Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 2005

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 for 2005. 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 2001.
- *Salmonella* and parasitic infections rank 2nd and 3rd in prevalence, respectively.
- Total *Salmonella* infections have been increasing since 2003.

***Salmonella* from Human Sources:**

- Of all *Salmonella* infections, 56% were caused by 3 serovars: *S*. Enteritidis (27%), *S*. Typhimurium (17%) and *S*. Heidelberg (11%).
- Each of the remaining most prevalent serovars in the top 15 represented only 1% to 4% of infections.
- The national isolation rate increased to 19.7 isolations per 100,000 people in 2005, up from 17.2 in 2004.
- Ontario had the highest isolation rate with 25.9 isolates per 100,000 people and the Northwest Territories had the lowest with 4.7.
- *S.* Enteritidis is the most prevalent serovar in British Columbia, Alberta, Ontario, Québec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland.
- *S*. Heidelberg is most prevalent in Saskatchewan.
- *S*. Typhimurium is most prevalent in Manitoba.
- *S*. Enteritidis PT 13 is now the most predominant *S*. Enteritidis phage type, increasing dramatically from 18% of all *S*. Enteritidis in 2004, to 55% in 2005. PT 4 has decreased from 30% in 2004 to 11% in 2005 of all isolates tested.
- *S*. Heidelberg PT 19 continues to be most prevalent representing 38% of the S. Heidelberg isolates tested, remaining relatively constant since 2001. PT 29 has decreased from 24% in 2004 to 17% in 2005.
- *S*. Typhimurium PT 104 identifications have continued to decline from approximately 28% in 2001 to approximately 18% in 2005.
- *S.* Newport PT 9 remains most prevalent, though the proportion of identifications has declined considerably from 30% in 2002 to 15% in 2005.

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

- Of all non-human *Salmonella*, 39% of the isolations are either *S*. Typhimurium (22%) or *S*. Heidelberg (17%).
- *S*. Kentucky continues to rank a distant third representing 7% of all non-human *Salmonella*.
- *S*. Heidelberg is now most prevalent from chicken sources; *S*. Saintpaul continues to be most prevalent from turkey sources, *S*. Typhimurium continues to be most prevalent from bovine and porcine sources; and *S*. Thompson is now most prevalent from animal feed, replacing *S*. Heidelberg as most prevalent in 2004.
- *S*. Enteritidis PT 13 is the most prevalent phage type from non-human sources, increasing dramatically from 5% of the strains in 2003, to 65% in 2005.
- *S*. Heidelberg PT 29 has surpassed PT19 as most predominant accounting for 36% of S. Heidelberg tested in 2005. PT 19 levels have remained relatively constant at approx. 30% since 2003.
- *S*. Typhimurium PT104 levels have increased from 28% between 2001 and 2004, to 43% in 2005.

Pathogenic *Escherichia coli*:

- The national *E. coli* O157 isolation rate has decreased from 3.4 identifications per 100,000 people in 2004 to 2.4 in 2005.
- Nunavut has the highest isolation rate with 7.0 isolations per 100,000 population.
- PT 14a is the most predominant phage type constituting approximately 56% of all isolates tested, followed distantly by PT 14 and PT 2 with 7% each.

***Campylobacter* :**

- The national *Campylobacter* isolation rate has continued to decrease from 31.5 isolations per 100,000 people in 2003 to 29.9 in 2004.
- British Columbia continues to have the highest isolation rate with approximately 35.0 isolations per 100,000 people. This increased rate may be due to enhanced detection and reporting systems or special studies being conducted in that province.

***Shigella*:**

- *S. sonnei* infections accounted for 51% of the *Shigella* infections in Canada in 2005, followed by *S. flexneri* (26%), *S. boydii* (4%) and *S. dysenteriae* (3%).
- The national *Shigella* isolation rate increased from 2.3 isolations per 100,000 people in 2004 to 3.1 in 2005.
- British Columbia has the highest isolation rate with 5.4 isolations per 100,000 people.

Parasites:

- The national parasite (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) isolation rate has decreased slightly from 17.3 isolations per 100,000 people in 2004 to 16.9 in 2005.
- Nunavut has the highest isolation rate with approximately 73.3 isolations per 100,000 people.

***Yersinia*:**

- *Y. enterocolitica* represented the majority (91%) of *Yersinia* identifications in Canada during 2005.
- The national *Yersinia* isolation rate has decreased slightly from 1.9 isolations per 100,000 people in 2004 to 1.7 in 2005.
- Ontario has the highest isolation rate with approximately 2.8 isolations per 100,000 people.

***Vibrio*:**

- *V. paraheamolyticus* represented the majority of *Vibrio* isolations, accounting for 21 of the 41 strains identified in Canada during 2005.
- Two *V. cholerae* O1 (1 serotype Inaba and 1 Ogawa) were identified in Alberta in 2005, both associated with foreign travel.

Major Outbreaks of 2005:

- There were 106 outbreaks and case clusters reported and/or detected in Canada during 2005 involving 1654 cases of illness.
- The largest outbreak of 2005 occurred in Ontario involved 552 illnesses attributed to *Salmonella* Enteritidis PT13 and was linked to the consumption of mung bean sprouts.
- A *Salmonella* Typhimurium PT104 outbreak was linked to a Mother's Day Buffet in Ontario and included 155 illnesses.
- Forty-five illnesses caused by *Campylobacter jejuni* were associated with drinking water at an Alberta youth camp.
- Two *Cyclospora* outbreaks in Ontario and Québec during 2005 caused approximately 244 cases of illness linked to the consumption of fresh basil as an ingredient in various food items.
- Some outbreaks of interest include: 55 illnesses of *S*. Schwarzengrund (7 confirmed cases) associated with a culinary event in Ontario; 4 cases of *E. coli* O157:H7 infection in Ontario from consuming raw milk; 16 cases of *E. coli* O157:H7 infection linked to an ill employee of a restaurant on the Trans-Canada Highway in Alberta; 3 cases of *E. coli* O157:H7 from home-made cheese; and 4 cases from unpasteurized apple cider.
- There were two family associated outbreaks associated with Non-O157 VTEC: one consisting of 3 cases of *E. coli* O26:NM; and another with 5 cases of *E. coli* O121:H19 (ECXAI.1356)
- There were 358 outbreaks attributed to Norovirus (includes SRSV/Calicivirus/Norwalk-like virus) down from 380 recorded in 2004 through the NESP. Institutional (long term care and senior's facilities) outbreaks accounted for 236 (66%) of the outbreaks reported, 38 were reported as hospital outbreaks, 12 were linked to daycare centres, 10 cases were related to food establishments or events, 9 were identified in schools and 45 were from unknown settings.

Introduction

Data presented in this report are based on laboratory-confirmed enteric pathogens isolated from humans, food, animal and the environment. Annual data are received from a variety of sources and the most suitable data are selected and compiled 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 infections in Canada. These data can then be used for risk assessment, to detect and monitor outbreaks or 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 identify increasing or decreasing trends of particular enteric pathogens.

This Annual Summary is a compilation of data from: 1) provincial public health and reference 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.

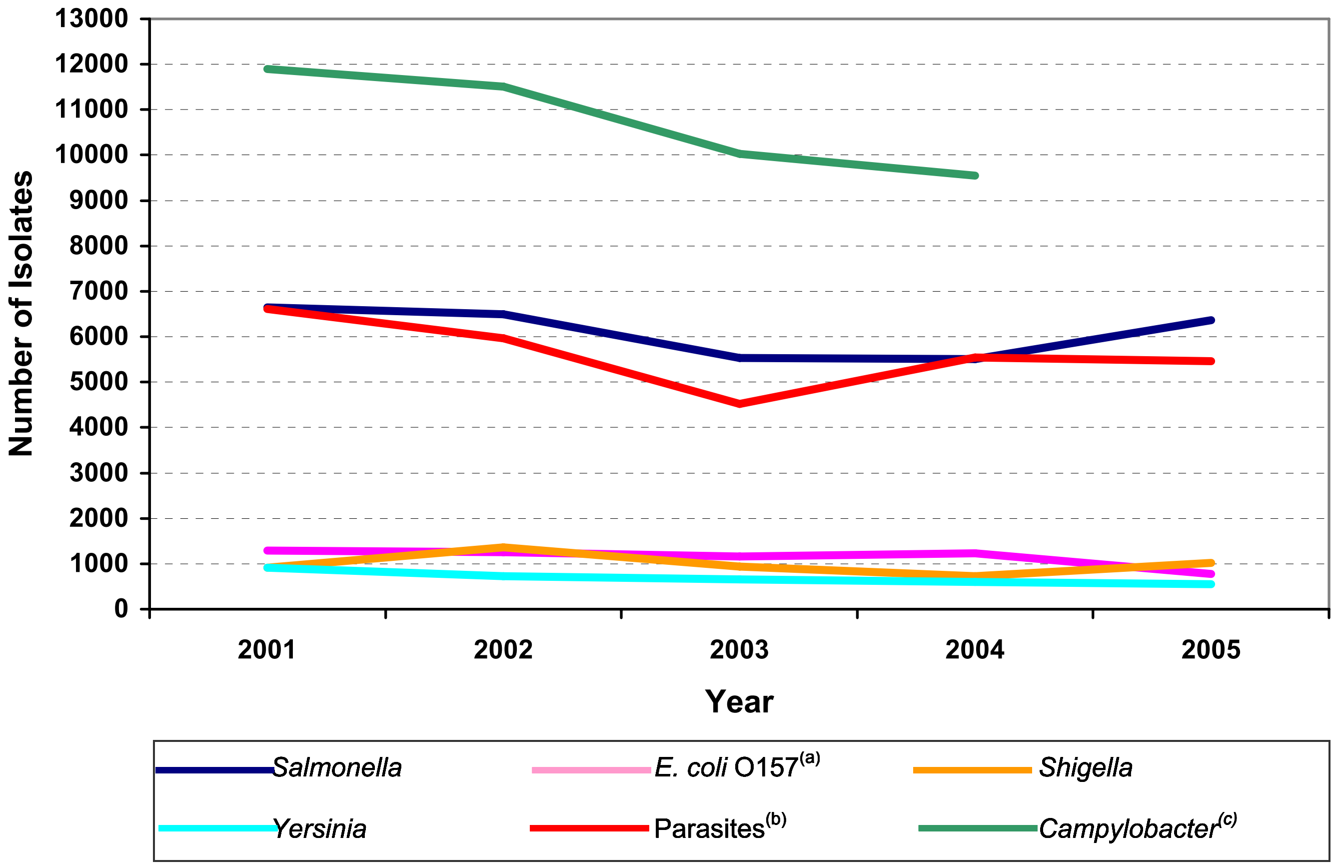
Provincial reports and the NESP database contain summarized and aggregated data in the form of weekly, monthly or annual reports that are forwarded to the NML by the PPHLs. The NESP is a joint project managed by the NML and the Foodborne, Waterborne and Zoonotic Infections Division (FWZID) of the Public Health Agency of Canada (PHAC), in co-operation with PPHLs. The main objective of the NESP is to provide a mechanism for the rapid identification, investigation and management of enteric disease clusters and/or outbreaks, especially those of multi-provincial significance. The NESP is intended to contribute to the timely control and prevention of enteric disease in Canada. Since April 1997, the NESP has been collecting and collating weekly aggregate totals of new identifications on a select group of enteric organisms provided by the PPHLs. PHAC distributes NESP information to PPHLs and other public health and food safety stakeholders via weekly 'NESP News' and data tables, as well as NESP summary reports. The data sets of the LFZ and the NML are acquired through reference services for the confirmation, identification and further characterization of enteric pathogens for the purposes of hazard identification, passive surveillance, and surveys and for support in the containment, prevention and control of outbreaks of enteric disease. The NDRS receives data that are collected on a mandatory basis by local health units on a case-by-case basis and are collated by the Division of Surveillance and Risk Assessment, Centre for Infectious Disease Prevention and Control (CIDPC).

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

SECTION 1: MAJOR ENTERIC PATHOGENS 2005

Figure 1 illustrates the isolation trends of the 6 major enteric pathogen groups from 2001 to 2005. The total number of isolations has declined for all major groups with the exception of *Salmonella* and *Shigella* infections. *Campylobacter* identifications continue to be the most prevalent pathogen in Canada, declining from 10025 isolations in 2003 to 9547 isolates in 2004. After several years of decline, an increase in *Salmonella* isolations has been seen from 5504 in 2004 to 6320 isolations in 2005. This increase can be attributed to a couple very large outbreaks associated with the consumption of contaminated, raw mung bean sprouts. *Shigella* isolations have increased from 732 in 2004 to 1019 isolations in 2005. After remaining at a relatively steady level from 2001 to 2004 the number of *E. coli* O157 identifications isolations has dramatically decreased from 1232 to 778 between 2004 and 2005. Parasitic infections have also marginally decreased in 2005 from 5538 to 5459. *Yersinia* isolations have steadily decreased since 2001 when 912 isolations were reported to 553 isolations in 2005.

Figure 1: Major Enteric Pathogens from Humans in Canada, 2001 to 2005



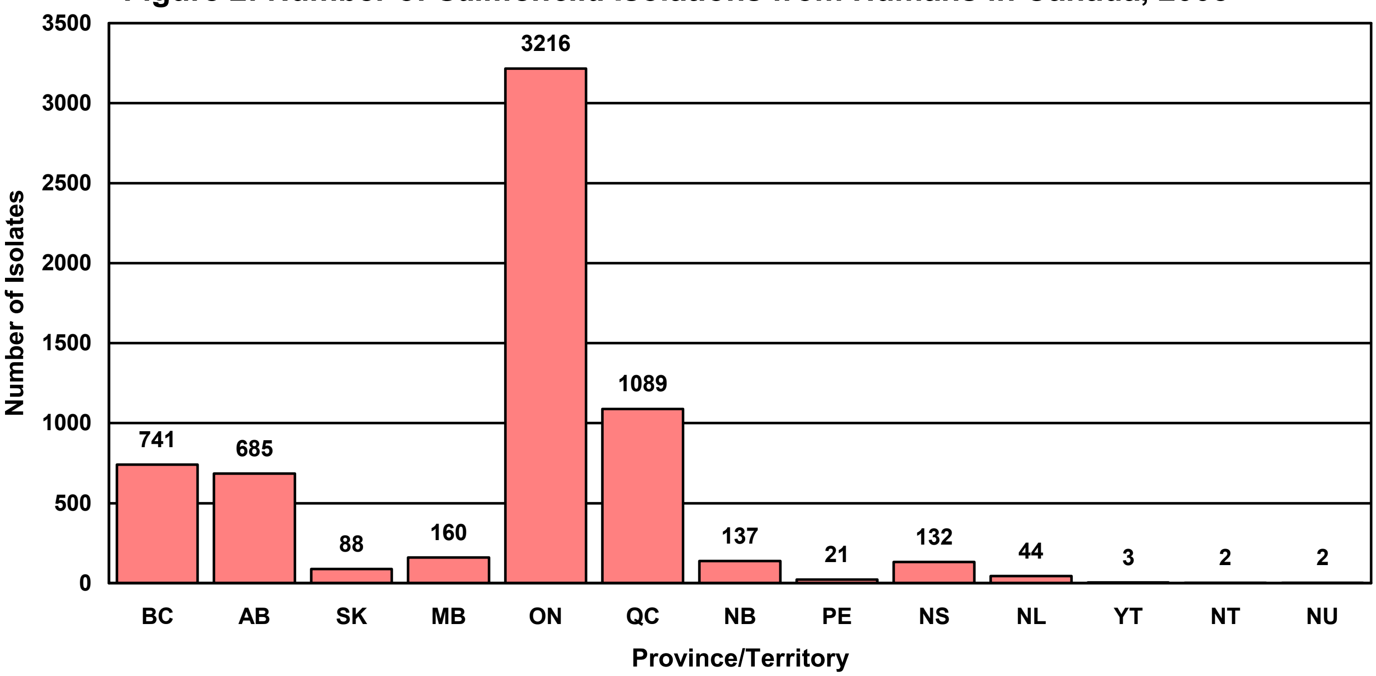
(a) *E. coli* O157 includes *E. coli* O157 VTEC, *E. coli* O157, *E. coli* O157:H7 and *E. coli* O157:NM isolations.
(b) *Entamoeba* is not notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported.
(c) Totals of *Campylobacter* and parasitic infections are largely based on data supplied by the NDRS database whereas the total number of isolations of other organisms relies on NESP data. The collection of total *Campylobacter* infection data for 2005 by NDRS was not complete at time of publication and will be reported in the 2006 Annual Summary.

SECTION 2: *SALMONELLA*

Salmonella from Humans in Canada

The total number of *Salmonella* isolations in 2005 from each province is shown in Figure 2 and population based rates for each province over the years 2001 to 2005 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. Although Quebec ranks 2nd among the provinces for total number of *Salmonella* reported (Figure 2), it ranks 6th overall for the population based isolation rate. After two years of decline, the national isolation rate has edged upward in 2005 to 19.6 isolations per 100,000 people. Isolation rates higher than the national level were seen in Ontario and Alberta with 25.6 and 20.9 isolations per 100,000 people, respectively. Isolation rates have also increased in Québec from 13.4 isolations per 100,000 people in 2004 to 14.3 in 2005, Nova Scotia (12.5 to 14.1), Prince Edward Island (12.3 to 15.2) and Newfoundland (6.4 to 8.6). The largest decreases between 2004 and 2005 occurred in the Northwest Territories where the rate has declined from 9.3 isolations per 100,000 people in 2004 to 4.7 in 2005, New Brunswick (21.0 to 18.2), Manitoba (15.0 to 13.6), Saskatchewan (13.1 to 8.9) and British Columbia (18.2 to 17.4).

Figure 2: Number of *Salmonella* Isolations from Humans in Canada, 2005*



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

Figure 3: Population Based Rates* of *Salmonella* Isolations in Canada, 2001 to 2005

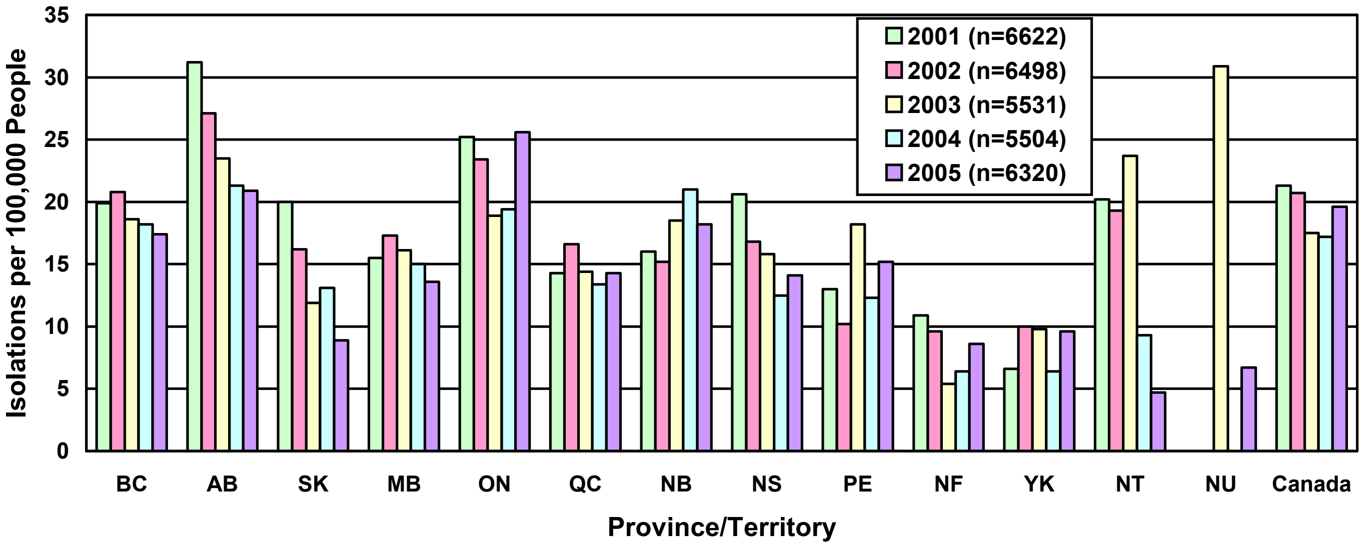


Table 1: Population Based Rates of *Salmonella* Isolations in Canada, 2001 to 2005

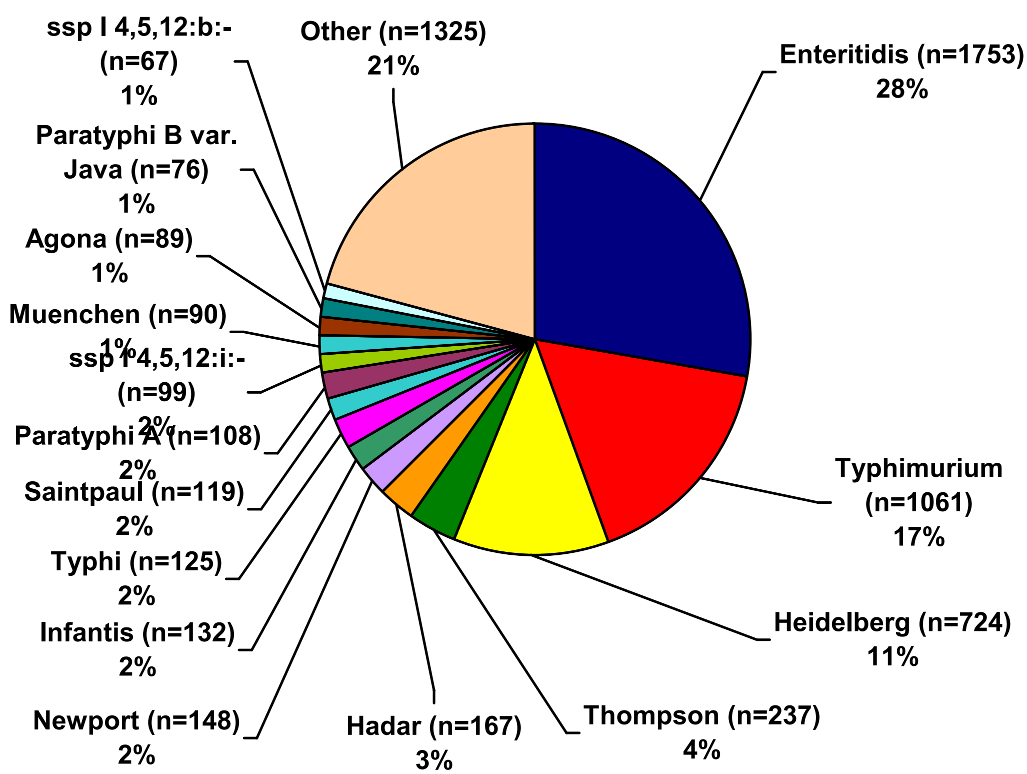
Province/Territory	2001	2002	2003	2004	2005
British Columbia	19.9	20.8	18.6	18.2	17.4
Alberta	31.2	27.1	23.5	21.3	20.9
Saskatchewan	20.0	16.2	11.9	13.1	8.9
Manitoba	15.5	17.3	16.1	15.0	13.6
Ontario	25.2	23.4	18.9	19.4	25.6
Quebec	14.3	16.6	14.4	13.4	14.3
New Brunswick	16.0	15.2	18.5	21.0	18.2
Nova Scotia	20.6	16.8	15.8	12.5	14.1
Prince Edward Island	13.0	10.2	18.2	12.3	15.2
Newfoundland and Labrador	10.9	9.6	5.4	6.4	8.6
Yukon Territories	6.6	10.0	9.8	6.4	9.6
Northwest Territories	20.2	19.3	23.7	9.3	4.7
Nunavut	0.0	90.6*	30.9	0.0	6.7
Canada	**21.3**	**20.7**	**17.5**	**17.2**	**19.6**

*The data point for NU in 2002 of 90.6 was removed from Figure 5 to improve scale. Provincial and Territorial population estimates used to calculate isolation rates are from the Statistics Canada public website.

Salmonella Serovars from Humans in 2005

The relative frequency of isolation of the fifteen most prevalent *Salmonella* serovars from humans in Canada in 2005 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 56% (n=3538) of the 6320 *Salmonella* reported in 2005. *S*. Enteritidis is most prevalent with 28% (n=1753), followed by *S*. Typhimurium with 17% (n=1061) and *S*. Heidelberg with 11% (n=724) of total isolations. *S*. Thompson ranks a distant fourth with 4% (n=237), and *S*. Hadar fifth overall with 3% (n=167). The next most prevalent serovar in 2005 is *S*. Newport (2%, n=148), followed by *S*. Infantis (2%, n=132), *S*. Typhi (2%, n=125), *S*. Saintpaul (2%, n=119), *S*. Paratyphi A (2%, n=108) and *S*. ssp I 4,5,12:i:- as the 11th most prevalent (2%, n=99). Serovars ranking 12th to 15th include, *S*. Muenchen, *S*. Agona, *S*. Paratyphi B var. Java, and *S*. ssp I 4,5,12:b:-, each accounting for 1% of the isolates identified in 2005. Other serovars represent the remaining 21% (n=1325) of the isolates in 2005.

Figure 4: Fifteen Most Prevalent *Salmonella* Serovars from Humans in Canada, 2005* (N=6320)

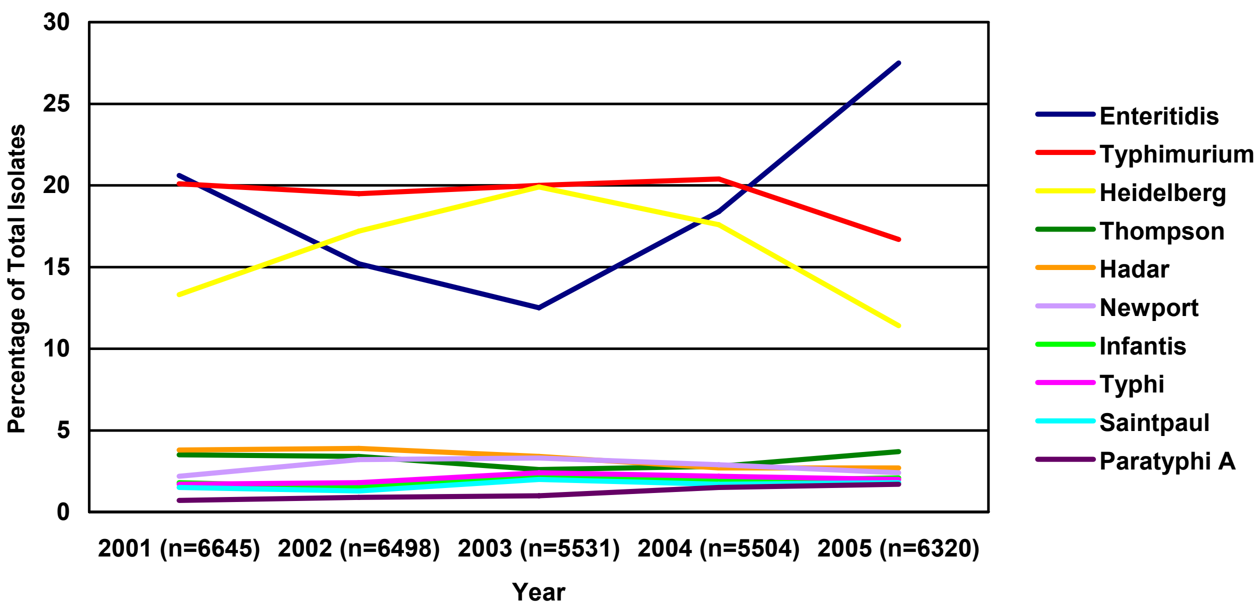


*Serovar totals are laboratory confirmed *Salmonella* based on information supplied to the NESP and supplemented with identifications from NML reference services. Totals include outbreak isolates.

Changes in the Occurrence of *Salmonella* Serovars from Humans in Canada, 2001 to 2005

The relative frequencies of the 10 most prevalent *Salmonella* serovars of human origin from 2001 to 2005 are shown in Figure 5. After a decline in the relative frequency in *S*. Enteritidis isolations from 2001 to 2003, levels have increased dramatically accounting for 12% of *Salmonella* identifications in 2003 to 27% in 2005, surpassing *S*. Heidelberg and S. Typhimurium as most the prevalent serovar. *S*. Typhimurium isolations had remained relatively constant at approximately 20% between 2001 and 2004, but have declined to 17% in 2005. The proportion of *Salmonella* isolates identified as *S*. Heidelberg in 2005 has also decreased from a high of 20% in 2003 to 17% in 2004 and then to 11% in 2005. These 3 serovars form a group that has consistently been elevated above the other top ten serovars over the previous 5 years. Serovars that make up the other seven most prevalent serovars each represent less than 5% of all *Salmonella* isolated and frequencies of isolation remain relatively constant from year to year.

Figure 5: Trends of the Prevalent *Salmonella* Serovars Isolated from Humans in Canada, 2001 to 2005*

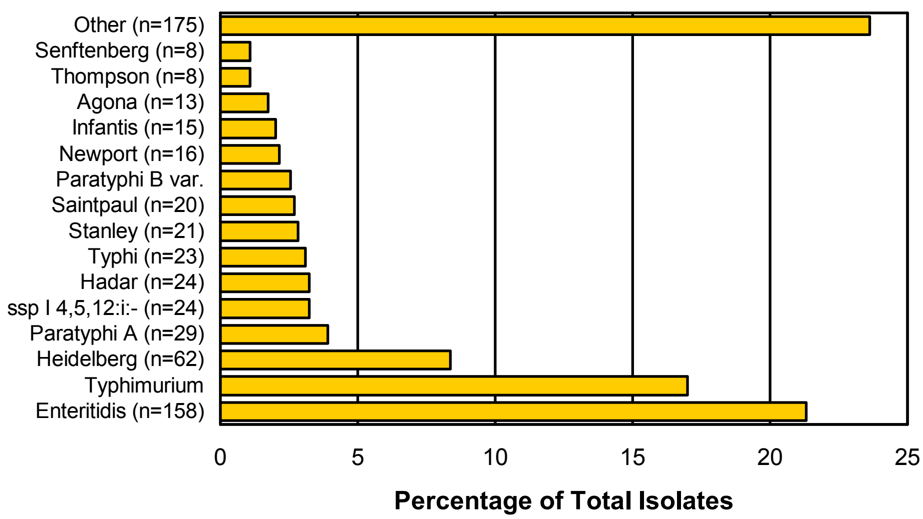


Most Prevalent Human *Salmonella* Serovars in Each Province

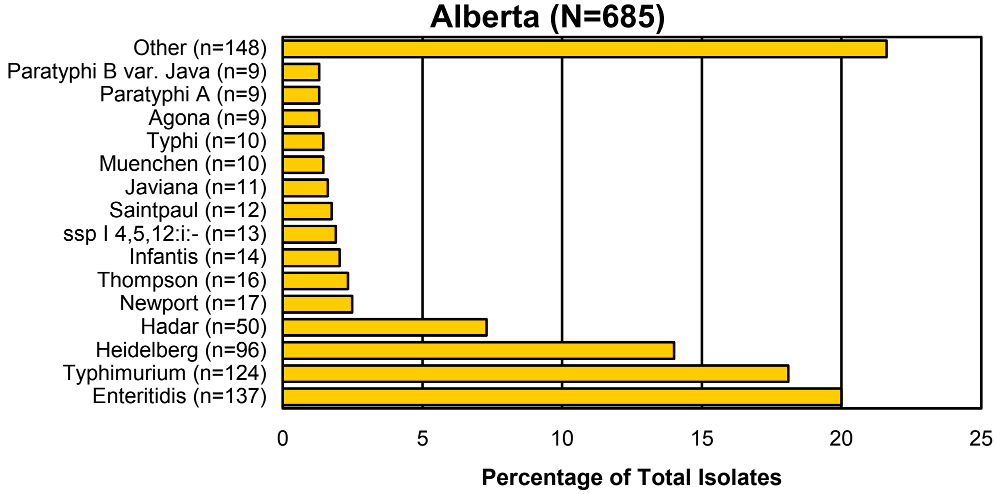
The fifteen most prevalent human *Salmonella* serovars isolated for each province/territory is illustrated in Figure 6. *S*. Enteritidis is the most prevalent serovar in all provinces except Saskatchewan and Manitoba. Prince Edward Island has the highest proportion of *Salmonella* identified as *S*. Enteritidis (58%, n=12), followed by Nova Scotia (41%, n=54), Ontario (34%, n=1097), New Brunswick (23%, n=31), British Columbia (22%, n=158), Québec (21%, n=223), Alberta (20%, n=137) and Newfoundland and Labrador (18%, n=8). *S*. Enteritidis is tied for the second most prevalent serovar in Saskatchewan representing 13% (n=11) of the *Salmonella* identified in that province and ranked third in prevalence in Manitoba with 13% (n=21) of the strains. *S*. Heidelberg is the most prevalent serovar in Saskatchewan with 19% (n=17), and the second most prevalent serovar in Manitoba (19%, n=30), Quebec (18%, n=197), New Brunswick (18%, n=25), Nova Scotia (12%, n=16) and Prince Edward Island (9%, n=2). *S*. Typhimurium was the most prevalent serovar in Manitoba representing 27% of the strains (n=44).

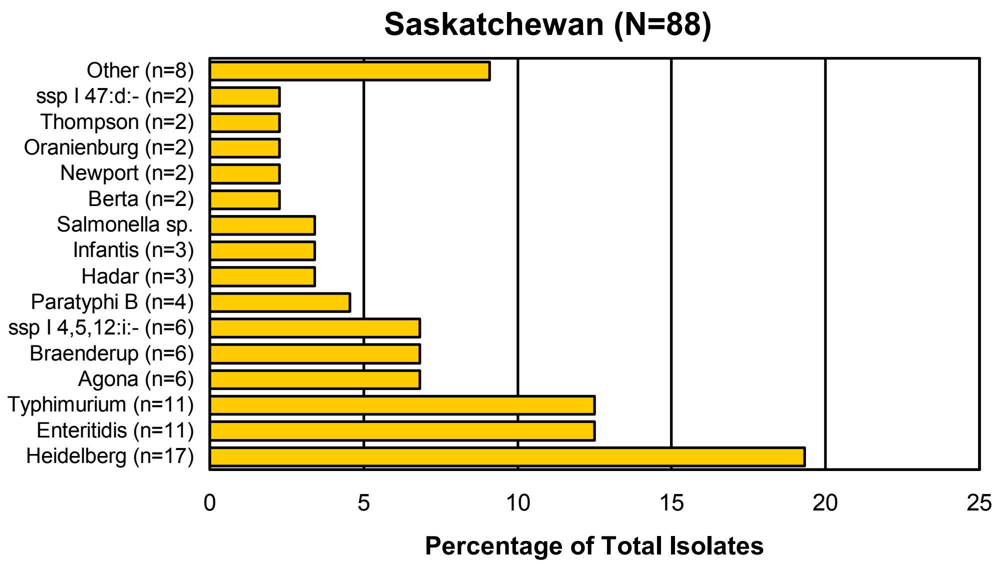
Figure 6: Fifteen Most Prevalent *Salmonella* Serovars from Humans in Each Province/Territory in 2005

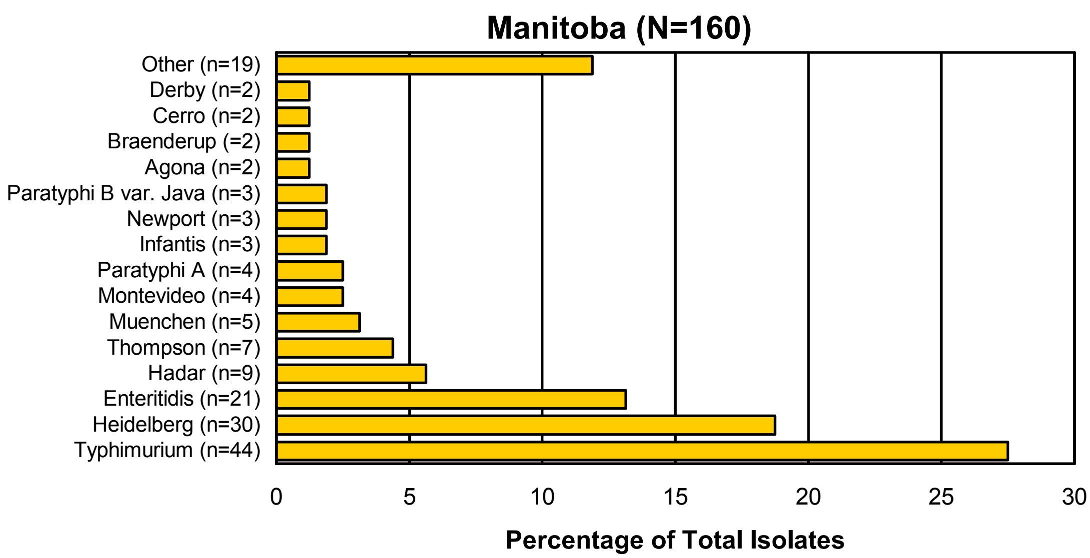
British Columbia (N=741)

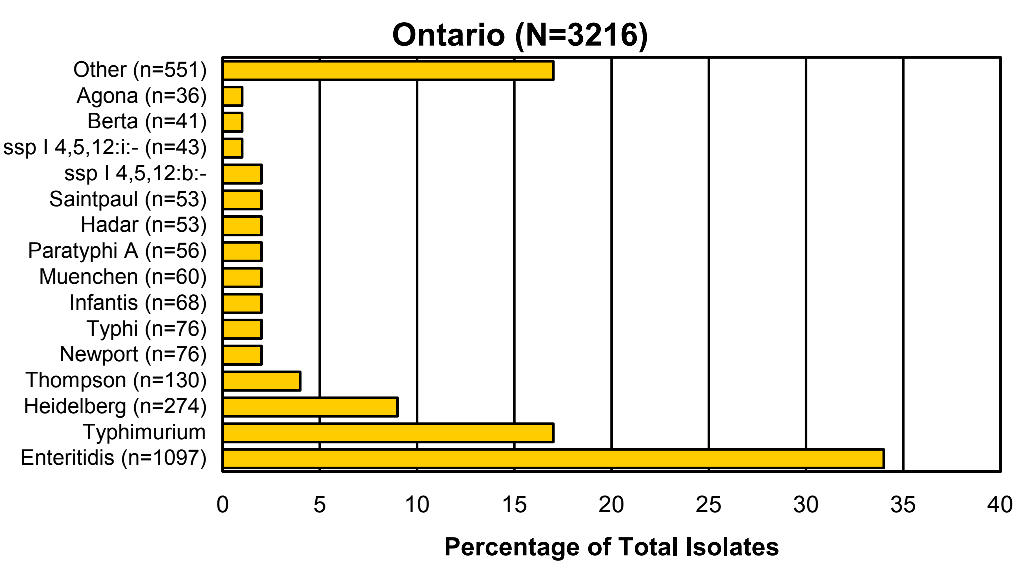


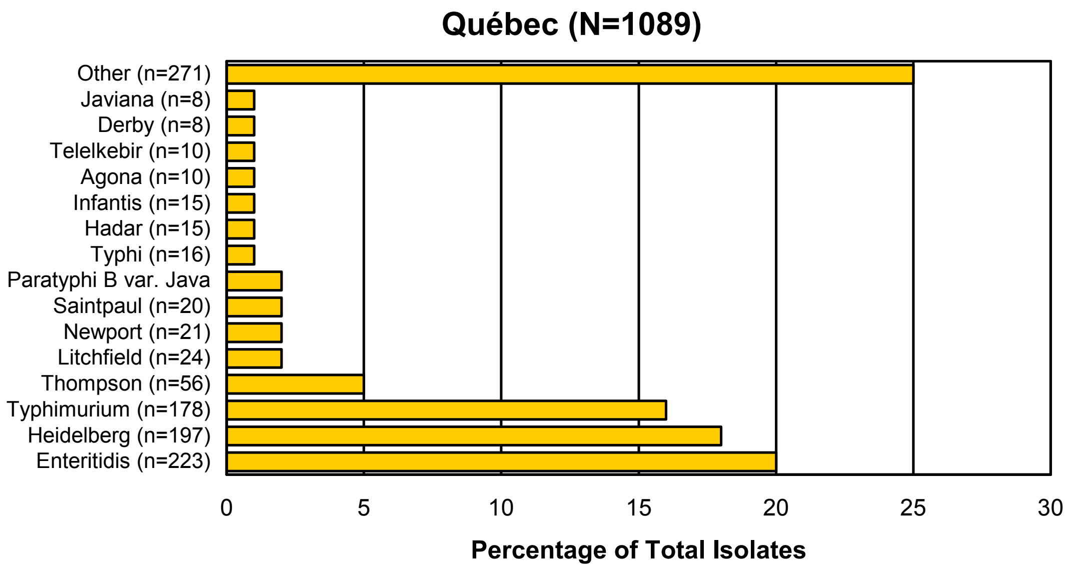
Alberta (N=685)

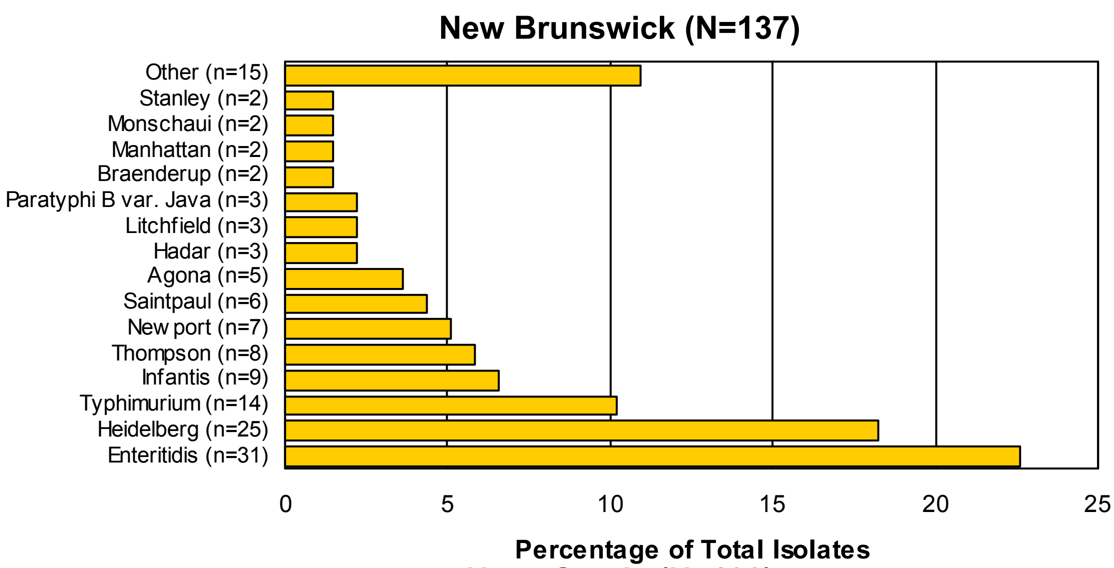


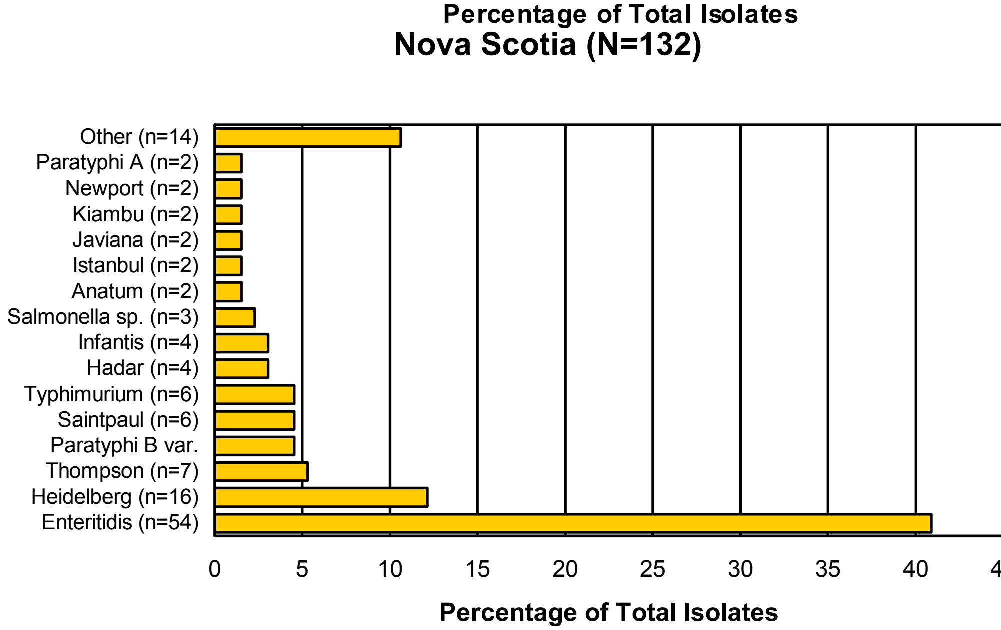

Saskatchewan (N=88)
Other (n=8)
ssp I 47:d:- (n=2)
Thompson (n=2)
Oranienburg (n=2)
Newport (n=2)
Berta (n=2)
Salmonella sp.
Infantis (n=3)
Hadar (n=3)
Paratyphi B (n=4)
ssp I 4,5,12:i:- (n=6)
Braenderup (n=6)
Agona (n=6)
Typhimurium (n=11)
Enteritidis (n=11)
Heidelberg (n=17)
0
5
10
15
20
25
Percentage of Total Isolates

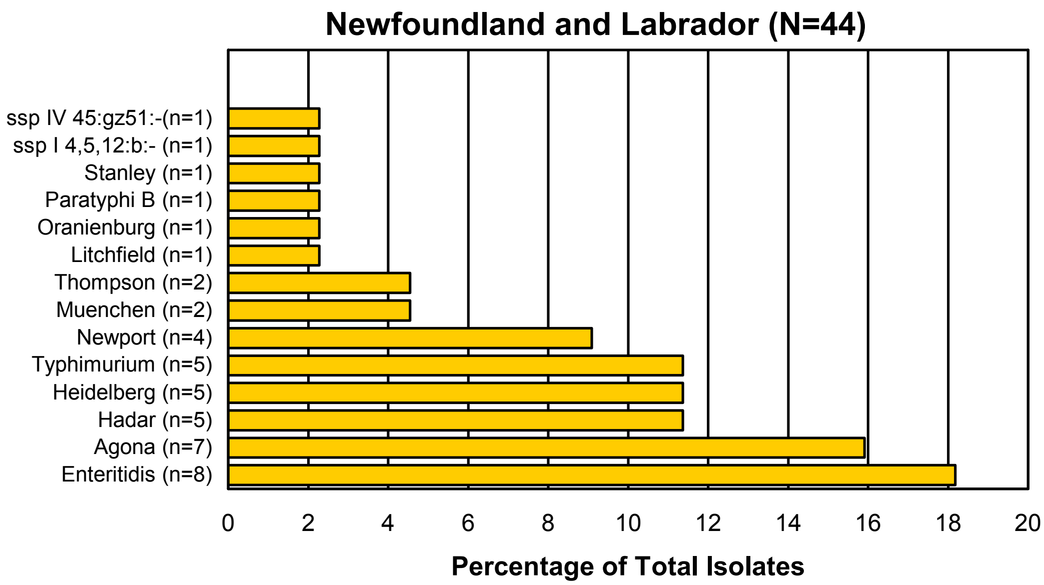

Manitoba (N=160)
Other (n=19)
Derby (n=2)
Cerro (n=2)
Braenderup (=2)
Agona (n=2)
Paratyphi B var. Java (n=3)
Newport (n=3)
Infantis (n=3)
Paratyphi A (n=4)
Montevideo (n=4)
Muenchen (n=5)
Thompson (n=7)
Hadar (n=9)
Enteritidis (n=21)
Heidelberg (n=30)
Typhimurium (n=44)
0
5
10
15
20
25
30
Percentage of Total Isolates

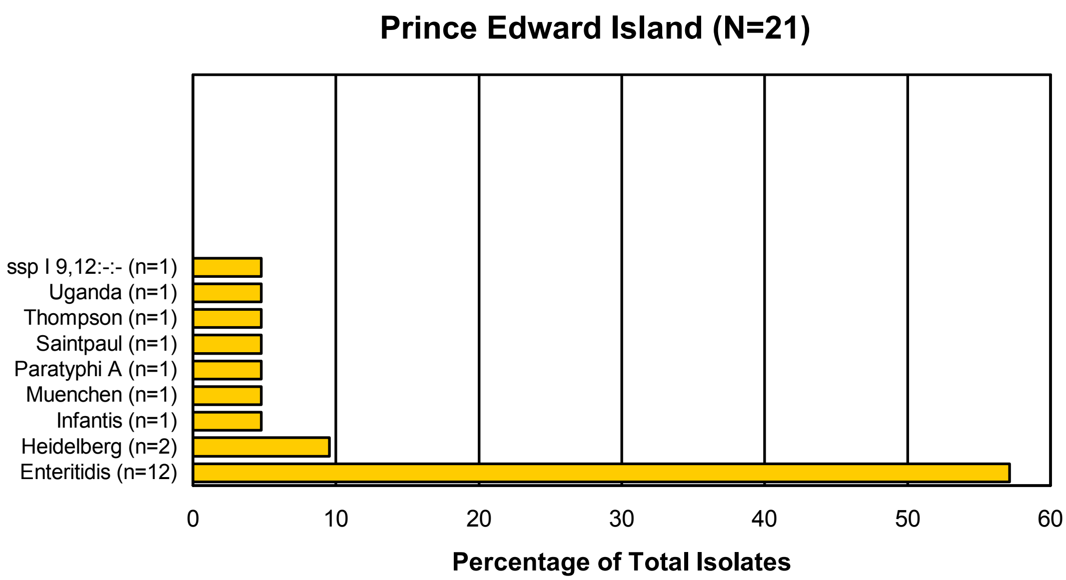

Ontario (N=3216)
Other (n=551)
Agona (n=36)
Berta (n=41)
ssp I 4,5,12:i:- (n=43)
ssp I 4,5,12:b:-
Saintpaul (n=53)
Hadar (n=53)
Paratyphi A (n=56)
Muenchen (n=60)
Infantis (n=68)
Typhi (n=76)
Newport (n=76)
Thompson (n=130)
Heidelberg (n=274)
Typhimurium
Enteritidis (n=1097)
0
5
10
15
20
25
30
35
40
Percentage of Total Isolates


Québec (N=1089)
Other (n=271)
Javiana (n=8)
Derby (n=8)
Telelkebir (n=10)
Agona (n=10)
Infantis (n=15)
Hadar (n=15)
Typhi (n=16)
Paratyphi B var. Java
Saintpaul (n=20)
Newport (n=21)
Litchfield (n=24)
Thompson (n=56)
Typhimurium (n=178)
Heidelberg (n=197)
Enteritidis (n=223)
0 5 10 15 20 25 30
Percentage of Total Isolates


New Brunswick (N=137)
Other (n=15)
Stanley (n=2)
Monschaui (n=2)
Manhattan (n=2)
Braenderup (n=2)
Paratyphi B var. Java (n=3)
Litchfield (n=3)
Hadar (n=3)
Agona (n=5)
Saintpaul (n=6)
New port (n=7)
Thompson (n=8)
Infantis (n=9)
Typhimurium (n=14)
Heidelberg (n=25)
Enteritidis (n=31)
0 5 10 15 20 25
Percentage of Total Isolates


Nova Scotia (N=132)
Other (n=14)
Paratyphi A (n=2)
Newport (n=2)
Kiambu (n=2)
Javiana (n=2)
Istanbul (n=2)
Anatum (n=2)
Salmonella sp. (n=3)
Infantis (n=4)
Hadar (n=4)
Typhimurium (n=6)
Saintpaul (n=6)
Paratyphi B var.
Thompson (n=7)
Heidelberg (n=16)
Enteritidis (n=54)
0 5 10 15 20 25 30 35 40 45
Percentage of Total Isolates


Newfoundland and Labrador (N=44)
ssp IV 45:gz51:-(n=1)
ssp I 4,5,12:b:- (n=1)
Stanley (n=1)
Paratyphi B (n=1)
Oranienburg (n=1)
Litchfield (n=1)
Thompson (n=2)
Muenchen (n=2)
Newport (n=4)
Typhimurium (n=5)
Heidelberg (n=5)
Hadar (n=5)
Agona (n=7)
Enteritidis (n=8)
0
2
4
6
8
10
12
14
16
18
20
Percentage of Total Isolates


Prince Edward Island (N=21)
ssp I 9,12:-:- (n=1)
Uganda (n=1)
Thompson (n=1)
Saintpaul (n=1)
Paratyphi A (n=1)
Muenchen (n=1)
Infantis (n=1)
Heidelberg (n=2)
Enteritidis (n=12)
0
10
20
30
40
50
60
Percentage of Total Isolates

Changes in the Occurrence of *Salmonella* Serovars from Humans in each Province/Territory, 2001 to 2005

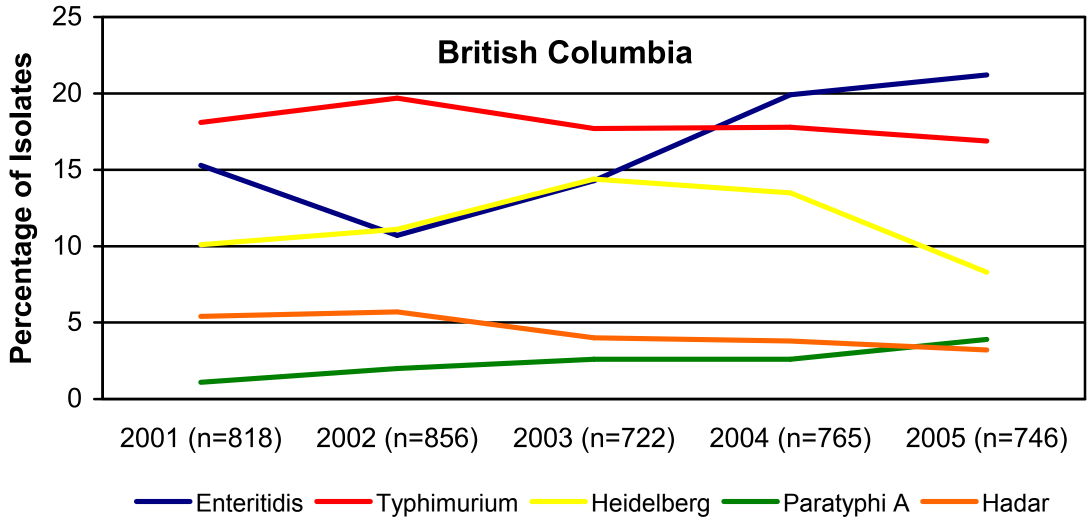
Figure 7 illustrates the variation of the five most prevalent serovars of each province/territory between 2001 and 2005. Data for previous years is taken from previous annual summaries and is based on information supplied to the NESP and supplemented with identifications by NML reference services. Data 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 chronic source of infection.

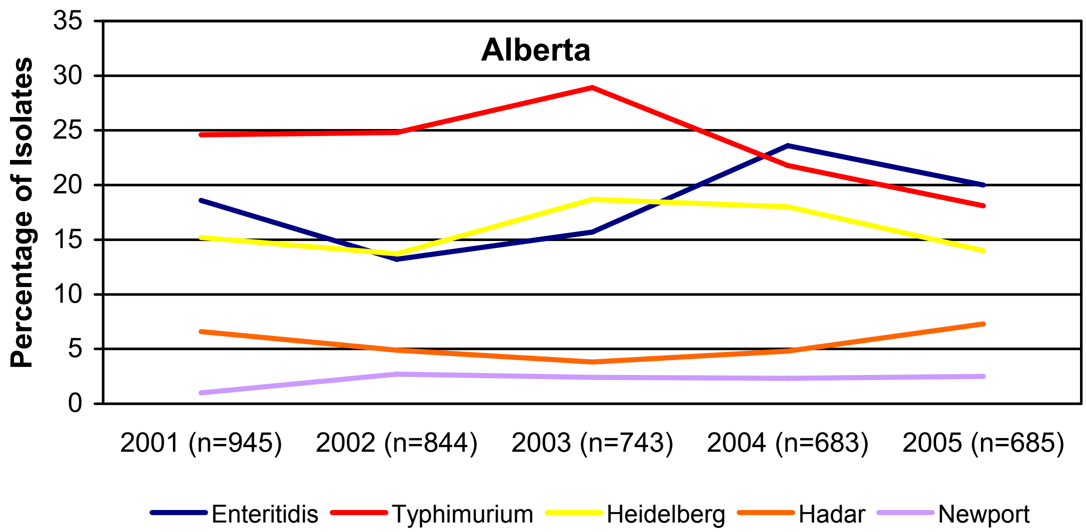
There has been an overall general increase in *S*. Enteritidis identifications in all provinces over the previous few years. *S*. Enteritidis isolations in Ontario have increased from accounting for 14% of all *Salmonella* in 2003 to 34% in 2005. Large increases have also been noted in British Columbia from a 5-year low of 11% in 2002 to 21% in 2005, in Nova Scotia from 7% in 2003 to 41% in 2005, and in Prince Edward Island increasing from 11% in 2003 to 58% in 2005. A general increasing trend in *S*. Enteritidis isolations has also been observed in Saskatchewan, Alberta, Québec, New Brunswick, and Newfoundland and Labrador. Only in Manitoba have the isolations remained at a relatively constant rate over the previous 5-year period at approximately 13%.

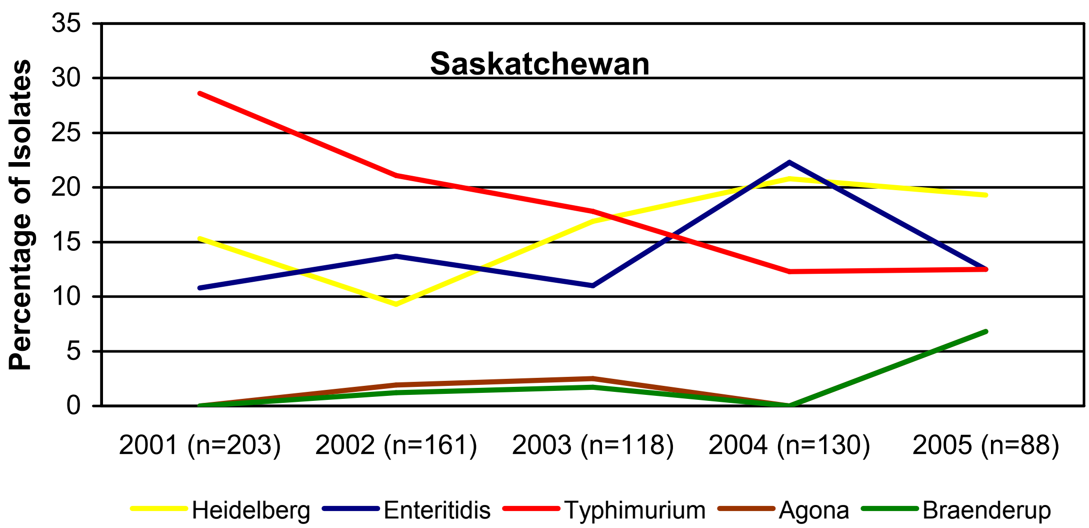
Saskatchewan is the only province showing a marked increase in the proportion of *S*. Heidelberg isolations over the 5 year period, increasing from a low of 9% in 2002 to accounting for 19% of all *Salmonella* in 2005. The proportion of *S*. Heidelberg has declined in most provinces, with the largest declines observed in Québec where levels have declined from a high of 29% in 2003 to 14% in 2005. Other large declines have been seen in New Brunswick from 41% in 2003 to 18% in 2005, British Columbia from 14% in 2003 to 7% in 2005, and in Ontario from 16% in 2003 to 8% in 2005. *S*. Heidelberg isolations levels have remained relatively constant over the 5-year period in Alberta (approx. 15%), Manitoba (20%), Nova Scotia (11%), and Prince Edward Island (10%).

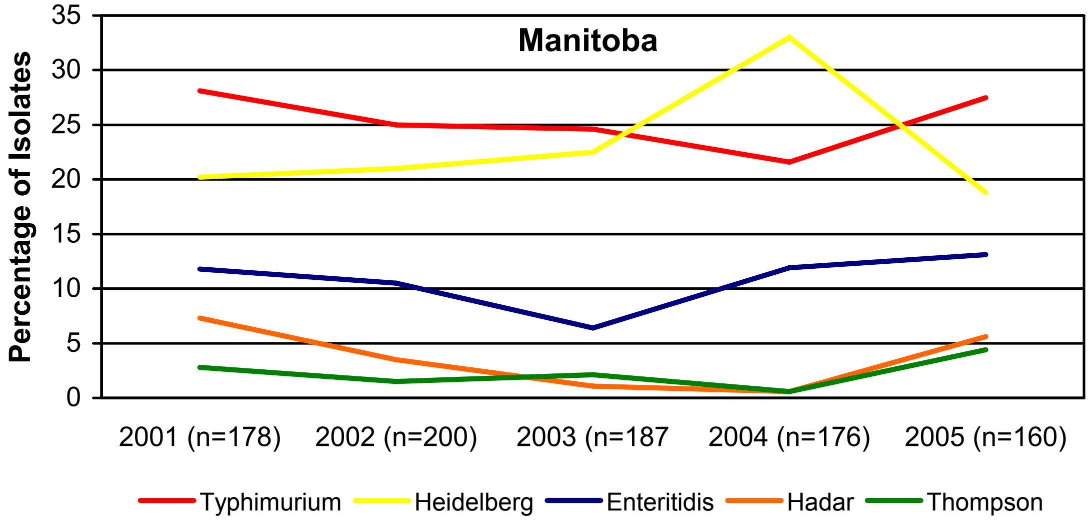
Other increases of note over the 5 year period include *S*. Paratyphi A in British Columbia, *S*. Braenderup in Saskatchewan, *S*. Litchefield in Québec, *S*. Saintpaul in Nova Scotia and *S*. Agona in Newfoundland and Labrador.

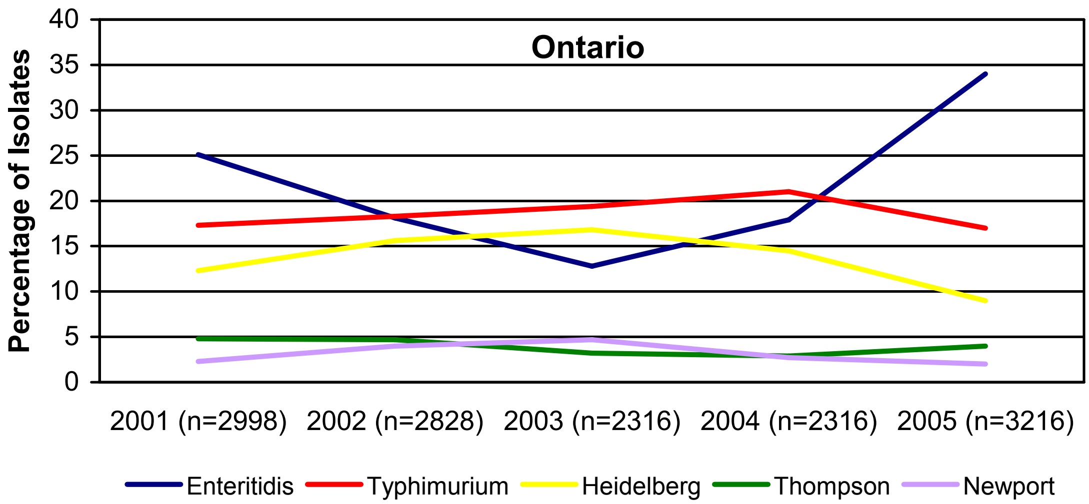
Figure 7: Provincial/Territorial Trends of the Prevalent *Salmonella* Serovars from Humans, 2001 to 2005

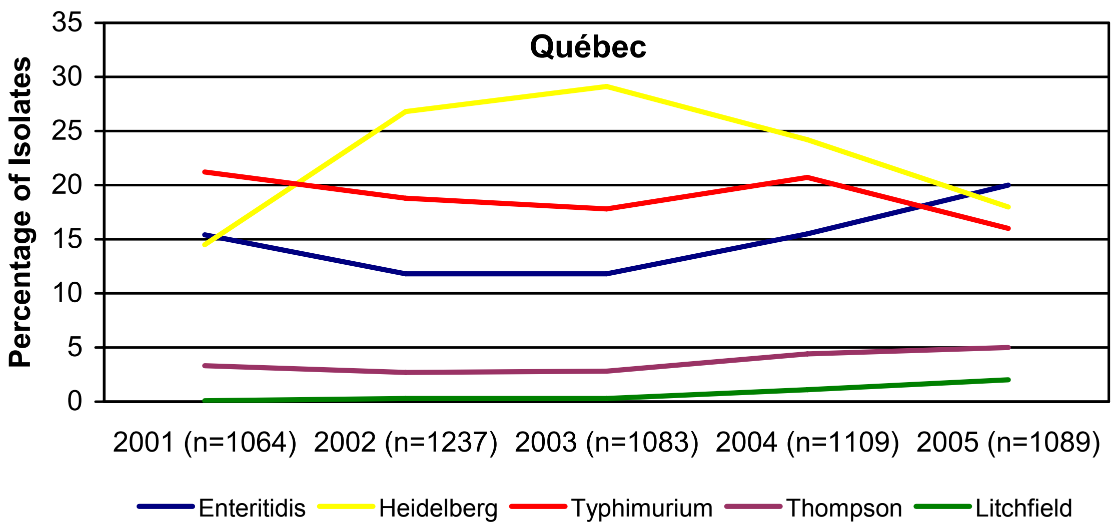


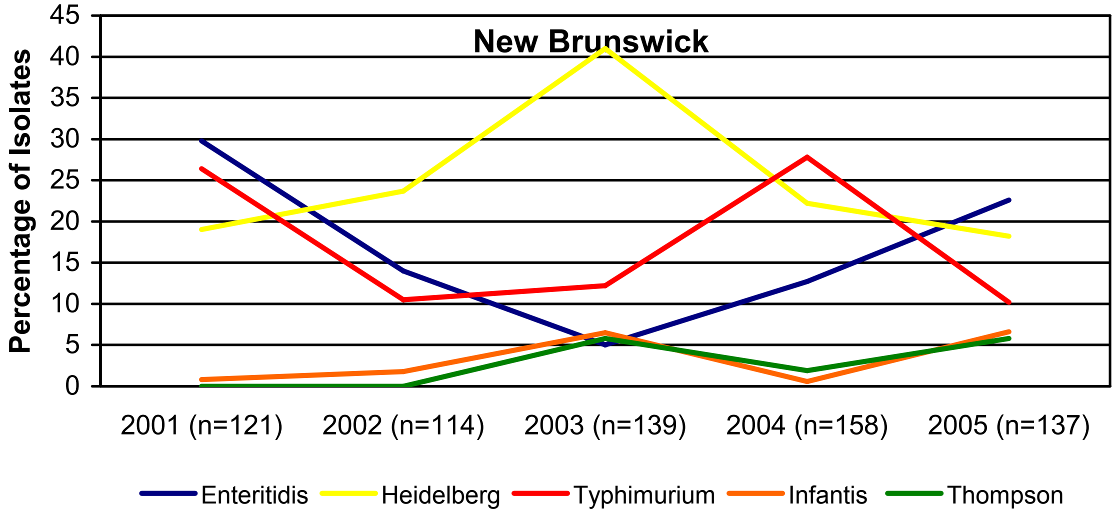


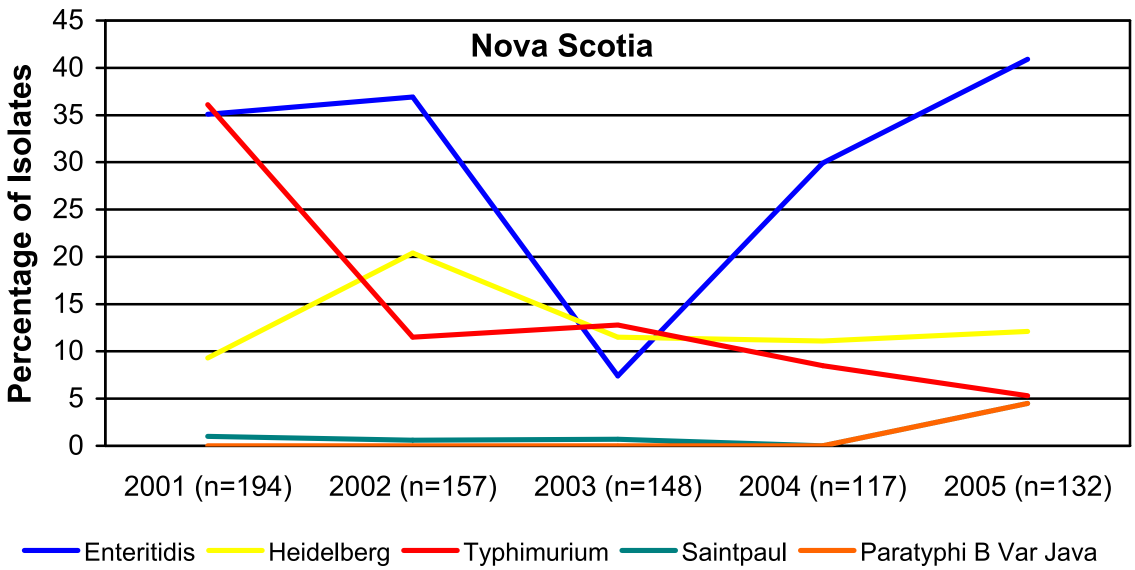


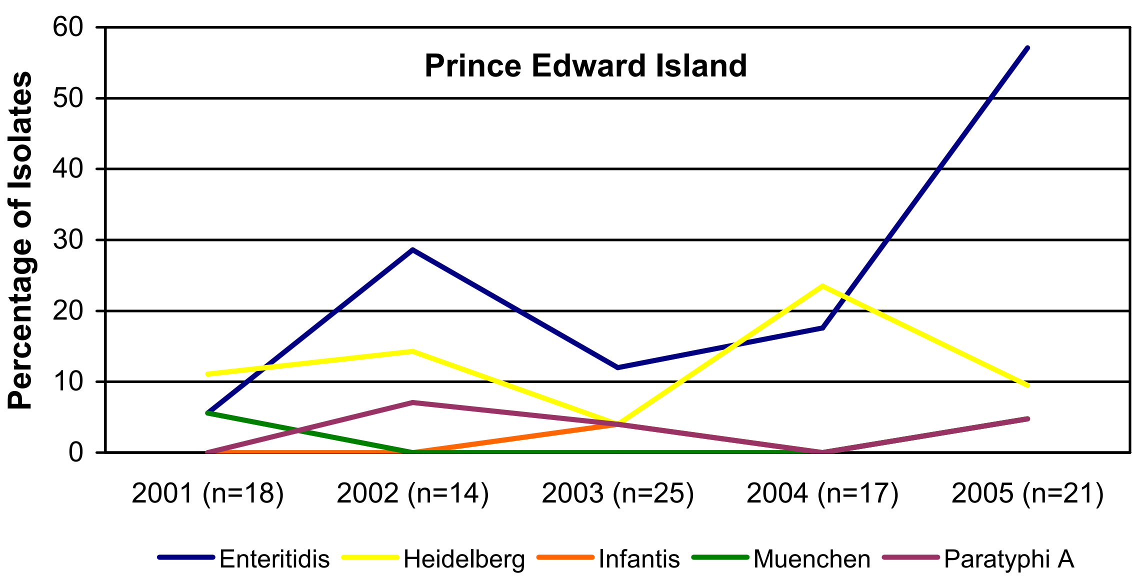

Manitoba
Percentage of Isolates
0
5
10
15
20
25
30
35
2001 (n=178)
2002 (n=200)
2003 (n=187
2004 (n=176)
2005 (n=160)
Typhimurium
Heidelberg
Enteritidis
Hadar
Thompson


Ontario
Percentage of Isolates
0
5
10
15
20
25
30
35
40
2001 (n=2998)
2002 (n=2828)
2003 (n=2316)
2004 (n=2316)
2005 (n=3216)
Enteritidis
Typhimurium
Heidelberg
Thompson
Newport


Québec
Percentage of Isolates
0
5
10
15
20
25
30
35
2001 (n=1064)
2002 (n=1237)
2003 (n=1083)
2004 (n=1109)
2005 (n=1089)
Enteritidis
Heidelberg
Typhimurium
Thompson
Litchfield


New Brunswick
Percentage of Isolates
45
40
35
30
25
20
15
10
5
0
2001 (n=121)
2002 (n=114)
2003 (n=139)
2004 (n=158)
2005 (n=137)
Enteritidis
Heidelberg
Typhimurium
Infantis
Thompson


Nova Scotia
Percentage of Isolates
45
40
35
30
25
20
15
10
5
0
2001 (n=194)
2002 (n=157)
2003 (n=148)
2004 (n=117)
2005 (n=132)
Enteritidis
Heidelberg
Typhimurium
Saintpaul
Paratyphi B Var Java


Prince Edward Island
Percentage of Isolates
60
50
40
30
20
10
0
2001 (n=18)
2002 (n=14)
2003 (n=25)
2004 (n=17)
2005 (n=21)
Enteritidis
Heidelberg
Infantis
Muenchen
Paratyphi A

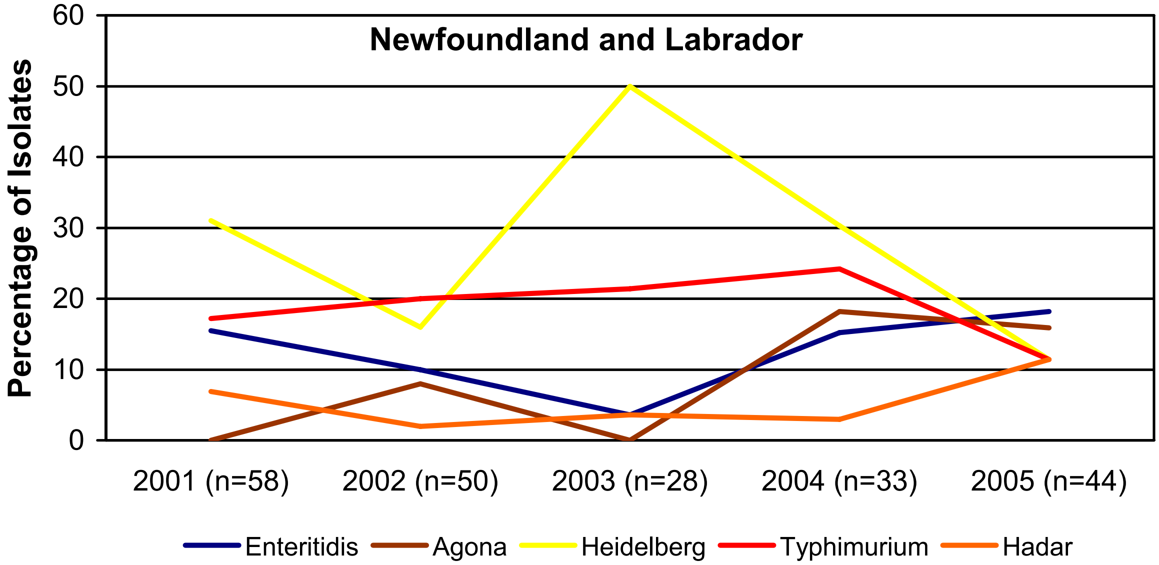

Newfoundland and Labrador
Percentage of Isolates
60
50
40
30
20
10
0
2001 (n=58)
2002 (n=50)
2003 (n=28)
2004 (n=33)
2005 (n=44)
Enteritidis
Agona
Heidelberg
Typhimurium
Hadar

Table 2: *Salmonella* Serovars from Humans in Canada in 2005

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	TOT
S. Aberdeen	2	4			2									**8**
S. Abortusequi	1													**1**
S. Adelaide	1													**1**
S. Agona	13	9	6	2	36	10	5		1	7				**89**
S. Agoueve					2									**2**
S. Ahmadi	1													**1**
S. Ajiobo	1													**1**
S. Alachua	2				1	1								**4**
S. Albany	1				4	1								**6**
S. Altona		1												**1**
S. Amager				1										**1**
S. Amsterdam						1								**1**
S. Anatum	6	1			11	2			2					**22**
S. Apapa					1	2								**3**
S. Arechavaleta	1													**1**
S. Bahati		1												**1**
S. Baildon					1									**1**
S. Banana						1								**1**
S. Bardo		3												**3**
S. Bareilly	6	1			3									**10**
S. Barranquilla				1										**1**
S. Berta	1		2	1	41	1			1					**47**
S. Birkenhead		1												**1**
S. Blockley	4	1			1	1								**7**
S. Bochum				1										**1**
S. Bonariensis					3									**3**
S. Bouake					2									**2**
S. Bovismorbificans		1			3									**4**
S. Braenderup	4	4	6	2	24	5	2		1					**48**
S. Brandenburg	1	4			6	7	1							**19**
S. Bredeney	1	2			2	1								**6**
S. Butantan					2									**2**
S. Carrau		1												**1**
S. Cerro				2	2									**4**
S. Chailey					1									**1**
S. Chester	3	5			2									**10**
S. Choleraesuis	2				1	1								**4**
S. Colindale						2								**2**
S. Corvallis	3	4			1	2								**10**
S. Cubana	1	1												**2**
S. Daytona	4	1												**5**
S. Denver		1												**1**
S. Derby	5	3		2	21	8								**39**
S. Dublin	2	1			2	1								**6**
S. Dugbe						1								**1**
S. Durban						1								**1**
S. Durham	1													**1**
S. Ealing		1			3									**4**
S. Eastbourne	1				3	2								**6**
S. Ebrie		2												**2**
S. Eko	1													**1**
S. Emek			1		3	1								**5**
S. Enteritidis	158	137	11	21	1097	223	31	12	54	8			1	**1753**
S. Farmsen		1												**1**
S. Fluntern					1									**1**
S. Galiema					1									**1**
S. Gaminara					1									**1**
S. Garba						1								**1**
S. Give	4	3			2	1								**10**
S. Glostrup					1									**1**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	TOT
S. Haardt		1												**1**
S. Hadar	24	50	3	9	53	15	3		4	5			1	**167**
S. Haifa	2	2			1	1								**6**
S. Hartford	3				16									**19**
S. Havana	2				3	1								**6**
S. Heidelberg	62	96	17	30	274	197	25	2	16	5				**724**
S. Hull		1			1									**2**
S. Hvittingfoss	3	2		1	1	1								**8**
S. Ibadan						1								**1**
S. Idikan			1	1										**2**
S. Indiana	2	1			10	1								**14**
S. Infantis	15	14	3	3	68	15	9	1	4					**132**
S. Inverness		1			3									**4**
S. Istanbul	1	1			3				2					**7**
S. Javiana	6	11	1		19	8	1		2					**48**
S. Kedougou					1									**1**
S. Kentucky	2				7	4								**13**
S. Kiambu	1	1			28	2			2					**34**
S. Kingston	1	1												**2**
S. Larochelle						1	1							**2**
S. Lexington					1									**1**
S. Litchfield	1				20	24	3			1				**49**
S. Liverpool					1									**1**
S. Livingstone					5									**5**
S. Lomalinda		1									1			**2**
S. London	1				4	1								**6**
S. Manhattan	2			1	5	1	2							**11**
S. Mbandaka	6	3			9	3								**21**
S. Meleagridis	1													**1**
S. Memphis					1									**1**
S. Miami					2	2								**4**
S. Mikawasima		1												**1**
S. Minnesota	1													**1**
S. Mississippi	1				3									**4**
S. Mkamba		1												**1**
S. Monschaui						1	2							**3**
S. Montevideo	4	5	1	4	22	7	1				1			**45**
S. Muenchen	5	10		5	60	7		1		2				**90**
S. Muenster	2	1			15	2								**20**
S. Naestved	1													**1**
S. Napoli		1												**1**
S. Newport	16	17	2	3	76	21	7		2	4				**148**
S. Nima		1		1	1									**3**
S. Nottingham						1								**1**
S. Offa					1									**1**
S. Ohio	2	2			5									**9**
S. Oranienburg	8	2	2		27	8			1	1				**49**
S. Orion					2									**2**
S. Oslo	1	2												**3**
S. Panama	2	4			17	6								**29**
S. Paratyphi A	29	9		4	56	6	1	1	2					**108**
S. Paratyphi B	3		4		3					1				**11**
S. Paratyphi B var. Java	19	9		3	19	17	3		6					**76**
S. Pomona	4				7	2								**13**
S. Poona	1	3			3	2	1							**10**
S. Potsdam	1													**1**
S. Praha					1									**1**
S. Putten						1								**1**
S. Reading						2								**2**
S. Richmond	2				2									**4**
S. Rissen	2				2				2					**6**
S. Rubislaw		1			1									**2**
S. Ruiru						1								**1**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	TOT
S. Saintpaul	20	12		1	53	20	6	1	6					**119**
S. Sandiego	3	4			7	2								**16**
S. Schwarzengrund	2	1		2	26	4								**35**
S. Sendai					2									**2**
S. Senftenberg	8	2		1	4									**15**
S. Singapore					1									**1**
S. Stanley	21	4			32	2	2		1	1				**63**
S. Tambacounda	1													**1**
S. Telelkebir	1				3	10								**14**
S. Tennessee	1	1			7									**9**
S. Thompson	8	16	2	7	130	56	8	1	7	2				**237**
S. Typhi	23	10			76	16								**125**
S. Typhimurium	126	124	11	44	551	178	14		6	5	1	1		**1061**
S. Uganda	3	7		1	10	1		1						**23**
S. Urbana		1	1		1	1	1		1					**6**
S. Vejle	1													**1**
S. Virchow	6	6	1		21	7			1					**42**
S. Wangata						1								**1**
S. Weltevreden	2	2			8									**12**
S. Worthington	1	1			1									**3**
Salmonella sp.			3	1	0	123	0		3	0		1		**131**
Salmonella ssp I 4,12:-:-			0		2		1							**3**
Salmonella ssp I 4,12:-:1,2						1								**1**
Salmonella ssp I 4,5,12:-:-		6	0		5	1	1		1					**14**
Salmonella ssp I 4,12:b:-		1												**1**
Salmonella ssp I 4,5,12:b:-	5	3		1	51	6				1				**67**
Salmonella ssp I 4,5,12:e,h:-					1	1								**2**
Salmonella ssp I 4,12:i:-	6	2		1			1							**10**
Salmonella ssp I 4,5,12:i:-	24	13	6	2	43	8	1		2					**99**
Salmonella ssp I 6,7:-:-					1									**1**
Salmonella ssp I 6,7:d:-					1									**1**
Salmonella ssp I 6,7:-:1,5				1										**1**
Salmonella ssp I 6,7:r:-					1	1								**2**
Salmonella ssp I 6,7:z29:-						1								**1**
Salmonella ssp I 9,12:-:-					3	1	1	1						**6**
Salmonella ssp I 9,12:-:1,5	2					1								**3**
Salmonella ssp I 9,12:l,z13,z28:-	1													**1**
Salmonella ssp I 3,10:r:-					1									**1**
Salmonella spp I 28:d:z6					1									**1**
Salmonella ssp I 13,23:b:-					1									**1**
Salmonella ssp I 30:-:-						1								**1**
Salmonella ssp I 35:-:-					1									**1**
Salmonella ssp I 47:d:-			2											**2**
Salmonella ssp I Rough-O:-:-		1	1		4	1	1							**8**
Salmonella ssp I Rough-O:e,h:1,2						1								**1**
Salmonella ssp I Rough-O:g,m:-					1									**1**
Salmonella ssp I Rough-O:g,m,s:-					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:m,t:-	1						1							**2**
Salmonella ssp I Rough-O:r:-					1									**1**
Salmonella ssp II 13,23:g,t:-					1									**1**
Salmonella ssp II 48:d:z6					1									**1**
Salmonella ssp II 50:b:z6					1									**1**
Salmonella ssp II 58:c:z6		1												**1**
Salmonella ssp II 9,46:z:z39			1											**1**
Salmonella ssp IIIa 41:z4,z23:-					1				1					**2**
Salmonella ssp IIIa 44:z4,z24:-		1												**1**
Salmonella ssp IIIa 48:z4,z24:-					2									**2**
Salmonella ssp IIIb 16:k:-					1									**1**
Salmonella ssp IIIb 47:k:z35		1			1									**2**
Salmonella ssp IIIb 48:i:z		1												**1**
Salmonella ssp IIIb 48:k:1,5,7					1									**1**

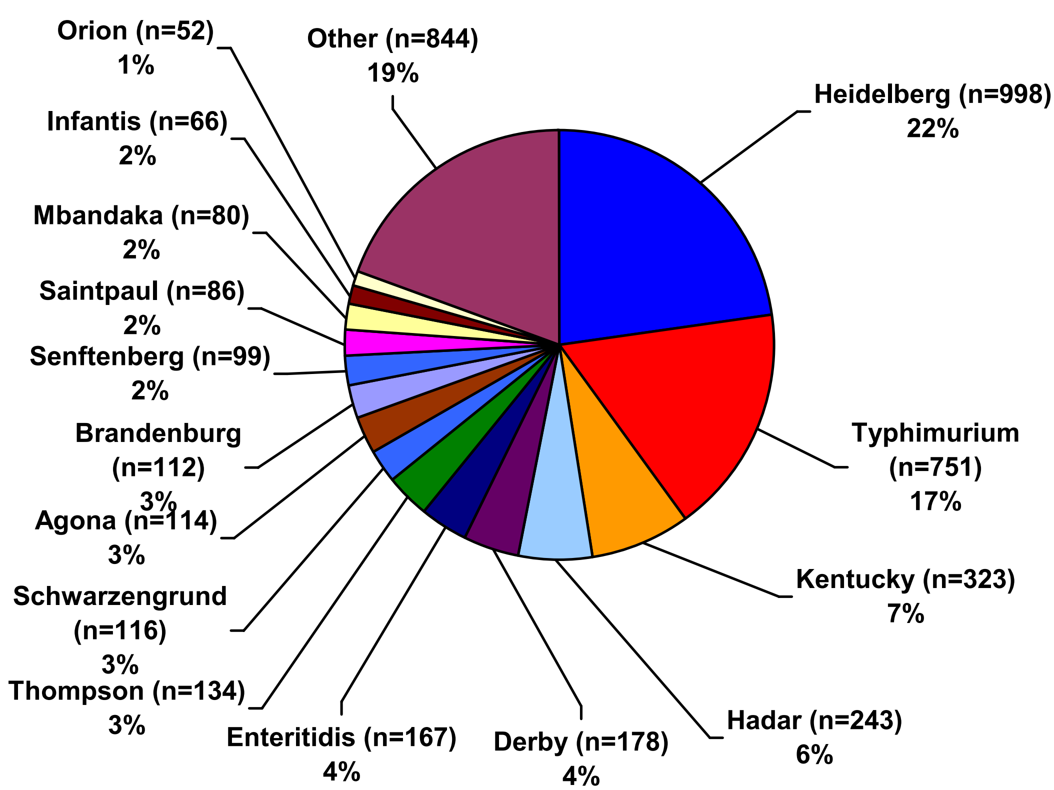
Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YT	NT	NU	TOT
Salmonella ssp IIIb 48:z52:e,n,x,z15					1									**1**
Salmonella ssp IIIb 50:k:z53							1							**1**
Salmonella ssp IIIb 50:k:z	1													**1**
Salmonella ssp IIIb 50:l,v:z35	1													**1**
Salmonella ssp IIIb 53:z10:z	1													**1**
Salmonella ssp IIIb 61:i:z53		4												**4**
Salmonella ssp IIIb 61:k:1,5						1								**1**
Salmonella ssp IIIb 61:l,v:1,5		3												**3**
Salmonella ssp IIIb 61:r:z						1								**1**
Salmonella ssp IIIb 61:-:1,5,7						1								**1**
Salmonella ssp IIIb 61:k:1,5,7	1													**1**
Salmonella ssp IIIb 61:l,v:1,5,7	1													**1**
Salmonella ssp IIIb 61:z52:z53		2												**2**
Salmonella ssp IIIb Rough-O:i:z					1									**1**
Salmonella ssp IV 11:z4,z23:-						1								**1**
Salmonella ssp IV 16:z4,z32:-		1			1									**2**
Salmonella ssp IV 43:z4,z32:-					1									**1**
Salmonella ssp IV 44:z4,z23:-		1												**1**
Salmonella ssp IV 44:z4,z24:-		1												**1**
Salmonella ssp IV 44:z4,z32:-		1				1								**2**
Salmonella ssp IV 45:g,z51:-		1								1				**2**
Salmonella ssp IV 48:g,z51:-					1									**1**
Salmonella ssp IV 50:z4,z23:-					2									**2**
Salmonella ssp IV 50:z4,z32:-		1												**1**
Salmonella ssp IV Rough-O:z4,z32:-					1									**1**
TOTAL	**741**	**685**	**88**	**160**	**3216**	**1089**	**137**	**21**	**132**	**44**	**3**	**2**	**2**	**6320**

Salmonella Isolations from Non-Human Sources in 2005

Non-human sources of *Salmonella* include animal, food, environmental or water and the data 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. 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 (with the exclusion of outbreak investigations and enhanced surveillance projects). Figure 8 shows the fifteen most prevalent serovars isolated from non-human sources in Canada in 2005.

S. Heidelberg is the most prevalent serovar isolated from non-human sources in Canada accounting for 22% (n=998) of the 4363 isolates reported in 2005. *S*. Typhimurium ranked second most prevalent with 17% (n=751) followed distantly by 3rd ranking *S*. Kentucky with 7% (n=323) followed by *S*. Hadar (6%, n=243), *S*. Derby (4%, n=178), *S*. Enteritidis (4%, n=167), *S*. Thompson (3%, n=134), *S*. Schwarzengrund (3%, n=116), *S*. Agona (3%, n=114) and *S*. Brandenburg ranked 10th (3%, n=112). Serovars ranking from 11th to 14th include *S*. Senftenburg, *S*. Saintpaul, *S*. Mbandaka and *S*. Infantis each accounting for 2%. *S*. Orion ranked 15th with 1% and other serovars represent 19% (n=844) of the isolates identified in 2005.

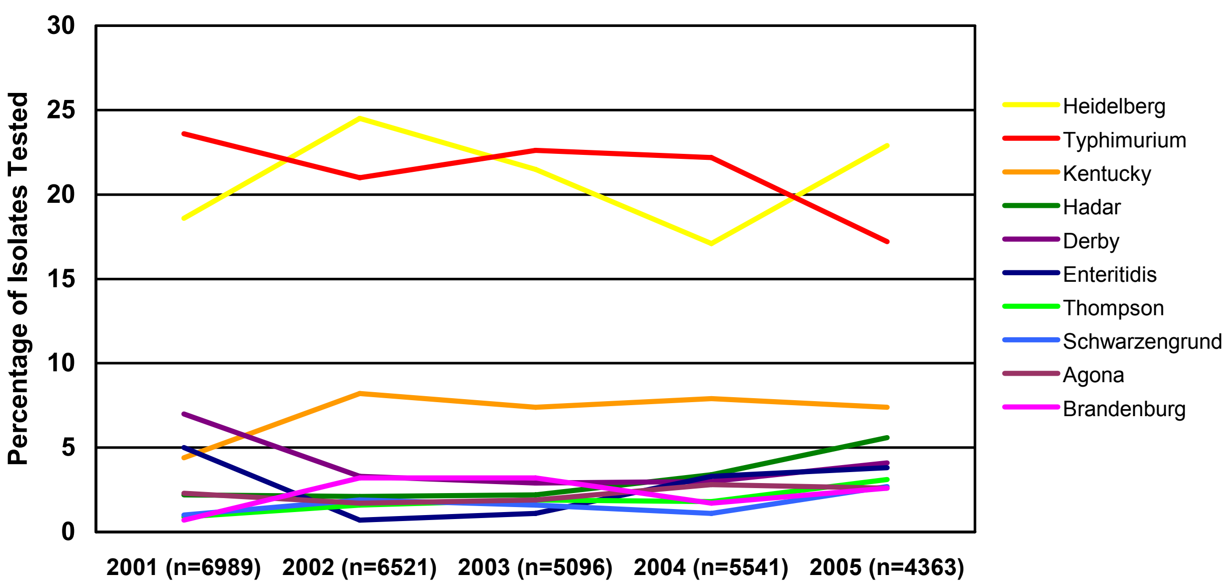
Figure 8: Fifteen Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2005 (N=4363)



Changes in the Occurrence of *Salmonella* Serovars from Non-Human Sources in Canada 2001 to 2005

The relative frequencies of the 10 most prevalent *Salmonella* serovars of non-human sources from 2001 to 2005 are shown in Figure 9. *S*. Heidelberg and *S*. Typhimurium have remained the most prevalent serovars isolated from non-human sources between 2001 and 2005. After declining from a high of 24% in 2002 to 17% in 2004, *S*. Heidelberg once again has become the most prevalent serovar identified from non-human sources in 2005 accounting for 23% of the 4363 strains tested. The proportion of isolates identified as *S*. Typhimurium, the second most prevalent serovar, has gradually declined since 2001 from 24% to 17% in 2005. *S*. Kentucky has ranked 3rd most prevalent since 2002 accounting for 8% of the isolates in each year. *S*. Hadar has steadily increased in prevalence among non-human isolations over the 5 year period. Between 2001 and 2003 levels of *S*. Hadar isolations remained constant at 2% for each year, then increased to rank 4th overall in 2004 with 3% of the identifications and then continued to increase to 6% of the 4363 *Salmonella* isolates tested in 2005. *S*. Enteritidis isolations have also increased to account for 6% in 2005, up from 1.0% in 2002 and 2003 and 3% in 2004.

Figure 9: Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2001 to 2005



* 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.

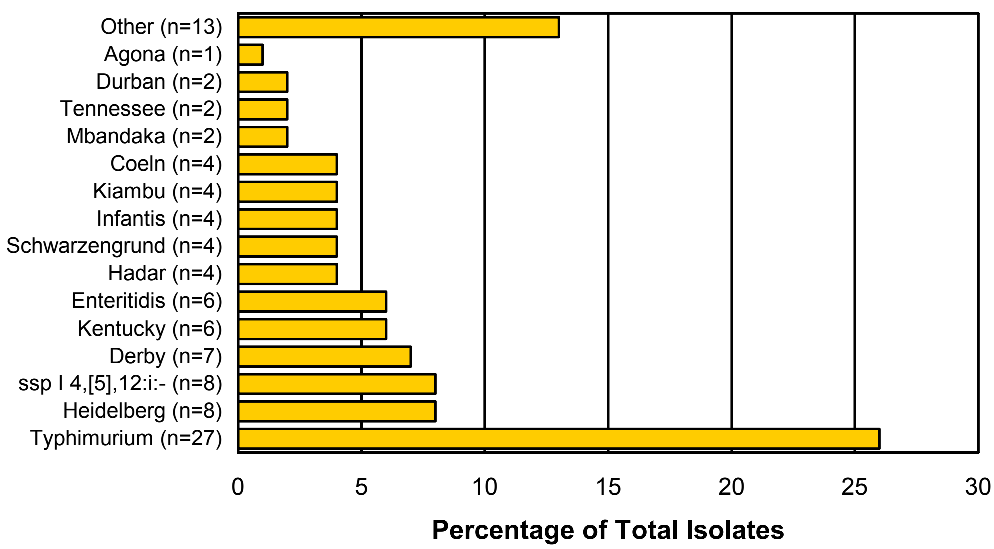
Provincial Distribution of *Salmonella* Serovars from Non-Human Sources in 2005

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

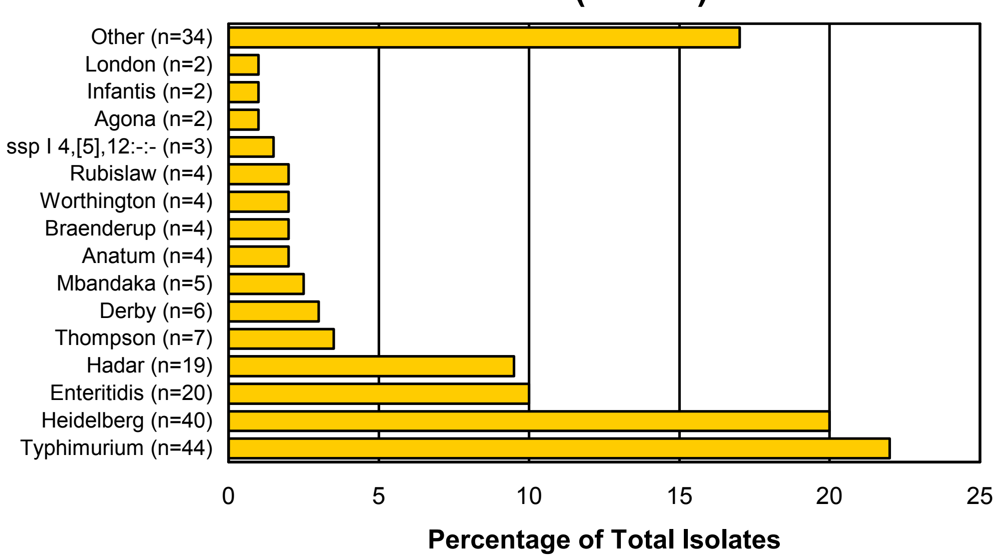
The most common *Salmonella* serovars from non-human origin in each province are shown in Figure 10. In 2005, *S.* Typhimurium ranked first in British Columbia, Alberta, Saskatchewan and Quebec. *S*. Heidelberg was most prevalent in Ontario and New Brunswick, *S*. Hadar in Manitoba, *S*. Thompson in Nova Scotia, *S*. Derby in Prince Edward Island and *S*. Agona in Newfoundland.

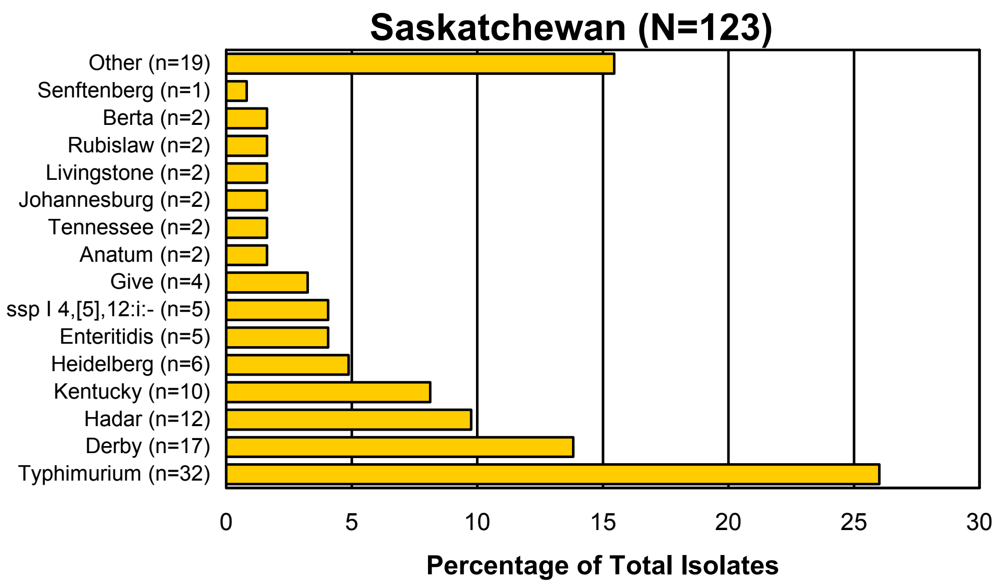
Figure 10: Most Prevalent *Salmonella* Serovars of Non-Human Origin in Each Province, 2005

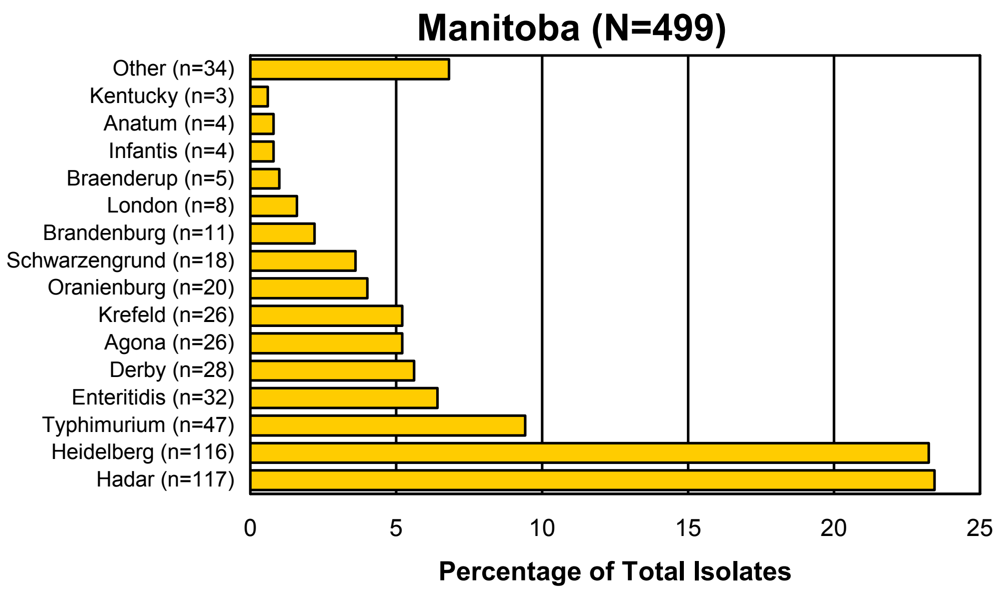
British Columbia (N=102)

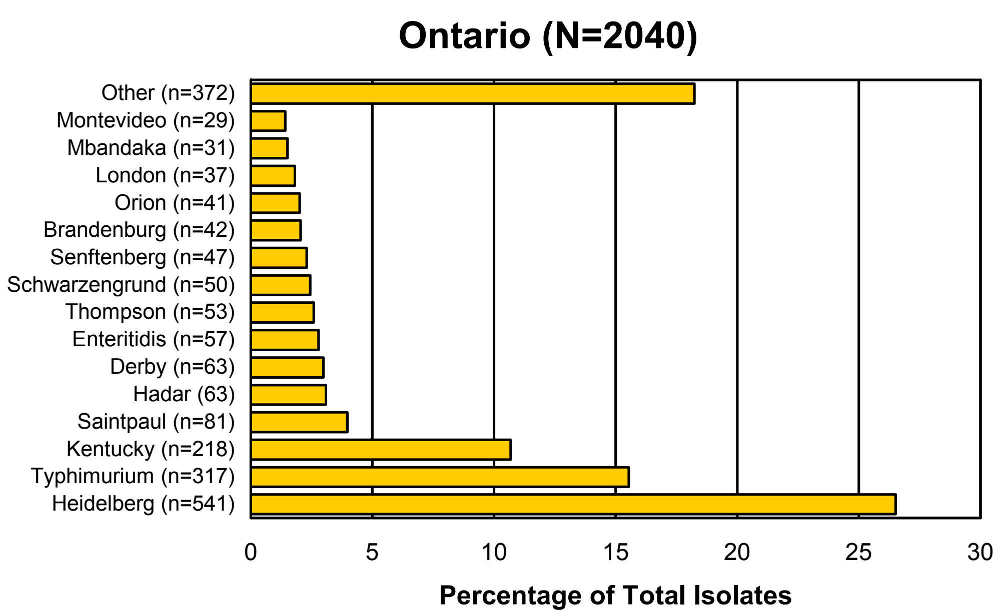


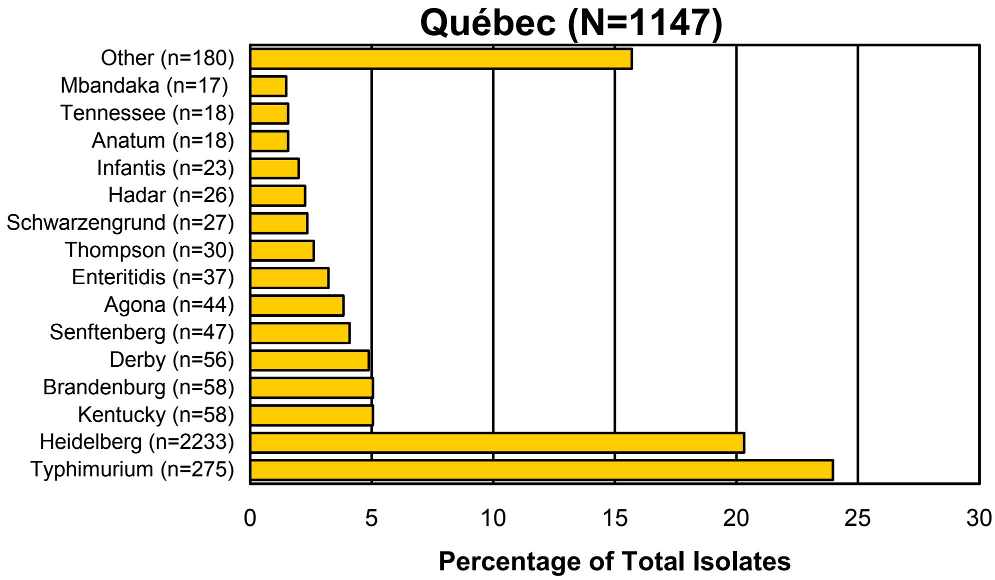
Alberta (N=200)

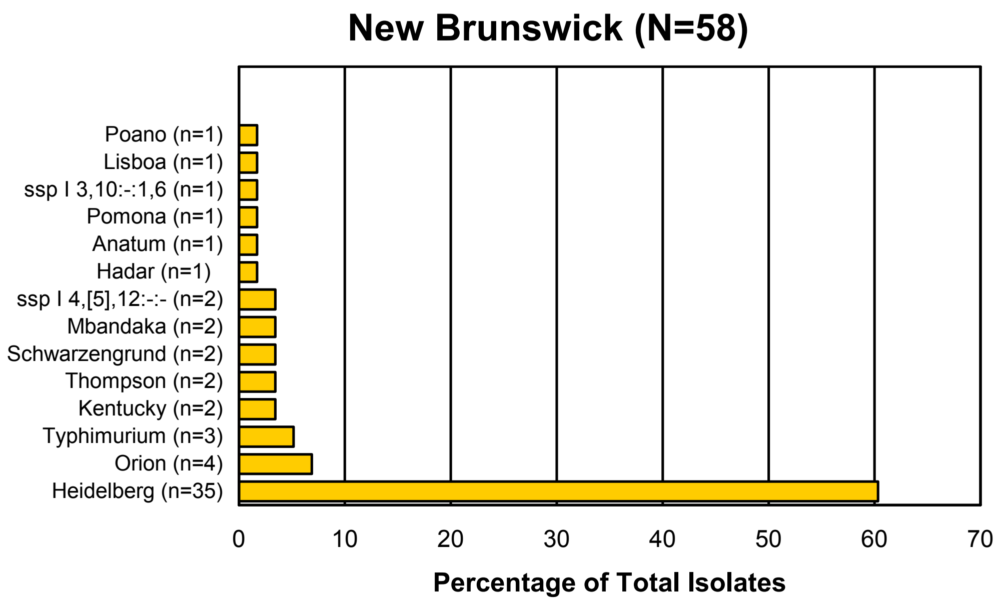


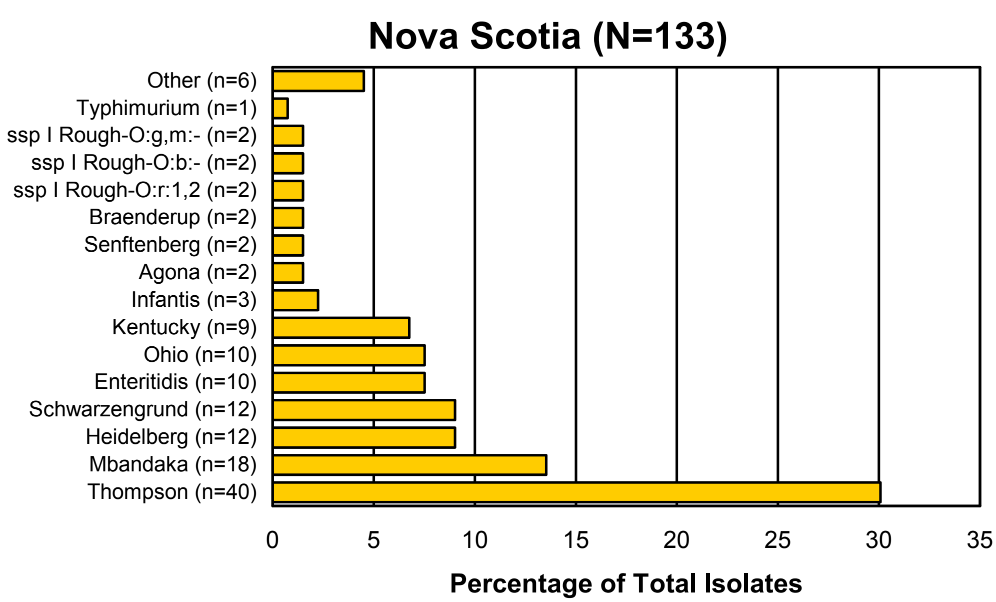

Saskatchewan (N=123)
Other (n=19)
Senftenberg (n=1)
Berta (n=2)
Rubislaw (n=2)
Livingstone (n=2)
Johannesburg (n=2)
Tennessee (n=2)
Anatum (n=2)
Give (n=4)
ssp I 4,[5],12:i:- (n=5)
Enteritidis (n=5)
Heidelberg (n=6)
Kentucky (n=10)
Hadar (n=12)
Derby (n=17)
Typhimurium (n=32)
0
5
10
15
20
25
30
Percentage of Total Isolates

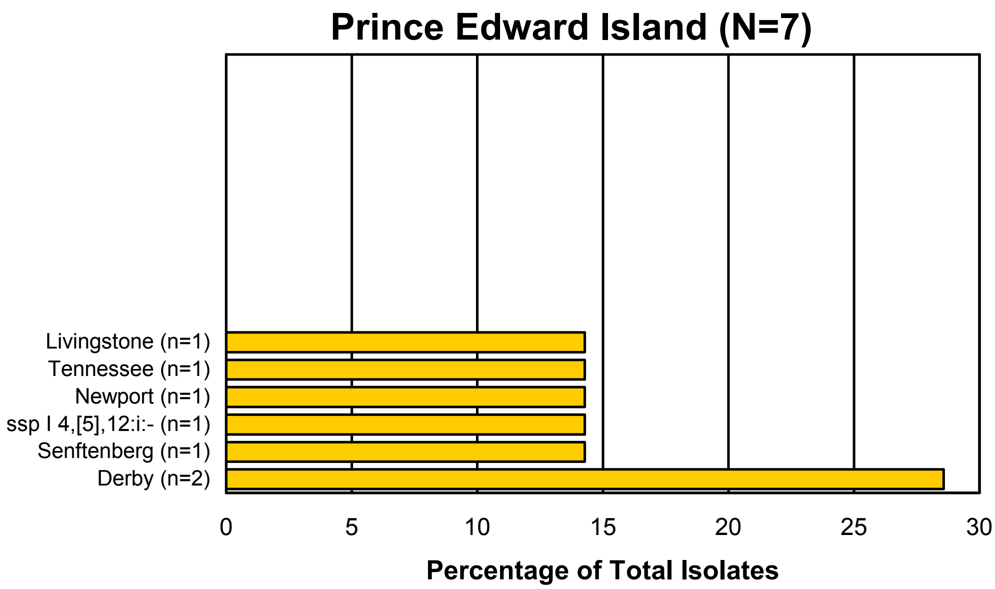

Manitoba (N=499)
Other (n=34)
Kentucky (n=3)
Anatum (n=4)
Infantis (n=4)
Braenderup (n=5)
London (n=8)
Brandenburg (n=11)
Schwarzengrund (n=18)
Oranienburg (n=20)
Krefeld (n=26)
Agona (n=26)
Derby (n=28)
Enteritidis (n=32)
Typhimurium (n=47)
Heidelberg (n=116)
Hadar (n=117)
0
5
10
15
20
25
Percentage of Total Isolates

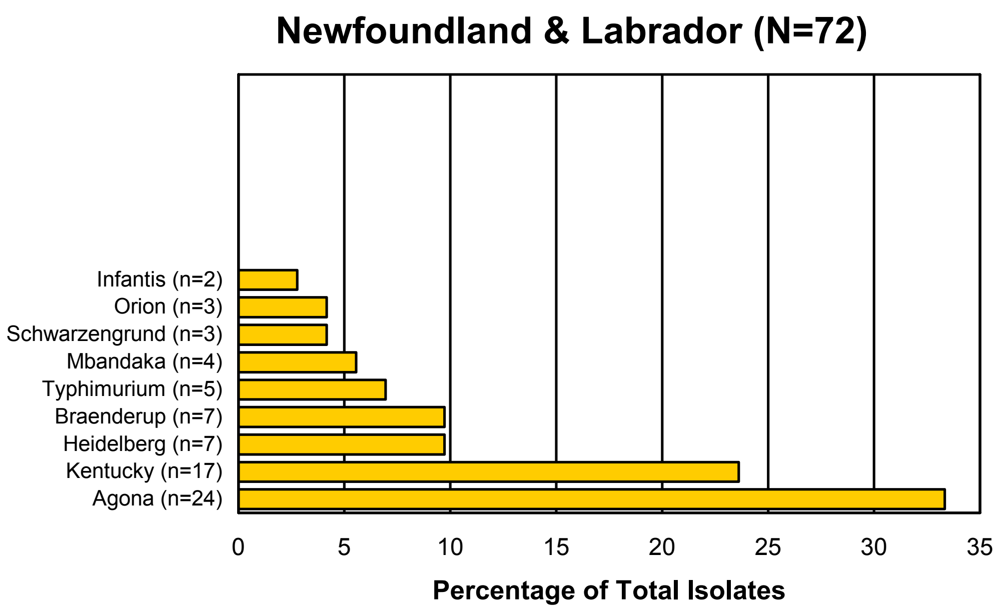

Ontario (N=2040)
Other (n=372)
Montevideo (n=29)
Mbandaka (n=31)
London (n=37)
Orion (n=41)
Brandenburg (n=42)
Senftenberg (n=47)
Schwarzengrund (n=50)
Thompson (n=53)
Enteritidis (n=57)
Derby (n=63)
Hadar (63)
Saintpaul (n=81)
Kentucky (n=218)
Typhimurium (n=317)
Heidelberg (n=541)
0
5
10
15
20
25
30
Percentage of Total Isolates


Québec (N=1147)
Other (n=180)
Mbandaka (n=17)
Tennessee (n=18)
Anatum (n=18)
Infantis (n=23)
Hadar (n=26)
Schwarzengrund (n=27)
Thompson (n=30)
Enteritidis (n=37)
Agona (n=44)
Senftenberg (n=47)
Derby (n=56)
Brandenburg (n=58)
Kentucky (n=58)
Heidelberg (n=2233)
Typhimurium (n=275)
0 5 10 15 20 25 30
Percentage of Total Isolates


New Brunswick (N=58)
Poano (n=1)
Lisboa (n=1)
ssp I 3,10:-:1,6 (n=1)
Pomona (n=1)
Anatum (n=1)
Hadar (n=1)
ssp I 4,[5],12:-:- (n=2)
Mbandaka (n=2)
Schwarzengrund (n=2)
Thompson (n=2)
Kentucky (n=2)
Typhimurium (n=3)
Orion (n=4)
Heidelberg (n=35)
0 10 20 30 40 50 60 70
Percentage of Total Isolates


Nova Scotia (N=133)
Other (n=6)
Typhimurium (n=1)
ssp I Rough-O:g,m:- (n=2)
ssp I Rough-O:b:- (n=2)
ssp I Rough-O:r:1,2 (n=2)
Braenderup (n=2)
Senftenberg (n=2)
Agona (n=2)
Infantis (n=3)
Kentucky (n=9)
Ohio (n=10)
Enteritidis (n=10)
Schwarzengrund (n=12)
Heidelberg (n=12)
Mbandaka (n=18)
Thompson (n=40)
0 5 10 15 20 25 30 35
Percentage of Total Isolates


Prince Edward Island (N=7)
Livingstone (n=1)
Tennessee (n=1)
Newport (n=1)
ssp I 4,[5],12:i:- (n=1)
Senftenberg (n=1)
Derby (n=2)
0
5
10
15
20
25
30
Percentage of Total Isolates


Newfoundland & Labrador (N=72)
Infantis (n=2)
Orion (n=3)
Schwarzengrund (n=3)
Mbandaka (n=4)
Typhimurium (n=5)
Braenderup (n=7)
Heidelberg (n=7)
Kentucky (n=17)
Agona (n=24)
0
5
10
15
20
25
30
35
Percentage of Total Isolates

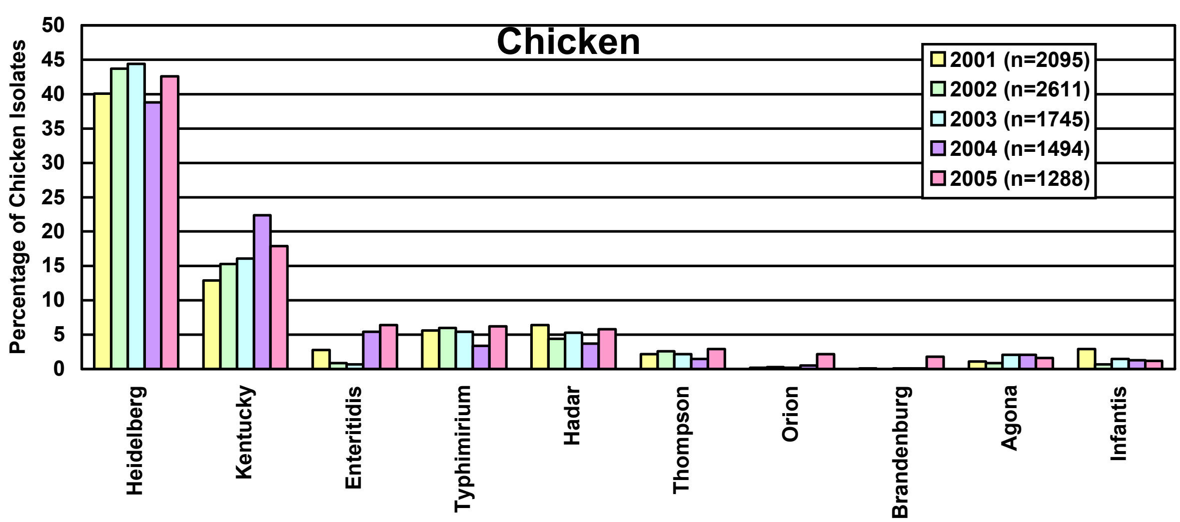
Source Distribution of *Salmonella* Serovars in Canada, 2001 to 2005

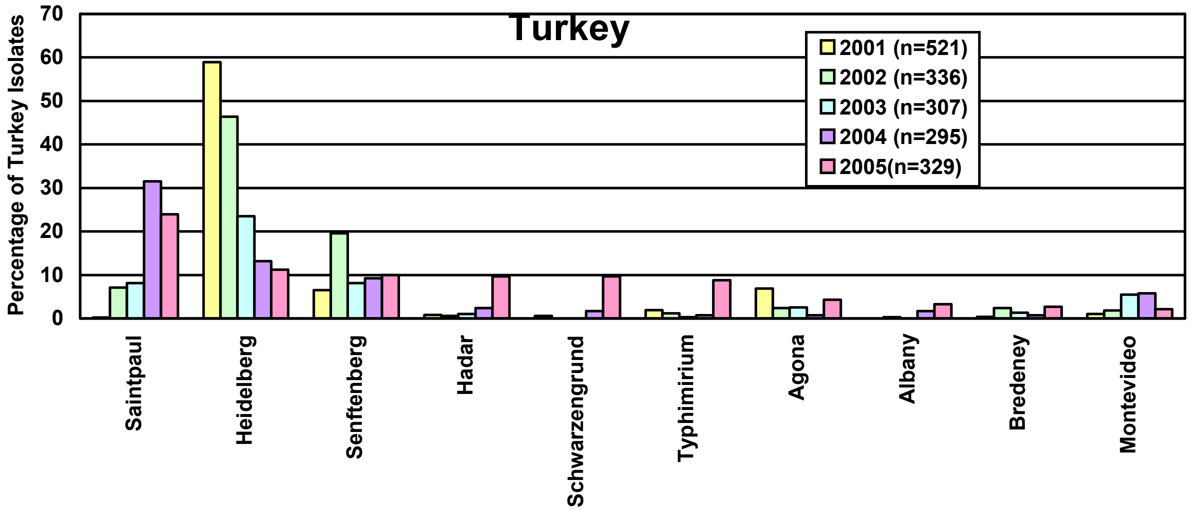
The ten most prevalent *Salmonella* serovars isolated from bovine, chicken, turkey, porcine and feed sources between 2001 and 2004 are shown in Figure 11. *S*. Heidelberg continued to be the most prevalent serovar isolated from chicken accounting for 43% of the 1288 strains isolated from chicken sources in 2005, up from 39% of the isolates reported in 2004. Although *S*. Kentucky has decreased from 22% in 2004 to 18% in 2005, levels have steadily increased in chicken isolates over the 5 year period from 13% in 2001.

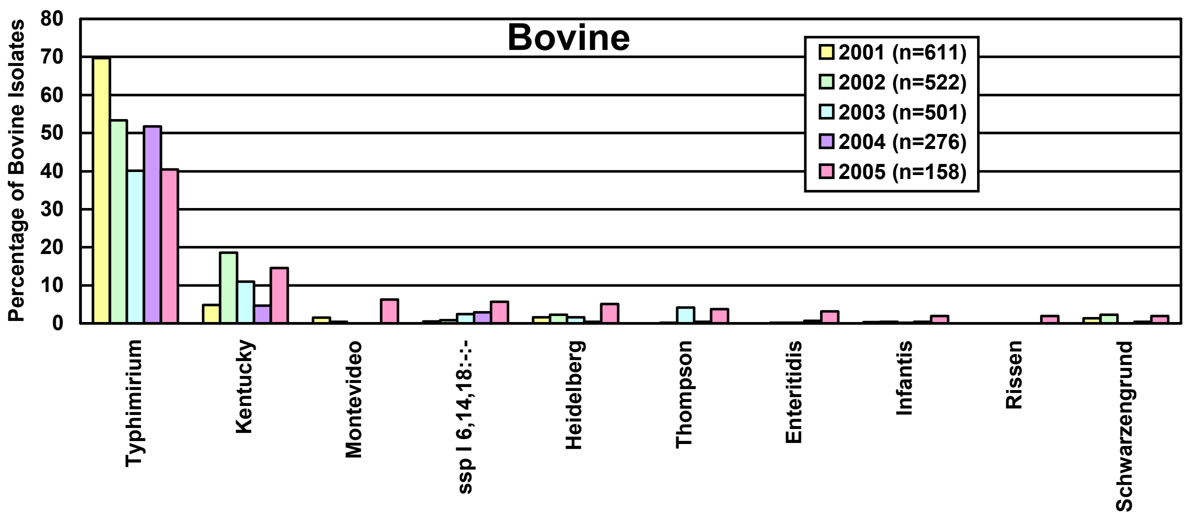
S. Saintpaul remains the most prevalent serovar isolated from turkey sources in 2005 accounting for 22% of Salmonella isolated, down from 32% in 2004. Although *S*. Heidelberg continues to rank as the 2nd most prevalent serovar isolated from turkey sources, isolations continue to decline dramatically from 59% in 2001 to 11% in 2005. *S*. Senftenberg isolations continue a gradual increase over the 5 year period from 6% in 2001 to 10% in 2005. *S*. Typhimurium remains the most prevalent serovar isolated from both bovine and porcine sources in 2005. Over the previous 5 years the level of *S*. Typhimurium isolated from bovine sources has decreased from 70% to 40% and has increased in porcine isolates from 30% in 2001 to 44% in 2005.

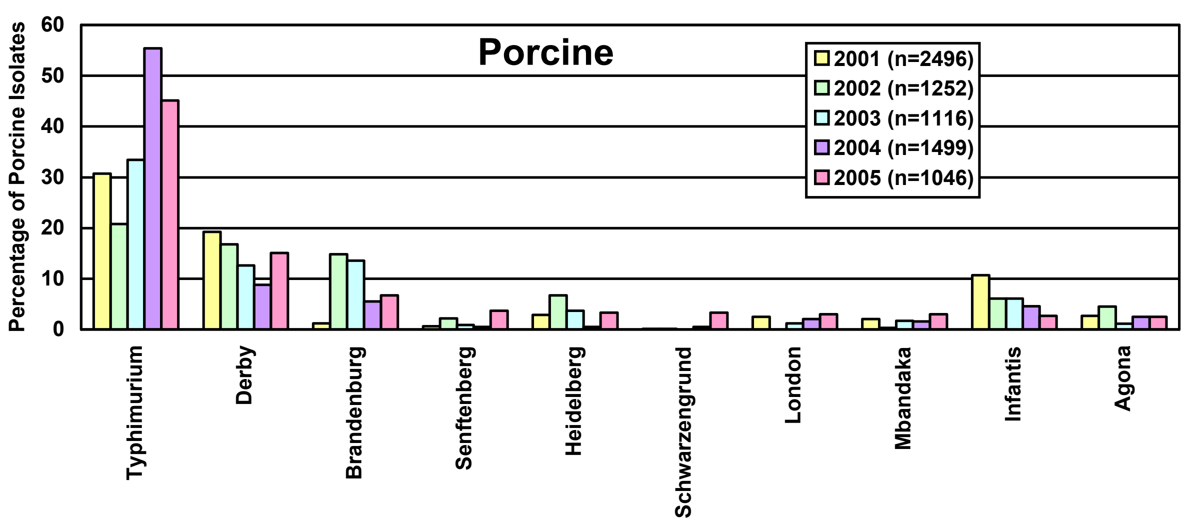
S. Thompson is the most prevalent serovar isolated from animal feed and feed ingredients in 2005 accounting for 16% of isolates followed by *S*. Schwarzengrund (8%), *S*. Cerro (7%), *S*. Anatum (6%), *S*. Heidelberg (6%), *S*. Montevideo (5%), *S*. London (5%), *S*. Infantis (4%), *S*. Orion (4%) and *S*. Alachua (3%).

Figure 11: Most Prevalent *Salmonella* Serovars from Selected Sources in Canada, 2005




Turkey
Percentage of Turkey Isolates
0
10
20
30
40
50
60
70
2001 (n=521)
2002 (n=336)
2003 (n=307)
2004 (n=295)
2005(n=329)
Saintpaul
Heidelberg
Senftenberg
Hadar
Schwarzengrund
Typhimirium
Agona
Albany
Bredeney
Montevideo


Bovine
Percentage of Bovine Isolates
0
10
20
30
40
50
60
70
80
2001 (n=611)
2002 (n=522)
2003 (n=501)
2004 (n=276)
2005 (n=158)
Typhimirium
Kentucky
Montevideo
ssp I 6,14,18:-:-
Heidelberg
Thompson
Enteritidis
Infantis
Rissen
Schwarzengrund


Porcine
Percentage of Porcine Isolates
0
10
20
30
40
50
60
2001 (n=2496)
2002 (n=1252)
2003 (n=1116)
2004 (n=1499)
2005 (n=1046)
Typhimurium
Derby
Brandenburg
Senftenberg
Heidelberg
Schwarzengrund
London
Mbandaka
Infantis
Agona

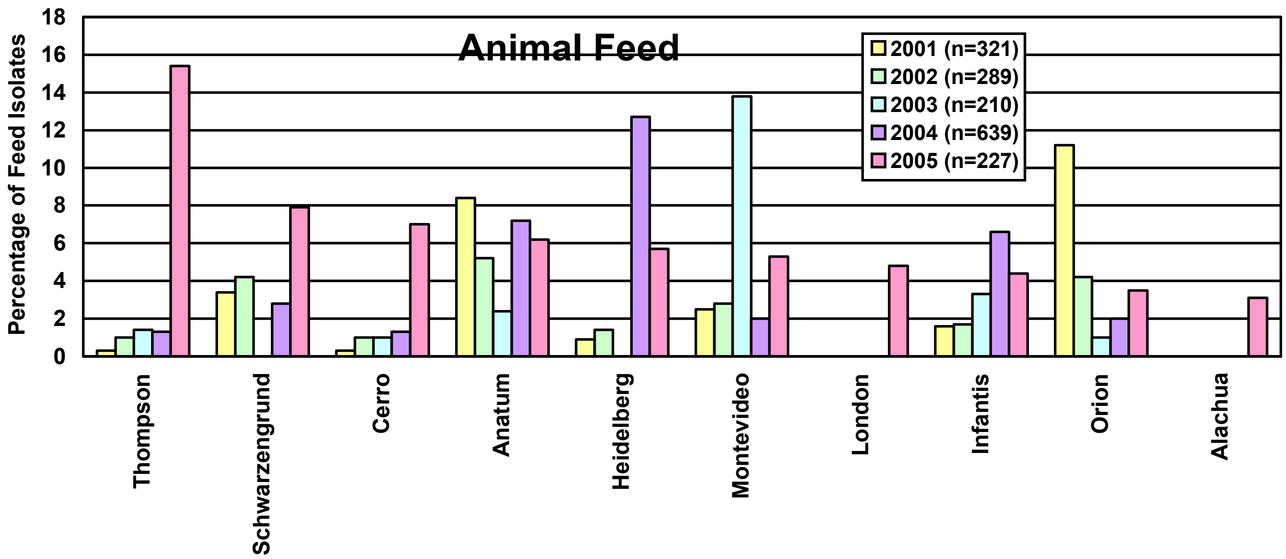

Animal Feed
Percentage of Feed Isolates
0
2
4
6
8
10
12
14
16
18
2001 (n=321)
2002 (n=289)
2003 (n=210)
2004 (n=639)
2005 (n=227)
Thompson
Schwarzengrund
Cerro
Anatum
Heidelberg
Montevideo
London
Infantis
Orion
Alachua

Table 3: *Salmonella* from Non-Human Sources, 2005

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
S. Adelaide	Animal Feed						1					1
S. Agona	Animal Feed		1			1					1	3
	Avian					1						1
	Bovine					1						1
	Chicken	1					13					14
	Chicken - Meat				5	1						6
	Eggs								2		23	25
	Environmental Swab				3							3
	Equine					2						2
	Food - Unknown				5							5
	Porcine		1		2	5	18					26
	Soil				11							11
	Turkey					2	12					14
	Unknown					1						1
	Water					1						1
	Subtotal	**1**	**2**	**0**	**26**	**15**	**43**	**0**	**2**	**0**	**24**	**113**
S. Alachua	Animal Feed						7					7
	Porcine						1					1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**8**	**0**	**0**	**0**	**0**	**9**
S. Albany	Chicken - Meat					1						1
	Environmental Swab				1							1
	Turkey					11						11
	Subtotal	**0**	**0**	**0**	**1**	**12**	**0**	**0**	**0**	**0**	**0**	**13**
S. Anatum	Animal Feed				3	1	8					12
	Avian			1			1					2
	Bovine						1					1
	Chicken	1	3			1	2	1				8
	Eggs						2		1			3
	Pet Food					2						2
	Porcine		1	1	1		4					7
	Subtotal	**1**	**4**	**2**	**4**	**4**	**18**	**1**	**1**	**0**	**0**	**35**
S. Babelsberg	Animal Feed						1					1
S. Ball	Environmental Swab				1							1
S. Bardo	Environmental Swab				1							1
	Snake		1									1
	Subtotal	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Berta	Chicken					1						1
	Chicken - Meat			2								2

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Porcine						2					2
	Subtotal	**0**	**0**	**2**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**5**
S. Blockley	Chicken		1	1								2
	Porcine		1									1
	Subtotal	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Bovismorbificans	Bovine						1					1
	Chicken						1					1
	Pet Food					2						2
	Porcine				1	1	1					3
	Subtotal	**0**	**0**	**0**	**1**	**3**	**3**	**0**	**0**	**0**	**0**	**7**
S. Braenderup	Avian			1					2			3
	Eggs		4		5	6					4	19
	Environmental Swab										3	3
	Fertilizer					1						1
	Porcine					2						2
	Subtotal	**0**	**4**	**1**	**5**	**9**	**0**	**0**	**2**	**0**	**7**	**28**
S. Brandenburg	Avian	1										1
	Bovine						1					1
	Canine					7						7
	Chicken						23					23
	Pet Food					2						2
	Porcine				11	31	28					70
	Pork					1						1
	Turkey					1	3					4
	Subtotal	**1**	**0**	**0**	**11**	**42**	**55**	**0**	**0**	**0**	**0**	**109**
S. Bredeney	Avian						1					1
	Turkey					7	2					9
	Subtotal	**0**	**0**	**0**	**0**	**7**	**3**	**0**	**0**	**0**	**0**	**10**
S. California	Porcine		1		1		1					3
S. Cerro	Animal Feed					5	9					14
	Avian			1			3					4
	Chicken						2					2
	Food - Unknown Meat						1					1
	Pet Food		2									2
	Subtotal	**0**	**2**	**1**	**0**	**5**	**15**	**0**	**0**	**0**	**0**	**23**
S. Chester	Environmental Swab				1							1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Choleraesuis	Porcine					1						1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
S. Coeln	Food - Unknown	1										1
	Spice - Pepper	3										3
	Subtotal	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
S. Cubana	Avian			1								1
	Chicken		1									1
	Potato						2					2
	Turkey					1						1
	Subtotal	**0**	**1**	**1**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**5**
S. Derby	Pet Food					4						4
	Porcine	7	6	17	14	56	55		1	2		158
	Soil				14							14
	Turkey						1					1
	Unknown - Animal					1						1
	Subtotal	**7**	**6**	**17**	**28**	**61**	**56**	**0**	**1**	**2**	**0**	**178**
S. Durban	Environmental Swab	2										2
S. Ealing	Animal Feed						1					1
S. Eastborne	Environmental Swab					5						5
S. Enteritidis	Amphibian						1					1
	Avian					1	10		5			16
	Bean Sprouts					9						9
	Beef		1									1
	Bovine		2	2			1					5
	Chicken	5	9	3	1	11	16		5			50
	Chicken - Meat				28	2	2					32
	Duck					12						12
	Eggs					3	3					6
	Environmental Swab		1		2	10						13
	Food - Unknown		2			4						6
	Mouse						1					1
	Porcine		5				1					6
	Turkey	1										1
	Unknown					4	1					5
	Subtotal	**6**	**20**	**5**	**31**	**56**	**36**	**0**	**10**	**0**	**0**	**164**
S. Fluntern	Gecko					1						1
	Lizard			1								1
	Unknown					1						1
	Subtotal	**0**	**0**	**1**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**
S. Give	Ovine		1									1
	Pet Food		1									1
	Subtotal	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
S. Give (a)	Duck					2						2
	Pet Food					6						6
	Porcine			4			1					5
	Subtotal	**0**	**0**	**4**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**13**
S. Glostrup	Unknown					1						1
S. Hadar	Avian			1		5	3					9
	Chicken	4	15	4	1	13	8	1				46
	Chicken - Meat			7	13	7	2					29
	Duck					4						4
	Eggs								1			1
	Environmental Swab		4		17	13						34
	Food - Unknown				48							48
	Porcine					1						1
	Soil				37							37
	Turkey					19	13					32
	Subtotal	**4**	**19**	**12**	**116**	**62**	**26**	**1**	**1**	**0**	**0**	**241**
S. Hartford	Aquarium Water						1					1
	Equine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
S. Havana	Avian					3						3
	Porcine					3	1					4
	Subtotal	**0**	**0**	**0**	**0**	**6**	**1**	**0**	**0**	**0**	**0**	**7**
S. Heidelberg	Animal Feed		1				4					5
	Avian	3					19	21	5			48
	Bovine					7	1					8
	Canine					33						33
	Caprine						1					1
	Chicken	3	23			277	136	14			6	459
	Chicken - Meat		2	4	30	43	11					90
	Eggs		5			1	4		5			15
	Environmental Swab		4		5	53	6				1	69
	Equine	1	3			95			2			101
	Feline					2						2
	Food - Unknown		1		32							33
	Pet Food					8						8
	Porcine			2	8	10	15					35
	Soil				40							40
	Turkey	1	1			9	26					37
	Unknown						8					8
	Unknown - Animal					2						2
	Subtotal	**8**	**40**	**6**	**115**	**540**	**231**	**35**	**12**	**0**	**7**	**994**
S. Indiana	Avian						1					1
	Chicken					1						1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Chicken - Meat				1	1						2
	Duck					1						1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**1**	**4**	**1**	**0**	**0**	**0**	**0**	**6**
S. Infantis	Animal Feed					1	3					4
	Avian								2			2
	Bovine					1	2					3
	Canine					3						3
	Chicken	1		1		4	2					8
	Chicken - Meat				1	6	1					8
	Eggs		1						1		2	4
	Pet Food					6						6
	Porcine	3	1		3	6	15					28
	Subtotal	**4**	**2**	**1**	**4**	**27**	**23**	**0**	**3**	**0**	**2**	**66**
S. Instanbul	Avian						2					2
S. Istanbul	Chicken		1	1								2
S. Javiana	Aquarium Water						1					1
	Water						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Johannesburg	Animal Feed						3					3
	Avian			1								1
	Chicken				1							1
	Porcine			1	1	1						3
	Turkey						1					1
	Subtotal	**0**	**0**	**2**	**2**	**1**	**4**	**0**	**0**	**0**	**0**	**9**
S. Kanifing	Environmental Swab				1							1
S. Kentucky	Animal Feed						1					1
	Avian			1		2	1	1	1			6
	Bovine					12	11					23
	Canine					17						17
	Cheese						15					15
	Chicken	6		8	1	160	18	1	1		5	200
	Chicken - Meat			1	2	23	5					31
	Eggs						2		7		11	20
	Environmental Swab						2				1	3
	Equine					1						1
	Feline					1						1
	Porcine					1	1					2
	Turkey					1	1					2
	Subtotal	**6**	**0**	**10**	**3**	**218**	**57**	**2**	**9**	**0**	**17**	**322**
S. Kiambu	Avian						1					1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Bovine					2						2
	Chicken	4				3	1					8
	Chicken - Meat					2						2
	Subtotal	**4**	**0**	**0**	**0**	**7**	**2**	**0**	**0**	**0**	**0**	**13**
S. Kouka	Canine					1						1
S. Krefeld	Porcine					2						2
	Soil				26							26
	Subtotal	**0**	**0**	**0**	**26**	**2**	**0**	**0**	**0**	**0**	**0**	**28**
S. Lexington	Turkey					1						1
S. Lisboa	Reptile							1				1
S. Litchefield	Avian						1					1
	Chicken - Meat					1						1
	Equine						1					1
	Turkey						2					2
	Subtotal	**0**	**0**	**0**	**0**	**1**	**4**	**0**	**0**	**0**	**0**	**5**
S. Livingstone	Animal Feed						2					2
	Avian			1								1
	Eggs								1			1
	Porcine			1		3				1		5
	Subtotal	**0**	**0**	**2**	**0**	**3**	**2**	**0**	**1**	**1**	**0**	**9**
S. Llandoff	Animal Feed						1					1
S. London	Animal Feed		2									2
	Duck					6						6
	Pet Food					9						9
	Porcine			1	8	22						31
	Subtotal	**0**	**2**	**1**	**8**	**37**	**0**	**0**	**0**	**0**	**0**	**48**
S. Manhattan	Bovine						1					1
	Pet Food					2						2
	Turkey					3						3
	Subtotal	**0**	**0**	**0**	**0**	**5**	**1**	**0**	**0**	**0**	**0**	**6**
S. Mapong	Environmental Swab				1							1
S. Mbandaka	Animal Feed		1			2	3	1				7
	Avian							1				1
	Bovine						1					1
	Chicken	1				1	1					3
	Eggs		1		1		2		17		4	25
	Environmental Swab					7			1			8
	Equine					1						1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Porcine	1	3			17	10					31
	Turkey					3						3
	Subtotal	**2**	**5**	**0**	**1**	**31**	**17**	**2**	**18**	**0**	**4**	**80**
S. Meleagridis	Pet Food		1									1
S. Miami	Aquarium Water						1					1
S. Midway	Snake		1									1
S. Minnesota	Avian	1										1
	Canine			1								1
	Subtotal	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Montevideo	Animal Feed	1				8	3					12
	Bovine					8	2					10
	Chicken			1	1							2
	Chicken - Meat					4						4
	Eggs						1					1
	Equine					1						1
	Turkey					7						7
	Subtotal	**1**	**0**	**1**	**1**	**28**	**6**	**0**	**0**	**0**	**0**	**37**
S. Morehead	Spice - Pepper	1										1
S. Moscow	Unknown					1						1
S. Muenchen	Environmental Swab				1							1
	Porcine					2	4					6
	Unknown					2						2
	Subtotal	**0**	**0**	**0**	**1**	**4**	**4**	**0**	**0**	**0**	**0**	**9**
S. Muenster	Bovine					2						2
	Environmental Swab					2						2
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**5**
S. Newport	Animal Feed					4						4
	Bovine					1						1
	Environmental Swab					2						2
	Equine					4						4
	Porcine			1		1						2
	Snake		1							1		2
	Spice - Coriander					1						1
	Turkey					2	5					7
	Water					5						5
	Subtotal	**0**	**1**	**1**	**0**	**20**	**5**	**0**	**0**	**1**	**0**	**28**
S. Ohio	Animal Feed						1					1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Canine					1						1
	Chicken					1						1
	Eggs								10			10
	Pet Food					2						2
	Porcine					1	6					7
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**6**	**7**	**0**	**10**	**0**	**0**	**23**
S. Oranienburg	Bovine					1						1
	Chicken		2									2
	Chicken - Meat				5							5
	Eggs								1			1
	Environmental Swab				1		1					2
	Food - Unknown				6							6
	Peaches					1						1
	Porcine					1						1
	Soil				8							8
	Subtotal	**0**	**2**	**0**	**20**	**3**	**1**	**0**	**1**	**0**	**0**	**27**
S. Orion	Animal Feed					3	4	1				8
	Chicken					25		3				28
	Eggs					6					3	9
	Equine					2						2
	Porcine					5						5
	Subtotal	**0**	**0**	**0**	**0**	**41**	**4**	**4**	**0**	**0**	**3**	**52**
S. Ouakam	Animal Feed						2					2
	Environmental Swab					4						4
	Lizard			1								1
	Unknown - Animal					1						1
	Subtotal	**0**	**0**	**1**	**0**	**5**	**2**	**0**	**0**	**0**	**0**	**8**
S. Panama	Porcine		1				3					4
S. Paratyphi B	Water						2					2
S. Paratyphi B var. Java	Snake						1					1
	Water						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Pomona	Animal Feed		1					1				2
	Equine					1						1
	Turkey					1						1
	Subtotal	**0**	**1**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**4**
S. Putten	Canine			1								1
S. Rissen	Animal Feed	1										1
	Bovine						3					3

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Porcine		1				1					2
	Unknown						1					1
	Subtotal	**1**	**1**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**7**
S. Rittersbach	Water						1					1
S. Rubislaw	Animal Feed	1					1					2
	Avian			2								2
	Bovine		1									1
	Chicken		1									1
	Lizard						1					1
	Subtotal	**1**	**2**	**2**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**7**
S. Saintpaul	Bovine					1						1
	Chicken			1		1						2
	Environmental Swab					2						2
	Porcine				1							1
	Turkey					77	2					79
	Subtotal	**0**	**0**	**1**	**1**	**81**	**2**	**0**	**0**	**0**	**0**	**85**
S. Sandiego	Avian			1								1
S. Schwarzengrund	Animal Feed	2				6	8					16
	Avian						1	2	3			6
	Bovine					2	1					3
	Canine					4						4
	Chicken	2					3					5
	Eggs						2		7		1	10
	Environmental Swab										2	2
	Pet Food					2						2
	Porcine				17	4	12		2			35
	Turkey					32						32
	Subtotal	**4**	**0**	**0**	**17**	**50**	**27**	**2**	**12**	**0**	**3**	**115**
S. Senftenberg	Animal Feed						4		1			5
	Avian						1		1			2
	Caprine						2					2
	Chicken					7	1					8
	Chicken - Meat					1						1
	Eggs					9						9
	Porcine			1	1	1	35			1		39
	Turkey					29	4					33
	Subtotal	**0**	**0**	**1**	**1**	**47**	**47**	**0**	**2**	**1**	**0**	**99**
S. Singapore	Environmental Swab	1										1
S. Sorenga	Animal Feed						2					2
S. Tennessee	Animal Feed	2	2				1					5

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Avian									1		1
	Bovine						3					3
	Chicken			2			3					5
	Eggs						2					2
	Porcine						8					8
	Turkey						1					1
	Subtotal	**2**	**2**	**2**	**0**	**0**	**18**	**0**	**0**	**1**	**0**	**25**
S. Thompson	Avian					1	1		5			7
	Bovine					1	5					6
	Canine		1			3						4
	Chicken		1			10	16	2	4			33
	Chicken - Meat					2	2					4
	Duck					1						1
	Eggs						2		30			32
	Environmental Swab				2		2		1			5
	Equine					1						1
	Pet Food		5			30						35
	Unknown						2					2
	Water					4						4
	Subtotal	**0**	**7**	**0**	**2**	**53**	**30**	**2**	**40**	**0**	**0**	**134**
S. Typhimurium	Almonds					1						1
	Animal Feed	1				1	1					3
	Avian	4		5	3	7	12				1	32
	Bovine	9	14	2	1	20	14				4	64
	Canine		2			2	1					5
	Caprine							1				1
	Cervid						1					1
	Cheese	2										2
	Chicken	2	6	11		36	17	2				74
	Chicken - Meat					5	1					6
	Eggs						1					1
	Environmental Swab	2	1		2	4						9
	Equine					11						11
	Feline			1			1					2
	Ferret					1						1
	Food - Unknown		1									1
	Goose				1							1
	Hedgehog		1	1								2
	Milk		2									2
	Ovine					2						2
	Porcine	4	10	12	15	222	208		1			472
	Pork					1						1
	Snake		3									3
	Soil				2							2
	Soya					1						1
	Sparrow	1										1
	Turkey		2		23	1	3					29

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Unknown						9					9
	Unknown - Animal	2				2						4
	Water						3					3
	Subtotal	**27**	**42**	**32**	**47**	**317**	**272**	**3**	**1**	**0**	**5**	**746**
S. Uganda	Animal Feed						1					1
	Chicken					1						1
	Equine					1						1
	Porcine					2						2
	Subtotal	**0**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**5**
S. Wandsworth	Water						3					3
S. Weltevreden	Spice - Pepper					1						1
S. Woodinville	Rodent					1						1
S. Worthington	Bovine					1						1
	Chicken					2						2
	Environmental Swab		1									1
	Porcine		3			1	3					7
	Turkey					1						1
	Subtotal	**0**	**4**	**0**	**0**	**5**	**3**	**0**	**0**	**0**	**0**	**12**
S. Zanzibar	Avian						1					1
*S.*spp I 6,14,18:-:-	Bovine		1									1
S. ssp I 28:y:-	Turkey					1						1
S. ssp I 3,10:-:1,6	Animal Feed						1					1
	Chicken							1				1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**2**
*S.*ssp I 3,10:-:1,7	Porcine			1								1
*S.*ssp I 3,10:e,h:-	Shrimp					1						1
*S.*ssp I 3,10:l,v:-	Porcine			1								1
S. ssp I 3,10:z10:-	Porcine					1						1
S. ssp I 39:b:-	Reptile						1					1
S. ssp I 4,[5],12:-:-	Bovine		1									1
	Canine							1				1
	Chicken		1			2		1				4
	Porcine		1				1					2
	Turkey						1					1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Subtotal	**0**	**3**	**0**	**0**	**2**	**2**	**2**	**0**	**0**	**0**	**9**
S. ssp I 4,[5],12:-:1,2	Chicken					7						7
	Chicken - Meat					1						1
	Subtotal	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**8**
S. ssp I 4,[5],12:-:e,n,z15	Clams	1										1
	Porcine					1						1
	Subtotal	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. ssp I 4,[5],12:b:-	Environmental Swab					1						1
	Turkey					1						1
	Water						2					2
	Subtotal	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**4**
S. ssp I 4,[5],12:i:-	Avian	1				1	4			1		7
	Bovine		1				1					2
	Canine					2						2
	Chicken	4		3		4						11
	Chicken - Meat			2		1						3
	Environmental Swab				2							2
	Porcine	3				4	4					11
	Subtotal	**8**	**1**	**5**	**2**	**12**	**9**	**0**	**0**	**1**	**0**	**38**
S. ssp I 4,[5],12:r:-	Avian					1						1
	Pet Food					2						2
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**
*S.*ssp I 42:z4,z23:-	Animal Feed					1						1
S. ssp I 6,14,18:-:-	Bovine					9						9
S. ssp I 6,7:-:-	Porcine					1						1
S. ssp I 6,7:-:1,5	Chicken					1	1					2
	Chicken - Meat						1					1
	Environmental Swab						1					1
	Pet Food					2						2
	Porcine					1	1					2
	Subtotal	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**8**
S. ssp I 6,7:-:e,n,z15	Animal Feed						1					1
S. ssp I 6,7:b:-	Porcine						1					1
S. ssp I 6,7:r:-	Chicken	1										1
S. ssp I 6,7:z10:-	Animal Feed						3					3

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
S. ssp I 6,8:-:e,n,x	Chicken	1										1
	Chicken - Meat					1						1
	Subtotal	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. ssp I 8,20:-:z6	Chicken					2	1					3
S. ssp I 8,20:i:-	Avian								1			1
	Chicken					1						1
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**3**
S. ssp I 9,12:-:-	Cheese						1					1
S. ssp I Rough-O:-:-	Avian						1					1
	Porcine						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. ssp I Rough-O:-:1,2	Chicken						1					1
*S.*ssp I Rough-O:b:-	Eggs								2			2
S. ssp I Rough-O:d:1,7	Chicken					2						2
*S.*ssp I Rough-O:e,h:-	Chicken					1						1
S. ssp I Rough-O:e,h:1,2	Turkey					5						5
S. ssp I Rough-O:f,g,s:-	Turkey					1						1
S. ssp I Rough-O:g,m:-	Avian								1			1
	Bovine								1			1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**2**
S. ssp I Rough-O:i:-	Chicken					1						1
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. ssp I Rough-O:i:1,2	Chicken					2						2
*S.*ssp I Rough-O:i:z6	Chicken					5						5
S. ssp I Rough-O:r:-	Chicken					2						2
	Environmental Swab						2					2
	Subtotal	**0**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**4**
S. ssp I Rough-O:r:1,2	Avian						1					1
	Chicken		2			14						16
	Eggs								2			2

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
	Environmental Swab					2						2
	Turkey					3						3
	Subtotal	**0**	**2**	**0**	**0**	**19**	**1**	**0**	**2**	**0**	**0**	**24**
S. ssp I Rough-O:r:1,5	Porcine				1							1
S. ssp I Rough-O:z10:-	Chicken			1								1
S. ssp I Rough-O:z10:e,n,x	Chicken		1			1						2
	Pet Food					4						4
	Subtotal	**0**	**1**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**6**
S. ssp I Rough-O:z10:e,n,z15	Animal Feed						1					1
S. ssp I Rough-O:z29:-	Bovine						1					1
S. ssp I Rough:g,s,t:-	Eggs					1						1
S. ssp I Rough:l,v:e,n,z15	Porcine		1									1
S. ssp II 30:l,z28:z6	Lizard						1					1
*S.*ssp II 56:b:1,5	Gecko						1					1
S. ssp II 57:z29:z42	Unknown					1						1
S. ssp II 59:k:z65	Unknown					1						1
S. ssp IIIa 41:z4,z23:-	Reptile						1					1
	Snake		2									2
	Subtotal	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**
S. ssp IIIa 42:g,z51:-	Reptile						1					1
S. ssp IIIa 56:z4,z23,z32:-	Snake					1						1
	Unknown					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. ssp IIIb 11:k:z53	Unknown					1						1
S. ssp IIIb 48:i:z	Snake	1										1
S. ssp IIIb 48:r:z	Turkey	1										1
S. ssp IIIb 48:z52:e,n,x,z15	Python					1						1
S. ssp IIIb 50:z52:z35	Water						1					1
S. ssp IIIb 60:r:e,n,x,z15	Snake					1						1

Organism	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	TOTAL
S. ssp IIIb 61:-:1,5	Ovine						2					2
S. ssp IIIb 61:l,v:1,5	Ovine			1								1
S. ssp IIIb 65:-:z53	Reptile						1					1
*S.*ssp IV 16:z4,z32:-	Iguana						1					1
	Reptile						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. ssp IV 43:z4,z23:-	Water						1					1
S. ssp IV 44:z4,z23:-	Unknown - Animal		1									1
S. ssp IV 45:g,z51:-	Unknown					1						1
S. ssp IV 48:g,z51:-	Iguana		1									1
S. ssp IV 50:z4,z23:-	Aquarium Water						1					1
	Water						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
Total Non Human *Salmonella* 2005		**106**	**192**	**123**	**499**	**2011**	**1146**	**59**	**145**	**7**	**75**	**4363**

New and Unique *Salmonella* Serovars in Canada, 2005

Serotype	Province	Source	Month
***Salmonella* ssp IIIa 56:z4,z23,z32:-**	**Ontario**	**Snake Feces**	**January**
***Salmonella* ssp IIIb 48:r:z)**	**British Columbia**	**Turkey**	**June**
***Salmonella* Mkamba (6,7:l,v:1,6)**	**Alberta**	**Human**	**August**
***Salmonella* ssp II 9,46:z:z39**	**Saskatchewan**	**Human**	**August**
***Salmonella* Farmsen (13,23:z:1,6)**	**Alberta**	**Human**	**August**
***Salmonella* Bouake(16:z:z6)**	**Ontario**	**Human**	**September**
***Salmonella* Abortusequi (4,12:-:e,n,x)**	**British Columbia**	**Human**	**October**
***Salmonella* ssp II 59:k:z65**	**Ontario**	**Unknown**	**December**

Phage Types of *Salmonella* Serovars Identified in Humans in Canada

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

The number of *S*. Enteritidis PT 13 isolates has increased dramatically to now rank as the most prevalent phage type accounting for 55% (n=902) of the 1651 isolates tested in 2005, up from 4% (48 of 1275) in 2001. Although many of these isolates may be attributed to a large outbreak of *S*. Enteritidis PT 13 associated with mung bean sprouts in Ontario, the decrease in PT 4 isolations from 30% (278 of 927) in 2004 to 11% (n=206) in 2005 indicates there may be 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 in 2004 from 5% in 2003 to 50% in 2004 and now accounts for 65% of the isolates tested in 2005. The proportion of PT 8, 1 and 2, ranking in prevalence from 3rd to 5th, respectively, have all also declined since 2004.

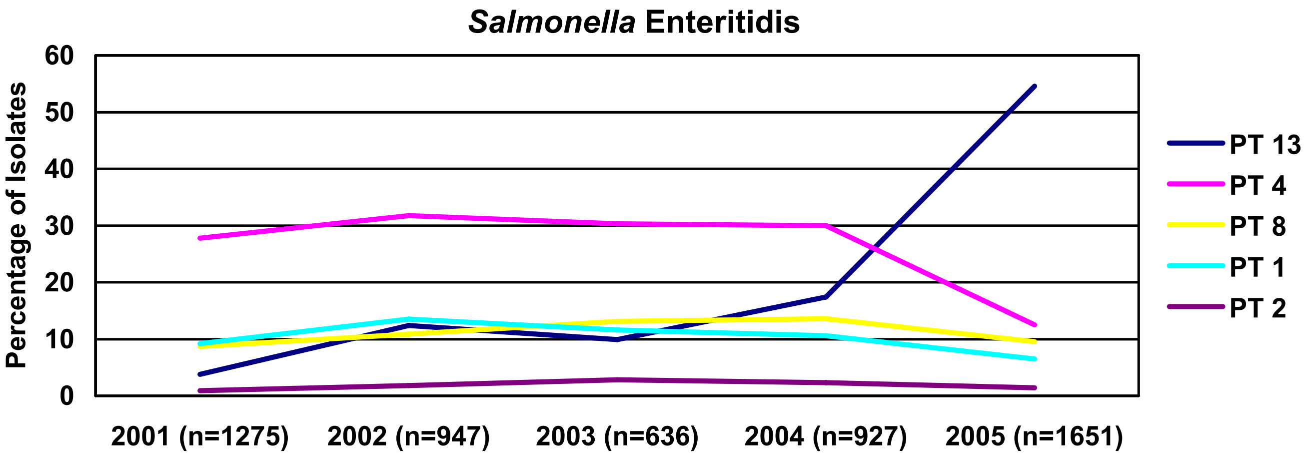
After a sharp increase in 2003, the level of *S*. Hadar PT 2 identifications have since remained relatively constant representing 32% (n=39) of the 122 strains tested in 2005. During 2001 and 2002, no PT 5 strains were observed, but a dramatic increase in 2003 has now resulted in this phage type ranking 2nd most prevalent 15% (n=18) of the isolates in 2005. Similarly, there has been a sharp increase in PT 17 identifications in 2005, ranking 3rd most prevalent with 12% (n=14) of the strains.

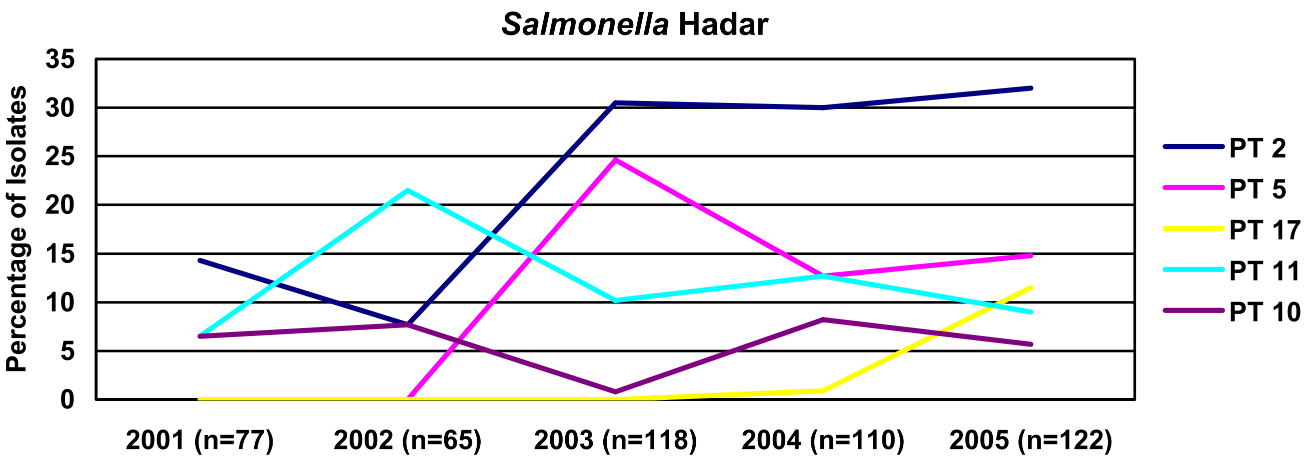
S. Heidelberg PT 19 continues to be the most prevalent phage type, increasing slightly from 36% (328 of 917 isolates) in 2004 to 38% in 2005 (264 of 690). Levels of the second most prevalent phage type, PT 29, were relatively constant between 2001 and 2003, then increased in 2004 to 24.0% (n=328), and have decreased in 2005 to 17% (n=119). The proportion of PT 29 identifications in non-human isolates have increased dramatically from 11% in 2003 to become the most prevalent phage type accounting for 35% of the strains in 2005.

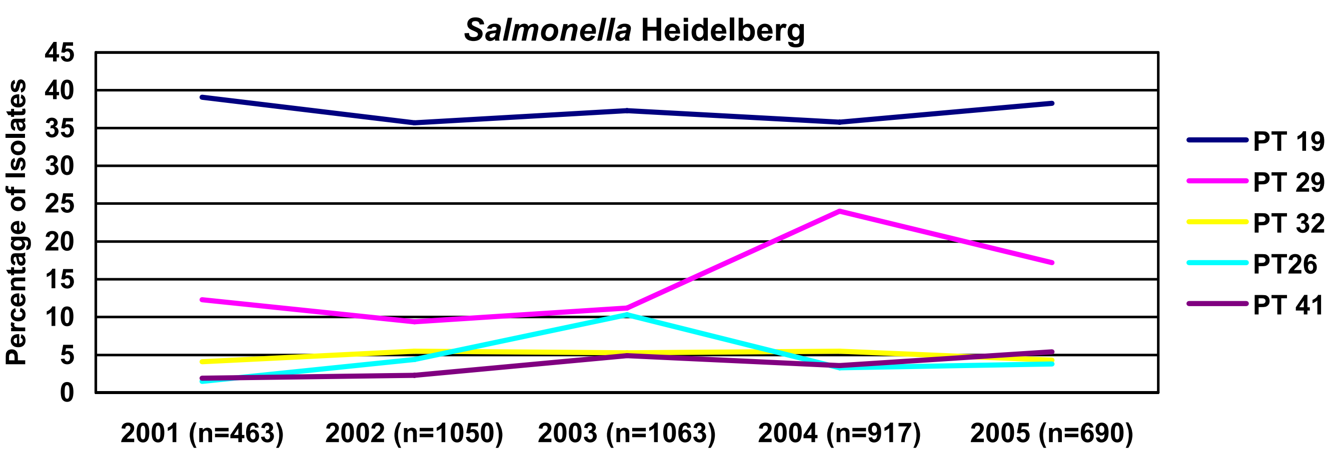
Although *S.* Newport PT 9 remains most prevalent, the proportion of identifications has declined considerably from a high of 30% (45 or 152 isolates) in 2004 to 15% (28 of 184) in 2005. PT 13 also decreased from being the second most prevalent phage type in 2004 (13%, n=20) to tie for a rank of 5th (5%, n=10) in 2005.

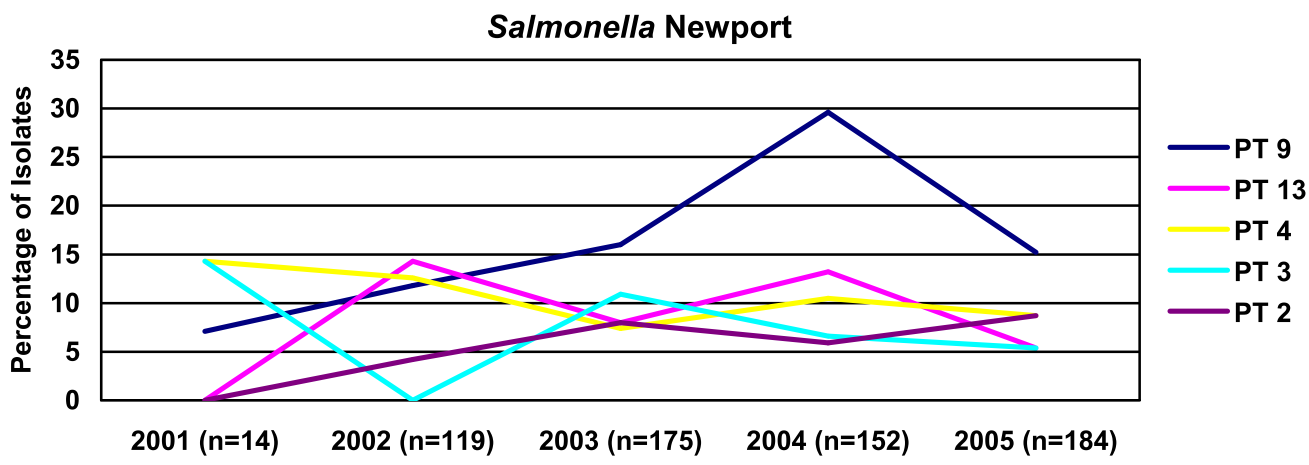
The number of *S*. Typhimurium PT 104 identifications continued a decreasing trend from accounting for 29% (238 of 835 isolates) tested in 2001 to 19% (161 of 861) in 2005. The proportion of PT 108 isolates has decreased to 8% (n=65) in 2005 after an increase in 2004 to 12% (n=94) in 2004 and now ranks 4th overall. The proportion of PT U302, 104a and 193 identifications have increased slightly in 2005 by approximately 5% over 2004 levels.

Figure 12: Most Prevalent Phage Types of Various *Salmonella* Serovars Isolated from Humans in Canada, 2001 to 2005








Salmonella Newport
Percentage of Isolates
35
30
25
20
15
10
5
0
2001 (n=14)
2002 (n=119)
2003 (n=175)
2004 (n=152)
2005 (n=184)
PT 9
PT 13
PT 4
PT 3
PT 2

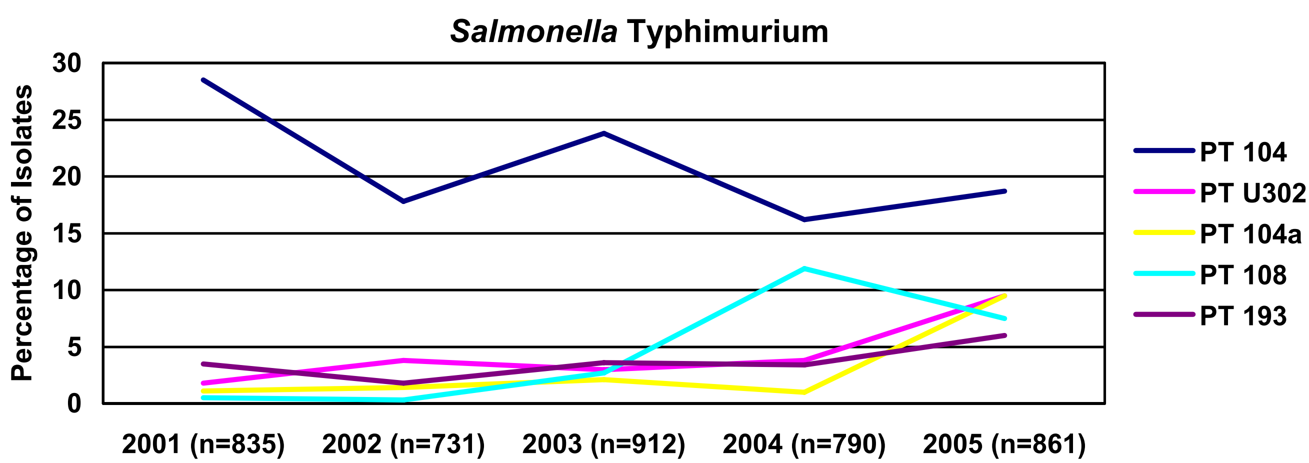
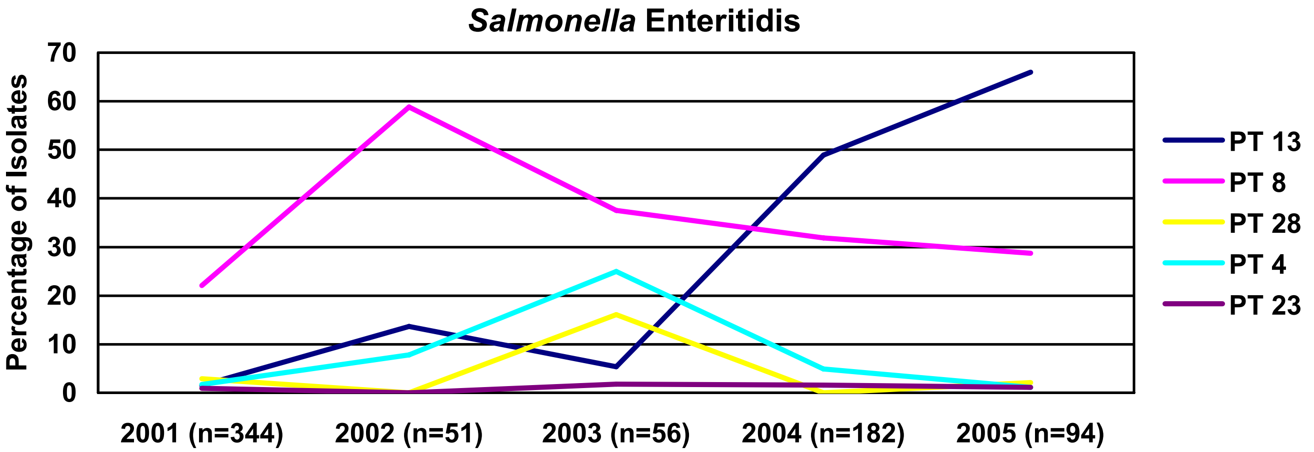
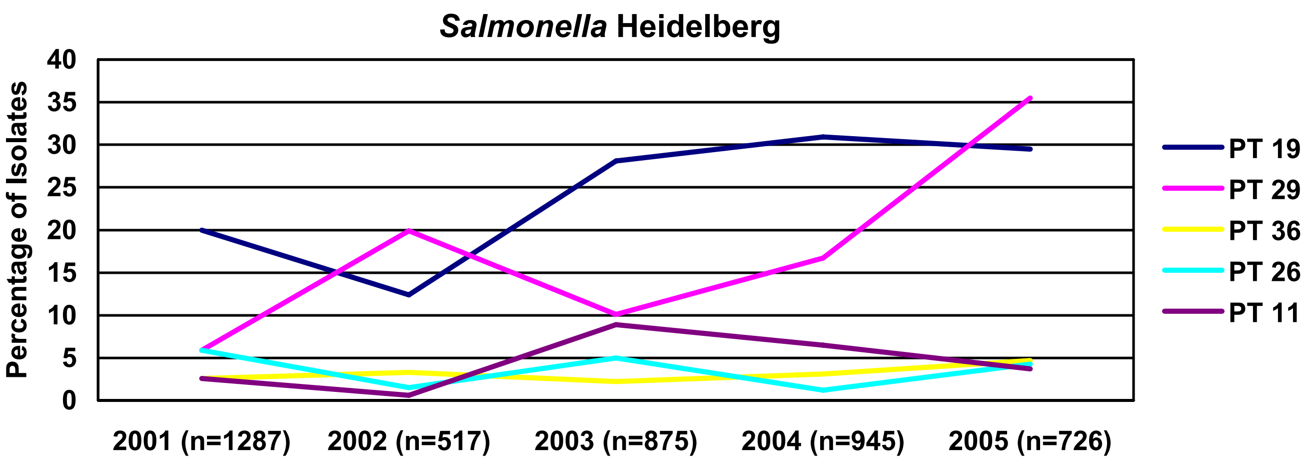

Salmonella Typhimurium
Percentage of Isolates
30
25
20
15
10
5
0
2001 (n=835)
2002 (n=731)
2003 (n=912)
2004 (n=790)
2005 (n=861)
PT 104
PT U302
PT 104a
PT 108
PT 193

Figure 13: Most Prevalent Phage Types of Various *Salmonella* Serovars Isolated from Non-Human Sources in Canada, 2001 to 2005





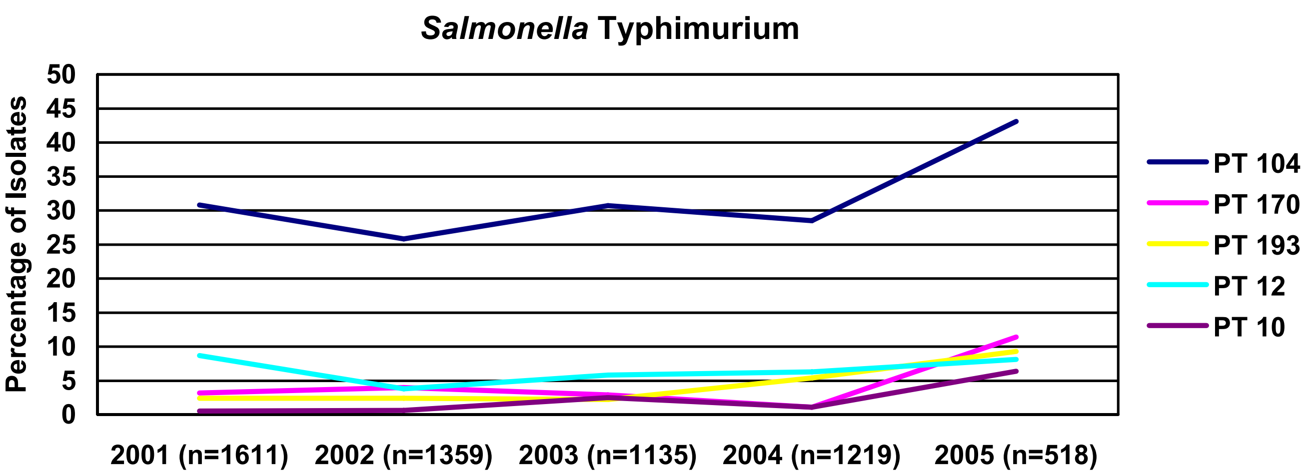


Table 4: Phage Types of Various Serovars of *Salmonella* in Canada from Human Sources, 2005

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
S. Enteritidis	1	7	25	3	1	49	17		3	1	1	**107**
	1a	1		1		2				1		**5**
	2		6		3	13	1					**23**
	3		1			3						**4**
	4	16	28	2	3	101	44	2	5	2	3	**206**
	4a	3				11			1			**15**
	4b		1			7	3	1				**12**
	5					1						**1**
	5a					1						**1**
	5b					2	2					**4**
	6		2			6	2					**10**
	6a	1	3			7	1		1			**13**
	7					1						**1**
	8	20	29	1	3	62	24	8	5	4	1	**157**
	9c			1								**1**
	11b	9	7	3			3					**22**
	12						1					**1**
	13	10	13		6	740	77	12	38	4	2	**902**
	13a					9	3					**12**
	14b		2		1	1	3		1			**8**
	17		1			1					1	**3**
	18	1				3						**4**
	20	1										**1**
	21	3	4		2	10	3					**22**
	21a	1					1					**2**
	21b					1						**1**
	22					9	1					**10**
	23	1				2	1					**4**
	24		1			1						**2**
	24 var.	1				1						**2**
	24a					1						**1**
	26					1						**1**
	28	1				4	1					**6**
	29					4	1					**5**
	29a					1						**1**
	30					7						**7**
	33		8		1							**9**
	34		1			1						**2**
	34a	1					1					**2**
	43					2						**2**
	911					6						**6**
	Atypical	2	4	1		7	5	1	1			**21**
	Untypable						29	3				**32**
	Subtotal	**79**	**136**	**12**	**20**	**1078**	**224**	**27**	**55**	**12**	**8**	**1651**
S. Hadar	1	1										**1**
	2	1	25		1	3	3	1			5	**39**
	4					1						**1**
	5	1	7	1	2	6	1					**18**
	10		2			5						**7**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	11	2	4	2	2	1						**11**
	14	2			1							**3**
	17	3	2		1	2	5	1				**14**
	18	1				1						**2**
	21				1	1						**2**
	23	1										**1**
	41					1						**1**
	43					1						**1**
	47			1								**1**
	54		1						1			**2**
	55		1			1						**2**
	56					1						**1**
	58		1									**1**
	Atypical		7			3	1	1				**12**
	Untypable				1	1						**2**
	Subtotal	**12**	**50**	**4**	**9**	**28**	**10**	**3**	**1**	**0**	**5**	**122**
	1	2	2			3	1		1			**9**
	2		3		4	3						**10**
	4					2	4					**6**
	5	1	1			6	4					**12**
	6		2			1						**3**
	8						1					**1**
	9					1	1					**2**
	10						1	1				**2**
	11	3	1			4	1		1			**10**
	11a	1	4		2	15	1					**23**
	17						2					**2**
	18	1				1	2					**4**
	19	7	44	14	7	98	81	7	1		5	**264**
	19a					3	4					**7**
	19b	1										**1**
	19c					1						**1**
	20					2						**2**
	21		1					1				**2**
	22		2			1						**3**
	24					1		1	2			**4**
	25						2	4				**6**
	26		2			11	13					**26**
	29	5	9		5	52	40	5	3			**119**
	29a	1				1						**2**
	32	2	9	1	6	8	2		2			**30**
	32b		1				2					**3**
	35	1					1			1		**3**
	36	1				2	2	1				**6**
	37						1			1		**2**
	39					3		1				**4**
	40					5	6					**11**
	41		2			20	12	2	1			**37**
	44				1	2						**3**
	47		3		1	1						**5**
	52		2			3		1				**6**
	53					2	2					**4**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	54	1				4	3	1				**9**
	55					1						**1**
	56	1	5						1			**7**
	Atypical		6		3	17	9		3			**38**
	Subtotal	**28**	**99**	**15**	**29**	**274**	**198**	**25**	**15**	**2**	**5**	**690**
S. Infantis	1					2						**2**
	3					1						**1**
	4			1		5	2	2				**10**
	5					3	3					**6**
	7	1	5			7	4	3				**20**
	8	2			1	3		1		1		**8**
	9		1									**1**
	10				1	4	1					**6**
	13		2		1	4	1		1			**9**
	15					1						**1**
	22	1		1								**2**
	25			1								**1**
	26					6	1					**7**
	Atypical		1					1				**2**
	Subtotal	**4**	**9**	**3**	**3**	**36**	**12**	**7**	**1**	**1**	**0**	**76**
S. Muenchen						21						**21**
	2					16						**16**
	3					2						**2**
	4					2						**2**
	5					2						**2**
	6					3						**3**
	7					1						**1**
	8					1	1					**2**
	9				1							**1**
	10				1							**1**
	Untypable					2						**2**
	Subtotal	**0**	**0**	**0**	**2**	**50**	**1**	**0**	**0**	**0**	**0**	**53**
S. Newport	2		5		2	6	2				1	**16**
	3		4			2	3	1				**10**
	4		3			10	2				1	**16**
	5		1									**1**
	6	1				3					2	**6**
	9	1		2		16	3	6				**28**
	10					10						**10**
	11	1										**1**
	13					9	1					**10**
	14a					3	4					**7**
	14b					3	2					**5**
	14c				1	2						**3**
	16	1	1			3						**5**
	17a	2	1			1	1					**5**
	17c					1	1					**2**
	Atypical	6	2			7	2					**17**
	Subtotal	**12**	**17**	**2**	**3**	**76**	**21**	**7**	**0**	**0**	**4**	**142**
S. Oranienburg	1		1			5						**6**
	3					1						**1**
	5					1						**1**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	6	2		1		5	3		1			**12**
	9					2						**2**
	10	1										**1**
	11			1		4						**5**
	13					1						**1**
	Atypical										1	**1**
	Subtotal	**3**	**1**	**2**	**0**	**19**	**3**	**0**	**1**	**0**	**1**	**30**
S. Panama	A		2			2						**4**
	Atypical						2					**2**
	E					1						**1**
	G	2	1			7	2					**12**
	H					1						**1**
	Subtotal	**2**	**3**	**0**	**0**	**11**	**4**	**0**	**0**	**0**	**0**	**20**
S. Paratyphi B	Atypical			4			1					**5**
	Dundee var. 2					1						**1**
	Untypable					1					1	**2**
	Subtotal	**0**	**0**	**4**	**0**	**2**	**1**	**0**	**0**	**0**	**1**	**8**
S. Paratyphi B var. Java	1 var. 3		1									**1**
	1 var. 6				1							**1**
	3b var. 7					1						**1**
	50								1			**1**
	Atypical	5	3		1	7	16	3	4			**39**
	Battersea	1	2									**3**
	Dundee		1			1						**2**
	Dundee var. 1				1	1						**2**
	Untypable		1			1			1			**3**
	Subtotal	**6**	**8**	**0**	**3**	**11**	**16**	**3**	**6**	**0**	**0**	**53**
S. Thompson	1		1			2	3					**6**
	2					1	2	2				**5**
	3		2	1	3	58	34	1			2	**101**
	4	1										**1**
	5	2	8	2		34	9	2		1		**58**
	8					6		1				**7**
	25				2	4						**6**
	26		2		2			1	1			**6**
	27		2									**2**
	Atypical	2	1			3	3	1	1			**11**
	Untypable						3					**3**
	Subtotal	**5**	**16**	**3**	**7**	**108**	**54**	**8**	**2**	**1**	**2**	**206**
S. Typhi	54						1					**1**
	A					2	1					**3**
	B1					3						**3**
	B2	1				1						**2**
	C 1						1					**1**
	D 2		2			1						**3**
	D 6					2						**2**
	DVS	1				2	1					**4**
	E 1	13	2			27	7					**49**
	E 2											**0**
	E 4					2						**2**
	E 9	3				8	1					**12**
	E14	3	1			3						**7**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	F6						1					**1**
	J1					2						**2**
	M1		1			1						**2**
	N					3						**3**
	O	1				2	1					**4**
	UVS					2	1					**3**
	Untypable	1	3			12	1					**17**
	Subtotal	**23**	**9**	**0**	**0**	**73**	**16**	**0**	**0**	**0**	**0**	**121**
S. Typhimurium	1	3	8	1	1	9	3					**25**
	2	1	4		6	13	3					**27**
	4								1			**1**
	9					1						**1**
	10	2	2	1	12	18	3					**38**
	12	2	2	1		4	18					**27**
	12a					1						**1**
	13					1						**1**
	15				1							**1**
	20		1									**1**
	21		1			3					1	**5**
	22	1		1								**2**
	27		3				4				1	**8**
	35					4	1		2			**7**
	37		1			1						**2**
	40					2	1					**3**
	41				1	3	4	1				**9**
	46	1						2	1			**4**
	49	4	2			1						**7**
	66		1			3						**4**
	66a	1										**1**
	69					1						**1**
	69 var.						2					**2**
	74						1					**1**
	75 var.		1				1					**2**
	80		1									**1**
	82					1						**1**
	94				2							**2**
	95		1									**1**
	96		12	1								**13**
	96 var.		1									**1**
	99				1	4		1				**6**
	102		1				1					**2**
	104	5	27	3	5	108	13					**161**
	104a	4				42	15	4				**65**
	104b		3	2	2	22	10					**39**
	105					1						**1**
	107	1			1	2	5					**9**
	108		2			23	27					**52**
	110		1									**1**
	110b		1			5	3					**9**
	120	1	2			7						**10**
	124 var.		2		2	3					1	**8**
	125					1	1					**2**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	126					1						**1**
	132		1			1	1	1				**4**
	135	4	1		1	5						**11**
	136					1						**1**
	146	1				3						**4**
	146 var.		1									**1**
	159						1					**1**
	160		7				2					**9**
	161					2						**2**
	170					4	5		1			**10**
	177					1						**1**
	181		1									**1**
	193	2	8	1		15	11	2	1		1	**41**
	195					4	1					**5**
	196					1						**1**
	206	1	1									**2**
	208	1	4			4	2					**11**
	208 var.		3			6	1					**10**
	Atypical	2	7		4	18	13	1				**45**
	U284	3					1					**4**
	U284 var.	2					2					**4**
	U285					1						**1**
	U287					1						**1**
	U291	1					1					**2**
	U301		1									**1**
	U302		2			59	20				1	**82**
	UT 1	12	1		2	3	4	2				**24**
	UT 2	1	2		1	1	1					**6**
	UT 5		3		1	2	1					**7**
	UT 6	1										**1**
	Untypable		2									**2**
	Subtotal	**57**	**125**	**11**	**43**	**417**	**183**	**14**	**6**	**0**	**5**	**861**
Salmonella ssp I 4,[5],12:i:-	8	1										**1**
	41	2	3	1		8		1				**15**
	41					1						**1**
	99			1								**1**
	120	1				2						**3**
	120					1						**1**
	125					1						**1**
	146	2				1						**3**
	146	1										**1**
	146a var.					1						**1**
	179					1						**1**
	181								1			**1**
	191	1	2			2	2					**7**
	193		1		1							**2**
	Atypical		5		1	3	1					**10**
	Atypical					1						**1**
	U284	2										**2**
	U287		1	3				1				**5**
	U291	4	3			5	5		1			**18**
	U302	1			1							**2**

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	Total
	UT 1	1										**1**
	UT 2					1						**1**
	Subtotal	**16**	**15**	**5**	**3**	**28**	**8**	**2**	**2**	**0**	**0**	**79**
Salmonella ssp I 4,[5],12:b:-	3b var. 2					1						**1**
	Atypical		1			8	1					**10**
	Battersea		1									**1**
	Battersea		1			2	2					**5**
	Dundee var. 1					4	1					**5**
	Untypable	5			1	4	2				1	**13**
	Subtotal	**5**	**3**	**0**	**1**	**19**	**6**	**0**	**0**	**0**	**1**	**35**

Table 5: Phage Types of *Salmonella* from Non-Human Sources in Canada, 2005

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Enteritidis	4	Food - Unknown		1									1
	8	Avian						1					1
	8	Bovine			2			1					3
	8	Chicken		9	3	1	1	2					16
	8	Eggs						2					2
	8	Environmental Swab		1									1
	8	Porcine		2				1					3
	8	Turkey	1										1
	13	Avian					1	2		5			8
	13	Bean Sprouts					9						9
	13	Chicken	4				4	9		2			19
	13	Chicken - Meat				4		2					6
	13	Eggs					3	1					4
	13	Environmental Swab					7						7
	13	Food - Unknown					3						3
	13	Mouse						1					1
	13	QA						1					1
	13	Unknown					4	1					5
	23	Chicken								1			1
	28	Porcine		2									2
		Subtotal	**5**	**15**	**5**	**5**	**32**	**24**	**0**	**8**	**0**	**0**	**94**
S. Hadar	2	Chicken - Meat					2						2
	5	Chicken		7									7
	5	Environmental Swab		1									1
	11	Avian			1								1
	11	Chicken		4	1								5
	11	Environmental Swab		3									3
	14	Chicken		1									1
	23	Chicken - Meat				2							2
	47	Chicken		1									1
		Subtotal	**0**	**17**	**2**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**23**
S. Heidelberg	1	Porcine					1						1
	5	Chicken - Meat					3						3
	5	Turkey					1						1
	5	Chicken					12	1				1	14
	6	Animal Feed						1					1
	6	Chicken					1						1
	6	Chicken - Meat						1					1
	6	Equine					1						1
	7	Chicken					1						1
	8	Porcine					1						1
	8	Turkey						2					2
	9	Chicken						1					1
	10	Avian								1			1
	10	Eggs								2			2
	11	Chicken					16	5					21
	11	Chicken - Meat					4						4
	11	Pet Food					1						1
	11	Porcine					1						1

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	12	Canine					2						2
	12	Chicken						2					2
	13	Canine					2						2
	16	Unknown						1					1
	17	Chicken		1			3						4
	18	Avian						1					1
	18	Chicken	1	1			2	7					11
	18	Pet Food					1						1
	19	Animal Feed		1				1					2
	19	Avian	1					2	4				7
	19	Bovine					4						4
	19	Canine					21						21
	19	Chicken	1	13			96	22					132
	19	Chicken - Meat		1	3	1	10	3					18
	19	Eggs		5				2		1			8
	19	Environmental Swab		4									4
	19	Pet Food					4						4
	19	Porcine					2	2					4
	19	QA						2					2
	19	Turkey					2	3					5
	19	Unknown						6					6
	19	Unknown - Animal					1						1
	22	Porcine			2	1							3
	23	Chicken							1				1
	23	Turkey					1						1
	26	Avian						2	1				3
	26	Canine					7						7
	26	Chicken						5	9				14
	26	Chicken - Meat				3							3
	26	Feline					2						2
	26	Pet Food					1						1
	26	Unknown						1					1
	27	Chicken					1						1
	29	Animal Feed						1					1
	29	Avian	2					4	1				7
	29	Canine					1						1
	29	Chicken					12	56				3	71
	29	Chicken - Meat				6	11	2					19
	29	Eggs					1						1
	29	Environmental Swab					52						52
	29	Equine	1	2			92			2			97
	29	Pet Food					1						1
	29	Porcine					2	3					5
	29	Turkey						2					2
	29	Unknown - Animal					1						1
	32	Chicken		1			1	7					9
	32	Chicken - Meat						1					1
	32	Eggs						1					1
	32	Equine					1						1
	32	Turkey					2	9					11
	35	Avian							11	4			15
	35	Chicken					3		1			1	5

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	35	Chicken - Meat					1						1
	36	Avian						2	2				4
	36	Chicken		2			25						27
	36	Eggs								1			1
	36	QA				1	1						2
	37	Chicken					2						2
	37	Porcine						1					1
	39	Equine		1									1
	39	Porcine						1					1
	39	Turkey	1										1
	40	Chicken					1						1
	40	Chicken - Meat				1	1						2
	40	Environmental Swab						1					1
	41	Avian						1	1				2
	41	Chicken	1				6	1	1			1	10
	41	Chicken - Meat		1			3	2					6
	41	Environmental Swab						5					5
	41	Equine					1						1
	41	Food - Unknown		1									1
	45	Environmental Swab										1	1
	46	Avian						1					1
	47	Chicken							2				2
	47	Turkey						9					9
	52	Chicken					1						1
	52	Chicken - Meat					1						1
	52	Eggs						1					1
	52	Turkey					1						1
	53	Environmental Swab					1						1
	54	Chicken		1									1
	54	Chicken - Meat				1							1
		Subtotal	**8**	**35**	**5**	**14**	**430**	**184**	**34**	**11**	**0**	**7**	**728**
S. Newport	3	Spice - Coriander					1						1
	4	Turkey						4					4
	9	Animal Feed					2						2
	9	Environmental Swab					2						2
	9	Equine					4						4
	9	Porcine					1						1
	9	Turkey					1						1
	9	Water					5						5
	13	Turkey						1					1
	16	Animal Feed					2						2
	16	Bovine					1						1
	16	Turkey					1						1
		Subtotal	**0**	**0**	**0**	**0**	**20**	**5**	**0**	**0**	**0**	**0**	**25**
S. Thompson	3	Unknown						2					2
	5	Canine		1									1
	5	Chicken - Meat					2						2
	5	Pet Food		3									3
	25	Pet Food		1									1
		Subtotal	**0**	**5**	**0**	**0**	**2**	**2**	**0**	**0**	**0**	**0**	**9**

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
S. Typhimurium	1	Goose				1							1
	2	Avian	1				1						2
	2	Bovine					2						2
	2	Porcine				1		1		1			3
	2	Soya					1						1
	4	Food - Unknown		1									1
	10	Avian			1	1	1	1					4
	10	Bovine					1						1
	10	Chicken			1								1
	10	Equine					6						6
	10	Ferret					1						1
	10	Turkey				20							20
	12	Bovine						1					1
	12	Chicken						1					1
	12	Equine					1						1
	12	Porcine					7	31					38
	12	Unknown						1					1
	20	Chicken		1									1
	21	Ovine					2						2
	21	Porcine		2	1		1						4
	22	Eggs						1					1
	22	Porcine	1		5								6
	27	Porcine						1					1
	35	Porcine					2						2
	40	Avian			1								1
	40	Unknown - Animal	1										1
	41	Avian					1	2					3
	41	Equine					2						2
	46	Bovine										4	4
	66	Bovine					1						1
	66	Turkey				3							3
	69	Bovine					1						1
	71	Chicken						1					1
	96	Snake		2									2
	99	Avian					1						1
	99	Porcine						1					1
	104	Almonds					1						1
	104	Avian			1			3					4
	104	Bovine		4			9	2					15
	104	Canine		1									1
	104	Caprine							1				1
	104	Chicken		4	1		4	1					10
	104	Chicken - Meat					1						1
	104	Porcine	2	8	3	4	132	38					187
	104	Snake		1									1
	104	Turkey						2					2
	107	Chicken			5		1	1					7
	108	Porcine					3	6					9
	108	Turkey					1						1
	110	Avian			1								1
	110	Porcine					1						1

Serovar	PT	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	Total
	120	Bovine			1								1
	120	Canine					1						1
	120	Porcine					3	1					4
	120	Water						2					2
	124	Unknown - Animal					2						2
	132	Canine					1						1
	132	Porcine					1						1
	132	QA						1					1
	135	Bovine					1						1
	160	Avian			1								1
	160	Canine		1				1					2
	160	Chicken			1								1
	160	Feline			1								1
	160	Sparrow	1										1
	169	Porcine						1					1
	170	Bovine					1	3					4
	170	Chicken					22	12					34
	170	Porcine				3	4	13					20
	170	Unknown						1					1
	191	Environmental Swab					1						1
	193	Avian					1	3					4
	193	Chicken			1		3						4
	193	Environmental Swab		1			1						2
	193	Feline						1					1
	193	Porcine					10	24					34
	193	Turkey						1					1
	193	Unknown - Animal	1										1
	193	Water						1					1
	195	Avian										1	1
	206	Hedgehog		1									1
	208	Bovine		1									1
	208	Chicken						1					1
	208	Chicken - Meat						1					1
	208	Porcine					14	5					19
		Subtotal	**7**	**28**	**25**	**33**	**251**	**167**	**1**	**1**	**0**	**5**	**518**
S. ssp I 4,[5],12:i:-	2	Avian	1				1						2
	2	Porcine	2										2
	41	Avian									1		1
	41	Chicken	1										1
	104	Porcine					1	2					3
	132	Chicken	1										1
	191	Bovine		1									1
	191	Chicken					2						2
	191	Chicken - Meat					1						1
	193	Canine					2						2
	208	Porcine					1						1
		Subtotal	**5**	**1**	**0**	**0**	**8**	**2**	**0**	**0**	**1**	**0**	**17**

SECTION 3: PATHOGENIC *ESCHERICHIA COLI*

The total number of *E. coli* O157 isolations in 2005 from each province and territory is shown in Figure 14 and population based rates for each province for the years 2001 to 2005 are shown in Figure 15. Total *E. coli* O157 isolations are based largely on NESP data and supplemented with identifications from NML reference services and include *E. coli* O157:H7, *E. coli* O157:NM, *E. coli* O157 VT+ and *E. coli* O157. Due to differing disease reporting procedures from province to province, high rates of *E. coli* O157 isolation may not necessarily reflect 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 population. Although Ontario ranks 1st among the provinces for total number of *E. coli* O157 reported in 2005 with 285 isolations (Figure 14), it ranks 6th overall with the population based isolation rate of 2.3 isolates per 100,000 people (Table 5).

The national isolation rate decreased from 3.4 isolations per 100,000 people in 2004 to 2.4 in 2005, extending a general decrease over the previous 5 years. The largest declines in isolation rates between 2004 and 2005 have been seen the Northwest Territories where rates have decreased from 12.9 to 3.2 and in Manitoba from 10.4 to 1.6 isolations per 100,000 people. The isolation rate in Prince Edward Island has seen a dramatic decline over the 5 year period from a high of 22.6 in 2002 to 6.5 in 2005. Isolation rates higher than the national average of 2.4 isolations per 100,000 people were seen in the Nunavut with 7.0, Prince Edward Island with 6.5, Alberta with 5.7, Northwest Territories with 3.2 and Saskatchewan with 3.1 isolations per 100,000 people.

Figure 14: Number of *E. coli* O157 Isolations from Humans in Canada, 2005

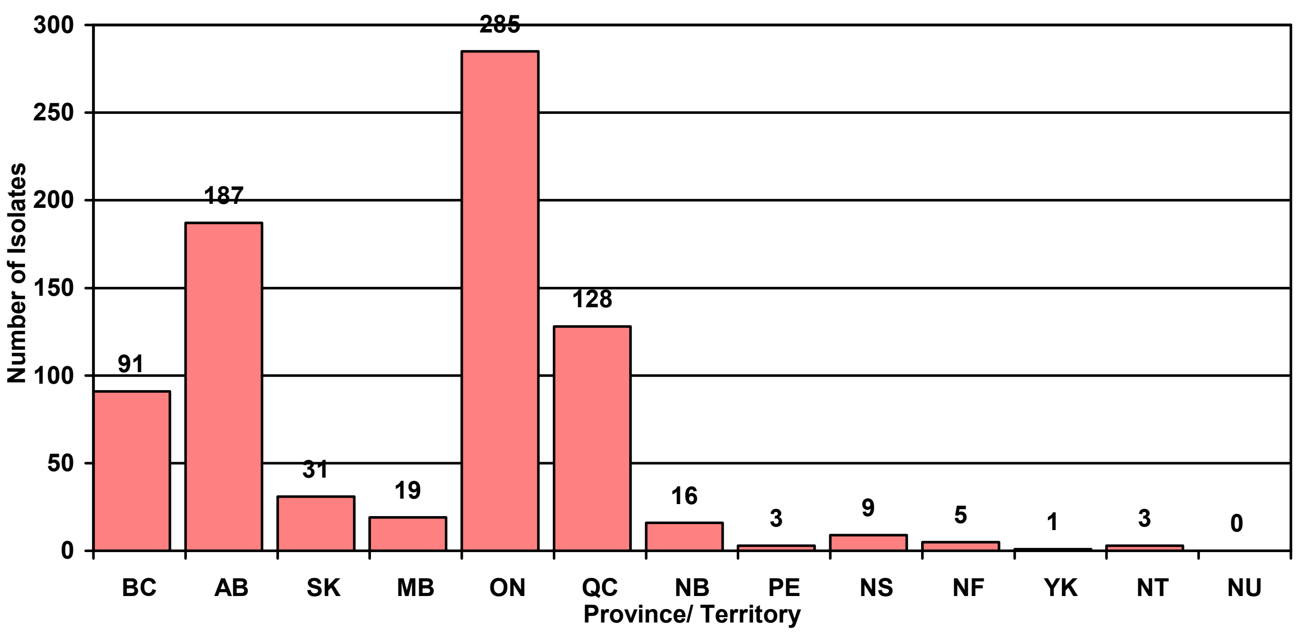


Figure 15: Rates of *E. coli* O157 Isolations from Humans in Canada, 2001 to 2005**

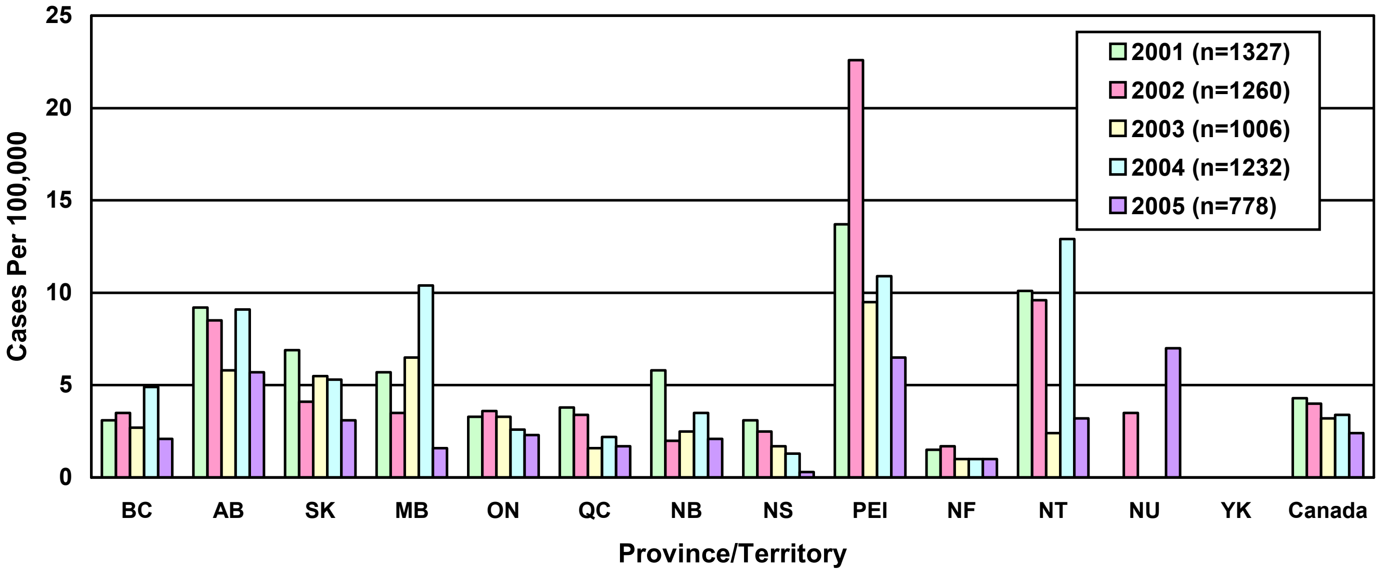


Table 6: Rate of *E. coli* O157 Isolations per 100,000 Population, 2001 to 2005**

Province/Territory	2001	2002	2003	2004	2005
British Columbia	3.1	3.5	2.7	4.9	2.1
Alberta	9.2	8.5	5.8	9.1	5.7
Saskatchewan	6.9	4.1	5.5	5.3	3.1
Manitoba	5.7	3.5	6.5	10.4	1.6
Ontario	3.3	3.6	3.3	2.6	2.3
Quebec	3.8	3.4	1.6	2.2	1.7
New Brunswick	5.8	2.0	2.5	3.5	2.1
Nova Scotia	3.1	2.5	1.7	1.3	0.3
Prince Edward Island	13.7	22.6	9.5	10.9	6.5
Newfoundland and Labrador	1.5	1.7	1.0	1.0	1.0
Northwest Territories	10.1	9.6	2.4	12.9	3.2
Nunavut	0.0	3.5	0.0	0.0	7.0
Yukon Territories	0.0	0.0	0.0	0.0	0.0
Canada	4.3	4.0	3.2	3.4	2.4

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

Table 7: *E. coli* Serotypes Identified from Humans in Canada, 2005*

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YK	NT	NU	TOTAL
E. coli O4:H5						1	1							**2**
E. coli O5:NM	1													**1**
E. coli O2:NM		1				1	1							**3**
E. coli O6:NM	1					1								**2**
E. coli O8:H8				1										**1**
E. coli O8:H19					1									**1**
E. coli O9:NM	1													**1**
E. coli O15:H11							1							**1**
E. coli O17:H18					1									**1**
E. coli O18:H7							1							**1**
E. coli O22:NM		2												**2**
E. coli O25:H4				1										**1**
E. coli O25:NM					1									**1**
E. coli O26	2													**2**
E. coli O26:H11	2			8			1		1					**12**
E. coli O26:NM	7			2										**9**
E. coli O36:NM		1												**1**
E. coli O44				3										**3**
E. coli O45:H2									1					**1**
E. coli O57:H7							1							**1**
E. coli O61:H17						1								**1**
E. coli O63:H6				1										**1**
E. coli O71:H4				1										**1**
E. coli O71:NM		1												**1**
E. coli O75:H8	1													**1**
E. coli O91:H14	1													**1**
E. coli O92:H11	1													**1**
E. coli O98:H8	1													**1**
E. coli O103:H2				1										**1**
E. coli O110:NM		1												**1**
E. coli O111	5			1										**6**
E. coli O111:NM	3			2										**5**
E. coli O117:H7	1													**1**
E. coli O120:H48						1								**1**
E. coli O121:H19	2			1					3					**6**
E. coli O121:NM	5													**5**
E. coli O123:NM	1													**1**
E. coli O126	1													**1**
E. coli O126ac:NM	1													**1**
E. coli O126:H20							1							**1**
E. coli O127				1										**1**
E. coli O141:H33							1							**1**
E. coli O141:NM		1												**1**
E. coli O151:H28					1									**1**
E. coli O157:H7	86	184	30	18	273	123	14	3	9	3	1	3		**747**
E. coli O157:H16		1								1				**2**
E. coli O157:H19			1											**1**
E. coli O157:NM	5	2		1	12	5	2			1				**28**
E. coli O165:NM	1													**1**
E. coli O172:NM		1												**1**
E. coli O176:NM				1										**1**

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YK	NT	NU	TOTAL
E. coli O177:NM	1													**1**
E. coli O189:NM		1												**1**
E. coli Non-O157 VTEC	8			14										**22**
E. coli O-Untypeable:H10		1												**1**
E. coli O-Untypeable:H18						1								**1**
TOTAL	**140**	**197**	**33**	**57**	**290**	**134**	**25**	**5**	**14**	**6**	**1**	**3**	**0**	**905**

*Data represented in Table 7 and Figure 14 are under representative of true incidence. It is provided here to give a general overview of the various pathogenic serotypes of *E. coli* observed in Canada. Few provinces routinely report non-O157 verotoxigenic *E. coli* or non-verotoxigenic *E. coli* isolations and therefore the values listed are largely those that have been forwarded to the NML for reference services. See Appendix 1 for details.

Table 8: Phage Types of *E. coli* O157:H7 in Canada, 2005*

Phage Type	Source	AB	SK	MB	ON	QC	NB	PEI	NF	Total
1	Human		1			6				**7**
2	Human	1	2		19	10				**32**
4	Human				10	4	2			**16**
8	Human				6	6			1	**13**
10	Human				1					**1**
14	Human	11	1	1	12	6	1			**32**
14a	Human	2	17	11	159	62	11	3	1	**266**
14b	Human				1					**1**
14c	Human				2	1				**3**
20	Human				1					**1**
21	Human			1	1					**2**
23	Human				7	2				**9**
27	Human			1	4	1				**6**
31	Human				14	5				**19**
32	Human	2		1	10	2				**15**
33	Human				2	3				**5**
34	Human				5					**5**
49	Human		1		3	1				**5**
51	Human					1				**1**
54	Human	1	4		3	3			1	**12**
63	Human				1					**1**
68	Human				1					**1**
73	Human					1				**1**
74	Human				2					**2**
87	Human			1						**1**
Atypical	Human		1		8	7				**16**
	Subtotal	**17**	**27**	**16**	**272**	**121**	**14**	**3**	**3**	**473**
2	Food - Raw Beef				1					**1**
2	Food - Cheese	10			5					**15**
8	Food - Raw Beef				2					**2**
14	Food - Raw Beef	1								**1**
14a	Food - Raw Beef	4			2					**6**
21	Food - Raw Beef	2								**2**
31	Food - Raw Beef				1					**1**
	Subtotal	**17**	**0**	**0**	**11**	**0**	**0**	**0**	**0**	**28**

*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 (NDRS) for 2004. 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, Quebec, Newfoundland and Labrador, Yukon and Nunavut) provide case-by-case reports that include demographic, clinical, laboratory (minimal) and additional epidemiologic data. The remaining provinces and territories (New Brunswick, Nova Scotia, Prince Edward Island, Manitoba and the Northwest Territories) report aggregate data. With regard to campylobacteriosis, differences exist between numbers of reported *Campylobacter* isolates/cases in the epidemiology arm (i.e. 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 by each province and territory are represented in Figure 16 and population-based rates are shown in Figure 18. 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=3945) in 2004 (Figure 16), due to its large population, the province only ranked 3rd overall in the rate of reported campylobacteriosis with 31.8 cases per 100,000 people.

Rates of reported campylobacteriosis have continued a gradual decline nationally from 39.1 in 2000 to 29.9 isolations per 100,000 people in 2004. Over the 5 year period, British Columbia has shown the largest decreases in rates of infection from 62.0 in 2000 to 35.0 in 2004. Provinces with rates of infection higher than the national level include British Columbia, Ontario and Quebec with 35.0, 31.8 and 32.1 cases per 100,000 people, respectively.

Table 9 shows the *Campylobacter* species identified in 2004. *Campylobacter jejuni* represented the large majority of the isolates with 963 of 9547 cases reported, followed by *C. coli* with 196 isolates.

Figure 16: Number of Reported Cases of Campylobacteriosis, by Province/Territory, 2004 (N=9547)

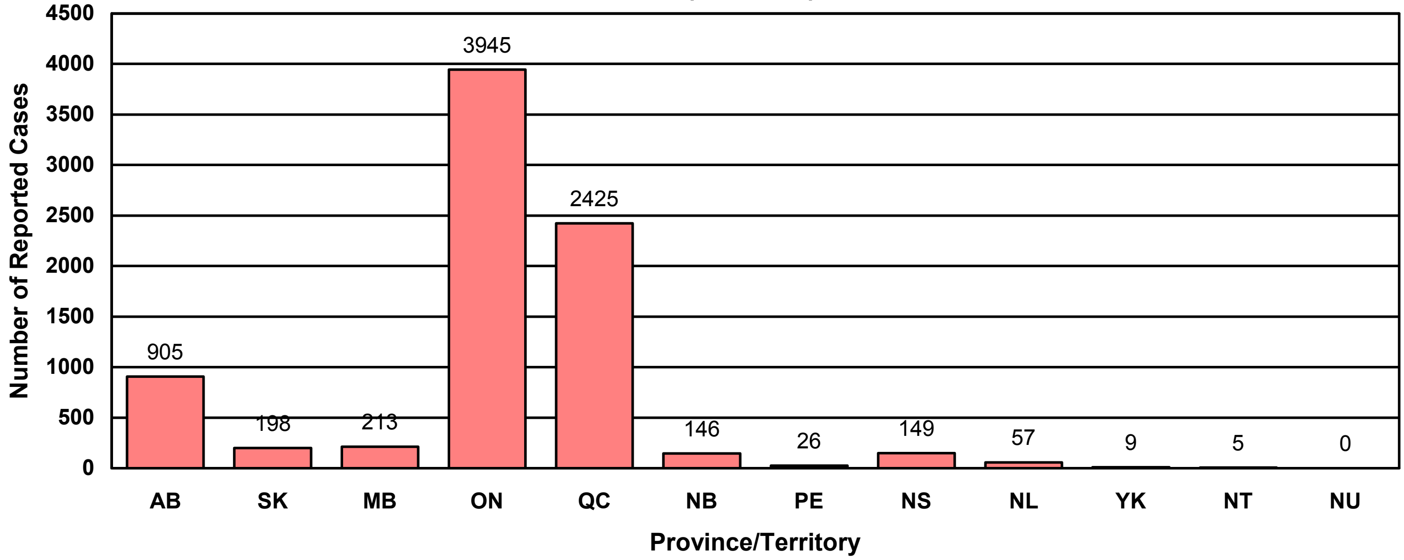


Figure 17: Age and Gender Distribution of *Campylobacter* Infections in Canada, 2004 (N=9345)

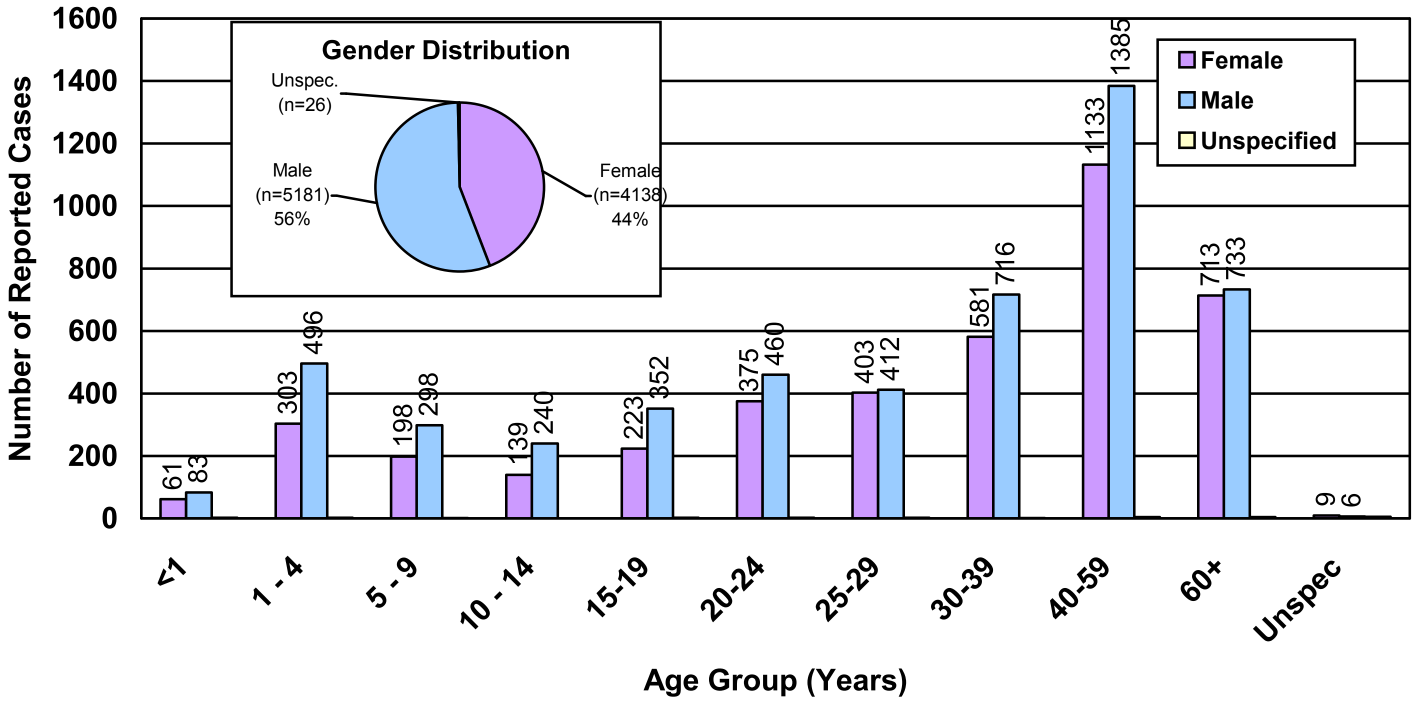


Figure 18: Rate of Reported Campylobacteriosis in Canada, 2000 to 2004

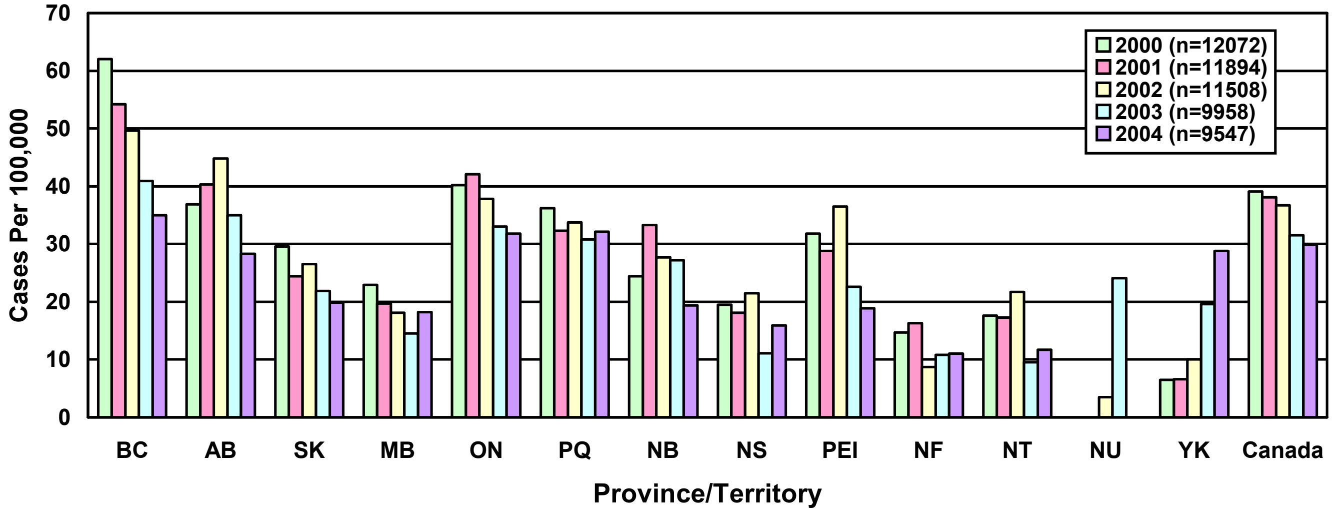


Table 9: Rate of *Campylobacter* Isolations per 100,000 People, 2000 to 2004

Province	2000	2001	2002	2003	2004
British Columbia	62.0	54.2	49.6	40.9	35.0
Alberta	36.9	40.3	44.8	35.0	28.3
Saskatchewan	29.6	24.4	26.5	21.9	19.9
Manitoba	22.9	19.7	18.1	14.5	18.2
Ontario	40.2	42.1	37.8	33.0	31.8
Quebec	36.2	32.3	33.7	30.8	32.1
New Brunswick	24.4	33.3	27.7	27.2	19.4
Nova Scotia	19.5	18.1	21.5	11.1	15.9
Prince Edward Island	31.8	28.8	36.5	22.6	18.9
Newfoundland	14.7	16.3	8.7	10.8	11.0
Northwest Territories	17.6	17.3	21.7	9.5	11.7
Nunavut	0.0	0.0	3.5	24.1	0.0
Yukon Territory	6.5	6.6	10.0	19.6	28.8
Canada	**39.1**	**38.1**	**36.7**	**31.5**	**29.9**

Table 10: *Campylobacter* species Isolates from Humans, 2004

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YK	NT	NU	TOTAL
C. coli	34	23	23	9	78	20	8				1			**196**
C. fetus ssp fetus					8	9								**17**
C. jejuni	45	267	173	106	131	93	86			52	8	2		**963**
C. jejuni/coli		6					6	26	58					**96**
C. lanienae					2									**2**
C. lari		1	1		1	3	7							**13**
C. showae - like						1								**1**
C. upsaliensis		4			7									**11**
Campylobacter sp.	1390	604	1	98	3718	2299	39	0	91	5		3	0	**8248**
Total	**1469**	**905**	**198**	**213**	**3945**	**2425**	**146**	**26**	**149**	**57**	**9**	**5**	**0**	**9547**

SECTION 5: *SHIGELLA*

The total number of *Shigella* isolations in 2005 from each province and territory is shown in Figure 19 and population based isolation rates for each province between 2001 and 2005 are shown in Figure 20. 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 increased from 2.3 isolations per 100,000 people in 2004 to 3.1 in 2005 reflecting the unchanged or elevated isolation rates in all provinces or territories over 2004 levels. Prince Edward Island reported the largest increase from 0 in 2004 to 3.6 in 2005. Over the 5 year period, Ontario has shown the largest decrease in rate of infection from 6.8 isolations per 100,000 people in 2002 to 2.7 in 2005. Provinces with rates of infection higher than the national level include British Columbia, Alberta, Quebec, Prince Edward Island and Nunavut with 5.4, 3.3, 3.4, 3.6 and 3.2 isolations per 100,000 people, respectively

Shigella sonnei accounted for the majority of identifications with 522 isolates, followed by 267 *S. flexneri*, 37 *S. boydii* and 29 *S. dysenteriae* isolations in 2005. Serotypes are listed in Table 12.

Figure 19: Number of S*higella* Isolations from Humans in Canada, 2005

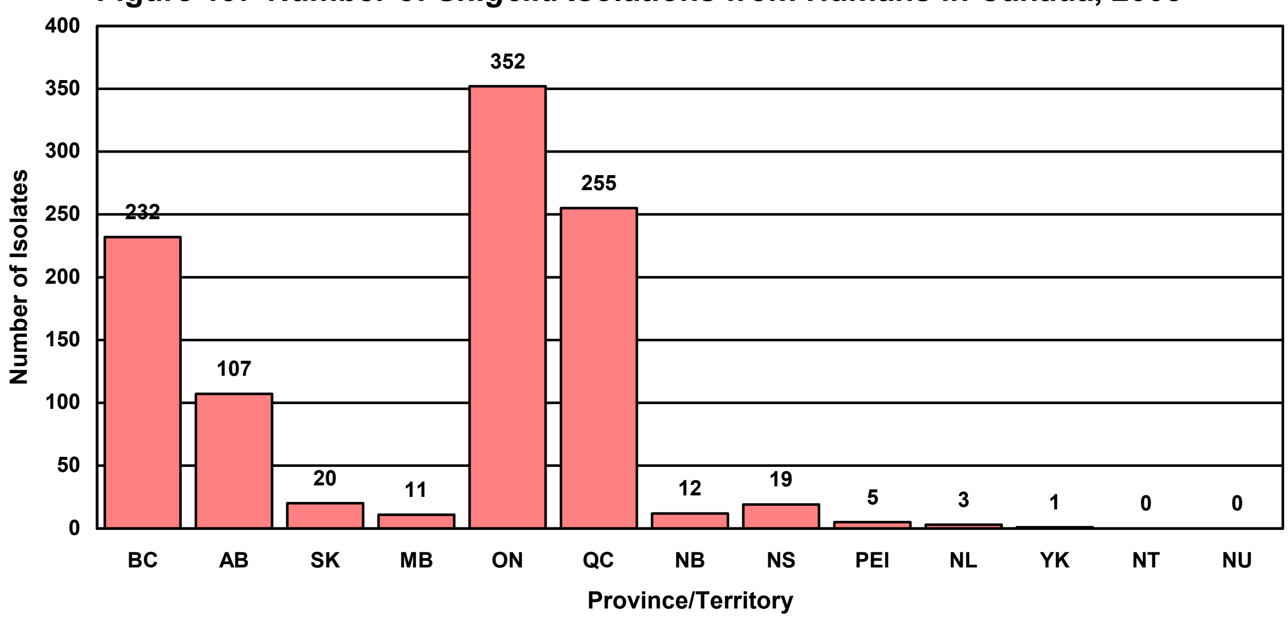


Figure 20: Rate of *Shigella* Isolations from Humans in Canada, 2001 to 2005*

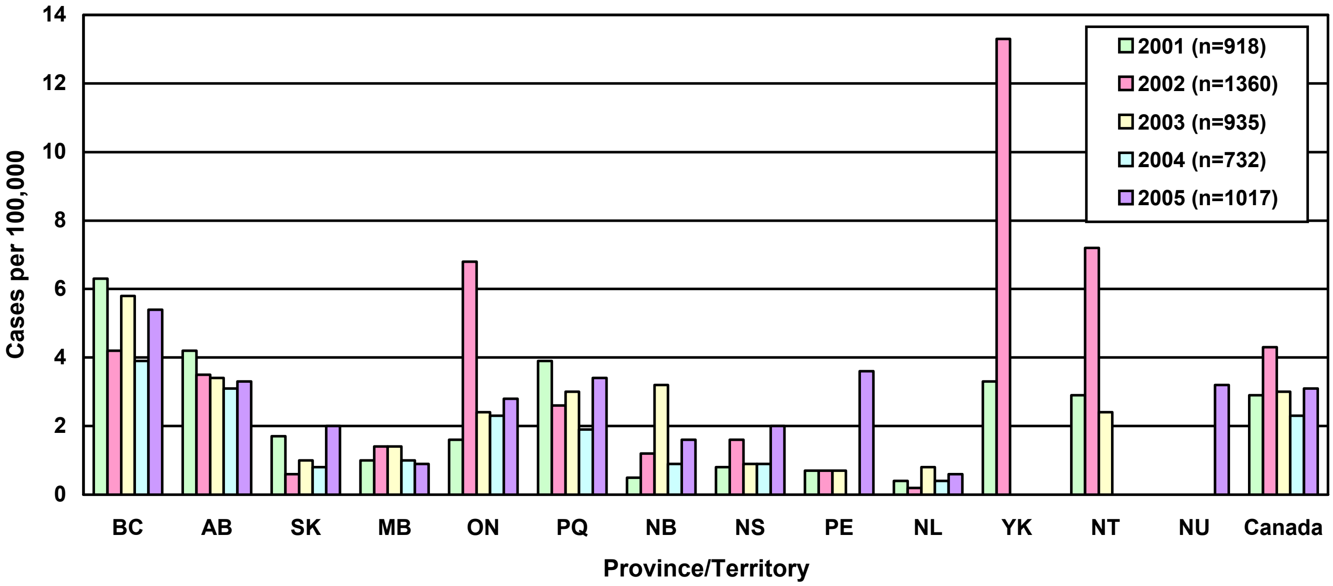


Table 11: Rate of *Shigella* Isolations per 100,000 People, 2001 to 2005*

Province	2001	2002	2003	2004	2005
British Columbia	6.3	4.2	5.8	3.9	5.4
Alberta	4.2	3.5	3.4	3.1	3.3
Saskatchewan	1.7	0.6	1.0	0.8	2.0
Manitoba	1.0	1.4	1.4	1.0	0.9
Ontario	1.6	6.8	2.4	2.3	2.8
Quebec	3.9	2.6	3.0	1.9	3.4
New Brunswick	0.5	1.2	3.2	0.9	1.6
Nova Scotia	0.8	1.6	0.9	0.9	2.0
Prince Edward Island	0.7	0.7	0.7	0.0	3.6
Newfoundland and Labrador	0.4	0.2	0.8	0.4	0.6
Yukon	3.3	13.3	0.0	0.0	0.0
Northwest Territories	2.9	7.2	2.4	0.0	0.0
Nunavut	0.0	0.0	0.0	0.0	3.2
Canada	**2.9**	**4.3**	**3.0**	**2.3**	**3.1**

*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, 2005

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NL	YK	NT	NU	Total
Shigella boydii		1	1		7			0						**9**
Shigella boydii 1	1													**1**
Shigella boydii 2		2			1									**3**
Shigella boydii 4	2													**2**
Shigella boydii 6	1													**1**
Shigella boydii 9	2													**2**
Shigella boydii 12	2													**2**
Shigella boydii 13		1												**1**
Shigella boydii 14	1				2									**3**
Shigella boydii 18	1	2	1											**4**
Shigella boydii 19	1							1						**2**
Shigella boydii 20	2	1			1	3								**7**
Total *Shigella boydii*	**13**	**7**	**2**	**0**	**11**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**37**
Shigella dysenteriae		1			1		2	1						**5**
Shigella dysenteriae 2	2				4	1		2						**9**
Shigella dysenteriae 3					1									**1**
Shigella dysenteriae 4	1						1							**2**
Shigella dysenteriae 6	1													**1**
Shigella dysenteriae 7	1													**1**
Shigella dysenteriae 9		1												**1**
Shigella dysenteriae 12	1				1									**2**
Shigella dysenteriae 13		1			1									**2**
Shigella dysenteriae 14		1												**1**
Shigella dysenteriae 16	1									1				**2**
Shigella dysenteriae SH-111					1	1								**2**
Total *Shigella dysenteriae*	**7**	**4**	**0**	**0**	**9**	**2**	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**29**
Shigella flexneri	2	4	7	5	109		2	6	0					**135**
Shigella flexneri 1	2	6												**8**
Shigella flexneri 1b					4	6	1							**11**
Shigella Flexneri 1c														**0**
Shigella flexneri 2	17	15				1								**33**
Shigella flexneri 2a	2			1	2	15			1					**21**
Shigella flexneri 2b						1								**1**
Shigella flexneri 3	7	5												**12**
Shigella flexneri 3a				1		6			3					**10**
Shigella flexneri 3b						2								**2**
Shigella flexneri 4	5													**5**
Shigella flexneri 4a					7									**7**
Shigella flexneri 6	5	5				3								**13**
Shigella flexneri 16						0								**0**
Shigella flexneri Prov. SH-101	1													**1**
Shigella flexneri Prov. SH-104	5	2			1									**8**
Total *Shigella flexneri*	**46**	**37**	**7**	**7**	**123**	**34**	**3**	**6**	**4**	**0**	**0**	**0**	**0**	**267**
Shigella sonnei	**157**	**59**	**8**	**3**	**209**	**70**	**4**	**8**	**1**	**2**	**1**	**0**	**0**	**522**
Shigella species	9		3	1		146	2	1						**162**
Total *Shigella*	**232**	**107**	**20**	**11**	**352**	**255**	**12**	**19**	**5**	**3**	**1**	**0**	**0**	**1017**

Table 13 lists *Shigella* phage types of human isolates identified in 2005. 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 useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the subtypes found in Canada.

PT1 continues to be the predominant phage type of *S. sonnei* in 2005 accounting for 57% (n=148) of the 260 isolates tested. A larger number of isolates from other parts of the country may substantially improve the sub-typing databases for this organism and become more reliable for assisting in outbreak investigations of public health significance.

Table 13: Phage Types of *S. boydii* and *S. sonnei* Isolates from Humans, 2005

Organism	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Shigella boydii	3	2	3	1		1			1			**8**
	6		2			2						**4**
	10	1										**1**
	14	1										**1**
	Untypable	1	1									**1**
	Total	**4**	**5**	**1**	**0**	**3**	**0**	**0**	**1**	**0**	**0**	**15**
Shigella sonnei	1	76	39			33						**148**
	2	1	2					2				**5**
	4	1	1									**2**
	5	8										**8**
	7	2	4					2				**8**
	10	2	1									**3**
	11	1				1						**2**
	15	3	6			22						**31**
	16		1									**1**
	17	1										**1**
	19	3	1			1						**5**
	20		2			1						**3**
	25	42				1						**43**
	Atypical	9	3			1				1		**14**
	Total	**140**	**57**	**0**	**0**	**59**	**0**	**4**	**0**	**0**	**0**	**260**

SECTION 6: PARASITES

The total number of *Cryptosporidium*, *Cyclospora, Entamoeba* and *Giardia* isolations in 2005 from each province is shown in Figure 21 and population-based isolation rates for each province between 2001 and 2005 are shown in Figure 22. The data are collected through the NESP and are supplemented with NDRS data. *Entamoeba* is currently not nationally notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported. Due to differing disease reporting procedures from province to province, higher numbers of isolations may not necessarily reflect 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 relatively consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the organisms found in Canada.

Although Ontario reported the highest number of cases of parasitic infections in 2005 (Figure 21), due to its large population, the province ranked 5th overall in population based rates with 17.1 cases per 100,000 people.

There has been a slight decrease in the national isolation rate from 17.3 cases per 100,000 people in 2004 to 16.9 in 2005. Rates higher than the national level were observed in Nunavut (73.3), Yukon (45.0), British Columbia (22.2), Alberta (17.3) and Ontario (17.1).

The greatest decrease in isolation rates was seen in the Northwest Territories where rates have decreased from 28.0 cases per 100,000 in 2004 to 14.1 in 2005.

Figure 21: Number of Parasitic Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2005

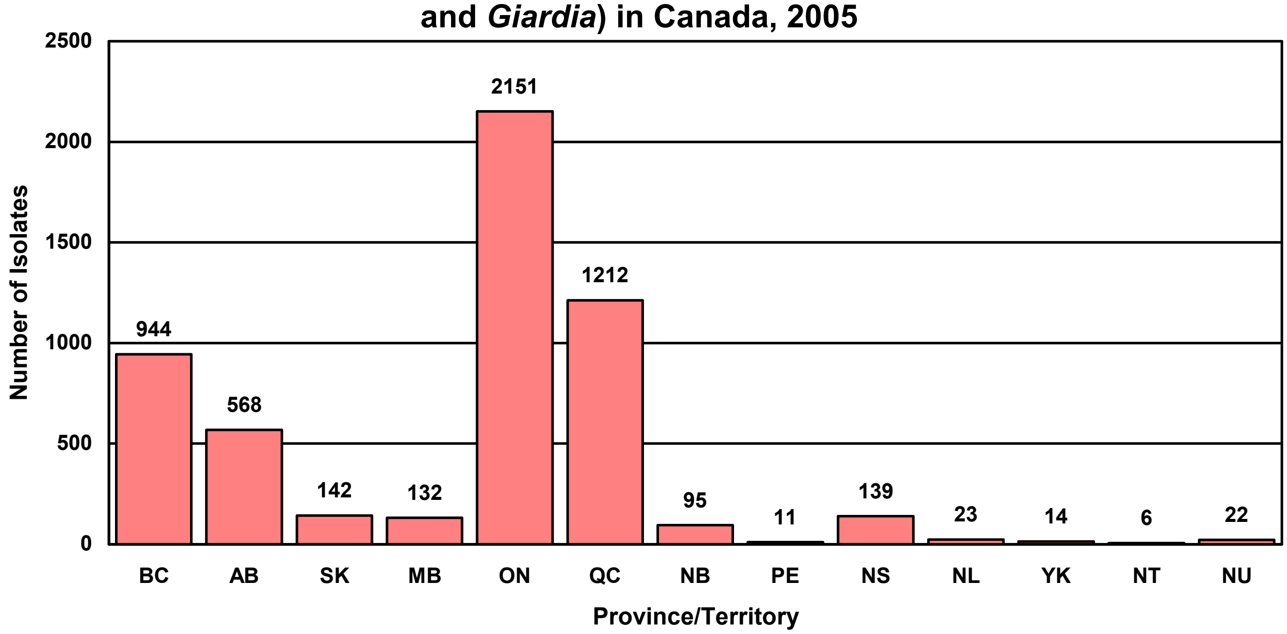


Figure 22: Rate of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) in Canada, 2001 to 2005

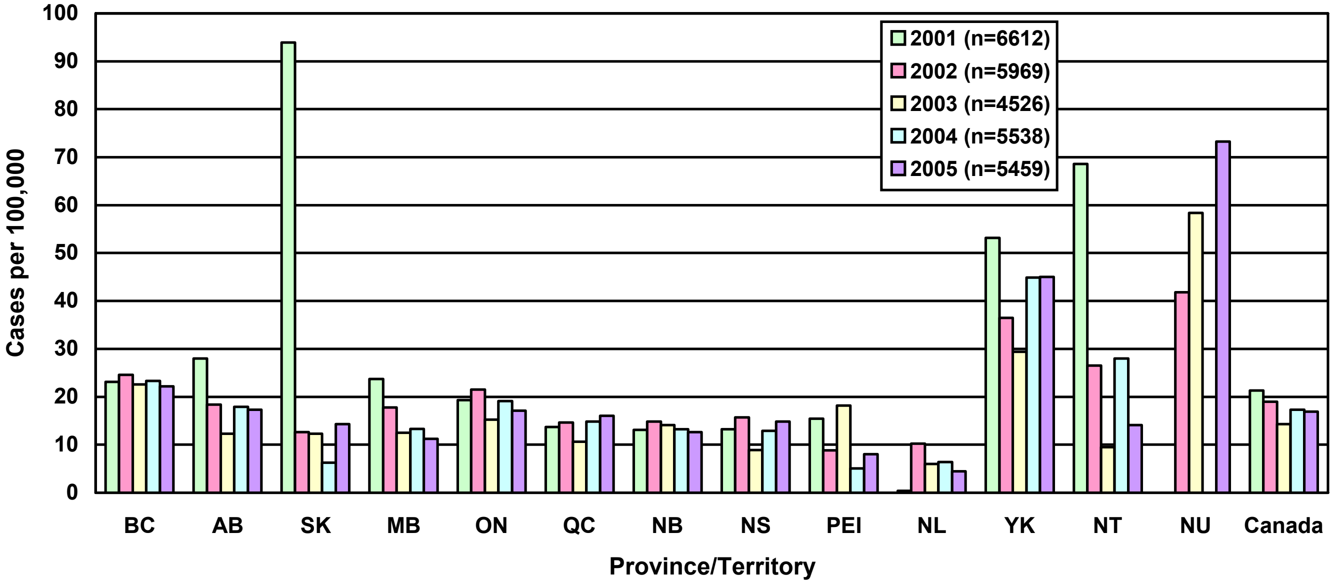


Table 14: Provincial Rates of Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) per 100,000 People, 2001 to 2005*

Province	2001	2002	2003	2004	2005
British Columbia	23.1	24.6	22.6	23.3	22.2
Alberta	28.0	18.4	12.3	17.9	17.3
Saskatchewan	93.9	12.6	12.3	6.3	14.3
Manitoba	23.7	17.8	12.5	13.3	11.2
Ontario	19.3	21.5	15.2	19.1	17.1
Quebec	13.7	14.6	10.6	14.8	16.0
New Brunswick	13.1	14.8	14.1	13.2	12.6
Nova Scotia	13.2	15.7	8.9	12.9	14.8
Prince Edward Island	15.4	8.8	18.2	5.1	8.0
Newfoundland and Labrador	0.4	10.2	6.0	6.4	4.5
Yukon	53.2	36.5	29.4	44.9	45.0
Northwest Territories	68.6	26.5	9.5	28.0	14.1
Nunavut	0.0	41.8	58.4	0.0	73.3
Canada	**21.3**	**19.0**	**14.3**	**17.3**	**16.9**

Table 15: Parasite Isolations (*Cryptosporidium, Cyclospora, Entamoeba* and *Giardia*) Identifications in Canada, 2005*

Organism	BC	AB	SK	MB	ON	QC	NB	PE	NS	NL	YK	NT	NU	Total
Cryptosporidium	124	110	26	15	238	30	10	2	20	0	0	0	0	**575**
Cyclospora	35	0	0	0	125	39	1	0	0	0	0	0	0	**200**
*Entamoeba**	98	6	11	14	345	138	3	0	11	0	2	0	0	**628**
Giardia	687	452	105	103	1443	1005	81	9	108	23	12	6	22	**4056**
Total	**944**	**568**	**142**	**132**	**2151**	**1212**	**95**	**11**	**139**	**23**	**14**	**6**	**22**	**5459**

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

SECTION 7: *YERSINIA*

The total number of *Yersinia* isolations in 2005 from each province is shown in Figure 23 and population based isolation rates for each province between 2001 and 2005 are shown in Figure 24. Data is from the NESP and is supplemented with identifications from reference services provided by the NML. The data is based on laboratory identifications and should not be confused with incidence of disease. Due to differing disease reporting procedures from province to province, higher numbers of isolations may not necessarily reflect incidence of disease, but better sampling and reporting structures. As well, the proportion of specimens forwarded to provincial laboratories may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains relatively consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the organisms found in Canada (see Appendix 1 for details).

The national rate of *Yersinia* isolations has continued to decline with a slight decrease from 1.9 isolates per 100,000 people in 2004 to 1.7 in 2005 (Figure 24). Ontario had the highest number of isolations with 352 reported, as well as the highest population based rate of 2.8 isolations per 100,000 people followed by Alberta with 83 isolations and a rate of 2.5 isolations per 100,000 people. Marginal increases were observed in Ontario where isolations have increased from 2.4 in 2004 to 2.8 cases per 100,000 people in 2005.

Y. enterocolitica is the most prominent strain in Canada with 505 isolates reported in 2005, followed distantly by *Y. frederiksenii* and *Y. intermedia* with 25 and 10 isolations reported, respectively.

Figure 23: Number of *Yersinia* Isolations from Humans in Canada, 2005

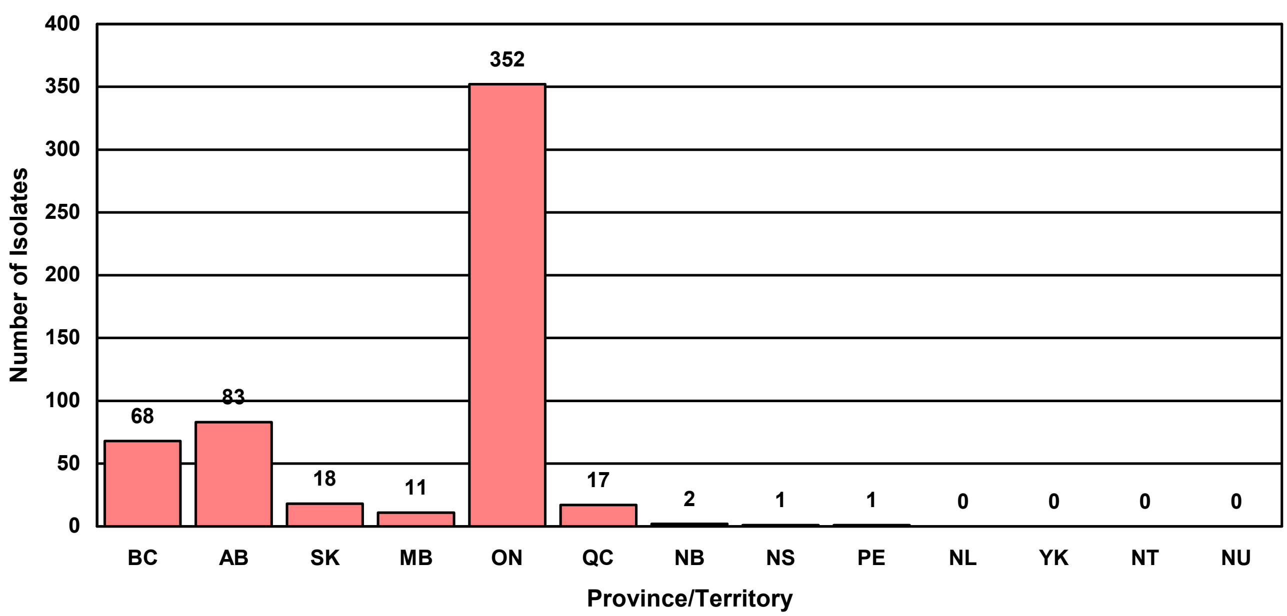


Figure 24: Rate of *Yersinia* Isolations from Humans in Canada, 2001 to 2005*

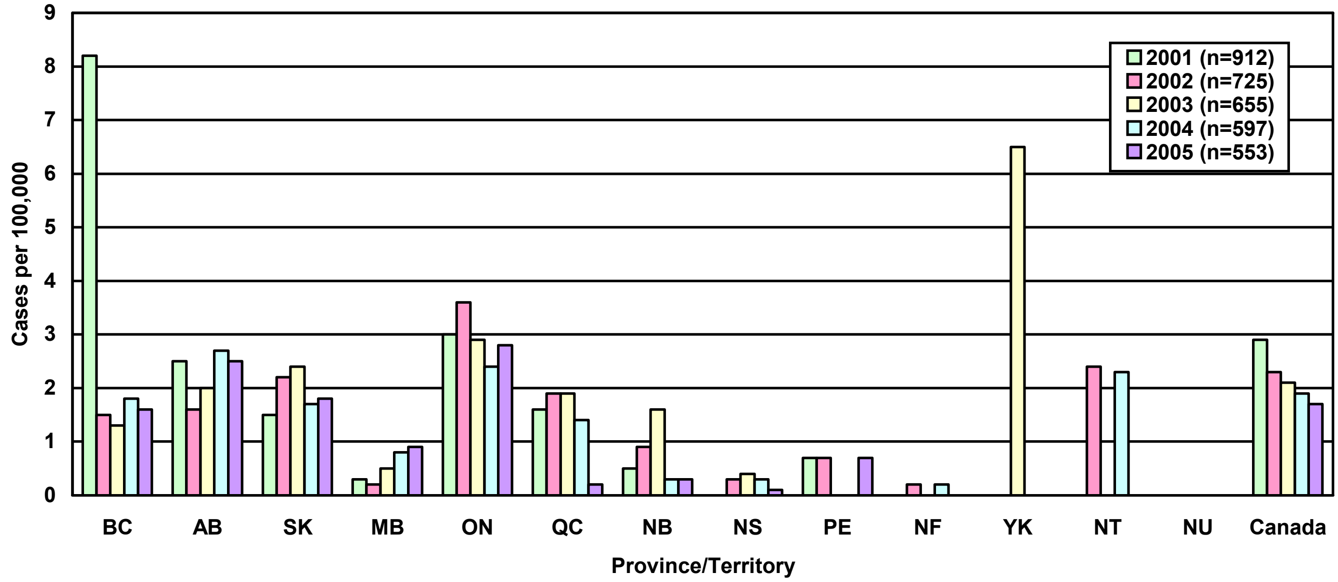


Table 16: Provincial and Territorial Rates of *Yersinia* Isolations per 100,000 People, 2001 to 2005

Province	2001	2002	2003	2004	2005
British Columbia	8.2	1.5	1.3	1.8	1.6
Alberta	2.5	1.6	2.0	2.7	2.5
Saskatchewan	1.5	2.2	2.4	1.7	1.8
Manitoba	0.3	0.2	0.5	0.8	0.9
Ontario	3.0	3.6	2.9	2.4	2.8
Quebec	1.6	1.9	1.9	1.4	0.2
New Brunswick	0.5	0.9	1.6	0.3	0.3
Nova Scotia	0.0	0.3	0.4	0.3	0.1
Prince Edward Island	0.7	0.7	0.0	0.0	0.7
Newfoundland and Labrador	0.0	0.2	0.0	0.2	0.0
Yukon	0.0	0.0	6.5	0.0	0.0
Northwest Territories	0.0	2.4	0.0	2.3	0.0
Nunavut	0.0	0.0	0.0	0.0	0.0
Canada	**2.9**	**2.3**	**2.1**	**1.9**	**1.7**

Table 17: *Yersinia* Isolates from Humans in Canada, 2005

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
Y. enterocolitica	50	71	13	8	343	16	2	1	1					**505**
Y. frederiksenii	10	5	2	2	6									**25**
Y. intermedia	3	3	2		1	1								**10**
Y. kristensenii	2		1		1									**4**
Y. pseudotuberculosis	2													**2**
Y. rohdei	1	4			1									**6**
Yersinia sp.				1										**1**
Total	**68**	**83**	**18**	**11**	**352**	**17**	**2**	**1**	**1**	**0**	**0**	**0**	**0**	**553**

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. paraheamolyticus*. There were two *Vibrio cholerae* O1 strains reported in Canada in 2005, one serotype Inaba was associated with travel to Pakistan and the other serotype Ogawa strain was associated with travel to Mexico (see Table 19).

Table 18: *Vibrio* Isolations by Province/Territory in Canada, 2005

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YK	NT	NU	Total
V. cholerae Non-O1/O139	1	1	3		1	2	3							**11**
V. cholerae O1 Inaba		1												**1**
V. cholerae O1 Ogawa		1												**1**
V. fluvialis	1	1												**2**
V. hollisae	1	1			1									**3**
V. parahaemolyticus	13	8												**21**
V. vulnificus					1									**1**
Vibrio sp.							1							**1**
Total	**16**	**13**	**3**	**0**	**3**	**2**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**41**

Table 19: *Vibrio* Identified in Canada Between 2001 and 2005

Organism	2001	2002	2003	2004	2005
V. alginolyticus	2	2	5	2	
V. cholerae non-O1/O139	10	16	16	8	11
V. cholerae O1 Inaba		1			1
V. cholerae O1 Ogawa	3			1	1
V. fluvialis	1		2	3	2
V. hollisae	1		1		3
V. mimicus		2	2		
V. metschnikovii	1				
V. parahaemolyticus	5	20	19	16	21
V. vulnificus	1	1		1	1
Vibrio sp.	1	1			1
Total	**25**	**43**	**45**	**31**	**41**

SECTION 9: OUTBREAKS

Table 17 summarizes outbreaks of enteric disease reported for the years 2001 to 2005 through various surveillance systems such as the NESP, PulseNet Canada and cluster investigations where the NML and CIDPC have provided assistance. This list is not an exhaustive account of all outbreaks that have occurred in Canada and may also contain clusters of identical isolates that have not been epidemiologically linked. There currently is no national outbreak reporting system that systematically and routinely collates outbreak summary data from provincial health authorities. As a consequence, this 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 are grouped by causative organism and outbreak type. Outbreak types classify the events into general categories of community, family, institutional, restaurant and travel. Community outbreaks include those events involving a group of individuals with common exposure to specific events (banquets, weddings and parties) or products (ground beef from retail outlets). Family outbreaks are small events consisting of immediate family members and friends and generally consist of person-to-person spread of the infectious agent within a household. Institutional outbreaks include hospitals, long-term care facilities, schools and other events in which individuals are in close contact and share exposures. Day care outbreaks are a sub-set of the institutional category, but because of the extra concerns of young children being affected, these events are described separately. Restaurant outbreaks involve events related to commercial distribution of prepared meals. Travel related outbreaks involve those events where the original infection is thought to have occurred outside the country but symptoms are displayed after returning to Canada.

There were 106 outbreaks and clusters reported in Canada during 2005 causing 1654 cases of illness. *Salmonella* continues to be the prominent causative agent of enteric outbreaks accounting for 52% (n=55) of the reported outbreaks and 66% (n=1086) of all outbreak-related illnesses (Table 17). The number of *Salmonella* outbreaks has remained at 2004 levels, however the number of illnesses dramatically increased from accounting for 47% (n=345) of outbreak-related illnesses indicating larger outbreaks in 2005. Community and restaurant-associated outbreaks involved the highest number of cases with 830 and 170 illnesses, respectively. Verotoxigenic *E. coli* was implicated in 33% of the outbreaks (n=33) involving 10% (n=152) of the associated outbreak related illnesses, continuing a general downward trend since 2002 when 36% (n=25) of the outbreaks caused 22% (n=245) of all outbreak associated illnesses. The majority of illnesses attributed to *E. coli* O157 VTEC continue to be from community-associated outbreaks that account for 12 outbreaks a total of 69 illnesses. The number of restaurant-associated outbreaks of *E. coli* O157 illness has decreased from a total of 149 illnesses from 6 outbreaks in 2004 to 28 illnesses from 3 outbreaks in 2005. *Shigella sonnei* outbreaks and clusters have increased dramatically from 2004 when there were 3 outbreaks with 7 illnesses to 9 outbreaks causing 95 illnesses in 2005. Two outbreaks of *Shigella flexneri* causing 7 cases of illness and one outbreak of *Yersinia enterocolitica* involving 3 illnesses were observed for the first time over the 5 year period between 2001 and 2005. Also of note are 5 outbreaks of *Cyclospora* causing 255 cases of illness reported in 2005 when there was only one previous outbreak of 8 cases reported over the previous 4 years.

Table 20: Outbreaks and Case Clusters of Enteric Disease in Canada, 2001 to 2005

Organism	Outbreak Type	2001		2002		2003		2004		2005	
		#OB [a]	Cases	#OB	Cases	#OB	Cases	#OB	Cases	#OB	Cases
Salmonella	Community	16	360	19	381	12	155	15	108	23	830
	Day Care	1	35	0	0	0	0	0	0	0	0
	Family	17	39	21	58	10	23	18	48	21	54
	Institutional	0	0	0	0	5	26	3	35	3	21
	Restaurant	3	162	3	22	7	99	10	154	4	170
	Travel	1	3	0	0	0	0	0	0	4	11
	Total	**38**	**599**	**43**	**461**	**34**	**303**	**43**	**345**	**55**	**1086**
E. coli O157 VTEC	Community	2	7	7	166	9	206	9	90	12	69
	Day Care	1	3	5	35	1	4	1	11	1	11
	Family	7	16	11	30	7	19	13	34	17	44
	Institutional	0	0	1	12	0	0	0	0	0	0
	Restaurant	1	15	1	2	1	5	6	149	3	28
	Total	**11**	**41**	**25**	**245**	**18**	**234**	**29**	**284**	**33**	**152**
C. jejuni	Community	0	0	0	0	0	0	0	0	1	45
C. coli	Restaurant	0	0	0	0	0	0	1	40	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**40**	**1**	**45**
Shigella flexneri	Family	0	0	0	0	0	0	0	0	1	4
	Travel	0	0	0	0	0	0	0	0	1	3
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**7**
Shigella sonnei	Community	1	26	1	426	6	40	0	0	3	32
	Day Care	0	0	0	0	0	0	0	0	1	11
	Family	1	2	0	0	4	18	2	5	3	6
	Institutional	0	0	0	0	1	15	0	0	0	0
	Travel	0	0	1	6	0	0	0	0	1	52
	Restaurant	0	0	0	0	0	0	1	2	0	0
	Total	**2**	**28**	**2**	**432**	**11**	**73**	**3**	**7**	**8**	**101**
Y. enterocolitica	Community	0	0	0	0	0	0	0	0	1	3
Cryptosporidium	Community	0	0	0	0	1	4	0	0	0	0
	Family	0	0	0	0	0	0	4	47	1	5
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**
Cyclospora	Community	0	0	0	0	0	0	1	8	1	44
	Restaurant	0	0	0	0	0	0	0	0	1	200
	Travel	0	0	0	0	0	0	0	0	1	11
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**8**	**5**	**255**
Giardia	Community	0	0	0	0	0	0	1	6	0	0
	Family	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total		**51**	**668**	**70**	**1138**	**64**	**614**	**82**	**737**	**106**	**1654**

(a) = Number of Outbreaks

Outbreaks 2005

Salmonella

There were 58 *Salmonella*-related outbreaks and clusters involving 18 serovars and causing 1190 cases of illness in 2005. *S*. Enteritidis was associated with the majority of the outbreaks and clusters, identified in 11 outbreaks and causing 663 cases of illness. The largest outbreak of 2005 involved 552 confirmed *S*. Enteritidis PT 13 infections linked to the consumption of mung bean sprouts in Ontario between October 1 and December 14. Another outbreak in Québec during February, involved 23 isolates with PFGE pattern SENXAI.0077 / SENBNI.0005 and PT 11b. Matching PFGE patterns and phage type were also observed among 9 isolates from British Columbia and 2 isolates from New Brunswick. An investigation conducted by provincial and federal agencies did not identify a common source for these infections. In August, 16 cases of PT 13 were linked to the consumption of turkey pot pie at an Ontario senior's residence. In Alberta, 8 cases of PT 33 infection during June were where suspected to be associated with locally produced mung bean sprouts served in restaurants. Two family outbreaks with 2 cases each were reported in British Columbia and 2 travel-related outbreaks reported in Québec where 5 cases of PT 4 were associated with travel to Cuba and 2 cases of PFGE pattern SENXAI.0004 were associated with travel to China. Other clusters observed in 2005 included 3 cases of PT2 / PFGE pattern SENXAI.0003 in Manitoba during January, 3 cases of PT 11b / PFGE pattern SENXAI.0013 in Alberta during May and 6 cases of PT 8 / PFGE pattern SENXAI.0003 in New Brunswick.

S. Typhimurium was associated with 256 illnesses in 12 outbreaks and case clusters during 2005, the largest of these involving 155 illnesses of *S*. Typhimurium PT 104 as well as 1 *S*. Agona, 5 *S*. Berta and 5 *S*. Derby infections linked to a Mother's Day buffet held in Ontario. Phage typing of *S*. Typhimurium isolates in Ontario led to the identification of a widespread outbreak involving 45 cases of the uncommon PT U302 with onset dates from March through May 2005. An investigation failed to identify a common source of infection (CCDR, April 1, 2006). Three *S*. Typhimurium outbreaks were associated with food establishments or social events where food was served. Among these were 18 cases of *S*. Typhimurium PT 104a / PFGE pattern STXAI.0285 in January involving roasted meats purchased at a local food restaurant/bakery. Five cases of *S*. Typhimurium infection reported by Québec in September were linked to a barbecue type gathering (méchoui) and in December and in British Columbia 4 cases where linked to another food establishment. An outbreak involving 8 cases of *S*. Typhimurium PT 2 was also reported among workplace employees in Manitoba during December. There were also 4 relatively small family related outbreaks of *S*. Typhimurium accounting for 16 illnesses and 1 institutional outbreak causing 3 illnesses at an Alberta college.

S. Schwarzengrund PT 1 / PFGE pattern SchwaXAI.0010 was implicated in an outbreak in late June 2005. The outbreak involved a total of 55 illnesses (7 were laboratory confirmed) that were associated with a culinary event held for 230 attendees from Ontario and New York State. No common source of infection was determined. There were also 2 family contact outbreaks; 3 isolates of SchwaXAI.0012 in Québec during July and 2 cases in British Columbia during August.

There were 4 outbreaks of *S*. Thompson noted in 2005. Twenty-two cases of *S*. Thompson PT 5 / PFGE pattern STHXAI.0046 were identified among employees at a manufacturing plant in southern Ontario during October and linked to chicken served at a luncheon. A second cluster, included 3 cases of *S*. Thompson PT 5 / PFGE pattern

STHXAI.0034, two identified in Alberta and one in British Columbia between January and May were linked to natural pet treats produced by a United States company. Two cases matching the outbreak pattern were also identified in Washington State. Both the CFIA and the USFDA issued recalls of the affected products in early June. Another outbreak in Ontario during December involved 3 cases of illness associated with eggs served at a restaurant. There was also 1 family contact outbreak of 2 cases of PT 2 / STHXAI.0002 in New Brunswick reported in July.

A cluster investigation in Ontario during July identified 27 cases of *S*. Muenchen with PFGE pattern MueXAI.0042, however no common source of infection was identified.

There were 3 small household clusters of *S*. Paratyphi B var. Java. Two were reported in Nova Scotia with one in February involving 2 cases and the other in October included 3 cases. Another family outbreak in BC in November involved 2 cases. Two cases from British Columbia during November were related to travel to Mexico.

A cluster of 5 cases of *S*. Telelkebir was investigated in Québec in October where a chameleon related to one of these cases was confirmed with *S*. Telelkebir. Another family cluster of 2 *S*. Monschaui infections were likely linked to a pet iguana.

Two cases of *S*. Javiana were related to an outbreak in a long-term care facility and 4 cases of *S*. Saintpaul with PFGE pattern SainXAI.0033 were associated with a wedding. There were 12 other family related outbreaks and case cluster investigations involving 1 to 5 cases each of *S*. Agona, *S*. Hadar, *S*. Heidelberg, *S*. Newport, *S*. Paratyphi A and *S*. Stanley for a total of 33 illness.

There were 3 other unidentified cluster investigations reported to PulseNet in 2005, one with 10 cases of *S*. Berta BertXAI.0005 and another of 6 cases of *S*. Brandenburg BraXAI.0002 reported by Quebec, 5 cases of *S*. Hadar PT 2 / SHAXAI.0003 in Alberta.

Campylobacter jejuni

Only one *Campylobacter*-related outbreak was identified in 2005 involving 45 identifications of *C. jejuni* infection at a youth camp event in Alberta in June. *C. jejuni*, as well as *E. coli*, was isolated from the well water used at the camp following heavy rains in the area.

Verotoxigenic *Escherichia coli*

Thirty outbreaks and case clusters were associated with *E. coli* O157:H7, one with *E. coli* O157:NM, one with *E. coli* O26:NM and one with *E. coli* O121:H19 were noted in 2005.

There were six community outbreaks identified in 2005. An outbreak associated with the consumption of unpasteurized milk in Ontario consisted of 4 cases in April with PFGE pattern ECXAI.0001.

Two outbreaks were linked to the consumption of ground beef resulting in the recall of affected products. One of these involved 2 cases (PFGE pattern ECXAI.0044) in British Columbia in July. Another outbreak was an inter-provincial outbreak involving 19 cases (ECXAI.1339) in Alberta and British Columbia in November. There was a secondary cluster of 6 cases (ECXAI.1340) occurring concurrently in these two provinces linked to ground beef as well. In July, 6 cases of PT 31 / PFGE pattern ECXAI.1240 in Ontario were linked to roast beef and 4 in October to unpasteurized apple cider produced and sold at a small local retail outlet.

Three outbreaks associated with *E. coli* O157:H7 were linked to food establishments in Alberta in 2005, the largest involved 16 cases (ECXAI.0816) linked to an ill food handler preparing milk shakes at a popular road-side eatery on the Trans-Canada highway in Alberta between April and May. A second outbreak, occurring at the same time, included 9 cases associated with a separate establishment in another community. Although the PFGE patterns for these isolates from the two outbreaks were identical, no link was established between the two events. The third outbreak involving 3 cases with PFGE pattern ECXAI.0992 was linked to a café-style food establishment in July.

An outbreak in a daycare centre was identified in Ontario in late June and early July consisted of 11 cases of E. coli O157:H7 with PFGE pattern ECXAI.1221. It is believed that the *E. coli* was introduced into the facility and was spread by person-person contact.

There were 17 household-related clusters consisting of between 2 and 5 cases each for a total of 43 illnesses, including one associated with the consumption of home-made cheese, one occurring on a cattle farm, one associated with *E. coli* O157:NM, one with *E. coli* O26:NM, and another with *E. coli* O121:H19 (ECXAI.1356). There were also 6 other clusters reported by PulseNet Canada for which a source was not identified causing 28 cases of illness.

Shigella

There were 10 outbreaks and clusters associated with *Shigella* reported in 2005, 8 of them involving *S. sonnei*. Two of these were linked to the men who have sex with men (MSM) community in British Columbia in July. One of these involved 10 isolates of *S. sonnei* with PFGE pattern SSOXAI.0154 and the other 2 isolates with pattern SSOXAI.0155. An outbreak in Ontario during August involved sewage-contaminated drinking water at a workplace causing 11 cases of illness among the employees and another institutional outbreak included 11 cases in a daycare setting. In August, 52 illnesses in British Columbia identified as *S. sonnei* with PFGE pattern SSOXAI.0159 were related to a retreat held in Mexico. Two other family outbreaks were noted in Quebec and one in British Columbia. Two *S. flexneri* clusters where identified in 2005, one in Prince Edward Island associated with a family cluster, the other in Nova Scotia related to travel to the Dominican Republic.

Yersinia

There was one *Y. enterocolitica* outbreak reported in 2005 consisting of 3 cases in Ontario during July associated with a staff picnic.

Parasites

There were 4 outbreaks associated with parasitic organisms reported in 2005. In April, 5 cases of *Cryptosporidium* infection were reported among family members linked to direct contact with infected calves. The remaining 3 outbreaks and case clusters were related to *Cyclospora* infections identified in Ontario and Québec. In April, 44 illnesses attributed to *Cyclospora* were identified among students and teachers attending a catered retreat in Ontario and in June, an estimated 200 illnesses where reported among patrons of a popular restaurant in Québec. In both events, menu items containing fresh basil were consumed. Another cluster of 5 cases in Ontario and 6 in Québec were associated with travel to Florida.

Table 21: Outbreaks, Case Clusters and Laboratory Investigations of *Salmonella,* Verotoxigenic *E. coli*, *Shigella, Campylobacter* and Parasitic Infections in Canada, 2005

Organism	Month	Prov	Cases	PT [(a)]	PFGE [(b)]	Comments
S. Agona	Aug	NB	3		SAGXAI.0011	Community - Cluster Investigation
S. Berta	Oct	ON	10		BertXAI.0005	Community - Cluster Investigation
S. Brandenburg	Jul	QC	6		BraXAI.0002	Community - Cluster Investigation
S. Enteritidis	Jan	MB	3	PT 2	SENXAI.0003	Community - Cluster Investigation
	Feb	QC, BC, NB	34	PT 11b	SENXAI.0077	Community - Cluster Investigation
	May	AB	8	PT 33	SENXAI.0077	Restaurant - Mung Bean Sprouts
	May	AB	3	PT 11b	SENXAI.0013	Community - Cluster Investigation
	Jun	NB	6	PT8	SENXAI.0003	Community - Cluster Investigation
	Jul	BC	2			Family - Contact
	Aug	ON	16	PT 13		Institutional - Seniors Residence - Turkey Pot Pie
	Sep	BC	2			Family - Contact
	Oct	QC	5	PT 4		Travel - Cuba
	Nov	ON	552	PT13	SENXAI.0038	Community - Mung Bean Spouts
	Nov	QC	2		SENXAI.0004	Travel - China
S. Hadar	May	AB	3	PT2	SHAXAI.0025	Community - Cluster Investigation
	May	AB	2	PT2	SHAXAI.0005	Community - Cluster Investigation
	Jul	AB	7	PT2	SHAXAI.0003/0011[(c)]	Community - Cluster Investigation
	Jul	NF	4	PT2	SHAXAI.0003	Family - Contact
	Aug	QC	2			Family - Contact
	Nov	QC	4		SHAXAI.0003	Community - Cluster Investigation
S. Heidelberg	Aug	QC	2			Family - Contact
	Aug	QC	2			Family - Contact
S. Javiana	Jan	AB	2			Institutional - Long Term Care Facility
S. Monshaui	Jan	NB	2			Family - Contact - Pet Iguana
S. Muenchen	Jul	ON	27		MueXAI.0043	Community - Cluster Investigation
S. Newport	Jul	NB	5	PT9	NewpXAI.0153	Community - Cluster Investigation
S. Paratyphi A	Oct	MB	2			Family - Contact
S. Paratyphi B var. Java	Feb	NS	2			Family - Contact
	Nov	BC	2			Travel - Mexico
	Nov	BC	2			Family - Contact
	Oct	NS	3	Atypical	PBXAI.0008	Family - Contact
S. Saintpaul	Jun	NB	4	PT1	SainXAI.0033	Community - Wedding
	Dec	QC	2			Family - Contact
S. Schwarzengrund	Jul	ON	55	PT 1	SchwaXAI.0010	Community - Culinary Event
	Jul	QC	3		SchwaXAI.0012	Family - Contact
	Aug	BC	2			Family - Contact

Organism	Month	Prov	Cases	PT [(a)]	PFGE [(b)]	Comments
S. Stanley	Mar	BC	2			Family - Contact
S. Telelkebir	Oct	QC	5		Various	Community - Reptiles
S. Thompson	Jun	BC, AB	3	PT5	STHXAI.0034	Community - Dog Treats
	Jul	NB	2	PT2	STHXAI.0002	Family - Contact
	Oct	ON	22	PT 5	STHXAI.0046	Community - Workplace Luncheon - Chicken
	Dec	ON	3			Restaurant - Eggs
S. Typhi	Sep	QC	2			Travel - Haiti
S. Typhimurium	Jan	ON	18	PT 104a	STXAI.0285	Community - Barbeque
	Mar	AB	3			Institutional - College
	Mar	ON	45	PT U302		Community – Unknown
	May	ON	155	PT 104		Restaurant - Mother's Day Banquet - Roast Beef [(c)]
	Jun	MB	6	PT 10	STXAI.0233	Family - Contact
	Jun	NB	2	PT 104a	STXAI.0307	Family - Contact
	Jul	AB	5	PT 1		Family - Contact
	Jul	NB	3		STXAI.0307	Family - Pig Farm
	Aug	QC	2			Family - Contact
	Sep	QC	5			Community – Barbeque
	Dec	BC	4			Restaurant
	Dec	MB	8	PT 2		Community – Workplace
C. jejuni	Jun	AB	45			Community - Youth Camp - Drinking Water
Cryptosporidium	Aug	SK	5			Family - Contact - Calves
Cyclospora	Apr	ON	44			Community - School Retreat - Basil
	Apr	ON,QC	11			Travel - Florida
	Jul	QC	200			Restaurant - Basil
E. coli O26:NM	Nov	BC	3			Family - Contact
E. coli O121:H19	Nov	NB	5		ECXAI.1356	Family - Contact
E. coli O157:H7	Mar	QC	3			Family - Contact
	Apr	ON	4		ECXAI.0001	Community - Raw Milk
	May	AB	16		ECXAI.0816	Restaurant - Employee - Milkshakes
	May	AB	9		ECXAI.0816	Restaurant
	May	NB	3	PT 14a	ECXAI.2019	Family - Contact
	May	QC	2			Family - Contact
	Jun	AB	2		ECXAI.2027	Family - Contact
	Jun	ON	3	PT2	ECXAI.0478	Family - Home Made Cheese
	Jun	ON	11	PT 14a	ECXAI.1221	Institutional - Day Care
	Jul	AB	3		ECXAI.0992	Restaurant - Café
	Jul	AB	5		ECXAI.2027	Community - Cluster Investigation

Organism	Month	Prov	Cases	PT [a]	PFGE [b]	Comments
	Jul	BC	2		ECXAI.0444	Community – Ground Beef
	Jul	QC	2			Family - Contact
	Jul	ON	6	PT 31	ECXAI.1240	Community - Roast Beef
	Aug	BC	3			Family - Contact
	Aug	QC	2			Family - Contact
	Aug	QC	2			Family - Contact
	Sep	NB	2		ECXAI.1301	Family - Contact
	Sep	SK	3		ECXAI.1312	Family - Contact
	Oct	ON	4			Community - Unpasteurized Apple Cider
	Oct	QC	2			Family - Contact
	Oct	BC	2			Family - Contact
	Oct	SK	3		ECXAI.1312	Community - Cluster Investigation
	Oct	SK	3		ECXAI.1319	Family - Cattle Farm
	Nov	AB,BC	19		ECXAI.1339	Community - Ground Beef
	Nov	AB,BC	6		ECXAI.1340	Community - Ground Beef
	Nov	AB	7		ECXAI.0816	Community - Cluster Investigation
	Nov	QC	9		ECXAI.0008	Community - Cluster Investigation
	Dec	QC	2		ECXAI.1070	Community - Cluster Investigation
	Dec	QC	2		ECXAI.1307	Community - Cluster Investigation
E. coli O157:NM	Nov	QC	2		ECXAI.1351	Family - Contact
Shigella flexneri	May	NS	3			Travel - Dominican Republic
Shigella flexneri 3a	Apr	PEI	4		SFXXAI.0021	Family - Contact
Shigella sonnei	Feb	BC	2			Family - Contact
	Apr	QC	2			Family - Contact
	Jul	BC	10		SSOXAI.0154	Community - MSM
	Jul	BC	2	PT25	SSOXAI.0155	Community - MSM
	Aug	BC	52		SSOXAI.0159	Travel - Mexico - Retreat
	Aug	ON	11			Community - Workplace - Drinking Water
	Aug	ON	11			Institutional - Day Care
	Dec	QC	2			Family - Contact
Y. enterocolitica	Jul	ON	3			Community - Staff Picnic

(a) Predominant Phage Type.
(b) Predominant *Xba*I Pulsed Field Gel Electrophoresis Pattern.
(c) 5 cases SHAXAI.0003, 2 cases SHAXAI.0011 (one band difference).
(d) Also 1 case of *S*. Agona, 5 *S*. Berta and 5 *S*. Derby identified.

SECTION 10: MISCELLANEOUS INFORMATION

Table 22: Travel Related Enteric Pathogen Infections, 2005

Organism	Country of Travel
Campylobacter coli	1 Bangladesh, 1 Lebanon, 1 Philippines
Campylobacter *jejuni*	1 India, 3 Mexico, 1 Taiwan, 1 Thailand
Campylobacter jejuni/coli	1 Carribean
Cyclospora	1 Haiti, 1 Cuba, 1 Guatemala
Entamoeba histolytica/dispar	1 Africa, 1 Hungary, 1 India, 1 Indonesia, 1 Nicaragua
Giardia	4 Afghanistan, 3 Africa, 2 Haiti, 3 India, 1 Nicaragua, 1 Peru, 1 Unknown
E. coli O111:NM VTEC	1 Dominican Republic
E. coli O157 VTEC	1 Cuba, 2 Mexico
S. Agona	1 Cuba
S. Bardo	1 El Salvador
S. Bredeney	1 Sri Lanka
S. Chester	1 India
S. Choleraesuis	1 African (countries)
S. Enteritidis	2 African (countries), 1 Bali, 2 Cuba, 7 Dominican Republic, 1 France
S. Give	1 Mexico
S. Heidelberg	1 South America
S. Indiana	1 Algeria
S. Infantis	1 Cuba
S. Javiana	1 Cuba, 1 Mexico
S. Montevideo	1 Mexico
S. Muenchen	1 India
S. Newport	1 Afghanistan, 1 Indonesia, 2 Mexico
S. Paratyphi A	5 India, 1 Mexico
S. Paratyphi B var. Java	1 Thailand
S. Saintpaul	1 South America
S. Sandiego	1 Thailand
S. Stanley	1 Thailand
S. Thompson	1 Mexico, 1 Vietnam
S. Typhi	1 Burma, 1 Cambodia, 2 Haiti, 3 India, 1 Pakistan
S. Typhimirium	1 China, 1 Europe, 3 Mexico, 1 Portugal, 1 United Kingdom
S. Uganda	1 Cuba, 1 Mexico
S. Virchow	1 India, 1 Thailand
Salmonella ssp I 4,5,12:b:-	1 United States
Salmonella ssp IV 50:z4,z32:-	1 Costa Rica
Shigella boydii 2	1 Dominican Republic
Shigella boydii 13	1 India
Shigella boydii 18	1 Argentina
Shigella dysenteriae 2	1 Dominican Republic, 1 India
Shigella dysenteriae 4	1 Dominican Republic, 1 Mexico
Shigella flexneri	4 Dominican Republic
Shigella flexneri 1	1 Africa
Shigella flexneri 2	1 Argentina, 3 Dominican Republic, 2 Mexico
Shigella flexneri 3	1 Indonesia

Organism	Country of Travel
Shigella flexneri 6	1 China, 1 India, 1 Iraq, 1 Taiwan
Shigella sonnei	2 Argentina, 1 Cuba, 1 Dominican Republic, 1 Egypt, 3 India,
	1 Indonesia, 2 Jamaica, 3 Mexico, 1 Pakistan, 3 Thailand, 2 Vietnam
Shigella sp.	2 Dominican Republic, 1 Haiti
V. cholerae non-O1/O139	1 Cuba, 1 Mexico
V. cholerae O1 Inaba	1 Pakistan
V. cholerae O1 Ogawa	1 Mexico
Yersinia enterocolitica	1 China, 1 Cuba, 1 Guatemala, 1 Mexico, 1 Sri Lanka
Yersinia intermedia	1 Africa
Yersinia rohdei	1 China

Table 23: Unusual Enteric Pathogen Infection Sites, 2005

Isolation Site	Organism	Total
Abcess (Abdominal)	*S.* Newport	**1**
Abscess	*S.* Enteritidis	**1**
Abscess (Neck)	*S.* Enteritidis	**1**
Bile	*S.* Montevideo	**1**
Blood	*C. coli*	**1**
	C. concisus - like	**1**
	C. fetus ssp fetus	**3**
	C. jejuni	**4**
	C. jejuni/coli	**1**
	E. coli O17:H18	**1**
	E. coli O2:NM	**1**
	E. coli O4:H5	**1**
	E. coli O6:NM	**1**
	E. coli O61:H17	**1**
	E. coli O-Untypeable:H10	**1**
	E. coli O-Untypeable:H18	**1**
	S. Aberdeen	**1**
	S. Brandenburg	**1**
	S. Choleraesuis	**3**
	S. Corvallis	**1**
	S. Dublin	**1**
	S. Eastbourne	**1**
	S. Enteritidis	**37**
	S. Hadar	**2**
	S. Heidelberg	**78**
	S. Hvittingfoss	**1**
	S. Infantis	**1**
	S. Javiana	**3**
	S. Kiambu	**1**
	S. Manhattan	**2**
	S. Miami	**1**
	S. Muenchen	**1**
	S. Newport	**2**
	S. Oranienburg	**6**
	S. Panama	**3**

Isolation Site	Organism	Total
	S. Paratyphi A	**33**
	S. Paratyphi B var. Java	**3**
	S. Pomona	**1**
	S. Rubislaw	**1**
	S. Saintpaul	**2**
	S. Schwarzengrund	**4**
	S. Thompson	**6**
	S. Typhi	**71**
	S. Typhimurium	**20**
	S. Uganda	**1**
	S. Urbana	**1**
	S. Virchow	**1**
	Salmonella ssp I 4,[5],12:b:-	**1**
	Salmonella ssp I 4,[5],12:i:-	**2**
	Salmonella ssp I 6,7:-:1,5	**1**
	Salmonella ssp IV 16:z4,z32:-	**1**
	Salmonella ssp IV 50:z4,z23:-	**2**
	Shigella flexneri 2	**1**
Bone	*S.* London	**1**
Cerebral Spinal Fluid	*S.* Heidelberg	**1**
Ear	*S.* Vejle	**1**
Fluid (Knee)	*C. jejuni*	**1**
Gall Bladder	*S.* Urbana	**1**
Joint	*S.* Enteritidis	**1**
Surgical incision	*S.* Sandiego	**1**
Swab	*V. cholerae* Non O1/Non O139	**1**
Tracheal Secretions	*S.* Heidelberg	**1**
Urine	*E. coli* (Inactive)	**2**
	E. coli O157:H7	**2**
	E. coli O25:H4	**1**
	E. coli O8:H19	**1**
	S. Agona	**5**
	S. Amager	**1**
	S. Anatum	**1**
	S. Baildon	**1**
	S. Berta	**1**
	S. Birkenhead	**1**
	S. Braenderup	**1**
	S. Brandenburg	**1**
	S. Bredeney	**1**
	S. Cayar	**1**
	S. Enteritidis	**24**
	S. Fluntern	**1**
	S. Hadar	**6**
	S. Hartford	**1**
	S. Heidelberg	**33**
	S. Hvittingfoss	**1**
	S. Infantis	**8**
	S. Inverness	
	S. Javiana	**1**
	S. Kiambu	**1**

Isolation Site	Organism	Total
	S. Litchfield	**1**
	S. Lomalinda	**1**
	S. Mbandaka	**1**
	S. Muenchen	**3**
	S. Muenster	**1**
	S. Newport	**6**
	S. Nima	**1**
	S. Ohio	**1**
	S. Oranienburg	**5**
	S. Panama	**1**
	S. Paratyphi A	**2**
	S. Paratyphi B var. Java	**1**
	S. Pomona	**1**
	S. Poona	**1**
	S. Saintpaul	**4**
	S. Senftenberg	**1**
	S. Stanley	**2**
	S. Tennessee	**1**
	S. Thompson	**10**
	S. Typhimurium	**12**
	S. Uganda	**1**
	Salmonella ssp I 4,[5],12:i:-	**1**
	Salmonella ssp I 4,[5],12:-:-	**4**
	Salmonella ssp I 4,[5],12:-:1,2	
	Salmonella ssp I 47:d:-	**2**
	Salmonella ssp I 9,12:-:-	**1**
	Salmonella ssp I Rough-O:-:-	**2**
	Salmonella ssp I Rough-O:i:1,2	**1**
	Salmonella ssp I Rough-O:r:-	**1**
	Salmonella ssp IIIb 47:k:z35	**1**
	Salmonella ssp IIIb 48:i:z	**1**
	Salmonella ssp IIIb Rough-O:i:z	**1**
	Sh. dysenteriae Prov. SH-111	**1**
	Y. enterocolitica	**1**
Vaginal Swab	*E. coli* O151:H28	**1**
Wound	*S.* Enteritidis	**1**
	S. Senftenberg	**1**
	Y. enterocolitica	**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. To facilitate the production of this report quickly, *Campylobacter* data from the previous year will be included in the annual summaries.

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 local public health unit. A local laboratory may forward an isolate on to the PPHL 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 and then reported to the provincial health authorities. Eight provinces and territories (BC, AB, SK, ON, QC, NF, YK and NU) provide case-by-case reports that include demographic, clinical, laboratory (minimal) and additional epidemiologic data. The remaining provinces and territories (NB, NS, PE, MB and NT) report aggregate data. Because legislation requires the reporting of this information by the health units, the epidemiologically based processes tends to be more reliable for total numbers of illnesses (i.e. Salmonellosis). The NESP data however, supplemented with the National Microbiology Laboratory (NML) characterizations, has better strain characterization information (i.e. numbers of *Salmonella* ssp I 4,5,12:i:- isolations). Discrepancies in numbers between the two surveillance systems can be largely attributed to under-reporting caused by interruptions in the data transfer chain.

Weekly reports of laboratory-based data at the provincial laboratories that are forwarded as part of the NESP, are summarized annually. In addition, ten provincial laboratories send us paper/electronic reports: some send monthly reports, some annual, and some send data in raw form or reports specifically produced for this document. The non-human data arrive in monthly and an annual paper reports from Laboratory for Foodborne Zoonoses, Guelph, Ontario (LFZ) and data is selected and interpreted for this compilation. The Centre for Infectious Disease Prevention and Control (CIDPC) provides annual totals of gastro-intestinal disease information from their NDRS database. Data from NML is collected from various paper and electronic sources: from the Laboratory Data Management System / Canadian Integrated Public Health Surveillance (LDMS/CIPHS), our current operational database at NML; from specialized custom electronic databases (e.g., data from PulseNet Canada and Phage Typing Laboratory and Canadian Integrated Program for Antimicrobial Resistance Surveillance); 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 harder to visualize usual statistics, like accuracy and precision. If there was only one database for each category of information (e.g., data from human isolates in Manitoba), then we would have one unambiguous estimate of the number of lab-confirmed cases of enteric pathogens in that category. However, there is usually more than one data set corresponding to each category and specimens and isolates are often sent between regions for analysis using specialist expertise that may exist there. It is a challenge even to correctly produce an estimate of the number of isolates processed through Canadian laboratories. The laboratory data are attractive and useful mainly because they are available, often extending back in time many years.

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

Human *Salmonella*

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

Salmonella phage types

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

Non-human *Salmonella* serovars

Provincial distributions of LFZ data are considered reasonable approximations of what is actually happening in the field (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 is as severe as those for *E. coli* O157:H7, it would seem that future surveillance systems should consider testing for all VTEC across Canada.

Campylobacter, Arcobacter, and *Helicobacter*

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

Arcobacter and *Helicobacter* are no longer included in the summary because improved laboratory identification methods have resulted in the mis-identification of *Campylobacter.* It 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 (Norovirus, Norwalk-like virus, Calicivirus, Rotavirus, Small Round Enteric Viruses, etc.) are currently not represented in this compilation. Case by case reporting of Norovirus is rare nationally and most cases are identified through outbreak investigation. 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. A brief update is provided in the Report Highlights section of this report. It was not always possible to determine distinct versus ongoing outbreaks and clusters from the information provided to the NESP and therefore the total number of outbreaks reported is an approximation only. During viral gastroenteridis outbreaks, testing is limited to confirmation of the agent causing the outbreak and the majority of associated cases are identified by clinical syndrome only. The numbers of cases related to these outbreaks, as reported to the NESP, are therefore significantly under-reported.

The Future

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

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

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

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