Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 2006

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

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This report summarizes the information received from federal, provincial and public health agencies on enteric pathogens identified in Canada during 2006. 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.

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Report Highlights

Major Enteric Pathogen Groups:

- *Campylobacter* continues to be the most prevalent enteric pathogen in Canada, though total isolations have been decreasing since 2002.
- *Salmonella* and parasitic infections rank 2nd and 3rd in prevalence, respectively.
- The number of *E. coli* O157 infections have remained relatively constant since 2002, ranking 4th in prevalence.

***Salmonella* from Human Sources:**

- The national isolation rate decreased to 18.0 isolations per 100,000 people in 2006 from 19.6 in 2005.
- Total *Salmonella* infections in 2006 remain elevated above levels observed in 2003 and 2004.
- Ontario had the highest number of *Salmonella* isolations (n=2697) followed by Québec (n=1078) and British Columbia (n=735).
- Nunavut had the highest isolation rate with 51.9 isolates per 100,000 people, followed by New Brunswick (24.6) and the Northwest Territories (23.9), whereas Newfoundland and Labrador had the lowest isolation rate with 7.1 isolates per 100,000 people.
- Three serovars: *S*. Enteritidis (23%), *S*. Typhimurium (17%) and *S*. Heidelberg (12%) accounted for 52% of all salmonellosis. Serovars ranking 4th to 15th most prevalent each represented only 1% to 3% of the *Salmonella* infections.
- *S*. Enteritidis isolations in Canada have generally increased since 2002. It is the most prevalent serovar in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Québec and Nova Scotia. *S*. Enteritidis PT 4 and PT 13 are the most predominant phage types, each representing approximately 24% of the *S*. Enteritidis tested. The number of *S*. Enteritidis isolations, as well as the number identified as PT 13, from non-human sources has also increased significantly.
- *S*. Typhimurium isolations have decreased in Canada since 2002. It is the most prevalent serovar in Prince Edward Island. *S*. Typhimurium PT 104 continues to be the most prevalent phage type accounting for 15% of the isolates tested. PT 170 has dramatically increased and now ranks 2nd with 14% of the *S*. Typhimurium isolates tested.
- *S*. Heidelberg isolations have generally decreased in Canada since 2002, reflecting a decrease in prevalence from poultry sources. It is the most prevalent serovar in New Brunswick and Newfoundland and Labrador. *S*. Heidelberg PT 19 continues to be most prevalent representing 38% of the isolates tested, remaining relatively constant since 2001 and PT 29 has decreased from 24% in 2004 to 7% in 2006.

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

- 46% of all non-human *Salmonella* are *S*. Typhimurium (23%), *S*. Heidelberg (13%) or *S*. Kentucky (10%).
- *S*. Typhimurium identifications among non-human sources have increased from 19% in 2002 to 23% in 2006. *S*. Typhimurium continues to be most prevalent from bovine and porcine sources. *S.* Typhimurium PT104 levels have decreased from 43% in 2005 to 23% in 2006.
- *S*. Heidelberg has decreased in prevalence from 23% of the non-human *Salmonella* in 2002 to 14% in 2006. It is the most prevalent serovar isolated from chicken and turkey sources. *S*. Heidelberg PT 19 continues to be the most prevalent phage type among

non-human *S*. Heidelberg strains accounting for 31% of the isolates, surpassing PT29 which predominated in 2005 (36%). PT 19 levels have remained relatively constant at approximately 30% since 2003.

- *S*. Kentucky has remained the 3rd most prevalent serovar isolated from non-human sources since 2002, increasing slightly from accounting for 7% of the identifications to 10% in 2006.
- *S*. Enteritidis has increased in prevalence from less than 1% of the non-human isolates in 2002 to now rank 4th most prevalent with 7%. *S*. Enteritidis PT 8 is the most prevalent phage type in 2006 representing 39% of the non-human strains tested, followed by PT 13 with 26%.
- *S*. Orion is the most prevalent serovar isolated from animal feed, increasing dramatically from accounting for 4% of the animal feed isolates in 2005 to 35% in 2006. There were no *S*. Orion isolates identified from human sources in 2006.

Pathogenic *Escherichia coli*:

- The national *E. coli* O157 isolation rate has increased from 2.4 identifications per 100,000 people in 2005 to 3.1 in 2006.
- Prince Edward Island has the highest isolation rate with 15.9 isolations per 100,000 people, followed by Manitoba (8.8) and British Columbia (3.5).
- PT 14a is the predominant phage type accounting for approximately 61% (n=397) of the 656 isolates tested in 2006, followed distantly by PT 14 with 9% (n=63) and PT 2 with 4% (n=26).

***Campylobacter* (2005)**

- The national *Campylobacter* isolation rate has decreased from 38.1 cases per 100,000 people in 2001 to 29.7 in 2005.
- British Columbia continues to have the highest isolation rate with 36.8 isolations per 100,000 people, followed by Alberta (36.1) and Saskatchewan (23.9).

***Shigella*:**

- The national *Shigella* isolation rate decreased from 3.1 isolations per 100,000 people in 2005 to 2.0 in 2006.
- British Columbia has the highest isolation rate with 3.9 isolations per 100,000 people, followed by Alberta (2.7) and Québec (1.9).
- *S. sonnei* infections accounted for 41% of the *Shigella* infections, followed by *S. flexneri* (31%), *S. boydii* (6%) and *S. dysenteriae* (4%).
- There were no *S*. *dysenteriae* serotype 1 identifications in Canada during 2006.

Parasites:

- The 2006 national parasite (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) isolation rate has remained similar to that of 2005, with 16.8 isolations per 100,000 people.
- The Yukon Territory have the highest isolation rate with 38.5 isolations per 100,000 people, followed by British Columbia (22.2) and Ontario (17.1).

***Yersinia*:**

- The national *Yersinia* isolation rate has remained relatively constant over 5 years, decreasing slightly to 1.8 isolates per 100,000 people in 2006.

- Ontario has the highest isolation rate with approximately 2.9 isolations per 100,000 people, followed by Saskatchewan (2.7) and British Columbia (1.9).
- *Y. enterocolitica* represented the large majority (91%) of *Yersinia* identifications in Canada during 2006.

***Vibrio*:**

- *V. paraheamolyticus* accounted for 56% (n = 25) of the 45 *Vibrio* strains identified in Canada during 2006.
- All three *V. cholerae* O1 identified in Canada in 2006 were travel related. In British Columbia, an isolate of serotype Inaba was associated with travel to India and a serotype Ogawa was related to travel to Mexico. In Ontario, a biotype El Tor was related to travel to Mexico.

Outbreaks:

- There were 101 outbreaks and case clusters reported in Canada during 2006 involving 645 cases of illness. The number of outbreaks has remained similar to that of 2005 (n=106), however the number of illnesses has declined dramatically from last year (n=1654) due to the large Ontario outbreak linked to mung bean sprouts.
- A cluster of 40 *E. coli* O157:H7 cases in Québec were linked to ground beef. Although cases with indistinguishable PFGE patterns were detected in other provinces, no common link was established, and a product recall was limited to Québec.
- 36 cases of *Cyclospora* where linked to 2 restaurants in British Columbia serviced by a common caterer.
- 25 cases of *E. coli* O157:H7 in Manitoba were linked to a daycare.
- 23 cases of *E. coli* O157:H7 were linked to a restaurant/bakery in Ontario.
- 22 cases of *E. coli* O157:H7 in 2 separate outbreaks in Alberta were related to 2 beef donair restaurants.
- 21 cases of *S*. Schwarzengrund in Ontario were linked to locally produced cheese made with raw milk.
- Some other outbreaks of interest include: 4 cases of *S*. Paratyphi B associated with pet turtles and 3 more cases with a tropical fish tank; 11 cases of *Campylobacter jejuni* linked to contaminated bean sprouts; 1 case of *E. coli* O157:H7 linked to a large outbreak in the USA associated with bagged spinach; 17 cases of *E. coli* O157:H7 from 2 separate outbreaks were linked to lettuce; 7 cases of *S*. Newport linked to salad croutons at a fast food restaurant; 2 cases of *S*. Typhimurium linked to a large outbreak in the USA linked to fresh tomatoes; 6 cases of *V. paraheamolyticus* linked to a large outbreak in the USA linked to fresh oysters; and 3 cases of *Y. enterocolitica* linked to the consumption of commercially prepared soy milk.

Public Health Interventions, Outcomes and Policy Review:

- Health Canada hosted a meeting with the Canadian Food Inspection Agency (CFIA), the Public Health Agency of Canada (PHAC) and members of the produce industry to discuss outbreaks linked to produce. Integrated research and communication is underway concerning enteric pathogen contamination of lettuce.
- PHAC is reviewing reporting Standard Operation Procedures for *Clostridium botulinum* within the country following an outbreak associated with carrot juice.

- A working group, formed in 2005 in response to an outbreak in 2004, continues to work on guidelines for the risk assessment of *E. coli* O157:H7 in donairs (A Dialogue on the Recommended Guidelines for Management of the Risks Related to Donairs and Similar Products (Gyros, Kebabs, Chawarmas and Shawarmas).
- Guidelines assessing the health risks of the production and sale of bean sprouts, based on information from a 2005 outbreak continue to be reviewed.

Introduction

Data presented in this report are based on laboratory-confirmed enteric pathogens isolated from humans, food, animals 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.

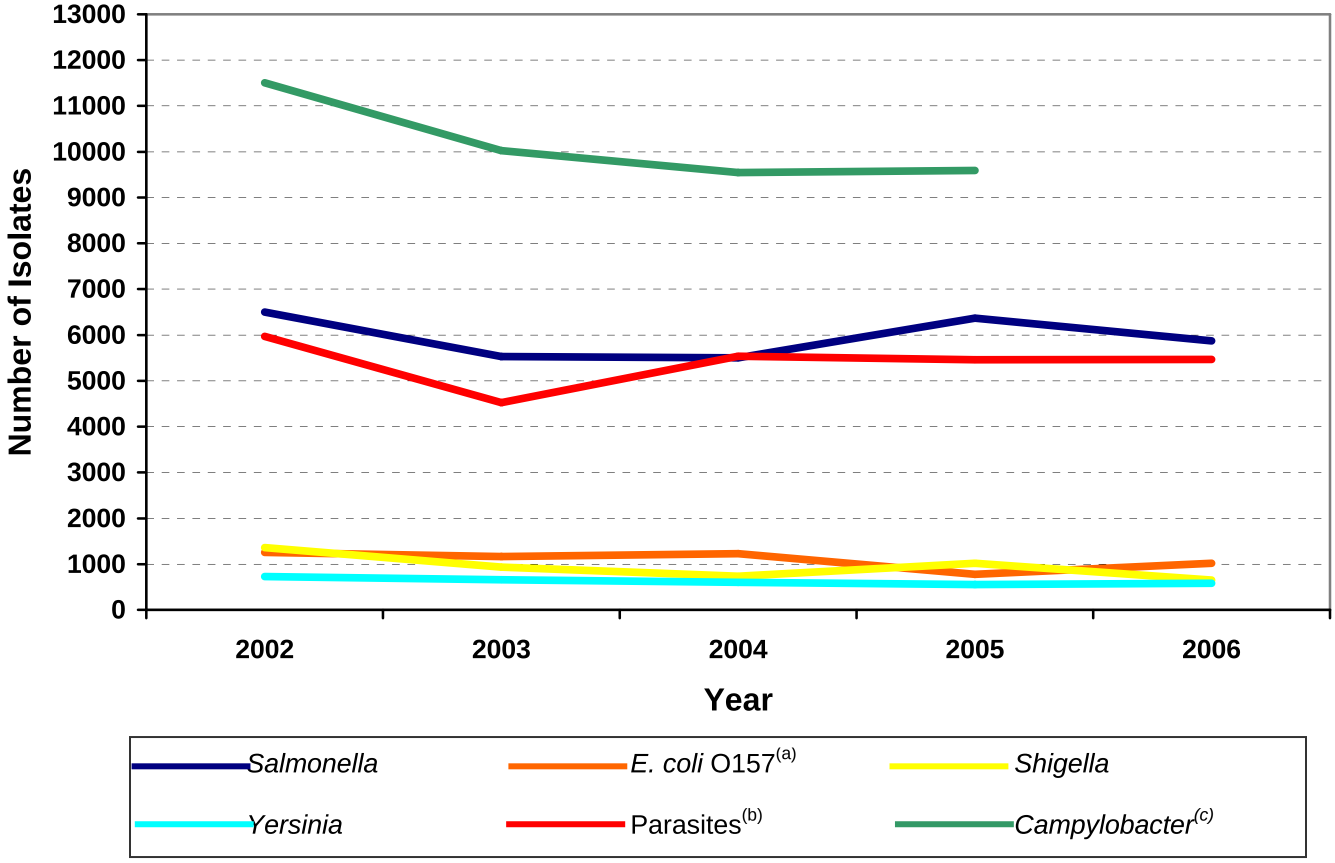
Provincial reports and the NESP database contain summarized aggregated data in the form of weekly, monthly or annual reports of isolates forwarded to the PPHLs for further analysis and characterization. The data sets of the LFZ and the NML are acquired through reference services for the confirmation, 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, forwarded to provincial/territorial health authorities and then collated by the Division of Surveillance and Risk Assessment, Centre for Infectious Disease Prevention and Control (CIDPC). Population estimates used in the calculation of pathogen identification rates per 100,000 people were acquired from Statistics Canada and represent the number of people in a particular jurisdiction as of July 1, 2006.

It should be noted that there are some inherent limitations of the data and any interpretation should be taken 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 among the provinces/territories, the subset of data from each province presented in this report remains relatively 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 2006

Figure 1 illustrates the isolation trends of the 6 major enteric pathogen groups from 2002 to 2006. *Campylobacter*[(c)], *Salmonella* and parasitic infections (*Cryptosporidium*, *Cyclospora*, *Giardia* and *Entamoeba*) represent the majority of isolations of enteric pathogens. *Campylobacter* continues to be the most prevalent enteric pathogen in Canada, increasing slightly from 9547 isolations in 2004 to 9593 in 2005. Although *Salmonella* identifications have decreased from 6368 in 2005 to 5870 in 2006, levels have remained higher than those of 2004 (n=5531) and 2005 (n=5504). Parasitic infections have remained similar to 2005 levels, with 5468 identifications reported in 2006. After decreasing to 778 identifications in 2005, *E. coli* O157 infections have once again increased to 1022 in 2006. *Shigella* isolations have decreased from 1019 isolations in 2005 to 647 in 2006. After a steady decrease during 2002 to 2005, *Yersinia* isolations have edged upward in 2006 with 577 isolations reported.

Figure 1: Major Enteric Pathogens from Humans in Canada, 2002 to 2006



(a) *E. coli* O157 includes *E. coli* O157 VTEC, *E. coli* O157, *E. coli* O157:H7 and *E. coli* O157:NM isolations.
(b) *Entamoeba* is not nationally notifiable and numbers of cases are those reported to the NESP and may be under-reported.
(c) Totals for *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 2006 by NDRS was not complete at time of publication and will be reported in the 2007 Annual Summary.

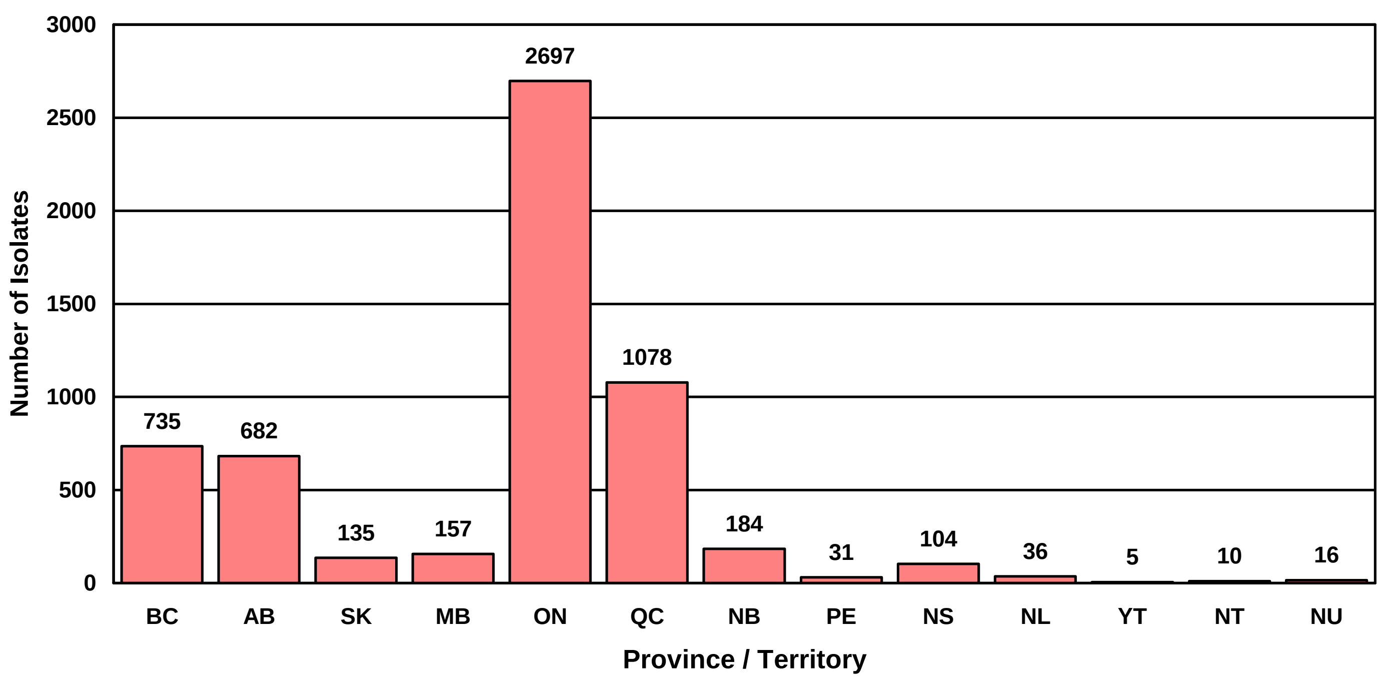
SECTION 2: *SALMONELLA*

Salmonella from Humans in Canada

The total number of *Salmonella* isolations in 2006 from each province is shown in Figure 2 and population based rates for each province over the years 2002 to 2006 is shown in Figure 3. 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.

The national isolation rate has remained relatively constant over the 5 year period from 2002 to 2006, decreasing slightly in 2006 to 18.0 identifications per 100,000 people from 19.6 in 2005. Although Ontario has the highest number of *Salmonella* reported in 2006 with 2697 isolations (Figure 2), its rate of 21.3 isolates per 100,000 people is lower than that of some other provinces (Table 1). Decreases in isolation rates have been seen in Ontario from 25.9 isolations per 100,000 people in 2005 to 21.3 in 2006, and in Nova Scotia from 14.1 to 11.1. Nunavut had the highest isolation rate in 2006 with 51.9 isolations per 100,000 people, a considerable increase from 6.7 in 2005. Isolation rates have also increased in New Brunswick from 18.2 isolations per 100,000 people in 2005 to 24.6 in 2006, as well as in the Northwest Territories (4.7 to 23.9), Prince Edward Island (15.2 to 22.4), Yukon Territory (9.6 to 16.0) and Saskatchewan (8.9 to 13.7). Isolations rate higher than the national average of 18.0 isolations per 100,000 people were seen in Alberta (20.2), Ontario (21.3), New Brunswick (24.6), Prince Edward Island (22.4), Northwest Territories (23.9) and Nunavut (51.9).

Figure 2: Number of *Salmonella* Isolations from Humans in Canada, 2006



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, YT= Yukon Territory, NT=Northwest Territories and NU = Nunavut.

Figure 3: Rates of *Salmonella* Isolations in Canada, 2002 to 2006* (per 100,000 people)

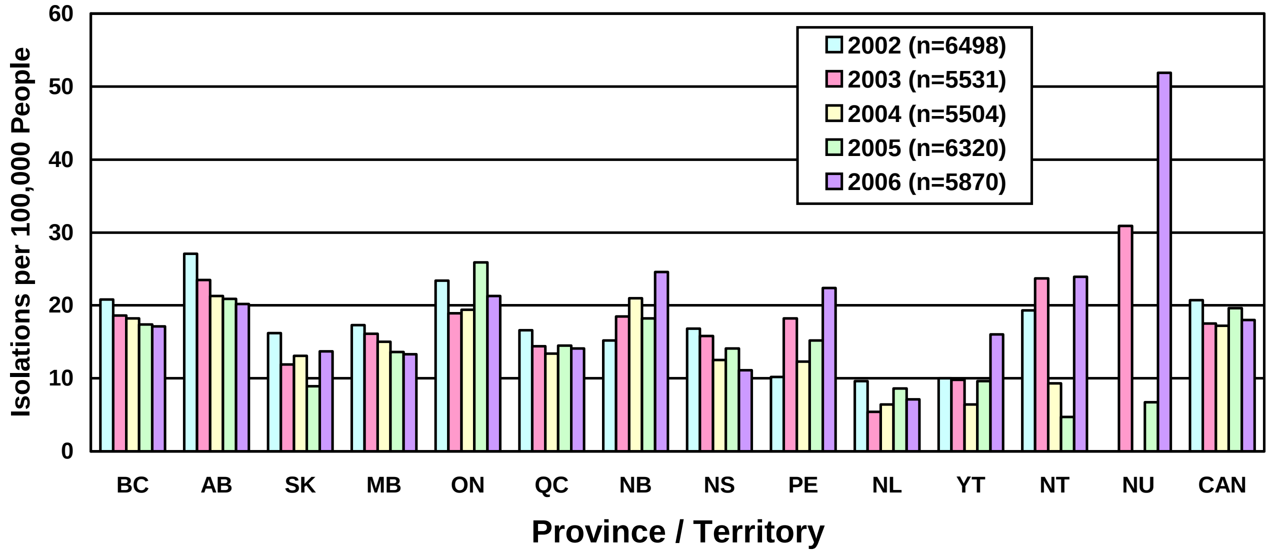


Table 1: Rate of *Salmonella* Isolations per 100,000 People, 2002 to 2006

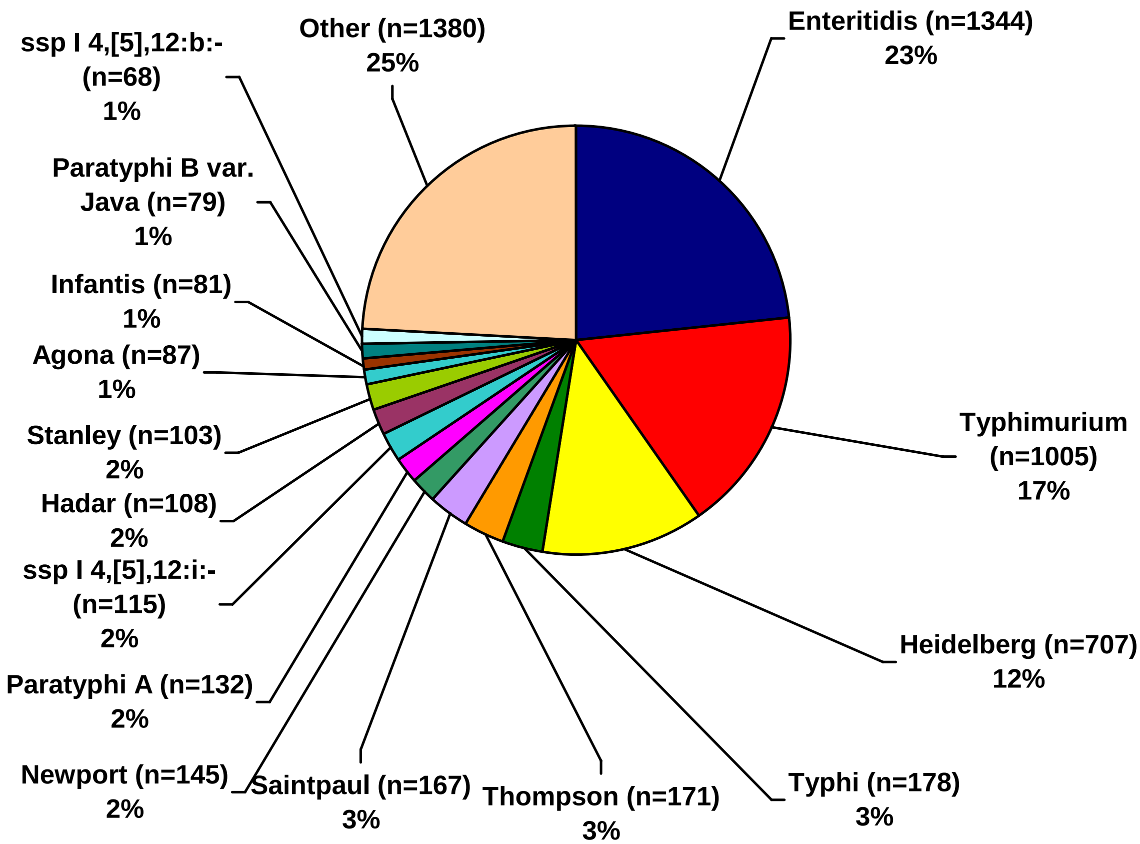
Province / Territory (Population)**	2002	2003	2004	2005	2006
British Columbia (4,310,500)	20.8	18.6	18.2	17.4	17.1
Alberta (3,375,800)	27.1	23.5	21.3	20.9	20.2
Saskatchewan (985,400)	16.2	11.9	13.1	8.9	13.7
Manitoba (1,177,800)	17.3	16.1	15.0	13.6	13.3
Ontario (12,687,000)	23.4	18.9	19.4	25.9	21.3
Quebec (7,651,500)	16.6	14.4	13.4	14.5	14.1
New Brunswick (749,200)	15.2	18.5	21.0	18.2	24.6
Nova Scotia (934,400)	16.8	15.8	12.5	14.1	11.1
Prince Edward Island (138,500)	10.2	18.2	12.3	15.2	22.4
Newfoundland and Labrador (509,700)	9.6	5.4	6.4	8.6	7.1
Yukon Territory (31,200)	10.0	9.8	6.4	9.6	16.0
Northwest Territories (41,900)	19.3	23.7	9.3	4.7	23.9
Nunavut (30,800)	90.6*	30.9	0.0	6.7	51.9
Canada (32,623,500)	20.7	17.5	17.2	19.6	18.0

*The data point for of 90.6 for Nunavut in was removed from Figure 3 to improve scale.
**Population estimate as of July 1, 2006 as reported on the Statistics Canada website.

Salmonella Serovars from Humans in 2006

The relative frequency of isolation of the fifteen most prevalent *Salmonella* serovars from humans in Canada in 2006 is illustrated in Figure 4. *S*. Enteritidis, *S*. Typhimurium and *S*. Heidelberg continue to be the most prevalent *Salmonella* serovars isolated from humans in Canada, together accounting for 52% (n=3056) of the 5870 *Salmonella* isolates reported in 2006. *S*. Enteritidis is most prevalent with 23% (n=1344), followed by *S*. Typhimurium with 17% (n=1005) and *S*. Heidelberg with 12% (n=707) of total isolations. *S*. Typhi (n=178), *S*. Thompson (n=171) and *S*. Saintpaul (n=167) rank a distant fourth, fifth and sixth with 3% each. The seventh most prevalent serovar in 2006 is *S*. Newport (2%, n=145), followed by *S*. Paratyphi A (2%, n=132), *S*. ssp I 4,[5],12:i:- (2%, n=115), *S*. Hadar (2%, n=108) and *S*. Stanley (2%, n=103) is the 11th most prevalent. Serovars ranking 12th to 15th include, *S*. Agona, *S*. Infantis, *S*. Paratyphi B var. Java and *S*. ssp I 4,[5],12:b:-, each accounting for 1% of the isolates identified in 2006. Other serovars represent 25% (n=1380) of the isolates in 2006.

Figure 4: Fifteen Most Prevalent *Salmonella* Serovars from Humans in Canada, 2006* (N=5870)



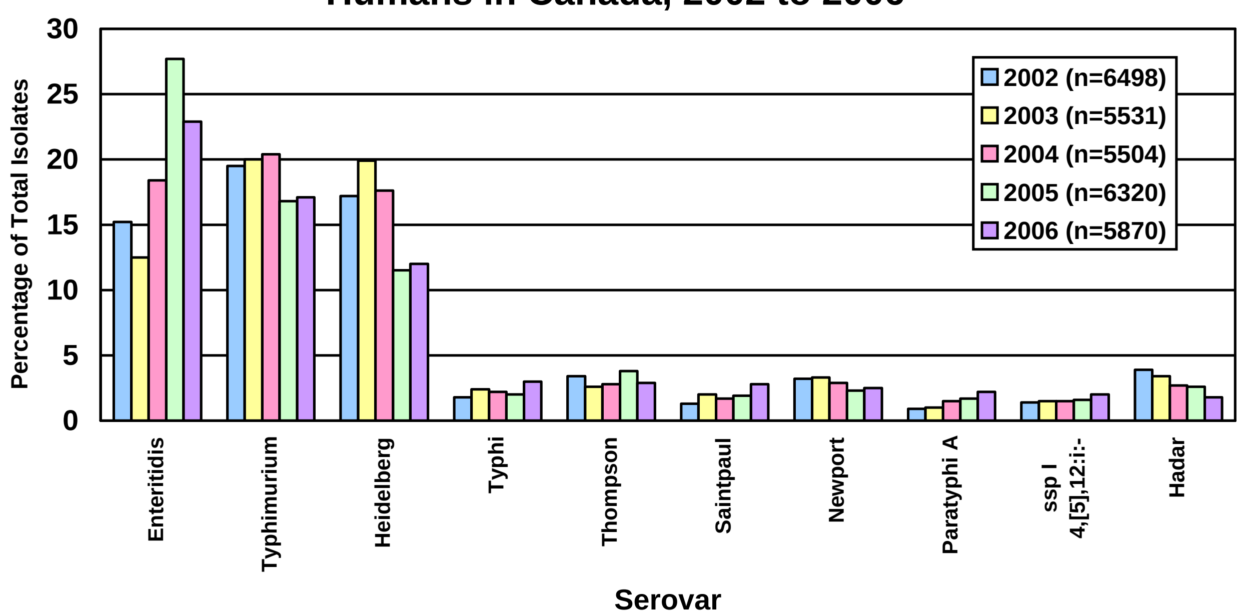
*Serovar totals are laboratory confirmed *Salmonella* based on information supplied to the NESP and supplemented with identifications from NML reference services. Totals include outbreak isolates.

Changes in the Occurrence of *Salmonella* Serovars from Humans in Canada, 2002 to 2006

The relative frequencies of the 10 most prevalent *Salmonella* serovars of human origin from 2002 to 2006 are shown in Figure 5. *S*. Enteritidis has been the most prevalent serovar isolated from humans for two consecutive years, surpassing *S*. Typhimurium and *S*. Heidelberg in 2005. Despite a drop in the relative frequency of *S*. Enteritidis isolations in 2006 to 23% of total *Salmonella* identifications from 27% in 2005, levels remain considerably higher than those of 2002 (15%), 2003 (13%) and 2004 (18%). *S*. Typhimurium isolations had remained relatively constant at approximately 20% between 2002 and 2004, but have declined to 17% in 2005 and 2006. The proportion of *Salmonella* isolates identified as *S*. Heidelberg has also decreased from a high of 20% in 2003 to 12% in 2006. Over the past 5 years, identifications of these three serovars have consistently been elevated above the other top ten serovars.

The remaining seven most prevalent serovars each represent less than 5% of all *Salmonella* isolated and frequencies of isolation remain relatively constant from year to year. *S*. Typhi has increased steadily, from ranking 8th overall accounting for 2% of the isolates in 2002, to rank 4th with 3% of the isolates in 2006. Identifications of *S*. Saintpaul, *S*. Paratyphi A and *S*. ssp I 4,[5],12:i:- have similarly increased in frequency over this 5 year period. A notable decrease in the prevalence of *S*. Hadar isolations has been observed, from ranking 4th with 4% of the *Salmonella* isolates in 2002 to rank 10th with 2% in 2006.

Figure 5: Trends of Most Common *Salmonella* Serovars Isolated from Humans in Canada, 2002 to 2006



Provincial/Territorial Distribution of *Salmonella* Serovars from Humans

The fifteen most prevalent human *Salmonella* serovars isolated for each province and territory during 2006 and the variation in prevalence of the ten most prevalent serovars of each province/territory between 2002 and 2006 are shown in Figure 6. Data for previous years are taken from previous annual summaries and are based on information supplied to the NESP and supplemented with identifications by 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 may indicate the establishment of a persistent strain within the population or a recurring source of infection.

S. Enteritidis is the most prevalent serovar in all provinces and territories in 2006 except in New Brunswick, Newfoundland and Labrador and Prince Edward Island. Nova Scotia has the highest proportion of *Salmonella* identified as *S*. Enteritidis (33%, n=34), followed by Saskatchewan (26%, n=35), Ontario (25%, n=674), Alberta (24%, n=162), Manitoba (23%, n=36), Québec (19%, n=202) and British Columbia (19%, 143). *S*. Enteritidis ranks as the second most prevalent *Salmonella* serovar identified in New Brunswick (19%, n=35) and Prince Edward Island (26%, n=8). Despite a large decline in isolations of *S*. Enteritidis in Ontario from 34% (rank=1) in 2005 to 25% (rank=1) in 2006, the proportion of *S*. Enteritidis identified in 2006 continued to be elevated above those seen between 2002 and 2004. Levels in 2005 were unusually high in Ontario due to a large outbreak of illnesses associated with the consumption of mung bean sprouts. Nova Scotia has also shown a decline in the levels of S. Enteritidis isolations from 41% (rank=1) in 2005 to 32% (rank=1) in 2006. A large increase in *S*. Enteritidis isolations has been noted in Manitoba from 13% (rank=3) in 2005 to 23% (rank=1) in 2006, surpassing *S*. Heidelberg to tie for most prevalent serovar with *S*. Typhimurium. Increases have also been observed in Saskatchewan from a 5 year low of 11% (rank=3) in 2003 to 26% (rank=1) in 2006 and in New Brunswick from 5% (rank=4) in 2003 to 19% (rank=2) in 2006. Levels have remained relatively constant in British Columbia, Alberta and Québec over the previous 3 years, but levels remain higher than those seen in 2002 and 2003.

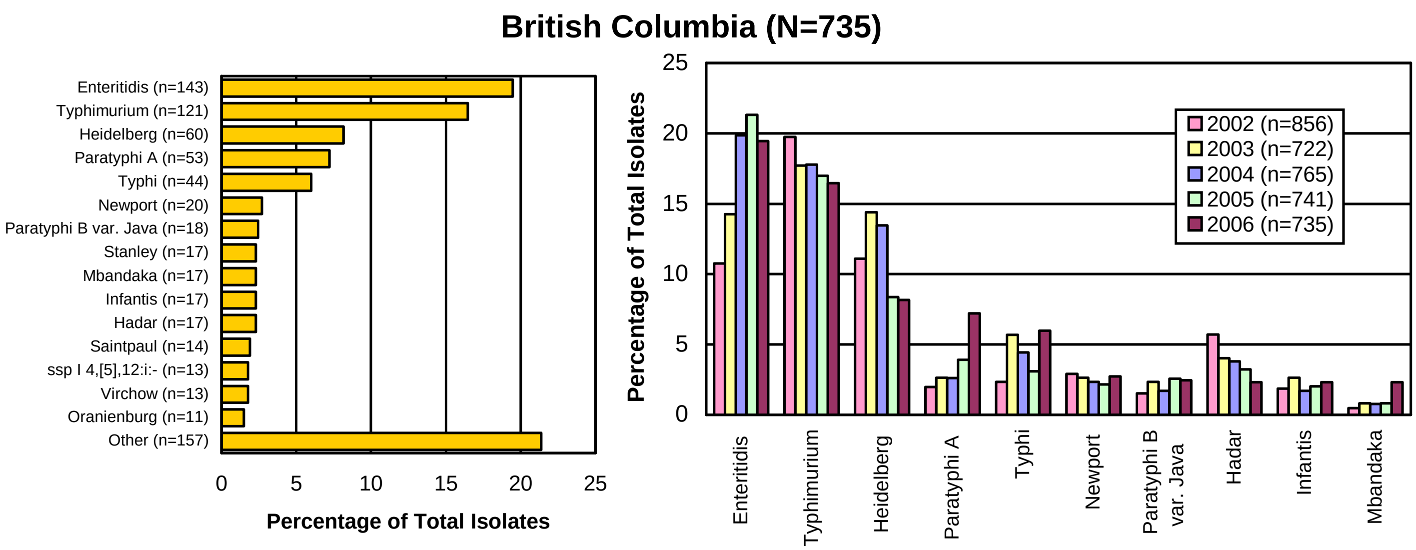
S. Typhimurium was the most prevalent serovar in Prince Edward Island, representing 33% (n=10) of *Salmonella* isolated in that province and ranked 2nd in all other provinces except New Brunswick and Nova Scotia where it ranked 3rd overall. *S.* Typhimurium isolations have remained relatively constant, or have slightly decreased in many provinces in 2006. The largest decrease was seen in New Brunswick where levels have dropped from 28% (rank=1) in 2004 to 15% (rank=3) in 2006. Decreases were also observed in Alberta from 29% (rank=1) in 2003 to 20% (rank=2) in 2006, in Saskatchewan from 21% (rank=1) in 2002 to 16% (rank=3) in 2006 and in Newfoundland and Labrador from 24% (rank=2) in 2004 to 5% (rank=5) in 2006. The largest increase in *S*. Typhimurium isolations has been seen in Prince Edward Island where levels have risen dramatically from 11% (rank=3) in 2004 to 33% (rank=1) in 2006.

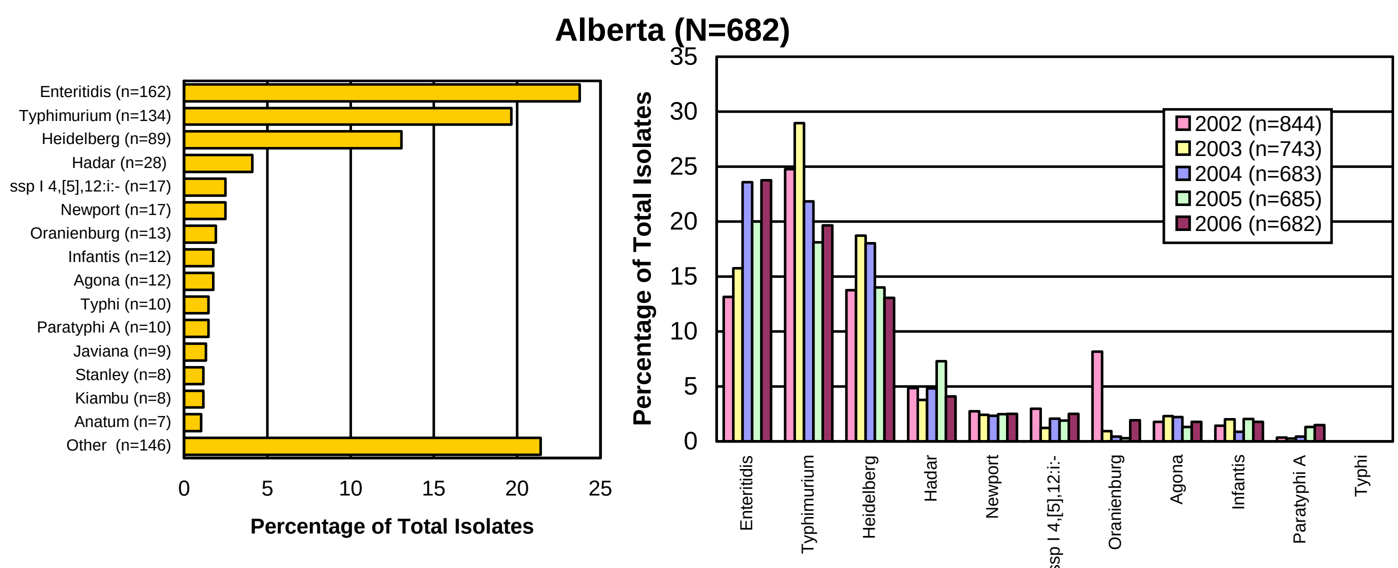
S. Heidelberg is the most prevalent serovar in New Brunswick with 39% (n=72) and in Newfoundland and Labrador with 19% (n=7). It was the second most prevalent serovar in Nova Scotia (17%, n=18) and third most prevalent in all other provinces. *S*. Heidelberg isolations have decreased, or remained relatively constant in all provinces except Nova Scotia and New Brunswick where a marked increase in *S*. Heidelberg isolations has been observed in

2006. Isolations in Nova Scotia have increased from approximately 11% (rank=3) between 2003 and 2005 to 17% (rank=2) in 2006 and in New Brunswick, isolations are up from 18% (rank=2) in 2005 to 39% (rank=1) in 2006. The proportion of *S*. Heidelberg has declined in most provinces, with the largest declines observed in Manitoba where levels have gone from a high of 33% (rank=1) in 2004 to 13% (rank = 3) in 2006. Other declines have been seen in Saskatchewan from 21% (rank=2) in 2004 to 11% (rank=3) in 2006, in Québec from 29% (rank=1) in 2003 to 16% (rank=3) in 2006, and in Newfoundland and Labrador from 50% (rank=1) in 2002 to 20% (rank=1) in 2006. *S*. Heidelberg isolation levels have remained relatively constant between 2005 and 2006 in British Columbia (approx. 8%), Alberta (approx. 13%) and Ontario (9%).

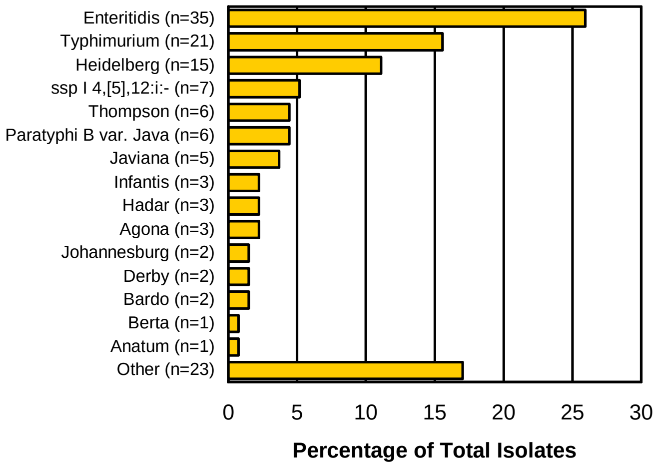
Other increases of note over the 5-year period include: *S*. Paratyphi A (rank=4) and *S*. Typhi (rank=5) in British Columbia; *S*. Agona (rank=2) in Newfoundland and Labrador; and *S*. ssp I 4,[5],12:i:- in Alberta (rank=6), Saskatchewan (rank=4), New Brunswick (rank=4), and Prince Edward Island (rank=4).

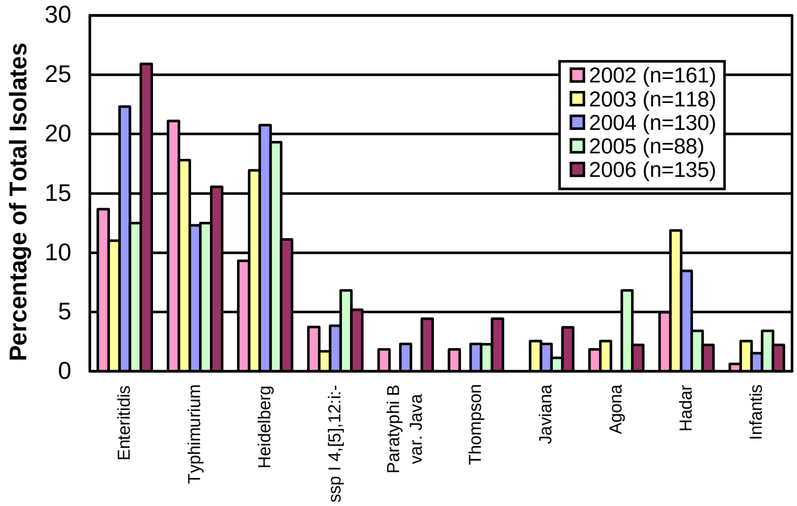
Figure 6: Most Prevalent *Salmonella* Serovars from Humans in Each Province/Territory in 2006



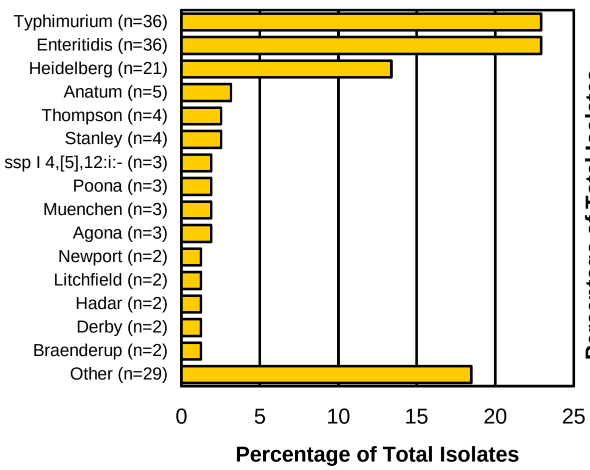


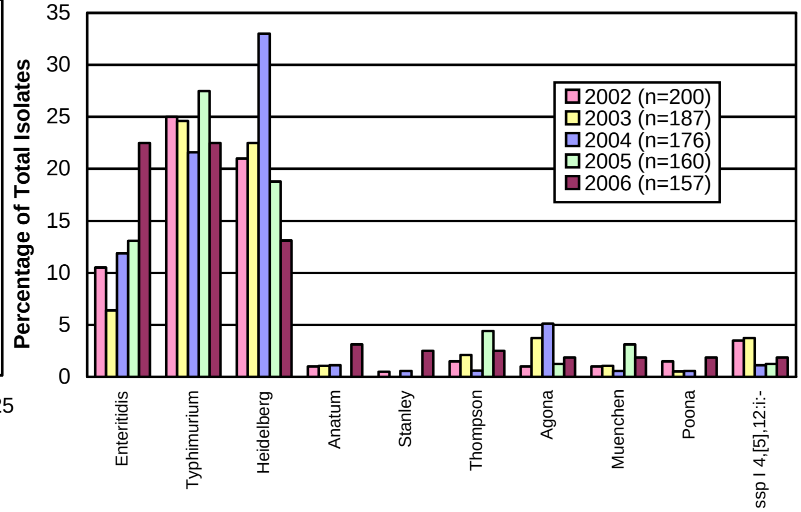
Saskatchewan (N=135)



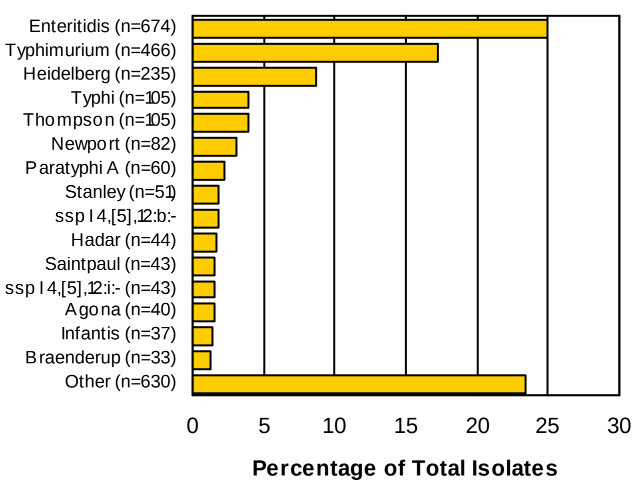


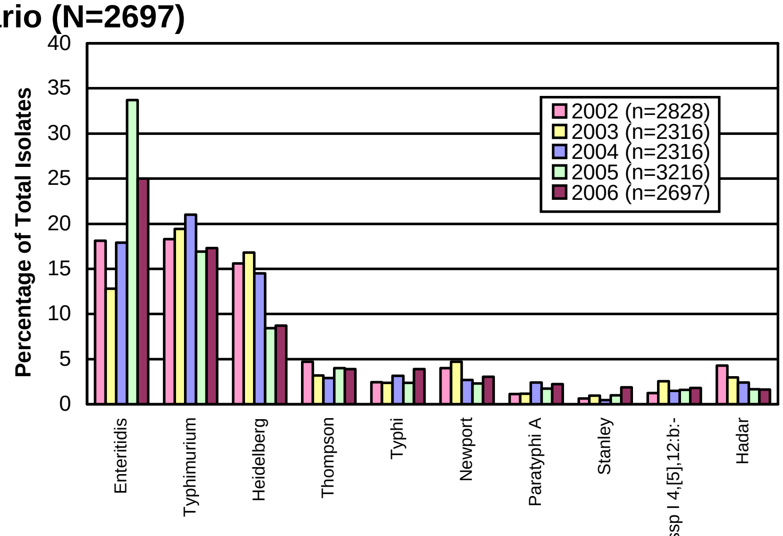
Manitoba (N=157)



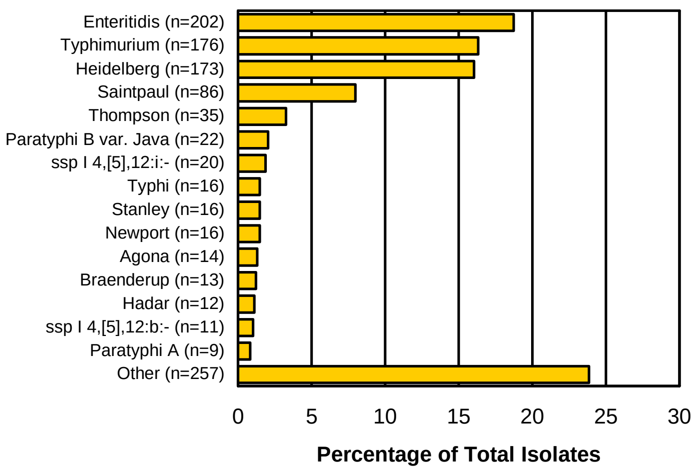


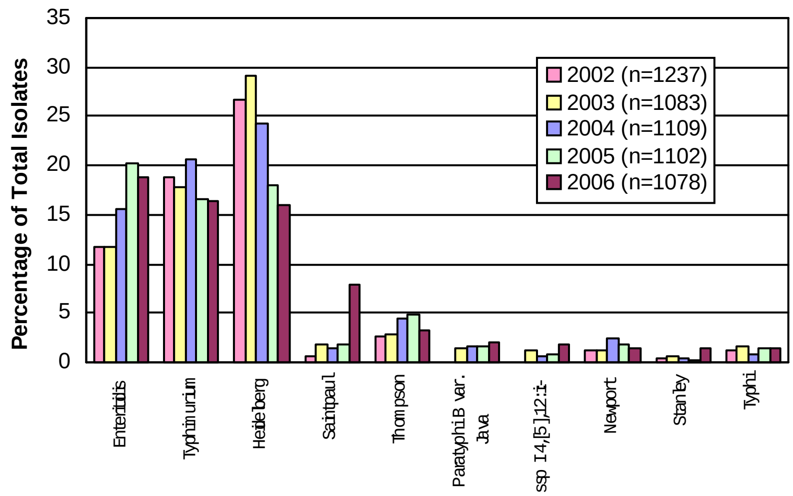
Ontario (N=2697)



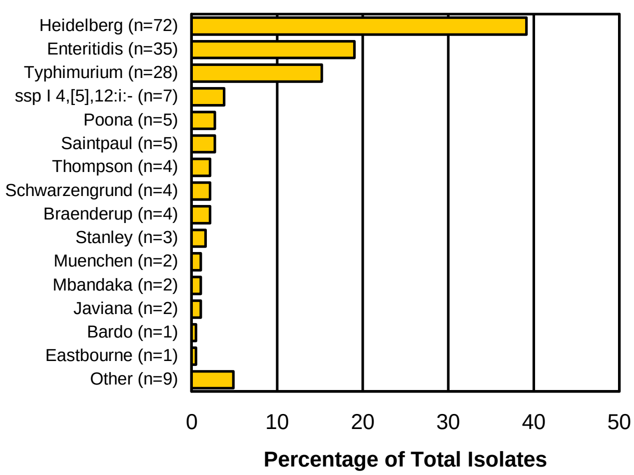


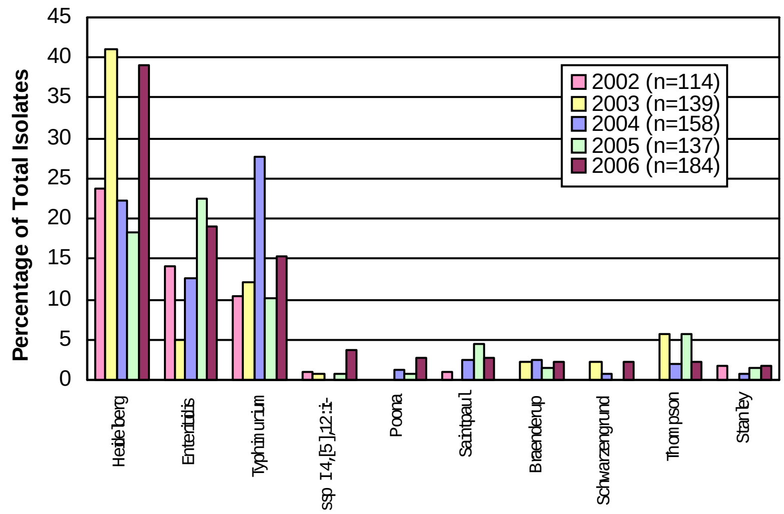
Québec (N=1078)



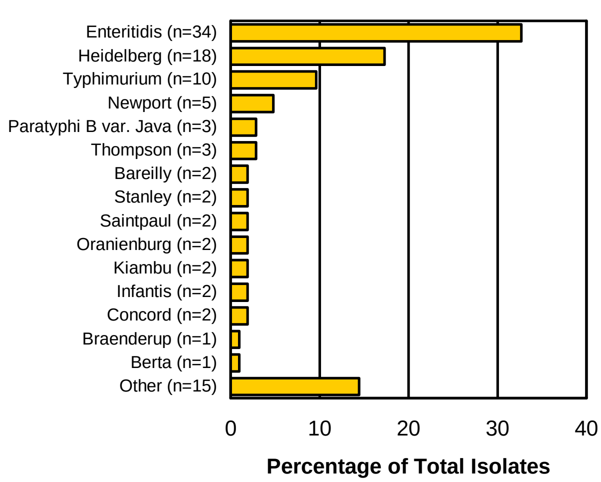


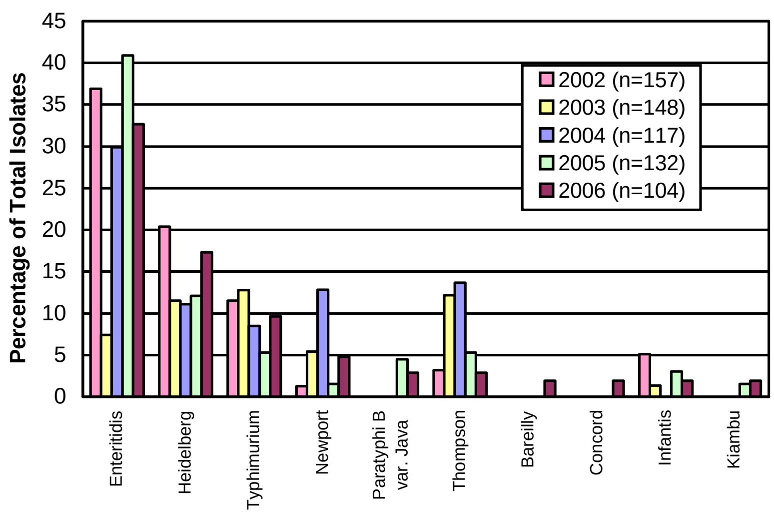
New Brunswick (N=184)



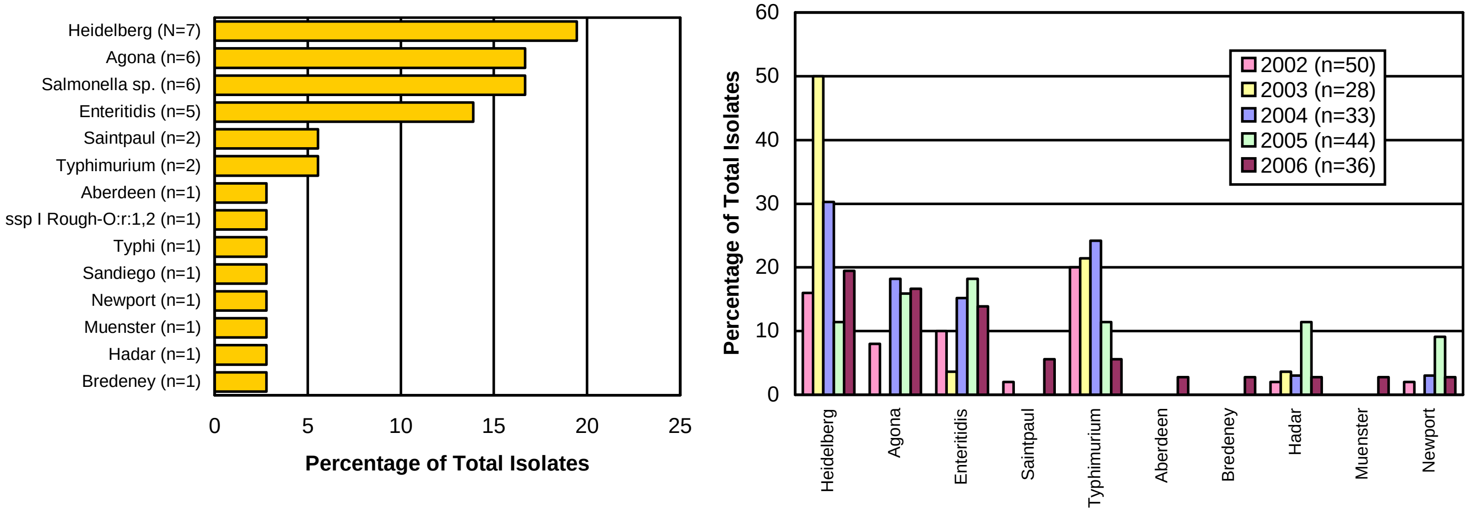


Nova Scotia (N=104)

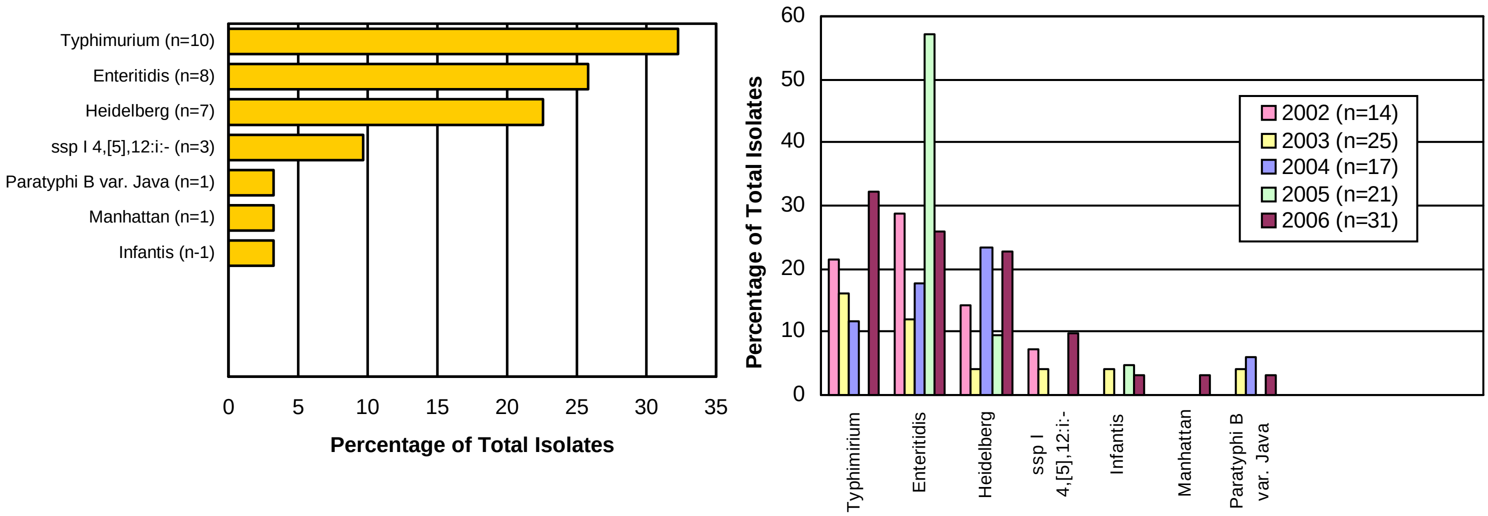




Newfoundland and Labrador (N=36)



Prince Edward Island (N=31)



Yukon Territory, Northwest Territories and Nunavut (N=31)

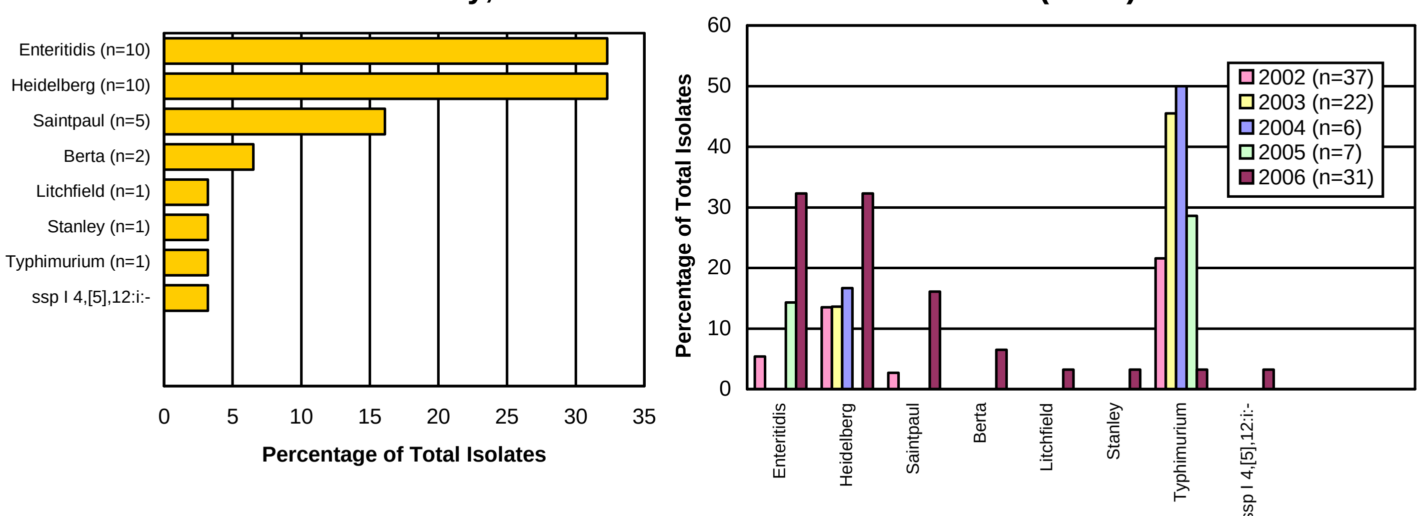


Table 2: *Salmonella* Serovars from Humans in Canada in 2006

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
S. Abaetetuba					2									**2**
S. Aberdeen		1		1	2					1				**5**
S. Abony						1								**1**
S. Adelaide				1	6	2								**9**
S. Agbeni		1												**1**
S. Ago					3									**3**
S. Agona	9	12	3	3	40	14				6				**87**
S. Agoueva					1									**1**
S. Alachua						1								**1**
S. Albany	2				1									**3**
S. Altona	1													**1**
S. Anatum		7	1	5	10									**23**
S. Arechavaleta						1								**1**
S. Baildon					3									**3**
S. Bardo		2	2				1							**5**
S. Bareilly	5				8	2			2					**17**
S. Beaudesert					1									**1**
S. Benin						1								**1**
S. Berkeley	1													**1**
S. Berta	1	2	1		32	2			1			2		**41**
S. Blockley		4			3	1								**8**
S. Bonariensis					2									**2**
S. Bovismorbificans	3	3		1	1									**8**
S. Braenderup	1	5	1	2	33	13	4		1					**60**
S. Brandenburg	3	4			8	6								**21**
S. Bredeney	1				3	1				1				**6**
S. California	1													**1**
S. Canada					1									**1**
S. Caracas					1									**1**
S. Carrau		1												**1**
S. Cerro			1						1					**2**
S. Chandans	1													**1**
S. Chester	2		1		3	1								**7**
S. Choleraesuis	1	1				1								**3**
S. Coeln					2									**2**
S. Colindale		1			2	1								**4**
S. Concord		1		1					2					**4**
S. Corvallis	4	2			1									**7**
S. Cubana					1	1								**2**
S. Daytona	2													**2**
S. Denver					2									**2**
S. Derby	2	5	2	2	17									**28**
S. Drac					1									**1**
S. Dublin						1								**1**
S. Durban		1			2	2								**5**
S. Ealing		1	1		6									**8**
S. Eastbourne					1		1							**2**
S. Ebrie					3									**3**
S. Emek					2									**2**
S. Enteritidis	143	162	35	36	674	202	35	8	34	5	3	4	3	**1344**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
S. Farakan						1								**1**
S. Florida					1									**1**
S. Gaminara		1	1											**2**
S. Gatow						2								**2**
S. Gatuni	1				1									**2**
S. Give		1			2	1								**4**
S. Goettingen					1									**1**
S. Goldcoast						1								**1**
S. Grumpensis						1								**1**
S. Haardt		1												**1**
S. Hadar	17	28	3	2	44	12			1	1				**108**
S. Haifa					3									**3**
S. Hartford		1			12	1								**14**
S. Havana		1			5	1	1							**8**
S. Heidelberg	60	89	15	21	235	173	72	7	18	7	1	2	7	**707**
S. Herston					1									**1**
S. Hull	1				1									**2**
S. Hvittingfoss	2	1			5	2								**10**
S. Ibadan		1				1								**2**
S. Ikeja						1								**1**
S. Indiana		1			5	2								**8**
S. Infantis	17	12	3	1	37	8		1	2					**81**
S. Inverness							1							**1**
S. Irumu	1													**1**
S. Istanbul		3												**3**
S. Jangwani					1									**1**
S. Javiana	8	9	5	1	16	7	2		1					**49**
S. Johannesburg	1		2	1	2									**6**
S. Kedougou					1									**1**
S. Kentucky	1		1		9	6								**17**
S. Kiambu	4	8	1		18	3			2					**36**
S. Kingabwa				1	3									**4**
S. Kintambo				1	1									**2**
S. Kottbus					5									**5**
S. Landwasser					1									**1**
S. Lansing	1													**1**
S. Litchfield	3	2		2	14	3	1						1	**26**
S. Livingstone		1												**1**
S. Lomalinda		1												**1**
S. London	4													**4**
S. Madelia					1									**1**
S. Makisao					1									**1**
S. Makiso					1									**1**
S. Malstatt					1									**1**
S. Manhattan	5	3			16			1						**25**
S. Matadi						1								**1**
S. Mbandaka	17	6			17	4	2							**46**
S. Meleagridis					1									**1**
S. Mgulani		1												**1**
S. Miami						1								**1**
S. Minnesota					2									**2**
S. Mississippi					15									**15**

Organism	**BC**	**AB**	**SK**	**MB**	**ON**	**QC**	**NB**	**PE**	**NS**	**NL**	**YT**	**NT**	**NU**	**Total**
S. Mjulani		1												**1**
S. Monshchaui						2								**2**
S. Montevideo	9	7			27	8			1					**52**
S. Muenchen	4	4	1	3	33	4	2							**51**
S. Muenster	4	2	1	1	6	6			1	1				**22**
S. Napoli					1									**1**
S. Nessziona	1	1												**2**
S. Newport	20	17	1	2	82	16	1		5	1				**145**
S. Nima	1				2									**3**
S. Norwich					1									**1**
S. Ohio		2			3	1								**6**
S. Oranienburg	11	13	1	2	30	8			2					**67**
S. Orientalis	1													**1**
S. Oslo	1	1			1	1								**4**
S. Overschie					1									**1**
S. Panama	3	4		1	7	6								**21**
S. Paratyphi A	53	10			60	9								**132**
S. Paratyphi B	2	1			3	1								**7**
S. Paratyphi B var. Java	18	7	6	2	19	22	1	1	3					**79**
S. Pensacola	1													**1**
S. Poano		1												**1**
S. Pomona			1		5	1								**7**
S. Poona	1	5	1	3	16	6	5		1					**38**
S. Portland	1													**1**
S. Potsdam	1				1									**2**
S. Praha					3									**3**
S. Reading	2				2									**4**
S. Richmond						1								**1**
S. Rissen	3													**3**
S. Roodepoort		1												**1**
S. Rubislaw					3	1								**4**
S. Saintpaul	14	7	1	2	43	86	5		2	2		1	4	**167**
S. Sandiego	2	1		1	8	1				1				**14**
S. Schwarzengrund	3	1			30	5	4							**43**
S. Senftenberg	3	6	1		12	2								**24**
S. Singapore					2									**2**
S. Soerenga	1													**1**
S. Stanley	17	8	1	4	51	16	3		2		1			**103**
S. Stanleyville					1									**1**
S. Takoradi					2									**2**
S. Telelkebir					7	2								**9**
S. Tennessee		1			13	1								**15**
S. Thetford					1									**1**
S. Thompson	10	4	6	4	105	35	4		3					**171**
S. Tomegbe					1									**1**
S. Toucra									1					**1**
S. Typhi	44	10	1	1	105	16				1				**178**
S. Typhimurium	121	134	21	36	466	176	28	10	10	2		1		**1005**
S. Uganda	3			1	10	3			1					**18**
S. Urbana	1				4									**5**
S. Vejle		1												**1**
S. Virchow	13	3		1	23	5			1					**46**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
S. Virginia		1		1	2									**4**
S. Wandsworth		1		1										**2**
S. Wangata					1									**1**
S. Waycross					1									**1**
S. Weltevreden	8	1			7									**16**
S. Worthington					1									**1**
Salmonella ssp I 4,[5],12:-:-	1				4	2								**7**
Salmonella ssp I 4,[5],12:-:1,2	1	1			4									**6**
Salmonella ssp I 4,[5],12:-:e,n,x				1										**1**
Salmonella ssp I 4,[5],12:a:-	1													**1**
Salmonella ssp I 4,[5],12:b:-	4	3	1		49	11								**68**
Salmonella ssp I 4,[5],12:d:-					1									**1**
Salmonella ssp I 4,[5],12:e,h:-					1									**1**
Salmonella ssp I 4,[5],12:i:-	13	17	7	3	43	20	7	3	1				1	**115**
Salmonella ssp I 4,[5],12:r:-						1								**1**
Salmonella ssp I 6,7:eh:-						1								**1**
Salmonella ssp I 6,7:k:-	1													**1**
Salmonella ssp I 6,7:z29:-				2										**2**
Salmonella ssp I 6,8:-:1,2					1									**1**
Salmonella ssp I 6,8:-:e,n,x	1													**1**
Salmonella ssp I 6,8:e,h:-					1									**1**
Salmonella ssp I 8,20:i:-	1				1									**2**
Salmonella ssp I 8:i:-					1									**1**
Salmonella ssp I 9,12:-:-		1			2									**3**
Salmonella ssp I 9,12:-:1,5					1				1					**2**
Salmonella ssp I 9,12:-:e,n,x		2												**2**
Salmonella ssp I 9,12:r:-					1									**1**
Salmonella ssp I 3,10:e,h:-				1										**1**
Salmonella ssp I 13,22:-:-		1												**1**
Salmonella ssp I 43:k:-					1									**1**
Salmonella ssp I Rough-O:-:-	1				8									**9**
Salmonella ssp I Rough-O:b:1,5									1					**1**
Salmonella ssp I Rough-O:f,g:-						1								**1**
Salmonella ssp I Rough-O:i:1,2		1												**1**
Salmonella ssp I Rough-O:k:1,5			1											**1**
Salmonella ssp I Rough-O:l,v:1,2							1							**1**
Salmonella ssp I Rough-O:m,t:-		1												**1**
Salmonella ssp I Rough-O:r:1,2						1	1			1				**3**
Salmonella ssp I Rough-O:z:1,5									1					**1**
Salmonella ssp I Rough-O:z10:e,n,x						1								**1**
Salmonella ssp I Rough-O:z10:e,n,z15		1												**1**
Salmonella ssp I Rough-O:z4,z23:-			1											**1**
Salmonella ssp II	1													**1**
Salmonella ssp II 21:z10:z6		1				1								**2**
Salmonella ssp II 30:l,z28:z6						1								**1**
Salmonella ssp II 4,12,27:b:-					1									**1**
Salmonella ssp II 40:c:e,n,x,z15					1									**1**
Salmonella ssp II 42:r:-			1											**1**
Salmonella ssp II 58:c:z6					1									**1**
Salmonella ssp II 58:l,z13,z23:z6					1									**1**
Salmonella ssp II 9,12:l,z28:1,5:z42					1									**1**
Salmonella ssp IIIa 11:z4,z23:-						2								**2**

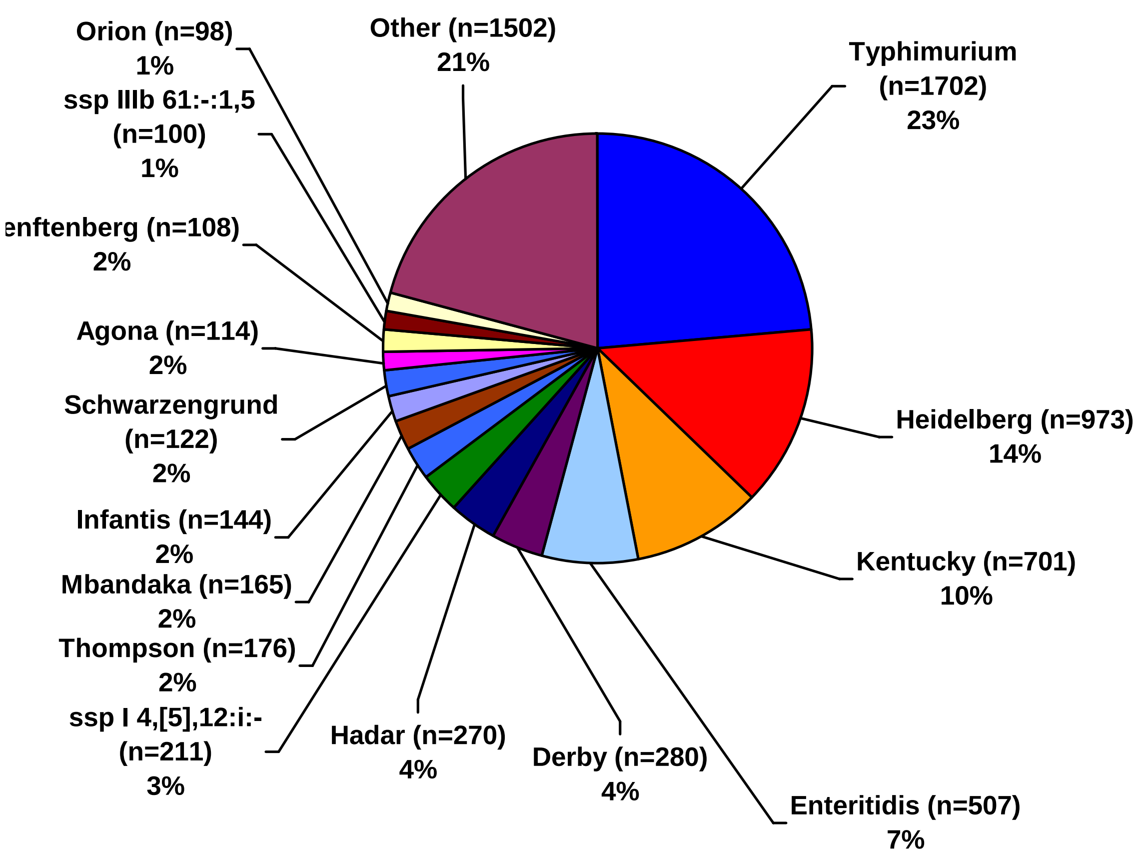
Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
Salmonella ssp IIIa 13,23:z4,z23,z32:-					2									**2**
Salmonella ssp IIIa 13,23:z4,z23:-					1	2								**3**
Salmonella ssp IIIa 41:z4,z23:-			1		1	1								**3**
Salmonella ssp IIIa 41:z4,z32:-					1									**1**
Salmonella ssp IIIa 48:g,z51:-		1												**1**
Salmonella ssp IIIb	1													**1**
Salmonella ssp IIIb 16:z10:e,n,x,z15									1					**1**
Salmonella ssp IIIb 47:i:z53					1									**1**
Salmonella ssp IIIb 50:k:z		1												**1**
Salmonella ssp IIIb 50:r:-	1													**1**
Salmonella ssp IIIb 50:r:z						1								**1**
Salmonella ssp IIIb 53:z10:z		1												**1**
Salmonella ssp IIIb 60:i:z					1									**1**
Salmonella ssp IIIb 60:r:e,n,x,z15						1								**1**
Salmonella ssp IIIb 61:c:z35					1									**1**
Salmonella ssp IIIb 61:i:z	1				1									**2**
Salmonella ssp IIIb 61:k:1,5						2								**2**
Salmonella ssp IIIb 61:k:1,5,7	1													**1**
Salmonella ssp IIIb 61:k:z35			1			1								**2**
Salmonella ssp IIIb 61:l,v:-		1												**1**
Salmonella ssp IIIb 61:r:z35	1													**1**
Salmonella ssp IV		1												**1**
Salmonella ssp IV 44:z4,z23:-		1			2	1								**4**
Salmonella ssp IV 48:g,z51:-	2				2									**4**
Salmonella ssp IV 48:z4,z32:-		3												**3**
Salmonella ssp IV 50:g,z51:-		1			1									**2**
Salmonella ssp IV 6,7:z4,z23:-				2										**2**
Salmonella sp.						100			1	6				**107**
Salmonella ssp I							2							**2**
TOTAL	**735**	**682**	**135**	**157**	**2697**	**1078**	**184**	**31**	**104**	**36**	**5**	**10**	**16**	**5870**

Salmonella **Isolations from Non-Human Sources in 2006**

Non-human sources of *Salmonella* include animal, food, environmental or water. The data were gathered through the passive surveillance systems of the LFZ and NML in the course of performing reference services, collaborating in special studies and assisting in outbreak investigations. The non-human data are generated from the analysis of isolates that are submitted mainly by the good will of agriculture, veterinary and university laboratories and are not part of a structured sampling plan. There is no control of the relative numbers forwarded by a province/territory; however, the proportion of isolates forwarded remains relatively consistent from year to year.

Figure 7 shows the fifteen most prevalent serovars isolated from non-human sources in Canada in 2006. *S*. Typhimurium is the most prevalent serovar isolated from non-human sources in Canada accounting for 23% (n=1702) of the 7173 isolates reported in 2006. *S*. Heidelberg ranked 2nd most prevalent with 13% (n=973), followed by 3rd ranked *S*. Kentucky with 10% (n=323) and then *S*. Enteritidis (7%, n=507), *S*. Derby (4%, n=280), *S*. Hadar (4%, n=270), *S*. ssp I 4,[5],12:i:- (3%, n=211), *S*. Thompson (2%, n=176), *S*. Mbandaka (2%, n=165) and *S*. Infantis ranking 10th (2%, n=144). Serovars ranking 11th to 15th include *S*. Schwarzengrund, *S*. Agona, *S*. Senftenberg, *S*. ssp IIIb 61:-:1,5 and *S*. Orion, each accounting for 2% or less of all *Salmonella* from non-human sources. Other serovars represented 21% (n=1502) of the isolates identified in 2006.

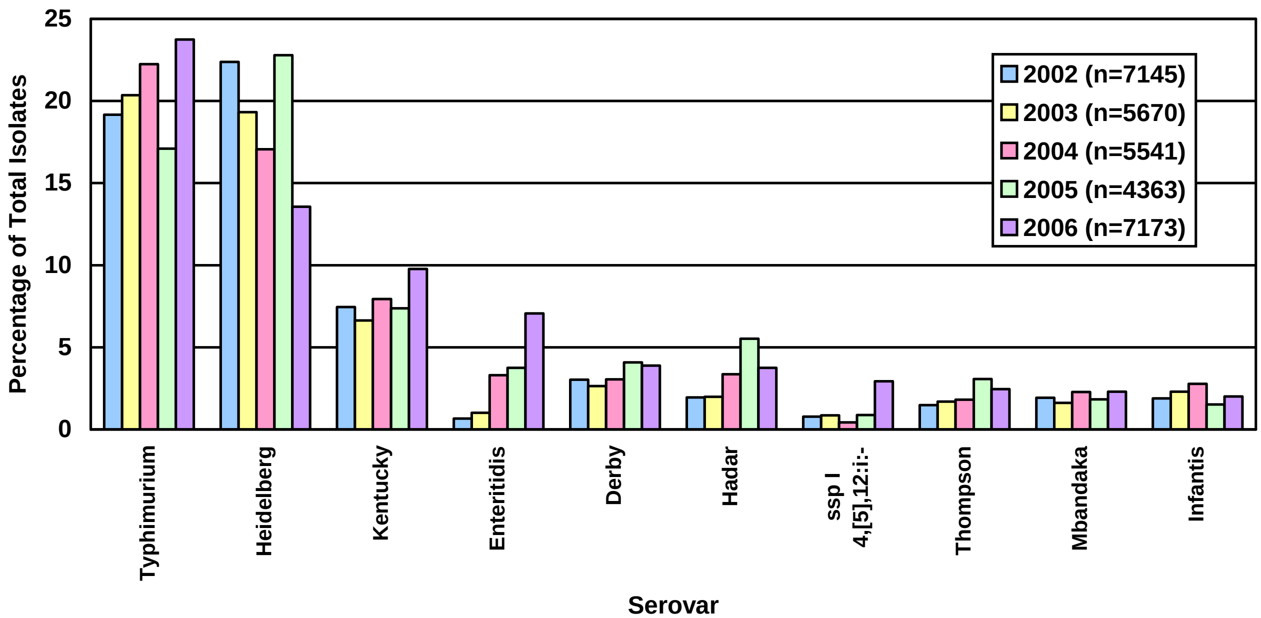
Figure 7: Fifteen Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2006 (N=7173)



Changes in the Occurrence of *Salmonella* Serovars from Non-Human Sources in Canada, 2002 to 2006

The relative frequencies of the 10 most prevalent *Salmonella* serovars from non-human sources between 2002 and 2006 are shown in Figure 8. *S*. Heidelberg and *S*. Typhimurium have remained the most prevalent serovars isolated from non-human sources between 2002 and 2006. After declining from a high of 22% in 2004 to 17% in 2005, *S*. Typhimurium once again has become the most prevalent serovar identified from non-human sources accounting for 24% of the 7173 strains tested in 2006, continuing an increase from 2002, 2003 and 2004 levels. The proportion of isolates identified as *S*. Heidelberg, the second most prevalent serovar in 2006, has gradually declined from 22% in 2002 to 13% in 2006. *S*. Kentucky has ranked 3rd most prevalent since 2002 accounting for 8% of the isolates in each previous year and increasing slightly to 10% in 2006. *S*. Enteritidis isolations have also increased steadily to now account for 7% in 2006, up from approximately 1% in 2002 and 2003 and 3% in 2004 and 2005. *Salmonella* ssp I 4,[5],12:i:- isolations have increased to account for 3% of non-human *Salmonella* isolations in 2006, up from about 1% for each of the previous 4 years.

Figure 8: Trends of the Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2002 to 2006



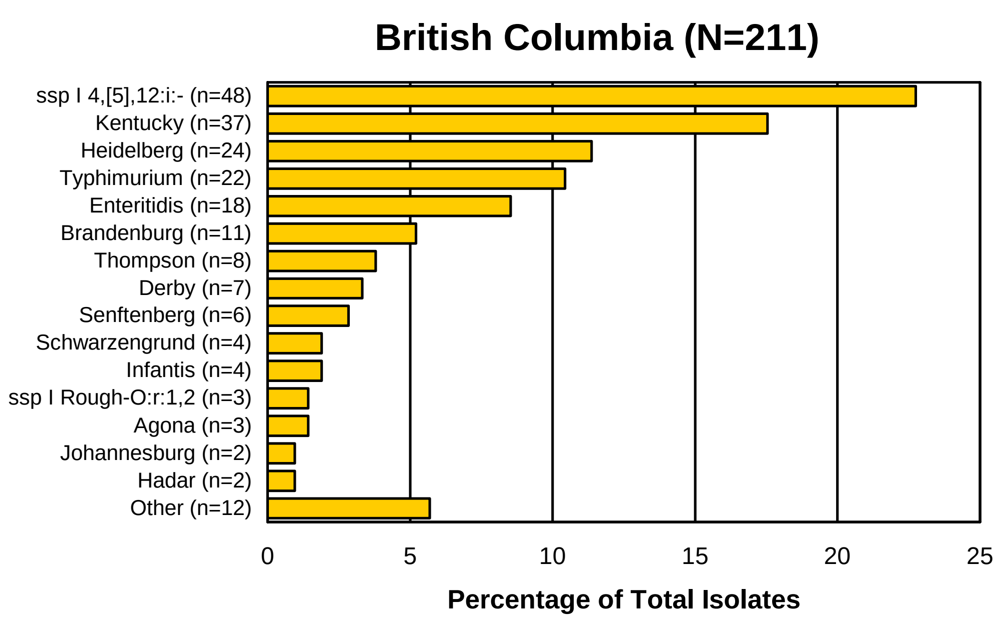
* Non-human sources include food, water, animal and environmental sources. Serovar totals are laboratory confirmed isolates based on information gathered through passive surveillance at the LFZ and NML through routine reference services. Although data is representative of laboratory confirmed isolates 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.

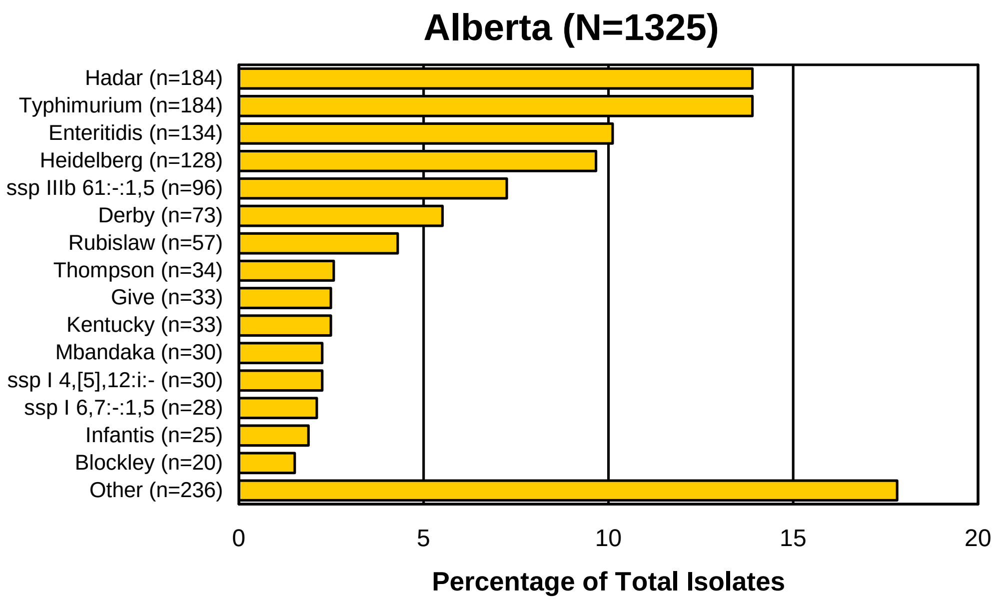
Provincial Distribution of *Salmonella* Serovars from Non-Human Sources in 2006

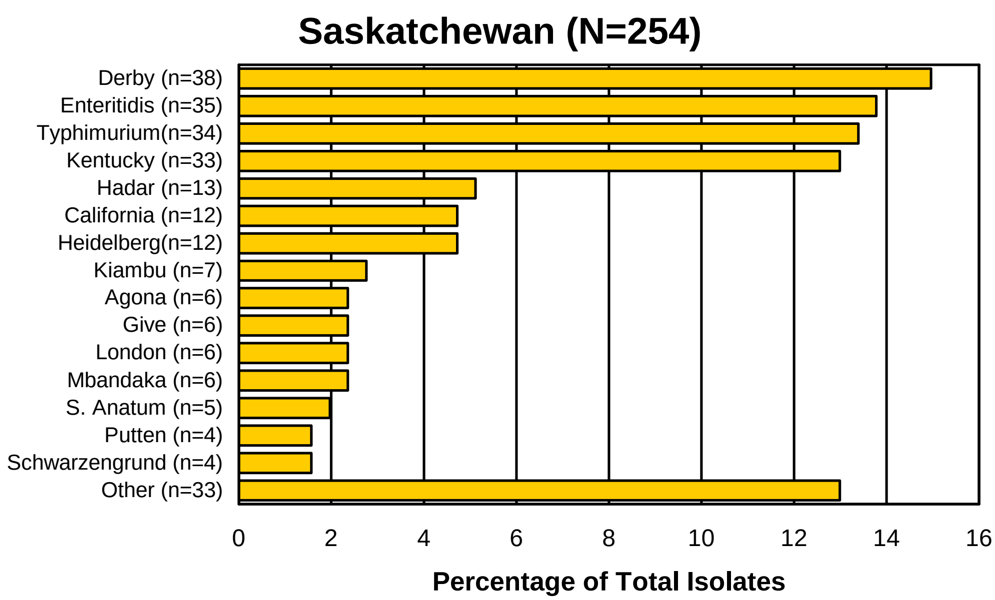
Non-human data is gathered through passive surveillance systems of the LFZ and NML in the course of reference services, special studies and outbreak investigations. There is no control of the relative numbers forwarded by a province. Large numbers of isolates should not be interpreted as incidence of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

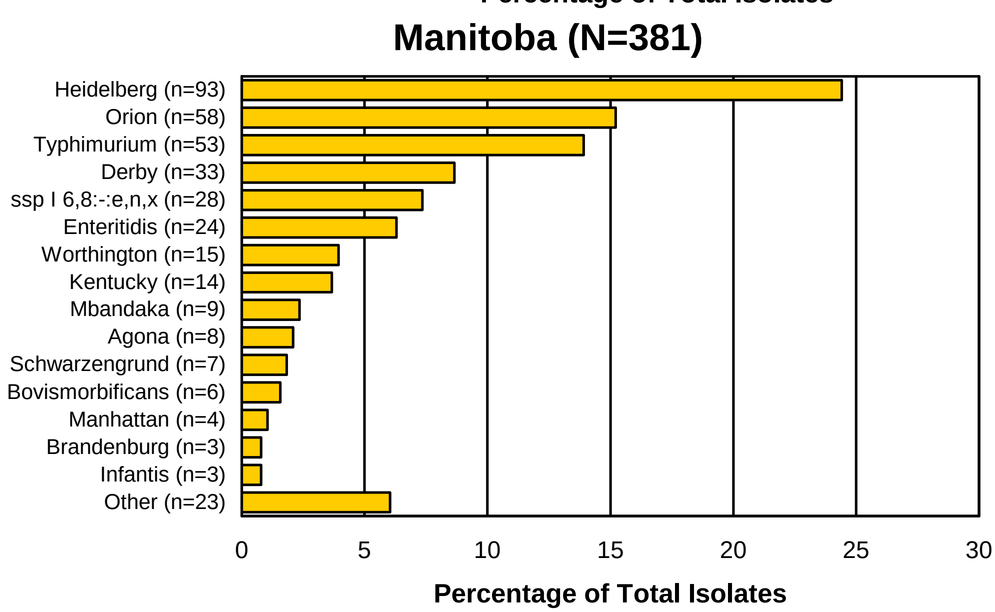
The most common *Salmonella* serovars from non-human origin in each province are shown in Figure 9. In 2006, *S.* Typhimurium was the most prevalent serovar identified from non-human sources in Alberta (14%, n=184), Ontario (29%, n=1099), Québec (32%, n=286) and Prince Edward Island (45%, n=8). Porcine sources accounted for 49% (n=91) of all the *S*. Typhimurium identified in Alberta, 41% (n=451) of those in Ontario and 55% (n=158) of strains in Québec. *S*. Heidelberg was most prevalent in Manitoba (24%, n=93), Nova Scotia (41%, n=48) and New Brunswick (29%, n=34). *Salmonella* ssp I 4,[5],12:i:- was most prevalent in British Columbia with 23% (n=48) of the non-human *Salmonella* identified, all of which were from chicken sources. In Saskatchewan, *S*. Derby was predominant with 15% (n=36) of the non-human isolates, all of which were from porcine sources. *Salmonella* Kentucky was the most prevalent non-human serovar in Newfoundland and Labrador, accounting for 55% (n=42) of the isolates. Of the 42 *S*. Kentucky isolates identified in Newfoundland and Labrador, 79% (n=33) where isolated from eggs and the remainder (n= 9) from chicken.

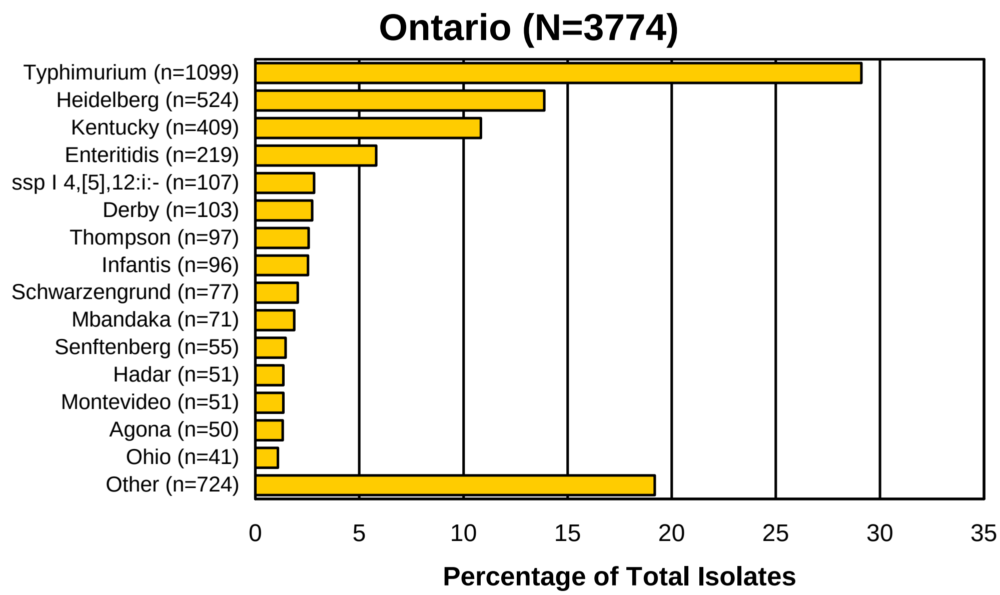
Figure 9: Most Prevalent *Salmonella* Serovars of Non-Human Origin in Each Province, 2006

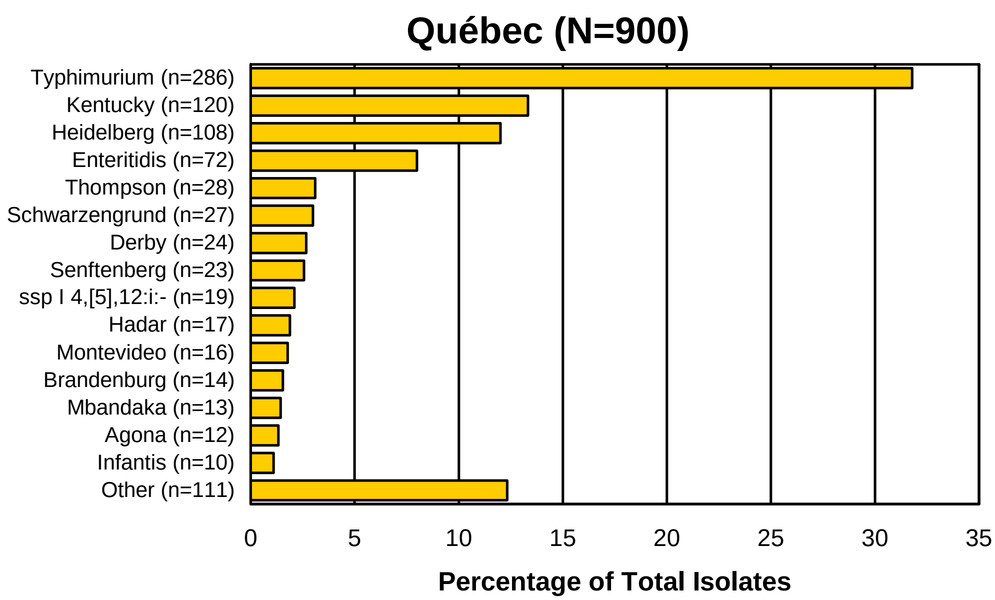


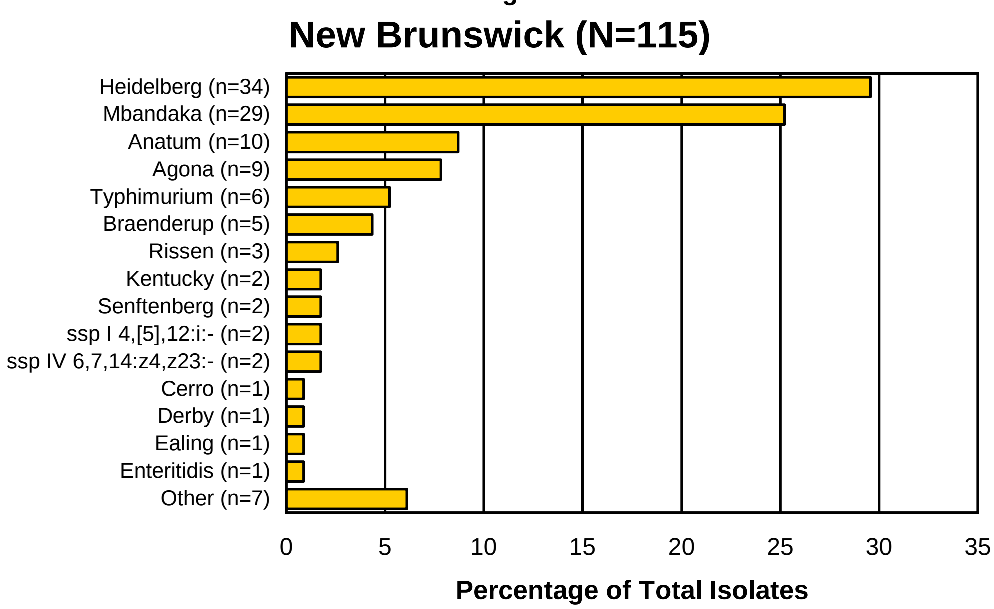

Alberta (N=1325)
Hadar (n=184)
Typhimurium (n=184)
Enteritidis (n=134)
Heidelberg (n=128)
ssp IIIb 61:-:1,5 (n=96)
Derby (n=73)
Rubislaw (n=57)
Thompson (n=34)
Give (n=33)
Kentucky (n=33)
Mbandaka (n=30)
ssp I 4,[5],12:i:- (n=30)
ssp I 6,7:-:1,5 (n=28)
Infantis (n=25)
Blockley (n=20)
Other (n=236)
0
5
10
15
20
Percentage of Total Isolates

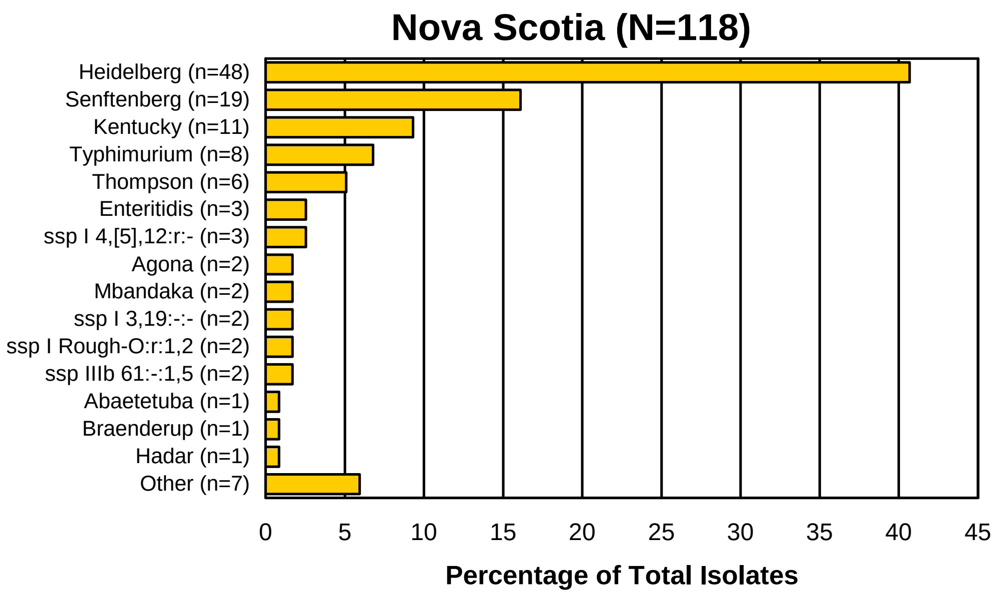

Saskatchewan (N=254)
Derby (n=38)
Enteritidis (n=35)
Typhimurium(n=34)
Kentucky (n=33)
Hadar (n=13)
California (n=12)
Heidelberg(n=12)
Kiambu (n=7)
Agona (n=6)
Give (n=6)
London (n=6)
Mbandaka (n=6)
S. Anatum (n=5)
Putten (n=4)
Schwarzengrund (n=4)
Other (n=33)
0
2
4
6
8
10
12
14
16
Percentage of Total Isolates

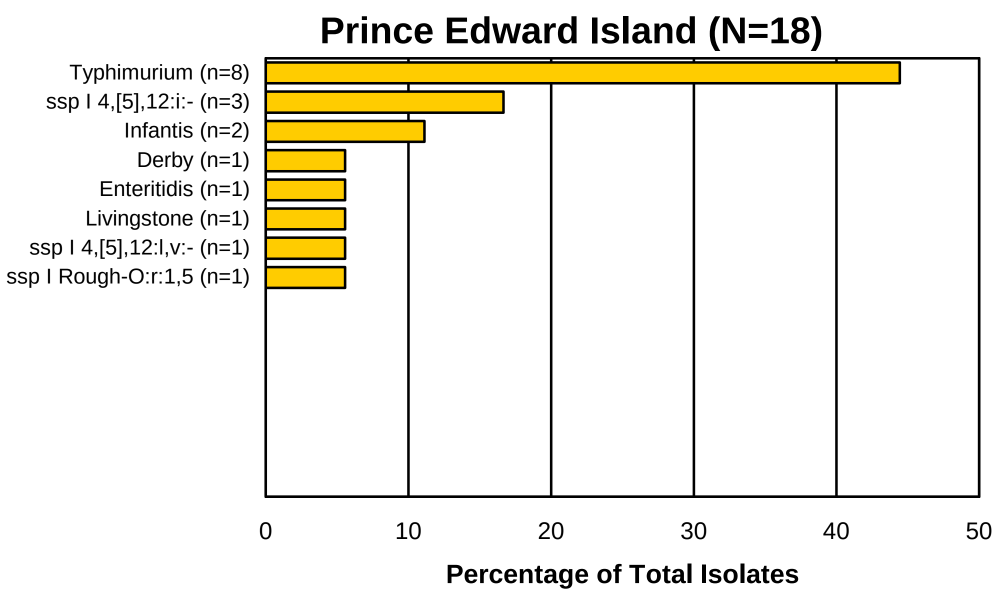

Manitoba (N=381)
Heidelberg (n=93)
Orion (n=58)
Typhimurium (n=53)
Derby (n=33)
ssp I 6,8:-:e,n,x (n=28)
Enteritidis (n=24)
Worthington (n=15)
Kentucky (n=14)
Mbandaka (n=9)
Agona (n=8)
Schwarzengrund (n=7)
Bovismorbificans (n=6)
Manhattan (n=4)
Brandenburg (n=3)
Infantis (n=3)
Other (n=23)
0
5
10
15
20
25
30
Percentage of Total Isolates

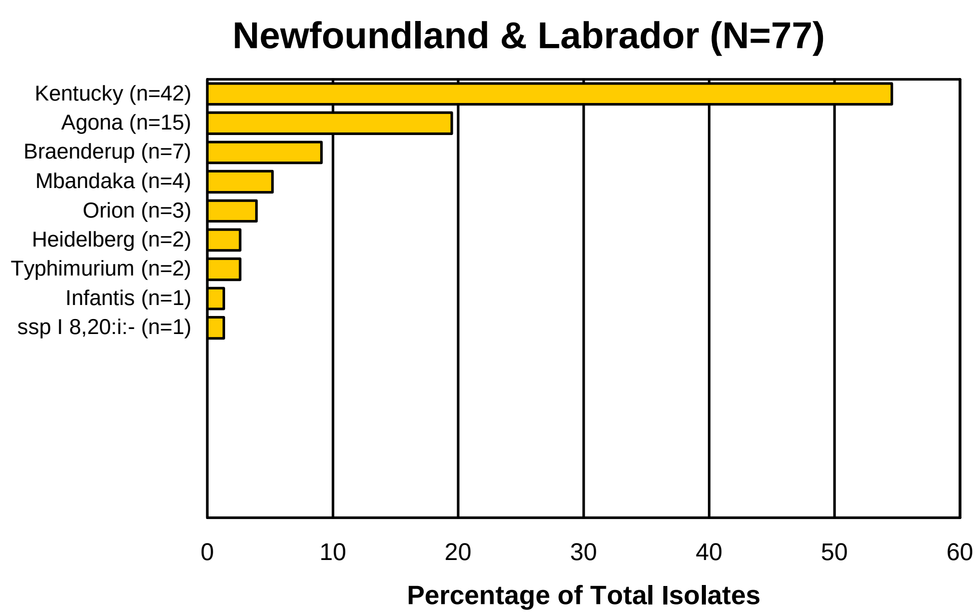

Ontario (N=3774)
Typhimurium (n=1099)
Heidelberg (n=524)
Kentucky (n=409)
Enteritidis (n=219)
ssp I 4,[5],12:i:- (n=107)
Derby (n=103)
Thompson (n=97)
Infantis (n=96)
Schwarzengrund (n=77)
Mbandaka (n=71)
Senftenberg (n=55)
Hadar (n=51)
Montevideo (n=51)
Agona (n=50)
Ohio (n=41)
Other (n=724)
0
5
10
15
20
25
30
35
Percentage of Total Isolates


Québec (N=900)
Typhimurium (n=286)
Kentucky (n=120)
Heidelberg (n=108)
Enteritidis (n=72)
Thompson (n=28)
Schwarzengrund (n=27)
Derby (n=24)
Senftenberg (n=23)
ssp I 4,[5],12:i:- (n=19)
Hadar (n=17)
Montevideo (n=16)
Brandenburg (n=14)
Mbandaka (n=13)
Agona (n=12)
Infantis (n=10)
Other (n=111)
0
5
10
15
20
25
30
35
Percentage of Total Isolates


New Brunswick (N=115)
Heidelberg (n=34)
Mbandaka (n=29)
Anatum (n=10)
Agona (n=9)
Typhimurium (n=6)
Braenderup (n=5)
Rissen (n=3)
Kentucky (n=2)
Senftenberg (n=2)
ssp I 4,[5],12:i:- (n=2)
ssp IV 6,7,14:z4,z23:- (n=2)
Cerro (n=1)
Derby (n=1)
Ealing (n=1)
Enteritidis (n=1)
Other (n=7)
0
5
10
15
20
25
30
35
Percentage of Total Isolates


Nova Scotia (N=118)
Heidelberg (n=48)
Senftenberg (n=19)
Kentucky (n=11)
Typhimurium (n=8)
Thompson (n=6)
Enteritidis (n=3)
ssp I 4,[5],12:r:- (n=3)
Agona (n=2)
Mbandaka (n=2)
ssp I 3,19:-:- (n=2)
ssp I Rough-O:r:1,2 (n=2)
ssp IIIb 61:-:1,5 (n=2)
Abaetetuba (n=1)
Braenderup (n=1)
Hadar (n=1)
Other (n=7)
0
5
10
15
20
25
30
35
40
45
Percentage of Total Isolates


Prince Edward Island (N=18)
Typhimurium (n=8)
ssp I 4,[5],12:i:- (n=3)
Infantis (n=2)
Derby (n=1)
Enteritidis (n=1)
Livingstone (n=1)
ssp I 4,[5],12:l,v:- (n=1)
ssp I Rough-O:r:1,5 (n=1)
0
10
20
30
40
50
Percentage of Total Isolates


Newfoundland & Labrador (N=77)
Kentucky (n=42)
Agona (n=15)
Braenderup (n=7)
Mbandaka (n=4)
Orion (n=3)
Heidelberg (n=2)
Typhimurium (n=2)
Infantis (n=1)
ssp I 8,20:i:- (n=1)
0
10
20
30
40
50
60
Percentage of Total Isolates

Source Distribution of *Salmonella* Serovars in Canada, 2002 to 2006

The ten most prevalent *Salmonella* serovars isolated from bovine, chicken, turkey, porcine and feed sources between 2002 and 2006 are shown in Figure 10. *S*. Heidelberg continued to be the most prevalent serovar isolated from chicken accounting for 23% of the 1797 strains isolated from chicken sources in 2006, down dramatically from 43% in 2005. The proportion of isolates identified as *S*. Kentucky among *Salmonella* strains isolated from chicken has steadily increased from 15% in 2002 to 22% in 2006. *S*. Enteritidis isolations have also increased dramatically over the 5-year period, up from less than 1% of the chicken strains in 2002 to 13% in 2006. Another increase of note among chicken isolates is *S*. ssp I 4,[5],12:i:-, that included 7% of the strains in 2006 compared to less than 1% over the previous 4 years.

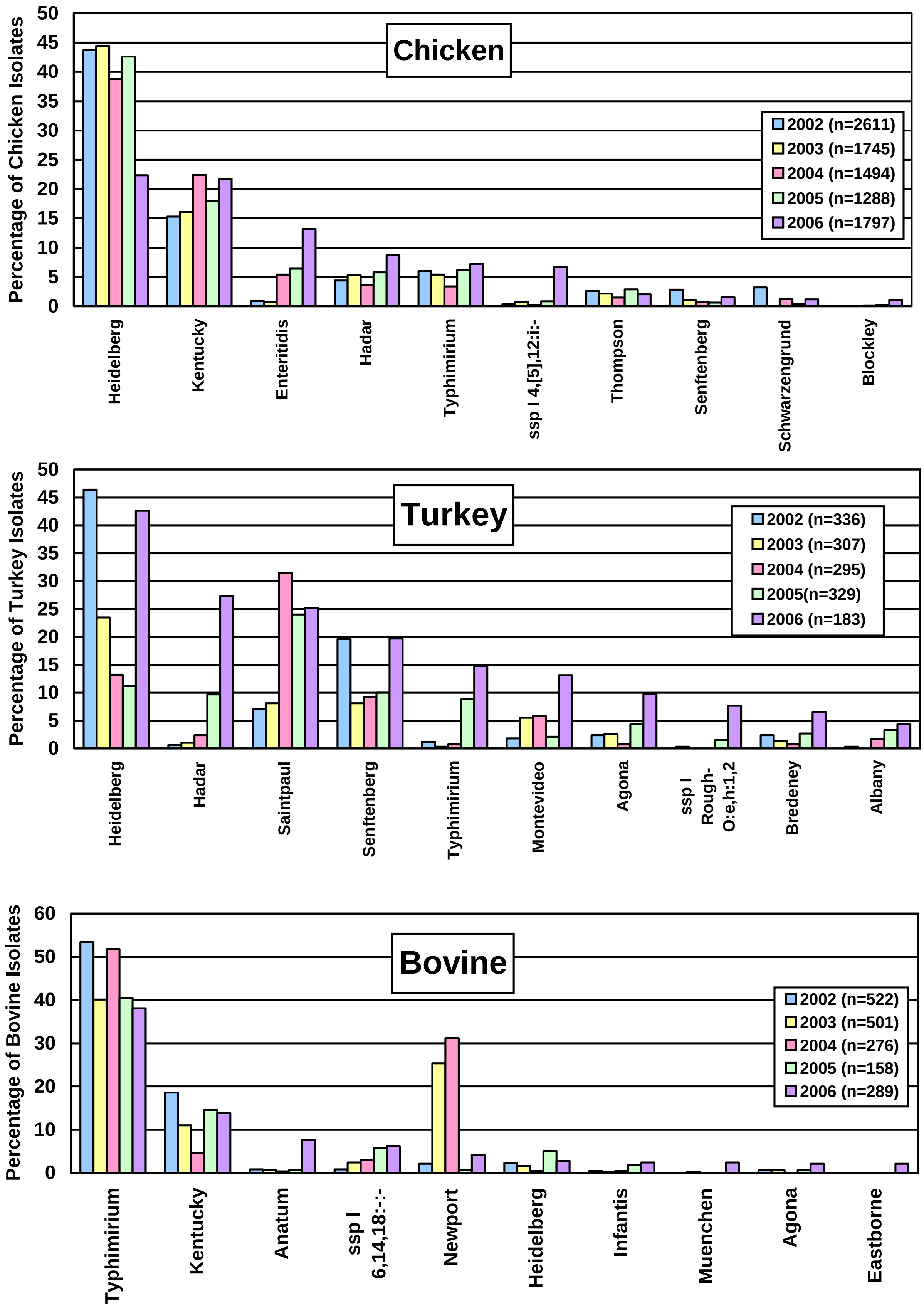
After a four year decline, the proportion of turkey isolates identified as *S*. Heidelberg has increased dramatically to 43% (rank=1) in 2006 from 11% (rank=2) in 2005. *S*. Hadar isolations from turkey sources has increased over this 5-year period, up from less than 1% in 2002 to 27% (rank=2) in 2006. Although the proportion of *S*. Saintpaul isolates has remained relatively constant over the previous 3 years (rank=1), this serovar now ranks 3rd most prevalent accounting for 25% of the turkey strains in 2006. Other increases of note among turkey isolations include *S*. Senftenberg from 10% in 2005 to 20% in 2006, *S*. Typhimurium from 9% to 15%, *S*. Montevideo from 2% to 13% and *S*. Agona from 4% to 10%.

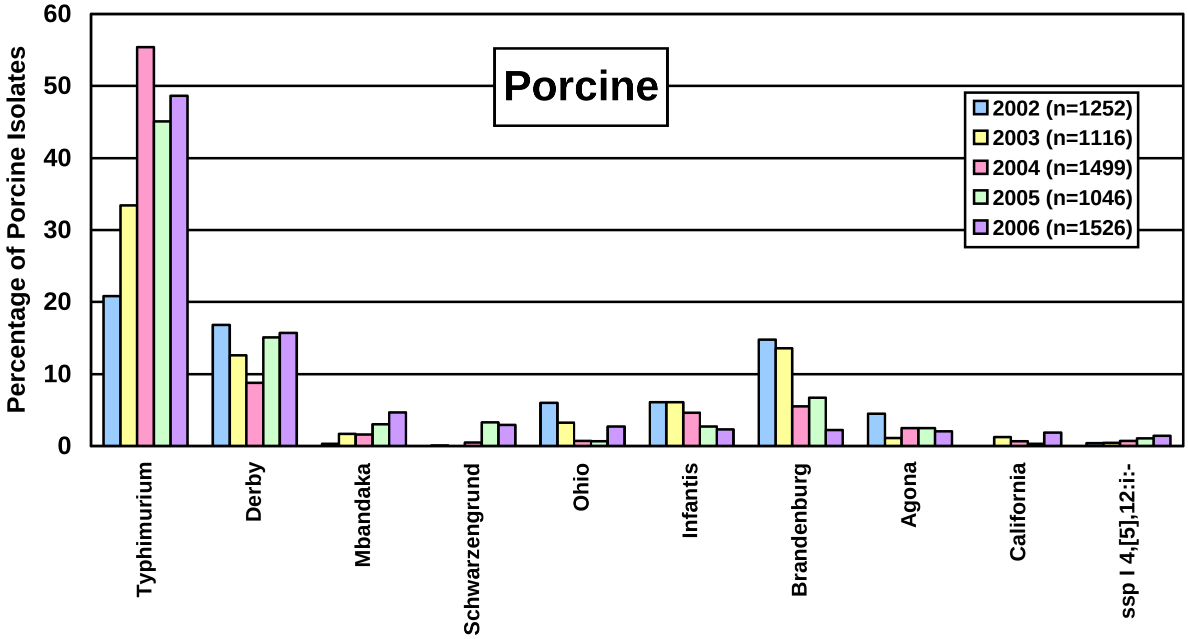
S. Typhimurium remains the most prevalent serovar isolated from both bovine and porcine sources in 2006. Over the 5-year period from 2002 to 2006, the level of *S*. Typhimurium isolated from bovine sources has decreased from 54% in 2002 to 39% in 2006. *S*. Kentucky continues to rank as 2nd among serovars isolated from bovine sources, accounting for 12% of these strains. A dramatic decrease has been observed in the proportion of *S*. Newport strains identified from bovine sources, from 26% and 31% in 2003 and 2004, respectively, to 4% in 2006.

Among isolates from porcine sources, *S*. Typhimurium has increased from 20% of the *Salmonella* in 2002 to 49% in 2006. *S*. Derby identifications have remained relatively constant at around 16% and ranks 2nd most prevalent over the 5-year period. The proportion of *S*. Brandenburg identified among porcine isolates has declined from about 16% in 2002 to 1% in 2006.

S. Orion is now the most prevalent serovar isolated from animal feed, increasing from approximately 3% of the isolates over the previous 4 years to 35% of the feed isolates in 2006. After a dramatic increase in 2005, *S*. Thompson isolations have decreased from 16% (rank=1) of the feed isolates to less than 1% in 2006, and it no longer ranks among the top ten serovars. A large decrease has also been seen over the 5-year period in *S*. Senftenberg isolations from 35% in 2002 to 5% in 2006. Despite this decrease, only a modest decrease has been noted among chicken isolates from 3% in 2002 to 1% in 2006. In turkey isolates, *S*. Senftenberg isolations have returned to 2002 levels of 20% in 2002 after a decreasing to 9% between 2003 and 2005. Isolation of this serovar from human sources has remained relatively constant between 2002 and 2006, at approximately 0.3% of *Salmonella* identified.

Figure 10: Most Prevalent *Salmonella* Serovars from Selected Non-Human Sources in Canada, 2006




Porcine
Percentage of Porcine Isolates
0
10
20
30
40
50
60
2002 (n=1252)
2003 (n=1116)
2004 (n=1499)
2005 (n=1046)
2006 (n=1526)
Typhimurium
Derby
Mbandaka
Schwarzengrund
Ohio
Infantis
Brandenburg
Agona
California
ssp I 4,[5],12:i:-

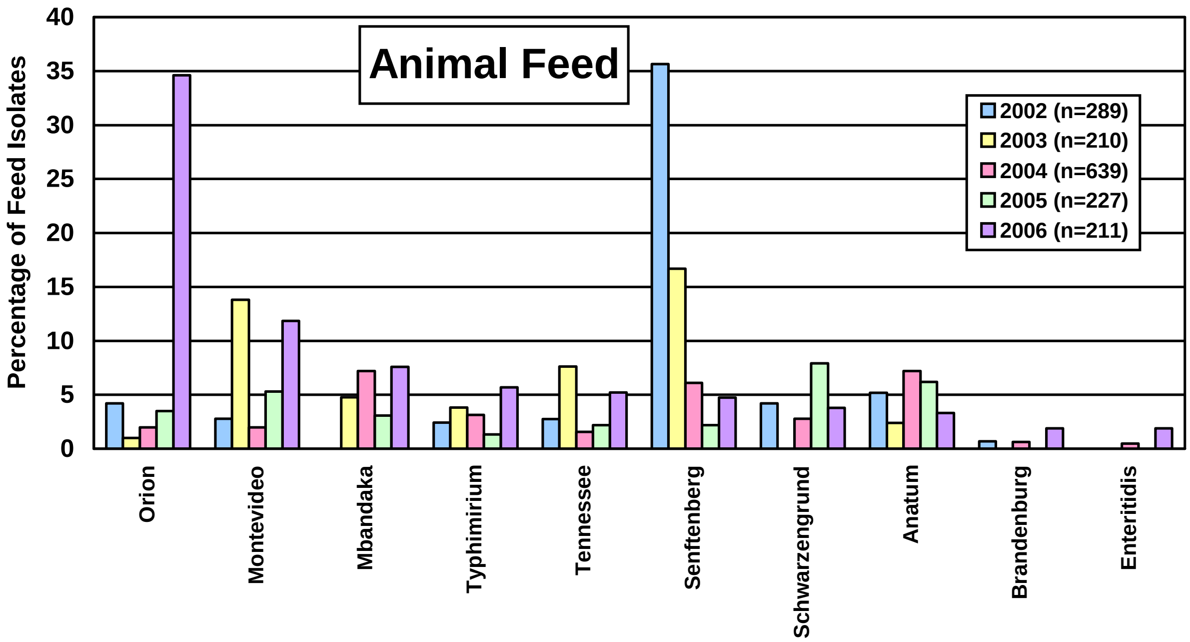

Animal Feed
Percentage of Feed Isolates
0
5
10
15
20
25
30
35
40
2002 (n=289)
2003 (n=210)
2004 (n=639)
2005 (n=227)
2006 (n=211)
Orion
Montevideo
Mbandaka
Typhimirium
Tennessee
Senftenberg
Schwarzengrund
Anatum
Brandenburg
Enteritidis

Table 3: *Salmonella* Serovars from Non-Human Sources, 2006

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Abaetetuba	Eggs				1							**1**
	Food - Oyster								1			**1**
	Water				1							**1**
	Subtotal	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**3**
S. Aberdeen	Food - Pepper (Spice)					1						**1**
	Water - River		1									**1**
	Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Adelaide	Animal Feed						1					**1**
S. Ago	Water - River					2						**2**
S. Agona	Animal Feed						1					**1**
	Avian						1					**1**
	Bovine					5	1					**6**
	Canine					3						**3**
	Chicken		8		1	1	3					**13**
	Eggs				4				2		15	**21**
	Environmental Swab					3						**3**
	Food - Chicken					1						**1**
	Ovine					1						**1**
	Pheasant							9				**9**
	Porcine		1	6	3	17	4					**31**
	Turkey					7	2					**9**
	Water	3										**3**
	Water - River					12						**12**
	Subtotal	**3**	**9**	**6**	**8**	**50**	**12**	**9**	**2**	**0**	**15**	**114**
S. Albany	Food - Sea Snail					1						**1**
	Porcine					1						**1**
	Turkey					4						**4**
	Water					5						**5**
	Subtotal	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**	**0**	**0**	**11**
S. Amsterdam	Environmental Swab		1									**1**
S. Anatum	Animal Feed	1				1	5					**7**
	Avian			1			1					**2**
	Bovine					22						**22**
	Chicken		5	1		2	1					**9**
	Environmental Swab							10				**10**
	Food - Chicken			1								**1**
	Food - Sea Snail					1						**1**
	Food - Unknown		1									**1**
	Partridge					1						**1**
	Porcine			2								**2**
	Turkey					1						**1**
	Unknown		1									**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Water - River		1			5						**6**
	Subtotal	**1**	**8**	**5**	**0**	**33**	**7**	**10**	**0**	**0**	**0**	**64**
S. Apapa	Reptile					1						**1**
	Reptile - Turtle					1						**1**
	Subtotal					**2**						**2**
S. Bardo	Water - River		1									**1**
S. Bareilly	Food - Sea Snail					2						**2**
S. Berta	Canine					1						**1**
	Porcine		1			4	1					**6**
	Water - River					11						**11**
	Subtotal	**0**	**1**	**0**	**0**	**16**	**1**	**0**	**0**	**0**	**0**	**18**
S. Blegdam	Duck					4						**4**
S. Blijdorp	Reptile - Chameleon					1						**1**
S. Blockley	Chicken		20									**20**
S. Bovismorbificans	Food - Sea Snail					1						**1**
	Porcine		10	1	6	3						**20**
	Water					13	1					**14**
	Subtotal	**0**	**10**	**1**	**6**	**17**	**1**	**0**	**0**	**0**	**0**	**35**
S. Bradford	Porcine		1									**1**
S. Braenderup	Animal Feed		1									**1**
	Avian					1						**1**
	Bovine					2						**2**
	Chicken		2			3		5				**10**
	Duck					3						**3**
	Eggs		4						1		7	**12**
	Equine						1					**1**
	Porcine					4						**4**
	Subtotal	**0**	**7**	**0**	**0**	**13**	**1**	**5**	**1**	**0**	**7**	**34**
S. Brandenburg	Animal Feed					3	1					**4**
	Bovine					1						**1**
	Canine					15						**15**
	Chicken	11				2						**13**
	Feline					4						**4**
	Food - Beef					1						**1**
	Food - Mushrooms					1						**1**
	Food - Pork					1						**1**
	Porcine		10	2	3	8	11					**34**
	Turkey						2					**2**
	Subtotal	**11**	**10**	**2**	**3**	**36**	**14**	**0**	**0**	**0**	**0**	**76**
S. Bredeney	Turkey					6						**6**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. California	Porcine			12		15	1					**28**
	Water - River		1									**1**
	Subtotal	**0**	**1**	**12**	**0**	**15**	**1**	**0**	**0**	**0**	**0**	**29**
S. Carmel	Reptile			1								**1**
	Reptile - Lizard			1								**1**
	Subtotal	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Cerro	Animal Feed					2						**2**
	Bovine					3						**3**
	Chicken			1								**1**
	Eggs				1							**1**
	Environmental Swab				1			1				**2**
	Food - Meat		1									**1**
	Porcine					8	1					**9**
	Water - River		1									**1**
	Subtotal	**0**	**2**	**1**	**2**	**13**	**1**	**1**	**0**	**0**	**0**	**20**
S. Choleraesuis	Porcine			1								**1**
S. Cubana	Chicken		5									**5**
	Food - Sprouts						2					**2**
	Subtotal	**0**	**5**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**7**
S. Daytona	Water	1										**1**
	Water - River		2									**2**
	Subtotal	**1**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Derby	Bovine					1						**1**
	Chicken					1	1					**2**
	Pheasant							1				**1**
	Porcine	2	48	38	33	95	23			1		**240**
	Turkey					3						**3**
	Water	5	3									**8**
	Water - River		22			3						**25**
	Subtotal	**7**	**73**	**38**	**33**	**103**	**24**	**1**	**0**	**1**	**0**	**280**
S. Drac	Environmental Swab				2							**2**
S. Dublin	Food - Seafood					1						**1**
S. Ealing	Eggs							1				**1**
S. Eastborne	Bovine					6						**6**
S. Enteritidis	Animal Feed				3		1					**4**
	Avian		1	7		20	25	1				**54**
	Bovine					1				1		**2**
	Canine		1			3						**4**
	Chicken	16	112	8	9	84	6		2			**237**
	Chicken - Meat		2		12	3						**17**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Duck					62						**62**
	Eggs		2	1			6					**9**
	Environmental Swab					2	12					**14**
	Feline					1			1			**2**
	Food - Chicken			7		8	2					**17**
	Food - Crab					3						**3**
	Food - Grape					1						**1**
	Food - Sea Snail					1						**1**
	Food - Unknown		1			4	1					**6**
	Food - Vegetable/Spice					2						**2**
	Hedgehog		1									**1**
	Owl						2					**2**
	Porcine	1	3	12		5						**21**
	Reptile					1	1					**2**
	Turkey		1									**1**
	Unknown	1				14	16					**31**
	Water		5			2						**7**
	Water - River		5			2						**7**
	Subtotal	**18**	**134**	**35**	**24**	**219**	**72**	**1**	**3**	**1**	**0**	**507**
S. Gaminara	Reptile - Lizard					1						**1**
S. Give	Avian - Wild Bird		3									**3**
	Bovine		3									**3**
	Food - Vegetable/Spice					1						**1**
	Goose		6									**6**
	Ovine		1									**1**
	Porcine		3	6		2	1					**12**
	Water		10									**10**
	Water - River		7			1						**8**
	Subtotal	**0**	**33**	**6**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**44**
S. Godesberg	Chicken						1					**1**
S. Hadar	Animal Feed		1				1					**2**
	Bovine					1						**1**
	Canine					5						**5**
	Chicken	1	138	3		8	7					**157**
	Chicken - Meat		1		2							**3**
	Duck					1						**1**
	Environmental Swab					2	3					**5**
	Equine					1						**1**
	Food - Chicken	1		10		4	3					**18**
	Food - Herbs						1					**1**
	Pelican		28									**28**
	Porcine					2						**2**
	Raven								1			**1**
	Turkey					23	2					**25**
	Unknown - Animal		4									**4**
	Water - River		12			4						**16**
	Subtotal	2	184	13	2	51	17	0	1	0	0	**270**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Hartford	Water - River		4			1						**5**
S. Havana	Bovine					1						**1**
	Porcine					18						**18**
	Subtotal	**0**	**0**	**0**	**0**	**19**	**0**	**0**	**0**	**0**	**0**	**19**
S. Heidelberg	Animal Feed		1									**1**
	Avian		3			19	12	2	14		1	**51**
	Bovine					5	3					**8**
	Canine		1			106						**107**
	Chicken	18	71	1	1	235	32	12	31		1	**402**
	Chicken - Meat		16		90							**106**
	Chicken - Water								2			**2**
	Eggs		2				2	1	1			**6**
	Environmental Swab		1			6	4	19				**30**
	Equine	1				46	1					**48**
	Feline					2						**2**
	Food - Chicken	2		11		38	45					**96**
	Food - Meat		1			2						**3**
	Food - Tomato						1					**1**
	Food - Unknown		1									**1**
	Porcine		1		2	8	2					**13**
	Turkey		6			34	2					**42**
	Unknown					2	1					**3**
	Unknown - Animal	3	2									**5**
	Water		2			1	1					**4**
	Water - River		20			20	2					**42**
	Subtotal	**24**	**128**	**12**	**93**	**524**	**108**	**34**	**48**	**0**	**2**	**973**
S. Idikan	Animal Feed						1					**1**
S. Indiana	Canine					13						**13**
	Chicken					2	1					**3**
	Food - Chicken					5						**5**
	Goose		8									**8**
	Guinea Fowl						1					**1**
	Partridge					1						**1**
	Water - River					3						**3**
	Subtotal	**0**	**8**	**0**	**0**	**24**	**2**	**0**	**0**	**0**	**0**	**34**
S. Infantis	Animal Feed		1									**1**
	Bovine					5	2					**7**
	Canine					15						**15**
	Chicken	4	8			4	1					**17**
	Eggs					1					1	**2**
	Environmental Swab					6						**6**
	Feline					1						**1**
	Food - Chicken			2		1	1					**4**
	Food - Chocolate					6						**6**
	Food - Unknown					28						**28**
	Porcine		15	1	3	9	5			2		**35**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Water					5	1					**6**
	Water - River		1			15						**16**
	Subtotal	**4**	**25**	**3**	**3**	**96**	**10**	**0**	**0**	**2**	**1**	**144**
S. Istanbul	Chicken		1									**1**
S. Johannesburg	Animal Feed		1			2	1					**4**
	Chicken		3									**3**
	Eggs	2										**2**
	Environmental Swab		2									**2**
	Food - Pork			2								**2**
	Porcine		1	1	1							**3**
	Subtotal	**2**	**7**	**3**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**16**
S. Kentucky	Avian			8		3	13	2	1			**27**
	Bovine					35	5					**40**
	Canine					30						**30**
	Chicken	37	16	19		255	46		9		9	**391**
	Chicken - Meat				14							**14**
	Eggs					2			1		33	**36**
	Environmental Swab					4						**4**
	Equine					1						**1**
	Food - Beef					8	9					**17**
	Food - Cheese						13					**13**
	Food - Chicken			5		34	32					**71**
	Food - Pork					1						**1**
	Food - Vegetable/Spice					1						**1**
	Porcine			1		1	1					**3**
	Turkey					1						**1**
	Unknown - Animal						1					**1**
	Water		6			14						**20**
	Water - River		11			19						**30**
	Subtotal	**37**	**33**	**33**	**14**	**409**	**120**	**2**	**11**	**0**	**42**	**701**
S. Kiambu	Avian						2					**2**
	Chicken	1				13						**14**
	Food - Chicken			7		3						**10**
	Water - River					9						**9**
	Subtotal	**1**	**0**	**7**	**0**	**25**	**2**	**0**	**0**	**0**	**0**	**35**
S. Kokomlemle	Fertilizer					1	1					**2**
S. Krefeld	Avian			1								**1**
	Porcine			2		3						**5**
	Subtotal	**0**	**0**	**3**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**6**
S. Lexington	Chicken		1									**1**
	Food - Fish					1						**1**
	Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Lille	Animal Feed						1					**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Avian						1					**1**
	Environmental Swab						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**
S. Litchefield	Food - Chicken						1					**1**
	Porcine			3		3						**6**
	Turkey					1	1					**2**
	Water - River					1						**1**
	Subtotal	**0**	**0**	**3**	**0**	**5**	**2**	**0**	**0**	**0**	**0**	**10**
S. Livingstone	Animal Feed						1					**1**
	Avian						1					**1**
	Porcine					16				1		**17**
	Subtotal	**0**	**0**	**0**	**0**	**16**	**2**	**0**	**0**	**1**	**0**	**19**
S. London	Animal Feed		1			1						**2**
	Bovine					1						**1**
	Duck					7						**7**
	Food - Flax Seed					2						**2**
	Porcine			6	3	4	1					**14**
	Subtotal	**0**	**1**	**6**	**3**	**15**	**1**	**0**	**0**	**0**	**0**	**26**
S. Manhattan	Food - Chicken				4							**4**
S. Mastatt	Environmental Swab				1							**1**
S. Mbandaka	Animal Feed			3		8	5					**16**
	Avian					1	1	7	1			**10**
	Bovine					2						**2**
	Chicken		8		1	1		2	1		1	**14**
	Chicken - Meat				8							**8**
	Eggs		2					5			3	**10**
	Environmental Swab							15				**15**
	Food - Chicken	1				1						**2**
	Food - Sesame Seeds					1						**1**
	Food - Unknown					1						**1**
	Porcine		13	3		48	7					**71**
	Soil					1						**1**
	Water - River		7			7						**14**
	Subtotal	1	30	6	9	71	13	29	2	0	4	**165**
S. Meleagridis	Avian			1								**1**
S. Minnesota	Water					5						**5**
S. Montevideo	Animal Feed				1	13	11					**25**
	Canine					1						**1**
	Chicken	1				7	2					**10**
	Environmental Swab					5	1					**6**
	Fertilizer					1						**1**
	Food - Beef					2	1					**3**
	Food - Chicken					1	1					**2**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Food - Sesame Seeds					1						**1**
	Turkey					12						**12**
	Water - River		2			8						**10**
	Subtotal	**1**	**2**	**0**	**1**	**51**	**16**	**0**	**0**	**0**	**0**	**71**
S. Muenchen	Bovine					7						**7**
	Porcine					3						**3**
	Reptile		1									**1**
	Water		3									**3**
	Water - River		7			1						**8**
	Subtotal	**0**	**11**	**0**	**0**	**11**	**0**	**0**	**0**	**0**	**0**	**22**
S. Muenster	Animal Feed					2						**2**
	Bovine					3						**3**
	Duck					1						**1**
	Food - Beef					2						**2**
	Food - Sprouts						1					**1**
	Water					4						**4**
	Water - River		13			2						**15**
	Subtotal	**0**	**13**	**0**	**0**	**14**	**1**	**0**	**0**	**0**	**0**	**28**
S. Nessziona	Environmental Swab				1							**1**
S. Newport	Animal Feed		1		1							**2**
	Bovine					12						**12**
	Food - Beef						1					**1**
	Food - Sea Snail					5						**5**
	Food - Unknown					1						**1**
	Porcine					5						**5**
	Turkey					1						**1**
	Unknown				1							**1**
	Water		2			6						**8**
	Water - River		8			5						**13**
	Subtotal	**0**	**11**	**0**	**2**	**35**	**1**	**0**	**0**	**0**	**0**	**49**
S. Nima	Water					1						**1**
S. Ohio	Animal Feed		1									**1**
	Avian					2						**2**
	Chicken		2									**2**
	Fertilizer					2						**2**
	Porcine			1		37	3					**41**
	Subtotal	**0**	**3**	**1**	**0**	**41**	**3**	**0**	**0**	**0**	**0**	**48**
S. Oranienburg	Animal Feed					3	1					**4**
	Food - Spinach								1			**1**
	Unknown					3						**3**
	Water					2						**2**
	Water - River		2			12						**14**
	Subtotal	**0**	**2**	**0**	**0**	**20**	**1**	**0**	**1**	**0**	**0**	**24**
S. Orion	Animal Feed				58	6	9					**73**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Bovine					3						3
	Chicken		1			8						9
	Eggs										3	3
	Food - Beef					1						1
	Porcine					6						6
	Water - River					3						3
	Subtotal	0	1	0	58	27	9	0	0	0	3	98
S. Ouakam	Canine					11						11
	Chicken					9						9
	Turkey					1						1
	Subtotal	0	0	0	0	21	0	0	0	0	0	21
S. Panama	Fertilizer					1						1
	Porcine						2					2
	Subtotal	0	0	0	0	1	2	0	0	0	0	3
S. Paratyphi A	Unknown					1						1
		0	0	0	0	1	0	0	0	0	0	1
S. Paratyphi B	Avian						1					1
S. Paratyphi B var. Java	Unknown						2					2
S. Pomona	Environmental Swab				1							1
	Reptile						1					1
	Reptile - Lizard					1						1
	Water - River					1						1
	Subtotal	0	0	0	1	2	1	0	0	0	0	4
S. Putten	Animal Feed						1					1
	Chicken					4						4
	Food - Chicken					2						2
	Porcine			4		1						5
	Water - River					6						6
	Subtotal	0	0	4	0	13	1	0	0	0	0	18
S. Rissen	Chicken							3				3
S. Rubislaw	Equine		1									1
	Water		13									13
	Water - River		43									43
	Subtotal	0	57	0	0	0	0	0	0	0	0	57
S. Saintpaul	Bovine					2						2
	Chicken					1						1
	Environmental Swab					1						1
	Goose		3									3
	Turkey					23						23
	Water	2										2
	Water - River		4			4						8
	Subtotal	2	7	0	0	31	0	0	0	0	0	40

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Sandiego	Equine		1									**1**
	Water - River		1									**1**
	Subtotal	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Saphra	Food - Cantelope								1			**1**
S. Schwarzengrund	Animal Feed					5	3					**8**
	Avian						2					**2**
	Bovine					2						**2**
	Chicken	4	2			9	6					**21**
	Chicken - Meat				2							**2**
	Eggs						1					**1**
	Fertilizer					1						**1**
	Food - Beef						1					**1**
	Food - Cheese					22						**22**
	Food - Chicken					4						**4**
	Food - Meat					4						**4**
	Food - Pork					1						**1**
	Food - Shrimp					4						**4**
	Food - Unknown					2						**2**
	Partridge					1						**1**
	Porcine			4	5	21	14		1			**45**
	Turkey					1						**1**
	Subtotal	**4**	**2**	**4**	**7**	**77**	**27**	**0**	**1**	**0**	**0**	**122**
S. Senftenberg	Animal Feed					4	3		3			**10**
	Avian						2		8			**10**
	Chicken	2				17		1	8			**28**
	Eggs					2		1				**3**
	Environmental Swab					1	4					**5**
	Equine					3						**3**
	Food - Fish						1					**1**
	Food - Vegetable/Spice						6					**6**
	Porcine					1	7					**8**
	Turkey					18						**18**
	Water		1									**1**
	Water - River	4	2			9						**15**
	Subtotal	**6**	**3**	**0**	**0**	**55**	**23**	**2**	**19**	**0**	**0**	**108**
S. Senftenburg	Avian			1								**1**
S. Sorenga	Animal Feed						1					**1**
	Food - Confection						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Sundsvall	Environmental Swab				1							**1**
S. Tennessee	Animal Feed					8	3					**11**
	Avian		9									**9**
	Canine					7						**7**
	Chicken			1		2		1				**4**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Food - Beef						1					**1**
	Reptile - Lizard					1						**1**
	Turkey						1					**1**
	Water		3									**3**
	Water - River					8						**8**
	Subtotal	**0**	**12**	**1**	**0**	**26**	**5**	**1**	**0**	**0**	**0**	**45**
S. Thompson	Avian			1		3						**4**
	Bovine					5	1					**6**
	Canine					8						**8**
	Chicken	8	6			16	5		2			**37**
	Chicken - Meat		1									**1**
	Eggs					1	1		4			**6**
	Environmental Swab				1	1	5					**7**
	Equine						2					**2**
	Fish					3						**3**
	Food - Beef					22	8					**30**
	Food - Chicken			1		2	4					**7**
	Food - Milk						1					**1**
	Food - Pork					2						**2**
	Food - Sea Snail					2						**2**
	Porcine						1					**1**
	Turkey					1						**1**
	Water		9			12						**21**
	Water - River		18			19						**37**
	Subtotal	**8**	**34**	**2**	**1**	**97**	**28**	**0**	**6**	**0**	**0**	**176**
S. Tumodi	Avian						1					**1**
	Bovine					1						**1**
	Chicken					3						**3**
	Environmental Swab						1					**1**
	Food - Beef						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**4**	**3**	**0**	**0**	**0**	**0**	**7**
S. Typhi	Unknown						1					**1**
S. Typhimurium	Animal Feed					1	11					**12**
	Avian			1		35	32			5	2	**75**
	Avian - Wild Bird			1		2						**3**
	Bovine		3	10	10	53	32					**108**
	Bvoine					2						**2**
	Canine					94	1					**95**
	Cardinal					1						**1**
	Chicken	4	22	1		92	11					**130**
	Chicken - Meat		1		6	5						**12**
	Duck			1								**1**
	Eggs				3		1					**4**
	Environmental Swab	1				15	1					**17**
	Equine			2		29	2		2			**35**
	Falcon					2						**2**
	Feline					2	1					**3**
	Food - Beef					23	4					**27**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Food - Chicken	1		1		7	6					**15**
	Food - Fish					1						**1**
	Food - Meat					2						**2**
	Food - Milk		4				1					**5**
	Food - Mixed Cereals							1				**1**
	Food - Pork					2	1			2		**5**
	Food - Spinach					1						**1**
	Food - Turkey							1				**1**
	Food - Unknown					147	2					**149**
	Food - Vegetable/Spice					3						**3**
	Goose				2							**2**
	Gull			1		1						**2**
	Hedgehog						1					**1**
	Mouse				1							**1**
	Ovine				1	2						**3**
	Pet Food - Canine					2						**2**
	Pigeon		1			1						**2**
	Pine Siskin								1			**1**
	Porcine		91	14	24	451	158		3	1		**742**
	Raccoon		1									**1**
	Redpoll							3	2			**5**
	Rodent						1					**1**
	Snake		1									**1**
	Sparrow		1	1		1	1					**4**
	Turkey			1	5	9	1					**16**
	Unknown				1	11	1	1				**14**
	Unknown - Animal						16					**16**
	Water	3	4			52	1					**60**
	Water - River	13	55			50						**118**
	Subtotal	**22**	**184**	**34**	**53**	**1099**	**286**	**6**	**8**	**8**	**2**	**1702**
S. Uganda	Bovine					4						**4**
	Chicken						2					**2**
	Elephant					2						**2**
	Environmental Swab						2					**2**
	Food - Beef						1					**1**
	Water - River					7						**7**
	Subtotal	**0**	**0**	**0**	**0**	**13**	**5**	**0**	**0**	**0**	**0**	**18**
S. Urbana	Bovine					1						**1**
S. Westhampton	Chicken					1						**1**
S. Worthington	Animal Feed						1					**1**
	Chicken		2									**2**
	Eggs				1							**1**
	Food - Chicken				14							**14**
	Porcine					4						**4**
	Water - River		2			1						**3**
		0	4	0	15	5	1	0	0	0	0	**25**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Salmonella ssp I	Environmental Swab				1							**1**
		0	0	0	1	0	0	0	0	0	0	**1**
Salmonella ssp I 11:r:-	Bovine		2									**2**
	Water		3									**3**
	Water - River		6									**6**
		0	11	0	0	0	0	0	0	0	0	**11**
Salmonella ssp I 15,34:-:-	Unknown - Animal						1					**1**
Salmonella ssp I 16:c:-	Animal Feed					1						**1**
Salmonella ssp I 23:-:-	Chicken		2									**2**
Salmonella ssp I 23:d:-	Water - River					1						**1**
Salmonella ssp I 28:y:-	Water - River					3						**3**
Salmonella ssp I 3,10:-:-	Water					5						**5**
Salmonella ssp I 3,10:-:1,5	Animal Feed					1						**1**
Salmonella ssp I 3,10:-:1,6	Environmental Swab							1				**1**
Salmonella ssp I 3,10:-:z6	Food - Sea Snail					1						**1**
Salmonella ssp I 3,10:l,v:-	Porcine				1							**1**
Salmonella ssp I 3,19:-:-	Chicken					1						**1**
	Porcine								2			**2**
	Turkey					1						**1**
	Water - River					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**2**	**0**	**0**	**5**
Salmonella ssp I 4,[5],12:-:-	Avian						1		1			**2**
	Bovine					1						**1**
	Chicken					5						**5**
	Environmental Swab						2					**2**
	Porcine					9						**9**
	Turkey		1									**1**
	Water - River		1			1						**2**
	Subtotal	**0**	**2**	**0**	**0**	**16**	**3**	**0**	**1**	**0**	**0**	**22**
Salmonella ssp I 4,[5],12:-:1,2	Canine					1						**1**
	Chicken		1			15						**16**
	Goose		2									**2**
	Water - River		1									**1**
	Subtotal	**0**	**4**	**0**	**0**	**16**	**0**	**0**	**0**	**0**	**0**	**20**
Salmonella ssp I 4,[5],12:-:1,7	Canine					1						**1**
	Porcine						3					**3**
	Subtotal	**0**	**0**	**0**	**0**	**1**	**3**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 4,[5],12:-:e,n,z15	Porcine		1									**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Salmonella ssp I 4,[5],12:b:-	Equine		2									**2**
	Food - Broccoli					1						**1**
	Food - Sea Snail					2						**2**
	Water		3			4						**7**
	Water - River		3			12						**15**
		0	8	0	0	19	0	0	0	0	0	**27**
Salmonella ssp I 4,[5],12:d:-	Duck					2						**2**
	Environmental Swab							1				**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**3**
Salmonella ssp I 4,[5],12:i:-	Avian					8	4					**12**
	Bovine		1			2	1					**4**
	Canine					2						**2**
	Chicken	48	22			50						**120**
	Chicken - Meat		1			1						**2**
	Cormorant					4						**4**
	Eggs						2					**2**
	Environmental Swab						9					**9**
	Equine					7						**7**
	Food - Beef					3						**3**
	Food - Chicken			1		1						**2**
	Food - Scallop								1			**1**
	Food - Unknown					3						**3**
	Porcine		1			15	3			3		**22**
	Redpoll					2		1				**3**
	Turkey					2						**2**
	Unknown							1				**1**
	Water					4						**4**
	Water - River		5			3						**8**
	Subtotal	**48**	**30**	**1**	**0**	**107**	**19**	**2**	**1**	**3**	**0**	**211**
Salmonella ssp I 4,[5],12:l,v:-	Porcine					1				1		**2**
Salmonella ssp I 4,[5],12:r:-	Avian								1			**1**
	Chicken	1				1			2			**4**
	Porcine		1									**1**
	Subtotal	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**6**
Salmonella ssp I 4,[5],12:z:-	Chicken					1						**1**
Salmonella ssp I 4,5,12:r:-	Canine					1						**1**
Salmonella ssp I 47:z4,z23:-	Animal Feed					1						**1**
Salmonella ssp I 51:-:1,2	Reptile - Python		1									**1**
Salmonella ssp I 6,14,18:-:-	Bovine					18						**18**
	Environmental Swab					1						**1**
	Food - Beef					3	1					**4**
	Porcine					2						**2**
	Turkey					1						**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Subtotal	**0**	**0**	**0**	**0**	**25**	**1**	**0**	**0**	**0**	**0**	**26**
Salmonella ssp I 6,7,14:-:l,w	Porcine					1						**1**
Salmonella ssp I 6,7:-:-	Animal Feed					1						**1**
	Bovine					1						**1**
	Canine					1						**1**
	Environmental Swab						2					**2**
	Fertilizer					1						**1**
	Porcine			1			2					**3**
	Subtotal	**0**	**0**	**1**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**9**
Salmonella ssp I 6,7:-:1,5	Avian					1						**1**
	Chicken		1									**1**
	Turkey					1						**1**
	Water - River		27									**27**
	Subtotal	**0**	**28**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**30**
Salmonella ssp I 6,7:-:1,6	Water	1										**1**
Salmonella ssp I 6,7:-:e,n,z15	Avian					1		1				**2**
	Porcine			1								**1**
	Water - River		1									**1**
	Subtotal	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**4**
Salmonella ssp I 6,7:-:l,w	Porcine			1		2						**3**
Salmonella ssp I 6,7:k:-	Water		1									**1**
Salmonella ssp I 6,8:-:-	Bovine					1						**1**
Salmonella ssp I 6,8:-:e,n,x	Chicken		1									**1**
	Chicken - Meat				28							**28**
	Food - Chicken					1						**1**
	Subtotal	**0**	**1**	**0**	**28**	**1**	**0**	**0**	**0**	**0**	**0**	**30**
Salmonella ssp I 6,8:z10:-	Chicken		2									**2**
	Food - Chicken			1								**1**
	Pelican		1									**1**
	Subtotal	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 8,20:-:-	Bovine					1	1					**2**
	Chicken						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I 8,20:-:z6	Bovine					1						**1**
	Chicken	1				1	1					**3**
	Subtotal	**1**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 8,20:i:-	Avian						1				1	**2**
	Canine					1						**1**
	Chicken					1						**1**
	Food - Chicken					2	1					**3**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Subtotal	0	0	0	0	4	2	0	0	0	1	**7**
Salmonella ssp I 9,12:-:-	Chicken					1						**1**
	Food - Cheese					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 9,12:e,h:-	Hedgehog		1									**1**
Salmonella ssp I Rough-O:-:-	Animal Feed				1							**1**
	Chicken					1			1			**2**
	Subtotal	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**3**
Salmonella ssp I Rough-O:-:1,2	Chicken					1						**1**
	Porcine						1					**1**
		0	0	0	0	1	1	0	0	0	0	**2**
Salmonella ssp I Rough-O:-:1,5	Avian						1					**1**
	Chicken		1									**1**
	Subtotal	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:-:e,n,x	Chicken		1									**1**
Salmonella ssp I Rough-O:-:l,w	Chicken					1						**1**
Salmonella ssp I Rough-O:b:-	Chicken		2									**2**
	Water		2									**2**
	Subtotal	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I Rough-O:b:l,w	Porcine					3						**3**
Salmonella ssp I Rough-O:d:-	Chicken					1						**1**
Salmonella ssp I Rough-O:d:1,7	Porcine					2						**2**
Salmonella ssp I Rough-O:d:l,w	Water - River					1						**1**
Salmonella ssp I Rough-O:e,h:1,2	Turkey					7						**7**
Salmonella ssp I Rough-O:f,g,t:-	Porcine						1					**1**
	Water - River					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:f,g:-	Porcine					2						**2**
	Water		1									**1**
	Subtotal	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:g,m,s:-	Animal Feed							1				**1**
Salmonella ssp I Rough-O:g,m:-	Chicken		1									**1**
Salmonella ssp I Rough-O:i:-	Chicken	1				1						**2**
Salmonella ssp I Rough-O:i:1,2	Animal Feed					3						**3**
	Avian					1						**1**
	Chicken					4						**4**
	Environmental Swab					1						**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Porcine					3	1					**4**
	Unknown - Animal						1					**1**
	Water		1			1						**2**
	Subtotal	**0**	**1**	**0**	**0**	**13**	**2**	**0**	**0**	**0**	**0**	**16**
Salmonella ssp I Rough-O:i:z6	Bovine					1						**1**
	Chicken					5						**5**
	Environmental Swab						2					**2**
	Subtotal	**0**	**0**	**0**	**0**	**6**	**2**	**0**	**0**	**0**	**0**	**8**
Salmonella ssp I Rough-O:k:-	Environmental Swab						1					**1**
	Water		2									**2**
	Subtotal	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:k:1,5	Avian						1					**1**
	Chicken		3			1			1			**5**
	Subtotal	**0**	**3**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**6**
Salmonella ssp I Rough-O:k:e,n,x	Reptile - Lizard						1					**1**
	Water - River		2									**2**
	Subtotal	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:l,v:e,n,x	Water - River		4									**4**
Salmonella ssp I Rough-O:r:-	Avian						2					**2**
	Canine					1						**1**
	Chicken		1			1						**2**
	Subtotal	**0**	**1**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I Rough-O:r:1,2	Avian						3					**3**
	Chicken	3	1			10		1	2			**17**
	Chicken - Water					1						**1**
	Subtotal	**3**	**1**	**0**	**0**	**11**	**3**	**1**	**2**	**0**	**0**	**21**
Salmonella ssp I Rough-O:r:1,5	Porcine		1							1		**2**
Salmonella ssp I Rough-O:z:-	Chicken					1						**1**
Salmonella ssp I Rough-O:z:l,w	Water - River		1									**1**
Salmonella ssp I Rough-O:z10:e,n,x	Chicken		8									**8**
	Food - Chicken					1						**1**
	Pelican		1									**1**
	Subtotal	**0**	**9**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**10**
Salmonella ssp I Rough-O:z10:e,n,z15	Porcine					1						**1**
Salmonella ssp I Rough-O:z29:-	Animal Feed					1						**1**
	Canine					5						**5**
	Subtotal	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp II 40:b:-	Bovine					1						**1**
Salmonella ssp II 6,8:-:-	Equine					1						**1**
Salmonella ssp IIIa 18:z4:z32:-	Chicken			1								**1**

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
Salmonella ssp IIIa 41:z4,z23:-	Reptile - Python		1									**1**
	Reptile - Snake						1					**1**
	Subtotal	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp IIIa 42:z4,z24:-	Food - Lettuce					1						**1**
Salmonella ssp IIIa 51:z4,z23:-	Environmental Swab					5						**5**
	Food - Cheese						2					**2**
	Subtotal	**0**	**0**	**0**	**0**	**5**	**2**	**0**	**0**	**0**	**0**	**7**
Salmonella ssp IIIa Rough-O:z4,z23:-	Environmental Swab					1						**1**
	Food - Cheese						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp IIIb 35:i:-	Snake		1									**1**
Salmonella ssp IIIb 38:l,v:-	Reptile		1									**1**
Salmonella ssp IIIb 38:l,v:z53	Unknown						1					**1**
Salmonella ssp IIIb 38:r:-	Water - River		1									**1**
Salmonella ssp IIIb 38:z10:z53	Water - River		5									**5**
Salmonella ssp IIIb 50:z:z52	Reptile							1				**1**
Salmonella ssp IIIb 61:-:-	Ovine		1									**1**
Salmonella ssp IIIb 61:-:1,5	Ovine		91				1		2			**94**
	Ovine - Meat					1						**1**
	Water - River		5									**5**
	Subtotal	**0**	**96**	**0**	**0**	**1**	**1**	**0**	**2**	**0**	**0**	**100**
Salmonella ssp IIIb 61:-:1,5,7	Ovine			1								**1**
Salmonella ssp IV 40:z4,z23:-	Reptile						1					**1**
Salmonella ssp IV 45:g,z51:-	Canine					1						**1**
Salmonella ssp IV 50:g,z51:-	Reptile - Lizard			1								**1**
Salmonella ssp IV 50:r:z	Reptile	1										**1**
Salmonella ssp IV 53:g,z51:-	Snake		1									**1**
Salmonella ssp IV 6,7,14:z4,z23:-	Animal Feed						1					**1**
	Chicken							2				**2**
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**3**
Total		**211**	**1325**	**254**	**381**	**3774**	**900**	**115**	**118**	**18**	**77**	**7173**

First-time Identifications of *Salmonella* Serovars in Canada, 2006

Serovars listed here represent strains identified for the first time in Canada.

Serotype	Province	Source	Month
Salmonella **ssp I 28:d:z6**	**ON**	**Human**	**January**
Salmonella **ssp I 9,12:lz 13,z28:e,n,x**	**BC**	**Human**	**January**
Salmonella **Malstatt (16:b:z6)**	**ON**	**Human**	**March**
Salmonella **Tomegbe (42:b:e,n,z15)**	**ON**	**Human**	**April**
Salmonella **Makiso (6,7:1z13,z28:z6)**	**ON**	**Human**	**May**
Salmonella **Drac (47:1,v:e,n,x)**	**ON**	**Human**	**July**
Salmonella **Overschie (51:1,v:1,5)**	**ON**	**Human**	**July**
Salmonella **Landwasser (3,10:z:z6)**	**ON**	**Human**	**September**
Salmonella **Benin (9,46:y:1,7)**	**QC**	**Human**	**October**
Salmonella **ssp II 1,40:c:e,n,x,z15**	**ON**	**Human**	**October**
Salmonella **ssp IIIa 53:g,z51:-**	**AB**	**Snake pericardium**	**October**
Salmonella **IIIb 53:z10:z**	**BC**	**Human**	**January**

Phage Types of *Salmonella* Serovars Identified in Canada, 2006

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 phage types found in Canada.

Despite a large decrease in *S*. Enteritidis PT 13 from 55% (n=902) of the human isolates tested in 2005, to 23% (n=298) in 2006, levels continue to steadily increase from those seen in 2002 where 11% of *S*. Enteritidis isolates were identified as PT 13. Although much of the increase in these isolates may be attributed to a large outbreak of *S*. Enteritidis PT 13 associated with mung bean sprouts in Ontario in 2005, a steady decrease in human PT 4 isolations from 32% in 2002 to 24% in 2006 may suggest a shift in the endemic strain circulating in Canada. This shift is also noted in the predominant phage types of non-human isolates where the proportion of isolates identified as PT 13 increased dramatically from 5% in 2003 to 50% in 2004 and then to 65% of isolates tested in 2005. As with the human trends, PT 13 identifications have decreased to 27% of the non-human strains tested in 2006, however, it remains above 2002 and 2003 levels of 13% and 5%, respectively. The proportions of PT 8 and PT 1 have remained relatively constant among human isolates over this 5 year period, each accounting for approximately 12% of the *S*. Enteritidis strains tested. Among the non-human isolates, PT 8 increased from 29% in 2005 to 39% in 2006 after a steady decline over the previous 4 years from 60% in 2002.

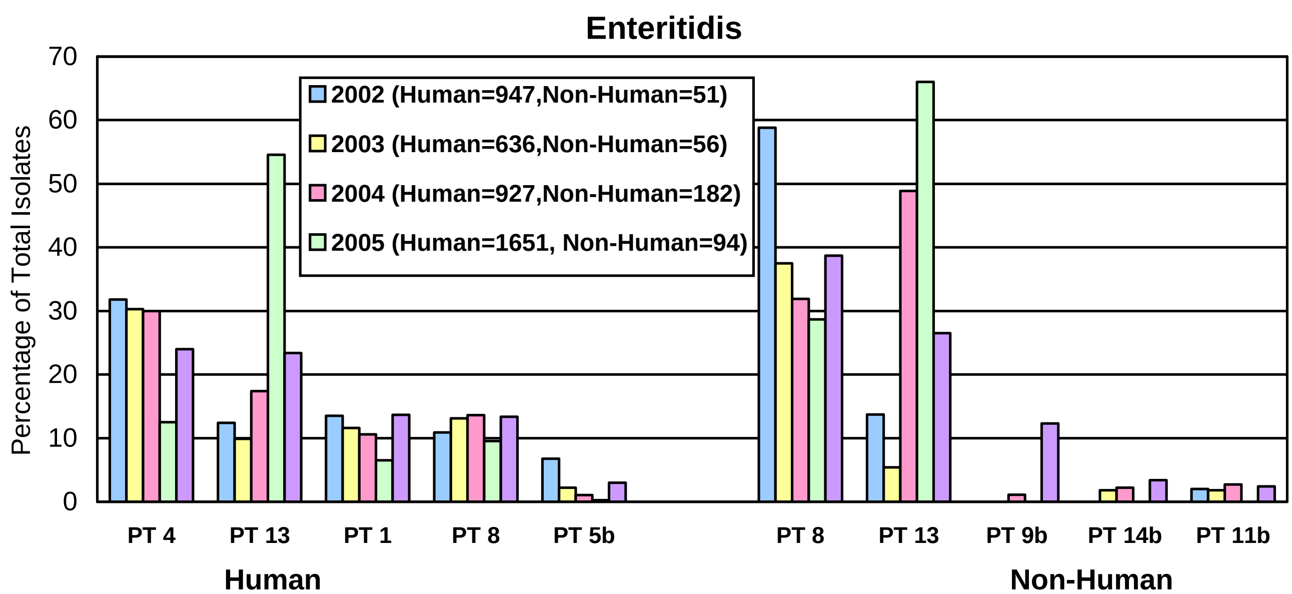
S. Typhimurium PT 104 remains the most prevalent phage type identified among both human and non-human isolates in 2006, however, a slight decreasing trend continues. Human identifications of PT 104 have dropped from 18% in 2002 to 15% in 2006. Similarly in non-human strains, the proportion of isolates identified as PT 104 has declined from 25% to 23% between 2002 and 2006. A large increase in PT170 has been observed among human strains in 2006. It accounts for 14% of the strains tested in 2006, up from approximately 3% for each of the previous 4 years, and now ranks as the 2nd most prevalent human phage type. PT UT1, U302 and 104b, each accounting for approximately 5% of the *S*. Typhimurium identifications rank 3rd, 4th and 5th, respectively, among human strains. PT 132 has increased in non-human *S*. Typhimurium identifications, accounting for 10% of the strains in 2006, up from approximately 2% for each of the 4 previous years. PT 104b, PT 104a and PT 193 rank as the next most prevalent non-human phage types.

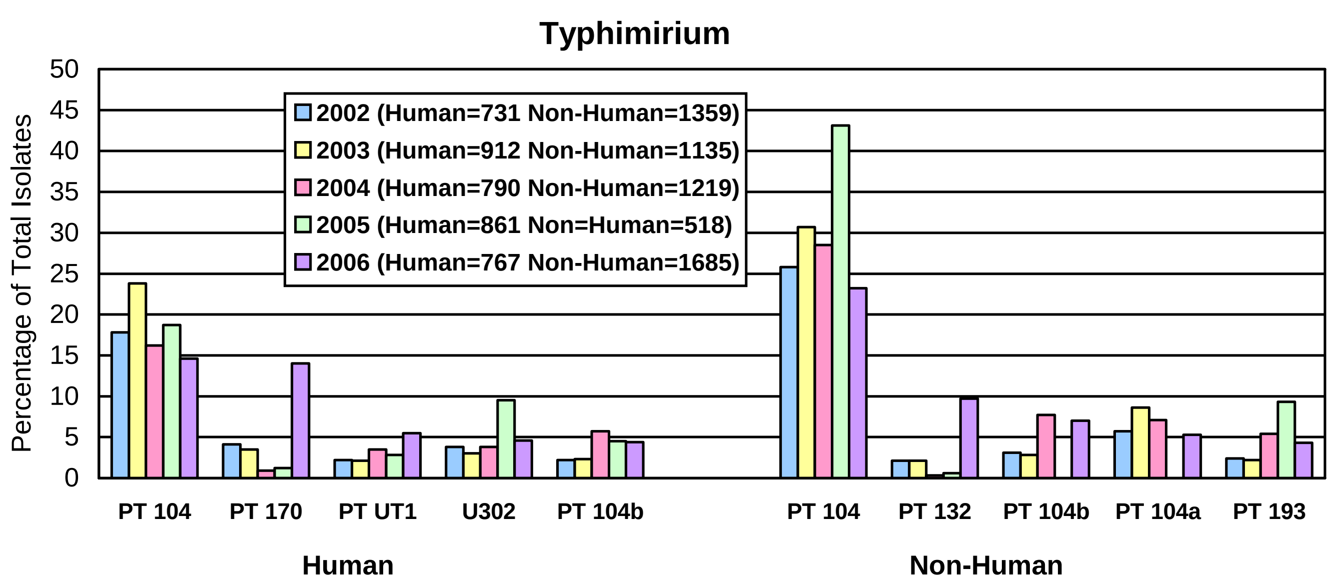
S. Heidelberg PT 19 continues as the most prevalent phage type, increasing slightly over the 5 year period from 35% of human isolates in 2002 to 38% in 2006, and from 28% of non-human isolates in 2003 to 31% in 2006. PT 29 is second most prevalent among human and non-human *S*. Heidelberg isolates. Among human strains, levels have decreased from a 5-year high of 24% in 2004 to only 7% in 2006. The proportion of PT 29 identifications in non-human isolates had increased to 35% to become the most prevalent phage type in 2005, but levels have declined in 2006 to 14%, ranking 2nd in prevalence.

After remaining relatively constant from 2003 to 2005, the level of *S*. Hadar PT 2 identifications has increased in 2006 to account for 46% of human strains tested. The second most prevalent phage type, PT 5, has increased from 12% of human strains in 2004 to 20% in 2006. PT 5 is also the most prevalent non-human *S*. Hadar phage type, accounting for 64% of strains in 2006, up from 11% in 2004 and no identifications in 2002. PT 11 identifications among human strains have remained relatively constant since 2003, with approximately 10% in each of the 4 years. *S*. Hadar PT 11 is the 2nd most prevalent non-human phage type, accounting for 20% of the strains identified in 2006, a decline from 40% in 2005 when it ranked 1st.

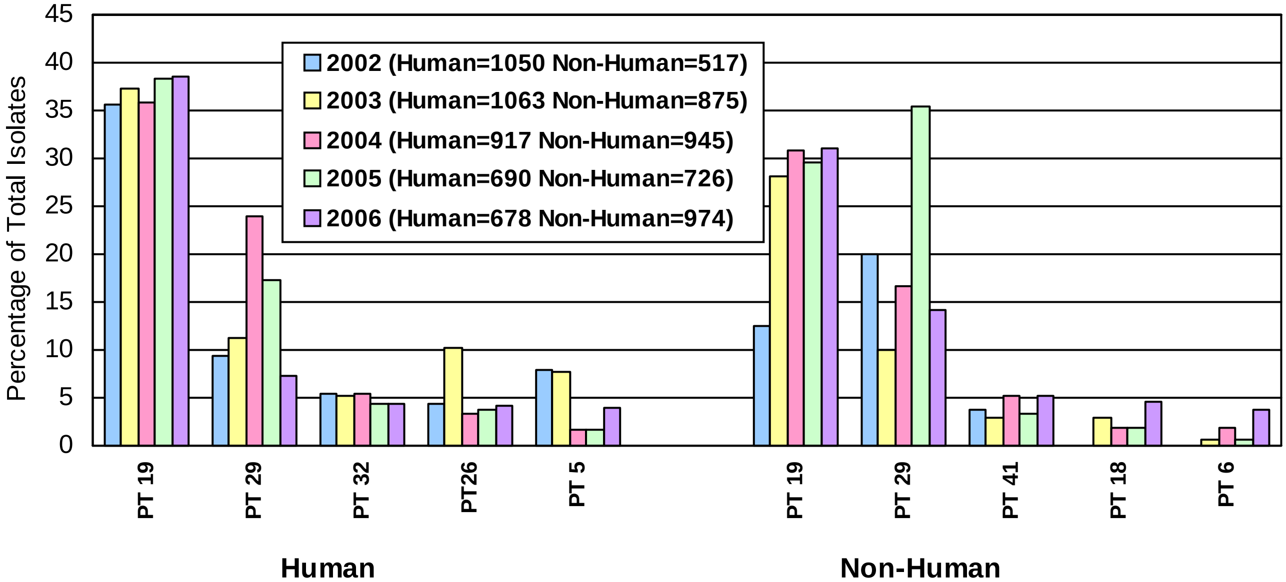
Although *S.* Newport PT 9 still remains the most prevalent human phage type in 2006, the proportion of identifications has declined considerably from a high of 30% in 2004 to 13% in 2006. PT 3 and PT 4, each accounting for approximately 11% of human isolates, rank a close 2nd and 3rd, respectively. Only 2 non-human S. Newport isolates were tested in 2006, one isolate was PT 13 and the other PT 14c.

Figure 11: Most Prevalent Phage Types of Various *Salmonella* Serovars Isolated in Canada, 2002 to 2006

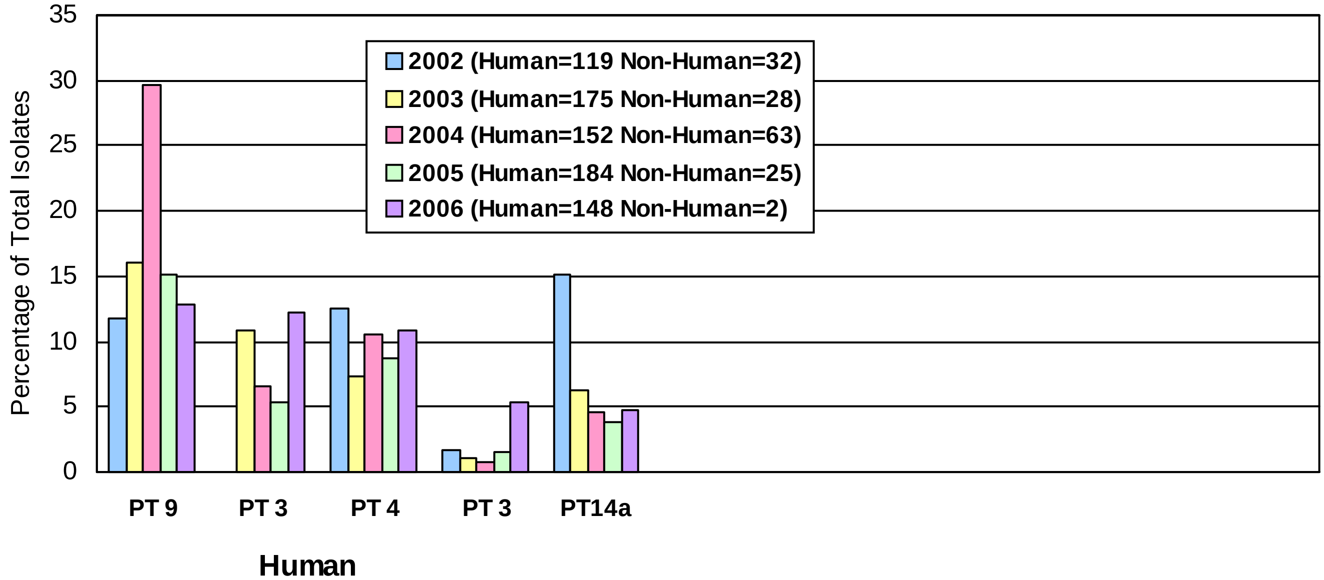




Heidelberg



Newport



Hadar

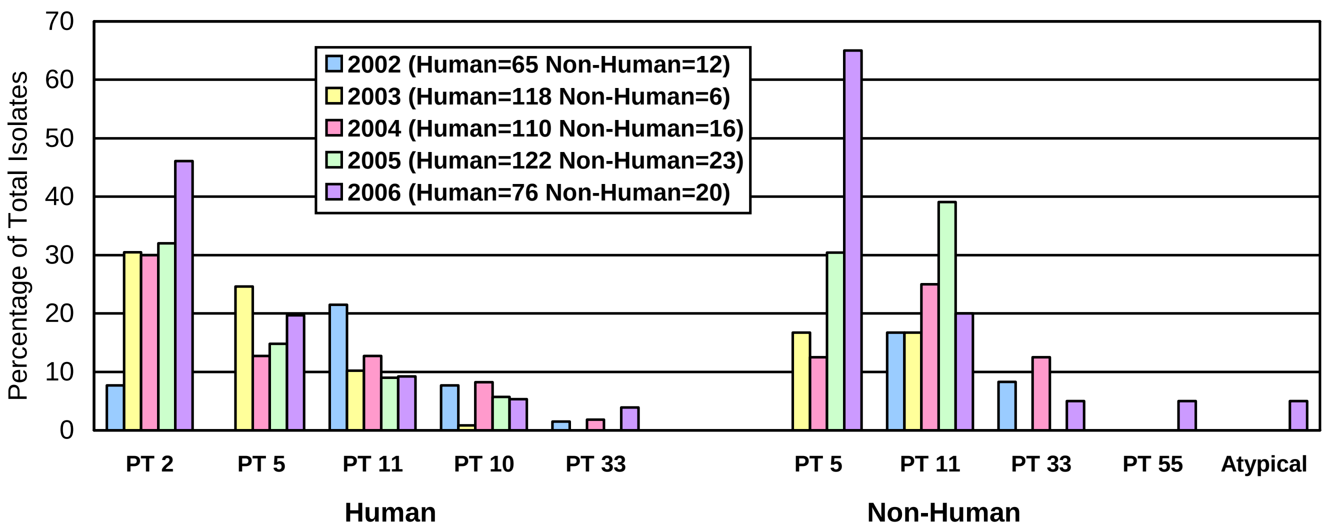


Table 4: Phage Types of *Salmonella* Serovars from Human Sources, 2006

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Enteritidis	1	13	20	2	4	91	33	1	6	3	1	**174**
	1a	3				4	1					**8**
	1b		1			2			1			**4**
	2		7			10						**17**
	3					1	1					**2**
	4	16	49	5	10	159	34	14	15	2	2	**306**
	4a		4		1	9	3					**17**
	4b	1	1	1		7	2					**12**
	5						1					**1**
	5a		1				1					**2**
	5b	2				27	8			1		**38**
	5c					2						**2**
	6	2	2			7	4					**15**
	6a	8	9	2	2	10		3				**34**
	6b		2				1					**3**
	7					1						**1**
	7a			1								**1**
	8	13	43	11	8	51	33	7	1	2	1	**170**
	9b		1									**1**
	11b			4			1					**5**
	13	5	8	2	1	219	52	6	5			**298**
	13a		1			1	1	1	1			**5**
	14b		1		1	3	3					**8**
	18					1						**1**
	19					1						**1**
	20		1	2								**3**
	21	3	3	1	1	13	2					**23**
	21b					1						**1**
	21c					1						**1**
	22		1			9	1	1				**12**
	23							1				**1**
	28					1						**1**
	29	3										**3**
	29a											**0**
	30	1	4	1	3	10	1	1	2			**23**
	31		4			2						**6**
	32a						1					**1**
	34					1						**1**
	34b						1					**1**
	35	1				1						**2**
	37					1						**1**
	911		1	1	4	5	1					**12**
	Atypical	4	6	1		22	6		2		1	**42**
	Untypable	2	3			6	4					**15**
	Subtotal	**77**	**173**	**34**	**35**	**679**	**196**	**35**	**33**	**8**	**5**	**1275**
S. Hadar	1					1						**1**
	2	7	15			11	2					**35**
	5	3	7	2		2	1					**15**
	9		1									**1**
	10	1				2			1			**4**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	11		3	1	2	1						**7**
	33		1			1					1	**3**
	34		1									**1**
	36					1						**1**
	42						1					**1**
	51						1					**1**
	58					1						**1**
	Atypical	1				1	1					**3**
	Untypable					2						**2**
	Subtotal	**12**	**28**	**3**	**2**	**23**	**6**	**0**	**1**	**0**	**1**	**76**
S. Heidelberg	1		1	1		1		2	1			**6**
	2		2		1	1	3	1				**8**
	4				1							**1**
	5				1	8	5	11	2			**27**
	6				1	4					1	**6**
	8		1								1	**2**
	10		2			1					1	**4**
	11	1	2			13	4		1			**21**
	11a					18	3					**21**
	16	1				1						**2**
	18		2			5	2			1		**10**
	18a		1					21				**22**
	19	10	45	6	6	95	78	10	7	1	3	**261**
	19a		1			10		1	1			**13**
	19b						1	7				**8**
	19c	2	1	1			2					**6**
	20					1	1					**2**
	21						1					**1**
	22		5			1						**6**
	24					1						**1**
	25						1					**1**
	26		1			7	15	3	2			**28**
	29		6		4	21	9	6		2	1	**49**
	29a					2				1		**3**
	32	6	8	3		4	4	4				**29**
	32a						1					**1**
	32b				1	1						**2**
	35			1	1	1	1					**4**
	36	1	1			1						**3**
	39		1				1					**2**
	40					4	16			1		**21**
	41	1	3		1	7	8	1	1			**22**
	43				1							**1**
	44		1									**1**
	47						1					**1**
	51				1	1	1	1				**4**
	52					1	3					**4**
	53	1		1		2	3					**7**
	54	1	1			2		1				**5**
	55					5	3		1			**9**
	56	1										**1**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Atypical	6	11	1	3	12	14	3	1	1		**52**
	Subtotal	**31**	**96**	**14**	**22**	**231**	**181**	**72**	**17**	**7**	**7**	**678**
S. Infantis	1					1						**1**
	3					1						**1**
	4		2			3	4					**9**
	5					1	1					**2**
	7	3	2	1	1	12	2					**21**
	8	1	1	1						1		**4**
	12					1						**1**
	13	3		1		1						**5**
	22		1									**1**
	25	1										**1**
	26	1										**1**
	29					1						**1**
	Subtotal	**9**	**6**	**3**	**1**	**21**	**7**	**0**	**0**	**1**	**0**	**48**
S. Newport	2	2	1			2						**5**
	3	3	1	1		11	1		1			**18**
	4	1	2			12	1					**16**
	5		1									**1**
	8					2						**2**
	9					17	2					**19**
	10					1	3					**4**
	11	2										**2**
	12		1									**1**
	13	3	1			2						**6**
	14					2						**2**
	14a	1			2	2	2					**7**
	14b	1				1	1					**3**
	14c		1			4	2		1			**8**
	15	2				1	1					**4**
	16	1				5						**6**
	17	3										**3**
	17a	1	1			5						**7**
	17b					1						**1**
	17c		2			3	1	1				**7**
	17e		1		1							**2**
	Atypical		2		2	14	2					**20**
	Untypable		4									**4**
	Subtotal	**20**	**18**	**1**	**5**	**85**	**16**	**1**	**2**	**0**	**0**	**148**
S. Oranienburg	1	3	4			10						**17**
	2	1				2	1					**4**
	6	3	3		1	7	1					**15**
	7					1						**1**
	8			1		2						**3**
	10		1									**1**
	13					1						**1**
	15		3		1	1						**5**
	Atypical					1						**1**
	Subtotal	**7**	**11**	**1**	**2**	**25**	**2**	**0**	**0**	**0**	**0**	**48**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Panama	A	1				1						**2**
	Atypical	1			1							**2**
	F		1									**1**
	G		2			1						**3**
	H		1			1	1					**3**
	Untypable						1					**1**
	Subtotal	**2**	**4**	**0**	**1**	**3**	**2**	**0**	**0**	**0**	**0**	**12**
S. Paratyphi B	Atypical						3					**3**
	Battersea						3					**3**
	Dundee	1				1	1					**3**
	Dundee var. 1		1									**1**
	Dundee var. 2						1					**1**
	Untypable						1					**1**
	Subtotal	**1**	**1**	**0**	**0**	**1**	**9**	**0**	**0**	**0**	**0**	**12**
S. Paratyphi B var. Java	1 var. 5	1	1			2	1	1				**6**
	1 var. 6				1							**1**
	Atypical	4	1			3	1		3			**12**
	Battersea			5			1					**6**
	Dundee		1	1	1	5	1					**9**
	Dundee var. 1		1									**1**
	Dundee var. 2		1									**1**
	Sterling						1					**1**
	Untypable	1	2				7			1		**11**
	Subtotal	**6**	**7**	**6**	**2**	**10**	**12**	**1**	**3**	**1**	**0**	**48**
S. Thompson	2	1	1	3		3	1					**9**
	3	1	1			50	9	3				**64**
	8					5						**5**
	25	1				1	1					**3**
	26		1		2							**3**
	27					14		1				**15**
	Atypical	1			1	3						**5**
	Untypeable	1	1	4	1	3	1					**11**
	Subtotal	**5**	**4**	**7**	**4**	**79**	**12**	**4**	**0**	**0**	**0**	**115**
S. Typhi	46						1					**1**
	53					1	2					**3**
	A	1				4	3					**8**
	C 1					1						**1**
	D 1	4				8	1					**13**
	D 2	2				2						**4**
	DVS		1			2						**3**
	E					1						**1**
	E 1	18	4	1		38	3				1	**65**
	E 9	1				7						**8**
	E14	5	1			2	1					**9**
	G3	3	1			12	1					**17**
	M1	1				1						**2**
	N						3					**3**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	O				1	4						**5**
	UVS	3	2									**5**
	UVS-(I+IV)	1				2						**3**
	Untypable	5	1			9	1					**16**
	Subtotal	**44**	**10**	**1**	**1**	**94**	**16**	**0**	**0**	**0**	**1**	**167**
S. Typhimurium	1	2	2			16	2	1				**23**
	2		2		2	7	4	2				**17**
	3 aerogenic	1	2	1		2						**6**
	10	1	2		3	17	5				1	**29**
	12		1		1	4	7	1				**14**
	12a					1						**1**
	15a			1	1	1						**3**
	21		1	1		1	3					**6**
	22			1		2	1					**4**
	35	2					5		1			**8**
	39					2	1					**3**
	40	1				1						**2**
	41	2	3	1	1	4	1					**12**
	42					1						**1**
	46					1	2	14	1			**18**
	56						1					**1**
	64	1				1						**2**
	66					8	1					**9**
	69					4	2					**6**
	80					1						**1**
	82	2				2						**4**
	96		4		3							**7**
	99		1			2	2					**5**
	102					1						**1**
	104	6	43	4	2	21	35		1			**112**
	104a		1			14	10					**25**
	104b	5			1	22	6					**34**
	107	1	1		1	3	9					**15**
	108	1			2	9	4			1		**17**
	110b					1						**1**
	120	1	2			5	3					**11**
	121		1									**1**
	124 var.				1			1				**2**
	125					1						**1**
	132	2				2						**4**
	135	2	9		1	1	1					**14**
	146	1	1	1								**3**
	151						3					**3**
	160		2	2	1	5	1					**11**
	161						1					**1**
	170		3		3	75	17		2	7		**107**
	177					2						**2**
	192		1		1		1					**3**
	193	7	7	1		5	10		1			**31**
	195		1			1	2					**4**
	199				1							**1**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	202			1								**1**
	204a						1					**1**
	208		1				3					**4**
	208 var.		6		1							**7**
	Atypical	6	10	4	2	22	8	4		1	1	**58**
	U276		1				1					**2**
	U284						1					**1**
	U284 var.						2					**2**
	U285	2	3									**5**
	U287	1	2									**3**
	U291				1	1						**2**
	U292		1									**1**
	U297		1									**1**
	U302	1	2			19	12	1				**35**
	UT 1	16	12	2	5	2	3		1	1		**42**
	UT 2		1			1	1					**3**
	UT 5		2			1	2					**5**
	UT 6		2			1						**3**
	UT 7	1										**1**
	Untypable		1			3						**4**
	Subtotal	**65**	**135**	**20**	**34**	**296**	**174**	**24**	**7**	**10**	**2**	**767**
Salmonella ssp I 4,12:b:-	Sterling					1						**1**
	Untypable					1	1					**2**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I 4,[5],12:b:-	Atypical		1			6	2					**9**
	Battersea		1			3	5					**9**
	Dundee	1				1						**2**
	Dundee var. 1					3						**3**
	Dundee var. 2		1			4						**5**
	Sterling					2						**2**
	Untypable	3	1	1		5	3					**13**
	Subtotal	**4**	**4**	**1**	**0**	**24**	**10**	**0**	**0**	**0**	**0**	**43**
Salmonella ssp I 4,[5],12:i:-	2	1										**1**
	21						2					**2**
	35					3						**3**
	41	1					1					**2**
	104						1					**1**
	110b						1					**1**
	125		1									**1**
	179									2		**2**
	191	1	1	3		2	2			1		**10**
	193				1		1					**2**
	Atypical	1	4	1		3	1	2	1			**13**
	U284	1										**1**
	U284 var.						1					**1**
	U287			1	1							**2**
	U291	1	8	2	1	7	5	4				**28**
	U291 var.		1				1					**2**
	U302		1					1				**2**

Organism	PT	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	UT 1						1					**1**
	UT 2					2	1					**3**
	UT 7						1					**1**
	Subtotal	**6**	**16**	**7**	**3**	**17**	**19**	**7**	**1**	**3**	**0**	**79**

Table 5: Phage Types of *Salmonella* Serovars from Non-Human Sources, 2006

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Enteritidis	1	Unknown	1				1						**1**
	1b	Unknown					1						**1**
	2	Chicken		1									**1**
	4	Water					1						**1**
	4	Water - River					1						**1**
	6	Unknown					1						**1**
	8	Animal Feed						1					**1**
	8	Avian		1	3		5	14	1				**24**
	8	Canine		1			2						**3**
	8	Chicken	5	91	2	8	10	3					**114**
	8	Chicken - Meat		2		7	2						**11**
	8	Eggs		1	1			6					**8**
	8	Environmental Swab						4					**4**
	8	Food - Chicken			7		2	1					**10**
	8	Food - Grape					1						**1**
	8	Food - Unknown					1						**1**
	8	Porcine	1	2	2		2						**6**
	8	Unknown						5					**5**
	8	Water					1						**1**
	8	Water - River					1						**1**
	9	Avian						1					**1**
	9	Duck					2						**2**
	9	Porcine			6								**6**
	9a	Chicken			1								**1**
	9b	Avian					2						**2**
	9b	Duck					59						**59**
	9b	Unknown					1						**1**
	9c	Avian			1								**1**
	11	Chicken					2						**2**
	11b	Avian			2								**2**
	11b	Chicken			4		3						**7**
	11b	Food - Unknown		1									**1**
	11b	Porcine			1								**1**
	11b	Unknown					1						**1**
	13	Avian					10	2					**12**
	13	Bovine					1				1		**2**
	13	Canine					1						**1**
	13	Chicken	11	9			54	2		2			**67**
	13	Chicken - Meat				1	1						**2**
	13	Environmental Swab						5					**5**
	13	Feline					1			1			**2**
	13	Food - Chicken					6						**6**
	13	Food - Unknown					3						**3**
	13	Food - Vegetable/Spice					1						**1**
	13	Porcine					1						**1**
	13	Reptile					1	1					**2**
	13	Unknown					3	11					**14**
	13	Water - River		5									**5**
	13a	Animal Feed				3							**3**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	14b	Avian					1	2					**3**
	14b	Chicken					6	1					**7**
	14b	Chicken - Meat				4							**4**
	14b	Environmental Swab					1	1					**2**
	14b	Food - Vegetable/Spice					1						**1**
	20	Hedgehog		1									**1**
	20	Porcine		1	3								**4**
	21	Unknown					1						**1**
	23	Chicken		8			2						**10**
	23	Turkey		1									**1**
	29	Unknown					1						**1**
	30	Food - Unknown						1					**1**
	30	Unknown					1						**1**
	30	Water		5									**5**
	911	Chicken				1							**1**
	911	Unknown					1						**1**
	913	Food - Crab					3						**3**
	Atypical	Avian			1		2	6					**9**
	Atypical	Chicken		1	1		7						**9**
	Atypical	Duck					1						**1**
	Atypical	Eggs		1									**1**
	Atypical	Environmental Swab					1	2					**3**
	Atypical	Food - Chicken						1					**1**
	Atypical	Porcine					2						**2**
	Atypical	Unknown					2						**2**
	Untypable	Chicken		1									**1**
	Untypable	Food - Sea Snail					1						**1**
	Untypable	Owl						2					**2**
		Subtotal	**18**	**133**	**35**	**24**	**219**	**72**	**1**	**3**	**1**	**0**	**488**
S. Hadar	5	Animal Feed		1									**1**
	5	Chicken		10									**10**
	5	Chicken - Meat		1		1							**2**
	11	Chicken		4									**4**
	33	Chicken		1									**1**
	55	Chicken		1									**1**
	Atypical	Chicken - Meat				1							**1**
		Subtotal	**0**	**18**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**20**
S. Heidelberg	2	Canine					1						**1**
	2	Chicken						1					**1**
	2	Food - Chicken			1								**1**
	2	Porcine					1						**1**
	3	Avian							1				**1**
	3	Chicken						1					**1**
	4	Chicken - Meat				11							**11**
	5	Avian					1						**1**
	5	Chicken					10			1			**11**
	5	Food - Chicken			1		1	2					**4**
	5	Water					1	1					**2**
	6	Avian						2					**2**
	6	Canine					2						**2**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	6	Chicken	6	3	1		11						**21**
	6	Food - Chicken	2					3					**5**
	6	Turkey						1					**1**
	6	Water - River		5			1						**6**
	8	Environmental Swab					1						**1**
	8	Turkey		1									**1**
	9	Avian					1						**1**
	10	Avian					1						**1**
	10	Chicken								2			**2**
	10	Food - Chicken						1					**1**
	11	Bovine					1						**1**
	11	Canine					3						**3**
	11	Chicken					5						**5**
	11	Food - Chicken					1	1					**2**
	11	Turkey					1						**1**
	11a	Canine					3						**3**
	11a	Chicken		2			21						**23**
	11a	Food - Chicken					4	4					**8**
	11a	Unknown					1						**1**
	11a	Water - River					1						**1**
	12	Food - Chicken						2					**2**
	13	Food - Chicken						1					**1**
	14	Food - Chicken					1						**1**
	17	Canine					2						**2**
	17	Chicken					5			1			**6**
	17	Food - Chicken					1						**1**
	18	Avian						1					**1**
	18	Canine					5						**5**
	18	Chicken	3	2			13	3		1			**22**
	18	Food - Chicken			3		1	8					**12**
	18	Porcine					1						**1**
	18	Turkey					1	1					**2**
	18	Water - River					1						**1**
	19	Avian		1			2	3		2			**8**
	19	Bovine					2	2					**4**
	19	Canine					58						**58**
	19	Chicken	2	28			89	10	3	7		1	**140**
	19	Chicken - Meat		13		33							**46**
	19	Eggs		2					1				**3**
	19	Environmental Swab		1			3		2				**6**
	19	Equine					2	1					**3**
	19	Feline					2						**2**
	19	Food - Chicken			1		6	2					**9**
	19	Turkey					4						**4**
	19	Unknown					1						**1**
	19	Unknown - Animal	3										**3**
	19	Water - River		7			8						**15**
	19a	Avian					4						**4**
	19a	Chicken						1	2	1			**4**
	19a	Food - Meat					2						**2**
	19b	Porcine					1						**1**
	19c	Water - River		4									**4**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	20	Food - Chicken					1						**1**
	21	Chicken		1									**1**
	22	Food - Meat		1									**1**
	22	Food - Unknown		1									**1**
	23	Chicken	1				3						**4**
	24	Chicken						1					**1**
	25	Food - Chicken					1						**1**
	26	Canine					5						**5**
	26	Chicken					2	4					**6**
	26	Chicken - Meat				5							**5**
	26	Environmental Swab							8				**8**
	26	Food - Chicken					3	1					**4**
	26	Food - Tomato						1					**1**
	26	Turkey					1						**1**
	26	Unknown						1					**1**
	26	Water - River					3						**3**
	29	Bovine					1						**1**
	29	Canine		1			11						**12**
	29	Chicken		5			14		4				**23**
	29	Chicken - Meat		2		38							**40**
	29	Environmental Swab					2		1				**3**
	29	Equine	1				41						**42**
	29	Food - Chicken			4		3	2					**9**
	29	Turkey		1			4						**5**
	29	Water - River					1						**1**
	29a	Turkey					1						**1**
	29a	Water - River					1						**1**
	30	Avian					1						**1**
	30	Unknown - Animal		1									**1**
	32	Avian		2									**2**
	32	Canine					3						**3**
	32	Chicken		11									**11**
	32	Turkey		3			10						**13**
	32a	Food - Chicken					1	3					**4**
	32b	Canine					8						**8**
	32b	Chicken					3						**3**
	32b	Food - Chicken					2						**2**
	32b	Porcine						1					**1**
	33	Chicken	3				1						**4**
	34	Food - Chicken						1					**1**
	35	Avian							1	1			**2**
	35	Chicken						1		1			**2**
	36	Chicken		7			5		1	1			**14**
	36	Environmental Swab							1				**1**
	36	Food - Chicken						1					**1**
	37	Food - Chicken					1						**1**
	39	Chicken		1									**1**
	39	Equine					1						**1**
	39	Food - Chicken					1						**1**
	39	Turkey					4						**4**
	40	Avian					2	2		3			**7**
	40	Chicken								2			**2**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	41	Avian					4	2		6			**12**
	41	Canine					2						**2**
	41	Chicken		4			16	1	1	6			**28**
	41	Eggs						1		1			**2**
	41	Environmental Swab						2					**2**
	41	Equine					1						**1**
	41	Food - Chicken					2	2					**4**
	41	Turkey					1						**1**
	45	Food - Chicken					1						**1**
	46	Chicken		2									**2**
	46	Water - River					1						**1**
	47	Chicken	1				4						**5**
	49	Food - Chicken						2					**2**
	51	Chicken					1						**1**
	52	Avian						1					**1**
	52	Bovine					1	1					**2**
	52	Canine					3						**3**
	52	Chicken				1	2		1	4			**8**
	52	Food - Chicken						2					**2**
	53	Chicken					1						**1**
	54	Porcine				1							**1**
	54	Turkey		1									**1**
	Atypical	Animal Feed		1									**1**
	Atypical	Avian					2	1		2		1	**6**
	Atypical	Chicken	2	6			24	9		3			**44**
	Atypical	Chicken - Meat		1		3							**4**
	Atypical	Chicken - Water								2			**2**
	Atypical	Eggs						1					**1**
	Atypical	Environmental Swab						2	7				**9**
	Atypical	Equine					1						**1**
	Atypical	Food - Chicken			1		6	7					**14**
	Atypical	Porcine		1		1	5						**7**
	Atypical	Turkey					7						**7**
	Atypical	Unknown - Animal		1									**1**
	Atypical	Water		2									**2**
	Atypical	Water - River		4			3	2					**9**
	Untypable	Avian					1						**1**
	Untypable	Chicken		2			2			1			**5**
	Untypable	Food - Chicken					1						**1**
	Untypable	Porcine						1					**1**
		Subtotal	**24**	**131**	**12**	**93**	**521**	**108**	**34**	**48**	**0**	**2**	**973**
S. Infantis	4	Environmental Swab					6						**6**
	4	Food - Chocolate					6						**6**
	4	Food - Unknown					28						**28**
		Subtotal	**0**	**0**	**0**	**0**	**40**	**0**	**0**	**0**	**0**	**0**	**40**
S. Newport	13	Food - Unknown					1						**1**
	14c	Animal Feed		1									**1**
		Subtotal	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Oranienburg	1	Water					2						**2**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	Atypical	Unknown					3						**3**
		Subtotal	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**5**
S. Paratyphi B var. Java	Atypical	Unknown						2					**2**
S. Schwarzengrund	2	Food - Cheese					22						**22**
	2	Food - Chicken					2						**2**
	2	Food - Meat					4						**4**
	2	Food - Shrimp					4						**4**
	2	Food - Unknown					2						**2**
		Subtotal	**0**	**0**	**0**	**0**	**34**	**0**	**0**	**0**	**0**	**0**	**34**
S. Thompson	3	Avian			1								**1**
	5	Chicken - Meat		1									**1**
	25	Chicken		1									**1**
		Subtotal	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Typhi	46	Unknown						1					**1**
S. Typhimurium	1	Avian					3				3		**6**
	1	Food - Vegetable/Spice					2						**2**
	1	Porcine				1	1						**2**
	1	Water - River		1									**1**
	2	Avian					2						**2**
	2	Bovine					1						**1**
	2	Canine					4						**4**
	2	Food - Beef					18	2					**20**
	2	Food - Fish					1						**1**
	2	Food - Unknown					1						**1**
	2	Ovine					2						**2**
	2	Pigeon		1			1						**2**
	2	Porcine					2						**2**
	2	Unknown				1	1						**2**
	8	Avian					1	1					**2**
	8	Bovine					1						**1**
	9	Chicken			1								**1**
	9	Porcine						2					**2**
	9	Turkey				4							**4**
	9	Unknown					1						**1**
	10	Animal Feed					1	1					**2**
	10	Bovine					1						**1**
	10	Chicken - Meat				6							**6**
	10	Equine					1						**1**
	10	Feline					1						**1**
	10	Food - Beef					3	1					**4**
	10	Unknown					1						**1**
	10	Water - River		3									**3**
	12	Avian						1					**1**
	12	Bovine						6					**6**
	12	Bvoine					2						**2**
	12	Environmental Swab						1					**1**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	12	Equine						1					**1**
	12	Food - Unknown						2					**2**
	12	Porcine		2	1	12	13	22					**50**
	12	Unknown					1						**1**
	15	Porcine					1						**1**
	20	Chicken		1									**1**
	21	Food - Unknown					1						**1**
	21	Porcine		10							1		**11**
	21	Unknown						1					**1**
	22	Water					2						**2**
	22	Water - River					2						**2**
	25	Porcine						1					**1**
	27	Porcine					1			2			**3**
	32	Unknown					1						**1**
	35	Bovine						2					**2**
	35	Food - Pork					1						**1**
	35	Porcine					5	5		1			**11**
	36	Goose				2							**2**
	37	Avian					1	1					**2**
	40	Chicken		1									**1**
	40	Equine			1								**1**
	40	Food - Spinach					1						**1**
	40	Gull			1								**1**
	40	Porcine			1								**1**
	40	Sparrow		1									**1**
	41	Avian					2	4					**6**
	41	Chicken					1						**1**
	41	Food - Vegetable/Spice					1						**1**
	41	Water		3			4						**7**
	41	Water - River		6			4						**10**
	41a	Gull					1						**1**
	46	Eggs						1					**1**
	46	Porcine					1						**1**
	46	Turkey					7						**7**
	46	Unknown							1				**1**
	51	Food - Chicken						1					**1**
	66	Bovine					1	1					**2**
	66	Equine					1						**1**
	69	Water					3						**3**
	74	Bovine					1						**1**
	96	Snake		1									**1**
	99	Food - Unknown					2						**2**
	99	Porcine		1			2						**3**
	99	Water	1										**1**
	99	Water - River		1									**1**
	104	Avian					2	2					**4**
	104	Bovine					11	5					**16**
	104	Canine					1	1					**2**
	104	Chicken		12			12	3					**27**
	104	Chicken - Meat					1						**1**
	104	Equine					15			2			**17**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	104	Food - Chicken			1								**1**
	104	Food - Unknown					36						**36**
	104	Porcine		14	2	6	164	33					**219**
	104	Rodent						1					**1**
	104	Turkey			1		1						**2**
	104	Unknown					3						**3**
	104	Unknown - Animal						3					**3**
	104	Water					29						**29**
	104	Water - River		1			29						**30**
	104a	Bovine					3	6					**9**
	104a	Chicken					2						**2**
	104a	Chicken - Meat					1						**1**
	104a	Equine					1	1					**2**
	104a	Feline						1					**1**
	104a	Food - Chicken					1						**1**
	104a	Food - Milk						1					**1**
	104a	Food - Unknown					7						**7**
	104a	Porcine			1		37	24					**62**
	104a	Water					1						**1**
	104a	Water - River		2			1						**3**
	104b	Chicken		1			1						**2**
	104b	Food - Unknown					33						**33**
	104b	Porcine					82	1					**83**
	104c	Porcine					1						**1**
	107	Chicken					1						**1**
	108	Bovine					12	3					**15**
	108	Chicken					8						**8**
	108	Equine					1						**1**
	108	Food - Chicken					1						**1**
	108	Food - Pork									2		**2**
	108	Mouse				1							**1**
	108	Porcine					6	11					**17**
	110	Porcine						2					**2**
	110b	Avian					1	2					**3**
	110b	Bovine					1	1					**2**
	110b	Chicken	1										**1**
	110b	Porcine					3						**3**
	120	Food - Pork						1					**1**
	120	Food - Unknown					3						**3**
	120	Porcine					6	2					**8**
	120	Unknown					1						**1**
	120	Unknown - Animal						1					**1**
	121	Food - Unknown					1						**1**
	121	Water	1										**1**
	124	Food - Beef					2						**2**
	124	Water - River		6									**6**
	125	Water						1					**1**
	126	Avian						1					**1**
	132	Animal Feed						1					**1**
	132	Avian					1					2	**3**
	132	Canine					85						**85**
	132	Environmental Swab					14						**14**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	132	Equine					7						**7**
	132	Food - Beef						1					**1**
	132	Food - Mixed Cereals							1				**1**
	132	Food - Pork					1						**1**
	132	Food - Turkey							1				**1**
	132	Food - Unknown					13						**13**
	132	Pet Food - Canine					2						**2**
	132	Porcine			2		1						**3**
	132	Turkey					1						**1**
	132	Unknown - Animal						5					**5**
	132	Water - River	6	20									**26**
	135	Eggs				3							**3**
	135	Food - Unknown					1						**1**
	135	Unknown - Animal						1					**1**
	140 var.	Bovine				2							**2**
	146	Bovine					1						**1**
	146a	Hedgehog						1					**1**
	151	Porcine					2	1					**3**
	160	Avian					8				1		**9**
	160	Avian - Wild Bird			1		2						**3**
	160	Cardinal					1						**1**
	160	Chicken					1						**1**
	160	Pine Siskin								1			**1**
	160	Porcine			4								**4**
	160	Redpoll							3	2			**5**
	160	Sparrow			1		1	1					**3**
	169	Chicken					4	3					**7**
	169	Chicken - Meat					2						**2**
	169	Food - Chicken					2						**2**
	170	Bovine					6	1					**7**
	170	Chicken					25	1					**26**
	170	Food - Chicken					2						**2**
	170	Food - Meat					2						**2**
	170	Food - Unknown					2						**2**
	170	Porcine						2					**2**
	170	Raccoon		1									**1**
	170	Water - River		2									**2**
	185	Bovine						1					**1**
	191	Bovine					1	1					**2**
	191	Chicken	1	1			18						**20**
	193	Bovine					1						**1**
	193	Canine					1						**1**
	193	Chicken					6						**6**
	193	Equine					1						**1**
	193	Falcon					2						**2**
	193	Food - Chicken						2					**2**
	193	Food - Unknown					3						**3**
	193	Porcine			2		27	13					**42**
	193	Turkey						1					**1**
	193	Unknown					1						**1**
	193	Unknown - Animal						2					**2**
	193	Water					5						**5**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	193	Water - River					6						**6**
	195	Avian					1	1			1		**3**
	195	Chicken					1						**1**
	195	Equine					1						**1**
	195	Food - Chicken						1					**1**
	195	Porcine					17						**17**
	195	Water					2						**2**
	195	Water - River					2						**2**
	208	Avian					1	1					**2**
	208	Chicken						3					**3**
	208	Food - Chicken						2					**2**
	208	Food - Milk		2									**2**
	208	Porcine		7			3	1					**11**
	208	Water - River		3									**3**
	208 var.	Bovine		2									**2**
	208 var.	Food - Milk		2									**2**
	208 var.	Porcine		7			2						**9**
	208 var.	Water					1						**1**
	208 var.	Water - River					1						**1**
	Atypical	Avian					1	2					**3**
	Atypical	Bovine				3	8	1					**12**
	Atypical	Chicken	1				6						**7**
	Atypical	Equine					1						**1**
	Atypical	Food - Unknown					2						**2**
	Atypical	Porcine		10			12	9					**31**
	Atypical	Water					2						**2**
	Atypical	Water - River		1			2						**3**
	U276	Food - Chicken	1										**1**
	U284	Environmental Swab	1										**1**
	U284	Water - River	7										**7**
	U284 var.	Water - River		5									**5**
	U285	Food - Unknown					1						**1**
	U285	Unknown - Animal						1					**1**
	U291	Avian					7	8					**15**
	U291	Chicken					1						**1**
	U291	Food - Unknown					1						**1**
	U291 var.	Avian					4	4					**8**
	U292	Food - Unknown					4						**4**
	U292	Water - River		4									**4**
	U301	Chicken						1					**1**
	U302	Avian			1								**1**
	U302	Bovine					1	1					**2**
	U302	Canine					1						**1**
	U302	Food - Unknown					8						**8**
	U302	Porcine			1	1	24	22					**48**
	U302	Unknown					1						**1**
	U302	Unknown - Animal						1					**1**
	Untypable	Bovine				3	1						**4**
	Untypable	Canine					1						**1**
	Untypable	Chicken		1									**1**
	Untypable	Food - Unknown					1						**1**
	Untypable	Porcine		2		1	4						**7**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	UT 1	Food - Unknown					23						**23**
	UT 1	Porcine					2						**2**
	UT 2	Bovine		1									**1**
	UT 2	Chicken					2						**2**
	UT 3	Water					3						**3**
	UT 5	Food - Unknown					2						**2**
	UT 5	Porcine					2						**2**
	UT 6	Chicken - Meat					1						**1**
	UT 6	Food - Unknown					2						**2**
	UT 7	Chicken					1						**1**
	UT 7	Chicken - Meat		1									**1**
	UT 8	Environmental Swab					1						**1**
	UT1	Bovine			8		1	1					**10**
	UT1	Canine					1						**1**
	UT1	Chicken		1			2						**3**
	UT1	Duck			1								**1**
	UT1	Equine			1								**1**
	UT1	Feline					1						**1**
	UT1	Porcine		1		3	26	3					**33**
	UT1	Unknown - Animal						1					**1**
	UT1	Water		1									**1**
	UT2	Chicken		2									**2**
	UT3	Water - River					3						**3**
	UT5	Bovine			2	2							**4**
	UT5	Ovine				1							**1**
	UT5	Porcine		37			3						**40**
	UT5	Turkey				1							**1**
	UT5	Water	1										**1**
	UT6	Chicken		1									**1**
	UT6	Food - Chicken					1						**1**
	UT7	Chicken		1									**1**
	UT8	Animal Feed						5					**5**
	UT8	Unknown - Animal						1					**1**
		Subtotal	**21**	**184**	**34**	**53**	**1097**	**272**	**6**	**8**	**8**	**2**	**1685**
Salmonella ssp I 4,[5],12:i:-	2	Bovine					1						**1**
	21	Porcine					2				3		**5**
	41	Avian					1						**1**
	41	Environmental Swab						1					**1**
	46	Turkey					2						**2**
	99	Water					1						**1**
	99	Water - River					1						**1**
	104	Chicken		1									**1**
	104	Porcine						1					**1**
	104b	Chicken		1			1						**2**
	104b	Porcine					4						**4**
	120	Chicken		1			1						**2**
	120	Water					1						**1**
	120	Water - River		3			1						**4**
	132	Canine					1						**1**
	146	Water					1						**1**
	160	Avian					1						**1**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	160	Redpoll							1				**1**
	191	Avian					2						**2**
	191	Bovine		1			1	1					**3**
	191	Chicken	35	9			27						**71**
	191	Chicken - Meat		1									**1**
	191	Food - Beef					3						**3**
	191	Food - Unknown					2						**2**
	191	Porcine					1						**1**
	192	Avian						1					**1**
	193	Porcine					2						**2**
	193	Water					1						**1**
	193	Water - River					1						**1**
	195	Porcine					1						**1**
	Atypical	Avian					1	1					**2**
	Atypical	Chicken	13	7			14						**34**
	Atypical	Cormorant					3						**3**
	Atypical	Environmental Swab						1					**1**
	Atypical	Equine					5						**5**
	Atypical	Food - Chicken			1								**1**
	Atypical	Food - Scallop								1			**1**
	U284	Avian					2						**2**
	U284	Redpoll					2						**2**
	U284 var.	Cormorant					1						**1**
	U291	Avian					1	2					**3**
	U291	Canine					1						**1**
	U291	Chicken					4						**4**
	U291	Chicken - Meat					1						**1**
	U291	Eggs						2					**2**
	U291	Environmental Swab						6					**6**
	U291	Equine					2						**2**
	U291	Food - Chicken					1						**1**
	U291	Food - Unknown					1						**1**
	U291	Porcine						1					**1**
	U291	Unknown							1				**1**
	U291 var.	Environmental Swab						1					**1**
	U302	Porcine						1					**1**
	Untypable	Porcine					4						**4**
	UT 6	Chicken					3						**3**
	UT1	Porcine					1						**1**
	UT5	Porcine		1									**1**
	UT6	Chicken		3									**3**
	UT6	Water - River		2									**2**
		Subtotal	**48**	**30**	**1**	**0**	**107**	**19**	**2**	**1**	**3**	**0**	**211**

SECTION 3: PATHOGENIC *ESCHERICHIA COLI*

The total number of *E. coli* O157 isolations in 2006 from each province and territory is shown in Figure 12. Population based rates for each province and territory for the years 2002 to 2006 are shown in Figure 13. Total *E. coli* O157 isolations are based largely on NESP data that are supplemented with identifications from NML reference services and include *E. coli* O157:H7, *E. coli* O157:NM, verotoxin-producing *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 high 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/territorial population.

The national isolation rate increased in 2006 to 3.1 isolations per 100,000 people, up from 2.4 in 2005, reversing a gradual decline over the previous 4 years. Although Ontario has the highest number of *E. coli* O157 reported in 2006 with 337 isolations (Figure 12), its isolation rate of 2.7 isolates per 100,000 people is lower than some other provinces (Table 6). Saskatchewan is the only province with a decrease in the isolation rate, continuing a 5-year downward trend from 4.1 isolations per 100,000 people in 2002 to 2.7 in 2006. After a dramatic decline in the isolation rate in Prince Edward Island over the previous 4 years from 22.6 in 2002 to 6.5 in 2005, the rate has increased to 15.9 isolations per 100,000 people in 2006. Another large increase has been observed in Manitoba where the isolation rate has gone from 1.6 isolations per 100,000 in 2005 to 8.8 in 2006. This rate remains lower than the province's 5-year high of 10.4 isolations per 100,000 people in 2004. Rates higher than the national average of 3.1 isolations per 100,000 people were seen in Alberta with 6.0, British Columbia with 3.5 and the Yukon Territory with a rate of 3.2.

Figure 12: Number of *E. coli* O157 Isolations from Humans in Canada, 2006

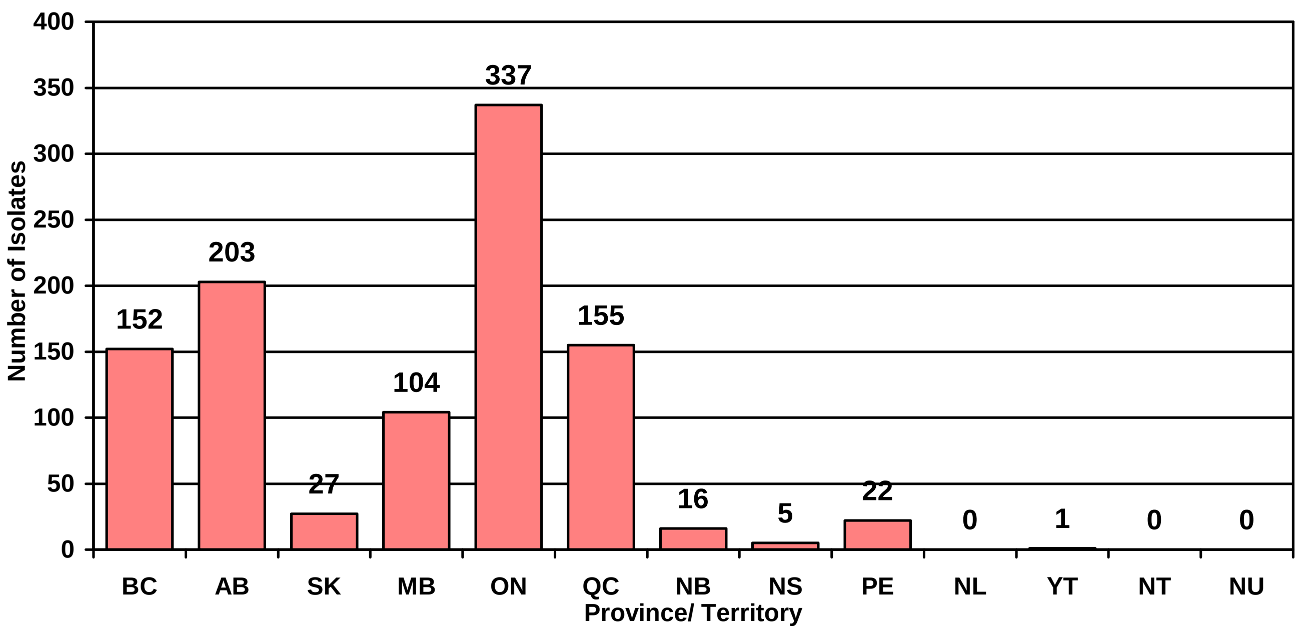


Figure 13: Rates of *E. coli* O157 Isolations from Humans in Canada, 2002 to 2006 (per 100,000 population)**

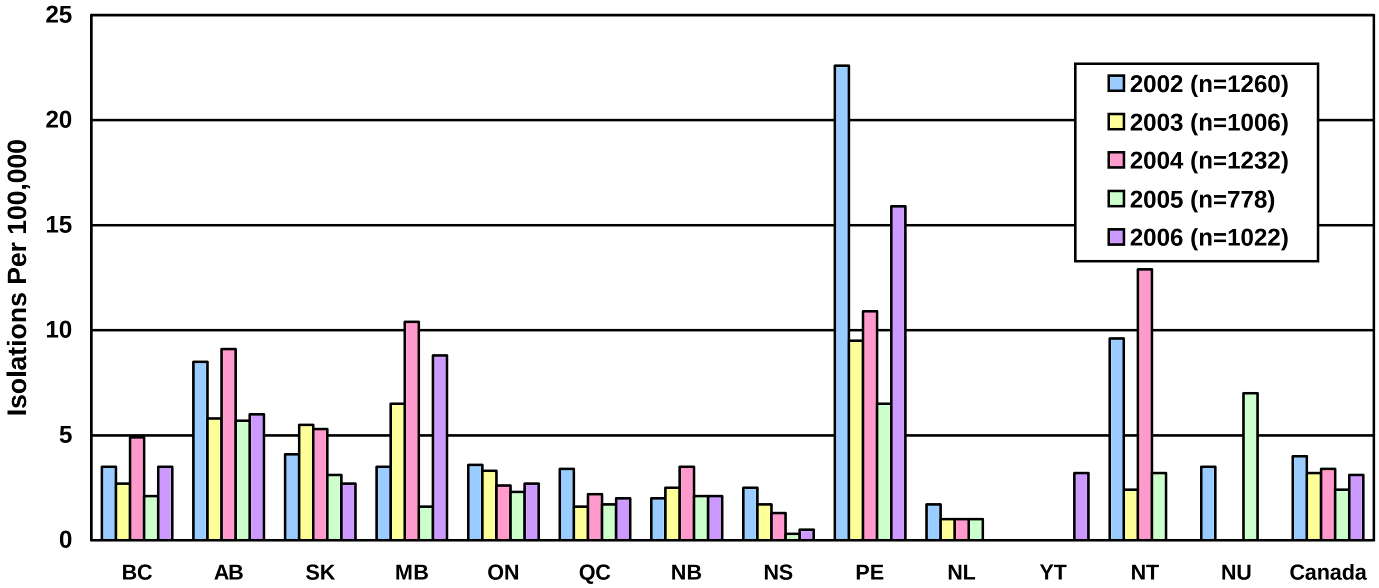


Table 6: Rates of *E. coli* O157 Isolations per 100,000 Population, 2002 to 2006**

Province / Territory	2002	2003	2004	2005	2006
British Columbia	3.5	2.7	4.9	2.1	3.5
Alberta	8.5	5.8	9.1	5.7	6.0
Saskatchewan	4.1	5.5	5.3	3.1	2.7
Manitoba	3.5	6.5	10.4	1.6	8.8
Ontario	3.6	3.3	2.6	2.3	2.7
Québec	3.4	1.6	2.2	1.7	2.0
New Brunswick	2.0	2.5	3.5	2.1	2.1
Nova Scotia	2.5	1.7	1.3	0.3	0.5
Prince Edward Island	22.6	9.5	10.9	6.5	15.9
Newfoundland	1.7	1.0	1.0	1.0	0.0
Northwest Territories	9.6	2.4	12.9	3.2	0.0
Nunavut	3.5	0.0	0.0	7.0	0.0
Yukon Territory	0.0	0.0	0.0	0.0	3.2
Canada	4.0	3.2	3.4	2.4	3.1

**Provincial/territorial 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 7: *E. coli* Serotypes Identified from Humans in Canada, 2006*

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
E. coli O1:H7						1	2							**3**
E. coli O1:NM							1							**1**
E. coli O2:H1							1							**1**
E. coli O2:H42								1						**1**
E. coli O2:H7							3							**3**
E. coli O2:H-Rough							1							**1**
E. coli O2:H-Untypeable	1													**1**
E. coli O2:NM						1	1							**2**
E. coli O4:H5						1								**1**
E. coli O5:NM	2													**2**
E. coli O6:H1							1							**1**
E. coli O6:NM	1													**1**
E. coli O7:H35							1							**1**
E. coli O11:H32							1							**1**
E. coli O12:NM	1													**1**
E. coli O13:H4							1							**1**
E. coli O15:H12							1							**1**
E. coli O16:H38								1						**1**
E. coli O16:H5							1							**1**
E. coli O18ac:H12							1							**1**
E. coli O18ac:NM							1							**1**
E. coli O24:H4							1							**1**
E. coli O25:H18								1						**1**
E. coli O25:H4						2								**2**
E. coli O26														**0**
E. coli O26:H11	1			9										**10**
E. coli O26:NM	5													**5**
E. coli O29:H4							1							**1**
E. coli O40:NM		1												**1**
E. coli O55				1										**1**
E. coli O55:H7							2		1					**3**
E. coli O57:NM	1													**1**
E. coli O65:H19							1							**1**
E. coli O66:H25				1										**1**
E. coli O75:NM					1	1	1	1						**4**
E. coli O76:H51	1													**1**
E. coli O83:H6							1							**1**
E. coli O103	1													**1**
E. coli O103:H11				1										**1**
E. coli O103:H2	2			1										**3**
E. coli O103:H25								1						**1**
E. coli O105:H18	1													**1**
E. coli O111:NM	4													**4**
E. coli O117:H7				1										**1**
E. coli O117:NM							1							**1**
E. coli O118:H16	1													**1**
E. coli O120:NM	1													**1**
E. coli O121:H19	2			1										**3**
E. coli O121:NM	7			1										**8**
E. coli O124:NM	1													**1**
E. coli O127:H4							1							**1**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	Total
E. coli O127:NM							1							**1**
E. coli O127a				3										**3**
E. coli O128				1										**1**
E. coli O146:H28									1					**1**
E. coli O154:H4								1						**1**
E. coli O156:NM	1						1							**2**
E. coli O157:H19			1											**1**
E. coli O157:H25					1									**1**
E. coli O157:H26					1									**1**
E. coli O157:H7	150	201	25	104	322	154	15	5	22	0	1	0	0	**999**
E. coli O157:NM	2	2	1		13	1	1							**20**
E. coli O162:H12							1							**1**
E. coli O164:H30	1													**1**
E. coli O165:NM	1													**1**
E. coli O172:NM		1												**1**
E. coli O177:NM	1								1					**2**
E. coli O189:NM	1													**1**
E. coli O-Rough:H6							1							**1**
E. coli O-Rough:NM							1							**1**
E. coli O-Untypeable:H16						1								**1**
E. coli O-Untypeable:H6							1							**1**
E. coli O-Untypeable:H7							1							**1**
E. coli O-Untypeable:H8							1							**1**
E. coli O-Untypeable:K1:H1						1								**1**
E. coli O-Untypeable:K1:NM						1								**1**
E. coli O-Untypeable:NM							5							**5**
E. coli Rough-O:H11							1							**1**
E. coli Rough-O:H12						1								**1**
E. coli (Inactive)	14	6	1	2		1	2				1			**27**
TOTAL	**190**	**205**	**27**	**124**	**338**	**165**	**57**	**11**	**25**	**0**	**2**	**0**	**0**	**1143**

*Data represented in Table 6 and Figure 13 are under representative of true incidence. It is provided here to give a general overview of the various serotypes of pathogenic *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 8: Phage Types of *E. coli* O157:H7 in Canada, 2006*

Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
1	Human				3	1	1					5
2	Human			1	1	20	3	1				26
4	Human			1		12	8					21
8	Human					7	14			1		22
14	Human				35	21	3	1		3		63
14a	Human		1	17	74	189	99	12	4	1		397
14b	Human					4						4
14c	Human					9	5					14
21	Human					2	3					5
23	Human		1			3	3					7
31	Human					19	1					20
32	Human					7						7
33	Human						2					2
34	Human			1		4	3					8
42	Human		1			1						2
45	Human					4	4	1				9
48	Human					4						4
49	Human					3						3
54	Human					6						6
74	Human					1						1
77	Human						1					1
87	Human						1					1
Atypical	Human		1	3	2	17	5					28
Total		**0**	**4**	**23**	**115**	**334**	**156**	**15**	**4**	**5**	**0**	**656**

*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 consistent 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 (NNDRS) for 2005. 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 NNDRS 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, NNDRS 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, Québec, 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. NNDRS 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 in 2005 by each province and territory are represented in Figure 14 and population-based rates are shown in Figure 15. 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 (n=3476) in 2005 (Figure 14), it has the 4th highest rate of reported campylobacteriosis among the provinces due to the larger population.

The national rate of reported campylobacteriosis has continued a gradual decline over the previous 5-year period, from 38.1 in 2001 to 29.7 isolations per 100,000 people in 2005.

In 2005, decreased isolation rates have been observed in Ontario (from 31.8 in 2004 to 27.7 cases per 100,000 people), Nova Scotia (15.9 to 13.4) and the Yukon Territory (28.8 to 10.0). Although there were some slight increases in other provinces, there is a general decrease in case rates over the 5-year period in British Columbia, Alberta, Saskatchewan, New Brunswick and Prince Edward Island. A more significant increase have been seen in Newfoundland and Labrador where rates have gone from 8.7 cases per 100,000 in 2002 to 16.7 in 2005. Provinces with rates of infection higher than the national level in 2005 include British Columbia, Alberta and Québec with 36.8, 36.1 and 32.2 cases per 100,000 people, respectively.

Table 10 shows the *Campylobacter* species identified in 2005. *Campylobacter jejuni* represented the majority of the isolates identified with 11% (1036 of 9593), followed by *C. coli* which accounted for 2% (n=187).

Figure 14: Number of Reported Cases of Campylobacteriosis, by Province/Territory, 2005 (N=9593)

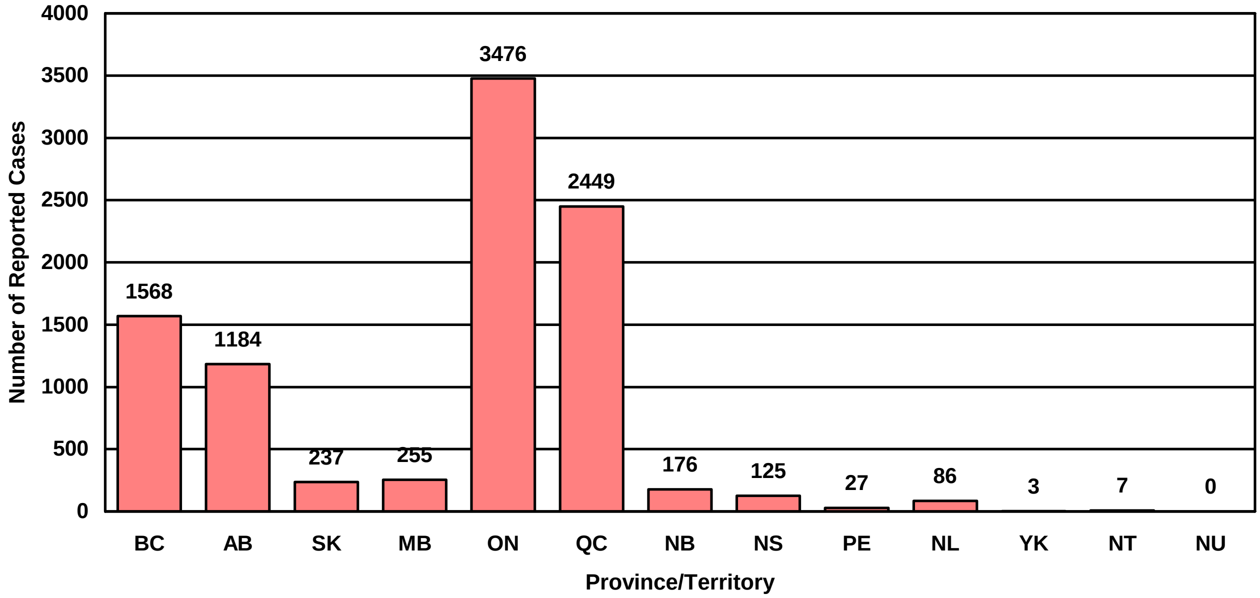


Figure 15: Rates of Reported Campylobacteriosis in Canada, 2001 to 2005 (per 100,000 population)

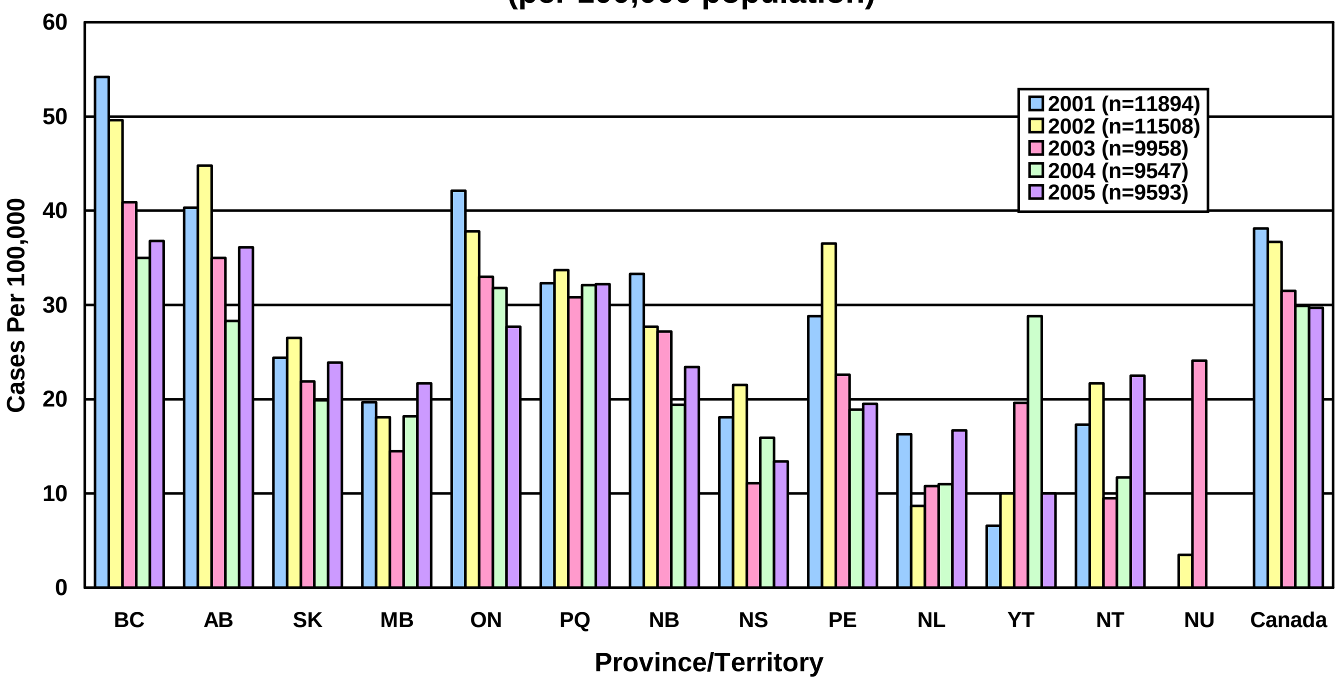


Table 9: Rates of *Campylobacter* Isolations per 100,000 People, 2001 to 2005

Province/Territory	2001	2002	2003	2004	2005
British Columbia	54.2	49.6	40.9	35.0	36.8
Alberta	40.3	44.8	35.0	28.3	36.1
Saskatchewan	24.4	26.5	21.9	19.9	23.9
Manitoba	19.7	18.1	14.5	18.2	21.7
Ontario	42.1	37.8	33.0	31.8	27.7
Québec	32.3	33.7	30.8	32.1	32.2
New Brunswick	33.3	27.7	27.2	19.4	23.4
Nova Scotia	18.1	21.5	11.1	15.9	13.4
Prince Edward Island	28.8	36.5	22.6	18.9	19.5
Newfoundland	16.3	8.7	10.8	11.0	16.7
Northwest Territories	17.3	21.7	9.5	11.7	22.5
Nunavut	0.0	3.5	24.1	0.0	0.0
Yukon Territory	6.6	10.0	19.6	28.8	10.0
Canada	**38.1**	**36.7**	**31.5**	**29.9**	**29.7**

Figure 16: Age and Gender Distribution of *Campylobacter* Infections in Canada, 2005 (N=9593)

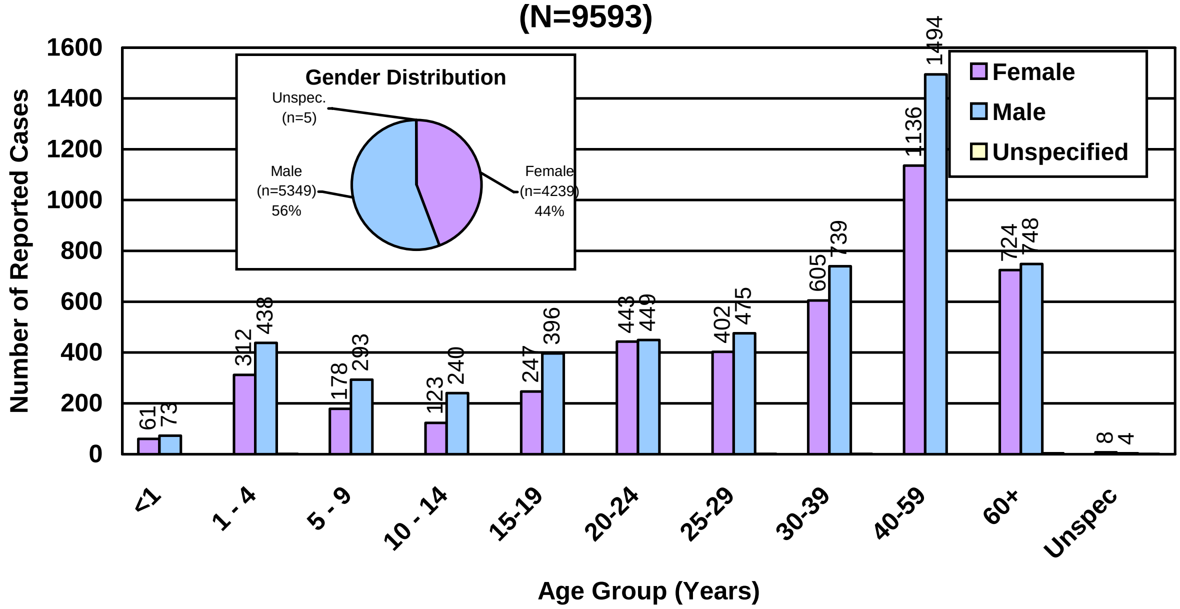


Table 10: *Campylobacter* species Isolated from Humans, 2005

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	TOTAL
C. coli	8	34	24	16	72	22	3	6		1	1			187
C. concisus		1				1								2
C. fetus ssp fetus		2			5	10		1						18
C. hyointestinalis					1	1								2
C. jejuni	53	307	188	111	86	75	127		3	83	1	2		1036
C. jejuni/coli	43	219		71	104	43		58	24			1		563
C. lanienae					1									1
C. lari		1			9	7	1							18
C. showae						1								1
C. showae - like						1								1
C. upsaliensis	2	4	4		13	1	1				1			26
Camplylobacter sp.	1462	616	21	57	3185	2287	44	60		2		4		7738
TOTAL	**1568**	**1184**	**237**	**255**	**3476**	**2449**	**176**	**125**	**27**	**86**	**3**	**7**	**0**	**9593**

SECTION 5: *SHIGELLA*

The total number of *Shigella* isolations in 2006 from each province and territory is shown in Figure 17 and population based isolation rates for each province between 2002 and 2006 are shown in Figure 18. 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 decreased over the past 5 years from 4.3 isolations per 100,000 people in 2002 to 2.0 in 2006. All provinces and territories had lower rates in 2006, with the largest decreases seen in Nunavut and Prince Edward Island. Provinces with rates of infection higher than the national level in 2006 include British Columbia with 3.9 and Alberta with 2.7 identifications per 100,000 people.

Shigella sonnei accounted for the majority of *Shigella* identifications with 41% (264 of 647) of the isolations, followed by *S. flexneri* with 31% (n=201), *S. boydii* with 6% (n=40) and *S. dysenteriae* with 4% (n=25). There were no *S. dysenteriae* serotype 1 isolates reported in Canada during 2006.

Figure 17: Number of S*higella* Isolations from Humans in Canada, 2006 (N=647)

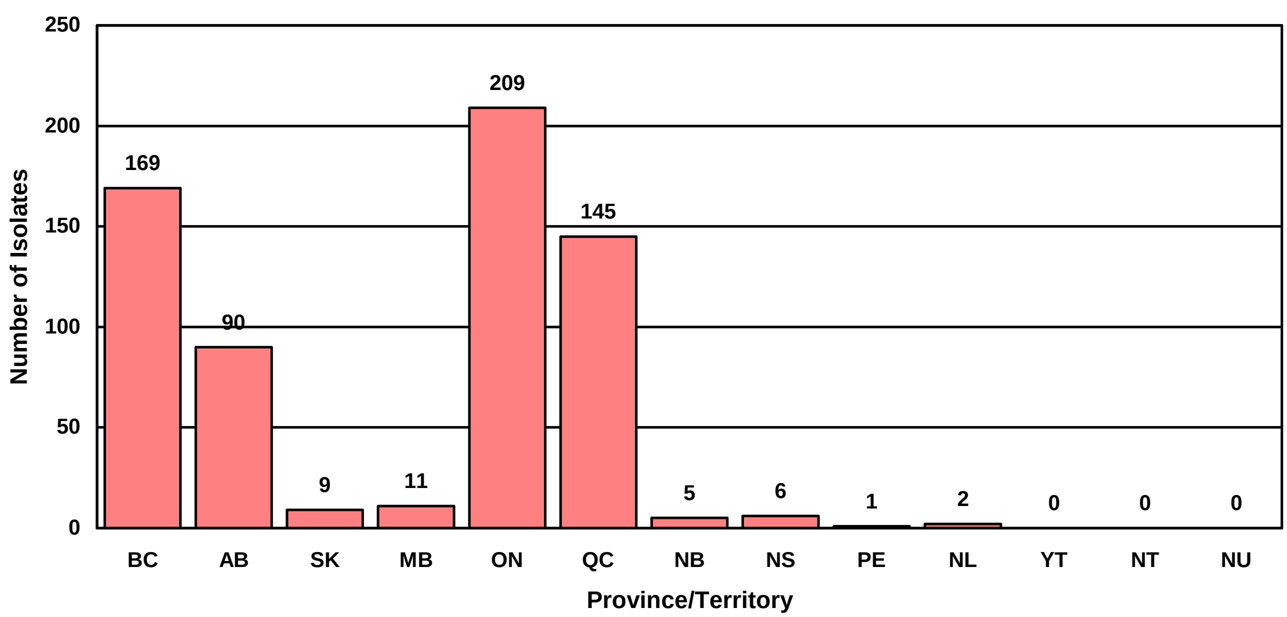


Figure 18: Rates of *Shigella* Isolations from Humans in Canada, 2002 to 2006* (per 100,000 population)

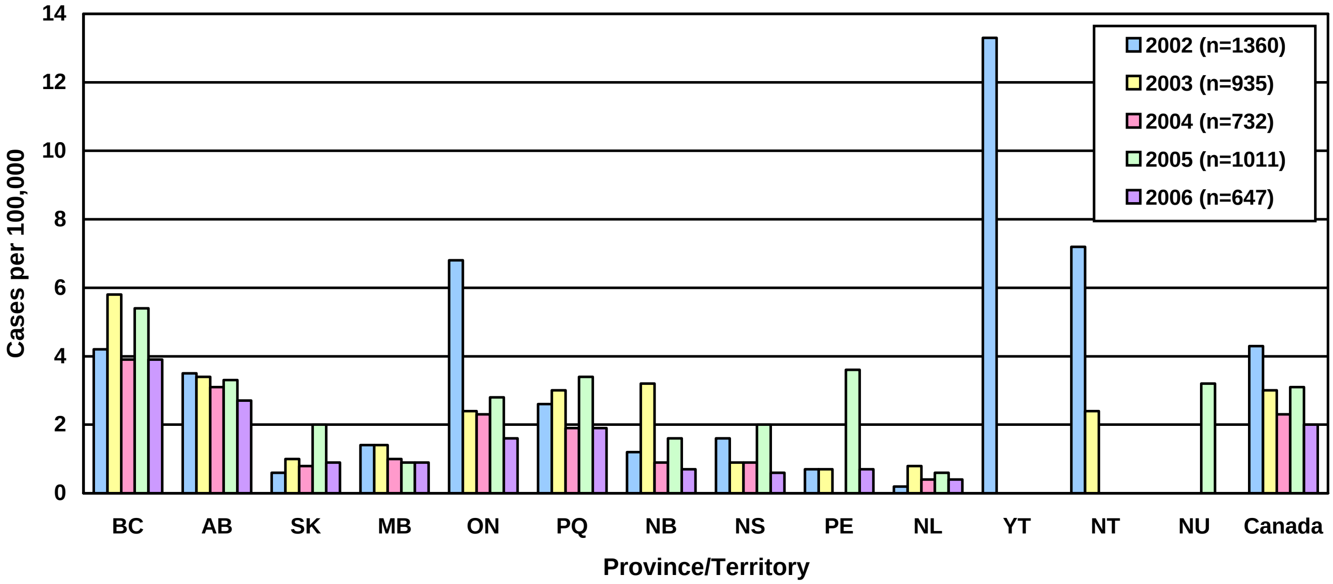


Table 11: Rates of *Shigella* Isolations per 100,000 People, 2002 to 2006*

Province/Territory	2002	2003	2004	2005	2006
British Columbia	4.2	5.8	3.9	5.4	3.9
Alberta	3.5	3.4	3.1	3.3	2.7
Saskatchewan	0.6	1.0	0.8	2.0	0.9
Manitoba	1.4	1.4	1.0	0.9	0.9
Ontario	6.8	2.4	2.3	2.8	1.6
Québec	2.6	3.0	1.9	3.4	1.9
New Brunswick	1.2	3.2	0.9	1.6	0.7
Nova Scotia	1.6	0.9	0.9	2.0	0.6
Prince Edward Island	0.7	0.7	0.0	3.6	0.7
Newfoundland	0.2	0.8	0.4	1.0	0.4
Yukon	13.3	0.0	0.0	0.0	0.0
Northwest Territories	7.2	2.4	0.0	0.0	0.0
Nunavut	0.0	0.0	0.0	3.2	0.0
Canada	**4.3**	**3.0**	**2.3**	**3.1**	**2.0**

*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 12: *Shigella* Species and Serotypes from Humans in Canada, 2006

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	Total
Shigella boydii	1					2								**3**
Shigella boydii 1					4		1							**5**
Shigella boydii 2	4	1												**5**
Shigella boydii 4		1			3	1								**5**
Shigella boydii 5					1									**1**
Shigella boydii 10						1								**1**
Shigella boydii 12					2									**2**
Shigella boydii 13					1									**1**
Shigella boydii 14		1			1									**2**
Shigella boydii 18		1			4									**5**
Shigella boydii 19	1	1												**2**
Shigella boydii 20	5				3									**8**
Total *Shigella boydii*	**11**	**5**	**0**	**0**	**19**	**4**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**40**
Shigella dysenteriae 2	1				5	5								**11**
Shigella dysenteriae 3	1				2	1								**4**
Shigella dysenteriae 6		1												**1**
Shigella dysenteriae 9					1									**1**
Shigella dysenteriae 12	1	1												**2**
Shigella dysenteriae 13						1								**1**
Shigella dysenteriae 16	1													**1**
Shigella dysenteriae Prov.SH-103	1													**1**
Shigella dysenteriae Prov.SH-111	1					2								**3**
Total *Shigella dysentariae*	**6**	**2**	**0**	**0**	**8**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**25**
Shigella flexneri				5	5		2	1		1				**14**
Shigella flexneri 1	12	1												**13**
Shigella flexneri 1a					2									**2**
Shigella flexneri 1b					13	4								**17**
Shigella flexneri 2	21	9	2											**32**
Shigella flexneri 2a					28	9								**37**
Shigella flexneri 2b					3	2								**5**
Shigella flexneri 3	3	2												**5**
Shigella flexneri 3a	1				7	6								**14**
Shigella flexneri 3b					1									**1**
Shigella flexneri 4	7	4				1								**12**
Shigella flexneri 4a					7									**7**
Shigella flexneri 4b						1								**1**
Shigella flexneri 4c		1												**1**
Shigella flexneri 6	8	3			14									**25**
Shigella flexneri 6b						1								**1**
Shigella flexneri Prov. SH-101					1									**1**
Shigella flexneri Prov. SH-104	2	1			4		1							**8**
Shigella flexneri var. X		1												**1**
Shigella flexneri var. Y	2	1				1								**4**
Total *Shigella flexneri*	**56**	**23**	**2**	**5**	**85**	**25**	**3**	**1**	**0**	**1**	**0**	**0**	**0**	**201**
Shigella sonnei	**69**	**60**	**4**	**2**	**97**	**26**	**0**	**4**	**1**	**1**	**0**	**0**	**0**	**264**
***Shigella* sp.**	**27**		**3**	**4**		**81**	**1**	**1**						**117**
Total *Shigella*	**169**	**90**	**9**	**11**	**209**	**145**	**5**	**6**	**1**	**2**	**0**	**0**	**0**	**647**

Table 13 lists *Shigella* phage types of human isolates identified in 2006. 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 consistent from year to year and can be used to establish general trends, to recognize emerging or re-emerging strains and to provide an overview of the subtypes found in Canada.

Table 13: Phage Types of *S. boydii* and *S. sonnei* Isolates from Humans, 2006

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	Total
Shigella boydii 1	3					1		1			**2**
Shigella boydii 4	13		1								**1**
Shigella boydii 5	21					1					**1**
Shigella boydii 12	Atypical					1					**1**
Shigella boydii 14	13		1			1					**2**
Shigella boydii 18	3					1					**1**
Shigella boydii 18	Atypical		1								**1**
Shigella boydii 19	3	1	1								**2**
Shigella boydii 20	3	3									**3**
Shigella boydii 20	Atypical	2				1					**3**
	Subtotal	**6**	**4**	**0**	**0**	**6**	**0**	**1**	**0**	**0**	**17**
Shigella sonnei	Atypical	5	1								**6**
	S 1	44	51	3					1	1	**100**
	S 2		1								**1**
	S 7	4	2								**6**
	S10	7	1								**8**
	S11	1									**1**
	S13	2									**2**
	S15	1	3								**4**
	S19	1	1								**2**
	S25	5									**5**
	Subtotal	**70**	**60**	**3**	**0**	**0**	**0**	**0**	**1**	**1**	**135**

SECTION 6: PARASITES

The total number of *Cryptosporidium*, *Cyclospora, Entamoeba* and *Giardia* isolations in 2006 from each province is shown in Figure 19 and population-based isolation rates for each province between 2002 and 2006 are shown in Figure 20. The data are collected through the NESP and are supplemented with NNDRS 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 a higher 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 used to establish general trends, to recognize emerging or re-emerging strains and to provide an overview of the organisms found in Canada.

The national isolation rate of parasitic infections in Canada has remained relatively constant over the past 5-year period, with 16.8 cases per 100,000 people in 2006. Although Ontario reported the highest number of cases of parasitic infection in 2006 (Figure 19), the province ranks 3rd overall with 17.1 cases per 100,000 people, due to its large population (Figure 20).

The greatest decrease in isolation rates of parasitic infections was seen in the Yukon Territories where rates have decreased from 45.0 to 38.5 cases per 100,000 from 2005 to 2006. The largest increases in isolation rates were seen in Newfoundland and Labrador where rates have gone from 4.5 to 8.6, Manitoba from 11.2 to 14.2 and the Northwest Territories from 14.1 to 16.7 cases per 100,000 from 2005 to 2006. Provinces with rates higher than the national average (16.8 cases per 100,000) include the Yukon Territory (38.5), British Columbia (22.2) and Ontario (17.1).

Giardia was most prevalent, representing 73% (n=3965) of the parasitic infections, distantly followed by *Cryptosporidium* with 13% (n=726), *Entamoeba* with 12% (n=630) and then *Cyclospora* with only 3% (n=147) of the parasitic infections reported in 2006.

Figure 19: Number of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2006 (N=5468)

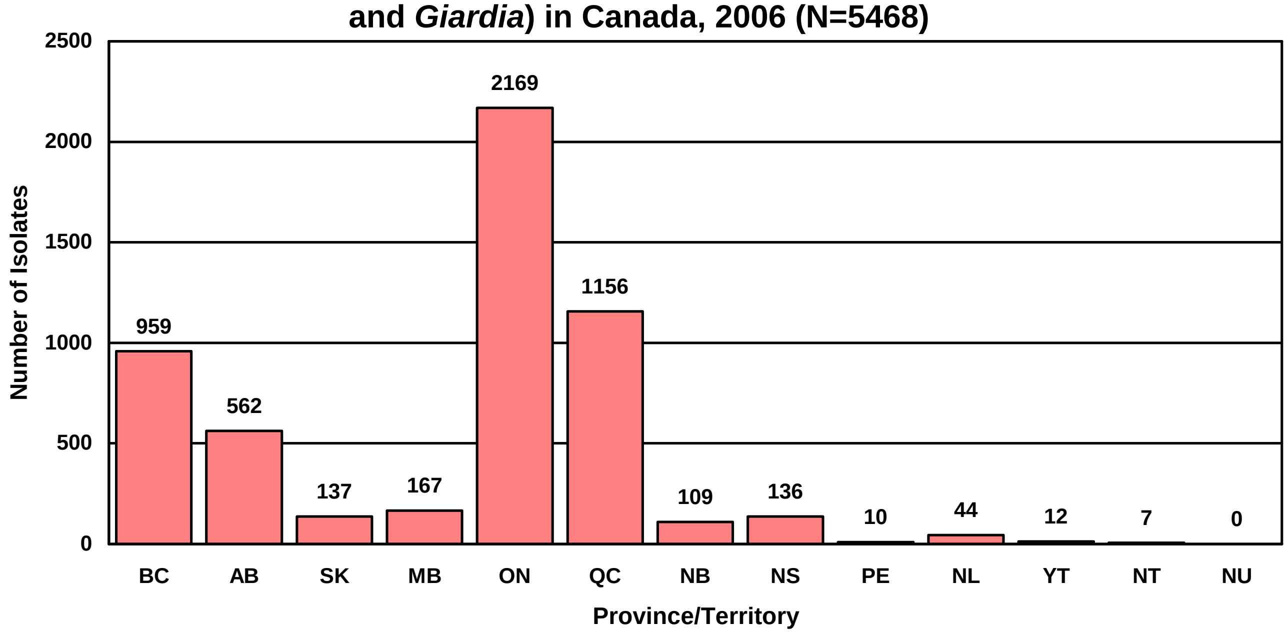


Figure 20: Rates of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2002 to 2006 (per 100,000 population)

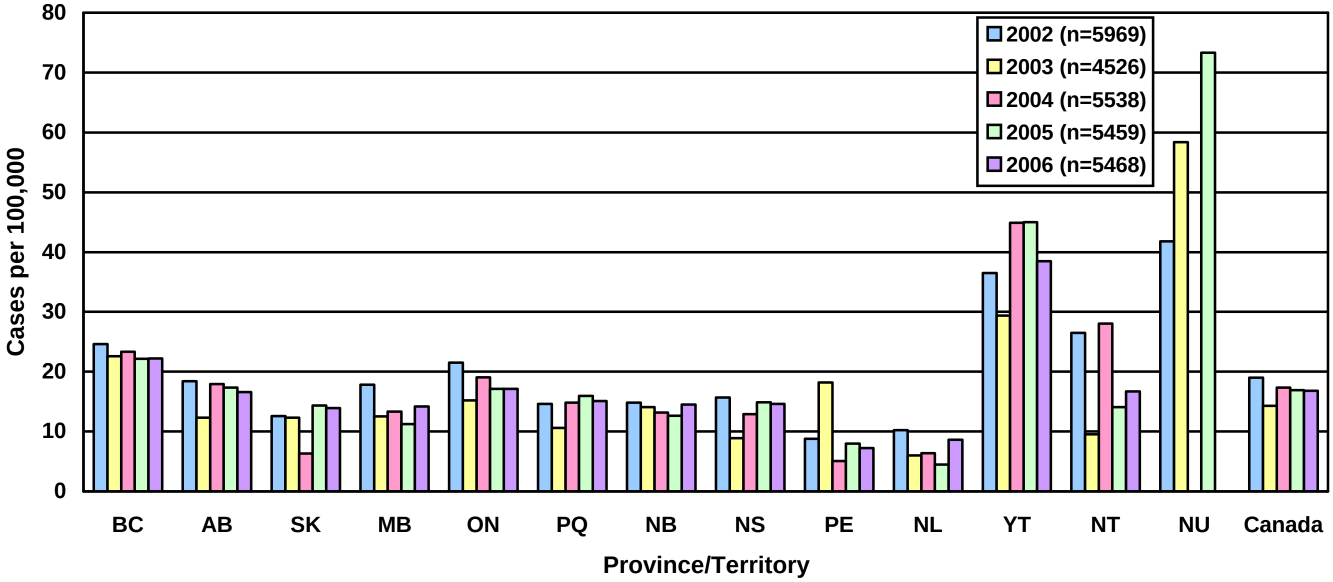


Table 14: Rates of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) per 100,000 People, 2002 to 2006*

Province/Territory	2002	2003	2004	2005	2006
British Columbia	24.6	22.6	23.3	22.2	22.2
Alberta	18.4	12.3	17.9	17.3	16.6
Saskatchewan	12.6	12.3	6.3	14.3	13.9
Manitoba	17.8	12.5	13.3	11.2	14.2
Ontario	21.5	15.2	19.1	17.1	17.1
Québec	14.6	10.6	14.8	16.0	15.1
New Brunswick	14.8	14.1	13.2	12.6	14.5
Nova Scotia	15.7	8.9	12.9	14.8	14.6
Prince Edward Island	8.8	18.2	5.1	8.0	7.2
Newfoundland	10.2	6.0	6.4	4.5	8.6
Northwest Territories	26.5	9.5	28.0	14.1	16.7
Nunavut	41.8	58.4	0.0	73.3	0
Yukon Territory	36.5	29.4	44.9	45.0	38.5
Canada	**19.0**	**14.3**	**17.3**	**16.9**	**16.8**

Table 15: Parasite Identifications (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2006*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	Total
Cryptosporidium	130	149	28	25	348	21	13	9	0	2	1	0	0	**726**
Cyclospora	53	0	0	0	85	6	0	3	0	0	0	0	0	**147**
Entamoeba histolytica/dispar	104	6	21	16	307	155	1	17	2	1	0	0	0	**630**
Giardia	672	407	88	126	1429	974	95	107	8	41	11	7	0	**3965**
Total	**959**	**562**	**137**	**167**	**2169**	**1156**	**109**	**136**	**10**	**44**	**12**	**7**	**0**	**5468**

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

SECTION 7: ENTERIC *YERSINIA*

The total number of *Yersinia* isolations causing gastro-enteritis in 2006 from each province is shown in Figure 21 and population based isolation rates for each province between 2002 and 2006 are shown in Figure 22. Despite a small increase in 2006, the national rate of *Yersinia* isolations has declined steadily from 2.3 per 100,000 people from 2005 to 1.8 in 2006.

A decrease in isolation rate since 2005 was seen in Alberta where rates have gone from 2.5 to 1.8 cases per 100,000 in 2006. Decreases over the past 5-year period between 2002 and 2006 have been observed in Québec (from 1.9 to 0.3 cases per 100,000 people) and Ontario (3.6 to 2.9). A decrease has also been observed in Alberta from a 5-year high of 2.7 in 2004 to 1.8 in 2006 and in New Brunswick from a high of 1.6 in 2003 to 0.8 in 2006.

Ontario had the highest number of isolates reported (n = 368) and the highest rate with 2.9 isolations per 100,000 people. The largest increases in isolation rates where seen in Saskatchewan where rates have gone from 1.8 to 2.7, British Columbia from 1.6 to 1.9 and New Brunswick from 0.3 to 0.8 cases per 100,000 from 2005 to 2006. Increases over the last 5-years have been observed in Saskatchewan from 2.2 to 2.7, British Columbia from 1.5 to 1.9 and Manitoba from 0.2 to 1.1 cases per 100,000 between 2002 and 2006. Provinces with rates higher than the national average (1.8 cases per 100,000 people) include the Ontario (2.9), Saskatchewan (2.7) and British Columbia (1.9).

Y. enterocolitica is the prominent strain in Canada with 523 isolates (91%) reported in 2006, followed distantly by *Y. frederiksenii* with 24 isolations and *Y. intermedia* with 21.

Figure 21: Number of *Yersinia* Isolations from Humans in Canada, 2006 (N=577)

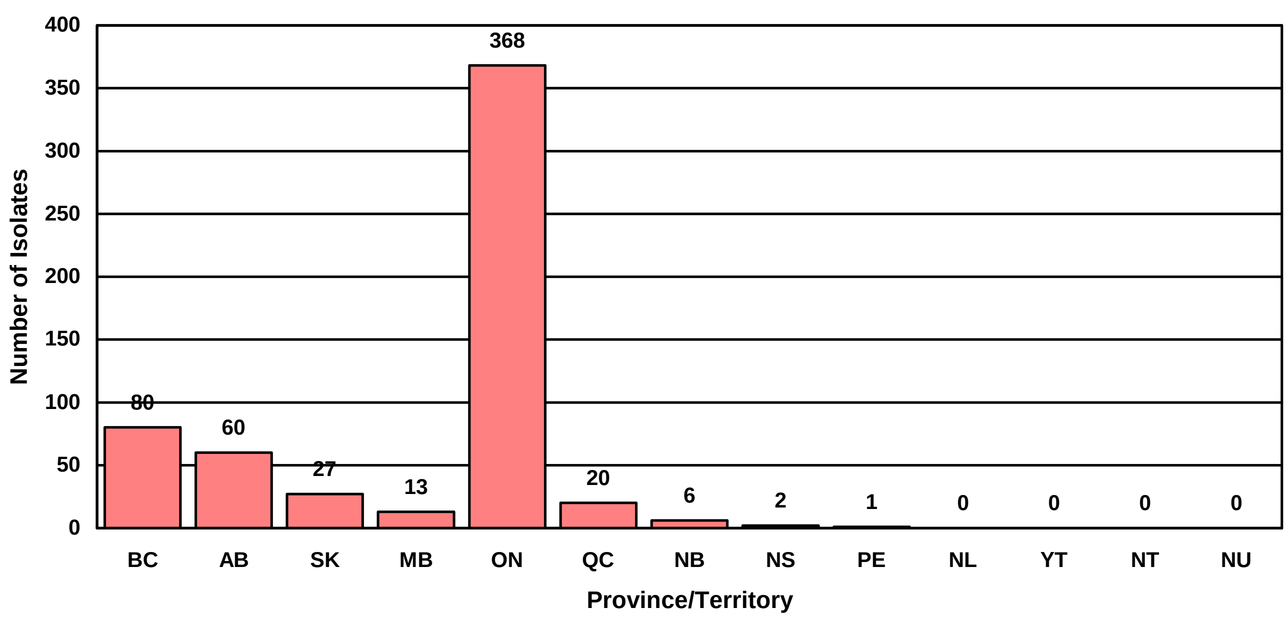


Figure 22: Rates of *Yersinia* Isolations from Humans in Canada, 2002 to 2006 (per 100,000 people)

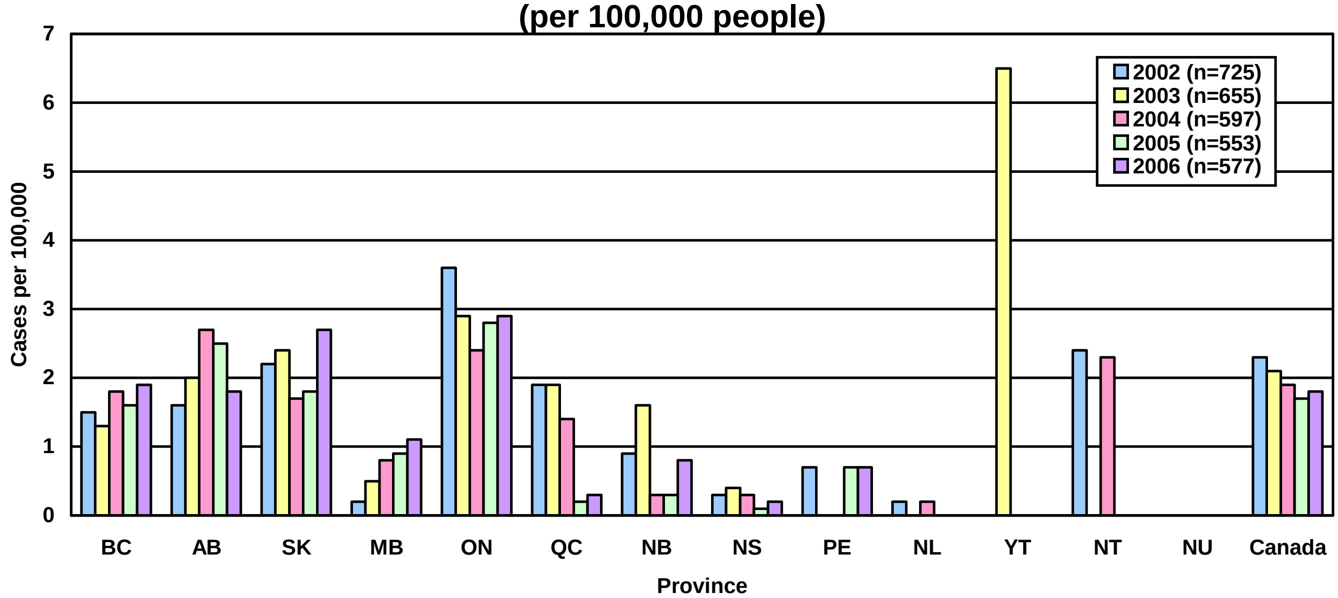


Table 16: Rates of *Yersinia* Isolations per 100,000 People, 2002 to 2006

Province/Territory	2002	2003	2004	2005	2006
British Columbia	1.5	1.3	1.8	1.6	1.9
Alberta	1.6	2.0	2.7	2.5	1.8
Saskatchewan	2.2	2.4	1.7	1.8	2.7
Manitoba	0.2	0.5	0.8	0.9	1.1
Ontario	3.6	2.9	2.4	2.8	2.9
Quebec	1.9	1.9	1.4	0.2	0.3
New Brunswick	0.9	1.6	0.3	0.3	0.8
Nova Scotia	0.3	0.4	0.3	0.1	0.2
Prince Edward Island	0.7	0.0	0.0	0.7	0.7
Newfoundland	0.2	0.0	0.2	0.0	0.0
Northwest Territories	2.4	0.0	2.3	0.0	0.0
Nunavut	0.0	0.0	0.0	0.0	0.0
Yukon Territory	0.0	6.5	0.0	0.0	0.0
Canada	**2.3**	**2.1**	**1.9**	**1.7**	**1.8**

Table 17: *Yersinia* Isolates from Humans in Canada, 2006

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	NU	Total
Y. enterocolitica	58	54	24	9	350	20	5	2	1					**523**
Y. frederiksenii	9	4	2	2	7									**24**
Y. intermedia	10	2	1		8									**21**
Y. kristensenii	2			1										**3**
Y. pseudotuberculosis	1				2									**3**
Y. rohdei					1									**1**
Yersinia sp.				1			1							**2**
Total	**80**	**60**	**27**	**13**	**368**	**20**	**6**	**2**	**1**	**0**	**0**	**0**	**0**	**577**

SECTION 8: *VIBRIO*

Generally, very low levels of *Vibrio* are reported in Canada and although complete information is limited at the national level, most infections are foreign-acquired, with the exception of some of the food-borne strains such as *V. parahaemolyticus*. There where three *Vibrio cholerae* O1 strains reported in Canada in 2006, one serotype Inaba was associated with travel to India, a serotype Ogawa and a bio El Tor strain were associated with travel to Mexico (see Table 19).

Table 18: Provincial Isolations of *Vibrio* Species in Canada, 2006

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
V. alginolyticus	1										**1**
V. cholerae Non O1/Non O139	2	7	2	1							**12**
V. cholerae O1 Bio El Tor					1						**1**
V. cholerae O1 Inaba	1										**1**
V. cholerae O1 Ogawa	1										**1**
V. fluvialis	1	1					1				**3**
V. parahaemolyticus	14	5			2		3		1		**25**
V. vulnificus					1						**1**
Total	**20**	**13**	**2**	**1**	**4**	**0**	**4**	**0**	**1**	**0**	**45**

Table 19: *Vibrio* Species Identified in Canada Between 2002 and 2006

Organism	2002	2003	2004	2005	2006
V. alginolyticus	2	5	2		1
V. cholerae non-O1/O139	16	16	8	11	12
V. cholerae O1 bio El Tor					1
V. cholerae O1 Inaba	1			1	1
V. cholerae O1 Ogawa			1	1	1
V. fluvialis		2	3	2	3
V. hollisae		1		3	
V. mimicus	2	2			
V. metschnikovii					
V. parahaemolyticus	20	19	16	21	25
V. vulnificus	1		1	1	1
Vibrio sp.	1			1	
Total	**43**	**45**	**31**	**41**	**45**

SECTION 9: OUTBREAKS

Table 20 summarizes outbreaks of enteric disease reported for the years 2002 to 2006 through various surveillance systems such as the NESP, PulseNet Canada and cluster investigations where the NML and CIDPC have provided assistance. There is currently no national outbreak summary reporting system in Canada. Therefore, this list is not a comprehensive or representative sample of all enteric disease outbreaks that have occurred in Canada. The table also contains some clusters of identical isolates that have not been epidemiologically linked and the case counts may not represent the final outbreak case distribution. Outbreaks are grouped by causative organism and setting in which the outbreak occurred. Outbreak settings include 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, house-hold members and/or friends and generally consist of person-to-person spread of the infectious agent within a household. Institutional outbreaks include those that occur in hospitals, daycares, long-term care facilities, schools and other events in which individuals are in close contact and share exposures. Restaurant outbreaks involve events related to food establishments and/or the 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 101 outbreaks and case clusters reported in Canada during 2006 involving 645 cases of illness. *Salmonella* continues to be the prominent causative agent of enteric outbreaks accounting for 55% (n=56) of the reported outbreaks and 44% (n=283) of all outbreak-related illnesses (Table 20). The proportion of outbreaks attributed to *Salmonella* has remained relatively constant over this 5 year period, from a high of 61% (n=43) of the 70 outbreaks in 2002. With the exception of 2005, in which a large outbreak of *S*. Enteritidis was associated with consumption of mung bean sprouts, the proportion of total illnesses attributed to *Salmonella* has remained relatively constant since 2002 representing about 40% of the outbreak cases. The highest number of illnesses was associated with community and family outbreaks with 197 and 41 cases, respectively. The number and size of restaurant-associated *Salmonella* outbreaks has decreased from 4 outbreaks causing 170 illnesses in 2005 to 1 outbreak causing 7 illnesses in 2006.

Verotoxigenic *E. coli* (VTEC) was implicated in 30% of the outbreaks (n=31) involving 36% (n=236) of the associated outbreak related illnesses, extending a relatively constant trend since 2003 when 28% (n=18) of the outbreaks caused 38% (n=234) of all outbreak associated illnesses. The majority of outbreak-related illnesses attributed to O157 VTEC in 2006 continue to be from community-associated outbreaks, accounting for 20 outbreaks and a total of 134 illnesses. The number of family-associated outbreaks of O157 VTEC illness has decreased from a total of 44 illnesses from 17 outbreaks in 2005 to 10 illnesses from 4 outbreaks in 2006. Institutional outbreaks have increased from 1 outbreak of 11 cases in 2005 to 3 outbreaks causing a total of 40 illnesses in 2006.

Shigella sonnei outbreaks and clusters have decreased dramatically from 2005 when there were 8 outbreaks causing 101 illnesses in 2005 to 1 outbreak causing 9 illnesses in 2006. There was 1 outbreak of *Shigella flexneri* that caused 4 cases of illness, 1 outbreak of *Yersinia enterocolitica* (3 cases), 1 outbreak of *V. paraheamolyticus* (6 cases), 1 *Cryptosporidium* (31 cases) and 3 outbreaks of *Cyclospora* (40 cases) reported in 2006.

Table 20: Outbreaks and Case Clusters of Enteric Disease in Canada, 2002 to 2006*

Organism	Outbreak Type	2002		2003		2004		2005		2006	
		#OB[a]	Cases	#OB	Cases	#OB	Cases	#OB	Cases	#OB	Cases
Salmonella	Community	19	381	12	155	15	108	23	830	30	197
	Family	21	58	10	23	18	48	21	54	18	41
	Institutional	0	0	5	26	3	35	3	21	4	27
	Restaurant	3	22	7	99	10	154	4	170	1	7
	Travel	0	0	0	0	0	0	4	11	3	11
	Total	**43**	**461**	**34**	**303**	**43**	**345**	**55**	**1086**	**56**	**283**
***E. coli* O157**	Community	7	166	9	206	9	90	12	69	20	134
	Family	11	30	7	19	13	34	17	44	4	10
	Institutional	6	47	8	23	14	45	1	11	3	40
	Restaurant	1	2	1	5	6	149	3	28	4	52
	Total	**25**	**245**	**18**	**234**	**29**	**284**	**33**	**152**	**31**	**236**
***E. coli* non-O157**	Community	0	0	0	0	1	2	0	0	0	0
	Family	0	0	0	0	0	0	2	8	2	4
	Institutional	0	0	0	0	0	0	0	0	1	5
	Total	**0**	**0**	**0**	**0**	**1**	**2**	**2**	**8**	**3**	**9**
Campylobacter	Community	0	0	0	0	0	0	1	45	2	8
	Restaurant	0	0	0	0	1	40	0	0	1	11
	Travel	0	0	0	0	0	0	0	0	2	5
	Total	**0**	**0**	**0**	**0**	**1**	**40**	**1**	**45**	**5**	**24**
Shigella flexneri	Family	0	0	0	0	0	0	1	4	1	4
	Travel	0	0	0	0	0	0	1	3	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**7**	**1**	**4**
Shigella sonnei	Community	1	426	6	40	0	0	3	32	0	0
	Day Care	0	0	0	0	0	0	1	11	0	0
	Family	0	0	4	18	2	5	3	6	0	0
	Institutional	0	0	1	15	0	0	0	0	0	0
	Travel	1	6	0	0	0	0	1	52	0	0
	Restaurant	0	0	0	0	1	2	0	0	1	9
	Total	**2**	**432**	**11**	**73**	**3**	**7**	**8**	**101**	**1**	**9**
Y. enterocolitica	Community	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**3**	**1**	**3**
V. paraheamolyticus	Community	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**6**
Cryptosporidium	Community	0	0	1	4	0	0	0	0	1	31
	Family	0	0	0	0	4	47	1	5	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**	**1**	**31**
Cyclospora	Community	0	0	0	0	1	8	1	40	0	0
	Restaurant	0	0	0	0	0	0	2	204	2	36
	Travel	0	0	0	0	0	0	2	11	1	4
	Total	**0**	**0**	**0**	**0**	**1**	**8**	**5**	**255**	**3**	**40**
Giardia	Community	0	0	0	0	1	6	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**1**	**6**	**0**	**0**	**0**	**0**
Total		**70**	**1138**	**64**	**614**	**82**	**737**	**106**	**1654**	**101**	**645**

(a) = Number of Outbreaks

*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. The list does not represent all enteric illness outbreaks identified nationally nor is the case count representative of the actual final number of cases or illnesses that may have been associated with the outbreak or cluster.

Outbreaks 2006

Salmonella

There were 58 *Salmonella*-related outbreaks and clusters involving 21 serovars and causing 289 cases of illness in 2006.

S. Heidelberg was associated with the majority of the outbreaks and clusters, identified in 9 outbreaks or case clusters, causing 60 cases of illness. The largest case cluster occurred during August in New Brunswick where 18 cases of S. Heidelberg PT 18a / PFGE pattern SHEXAI.0001 were identified. A previous cluster reported in July involved 8 cases of PT 19b, also with PFGE pattern SHEXAI.0001. New Brunswick identified a third outbreak in September that was associated with a long term care facility and included 9 cases of PT5 / PFGE pattern SHEXAI.0005. Two other institutional outbreaks associated with *S*. Heidelberg were also reported in Canada during 2006: one in a hospital setting in Alberta in May involving 3 cases; and another in a Québec senior's residence in April consisted of 6 cases of PT 40. There was a household cluster reported in British Columbia and Québec with 2 cases associated with each. Two other multi-provincial case clusters were reported to PulseNet Canada: one in September involved 4 cases of PT 5 with PFGE pattern SHEXAI.0011 in Québec, New Brunswick and Nova Scotia; and a second cluster of 8 isolates of PT 2 / SHEXAI.0007 reported in New Brunswick and Manitoba.

Nine outbreaks and case clusters of *S.* Typhimurium infection causing a total of 45 illnesses were reported in 2006. The largest event was associated with a dinner event in September in New Brunswick and involved 11 cases of *S*. Typhimurium PT 46 with PFGE pattern STXAI.0214. In July, 9 cases of *S*. Typhimurium were linked to a wedding banquet in Ontario. Another outbreak involving 5 cases of PT 170 / PFGE pattern STXAI.0232 was linked to a pork product(s) sold at a farmers market in Prince Edward Island. In Manitoba, 5 cases of PT 2 / PFGE pattern STXAI.0098 were identified from employees of the same workplace. There were 2 family related outbreaks of *S*. Typhimurium, one involving 4 cases identified in Ontario in June that were associated with a pet raccoon, and another in Alberta consisting of 3 illnesses. Three other case clusters were reported to PulseNet Canada including 3 cases of STXAI.0233 in Manitoba during April, 3 cases of STXAI.0001 in Alberta during November and two cases of STXAI.0019 were identified in New Brunswick and Prince Edward Island that matched a large outbreak occurring in the USA involving fresh tomatoes.

A total of 34 illnesses were associated with 5 *S.* Saintpaul outbreaks and case clusters, 4 of which were located in Québec. One outbreak during December in Québec was family-related involving 2 cases of illness. In March, Québec reported one cluster of 18 isolates with PFGE pattern SainXAI.0036 to PulseNet Canada and another of 2 isolates with PFGE pattern SainXAI.0038. In December, another cluster of 9 SainXAI.0036 strains was reported in Québec and 3 isolates of SainXAI.0005 were reported by New Brunswick.

Although *S.* Enteritidis was the most frequently identified serovar in 2006, only two small household clusters (2 cases each) were reported in Québec and a cluster of 5 cases of PT 30 with PFGE pattern SENXAI.0025 was reported to PulseNet Canada by Ontario in March. An investigation into an increase in *S*. Enteritidis PT 13 was initiated in Ontario in June, but a common source of infection could not be identified.

There were 5 outbreaks and case clusters of *S*. Paratyphi B var. Java causing 14 illnesses in 2006. Pet turtles were associated with a community outbreak involving 4 cases of *S*. Paratyphi B var. Java PT Battersea / PFGE pattern PBXAI.0063 in Saskatchewan in February. Three cases of *S*. Paratyphi B var. Java reported by Nova Scotia in December were associated with a tropical fish tank. There was one family cluster of 2 cases identified in Saskatchewan in February, and one in Québec in November, also with 2 cases.

A total of 9 *S*. Oranienburg infections were linked to a seniors' residence in Alberta, with cases identified between December 2006 and March 2007. Some of the cases that were identified among residents and staff of the facility, were asymptomatic. A cluster of isolates with PFGE pattern OraniXAI.0041 in Ontario (3 cases) and Alberta (1 case) were reported to PulseNet Canada in December, matching a strain isolated from recalled bagged spinach. A smaller cluster of 2 isolates with PFGE pattern OraniXAI.0007 was also reported in April by Manitoba.

Salmonella Schwarzengrund was implicated in an Ontario outbreak which began during December 2005 and into 2006 involving 21 cases with PFGE pattern SchwaXAI.0011. Investigations by local and provincial public health agencies led to the identification of pasteurized soft cheese produced by a local cheese maker in the Niagara region, as the likely source of these illnesses. A Health Hazard Alert was posted by the CFIA and affected products were recalled from the marketplace.

Recalled salad croutons used in a popular fast food establishment were linked to 7 illnesses of *S.* Newport with PFGE pattern NewpXAI.0166 in Ontario during September. Another small cluster of 3 cases with NewpXAI.0122 was posted to PulseNet Canada in October with cases seen in Ontario and New Brunswick.

Other outbreaks and case clusters include: 3 clusters of *S*. Stanley reported in 2006 including 3 cases in New Brunswick of StanXAI.0030, 3 cases in Alberta with StanXAI.0050 and 2 family-related cases reported in Québec; 2 clusters of *S*. Thompson including one cluster of 22 cases of PT 3 with PFGE pattern STHXAI.0002 in Ontario and another cluster of 2 family-related cases reported in Québec; 2 household related clusters of *S*. Typhi of 2 cases each in Québec and British Columbia; 3 cases of *S*. Anatum in Manitoba; 7 cases of *S*. Braenderup in Québec; 2 family related cases of *S*. Hadar in Québec; 2 family related cases of *S*. Javiana in Quebec; 3 family cases of *S*. London in British Columbia; 3 cases of *S*. Poona in New Brunswick; 4 cases of *S*. Virchow in Québec; 2 family related cases of *S*. ssp IV 44:z4,z23:- in Ontario; and 2 cases of *S*. ssp I 4,[5],12:i:- PT U291 / STXAI.0010 in New Brunswick.

Travel related clusters reported include a cluster of 6 cases of *S*. Enteritidis in Ontario and 2 cases in Alberta during January that were associated with travel to the Domincan Republic and 5 cases of *S*. Kiambu in British Columbia that were linked to travel to Mexico.

Campylobacter jejuni

There were 5 *Campylobacter*-related outbreaks and case clusters in 2006, the largest occurred in Alberta consisting of 11 cases associated with contaminated bean sprouts served at a restaurant in August. In June, a community outbreak in Saskatchewan involved 6 illnesses and a social gathering in Alberta had 2 cases. There were also 2 travel related clusters with a total of 5 cases reported.

Verotoxigenic *Escherichia coli*

Thirty-one outbreaks and case clusters were associated with *E. coli* O157:H7, one with *E. coli* O26:NM, one with O103:H2 and one O:86 were noted in 2006.

Six outbreaks were identified in Alberta, two of these were linked to the consumption of donair meat that was prepared locally. The first in May and June involved 9 cases of *E. coli* O157:H7 with PFGE pattern ECXAI.1455 and 1 with pattern ECXAI.1468 and a second included 13 cases with pattern ECXAI.2028 reported between September and November. A smaller community-based outbreak of 4 cases with PFGE pattern ECXAI.1061 in Alberta was associated with the consumption of a meat and onion type spread. Five cases were associated with a day home, and a total of 6 family-related cases were from 2 separate outbreaks. There were also 4 other clusters reported to PulseNet Canada accounting for a total of 15 cases.

In Ontario, 23 cases of infection during February were linked to a restaurant/bakery and isolates were characterized as *E. coli* O157:H7 PT 14a with PFGE pattern ECXAI.0292. In September, Ontario also reported 10 confirmed cases of *E. coli* O157:H7 related to an outbreak among students at a school in Hamilton. The PFGE pattern associated with this outbreak was ECXAI.0017. Another restaurant associated outbreak, involving 7 cases with an indistinguishable PFGE pattern, was investigated in the Sudbury area and lettuce was identified as the likely common source of infection. One family associated outbreak with 2 cases of PT 48 / PFGE pattern ECXAI.0052 was reported in February. In September, a single case of infection with PFGE pattern ECXAI.0128 was linked to a large multi-state outbreak of *E. coli* O157 associated with fresh bagged spinach in the USA by comparing PFGE patterns through PulseNet USA. Three other PFGE clusters consisting of a total of 17 cases were also reported to PulseNet Canada.

In Québec, 40 isolates with PFGE pattern ECXAI.1175 were reported to PulseNet Canada between late June and August. Cases with indistinguishable patterns were also identified in New Brunswick (3 cases), Ontario (4 cases), British Columbia (2 cases) and Vermont (1 case associated with travel to Canada). Following a multi-provincial investigation, recalls of locally distributed ground beef products were initiated in Québec, but no common link was established between the other provinces. Three other community-based clusters where reported to PulseNet Canada including 5 cases of ECXAI.0001, 4 cases of ECXAI.0006 and 4 cases of ECXAI.1629.

Manitoba experienced a significant increase in verotoxigenic *E. coli* isolations over the summer months, particularly in August. An investigation conducted by the Winnipeg Regional Health Authority in August, linked 9 infections with PFGE pattern ECXAI.0854 to the consumption of ground beef. An outbreak in a daycare centre was identified in Manitoba in November involving 25 illnesses identified with PFGE pattern ECXAI.1497. A cluster of 5 isolates of ECXAI.1128 was posted to PulseNet Canada in July and another of 7 cases of ECXAI.1551 was posted in September.

There were 4 clusters in British Columbia including a 14 cases of ECXAI.0048 posted in August, 3 cases of ECXAI.1624 posted in November and 2 family-related cases reported in September. There where also 3 cases of ECXAI.1248 associated with travel to Mexico during March 2006.

The three non-O157 *E. coli* outbreaks were reported in British Columbia and include: 2 cases of O26:HNM associated with family contact; 2 cases of O103:H2 from siblings within a household; and 5 cases of O86 linked to a day care.

Shigella

There were 2 outbreaks and clusters associated with *Shigella* reported in 2006. One of these involved 4 isolates of *S. flexneri* serotype 4 from a family that recently adopted children from an endemic country in British Columbia and another cluster of 9 cases of *Shigella sonnei* with PFGE pattern SSOXAI.00166 were linked to food establishment in Alberta.

Yersinia

There was one *Y. enterocolitica* outbreak reported in 2006 consisting of 3 cases in Ontario during June associated with the consumption of soy milk.

Vibrio parahaemolyticus

There was one *V. parahaemolyticus* outbreak reported in 2007 consisting of 6 cases in British Columbia in July associated with the consumption of raw oysters imported from the Pacific Northwest of the USA. There were an estimated 182 illnesses in Washington, New York and Oregon states.

Parasites

There were 2 separate restaurant outbreaks of *Cylcospora* in British Columbia in 2006 that were linked to a single caterer. In July, 8 illness were associated with fresh berries, and in August, another 28 cases were linked to a salad dressing. A cluster of 31 *Cryptosporidium* was detected in north-central Ontario during September, however no common source of infection was found.

Table 21: Outbreaks, Case Clusters and Laboratory Investigations of *Salmonella*, Verotoxigenic *E. coli*, *Shigella, Campylobacter* and Parasitic Infections in Canada, 2006

Organism	Month[a]	Province	Cases	PT[b]	PFGE[c]	Comments
Campylobacter jejuni	Jun	AB	2			Community - Social Gathering
	Jun	NL	3			Travel - Portugal
	Jun	SK	6			Community - Cluster Investigation
	Aug	AB	11 [d]			Restaurant - Bean Sprouts (Raw Chicken)
Campylobacter sp.	Aug	AB	2			Travel - Lebanon - 2 Families
Cryptosporidium	Sep	ON	31			Community - Cluster Investigation
Cyclospora	Jun	National	4			Travel - Dominican Republic - 2 Catered Weddings
Cyclospora	Jul	BC	8			Restaurant - Berries
Cyclospora	Aug	BC	28			Restaurant - Salad Dressing
E. coli O103:H2	May	BC	2			Family - Siblings
E. coli O26:NM	Apr	BC	2			Family - Contact
E. coli O86	Oct	BC	5 [e]			Institutional - Daycare
E. coli O157:H7	Feb	NB	3	PT14	ECXAI.1369	Community - Cluster Investigation
	Feb	ON	23 [f]	PT 14a	ECXAI.0292	Restaurant - Bakery
	Feb	ON	2	PT 48	ECXAI.0052	Family - Contact
	Mar	AB	4		ECXAI.1061	Community - Meat/Onion Spread
	Mar	BC	3		ECXAI.1248	Travel - Mexico
	May	ON	3		ECXAI.0262	Community - Cluster Investigation
	Jun	AB	9		ECXAI.1455	Restaurant - Beef Donairs
	Jun	AB	3			Family - Contact
	Jun	QC	5		ECXAI.0001	Community - Cluster Investigation
	Jun	QC	4		ECXAI.0006	Community - Cluster Investigation
	Jul	MB	5		ECXAI.1128	Community - Cluster Investigation
	Jul	QC	40 [g]		ECXAI.1175	Community - Ground Beef
	Jul	AB	5			Institutional - Day Home
	Aug	AB	2		ECXAI.0045	Community - Cluster Investigation
	Aug	AB	3		ECXAI.1518	Community - Cluster Investigation
	Aug	BC	14		ECXAI.0048	Community - Cluster Investigation
	Aug	MB	9		ECXAI.0854	Community - Ground Beef
	Sep	MB	7		ECXAI.1551	Community - Cluster Investigation
	Sep	ON	6		ECXAI.0073	Community - Cluster Investigation
	Sep	SK	3		ECXAI.1252	Community - Cluster Investigation
	Sep	BC	2			Family - Contact
	Sep	ON, USA	1		ECXAI.0128	Community - Bagged Spinach
	Oct	AB	3		ECXAI.0001	Family - Contact
	Oct	AB	3		ECXAI.0519	Community - Cluster Investigation
	Oct	AB	7		ECXAI.0146	Community - Cluster Investigation
	Oct	ON	10		ECXAI.0017	Institutional - School (Lettuce)
	Oct	ON	7		ECXAI.0017	Restaurant - Lettuce
	Oct	ON	8		ECXAI.0073	Community - Cluster Investigation
	Nov	MB	25[h]		ECXAI.1497	Institutional - Daycare
	Nov	AB	13	PT1	ECXAI.2028	Restaurant - Beef Donairs
	Nov	BC	3		ECXAI.1624	Community - Cluster Investigation
	Dec	QC	4		ECXAI.1629	Community - Cluster Investigation
S. Anatum	Nov	MB	3		SANAXAI.0022	Community - Cluster Investigation
S. Braenderup	Jul	QC	7		BraeXAI.0029	Community - Cluster Investigation
S. Enteritidis	Jan	AB	2			Travel - Dominican Republic

Organism	Month[a]	Province	Cases	PT[b]	PFGE[c]	Comments
	Jan	ON	6			Travel - Dominican Republic
	Mar	ON	5	PT30	SENXAI.0025	Community - Cluster Investigation
	Jul	QC	2			Family - Contact
	Oct	QC	2			Family - Contact
S. Hadar	Jul	QC	2			Family - Contact
S. Heidelberg	Apr	QC	6	PT40		Institutional - Seniors Residence
	May	AB	3			Institutional - Hospital
	Jun	BC	2			Family - Contact
	Jul	NB	8	PT19b	SHEXAI.0001	Community - Cluster Investigation
	Jul	QC	2			Family - Contact
	Aug	NB	18	PT18a	SHEXAI.0001	Community - Cluster Investigation
	Sep	QC,NB,NS	4	PT 5	SHEXAI.0011	Community - Cluster Investigation
	Sep	NB	9	PT 5	SHEXAI.0005	Institutional - Long Term Care
	Oct	NB, MB	8	PT2	SHEXAI.0007	Community - Cluster Investigation
S. Javiana	Nov	QC	2			Family - Contact
S. Kiambu	Dec	BC	5 [i]			Travel - Mexico
S. London	Jun	BC	3			Family - Contact
S. Newport	Sep	ON	7		NewpXAI.0166	Restaurant - Fast Food Croutons
	Oct	ON, NB	3		NewpXAI.0122	Community - Cluster Investigation
S. Oranienburg	Apr	MB	2		OraniXAI.0007	Community - Cluster Investigation
	Dec	ON, AB	4 [j]		OraniXAI.0041	Community - Spinach
	Dec	AB	9			Institutional - Seniors Residence
S. Paratyphi B var. Java	Feb	SK	2			Family - Contact
	Feb	SK	4	Battersea	PBXAI.0063	Community - Pet Turtles
	Jul	BC	3		PBXAI.0069	Community - Cluster Investigation
	Nov	QC	2			Family - Contact
	Dec	NS	3			Family - Tropical Fish
S. Poona	Aug	NB	3		POOXAI.0024	Community - Cluster Investigation
S. Saintpaul	Mar	QC	18		SainXAI.0036	Community - Cluster Investigation
	Mar	QC	2		SainXAI.0038	Community - Cluster Investigation
	Dec	QC	2			Family - Contact
	Dec	NB	3		SainXAI.0005	Community - Cluster Investigation
	Dec	QC	9		SainXAI.0036	Community - Cluster Investigation
S. Schwarzengrund	Feb	ON	21	PT2	SchwaXAI.0011	Community - Cheese (Raw Milk)
S. Stanley	Apr	NB	3		StanXAI.0030	Community - Cluster Investigation
	Nov	AB	3		StanXAI.0050	Community - Cluster Investigation
	Sep	QC	2			Family - Contact
S. Thompson	Jun	QC	2			Family - Contact
	Aug	ON	22	PT 3	STHXAI.0002	Community - Cluster Investigation
S. Typhi	May	QC	2			Family - Contact
	Jun	BC	2			Family - Contact
S. Typhimurium	Jan	MB	5	PT2	STXAI.0098	Community - Workplace
	Apr	MB	3		STXAI.0233	Community - Cluster Investigation
	Jun	ON	4			Family - Pet Raccoon

Organism	Month[(a)]	Province	Cases	PT[(b)]	PFGE[(c)]	Comments
	Jul	ON	9			Community - Wedding Banquet
	Aug	PEI	5	PT170	STXAI.0232	Community - Market (Pork Products)
	Aug	AB	3			Family - Contact
	Sep	NB	11	PT46	STXAI.0214	Community - Dinner Event
	Oct	NB,PE,USA	2	Atypical	STXAI.0019	Community - USA Tomatoes
	Nov	AB	3		STXAI.0001	Community - Cluster Investigation
S. Virchow	Aug	QC	4		VircXAI.0016	Community - Cluster Investigation
S. ssp IV 44:z4,z23:-	Nov	ON	2			Family - Siblings
S. ssp I 4,5,12:i:-	Feb	NB	2	U291	STXAI.0010	Community - Cluster Investigation
Shigella flexneri 4	Apr	BC	4			Family - Liberia
Shigella sonnei	Oct	AB	9		SSOXAI.0166	Restaurant
V. parahemolyticus	Jul	BC, USA	6			Community - Raw Oysters
Y. enterocolitica	Jun	ON	3			Community - Soy Milk

Notes: (a) Month outbreak or case cluster recognized; (b) Predominant Phage Type; (c) Predominant *Xba*I Pulsed Field Gel Electrophoresis Pattern; (d) 2 epidemiologically linked, 9 confirmed; (e) = 5 ill, 2 confirmed; (f) 23 ill, 12 confirmed, (g) 40 cases in Quebec, 3 in New Brunswick, 4 in Ontario and 2 in British Columbia; (h) 25 ill, 23 confirmed; (i) 5 ill, 3 confirmed, (j) 3 cases in Ontario and 1 in Alberta.

SECTION 10: MISCELLANEOUS INFORMATION

Travel Acquired Infections 2006

Although foreign travel is one of the major risk factors for gastro-intestinal illness, this information is rarely captured or reported at a federal level and is therefore greatly under-reported. Although there are limited public health interventions and responses available to combat foreign acquired infections other than travel advisories and education campaigns, the health costs associated with treating these infections and lost productivity place a burden on the Canadian health care system. Of the information that has been captured, travel to winter holiday destinations tend to be the predominant area in which infections are brought back into the country, such as Mexico, Central America and the Caribbean.

Table 22: Travel Related Enteric Pathogen Infections, 2006

Organism	Country of Travel
Campylobacter coli	2 Mexico, 2 Honduras, 1 Hungary
Campylobacter jejuni	1 Dominican Republic, 1 Jamaica, 1 Pakistan, 1 Thailand,
Campylobacter upsaliensis	1 Jamaica
E. coli O157 VTEC	1 Algeria, 1 Dominican Republic
Cryptosporidium	1 Honduras
Entamoeba histolytica/dispar	3 Africa, 1 Burma, 1 Columbia, 1 Congo, 1 Europe, 1 Guinea
	1 India, 1 Mali, 1 Sierra Leone, 1 Sudan, 2 Uzbekistan
Giardia	2 Burma, 1 Haiti, 2 India, 1 Sudan
S. Agona	1 Dominican Republic
S. Anatum	1 Mexico, 1 Phillippines
S. Blockley	1 Dominican Republic
S. Braenderup	1 Phillippines, 1 Thailand
S. Choleraesuis	1 Dominican Republic
S. Derby	1 Mexico
S. Enteritidis	2 Africa, 4 Cuba, 4 Dominican Republic, 1 India, 2 Jamaica,
	1 Kenya, 13 Mexico, 2 Portugal, 1 Thailand
S. Hadar	1 Cuba
S. Heidelberg	1 Dominican Republic
S. Manhattan	1 Cuba
S. Paratyphi A	1 China, 6 India, 1 Pakistan,
S. Paratyphi B	1 Pakistan, 1 South America
S. Typhi	2 India
S. Sandiego	1 Mexico
S. Schwarzengrund	1 Thailand
Salmonella ssp I 13,22:-:-	1 Mexico
Salmonella ssp I 4,[5],12:i:-	1 Dominican Republic
Salmonella ssp IV 48:g,z51:-	1 Costa Rica
S. Stanley	1 Thailand
S. Typhimurium	2 Cuba, 1 Mexico, 1 Russia
S. Virchow	1 Thailand

Organism	Country of Travel
Shigella boydii 2	2 Africa
Shigella boydii 4	1 Jordan
Shigella boydii 14	1 Mexico
Shigella boydii 19	1 Pakistan
Shigella flexneri 1	1 Mexico
Shigella flexneri 2	1 Asia
Shigella flexneri 3	1 Haiti
Shigella flexneri 4	1 Ghana
Shigella flexneri 4	4 Liberia
Shigella flexneri 4c	1 Ethiopia
Shigella sonnei	1 Argentina, 1 Ecuador, 1 India, 5 Mexico, 1 Pakistan,
	1 South America
Vibrio cholerae non- O1/O139	2 Dominican Republic, 1 Mexico, 1 Hong Kong
Vibrio cholerae O1 bio El Tor	1 Mexico
Vibrio cholerae O1 Ogawa	1 Mexico
Vibrio cholerae O1 Inaba	1 India
Vibrio fluvialis	1 Mexico
Vibrio paraheamolyticus	1 Ecuador, 1 Mexico
Yersinia enterocolitica	1 Cuba, 1 Hong Kong

Unusual Isolation Sites

Although complete data of the source of isolations are not available at the federal level, the amount of information obtained remains relatively consistent from year to year. The isolation of enteric pathogens from sources other than stool may indicate enhanced virulence of the strains, such as *S*. Typhi and *S*. Paratyphi A. Noting increased numbers of disease-causing strains which normally only result in gastro-enteritis, being isolated from other infection sites, may signal a change to a more pathogenic state of the strain.

Table 23: Unusual Enteric Pathogen Isolation Sites, 2006

Site of Isolation	Organism	Total
Abscess	*S.* Arechavaleta	1
	S. Enteritidis	1
	S. Stanley	1
	S. Typhi	2
	S. Typhimurium	3
Abscess (Foot)	*S*. Telelkebir	1
	S. Typhimurium	1
Appendix	*S*. Heidelberg	1
Aspirate	*S*. Enteritidis	1
	S. Typhi	1
Blood	*C. fetus* ssp. fetus	1
	C. jejuni	7
	E. coli O1:H7	1
	E. coli O157:H7	2
	E. coli O2:NM	1
	E. coli O25:H4	2
	E. coli O4:H5	1
	E. coli O75:NM	2
	E. coli O-Untypeable:H16	1
	E. coli O-Untypeable:K1:H1	1
	E. coli O-Untypeable:K1:NM	1
	E. coli Rough-O:H12	1
	S. Agona	2
	S. Anatum	1
	S. Berta	1
	S. Brandenburg	1
	S. Carrau	1
	S. Choleraesuis	3
	S. Durban	1
	S. Enteritidis	36
	S. Goettingen	1
	S. Grumpensis	1
	S. Heidelberg	55
	S. Indiana	1

Site of Isolation	Organism	Total
	S. Infantis	2
	S. Javiana	1
	S. Kiambu	1
	S. Montevideo	1
	S. Muenster	1
	S. Newport	5
	S. Oranienburg	2
	S. Panama	1
	S. Paratyphi A	59
	S. Paratyphi B	2
	S. Paratyphi B var. Java	2
	S. Poona	2
	S. Saintpaul	7
	S. Sandiego	3
	S. Schwarzengrund	2
	S. Stanley	4
	S. Telelkebir	1
	S. Thompson	2
	S. Typhi	50
	S. Typhimurium	14
	S. Virchow	1
	S. Wandsworth	1
	Salmonella ssp I 4,[5],12:b:-	1
	Salmonella ssp I 4,[5],12:i:-	2
	Salmonella ssp I 9,12:-:e,n,x	1
	Salmonella ssp I 9,12:r:-	1
	Salmonella ssp IIIa 41:z4,z32:-	1
	Salmonella ssp IIIa 48:g,z51:-	1
	Salmonella ssp IV 44:z4,z23:-	1
	Y. enterocolitica	1
Bone	*S.* Indiana	1
Cerebral Spinal Fluid	*E. coli* O75:NM	1
Diaphragm	*S.* Enteritidis	1
Ear	*V. cholerae* non-O1/O139	1
Fluid	*S.* Muenchen	1
Pleural Fluid	*S.* Enteritidis	1
	S. Heidelberg	1
	S. Telelkebir	1
	S. Typhimurium	1
Sputum	*S.* Hadar	
Urine	*E. coli* O127:H4	1
	E. coli O127:NM	1
	E. coli O157:H19	1
	S. Agona	2

Site of Isolation	Organism	Total
	S. Albany	1
	S. Anatum	2
	S. Berta	1
	S. Braenderup	5
	S. Bredeney	1
	S. Chester	1
	S. Derby	1
	S. Dublin	1
	S. Durban	1
	S. Ealing	1
	S. Eastbourne	1
	S. Enteritidis	24
	S. Hadar	4
	S. Hartford	1
	S. Havana	1
	S. Heidelberg	34
	S. Infantis	4
	S. Inverness	1
	S. Javiana	2
	S. Kiambu	1
	S. Litchfield	1
	S. Manhattan	1
	S. Mbandaka	2
	S. Montevideo	2
	S. Muenchen	1
	S. Newport	11
	S. Nima	1
	S. Oranienburg	3
	S. Paratyphi B	1
	S. Paratyphi B var. Java	2
	S. Poona	2
	S. Rubislaw	1
	S. Saintpaul	4
	S. Sandiego	1
	S. Schwarzengrund	4
	S. Senftenberg	2
	S. sonnei	1
	S. Stanley	2
	S. Takoradi	1
	S. Tennessee	1
	S. Thompson	5
	S. Toucra	1
	S. Typhimurium	16
	S. Virginia	1
	Salmonella ssp I 4,[5],12:b:-	2
	Salmonella ssp I 4,[5],12:i:-	2
	Salmonella ssp I 6,7:k:-	1
	Salmonella ssp I 6,8:-:e,n,x	1
	Salmonella ssp I Rough-O:i:1,2	1
	Salmonella ssp I Rough-O:z10:e,n,z15	1
	Salmonella ssp II	1
	Salmonella ssp IIIa 48:g,z51:-	1

Site of Isolation	Organism	Total
	Salmonella ssp IIIb 53:z10:z	1
	Salmonella ssp IIIb 60:i:z	1
	Salmonella ssp IIIb 61:c:z35	1
	Salmonella ssp IIIb 61:k:1,5	1
	Salmonella ssp IIIb 61:k:z35	1
	Shigella sonnei	1
Wound	*S.* Enteritidis	1
	S. Paratyphi B var. Java	1
Wound (Foot)	*V. cholerae* Non O1/Non O139	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. The combined 2002 and 2003 Annual Summary allowed the reporting processes to get caught up to date and addressed data acquisition issues involved in the compilation of the *Campylobacter* reporting. To facilitate the production of subsequent reports, the previous year's *Campylobacter* data are now included in the current year's 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) and is more timely. 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 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., PulseNet Canada and the Phage Typing 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, characteristics and limitations 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, food and environmental 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* where once included in the summary because many of these strains were mis-identified as *Campylobacter*. Due to improved laboratory identification methods, this is now a rarity and information on these other organisms is 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 stakeholders 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 comprehensiveness and understanding of enteric disease in Canada.

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 PHLs 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.