Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 2004

Public Health Agency of Canada
Agence de santé publique du Canada

Canada

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"The Enteric Diseases Program is committed to maintaining and improving the health of Canadians by identifying, characterizing and conducting surveillance and research on enteric pathogens for the prevention and control of diarrhoeal diseases."

Enteric Diseases Program
National Microbiology Laboratory

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

Public Health Agency of Canada

PUBLIC HEALTH AGENCY *of* CANADA
AGENCE DE SANTÉ PUBLIQUE *du* CANADA

This report summarizes the information received from federal, provincial and public health agencies on enteric pathogens identified in Canada for 2004. The information is intended primarily for those with responsibilities for the control and prevention of enteric foodborne disease.

The data contained in this report should not be quoted or used in any publication without prior approval from the National Microbiology Laboratory.

ISBN: 978-0-662-46373-3
Catalogue No.: HP57-1/2004E-PDF

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We also take this time to thank the Directors of the participating Provincial Laboratories and of the Laboratory for Food Borne Zoonoses:
Dr. Judy Isaac-Renton, BC Centre for Disease Control, British Columbia
Dr. Jutta Preiksaitis, Provincial Laboratory of Public Health, Alberta
Dr. Greg Horsman, Department of Saskatchewan Health, Saskatchewan
Dr. Paul Van Caeseele, CADHAM Provincial Laboratory, Manitoba
Dr. Frances Jamieson, Central Public Health Laboratory, Ontario
Dr. Mohamed Karmali, Health Canada, Laboratory for Food Borne Zoonoses, Guelph, Ontario
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Report Highlights

Major Enteric Pathogen Groups:

- The total number of isolations of the major pathogens has continued to decline.
- *Campylobacter* continues to be the most prevalent pathogen in Canada followed by *Salmonella* and parasitic infections.

***Salmonella* from Human Sources:**

- 56% of all *Salmonella* infections were caused by 3 serovars: *S*. Typhimurium (20%), *S*. *S*. Enteritidis (12.5%), and *S*. Heidelberg (18%).
- Each of the remaining most prevalent serovars in the top 10 represented only 1.0% to 3% of infections.
- Ontario had the highest number of isolations (n=2410) followed by Québec (n=1099).
- The national isolation rate decreased to 17.2 isolations per 100,000 population.
- Alberta had the highest isolation rate with 21.3 isolates per 100,000 population and Newfoundland and the Yukon had the lowest with 6.4 isolations per 100,000.
- Increases of isolation rates have been observed in Saskatchewan, Ontario, New Brunswick and Newfoundland.
- *S.* Enteritidis has increased in prevalence in all provinces.
- *S.* Enteritidis is the most prevalent serovar in British Columbia, Alberta, Saskatchewan and Nova Scotia.
- *S*. Heidelberg remains most prevalent in Manitoba, Québec, Newfoundland and Prince Edward Island.
- *S*. Enteritidis PT 4 is still most predominant and levels of PT 13 increased from 10% in 2003 to 18% in 2004.
- *S*. Heidelberg PT 19 continues to be most prevalent and levels have remained similar to those in 2003. PT 29 has increased from 11% in 2003 to 24% in 2004.
- *S*. Typhimurium PT 104 identifications has continued to decrease from approximately 33% in 2000 to approximately 16% in 2004.
- *S*. Newport PT9 has significantly increased from 16% in 2003 to 30% in 2004.

***Salmonella* from Non-Human Sources:**

- 39% of all non-human *Salmonella* are *S*. Typhimurium (22%) and *S*. Heidelberg (17%).
- *S*. Kentucky has increased in prevalence since 2000 and now ranks a distant third representing 8% of all non-human *Salmonella*.
- *S*. Heidelberg is now most prevalent in animal feed, replacing *S*. Senftenberg in 2003; *S*. Typhimurium continues to be most prevalent from bovine and porcine sources; and *S*. Heidelberg is most prevalent in chicken, and *S*. Saintpaul is now most prevalent from turkey sources.

Pathogenic *Escherichia coli*:

- The national *E. coli* O157 isolation rate has increased slightly from 3.2 isolations per 100,000 population in 2003 to 3.4 in 2004.
- Alberta has the highest isolation rate with approx. 8.8 isolations per 100,000 population.
- Prince Edward Island had the largest decrease in isolation rate from 9.5 in 2003 to 4.4 in 2004.
- Other increases in isolation rates have been observed in British Columbia, Québec and Northwest Territories.
- PT 14a is the most predominant phage type constituting approximately 63% of all isolates tested, followed distantly by PT 14 with 7% and PT 32 with 6%.

***Campylobacter* :**

- The national *Campylobacter* isolation rate has decreased from 36.7 isolations per 100,000 population in 2002 to 31.4 isolations per 100,000 population in 2003.
- British Columbia had the highest isolation rate with approximately 40.5 isolations per 100,000 population.
- Newfoundland had the lowest rate in 2003 with approximately 10.8 per 100,000 population, up from 8.7 in 2002.

***Shigella*:**

- The national *Shigella* isolation rate has decreased from 3.7 isolations per 100,000 population in 2000 to 2.3 isolations per 100,000 population in 2004.
- British Columbia has the highest isolation rate with approximately 4 isolations per 100,000 population.

Parasites:

- The national parasite (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) isolation rate has decreased from 21.3 isolations per 100,000 population in 2001 to 17.3 isolations per 100,000 population in 2004.
- British Columbia has the highest isolation rate with approximately 23 isolations per 100,000 population and Prince Edward Island has the lowest rate with approximately 5 per 100,000 population.
- Increases in isolation rates have been observed in British Columbia, Alberta, Manitoba, Ontario, Québec, Nova Scotia, Northwest Territories and the Yukon.

***Yersinia*:**

- The national *Yersinia* isolation rate has decreased slightly from 2.6 isolations per 100,000 population in 2000 to 1.9 isolations per 100,000 population in 2004.
- Alberta has the highest isolation rate with approximately 3 isolations per 100,000 population.
- Increases in isolation rates have been observed in British Columbia and the Northwest Territories.

Major Outbreaks of 2004:

- There were 82 outbreaks reported in Canada during 2004 involving 734 cases of illness.
- A major outbreak includes 133 cases of *E. coli* O157:H7, PT14a, PFGE ECXAI.1107 from Alberta linked to Donairs beef served in a restaurant.
- Also in Alberta, an outbreak of *S*. Javiana associated with an employee from an Asian Buffet reported 45 cases as PT19, PFGE SHEXAI.0001.
- A restaurant deli-counter in British Columbia is responsible for the outbreak of 40 cases of *Campylobacter coli* in January.
- Some outbreaks of interest are 7 cases of *S*. Javiana from Ontario where tomatoes were suspected, 4 cases of *E. coli* O157:H7 from British Columbia were linked to a petting zoo, and 8 cases of *Cyclospora* from British Columbia where cilantro was the suspected cause.

Introduction

Data presented in this report are based on laboratory-confirmed enteric pathogens isolated from humans, food, animal and the environment. Annual data are received from a variety of sources and the most suitable data are selected and developed into an annual summary. In Canada, surveillance data are collected at regional and provincial levels and compiled at the national level. It is recognized that although laboratory surveillance may vary from region to region, the centralized collection of surveillance data at a national level may enhance our understanding of the epidemiology of enteric infection in Canada. These data can then be used to target potential preventive measures. The laboratory-based surveillance data summarized here can be used for the purposes of detecting emergent and re-emergent pathogens, serovars, phage types, molecular types and increasing or decreasing trends of particular enteric pathogens.

This Annual Summary is a compilation of data from: 1) provincial public health laboratories (PPHL); 2) the Laboratory for Foodborne Zoonoses, Guelph (LFZ); 3) the Enteric Disease Program, National Microbiology Laboratory, Winnipeg (NML); 4) the National Enteric Surveillance Program (NESP); and 5) the National Notifiable Diseases Reporting System (NDRS) database.

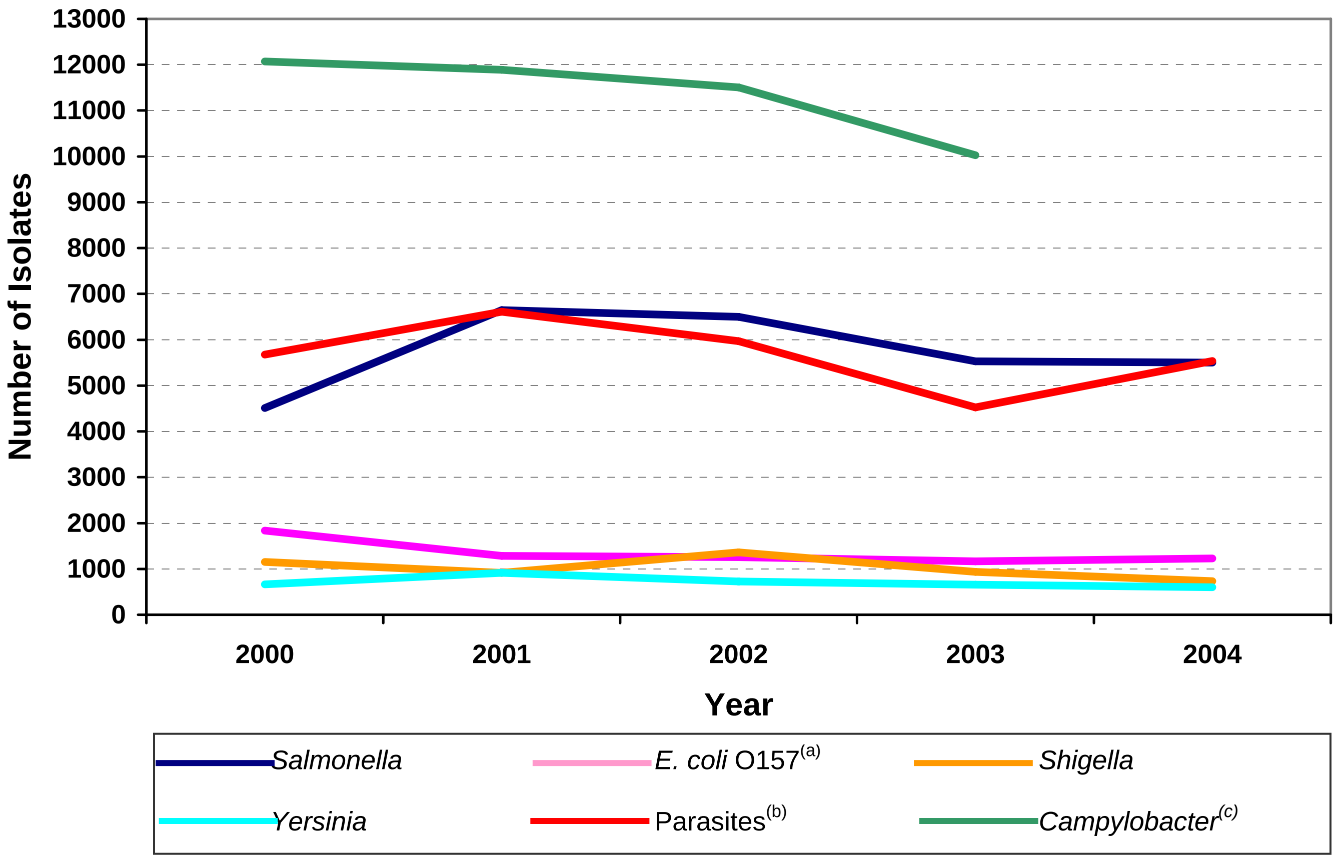
Provincial reports and the NESP database contain summarized aggregated data in the form of weekly, monthly or annual reports of isolates forwarded to the PPHLs for further analysis and characterization. The data sets of the LFZ and the NML are acquired through reference services for the confirmation, identification and characterization of enteric pathogens for hazard identification, passive surveillance, surveys and for support in the containment, prevention and control of outbreaks of enteric disease. The NDRS receives data that are collected on a mandatory basis by local health units on a case-by-case basis and is collated by the Division of Surveillance and Risk Assessment, Centre for Infectious Disease Prevention and Control (CIDPC).

It should be noted that there are some inherent limitations of the data and any interpretation should be done with caution. Not all specimens/isolates are referred from the regional and local laboratories to the PPHLs and therefore the provincial reports and NESP data may be an under-representation of the true incidence of disease in Canada. An attempt to remedy this shortfall is made by using NDRS data, which itself is an under-representation as most people exhibiting symptoms of a foodborne infection do not seek medical attention. Although the proportion of specimens forwarded may differ from province to province the subset of data from each province presented in this report remains consistent from year to year and can be useful to establish general trends. See Appendix I for details in data sources.

SECTION 1: MAJOR ENTERIC PATHOGENS 2004

Figure 1 illustrates the isolation trends of the 6 major enteric pathogen groups from 2000 to 2004. The total number of isolations has declined for all major enteric pathogen groups with the exception of parasitic infections that have increased from 4526 isolations in 2003 to 5538 isolations in 2004. *Campylobacter* identifications continue to be the most prevalent pathogen in Canada, declining from 11508 isolations in 2002 to 9958 isolates in 2003. *Salmonella* and parasitic infections follow distantly with 5504 and 5538 identifications, respectively. *E. coli* O157, *Shigella* and *Yersinia* isolations have remained relatively constant since 2000 and account for a combined total of 2561 isolations in 2004.

Figure 1: Major Enteric Pathogens from Humans in Canada, 2000 to 2004



(a) *E. coli* O157 includes *E. coli* O157 VTEC, *E. coli* O157, *E. coli* O157:H7 and *E. coli* O157:NM isolations.

(b) *Cryptosporidium* and *Cyclospora* were not nationally notifiable until January 2000. *Entamoeba* is not notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported.

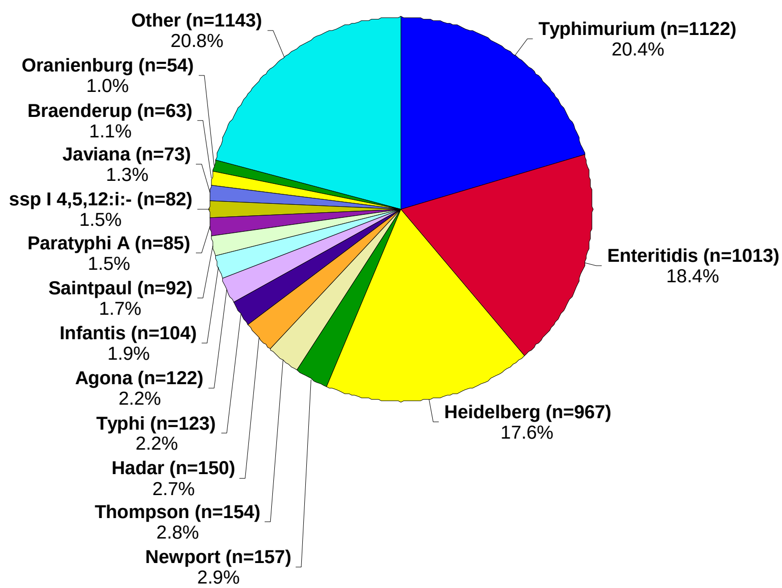
(c) Totals of *Campylobacter* and parasitic infections are largely based on data supplied by the NDRS database whereas the total number of isolations of other organisms relies on NESP data. The collection of total *Campylobacter* infection data for 2004 by NDRS was not complete at time of publication and will be reported in the 2005 Annual Summary.

SECTION 2: *SALMONELLA*

Salmonella Isolations from Humans in 2004

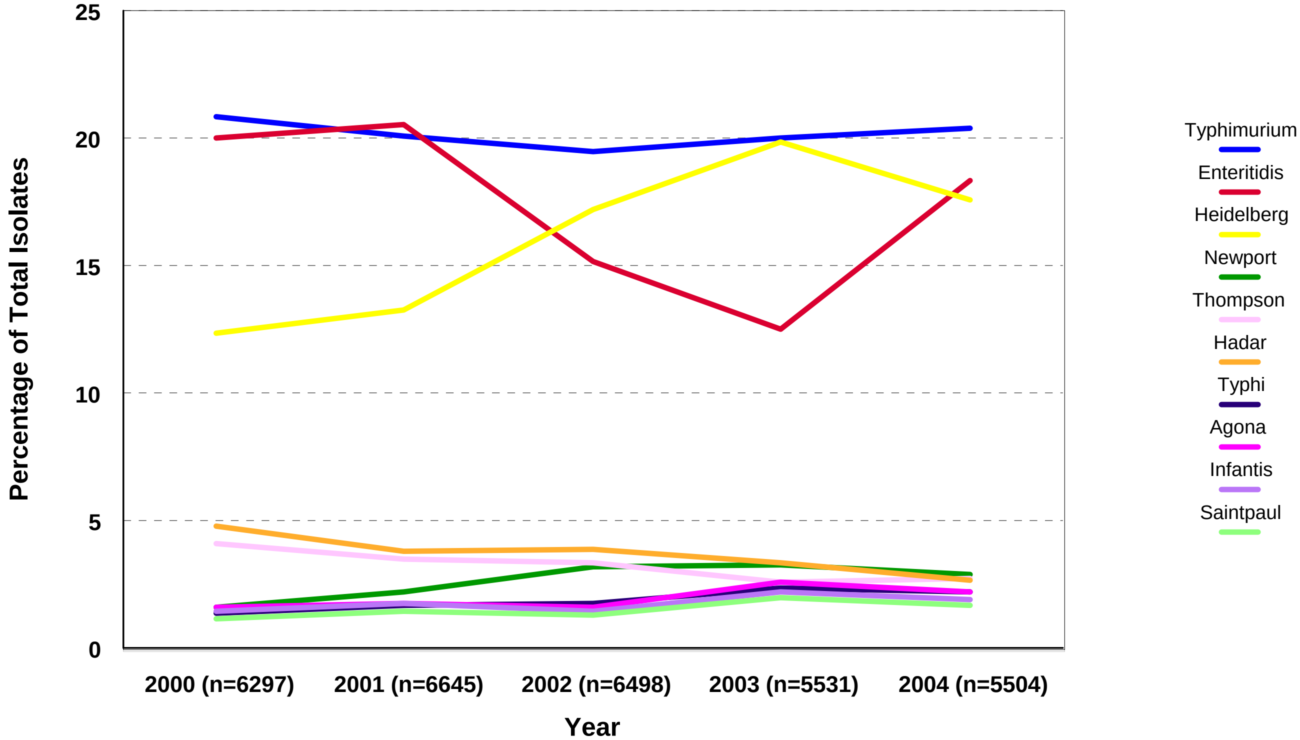
The relative frequency of isolation of the fifteen most prevalent *Salmonella* serovars from humans in Canada in 2004 is illustrated in Figure 2. *S*. Typhimurium, *S*. Enteritidis and *S*. Heidelberg are the most prevalent *Salmonella* serovars isolated from humans in Canada, together accounting for 56.4% (n=3102) of the 5504 of the *Salmonella* reported in 2004. *S*. Typhimurium is most prevalent with 20.4% (n=1122), followed by *S*. Enteritidis with 18.4% (n=1013) and *S*. Heidelberg with 17.6% (n=967) of total isolations. *S*. Newport ranks a distant fourth with 2.9% (n=157) and *S*. Thompson fifth overall with 2.8% (n=154). The sixth most prevalent serovar in 2004 is *S*. Hadar (2.7%, n=150), followed by *S*. Typhi (2.2%, n=123), *S*. Agona (2.2%, n=122), *S*. Infantis (1.9%, n=104) and *S*. Saintpaul was 10th most prevalent (1.7%, n=92). Serovars ranking 11th to 15th include *S*. Paratyphi A, *S*. ssp I 4,5,12:i:-, *S*. Javiana, *S*. Braenderup and *S*. Oranienburg, each accounting for 1.0 to 1.5% of the isolates identified in 2004. Other serovars represent 20.8% (n=1143) of the isolates in 2004.

Figure 2: Fifteen Most Prevalent *Salmonella* Serovars from Humans in Canada, 2004* (N=5504)



*Serovar totals are laboratory confirmed *Salmonella* based on information supplied to the NESP and supplemented with identifications from NML reference services. Totals include outbreak isolates.

Figure 3: Prevalent *Salmonella* Serovars Isolated from Humans in Canada, 2004*



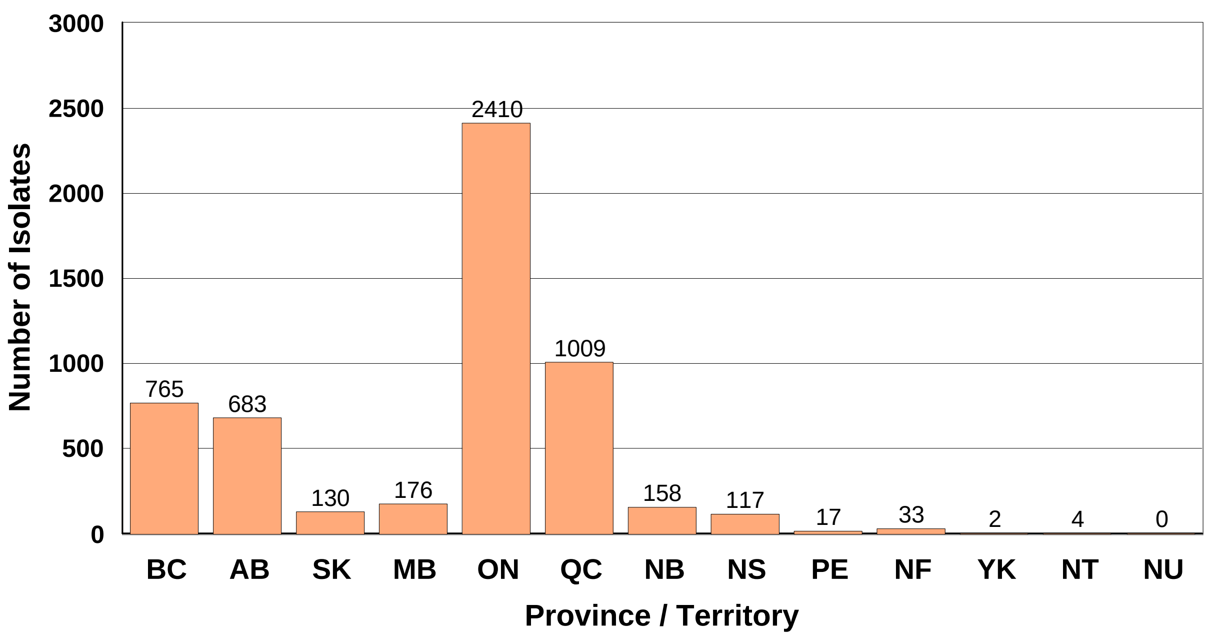
Changes in the Occurrence of *Salmonella* Serovars from Humans in Canada, 2000 to 2004

The relative frequencies of the 10 most prevalent *Salmonella* of human origin from 2000 to 2004 are shown in Figure 3. Although *S*. Typhimurium has ranked as the most prevalent serovar identified in Canada since 2000, *S*. Heidelberg has increased in relative frequency since 2000, surpassing *S*. Enteritidis in 2002 as the second most prevalent serovar isolated from humans and matched the levels of *S*. Typhimurium in 2003. In 2004, *S*. Heidelberg isolations declined slightly to 17.6% of *Salmonella* serovars, down from 19.9% of the *Salmonella* identified last year. The proportion of *S*. Enteritidis isolations has increased in 2004 to account for 18.4% of the serovars after a steady decline from 2001 to 2003 when isolations had dropped to 12.5%. These 3 serovars form a group that has consistently been elevated above the other top ten serovars over the previous 5 years. Serovars that make up the other seven most prevalent serovars each represent less than 5% of all *Salmonella* isolated and frequencies of isolation remain relatively constant from year to year.

Provincial Distribution of *Salmonella* from Humans in Canada

The total number of *Salmonella* isolations in 2004 from each province is shown in Figure 4 and population based rates for each province over the years 2000 to 2004 is shown in Figure 5. By representing the data as isolations per 100,000 people, the data is a more accurate reflection of the relative isolation levels among the provincial population. Although Quebec ranks 2nd among the provinces for total number of *Salmonella* reported (Figure 6), it ranks 6th overall for the population based isolation rate. Isolation rates higher than the national average of 17.2 isolations per 100,000 people were seen in Alberta with 21.3, New Brunswick with 21.0, Ontario with 19.4 and British Columbia with 18.2. Although rates have continued to decline nationally and in most provinces during 2004, isolation rates have increased in New Brunswick from 18.5 isolations per 100,000 in 2003 to 21.0 in 2004, Saskatchewan (11.9 to 13.1), Ontario (18.9 to 19.4) and Newfoundland (5.4 to 6.4). The largest decreases from 2003 to 2004 occurred in the Northwest Territories where the rate has declined from 23.7 isolations per 100,000 people in 2003 to 9.3 in 2004, in Prince Edward Island from 18.2 to 12.3 and in Nova Scotia from 15.8 to 12.5.

Figure 4: Number of *Salmonella* Isolations from Humans in Canada, 2004*



BC=British Columbia, AB=Alberta, SK=Saskatchewan, MB Manitoba, ON=Ontario, QC=Quebec, NB=New Brunswick, NS=Nova Scotia, PE=Prince Edward Island, NF=Newfoundland and Labrador, YK= Yukon Territory, NT=Northwest Territories and NU = Nunavut.

Figure 5: Population Based Rate of *Salmonella* Isolations in Canada, 2000 to 2004

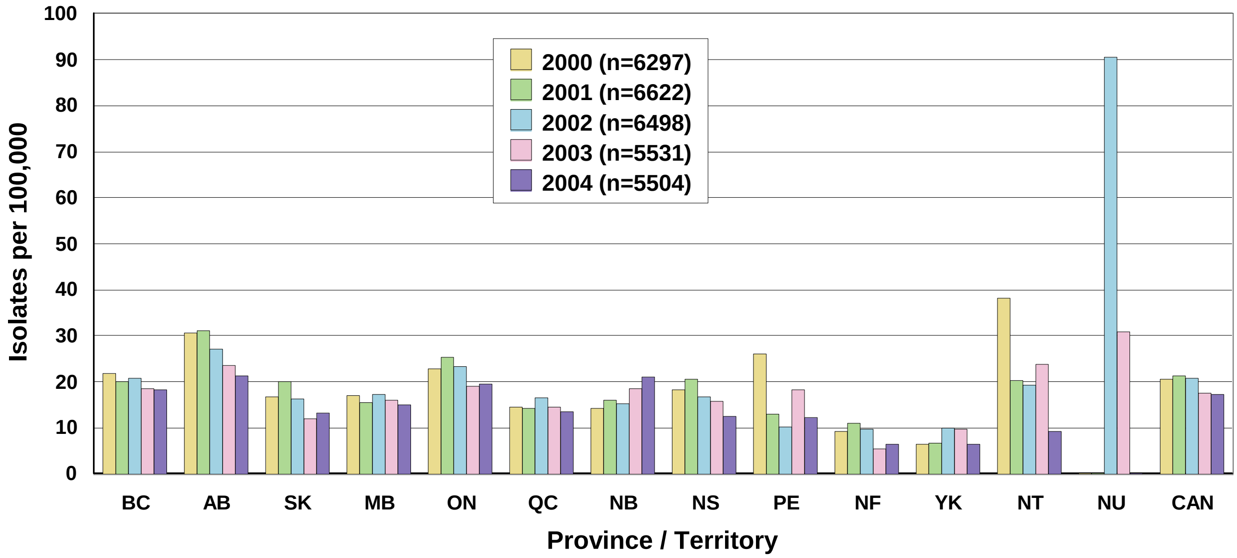


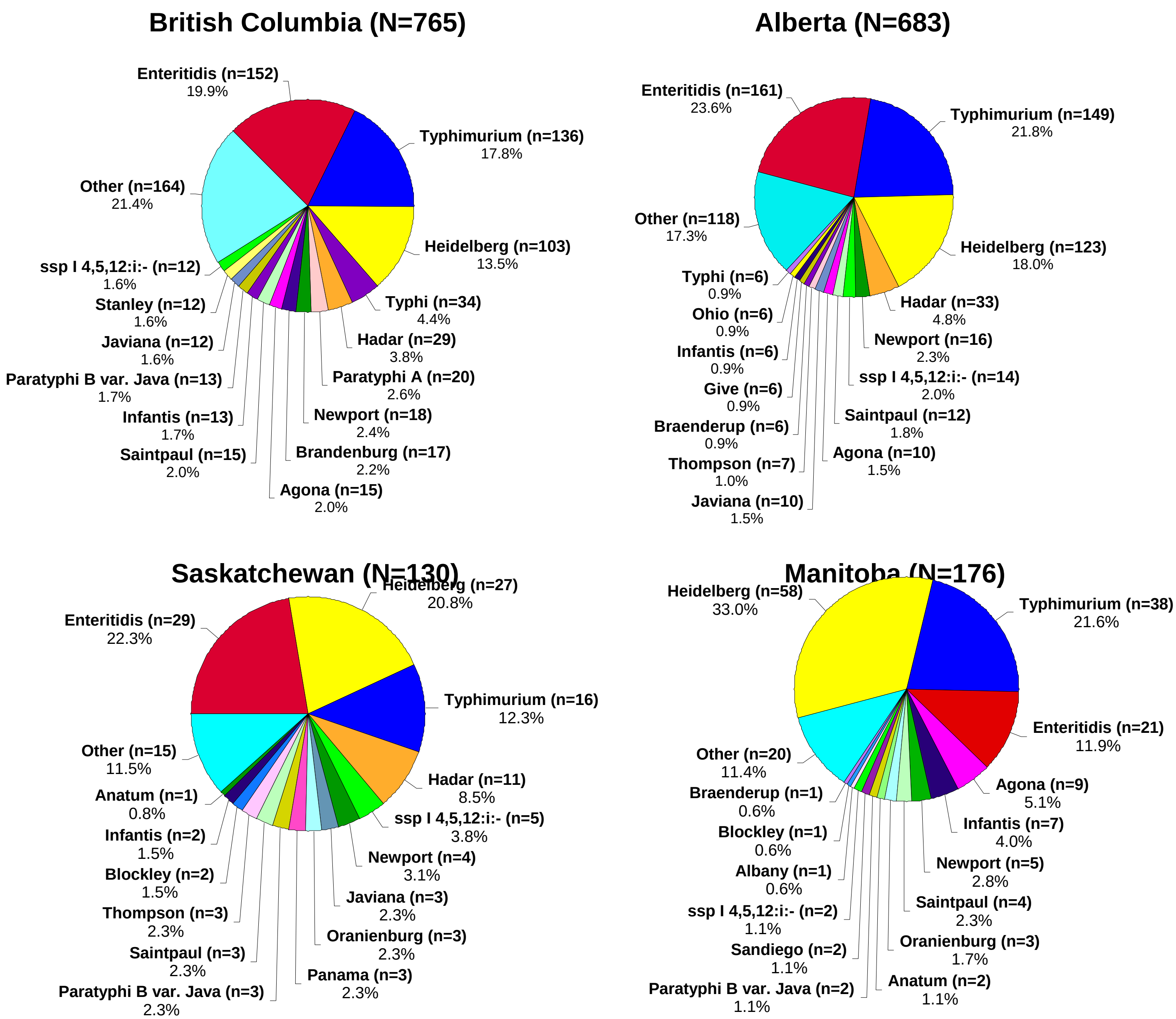
Table 1: Rate of *Salmonella* Isolations per 100,000 Population, 2000 to 2004

Province	2000	2001	2002	2003	2004
British Columbia	21.7	19.9	20.8	18.6	18.2
Alberta	30.5	31.2	27.1	23.5	21.3
Saskatchewan	16.8	20.0	16.2	11.9	13.1
Manitoba	17.1	15.5	17.3	16.1	15.0
Ontario	22.7	25.2	23.4	18.9	19.4
Quebec	14.6	14.3	16.6	14.4	13.4
New Brunswick	14.3	16.0	15.2	18.5	21.0
Nova Scotia	18.3	20.6	16.8	15.8	12.5
Prince Edward Island	26.0	13.0	10.2	18.2	12.3
Newfoundland	9.1	10.9	9.6	5.4	6.4
Yukon	6.5	6.6	10.0	9.8	6.4
Northwest Territories	38.1	20.2	19.3	23.7	9.3
Nunavut	0.0	0.0	90.6	30.9	0.0
Canada	20.5	21.3	20.7	17.5	17.2

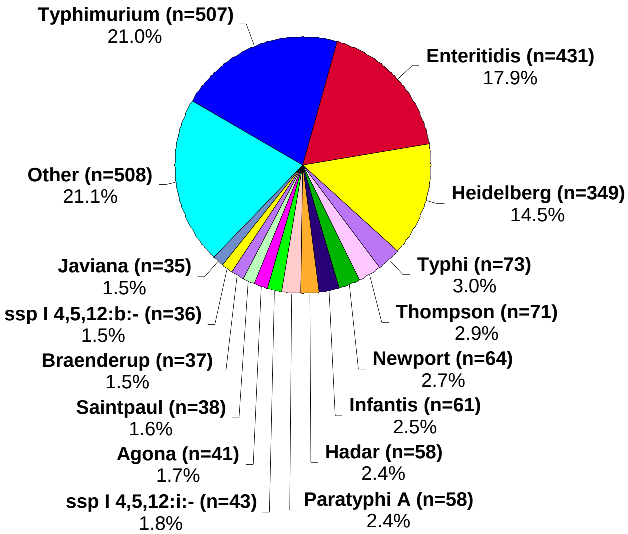
Most Prevalent *Salmonella* Serovars from Humans in Each Province

The fifteen most prevalent human *Salmonella* serovars isolated for each province is illustrated in Figure 6. *S*. Enteritidis is the most prevalent serovar in British Columbia accounting for 19.9% (n=152) of all *Salmonella* identified in that province. *S*. Enteritidis is also the most prevalent in Alberta with 23.6% of the isolations (n=161), Saskatchewan (22.3%, n=29) and Nova Scotia (29.9%, n=35). *S*. Heidelberg is the most prevalent serovar in Manitoba with 33.0% (n=58), Quebec (24.2%, n=224) Prince Edward Island (23.5%, n=17) and Newfoundland (30.3%, n=10). The most prevalent serovar in Ontario and New Brunswick is *S*. Typhimurium, accounting for 21.0% (n=507) and 27.8% (n=44), respectively.

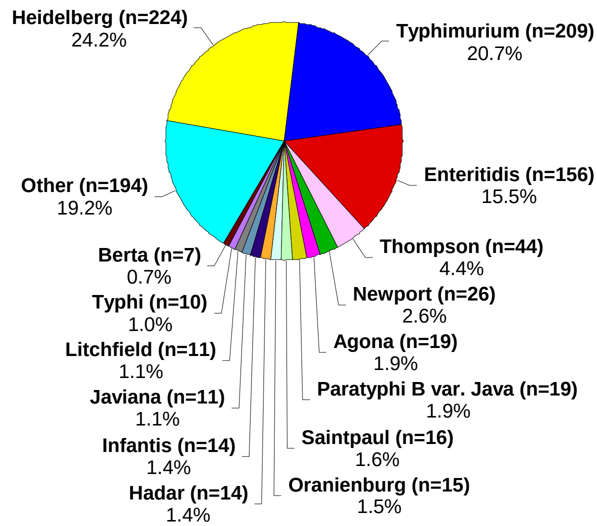
Figure 6: Fifteen Most Prevalent *Salmonella* Serovars from Humans in Each Province/Territory in 2004



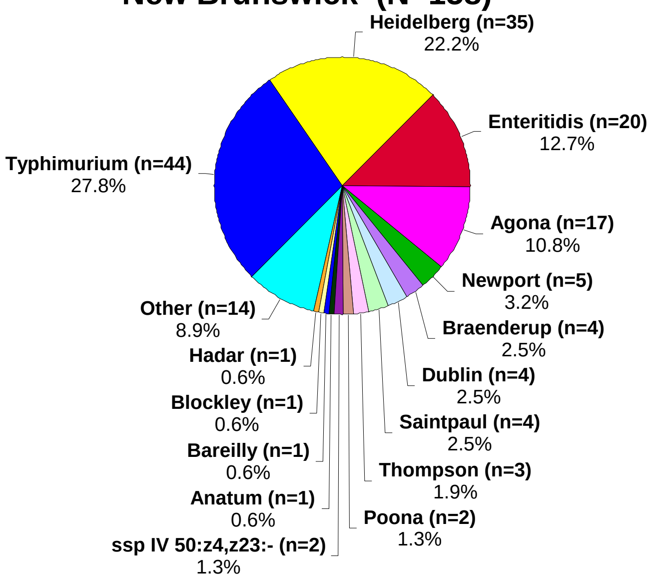
Ontario (N=2410)



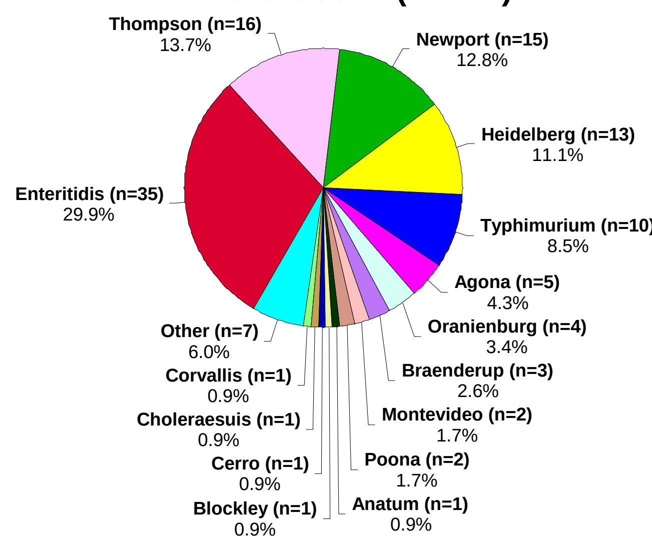
Quebec (N=1009)



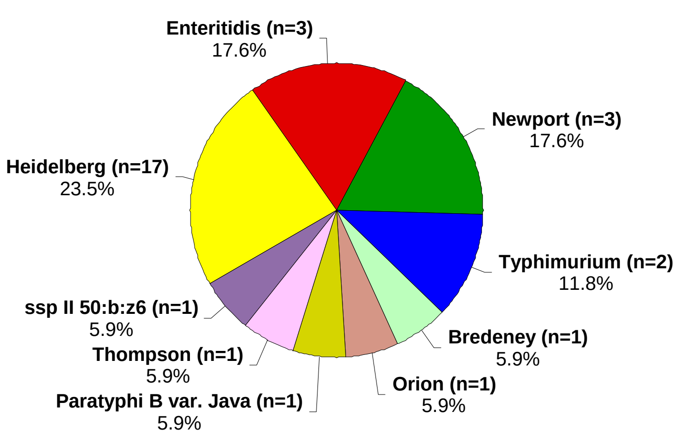
New Brunswick (N=158)



Nova Scotia (N=117)



Prince Edward Island (N=17)



Newfoundland and Labrador (N=33)

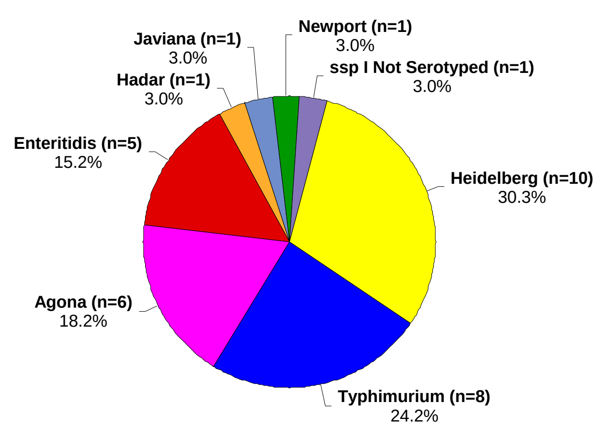
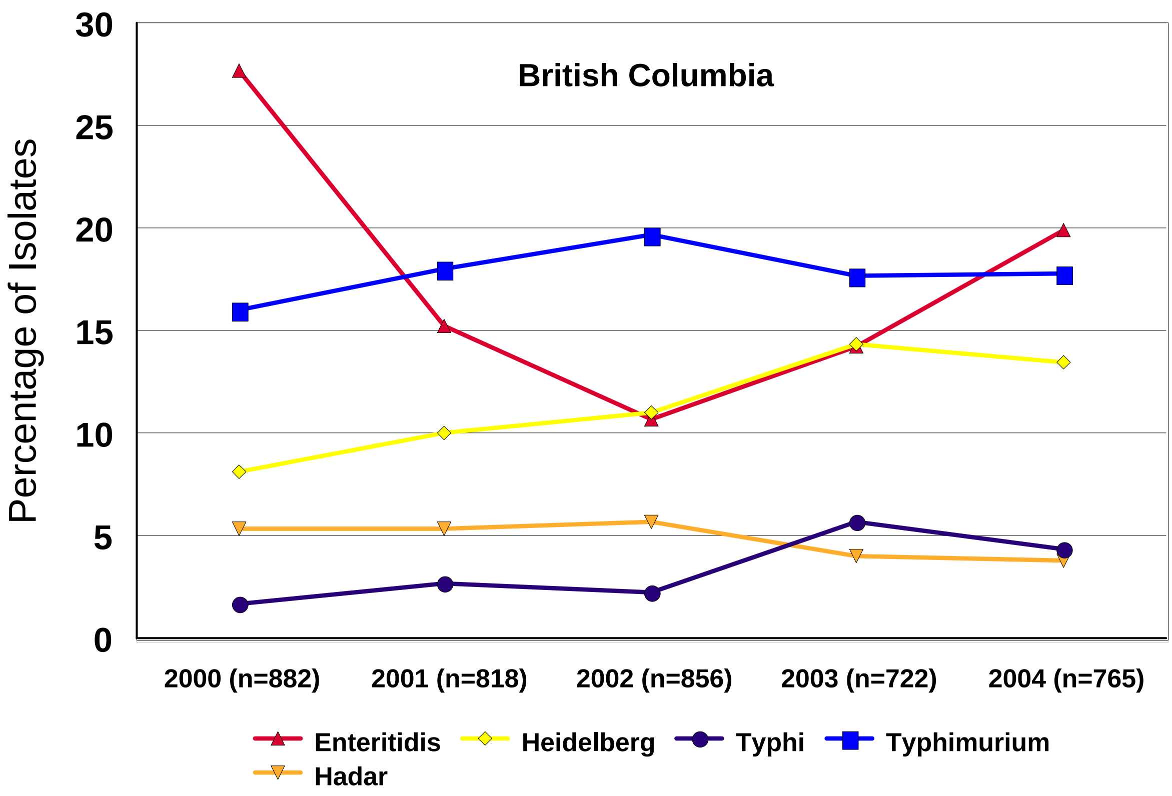
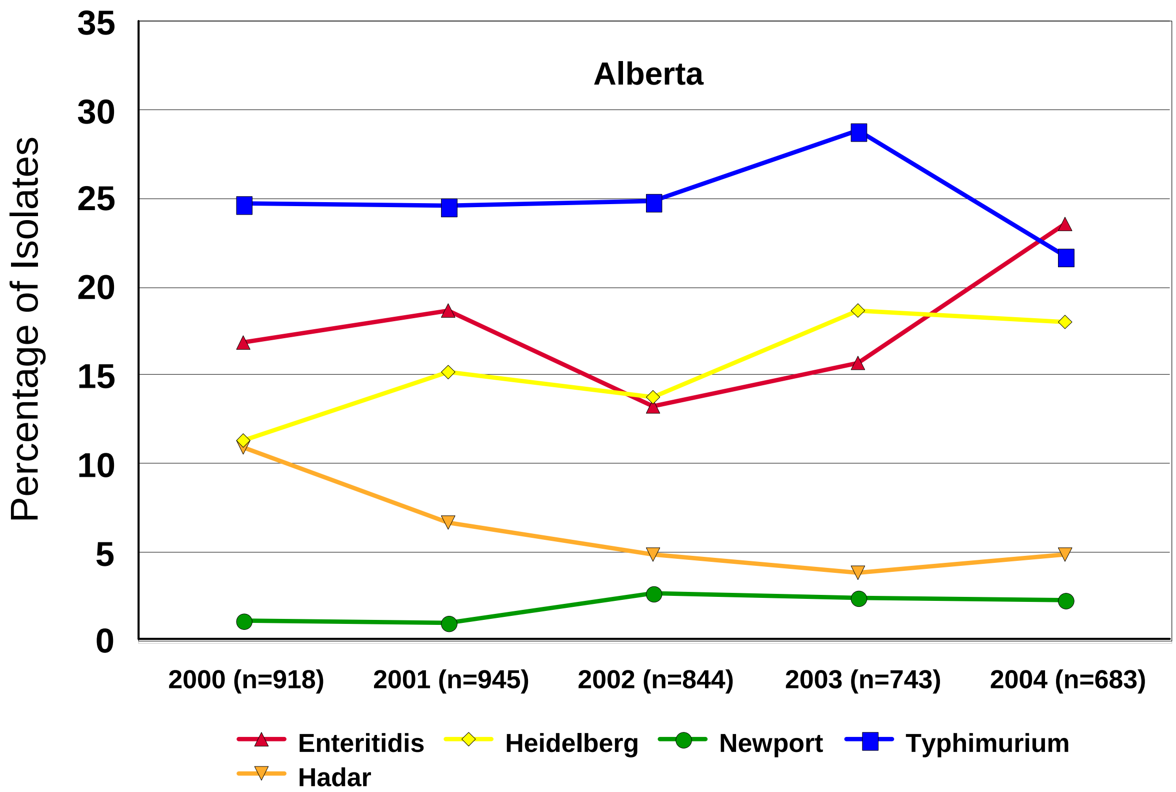


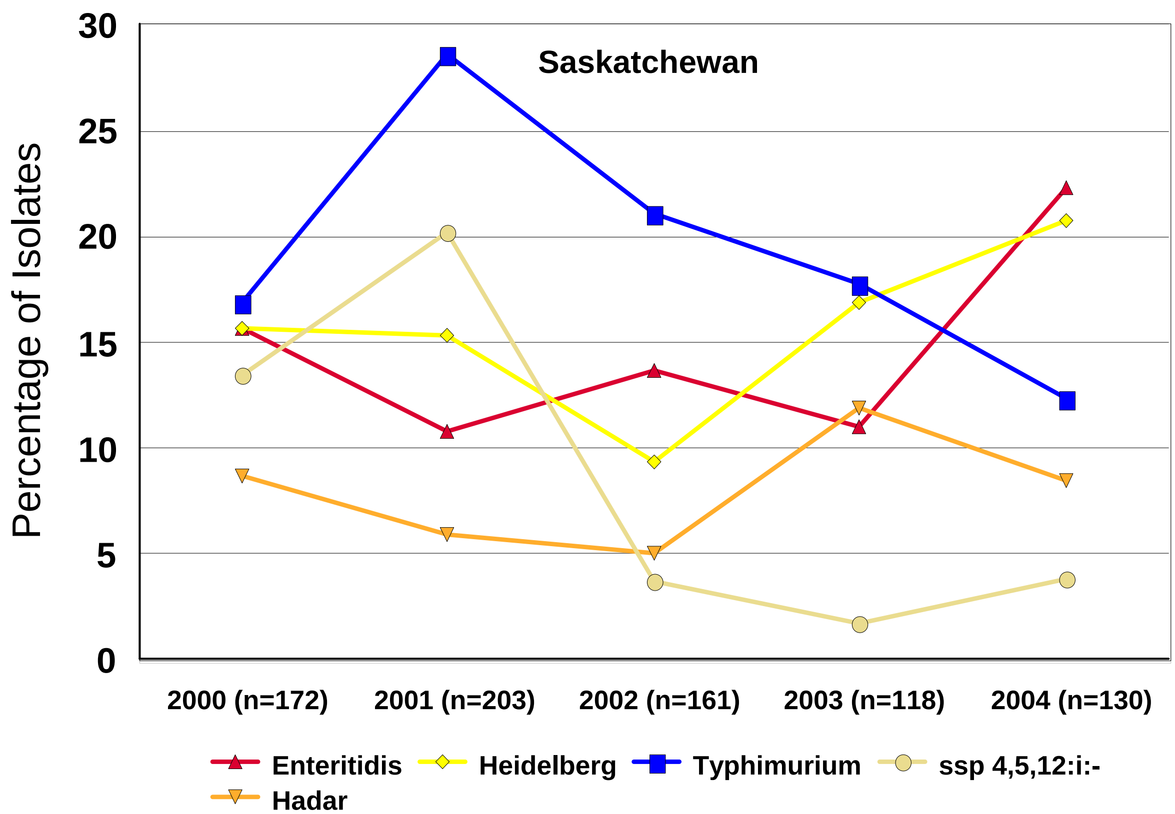
Figure 7 illustrates the variation of the five most prevalent serovars of each province/territory from 2000 to 2004. Data for previous years is taken from previous annual summaries, which is based on information supplied to the NESP and supplemented with identifications from the NML reference services. Data is representative of laboratory confirmed isolates only and should not be confused with incidence of disease. This subset of data however is consistently gathered from year to year and can indicate emerging or re-emerging trends. See Appendix 1 for details. The larger short term fluctuations in prevalence can be attributed to outbreaks of gastroenteritis, however longer multi-year trends such as the increases in *S*. Heidelberg in many provinces/territories may indicate the establishment of a persistent strain within the population or a chronic source of infection.

Figure 7: Trends of the Most Prevalent *Salmonella* Serovars from Humans in Each Province, 2000 to 2004

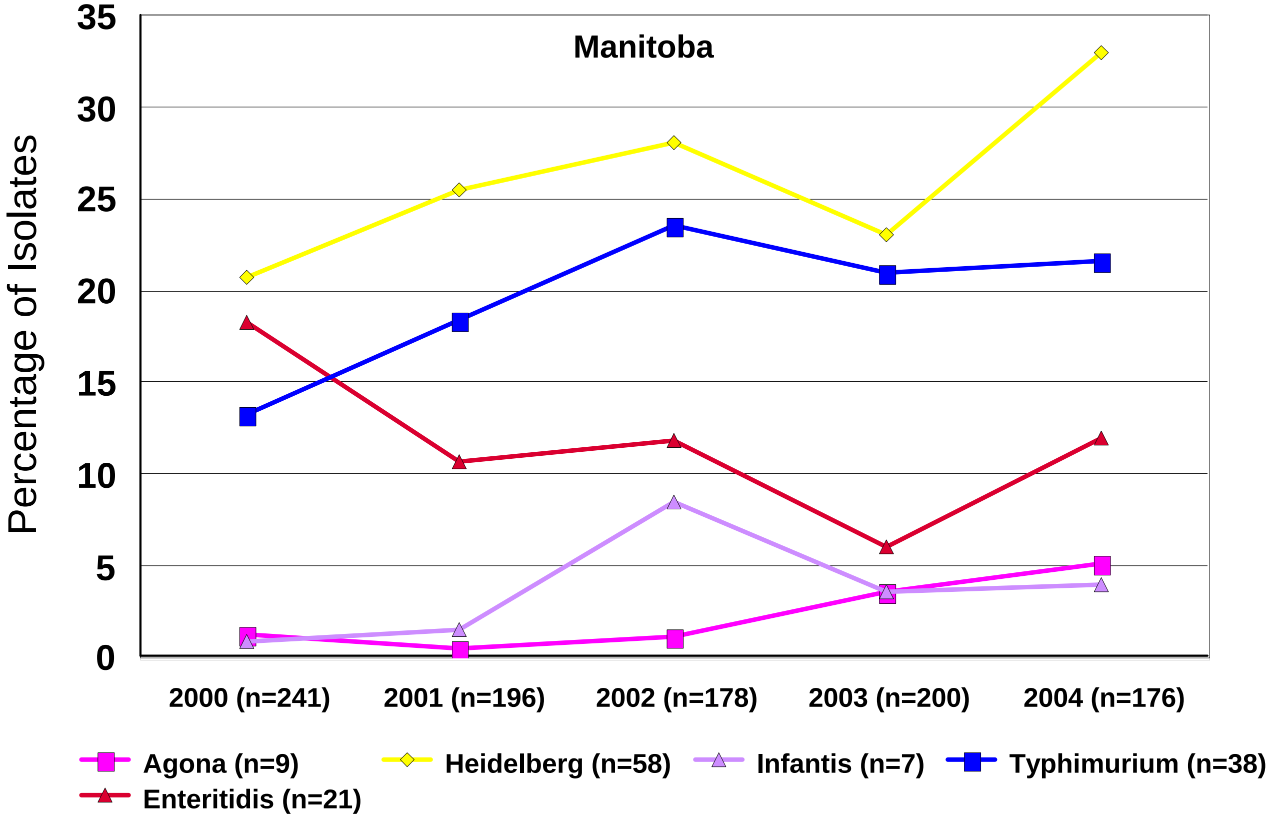


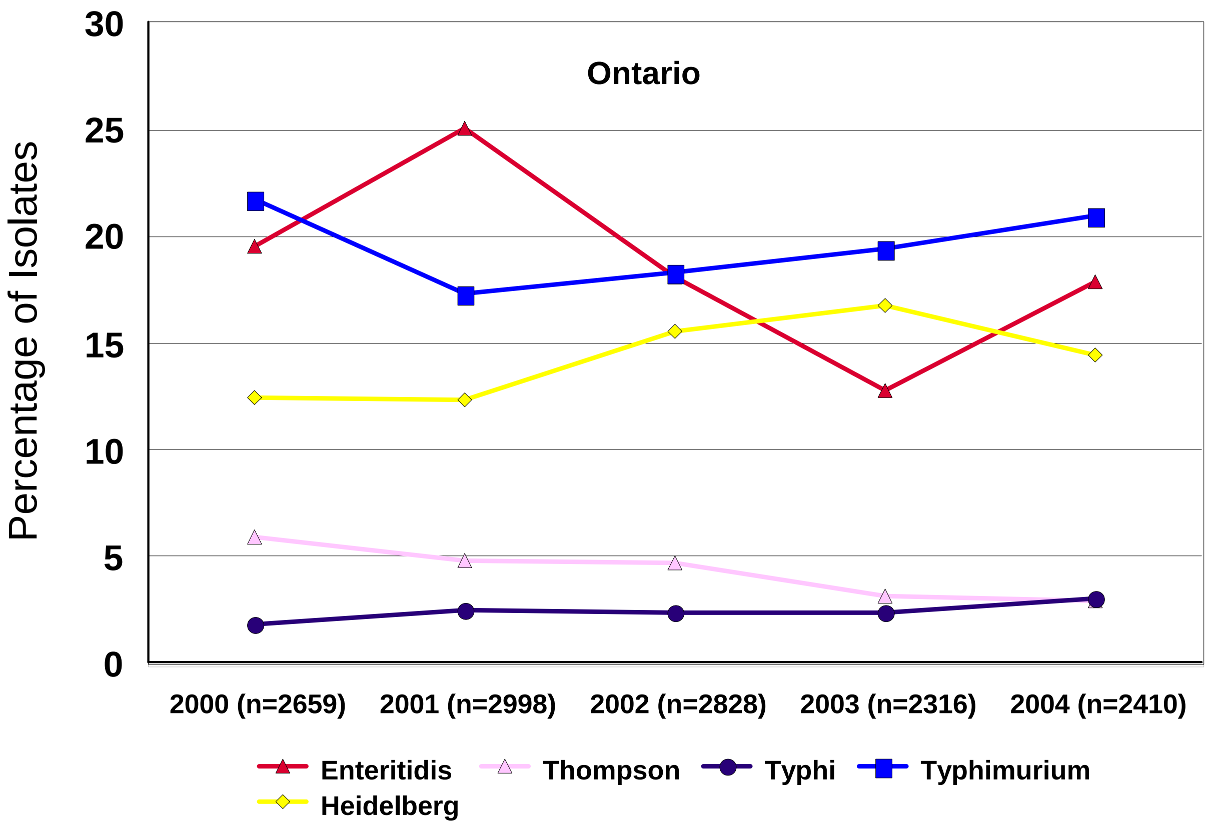


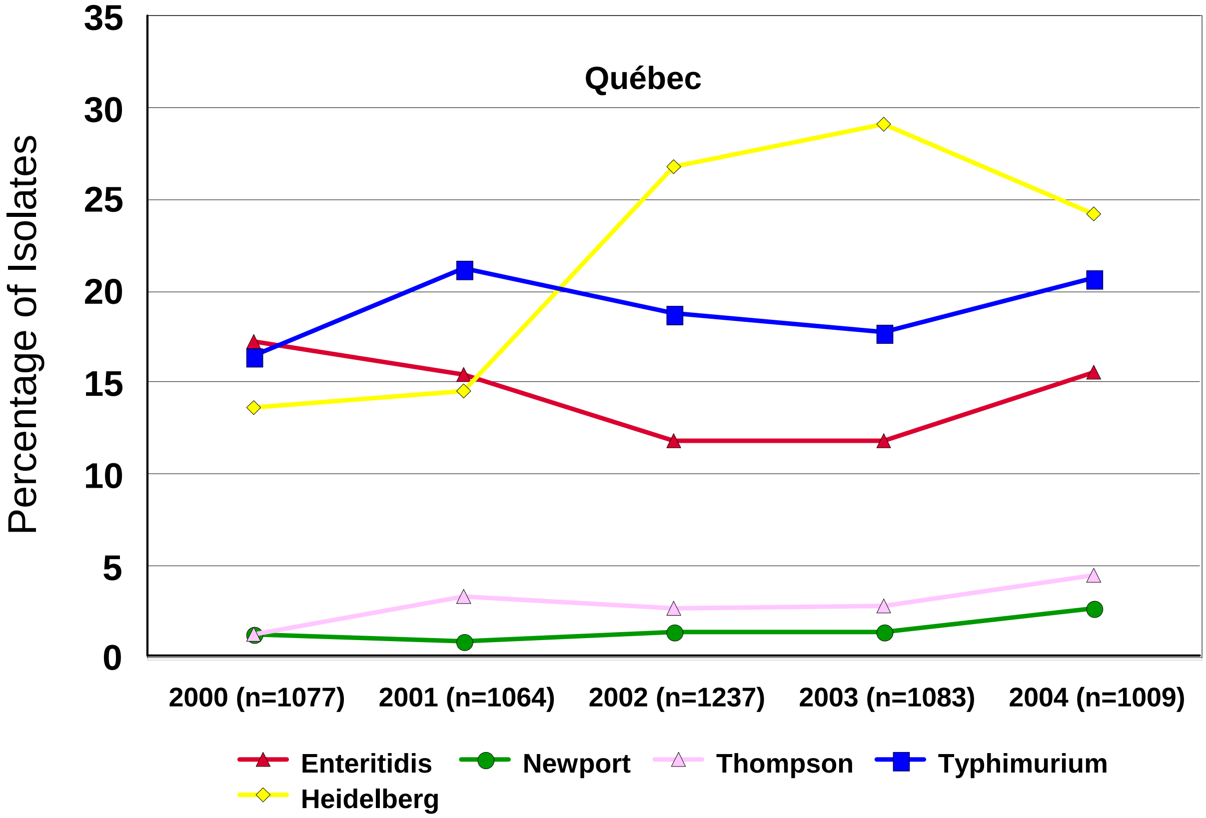
Alberta
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=918)
2001 (n=945)
2002 (n=844)
2003 (n=743)
2004 (n=683)
Enteritidis
Heidelberg
Newport
Typhimurium
Hadar

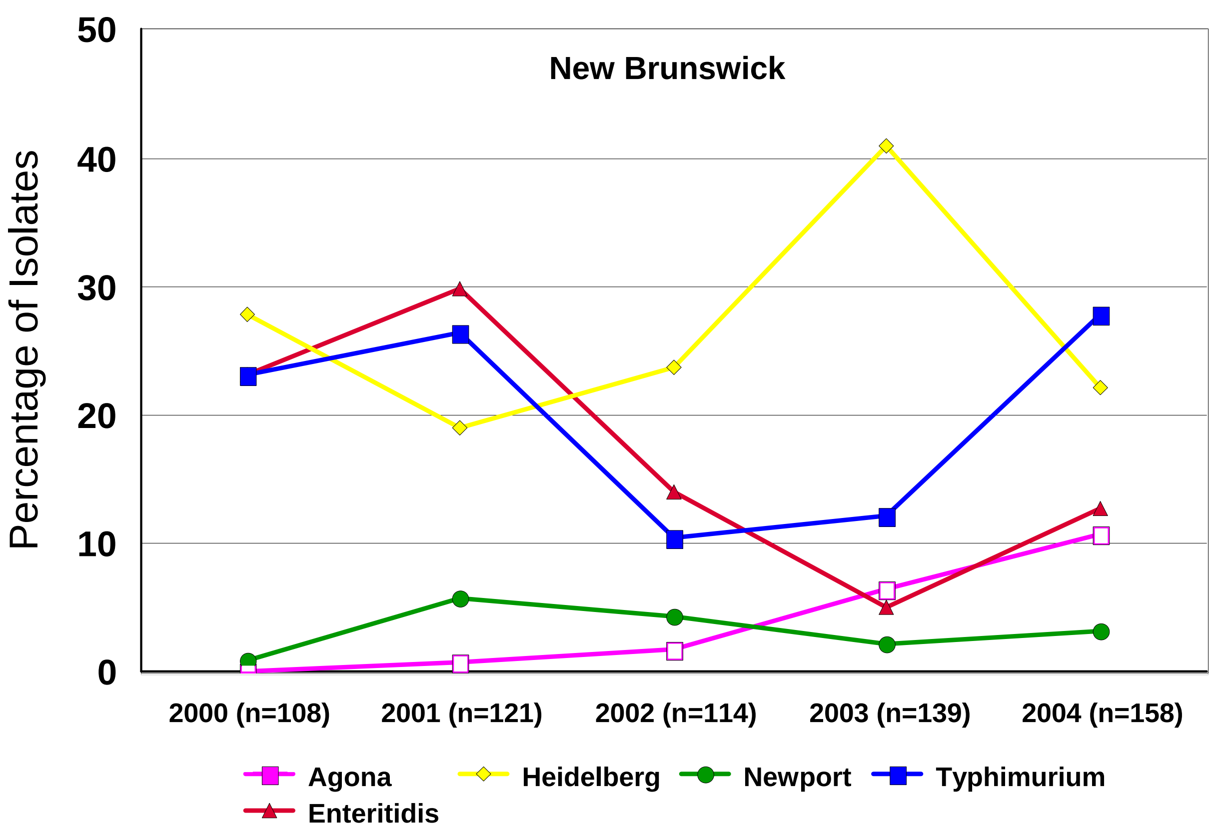


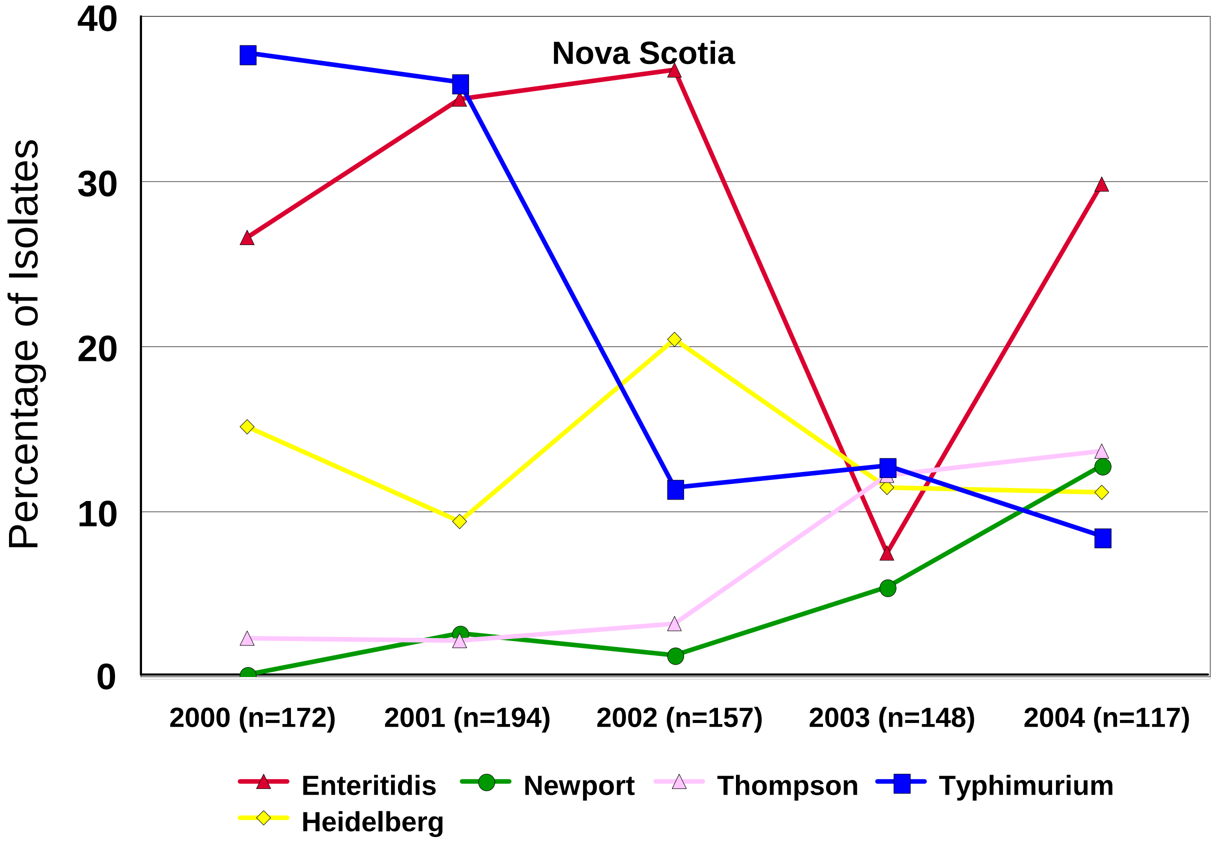
Saskatchewan
Percentage of Isolates
30
25
20
15
10
5
0
2000 (n=172)
2001 (n=203)
2002 (n=161)
2003 (n=118)
2004 (n=130)
Enteritidis
Heidelberg
Typhimurium
ssp 4,5,12:i:-
Hadar

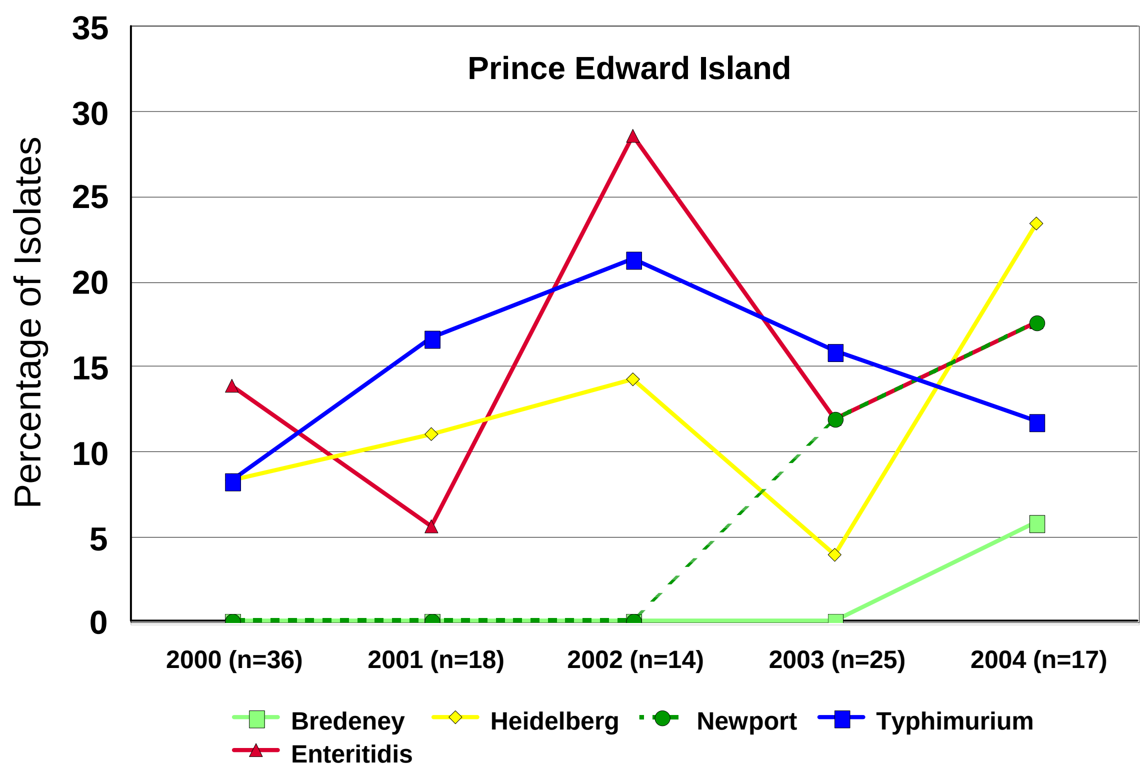

Manitoba
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=241)
2001 (n=196)
2002 (n=178)
2003 (n=200)
2004 (n=176)
Agona (n=9)
Heidelberg (n=58)
Infantis (n=7)
Typhimurium (n=38)
Enteritidis (n=21)


Ontario
Percentage of Isolates
30
25
20
15
10
5
0
2000 (n=2659)
2001 (n=2998)
2002 (n=2828)
2003 (n=2316)
2004 (n=2410)
Enteritidis
Thompson
Typhi
Typhimurium
Heidelberg


Québec
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=1077)
2001 (n=1064)
2002 (n=1237)
2003 (n=1083)
2004 (n=1009)
Enteritidis
Newport
Thompson
Typhimurium
Heidelberg


New Brunswick
Percentage of Isolates
50
40
30
20
10
0
2000 (n=108)
2001 (n=121)
2002 (n=114)
2003 (n=139)
2004 (n=158)
Agona
Heidelberg
Newport
Typhimurium
Enteritidis


Nova Scotia
Percentage of Isolates
40
30
20
10
0
2000 (n=172)
2001 (n=194)
2002 (n=157)
2003 (n=148)
2004 (n=117)
Enteritidis
Newport
Thompson
Typhimurium
Heidelberg


Prince Edward Island
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=36)
2001 (n=18)
2002 (n=14)
2003 (n=25)
2004 (n=17)
Bredeney
Heidelberg
Newport
Typhimurium
Enteritidis

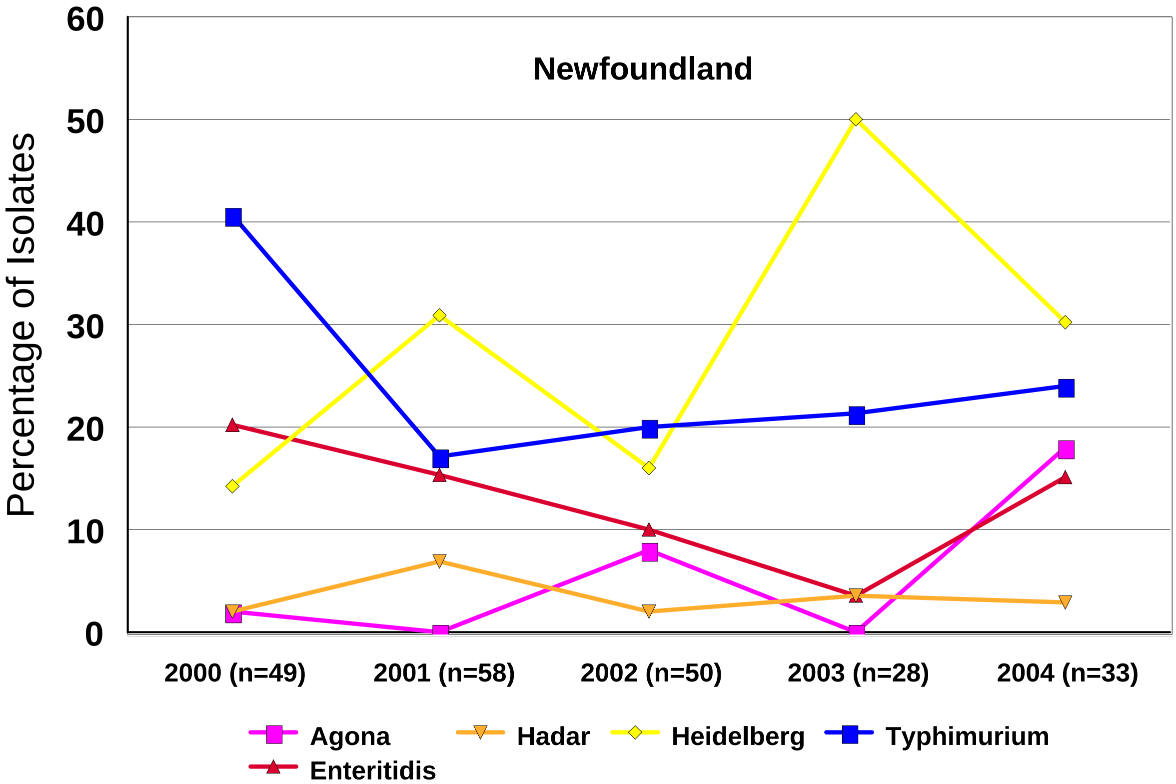

Newfoundland
Percentage of Isolates
60
50
40
30
20
10
0
2000 (n=49)
2001 (n=58)
2002 (n=50)
2003 (n=28)
2004 (n=33)
Agona
Hadar
Heidelberg
Typhimurium
Enteritidis

Table 2: *Salmonella* Serovars from Humans in Canada in 2004*

Organism	**BC**	**AB**	**SK**	**MB**	**ON**	**QC**	**NB**	**NS**	**PE**	**NF**	**NT**	**NU**	**YK**	**Total**
S. Aba						2								**2**
S. Abaetetuba					1									**1**
S. Adelaide	2	1			6	1								**10**
S. Agama						1								**1**
S. Agbeni					1	1								**2**
S. Agona	15	10		9	41	19	17	5		6				**122**
S. Ajiobo					1									**1**
S. Alachua		3												**3**
S. Albany	1			1	2									**4**
S. Anatum (a)	4	2	1	2	7		1	1						**18**
S. Arechavaleta	1				2	2								**5**
S. Bardo		2			1									**3**
S. Bareilly	2				11	2	1							**16**
S. Berta					28	7								**35**
S. Bispebjerg					1									**1**
S. Blockley	1	2	2	1	5		1	1						**13**
S. Bonariensis					1									**1**
S. Bonn						1								**1**
S. Bornairensis														**0**
S. Boussa														**0**
S. Bousso		1												**1**
S. Bovismorbificans	11	2	1		8	3								**25**
S. Braenderup	8	6		1	37	4	4	3						**63**
S. Brandenburg	17			1	14	5								**37**
S. Bredeney	4				2				1					**7**
S. Butantan					1									**1**
S. Carrau					1									**1**
S. Cerro		1			2			1						**4**
S. Chailey					1									**1**
S. Chester	3				5									**8**
S. Choleraesuis	1				2	1		1						**5**
S. Clackamas	1													**1**
S. Colindale		1												**1**
S. Corvallis	1	1			3	2		1						**8**
S. Cotham					1									**1**
S. Cubana	1	1			2									**4**
S. Daytona	4													**4**
S. Derby	2	5			10	5								**22**
S. Dublin	2	1				3	4							**10**
S. Durban	1				1									**2**
S. Durham						2								**2**
S. Ealing					1									**1**
S. Eastbourne					2									**2**
S. Edinburg					2									**2**
S. Emek					1									**1**
S. Enteritidis	152	161	29	21	431	156	20	35	3	5				**1013**
S. Essen					1									**1**
S. Falkensee					2									**2**
S. Freetown	1													**1**

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	Total
S. Galiema					1									**1**
S. Gallinarum		1												**1**
S. Gaminara	1				1									**2**
S. Gatuni		1			1									**2**
S. Georgia		1												**1**
S. Give	3	6			3	1								**13**
S. Haardt						1								**1**
S. Hadar	29	33	11	1	58	14	1	1		1	1			**150**
S. Haifa	2	2			3	2								**9**
S. Hartford			1		7	2								**10**
S. Havana	2				2									**4**
S. Heidelberg	103	123	27	58	349	244	35	13	4	10	1			**967**
S. Hvittingfoss	2	2			3									**7**
S. Indiana		2			4	5								**11**
S. Infantis	13	6	2	7	61	14	1							**104**
S. Irumu					3									**3**
S. Isangi					3									**3**
S. Istanbul			1		1	1								**3**
S. Itami		2												**2**
S. Javiana	12	10	3	1	35	11				1				**73**
S. Johannesburg					1	1								**2**
S. Kedougou					1									**1**
S. Kentucky	4				7	3								**14**
S. Kiambu		1			5	3								**9**
S. Kingabwa				1										**1**
S. Kintambo					1									**1**
S. Kisarawe					1									**1**
S. Kottbus	1													**1**
S. Lexington					1									**1**
S. Litchfield	2				16	11	1	1						**31**
S. Livingstone (b)					2	1								**3**
S. London					3									**3**
S. Luciana	1													**1**
S. Luke					1									**1**
S. Madelia					1									**1**
S. Manhattan	1	2			4	5								**12**
S. Matopeni	1													**1**
S. Mbandaka	6	4		1	16									**27**
S. Meleagridis					1									**1**
S. Miami					1	1								**2**
S. Michigan			1											**1**
S. Milwaukee		2												**2**
S. Minnesota					1									**1**
S. Mississippi		1			3	1								**5**
S. Monschaui		1		1		1								**3**
S. Montevideo	3	4	1	1	30	6	1	2						**48**
S. Muenchen	6	2	1	1	26	6	1	1						**44**
S. Muenster (a)				1	6									**7**
S. Napoli		1		1				1						**3**
S. Nessziona					1									**1**

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	Total
S. Newport	18	16	4	5	64	26	5	15	3	1				**157**
S. Nima		2			2									**4**
S. Norwich					1									**1**
S. Ohio (b)	3	6			2	2								**13**
S. Oranienburg	6	3	3	3	19	15	1	4						**54**
S. Orion (a)	1				1				1					**3**
S. Oslo			1		2									**3**
S. Panama	3	2	3		11	6								**25**
S. Paratyphi A	20	3			58	3		1						**85**
S. Paratyphi B	2				3									**5**
S. Paratyphi B var. Java	13	3	3	2	12	19	1		1					**54**
S. Pomona		2			2	1								**5**
S. Poona	1	2	1	1	7	2	2	2						**18**
S. Potsdam	1													**1**
S. Presov						1								**1**
S. Putten					1									**1**
S. Richmond	1	1			3									**5**
S. Riogrande						1								**1**
S. Rissen	3	1			1	1								**6**
S. Roodepoort		1												**1**
S. Rubislaw		3	1		1									**5**
S. Saintpaul	15	12	3	4	38	16	4							**92**
S. Sandiego	1	4		2	12	4		1						**24**
S. Saphra					2									**2**
S. Schwarzengrund	1	3	1		12	1	1							**19**
S. Senftenberg	8	3			7	1								**19**
S. Singapore					2	1								**3**
S. Stanley	12	1	1	1	11	4	1							**31**
S. Telelkebir					2	1								**3**
S. Tennessee					5									**5**
S. Thompson	8	7	3	1	71	44	3	16	1					**154**
S. Tsevie						1								**1**
S. Typhi	34	6			73	10								**123**
S. Typhimurium	136	149	16	38	507	209	44	10	2	8	2		1	**1122**
S. Uganada														**0**
S. Uganda		1			4	1		1						**7**
S. Urbana	1				3									**4**
S. Vejle	1													**1**
S. Virchow	10	3			16	6								**35**
S. Wandsworth														**0**
S. Weltevreden	4	1			11									**16**
S. Westminster					1									**1**
S. Worthington	2	1			4	1								**8**
S. Zanzibar					1									**1**
Salmonella ssp I	4		1	3						1			1	**10**
Salmonella ssp I 2,12:-:-						3								**3**
Salmonella ssp I 11:b:-						1								**1**
Salmonella ssp I 13,23:-:-														**0**
Salmonella ssp I 13,23:-:e,n,z15														**0**

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	Total
Salmonella ssp I 13,23:i:-					1									**1**
Salmonella ssp I 28:y:-		1												**1**
Salmonella ssp I 3,1:-:-					1									**1**
Salmonella ssp I 3,1:-:z6		1												**1**
Salmonella ssp I 3,1:l,v:-					1									**1**
Salmonella ssp I 3,15:-:-					1									**1**
Salmonella ssp I 3,15:l,v:-														**0**
Salmonella ssp I 3,19:-:-					1									**1**
Salmonella ssp I 4,12:-:-					3									**3**
Salmonella ssp I 4,12:-:1,2						1								**1**
Salmonella ssp I 4,12:d:-		1												**1**
Salmonella ssp I 4,12:i:-	6	3		1	2	1	1							**14**
Salmonella ssp I 4,5,12:-:-					1	2	1							**4**
Salmonella ssp I 4,5,12:-:1,2					2									**2**
Salmonella ssp I 4,5,12:b:-	2	6			36	5								**49**
Salmonella ssp I 4,5,12:d:-					1									**1**
Salmonella ssp I 4,5,12:i:-	12	14	5	2	43	6								**82**
Salmonella ssp I 4,5,12:r:-					1									**1**
Salmonella ssp I 51:-:-		1												**1**
Salmonella ssp I 6,7:-:-						36								**36**
Salmonella ssp I 6,7:-:e,n,z15					1									**1**
Salmonella ssp I 6,7:b:-						1								**1**
Salmonella ssp I 6,7:k:-					1									**1**
Salmonella ssp I 6,7:f,g,s:-	1													**1**
Salmonella ssp I 6,7:r:-					1									**1**
Salmonella ssp I 6,8:-:-						6	2							**8**
Salmonella ssp I 6,8:e,h:-					1									**1**
Salmonella ssp I 8,2:i:-					3									**3**
Salmonella ssp I 8:-:-						2								**2**
Salmonella ssp I 8:-:1,2					1									**1**
Salmonella ssp I 9,12:-:-		3			5	4								**12**
Salmonella ssp I 9,12:-:1,5	1		1											**2**
Salmonella ssp I 9,12:r:e,n,x														**0**
Salmonella ssp I Rough-O:-:-		1			5									**6**
Salmonella ssp I Rough-O:b:-					1									**1**
Salmonella ssp I Rough-O:d:1,2	1													**1**
Salmonella ssp I Rough-O:i:-							1							**1**
Salmonella ssp I Rough-O:i:1,2					2									**2**
Salmonella ssp I Rough-O:k:1,5						1								**1**
Salmonella ssp I Rough-O:r:1,5	1				1									**2**
Salmonella ssp I Rough-O:z4,z24:-					1									**1**
Salmonella ssp II														**0**
Salmonella ssp II 48:d:z6					1									**1**
Salmonella ssp II 5:b:z6					1	1			1					**3**
Salmonella ssp II 58:c:z6		1												**1**
Salmonella ssp II 58:l,z13,z28:z6						1								**1**
Salmonella ssp II 6,7:g,m,s,t:-														**0**
Salmonella ssp II 6,7:m,t:-	1													**1**
Salmonella ssp II 9,12:z29:1,5					1									**1**

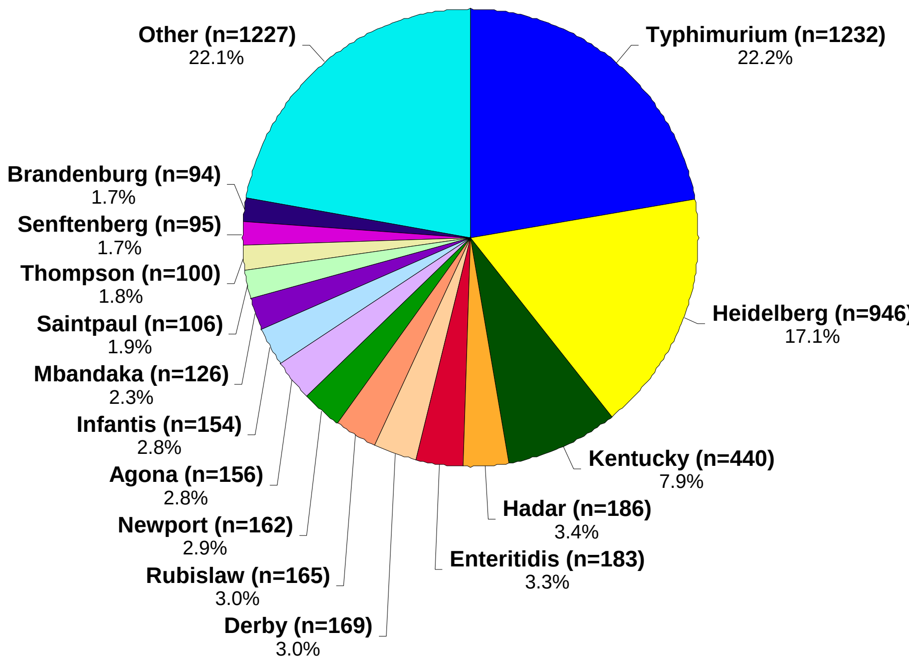
Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	Total
Salmonella ssp IIIa				1										**1**
Salmonella ssp IIIa 4:z4,z23:-					1									**1**
Salmonella ssp IIIa 41:z4,z23:-		2				2								**4**
Salmonella ssp IIIa Rough-O:-:-				1										**1**
Salmonella ssp IIIb														**0**
Salmonella ssp IIIb 43:-:e,n,z15			1											**1**
Salmonella ssp IIIb 47:-:-							1							**1**
Salmonella ssp IIIb 47:k:z35		1			1									**2**
Salmonella ssp IIIb 47:r:z53		1												**1**
Salmonella ssp IIIb 48:i:z					2									**2**
Salmonella ssp IIIb 48:r:z	1													**1**
Salmonella ssp IIIb 5:k:z		1			1									**2**
Salmonella ssp IIIb 5:z:z52		1												**1**
Salmonella ssp IIIb 6:r:z														**0**
Salmonella ssp IIIb 6:z52:z35					1									**1**
Salmonella ssp IIIb 61:k:1,5					1	2								**3**
Salmonella ssp IIIb 61:k:1,5,7						1								**1**
Salmonella ssp IIIb 61:l,v:1,5					3									**3**
Salmonella ssp IIIb 61:l,v:1,5,7														**0**
Salmonella ssp IIIb 65:k:z	1													**1**
Salmonella ssp IV														**0**
Salmonella ssp IV 11:z4,z23:-					1									**1**
Salmonella ssp IV 43:z4,z23:-	1				1									**2**
Salmonella ssp IV 44:z4,z23:-		1				1								**2**
Salmonella ssp IV 45:g,z51:-						2								**2**
Salmonella ssp IV 48:g,z51:-				1	1									**2**
Salmonella ssp IV 48:z4,z32:-			1											**1**
Salmonella ssp IV 5:g,z51:-		1			2	2								**5**
Salmonella ssp IV 5:z4,z23:-	1						2							**3**
Salmonella ssp V 48:z81														**0**
Salmonella ssp V 48:z81:-					1									**1**
TOTAL	**765**	**683**	**130**	**176**	**2410**	**1009**	**158**	**117**	**17**	**33**	**4**	**0**	**2**	**5504**

Salmonella **Isolations from Non-Human Sources in 2004**

Non-human sources of *Salmonella* include animal, food, environmental or water and were gathered through the passive surveillance systems of the LFZ and NML in the course of reference services, special studies and outbreak investigations. There is no control of the relative numbers forwarded by a province/territory. Figure 8 shows the fifteen most prevalent serovars isolated from non-human sources in Canada in 2004.

S. Typhimurium is the most prevalent serovars isolated from non-human sources in Canada in 2004 with 22.2% (n=1232) of the 5541 isolates reported, followed by *S*. Heidelberg with 17.1% (n=946). Ranked a distant 3rd is *S*. Kentucky (7.9%, n=440) followed by *S*. Hadar (3.4%, n=186), *S*. Enteritidis (3.3%, n=183), *S*. Derby (3.0%, n=169), *S*. Rubislaw (3.0%, n=165), *S*. Newport (2.9%, n=162), *S*. Agona (2.8%, n=156) and *S*. Infantis ranked 10th (2.8%, n=154). Serovars ranking from 11th to 15th include S. Mbandaka, *S*. Saintpaul, *S*. Thompson, *i*. Senftenberg and *S*. Brandenburg, each accounting for 1.7 to 2.3% of the isolates identified in 2004. Other serovars represent 22.1% (n=1227) of the isolates in 2004.

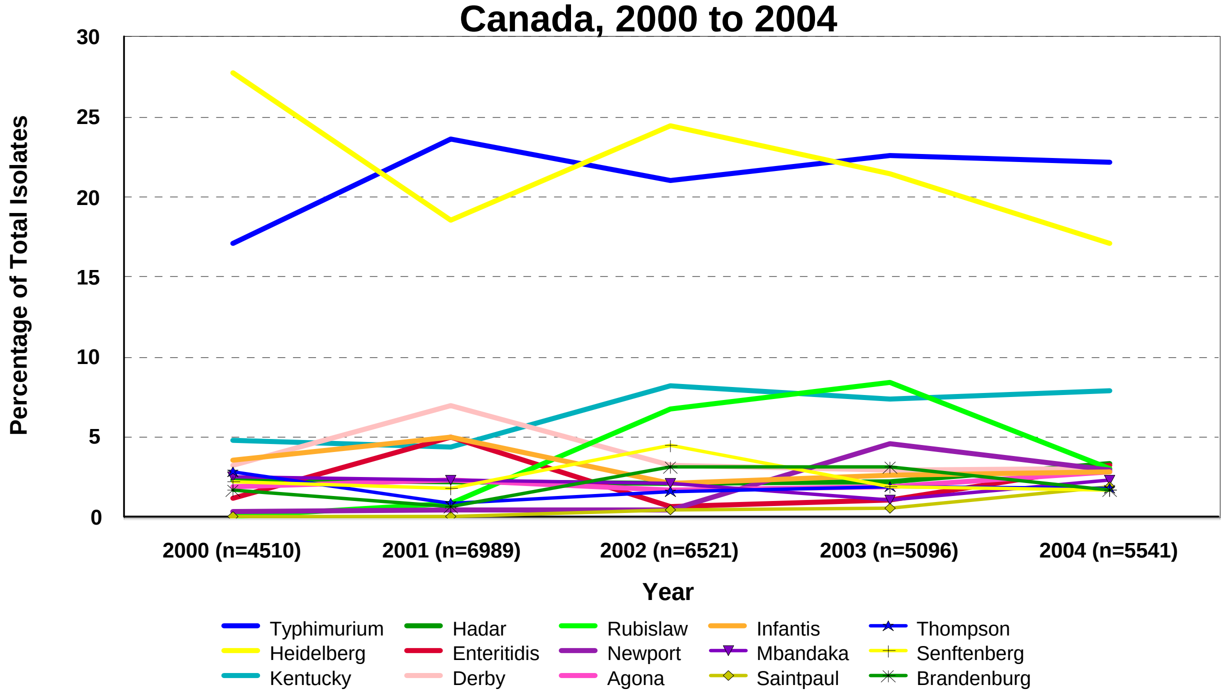
Figure 8: Fifteen Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2004 (N=5541)



Changes in the Occurrence of *Salmonella* Serovars From Non-Human Sources in Canada 2000 to 2004

The relative frequencies of the 10 most prevalent *Salmonella* serovars of non-human sources from 2000 to 2004 are shown in Figure 9. *S*. Typhimurium remained the most prevalent serovar isolated from non-human sources in 2004. After an increase from 17.1% (n=769) of isolates identified in 2000 to 23.6% (n=1648) of the 6989 in 2001, *S*. Typhimurium isolations have remained relatively constant since accounting for 21.0% (n=1369) of 6516 isolations in 2002, 22.6% (n=1154) of 5096 isolations in 2003 and 22.2% (n=1232) of the 5541 isolations in 2004. Although *S*. Heidelberg isolations have declined from a high of 24.5% (n=1599) in 2002 to 17.1% (n=946) in 2004, together with *S*. Typhimurium, this serovar has consistently been one of the most prevalent serovars isolated between 2000 and 2004. *S*. Kentucky has ranked 3rd most prevalent accounting for 8.2% (n=532) of the isolates in 2002, 7.4% (n=376) in 2003 and 7.9% (n=440) in 2004. *S*. Hadar and *S*. Enteritidis have increased slightly in prevalence among non-human isolations. *S*. Hadar increased to rank 4th overall 2004 with 3.4% (n=186) of the identifications, up from 2.1% (n=139) in 2002 and 2.2% (n=113) in 2003. *S*. Enteritidis has increased to 3.3% (n=183) from 1.0% (n=57) in 2003. *S*. Newport identifications have declined to 2.9% (n=162) of the isolated identified in 2004, down from 4.6% (n=232) in 2003. A decline in isolations has also been observed among *S*. Rubislaw isolations from 6.8% (n=427) in 2002 and 8.4% (n=407) in 2003 to rank 7th in overall prevalence with 3.0% (n=165) of the non-human isolates identified in 2004.

Figure 9: Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2000 to 2004



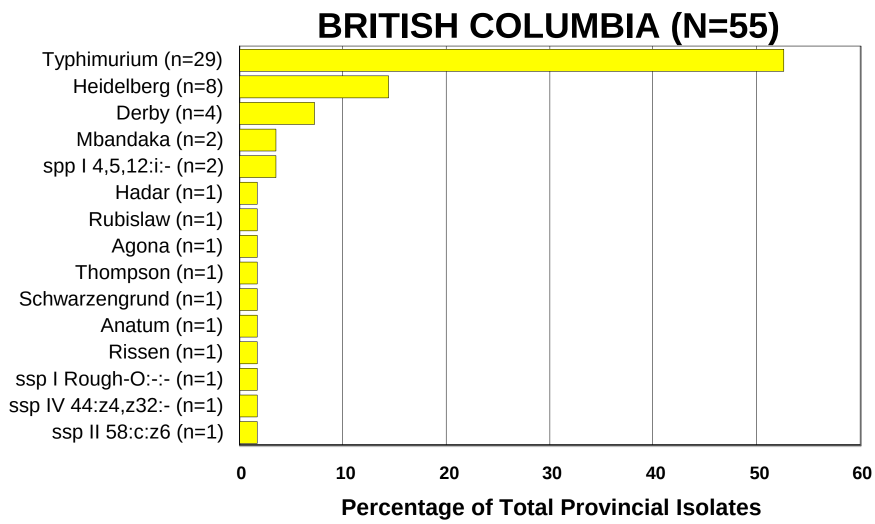
* Non-human sources include food, water, animal and environmental sources. Serovar totals are laboratory confirmed isolates based on information gathered through passive surveillance at the LFZ and NML through routine reference services. Although data is representative of laboratory confirmed isolates only and should not be confused with incidence of disease in animals, this subset of data is consistently gathered and standardized from year to year and can indicate emerging or re-emerging trends. See Appendix 1 for details.

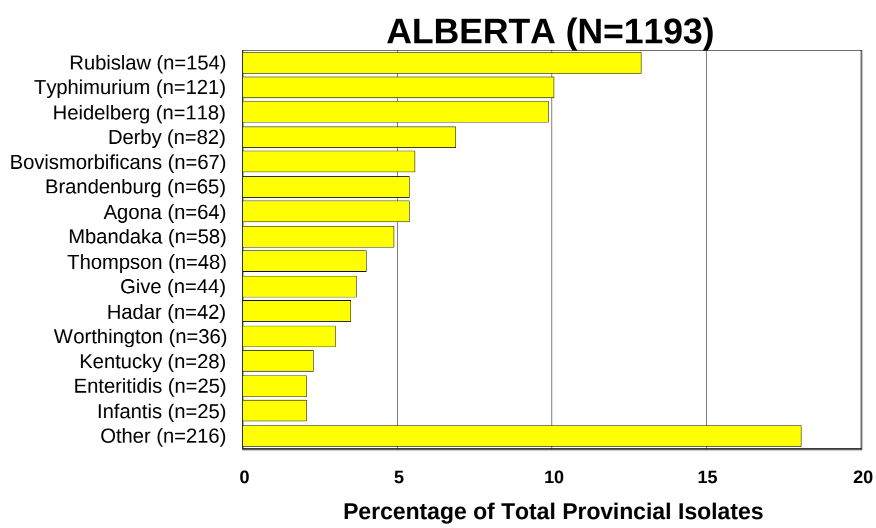
Provincial Distribution of *Salmonella* Serovars from Non-Human Sources in 2004

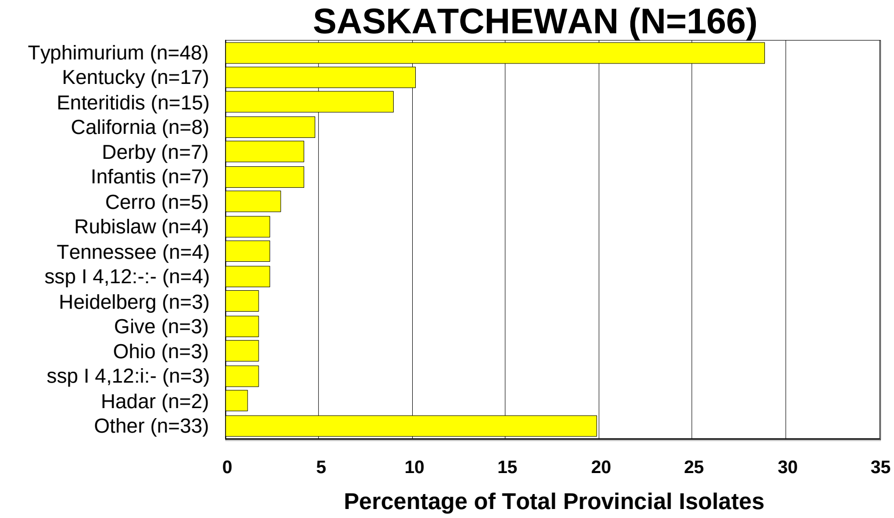
Non-human data is gathered through passive surveillance systems of the LFZ and NML in the course of reference services, special studies and outbreak investigations. There is no control of the relative numbers forwarded by a province. Large numbers of isolates should not be interpreted as incidence of disease but rather more rigorous passive surveillance practices.

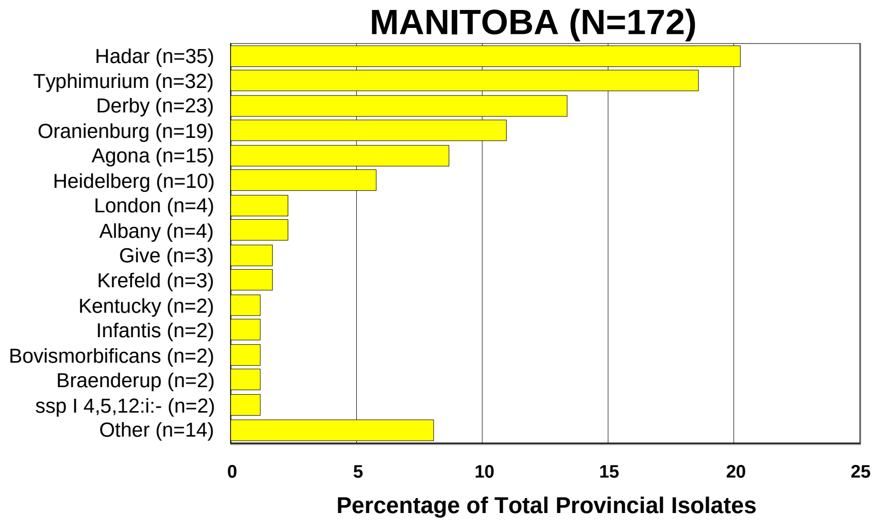
The most common *Salmonella* serovars from non-human origin in each province are shown in Figure 10. In 2004, *S.* Typhimurium ranked first in British Columbia, Saskatchewan, and Quebec. *S*. Heidelberg was most prevalent in Ontario and New Brunswick, *S*. Rubislaw in Alberta, *S*. Hadar in Manitoba, *S*. Thompson in Nova Scotia, *S*. Orion in Prince Edward Island and *S*. Agona in Newfoundland.

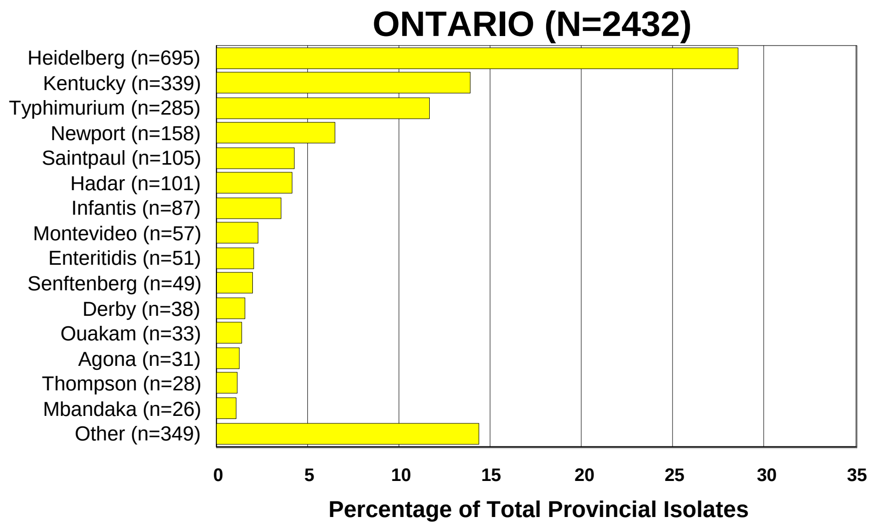
Figure 10: Most Prevalent *Salmonella* Serovars of Non-Human Origin in Each Province, 2004

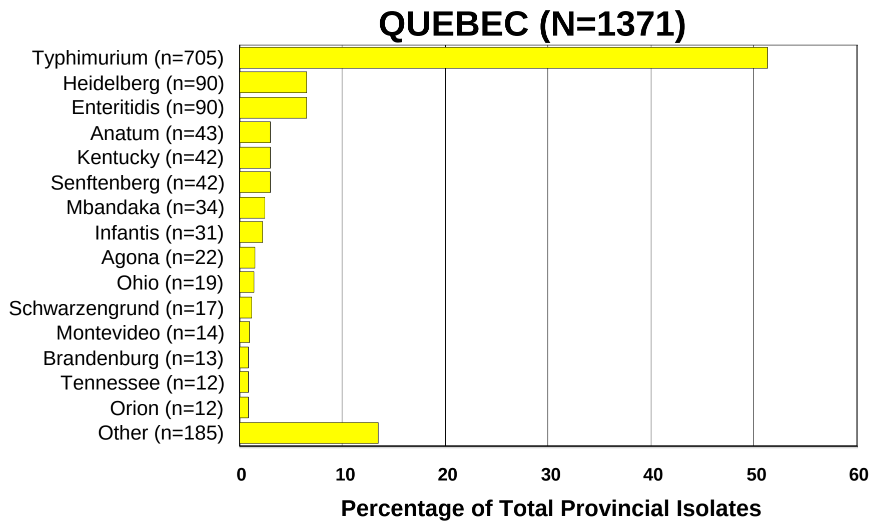


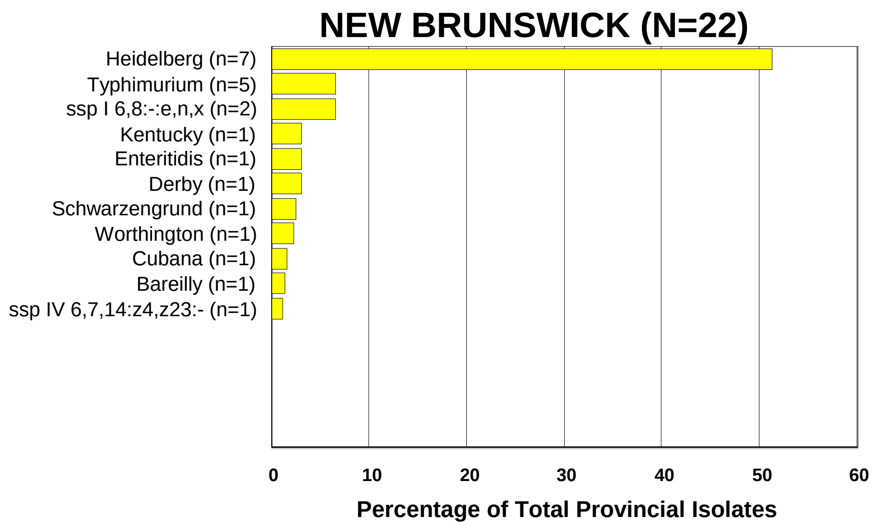


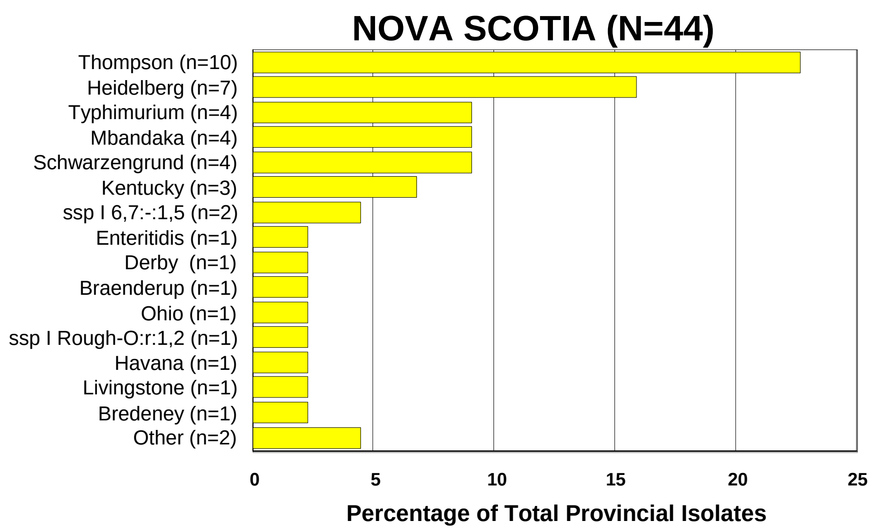

SASKATCHEWAN (N=166)
Typhimurium (n=48)
Kentucky (n=17)
Enteritidis (n=15)
California (n=8)
Derby (n=7)
Infantis (n=7)
Cerro (n=5)
Rubislaw (n=4)
Tennessee (n=4)
ssp I 4,12:-:- (n=4)
Heidelberg (n=3)
Give (n=3)
Ohio (n=3)
ssp I 4,12:i:- (n=3)
Hadar (n=2)
Other (n=33)
0
5
10
15
20
25
30
35
Percentage of Total Provincial Isolates

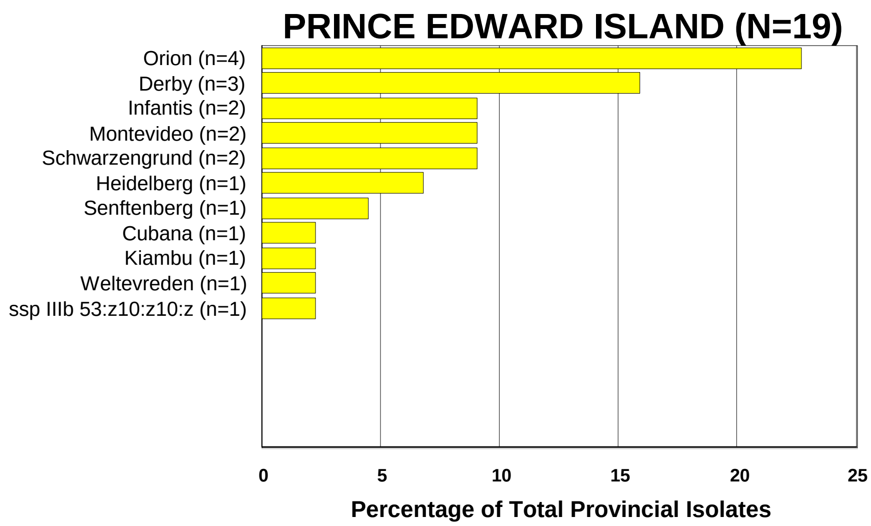

MANITOBA (N=172)
Hadar (n=35)
Typhimurium (n=32)
Derby (n=23)
Oranienburg (n=19)
Agona (n=15)
Heidelberg (n=10)
London (n=4)
Albany (n=4)
Give (n=3)
Krefeld (n=3)
Kentucky (n=2)
Infantis (n=2)
Bovismorbificans (n=2)
Braenderup (n=2)
ssp I 4,5,12:i:- (n=2)
Other (n=14)
0
5
10
15
20
25
Percentage of Total Provincial Isolates

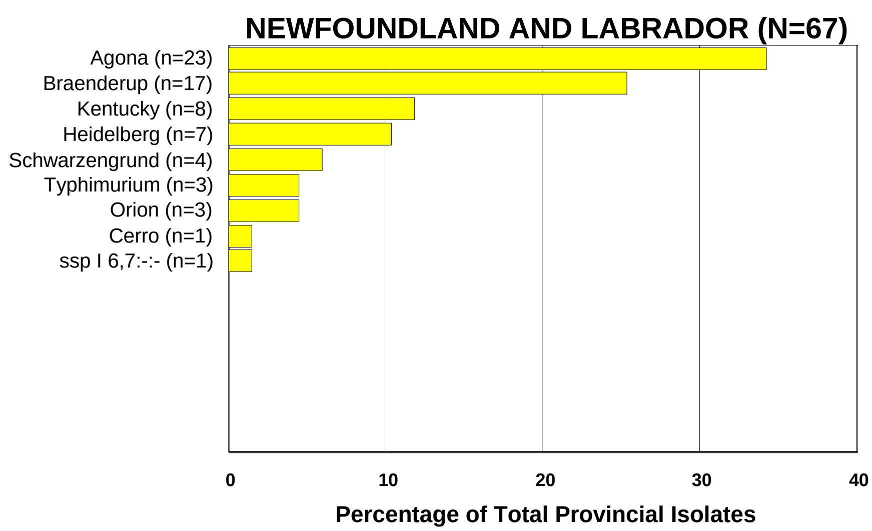

ONTARIO (N=2432)
Heidelberg (n=695)
Kentucky (n=339)
Typhimurium (n=285)
Newport (n=158)
Saintpaul (n=105)
Hadar (n=101)
Infantis (n=87)
Montevideo (n=57)
Enteritidis (n=51)
Senftenberg (n=49)
Derby (n=38)
Ouakam (n=33)
Agona (n=31)
Thompson (n=28)
Mbandaka (n=26)
Other (n=349)
0
5
10
15
20
25
30
35
Percentage of Total Provincial Isolates


QUEBEC (N=1371)
Typhimurium (n=705)
Heidelberg (n=90)
Enteritidis (n=90)
Anatum (n=43)
Kentucky (n=42)
Senftenberg (n=42)
Mbandaka (n=34)
Infantis (n=31)
Agona (n=22)
Ohio (n=19)
Schwarzengrund (n=17)
Montevideo (n=14)
Brandenburg (n=13)
Tennessee (n=12)
Orion (n=12)
Other (n=185)
0 10 20 30 40 50 60
Percentage of Total Provincial Isolates


NEW BRUNSWICK (N=22)
Heidelberg (n=7)
Typhimurium (n=5)
ssp I 6,8:-:e,n,x (n=2)
Kentucky (n=1)
Enteritidis (n=1)
Derby (n=1)
Schwarzengrund (n=1)
Worthington (n=1)
Cubana (n=1)
Bareilly (n=1)
ssp IV 6,7,14:z4,z23:- (n=1)
0 10 20 30 40 50 60
Percentage of Total Provincial Isolates


NOVA SCOTIA (N=44)
Thompson (n=10)
Heidelberg (n=7)
Typhimurium (n=4)
Mbandaka (n=4)
Schwarzengrund (n=4)
Kentucky (n=3)
ssp I 6,7:-:1,5 (n=2)
Enteritidis (n=1)
Derby (n=1)
Braenderup (n=1)
Ohio (n=1)
ssp I Rough-O:r:1,2 (n=1)
Havana (n=1)
Livingstone (n=1)
Bredeney (n=1)
Other (n=2)
0 5 10 15 20 25
Percentage of Total Provincial Isolates

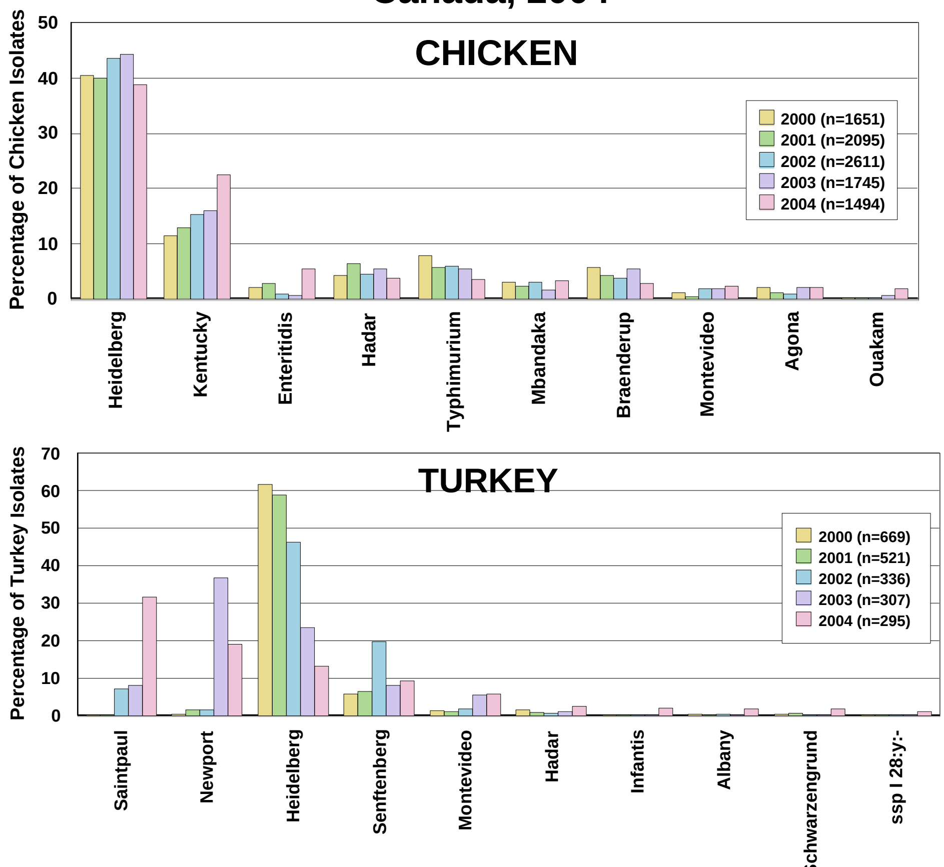

PRINCE EDWARD ISLAND (N=19)
Orion (n=4)
Derby (n=3)
Infantis (n=2)
Montevideo (n=2)
Schwarzengrund (n=2)
Heidelberg (n=1)
Senftenberg (n=1)
Cubana (n=1)
Kiambu (n=1)
Weltevreden (n=1)
ssp IIIb 53:z10:z10:z (n=1)
0
5
10
15
20
25
Percentage of Total Provincial Isolates

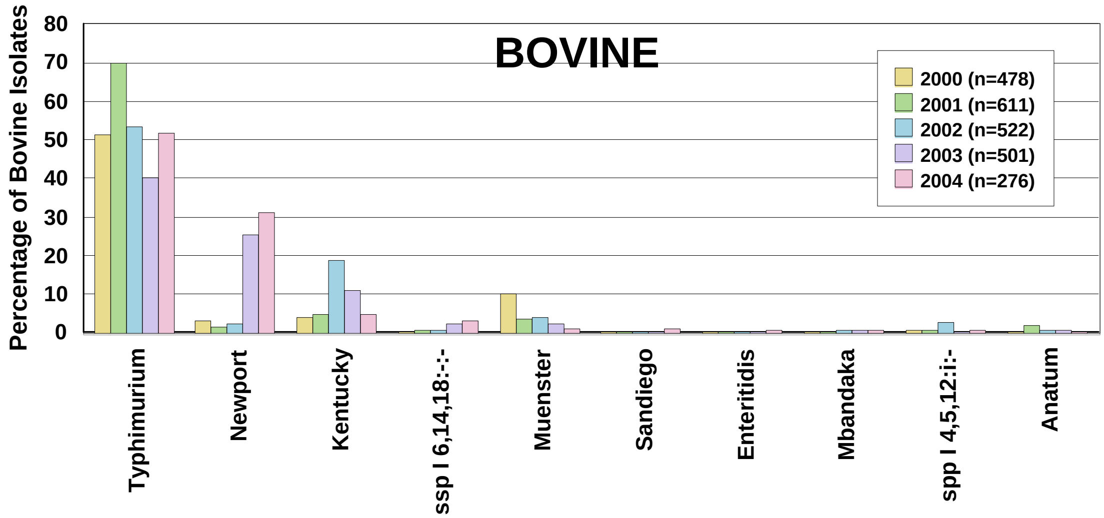

NEWFOUNDLAND AND LABRADOR (N=67)
Agona (n=23)
Braenderup (n=17)
Kentucky (n=8)
Heidelberg (n=7)
Schwarzengrund (n=4)
Typhimurium (n=3)
Orion (n=3)
Cerro (n=1)
ssp I 6,7:-:- (n=1)
0
10
20
30
40
Percentage of Total Provincial Isolates

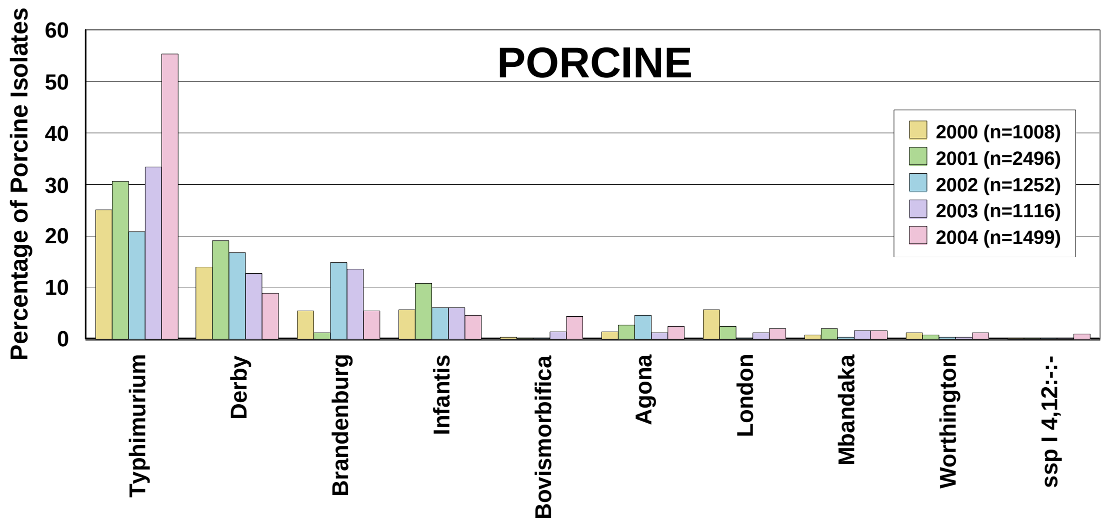
Source Distribution of *Salmonella* Serovars in Canada, 2000 to 2004

The ten most prevalent *Salmonella* serovars isolated from bovine, chicken, turkey, porcine and feed sources from 2000 to 2004 are shown in Figure 11. *S*. Heidelberg continued to be the most prevalent serovar isolated from chicken accounting for 38.8% (n=580) of the 1494 isolates reported in 2004 and now also ranks 1st among the animal feed isolates with 12.7% (n=81) of the 639 feed isolates in 2004. *S*. Kentucky has been steadily increasing in chicken isolates from 11.5% (n=190) of the 1651 isolates analyzed in 2000 to 22.4% (n=334) in 2004. The proportion of isolates identified from animal feed as *S*. Senftenberg continues to decrease and this serovar now ranks 7th most prevalent with 6.1% (n=39) of all feed isolates tested, down from 35.6% (n=103) of the 289 isolates tested in 2002. *S*. Typhimurium is most prevalent from bovine sources representing 51.8% (143 of 276 isolates) as well as from porcine sources with 55.4% (830 of 1499 isolates). *S*. Newport remains a relatively high proportion of the bovine isolations, increasing slightly in 2004 to account for 31.2% (n=86) of the isolates reported. *S*. Typhimurium among porcine isolates has increased dramatically from 25.0% (n=252) of the 1008 porcine isolates in 2000. There has been a dramatic increase in the proportion of *S*. Saintpaul isolates observed among turkey isolates, increasing from 8.1% (25 of 307 isolates) in 2003 to 31.5% (93 of 295) in 2004. *S*. Newport isolations, although down from 2003 levels, also remain high accounting for 19.0% (n=56) of the isolations from turkey in 2004. The isolation of *S*. Heidelberg from turkey sources has steadily declined from 61.7% (n=413) of the 669 turkey isolates in 2000 to only 13.2% (n=39) of those reported in 2004.

Figure 11: Most Prevalent *Salmonella* Serovars from Selected Sources in Canada, 2004




BOVINE
Percentage of Bovine Isolates
80
70
60
50
40
30
20
10
0
2000 (n=478)
2001 (n=611)
2002 (n=522)
2003 (n=501)
2004 (n=276)
Typhimurium
Newport
Kentucky
ssp I 6,14,18:-:-
Muenster
Sandiego
Enteritidis
Mbandaka
spp I 4,5,12:i:-
Anatum


PORCINE
Percentage of Porcine Isolates
60
50
40
30
20
10
0
2000 (n=1008)
2001 (n=2496)
2002 (n=1252)
2003 (n=1116)
2004 (n=1499)
Typhimurium
Derby
Brandenburg
Infantis
Bovismorbifica
Agona
London
Mbandaka
Worthington
ssp I 4,12:-:-

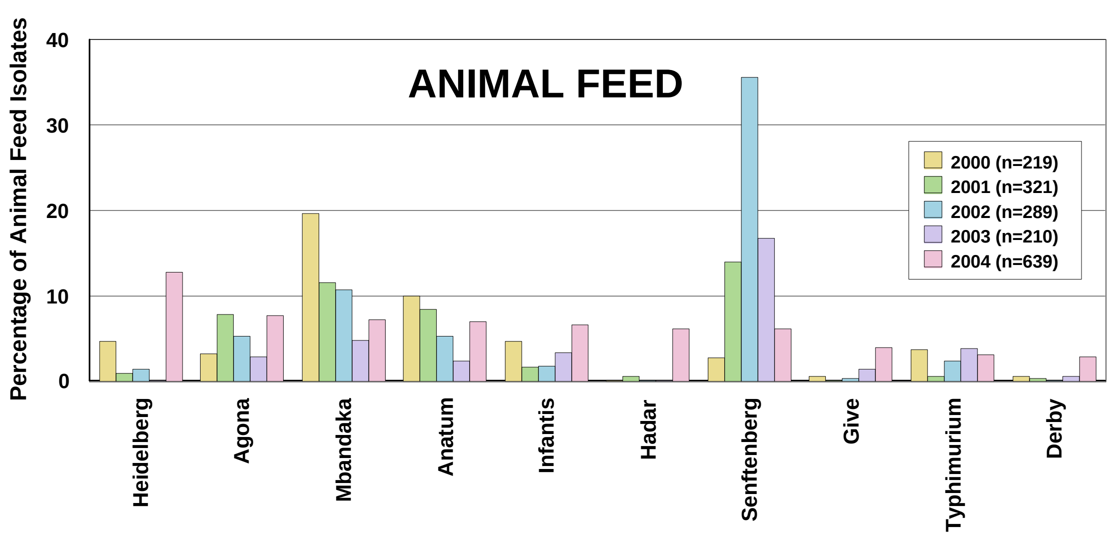

ANIMAL FEED
Percentage of Animal Feed Isolates
40
30
20
10
0
2000 (n=219)
2001 (n=321)
2002 (n=289)
2003 (n=210)
2004 (n=639)
Heidelberg
Agona
Mbandaka
Anatum
Infantis
Hadar
Senftenberg
Give
Typhimurium
Derby

Table 3: *Salmonella* from Non-Human Sources, 2004

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Abaetetuba	Chicken						1					1
	Environmental						8					8
	Food (Chicken)						1					1
	Unknown						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**	**0**	**11**
S. Ago	Lizard					1						1
S. Agona	Animal				15							15
	Animal Feed	1	34				14					49
	Avian					1						1
	Canine					1					1	2
	Chicken					8	1				22	31
	Fertilizer		1									1
	Food (Chicken)						4					4
	Food (Fish)		2									2
	Food (Turkey)					11						11
	Porcine		27			8	3					38
	Turkey					2						2
	Subtotal	**1**	**64**	**0**	**15**	**31**	**22**	**0**	**0**	**0**	**23**	**156**
S. Alachua	Unknown						1					1
S. Albany	Porcine				4							4
	Turkey					5						5
	Subtotal	**0**	**0**	**0**	**4**	**5**	**0**	**0**	**0**	**0**	**0**	**9**
S. Albert	Animal Feed		2									2
	Chicken		1									1
	Subtotal	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Amsterdam	Chicken (Fluff)			1								1
	Unknown						1					1
	Subtotal	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
S. Anatum (a)	Animal Feed		3			2	41					46
	Avian					1						1
	Bovine					1						1
	Chicken					2						2
	Chicken (Fluff)			1								1
	Environmental					1						1
	Food (Beef)											
	Food (Chicken)					1						1
	Porcine	1					2					3
	Water		3									3
	Unknown						1					1
	Subtotal	**1**	**6**	**1**	**0**	**8**	**44**	**0**	**0**	**0**	**0**	**60**
S. Banana	Porcine			1								1
S. Bareilly	Unknown							1				1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Beaudesert	Lizard		1									1
S. Berta	Chicken					1						1
	Environmental					1						1
	Food(Unknown)											
	Porcine					4	3					7
	Subtotal	**0**	**0**	**0**	**0**	**6**	**3**	**0**	**0**	**0**	**0**	**9**
S. Blegdam	Unknown					1						1
S. Blockley	Chicken		1									1
	Chicken Litter		2									2
	Unknown											
	Subtotal	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Bovismorbificans	Animal Feed		11			4						15
	Food (Chicken)											
	Food (Ovine)											
	Porcine		56		2	7						65
	Subtotal	**0**	**67**	**0**	**2**	**11**	**0**	**0**	**0**	**0**	**0**	**80**
S. Braenderup	Animal Feed						1					1
	Chicken		14		2	5	1		1		17	40
	Food (Chicken)											
	Porcine					1						1
	Subtotal	**0**	**14**	**0**	**2**	**6**	**2**	**0**	**1**	**0**	**17**	**42**
S. Brandenburg	Animal Feed		3			1						4
	Chicken					1						1
	Food (Beef)					2	1					3
	Food (Turkey)					2						2
	Porcine		62			9	12					83
	Turkey					1						1
	Unknown											
	Subtotal	**0**	**65**	**0**	**0**	**16**	**13**	**0**	**0**	**0**	**0**	**94**
S. Bredeney	Food (Turkey)					2						2
	Turkey					1			1			2
	Unknown						1					1
	Subtotal	**0**	**0**	**0**	**0**	**3**	**1**	**0**	**1**	**0**	**0**	**5**
S. Buzu	Unknown						1					1
S. California	Animal				1							1
	Porcine		1	8		1						10
	Unknown											
	Subtotal	**0**	**1**	**8**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**11**
S. Carrau	Unknown					1						1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Cerro	Animal Feed		1			1	6					8
	Avian						1					1
	Chicken					3					1	4
	Chicken (Fluff)			5								5
	Food (Beef)					1						1
	Porcine					3						3
	Unknown						1					1
	Subtotal	**0**	**1**	**5**	**0**	**8**	**8**	**0**	**0**	**0**	**1**	**23**
S. Chester	Duck			1								1
	Unknown						1					1
	Water						1					1
	Subtotal	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**3**
S. Choleraesuis	Porcine		2									2
S. Crossness	Unknown					1						1
S. Cubana	Animal Feed		2				8	1		1		12
	Chicken		5				1					6
	Chicken (Fluff)			1								1
	Turkey					2						2
	Water						2					2
	Subtotal	**0**	**7**	**1**	**0**	**2**	**11**	**1**	**0**	**1**	**0**	**23**
S. Dahra	Snake		1									1
S. Derby	Animal Feed		18									18
	Bovine									1		1
	Chicken					4						4
	Food (Turkey)					2						2
	Porcine	4	64	7	12	31	10	1	1	2		132
	Turkey					1						1
	Unknown				11							11
	Subtotal	**4**	**82**	**7**	**23**	**38**	**10**	**1**	**1**	**3**	**0**	**169**
S. Dublin	Bovine			1								1
	Food (Beef)											
	Food (Ovine)											
	Food (Porcine)											
	Unknown						1					1
	Subtotal	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
S. Enteritidis	Animal Feed						3					3
	Avian						8					8
	Bovine		1			1						2
	Chicken		11	2		36	31		1			81
	Chicken - Litter					4						4
	Chicken (Fluff)			13								13
	Duck					1		1				2
	Environmental					3	9					12
	Feline					1						1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Food (Chicken)					2						2
	Food (Porcine)					1						1
	Food (Shellfish)						2					2
	Ovine											
	Porcine		1									1
	Snake		9									9
	Turkey					2						2
	Unknown						37					37
	Water		3									3
	Subtotal	**0**	**25**	**15**	**0**	**51**	**90**	**1**	**1**	**0**	**0**	**183**
S. Fann	Reptile					1						1
S. Fluntern	Gecko		2									2
	Reptile					1						1
	Unknown					1	1					2
	Subtotal	**0**	**2**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**5**
S. Friedenau	Unknown					1						1
S. Give (a)	Animal Feed		24			1						25
	Bovine		1									1
	Duck					5						5
	Environmental						6					6
	Food (Beef)					2						2
	Porcine		7	3	3							13
	Turkey					2						2
	Water		12									12
	Subtotal	**0**	**44**	**3**	**3**	**10**	**6**	**0**	**0**	**0**	**0**	**66**
S. Hadar	Animal				35							35
	Animal Feed		3			36						39
	Chicken	1	4	2		48						55
	Duck		18			3						21
	Environmental					1						1
	Fish						2					2
	Food (Chicken)					2	3					5
	Food (Turkey)					2						2
	Porcine		1			2						3
	Poultry		15									15
	Rodent					1						1
	Turkey		1			6						7
	Subtotal	**1**	**42**	**2**	**35**	**101**	**5**	**0**	**0**	**0**	**0**	**186**
S. Havana	Animal Feed		1									1
	Chicken								1			1
	Porcine			1		6						7
	Subtotal	**0**	**1**	**1**	**0**	**6**	**0**	**0**	**1**	**0**	**0**	**9**
S. Heidelberg	Animal Feed		35			45	1					81
	Avian					1	1					2
	Bovine									1		1
	Canine		3			56						59

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Cervid							1				1
	Chicken	8	41	1	5	459	50	2	7		7	580
	Chicken Litter		37									37
	Environmental					14	6	4				24
	Equine					23						23
	Food (Chicken)					30	24					54
	Food (Pork)						1					1
	Food (Turkey)					27						27
	Porcine		1	2	1	1	2					7
	Poultry		1									1
	Turkey					39						39
	Unknown				4		5					9
	Subtotal	**8**	**118**	**3**	**10**	**695**	**90**	**7**	**7**	**1**	**7**	**946**
S. Hofit	Unknown					1						1
S. Indiana	Canine					1						1
	Chicken		1			1						2
	Duck					1						1
	Food(Unknown)						1					1
	Poultry		1									1
	Unknown											
	Subtotal	**0**	**2**	**0**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**6**
S. Infantis	Animal Feed		9	1		19	13					42
	Bovine		1									1
	Canine					4						4
	Chicken		6	2	1	7	3					19
	Environmental					1	2					3
	Equine					6						6
	Food (Chicken)					1	1					2
	Food (Porcine)					2						2
	Porcine		9	4	1	41	12			2		69
	Turkey					6						6
	Unknown											
	Subtotal	**0**	**25**	**7**	**2**	**87**	**31**	**0**	**0**	**2**	**0**	**154**
S. Inverness	Reptile				1							1
	Unknown					1						1
	Subtotal	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Istanbul	Chicken Fluff			2								2
	Poultry		1									1
	Unknown											
	Subtotal		**1**	**2**		**0**						**3**
S. Jangwani	Unknown						1					1
S. Johannesburg	Animal Feed		1									1
	Chicken				2							2
	Chicken (Fluff)			1								1
	Poultry		1									1
	Unknown											

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Subtotal	**0**	**2**	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**5**
S. Kedougou	Unknown						1					1
S. Kentucky	Animal Feed		2				1					3
	Avian		1									1
	Bovine					11	2					13
	Chicken		24	3		286	9	1	3		8	334
	Chicken Litter		1									1
	Duck					1						1
	Elephant					1						1
	Environmental			7		1	3					11
	Food (Beef)					28	13					41
	Food (Chicken)					10	13					23
	Food (Turkey)					1						1
	Porcine			7	2							9
	Unknown						1					1
	Subtotal	**0**	**28**	**17**	**2**	**339**	**42**	**1**	**3**	**0**	**8**	**440**
S. Kiambu	Chicken					4						4
	Equine									1		1
	Feline					1						1
	Food (Chicken)					1						1
	Food (Turkey)					1						1
	Subtotal	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**1**	**0**	**8**
S. Kokjovi	Unknown						1					1
S. Kottbus	Reptile					1						1
S. Krefeld	Animal				3							3
S. Lexington (a)	Animal Feed		1			2	1					4
S. Litchfield	Food (Turkey)					6						6
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**7**
S. Livingstone (b)	Animal Feed						4					4
	Fertilizer			1								1
	Porcine			1					1			2
	Turkey					1						1
	Subtotal	**0**	**0**	**2**	**0**	**1**	**4**	**0**	**1**	**0**	**0**	**8**
S. Lome	Reptile					1						1
	Unknown					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. London	Porcine		4		4	22	1					31
S. Manhattan	Animal Feed					9						9
	Porcine		4				2					6

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Subtotal	**0**	**4**	**0**	**0**	**9**	**2**	**0**	**0**	**0**	**0**	**15**
S. Mbandaka	Animal Feed		11	1		3	30		1			46
	Bovine					2						2
	Canine					1						1
	Chicken	2	32			11	1		3			49
	Food (Beef)						2					2
	Porcine		15		1	7	1					24
	Turkey					2						2
	Subtotal	**2**	**58**	**1**	**1**	**26**	**34**	**0**	**4**	**0**	**0**	**126**
S. Meleagridis	Animal Feed		9									9
	Avian					1						1
	Subtotal	**0**	**9**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**10**
S. Miami	Food (Pepper)					2						2
S. Midway	Snake		1									1
	Unknown						1					1
	Subtotal		**1**			**0**	**1**					**2**
S. Minnesota	Unknown						1					1
S. Molade	Animal Feed						2					2
S. Montevideo	Animal Feed						11			2		13
	Chicken		11			21	2					34
	Feline					1						1
	Food (Beef)		1			15	1					17
	Food (Turkey)					3						3
	Turkey					17						17
	Water		2									2
	Subtotal	**0**	**14**	**0**	**0**	**57**	**14**	**0**	**0**	**2**	**0**	**87**
S. Moscow	Unknown					1						1
S. Muenchen	Porcine					2						2
S. Muenster (a)	Animal Feed						2					2
	Avian					1						1
	Bovine					2	1					3
	Food (Beef)					2	1					3
	Food (Turkey)					1						1
	Porcine					3						3
	Snake		1									1
	Subtotal	**0**	**1**	**0**	**0**	**9**	**4**	**0**	**0**	**0**	**0**	**14**
S. Newport	Bovine					86						86
	Caprine					1						1
	Chicken					1						1
	Equine					1						1
	Fish						1					1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Food (Beef)						1					1
	Food (Turkey)					12						12
	Ovine					1						1
	Snake		1									1
	Turkey					56						56
	Unknown						1					1
	Subtotal	**0**	**1**	**0**	**0**	**158**	**3**	**0**	**0**	**0**	**0**	**162**
S. Nima	Animal		2									2
S. Nottingham	Unknown						1					1
S. Nyanza	Animal			1								1
S. Ohio (b)	Animal Feed						18					18
	Chicken					3			1			4
	Porcine		1	4		5	1					11
	Subtotal	**0**	**1**	**4**	**0**	**8**	**19**	**0**	**1**	**0**	**0**	**33**
S. Oranienburg	Animal				17							17
	Animal Feed						6					6
	Bovine					1						1
	Chicken					1	1					2
	Environmental					1						1
	Equine					1						1
	Reptile					1						1
	Unknown				2							2
	Water						1					1
	Subtotal	**0**	**0**	**0**	**19**	**5**	**8**	**0**	**0**	**0**	**0**	**32**
S. Orion (a)	Animal Feed			1			12					13
	Bovine									1		1
	Chicken					1				3	3	7
	Subtotal	**0**	**0**	**1**	**0**	**1**	**12**	**0**	**0**	**4**	**3**	**21**
S. Ouakam	Chicken					27						27
	Chicken - Litter					3						3
	Environmental					1						1
	Food (Turkey)					1						1
	Porcine					1						1
	Poultry						1					1
	Subtotal	**0**	**0**	**0**	**0**	**33**	**1**	**0**	**0**	**0**	**0**	**34**
S. Panama	Armadillo		1									1
	Reptile			1								1
	Subtotal	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Paratyphi A	Unknown					1	1					2
S. Paratyphi B	Environmental						1					1
	Water						1					1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Paratyphi B var. Java	Amphibian						1					1
	Reptile		1									1
	Unknown						9					9
	Subtotal	**0**	**1**	**0**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**11**
S. Pomona	Chicken					1						1
	Reptile		1									1
	Turkey					1						1
	Unknown						1					1
	Subtotal	**0**	**1**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**4**
S. Poona	Caprine											
	Feline						1					1
	Unknown						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Putten	Porcine			1		2						3
	Unknown											
	Subtotal	**0**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**
S. Quinhom	Unknown					1						1
S. Rissen	Animal Feed	1					1					2
	Chicken		5			1						6
	Environmental		1									1
	Subtotal	**1**	**6**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**9**
S. Rubislaw	Animal Feed	1	15	1	1							18
	Canine		1									1
	Chicken		24									24
	Environmental			2								2
	Equine		2			1						3
	Fertilizer		1									1
	Porcine		10	1								11
	Turkey					2						2
	Water		101				2					103
	Subtotal	**1**	**154**	**4**	**1**	**3**	**2**	**0**	**0**	**0**	**0**	**165**
S. Saintpaul	Animal Feed						1					1
	Bovine					1						1
	Chicken					2						2
	Food (Beef)											
	Food (Turkey)					9						9
	Turkey					93						93
	Subtotal	**0**	**0**	**0**	**0**	**105**	**1**	**0**	**0**	**0**	**0**	**106**
S. Sandiego	Animal Feed		1									1
	Bovine					3						3
	Chicken		3									3
	Chicken (Fluff)			1								1
	Water		3									3

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Subtotal	**0**	**7**	**1**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**11**
S. Schwarzengrund	Animal Feed		6				11			1		18
	Bovine					1						1
	Chicken		5			5	1		4		4	19
	Environmental						1					1
	Food (Beef)					1						1
	Food (Chicken)						1	1				2
	Food (Lettuce)					1						1
	Food (Tomato)					1						1
	Food (Turkey)					2						2
	Porcine	1				3	2			1		7
	Turkey					5						5
	Water						1					1
	Subtotal	**1**	**11**	**0**	**0**	**19**	**17**	**1**	**4**	**2**	**4**	**59**
S. Senftenberg	Animal Feed				1		37			1		39
	Chicken					11						11
	Chicken (Fluff)			1								1
	Environmental					1						1
	Food (Seafood)											
	Food (Turkey)					6						6
	Porcine		1			3	4					8
	Turkey					27						27
	Unknown					1	1					2
	Subtotal	**0**	**1**	**1**	**1**	**49**	**42**	**0**	**0**	**1**	**0**	**95**
S. Sorenga	Animal Feed						6					6
S. Szentes	Unknown					1						1
S. Tennessee	Animal Feed				1		9					10
	Canine			1		5						6
	Chicken (Fluff)			3								3
	Food (Beef)					6	3					9
	Food					1						1
	Turkey					1						1
	Subtotal	**0**	**0**	**4**	**1**	**13**	**12**	**0**	**0**	**0**	**0**	**30**
S. Thompson	Animal Feed		7				1					8
	Avian			2					1			3
	Bovine					1						1
	Canine		8			5			1			14
	Chicken					13	2		8			23
	Chicken Litter		4									4
	Environmental						2					2
	Equine	1				1						2
	Food (Beef)					5	3					8
	Food (Chicken)					1	1					2
	Porcine					1						1
	Poultry		7									7
	Turkey					1						1
	Unknown						2					2

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Water		22									22
	Subtotal	**1**	**48**	**2**	**0**	**28**	**11**	**0**	**10**	**0**	**0**	**100**
S. Typhimurium	Animal				11	1						12
	Animal Feed		8			10	1	1				20
	Avian					8	9	2	1			20
	Bovine	14	45	45	8	29	1	1				143
	Canine		5			1						6
	Caprine					4						4
	Chicken		15		6	21	2	1	3		3	51
	Environmental					1	9					10
	Equine		1			9						10
	Feline		1									1
	Ferret			3								3
	Food (Beef)					9						9
	Food (Cheese)											
	Food (Chicken)					2						2
	Food (Ovine)											
	Food (Pork)						532					532
	Food (Turkey)					1						1
	Food					4						4
	Goose				1							1
	Human					2						2
	Ovine											
	Porcine	1	25		5	180	87					298
	Poultry		13									13
	Reptile					1						1
	Rodent						2					2
	Turkey					2						2
	Unknown	14			1		62					77
	Water		8									8
	Subtotal	**29**	**121**	**48**	**32**	**285**	**705**	**5**	**4**	**0**	**3**	**1232**
S. Uganda	Porcine		1									1
S. Urbana	Unknown						1					1
S. Weltevreden	Canine			1								1
	Reptile									1		1
	Unknown					1						1
	Subtotal	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**3**
S. Westhampton	Unknown					1						1
S. Woodinville	Reptile					4						4
	Unknown					1						1
	Subtotal	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**5**
S. Worthington	Animal		1									1
	Animal Feed		3			1	1	1				6
	Avian					1						1
	Chicken		15									15
	Porcine		17				1					18

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Turkey					1						1
	Unknown						1					1
	Subtotal	**0**	**36**	**0**	**0**	**3**	**3**	**1**	**0**	**0**	**0**	**43**
S. Yoruba	Animal Feed						1					1
S. Zanzibar	Unknown					1						1
Salmonella spp I 4,5,12:i:-	Bovine	2										2
Salmonella ssp I 11:r:-	Chicken		1									1
	Porcine		1	1								2
	Water		10									10
	Subtotal	**0**	**12**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**
Salmonella ssp I 13,23:-:-	Unknown		1									1
Salmonella ssp I 17:-:-	Porcine					2						2
Salmonella ssp I 19:g,s,t:-	Porcine					1						1
Salmonella ssp I 28:-:1,7	Reptile		1									1
Salmonella ssp I 28:y:-	Animal Feed					2						2
	Environmental					1						1
	Equine					2						2
	Porcine					2						2
	Turkey					3						3
	Subtotal	**0**	**0**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**10**
Salmonella ssp I 3,10:-:-	Porcine		2									2
Salmonella ssp I 3,10:-:1,6	Animal Feed						5					5
	Porcine				1	2						3
	Subtotal	**0**	**0**	**0**	**1**	**2**	**5**	**0**	**0**	**0**	**0**	**8**
Salmonella ssp I 3,10:e,h:-	Animal Feed						3					3
Salmonella ssp I 3,10:l,v:-	Porcine		1									1
Salmonella ssp I 3,15:z10:-	Food											
Salmonella ssp I 3,19:-:-	Animal Feed					1	3					4
Salmonella ssp I 3,19:l,z13:-	Food											
Salmonella ssp I 4,12:-:-	Animal Feed		1									1
	Chicken		1			1						2
	Chicken Litter		1									1
	Environmental											
	Porcine		5	4		3	2					14
	Turkey					2						2
	Subtotal	**0**	**8**	**4**	**0**	**6**	**2**	**0**	**0**	**0**	**0**	**20**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I 4,12:-:e,n,z15	Porcine		2									2
Salmonella ssp I 4,12:i:-	Animal Feed					5						5
	Chicken				1							1
	Pelican			1								1
	Porcine		2	2		3						7
	Subtotal	**0**	**2**	**3**	**1**	**8**	**0**	**0**	**0**	**0**	**0**	**14**
Salmonella ssp I 4,12:l,v:-	Fertilizer			1								1
	Porcine		2				1					3
	Subtotal	**0**	**2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 4,12:r:-	Chicken					2						2
Salmonella ssp I 4,5,12:-:-	Porcine					1	1					2
Salmonella ssp I 4,5,12:e,h:-	Unknown											
Salmonella ssp I 4,5,12:i:-	Chicken				1	2						3
	Food (Chicken)					1						1
	Ovine		1									1
	Porcine			1	1	2						4
	Subtotal	**0**	**1**	**1**	**2**	**5**	**0**	**0**	**0**	**0**	**0**	**9**
Salmonella ssp I 4,5,12:r:-	Chicken		2			2						4
Salmonella ssp I 42:z4,z23:-	Animal Feed						2					2
Salmonella ssp I 6,14,18:-:-	Bovine					8						8
	Food (Beef)						1					1
	Subtotal	**0**	**0**	**0**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**9**
Salmonella ssp I 6,7,14:-:l,w	Chicken (Fluff)			1								1
Salmonella ssp I 6,7,14:z10:-	Animal Feed						2					2
	Porcine		1			1						2
	Subtotal	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 6,7:-:-	Animal Feed					1	3					4
	Chicken										1	1
	Environmental					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**1**	**6**
Salmonella ssp I 6,7:-:1,5	Bovine								1			1
	Chicken								1			1
	Equine					1						1
	Food (Beef)		1									1
	Porcine					1						1
	Turkey					1						1
	Water		2									2
	Subtotal	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**2**	**0**	**0**	**8**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I 6,7:-:e,n,z15	Caprine											
Salmonella ssp I 6,7:b:-	Unknown											
Salmonella ssp I 6,7:e,h:-	Chicken		5									5
Salmonella ssp I 6,7:k:-	Canine		8			1						9
	Chicken			1								1
	Subtotal	**0**	**8**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**10**
Salmonella ssp I 6,7:l,v:-	Reptile						1					1
Salmonella ssp I 6,8:-:1,2	Food (Turkey)					1						1
Salmonella ssp I 6,8:-:e,n,x	Chicken							2				2
	Food (Chicken)						2					2
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**4**
Salmonella ssp I 6,8:e,h:-	Turkey					1						1
Salmonella ssp I 6,8:z10:-	Food (Chicken)						1					1
Salmonella ssp I 8,20:-:-	Chicken					1						1
Salmonella ssp I 8,20:-:z6	Chicken					2						2
	Food (Chicken)					1						1
	Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I 8,20:i:-	Chicken								1			1
	Food (Beef)					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**2**
Salmonella ssp I 9,12:-:-	Food (Beef)											
Salmonella ssp I Rough:g,s,t:-	Turkey					1						1
Salmonella ssp I Rough:l,v:e,n,z15	Porcine		4				1					5
Salmonella ssp I Rough-O:-:-	Animal	1										1
	Canine		1									1
	Chicken					1						1
	Porcine		1	1								2
	Turkey					1						1
	Subtotal	**1**	**2**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I Rough-O:-:1,5	Environmental						1					1
Salmonella ssp I Rough-O:b:1,2	Water						1					1
Salmonella ssp I Rough-O:d:l,w	Animal Feed						1					1
	Chicken					1						1
	Porcine					4						4

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Subtotal	**0**	**0**	**0**	**0**	**5**	**1**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I Rough-O:e,h:1,2	Turkey					1						1
Salmonella ssp I Rough-O:e,h:1,5	Food (Beef)					1	2					3
Salmonella ssp I Rough-O:e,h:e,n,z15	Environmental						1					1
Salmonella ssp I Rough-O:e,h:l,w	Chicken					1						1
Salmonella ssp I Rough-O:f,g:-	Food(Shellfish)						2					2
	Porcine					1	2					3
	Subtotal	**0**	**0**	**0**	**0**	**1**	**4**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I Rough-O:g,m,s:-	Turkey					3						3
Salmonella ssp I Rough-O:g,s,t:-	Canine		1									1
Salmonella ssp I Rough-O:i:-	Chicken				1							1
Salmonella ssp I Rough-O:i:1,2	Bovine				1							1
	Porcine		2									2
	Subtotal	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:i:z6	Bovine					1						1
	Chicken		1									1
	Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:k:1,5	Chicken					1						1
	Water		2									2
	Subtotal	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:k:e,n,x	Reptile			1								1
Salmonella ssp I Rough-O:l,v.1,2	Food (Soya)					1						1
Salmonella ssp I Rough-O:m,t:-	Animal				2							2
Salmonella ssp I Rough-O:r:-	Chicken					3						3
Salmonella ssp I Rough-O:r:1,2	Animal Feed		1			1						2
	Avian						2					2
	Chicken		1			5			1			7
	Chicken Litter		2									2
	Turkey					3						3
	Subtotal	**0**	**4**	**0**	**0**	**9**	**2**	**0**	**1**	**0**	**0**	**16**
Salmonella ssp I Rough-O:r:1,5	Chicken Litter		1									1
	Porcine		4									4
	Subtotal	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I Rough-O:r:1,7	Chicken Litter		1									1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I Rough-O:r:e,n,x	Water		8									8
Salmonella ssp I Rough-O:z10:e,n,x	Chicken					2						2
Salmonella ssp I Rough-O:z10:e,n,x15	Environmental		1									1
Salmonella ssp II 17:g,t:e,n,x,z15	Animal		1									1
Salmonella ssp II 40:z:1,5	Unknown					1						1
Salmonella ssp II 42:b:e,n,x,z15	Rodent								1			1
Salmonella ssp II 57:z29:z42	Unknown					1						1
Salmonella ssp II 58:c:z6	Finch	1										1
Salmonella ssp II 9,12:g,m,s,t:e,n,x	Environmental											
Salmonella ssp II Rough-O:-:-	Animal Feed		1									1
Salmonella ssp IIIa 18:z4,z32:-	Turkey					1						1
Salmonella ssp IIIa 41:z4,z23:-	Reptile						1					1
	Snake		2									2
	Subtotal	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp IIIb 11:k:z53	Snake		1									1
Salmonella ssp IIIb 16:z10:e,n,x,z15	Snake			1								1
Salmonella ssp IIIb 47:k:z35	Snake		1									1
Salmonella ssp IIIb 47:r:z53	Snake		1									1
Salmonella ssp IIIb 48:-:1,5,7	Reptile					1						1
Salmonella ssp IIIb 48:l,v:1,5	Snake		2									2
Salmonella ssp IIIb 50:k:z	Lizard		1									1
Salmonella ssp IIIb 53:z10:z10:z	Reptile									1		1
Salmonella ssp IIIb 59:k:-	Unknown					1						1
Salmonella ssp IIIb 6,14:z10:z	Snake		1									1
Salmonella ssp IIIb 61:k:1,5	Ovine		1									1
	Unknown					1						1
	Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp IIIb 61:k:1,5,7	Ovine		1									1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp IIIb 61:k:z53	Snake		1									1
Salmonella ssp IIIb 61:z52:z53	Hedgehog		2									2
Salmonella ssp IIIb Rough-O:z10:e,n,x	Snake			1								1
Salmonella ssp IV 38:z4,z23:-	Snake		1									1
Salmonella ssp IV 43:z4,z32:-	Unknown											
Salmonella ssp IV 44:z4,z23:-	Iguana		1									1
Salmonella ssp IV 44:z4,z32:-	Lizard	1										1
	Reptile					1	1					2
	Snake		1									1
	Subtotal	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp IV 45:g,z51:-	Unknown						1					1
Salmonella ssp IV 47:k:z35	Reptile						1					1
Salmonella ssp IV 48:g,z51:-	Reptile			1								1
	Unknown						1					1
	Subtotal	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp IV 50:g,z51:-	Reptile					1						1
Salmonella ssp IV 6,7,14:z4,z23:-	Reptile							1				1
Salmonella ssp IV Rough-O:-:-	Animal Feed		1									1
	Canine					1						1
	Porcine					5						5
	Subtotal	**0**	**1**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**7**
Salmonella ssp V 66:z41:-	Unknown					1						1
Salmonella ssp VI 6,7,14:-:-	Porcine					1						1
Salmonella ssp VI Rough-O:-:-	Porcine					7						7
Total Non-Human *Salmonella* 2004		**55**	**1193**	**166**	**172**	**2432**	**1371**	**22**	**44**	**19**	**67**	**5541**

New and Unique *Salmonella* Serovars in Canada, 2004

Serotype	Province	Source	Month
Salmonella ssp VI 6,14,25:a:e,n,x	Québec	Non-Human	January
Salmonella Sambre (1,3,19:z4,z24)	Nova Scotia	Human	January
Salmonella ssp II 6,7:z4,z23:-**	British Columbia	Unknown	January
Salmonella Westminster (3,10:b:z35)	Ontario	Human	March
Salmonella ssp II 17:g,t:e,n,x,z15	Alberta	Chameleon	March
Salmonella Luke (1,47:g,m:-)	Ontario	Stool	April
Salmonella ssp II 58:c:z6	Alberta	Human	May
Salmonella ssp I 9,12:r:e,n,x	Alberta	Human	May
Salmonella Bousso (6,14,25:z4,z23:-)	Alberta	Human	May
Salmonella Dahra (17:6:1,5)	Alberta	Dragon Feces	June
Salmonella Clackamas (4,12:l,v:1,6)	British Columbia	Human	June
Salmonella Kodjovi (47:c:1,6)	Québec	Non-Human	July
Salmonella ssp V 48 :z81 :-	Ontario	Human	July
Salmonella Midway (6,14,24:d:1,7)	Québec	Non-Human	September
Salmonella Nyanza (11:z:z6)	Saskatchewan	Skunk Feces	September

**First isolation of this serovar in the world, confirmed by Institute Pasteur.

Phage Types of *Salmonella* Serovars Identified in Canada

Phage typing data is collected from isolates forwarded to the NML and LFZ by the provincial public health, agriculture, veterinary, university and CFIA laboratories as part of reference requests, passive surveillance, surveys or outbreak and cluster investigations. The proportion of specimens forwarded may differ from province to province and should be interpreted with caution, however the subset of data from each province remains consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging phage types and to provide an overview of the various subtypes found in Canada.

Phage Type (PT) 4 continues to be the most prevalent phage type identified among *S.* Enteritidis strains, decreasing from 43.6% (n=416) of the 955 isolates tested in 2000 to 30.0% (n=278) of the 927 isolates in 2004. The number of PT 13 isolates has increased dramatically to now rank as the 2nd most prevalent phage type, accounting for 17.4% (n=161) of the isolates tested in 2004, compared to 0.7% (n=7) in 2000. PT 8 has decreased from 21.8% (n=208) of the isolates in 2000 to 13.6% (n=126) in 2004 and now ranks 3rd overall among *S*. Enteritidis isolates.

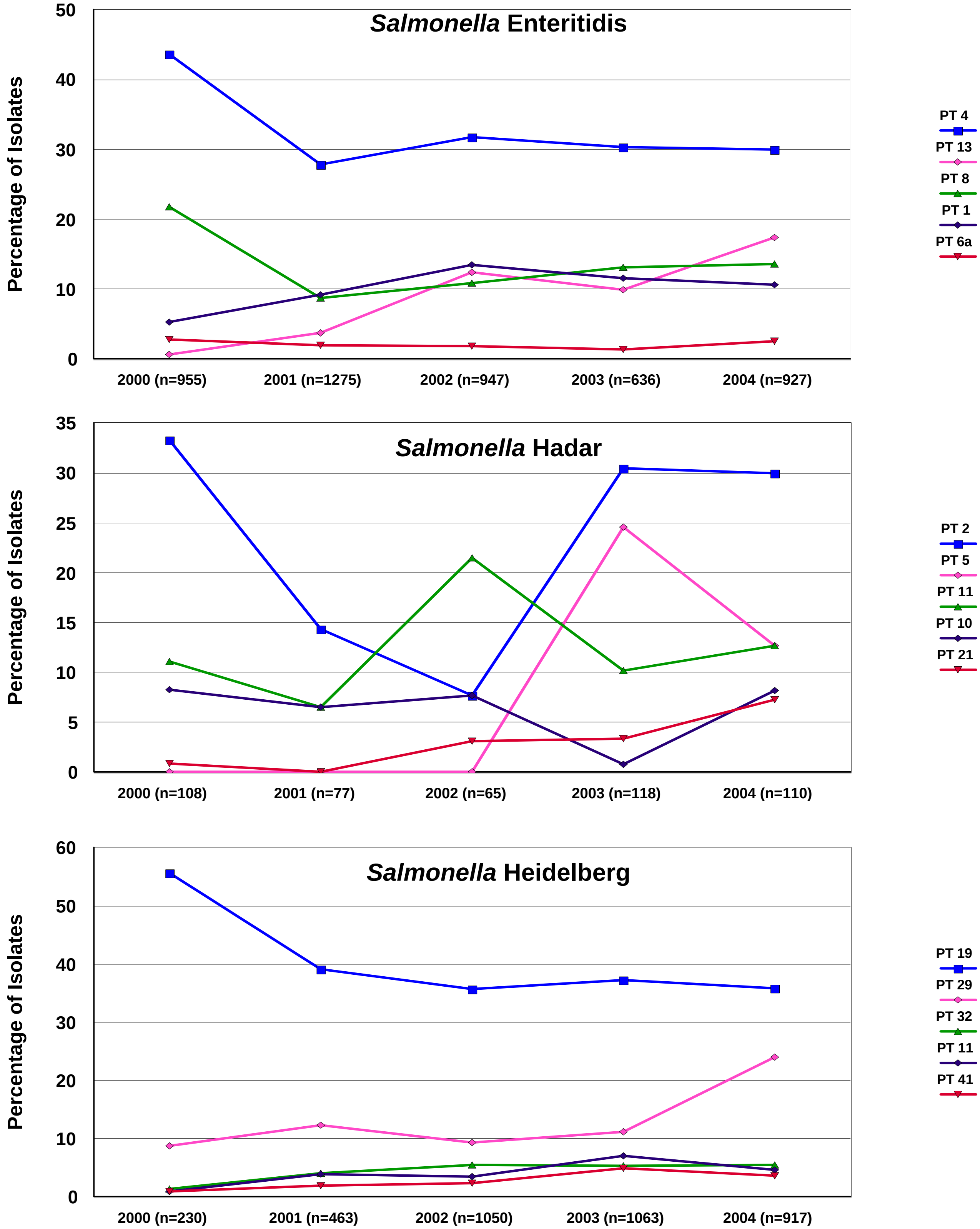
Among *S.* Hadar isolates, after a steep decline in isolations during 2001 and 2002, PT 2 is again the most prevalent in 2004 (33 of 110 isolates). There were no PT 5 strains observed between 2000 and 2002, but this phage type has now emerged as the 2nd most prevalent phage type, increasing dramatically in 2003 and 2004 to represent 24.6% (29 of 118) and 12.7% (14 of 110), respectively.

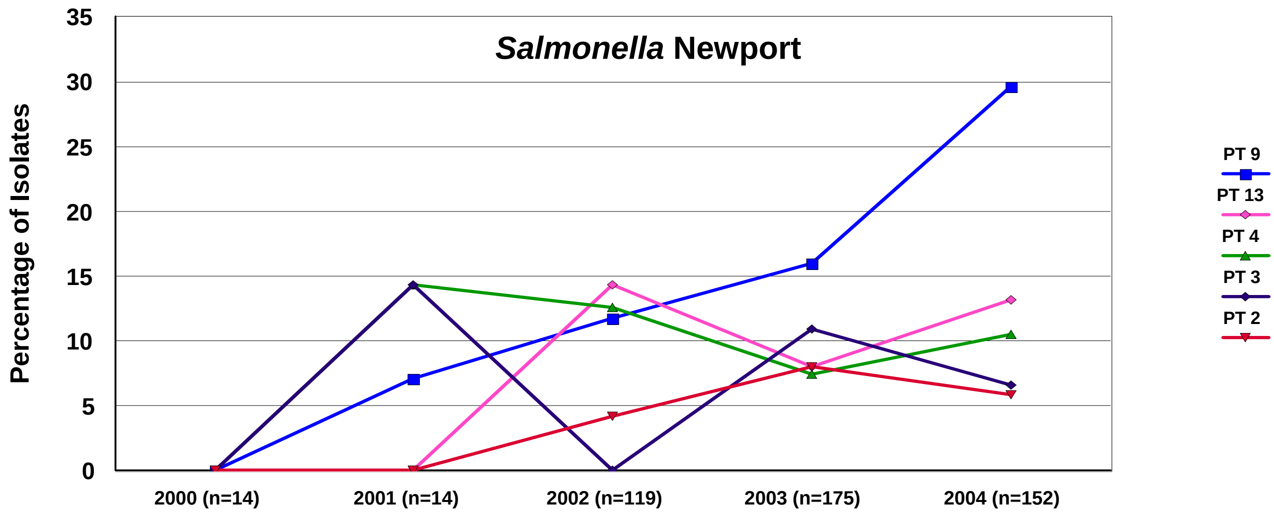
S. Heidelberg PT 19 is still most prevalent, declining from 55.7% (n=128) of the 230 *S.* Heidelberg tested in 2000 to 35.8% (n=328) of 917 isolates in 2004. Levels of the second most prevalent phage type, PT 29, were relatively constant between 2000 and 2003, but have increased in 2004 from 11.2% (119 of 1063) in 2003 to 24.0% (n=328) in 2004.

S. Newport PT 9 identifications have steadily increased since 2000 and this phage type has become the most prevalent phage type in 2003 and 2004, accounting for 29.6% (45 of 152) of the isolates in 2004, compared to 16.0% (28 of 175) in 2003.

The number of *S*. Typhimurium PT 104 identifications continued a decreasing trend from accounting for 32.3% (403 of 1246 isolates) tested in 2000 to only 16.2% (128 of 790 isolates) in 2004. The proportion of PT 108 isolates has been relatively constant between 2000 and 2003, representing approximately 3% of the isolates tested during that time range. A large increase was noted however from 2.7% (n=25) of 913 isolates in 2003 to 11.9% (n=94) in 2004.

Figure 12: Most Prevalent Phage Types of Various *Salmonella* Serovars Isolated from Humans in Canada, 2000 to 2004




Salmonella Newport
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=14)
2001 (n=14)
2002 (n=119)
2003 (n=175)
2004 (n=152)
PT 9
PT 13
PT 4
PT 3
PT 2

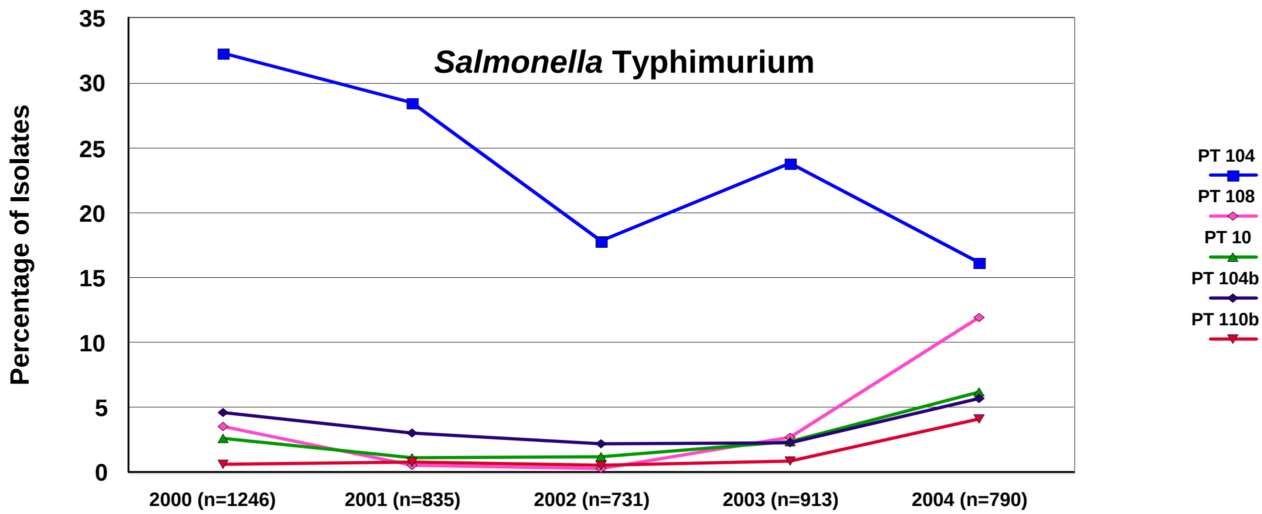

Salmonella Typhimurium
Percentage of Isolates
35
30
25
20
15
10
5
0
2000 (n=1246)
2001 (n=835)
2002 (n=731)
2003 (n=913)
2004 (n=790)
PT 104
PT 108
PT 10
PT 104b
PT 110b

Table 4: Phage Types of Various Serovars of *Salmonella* in Canada, 2004

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Enteritidis	1	Human	8	9	3	3	55	7	5	8			**98**
	1a	Human	2										**2**
	1c	Human					2						**2**
	2	Human	1	14			5	1					**21**
	2	Snake		1									**1**
	2	Water		1									**1**
	3	Human					1						**1**
	4	Emu						1					**1**
	4	Human	14	32	7	7	152	44	4	16	1	1	**278**
	4	Poultry						1					**1**
	4	Unspecified						7					**7**
	4a	Human		1		2	12	4					**19**
	4b	Human					5	4					**9**
	5a	Human		1			3			1			**5**
	5a	Ovine											**0**
	5b	Human	1	1			5	2		1			**10**
	5c	Human	1	3									**4**
	6	Human			1		5	1					**7**
	6a	Human	4	4			12	3					**23**
	7	Human		1									**1**
	8	Avian			7			1					**8**
	8	Bovine					1						**1**
	8	Chicken		11	2		4	19					**36**
	8	Chicken Litter		1			1						**2**
	8	Environmental		2			1						**3**
	8	Feline					1						**1**
	8	Food (Porcine)					1						**1**
	8	Food (Unspecified)						2					**2**
	8	Human	4	49	5	2	43	14	2	2	2	3	**126**
	8	Porcine		1									**1**
	8	Water		3									**3**
	9a	Human					1	1					**2**
	9b	Duck					1		1				**2**
	9c	Human		2	3		4						**9**
	11b	Avian			5								**5**
	11b	Human	1	1	3		3						**8**
	12	Human	1										**1**
	13	Animal Feed						2					**2**
	13	Avian						7					**7**
	13	Chicken		1			29	9		1			**40**
	13	Chicken Litter					3						**3**
	13	Environmental					2	7					**9**
	13	Food (Chicken)					1						**1**
	13	Human	10	18	4	1	59	58	3	5		3	**161**
	13	Poultry		1				23					**24**
	13	Unspecified						3					**3**
	13a	Human		1		1	6	2	1				**11**
	14b	Animal Feed						1					**1**
	14b	Chicken					1	2					**3**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	14b	Environmental						2					**2**
	14b	Human	2	5			10	4	1				**22**
	14b	Unspecified						1					**1**
	18	Human		2	1								**3**
	19	Human					1						**1**
	20	Human								1			**1**
	21	Human	4	5	1	1	10	1					**22**
	21c	Human					1						**1**
	22	Human					1	2		1			**4**
	23	Avian			1								**1**
	23	Turkey					2						**2**
	24	Human					3						**3**
	24 var.	Human					1						**1**
	28	Human				2	1	1					**4**
	29	Human	1				2						**3**
	29a	Human		1									**1**
	30	Human		2			5		1				**8**
	33	Bovine		1									**1**
	33	Human	4										**4**
	34	Human					2						**2**
	35	Human							1				**1**
	42	Human						1					**1**
	911	Chicken		1									**1**
	911	Human		9									**9**
	913	Human				1	1						**2**
	Atypical	Animal (Unspecified)		1									**1**
	Atypical	Chicken					2	1					**3**
	Atypical	Human	3	1	1		13	5					**23**
	Untypable	Food (Chicken)					1						**1**
	Untypable	Human	1	1			6	3	2				**13**
		Total Human	**62**	**163**	**29**	**20**	**430**	**158**	**20**	**35**	**3**	**7**	**927**
		Total Non-Human	**0**	**25**	**15**	**0**	**51**	**89**	**1**	**1**	**0**	**0**	**182**
S. Hadar	1	Human						1					**1**
	2	Human	1	13		1	12	5		1			**33**
	4	Human					2						**2**
	5	Chicken		2									**2**
	5	Human	2	7	4		1						**14**
	5	Poultry		5									**5**
	10	Human	3	1			4					1	**9**
	11	Chicken		1									**1**
	11	Environmental		1									**1**
	11	Human	2	5	1		5	1					**14**
	11	Poultry		2									**2**
	14	Human	2	1			3						**6**
	17	Human		1									**1**
	18	Chicken Litter		1									**1**
	18	Human	6				1						**7**
	19	Human						1					**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	21	Human		1	5		1		1				**8**
	23	Human	2	1									**3**
	33	Chicken		1									**1**
	33	Chicken Litter		1									**1**
	33	Human					2						**2**
	47	Human	1	2	1		1						**5**
	51	Human		1									**1**
	51	Unspecified				1							**1**
	54	Human					1						**1**
	56	Human	1										**1**
	56	Poultry		1									**1**
	Untypable	Human					1						**1**
		Total Human	**20**	**33**	**11**	**1**	**34**	**8**	**1**	**1**	**0**	**1**	**110**
		Total Non-Human	**0**	**15**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**16**
S. Heidelberg	1	Human					1	1					**2**
	2	Canine	1										**1**
	2	Chicken				3							**3**
	2	Human		3			2						**5**
	4	Food (Chicken)						1					**1**
	4	Human					8	7					**15**
	5	Chicken		2			11						**13**
	5	Chicken Litter		1									**1**
	5	Human		5		1	1		4	2	2		**15**
	6	Chicken					15	1					**16**
	6	Food (Chicken)					1						**1**
	6	Food (Turkey)					6						**6**
	6	Human						3					**3**
	7	Chicken					1						**1**
	8	Chicken					11						**11**
	8	Human				1	5						**6**
	9	Chicken					1						**1**
	9	Equine					2						**2**
	9	Human					2						**2**
	10	Human					2			2			**4**
	10	Porcine		1									**1**
	11	Animal Feed		3				1					**4**
	11	Chicken					51						**51**
	11	Food (Chicken)					1						**1**
	11	Food (Turkey)					3						**3**
	11	Human		2		2	33	5					**42**
	11	Unspecified						2					**2**
	11a	Human		2			4						**6**
	12	Human					1		2				**3**
	13	Chicken					2						**2**
	13	Human	5	1									**6**
	15	Chicken					1						**1**
	17	Chicken		2			2	12		1			**17**
	17	Environmental						2					**2**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	17	Human	3										**3**
	18	Bovine		1									**1**
	18	Chicken		2			2						**4**
	18	Food (Chicken)					4	4					**8**
	18	Human					1						**1**
	18	Porcine			1			1					**2**
	18	Poultry		2									**2**
	18a	Human							1				**1**
	19	Animal (Unspecified)	1										**1**
	19	Animal Feed		19			18						**37**
	19	Avian					1	1					**2**
	19	Canine		1			38						**39**
	19	Chicken	2	26		1	143	13		2			**187**
	19	Chicken Litter		4									**4**
	19	Environmental		2				1					**3**
	19	Food (Chicken)					4	1					**5**
	19	Food (Turkey)					1						**1**
	19	Human	12	80	15	18	112	76	7	4	2	2	**328**
	19	Porcine						2					**2**
	19	Poultry		8									**8**
	19	Unspecified				3							**3**
	19a	Canine					1						**1**
	19a	Chicken								4			**4**
	19a	Human					2	5					**7**
	20	Human		1									**1**
	21	Human			1								**1**
	22	Human		1			1			1			**3**
	23	Chicken					2						**2**
	24	Chicken					4						**4**
	24	Human	1				1	1		1			**4**
	25	Human							1				**1**
	26	Chicken					9						**9**
	26	Food (Chicken)					2						**2**
	26	Human	4	1			10	13	1			1	**30**
	29	Animal Feed		4			27						**31**
	29	Bovine									1		**1**
	29	Canine		1			3						**4**
	29	Cervid							1				**1**
	29	Chicken		2			50	8					**60**
	29	Environmental					14						**14**
	29	Equine					20						**20**
	29	Food (Chicken)					11	12					**23**
	29	Human	15	6	6	12	114	58	7	1		1	**220**
	29	Porcine			1								**1**
	29	Poultry		1									**1**
	29	Unspecified		1				1					**2**
	32	Canine		1									**1**
	32	Chicken	1	10			28						**39**
	32	Environmental		1									**1**
	32	Food (Chicken)						2					**2**
	32	Food (Turkey)					14						**14**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	32	Human	1	6	2	17	7	16				1	**50**
	32	Poultry		3									**3**
	32	Turkey	3				35						**38**
	32	Unspecified						1					**1**
	32b	Human						1					**1**
	35	Chicken					14					1	**15**
	35	Environmental							1				**1**
	35	Human	1				2					4	**7**
	36	Chicken		4			18	2					**24**
	36	Chicken Litter		2									**2**
	36	Human		1				2					**3**
	39	Animal Feed		3									**3**
	39	Canine					6						**6**
	39	Chicken					1						**1**
	39	Human		1				1		1			**3**
	40	Chicken					20	6				1	**27**
	40	Environmental						1					**1**
	40	Human		1				6					**7**
	41	Chicken					32	4	2			5	**43**
	41	Environmental							3				**3**
	41	Food (Chicken)					3						**3**
	41	Human	1			1	13	16	2				**33**
	43	Human				1							**1**
	44	Chicken					3						**3**
	44	Human					2	4					**6**
	45	Human		1	1	2							**4**
	47	Canine					1						**1**
	47	Chicken					1						**1**
	47	Food (Chicken)						2					**2**
	47	Food (Turkey)					2						**2**
	47	Human					4	5	4				**13**
	50	Human					1						**1**
	51	Chicken			1		1						**2**
	51	Human		1									**1**
	52	Chicken					7	1					**8**
	52	Food (Chicken)					1						**1**
	52	Human					3	4	3				**10**
	53	Chicken				1		1					**2**
	53	Food (Chicken)						1					**1**
	53	Human	1			1		14	1				**17**
	54	Animal Feed		3									**3**
	54	Chicken		1			4						**5**
	54	Food (Eggs)		1									**1**
	54	Human	11	4	1		2	3					**21**
	55	Food (Chicken)						1					**1**
	55	Porcine					1						**1**
	Atypical	Animal Feed		3									**3**
	Atypical	Canine		1			7						**8**
	Atypical	Chicken		1			25	2					**28**
	Atypical	Environmental						2					**2**
	Atypical	Equine					1						**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Atypical	Food (Chicken)					3						**3**
	Atypical	Food (Turkey)					1						**1**
	Atypical	Human		3		4	14	4	2	1			**28**
	Atypical	Porcine				1							**1**
	Atypical	Turkey		1			3						**4**
	Atypical	Unspecified						1					**1**
	Untypable	Human					1	1					**2**
	Untypable	Turkey					1						**1**
		Total Non-Human	**8**	**118**	**3**	**9**	**695**	**90**	**7**	**7**	**1**	**7**	**945**
		Total Human	**55**	**120**	**26**	**60**	**349**	**246**	**35**	**13**	**4**	**9**	**917**
S. Infantis	1	Human					1						**1**
	4	Human	1			4	6	1					**12**
	5	Human					2	2	1				**5**
	6	Human	1				2						**3**
	7	Human	1	2	1	3	10	2					**19**
	8	Human					1	1					**2**
	10	Human						1					**1**
	11	Human		1				1					**2**
	12	Human	1										**1**
	13	Human	1	1			1						**3**
	19	Human	1										**1**
	26	Human	1		1		1	1					**4**
		Total Human	**7**	**4**	**2**	**7**	**24**	**9**	**1**	**0**	**0**	**0**	**54**
S. Newport	1	Human						1					**1**
	2	Fish					1						**1**
	2	Human	3	1		2	2			1			**9**
	2	Turkey					1						**1**
	3	Human			1		3	3		3			**10**
	4	Environmental					1						**1**
	4	Human	2	2		1	5	5		1			**16**
	4	Turkey					27						**27**
	5	Human					1	1					**2**
	5	Turkey					1						**1**
	9	Bovine					2						**2**
	9	Chicken					1						**1**
	9	Human	4	5	2		18	6	1	7	1	1	**45**
	9	Ovine					1						**1**
	9	Turkey					1						**1**
	10	Human		1			1						**2**
	11	Human					1						**1**
	13	Human		1			12	3	2	1	1		**20**
	14	Human					1			1			**2**
	14a	Bovine					23						**23**
	14a	Caprine					1						**1**
	14a	Human	1				5	1					**7**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	14a	Ovine					1						**1**
	14b	Human	1	4	1		2						**8**
	14c	Human					1						**1**
	15	Human		1		1	3	1	1				**7**
	16	Human	1				2	2			1		**6**
	17	Human					1						**1**
	17a	Human					1	2	1				**4**
	17c	Human						1					**1**
	Atypical	Human	2			1	5			1			**9**
	Atypical	Snake		1									**1**
	Atypical	Unspecified						1					**1**
		Total Non-Human	**0**	**1**	**0**	**0**	**61**	**1**	**0**	**0**	**0**	**0**	**63**
		Total Human	**14**	**15**	**4**	**5**	**64**	**26**	**5**	**15**	**3**	**1**	**152**
S. Oranienburg	1	Human	1		1		5	3					**10**
	2 / 8	Human	2		1		1			3			**7**
	6	Human	1	1	2	1	1	3	1	1			**11**
	6	Unspecified				1							**1**
	7	Human				1	1						**2**
	10	Human						1					**1**
	11	Human					2						**2**
	Atypical	Human				1		4					**5**
	Untypable	Human					1						**1**
		Total Human	**4**	**1**	**4**	**3**	**11**	**11**	**1**	**4**	**0**	**0**	**39**
S. Panama	A	Human		2	1		2	3					**8**
	G	Human	1		2		1						**4**
	H	Human					1	1					**2**
	Untypable	Human	1										**1**
		Total Human	**2**	**2**	**3**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**15**
S. Paratyphi B	Atypical	Environmental						1					**1**
	Atypical	Human	1					2					**3**
	Dundee	Human					1						**1**
	Dundee var. 2	Human					1						**1**
		Total Human	**1**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**0**	**6**
S. Paratyphi B	1 var.	Human	1										**1**
var. Java	Atypical	Human	6	1	1	1	5	17			1		**32**
	Atypical	Unspecified						7					**7**
	Atypical	Water						1					**1**
	Battersea	Human						1					**1**
	Dundee	Human		2		1	6	1					**10**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	Dundee var. 2	Unspecified						1					1
	Untypable	Human			1								1
		Total Non-Human	0	0	0	0	0	9	0	0	0	0	9
		Total Human	7	3	2	2	11	19	0	0	1	0	45
Salmonella ssp I	3b var. 2	Human		1			3						4
4,5,12:b:-	Atypical	Human					8	1					9
	Battersea	Human		1			1						2
	Dundee	Human					4						4
	Dundee var. 1	Human					1						1
	Untypable	Human	2	4	1		4	3					14
		Total Human	2	6	1	0	21	4	0	0	0	0	34
S. Thompson	1	Avian			2								2
	1	Chicken Litter		1									1
	1	Human		3	1		38	20			1		63
	1	Unspecified						1					1
	2	Bovine		7									7
	2	Chicken Litter		2									2
	2	Human					3	4					7
	2	Poultry		1									1
	3	Human			1		2	2					5
	5	Human	1	2		1	4	2	3				13
	6	Human					1						1
	25	Human	1										1
	26	Human			1			1		16			18
	Atypical	Human	1				2	1					4
	Untypable	Human		1									1
		Total Non-Human	0	11	2	0	0	1	0	0	0	0	14
		Total Human	3	6	3	1	50	30	3	16	1	0	113
S. Typhi	A	Human		2			4						6
	B1	Human	2				4						6
	B2	Human		1									1
	C 4	Human						1					1
	D 1	Human	1				2						3
	D 2	Human	1	1			3						5
	D 6	Human					1						1
	D 9	Human					1						1
	E 1	Human	6	1			26	5					38
	E 2	Human	1										1
	E 9	Human	7				8	2					17
	E12	Human					1						1
	E14	Human	4										4
	F6	Human	1										1

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	G3	Human					1						**1**
	M1	Human					1						**1**
	O	Human		1			4						**5**
	38	Human					1						**1**
	40	Human					1						**1**
	46	Human		2			1						**3**
	DVS	Human	2				1	1					**4**
	UVS-(I+IV)	Human	2	1			5						**8**
	UVS	Human					1						**1**
	Untypable	Human	6				7	1					**14**
		Total Human	**33**	**9**	**0**	**0**	**73**	**10**	**0**	**0**	**0**	**0**	**125**
S. Typhimurium	1	Avian						1					**1**
	1	Human	1		1		4	1					**7**
	2	Avian					3	1	1				**5**
	2	Bovine					1						**1**
	2	Human	1	1		1		2					**5**
	2	Pigeon		2									**2**
	2	Unspecified						1					**1**
	3 aerogenic	Unspecified				1							**1**
	4	Equine					1						**1**
	8	Avian						1					**1**
	8	Human					1						**1**
	10	Avian						1					**1**
	10	Bovine					1						**1**
	10	Environmental						2					**2**
	10	Equine					1						**1**
	10	Food (Unspecified)					4						**4**
	10	Human		1	1	1	41	2	2	1			**49**
	10	Unspecified						4					**4**
	12	Bovine						1					**1**
	12	Chicken					1						**1**
	12	Human	5			1	1	5					**12**
	12	Porcine		4	2		1	67					**74**
	12	Rodent						1					**1**
	12	Unspecified						21					**21**
	13	Avian						6					**6**
	13	Environmental						3					**3**
	17	Human					1						**1**
	21	Turkey					1						**1**
	21	Unspecified						1					**1**
	22	Chicken				3	1			1			**5**
	22	Environmental						1					**1**
	22	Food (Beef)					1						**1**
	22	Human	1					1					**2**
	22	Porcine	1					5					**6**
	27	Human					2			1			**3**
	27	Porcine					2	1					**3**
	35	Food (Chicken)					1						**1**
	35	Porcine					4	2					**6**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	36	Human		2									**2**
	37	Human		2				1					**3**
	37	Water		4									**4**
	38	Human		1									**1**
	40	Avian			2								**2**
	40	Human		1		2	1	1					**5**
	40	Water		3									**3**
	41	Animal (Unspecified)					1						**1**
	41	Avian								1			**1**
	41	Equine					1						**1**
	41	Goose				1							**1**
	41	Human	1			2	10	1		1		2	**17**
	41	Porcine				1	2						**3**
	46	Chicken							1			2	**3**
	46	Environmental						1					**1**
	46	Human	2	1		1			24			1	**29**
	46	Porcine						1					**1**
	46	Poultry						2					**2**
	46	Unspecified						2					**2**
	49	Environmental	1										**1**
	49	Human	7	1									**8**
	50	Human					1						**1**
	56	Human						1					**1**
	56 var.	Human		1									**1**
	66	Human	2				1	1					**4**
	67	Reptile					1						**1**
	69	Human					4	1					**5**
	81	Human		3									**3**
	82	Human		1			2						**3**
	94	Chicken					2						**2**
	94	Human					1	2					**3**
	96	Ferret			3								**3**
	96	Human	1	7									**8**
	96	Snake		2									**2**
	99	Human		1						1			**2**
	99	Unspecified	2										**2**
	104	Animal Feed					7	1					**8**
	104	Bovine	2	16	7	3	11	9	1				**49**
	104	Canine					1						**1**
	104	Chicken		15			9						**24**
	104	Environmental						2					**2**
	104	Equine		1			1						**2**
	104	Food (Beef)					5						**5**
	104	Food (Chicken)		1									**1**
	104	Food (Vegetables)		1									**1**
	104	Human	12	33	3	5	34	38	2	1			**128**
	104	Porcine		11		4	82	135					**232**
	104	Poultry		2				1					**3**
	104	Snake		1									**1**
	104	Sparrow			1								**1**
	104	Turkey					1						**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	104	Unspecified						17					**17**
	104a	Human	1				5	2					**8**
	104a	Porcine		6			29	38					**73**
	104a	Unspecified						13					**13**
	104b	Animal (Unspecified)						1					**1**
	104b	Bovine		1			1						**2**
	104b	Chicken					1						**1**
	104b	Environmental					1						**1**
	104b	Equine					3						**3**
	104b	Human		7		1	26	11					**45**
	104b	Porcine					17	66					**83**
	104b	Unspecified						3					**3**
	107	Avian			12			2					**14**
	107	Chicken			2	3	1	1					**7**
	107	Human		1			1	9	4	1			**16**
	107	Unspecified						1					**1**
	108	Bovine						3					**3**
	108	Feline						1					**1**
	108	Human		6	2	6	33	42	4		1		**94**
	108	Porcine					4	67					**71**
	108	Unspecified						6					**6**
	110	Bovine					5						**5**
	110	Chicken					2						**2**
	110	Human			1		2						**3**
	110	Porcine		1			6	1					**8**
	110b	Avian					1						**1**
	110b	Bovine					1	2					**3**
	110b	Chicken						1					**1**
	110b	Environmental						1					**1**
	110b	Equine					1						**1**
	110b	Human		8			12	12					**32**
	110b	Porcine		1			1	54					**56**
	110b	Unspecified						2					**2**
	120	Human		3			2	1	1	1			**8**
	120	Porcine		2			5	5					**12**
	120	Water						1					**1**
	121	Human		1									**1**
	124	Avian					1						**1**
	124	Equine					1						**1**
	124	Human	1										**1**
	124 var.	Human	1	3		1	2	2	4				**13**
	124 var.	Sea Gull						1					**1**
	132	Environmental						1					**1**
	132	Food (Turkey)					1						**1**
	132	Human	1	6		2	4	1					**14**
	132	Porcine						1					**1**
	132	Poultry		1									**1**
	135	Animal Feed		8									**8**
	135	Bovine					4						**4**
	135	Canine		4									**4**
	135	Caprine					4						**4**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	135	Human		3			1						**4**
	135	Porcine					2						**2**
	136	Human	1				1						**2**
	140 var.	Bovine				4							**4**
	146	Human							1				**1**
	146 var.	Chicken										1	**1**
	146a var.	Human				1						1	**2**
	146a var.	Unspecified						1					**1**
	146a var,	Animal Feed							1				**1**
	146a var,	Chicken					1						**1**
	146a var.	Rodent						1					**1**
	160	Avian			2		1						**3**
	160	Equine			1								**1**
	160	Feline		1									**1**
	160	Human		11	2	1	2						**16**
	160	Sparrow			2								**2**
	164	Human		3									**3**
	170	Bovine					3						**3**
	170	Chicken					1						**1**
	170	Food (Chicken)					1						**1**
	170	Human					4	3					**7**
	170	Porcine					3	21					**24**
	190	Human					2						**2**
	191	Food (Beef)					2						**2**
	191	Human				2	2						**4**
	193	Avian					1						**1**
	193	Bovine			5			1					**6**
	193	Human	1	5	1	2	10	8					**27**
	193	Porcine					2	52					**54**
	193	Unspecified						5					**5**
	195	Avian							1				**1**
	195	Human		4				2			1		**7**
	203	Human		1		1	1						**3**
	206	Human							1				**1**
	208	Bovine		2									**2**
	208	Human	2	3			2	3					**10**
	208	Porcine					12	1					**13**
	208 var.	Bovine	5	22									**27**
	208 var.	Canine		1									**1**
	208 var.	Human	1	9	1	1	6	2					**20**
	208 var.	Mouse		1									**1**
	U276	Human						1					**1**
	U283	Human				2							**2**
	U284	Avian			3								**3**
	U284	Human	1										**1**
	U284 var.	Avian	1										**1**
	U284 var.	Finch	1										**1**
	U284 var.	Human			2	1		1					**4**
	U284 var.	Sea Gull	1										**1**
	U285	Bovine					1						**1**
	U285	Chicken								1			**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
	U285	Human						6					**6**
	U285	Unspecified						1					**1**
	U285	Water		1									**1**
	U288	Human		1									**1**
	U289	Human		1									**1**
	U290	Human					1						**1**
	U301	Animal Feed					3						**3**
	U301	Chicken					1						**1**
	U301	Human						1					**1**
	U301	Porcine						1					**1**
	U302	Animal (Unspecified)						1					**1**
	U302	Bovine						2					**2**
	U302	Environmental						1					**1**
	U302	Food (Unspecified)						1					**1**
	U302	Human					6	24					**30**
	U302	Porcine	2					26					**28**
	U302	Poultry						2					**2**
	U302	Unspecified						7					**7**
	UT 1	Bovine	5										**5**
	UT 1	Human	18	2		1	4	3					**28**
	UT 2	Bovine	1										**1**
	UT 2	Human	2	3			1						**6**
	UT 3	Porcine						1					**1**
	UT 5	Bovine	1										**1**
	UT 5	Human					1						**1**
	UT 7	Human			1								**1**
	UT1	Porcine					1						**1**
	UT5	Porcine					5						**5**
	UT7	Avian					1						**1**
	UT7	Porcine					1						**1**
	Atypical	Avian			3			1					**4**
	Atypical	Bovine	3	1			1						**5**
	Atypical	Chicken	1		3					1			**5**
	Atypical	Equine	1										**1**
	Atypical	Food (Beef)					1						**1**
	Atypical	Food (Unspecified)						1					**1**
	Atypical	Human	5	11	1	3	15	17	1	1		2	**56**
	Atypical	Porcine		1				3					**4**
	Atypical	Raccoon	1										**1**
	Atypical	Unspecified				1		3					**4**
	Untypable	Bovine		3		1		1					**5**
	Untypable	Chicken					1						**1**
	Untypable	Human		1			1						**2**
	Untypable	Porcine		1			1	6					**8**
	Untypable	Unspecified						1					**1**
		Total Non-Human	**29**	**121**	**48**	**22**	**283**	**704**	**5**	**4**	**0**	**3**	**1219**
		Total Human	**68**	**149**	**16**	**38**	**251**	**208**	**44**	**8**	**2**	**6**	**790**
Salmonella ssp I	22	Chicken				1							**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
4,[5],12:i:-	94	Human						1					**1**
	98	Porcine			1								**1**
	99	Pelican			1								**1**
	104	Human	1										**1**
	104	Porcine		1			4						**5**
	104b	Porcine					1						**1**
	110a	Porcine		1									**1**
	120	Human	1										**1**
	121	Human	1										**1**
	125	Human					1						**1**
	146	Animal Feed					3						**3**
	146a	Human						1					**1**
	146a var,	Food (Chicken)					1						**1**
	146a var.	Chicken					2						**2**
	146a var.	Human	1				2						**3**
	191	Human	4	8	1	2	9	2					**26**
	193	Human					1						**1**
	206	Human					1						**1**
	U284 var.	Human	1										**1**
	U291	Human					2						**2**
	U291	Porcine				1							**1**
	U302	Human						1	1				**2**
	UT 1	Bovine	2										**2**
	UT 1	Human	2	2			1						**5**
	UT 5	Human				1							**1**
	UT 7	Human		1									**1**
	UT7	Animal Feed					2						**2**
	Atypical	Chicken				1							**1**
	Atypical	Human		1									**1**
	Atypical	Human		2	3		2	2					**9**
	Atypical	Ovine		1									**1**
	Untypable	Porcine			2								**2**
		Total Non-Human	**2**	**3**	**4**	**3**	**13**	**0**	**0**	**0**	**0**	**0**	**25**
		Total Human	**11**	**14**	**4**	**3**	**19**	**7**	**1**	**0**	**0**	**0**	**59**

SECTION 3: PATHOGENIC *ESCHERICHIA COLI*

The total number of *E. coli* O157 isolations in 2004 from each province and territory is shown in Figure 13 and population based rates for each province over the years 2000 to 2004 is shown in Figure 14. Total *E. coli* O157 isolations are based largely on NESP data and supplemented with identifications from NML reference services and include *E. coli* O157:H7, *E. coli* O157:NM, *E. coli* O157 VT+ and *E. coli* O157. Due to differing disease reporting procedures from province to province, high rates of *E. coli* O157 isolation may not necessarily reflect incidence of disease, but better sampling and reporting structures. By representing the data as isolations per 100,000 people, the data is a more accurate reflection of the relative isolation levels among the provincial population. Although Ontario ranks 1st among the provinces for total number of *E. coli* O157 reported in 2004 (Figure 13), it ranks 7th overall for the population based isolation rate (Table 5).

Isolation rates higher than the national average of 3.4 isolations per 100,000 people were seen in the Northwest Territories with 9.3, Alberta with 8.8, Saskatchewan and Manitoba with 5.0 each, Prince Edward Island with 4.4 and in British Columbia with 4.1 isolations per 100,000 people. The national isolation rate in 2004 has remained constant compared to last year's levels. Prince Edward Island has seen the largest decline in isolation rates from a high of 22.6 in 2002 to 9.5 in 2003 and then down to 4.4 in 2004. Yearly increases from 2003 to 2004 have been noted in Alberta from 5.8 to 8.8, British Columbia from 2.7 to 4.1 and in the Northwest Territories from 2.4 to 9.3 isolations per 100,000 people.

Figure 13: Number of *E. coli* O157 Isolations from Humans in Canada, 2004*

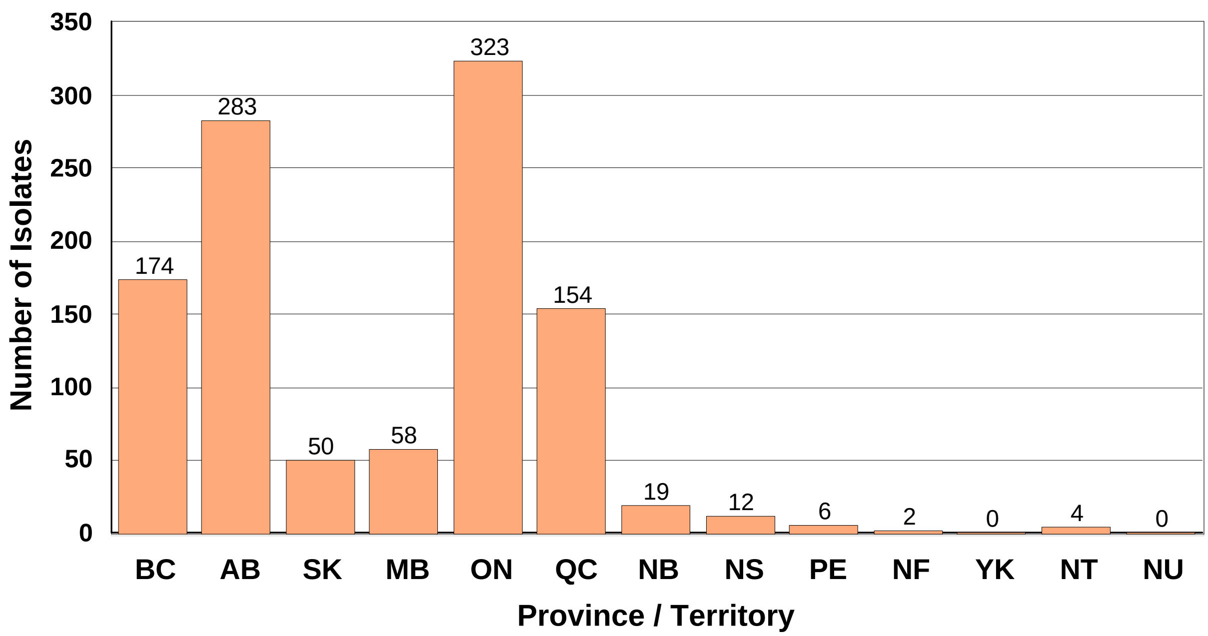


Figure 14: Rates of *E. coli* O157 Isolations from Humans in Canada, 2000 to 2004*

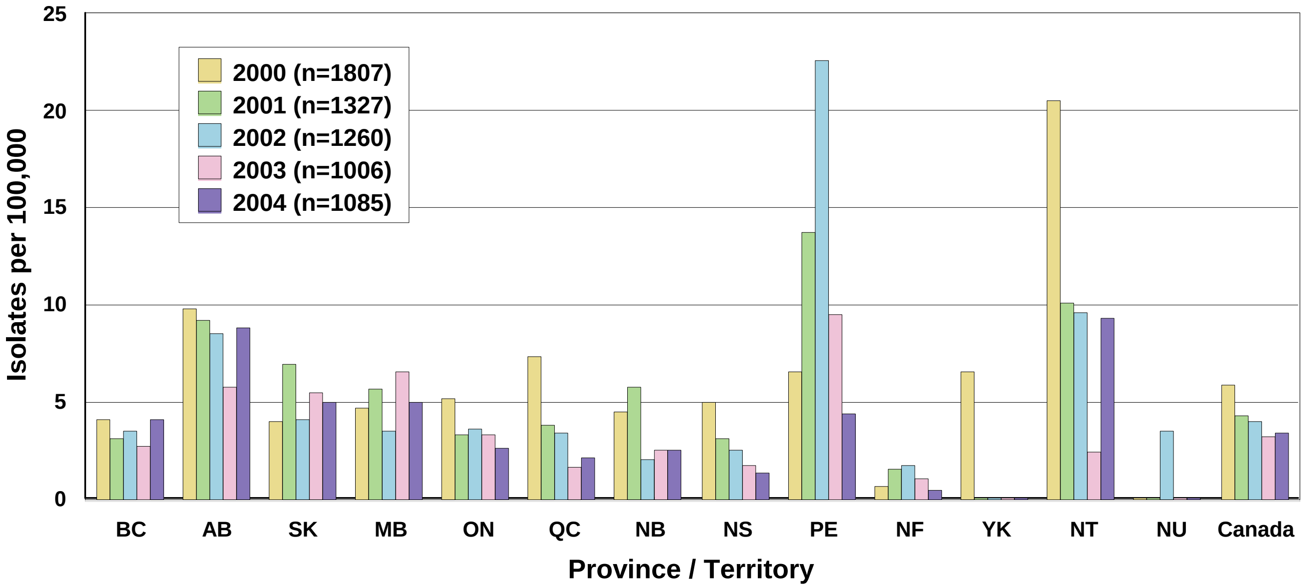


Table 5: Rate of *E. coli* O157 Isolations per 100,000 Population, 2000 to 2004*

Province	2000	2001	2002	2003	2004
British Columbia	4.1	3.1	3.5	2.7	4.1
Alberta	9.8	9.2	8.5	5.8	8.8
Saskatchewan	4.0	6.9	4.1	5.5	5.0
Manitoba	4.7	5.7	3.5	6.5	5.0
Ontario	5.2	3.3	3.6	3.3	2.6
Quebec	7.3	3.8	3.4	1.6	2.1
New Brunswick	4.5	5.8	2.0	2.5	2.5
Nova Scotia	5.0	3.1	2.5	1.7	1.3
Prince Edward Island	6.5	13.7	22.6	9.5	4.4
Newfoundland	0.6	1.5	1.7	1.0	0.4
Northwest Territories	20.5	10.1	9.6	2.4	9.3
Nunavut	0.0	0.0	3.5	0.0	0.0
Yukon Territories	6.5	0.0	0.0	0.0	0.0
Canada	5.9	4.3	4.0	3.2	3.4

*****Provincial population estimates used to calculate isolation rates are taken from the Statistics Canada website. Total *E. coli* O157 is based largely on NESP reports and include cluster and outbreak cases (see Appendix 1 for details). Values are laboratory-based identifications and should not be confused with incidence of disease.

Table 6: *E. coli* Serotypes Identified from Humans in Canada, 2004*

Organism		BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	Total
E. coli	Not Typed		7							5	1		**13**
E. coli	Inactive		1										**1**
E. coli	O1:K1:H7												
E. coli	O1:K1:NM		1										**1**
E. coli	O2:H7						1						**1**
E. coli	O3:H21	1											**1**
E. coli	O4:H5					1							**1**
E. coli	O5:NM	1			1								**2**
E. coli	O6:NM				1								**1**
E. coli	O15:H1						1						**1**
E. coli	O16:K1:NM	1											**1**
E. coli	O18:H1									2			**2**
E. coli	O22:NM		1										**1**
E. coli	O25:H1							6					**6**
E. coli	O25:H17		1										**1**
E. coli	O25:H51	1											**1**
E. coli	O25:NM				1								**1**
E. coli	O26	1			4								**5**
E. coli	O26:H11	3		1	1								**5**
E. coli	O26:NM	9			2								**11**
E. coli	O28ac:NM	1											**1**
E. coli	O40:H30						1						**1**
E. coli	O44				11								**11**
E. coli	O45:H2				1								**1**
E. coli	O52:H10					1							**1**
E. coli	O60:NM				1								**1**
E. coli	O73:H18						1						**1**
E. coli	O75:NM				2		1			1			**4**
E. coli	O86				3								**3**
E. coli	O86a				1								**1**
E. coli	O91:H14	1											**1**
E. coli	O103:H11				1								**1**
E. coli	O103:H2				1								**1**
E. coli	O103:H25	1			2								**3**
E. coli	O111				2								**2**
E. coli	O111:NM	3			3								**6**
E. coli	O113:H21				1								**1**
E. coli	O113:H4	1											**1**
E. coli	O114				1								**1**
E. coli	O117:H7	2											**2**
E. coli	O119				1								**1**
E. coli	O121:H19	2			2								**4**
E. coli	O123:NM	1											**1**
E. coli	O125				8								**8**
E. coli	O126				2								**2**
E. coli	O127				2								**2**
E. coli	O127a				1								**1**

E. coli	O128				1								**1**
E. coli	O128:H2	1											**1**
E. coli	O128:NM		1										**1**
E. coli	O145:NM	1			2								**3**
E. coli	O146:H21				1								**1**
E. coli	O146:NM	1											**1**
E. coli	O156:NM			1									**1**
E. coli	O157				58	2	1		12			1	**74**
E. coli	O157:H7	167	280	49		308	142	18		6	2	3	**975**
E. coli	O157:NM	7	3	1		13	11	1					**36**
E. coli	O157:H16										1		**1**
E. coli	O157:H25										1		**1**
E. coli	O157:H29					1							**1**
E. coli	O164:H1				1								**1**
E. coli	O-Untypeable:H12		1										**1**
E. coli	O-Untypeable:H4				1		2						**3**
E. coli	O-Untypeable:H48									1			**1**
E. coli	O-Untypeable:H7	1	1				1						**3**
E. coli	O-Untypeable:NM		1		2		3	1					**7**
	TOTAL	**207**	**298**	**52**	**122**	**326**	**165**	**26**	**12**	**15**	**5**	**4**	**1232**

*Data represented in this table is under representative of true incidence. It is provided here to give a general overview of the various serotypes of *E. coli* observed in Canada. Few provinces routinely report non-O157 verotoxigenic *E. coli* or non-verotoxigenic *E. coli* isolations and therefore the values listed are largely those that have been forwarded to the NML for reference services. See Appendix 1 for details

Table 7: Phage Types* of *E. coli* O157:H7 from Human and Non-Human Sources in Canada, 2004

Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
1	Human			3	1	5	2					**11**
2	Human					15	15					**30**
4	Human		1	2	1	7	4	1				**16**
8	Human		3			18	7	2				**30**
10	Human						1					**1**
14	Human		2		1	23	15	1		3		**45**
14a	Human	1	62	39	28	197	83	11		2		**423**
14c	Human					1		1				2
21	Human						1					**1**
23	Human		1	2		5	4				1	**13**
28	Human					1						**1**
31	Human		1			9	3					**13**
32	Human		1	4	2	22	6	3			1	**39**
33	Human					2	3					**5**
34	Human		1			6						**7**
38	Human					1						**1**
39	Human					1						**1**
45	Human					1				1		**2**
49	Human					2	2					**4**
50	Human					1						**1**
54	Human					4	1					**5**
67	Human						1					1
70	Human					1						**1**
74	Human					2						**2**
84	Human		5			1						**6**
87	Human					1						**1**
Atypical	Human					3	6					**9**
	Total	**1**	**77**	**50**	**33**	**329**	**154**	**19**	**0**	**6**	**2**	**671**
1	Unknown					1						**1**
2	Unknown					1						**1**
4	Food		9									**9**
4	Food (Raw Meat)					5						**5**
4	Food (Meat)					7						**7**
4	Unknown					1						**1**
8	Unknown					1						1
14	Food		1									**1**
14	Unknown						1					**1**
14a	Food (Beef)		23		1	5						**29**
14a	Food (Raw Meat)					3						**3**
14a	Food (Meat)				1	16						**17**
14a	Unknown						14					**14**
14c	Unknown					1						**1**
21	Unknown					1						**1**
23	Unknown					1						**1**
24	Unknown					1						**1**

Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
31	Unknown					1						**1**
32	Food (Beef)		1									**1**
32	Unknown					1						**1**
33	Unknown					1						1
47	Unknown					1						**1**
	Total	**0**	**34**	**0**	**2**	**48**	**15**	**0**	**0**	**0**	**0**	**99**

*Phage type data is generated from isolates forwarded to the NML and LFZ by the provincial health, agriculture, veterinary, university and CFIA laboratories as part of reference requests, passive surveillance, surveys and/or outbreak and cluster investigations. The proportion of specimens forwarded may differ from province to province and should be interpreted with caution, however the subset of data from each particular province remains consistant from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide a general overview of the subtypes found in Canada.

SECTION 4: *CAMPYLOBACTER*

This section summarizes data on both case-by-case reports and aggregate data of reported campylobacteriosis captured in the National Notifiable Diseases Reporting System (NDRS) for 2003. Updated totals for the province of Québec were supplied directly from Laboratoire de santé publique du Québec for the Ministère de la santé et des services sociaux du Québec. At the time of publication, the NDRS data have not been finalized and thus, should be considered preliminary. Data regarding cases of laboratory confirmed gastro-intestinal illness in Canada are generated along two concurrent paths, an epidemiology arm and a laboratory arm (see Appendix 1). Within the epidemiology arm, NDRS receives data that are collected on a mandatory basis by the local health units for an established set of communicable diseases. Eight provinces and territories (British Columbia, Alberta, Saskatchewan, Ontario, Quebec, Newfoundland and Labrador, Yukon and Nunavut) provide case-by-case reports that include demographic, clinical, laboratory (minimal) and additional epidemiologic data. The remaining provinces and territories (New Brunswick, Nova Scotia, Prince Edward Island, Manitoba and the Northwest Territories) report aggregate data. With regard to campylobacteriosis, differences exist between numbers of reported *Campylobacter* isolates/cases in the epidemiology arm (i.e. NDRS database) and the laboratory arm (i.e. NML/NESP database). The low frequency with which *Campylobacter* isolates are sent or reported from local laboratories to the provincial/territorial laboratories contributes to the differences between the databases.

The number of cases of campylobacteriosis reported by each province and territory are represented in Figure 15 and population-based rates are shown in Figure 17. By representing the data as cases per 100,000 people, the data provide a more accurate reflection of the relative levels of reported campylobacteriosis among the provinces and territories. For example, although Ontario reported the highest number of cases in 2003 (Figure 15), due to its large population, the province only ranked 3rd overall in the rate of reported campylobacteriosis with 32.6 cases per 100,000 people. Rates of reported campylobacteriosis have continued a gradual decline nationally from 38.5 in 1999 to 31.4 isolations per 100,000 people in 2003. Provinces with rates of infection higher than the national level include British Columbia, Alberta and Ontario with 40.5, 34.6 and 32.6 cases per 100,000 people, respectively. Although a slight increase was observed in Newfoundland with rates increasing from 8.7 in 2002 to 10.8 cases per 100,000 in 2003, rates are down considerably from 27.9 seen in 1999.

Table 9 shows the *Campylobacter* species identified in 2003. *Campylobacter jejuni* represented the large majority of the isolates with 2677 of 10025 cases reported, followed by *C. coli* with 281 isolates.

Figure 15: Number of Reported Cases of Campylobacteriosis, by Province/Territory, 2003 (N=10025)

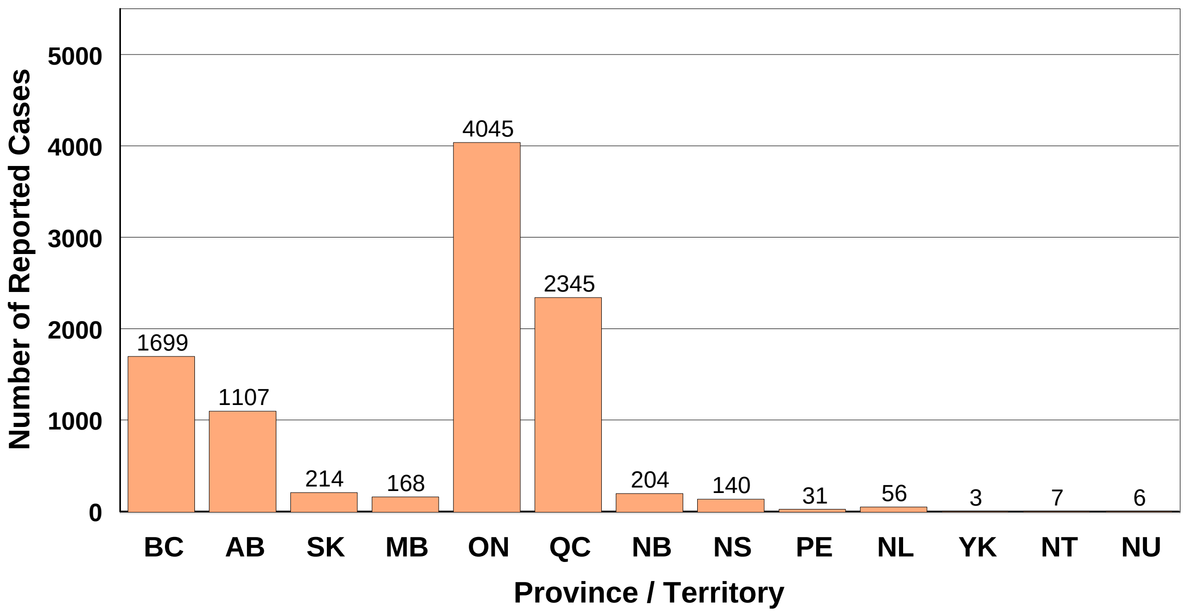


Figure 16: Age and Gender Distribution of *Campylobacter* Infections in Canada, 2003 (N=10025)

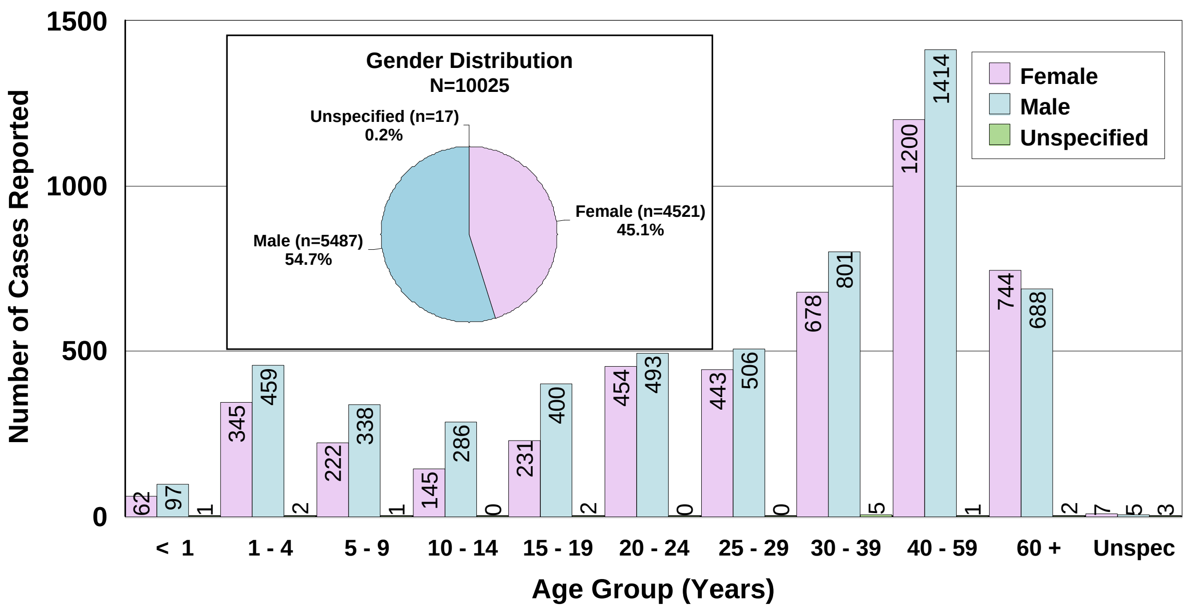


Figure 17: Rate of Reported Campylobacteriosis in Canada, 1999 to 2003

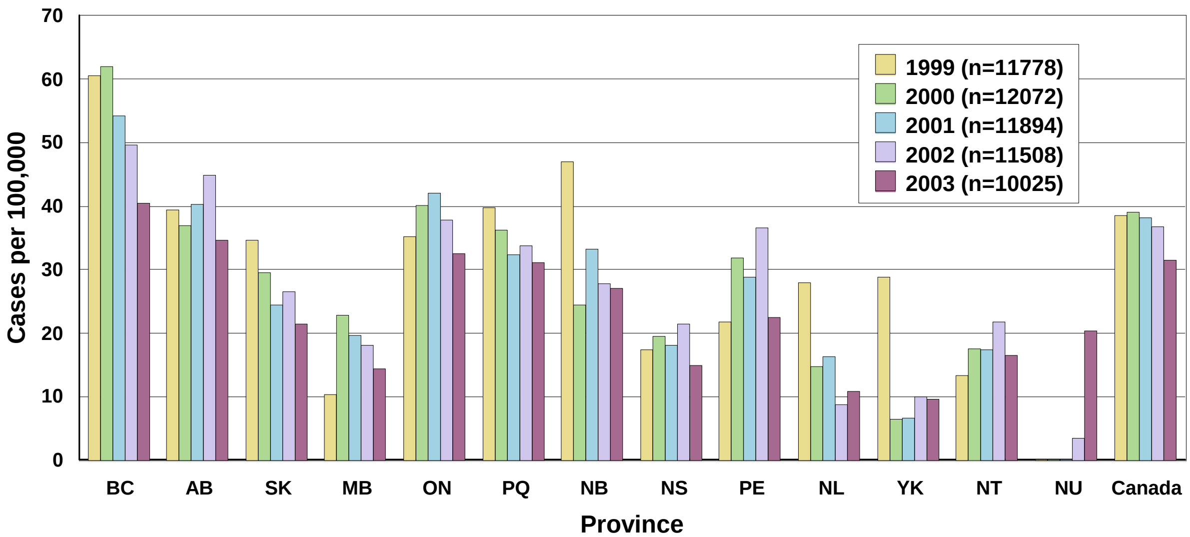


Table 8: Rate of *Campylobacter* Isolations per 100,000 People, 1999 to 2003

Province	1999	2000	2001	2002	2003
British Columbia	60.6	62.0	54.2	49.6	40.5
Alberta	39.4	36.9	40.3	44.8	34.6
Saskatchewan	34.6	29.6	24.4	26.5	21.5
Manitoba	10.3	22.9	19.7	18.1	14.4
Ontario	35.2	40.2	42.1	37.8	32.6
Quebec	39.8	36.2	32.3	33.7	31.1
New Brunswick	47.0	24.4	33.3	27.7	27.1
Nova Scotia	17.3	19.5	18.1	21.5	14.9
Prince Edward Island	21.8	31.8	28.8	36.5	22.5
Newfoundland and Labrador	27.9	14.7	16.3	8.7	10.8
Yukon Territories	28.9	6.5	6.6	10.0	9.6
Northwest Territories	13.3	17.6	17.3	21.7	16.4
Nunavut	0.0	0.0	0.0	3.5	20.3
Canada	38.5	39.1	38.1	36.7	31.4

Table 9: *Campylobacter* species Isolates from Humans, 2003

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
C. coli	4	17	23	4	110	113	8			1		1		**281**
C. fetus ssp *fetus*		2		1	6	15								**24**
C. hyointestinalis					2	1								**3**
C. jejuni	85	298	171	74	176	1724	146				3			**2677**
C. jejuni/coli	1					39	5	58	30	46		6		**185**
C. lanienae		1												**1**
C. lari		1	1			13	6		1	1				**23**
C. showae - like														**0**
C. sputorum					1									**1**
C. upsaliensis		9			4	7								**20**
Campylobacter sp.	1609	779	19	89	3746	433	39	82	0	8	0	0	6	**6810**
Total	**1699**	**1107**	**214**	**168**	**4045**	**2345**	**204**	**140**	**31**	**56**	**3**	**7**	**6**	**10025**

SECTION 5: *SHIGELLA*

The total number of *Shigella* isolations in 2004 from each province and territory is shown in Figure 18 and population based rates for each province over the years 2000 to 2004 are shown in Figure 19. Data is largely from the NESP and is supplemented with data collected through reference services provided by the NML. The data is based on laboratory identifications and should not be confused with incidence of disease. Due to differing disease reporting procedures from province to province, high rates of isolation may not necessarily reflect incidence of disease, but better sampling and reporting structures. As well, the proportion of specimens forwarded to provincial laboratories may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the subtypes found in Canada.

The national rate of reported shigellosis has continued a gradual decline from 3.7 in 2000 to 2.3 people in 2004, reflecting continued rate reductions in all provinces and territories. The largest decrease has been noted in Québec where rates have declined from 6.2 cases per 100,000 people in 2000 to only 1.9 in 2004.

Shigella sonnei accounted for the majority of identifications with 357 isolates, followed by 282 *S. flexneri*, 44 *S. boydii*, and 33 *S. dysenteriae* isolations in 2004. Two *S. dysenteriae* serotype 1 isolates reported in Alberta were associated with travel to Pakistan.

Figure 18: Number of S*higella* Isolations from Humans in Canada, 2004

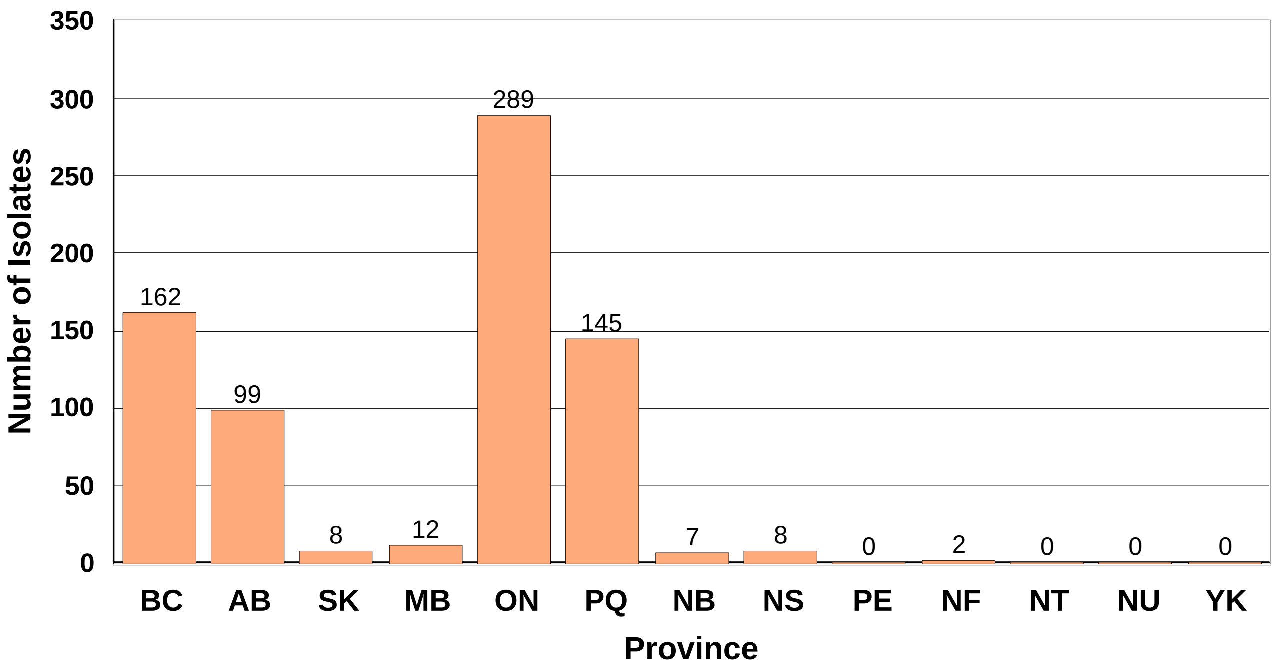


Figure 19: Rate of *Shigella* Isolations from Humans in Canada, 2000-2004*

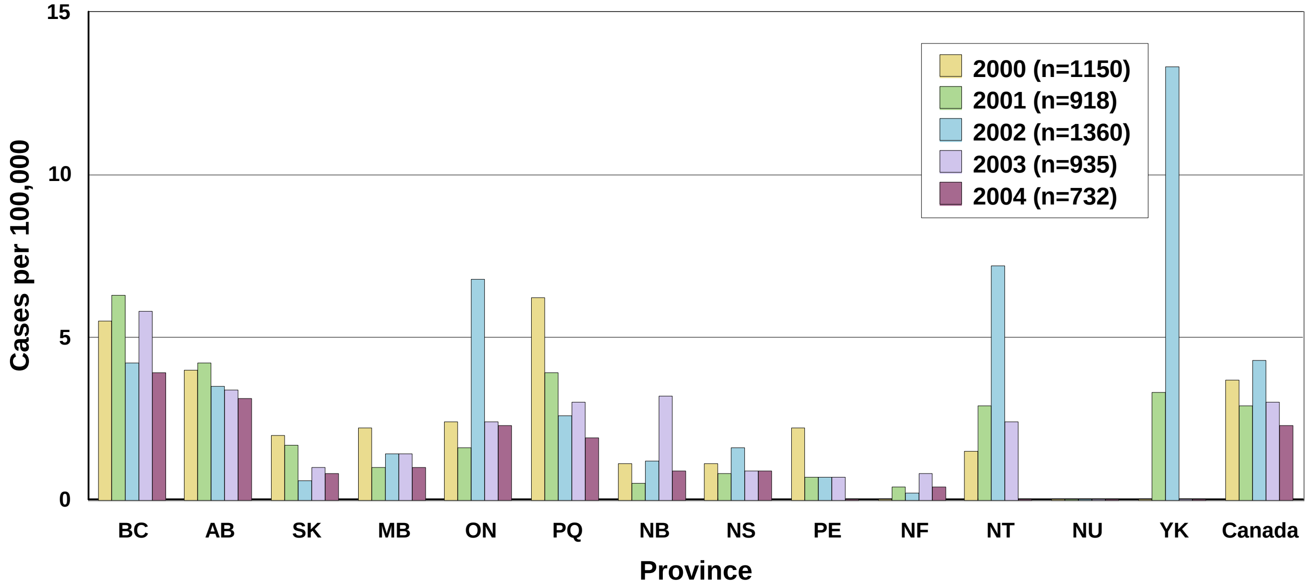


Table 10: Rate of *Shigella* Isolations per 100,000 People, 2000 to 2004*

Province	2000	2001	2002	2003	2004
British Columbia	5.5	6.3	4.2	5.8	3.9
Alberta	4.0	4.2	3.5	3.4	3.1
Saskatchewan	2.0	1.7	0.6	1.0	0.8
Manitoba	2.2	1.0	1.4	1.4	1.0
Ontario	2.4	1.6	6.8	2.4	2.3
Quebec	6.2	3.9	2.6	3.0	1.9
New Brunswick	1.1	0.5	1.2	3.2	0.9
Nova Scotia	1.1	0.8	1.6	0.9	0.9
Prince Edward Island	2.2	0.7	0.7	0.7	0.0
Newfoundland	0.0	0.4	0.2	0.8	0.4
Yukon	0.0	3.3	13.3	0.0	0.0
Northwest Territories	1.5	2.9	7.2	2.4	0.0
Nunavut	0.0	0.0	0.0	0.0	0.0
Canada	3.7	2.9	4.3	3.0	2.3

*Provincial population estimates used to calculate isolation rates are taken from the Statistics Canada website. Total isolations are based largely on NESP reports and include cluster and outbreak cases (see Appendix 1 for details). Values are based on laboratory-based identifications and should not be confused with incidence of disease.

Table 11: *Shigella* Species and Serotypes from Humans in Canada, 2004

ORGANISM	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	YK	NT	NU	Total
Shigella boydii					10			2						**12**
Shigella boydii 1					1									**1**
Shigella boydii 2	1	3				1								**5**
Shigella boydii 4	1					1								**2**
Shigella boydii 6					1									**1**
Shigella boydii 8	2	1			1									**4**
Shigella boydii 14		2			2									**4**
Shigella boydii 18	1	3			2	1								**7**
Shigella boydii 19	3				1									**4**
Shigella boydii 20	2	1				1								**4**
Total *Shigella boydii*	**10**	**10**	**0**	**0**	**18**	**4**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**44**
Shigella dysenteriae					10									**10**
Shigella dysenteriae 1		2												**2**
Shigella dysenteriae 2	3					3								**6**
Shigella dysenteriae 3	1													**1**
Shigella dysenteriae 4	1					1								**2**
Shigella dysenteriae 7	1													**1**
Shigella dysenteriae 9					1	1								**2**
Shigella dysenteriae 12		1												**1**
Shigella dysenteriae 14					1									**1**
Shigella dysenteriae 16		1												**1**
Shigella dysenteriae Prov. SH-103					1									**1**
Shigella dysenteriae Prov. SH-111	1	2			2									**5**
Total *Shigella dysenteriae*	**7**	**6**	**0**	**0**	**15**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**33**
Shigella flexneri			2	7	110	20	2	3		1				**145**
Shigella flexneri 1	6	5												**11**
Shigella flexneri 1a						2								**2**
Shigella flexneri 1b						2								**2**
Shigella flexneri 2	22	14												**36**
Shigella flexneri 2a					4	15	4			1				**24**
Shigella flexneri 3	9	5												**14**
Shigella flexneri 3a		1				3								**4**
Shigella flexneri 3b						3								**3**
Shigella flexneri 4	3													**3**
Shigella flexneri 4a	1													**1**
Shigella flexneri 6	7	8	1			7								**23**
Shigella flexneri Prov. SH-101	1	2			1									**4**
Shigella flexneri Prov. SH-104		2			2	2								**6**
Shigella flexneri var. Y		4												**4**
Total *Shigella flexneri*	**49**	**41**	**3**	**7**	**117**	**54**	**6**	**3**	**0**	**2**	**0**	**0**	**0**	**282**
Shigella sonnei	95	36	5	5	139	75		2						**357**
Shigella sp.	1	6				7	1	1						**16**
TOTAL *SHIGELLA*	**162**	**99**	**8**	**12**	**289**	**145**	**7**	**8**	**0**	**2**	**0**	**0**	**0**	**732**

Table 12 lists *Shigella* phage types of human isolates identified in 2004. The data represent isolates forwarded to the NML by the provincial health laboratories and reference centres for reference services, passive surveillance, surveys or outbreak and cluster investigations. The proportion of specimens forwarded may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains fairly consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the subtypes found in Canada.

PT1 continues to be the predominant phage type of *S. sonnei* in 2004, accounting for 59.5% (n=97) of the 163 isolates tested. PT 3 is the most prevalent phage type of *S.* boydii isolates with 50.0% (n=15) of 30 strains. Further surveillance is required to establish whether the prevalence of these sub-types is transitory. Isolates from other parts of the country may provide a substantially different phage type distribution. As more data are gathered, the typing databases for this organism will become more reliable and outbreaks of public health significance can be identified with greater precision and accuracy.

Table 12: Phage Types of *S. boydii* and *S. sonnei* Isolates from Humans, 2004

Organism	Phage Type	BC	AB	ON	QC	Total
Shigella boydii	3	5	4	5	1	**15**
	6		4	3		7
	9			1		1
	10			1		**1**
	14			1		**1**
	16		1			**1**
	18			1		**1**
	19			1		**1**
	Atypical			2		**2**
	Total	**5**	**9**	**15**	**1**	**30**
Shigella sonnei	1	48	24	25		**97**
	2	1	1	1		**3**
	4	1	1			**2**
	5	16				**16**
	6	1				**1**
	7			1		**1**
	8	1				**1**
	9			2		**2**
	10	1				**1**
	14			1		**1**
	15	12	5	3		**20**
	16	1		1		**2**
	17	1				**1**
	19	3	1	1		**5**
	24		1			**1**
	25	1				**1**
	Atypical	5	2	1		**8**
	Total	**92**	**35**	**36**	**0**	**163**

SECTION 6: PARASITES

The total number of *Cryptosporidium*, *Cyclospora, Entamoeba* and *Giardia* isolations in 2004 from each province is shown in Figure 20 and population-based rates for each province over the years 2000 to 2004 are shown in Figure 21. The data are collected through the NESP and are supplemented with NDRS data. *Entamoeba* is currently not nationally notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported. Due to differing disease reporting procedures from province to province, higher numbers of isolations may not necessarily reflect incidence of disease, but better sampling and reporting structures. As well, the proportion of specimens forwarded to provincial laboratories may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the organisms found in Canada.

Although Ontario reported the highest number of cases in 2004 (Figure 20), due to its large population, the province only ranked 4th overall in population based rates with 19.1 cases per 100,000 people. Similarly, Québec reported the second largest number of parasitic infections among the provinces, however ranked 6th overall in isolation rate with 14.8 identifications per 100,000 people.

There has been a slight increase in the national isolation rate nationally from 14.3 cases per 100,000 people in 2003 to 17.3 in 2004. Provinces with rates higher than the national level include British Columbia with 23.3, Alberta with 17.9, Ontario with 19.1,The Northwest Territories with 28.0 and the Yukon Territories with 44.9 cases per 100,000 population.

The greatest decreases in isolation rates were seen in Prince Edward Island where rates have decreased from 18.2 cases per 100,000 in 2003 to 5.1 in 2004 and in Saskatchewan from 12.3 to 6.3 cases per 100,000 people.

Figure 20: Number of Parasitic Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2004

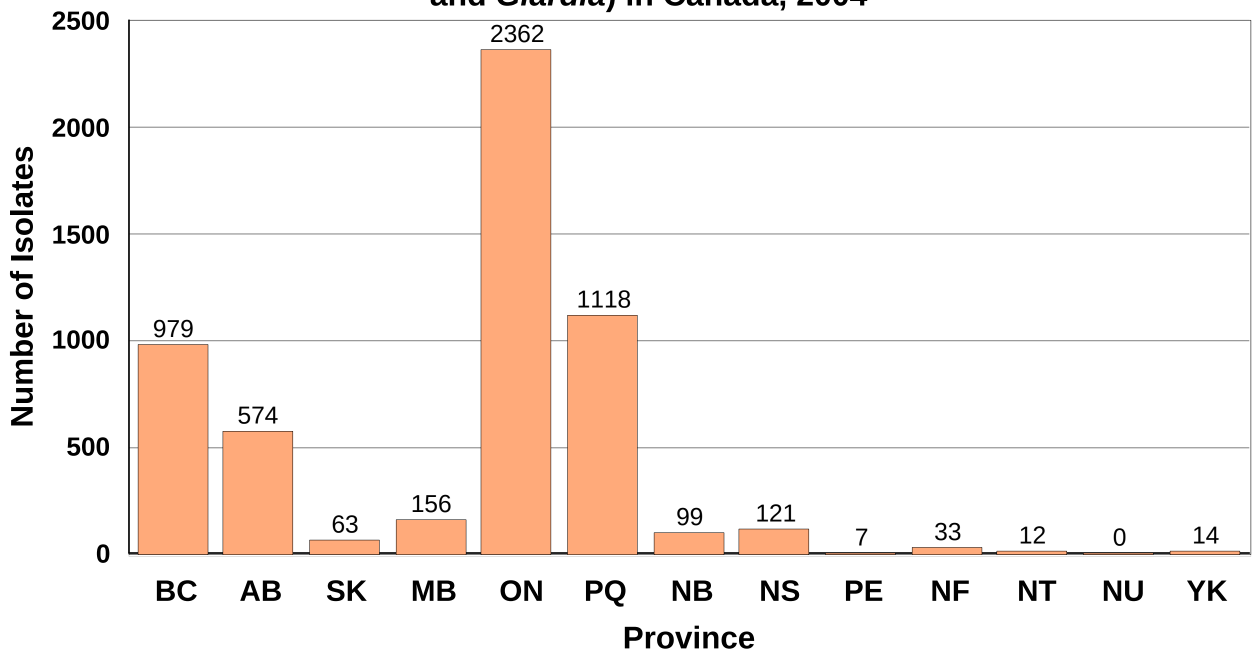


Figure 21: Rate of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2000 to 2004

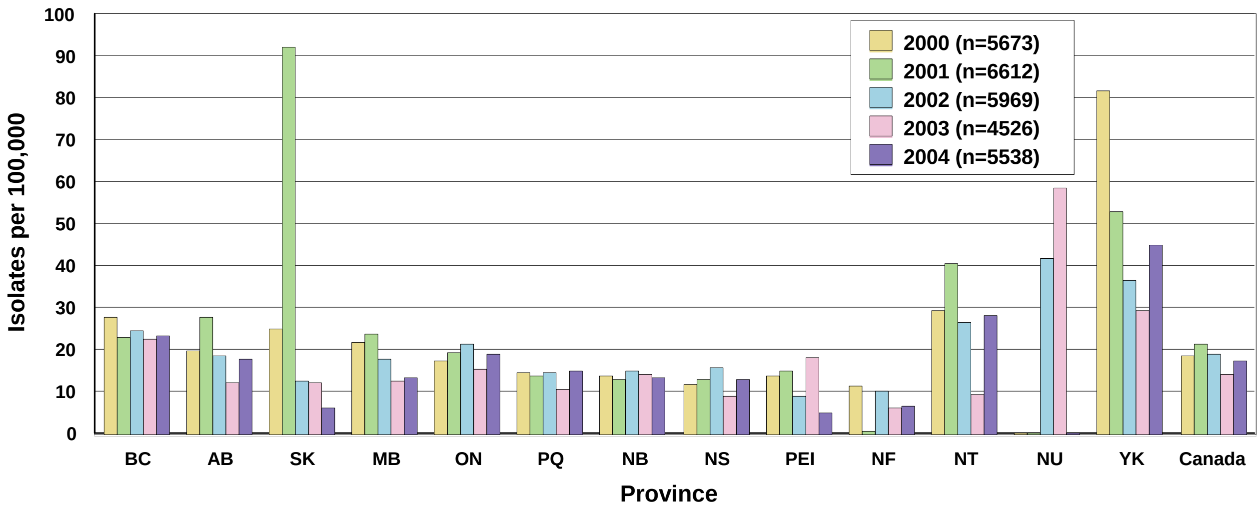


Table 13: Provincial Rates of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) per 100,000 People, 2000 to 2004*

Province	2000	2001	2002	2003	2004
British Columbia	27.9	23.1	24.6	22.6	23.3
Alberta	19.8	28.0	18.4	12.3	17.9
Saskatchewan	25.2	93.9	12.6	12.3	6.3
Manitoba	21.7	23.7	17.8	12.5	13.3
Ontario	17.5	19.3	21.5	15.2	19.1
Quebec	14.5	13.7	14.6	10.6	14.8
New Brunswick	13.9	13.1	14.8	14.1	13.2
Nova Scotia	11.9	13.2	15.7	8.9	12.9
Prince Edward Island	13.9	15.4	8.8	18.2	5.1
Newfoundland	11.4	0.4	10.2	6.0	6.4
Northwest Territories	49.4	68.6	26.5	9.5	28.0
Nunavut	0.0	0.0	41.8	58.4	0.0
Yukon Territories	82.2	53.2	36.5	29.4	44.9
Canada	18.5	21.3	19.0	14.3	17.3

Table 14: Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) Identifications in Canada, 2004*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	TOTAL
Cryptosporidium	99	104	8	18	298	36	10	10	3				**586**
Cyclospora	34				97	11		3					**145**
Entamoeba histolytica/dispar	109	10	1	16	394	113	1	21		1		5	**671**
Giardia	737	460	54	122	1573	958	88	87	4	32	12	9	**4136**
Total	**979**	**574**	**63**	**156**	**2362**	**1118**	**99**	**121**	**7**	**33**	**12**	**14**	**5538**

* *Entamoeba* is not notifiable and numbers of cases of illness are those reported to NESP, which may be under-reported.

SECTION 7: *YERSINIA*

The total number of *Yersinia* isolations in 2004 from each province is shown in Figure 22 and population based rates for each province over the years 2000 to 2004 are shown in Figure 23. Data is from the NESP and is supplemented with identifications from reference services provided by the NML. The data is based on laboratory identifications and should not be confused with incidence of disease. Due to differing disease reporting procedures from province to province, higher numbers of isolations may not necessarily reflect incidence of disease, but better sampling and reporting structures. As well, the proportion of specimens forwarded to provincial laboratories may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the organisms found in Canada (see Appendix 1 for details).

Ontario had the highest number of isolations with 295 isolates reported, followed by Quebec with 109, Alberta with 85 and British Columbia with 75 isolates identified in 2004. The national rate of *Yersinia* isolations has continued to decline with a slight decrease from 2.1 isolates per 100,000 people in 2003 to 1.9 cases per 100,000 population in 2004 (Figure 23). Increases were observed in Alberta where isolations have increased from 2.0 in 2003 to 2.7 cases per 100,000 people in 2004 and in British Columbia from 1.3 to 1.8 cases per 100,000 people.

Figure 22: Number of *Yersinia* Isolations from Humans in Canada, 2004*

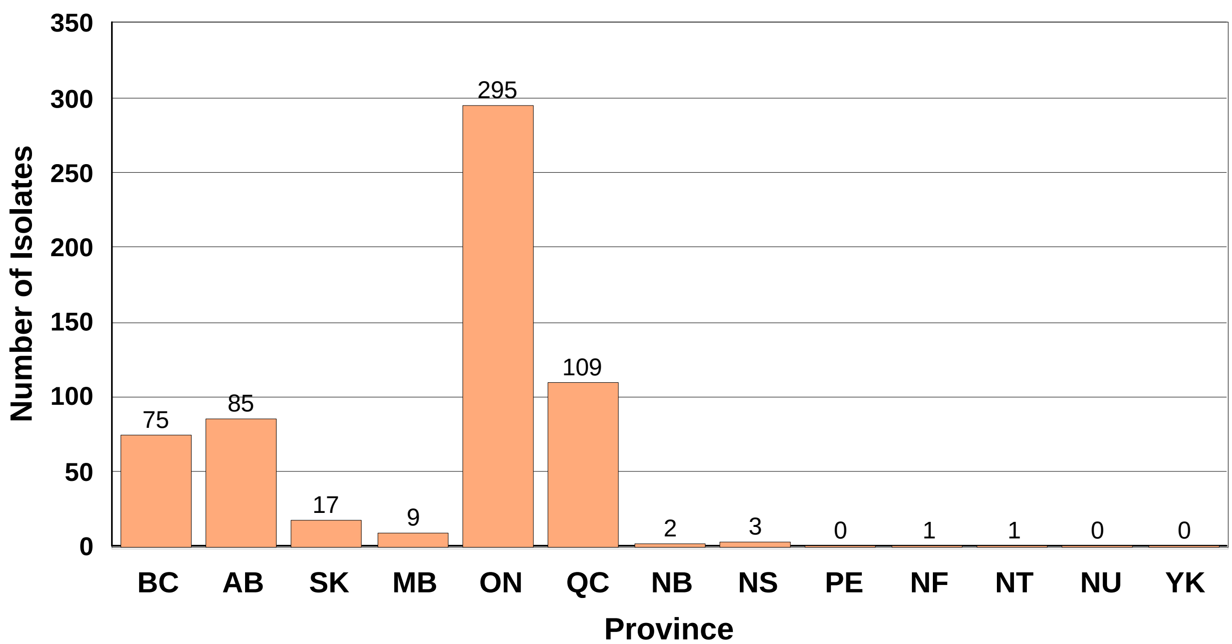


Figure 23: Rate of *Yersinia* Isolations from Humans in Canada, 2000 to 2004*

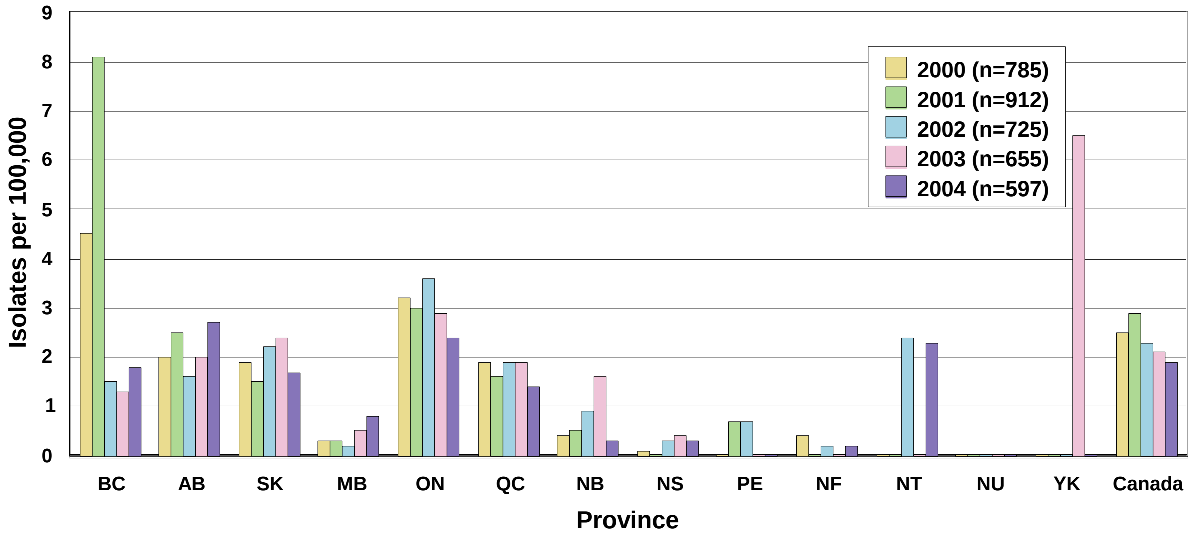


Table 15: Provincial and Territorial Rates of *Yersinia* Isolations per 100,000 People, 2000 to 2004*

Province	2000	2001	2002	2003	2004
British Columbia	4.5	8.2	1.5	1.3	1.8
Alberta	2.0	2.5	1.6	2.0	2.7
Saskatchewan	1.9	1.5	2.2	2.4	1.7
Manitoba	0.3	0.3	0.2	0.5	0.8
Ontario	3.2	3.0	3.6	2.9	2.4
Québec	1.9	1.6	1.9	1.9	1.4
New Brunswick	0.4	0.5	0.9	1.6	0.3
Nova Scotia	0.1	0.0	0.3	0.4	0.3
Prince Edward Island	0.0	0.7	0.7	0.0	0.0
Newfoundland	0.4	0.0	0.2	0.0	0.2
Northwest Territories	0.0	0.0	2.4	0.0	2.3
Nunavut	0.0	0.0	0.0	0.0	0.0
Yukon Territories	0.0	0.0	0.0	6.5	0.0
Canada	2.6	2.9	2.3	2.1	1.9

Table 16: *Yersinia* Isolates from Humans in Canada, 2004*

ORGANISM	BC	AB	SK	MB	ON	QC	NB	NS	NF	NT	Total
Y. enterocolitica	55	45	2	8	275	103	2	3	1	1	**495**
Y. enterocolitica bio 1A		25	9								**34**
Y. frederiksenii	13	8	4		14	2					**41**
Y. intermedia	7	2	2		4	4					**19**
Y. kristensenii		3			2						**5**
Y. pseudotuberculosis											
Y. rohdei		2									**2**
Yersinia sp.				1							**1**
Total	**75**	**85**	**17**	**9**	**295**	**109**	**2**	**3**	**1**	**1**	**597**

SECTION 8: OUTBREAKS

Table 17 summarizes major outbreaks of enteric disease reported for the years 2000 to 2004 through various surveillance systems such as the NESP, PulseNet Canada and cluster investigations where the NML and CIDPC have provided assistance. This list is not an exhaustive account of all outbreaks that have occurred in Canada and may also contain clusters of identical isolates that have not been epidemiologically linked. Some outbreaks are limited to a relatively small geographical location and are not reported by the PPHLs to current federal outbreak management systems. Outbreaks are grouped by causative organism and outbreak type. Outbreak types classify the events into general categories of community, family, institutional, restaurant and travel. Community outbreaks include those events involving a group of individuals with common exposure to specific events (banquets, weddings and parties) or products (ground beef from large retail outlets). Family outbreaks are small events consisting of immediate family members and friends and generally consist of person-to-person spread of the infectious agent within a household. Institutional outbreaks include hospitals, long-term care facilities, schools and other events in which individuals are in close contact and share exposures. Day care outbreaks are a sub-set of the institutional category, but because of the extra concerns of young children being affected, these events are described separately. Restaurant outbreaks involve events related to commercial distribution of prepared meals. Travel related outbreaks involve those events where the original infection is thought to have occurred outside the country but symptoms are displayed after returning to Canada.

There were 82 outbreaks reported in Canada during 2004 involving 737 cases of illness. *Salmonella* accounted for 52% (n=43) of the reported outbreaks and 47% (n=345) of all outbreak-related illnesses (Table 17). Community and restaurant-associated caused the highest number of illnesses causing 262 illnesses. Verotoxigenic *E. coli* was implicated in 29 outbreaks 35% involving 284 39% associated cases of illness. The majority of illnesses continue to be from community-associated outbreaks, however the total number of cases has declined from 206 cases in 2003 to 90 in 2004. The number of restaurant-associated outbreaks of *E. coli* O157:H7 illness has increased from a total of 22 illnesses from 3 outbreaks between 2000 to 2003 to 6 outbreaks causing 149 cases of disease in 2004. Reported *Shigella sonnei* outbreaks have declined dramatically from 2003 levels where 11 outbreaks caused 73 cases of illness to only 3 outbreaks causing 7 illnesses.

Table 17: Summary of Outbreaks and Case Clusters of Enteric Disease in Canada, 2000 to 2004

Organism	Outbreak Type	2000		2001		2002		2003		2004	
		#OB [(a)]	Cases	#OB	Cases	#OB	Cases	#OB	Cases	#OB	Cases
Salmonella	Community	12	199	16	360	19	381	12	155	15	108
	Day Care	0	0	1	35	0	0	0	0	0	0
	Family	40	94	17	39	21	58	10	23	18	48
	Institutional	2	16	0	0	0	0	5	26	3	35
	Restaurant	2	71	3	162	3	22	7	99	10	154
	Travel	1	11	1	3	0	0	0	0	0	0
	Total	**57**	**391**	**38**	**599**	**43**	**461**	**34**	**303**	**43**	**345**
E. coli O157 VTEC	Community	7	256	2	7	7	166	9	206	9	90
	Day Care	2	9	1	3	5	35	1	4	1	11
	Family	24	60	7	16	11	30	7	19	13	34
	Institutional	0	0	0	0	1	12	0	0	0	0
	Restaurant	0	0	1	15	1	2	1	5	6	149
	Total	**33**	**325**	**11**	**41**	**25**	**245**	**18**	**234**	**29**	**284**
Campylobacter coli	Family	2	8	0	0	0	0	0	0	0	0
	Restaurant	0	0	0	0	0	0	0	0	1	40
	Total	**2**	**8**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**40**
Shigella sonnei	Community	3	121	1	26	1	426	6	40	0	0
	Day Care	1	6	0	0	0	0	0	0	0	0
	Family	3	6	1	2	0	0	4	18	2	5
	Institutional	0	0	0	0	0	0	1	15	0	0
	Travel	1	2	0	0	1	6	0	0	0	0
	Restaurant									**1**	**2**
	Total	**8**	**135**	**2**	**28**	**2**	**432**	**11**	**73**	**3**	**7**
Cryptosporidium	Community	0	0	0	0	0	0	1	4	0	0
	Family	0	0	0	0	0	0	0	0	4	47
Cyclospora	Community	0	0	0	0	0	0	0	0	1	8
Giardia	Community	0	0	0	0	0	0	0	0	1	6
	Family	1	2	0	0	0	0	0	0	0	0
Total		**101**	**861**	**51**	**668**	**70**	**1138**	**64**	**614**	**82**	**737**

(a) = Number of Outbreaks

Outbreaks 2004

Salmonella

Forty-three outbreaks of *Salmonella* involving 15 serovars and 345 cases of illnesses were observed in 2004. *S*. Typhimurium was the most frequently confirmed serovar causing 13 outbreaks and 100 illnesses (29%), followed by *S*. Heidelberg with 8 outbreaks and 97 illnesses (28%) and *S*. Enteritidis with 8 outbreaks involving 63 cases of disease (18%).

A large outbreak in New Brunswick during April involved 26 cases of *S*. Typhimurium PT 46 / STXAI.0214 infections that were linked to the consumption of a restaurant-made salad dressing containing raw egg. Two of the cases were visitors from British Columbia and one was from Manitoba. Another large outbreak of 25 cases of PT 10 / STXAI.0233 occurred at a graduation party held at a restaurant in June and wild rice or salad was the suspected source of infection. Another 12 cases of *S*. Typhimurium PT 49 / STXAI.0031 infection in British Columbia during October were traced to the consumption of savoury items purchased from an Asian bakery. A community-based outbreak of 9 cases of *S*. Typhimurium STXAI.0003, also in British Columbia, occurred during August. Of the remaining outbreaks attributed to *S*. Typhimurium, one was associated with a restaurant (2 cases, plus one case of *S*. Heidelberg), four were in household settings (12 cases) and 2 were case clusters (6 cases) reported to PulseNet Canada where no source of infection was identified.

There were 8 *S*. Heidelberg outbreaks reported in 2004, 2 of which were associated with food establishments, 2 with family settings and 4 were community based outbreaks with no sources identified. The largest *Salmonella* outbreak in 2004 occurred in Alberta during July where 45 cases of *S*. Heidelberg PT 19 with PFGE pattern SHEXAI.0001 were traced to an employee of an Asian buffet-style restaurant. Another restaurant outbreak occurred, also in Alberta in December and consisted of 5 cases and 2 family outbreaks included 6 cases of infection. Manitoba reported 3 case clusters with no identified source to PulseNet Canada including a cluster of 10 cases of *S*. Heidelberg PT 29 / SHEXAI.0009 and another 14 isolates of PT 32 / SHEXAI.0111 in April, and a cluster of 2 cases of PT 45 / SHEXAI.0120 in September. The remaining cluster consisted of 15 isolations of PT 53 in Québec during the month of October.

Of the 8 outbreaks and case clusters of *S*. Enteritidis identified during 2004, 3 were associated with family contact with 7 cases of illness, 2 were institutional with 21 cases and one outbreak in Alberta (10 cases) was linked to a restaurant food handler. Another cluster of 23 cases of PT 13 / SENXAI.0038 in New Brunswick, British Columbia and Québec were reported to PulseNet Canada however no sources of infection were found.

A cluster of 16 cases of *S*. Thompson PT 1 / STHXAI.0004 infection in Ontario in June were tentatively linked to restaurants in the region. Another smaller community outbreak in Quebec involved 5 isolates of PT 1 in July and a family related outbreak was reported in New Brunswick involving 3 cases identified as PT 5 / STHXAI.0019.

An outbreak in a long-term care facility in Nova Scotia during August consisted of 14 cases of *S*. Newport PT 9 / NewpXAI.0010 infection. Two other clusters of 3 cases each were reported to PulseNet Canada in New Brunswick with no sources of infection identified. A cluster reported in August was characterized as PT 3 / NewpXAI.0050 and one reported in September was PT 13 / NewpXAI.0059.

In July, a cluster of 7 *S*. Javiana infections with PFGE pattern JAVXAI.0002 was reported in Ontario. During the same time period in the United States, a multi-state outbreak involving over 380 cases of *S*. Javiana was linked to the consumption of Roma tomatoes used by a popular delicatessen. Although the PFGE pattern of the Ontario strains differed from that of the US strains, all cases had eaten at the same restaurant and the only common food exposure was Roma tomatoes.

There were 7 other family related outbreaks reported, involving 1 to 4 cases each of *S*. Braenderup, *S*. Infantis, *S*. Kiambu, *S*. Oranienburg, *S*. Saintpaul and *S*. Stanley for a grand total of 18 illnesses. Two cases of *S*. Hadar SHAXAI.0001 in British Columbia during January were associated with aquarium fish and 2 other unidentified clusters were reported to PulseNet Canada, one with 5 cases of *S*. Agona PT 8 / SAGXAI.0037 in Newfoundland and another with 9 cases of *S*. Muenchen MuenXAI.0030 in Ontario.

Verotoxigenic *E. coli* (VTEC)

There were 29 outbreaks of *E. coli* O157:H7, 3 of *E. coli* O157:NM and 1 of *E. coli* O145:NM noted and a total of 294 illnesses identified in 2004. Relatively small household clusters, consisting of 2 to 4 cases each, accounted for 15 of these outbreaks. Isolates from an outbreak in a Saskatchewan daycare centre during July involved 11 cases of infections among children and adults were identified as PT 14a / ECXAI.0355.

An outbreak in Sudbury, Ontario in July resulted in 30 cases of illness among hockey camp participants. Fifteen cases were laboratory-confirmed as *E. coli* O157:H7 PT 14a and various PFGE patterns were identified that differed by a single band including 11 isolates with pattern ECXAI.1043 and 1 isolate each with ECXAI.1044, ECXAI.1045, ECXAI.1077 and ECXAI.0365. Cases began experiencing symptoms the same day that the implicated meal of undercooked hamburger was served. As a result of the investigation, it was concluded that the undercooked ground beef was the most likely source of the outbreak.

From June to August 27 *E. coli* O157:H7 isolates with PFGE pattern ECXAI.1016/ECBNI.0157 were identified across Canada with 10 reported in Québec, 7 in Manitoba, 6 in British Columbia, 3 in Alberta and 1 in Saskatchewan. The majority of cases reported ground beef consumption and several other cases also reported exposure to other beef products such as steak and beef cubes. Information obtained from a Manitoba case history and product trace-back investigations conducted by the CFIA resulted in a recall of certain ground beef products in August. During the same time period (late June to early August) a separate cluster of 11 isolates with PFGE pattern ECXAI.1016/ECBNI.0170 was linked to a water park in British Columbia. A visitor from Alberta was also confirmed with the strain but had not attended the facilities. The water park had been experiencing operational problems and was subsequently closed in order to implement safety measures.

Four cases of *E. coli* O157:H7 infection were reported in Saskatchewan, Manitoba, Québec and Northwest Territories with PFGE pattern ECXAI.1015 / ECBNI.0150 that were isolated in late July. Ground beef consumption was reported by several cases and no other common source was identified. The same PFGE patterns were also observed in the United States throughout the summer months, including 3 cases in Michigan, 2 in Connecticut, and 1 in Tennessee. An investigation in the United States revealed that 4 of the cases had consumed beef at a common restaurant chain and 1 case had consumed ground beef at home. The supplier of the beef to the restaurant chain was identified, however no link was established between the Canadian and US cases.

In September, 133 isolates of *E. coli* O157:H7 PT 14a / ECXAI.1107 were identified and linked to exposure to beef donairs from two related restaurants in the Calgary area. The regional CFIA lab in Calgary isolated *E. coli* O157:H7 from frozen beef samples from the same lot that was distributed to the restaurants, however none matched the outbreak strain. In a second localized cluster occurring during the same time period, and also linked to beef donairs, 5 isolates were identified as PT 84/PFGE pattern ECXAI.1110. The same strain was observed in one isolate from Ontario, 4 from California and 1 from Oregon but no epidemiological linkages were made.

Campylobacter coli

Only one distinct *Campylobacter*-related outbreak was reported in 2004 where 40 infections in British Columbia during January were associated with a deli counter at a grocery store.

Shigella sonnei

Only 3 *Shigella*-related outbreaks were reported in 2004, 2 of them in Québec involving *S. sonnei* in household settings and 1 from a restaurant for a total of 7cases of illness.

Parasites

Three outbreaks associated with parasitic organisms were noted, including 2 family-related *Cryptosporidium* outbreaks in New Brunswick involving 6 cases, one *Giardia* outbreak of 6 illnesses in an agricultural colony in Manitoba and one *Cyclospora* outbreak in British Columbia of 8 cases in which cilantro was suspect but not confirmed.

Table 18: Outbreaks, Case Clusters and Laboratory Investigations of *Salmonella, E. coli* O157:H7, *Shigella sonnei, Campylobacter* and Parasitic Infections in Canada, 2004

Organism	Month	Province	Cases	PFGE Pattern [(a)]	PT [(b)]	Comments
S. Agona	Aug	NL	5	SAGXAI.0037	PT 8	Community - Unidentified Cluster
S. Braenderup	Sep	NB	3	BraeXAI.0015	-	Family
S. Enteritidis	Feb	AB	6	-	PT 2	Institutional - Day Home
	Mar	BC	2	SENXAI.0001	-	Family
	May	AB	15	-	PT 911	Institutional - Long Term Care Facility
	May	NB	2	SENXAI.0049	PT 4	Community - Cluster
	Aug	AB	10	-	-	Restaurant - Employee
	Sep	NB, BC, QC	23	SENXAI.0038	PT 13	Community - Unidentified Cluster
	Sep	QC	3	-	-	Family
	Sep	QC	2	-	-	Family
S. Hadar	Jan	BC	2	SHAXAI.0001	-	Community - Aquarium Fish
S. Heidelberg	Mar	QC	3	-	-	Family
	Apr	MB	10	SHEXAI.0009	PT 29	Community - Unidentified Cluster
	Apr	MB	14	SHEXAI.0111	PT 32	Community - Unidentified Cluster
	Jul	AB	45	SHEXAI.0001	PT 19	Restaurant - Asian Buffet Employee
	Sep	MB	2	SHEXAI.0120	PT 45	Community - Unidentified Cluster
	Sep	NB	3	SHEXAI.0009	PT 47	Family
	Oct	QC	15	-	PT 53	Community - Unidentified Cluster
	Dec	AB	5	-	Mixed [(c)]	Restaurant - Asian
S. Infantis	Nov	QC	2	-	-	Family

Organism	Month	Province	Cases	PFGE Pattern [a]	PT [b]	Comments
S. Javiana	Jul	ON	7	JAVXAI.0022	-	Restaurant - Tomatoes suspected
S. Kiambu	Oct	QC	3	-	-	Family
S. Muenchen	Jul	ON	9	MuenXAI.0030	-	Community - Unidentified Cluster
S. Newport	Aug	NS	14	NewpXAI.0010	PT 9	Institutional - Long Term Care Facility
	Aug	NB	3	NewpXAI.0050	PT 3	Community - Unidentified Cluster
	Sep	NB	3	NewpXAI.0059	PT 13	Community - Unidentified Cluster
S. Oranienburg	Feb	QC	2	-	-	Family
S. Saintpaul	Jan	BC	2	-	-	Family
	Sep	NB	4	SainXAI.0007	-	Family
S. Stanley	Jan	QC	2	-	-	Family
S. Thompson	May	NB	3	STHXAI.0019	PT 5	Family
	Jun	ON	16	STHXAI.0004	PT 1	Restaurant - Chicken Suspected
	Jul	QC	5	-	PT 1	Community - Unidentified Cluster
S. Typhimurium	Jan	AB	2		PT 208 var.	Family
	Jan	AB	5		PT 104	Food Services Establishment
	Apr	NB	26	STXAI.0214	PT 46	Restaurant - Salad Dressing / Raw Egg
	May	BC	4	STXAI.0032	-	Family - Home Made Sausage
	May	AB	3	-	PT Atypical / PT 104	Restaurant (1 *S.* Heidelberg case)
	Jun	ON	25	STXAI.0233	PT 10	Restaurant - Graduation Party (Wild Rice and Salad)
	Jul	QC	2	-	-	Family
	Jul	QC	3	-	-	Community - Unidentified Cluster
	Aug	BC	9	STXAI.0003	-	Community - House Party
	Sep	MB	3	STXAI.0251	PT 108	Community - Unidentified Cluster
	Sep	NB	2	STXAI.0270	PT 124 var.	Family
	Oct	BC	12	STXAI.0031	PT 49	Restaurant - Asian Bakery
	Dec	QC	4	-	-	Family
E. coli O157:H7						
	May	SK	2	ECXAI.1007	PT 23	Restaurant - Fast Food
	May	SK	3	ECXAI.0001	PT 14a	Restaurant - Fast Food
	Jun	BC	2	-	-	Family
	Jun	BC	4	ECXAI.0052	-	Community - Petting Zoo (North Vancouver)
	Jun	QC, SK, MB [d]	24	EXCAI.1016	PT 14a	Community - Ground Beef
	Jul	SK, MB, QC, NT [e]	4	ECXAI.1015	-	Community - Ground Beef
	Jul	ON	30	Mixed [f]	PT 14a	Community - Hockey Camp (Hamburger)
	Jul	SK	11	ECXAI.0355	PT 14a	Institutional - Daycare
	Aug	BC	2	-	-	Community - Petting Zoo (Abbotsford)

Organism	Month	Province	Cases	PFGE Pattern [(a)]	PT [(b)]	Comments
	Aug	BC	3	ECXAI.0052	-	Family
	Aug	BC	11	ECXAI.1016	-	Community - Water Park
	Aug	NB	4	ECXAI.1090	PT 14a	Family
	Sep	ON	7	-	-	Community - Pig Roast
	Sep	BC	3	-	-	Family
	Sep	BC	3	ECXAI.0001	-	Family
	Sep	BC	3	-	-	Family
	Sep	AB	133	ECXAI.1107	PT 14a	Restaurant - Beef Donairs
	Sep	AB	5	ECXAI.1110	PT 84	Restaurant - Beef Donairs
	Sep	QC	2	-	-	Family
	Sep	MB	2	ECXAI.0365	-	Community
	Sep	NB, MB, SK [(g)]	6	ECXAI.0023	-	Community - Hot Dogs Suspected
	Sep	SK	3	ECXAI.0063	-	Family
	Oct	SK	2	-	-	Family
	Oct	BC	2	-	-	Family
	Oct	QC	3	-	Atypical	Family
	Oct	ON	3	ECXAI.0247	PT 14a	Restaurant
	Oct	ON	3	ECXAI.1140	PT 32	Restaurant - Asian
	Dec	PE	2	ECXAI.0776	PT 14	Family
	Dec	SK	2	ECXAI.0052/515	PT 32	Family
E. coli O157:NM	Jul	QC	4	ECXAI.1018	PT 14	Family
	Jul	QC	2	ECXAI.1018	PT 14	Family
	Dec	QC	2	ECXAI.1170	PT 2	Community - Unidentified Cluster
E. coli O145:NM	Nov	MB	2	ECXAI.1166	-	Community - Unidentified Cluster
Shigella sonnei	Oct	QC	2	-	-	Family
	Oct	AB	2	-	PT 1	Restaurant – Employee
	Nov	QC	3	-	-	Family
Campylobacter coli bio II	Jan	BC	40	-	-	Restaurant - Deli Counter
Cryptosporidium	Feb	AB	3	-	-	Family
	May	AB	38	-	-	Family (1 case *Giardia*)
	Aug	NB	4	-	-	Family
	Jul	NB	2	-	-	Family
Giardia	Jul	MB	6	-	-	Community - Agricultural Colony
Cyclospora	Jun	BC	8	-	-	Community - Cilantro suspected

(a) Predominant *Xba*I Pulsed Field Gel Electrophoresis Pattern.
(b) Predominant Phage Type.
(c) 5 cases PT19, 1 case PT 29, and 1 case PT 11.
(d) QC=10 cases, MB=7, BC=6, SK=1.
(e) SK=1 case, MB=1, QC=1, NWT=1.
(f) 11 isolates=ECXAI.1043, 1 isolate = ECXAI.1044, 1 isolate = ECXAI.1045, 1 isolate = ECXAI.1077, 1 isolate = ECXAI.00365, 2 meat isolates = ECXAI.1043.
(g) NB=3 cases, MB=1, SK=2.

SECTION 9: MISCELLANEOUS INFORMATION

Table 19: Travel Related Enteric Pathogen Infections, 2004

Organism	Country of Travel
Campylobacter coli	1 Egypt, 1 Italy, 1 Philippines, 1 Spain.
C. jejuni	2 Asia, 1 India, 1 Indonesia.
C. lari	2 United States.
Cryptosporidium	1 Africa, 1 Asia.
Cyclospora cayetanensis	2 Dominican Republic, 1 Haiti, 1 Mexico, 1 Peru.
Entamoeba histolytica/dispar	1 Africa, 1 Haiti, 2 India, 1 Mexico, 1 Thailand.
Giardia	1 Asia, 4 Burundi, 6 Haiti, 2 India, 2 Mexico, 1 Nepal, 1 Poland.
E. coli O157 VTEC	1 Netherlands.
E. coli O157:NM	1 Mexico, 1 Lima, 1 Peru.
S. Agona	3 Mexico.
S. Bardo	1 Cuba.
S. Braenderup	1 Mexico.
S. Derby	1 Cuba.
S. Durham	2 United States.
S. Enteritidis	1 Afghanistan, 1 Bosnia-Herzegovina, 4 Cuba, 1 Czech Republic,
	6 Dominican Republic, 2 Europe, 1 Germany, 1 Jamaica, 2 Lebanon,
	11 Mexico, 1 Taiwan, 1 China, 1 Poland.
S. Hadar	1 Algeria.
S. Haifa	1 Cuba.
S. Heidelberg	1 India.
S. Javiana	1 Costa Rica, 1 Cuba, 1 United States.
S. Manhattan	1 Cuba, 1 Mexico.
S. Panama	1 Caribbean, 1 Thailand.
S. Paratyphi A	6 India.
S. Paratyphi B var. Java	1 Indonesia.
S. Richmond	1 India.
S. Saintpaul	1 Mexico.
S. Schwarzengrund	1 Thailand.
S. Senftenberg	1 Thailand.
S. Stanley	2 Thailand.
S. Typhi	1 Burma, 4 India.
S. Typhimurium	1 Africa, 1 Dominican Republic, 1 France, 1 India, 1 Italy,
	3 Mexico, 1 Turkey.
Salmonella ssp I	1 India.
Salmonella ssp I 13,23:-:-	1 Mexico.
Salmonella ssp I 4,5,12:b:-	1 Asia, 1 Indonesia, 1 Bali, 1 China.
Salmonella ssp IV 48:z4,z32:-	1 Dominican Republic.
Shigella boydii	1 India, 1 Pakistan.
Shigella boydii 8	1 India.
Shigella boydii 18	1 Pakistan.

Organism	Country of Travel
Shigella boydii 20	1 India.
Shigella dysenteriae	2 Pakistan.
Shigella flexneri	4 Dominican Republic, 2 Mexico, 1 Pakistan.
Shigella flexneri 1	1 Africa.
Shigella flexneri 2	1 Africa, 3 Dominican Republic, 1 Peru.
Shigella flexneri 2a	3 Dominican Republic.
Shigella flexneri Prov. 101	1 El Salvador.
Shigella flexneri Prov. SH104	1 African (countries), 1 India.
Shigella sonnei	1 Costa Rica, 1 Dominican Republic, 1 Ethiopia, 1 Florida, 1 India,
	1 Japan, 1 Kenya, 5 Mexico, 1 Nepal, 1 Overseas,
	1 Panama, 1 Sri Lanka, 1 United States.
Yersinia enterocolitica	1 Cuba, 1 Mexico.
Yersinia frederiksenii	1 Poland.

Table 20: Unusual Enteric Pathogen Infection Sites, 2004

Isolation Site	Organism	Total
Abscess	*S.* Enteritidis	2
	S. Typhimurium	2
	Salmonella ssp I 4,5,12:i:-	1
Abscess (Face)	*Campylobacter showae* - like	1
Abscess (Perianal)	*S.* Typhimurium	1
Aorta	*Salmonella* ssp I 4,5,12:-:-	1
Aspirate	*S.* Enteritidis	1
	S. Typhimurium	1
	Salmonella ssp I 4,5,12:i:-	1
Blood	*Campylobacter fetus* ssp *fetus*	1
	Campylobacter jejuni / coli	2
	E. coli (Inactive)	1
	E. coli O1:K1:NM	1
	E. coli O2:H7	1
	E. coli O15:H1	1
	E. coli O40:H20	1
	E. coli O52:H10	1
	E. coli O73:H18	1
	E. coli O157:H7	3
	E. coli O164:H6	1
	E. coli O-Untypeable:H4	2
	E. coli O-Untypeable:H7	1
	E. coli O-Untypeable:NM	5
	S. Agona	1
	S. Berta	1
	S. Brandenburg	1
	S. Bredeney	1
	S. Choleraesuis	1
	S. Dublin	1
	S. Enteritidis	22
	S. Hadar	2
	S. Heidelberg	88
	S. Javiana	1
	S. Litchfield	1
	S. Montevideo	2
	S. Muenchen	1
	S. Muenster	2
	S. Napoli	1
	S. Newport	10
	S. Ohio	1
	S. Oranienburg	2
	S. Panama	2
	S. Paratyphi A	26
	S. Paratyphi B	1
	S. Paratyphi B var. Java	2

Isolation Site	Organism	Total
	S. Poona	2
Blood (continued)	*S.* Saintpaul	4
	S. Sandiego	2
	S. Schwarzengrund	2
	S. Thompson	2
	S. Typhi	59
	S. Typhimurium	25
	S. Virchow	2
	Salmonella ssp I 28:y:-	1
	Salmonella ssp I 4,5,12:b:-	2
	Salmonella ssp I 4,5,12:i:-	11
	Salmonella ssp II 50:b:z6	1
Bone	*S.* Pomona	1
Cerebral Spinal Fluid	*S.* Typhimurium	3
	Salmonella ssp I 4,5,12:i:-	2
Gallbladder	*S.* Durban	1
Heart	*S.* Agona	1
Joint Fluid	*S.* Typhi	1
Sputum	*Yersinia enterocolitica*	1
Urine	*E. coli* (Inactive)	2
	E. coli O6:NM	1
	E. coli O25:NM	1
	E. coli O60:NM	1
	E. coli O75:NM	3
	E. coli O-Untypeable:H4	1
	E. coli O-Untypeable:H7	1
	E. coli O-Untypeable:NM	2
	S. Agona	4
	S. Bareilly	1
	S. Berta	1
	S. Blockley	2
	S. Braenderup	3
	S. Brandenburg	3
	S. Bredeney	1
	S. Corvallis	1
	S. Cubana	1
	S. Derby	2
	S. Enteritidis	11
	S. Essen	1
	S. Hadar	5

Isolation Site	Organism	Total
	S. Heidelberg	27
	S. Indiana	2
Urine (continued)	*S.* Infantis	5
	S. Isangi	1
	S. Javiana	1
	S. Kedougou	1
	S. Kentucky	1
	S. Kiambu	1
	S. Litchfield	2
	S. Manhatten	1
	S. Mississippi	1
	S. Montevideo	2
	S. Muenchen	1
	S. Newport	5
	S. Oranienburg	4
	S. Orion	1
	S. Panama	1
	S. Paratyphi A	1
	S. Paratyphi B var. Java	2
	S. Roodepoort	1
	S. Saintpaul	4
	S. Saphra	1
	S. Schwarzengrund	1
	S. Stanley	1
	S. Tennessee	1
	S. Thompson	2
	S. Typhi	2
	S. Typhimurium	10
	S. Uganda	1
	S. Worthington	1
	Salmonella ssp I	1
	Salmonella ssp I 4,12:-:-	1
	Salmonella ssp I 4,12:i:-	1
	Salmonella ssp I 4,5,12:i:-	6
	Salmonella ssp I 9,12:-:1,5	1
	Salmonella ssp I Rough-O:-:-	1
	Salmonella ssp II 48:d:z6	1
	Salmonella ssp IIIb 43:-:e,n,z15	1
	Salmonella ssp IIIb 48:i:z	1
	Salmonella ssp IIIb 50:z:z52	1
	Salmonella ssp IIIb 60:z52:z35	1
	Salmonella ssp IIIb 61:l,v:1,5,7	3
	Salmonella ssp IV 44:z4,z23:-	1

Appendix 1: Discussion of Data Sources

The past few issues of the Annual Summary have been part of an effort to update and formalize this report series. Annual Summaries for 1995 and earlier years were data reports with tables and figures. Beginning in 1996, we adopted a descriptive report format and the 1997 Annual Summary saw an improvement in the textual information, even though the contents continued to be aimed at directing the reader to find the raw numbers of interest; very little interpretation was given. Production of the 1998 Annual Summary involved a fundamental shift in our handling of enteric data. Notably, the component data sets began to be stored by source, allowing a more balanced set of estimates of the number of lab-confirmed isolates in Canada. A simple estimator, the maximum value among the overlapping data sets, was introduced, based on the assumption that over-estimation is not likely. All of this work made the information easier to access, and organized the available data sets in anticipation of their more effective use. The 1999 and 2000 were completed with further enhancements and data clarification early in 2002. The 2001 Annual Summary attempted to redesign some of the figures and tables to convey more meaningful information. Footnotes and explanations have been added to help the reader understand the data sets and limitations of the information presented. This Annual Summary will allow the reporting processes to be up to date and address data acquisition issues involved in the compilation of the *Campylobacter* reporting. To facilitate the production of this report quickly, the 2004 *Campylobacter* data will be included in the 2005 annual summary.

Although data on acute gastro-intestinal illness (AGI) is routinely collected as part of a passive surveillance system, AGI remains significantly under-reported, and consequently under-counted in Canada. The under-reporting of this illness results from the relatively small number of ill patients who seek medical attention, despite AGI being quite common in the Canadian population. According to preliminary data resulting from the National Studies on Acute Gastro-intestinal Illness (Foodborne, Waterborne and Zoonotic Infections Division, CIDPC), only a small fraction (13%) of the approximately 1 in 5 people who do seek care for AGI, are requested to submit a specimen for laboratory testing. Consequently, the data on the enteric pathogens presented in this report represent only the "tip of the iceberg".

Currently in Canada, surveillance of disease caused by gastro-intestinal pathogens is accomplished through two separate, yet complementary systems: a laboratory based and an epidemiologically based method of collecting data. Generally, an illness is recorded when an individual seeks medical assistance from their local doctor, a specimen is collected for analysis, the specimen is tested, a pathogen isolated, identified and reported to the provincial health laboratory. A local lab may forward an isolate on to the provincial health laboratory for further testing and/or confirmation, which is then captured by the National Enteric Surveillance Program (NESP). In turn, the provincial laboratory may forward the culture on to the national laboratory for further characterization.

Within the epidemiology arm, the National Notifiable Diseases Reporting System (NDRS) receives data that are collected on a mandatory basis by the local health units for an established set of communicable diseases. Eight provinces and territories (BC, AB, SK, ON, QC, NF, YK and NU) provide case-by-case reports that include demographic, clinical, laboratory (minimal) and additional epidemiologic data. The remaining provinces and territories (NB, NS, PE, MB and NT) report aggregate data. Because legislation requires the reporting of this information by the health units, the epidemiologically based processes tends to be more reliable for total numbers of illnesses (i.e. Salmonellosis). The NESP data however, supplemented with the National Microbiology Laboratory (NML) characterizations, has better strain characterization information (i.e. numbers of *Salmonella* ssp I 4,5,12:i:- isolations).

Discrepancies in numbers between the two surveillance systems can be largely attributed to under-reporting caused by interruptions in the data transfer chain.

Weekly reports of laboratory-based analysis at the provincial laboratories forwarded as part of the NESP are summarized for annual numbers. In addition, ten provincial laboratories send us paper/electronic reports: some send monthly reports, some annual, and some send data in raw form or reports specifically produced for this document. The non-human data arrive in monthly and an annual paper report from Laboratory for Foodborne Zoonoses, Guelph, Ontario (LFZ) and data is selected and interpreted for this compilation. The Centre for Infectious Disease Prevention and Control (CIDPC) provides annual totals of gastro-intestinal disease information from their NDRS database. Data from NML is collected from various paper and electronic sources: from the Laboratory Data Management System / Canadian Integrated Public Health Surveillance (LDMS/CIPHS), our current operational database at NML; from specialized custom electronic databases (e.g., data from the Molecular Typing Laboratory and Phage Typing, Antimicrobial Resistance and Surveillance Laboratory); and from handwritten laboratory notebooks.

Given the large number of data sets and sizes of the data matrices, the accurate and timely production of this report presents a major challenge. Another characteristic of enteric data is that, while all numbers are categorical (counts), most are so small that they could be treated as binary (presence/absence) without loss of information, while a few exhibit large enough counts that their data can be treated as continuous. Another challenge stems from the fact that not all data within a particular database are equally meaningful, one datum may represent one case of human illness, a different datum may represent many cases (as is the case with outbreaks). Not all databases are of uniform quality and the differences must be addressed. For example, some databases result as isolates are submitted at the good will of the submitting doctor or nurse, while other databases result as isolates are submitted as part of a formal data collection program.

Lastly, since the data sets are not random samples meant to estimate some population parameter, it is even hard to visualize usual statistics, like accuracy and precision. If there was only one database for each category of information (e.g., data from human isolates in Manitoba), then we would have one unambiguous estimate of the number of lab-confirmed cases of enteric pathogens in that category. However, there is usually more than one data set corresponding to each category and specimens and isolates are often sent between regions for analysis using specialist expertise that may exist there. It is a challenge even to correctly produce an estimate of the number of isolates processed through Canadian laboratories. The laboratory data are attractive and useful mainly because they are available, often extending back in time many years.

It is thus clear that it is desirable that the data sets be treated systematically with regards to data quality. Yet, given the nature of the data, there is no systematic, analytical way of determining data quality. The only way to end up with the best data estimates is to deal carefully with each dataset, with as much knowledge about their origin and characteristics as available. This, at least, will ensure the best possible estimates. Now that the datasets are stored separately, it is possible to evaluate them. This is done below, by type of organism.

Human *Salmonella*

The reported number of isolates in the provincial reports and NESP are very similar. The individual differences are quite unique: both *Salmonella* sp. and *Salmonella* ssp. I are consistently higher in NESP and this may be a product of the timely reporting inherent in the design of NESP. By subtracting numbers, for example of *S.* Heidelberg and *S.* Typhimurium found in the LDMS/CIPHS database (as a result of reference services provided by NML) from the total reported *Salmonella* serogroup B numbers, a more accurate estimate can be achieved. As well, by adding a number of a generic group of *Salmonella* sp. to the totals to adjust level to those reported by the NDRS database, and thereby maintaining a constant denominator, the relative proportions of organisms can be compared from year to year. Differing identification procedures and antisera availability across provinces affect accuracy of the data, however proficiency testing is improving testing comparability.

Salmonella phage types

Analyses showed that the overlap between the NML and the LFZ data are minimal, with the NML database contributing information mainly about human isolates and LFZ data relating mainly to animal isolates. The non-human data are mainly from agriculture and veterinary labs; many isolates also come from Canadian Food Inspection Agency (CFIA) laboratories and Health Canada research laboratories. The few human samples that are recorded in LFZ's reports are mainly from research projects. Isolates are submitted to LFZ and NML for routine reference services, passive surveillance, studies and outbreak investigations.

Non-human *Salmonella* serovars

Provincial distributions of LFZ data are considered reasonable approximations of what is actually happening in the field, with the possible exception of *S*. Heidelberg (Anne Muckle, LFZ, personal communication). As with the non-human phage type data, isolates are submitted mainly by the good will of agriculture, veterinary and university laboratories and are not part of a structured sampling plan.

Escherichia coli

E. coli data is based largely on isolations reported to the NESP and supplemented with identifications from NML reference services. Few provinces routinely report fully antigenically characterized verotoxigenic *E. coli* isolations and therefore the values represented are largely those that have been forwarded to the NML. A national reporting standard for all VTEC is needed in order to provide a complete national picture of disease caused by this group of organisms.

It is difficult to assess the importance to human disease in Canada of the non-O157 *E. coli* organisms. The independent submission of isolates with the same serotype from different provinces suggests that laboratory surveillance may be detecting events occurring over larger geographical areas. However, the limited number of reported isolates makes it difficult to separate possible events or trends from chance associations, or to follow up on such cases epidemiologically. It is likely that the number of illnesses caused by these organisms is higher than the available data indicate. For example, the provincial laboratory in British Columbia currently reports the majority of human infections of non-O157 VTEC in Canada. Increased detection of these organisms in some provinces appears to be the result of enhanced surveillance through the use of testing protocols specific for VTEC. Assuming that non-O157

VTEC are found in the same ratio to the population as in the rest of Canada, this *E. coli* virulence group contributes significantly to morbidity due to enteric pathogens throughout the country. Since the disease symptoms of a subset of the non-O157:H7 VTEC are as severe as those for *E. coli* O157:H7, it would seem that future surveillance systems should consider testing for all VTEC across Canada.

Finally, please note that the EPEC were designated as such only on the basis of serotype, not on the basis of the FAS test or the presence of the *eae* gene in the absence of verotoxin genes.

Campylobacter, Arcobacter, and *Helicobacter*

Large differences exist between numbers of reported *Campylobacter jejuni/coli* cases in the NDRS database (epidemiology side) and the NML/NESP database (laboratory side). For example, in 1998, 10- to 31-fold differences existed between the numbers of *Campylobacter* cases reported in the NDRS database and the NML/NESP database in Ontario, Québec, British Columbia and Alberta, with the number of *Campylobacter* cases in the NDRS database being consistently higher. Due to the very large number of specimens, isolates are sent or reported from local laboratories to the provincial/territorial laboratories with lower frequencies. Information pertaining to these isolates is therefore made available only by reporting of cases through the health units to provincial epidemiologists, which contributes to the differences between the databases. Since isolates of other species of *Campylobacter* have been sent for laboratory confirmation, the two data sets are in better agreement.

Arcobacter and *Helicobacter* are no longer included in the summary. Improved laboratory identification methods have resulted in better identification of *Campylobacter. Arcobacter* and *Helicobacter* are now rarely found and information on these organisms are no longer deemed necessary to gain a full picture of the isolation of *Campylobacter* in Canada.

Shigella

There were many differences between the provincial and NESP databases but total numbers were relatively comparable. It could be that the differences are due to reporting, but it is not clear which are the most accurate data. Travel information has been identified as a risk factor for Shigellosis, however it is inconsistently reported. Data was supplemented by reference service identifications held in the NML database.

Yersinia

Although not a nationally notifiable disease, and listed as reportable in only 7 provinces, *Yersinia* constitutes a considerable proportion of gastro-intestinal disease in Canada. Reported numbers of disease are likely under reported and data may not be representative of true incidence.

Parasites

Parasitic gastro-intestinal infections, such as *Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*, have recently become of more interest and private laboratories are referring more testing to the provincial labs. Currently in many provinces, analysis of stool specimens for parasites is only done for specific requests by physicians or for cluster related specimens that are forwarded to the provincial laboratories. Although *Giardia* has been nationally notifiable for some time, *Entamoeba* is currently not and *Cryptosporidium* and *Cyclospora* were notifiable only since January 2000. Therefore numbers of isolations reported will not be representative of all cases occurring in Canada.

Viruses

Enteric viruses (Norwalk-like virus, Calicivirus, Rotavirus, etc.) are currently not represented in this compilation. Differing identification capabilities across Canada make it impossible to collect and summarize this data in a reasonable and standardized way. As the importance of this group of organisms to public health becomes more evident, cases of infection will be reported more reliably to current surveillance systems and then may be included in future annual summaries.

The Future

Progress is now being made in dealing with data standardization problems. An annual meeting of NESP stake-holders was initiated in 2001 and this is an important step in the process of obtaining a shared understanding of Canadian enteric disease reporting. There have recently been national meetings concerned with laboratory standardization and new initiatives by the CIDPC in conjunction with the NML, the LFZ, CPHLN and the Bureau of Microbial Hazards, Food Directorate and Healthy Products and Foods Branch, are aimed at developing a more comprehensive and complete national surveillance system. Cooperation and coordination between the various contributors to enteric surveillance in Canada continues to improve and new programs such as the Canadian Integrated Program for Antimicrobial Resistance (CIPARS) will enhance data validity.

By looking at the Canadian experience in an international perspective, it is useful to note that systems in use in the U.S., U.K. and Australia also collect only a small fraction of cases and outbreaks that actually occur. These deficiencies in data collection can be addressed through the implementation of a system analogous to the FoodNet system in the U.S. In such a case, the laboratory isolation data and reports of food-borne illness incidents would become only two components of a surveillance system that would also collect data through systems providing early alert of disease and the use of special epidemiological studies and surveys to determine a more accurate level of morbidity. Recent developments in this area include NSAGI, C-EnterNet, PulseNet Canada, Canadian Integrated Outbreak Surveillance Centre, Canadian Network for Public Health Intelligence and a web-based National Enteric Surveillance Program.

Information pertaining to isolates from animals suffers from similar deficiencies. There has never existed a nationwide network for obtaining a statistically valid sample of enteric bacteria infecting animals. Most data are collected through special projects and collated by the LFZ, while some data are collected by provincial PPHLs and reported through the NESP or in monthly/annual/ad hoc reports.

This report gives an estimate of the types of pathogenic enteric organisms circulating within Canada; identifies broad trends in populations of these enteric pathogens; identifies unusual public health events; identifies gaps where more surveillance data needs to be collected; and identifies knowledge gaps requiring further research. We trust that this report will be both informative and useful to you.