the 2010-2014 baseline period, a 33% decrease in the incidence of *S.* Typhimurium cases was noted in 2019 (2.1 versus 1.5 cases per 100,000 population, respectively). From 2015-2019, a slight decreasing trend can be seen in the incidence of S. Typhimurium (Figure 3). Although *S.* Typhimurium continues to rank among the top 3 most common serotypes causing human salmonellosis in Canada, it represents only 9% of all *Salmonella* isolates reported to NESP in 2019 (Table 4 and Table 5).

Salmonella ssp I 4,[5],12:i:-

Salmonella ssp I 4,[5],12:i:-, for the first time ever was the third most common serotype in Canada, which represented 5% of all human *Salmonella* isolates reported to NESP in 2019. The 2019 overall incidence (0.8 per 100,000 population) was the same as the 2010-2014 baseline period (0.8 per 100,000 population) (Figure 3).

Escherichia coli

The current rate of Shiga toxigenic *Escherichia coli* (STEC) O157 (1.06 cases per 100,000 population) has remained relatively stable since 2010 (1.2 cases per 100,000 population) (Figure 4). In 2019, several provinces reported incidence rates higher than the national reported incidence rate: Alberta (2.17 cases per 100,000 population), Manitoba (1.83 cases per 100,000 population), Prince Edward Island (3.19 cases per 100,000 population), and Newfoundland (2.49 cases per 100,000 population) (Table 3). The incidence rate of *E. coli* non-O157 increased in 2019 (2.5 cases per 100,000 population) from 2018 (1.6 cases per 100,000 population) (Figure 4). This is the third consecutive year where the proportion of non-O157 isolates reported has exceeded the proportion of O157 isolates. It should be noted that *E. coli* non-O157 are reported less consistently than *E. coli* O157 to NESP and therefore any changes observed over time are a reflection in testing practices by some provincial laboratories. Further, 8% of isolates were identified using culture-independent diagnostic tests (CIDT), which are PCR-based tests used for the identification of organisms without an isolate cultured. Reflex culture of a CIDT positive sample would obtain an isolate for further sub-typing.

Among non-O157 isolates, in 2019, 41% of these were represented by five serotypes: *E. coli* O26, *E. coli* O111, *E. coli* O103, *E. coli* O118, and *E. coli* O121 (Figure 5). In 2019, 41% of *E. coli* non-O157 did not have additional sub-type information. In 2017, a request was submitted by NML to provincial public health laboratories to report the testing method used for the identification of organisms, as the use of CIDTs are becoming more prevalent in Canada.

An increase in incidence rate was seen in *E. coli* O26 (0.21 cases per 100,000 population in 2018, 0.4 cases per 100,000 population in 2019), *E. coli* O111 (0.09 in 2018, 0.25 in 2019), *E. coli* O103 (0.09 in 2018, 0.21 in 2019), and *E. coli* O118 (0.04 in 2018, 0.08 in 2019). A small decrease in incidence rate was seen in *E. coli* O121 (0.11 in 2018, 0.08 in 2019) (Figure 6). All *E. coli* serotypes, including confirmed non-O157 STEC isolates, are summarized in Appendix 2.

Figure 4. Incidence rate (per 100,000 population) of *E. coli* O157, *E. coli* non-O157, & *E. coli* Non-Typed Serotypes reported to NESP, 1997-2019

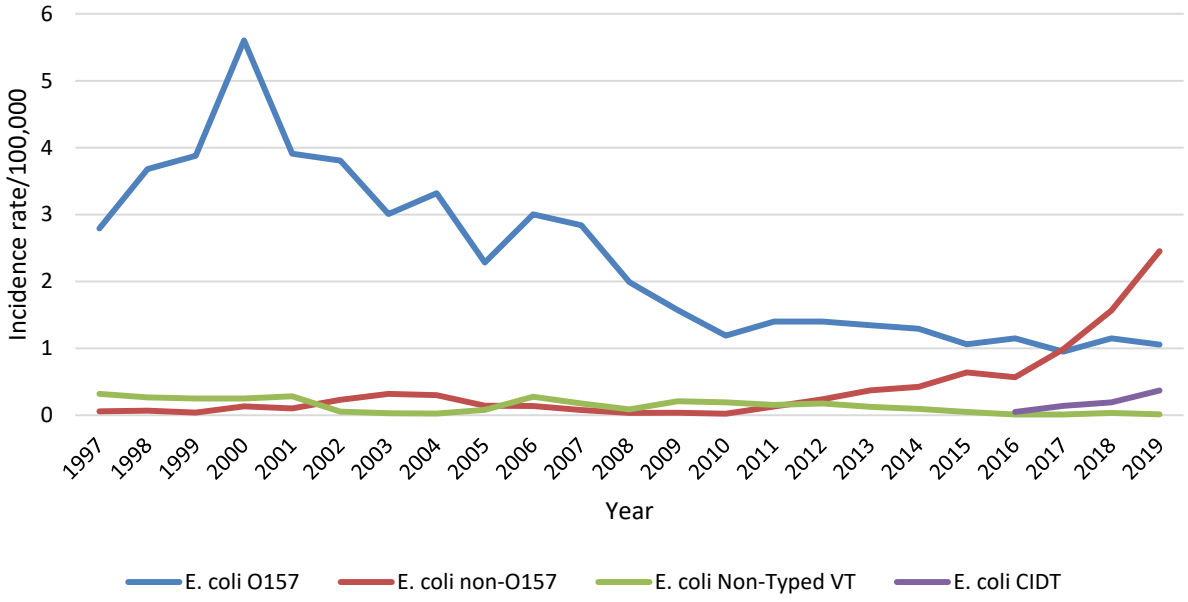
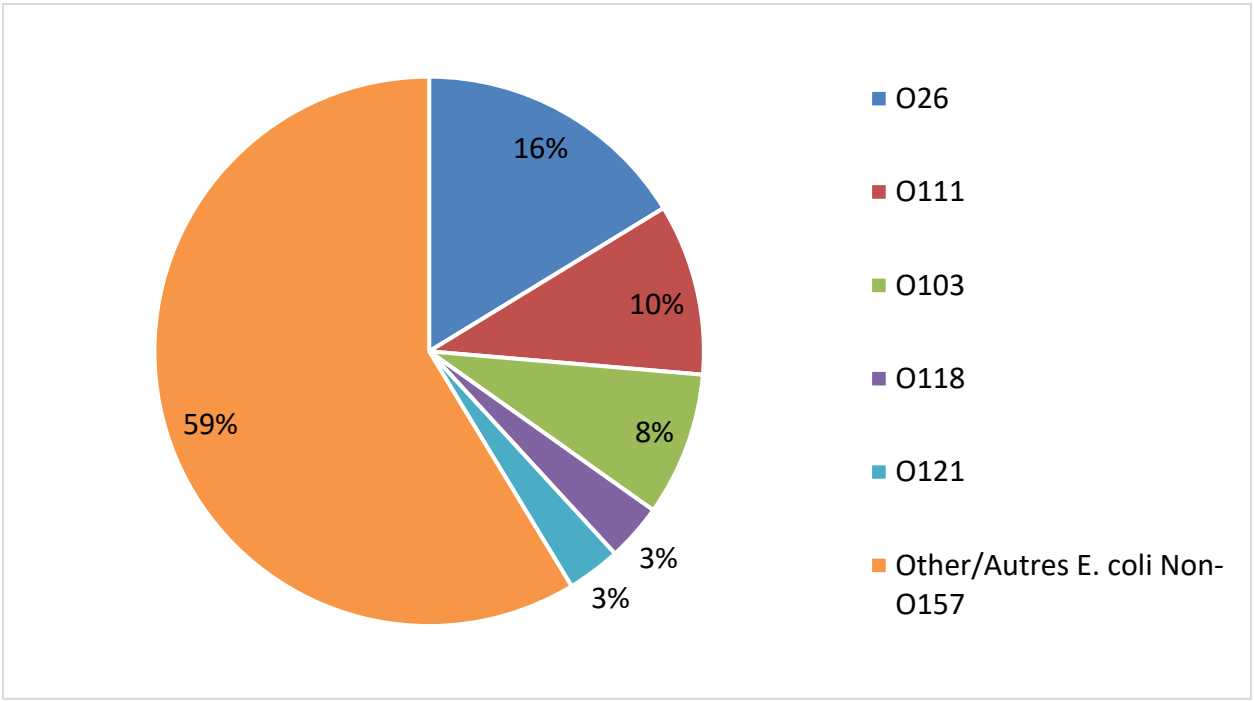
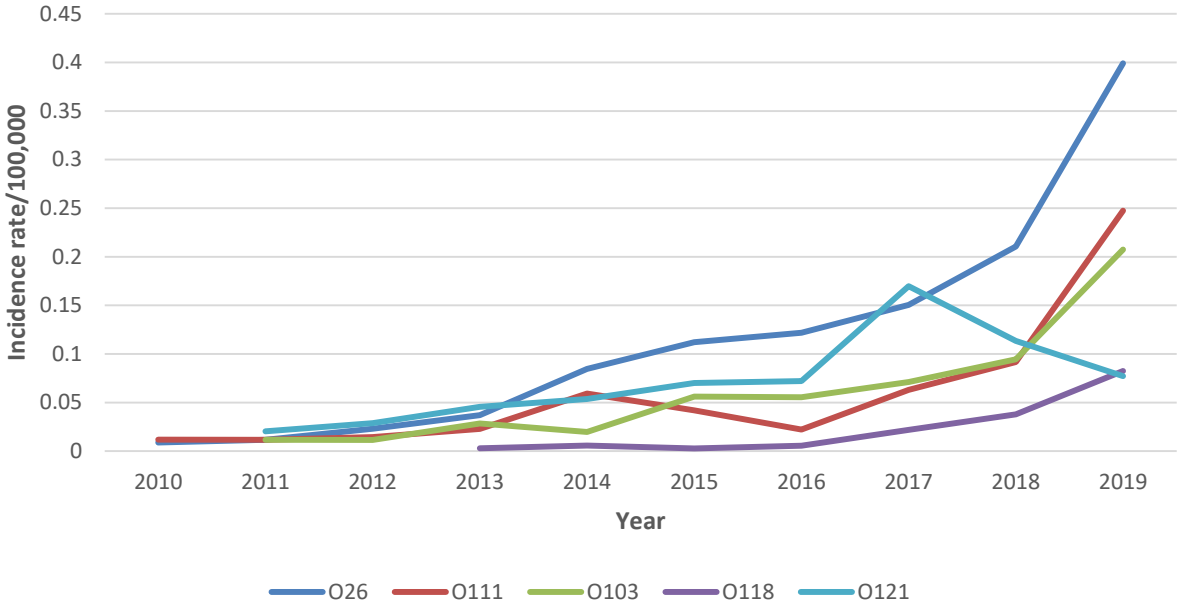


Figure 5. Distribution of *E. coli* non-O157 serotypes reported to NESP in 2019



*Other serotypes (541 isolates) were divided among 51 serotypes and 376 isolates were reported as unspecified *E. coli* non-O157 species.

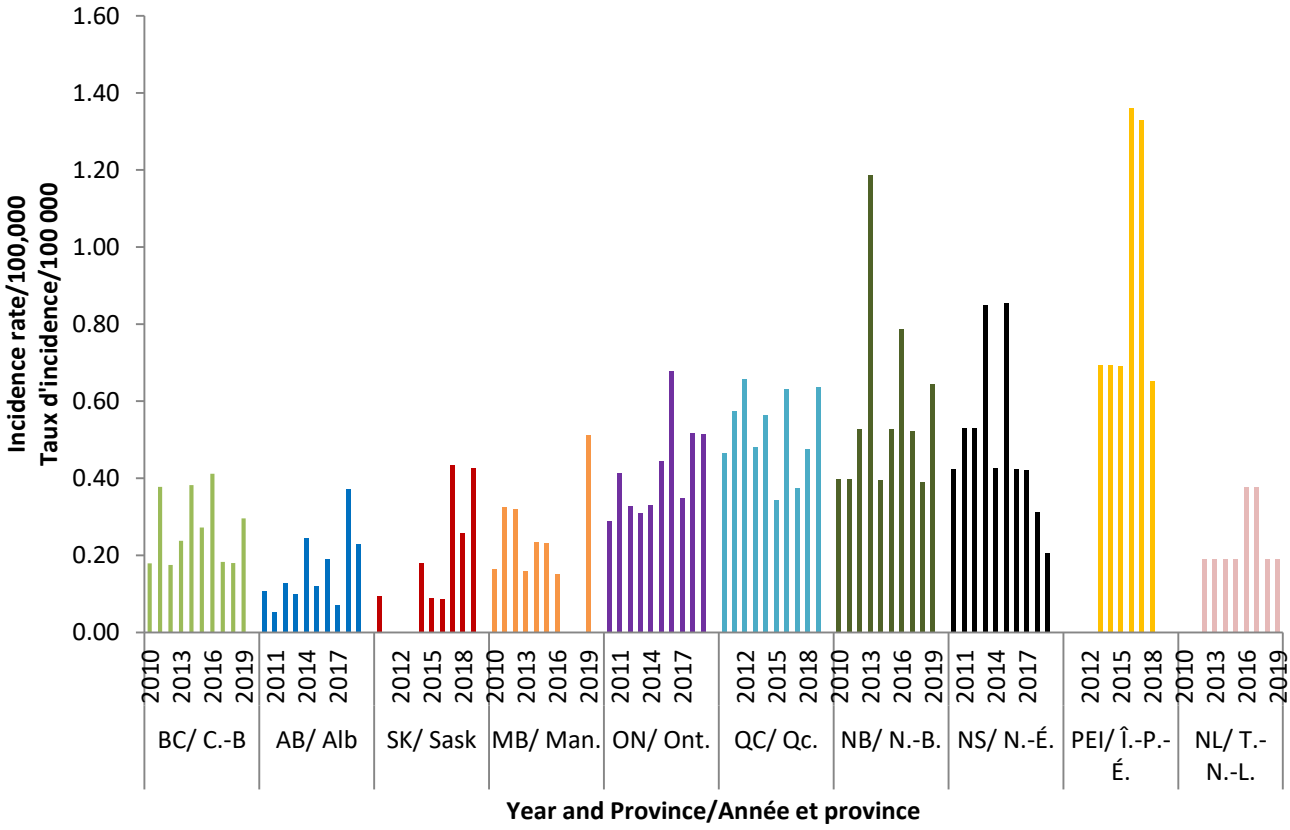
Figure 6. Incidence rate (per 100,000 population) of the top five *E. coli* non-O157 serotypes reported to NESP, 2010-2019



Listeria monocytogenes

As per the case definition for invasive listeriosis, only isolates obtained from a normally sterile site or placental/fetal tissues should be reported. An increased number of isolates for invasive listeriosis were reported in 2019 (174) compared to 2018 (150). As there are small numbers of cases of invasive listeriosis within most jurisdictions, the magnitude of the change is greatly affected with a difference of even one case (Figure 7). There were no cases of invasive listeriosis reported in 2019 by Prince Edward Island, Yukon, Northwest Territories, and Nunuvut.

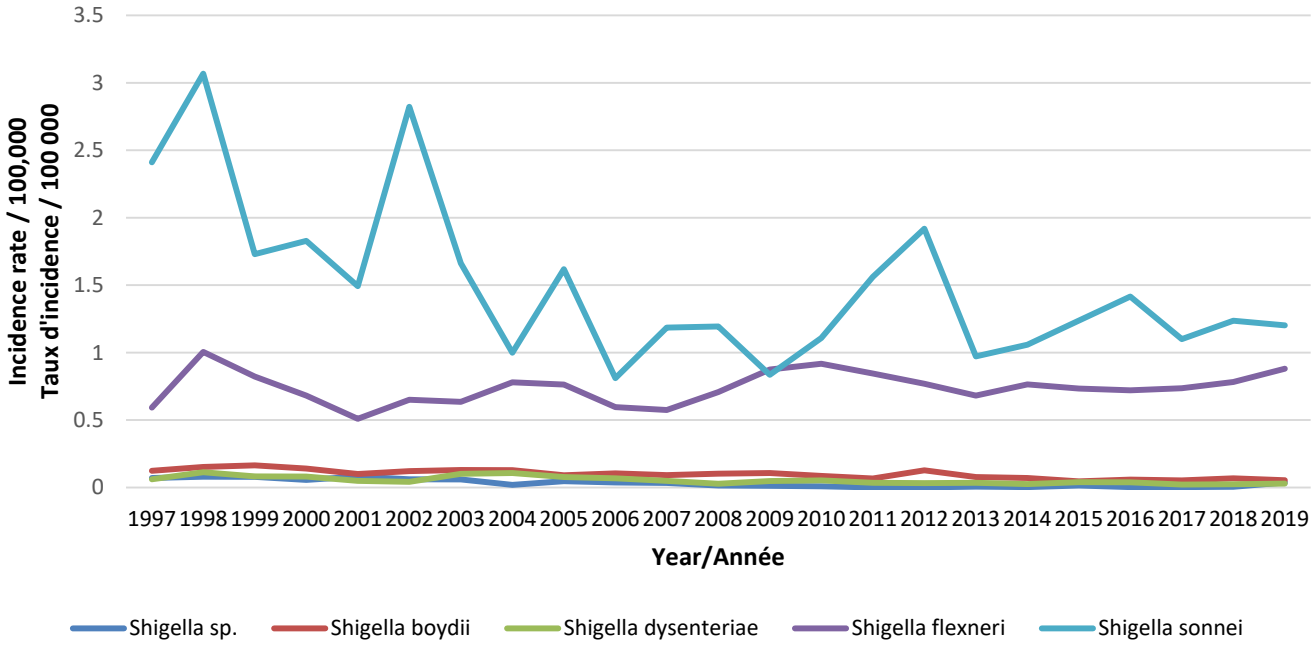
Figure 7. Incidence rate (per 100,000 population) of invasive listeriosis reported to NESP by province, 2010-2019



Shigella

There were 827 isolates of *Shigella* reported in 2019, representing a rate of 2.02 cases per 100,000 population compared to an average of 2.05 cases per 100,000 population reported between 2014 and 2018 (Figure 8). Isolates of *Shigella sonnei* and *Shigella flexneri* comprised 55% and 40% of total notifications respectively. Overall trends for *Shigella* are driven by the incidence of *S. sonnei* (1.20 cases per 100,000 population) (Figure 8). Among the other *Shigella* species, incidence trends over time have remained relatively unchanged with an incidence of 0.88 cases per 100,000 population for *Shigella flexneri*, 0.05 cases per 100,000 population for *Shigella boydii*, and 0.03 cases per 100,000 population for *Shigella dysenteriae* observed in 2018 (Figure 8).

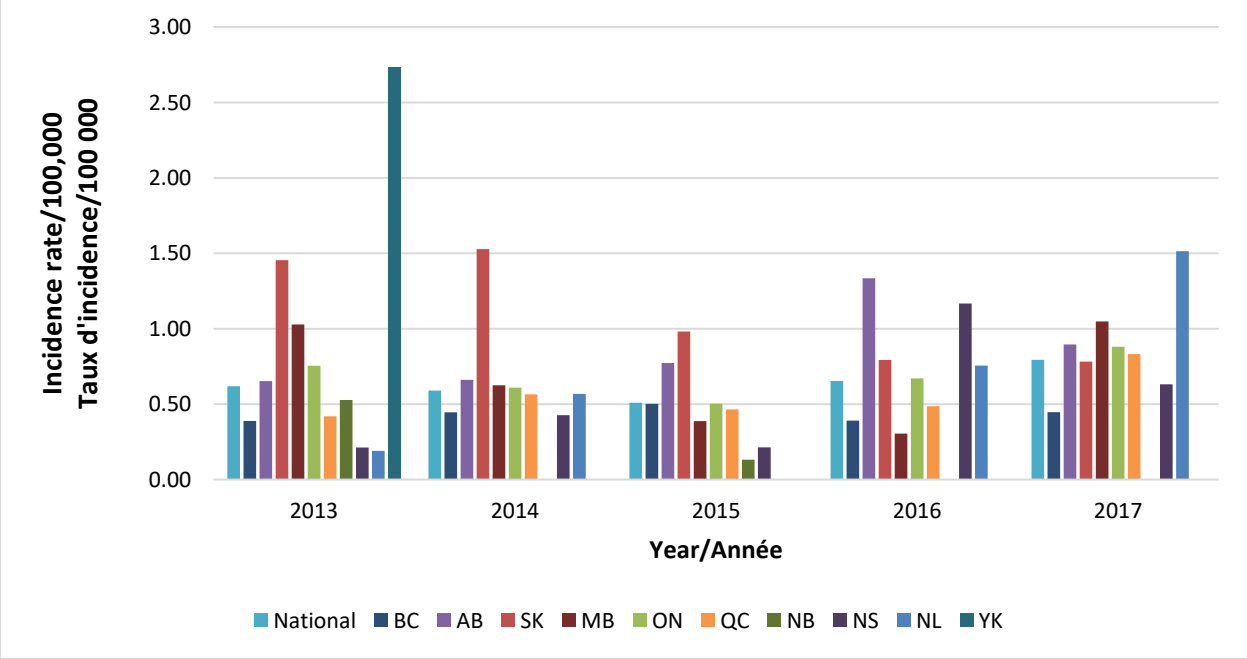
Figure 8. Incidence rate (per 100,000 population) of *Shigella* species reported to NESP, 1997-2019

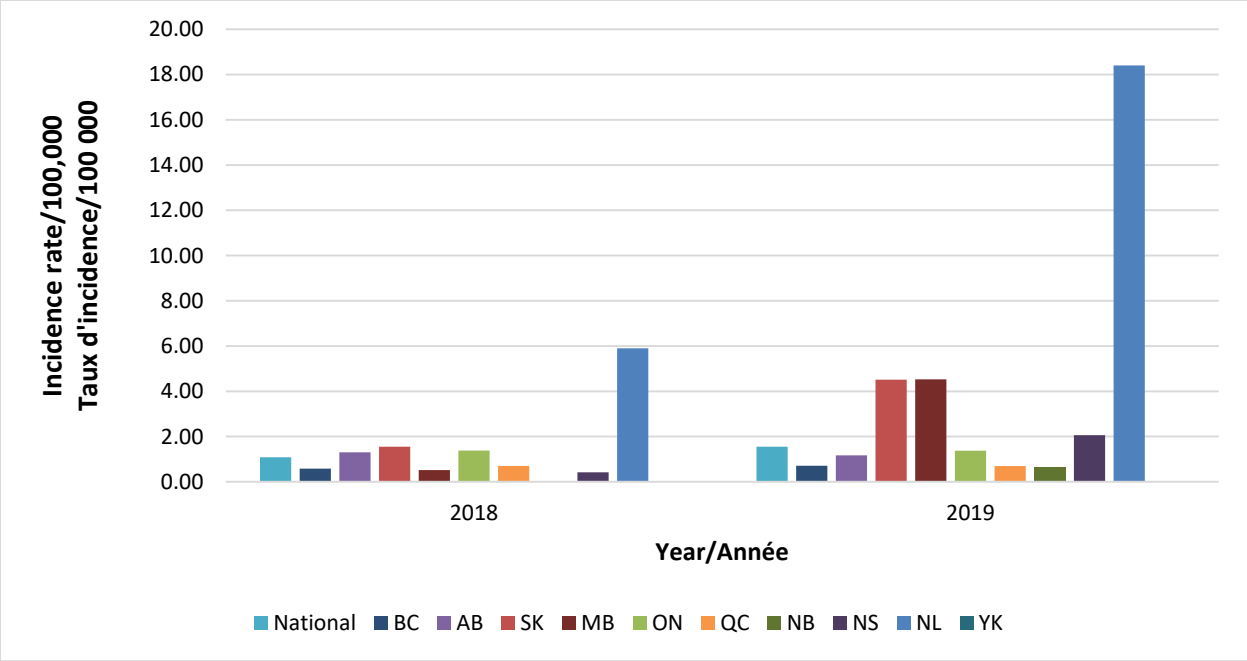


Hepatitis A

The national incidence rate for Hepatitis A in 2019 was the highest since its inclusion in NESP in 2012, with a rate of 1.55 cases per 100,000 population (Figure 9). Each provincial and territorial laboratory determines whether to report a case based solely on laboratory testing, without public health follow-up. A positive IgM result could be due to false positive or recent immunization. When local public health follow up occurs it is then determined whether case meets a confirmed case definition or not. If local public health determines it is not a case (e.g. recent immunization), this information may not always be relayed back to the laboratory, and therefore, our surveillance figures are not corrected. The drastic increases observed in Figure 9 could be a result of change of laboratory detection methods. Conversely, since not all specimens/isolates are referred from the regional and local laboratories to the provincial public health laboratories, viruses, including Hepatitis A, are under-represented in NESP and reported case counts are not representative of the true incidence of the disease in Canada.

Figure 9. National and provincial incidence rate (per 100,000 population) of Hepatitis A reported to NESP, 2013-2019




Incidence rate/100,000
Taux d'incidence/100 000
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
2018
2019
Year/Année
National
BC
AB
SK
MB
ON
QC
NB
NS
NL
YK

Appendix 1. Comparison of national totals, incidence per 100 000 population and proportion captured between the Canadian Notifiable Disease Surveillance System (CNDSS) and the National Enteric Surveillance Program (NESP) for enteric diseases, 2018[1]

Enteric, Food and Waterborne Diseases	Canadian Notifiable Disease Surveillance System (CNDSS)		National Enteric Surveillance Program (NESP)		% of CNDSS cases captured in NESP (NESP isolations / CNDSS cases[8])
2018	N	Rate per 100,000 population	N	Rate per 100,000 population	
Botulism	8	0.02	-	-	N/A
Campylobacteriosis[2]	10215	27.57	1333	-	13.0
Cholera[3]	0	0	2	0.005	0
Cryptosporidiosis[2]	1305	3.52	398	-	30.5
Cyclosporiasis[2]	337	0.91	46	-	13.6
Giardiasis[2]	3903	10.53	770	-	19.9
Hepatitis A	380	1.03	402	1.08	112.6[8]
Invasive Listeriosis	158	0.43	150	0.4	94.9
Norovirus[2,4,5]	560	11.42	1432	-	N/A
Paralytic Shellfish Poisoning[6]	2	0.01	-	-	N/A
Salmonellosis	7131	19.24	7300	19.7	102.4[8]
Shigellosis	863	2.33	784	2.12	90.8
Typhoid[7]	191	0.52	198	0.53	103.7[8]
Shiga toxigenic *Escherichia coli* Infection	1088	2.94	1091	2.94	100.9[8]

[1]CNDSS data for 2019 was not available at the time this summary was produced.
[2]*Campylobacter*, parasites (*Cryptosporidium*, *Cyclospora* and *Giardia*) and Norovirus 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]Includes *Vibrio cholerae* serotype O1 or O139.
[4]AB, MB, NB, NS, NT, ON, PEI, QC and SK did not report on norovirus in 2018. The populations of these provinces and territory have been removed for rate calculation.
[5]For Norovirus some provinces/territories report only on aggregated outbreak related data; these data are not included here.
[6]AB, MB, NT, QC and SK did not report on paralytic shellfish poisoning in 2018. The populations of these provinces and territory have been removed for rate calculation.
[7]Typhoid includes lab confirmation of *Salmonella* Typhi; *Salmonella* Paratyphi A, B and C are reported under salmonellosis.
[8]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 serotype data reported to NESP by province and territory, 2019

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Campylobacter															
Campylobacter coli	1	25	10	16	9	32	4	9	3	0	0	0	0		109
Campylobacter concisus	2	1	0	0	0	3	0	0	0	0	0	0	0		6
Campylobacter curvus	0	0	0	0	0	0	0	1	0	0	0	0	0		1
Campylobacter fetus	1	3	0	0	2	19	0	0	0	0	0	0	0		25
Campylobacter gracilis	4	0	0	0	0	6	0	0	0	0	0	0	0		10
Campylobacter hyointestinalis	0	1	0	0	1	2	0	0	0	0	0	0	0		4
Campylobacter jejuni	20	301	159	78	60	227	172	92	29	0	0	0	0		1138
Campylobacter lari	4	0	0	0	5	11	9	0	1	0	0	0	0		30
Campylobacter rectus	0	0	0	0	0	3	0	0	0	0	0	0	0		3
Campylobacter sp	0	0	0	0	0	3	51	1	0	191	0	0	0		246
Campylobacter upsaliensis	5	5	1	0	46	9	2	7	2	0	0	0	0		77
Campylobacter ureolyticus	2	1	0	0	0	12	0	0	0	0	0	0	0		15
Total Campylobacter	39	337	170	94	123	327	238	110	35	191	0	0	0		1664
Escherichia coli															
E. coli	0	0	0	0	0	0	0	0	0	2	0	0	0		2
E. coli CIDT Positive for STX/STEC	14	0	0	0	0	119	0	0	0	6	0	0	0		139
E. coli Non-O157 VTEC	2	0	8	22	0	18	0	0	0	0	0	0	0		50
E. coli Non-Typed EAEC	0	0	0	0	0	0	0	0	0	67	0	0	0		67
E. coli Non-Typed EPEC	0	0	0	0	0	0	0	0	0	208	0	0	0		208
E. coli Non-Typed ETEC	0	0	0	0	0	0	0	0	1	50	0	0	0		51
E. coli Non-Typed VTEC	2	0	0	0	0	0	0	0	0	0	1	0	0		3
E. coli O undetermined:H2	0	0	0	0	1	0	0	0	0	3	0	0	0		4
E. coli O undetermined:H2 VTEC	0	3	0	0	0	0	0	0	0	0	0	0	0		3
E. coli O undetermined:H21 VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O undetermined:H28	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O undetermined:H52 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O undetermined:H8	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O undetermined:HNM	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O-Rough:H Nonmotile	0	0	0	0	2	0	0	0	0	0	0	0	0		2
E. coli O-Rough:H11	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O-Rough:H11 VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O-Rough:H4	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O-Rough:H45	2	0	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O-Rough:H52	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O100:HNM	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O103	4	0	0	0	0	0	0	0	0	0	1	0	0		5

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
E. coli O103:H undetermined	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O103:H11 VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O103:H2	4	0	3	1	10	3	0	0	0	0	0	0	0		21
E. coli O103:H2 VTEC	0	34	0	1	0	0	0	0	0	0	0	0	0		35
E. coli O103:H25	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O103:H25 VTEC	0	6	0	0	1	0	0	0	0	0	0	0	0		7
E. coli O103:HNM	1	0	1	0	2	0	0	0	0	0	0	0	0		4
E. coli O103:HNM VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O104:H7	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O108:H25	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O108:HNM [VTEC]	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O111	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O111:H Non-motile VTEC	0	44	0	0	0	0	0	0	0	2	0	0	0		46
E. coli O111:H Nonmotile	0	0	13	0	11	4	0	0	0	10	0	0	0		38
E. coli O111:H8	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O111:NM	7	0	0	0	0	0	0	0	0	0	0	0	0		7
E. coli O116:H2	0	0	0	0	0	1	0	0	0	0	0	0	0		1
E. coli O117:H7	10	0	0	0	1	0	0	0	0	0	0	0	0		11
E. coli O117:NM	3	0	0	0	0	0	0	0	0	0	0	0	0		3
E. coli O118:H Undetermined	0	0	1	0	1	1	0	0	0	0	0	0	0		3
E. coli O118:H undetermined VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O118:H16	3	0	1	0	0	0	0	0	0	0	0	0	0		4
E. coli O118:H16 VTEC	0	7	1	1	1	0	0	0	0	0	0	0	0		10
E. coli O118:H2	0	0	1	0	7	0	0	0	0	0	0	0	0		8
E. coli O118:H2 VTEC	0	4	0	0	0	0	0	0	0	0	0	0	0		4
E. coli O119:HNM VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O121:H18	0	0	0	0	0	1	0	0	0	0	0	0	0		1
E. coli O121:H19	4	0	7	0	2	0	0	0	0	0	0	0	0		13
E. coli O121:H19 VTEC	0	15	0	0	0	0	0	0	0	0	0	0	0		15
E. coli O128ab:H2	2	0	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O128ab:HNM	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O136:H12 [VTEC]	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O13:HNM	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O145	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O145:H28	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O145:H34	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O145:HNM	1	0	3	0	0	1	0	0	0	0	0	0	0		5
E. coli O145:HNM VTEC	0	4	0	1	0	0	0	0	0	0	0	0	0		5
E. coli O145:NM	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O146:H21	1	0	1	0	0	0	0	0	0	0	0	0	0		2

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
E. coli O146:H21 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O154:HNM	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O156:H25	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O157	0	0	0	0	0	0	0	6	0	7	0	0	0		13
E. coli O157 VTEC	0	0	3	25	0	1	2	0	0	0	0	0	0		31
E. coli O157:H undetermined	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O157:H7	32	86	3	0	117	47	5	0	5	4	0	0	0		299
E. coli O157:HNM	0	9	0	0	36	0	0	0	0	2	0	0	0		47
E. coli O157:NM	4	0	0	0	0	2	0	0	0	0	0	0	0		6
E. coli O15:H18	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O15:H27	0	0	0	0	0	0	0	1	0	0	0	0	0		1
E. coli O165:HNM	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O166:HNM	0	0	0	0	0	0	1	0	0	0	0	0	0		1
E. coli O170:H49 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O171:HNM	0	0	0	0	2	0	0	0	0	0	0	0	0		2
E. coli O172:HNM VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O175:H27 VTEC	0	2	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O177:H Rough	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O177:HNM	1	0	0	0	2	0	0	0	0	0	0	0	0		3
E. coli O178:H7	0	0	0	0	0	0	0	0	0	0	0	1	0		1
E. coli O181:H6	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O182:H undetermined VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O182:H25 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O183:H18 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O186:H2	0	0	3	0	1	1	0	0	0	0	0	0	0		5
E. coli O186:H2 VTEC	0	7	0	0	0	0	0	0	0	0	0	0	0		7
E. coli O186:HNM	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O186:HNM VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O26	0	0	0	0	0	0	0	0	0	5	0	0	0		5
E. coli O26:H11	7	0	9	0	9	1	1	0	0	32	0	0	0		59
E. coli O26:H11 VTEC	0	52	0	0	0	0	0	0	0	0	0	0	0		52
E. coli O26:HNM	0	0	6	0	5	0	0	0	0	0	0	0	0		11
E. coli O26:HNM VTEC	0	23	0	0	0	0	0	0	0	0	0	0	0		23
E. coli O29:HNM	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O2:H7	0	0	0	0	0	0	0	0	0	1	0	0	0		1
E. coli O38:H21 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O45:H2	0	0	0	0	0	1	0	0	0	0	0	0	0		1
E. coli O49:HNM	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O52:H undetermined	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O52:H45	1	0	0	0	0	1	0	0	0	0	0	0	0		2

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
E. coli O59:H2 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O5:HNM	2	0	0	0	1	0	0	0	0	0	0	0	0		3
E. coli O5:HNM VTEC	0	10	0	0	0	0	0	0	0	0	0	0	0		10
E. coli O63:H6	0	0	0	0	0	2	0	0	0	0	0	0	0		2
E. coli O66:H25	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O69:H11	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O6:H32 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O71:H11	0	0	2	0	1	0	0	0	0	0	0	0	0		3
E. coli O71:H11 VTEC	0	8	0	0	0	0	0	0	0	0	0	0	0		8
E. coli O71:H8 VTEC	0	1	0	0	1	0	0	0	0	0	0	0	0		2
E. coli O71:HNM VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O75:H8	2	0	0	0	0	0	0	0	0	0	0	0	0		2
E. coli O76:H7	0	0	1	0	0	0	0	0	0	0	0	0	0		1
E. coli O77:H45 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O77:HNM	0	0	0	0	1	0	0	0	0	0	0	0	0		1
E. coli O78:HNM	1	0	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O80:H2 VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O84:HNM	2	0	1	0	1	0	0	0	0	0	0	0	0		4
E. coli O84:HNM VTEC	0	4	0	0	0	0	0	0	0	0	0	0	0		4
E. coli O85:H1 VTEC	0	2	1	0	0	0	0	0	0	0	0	0	0		3
E. coli O91:H14	2	0	0	1	1	0	0	0	0	0	0	0	0		4
E. coli O91:HNM VTEC	0	1	0	0	0	0	0	0	0	0	0	0	0		1
E. coli O9:H14 VTEC	0	0	0	1	0	0	0	0	0	0	0	0	0		1
Total *E. coli*	128	349	77	53	227	204	9	7	6	399	2	1	0		1462
Listeria															
Listeria monocytogenes	15	10	5	7	75	54	5	2	0	1	0	0	0		174
Salmonella															
Salmonella Aberdeen	1	0	0	0	5	0	0	0	0	0	0	0	0		6
Salmonella Abony	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Adelaide	1	1	0	0	2	1	0	0	0	0	0	0	0		5
Salmonella Adjame	0	0	0	0	2	0	1	1	0	0	0	0	0		4
Salmonella Agama	0	2	0	0	2	0	0	0	0	0	0	0	0		4
Salmonella Agona	23	11	1	3	50	11	0	2	0	0	0	0	0		101
Salmonella Alachua	0	0	0	0	1	1	0	0	0	0	0	0	0		2
Salmonella Albany	0	1	0	0	1	0	0	0	0	0	0	0	0		2
Salmonella Allandale	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Altona	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Amager	0	0	0	0	1	0	0	0	0	0	0	0	0		1

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Salmonella Anatum	6	1	1	2	16	4	1	0	0	0	0	0	0		31
Salmonella Apapa	0	0	0	0	0	0	1	0	0	0	0	0	0		1
Salmonella Arechavaleta	0	1	0	0	1	0	0	0	0	0	0	0	0		2
Salmonella Aschersleben	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Baildon	0	0	0	0	0	2	0	0	0	0	0	0	0		2
Salmonella Bardo	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Bareilly	4	3	0	0	10	2	0	0	0	0	0	0	0		19
Salmonella Barranquilla	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Bere	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Berta	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella Birkenhead	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Blockley	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Bonariensis	1	1	0	0	2	0	0	0	0	0	0	0	0		4
Salmonella Bovismorbificans	2	5	1	2	8	1	0	0	0	0	0	0	0		19
Salmonella Bradford	0	0	0	1	0	0	0	0	0	0	0	0	0		1
Salmonella Braenderup	14	11	0	6	44	24	0	2	0	1	0	0	0		102
Salmonella Brancaster	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Brandenburg	3	1	0	2	4	9	0	0	0	0	0	0	0		19
Salmonella Bredeney	1	0	0	0	4	0	0	0	0	0	0	0	0		5
Salmonella Butantan	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella California	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Carrau	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Cerro	0	1	0	0	1	0	1	0	0	0	0	0	0		3
Salmonella Chailey	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Chester	3	0	0	1	14	13	0	0	0	0	0	0	0		31
Salmonella Choleraesuis	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella Coeln	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Colindale	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Concord	1	0	0	0	6	0	0	0	0	0	0	0	0		7
Salmonella Corvallis	1	0	1	0	7	3	1	0	0	0	0	0	0		13
Salmonella Cotham	1	2	0	0	3	0	0	0	0	0	0	0	0		6
Salmonella Cubana	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Daytona	2	0	0	0	0	0	0	0	0	0	0	0	0		2
Salmonella Derby	3	1	0	0	11	7	0	0	0	0	0	0	0		22
Salmonella Dublin	2	2	1	0	7	11	0	1	0	0	0	0	0		24
Salmonella Durban	0	2	0	1	4	1	0	0	0	0	0	0	0		8
Salmonella Durham	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Ealing	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Eastbourne	0	0	0	1	5	2	0	0	0	0	0	0	0		8
Salmonella Ebrie	1	0	0	0	0	0	0	0	0	0	0	0	0		1

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Salmonella Emek	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Enteritidis	437	264	77	71	829	415	74	65	6	13	1	2	0		2254
Salmonella Fluntern	0	0	1	0	1	0	0	0	0	0	0	0	0		2
Salmonella Gaminara	1	2	0	0	2	1	0	0	0	0	0	0	0		6
Salmonella Gatuni	0	0	0	0	1	3	0	0	0	0	0	0	0		4
Salmonella Give	2	1	1	2	5	3	0	0	0	0	0	0	0		14
Salmonella Glostrup	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Goldcoast	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Goverdhan	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Haardt	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Hadar	4	6	1	8	26	9	1	1	1	1	0	0	0		58
Salmonella Haifa	0	2	0	0	2	2	0	0	0	0	0	0	0		6
Salmonella Hartford	0	0	0	0	10	1	0	0	0	0	0	0	0		11
Salmonella Havana	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella Heidelberg	8	27	6	5	102	81	20	16	1	1	0	0	0		267
Salmonella Herston	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Holcomb	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Hvittingfoss	2	2	0	0	3	0	1	0	0	0	0	0	0		8
Salmonella Ibadan	0	0	0	0	1	2	0	0	0	0	0	0	0		3
Salmonella Indiana	0	1	0	2	6	0	0	0	0	0	0	0	0		9
Salmonella Infantis	27	27	2	17	118	57	6	5	0	3	0	2	0		264
Salmonella Irumu	1	0	0	0	0	1	0	0	0	0	0	0	0		2
Salmonella Javiana	22	15	1	4	55	39	5	2	0	0	0	0	0		143
Salmonella Johannesburg	0	1	0	0	1	0	0	0	0	0	0	0	0		2
Salmonella Kaapstad	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Kedougou	0	1	0	0	2	0	0	0	0	0	0	0	0		3
Salmonella Kentucky	5	3	0	1	18	6	0	0	0	0	0	0	0		33
Salmonella Kiambu	3	2	0	1	5	4	0	0	1	0	0	0	0		16
Salmonella Kingabwa	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Kingston	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Kumasi	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Lagos	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Larochelle	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Lexington	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Lille	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Litchfield	2	1	0	1	19	7	1	0	0	0	0	0	0		31
Salmonella Livingstone	0	1	0	0	3	0	0	0	0	0	0	0	0		4
Salmonella Lomalinda	0	0	0	0	1	1	0	0	0	0	0	0	0		2
Salmonella Lome	0	3	0	0	3	0	0	0	0	0	0	0	0		6
Salmonella London	1	1	1	1	0	4	0	0	0	0	0	0	0		8

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Salmonella Manhattan	1	1	0	0	5	3	0	1	0	0	0	0	0		11
Salmonella Matopeni	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella Mbandaka	1	2	0	0	18	4	2	0	0	0	0	0	0		27
Salmonella Meleagridis	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Miami	0	1	0	0	1	2	0	1	0	0	0	0	0		5
Salmonella Michigan	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Mikawasima	0	1	0	0	1	1	0	1	0	0	0	0	0		4
Salmonella Mississippi	0	0	1	0	9	1	5	1	0	0	0	0	0		17
Salmonella Montevideo	3	3	7	1	14	6	2	0	0	0	0	0	0		36
Salmonella Muenchen	10	14	2	1	37	11	3	1	1	0	0	0	0		80
Salmonella Muenster	4	1	1	0	4	1	0	0	0	0	0	0	0		11
Salmonella Nchanga	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Nessziona	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella Newport	34	36	8	10	77	28	3	4	0	0	0	0	0		200
Salmonella Nigeria	0	0	0	0	1	1	0	0	0	0	0	0	0		2
Salmonella Nima	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella Norwich	0	0	0	0	2	10	1	0	1	0	0	0	0		14
Salmonella Nottingham	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Offa	0	1	0	0	0	1	0	0	0	0	0	0	0		2
Salmonella Ohio	0	0	0	0	2	1	0	0	0	0	0	0	0		3
Salmonella Okatie	0	0	0	0	4	0	0	0	0	0	0	0	0		4
Salmonella Oranienburg	7	9	8	7	46	25	0	2	0	0	0	0	0		104
Salmonella Orion	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Oslo	3	1	0	1	12	1	0	0	0	0	0	0	0		18
Salmonella Panama	3	7	1	1	17	6	0	1	0	0	0	0	0		36
Salmonella Paratyphi A	34	24	4	1	47	6	0	0	0	0	0	0	0		116
Salmonella Paratyphi B	2	0	0	1	1	0	0	0	0	0	0	0	0		4
Salmonella Paratyphi B var. Java	19	18	1	0	14	8	3	1	0	0	0	0	0		64
Salmonella Pensacola	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella Pomona	1	1	0	0	2	1	0	2	0	0	0	0	0		7
Salmonella Poona	4	4	1	0	7	5	0	1	0	0	0	0	0		22
Salmonella Potsdam	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella Putten	0	0	0	1	0	0	0	0	0	0	0	0	0		1
Salmonella Reading	14	30	6	14	10	2	0	0	1	0	0	0	0		77
Salmonella Richmond	3	0	0	0	2	0	0	0	0	0	0	0	0		5
Salmonella Rissen	6	2	0	0	4	0	0	0	0	0	0	0	0		12
Salmonella Rubislaw	0	1	0	0	2	0	0	0	0	0	0	1	0		4
Salmonella Saintpaul	7	24	5	4	40	14	2	1	0	0	0	2	0		99
Salmonella Sandiego	3	3	0	1	7	2	0	0	0	0	0	0	0		16
Salmonella Schwarzengrund	5	3	1	0	11	3	1	3	0	0	0	0	0		27

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Salmonella Senftenberg	1	2	1	0	4	4	0	0	0	0	0	0	0		12
Salmonella Shubra	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Singapore	1	0	0	0	1	0	0	0	0	0	0	0	0		2
Salmonella Stanley	20	29	1	5	20	10	0	2	0	0	0	0	0		87
Salmonella Stanleyville	0	2	0	0	1	0	0	0	0	0	0	0	0		3
Salmonella Sundsvall	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Takoradi	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Telelkebir	0	0	0	0	5	0	0	0	0	0	0	0	0		5
Salmonella Tennessee	0	1	0	0	3	0	2	1	0	0	0	0	0		7
Salmonella Thompson	7	4	0	2	56	23	5	1	0	0	0	0	0		98
Salmonella Tsevie	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Typhi	45	29	3	11	127	15	1	1	0	0	0	0	0		232
Salmonella Typhimurium	36	61	18	21	281	102	19	16	1	2	0	0	0		557
Salmonella Uganda	6	3	1	3	15	3	0	3	0	0	0	0	0		34
Salmonella Urbana	3	0	0	0	3	0	0	0	0	0	0	0	0		6
Salmonella Virchow	6	3	1	0	9	3	0	0	1	0	0	0	0		23
Salmonella Wangata	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella Weltevreden	12	3	1	4	12	1	0	0	0	0	0	0	0		33
Salmonella Wien	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella Worthington	0	0	0	0	0	2	0	0	0	0	0	0	0		2
Salmonella Zanzibar	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella bongori 48:z35:-	0	0	0	0	1	1	0	0	0	0	0	0	0		2
Salmonella sp	0	0	1	6	0	0	0	1	1	131	0	0	0		140
Salmonella ssp I	3	0	0	0	0	0	0	0	1	0	0	0	0		4
Salmonella ssp I 11:i:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp I 4,[5],12:-:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp I 4,[5],12:b:-	1	0	0	0	27	11	0	0	0	0	0	0	0		39
Salmonella ssp I 4,[5],12:d:-	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella ssp I 4,[5],12:i:-	43	21	6	8	114	95	3	4	0	0	0	0	0		294
Salmonella ssp I 6,7:c:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp I 6,7:e,h:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp I 6,7:z4,z23:-	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella ssp I 9,12:-:-	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Salmonella ssp I 9,12:-:1,5	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp I O Untypeable:HNM	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella ssp I Rough-O:HNM	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella ssp I Rough-O:r:1,6	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp II 40:f,g,t:e,n,z15	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp II 47:b:e,n,x,z15	0	0	0	0	0	0	1	0	0	0	0	0	0		1
Salmonella ssp II 58:l,z13,z28:z6	1	0	0	0	0	0	0	0	0	0	0	0	0		1

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Salmonella ssp IIIa 48:z4,z24:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIa 56:z4,z23,z32:-	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIa Rough-O:z4,z23:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb	0	0	0	2	0	0	0	0	0	0	0	0	0		2
Salmonella ssp IIIb 16:z10:e,n,x,z15	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 48:l,v:1,5,7	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 50:k:z	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella ssp IIIb 50:l,v:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 50:z:z52	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 53:r:z35	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 53:z10:z35	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 60:k:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 60:r:z	0	0	1	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 60:z52:z53	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 61:-:1,5,7	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella ssp IIIb 61:c:1,5,7	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 61:c:z35	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 61:i:z53	0	1	0	0	0	2	0	0	0	0	0	0	0		3
Salmonella ssp IIIb 61:k:1,5,7	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IIIb 61:r:z	0	2	0	0	0	0	0	0	0	0	0	0	0		2
Salmonella ssp IIIb Rough-O:i:z	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 16:z4,z32:-	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 40:z4,z24:-	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Salmonella ssp IV 43:z36,z38:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 43:z4,z23:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 44:z4,z23:-	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Salmonella ssp IV 45:g,z51:-	0	0	0	0	4	2	0	0	0	0	0	0	0		6
Salmonella ssp IV 48:g,z51:-	2	0	0	0	0	0	0	0	0	0	0	0	0		2
Salmonella ssp IV 48:z4,z32:-	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 50:g,z51:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 50:z4,z23:-	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Salmonella ssp IV 50:z4,z32:-	0	0	0	0	2	0	0	0	0	0	0	0	0		2
Total *Salmonella*	959	759	175	237	2578	1156	166	144	16	152	1	7	0		6350
Shigella															
Shigella	2	0	0	0	0	0	0	0	0	12	0	0	0		14
Shigella boydii 1	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Shigella boydii 10	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Shigella boydii 12	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Shigella boydii 14	1	0	0	0	0	0	0	0	0	0	0	0	0		1

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Shigella boydii 19	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Shigella boydii 2	0	0	0	0	1	3	0	0	0	0	0	0	0		4
Shigella boydii 20	0	1	0	0	0	1	0	0	0	0	0	0	0		2
Shigella boydii 4	1	0	0	0	1	0	0	0	0	0	0	0	0		2
Shigella boydii 8	0	0	0	0	0	2	0	0	0	0	0	0	0		2
Shigella boydii 9	1	1	0	0	0	0	0	0	0	0	0	0	0		2
Shigella boydii	3	0	0	0	0	0	0	0	0	0	0	0	0		3
Shigella dysenteriae 16	0	3	0	0	1	0	0	0	0	0	0	0	0		4
Shigella dysenteriae 2	0	0	0	0	0	1	0	0	0	0	0	0	0		1
Shigella dysenteriae 9	1	0	0	0	1	0	0	0	0	0	0	0	0		2
Shigella dysenteriae	1	0	0	1	0	1	0	0	0	0	0	0	0		3
Shigella dysenteriae Prov. SH-111	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Shigella flexneri 1	3	0	0	0	10	7	0	0	0	0	0	0	0		20
Shigella flexneri 16	0	0	0	0	0	2	0	0	0	0	0	0	0		2
Shigella flexneri 1a	0	0	0	0	3	0	0	0	0	0	0	0	0		3
Shigella flexneri 1b	13	7	0	1	18	42	0	0	0	0	0	0	0		81
Shigella flexneri 2a	20	15	0	2	29	39	0	0	0	0	0	0	0		105
Shigella flexneri 2b	0	1	0	0	1	1	0	0	0	0	0	0	0		3
Shigella flexneri 3	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Shigella flexneri 3a	6	3	0	0	5	4	0	0	0	0	0	0	0		18
Shigella flexneri 3b	1	0	0	0	1	7	0	0	0	0	0	0	0		9
Shigella flexneri 4	5	3	0	0	0	3	0	0	0	0	0	0	0		11
Shigella flexneri 4a	0	0	0	0	4	0	0	0	0	0	0	0	0		4
Shigella flexneri 4b	1	0	0	0	1	0	0	0	0	0	0	0	0		2
Shigella flexneri 4c	0	1	0	0	0	1	0	0	0	0	0	0	0		2
Shigella flexneri 6	1	2	0	0	5	2	0	0	0	0	0	0	0		10
Shigella flexneri	2	0	5	6	0	10	5	2	0	0	0	0	0		30
Shigella flexneri Prov. SH-104	0	3	0	0	7	4	0	0	0	0	0	0	0		14
Shigella flexneri var. X	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Shigella flexneri var. Y	1	2	0	0	6	6	0	0	0	0	0	0	0		15
Shigella sonnei	103	56	8	6	157	116	2	2	0	0	1	0	0		451
Total *Shigella*	167	99	13	16	253	255	7	4	0	12	1	0	0		827
Vibrio															
Vibrio alginolyticus	2	2	0	0	1	0	0	0	1	0	0	0	0		6
Vibrio cholerae	0	1	0	0	0	0	1	0	0	0	0	0	0		2
Vibrio cholerae O1	1	0	0	0	0	0	0	0	0	0	0	0	0		1
Vibrio cholerae O1 Ogawa	0	0	0	0	1	0	0	0	0	0	0	0	0		1
Vibrio cholerae non-O1/O139	4	0	0	0	1	6	0	1	0	0	0	0	0		12
Vibrio fluvialis	1	1	0	0	0	0	2	1	0	0	0	0	0		5

	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU		TOTAL
Vibrio mimicus	0	1	0	0	0	0	0	0	0	0	0	0	0		1
Vibrio parahaemolyticus	15	2	0	0	2	0	4	0	0	0	0	0	0		23
Vibrio sp	0	0	1	0	0	0	0	0	0	0	0	0	0		1
Total *Vibrio*	23	7	1	0	5	6	7	2	1	0	0	0	0		52
Yersinia															
Yersinia enterocolitica	37	22	6	2	161	23	3	0	0	3	1	0	0		258
Yersinia frederiksenii	17	2	4	0	0	0	1	0	0	0	0	0	0		24
Yersinia intermedia	9	12	2	0	0	0	0	0	0	0	0	0	0		23
Yersinia kristensenii	2	2	0	0	0	0	0	0	0	0	0	0	0		4
Yersinia massiliensis	5	0	0	0	0	0	0	0	0	0	0	0	0		5
Yersinia pseudotuberculosis	3	0	1	0	0	0	0	0	0	0	0	0	0		4
Total *Yersinia*	73	38	13	2	161	23	4	0	0	3	1	0	0		318
Parasites															
Cryptosporidium	30	1	20	25	257	2	38	39	13	32	0	0	0		457
Cyclospora	8	0	0	1	54	0	0	1	0	1	1	0	0		66
Entamoeba histolytica/dispar	153	5	18	20	131	33	0	8	0	1	8	0	0		377
Giardia	68	7	81	89	228	14	86	88	3	66	9	0	0		739
Total Parasites	259	13	119	135	670	49	124	136	16	100	18	0	0		1639
Viruses															
Adenovirus	16	5	0	48	53	0	0	4	0	64	0	0	0		190
Astrovirus	14	0	0	0	1	0	0	0	0	68	0	0	0		83
Enterovirus	0	0	0	7	0	0	0	0	0	0	0	0	0		7
Hepatitis A	36	52	53	62	200	59	5	20	0	96	0	0	0		583
Norovirus	318	104	71	127	613	0	63	55	58	144	0	1	0		1554
Rotavirus	29	5	44	22	22	0	39	14	17	22	0	0	0		214
Sapovirus	12	1	0	1	0	0	0	0	0	11	0	0	0		25
Total Virus	425	167	168	267	889	59	107	93	75	405	0	1	0		2656