

FOODNET CANADA TABLES AND FIGURES 2019

PROTECTING AND EMPOWERING CANADIANS TO IMPROVE THEIR HEALTH



Public Health
Agency of Canada

Agence de la santé
publique du Canada

Canada

**TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP,
INNOVATION AND ACTION IN PUBLIC HEALTH.**

— Public Health Agency of Canada

Également disponible en français sous le titre:
FoodNet Canada : Tableaux et figures 2019

To obtain additional information, please contact:

Public Health Agency of Canada
Address Locator 0900C2
Ottawa, ON K1A 0K9
Tel.: 613-957-2991
Toll free: 1-866-225-0709
Fax: 613-941-5366
TTY: 1-800-465-7735
E-mail: publications@hc-sc.gc.ca

This publication can be made available in alternative formats upon request.

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Health, 2019

Publication date: December 2020

This publication may be reproduced for personal or internal use only without permission provided the source is fully acknowledged.

Cat.: HP40-279/2019E-PDF
ISBN: 978-0-660-36263-2
Pub.: 200227

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
INFORMATION TO THE READER	5
<i>CAMPYLOBACTER</i>	7
Human Surveillance Summary	7
Food, Animal and Environmental Surveillance Summary	10
<i>SALMONELLA</i>	14
Human Surveillance Summary	14
Food, Animal and Environmental Surveillance Summary	17
SHIGATOXIGENIC <i>ESCHERICHIA COLI</i> (STEC).....	20
Human Surveillance Summary	20
Food, Animal and Environmental Surveillance Summary	23
<i>LISTERIA MONOCYTOGENES</i>	25
Human Surveillance Summary	25
Food, Animal and Environmental Surveillance Summary	25
<i>YERSINIA</i>	27
Human Surveillance Summary	27
<i>SHIGELLA</i>	30
Human Surveillance Summary	30
PARASITES	33
<i>Giardia duodenalis</i>	33
<i>Cryptosporidium spp.</i>	36
<i>Cyclospora cayetanensis</i>	39
TARGETED STUDY: Raw Bivalve Molluscs at Retail	41
APPENDIX A — DATA COLLECTION AND REPORTING	43
APPENDIX B — FOODNET CANADA SENTINEL SITE BOUNDARIES	46
APPENDIX C — NON-HUMAN SAMPLE TYPES TESTED IN 2019.....	49
APPENDIX D – ABBREVIATIONS AND REFERENCES.....	50

EXECUTIVE SUMMARY

The Public Health Agency of Canada's (PHAC) FoodNet Canada surveillance system is pleased to present this tables and figures report which provides the annual results of our surveillance activities conducted in 2019.

The report is based on findings from its sentinel sites in British Columbia, Alberta, and Ontario. It also provides preliminary findings from Quebec, representing a partial year due to their implementation part way through the year in July 2019. The report focuses on trends in enteric pathogen disease rates, as well as trends in the prevalence of these pathogens found on potential disease sources: retail meats, manure from food producing animals and water.

It is our hope that this report will be used to inform and shape discussions on food safety issues regarding enteric diseases and their sources.

Key findings:

- In 2019, *Campylobacter* and *Salmonella* remained the most common causes of human enteric illness in the FoodNet Canada sentinel sites.
- Travel continues to be an important factor in the burden of enteric disease. In 2019, approximately 30% of all cases of enteric disease were associated with travel outside of Canada.
- Exposure to retail meat products remains a potential source of infection for human enteric illness. However, decreases in the prevalence of certain pathogen-food combinations were observed in 2019. For example, *Salmonella* on frozen breaded chicken products significantly decreased in 2019 compared to 2018 and is likely associated with interventions implemented at the industry level in 2019.
- Other exposures, such as the farm environment and water, are also possible sources of infection for human enteric illness, with differences noted between the sites. For example, *Salmonella* is commonly found in broiler chicken manure, however, the prevalence significantly increased in BC whereas it significantly decreased in the AB site in 2019, resulting in an overall significant decrease in the combined sites.
- The majority of clinical cases of shigatoxigenic *Escherichia coli* (STEC) were domestically acquired in 2019, with a significant increase in both travel and endemic incidence rates, which is primarily driven by the AB sentinel site who test all STEC-confirmed stool samples for non-O157 serogroups.
- In 2019, surface water sampling was initiated for the first time in the ON site for STEC testing. The prevalence of STEC in the ON site (27%) was similar to the combined BC and AB irrigation water prevalence in 2019 (28%).
- Continued monitoring of human illness and the potential exposures is important to ensure the continued health and safety of Canadians.

The collection and integration of information across all of FoodNet Canada surveillance components (human, retail, on-farm, and water) in an enhanced and standardized way allows for the analysis of subtype distributions among human cases and potential exposure sources over time. This report will be followed by a comprehensive annual report, which will include more extensive analyses of temporal trends and subtyping information for an integrated perspective on enteric disease from exposure to illness.

For information on data collection and reporting and surveillance strategy please see Appendix A.

INFORMATION TO THE READER

FoodNet Canada is a multi-partner sentinel site surveillance system led by the Public Health Agency of Canada (PHAC) that monitors trends in enteric pathogens in Canada.

In collaboration with public health jurisdictions and provincial public health laboratories, FoodNet Canada conducts continuous and episodic surveillance activities in four sentinel sites collecting information across four components: human, retail (meat and produce), on-farm (farm animals), and water. Continuous surveillance occurs throughout the year to identify trends in human disease occurrence, exposure sources, and attributes illnesses to sources and settings for targeted enteric pathogens. Information on the potential sources of risk to human health helps direct food and water safety actions and programming as well as public health interventions, and to evaluate their effectiveness. Specifically, FoodNet Canada's core objectives are to:

- ◆ determine what food and other sources are making Canadians ill;
- ◆ determine significant risk factors for enteric illness;
- ◆ accurately track enteric disease rates and risks over time; and
- ◆ provide practical prevention information to assist local and provincial public health officials to:
 - ◆ prioritize risks;
 - ◆ compare interventions, direct actions and advance policy; and
 - ◆ assess effectiveness of food safety activities / public health interventions and measure performance.

ACKNOWLEDGEMENTS

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

DEFINITIONS

Endemic: Endemic case of disease are affected individuals who had an infection that was considered sporadic and domestically acquired (i.e. within Canada).

Exposure: Point along the water-borne, food-borne, animal-to-person, or person-to-person transmission route at which people were suspected to have been exposed to a given pathogen.

Travel: Travel-related cases of disease (excludes non-endemic cases) are individuals who travelled outside of Canada, and where the travel dates overlap with the expected disease incubation period (varies depending on the pathogen).

Lost to follow-up: Includes cases that could not be followed up with an interview by public health.

Non-endemic: Includes immigration-related cases where illness was acquired outside of Canada.

Outbreak: Outbreak-related cases of disease are one of a number of affected individuals associated with an increased occurrence of the same infectious disease, whose illness is confirmed through a public health partner (ON, AB, BC and QC sentinel sites) on the basis of laboratory and/or epidemiological evidence.

Shigatoxigenic *Escherichia coli* (STEC): *Escherichia coli* are normal intestinal inhabitants in humans and animals, and most strains do not cause enteric disease. However, the group of shigatoxigenic *E. coli* includes certain toxin-producing strains that can cause severe diarrhea and, in some people (particularly young children), a form of acute kidney failure called hemolytic uremic syndrome.

Significant: The term “significant” in this report has been reserved for statistically significant findings (i.e. $p < 0.05$).

CAMPYLOBACTER

HUMAN SURVEILLANCE SUMMARY

Figure 1.1: Incidence rates (per 100,000) of campylobacteriosis reported to FoodNet Canada, 2015-2019.

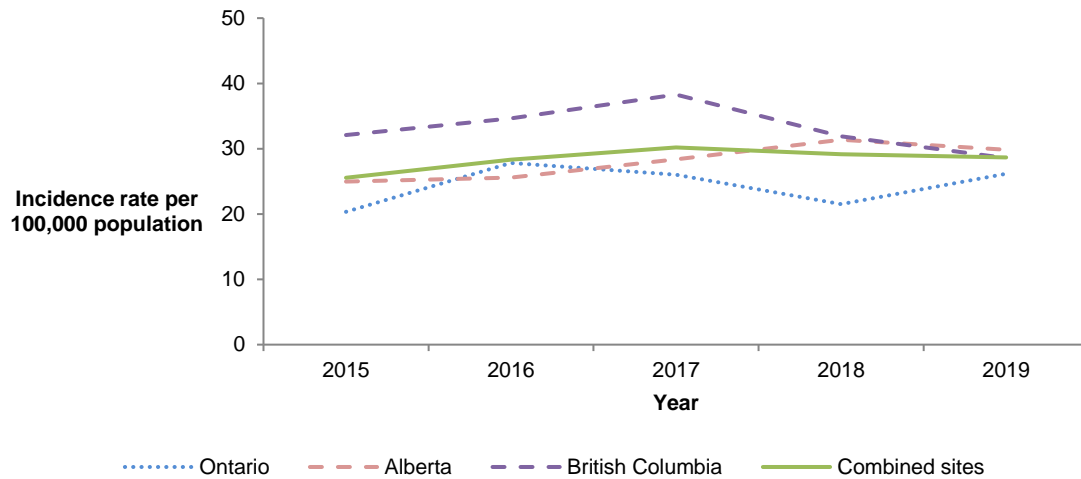


Figure 1.2: Incidence rates (per 100,000) of endemic campylobacteriosis reported to FoodNet Canada, 2015-2019.

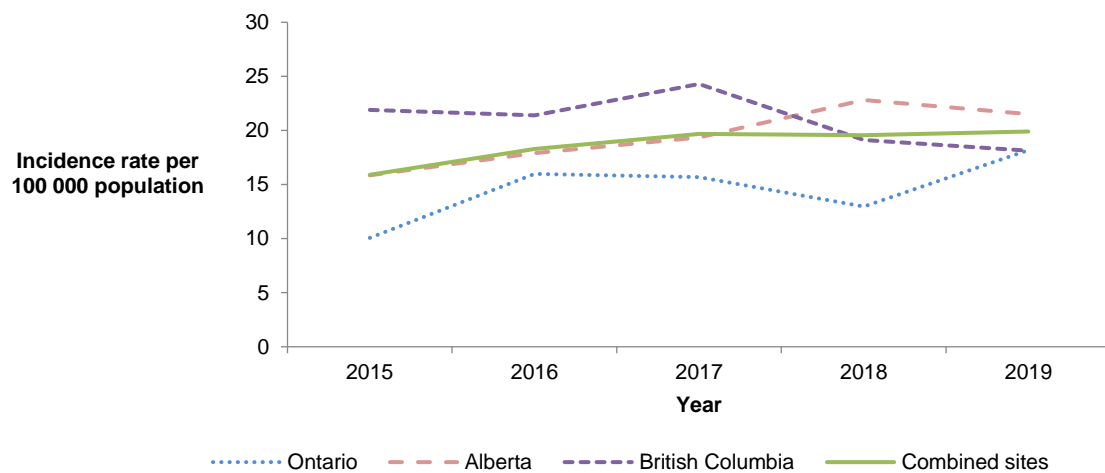


Table 1.1: Annual incidence rates (per 100,000 population) of campylobacteriosis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	12.98	18.18↑	22.81	21.52	19.13	18.13	19.57	19.90	26.81	19.57	20.82
Travel	4.87	5.39	5.12	6.77	10.16	8.87	6.28	6.95	6.55	6.28	6.90
Outbreak	0	0	0.47	0↓	0	0	0.24	0↓	0	0.24	0↓
Non-endemic	0	0	0	0	0	0	0	0	0	0	0
Lost to follow-up	3.65	2.60	2.98	1.56↓	2.59	1.58	3.04	1.81↓	15.27	3.04	3.59
Total	21.49	26.17	31.37	29.85	31.88	28.57	29.14	28.66	48.62	29.14	31.31

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019. The incidence of campylobacteriosis is seasonal. Months presenting a higher incidence may be over-represented.^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018.

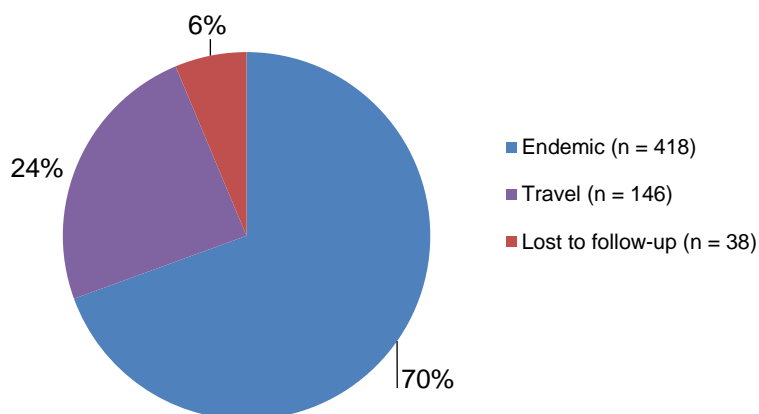
Figure 1.3: Relative proportion of *Campylobacter* infections by case classification, excluding Quebec.

Table 1.2: Proportion of *Campylobacter* subtypes for endemic cases only by site, 2019 (with 2018 shown for reference). Endemic isolates with subtype information in 2019: 363/418 (86.8%)^a.

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a	
	2018	2019	2018	2019	2018	2019	2018	2019
<i>C. jejuni</i>	75.86	70.27	87.65	91.88	94.68	90.22	88.52	89.26
<i>C. coli</i>	6.90	5.41	6.58	6.41	5.32	5.43	6.28	6.06
<i>C. upsaliensis</i>	6.90	10.81	4.94	1.28	0	1.09	3.83	2.20
<i>C. lari</i>	10.34	2.70	0.41	0	0	2.17	1.09	0.83
<i>C. concisus</i>	0	5.41	0	0	0	0	0	0.55
<i>C. fetus</i>	0	2.7	0.41	0	0	0	0.27	0.28
<i>C. hyointestinalis</i>	0	0	0	0.43	0	0	0	0.28
<i>C. showae</i>	0	2.70	0	0	0	0	0	0.28
<i>C. ureolyticus</i>	0	0	0	0	0	1.09	0	0.28

^a Excludes the Quebec sentinel site.

Figure 1.4: Age- and gender-specific annual incidence rates (per 100,000 population) for endemic *Campylobacter* cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

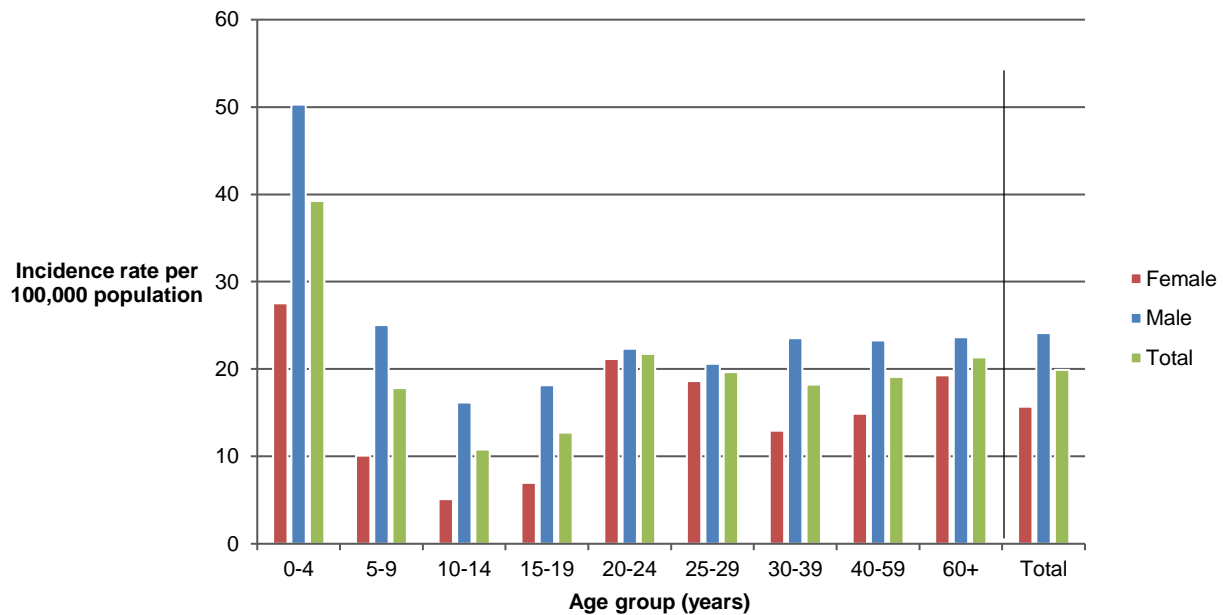


Table 1.3: Clinical profile of endemic *Campylobacter* cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	99%	98%
Abdominal pain	83%	82%
Fatigue	78%	80%
Anorexia	60%	69%
Fever	66%	68%
Indicators of severity:	2018	2019
Bloody diarrhea	43%	34%
ER visits	61%	54%
Hospitalizations	9%	10%
Antimicrobial prescriptions	54%	55%

FOOD, ANIMAL AND ENVIRONMENTAL SURVEILLANCE SUMMARY

Table 1.4: Prevalence of *Campylobacter* spp. by sample type and FoodNet Canada sentinel site, 2019.

Sample type		Ontario site	Alberta site	British Columbia site	Combined sites (ON, AB, BC) ^a	Quebec site ^b	All sites ^c
Chicken breast		40.31% (52/129)↑	37.69% (49/130)	48.09% (63/131)	42.05% (164/390)	29.17% (14/48)	40.64% (178/438)
Broiler chicken manure	Sample-level	13.04% (12/92)	32.50% (39/120)	34.56% (47/136)	28.16% (98/348)	16.67% (20/120)	25.21% (118/468)
	Farm-level	13.04% (3/23)	33.33% (10/30)	35.29% (12/34)	28.74% (25/87)	23.33% (7/30)	27.35% (32/117)
Swine manure	Sample-level	72.77% (139/191)	66.67% (80/120)	NT	70.42% (219/311)↓	61.90% (104/168)	67.43% (323/479)↓
	Farm-level	96.88% (31/32)	85.00% (17/20)	NT	92.31% (48/52)	78.57% (22/28)	87.50% (70/80)
Turkey manure	Sample-level	45.83% (55/120)	50.00% (20/40)	70.16% (87/124)	57.04% (162/284)	46.09% (53/115)	53.88% (215/399)
	Farm-level	53.33% (16/30)	50.00% (5/10)	74.19% (23/31)	61.97% (44/71)	48.28% (14/29)	58.00% (58/100)
Feedlot beef manure	Sample-level	NT	37.16% (110/296)↓	NT	-	NT	-
	Farm-level	NT	66.67% (20/30)↓	NT	-	NT	-
Irrigation water		NT	NT	11.43% (12/105)	-	NT	-

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019.^c Includes the Quebec sentinel site data.

NT - not tested.

↑/↓ Indicates a significant increase/decrease in prevalence compared to 2018.

Figure 1.5: Distribution of *Campylobacter* spp. among food, animal and environmental samples, FoodNet Canada, 2019, excluding Quebec.

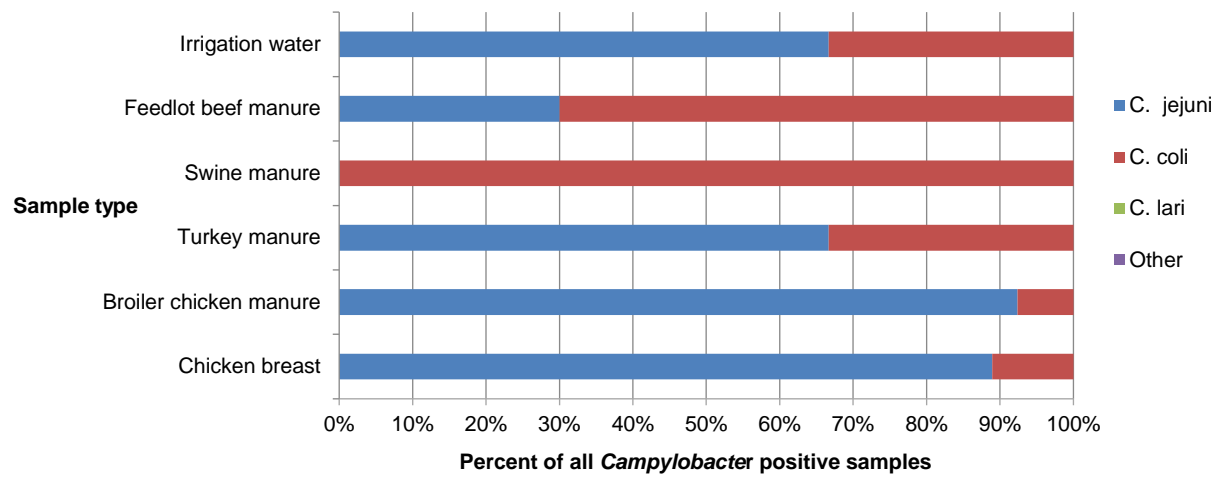


Figure 1.6: Percent of retail chicken breast samples positive for *Campylobacter*, 2015-2019.

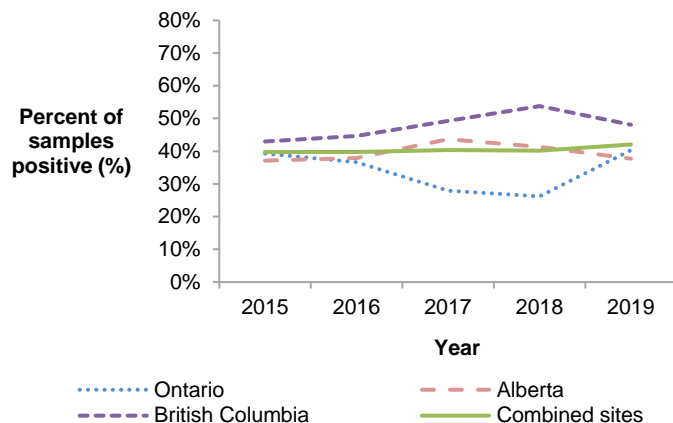


Figure 1.7: Percent of farm broiler chicken manure samples positive for *Campylobacter*, 2015-2019.

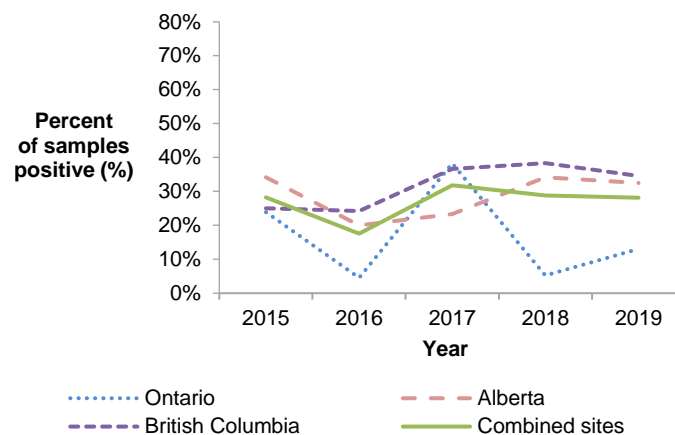


Figure 1.8: Percent of farm turkey manure samples positive for *Campylobacter*, 2015-2019.

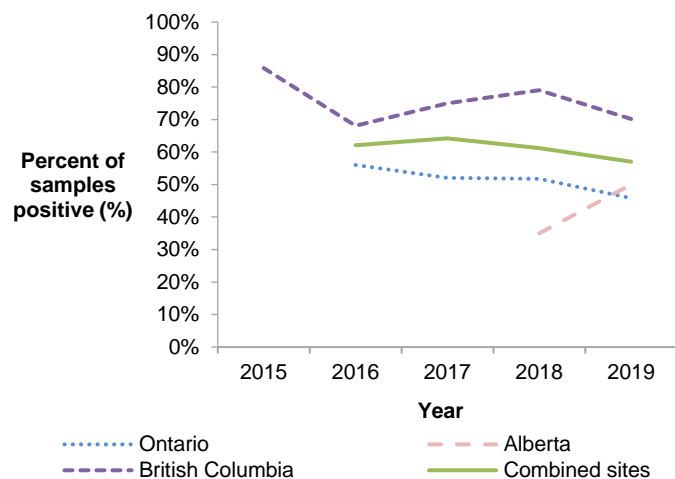


Figure 1.9: Percent of farm swine manure samples positive for *Campylobacter*, 2015-2019.

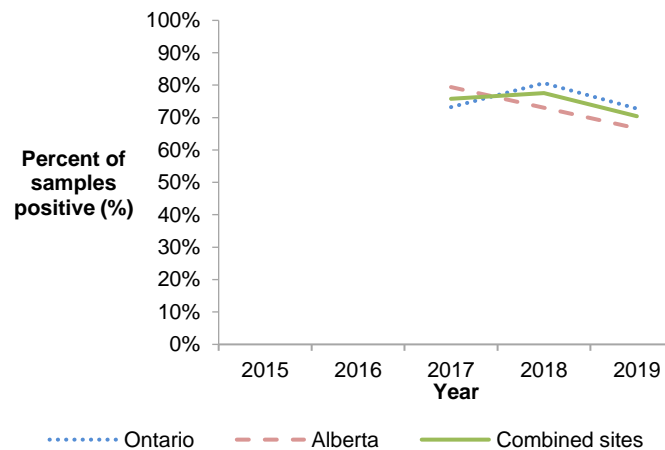


Figure 1.10: Percent of farm feedlot beef manure samples positive for *Campylobacter*, 2015-2019.

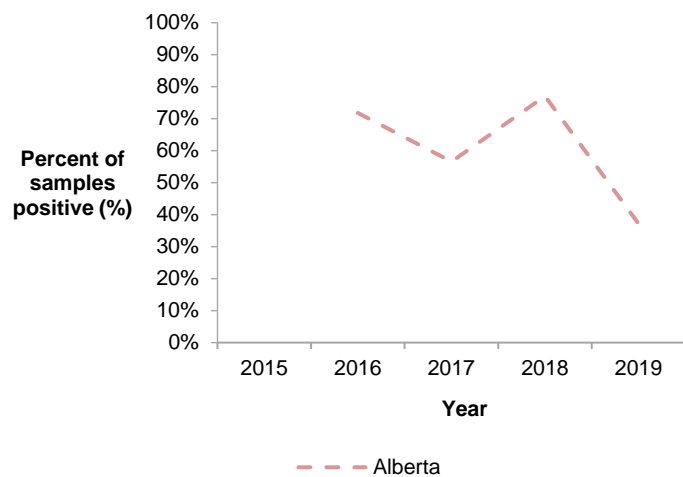
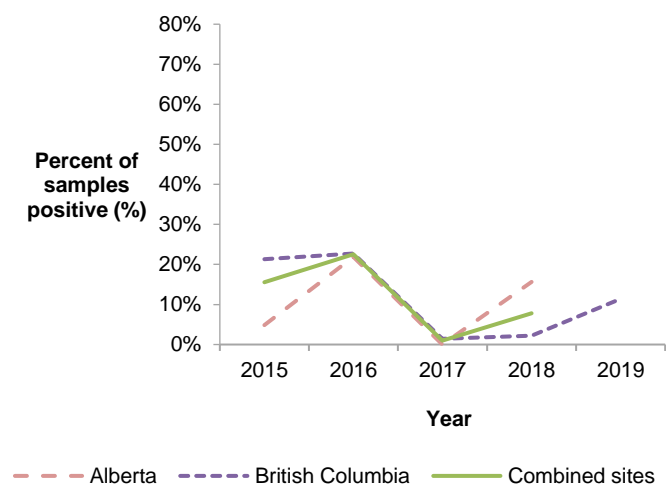


Figure 1.11: Percent of irrigation water samples positive for *Campylobacter*, 2015-2019.



SALMONELLA

HUMAN SURVEILLANCE SUMMARY

Figure 2.1: Incidence rates (per 100,000) of salmonellosis reported to FoodNet Canada, 2015-2019.

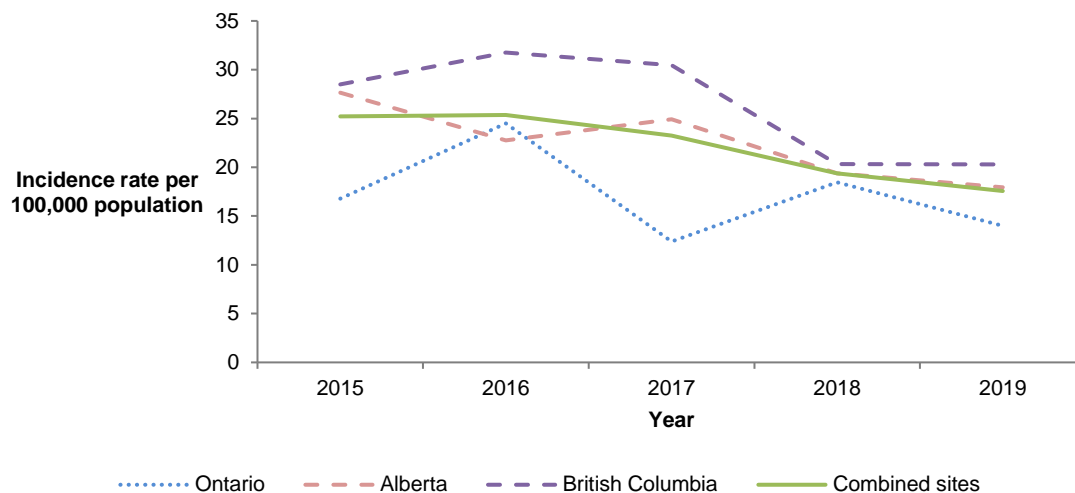


Figure 2.2: Incidence rates (per 100,000) of endemic salmonellosis reported to FoodNet Canada, 2015-2019.

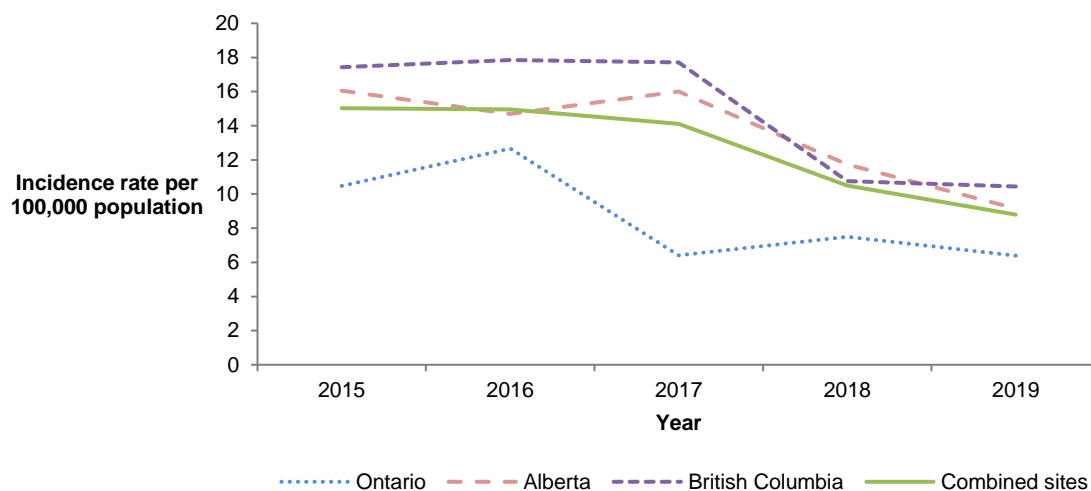


Table 2.1: Annual incidence rates (per 100,000 population) of salmonellosis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	7.50	6.39	11.73	9.16	10.76	10.44	10.49	8.81	11.53	10.49	9.17
Travel	5.07	5.19	5.21	5.22	6.58	7.88	5.51	5.86	0.62	5.51	5.16
Outbreak	5.27	1.00↓	1.02	1.65	1.99	0.59	2.27	1.24↓	0.62	2.27	1.16↓
Non-endemic	0	0.40	0	0.09	0	0	0	0.14	0	0	0.12
Lost to follow-up	0.61	1.00	1.40	1.83	1.00	1.38	1.11	1.52	3.74	1.11	1.82
Total	18.45	13.98	19.36	17.94	20.32	20.29	19.38	17.57	16.52	19.38	17.43

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019. The incidence of salmonellosis is impacted by the season. It is possible that the months with a higher incidence are over-represented.^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rate compared to 2018.

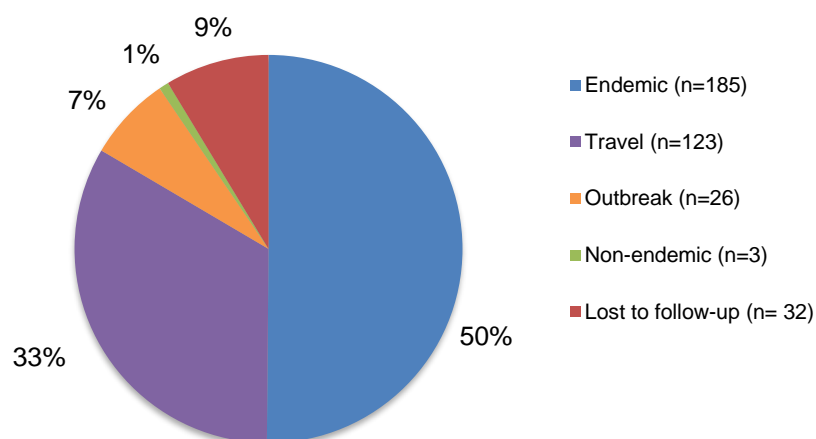
Figure 2.3: Relative proportion of *Salmonella* infections by case classification, excluding Quebec.

Figure 2.4: Age- and gender-specific annual incidence rates (per 100,000 population) for endemic *Salmonella* cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

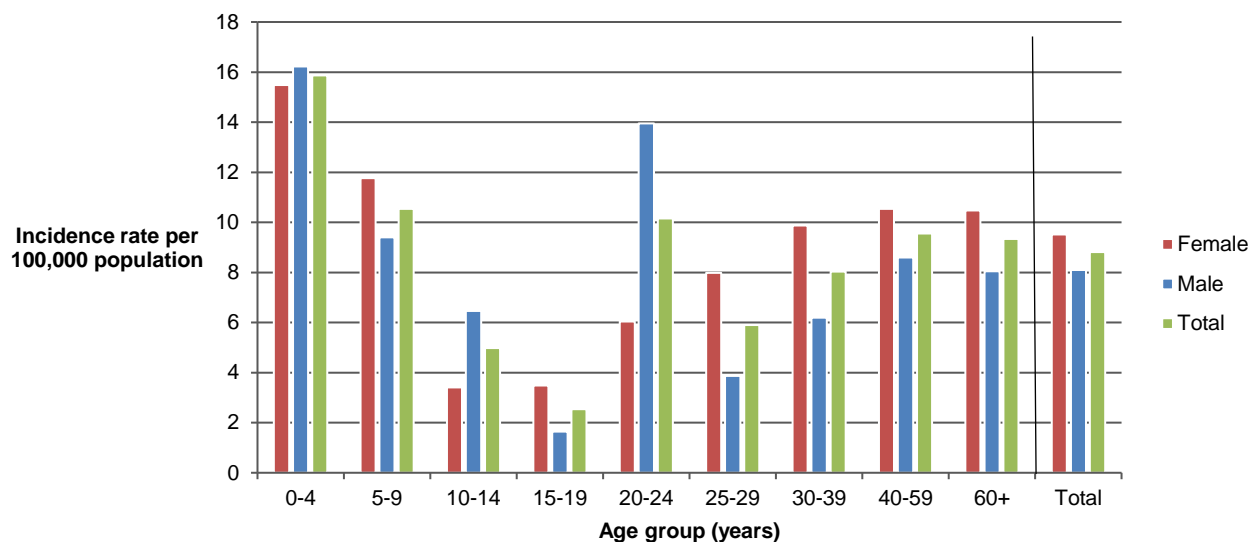


Table 2.2: Clinical profile of endemic *Salmonella* cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	92%	91%
Abdominal pain	80%	79%
Fatigue	74%	74%
Anorexia	69%	68%
Fever	68%	67%
Indicators of severity:	2018	2019
Bloody diarrhea	36%	32%
Emergency room visits	62%	56%
Hospitalizations	19%	17%
Antimicrobial prescriptions	45%	45%

FOOD, ANIMAL AND ENVIRONMENTAL SURVEILLANCE SUMMARY

Table 2.3: Prevalence of *Salmonella* spp. by sample type and FoodNet Canada sentinel site, 2019.

Sample type		Ontario site	Alberta site	British Columbia site	Combined sites (ON, AB, BC) ^a	Quebec site ^b	All sites ^c
Chicken breast		15% (19/129)	12% (15/130)↓	23% (30/132)	16% (64/391)	46% (22/48)	20% (86/439)
Frozen breaded chicken products		16% (19/117)	19% (23/120)	16% (21/132)↓	17% (63/369)↓	11% (3/27)	17% (66/396)
Pork sausage		9% (13/140)	3% (4/143)	3% (4/131)	5% (21/414)	4% (1/28)	5% (22/443)
Broiler chicken manure	Sample-level	37% (34/92)	14% (17/120)↓	75% (102/136)↑	44% (153/348)↓	78% (93/120)	53% (246/468)
	Farm-level	43% (10/23)	30% (9/30)↓	85% (29/34)	55% (48/87)	90% (27/30)	64% (75/117)
Swine manure	Sample-level	29% (55/191)	3% (3/120)	NT	19% (58/311)	35% (58/168)	24% (116/479)
	Farm-level	63% (20/32)	5% (1/20)	NT	40% (21/52)	68% (19/28)	50% (40/80)
Turkey manure	Sample-level	83% (100/120)	78% (31/40)	70% (87/124)↑	77% (218/284)	72% (83/115)	75% (301/399)
	Farm-level	90% (27/30)	80% (8/10)	74% (23/31)	82% (58/71)	88% (24/29)	82% (82/100)
Feedlot beef manure	Sample-level	NT	4% (13/296)	NT	NT	NT	NT
	Farm-level	NT	23% (7/30)	NT	NT	NT	NT
Irrigation water		NT	NT	9% (9/105)	NT	NT	NT

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019.^c Includes the Quebec sentinel site data.

NT - not tested.

↑/↓ Indicates a significant increase/decrease in prevalence compared to 2018.

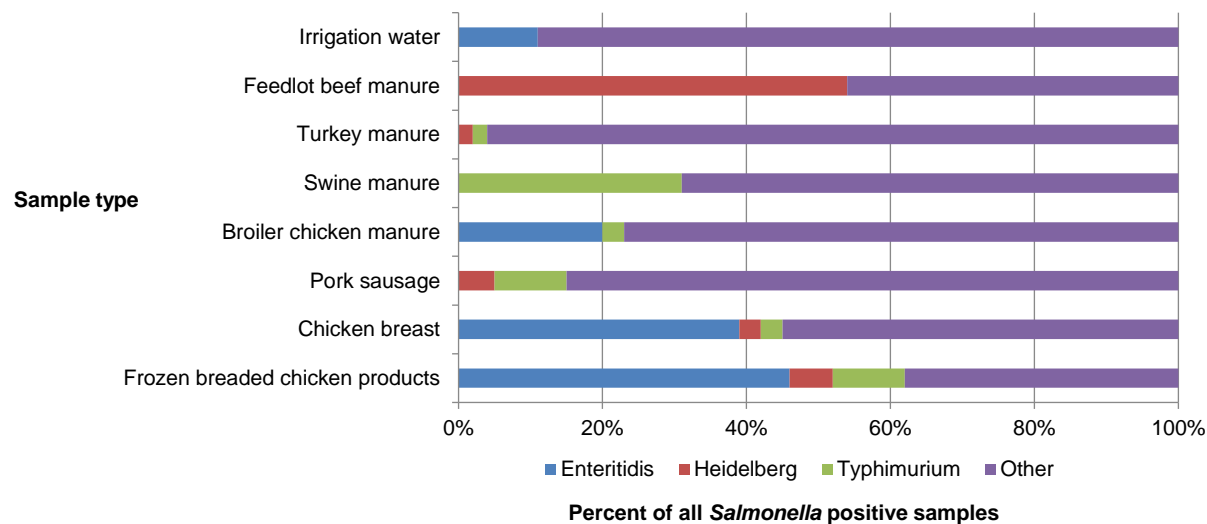
Figure 2.5: Distribution of *Salmonella* spp. among food, animal and environmental samples, FoodNet Canada, 2019.

Figure 2.6: Percent of retail chicken breast samples positive for *Salmonella*, 2015-2019.

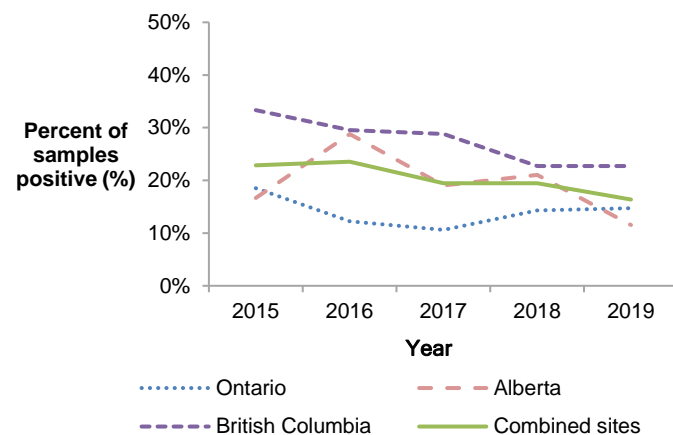


Figure 2.7: Percent of retail frozen breaded chicken samples positive for *Salmonella*, 2015-2019.

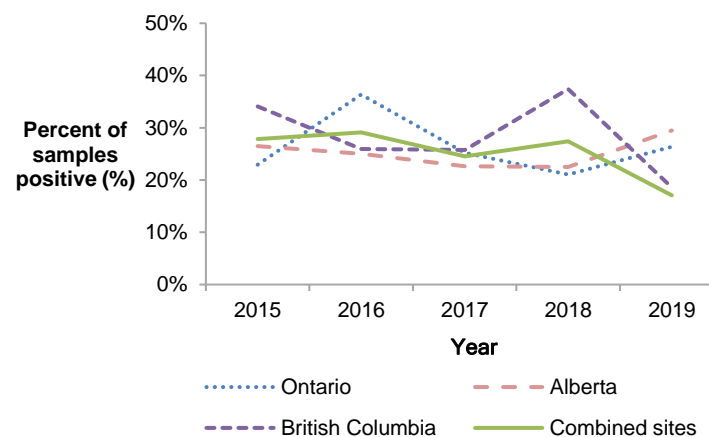


Figure 2.8: Percent of farm broiler chicken manure samples positive for *Salmonella*, 2015-2019.

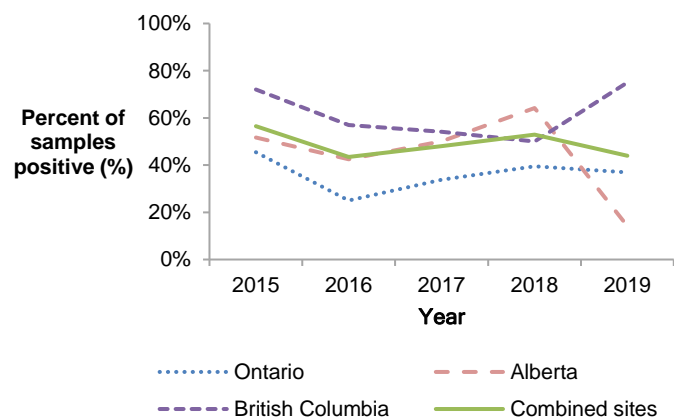


Figure 2.9: Percent of farm turkey manure samples positive for *Salmonella*, 2015-2019.

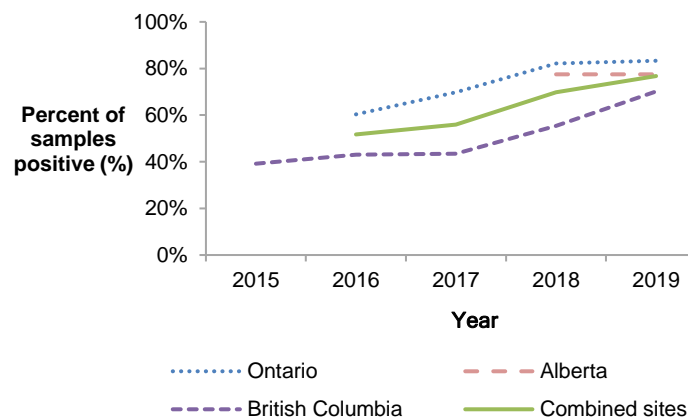


Figure 2.10: Percent of farm swine manure samples positive for *Salmonella*, 2015-2019.

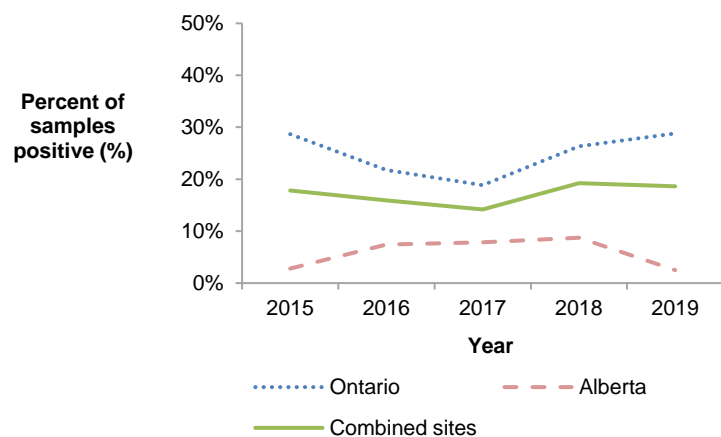


Figure 2.11: Percent of farm feedlot beef manure samples positive for *Salmonella*, 2015-2019.

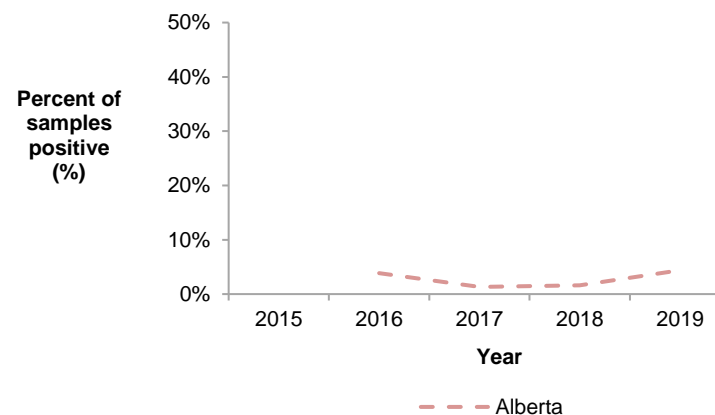
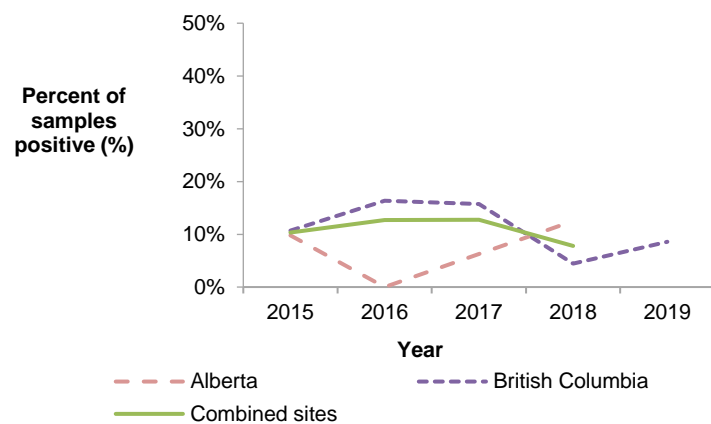


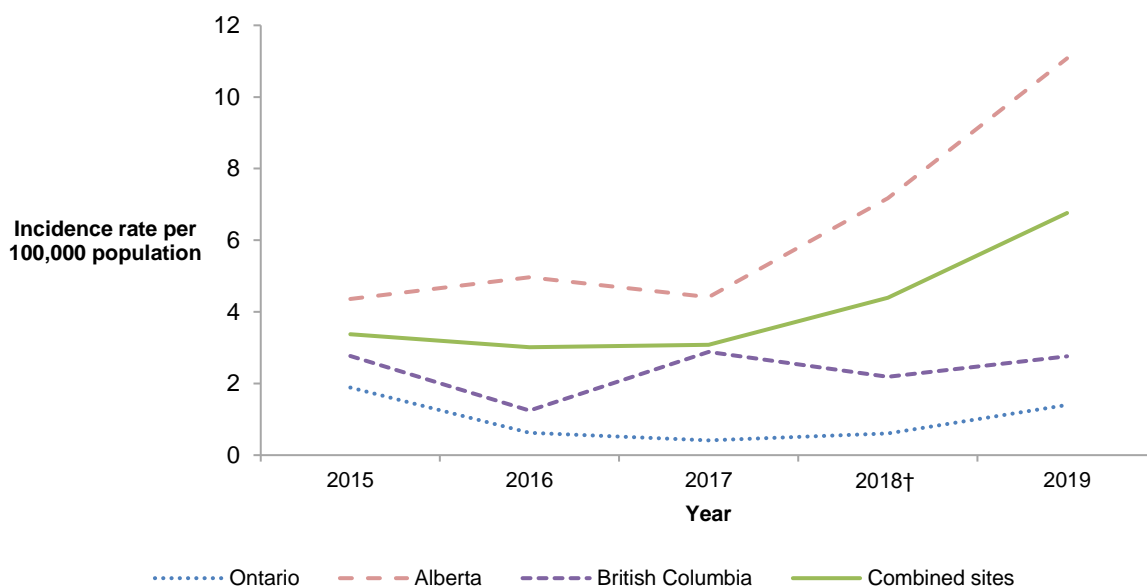
Figure 2.12: Percent of irrigation water samples positive for *Salmonella*, 2015-2019.



SHIGATOXIGENIC *ESCHERICHIA COLI* (STEC)

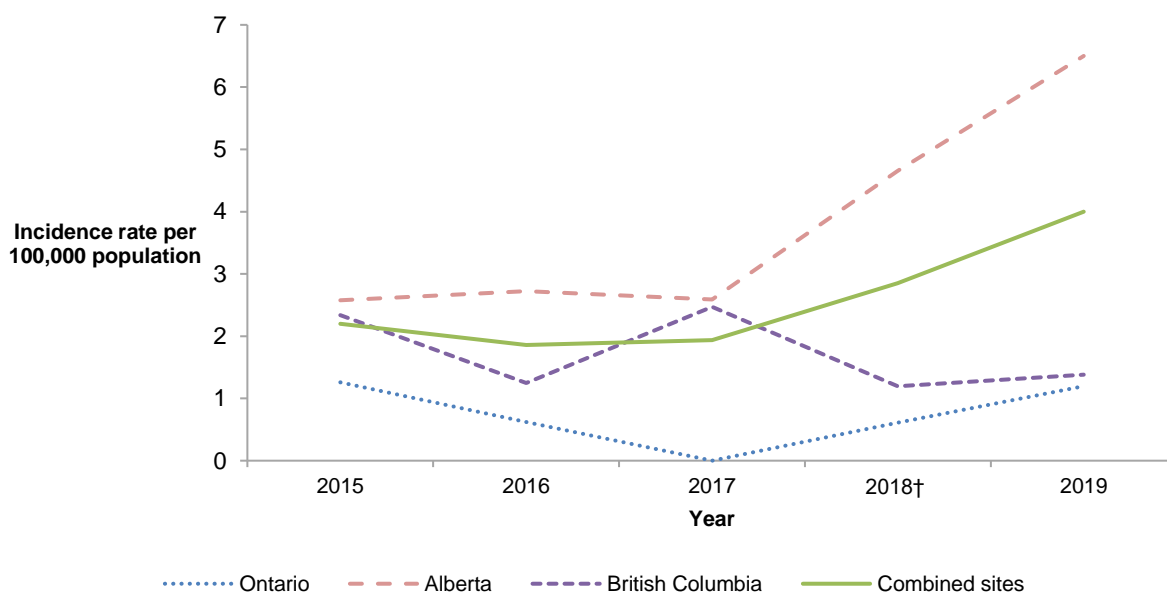
HUMAN SURVEILLANCE SUMMARY

Figure 3.1: Incidence rates (per 100,000) of STEC infections reported to FoodNet Canada, 2015-2019.



† Starting June 11, 2018, the AB site began testing all STEC samples for non-O157, in addition to continuing O157 testing.

Figure 3.2: Incidence rates (per 100,000) of endemic cases of STEC reported to FoodNet Canada, 2015-2019.



† Starting June 11, 2018, the AB site began testing all STEC samples for non-O157, in addition to continuing O157 testing.

Table 3.1: Annual incidence rates (per 100,000 population) of STEC infections by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site [†]		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	0.61	1.20	4.66	6.50	1.20	1.38	2.85	4.00↑	3.12	2.85	3.88
Travel	0	0.20	1.58	3.85↑	1.00	1.38	1.06	2.38↑	0	1.06	2.06↑
Outbreak	0	0	0.93	0.55	0	0	0.48	0.29	0	0.48	0.25
Non-endemic	0	0	0	0	0	0	0	0	0	0	0
Lost to follow-up	0	0	0	0.18	0	0	0	0.10	0.31	0	0.12
Total	0.61	1.40	7.17	11.08↑	2.19	2.76	4.40	6.76↑	3.43	4.40	6.32↑

[†] Starting June 11, 2018, the AB site began testing all STEC samples for non-O157, in addition to continuing O157 testing.

^a Excludes the Quebec sentinel site.

^b Quebec sentinel site data are only from July to December 2019. The incidence of STEC infections is seasonal. Months presenting a higher incidence may be over-represented. The Quebec site analyses all shigatoxigenic *E.coli* serotypes and not only O157:H7.

^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rate compared to 2018.

Figure 3.3: Relative proportion of STEC infections by case classification, excluding Quebec.

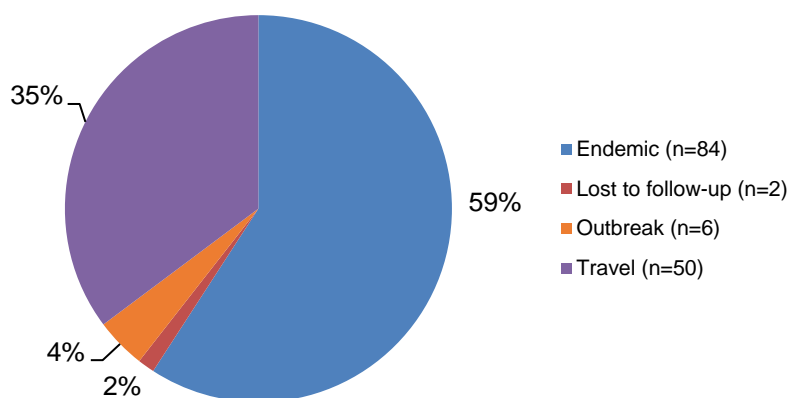


Table 3.2: Proportion of *E. coli* O157 and non-O157 priority subtypes for endemic cases only by site, 2019 (with 2018 shown for reference). Endemic isolates with subtype information in 2019: 77/84 (91.7%)^a.

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a	
	2018	2019	2018	2019	2018	2019	2018	2019
O157	100.00	100.00	35.56	35.39	25.00	50.00	36.00	41.56
O26	0	0	24.44	26.16	0	0	22.00	22.08
O103	0	0	13.33	7.70	0	0	12.00	6.50
O121	0	0	4.44	6.15	50.00	0	8.00	5.19
O111	0	0	6.67	4.62	0	0	6.00	3.90
O145	0	0	6.67	3.08	0	0	6.00	2.60
O45	0	0	0	0	0	0	0	0
Other	0	0	8.88	16.94	25.00	50.00	10.00	18.19

^a Excludes the Quebec sentinel site.

Figure 3.4: Age- and gender-specific annual incidence rates (per 100,000 population) for endemic STEC cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

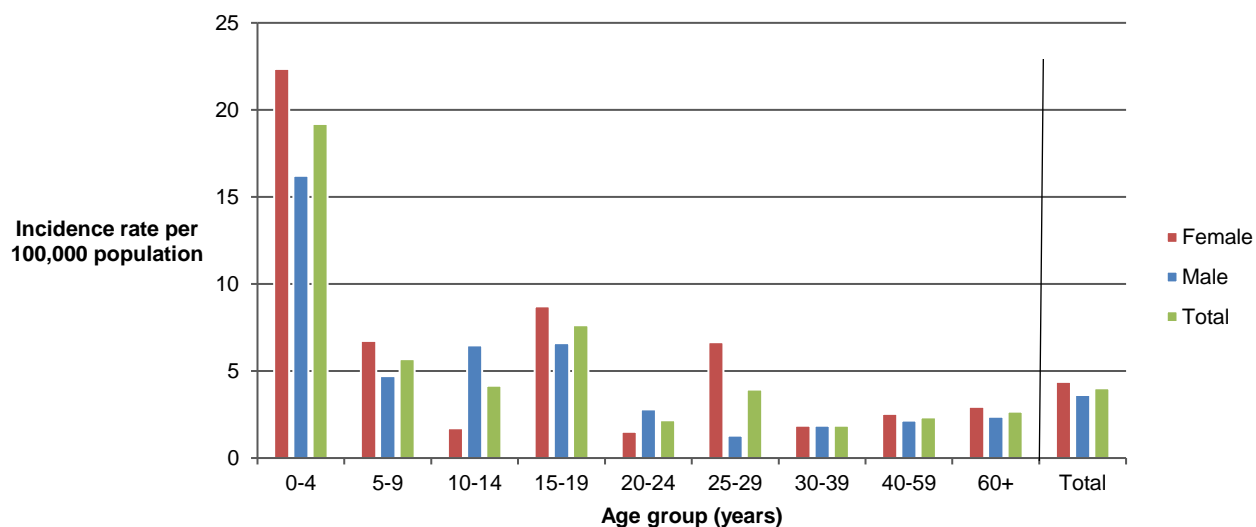


Table 3.3: Clinical profile of endemic STEC cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	92%	96%
Abdominal pain	85%	83%
Fatigue	68%	75%
Anorexia	64%	75%
Nausea	51%	62%
Indicators of severity:	2018	2019
Bloody diarrhea	58%	54%
Emergency room visits	68%	63%
Hospitalizations	14%	10%
Antimicrobial prescriptions	12%	19%

FOOD, ANIMAL AND ENVIRONMENTAL SURVEILLANCE SUMMARY

Table 3.4: Prevalence of STEC by sample type and FoodNet Canada sentinel site, 2019.

Sample type		Ontario site	Alberta site	British Columbia site	Combined sites (ON, AB, BC)^a	Quebec site^b	All sites^c
Ground beef		4.7% (6/128)	1.6% (2/123)	3.0% (4/132)	3.1% (12/383)	0.0% (0/45)	2.8% (12/428)
Pork sausage		10.0% (14/140)	3.7% (5/134)	1.5% (2/131)	5.2% (21/405)	2.2% (1/45)	4.9% (22/450)
Feedlot beef manure	Sample-level	NT	8.3% (20/241)	NT	-	NT	-
	Farm-level	NT	46.7% (14/30)	NT	-	NT	-
Irrigation water		NT	42.9% (24/56)	19.2% (20/104)↑	27.5% (44/160)	NT	27.5% (44/160)
Surface water		26.7% (8/30)	NT	NT	-	NT	-

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019.^c Includes the Quebec sentinel site data.

NT –not tested.

↑/↓ Indicates a significant increase/decrease in prevalence compared to 2018.

Figure 3.5. Percent of positive retail ground beef samples positive for STEC, 2015-2019.

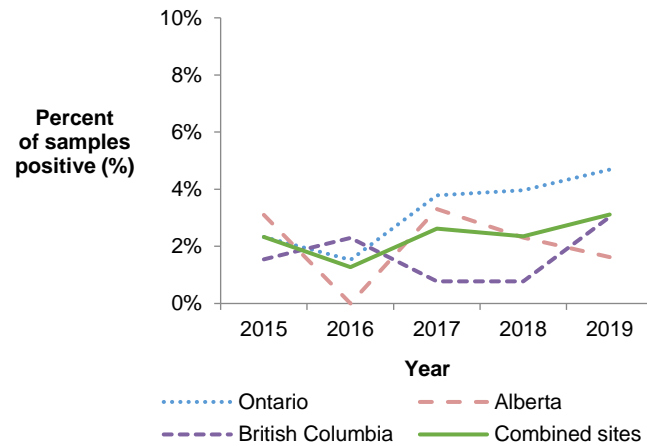


Figure 3.6. Percent of positive farm feedlot beef manure samples positive for STEC, 2015-2019.

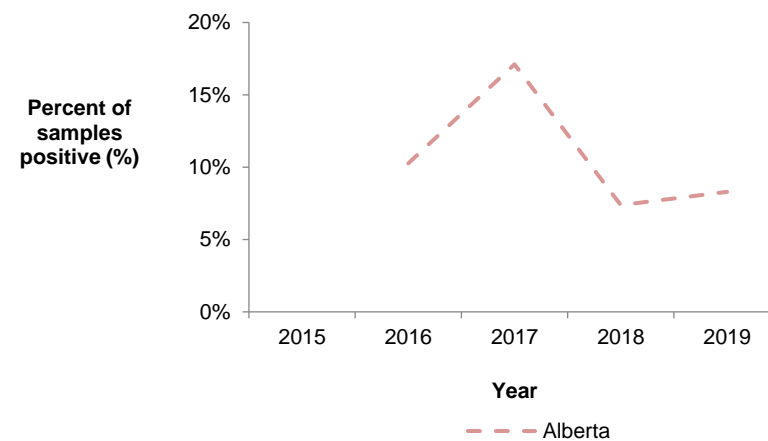
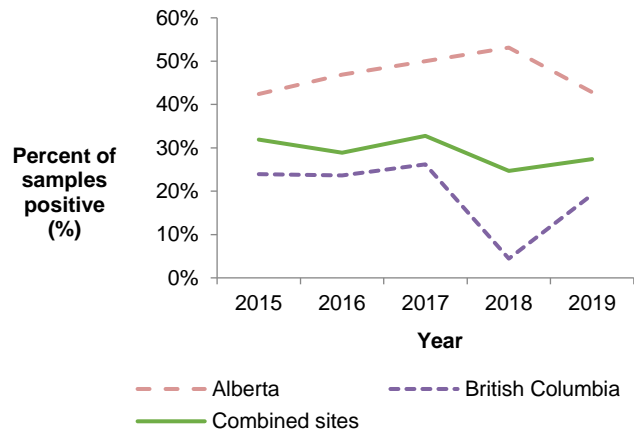


Figure 3.7. Percent of positive irrigation water samples positive for STEC, 2015-2019.



LISTERIA MONOCYTOGENES

HUMAN SURVEILLANCE SUMMARY

Table 4.1: Annual incidence rates (per 100,000 population) of *Listeria monocytogenes* cases[†] by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	0.20	0.60	0.37	0.09	0	0.20	0.24	0.24	1.56	0.24	0.41
Travel	0	0	0	0	0	0	0	0	0	0	0
Outbreak	0	0	0	0	0	0	0	0	0	0	0
Non-endemic	0	0	0	0	0	0	0	0	0	0	0
Lost to follow-up	0	0	0.09	0	0	0.20	0.05	0.05	0	0.05	0.04
Total	0.20	0.60	0.47	0.09	0	0.39	0.29	0.29	1.56	0.29	0.45

[†] Of 11 total cases reported in 2019, 10 cases were endemic (1 in BC site, 1 in AB site, 3 in ON site, 5 in QC site) and 1 case was lost to follow-up (in BC site).

^a Excludes the Quebec sentinel site.

^b Quebec sentinel site data are only from July to December 2019.

^c Includes the Quebec sentinel site data.

FOOD, ANIMAL AND ENVIRONMENTAL SURVEILLANCE SUMMARY

Table 4.2: Prevalence of *Listeria monocytogenes* in 2019 by sample type and FoodNet Canada sentinel site.

Sample type	Ontario site	Alberta site	British Columbia site	Combined sites (ON, AB, BC) ^a	Quebec site ^b	All sites ^c
Chicken Breast	15.50% (20/129)	3.82% (5/131)↓	15.15% (20/132)↓	11.48% (45/392)↓	10.42% (5/48)	11.36% (50/440)↓
Ground Beef	24.22% (31/128)	22.14% (29/131)	34.85% (46/132)	27.11% (106/331)	8.33% (4/48)	25.06% (110/439)
Frozen breaded chicken products	10.26% (12/117)↓	6.67% (8/120)↓	18.94% (25/132)	12.20% (45/369)↓	13.04% (6/46)	12.29% (51/415)↓
Pork Sausage	17.86% (25/140)	15.38% (22/143)	18.32% (24/131)	17.15% (71/414)	8.70% (4/46)	16.30% (75/460)
Molluscs (oysters and mussels)	NT	NT	NT	NT	NT	NT

^a Excludes the Quebec sentinel site.

^b Quebec sentinel site data are only from July to December 2019.

^c Includes the Quebec sentinel site data.

NT – not tested.

↑/↓ Indicates a significant increase/decrease in prevalence compared to 2018.

Figure 4.1: Percent of retail chicken breast samples positive for *Listeria monocytogenes* in each FoodNet Canada sentinel site and across all sites from 2015 to 2019.

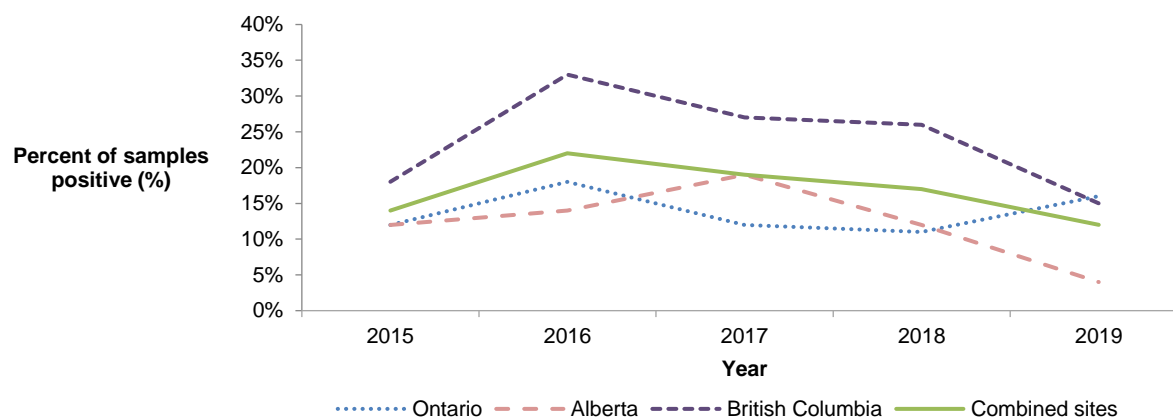


Figure 4.2: Percent of frozen breaded chicken product (FBCP) samples positive for *Listeria monocytogenes* in each FoodNet Canada sentinel site and across all sites from 2015 to 2019.

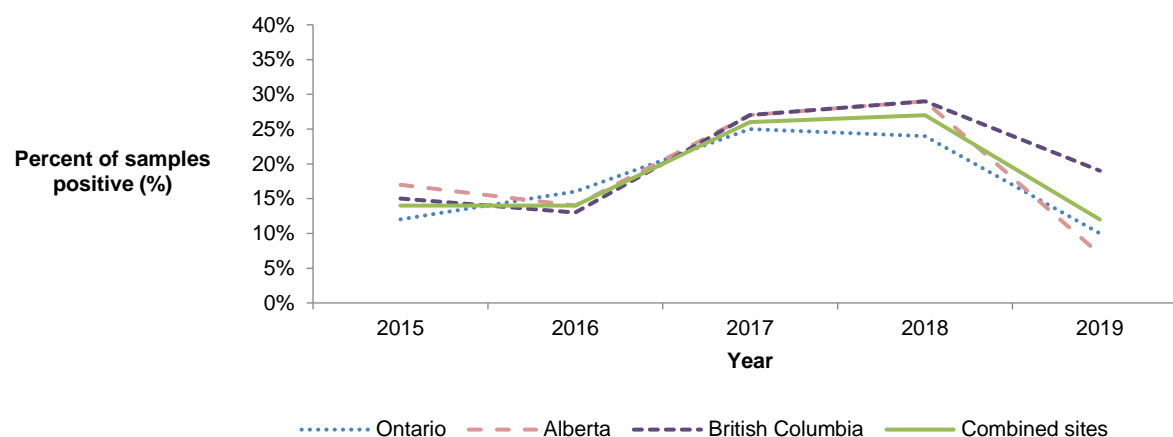
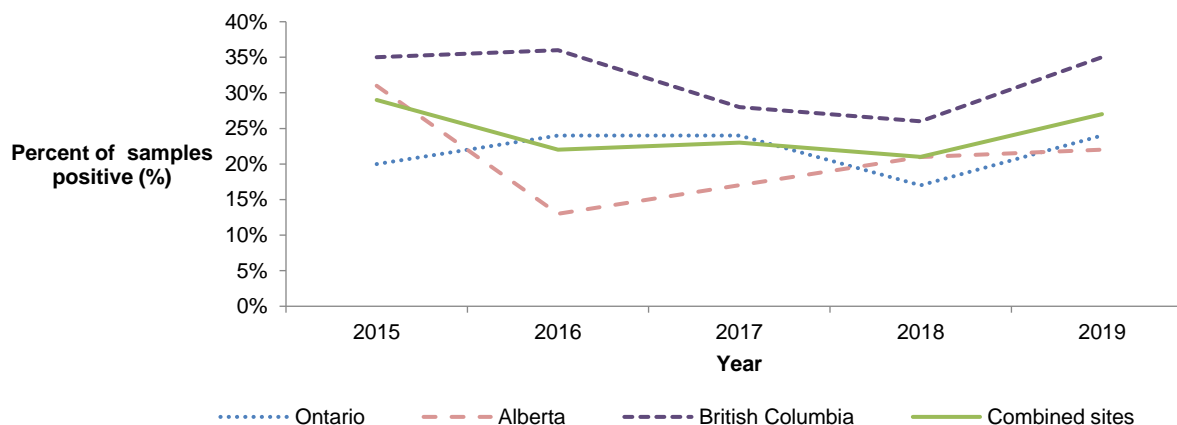


Figure 4.3: Percent of ground beef samples positive for *Listeria monocytogenes* in each FoodNet Canada sentinel site and across all sites from 2015 to 2019.



YERSINIA

HUMAN SURVEILLANCE SUMMARY

Figure 5.1: Incidence rates (per 100,000) of yersiniosis reported to FoodNet Canada, 2015-2019.

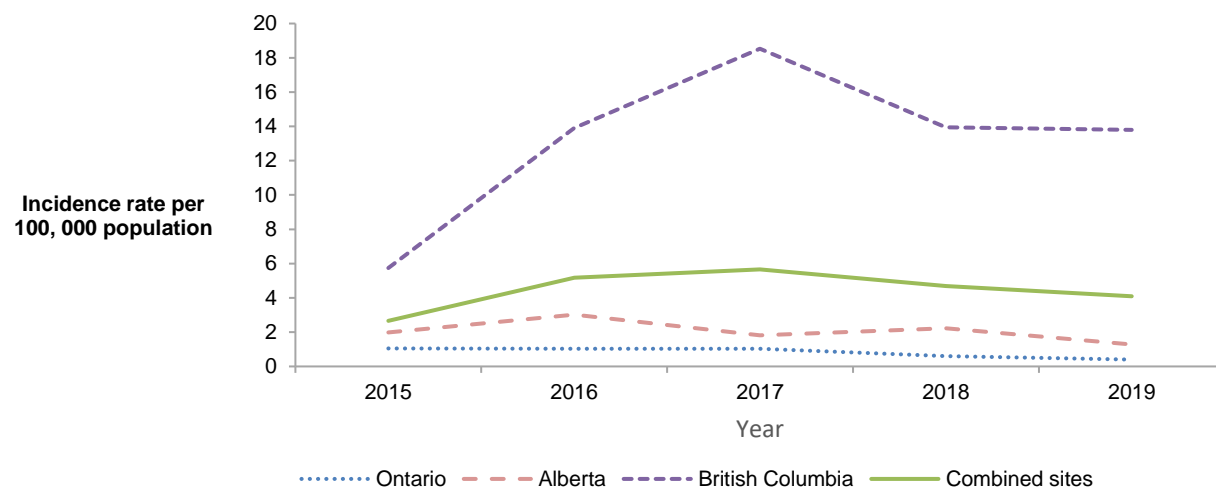


Figure 5.2: Incidence rates (per 100, 000) of endemic yersiniosis reported to FoodNet Canada, 2015-2019.

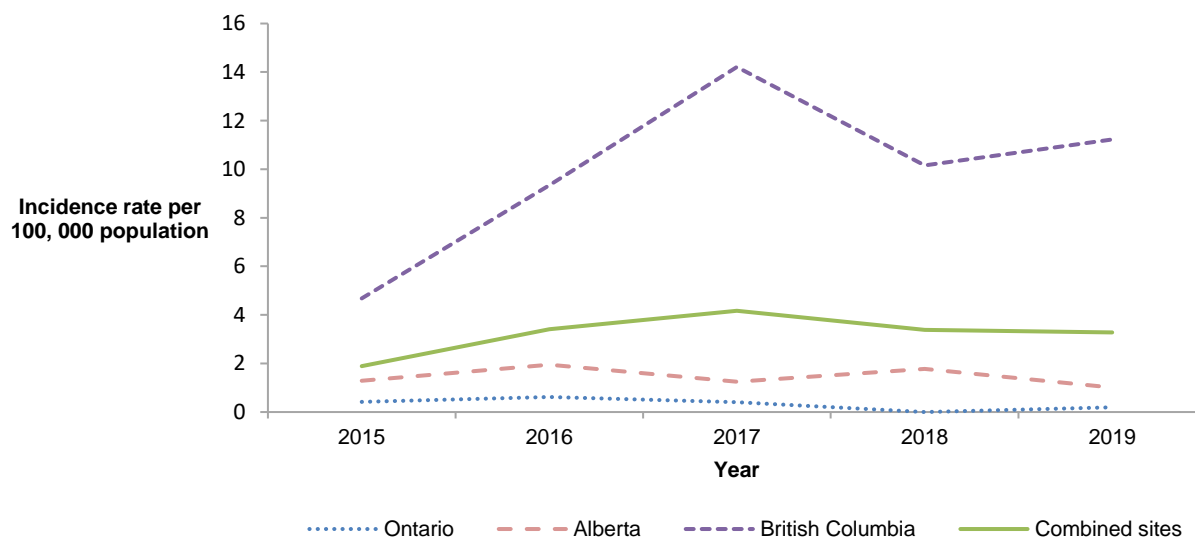
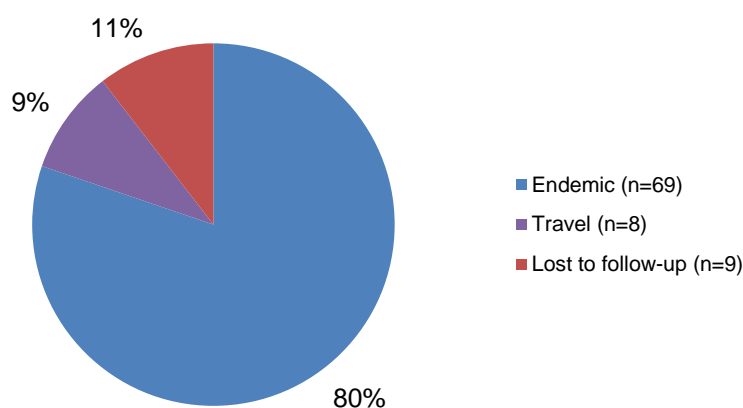


Table 5.1: Annual incidence rates (per 100,000 population) of yersiniosis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	0.00	0.20	1.77	1.01	10.16	11.23	3.38	3.28	1.87	3.38	3.10
Travel	0.41	0.20	0.28	0.18	2.39	0.99	0.82	0.38	0	0.82	0.33↓
Outbreak	0	0	0	0	0	0	0	0	0	0	0
Non-endemic	0	0	0	0	0	0	0	0	0	0	0
Lost to follow-up	0.20	0	0.19	0.09	1.39	1.58	0.48	0.43	0.94	0.48	0.50
Total	0.61	0.40	2.23	1.28	13.95	13.79	4.69	4.09	2.81	4.69	3.92

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019.^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018

Figure 5.3: Relative proportion of *Yersinia* infections by case classification, excluding Quebec.**Table 5.2:** Proportion of *Yersinia* subtypes for endemic cases only by site, 2019 (with 2018 shown for reference). Endemic isolates with subtype information in 2019: 69/69 (100%)^a.

	Ontario site		Alberta site		British Columbia site		Combined sites ^a	
	2018	2019	2018	2019	2018	2019	2018	2019
<i>Y. enterocolitica</i>	0	100	89.47	54.55	96.08	94.74	94.29	88.41
<i>Y. intermedia</i>	0	0	5.26	36.36	0	1.75	1.43	7.25
<i>Y. frederiksenii</i>	0	0	0	9.09	3.92	3.51	2.86	4.35
<i>Y. pseudotuberculosis</i>	0	0	5.26	0	0	0	1.43	0

^a Excludes the Quebec sentinel site.

Figure 5.4: Age- and gender-specific annual incidence rates (per 100,000 population) for endemic *Yersinia* cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

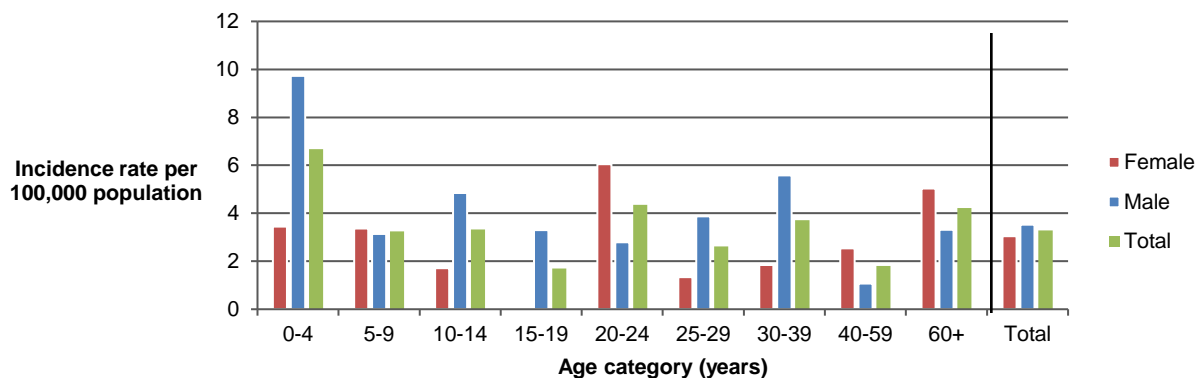


Table 5.3: Clinical profile of endemic *Yersinia* cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	83%	83%
Abdominal pain	64%	83%
Fatigue	46%	49%
Anorexia	29%	35%
Dehydration	17%	30%
Indicators of severity:	2018	2019
Bloody diarrhea	19%	7%
ER visits	14%	20%
Hospitalizations	6%	7%
Antimicrobial prescriptions	33%	29%

SHIGELLA

HUMAN SURVEILLANCE SUMMARY

Figure 6.1: Incidence rates (per 100,000) of shigellosis reported to FoodNet Canada, 2015-2019.

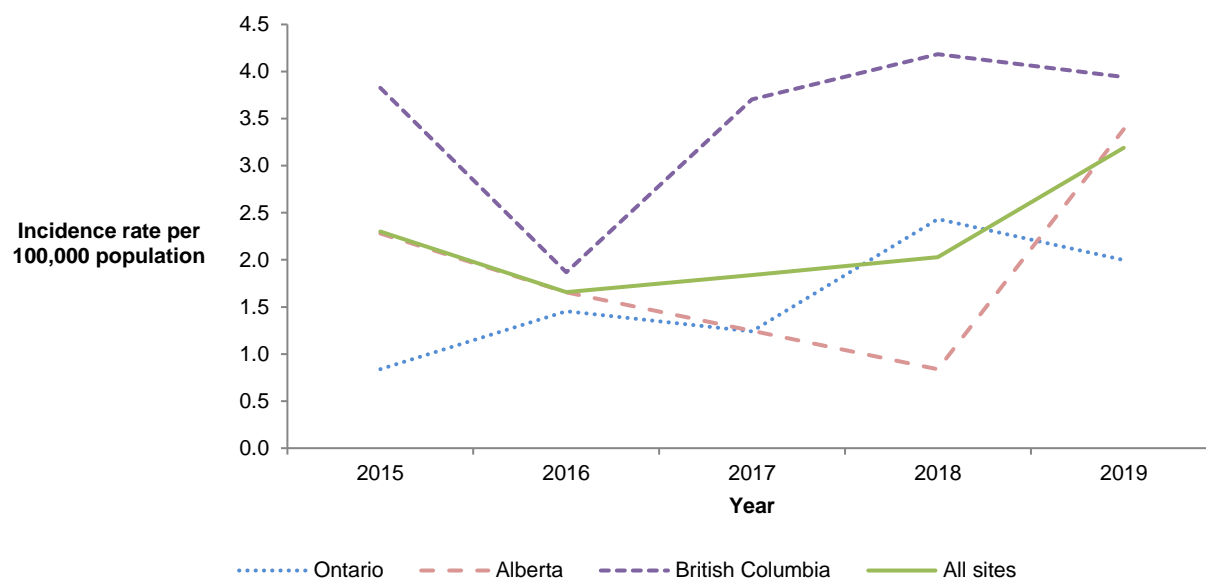


Figure 6.2: Incidence rates (per 100,000) of endemic shigellosis reported to FoodNet Canada, 2015-2019.

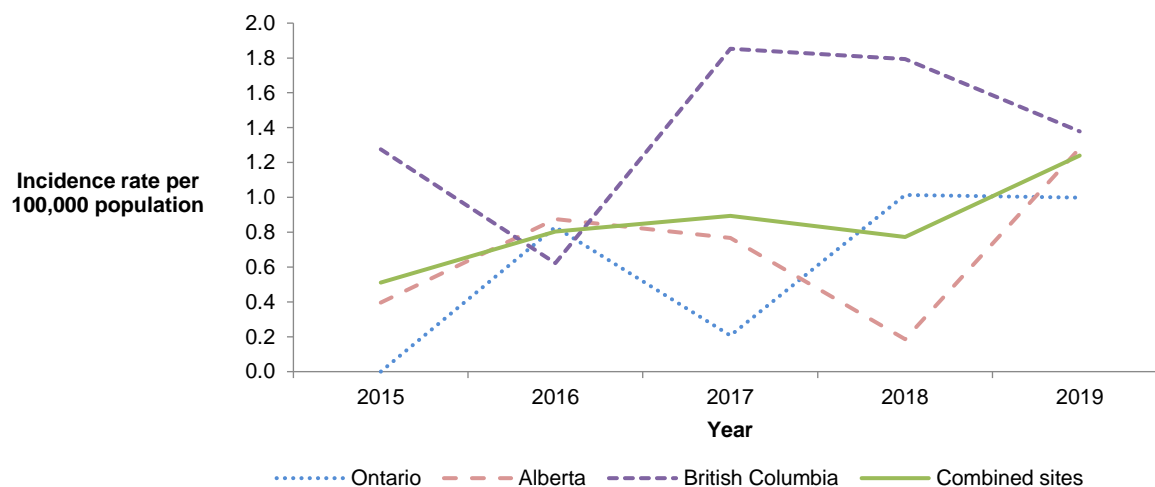


Table 6.1: Annual incidence rates (per 100,000 population) of shigellosis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	1.01	1.00	0.19	1.28↑	1.79	1.38	0.77	1.24	1.87	0.77	1.32
Travel	1.01	1.00	0.47	1.83↑	2.19	1.97	1.01	1.67	0	1.01	1.45
Outbreak	0	0	0	0	0	0	0	0	0	0	0
Non-endemic	0	0	0	0.09	0	0.20	0	0.10	0	0	0.08
Lost to follow-up	0.41	0	0.19	0.18	0.20	0.39	0.24	0.19	0	0.24	0.17
Total	2.43	2.00	0.84	3.39↑	4.18	3.94	2.03	3.19↑	1.87	2.03	3.01↑

^a Excludes the Quebec sentinel site.

^b Quebec sentinel site data are only from July to December 2019.

^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018

Figure 6.3: Relative proportion of *Shigella* infections by case classification, excluding Quebec.

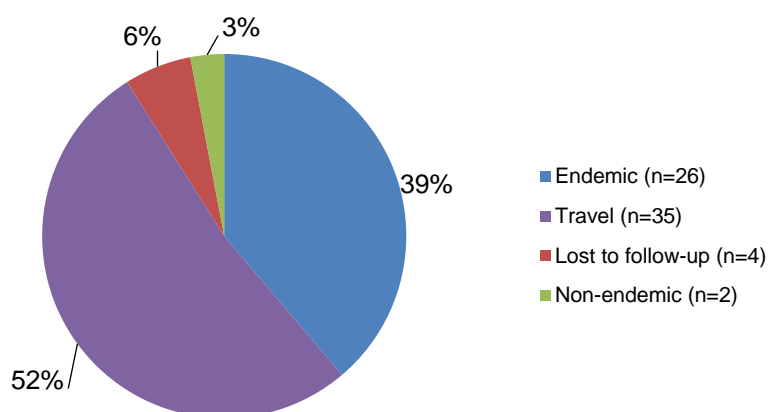
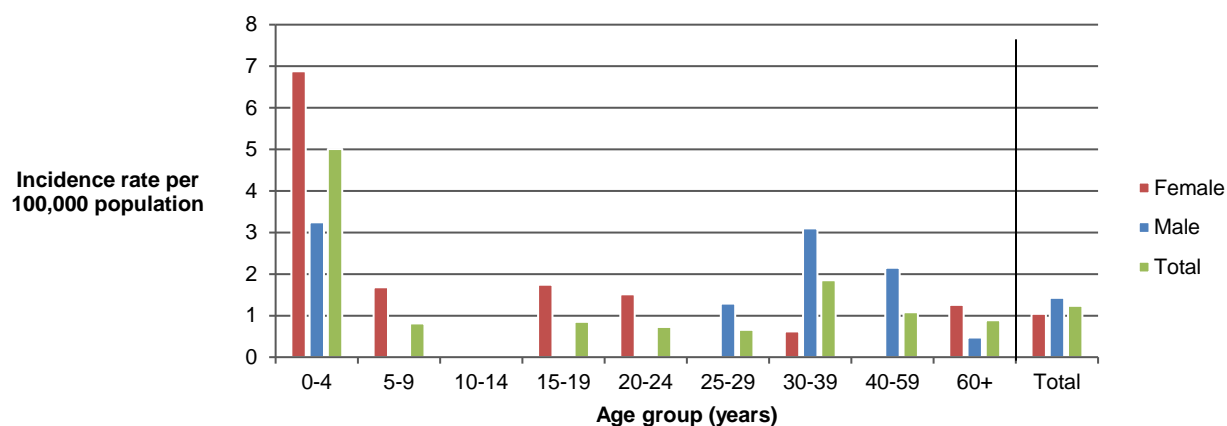


Table 6.2: Proportion of *Shigella* subtypes for endemic cases only by site, 2019 (with 2018 shown for reference). Endemic isolates with subtype information in 2019: 26/26 (100%)^a.

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a	
	2018	2019	2018	2019	2018	2019	2018	2019
<i>S. sonnei</i>	20.00	60.00	50.00	64.29	55.56	57.14	43.75	61.54
<i>S. flexneri</i>	80.00	40.00	50.00	28.57	44.44	42.86	56.25	34.62
<i>S. dysenteriae</i>	0	0	0	7.14	0	0	0	3.85

^a Excludes the Quebec sentinel site.

Figure 6.4: Age- and gender-specific annual incidence rates (per 100,000 population) for endemic *Shigella* cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.



PARASITES

GIARDIA

Figure 7.1: Incidence rates (per 100,000) of giardiasis reported to FoodNet Canada, 2015-2019.

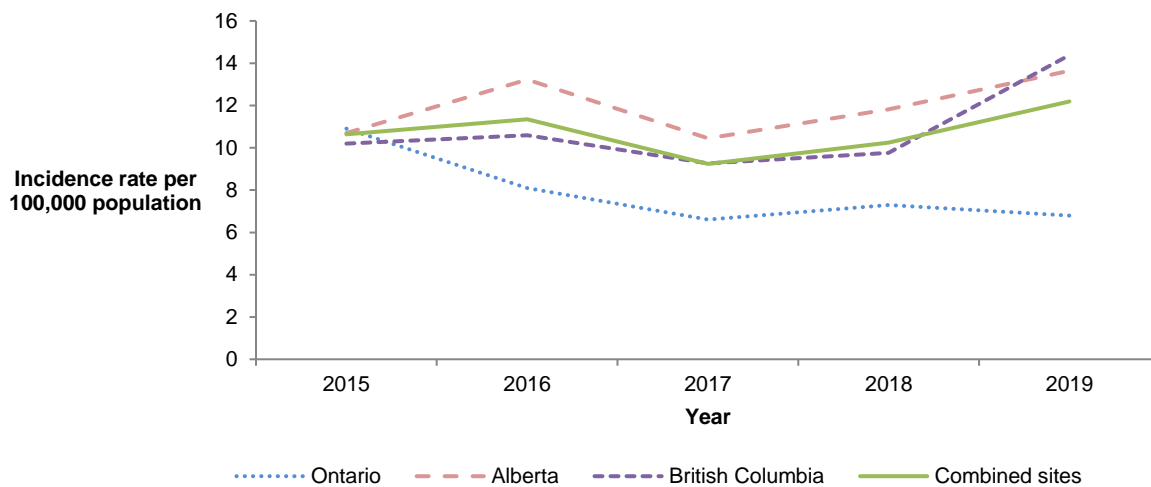


Figure 7.2: Incidence rates (per 100,000) of endemic giardiasis reported to FoodNet Canada, 2015-2019.

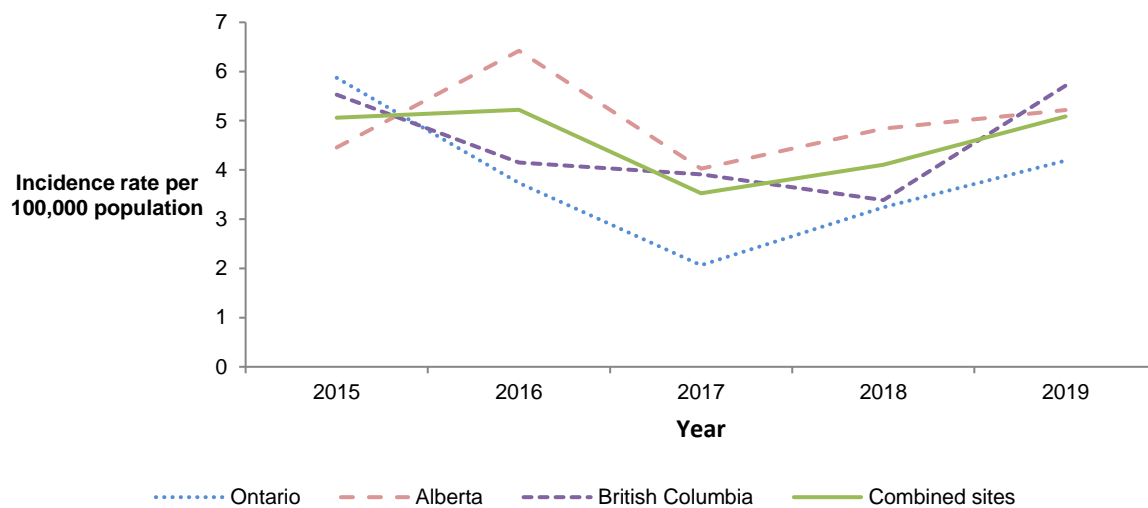


Table 7.1: Annual incidence rates (per 100,000 population) of giardiasis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	3.24	4.19	4.84	5.22	3.39	5.71	4.11	5.09	6.23	4.11	5.25
Travel	1.62	1.60	3.91	4.30	3.19	3.94	3.19	3.57	1.25	3.19	3.26
Outbreak	0	0	0	0	0	0	0	0	0	0	0
Non-Endemic	0	0.40	2.51	2.75	1.79	1.77	1.74	1.95	4.36	1.74	2.27
Lost to Follow-Up	2.43	0.60↓	0.56	1.37	1.39	2.96	1.21	1.57	1.56	1.21	1.57
Total	7.30	6.79	11.82	13.64	9.76	14.38↑	10.25	12.19	13.40	10.25	12.35↑

^a Excludes the Quebec sentinel site.

^b Quebec sentinel site data are only from July to December 2019.

^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018.

Figure 7.3: Relative proportion of *Giardia duodenalis* infections by case classification, excluding Quebec.

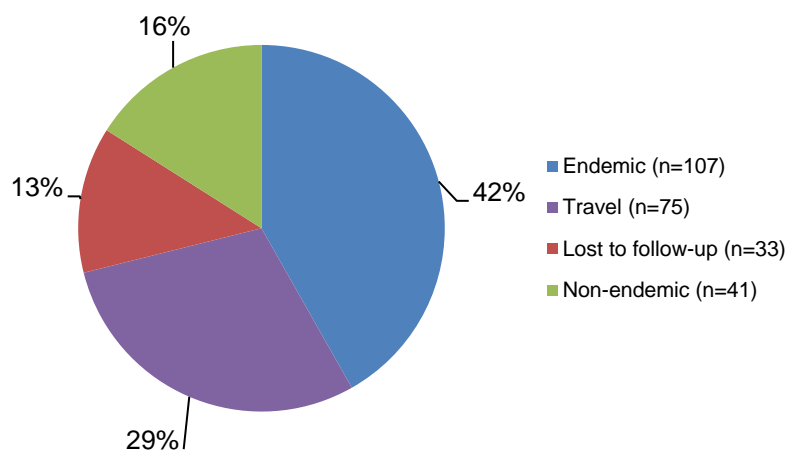


Figure 7.4: Age- and gender-specific incidence rates (per 100,000 population) for endemic *Giardia duodenalis* cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

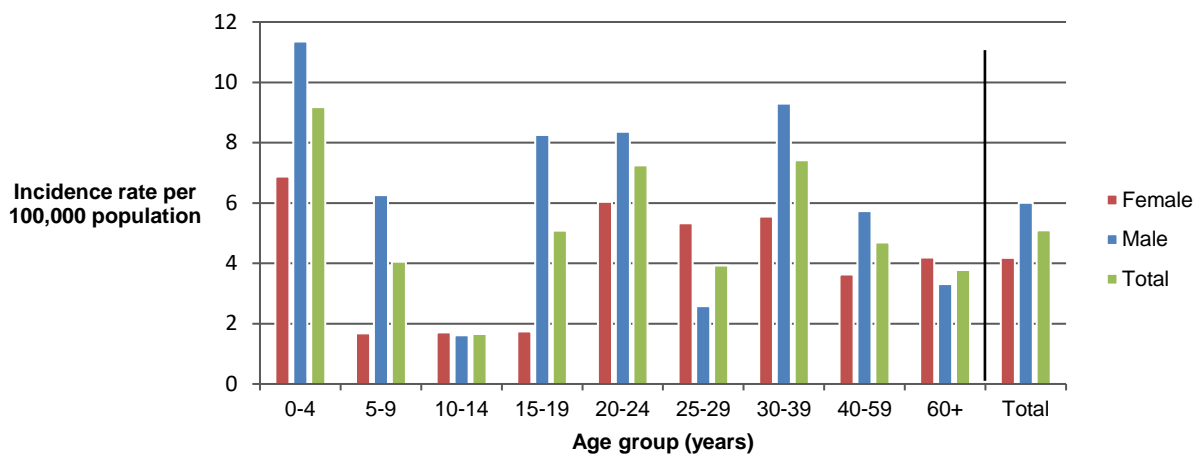


Table 7.2: Clinical profile of endemic *Giardia duodenalis* cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	86%	85%
Abdominal pain	69%	71%
Fatigue/weak	62%	61%
Anorexia	56%	55%
Nausea	60%	53%
Indicators of severity:	2018	2019
Bloody diarrhea	11%	10%
Emergency room visits	32%	21%
Hospitalizations	5%	3%
Antimicrobial prescriptions	71%	50%

CRYPTOSPORIDIUM

Figure 8.1: Incidence rates (per 100,000) of cryptosporidiosis reported to FoodNet Canada, 2015-2019.

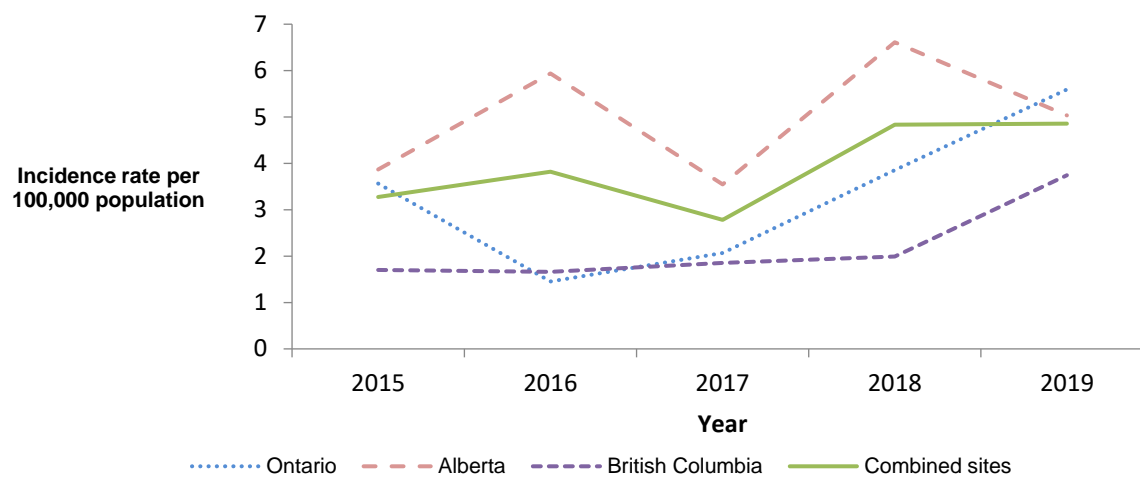


Figure 8.2: Incidence rates (per 100,000) of endemic cryptosporidiosis reported to FoodNet Canada, 2015-2019.

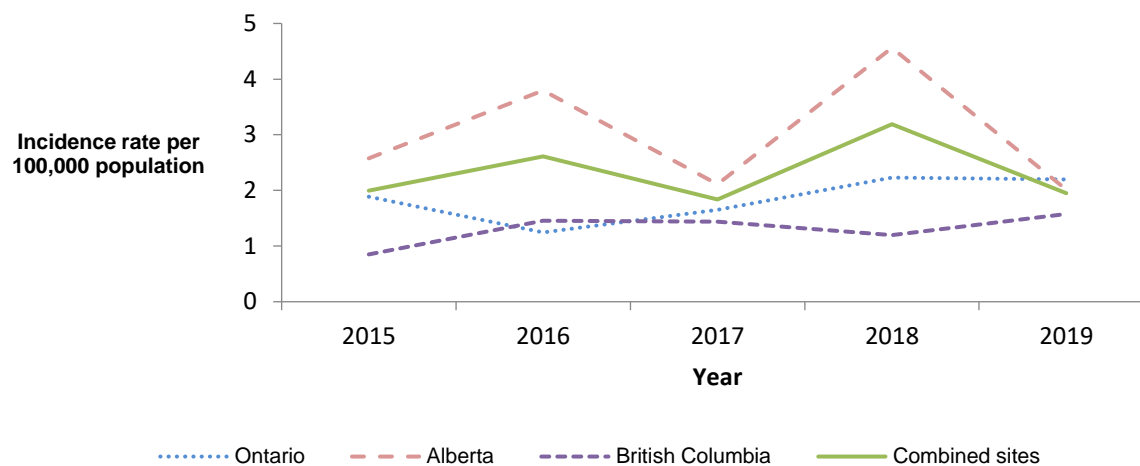


Table 8.1: Annual incidence rates (per 100,000 population) of cryptosporidiosis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	2.23	2.20	4.56	2.01↓	1.20	1.58	3.19	1.95↓	2.18	3.19	1.98↓
Travel	0.20	2.00↑	1.30	2.84	0.80	1.77↑	0.92	2.38↑	0.62	0.92	2.15↑
Outbreak	0	0	0	0	0	0.20	0	0.05	0	0	0.04
Non-endemic	0	0	0	0.09	0	0	0	0.05	0.31	0	0.08
Lost to follow-up	1.42	1.40	0.74	0.09↓	0	0.20	0.72	0.43	0.62	0.72	0.45
Total	3.85	5.59	6.61	5.04	1.99	3.74	4.83	4.86	3.74	4.83	4.71

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019. The incidence of cryptosporidiosis is seasonal. Months presenting a higher incidence may be over-represented.^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018.

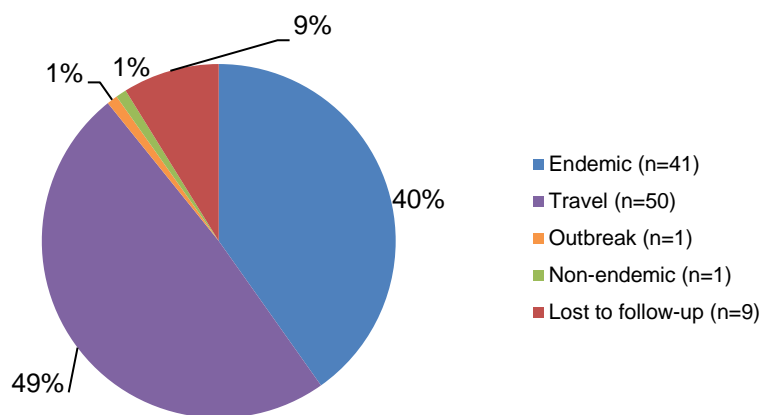
Figure 8.3: Relative proportion of *Cryptosporidium* spp. infections by case classification, excluding Quebec.

Figure 8.4: Age- and gender-specific incidence rates (per 100,000 population) for endemic *Cryptosporidium* spp. cases within FoodNet Canada sentinel sites, 2019, excluding Quebec.

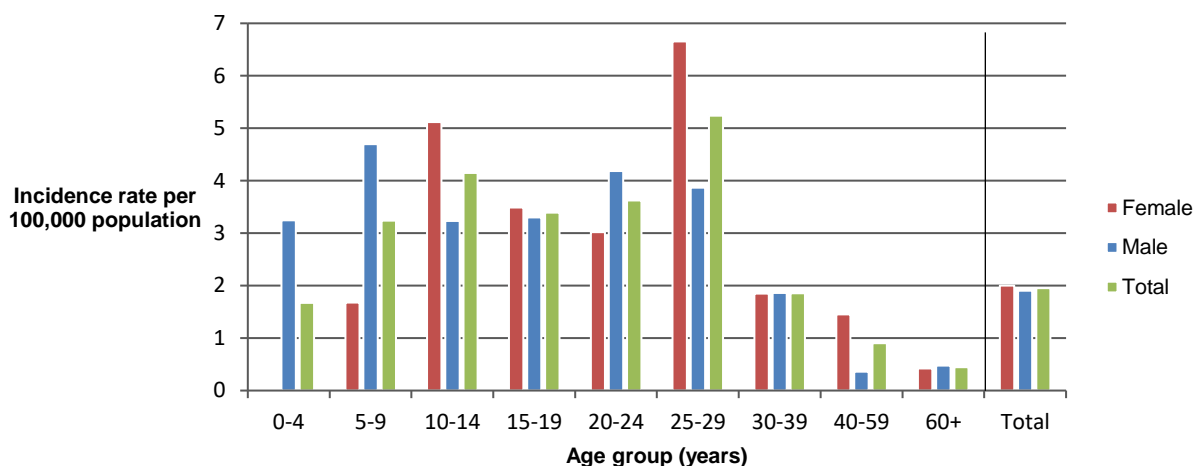


Table 8.2: Clinical profile of endemic *Cryptosporidium* spp. cases from 2019 compared to 2018, excluding Quebec.

Most commonly reported symptoms:	2018	2019
Diarrhea	100%	100%
Abdominal pain	80%	78%
Fatigue/weak	76%	66%
Nausea	71%	63%
Anorexia	74%	56%
Indicators of severity:	2018	2019
Bloody diarrhea	5%	7%
ER visits	53%	41%
Hospitalizations	3%	5%
Antimicrobial prescriptions	29%	29%

CYCLOSPORA

Figure 9.1: Incidence rates (per 100,000) of cyclosporiasis reported to FoodNet Canada, 2010-2019.

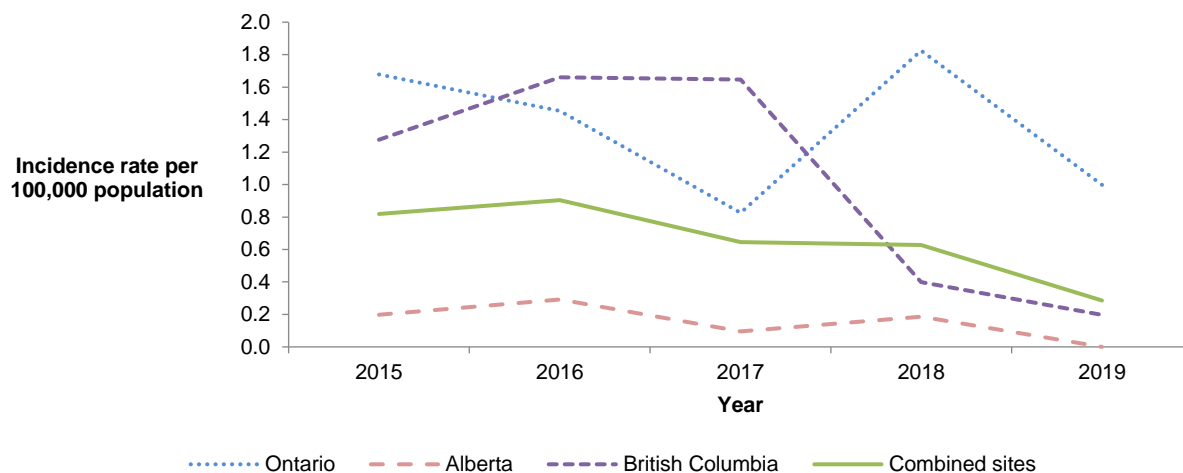


Figure 9.2: Incidence rates (per 100,000) of endemic cyclosporiasis reported to FoodNet Canada, 2010-2019.

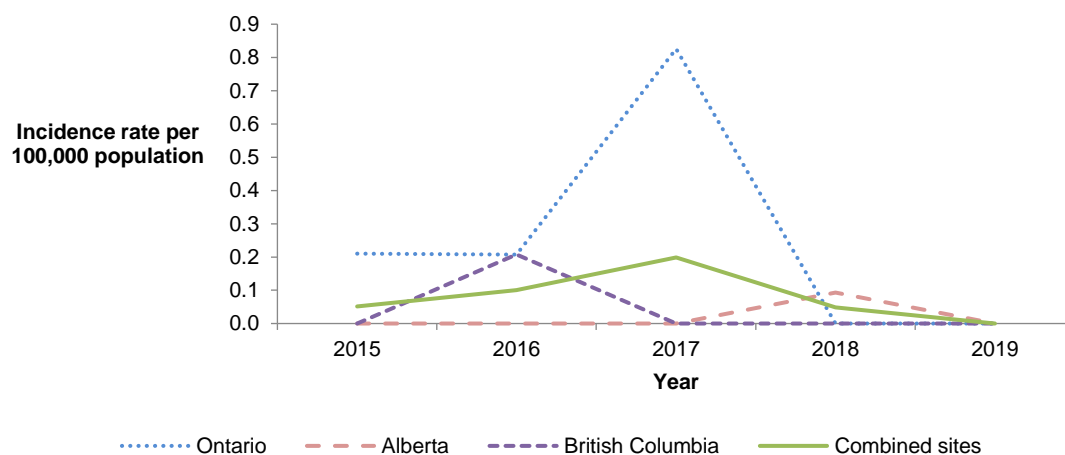
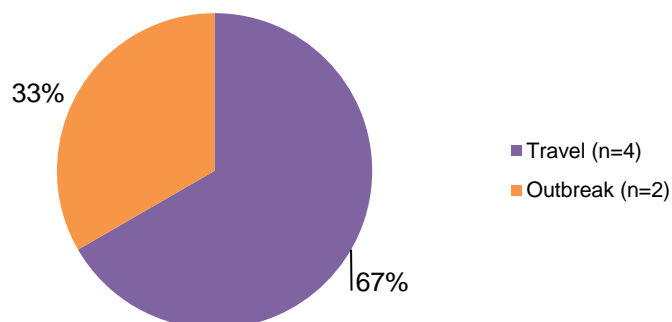


Table 9.1: Annual incidence rates (per 100,000 population) of cyclosporiasis by case classification and FoodNet Canada sentinel site, 2019 (with 2018 shown for reference).

	Ontario site		Alberta site		British Columbia site		Combined sites (ON, AB, BC) ^a		Quebec site ^b	All sites ^c	
	2018	2019	2018	2019	2018	2019	2018	2019	2019	2018	2019
Endemic	0	0	0.09	0	0	0	0.05	0	0	0.05	0
Travel	1.42	0.20↓	0.09	0	0.20	0.20	0.43	0.10↓	0	0.43	0.08↓
Outbreak	0	0.80	0	0	0.20	0	0.05	0.19	0	0.05	0.17
Non-Endemic	0	0	0	0	0	0	0	0	0	0	0
Lost to Follow-Up	0.41	0	0	0	0	0	0.10	0	0	0.10	0
Total	1.82	1.00	0.19	0	0.40	0.20	0.63	0.29	0	0.63	0.25

^a Excludes the Quebec sentinel site.^b Quebec sentinel site data are only from July to December 2019.^c Includes the Quebec sentinel site data.

↑/↓ Indicates a significant increase/decrease in incidence rates compared to 2018.

Figure 9.3: Relative proportion of *Cyclospora cayetanensis* infections by case classification, excluding Quebec.

TARGETED STUDY: RAW BIVALVE MOLLUSCS AT RETAIL

Table 10.1: Microorganisms tested and detected in raw mussels and oysters across three FoodNet Canada sentinel sites (ON, AB, BC), 2019.

Sample type	Bacteria				Parasites			Viruses	
	Generic <i>E. coli</i>	<i>Listeria</i>	<i>Salmonella</i>	<i>Vibrio</i>	<i>Giardia</i>	<i>Toxoplasma</i>	<i>Cryptosporidium</i>	Norovirus	Hepatitis A
Mussels	15% (17/116)	4% (5/126)	0% (0/116)	54% (69/128)	2% (2/128)	0% (0/128)	6% (8/128)	1% (1/128)	0% (0/128)
Oysters	23% (14/61)	2% (1/62)	0% (0/61)	69% (46/67)	3% (2/67)	0% (0/67)	10% (7/67)	0% (0/67)	0% (0/67)

Table 10.2: Genetic markers, including those associated with virulence, detected in *Vibrio* species using species-specific PCR on isolates from raw mussels and oysters across three FoodNet Canada sentinel sites, 2019.

Sample type	<i>Vibrio</i> spp. (Number of isolates)*	Number of virulence genes present					
		clg+	ctx+	tdh+	tlh+	trh+	Vvha+
Mussels							
	<i>V. alginolyticus</i> (n=66)	58			35		
	<i>V. cholera</i> (n=2)		1				
	<i>V. parahaemolyticus</i> (n=22)			1	22		
	<i>V. vulnificus</i> (n=2)						1
Oysters							
	<i>V. alginolyticus</i> (n=39)	28			23		
	<i>V. cholera</i> (n=7)		1				
	<i>V. parahaemolyticus</i> (n=17)	1			17		

* Number of isolates exceed the number of samples positive for *Vibrio* spp., as some samples yielded more than one species/isolate.

Table 10.3: Microorganisms tested and detected in raw mussels and oysters across three FoodNet Canada sentinel sites, 2018 and 2019 combined.

Sample Type	Bacteria				Parasites			Viruses	
	<i>Generic E.coli</i>	<i>Listeria</i>	<i>Salmonella</i>	<i>Vibrio</i>	<i>Giardia</i>	<i>Toxoplasma</i>	<i>Cryptosporidium</i>	Norovirus	Hepatitis A
Mussels	20% (46/235)	4% (10/244)	0% (0/235)	53% (132/249)	2% (6/247)	2% (4/249)	5% (13/247)	0.4% (1/253)	0% (0/253)
Oysters	27% (33/122)	2% (2/113)	1% (1/122)	74% (95/128)	4% (5/125)	0% (0/128)	7% (9/125)	0% (0/130)	0% (0/130)

Table 10.4: Microorganisms tested and detected in raw mussels and oysters across three FoodNet Canada sentinel sites, 2018 and 2019 separated.

		Bacteria				Parasites			Viruses	
Year	Sample Type	<i>Generic E.coli</i>	<i>Listeria</i>	<i>Salmonella</i>	<i>Vibrio</i>	<i>Giardia</i>	<i>Toxoplasma</i>	<i>Cryptosporidium</i>	Norovirus	Hepatitis A
2018	Mussels	24% (29/119)	4% (5/118)	0% (0/119)	52% (63/121)	3% (4/119)	3% (4/121)	4% (5/119)	0% (0/125)	0% (0/125)
	Oysters	31% (19/61)	2% (1/51)	2% (1/61)	80% (49/61)	5% (3/58)	0% (0/61)	3% (2/58)	0% (0/63)	0% (0/63)
2019	Mussels	15% (17/116)	4% (5/126)	0% (0/116)	54% (69/128)	2% (2/128)	0% (0/128)	6% (8/128)	1% (1/128)	0% (0/128)
	Oysters	23% (14/61)	2% (1/62)	0% (0/61)	69% (46/67)	3% (2/67)	0% (0/67)	10% (7/67)	0% (0/67)	0% (0/67)

APPENDIX A — DATA COLLECTION AND REPORTING AND SURVEILLANCE STRATEGY

DATA COLLECTION AND REPORTING

Each FoodNet Canada sentinel site relies on a unique partnership with the local public health authority, private laboratories, water and agri-food sectors as well as the provincial and federal institutions responsible for public health, food safety, and water safety. The sites include Ontario (Middlesex-London Health Unit), British Columbia (Fraser Health Authority), Alberta (Calgary and Central Zones of Alberta Health Services) and Quebec (Montérégie Health Region). The Ontario (ON) site data collection began in August of 2014; data from the ON pilot sentinel site (Region of Waterloo) (2005–March 2014) were not included in this report. The British Columbia (BC) site was officially established in April 2010 and includes the communities of Burnaby, Abbotsford, and Chilliwack. The province of Alberta (AB) contains the third site and data collection began in June of 2014. The fourth site was established in Quebec (QC) in July 2019. See appendix B for boundary maps.

Results are reported for the ON, AB and BC sites, unless otherwise stated, and some preliminary results are included for the QC site. Readers should be cautious when extrapolating these results to areas beyond the sentinel communities. As additional sentinel sites are established, comprehensive information from laboratory and epidemiological analyses from all sites will provide more representative national trends in enteric disease incidence and exposure sources to inform accurate estimates for all of Canada.

In 2019, the farm and retail components were active across all sentinel sites in ON, AB, BC, and QC whereas the water component was active in ON, AB and BC. The non-human surveillance data collected by FoodNet Canada represents possible exposure sources for human enteric illnesses within each sentinel site. The data are meant to be interpreted aggregately and cannot to be used to directly attribute a specific human case reported to FoodNet Canada to a positive isolate obtained from an exposure source. In this report, the non-human and human data are integrated using descriptive methods. The term “significant” is reserved in this report for describing trends that are statistically significant.

FoodNet Canada retail and farm sampling is integrated with CIPARS. This has included the streamlining and sharing of sampling and sampling sites, retrospective and prospective testing of antimicrobial resistance in selected bacteria isolated from FoodNet Canada samples, and improving data management mechanisms to maximize data linkages. CIPARS monitors trends and the relationship between antimicrobial use and antimicrobial resistance in selected bacterial organisms from human, animal, and food sources across Canada to inform evidence-based policy decision making to contain the emergence and spread of resistant bacteria. For further information about CIPARS, please refer to the program's website (<http://www.phac-aspc.gc.ca/cipars-picra/index-eng.php>).

SURVEILLANCE STRATEGY

HUMAN SURVEILLANCE

Public health professionals in each site use FoodNet Canada's enhanced standardized questionnaire to interview reported enteric disease cases (or proxy respondents). Information on potential exposures collected from the questionnaires is used to determine case classification (e.g. travel, endemic) and compare exposures between cases. In addition, advanced subtyping analyses on isolates from case specimens are conducted for further integration with non-human source information.

RETAIL SURVEILLANCE

The retail stage of food production represents the point closest to consumers through which they can be exposed to enteric pathogens. Retail meats, meat products are collected from a variety of large and small food retail outlets on a routine basis throughout the year within each site. FoodNet Canada collects samples of raw fresh (chilled) skinless chicken breasts and ground beef on a weekly basis. Each year, FoodNet Canada and its partners assess knowledge gaps and from this process, select targeted retail products to sample for a given year (see Appendix C for 2019 details). In past years, targeted meats have included but were not limited to pork chops, ground chicken and turkey, veal and uncooked frozen breaded chicken products, such as nuggets and strips. In 2019, FoodNet Canada opted to continue the targeted investigation of frozen breaded chicken products that began in 2011 as well as incorporating fresh pork sausage and fresh bivalve molluscs (oysters and mussels). In 2019, FoodNet Canada also continued a targeted study collecting retail meat samples (chicken breast, ground beef and pork sausage) from farmers' markets in the AB and ON sentinel sites. Samples were collected once per month from May–August, replacing grocery store samples during those weeks. Notable results from the farmers' market sampling are presented within this report. Microbiological testing continued in 2019 as in previous years with *Campylobacter* and *Salmonella* being tested for among all chicken products, *Salmonella* tested in pork sausage, *Listeria* spp. tested for in all retail meat products, and shigatoxigenic *Escherichia coli* (STEC) tested for in ground beef and pork sausage samples. Raw bivalve molluscs were tested for the presence of *Escherichia coli*, *Listeria monocytogenes*, *Salmonella*, *Vibrio*, *Giardia duodenalis*, *Toxoplasma gondii*, *Cryptosporidium* spp., Hepatitis A, and Norovirus.

Beginning in January 2018, a two-year targeted study was undertaken to describe the contamination of pathogens in raw, bivalve molluscs. In consultation with internal and external stakeholders, data from outbreak, surveillance, consumption, and research were used to define the study parameters. Raw shelled oysters and mussels were collected using the FoodNet Canada retail component sampling platform in all three sentinel sites (British Columbia, Alberta and Ontario). Sampling structure included large chain stores, and small independent stores and within the 2019 sampling schedule. Laboratory diagnostics for bacteria, viruses and parasites was conducted at FoodNet Canada-associated laboratories using culture-based methods for bacteria, PCR-based detection methods for viruses and PCR-based and microscopy methods for parasites. Enumeration of bacterial load was not conducted. *Vibrio* virulence genes associated with disease-causing properties were tested for using PCR methods in all *Vibrio* isolates. For the two-year study period, the results have been combined for the three sites.

ON-FARM SURVEILLANCE

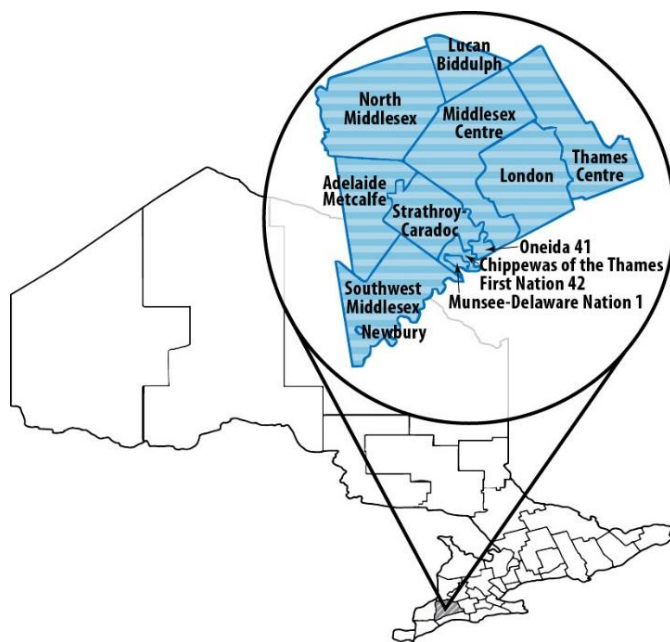
The presence of enteric pathogens on farms is a potential source of environmental exposure of enteric pathogens, and also represents an important source in the farm-to-fork transmission chain. In 2019, the farm component was active across all four sentinel sites, although commodities varied by site (Appendix C). Manure samples were collected from beef cattle, swine, broiler chicken, and turkey farms in order to estimate the pathogen levels on farms. Approximately 30 farms of each type of participating farm commodities are targeted in each site; however, the number of farms and sampling location is based on the representativeness of each commodity in a particular region. A short management survey, and up to ten manure samples (usually fresh pooled samples) were obtained at each farm visit. All samples were tested for *Campylobacter* and *Salmonella* with the beef samples additionally being tested for *E. coli* O157 and STEC. Throughout the report, farm results are reported at both the sample-level and farm-level to account for clustering within farms. Sample-level results include all manure samples collected on each farm, while farm-level results are based on a threshold of one positive manure sample per farm to report a farm as positive.

WATER SURVEILLANCE

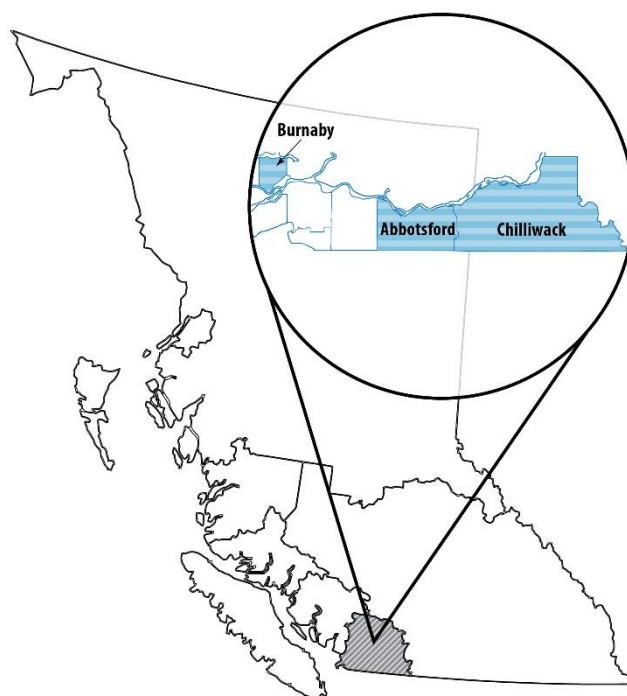
Water is another environmental source of enteric pathogens collected in the FoodNet Canada surveillance program. In 2019, irrigation water was sampled in both the BC and AB sentinel sites, and surface water was sampled in the ON sentinel site. Samples from BC were tested for *Campylobacter*, *Salmonella*, and STEC, while samples from ON and AB were tested for STEC only (Appendix C). Sampling in BC occurred bi-weekly from January to April, bi-weekly in ON from May to September, and monthly in AB from May to September.

APPENDIX B — FOODNET CANADA SENTINEL SITE BOUNDARIES

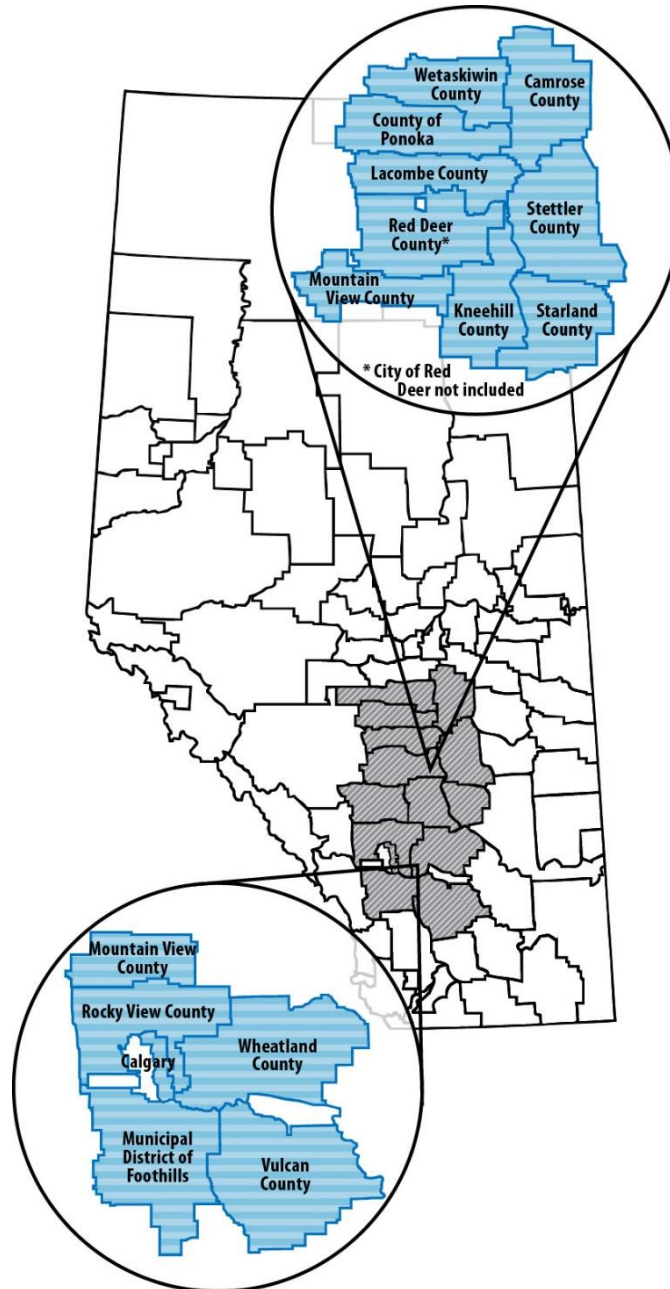
SENTINEL SITE 1: ONTARIO (MIDDLESEX-LONDON HEALTH UNIT)



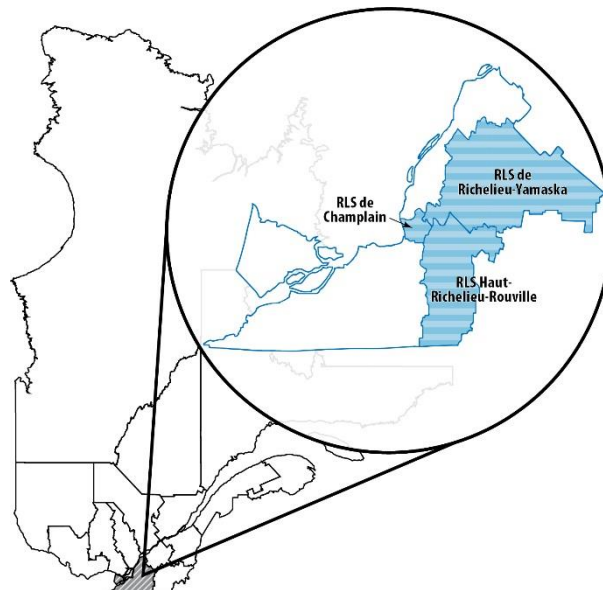
SENTINEL SITE 2: BRITISH COLUMBIA (FRASER HEALTH REGION)



SENTINEL SITE 3: ALBERTA (ALBERTA HEALTH SERVICES: CALGARY AND CENTRAL ZONES)



SENTINEL SITE 4: QUÉBEC (MONTÉRÉGIE HEALTH REGION)



APPENDIX C — NON-HUMAN SAMPLE TYPES TESTED IN 2019

Site	Retail	Farm	Water
British Columbia	Ground beef, skinless chicken breast, frozen breaded chicken products, pork sausage, bivalve molluscs	Broiler chickens & turkeys	Five sampling locations in the Sumas & Serpentine irrigation canals
Alberta	Ground beef, skinless chicken breast, frozen breaded chicken products, pork sausage, bivalve molluscs	Broiler chickens, swine, turkeys, & feedlot beef	Eight sampling locations in the Western Irrigation District
Ontario	Ground beef, skinless chicken breast, frozen breaded chicken products, pork sausage, bivalve molluscs	Broiler chickens, swine, & turkeys	Three sampling locations along the Thames River
Quebec	Ground beef, skinless chicken breast, frozen breaded chicken products, pork sausage	Broiler chickens, swine, & turkeys	Not tested

APPENDIX D – ABBREVIATIONS AND REFERENCES

ABBREVIATIONS

AB	Alberta
BC	British Columbia
CIPARS	Canadian Integrated Program for Antimicrobial Resistance Surveillance
FBCP	Frozen Breaded Chicken Products
NT	Not Tested
ON	Ontario
PCR	Polymerase chain reaction
PHAC	Public Health Agency of Canada
QC	Quebec
STEC	Shigatoxigenic <i>Escherichia coli</i>