

Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 2002 and 2003



Public Health
Agency of Canada

Agence de santé
publique du Canada

Canada

Laboratory Surveillance Data For Enteric Pathogens In Canada

Annual Summary 2002 and 2003

Enteric Diseases Program
National Microbiology Laboratory
Public Health Agency of Canada
The Canadian Science Centre for Human and Animal Health
1015 Arlington Street
Winnipeg, Manitoba, Canada
R3E 3R2

Phone: (204) 789-2000
Fax: (204) 789-5012

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

Enteric Diseases Program
National Microbiology Laboratory

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

Public Health Agency of Canada



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

This report summarizes the information received from federal, provincial and public health agencies on enteric pathogens identified in Canada for the years 2002 and 2003. The information is intended primarily for those with responsibilities for the control and prevention of enteric food borne disease.

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

ISBN: 0-662-41288-5
Catalogue No.: HP57-1/2003E

© Minister of Public Works and Government Services, 2005

Acknowledgements

Prepared By:

Walter Demczuk

Editors:

Lai King Ng
David Woodward
Rafiq Ahmed
Clifford Clark
Helen Tabor
Kathryn Dore
Nadia Ciampa
Anne Muckle

Data Analysis :

Walter Demczuk
Lori Buller
Michelle Boyd
Marielle Pauze
Carole Scott
Anne Muckle

Translation:

Translation Bureau, Public Works and Government Services Canada

Additional Support and Assistance:

Provincial Laboratory Contacts:

Ana Paccagnella, Quantine Wong, Marie Louie, Barry Chamberlin, Peter Tilley, Ellen Blewett, Loretta Ball, Dawn Colby, Katherine Brown, Brian Klisko, Cliff Koschik, Robert Terro, Jeremy Wan, Johanne Ismail, Jill Rae, Janet Slaunwhite, Allan Ellis, David Haldane, Elroy Mann, John Wylie, Elspeth Nickerson, Janet Reid, Dora Lee, Linda Chui, Yvonne Yaschuk, Evelyn Nagle, Bruce Ciebin, Sheila Cook, Marina Lombos, Suzanne Lombardi, G.J. Hardy and Sandra March.

We also take this time to thank the Directors of the participating Provincial Laboratories and of the Laboratory for Food Borne Zoonoses:

Dr. Judy Isaac-Renton, BC Centre for Disease Control, British Columbia

Dr. Jutta Preiksaitis, Provincial Laboratory of Public Health, Alberta

Dr. Greg Horsman, Department of Saskatchewan Health, Saskatchewan

Dr. Paul Van Caesele, CADHAM Provincial Laboratory, Manitoba

Dr. Frances Jamieson, Central Public Health Laboratory, Ontario

Dr. Mohamed Karmali, Health Canada, Laboratory for Food Borne Zoonoses, Guelph, Ontario

Dr. Jean Joly, Laboratoire de santé publique du Québec, Québec

Dr. Anne O'Brien, Saint John Regional Hospital, New Brunswick

Dr. Kevin Forward, Queen Elizabeth II Health Sciences Centre, Nova Scotia

Dr. Lewis Abbott, Provincial Health Laboratory, Prince Edward Island

Dr. Sam Ratnam, Newfoundland Public Health Laboratories, Newfoundland

Table of Contents

REPORT HIGHLIGHTS.....	1
INTRODUCTION.....	4
SECTION 1: MAJOR ENTERIC PATHOGENS.....	5
SECTION 2: <i>SALMONELLA</i>	6
<i>Salmonella</i> Isolations from Human Sources in 2002 and 2003.....	6
Most Prevalent <i>Salmonella</i> Serovars from Humans in 2002.....	6
Most Prevalent <i>Salmonella</i> Serovars from Humans in 2003.....	7
Changes in the Occurrence of <i>Salmonella</i> Serovars from Humans, 1999 to 2003.....	7
Provincial Distribution of <i>Salmonella</i> from Humans.....	8
Most Prevalent <i>Salmonella</i> Serovars from Humans in Each Province.....	10
New and Unique <i>Salmonella</i> Serovars in Canada.....	20
<i>Salmonella</i> Serovars from Humans in Canada, 2002.....	21
<i>Salmonella</i> Serovars from Humans in Canada, 2003.....	26
<i>Salmonella</i> Isolations from Non-Human Sources in 2002 and 2003.....	31
Most Prevalent <i>Salmonella</i> Serovars from Non-Human Sources in Canada, 2002.....	31
Most Prevalent <i>Salmonella</i> Serovars from Non-Human Sources in Canada, 2003.....	32
Changes in Occurrence of <i>Salmonella</i> Serovars from Non-Human Sources in Canada 1999 to 2003.....	32
Provincial Distribution of <i>Salmonella</i> Serovars from Non-Human Sources in 2002 and 2003.....	33
Source Distribution of <i>Salmonella</i> Serovars in Canada, 1999 to 2003.....	37
<i>Salmonella</i> from Non-Human Sources, 2002.....	40
<i>Salmonella</i> from Non-Human Sources, 2003.....	56
Phage Types of <i>Salmonella</i> Serovars in Canada.....	72
Most Prevalent Phage Types of Various <i>Salmonella</i> Serovars, 1999 to 2003.....	72
Phage Types of Various <i>Salmonella</i> Serovars in Canada, 2002.....	74
Phage Types of Various <i>Salmonella</i> Serovars in Canada, 2003.....	90
SECTION 3: PATHOGENIC <i>ESCHERICHIA COLI</i>	106
<i>E. coli</i> O157 Isolations from Humans in Canada.....	107
<i>E. coli</i> Serotypes Isolated from Humans in Canada, 2002.....	108
<i>E. coli</i> Serotypes Isolated from Humans in Canada, 2003.....	110
Phage Types of <i>E. coli</i> O157:H7 Isolated in Canada, 2002.....	111
Phage Types of <i>E. coli</i> O157:H7 Isolated in Canada, 2003.....	112
SECTION 4: <i>CAMPYOBACTER</i>	114
Rate of Reported Cases of Campylobacteriosis in Canada, 1998 to 2002.....	114
Number of Reported Cases of Campylobacteriosis in Canada, 2002.....	115
<i>Campylobacter</i> Isolations in Canada by Age and Gender.....	115
<i>Campylobacter</i> Species Isolated from Humans in Canada, 2002.....	115
SECTION 5: <i>SHIGELLA</i>	116
Rate of <i>Shigella</i> Isolations in Canada, 1999 to 2003.....	116
<i>Shigella</i> Isolated from Humans in Canada, 2002.....	118
<i>Shigella</i> Isolated from Humans in Canada, 2003.....	119

Phage Types of <i>Shigella boydii</i> and <i>Shigella sonnei</i> From Humans in Canada, 2002.....	120
Phage Types of <i>Shigella boydii</i> and <i>Shigella sonnei</i> From Humans in Canada, 2003.....	121
SECTION 6: PARASITES.....	122
Rates of Parasite Isolations in Canada (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i> , 2000 to 2003	122
Number of Parasite Isolations in Canada, 2002.....	123
Number of Parasite Isolations in Canada, 2003.....	123
SECTION 7: YERSINIA.....	124
<i>Yersinia</i> Isolates in Canada, 2002	126
<i>Yersinia</i> Isolates in Canada, 2003	126
SECTION 8: OUTBREAKS.....	127
Outbreaks of Enteric Disease in Canada during 2002	127
Outbreaks of Enteric Disease in Canada during 2003	134
SECTION 9: MISCELLANEOUS INFORMATION	138
Travel Related Enteric Pathogen Infections in 2002	138
Travel Related Enteric Pathogen Infections in 2003	140
Unusual Isolation Sites of Enteric Pathogens in 2002	141
Unusual Isolation Sites of Enteric Pathogens in 2003	142
APPENDIX I: DISCUSSION OF DATA SOURCES	144

List of Figures

Figure 1: Major Enteric Pathogens from Humans in Canada, 1999 to 2003	5
Figure 2: Most Prevalent <i>Salmonella</i> Serovars from Humans in Canada, 2002	6
Figure 3: Most Prevalent <i>Salmonella</i> Serovars from Humans in Canada, 2003	7
Figure 4: Ten Most Prevalent <i>Salmonella</i> Serovars from Humans in Canada, 1999 to 2003	8
Figure 5: Number of <i>Salmonella</i> Isolations in Canada in 2002	9
Figure 6: Number of <i>Salmonella</i> Isolations in Canada in 2003	9
Figure 7: Rate of <i>Salmonella</i> Isolation in Canada, 1999 to 2003	10
Figure 8: Ten Most Prevalent <i>Salmonella</i> Serovars from Humans in Each Province, 2002 and 2003.....	11
Figure 9: Five Most Prevalent <i>Salmonella</i> Serovars from Humans in Each Province, 1999 to 2003	15
Figure 10: Ten Most Prevalent <i>Salmonella</i> Serovars from Non-Human Sources in Canada, 2002	31
Figure 11: Ten Most Prevalent <i>Salmonella</i> Serovars from Non-Human Sources in Canada, 2003	32
Figure 12: Ten Most Prevalent <i>Salmonella</i> Serovars from Non-Human Sources in Canada, 1999 to 2003	33
Figure 13: Ten Most Prevalent <i>Salmonella</i> Serovars of Non-Human Origin in Each Province, 2002 and 2003	34
Figure 14: Ten Most Prevalent <i>Salmonella</i> Serovars from Selected Sources In Canada, 1999 to 2003	38
Figure 15: Five Most Prevalent Phage Types of Various <i>Salmonella</i> Serovars Isolated from Humans in Canada, 1999 to 2003	72
Figure 16: Rate of <i>E. coli</i> O157 Isolation in Canada, 1999 to 2003	106
Figure 17: Number of <i>E. coli</i> O157 Isolations from Humans in Canada, 2002.....	107
Figure 18: Number of <i>E. coli</i> O157 Isolations from Humans in Canada, 2003.....	107

Figure 19: Rate of Reported Cases of Campylobacteriosis in Canada, 1998 to 2002	114
Figure 20: Number of Reported Cases of Campylobacteriosis in Canada, 2002.....	115
Figure 21: <i>Campylobacter</i> Isolations in Canada by Age Group and Age Distribution	115
Figure 22: Rate of <i>Shigella</i> Isolation in Canada, 1999 to 2003	116
Figure 23: Number of <i>Shigella</i> Isolations from Humans in Canada, 2002.....	117
Figure 24: Number of <i>Shigella</i> Isolations from Humans in Canada, 2003.....	117
Figure 25: Rates of Parasite Isolation (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i>) in Canada, 2002 to 2003	122
Figure 26: Number of Parasite Isolations (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i>) in Canada, 2002	122
Figure 27: Number of Parasite Isolations (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i>) in Canada, 2003	123
Figure 28: Rates of <i>Yersinia</i> Isolation in Canada, 2002 to 2003	124
Figure 29: Number of <i>Yersinia</i> Isolations from Humans in Canada, 2002	125
Figure 30: Number of <i>Yersinia</i> Isolations from Humans in Canada, 2003	125

List of Tables

Table 1: <i>Salmonella</i> Serovars from Humans in Canada, 2002	21
Table 2: <i>Salmonella</i> Serovars from Humans in Canada, 2003	26
Table 3: <i>Salmonella</i> Serovars from Non-Human Sources, 2002	40
Table 4: <i>Salmonella</i> Serovars from Non-Human Sources, 2003	56
Table 5: Phage Types of Various <i>Salmonella</i> Serovars in Canada, 2002	74
Table 6: Phage Types of Various <i>Salmonella</i> Serovars in Canada, 2003	90
Table 7: <i>E. coli</i> Serotypes Isolated from Humans in Canada, 2002.....	108
Table 8: <i>E. coli</i> Serotypes Isolated from Humans in Canada, 2003.....	110
Table 9: Phage Types of <i>E. coli</i> O157:H7 Isolated in Canada, 2002	111
Table 10: Phage Types of <i>E. coli</i> O157:H7 Isolated in Canada, 2003.....	112
Table 11: <i>Campylobacter</i> Species Isolated from Humans in Canada, 2002.....	115
Table 12: <i>Shigella</i> Isolated from Humans in Canada, 2002.....	118
Table 13: <i>Shigella</i> Isolated from Humans in Canada, 2003.....	119
Table 14: Phage Types of <i>Shigella boydii</i> and <i>Shigella sonnei</i> from Humans In Canada, 2002.....	120
Table 15: Phage Types of <i>Shigella boydii</i> and <i>Shigella sonnei</i> from Humans In Canada, 2003.....	121
Table 16: Number of Parasite Isolations (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i>) in Canada, 2002	123
Table 17: Number of Parasite Isolations (<i>Cryptosporidium</i> , <i>Cyclospora</i> , <i>Entamoeba</i> and <i>Giardia</i>) in Canada, 2003	123
Table 18: <i>Yersinia</i> Isolates in Canada, 2002	126
Table 19: <i>Yersinia</i> Isolates in Canada, 2003	126
Table 20: Summary of Outbreaks in Canada, 1999 to 2003.....	129
Table 21: Outbreaks in Canada During 2002	131
Table 22: Outbreaks in Canada During 2003	136
Table 23: Travel Related Enteric Pathogen Infections, 2002.....	138
Table 24: Travel Related Enteric Pathogen Infections, 2003.....	140
Table 25: Unusual Isolation Sites of Enteric Pathogen Infections, 2002.....	141
Table 26: Unusual Isolation Sites of Enteric Pathogen Infections, 2003.....	142

Report Highlights

Major Enteric Pathogen Groups:

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

***Salmonella* from Human Sources:**

- 52.5% of all *Salmonella* infections are caused by 3 serovars: *S. Typhimurium* (20%), *S. Heidelberg* (20%) and *S. Enteritidis* (12.5%).
- Each of the remaining most prevalent serovars in the top 10 represent only 2.0% to 3.4% of infections.
- Ontario has the highest number of isolations (n=2316) followed by Quebec (n=1083).
- The national isolation rate has decreased from 24.1 isolations per 100,000 population in 1999 to 17.5 isolations per 100,000 population in 2003.
- Alberta has the highest isolation rate with 23.5 isolates per 100,000 population and Newfoundland has the lowest with 5.4 isolations per 100,000.
- Increases of isolation rates have been observed in New Brunswick, Prince Edward Island and Northwest Territories.
- *S. Heidelberg* has increased in prevalence in all provinces except Prince Edward Island.
- *S. Heidelberg* prevalence in Quebec has risen from 14% of all *Salmonella* isolated in 2002 to 29% in 2003, in New Brunswick from 19% to 41%, and in Newfoundland from 31% to 50%.
- *S. Enteritidis* PT 4 is still most predominant and levels of PT 8 have declined. PT 1 and PT 13 isolations have increased slightly since 2000.
- *S. Heidelberg* PT 19 is most prevalent but levels have declined since 1999.
- *S. Typhimurium* PT104 isolation has decreased from approximately 37% in 1999 to approx. 18% in 2002 and then rebounded slightly in 2003 to approximately 23%.

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

- 44% of all non-human *Salmonella* are *S. Typhimurium* (22.6%) and *S. Heidelberg* (21.5%).
- *S. Kentucky* has been increasing in prevalence since 2001 and now ranks a distant third representing 7.4% of all non-human *Salmonella*.
- *S. Senftenberg* is most prevalent in animal feed; *S. Typhimurium* in bovine and porcine sources; and *S. Heidelberg* in most prevalent in chicken and turkey sources.

Pathogenic *Escherichia coli*:

- The national *E. coli* O157 isolation rate has decreased from 8.8 isolations per 100,000 population in 1999 to 3.2 isolations per 100,000 population in 2003.
- Prince Edward Island has the highest isolation rate with approx. 9 isolations per 100,000 population and Newfoundland has the lowest rate with 1 per 100,000.
- Increases of isolation rates have been observed in Manitoba and New Brunswick.
- PT 14a is the most predominant phage type constituting approximately 50% of all isolates tested, followed distantly by PT 8 with 14%.

Campylobacter :

- The national *Campylobacter* isolation rate has decreased from 46.8 isolations per 100,000 population in 1998 to 36.7 isolations per 100,000 population in 2002.
- British Columbia has the highest isolation rate with approximately 50 isolations per 100,000 population and Newfoundland has the lowest rate with approximately 9 per 100,000 population.
- Increases of isolation rates have been observed in Alberta, Saskatchewan, Quebec, Nova Scotia, Prince Edward Island and the territories.

Shigella:

- The national *Shigella* isolation rate has decreased from 4.1 isolations per 100,000 population in 1999 to 3.0 isolations per 100,000 population in 2003.
- British Columbia has the highest isolation rate with approximately 6 isolations per 100,000 population and Prince Edward Island has the lowest rate with less than 1 per 100,000 population.
- Increases of isolation rates have been observed in British Columbia, Saskatchewan, Quebec and New Brunswick.

Parasites:

- The national parasite (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) isolation rate has decreased from 21.2 isolations per 100,000 population in 2001 to 14.3 isolations per 100,000 population in 2003.
- British Columbia has the highest isolation rate with approximately 22 isolations per 100,000 population and Newfoundland has the lowest rate with approximately 5 per 100,000 population.
- Increases of isolation rates have been observed in Prince Edward Island and Nunavut.

Yersinia:

- The national *Yersinia* isolation rate has decreased slightly from 2.7 isolations per 100,000 population in 1999 to 2.1 isolations per 100,000 population in 2003.
- Ontario has the highest isolation rate with approximately 3 isolations per 100,000 population.
- Increases of isolation rates have been observed in Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia and the Yukon.

Major Outbreaks of 2002:

- 189 cases of *S. Oranienburg* PT 1 / PFGE pattern OranXAI.0002 in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Nunavut between January to April 2002. German chocolate was reported as a source of salmonellosis in Germany during this time, but PFGE typing ruled out an association and no other sources of infection were identified.
- 45 cases of *E. coli* O157:H7 infections among 250 attendees at a youth bowling league banquet in Ontario in May 2002.
- 12 cases of *E. coli* O157:H7 PT32 / PFGE pattern ECXAI.0756 in November 2002 were linked to salads and sandwiches prepared in a hospital kitchen in Prince Edward Island.
- 87 cases of *E. coli* O157:H7 were identified as part of a multi-provincial cluster with a PFGE pattern of ECXAI.0508 during May and June 2002. The source was traced to ground beef distributed and sold through a large retail chain.
- 426 isolates of *Shigella sonnei* PT 15 / PFGE pattern SSOXAI.0088 were associated with the consumption of a Greek Style Pasta Salad in Ontario in May 2002. It is estimated that over 700 people were ill.

Major Outbreaks of 2003:

- 40 cases of *S. Oranienburg* PT 8 / PFGE pattern OranXAI.0020 associated with the consumption of hamburgers from a fast food restaurant in Nova Scotia in August 2003.
- 65 cases of *E. coli* O157:H7 infection among visitors of a petting zoo in British Columbia in November 2003.
- 60 people attending a Robbie Burns party who consumed improperly prepared haggis became infected with *E. coli* O157:H7.
- 44 cases of *E. coli* O157:H7 PT8 were identified in June among attendees of a high school graduation banquet.
- 15 illnesses of *Shigella sonnei* among hospital staff in Quebec in July were associated with the consumption of food from the salad bar of the hospital cafeteria.

Introduction

Data presented in this report are based on laboratory-confirmed enteric pathogens associated with disease, isolated from humans, food, animal and the environment. Annual data are received from a variety of sources and the most suitable data are selected and developed into an annual summary. In Canada, surveillance data are collected at regional and provincial levels and compiled at the national level. It is recognized that although laboratory surveillance may vary from region to region, the centralized collection of surveillance data at a national level may enhance our understanding of the epidemiology of enteric infection in Canada; these data can be used to target potential preventive measures. The laboratory based surveillance data summarized here can be used for the purposes of detecting emergent and re-emergent pathogens, serovars, phage types, molecular types and increasing or decreasing trends of particular enteric pathogens and should not be used to describe the incidence of disease.

This Annual Summary is a compilation of various data sets that include: 1) those generated by provincial public health laboratories (PPHL); 2) that from the annual report of the Laboratory for Food-borne Zoonoses, Guelph (LFZ); 3) that from the Enteric Disease Program, National Microbiology Laboratory, Winnipeg (NML); 4) the National Enteric Surveillance Program (NESP); and 5) the National Notifiable Diseases Reporting System (NDRS) database.

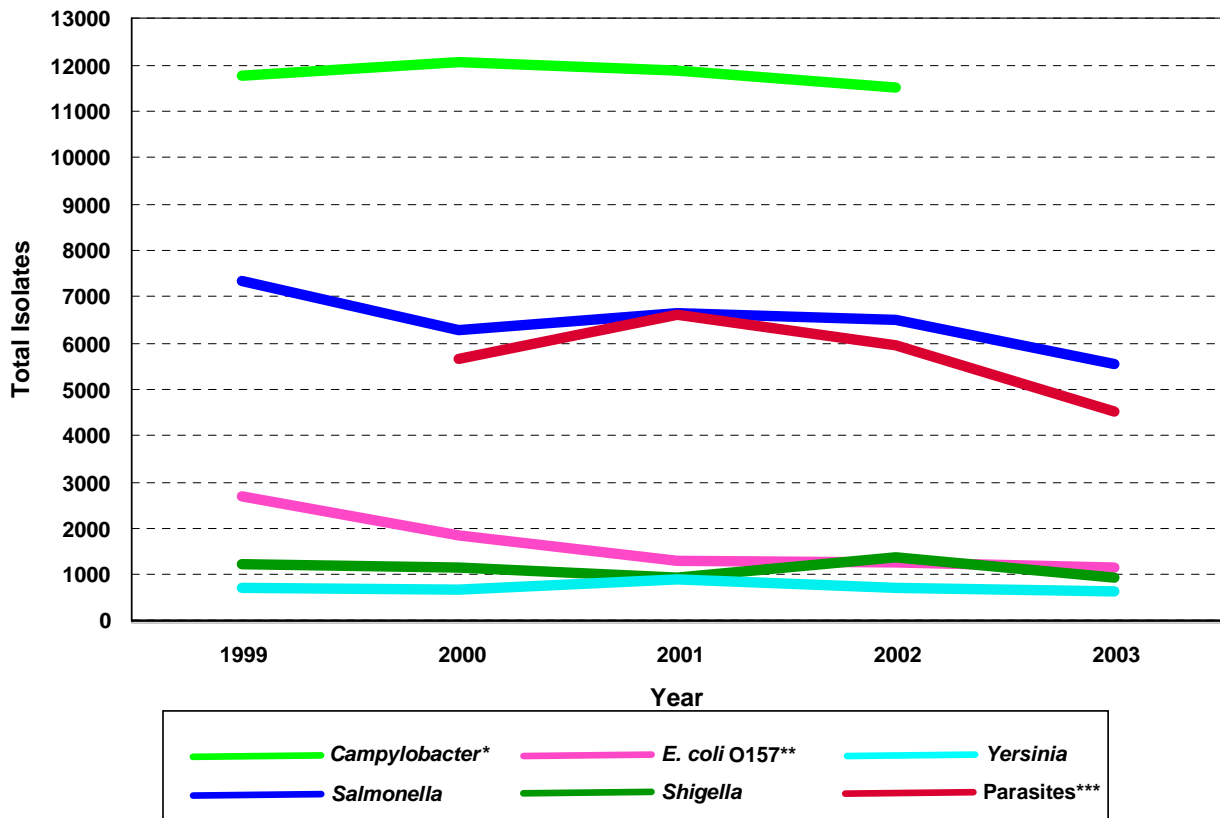
Provincial reports and the NESP database contain summarized aggregated data in the form of weekly, monthly or annual reports of isolates forwarded to the PPHLs for analysis and characterization. The data sets of the LFZ and the NML are acquired through reference services for the confirmation, identification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

It should be noted that there are some inherent limitations of the data and any interpretation should be done with caution. Not all specimens/isolates are referred from the regional and local laboratories to the PPHLs and therefore the provincial reports and NESP 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 food-borne 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.

SECTION 1: MAJOR ENTERIC PATHOGENS

Figure 1 illustrates the isolation trends of the 6 major enteric pathogen groups from 1999 to 2003. *Campylobacter* continues to be the most prevalent pathogen in Canada distantly followed by *Salmonella* and parasitic infections. The total number of isolations of the major enteric pathogens has been declining since 2001.

Figure 1: Major Enteric Pathogens from Humans in Canada, 1999 to 2003



*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 2003 by NDRS was not complete at time of publication and will be reported in the 2004 Annual Summary.

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

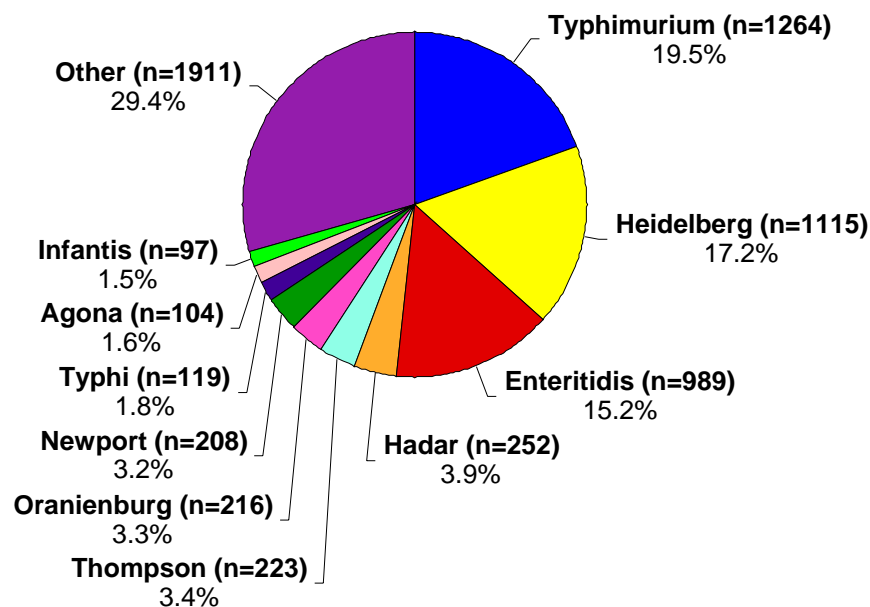
*** *Cryptosporidium* and *Cyclospora* were not nationally notifiable until January 2000. *Entamoeba* is not notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported.

SECTION 2: SALMONELLA

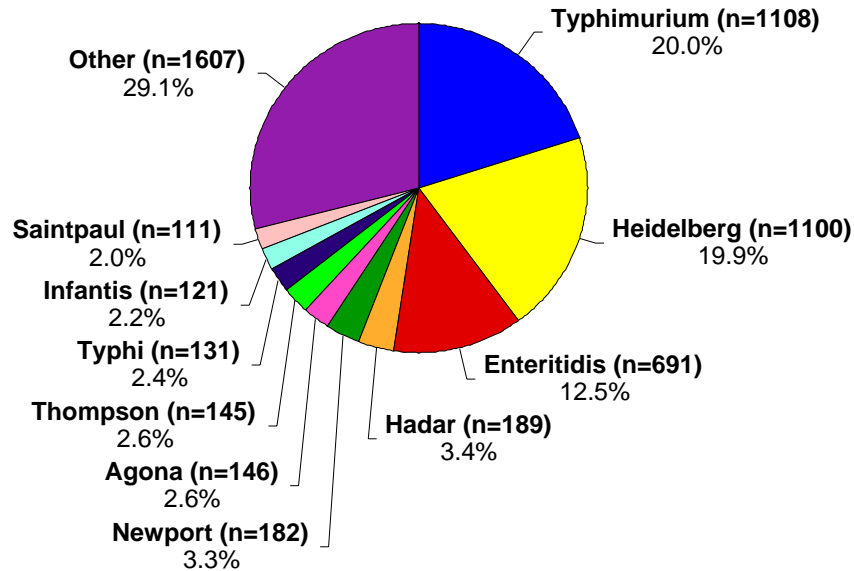
Salmonella Isolations from Human Sources in 2002 and 2003

Figures 2 and 3 illustrate the relative frequency of isolation of the ten most prevalent *Salmonella* serovars from patients in Canada in 2002 and 2003. *S. Typhimurium* remained the most prevalent *Salmonella* serovar isolated from humans in Canada for both years accounting for 19.5% (1264 of 6498) of the *Salmonella* reported in 2002 and 20.0% (1108 of 5531) in 2003. *S. Heidelberg*, *S. Enteritidis* and *S. Hadar* represent the second, third and fourth most prevalent serovars identified in both 2002 and 2003. *S. Heidelberg* represented 17.2% (n=1115) of the isolates in 2002 and 19.9% (n=1100) in 2003, *S. Enteritidis* 15.2% (n=989) in 2002 and 12.5% (n=691) in 2003 and *S. Hadar* 3.9% (n=252) in 2002 and 3.4% (n=189) in 2003. *S. Newport* ranked fifth overall in 2003 with 3.3% (n=182) of the isolates and seventh in 2002 with 3.2% (n=208). At sixth in 2003 was *S. Agona* (2.6%, n=146), followed by *S. Thompson* (2.6%, n=145), *S. Typhi* (2.4%, n=131) and *S. Infantis* (2.2%, n=121). New to the top ten list was *S. Saintpaul* ranking tenth with 2.0% (n=111) of the isolates in 2003. In 2002, *S. Thompson* ranked fifth with 3.4% (n=223) of the identified *Salmonella*. Also new to the top ten serovars for 2002 was *S. Oranienburg* (3.3%, n=216) due to a large outbreak associated with an unknown source in Ontario during January to April. *S. Typhi* ranked eighth (1.8%, n=208), *S. Agona* ninth (1.6%, n=104) and *S. Infantis* tenth (1.5%, n=97). Other serovars represented 29.4% (n=1911) of the isolates in 2002 and 29.1% (n=1607) in 2003.

Figure 2: Most Prevalent *Salmonella* Serovars from Humans in Canada, 2002* (N=6498)



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

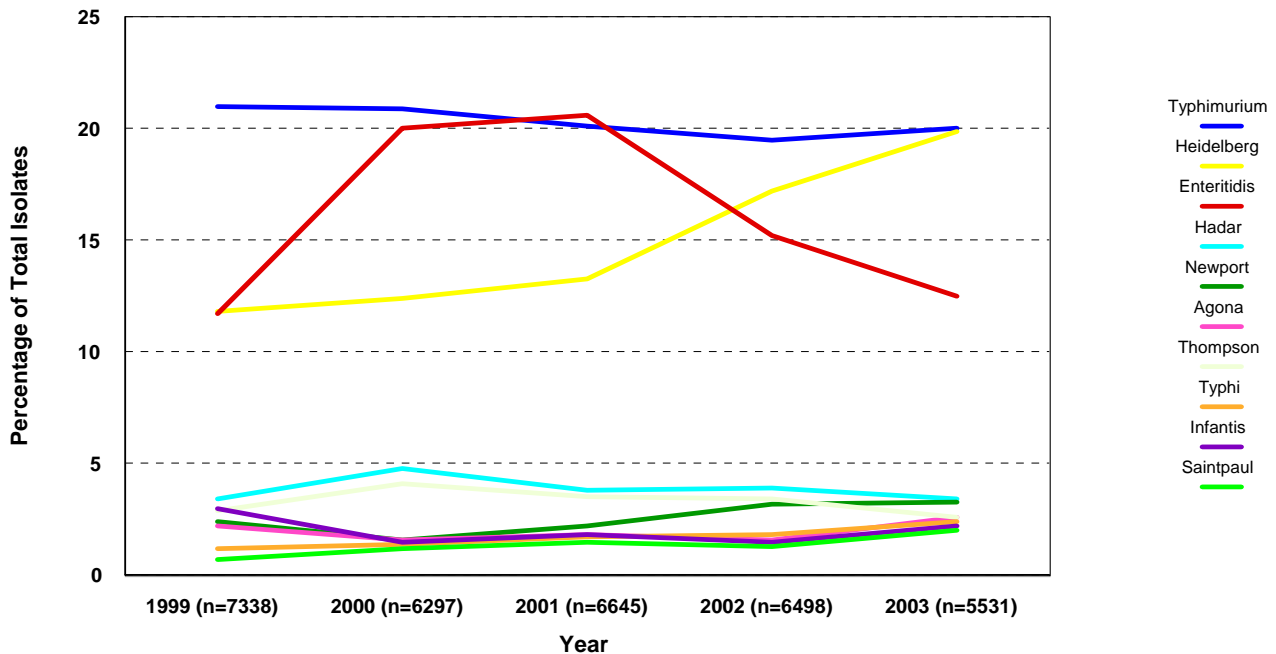
Figure 3: Most Prevalent *Salmonella* Serovars from Humans in Canada, 2003* (n=5531)

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

Changes in the Occurrence of *Salmonella* Serovars from Humans in Canada, 1999 to 2003

The relative frequencies of the 10 most prevalent *Salmonella* of human origin from 1999 to 2003 are shown in Figure 4. Although *S. Typhimurium* has ranked as the most prevalent serovar identified in Canada for the last five years, *S. Heidelberg* has been increasing in relative frequency since 1999, surpassing *S. Enteritidis* in 2002 as the second most prevalent serovar isolated from humans in Canada. Numbers of *S. Enteritidis* isolations have declined after an increase during 2000 and 2001, and in 2003 this serovar ranked 3rd after *S. Heidelberg* and *S. Typhimurium*. 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 4: Ten Most Prevalent *Salmonella* Serovars from Humans in Canada, 1999 to 2003*

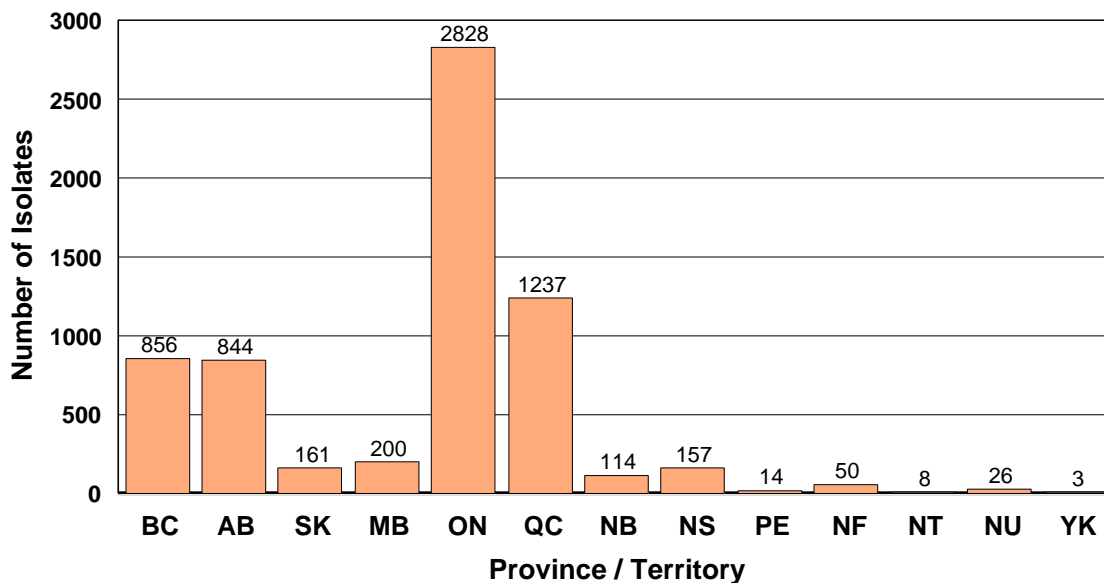
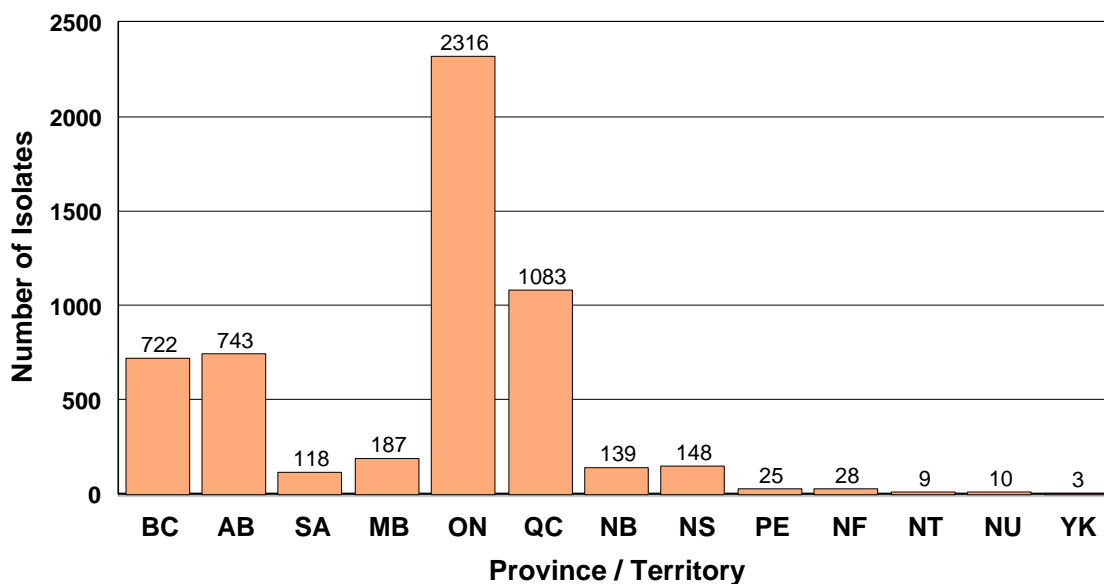


* Totals are laboratory confirmed *Salmonella* based on information supplied to the NESP with supplemented identifications from NML reference work. Total *Salmonella* is adjusted by adding enough *Salmonella* sp to bring totals those of the national notifiable disease data. Data is representative of laboratory confirmed isolates only which is consistently gathered from year to year, and should not be confused with incidence of disease. See Appendix 1 for details.

Provincial Distribution of *Salmonella* from Humans

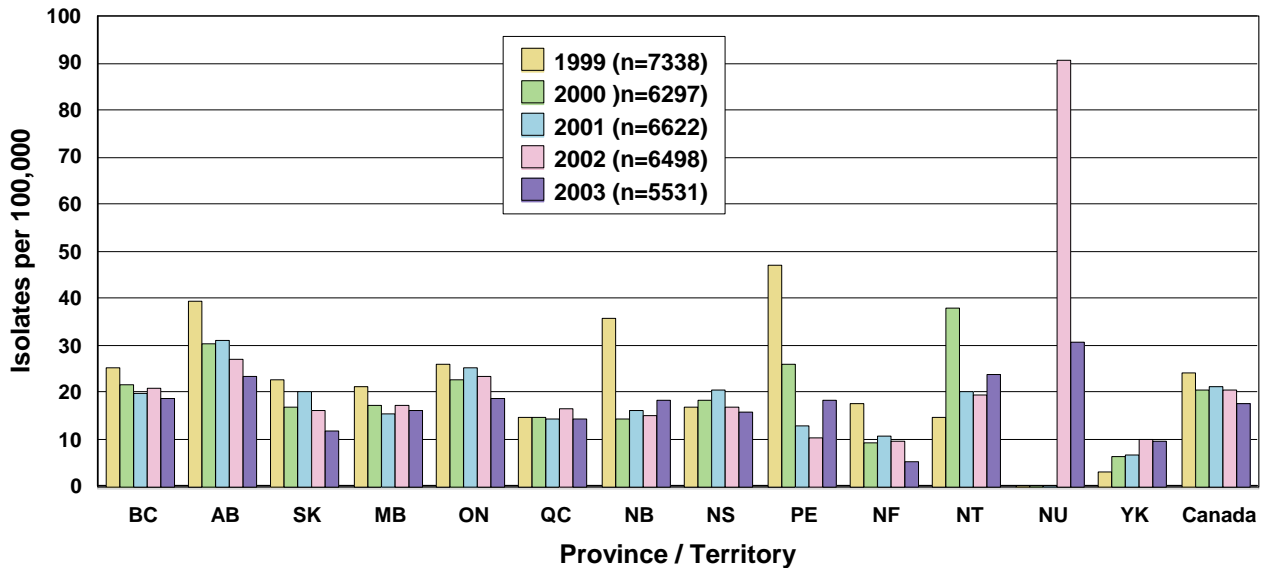
The total number of *Salmonella* isolations from each province for 2002 and 2003 is shown in Figures 5 and 6. Population based rates of *Salmonella* isolation for each province are shown for the years 1999 to 2003 in Figure 7. By representing the data as isolations per 100,000, the data is a more accurate reflection of the relative isolation levels among the provincial population. Although Quebec ranked 2nd among the provinces for the number of *Salmonella* isolated (Figures 5 and 6), the province ranked 11th overall for the population based isolation rate due to a large population. A high isolation rate was seen in Nunavut in 2002 due to 26 isolations reported to the NDRS and a low population within the territory.

Figure 7 shows the rate of *Salmonella* isolation for each province for each of the last 5 years. There have been no major increases in the rates of *Salmonella* isolations in provinces since 2001. Rates of isolation have declined slightly in many provinces with the largest year to year decrease occurring in Prince Edward Island where the rate has declined from 26 to 13 isolations per 100,000 since 2001.

Figure 5: Number of *Salmonella* Isolations in Canada in 2002Figure 6: Number of *Salmonella* Isolations in Canada in 2003

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, NT = Northwest Territories, NU = Nunavut, YK = Yukon Territory.

Figure 7: Rate of *Salmonella* Isolation in Canada, 1999 to 2003*



*Provincial population estimates used to calculate isolation rates are taken from the Statistics Canada website. Total *Salmonella* is based largely on NESP reports and includes cluster and outbreak cases but not duplicate isolates from the same patient. High numbers of *Salmonella* isolations may not necessarily reflect a higher incidence of disease, but rather a better sampling and reporting structure for a province. 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, NT = Northwest Territories, NU = Nunavut, YK = Yukon Territory.

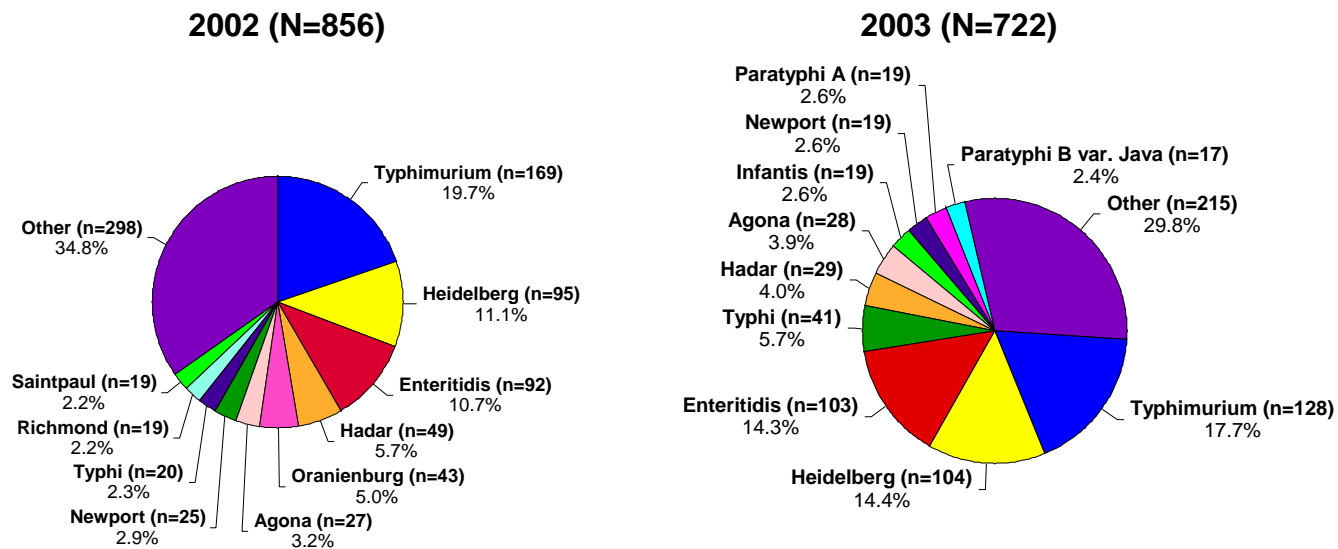
Prevalent *Salmonella* Serovars from Humans in Each Province

The ten most prevalent human *Salmonella* serovars isolated for each province is illustrated in Figure 8. In 2002, *S. Typhimurium* was the most prevalent serovar in British Columbia accounting for 19.7% (n=169) of all *Salmonella* identified in that province, and in Alberta (24.8%, n=209), Saskatchewan (21.1%, n=34), Manitoba (25.0%, n=50), Ontario (18.3%, n=518), Newfoundland (20.0%, n=10), and in the territories (21.6%, n=8). *S. Enteritidis* was most prevalent in Nova Scotia with 36.9% (n=58) of the human *Salmonella* isolated in that province. *S. Heidelberg* was most common in Quebec (26.8%, n=332) and New Brunswick (23.7%, n=27).

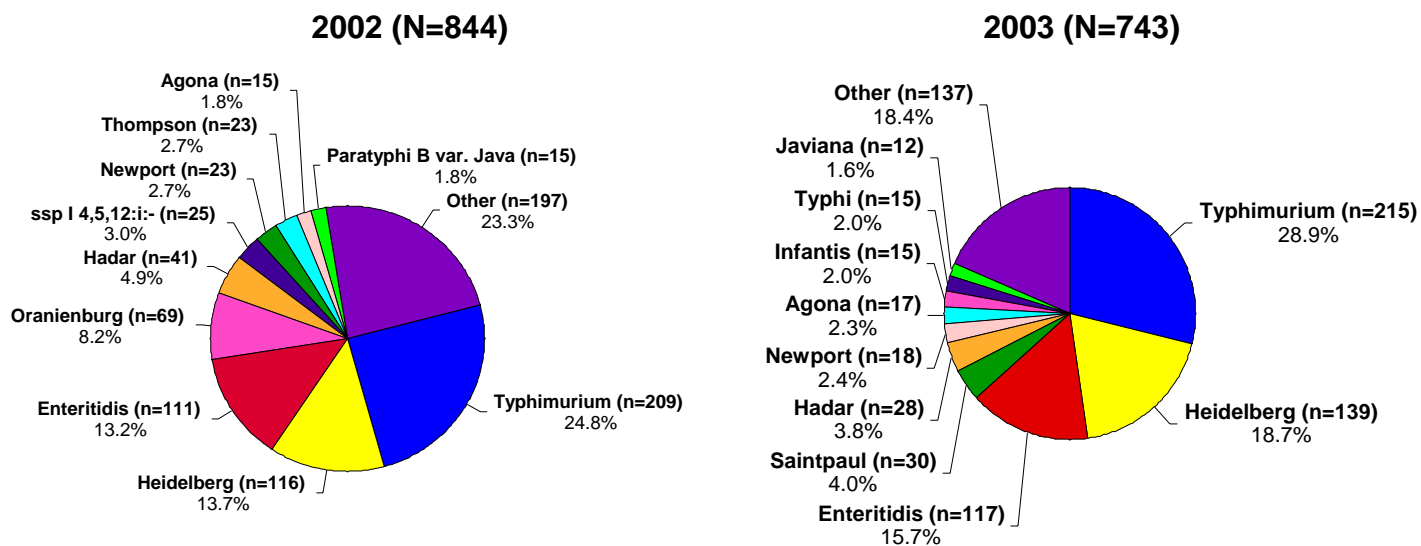
S. Typhimurium was also most prevalent in 2003 in British Columbia (17.7%, n=128), Alberta (28.9%, n=215), Saskatchewan (17.8%, n=21), Manitoba (24.6%, n=46), Ontario (19.4%, n=449) and Prince Edward Island (16.0%, n=4). In 2003, *S. Heidelberg* is most prevalent in New Brunswick (41.0%, n=57), Quebec (29.1%, n=315) Newfoundland (50.0%, n=14) and in the territories (45.5%, n=10). The prevalence of *S. Heidelberg* in Quebec has increased dramatically from 14.2% in 2002 to 29.1% in 2003, in New Brunswick from 19.0% to 41.0% and in Newfoundland from 31.0% to 50.0%. In Nova Scotia, *S. Oranienburg* was the prevalent serovar in 2003 because of a large outbreak associated with a fast food hamburger restaurant in August.

Figure 8: Ten Most Prevalent *Salmonella* Serovars from Humans in Each Province/Territory, 2002 and 2003

BRITISH COLUMBIA

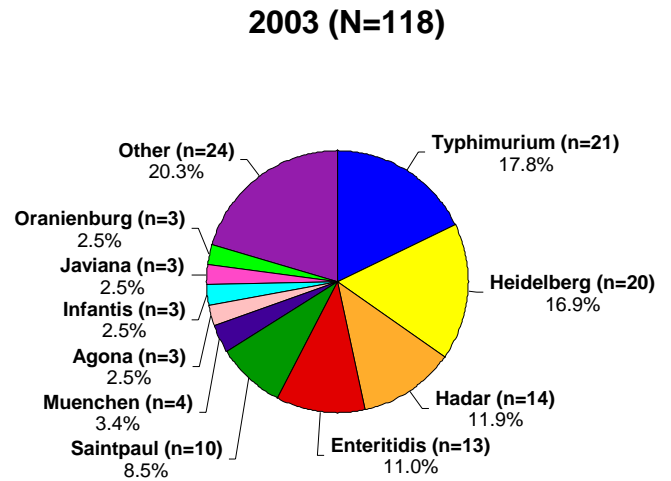
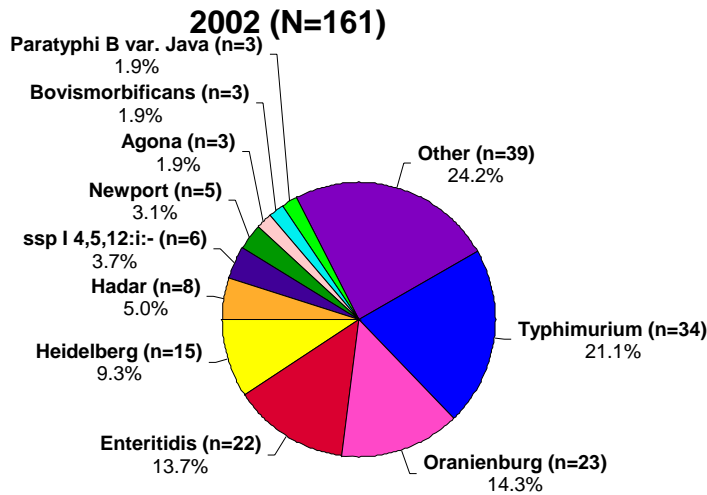


ALBERTA

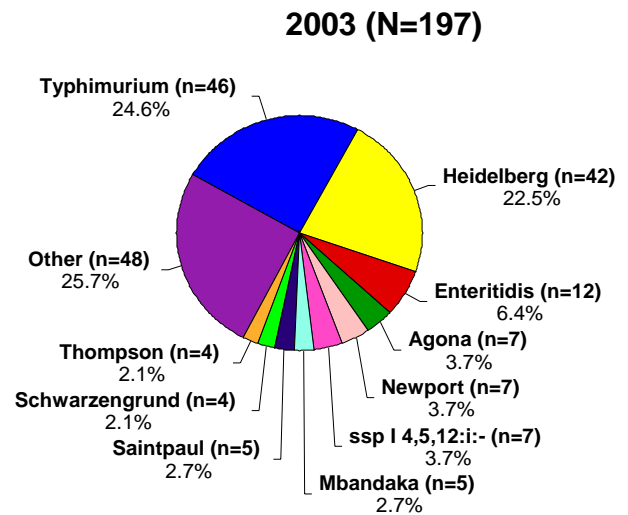
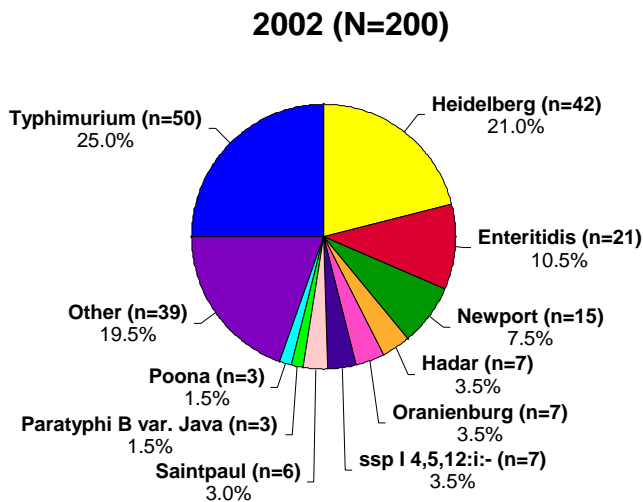


* Serovar totals are laboratory confirmed isolates based on information supplied to the NESP with supplemented identifications from NML reference services. Although this data is representative of laboratory confirmed isolates only and should not be confused with incidence of disease, this subset of data is consistently gathered from year to year and can indicate emerging or re-emerging trends. See Appendix 1 for details.

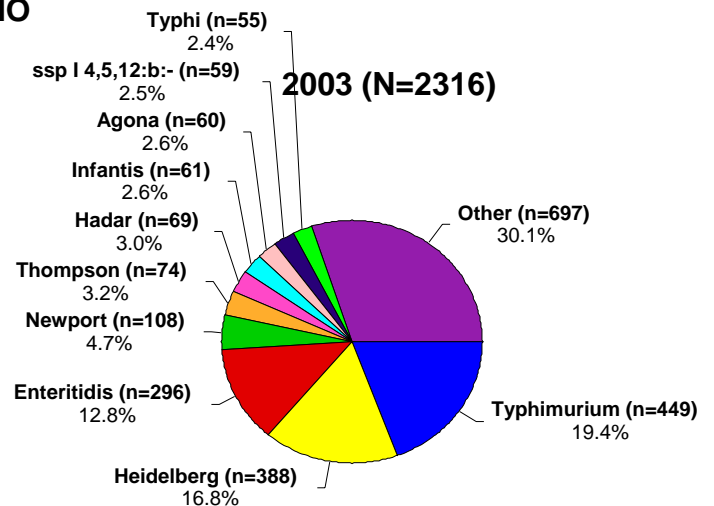
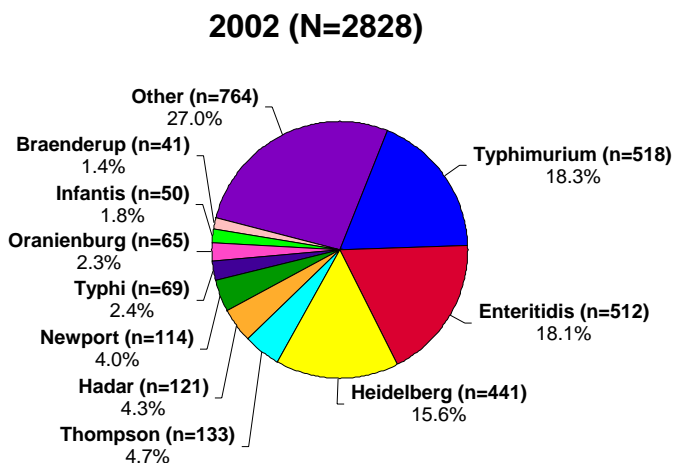
SASKATCHEWAN



MANITOBA

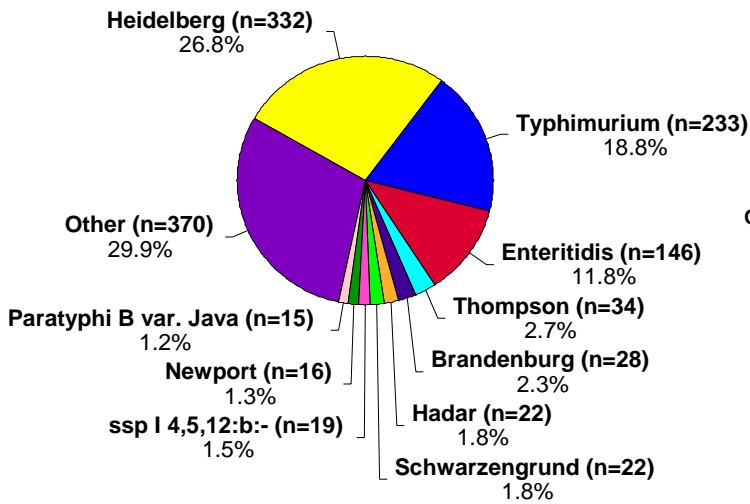


ONTARIO

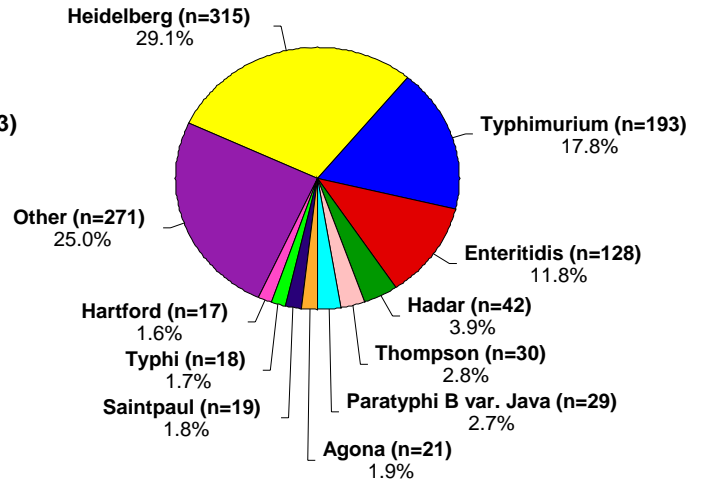


QUEBEC

2002 (N=1237)

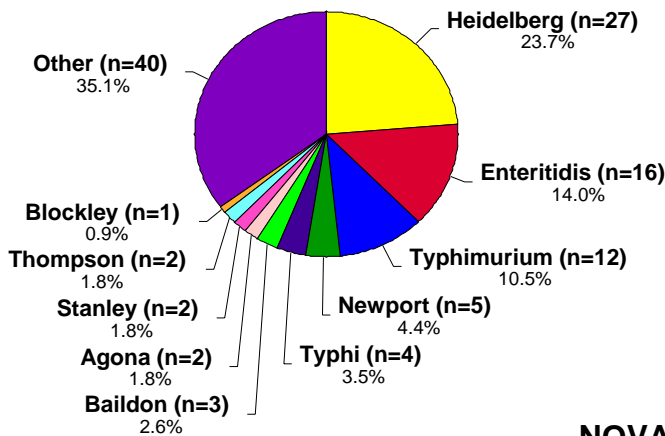


2003 (N=1083)

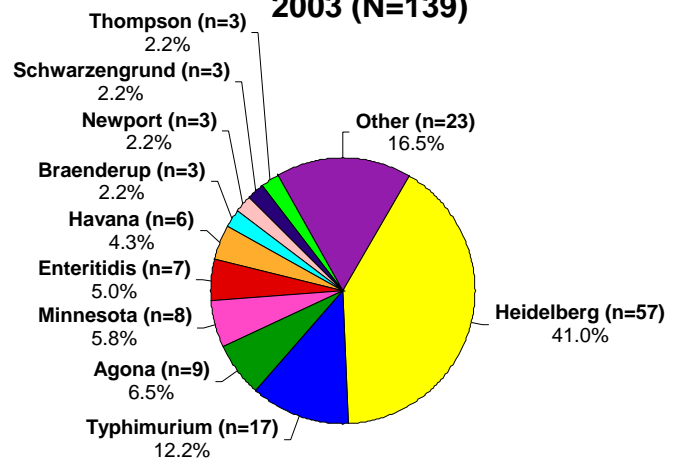


NEW BRUNSWICK

2002 (N=114)

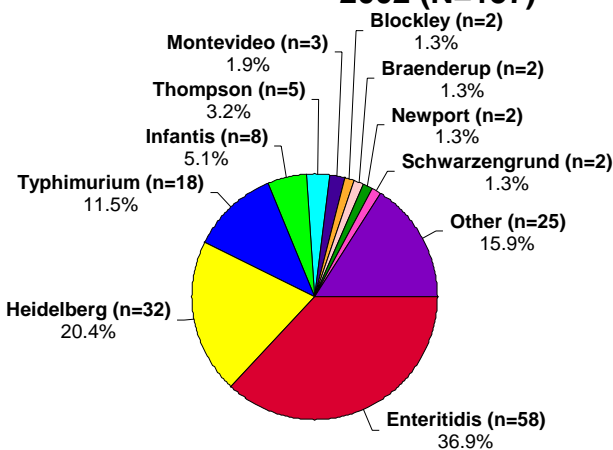


2003 (N=139)

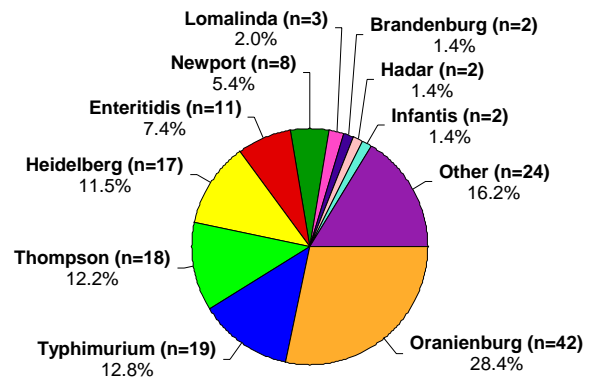


NOVA SCOTIA

2002 (N=157)

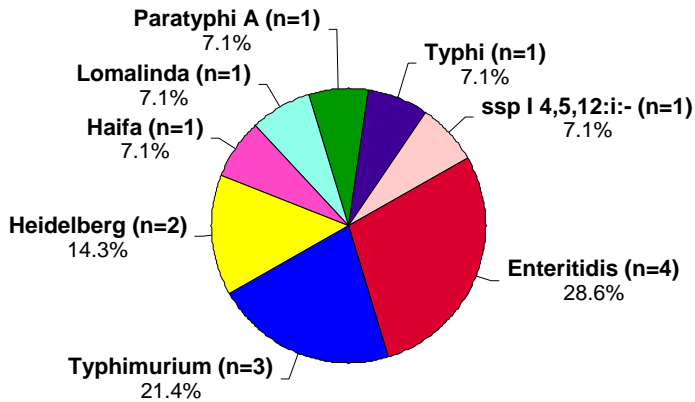


2003 (N=148)

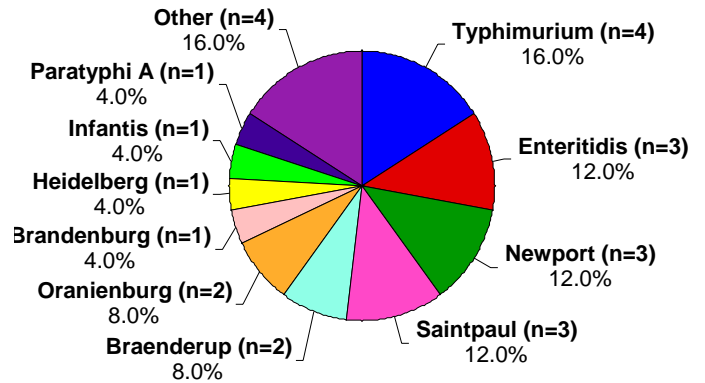


PRINCE EDWARD ISLAND

2002 (N=14)

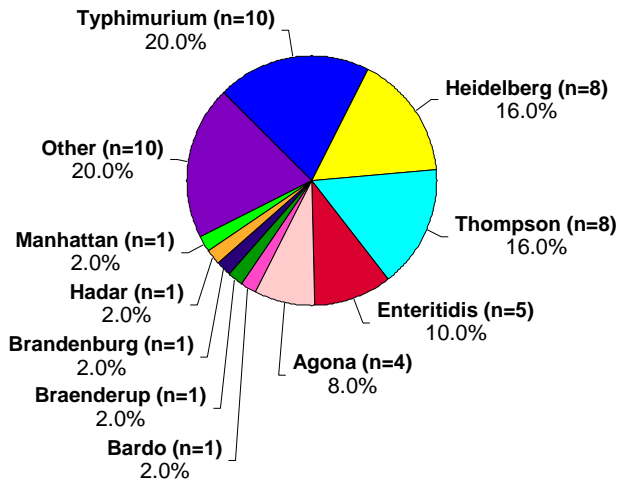


2003 (N=25)

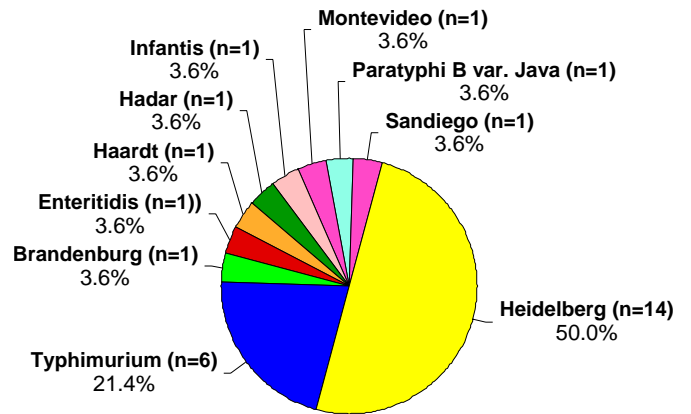


NEWFOUNDLAND and LABRADOR

2002 (N=50)

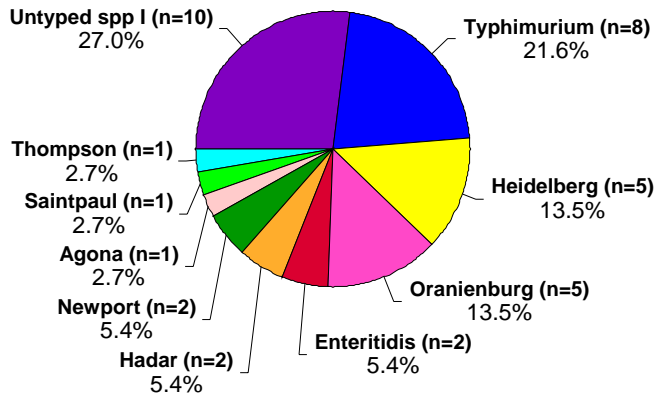


2003 (N=28)



NORTHWEST TERRITORIES, YUKON TERRITORY AND NUNAVUT

2002 (N=37)



2003 (N=21)

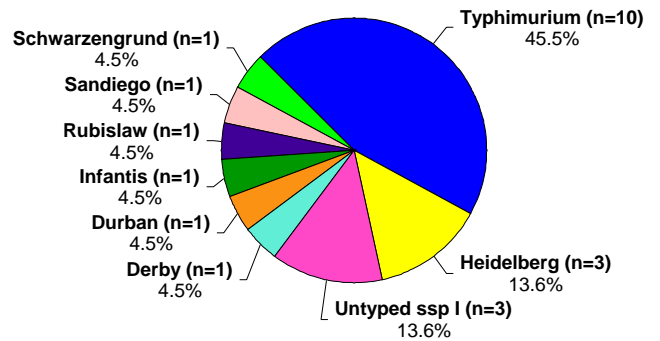
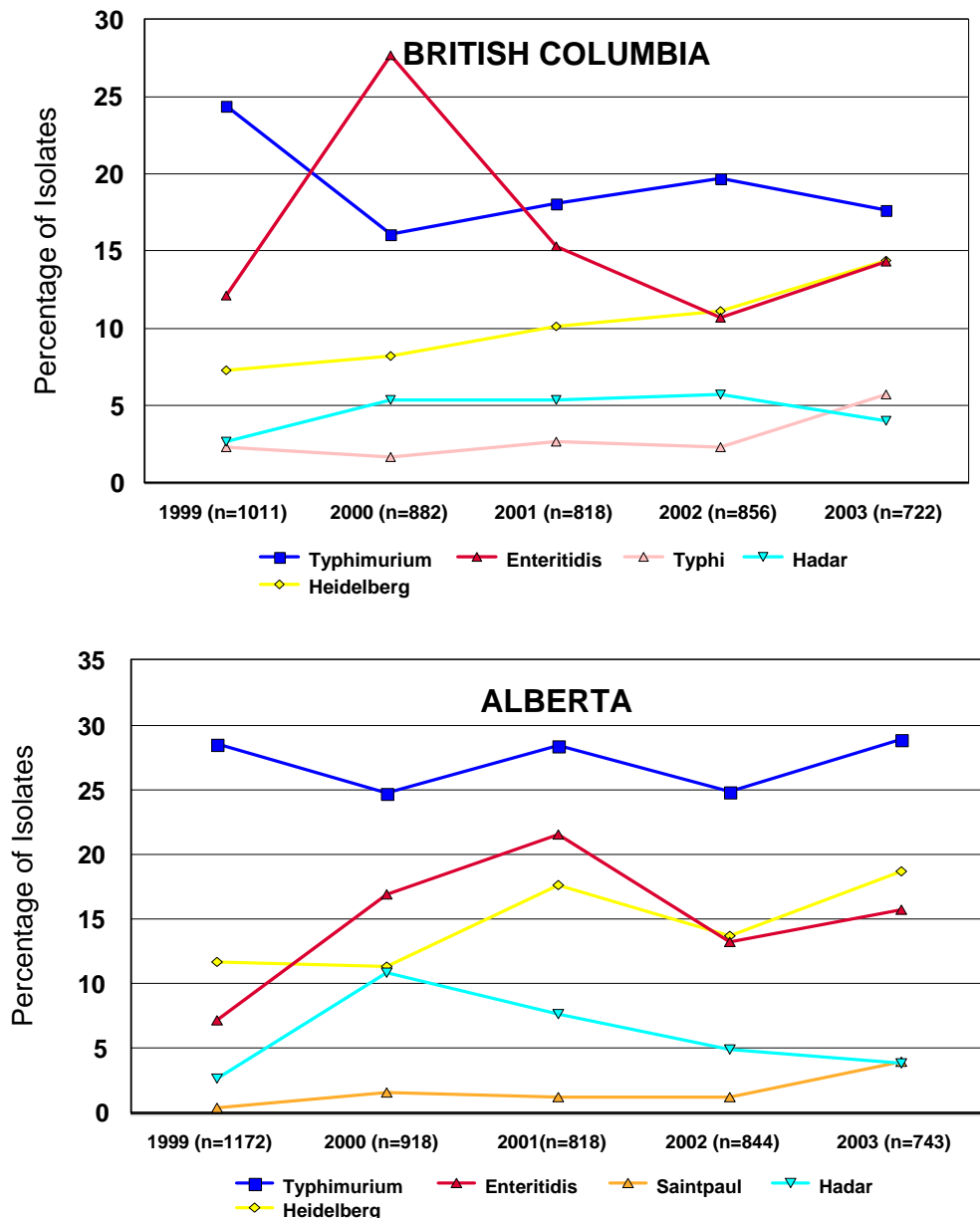
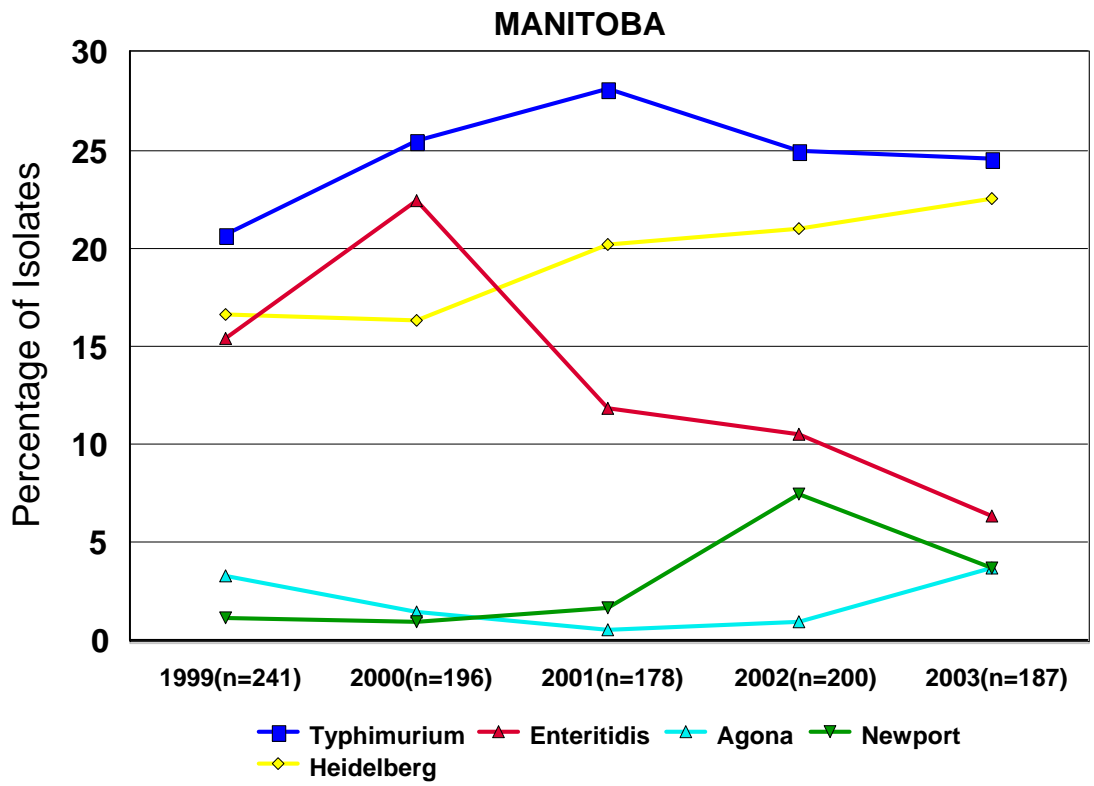
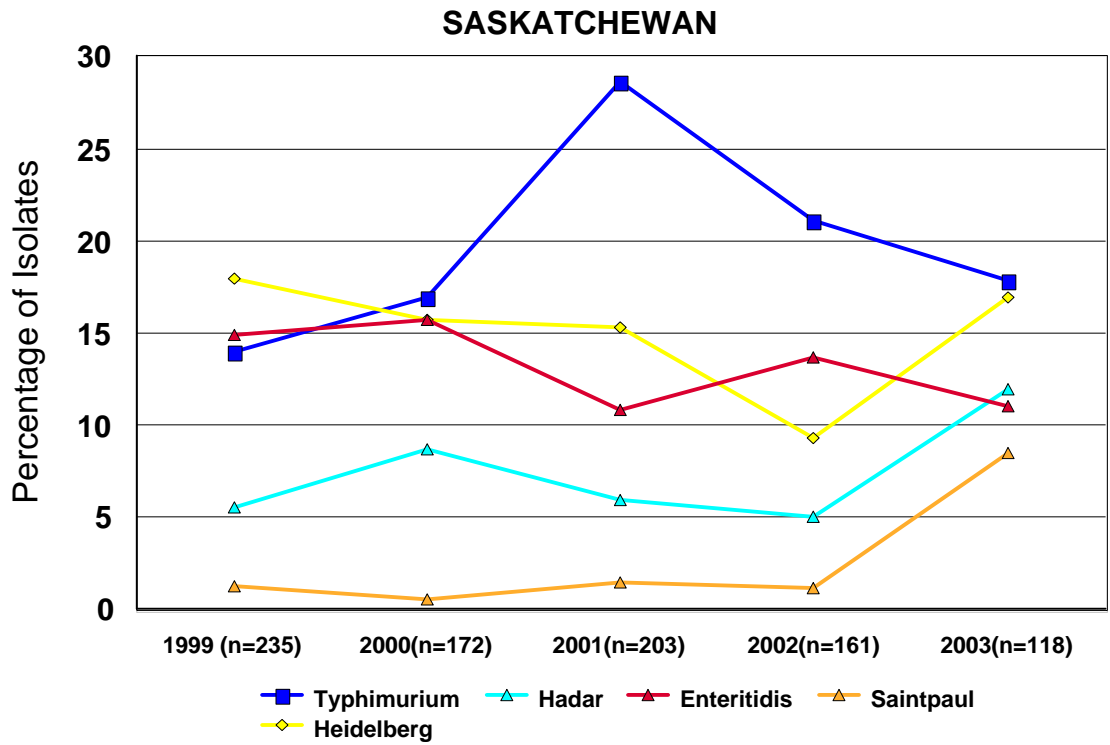
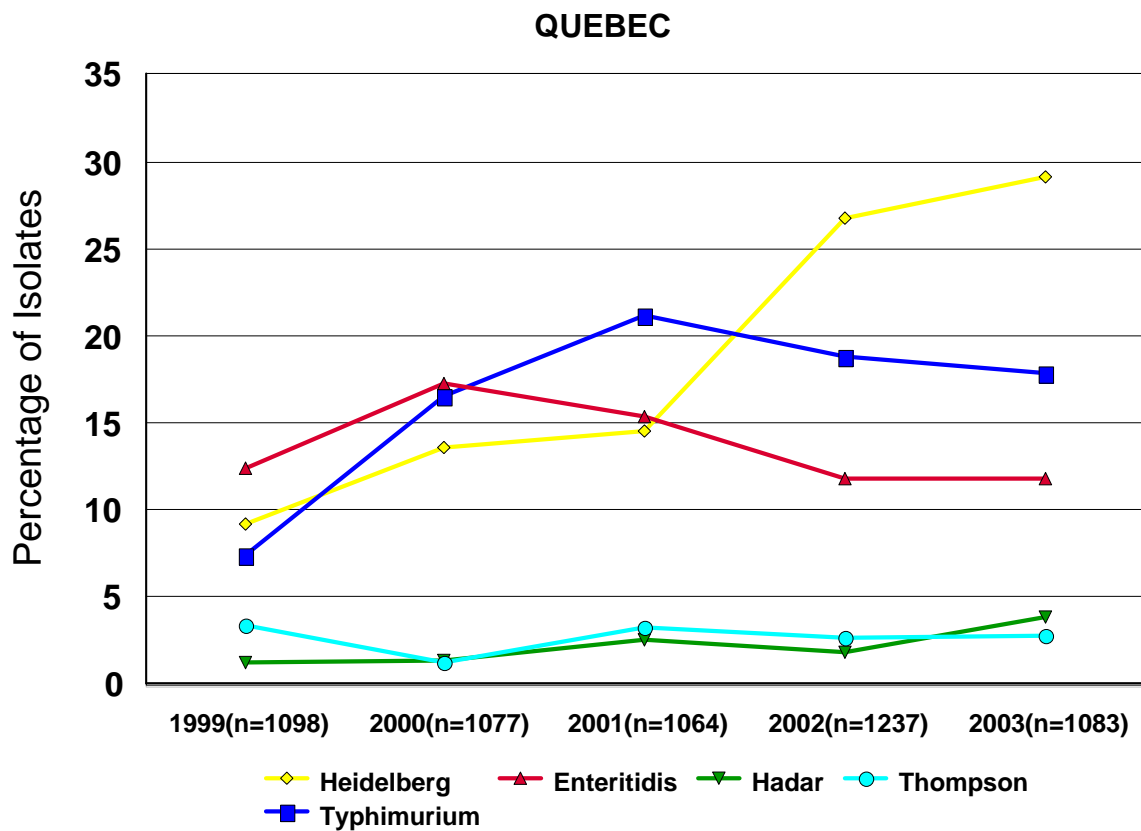
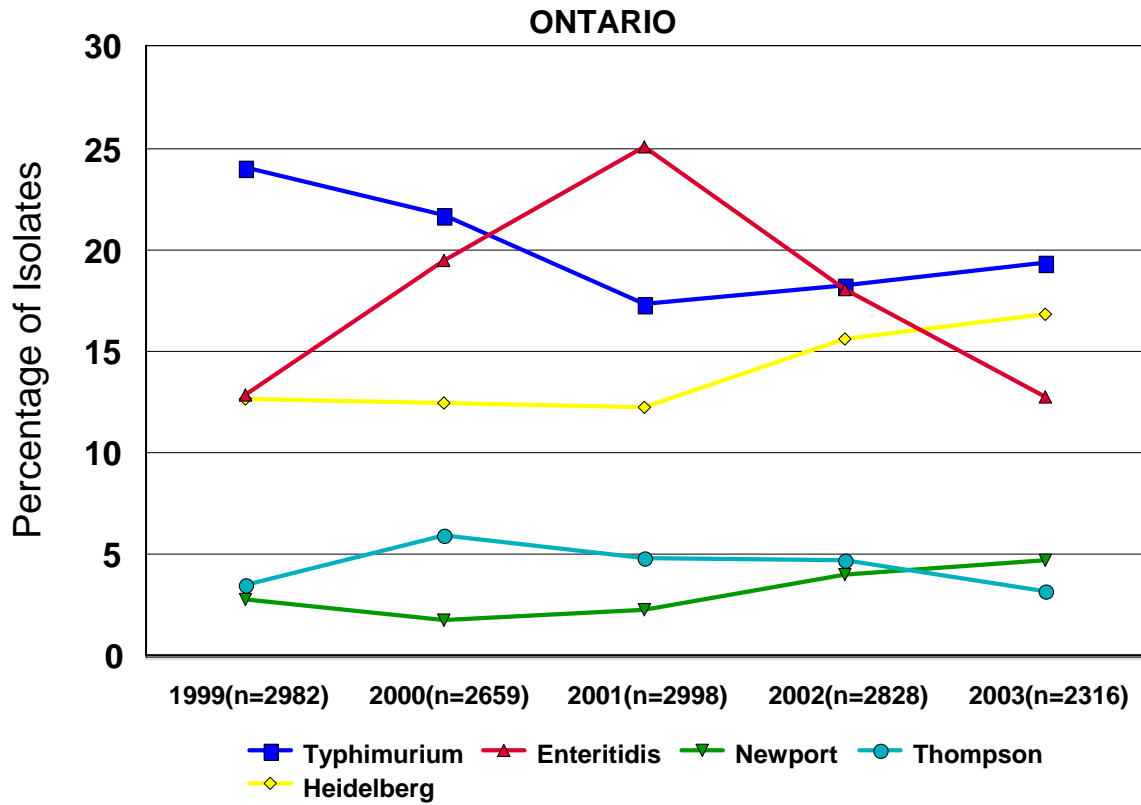


Figure 9 illustrates the variation of the five most prevalent serovars of 2003 from each province/territory for 1999 to 2003. Data for previous years is taken from previous annual summaries, which is based on information supplied to the NESP and supplemented with identifications from the NML reference services. Data is representative of laboratory confirmed isolates only and should not be confused with incidence of disease. This subset of data however is consistently gathered from year to year and can indicate emerging or re-emerging trends. See Appendix 1 for details. The larger year-to-year fluctuations in prevalence can be attributed to outbreaks of gastroenteritis. However, longer trends such as the increases in *S. Heidelberg* in many provinces/territories in 2002 and 2003 may indicate the emergence or recognition of a new pathogen.

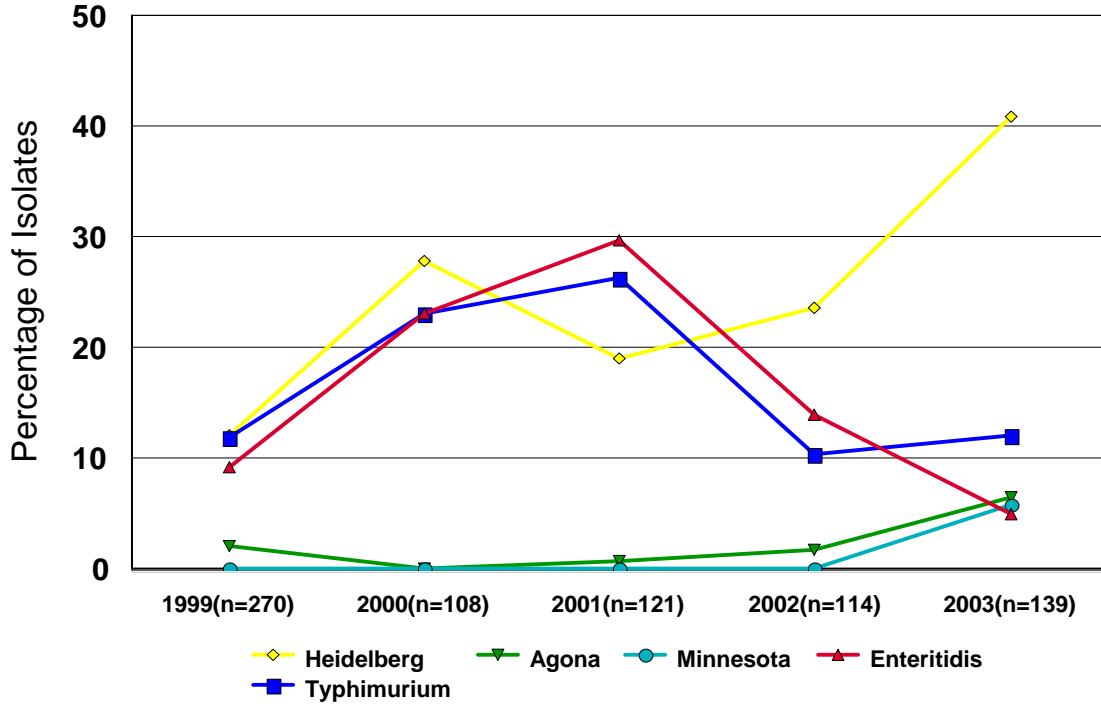
Figure 9: Five Most Prevalent *Salmonella* Serovars from Humans in Each Province, 1999 to 2003



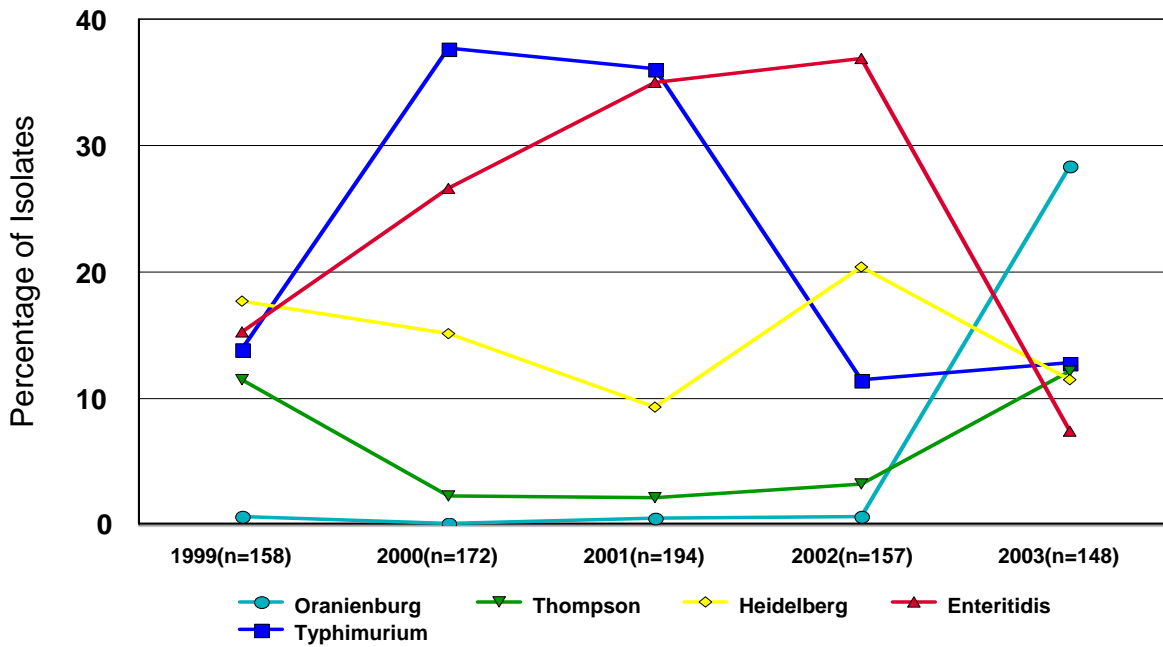


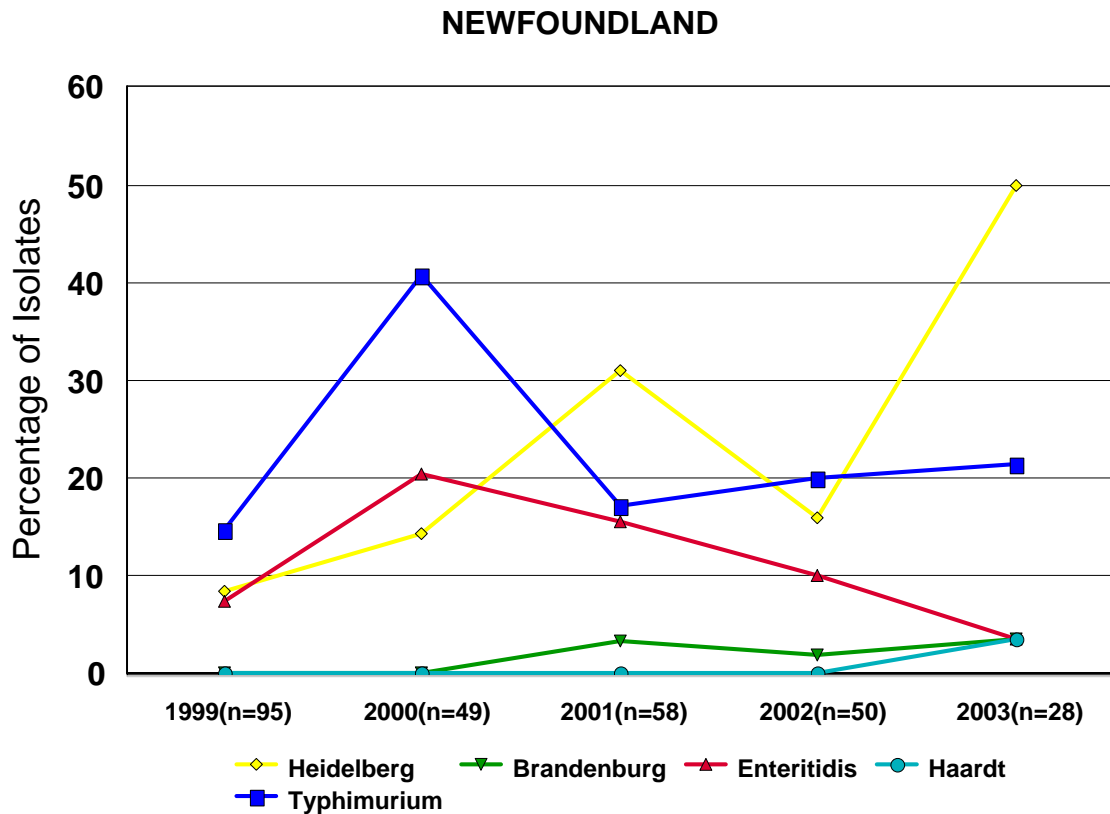
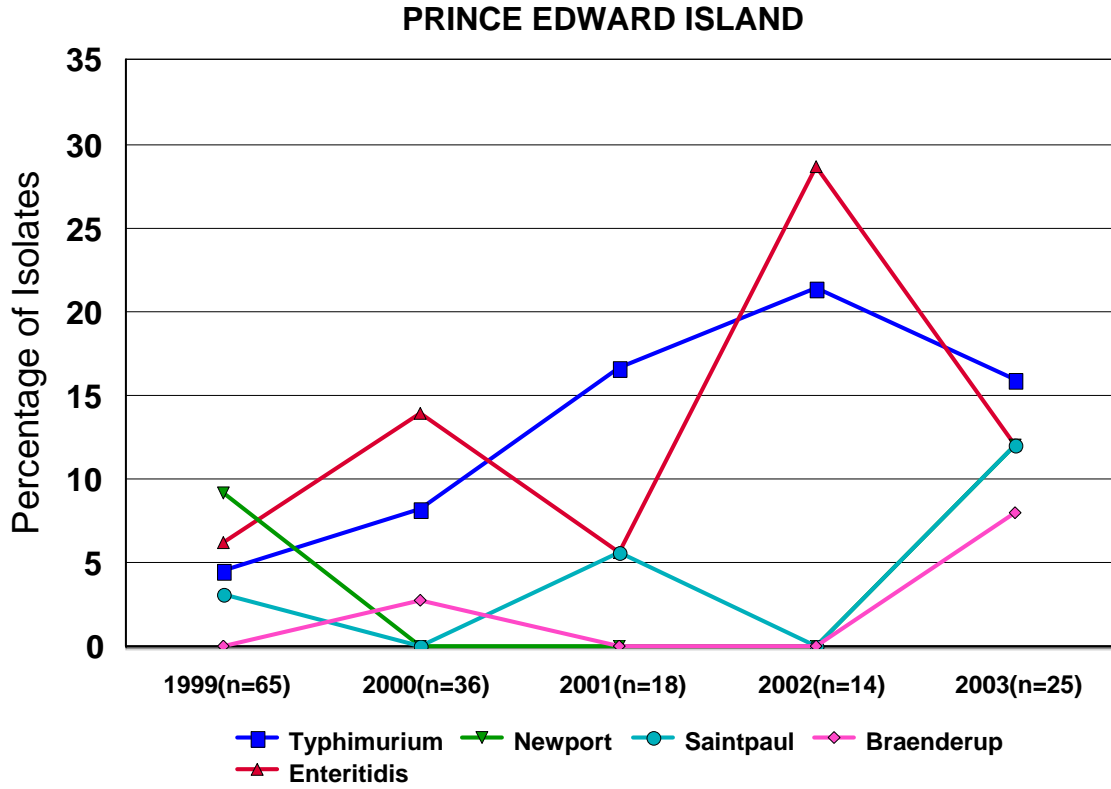


NEW BRUNSWICK



NOVA SCOTIA





New and Unique *Salmonella* Serovars in Canada

<u>Serovar</u>	<u>Province</u>	<u>Source</u>	<u>Month Isolated</u>
<i>S. Carno</i> (ssp I 1,3,19:z:l,w)	Ontario	Human	January, 2002
<i>S. diarizonae</i> (ssp IIIb) 47:k:z35	Saskatchewan	Human	January, 2002
<i>S. arizonae</i> (ssp IIIa) 44:z4,z23:-	Ontario	Human	March, 2002
<i>S. salamae</i> (ssp II) 30:l,z28:z6	Alberta	Gecko Lizard	May, 2002
<i>S. Goma</i> (ssp I 6,7:z4,z23:z6)	Ontario	Human	September, 2002
<i>S. Yoruba</i> (ssp I 16:c:l,w)	British Columbia	Fish	October, 2002
<i>S. salamae</i> (ssp II) 1,9,12:b:e,n,x	Alberta	Human	October, 2002
<i>S. Hithergreen</i> (ssp I 16:c:e,n,z15)	Ontario	Human	December, 2002
<i>S. Woodinville</i> (ssp I 11:c:e,n,x)	Alberta	Human	December, 2002
<i>S. diarizonae</i> (ssp IIIb) 60:i:-:Rz50	Saskatchewan	Human	August, 2002
<i>S. Ipswich</i> (ssp I 41:z4,z24:1,5)	Ontario	Human	January, 2003
<i>S. houtenae</i> (ssp IV) 1,40:g,t:-	British Columbia	Gecko Lizard	January, 2003
<i>S. Barranquilla</i> (ssp I 16:d:e,n,x)	Quebec	Human	February, 2003
<i>S. Brazzaville</i> (ssp I 6,7:b:1,2)	Ontario	Human	February, 2003
<i>S. Eschberg</i> (ssp I 9,12:d:1,7)	Alberta	Human	May, 2003
<i>S. Apapa</i> (ssp I 45:m,t:-)	Ontario	Human	August, 2003
<i>S. Beaudesert</i> (ssp I 6,14:e,h:1,7)	Alberta	Human	August, 2003
<i>S. Ireneae</i> (ssp I 17:k1,5)	Ontario	Human	August, 2003
<i>S. Zega</i> (ssp I 9,12:d:z6)	Alberta	Reptile	August, 2003
<i>S. Oldenburg</i> (ssp I 16:d:1,2)	Manitoba	Human	September, 2003

Table 1: *Salmonella* Serovars from Humans in Canada, 2002

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	YK	NT	NU	Total
<i>S. Abaetetuba</i>	2				3									5
<i>S. Aberdeen</i>			1		2									3
<i>S. Abony</i>					1									1
<i>S. Adelaide</i>	3	2			7	1								13
<i>S. Agona</i>	27	15	3	2	35	14	2	1		4		1		104
<i>S. Ahuza</i>	2													2
<i>S. Alachua</i>	1	4												5
<i>S. Albany</i>		3			2									5
<i>S. Altona</i>			1			1								2
<i>S. Amsterdam</i>		1												1
<i>S. Anatum</i>	9	4	1	2	29	3								48
<i>S. Arechavaleta</i>					1									1
<i>S. Baildon</i>					5		3	1						9
<i>S. Banana</i>						1								1
<i>S. Bardo</i>	4				4					1				9
<i>S. Bareilly</i>	3	1			6	1								11
<i>S. Berkeley</i>	1													1
<i>S. Berta</i>		2	1	1	38	12								54
<i>S. Blockley</i>	4	3		1	10	1	1	2						22
<i>S. Bonariensis</i>		1			1									2
<i>S. Bovismorbificans</i>	1	10	3	1	9	2								26
<i>S. Braenderup</i>	1	5	2	2	41	3		2		1				57
<i>S. Brandenburg</i>	5				20	28		1		1				55
<i>S. Bredeney</i>	5			1	4	1								11
<i>S. Brunei</i>					1									1
<i>S. California</i>		1												1
<i>S. Cannstatt</i>		1												1
<i>S. Caracas</i>						1								1
<i>S. Carno</i>					1									1
<i>S. Cerro</i>					3									3
<i>S. Chester</i>	7	1			1			1						10
<i>S. Choleraesuis</i>					2	1								3
<i>S. Corvallis</i>					2	1								3
<i>S. Cubana</i>		1				1								2
<i>S. Curacao</i>					1									1
<i>S. Dahra</i>						1								1
<i>S. Denver</i>					1									1
<i>S. Derby</i>	5	7			12	1		1						26
<i>S. Dublin</i>	1				2	1	1							5
<i>S. Durban</i>	1				3									4
<i>S. Ealing</i>					1									1
<i>S. Eastbourne</i>		1			2	1								4
<i>S. Emek</i>	1	1			1									3
<i>S. Enteritidis</i>	92	111	22	21	512	146	16	58	4	5		1	1	989
<i>S. Gaminara</i>	1	2			1									4
<i>S. Gatuni</i>					1									1

Human *Salmonella* 2002

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	YK	NT	NU	Total
S. Give	3	2			2									7
S. Give var. 15+		1	1											2
S. Glostrup		1												1
S. Goettingen						1								1
S. Goma					1									1
S. Haardt		1												1
S. Hadar	49	41	8	7	121	22		1		1		1	1	252
S. Haifa	2				2				1					5
S. Hartford					16									16
S. Havana	7				8									15
S. Heidelberg	95	116	15	42	441	332	27	32	2	8	1	1	3	1115
S. Hithergreen					1									1
S. Hvitvingfoss					4									4
S. Indiana	3	2			1									6
S. Infantis	16	12	1	2	50	7	1	8						97
S. Inverness	1													1
S. Isangi								1						1
S. Istanbul			1	1	8	2		1						13
S. Itami	1													1
S. Javiana	3	6		1	18	5								33
S. Johannesburg			1											1
S. Kedougou			1		2									3
S. Kentucky	4	2			5	5								16
S. Kiambu					5									5
S. Kingabwa	2													2
S. Kottbus					2									2
S. Litchfield	1				9	4	1							15
S. Liverpool						1								1
S. Livingstone	5													5
S. Lomalinda					1				1					2
S. London					1									1
S. Manhattan	1				1			1		1				4
S. Mbandaka	4	2		1	10	1	1	1						20
S. Miami	1				2									3
S. Milwaukee		1												1
S. Minnesota	1	1			2									4
S. Mississippi	2				6									8
S. Monschau	1				1	1		1						4
S. Montevideo	7	7	1	2	32	7	1	3						60
S. Mountpleasant					1									1
S. Muenchen	9	7	1	2	19	3				1				42
S. Muenster	2	2	1		5	6								16
S. Napoli					2									2
S. Ndolo		1												1
S. Newport	25	23	5	15	114	16	5	2		1	1	1		208
S. Nima				1	2	1								4
S. Norwich					1									1

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	YK	NT	NU	Total
S. Nottingham					1									1
S. Ohio	1	1			3		1			1				7
S. Oranienburg	43	69	23	7	65	2	1	1					5	216
S. Orion					1									1
S. Oslo					1									1
S. Panama	2	5			9	7	1	1						25
S. Paratyphi A	17	3	1		32	3			1					57
S. Paratyphi B	2	1	1		3									7
S. Paratyphi B var. Java	13	15	3	3	19	15	1	1		1				71
S. Poona	8	5	2	3	7	2								27
S. Pomona				1										1
S. Potsdam	1	1			1	1								4
S. Putten					1									1
S. Quiniela						1								1
S. Reading	1			1	6									8
S. Richmond	19	2			1									22
S. Rissen		1				1								2
S. Roodepoort								1						1
S. Rubislaw	1	5			4	1								11
S. Ruiru					1									1
S. Saintpaul	19	10	2	6	38	8	1	1		1	1			87
S. Sandiego	8	2	1	1	12	7								31
S. Saphra	1													1
S. Schwarzengrund	4	1		1	9	22		2		1				40
S. Senftenberg	5	1		1	7					1				15
S. Shubra		1												1
S. Singapore					1									1
S. Stanley	17	8		1	18	5	2							51
S. Sundsvall						1								1
S. Tananarive					1									1
S. Teitelkebir					2									2
S. Tennessee	1	2			2					1				6
S. Thompson	11	23	3	3	133	34	2	5		8		1		223
S. Tilburg								2						2
S. Tilene		1												1
S. Tsevie		1												1
S. Typhi	20	9		1	69	15	4		1					119
S. Typhimurium	169	209	34	50	518	233	12	18	3	10		1	7	1264
S. Uganda	2				18	3								23
S. Umbilo		1												1
S. Urbana					1	3		1						5
S. Virchow	15	6			9	2	1			1				34
S. Wandsworth					1									1
S. Weltevreden	7	4			8	1								20
S. Widemarsh					3									3
S. Woodinville		1												1

Human *Salmonella* 2002

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	YK	NT	NU	Total
S. Worthington		2			1									3
<i>Salmonella</i> ssp I		3	10	8		66	11	5		1		1	9	114
<i>Salmonella</i> ssp I 2,12:-:-	1													1
<i>Salmonella</i> Group B						48	5							53
<i>Salmonella</i> ssp I 4,12:-:-		1												1
<i>Salmonella</i> ssp I 4,5,12:-:-					1		1							2
<i>Salmonella</i> ssp I 4,5,12:-:1,2					1									1
<i>Salmonella</i> ssp I 4,12:b:-					2	2								4
<i>Salmonella</i> ssp I 4,5,12:b:-	3	7			35	19								64
<i>Salmonella</i> ssp I 4,5,12:d:-		1			2									3
<i>Salmonella</i> ssp I 4,5,12:e,h:-					1									1
<i>Salmonella</i> ssp I 4,12:i:-	14	1				8								23
<i>Salmonella</i> ssp I 4,5,12:i:-	18	25	6	7	33	1	1	1	1					93
<i>Salmonella</i> ssp I 4,5,12:r:-					1									1
<i>Salmonella</i> ssp I 4,5,12:z:-					1									1
<i>Salmonella</i> Group C					5	1								6
<i>Salmonella</i> Group C1						43	3							46
<i>Salmonella</i> ssp I 6,7,14:-:e,n,z15					1									1
<i>Salmonella</i> ssp I 6,7:-:1,5					2									2
<i>Salmonella</i> ssp I 6,7:k:-					8									8
<i>Salmonella</i> ssp I 6,7:r:-					3									3
<i>Salmonella</i> ssp I 6,7:y:-					2									2
<i>Salmonella</i> ssp I 6,7:z10:-	1				1									2
<i>Salmonella</i> Group C2						26	1							27
<i>Salmonella</i> ssp I 6,8:-:-		1			1									2
<i>Salmonella</i> ssp I 6,8:-:1,2					1									1
<i>Salmonella</i> ssp I 6,8:d:-					2									2
<i>Salmonella</i> ssp I 6,8:e,h:-					2									2
<i>Salmonella</i> ssp I 6,8:y:-		1												1
<i>Salmonella</i> ssp I 6,8:z10:-					5									5
<i>Salmonella</i> ssp I 6,8:z:-					1									1
<i>Salmonella</i> ssp I 8,20:-:z6					1									1
<i>Salmonella</i> ssp I 8,20:i:-					4									4
<i>Salmonella</i> Group D					2	1	4							7
<i>Salmonella</i> ssp I 9,12:-:-	1				5	1								7
<i>Salmonella</i> ssp I 9,12:-:1,5					2	1								3
<i>Salmonella</i> ssp I 9,12:a:-					1									1
<i>Salmonella</i> ssp I 9,12:l,z28:-						1								1
<i>Salmonella</i> Group E1						9								9
<i>Salmonella</i> ssp I 3,10:e,h:-	1													1
<i>Salmonella</i> ssp I 13,23:i:-					1									1
<i>Salmonella</i> ssp I 16:l,v:-					1									1
<i>Salmonella</i> ssp I 6,18:-:-					1									1
<i>Salmonella</i> Group L (O:21)					1									1
<i>Salmonella</i> ssp I Rough-O:-:-	2				9		1							12

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	YK	NT	NU	Total
<i>Salmonella</i> ssp I Rough-O:-:1,7							1							1
<i>Salmonella</i> ssp I Rough-O:d:l,w			1											1
<i>Salmonella</i> ssp I Rough-O:e,h:-					1									1
<i>Salmonella</i> ssp I Rough-O:e,h:1,5						1								1
<i>Salmonella</i> ssp I Rough-O:e,h:1,6						1								1
<i>Salmonella</i> ssp I Rough-O:f,g:-														
<i>Salmonella</i> ssp I Rough-O:f,g,s:-		1												1
<i>Salmonella</i> ssp I Rough-O:i:-							1							1
<i>Salmonella</i> ssp I Rough-O:i:1,2		1												1
<i>Salmonella</i> ssp I Rough-O:m,t:-		1			1									2
<i>Salmonella</i> ssp I Rough-O:r:1,2		1												1
<i>Salmonella</i> ssp I Rough-O:r:1,5					1									1
<i>Salmonella</i> ssp I Rough-O:z4,z23:-					1									1
<i>Salmonella</i> ssp II 1,9,12:b:e,n,x		1												1
<i>Salmonella</i> ssp II 13,23:z:1,5					1									1
<i>Salmonella</i> ssp II 45:z:1,5					1									1
<i>Salmonella</i> ssp II 48:d:z6	2													2
<i>Salmonella</i> ssp III														
<i>Salmonella</i> ssp IIIa					1									1
<i>Salmonella</i> ssp IIIa 44:z4,z23:-					1									1
<i>Salmonella</i> ssp IIIa 48:z4,z24:-			1		1									2
<i>Salmonella</i> ssp IIIb			1											1
<i>Salmonella</i> ssp IIIb 11:k:z53					1									1
<i>Salmonella</i> ssp IIIb 38:k:z35					1									1
<i>Salmonella</i> ssp IIIb 47:k:z35	1													1
<i>Salmonella</i> ssp IIIb 50:-:-	1													1
<i>Salmonella</i> ssp IIIb 60:i:-:R,z50			1											1
<i>Salmonella</i> ssp IIIb 60:r:e,n,z15					1									1
<i>Salmonella</i> ssp IIIb 60:r:z					1									1
<i>Salmonella</i> ssp IIIb 61:k:1,5														
<i>Salmonella</i> ssp IIIb 61:k:1,5,7	1				1	1								3
<i>Salmonella</i> ssp IIIb 65:k:z		1												1
<i>Salmonella</i> ssp IIIb 65:k:z53					1									1
<i>Salmonella</i> ssp IIIb Rough-O:k:1,5						1								1
<i>Salmonella</i> ssp IV 11:z4,z23:-						1								1
<i>Salmonella</i> ssp IV 16:z4,z32:-	1	1												2
<i>Salmonella</i> ssp IV 44:z4,z23:-					2	2								4
<i>Salmonella</i> ssp IV 44:z4,z32:-			1											1
<i>Salmonella</i> ssp IV 45:g,z51:-		1			2									3
<i>Salmonella</i> ssp IV 48:g,z51:-	1	1		1	3									6
Total	856	844	161	200	2828	1237	114	157	14	50	3	8	26	6498

Table 2: *Salmonella* Serovars from Humans in Canada, 2003

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	NT	NU	YK	Total
S. Abaetetuba					1	1								2
S. Aberdeen					3									3
S. Adelaide		1			4	1								6
S. Agona	28	17	3	7	60	21	9	1						146
S. Alachua	1				2									3
S. Albany	2	2			21									25
S. Amager				1										1
S. Amsterdam	3			1										4
S. Anatum	8	2		2	26	2	1	1						42
S. Anatum var. 15+		1												1
S. Apapa					1									1
S. Arechavaleta		1			1									2
S. Baildon								1						1
S. Bardo	4						1							5
S. Bareilly	5			1	8									14
S. Barranquilla						1								1
S. Beaudesert		1												1
S. Bergen		1												1
S. Berta	1	1		2	33	5								42
S. Bispebjerg					1									1
S. Blockley	3	3			8	2		1						17
S. Bovismorbificans		1		2	2									5
S. Braenderup	7	2	2	2	34	8	3		2					60
S. Brandenburg	4	1		1	13	7		2	1	1				30
S. Brazzaville					1									1
S. Bredeney	4	2			3	4								13
S. California		1												1
S. Carmel		1												1
S. Carrau	1													1
S. Cerro	3				3	1								7
S. Chester	2	1			2			1						6
S. Choleraesuis					1									1
S. Chomedey				1										1
S. Cochin	1			1										2
S. Coeln					1									1
S. Colindale						1								1
S. Concord					2									2
S. Corvallis		1			2									3
S. Cubana	1				2									3
S. Daytona	2													2
S. Derby	4	2		1	12	5							1	25
S. Dublin	2	1			1	2	1							7
S. Durban					1						1			2
S. Ealing					1									1
S. Eastbourne					2	1								3
S. Edinburg					1									1

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	NT	NU	YK	Total
S. Emek	1	1												2
S. Enteritidis	103	117	13	12	296	128	7	11	3	1				691
S. Eschberg		1												1
S. Falkensee						1								1
S. Fluntern		1				1								2
S. Friedenau					2									2
S. Gaminara		1			2									3
S. Gatuni					3									3
S. Give	1				4	3								8
S. Give var. 15+		2												2
S. Glostrup	1	1		1	1									4
S. Goverdhan	1													1
S. Haardt	1									1				2
S. Hadar	29	28	14	2	69	42	2	2		1				189
S. Haifa	1				1			1						3
S. Hartford					6	17								23
S. Havana					5		6							11
S. Heidelberg	104	139	20	42	388	315	57	17	1	14	2		1	1100
S. Hull		1												1
S. Hvitvingfoss	1		1		3									5
S. Indiana	3				6	4	2							15
S. Infantis	19	15	3	2	61	16		2	1	1	1			121
S. Inverness				1	1									2
S. Ipswich					1									1
S. Irene					1									1
S. Irumu					1									1
S. Istanbul	3	1	1				1							6
S. Jamaica		1												1
S. Javiana	11	12	3	1	30	8		2						67
S. Johannesburg					1									1
S. Kentucky	1				4	5								10
S. Kiambu				2	8	2								12
S. Kibusi						1								1
S. Kingabwa		1	1		1	1								4
S. Kintambo	1				1									2
S. Kottbus	1													1
S. Krefeld				1										1
S. Lagos						1								1
S. Larochelle					1									1
S. Lexington			1											1
S. Litchfield	2	1			10	3								16
S. Livingstone					3									3
S. Lomalinda								3						3
S. London		2			2	2								6
S. Manchester	1													1
S. Manhattan	2		1		4									7

Human *Salmonella* 2003

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	NT	NU	YK	Total
S. Mbandaka	6	5		5	14	2		1						33
S. Meleagridis					3									3
S. Miami					5	3	2							10
S. Mikawasima					1									1
S. Minnesota					2	1	8							11
S. Mississippi	2	3			3		1							9
S. Monschau				1	3									4
S. Montevideo	3		1	2	16	2	1	1		1				27
S. Mountpleasant					2									2
S. Muenchen	3	3	4	2	35	6	1	2						56
S. Muenster	1	1			3	1								6
S. Nessziona					1									1
S. Newport	19	18	2	7	108	14	3	8	3					182
S. Nima		1			1									2
S. Ohio	1		1		1	1								4
S. Oldenburg				1										1
S. Oranienburg	9	7	3	2	21	6	1	42	2					93
S. Orion				1										1
S. Orion var. 15+					1									1
S. Oslo			1		2									3
S. Panama	3				5	4								12
S. Paratyphi A	19	2		1	27	4	1		1					55
S. Paratyphi B	1				2									3
S. Paratyphi B var. Java	17	3		1	19	29	1		1	1				72
S. Plymouth		1												1
S. Pomona	1	1	2		1									5
S. Poona			1		7			1						9
S. Potsdam						1								1
S. Praha	1				1									2
S. Putten					1									1
S. Reading					1									1
S. Richmond	2	1	1		1									5
S. Rissen	1	2			1	1								5
S. Roan					1									1
S. Romanby					1									1
S. Rubislaw	2	6	1	1							1			11
S. Saintpaul	13	30	10	5	30	19		1	3					111
S. Sandiego		1			5	3				1	1			11
S. Schwarzengrund	3	7	2	4	16	1	3	1			1			38
S. Senftenberg	3				8	1			1					13
S. Sombre								1						1
S. Stanley	12	7	1		22	7								49
S. Stanleyville		2						1						3
S. Tallahassee						1								1
S. Teitelkebir		2			1	1								4
S. Tennessee		1			4									5

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	NT	NU	YK	Total
<i>S. Thompson</i>	9	7		4	74	30	3	18						145
<i>S. Typhi</i>	41	15		1	55	18	1							131
<i>S. Typhimurium</i>	128	215	21	46	449	193	17	19	4	6	2	7	1	1108
<i>S. Uganda</i>	6	2		1	8	3	2	2						24
<i>S. Urbana</i>	3				2									5
<i>S. Valdosta</i>						1								1
<i>S. Virchow</i>	9	2		3	19	3		1						37
<i>S. Waycross</i>					1									1
<i>S. Weltevreden</i>	3	2			4	2								11
<i>S. Weslaco</i>					1									1
<i>S. Westhampton</i>				1										1
<i>S. Widemarsh</i>					2									2
<i>S. Worthington</i>				2	2									4
<i>Salmonella</i> ssp I									1			3		4
<i>Salmonella</i> Group A						7								7
<i>Salmonella</i> Group B						7								7
<i>Salmonella</i> ssp I 4,12:-:e,n,x					1									1
<i>Salmonella</i> ssp I 4,12:b:-					1									1
<i>Salmonella</i> ssp I 4,12:i:-	9	7		1		1								18
<i>Salmonella</i> ssp I 4,12:r:-					1									1
<i>Salmonella</i> ssp I 4,5,12:-:-		2			2	1								5
<i>Salmonella</i> ssp I 4,5,12:-:1,2					3	1								4
<i>Salmonella</i> ssp I 4,5,12:b:-	5				59	2	1							67
<i>Salmonella</i> ssp I 4,5,12:d:-					1									1
<i>Salmonella</i> ssp I 4,5,12:e,h:-		1			1									2
<i>Salmonella</i> ssp I 4,5,12:i:-	7	9	2	7	40	13	1	2	1					82
<i>Salmonella</i> ssp I 4,5,12:r:-					1									1
<i>Salmonella</i> ssp I Group C						9								9
<i>Salmonella</i> ssp I Group C1						26								26
<i>Salmonella</i> ssp I 6,7:-:-					2									2
<i>Salmonella</i> ssp I 6,7:-:1,6	1													1
<i>Salmonella</i> ssp I 6,7:d:-					1									1
<i>Salmonella</i> ssp I 6,7:eh:-					2									2
<i>Salmonella</i> ssp I 6,7:k:-					3									3
<i>Salmonella</i> ssp I 6,7,14:r:-						1								1
<i>Salmonella</i> ssp I Group C2						30								30
<i>Salmonella</i> ssp I 6,8:-:e,n,x					1									1
<i>Salmonella</i> ssp I 6,8:-:1,2					1									1
<i>Salmonella</i> ssp I 6,8:d:-					4									4
<i>Salmonella</i> ssp I 6,8:e,h:-					1									1
<i>Salmonella</i> ssp I 6,8:z10:-					2									2
<i>Salmonella</i> ssp I 8,20:i:-					4									4
<i>Salmonella</i> ssp I 8,20:r:-					1									1
<i>Salmonella</i> ssp I 9,12:-:1,5					2									2
<i>Salmonella</i> ssp I 9,12:-:e,n,z15		1												1
<i>Salmonella</i> ssp I 3,10:b:-						1								1
<i>Salmonella</i> ssp I 3,10:e,h:-					1									1

Human *Salmonella* 2003

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PE	NF	NT	NU	YK	Total
<i>Salmonella</i> ssp I 3,10:r:-					1									1
<i>Salmonella</i> ssp I 45:-:-					1									1
<i>Salmonella</i> ssp I Rough-O:-:-			1		2									3
<i>Salmonella</i> ssp I Rough-O:-:1,2					1									1
<i>Salmonella</i> ssp I Rough-O,Vi:d:-							1							1
<i>Salmonella</i> ssp I Rough-O:e,h:1,2			1											1
<i>Salmonella</i> ssp I Rough-O:g,m,s:-					1									1
<i>Salmonella</i> ssp I Rough-O:m,t:-		1												1
<i>Salmonella</i> ssp I Rough-O:r:1,2						1								1
<i>Salmonella</i> spp I Rough-O:r:-					1									1
<i>Salmonella</i> ssp I Rough-O:y:1,5					1									1
<i>Salmonella</i> ssp II 48:d:z6	1													1
<i>Salmonella</i> ssp II 58:d:z6					1									1
<i>Salmonella</i> ssp II 9,12:m,t:-						1								1
<i>Salmonella</i> ssp IIIa 40:g,z51:-						1								1
<i>Salmonella</i> ssp IIIa 48:g,z51:-					1									1
<i>Salmonella</i> ssp IIIb 48:i:z		1												1
<i>Salmonella</i> ssp IIIb 50:k:z	1	1												2
<i>Salmonella</i> ssp IIIb 50:r:z				1										1
<i>Salmonella</i> ssp IIIb 60:r:e,n,z15					1									1
<i>Salmonella</i> ssp IIIb 50:z52:z35	2													2
<i>Salmonella</i> ssp IIIb 60:r:z		1												1
<i>Salmonella</i> ssp IIIb 61:i:z	1					1								2
<i>Salmonella</i> ssp IIIb 61:k:1,5,7					1	8								9
<i>Salmonella</i> ssp IV		1												1
<i>Salmonella</i> ssp IV 16:z4,z32:-					1	1		1						3
<i>Salmonella</i> ssp IV 44:z4,z23:-		3				1								4
<i>Salmonella</i> ssp IV 44:z4,z24:-					1									1
<i>Salmonella</i> ssp IV 45:g,z51:-				1	1									2
<i>Salmonella</i> ssp IV 48:g,z51:-					3		1	1						5
<i>Salmonella</i> ssp IV 50:g,z51:-	1													1
<i>Salmonella</i> ssp IV 50:z4,z23:-					1									1
Total	722	743	118	187	2316	1083	139	148	25	28	9	10	3	5531

Salmonella Isolations from Non-Human Sources in 2002 and 2003

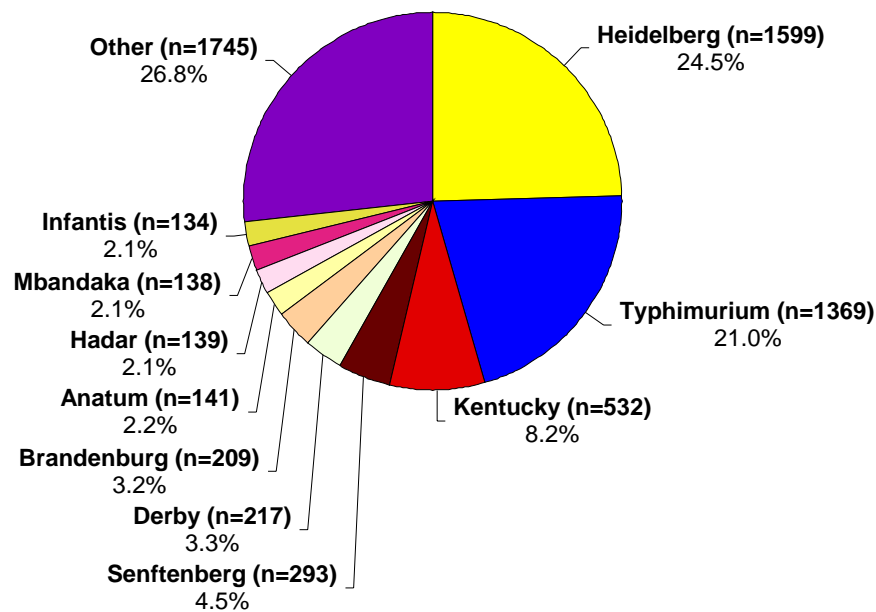
Non-human sources of *Salmonella* include animal, food, environmental or water and were gathered through the passive surveillance systems of the LFZ and NML in the course of reference services, special studies and outbreak investigations. There was no control of the relative numbers forwarded by a province/territory. Figures 10 and 11 show the ten most prevalent serovars isolated from non-human sources in Canada in 2002 and 2003.

S. Heidelberg was the most prevalent serovar isolated from non-human sources in Canada in 2002 with 24.5% (1599 of 6516) of the isolates identified, followed closely by *S. Typhimurium* with 21.0% (n=1369) of the isolates. Ranked a distant 3rd was *S. Kentucky* (8.2%, n=532) followed by *S. Senftenberg* (4.5%, n=293), *S. Derby* (3.3%, n=217), *S. Brandenburg* (3.2%, n=209), *S. Anatum* (2.2%, n=141), *S. Hadar* (2.1%, n=139), *S. Mbandaka* (2.1%, n=138) and ranked tenth was *S. Infantis* (2.1%, n=134).

In 2003, *S. Typhimurium* was most prevalent with 22.6% (1154 of 5096) of all *Salmonella* isolated from non-human sources, followed closely by *S. Heidelberg* with 21.5% (n=1095). *S. Kentucky* remained a distant 3rd (7.4%, n=376) and a new serovar to the top ten list, *S. Newport* ranked fourth most prevalent (4.6%, n=232), followed by *S. Brandenburg* (3.2%, n=161), *S. Derby* (2.9%, n=150), *S. Infantis* (2.6%, n=130), *S. Hadar* (2.2%, n=113), *S. Montevideo* (2.1%, n=108) and *S. Agona* in tenth place (1.9%, n=99).

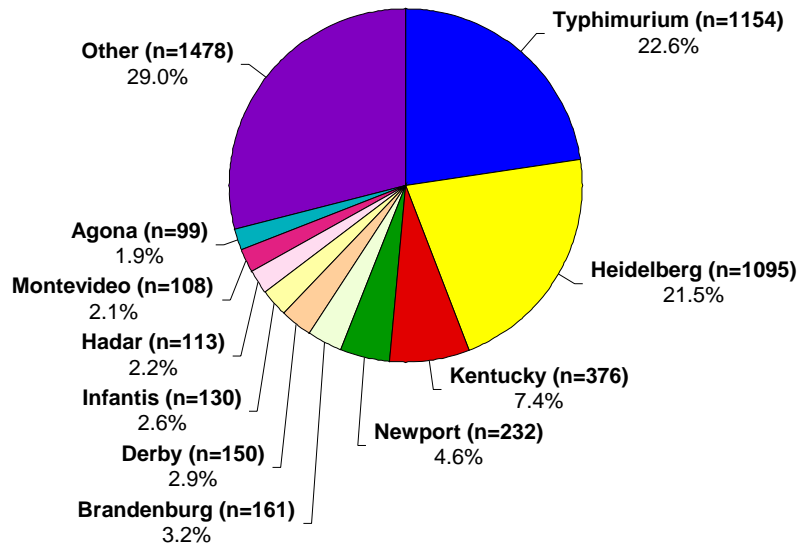
Other serovars accounted for 26.8% (n=1745) of the isolates in 2002 and 29.0% (n=1478) of the isolates in 2003.

Figure 10: Ten Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2002 (N=6516*)



*427 *S. Rubislaw*, 36 *S. ssp I 11:r:-*, 81 *S. ssp IIIb 61:-:1,5* and 61 *S. ssp IIIb 61:k:1,5* isolates associated with large research projects have been removed from trending totals.

Figure 11: Ten Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2003 (N=5096*)

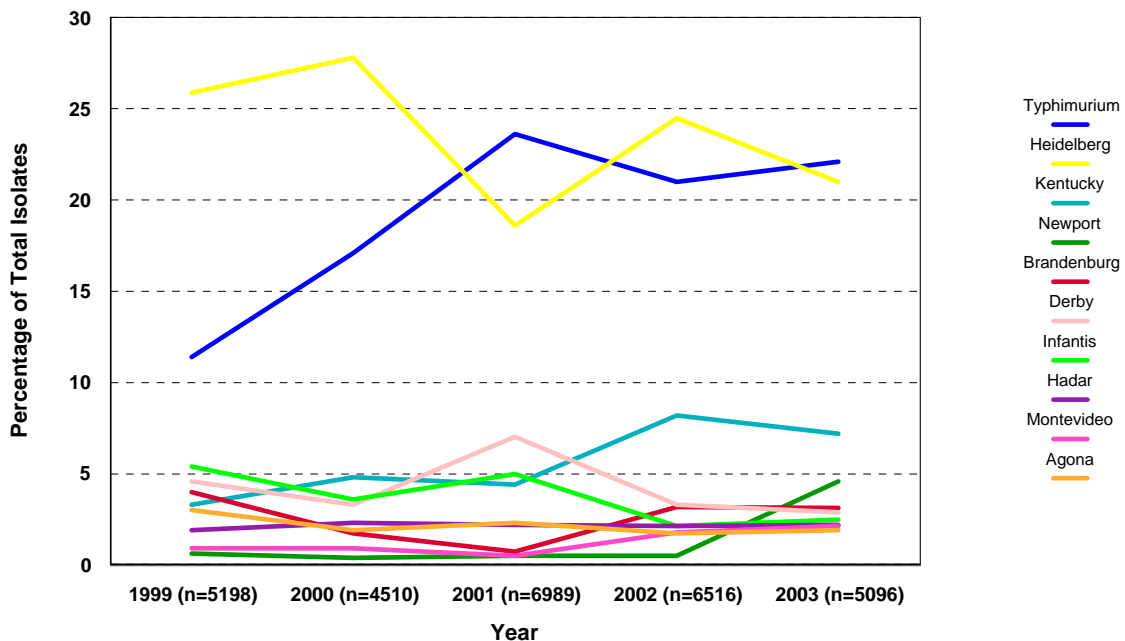


*407 *S. Rubislaw*, 54 *S. ssp I 11:r:-* and 113 *S. Newport* isolates associated with large research projects have been removed from trending totals.

Changes in the Occurrence of *Salmonella* Serovars From Non-Human Sources in Canada 1999 to 2003

The relative frequencies of the 10 most prevalent *Salmonella* serovars of non-human sources from 1999 to 2003 are shown in Figure 12. After an increase in prevalence in 2001, *S. Typhimurium* isolations levelled off, fluctuating with *S. Heidelberg* as the most prevalent serovar isolated from non-human sources. These two serovars have consistently been the most prevalent serovars isolated between 1999 and 2003. *S. Kentucky* and *S. Newport*, ranked third and fourth respectively, have increased in prevalence in 2002 and 2003, while *S. Derby* and *S. Infantis* isolations have decreased from these rankings in 2001 to rank sixth and seventh most prevalent in 2002 and 2003.

Figure 12: Ten Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 1999 to 2003



* 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.

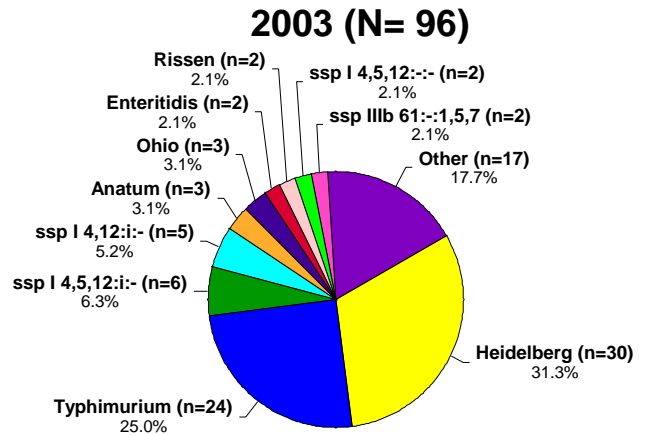
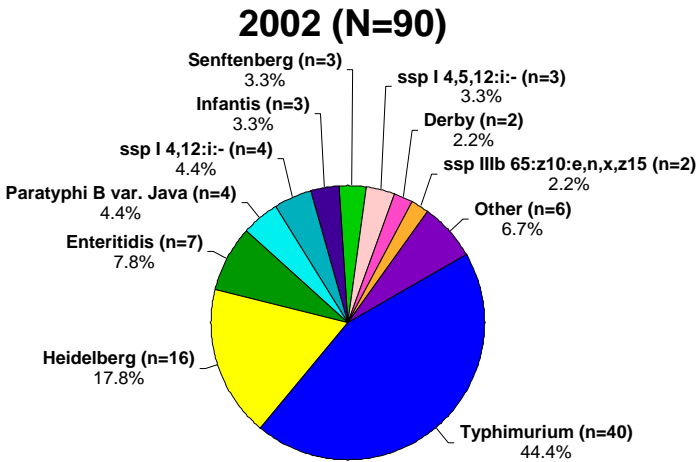
Provincial Distribution of *Salmonella* Serovars from Non-Human Sources in 2002 and 2003

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.

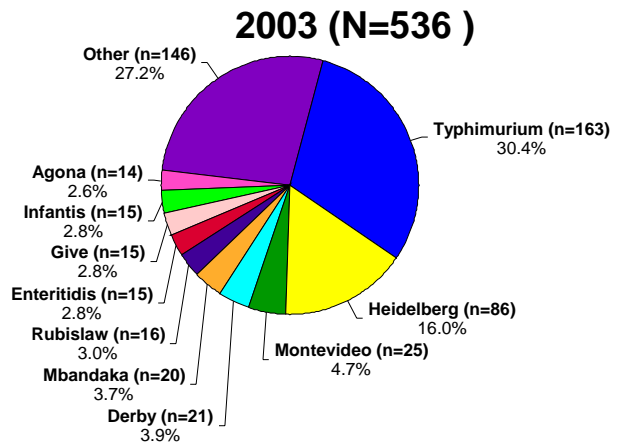
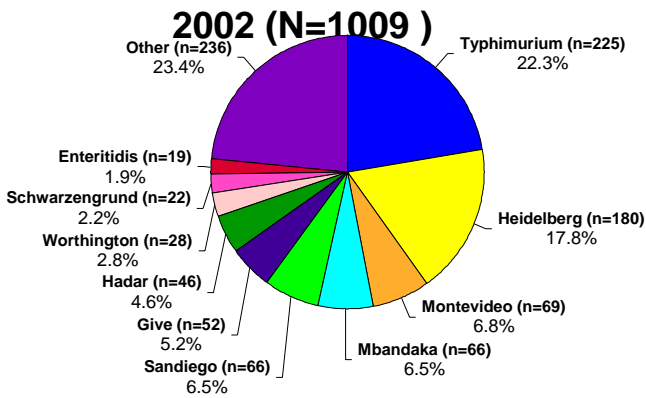
The most common *Salmonella* serovars from non-human origin in each province are shown in Figure 13. In both 2002 and 2003, *S. Typhimurium* ranked first in Alberta, Saskatchewan, Manitoba and Quebec. *S. Heidelberg* ranked first in Ontario and New Brunswick for the two years. In British Columbia and Nova Scotia, *S. Typhimurium* was most prevalent in 2002 but was overtaken by *S. Heidelberg* in 2003. *S. Braenderup* was the most prevalent serovar isolated from non-human sources in Prince Edward Island in both 2002 and 2003.

Figure 13: Ten Most Prevalent *Salmonella* Serovars of Non-Human Origin in Each Province, 2002 and 2003

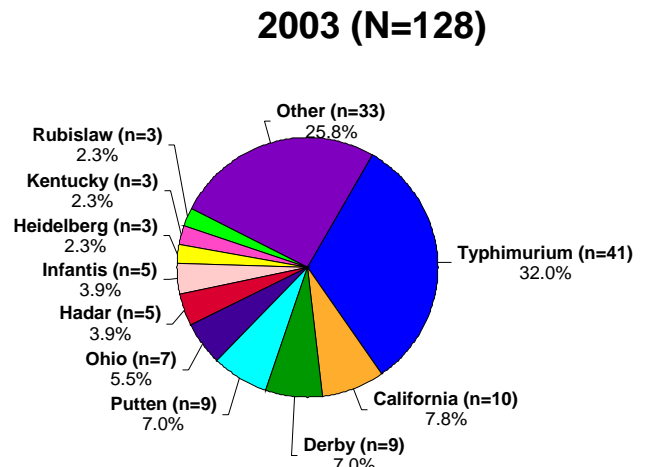
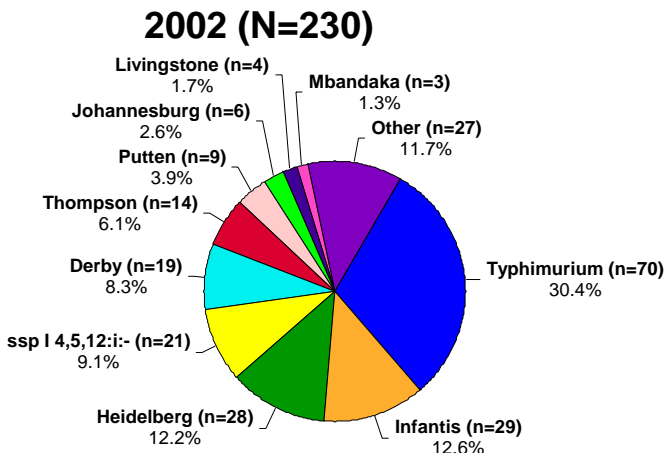
BRITISH COLUMBIA



ALBERTA

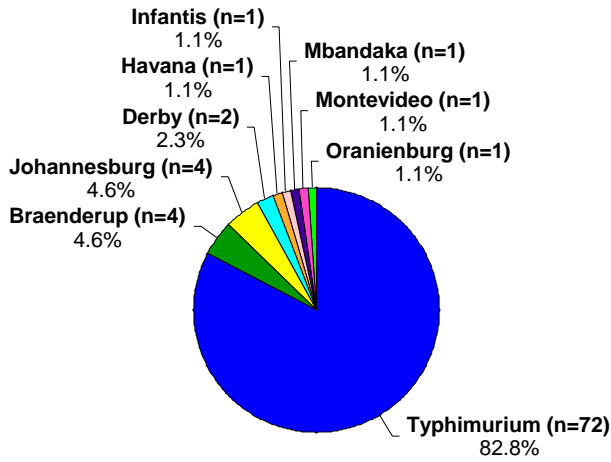


SASKATCHEWAN

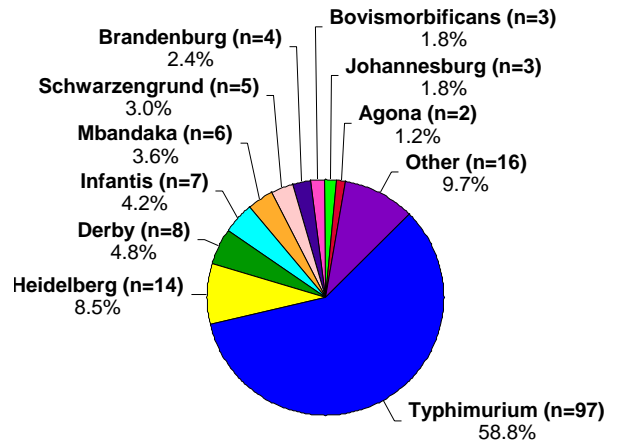


MANITOBA

2002 (N=87)

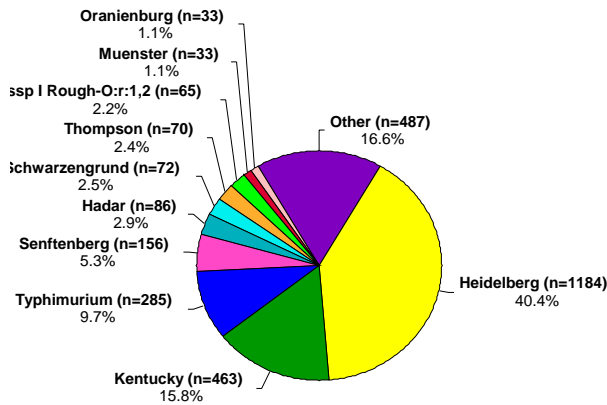


2003 (N=165)

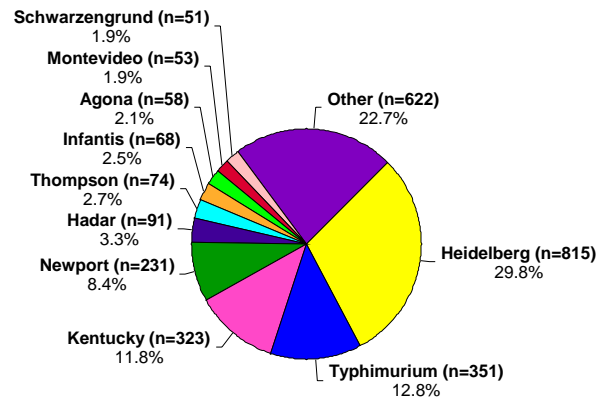


ONTARIO

2002 (N=2934)

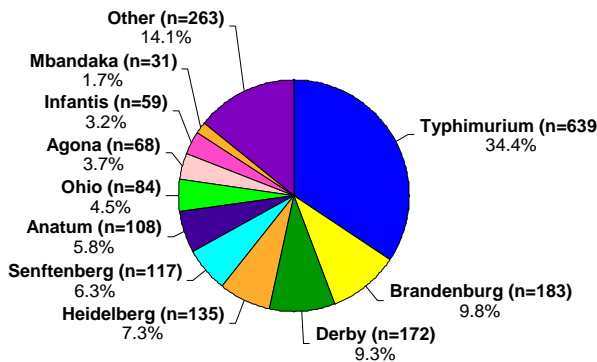


2003 (N=2737)

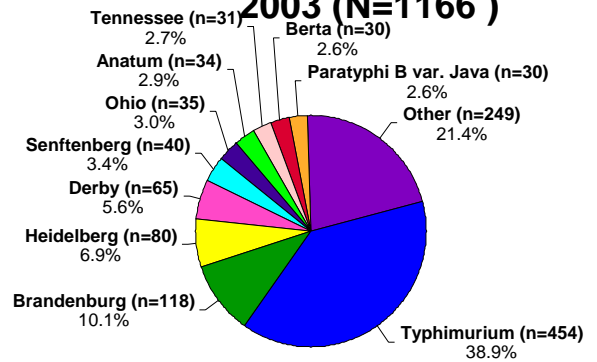


QUEBEC

2002 (N=1859)

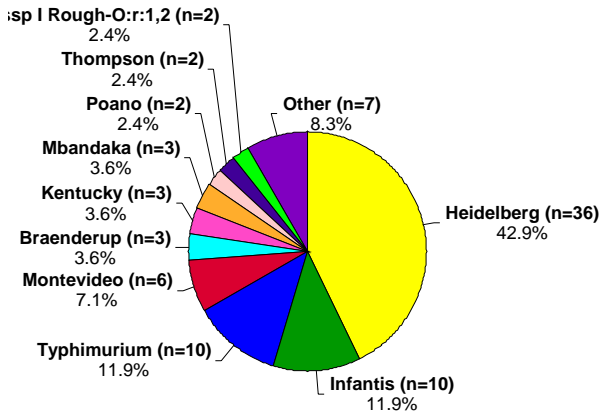


2003 (N=1166)

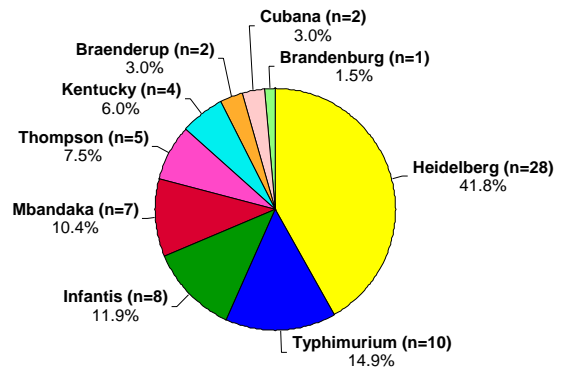


NEW BRUNSWICK

2002 (N=84)

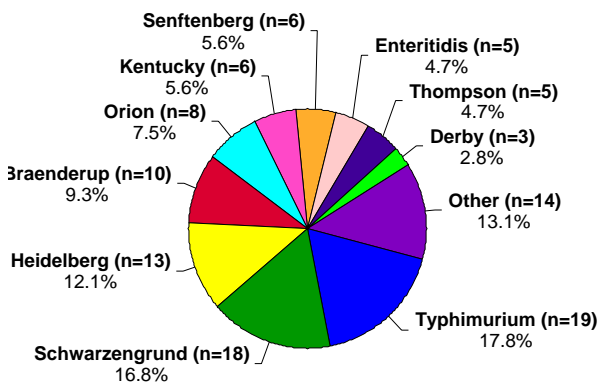


2003 (N=67)

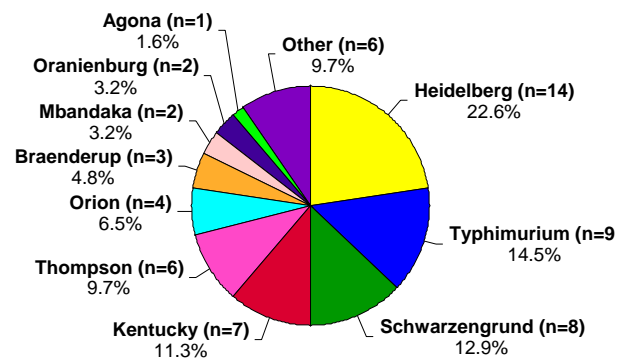


NOVA SCOTIA

2002 (N=84)

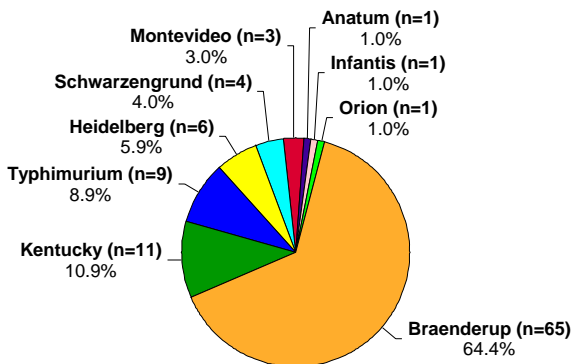


2003 (N=62)

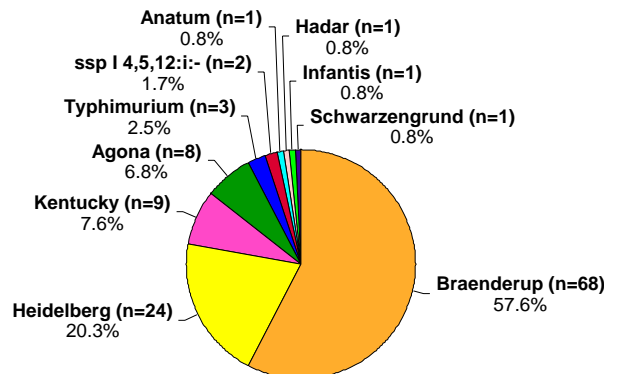


PRINCE EDWARD ISLAND

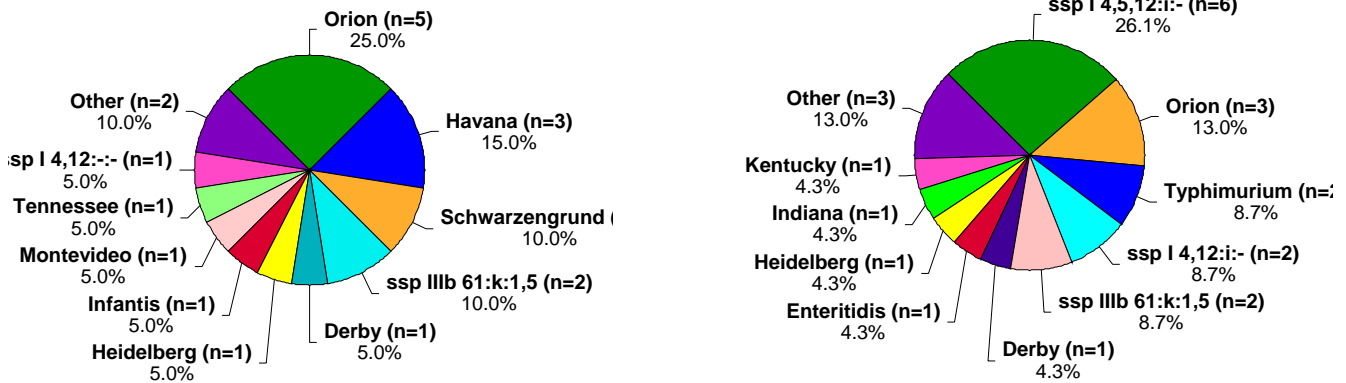
2002 (N=101)



2003 (N=118)



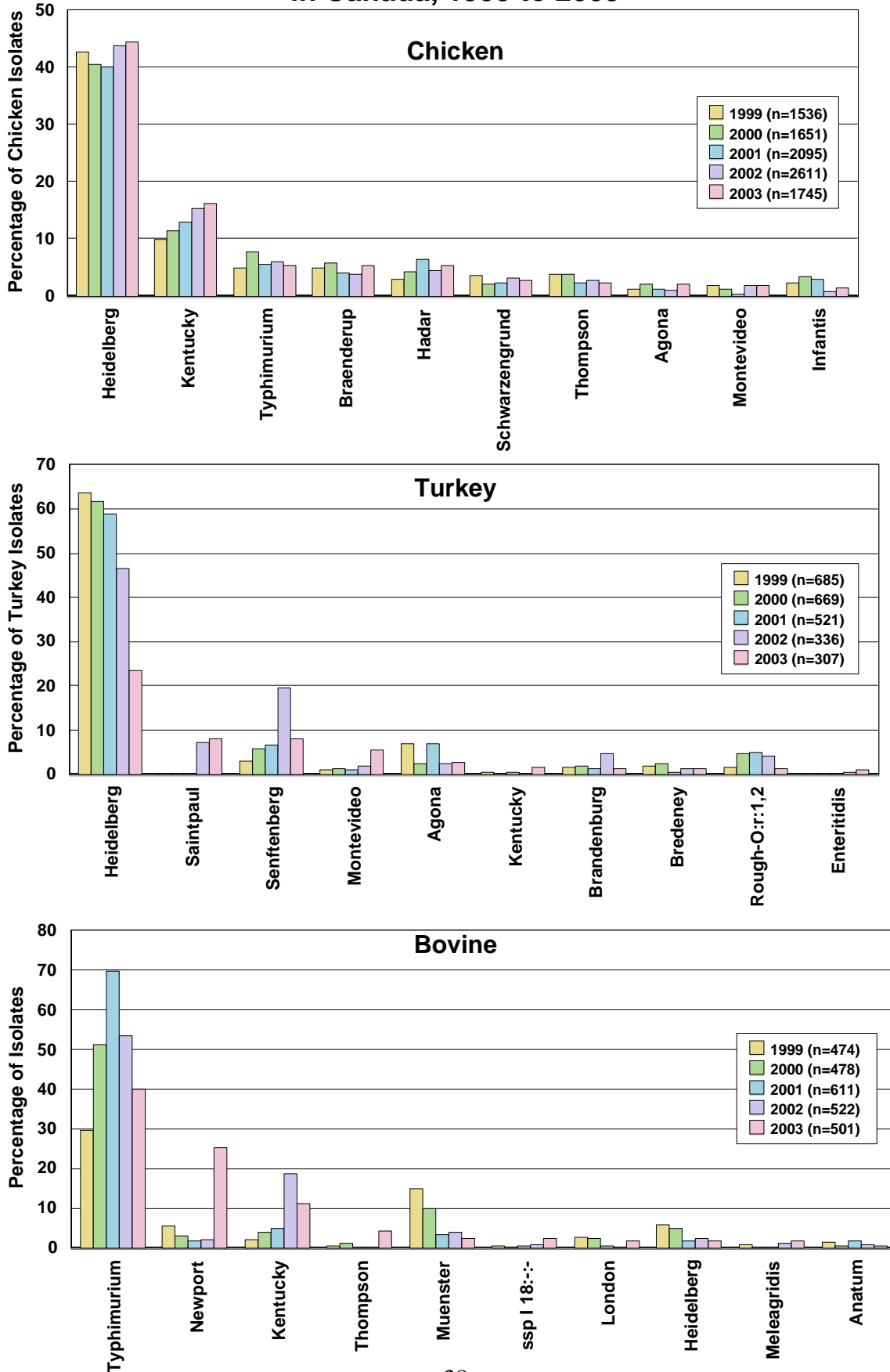
NEWFOUNDLAND and LABRADOR
2002 (N=20) **2003 (N=23)**

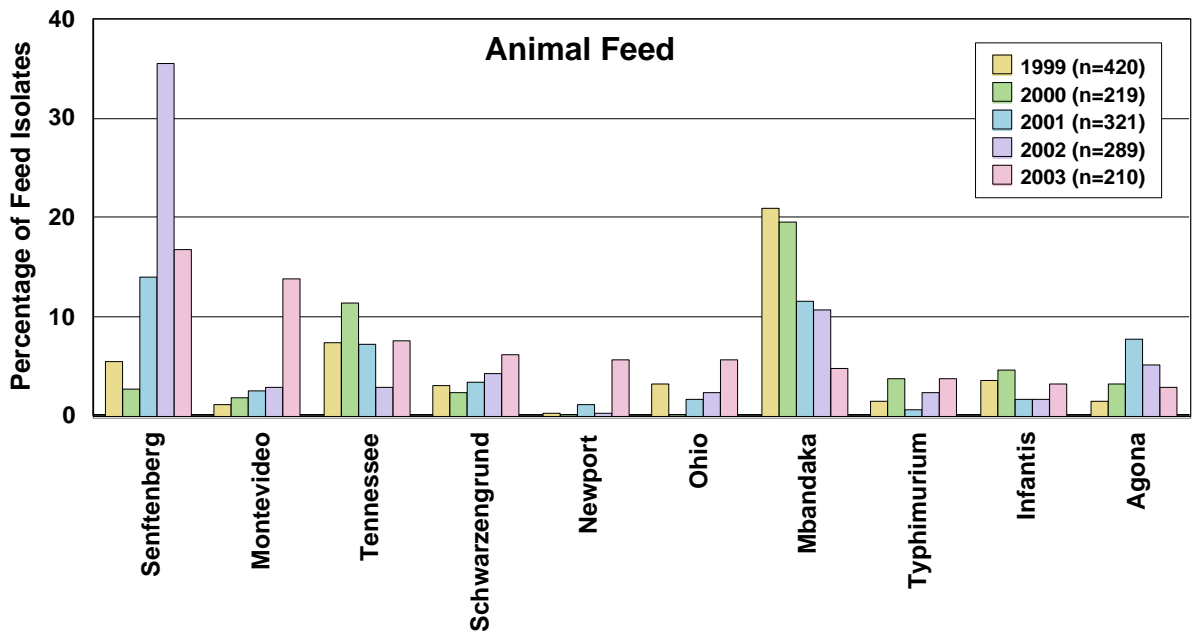
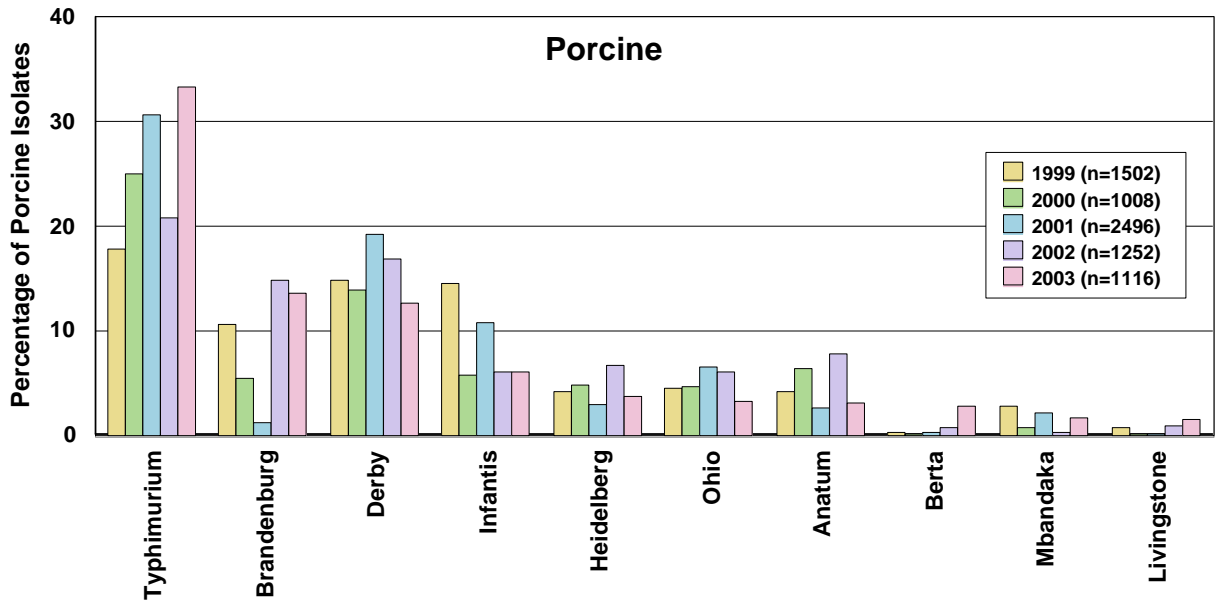


Source Distribution of *Salmonella* Serovars in Canada, 1999 to 2003

The ten most prevalent *Salmonella* serovars found in bovine, chicken, turkey, porcine and feed sources since 1999 are shown in Figure 14. *S. Heidelberg* continued to be the most prevalent serovar in turkey and chicken sources, whereas *S. Typhimurium* was most prevalent in bovine and porcine sources. *S. Heidelberg* decreased in isolation frequency from turkey sources since 1999 and increases have been observed with *S. Saintpaul* and *S. Senftenberg*. Prevalence of *S. Heidelberg*, *S. Kentucky* and *S. Typhimurium* from chicken sources has remained relatively unchanged. *S. Typhimurium* is decreasing from bovine sources, but *S. Newport* and *S. Kentucky* isolations have increased in 2002 and 2003. In porcine sources, *S. Typhimurium* has been increasing in frequency while *S. Derby* has decreased slightly since 1999. In feed and feed ingredients, *S. Senftenberg* has become the most prevalent serovar and *S. Montevideo* has increased since 1999 to rank second most prevalent.

Figure 14: Ten Most Prevalent *Salmonella* Serovars from Selected Sources in Canada, 1999 to 2003





* Non-human sources include food, water, animal and environmental samples. Serovar totals are laboratory confirmed isolates based on information gathered through passive surveillance at the LFZ and NML through reference services. Although data is only representative of laboratory confirmed isolates and should not be confused with incidence of disease in animals. The 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.

Table 3: *Salmonella* from Non-Human Sources, 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Abaetetuba	Unknown					1						1
S. Abortusequi	Equine					1						1
S. Agona	Animal (Unknown)					2						2
	Animal Feed		1			1	13					15
	Avian					1	1					2
	Bovine					2	1					3
	Chicken		13			8	1	1				23
	Environmental Swab					2						2
	Food (Unspecified)					1						1
	Ovine		1									1
	Porcine					4	52					56
	Turkey					8						8
	Water		1									1
	Subtotal	0	16	0	0	29	68	1	0	0	0	114
S. Alachua	Snake		1									1
S. Albany	Chicken					4						4
	Food (Chicken)					1						1
	Turkey					1						1
	Subtotal	0	0	0	0	6	0	0	0	0	0	6
S. Amsterdam (a)	Animal Feed					1						1
	Reptile					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
S. Anatum (a)	Animal (Unknown)					1						1
	Animal Feed		2			1	12					15
	Avian						1					1
	Bovine					4						4
	Chicken					6			1			7
	Environmental Swab			1								1
	Equine					1						1
	Fertilizer					1						1
	Food (Bovine)									1		1
	Food (Meat Loaf)					2						2
	Porcine	1				1	95					97
	Reptile											
	Turkey		1			1						2
	Water		8									8
	Subtotal	1	11	1	0	18	108	0	1	1	0	141
S. Bere	Unknown					1						1
S. Berta	Chicken					5	1					6
	Porcine					3	6					9
	Subtotal	0	0	0	0	8	7	0	0	0	0	15

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Bispebjerg	Food (Cumin Seeds)						1					1
S. Blockley	Chicken		1									1
	Chicken Litter		1									1
	Egg			2								2
	Food (Unspecified)		1									1
	Subtotal	0	3	2	0	0	0	0	0	0	0	5
S. Bovismorbificans	Bovine					1						1
S. Braenderup	Avian						1	3				4
	Chicken		7		4	9			10	65		95
	Chicken Fluff			1								1
	Subtotal	0	7	1	4	9	1	3	10	65	0	100
S. Brandenburg	Animal (Unknown)					3						3
	Animal Feed					1	1					2
	Bovine		1			2						3
	Food (Basil)						1					1
	Porcine					4	181					185
	Turkey					15						15
	Subtotal	0	1	0	0	25	183	0	0	0	0	209
S. Bredeney	Animal (Unknown)					2						2
	Bovine					1						1
	Chicken					1						1
	Turkey					4						4
	Subtotal	0	0	0	0	8	0	0	0	0	0	8
S. California	Water		6									6
S. Cerro	Animal Feed		1				2					3
	Bovine		1			8						9
	Chicken					1						1
	Subtotal	0	2	0	0	9	2	0	0	0	0	13
S. Chester	Bovine					1						1
S. Corvallis	Unknown					1						1
S. Cubana	Animal Feed		1				1					2
	Chicken					1						1
	Food (Bovine)	1										1

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Cubana	Food (Celery Seeds)						1					1
(continued)	Food (Parsley)						1					1
	Reptile					1						1
	Subtotal	1	1	0	0	2	3	0	0	0	0	7
S. Derby	Animal (Unknown)					1						1
	Avian			1								1
	Chicken					1						1
	Food (Porcine)								2			2
	Porcine	2	4	18	2	10	172		1		1	210
	Turkey					2						2
	Subtotal	2	4	19	2	14	172	0	3	0	1	217
S. Dublin	Bovine		1	1		1						3
S. Ealing	Animal Feed						1					1
S. Enteritidis	Animal (Unknown)						1					1
	Bovine			1								1
	Chicken	1	17			3	2					23
	Environmental Swab	1	1									2
	Fish	1										1
	Food (Chicken)	1										1
	Food (Pork)	2										2
	Food (Poultry)	1										1
	Hedgehog		1									1
	Porcine								3			3
	Poultry						2					2
	Rodent								2			2
	Turkey					1						1
	Unknown					2	5					7
	Subtotal	7	19	1	0	6	10	0	5	0	0	48
S. Fluntern	Gecko		1									1
S. Give (a)	Animal Feed						1					1
	Bovine					2						2
	Chicken					4						4
	Duck					1						1
	Porcine			1								1
	Water		52									52
	Subtotal		52	1	0	7	1	0	0	0	0	61
S. Grumpensis	Food (Pepper)						1					1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Hadar	Animal (Unknown)					1						1
	Avian					1	2					3
	Bovine		2									2
	Canine		2	1								3
	Chicken		30			81	1					112
	Chicken Fluff		1	1								2
	Feline					1						1
	Food (Cabbage)					1						1
	Food (Chicken)		2									2
	Food (Unspecified Spice)					1						1
	Poultry		1									1
	Turkey								2			2
	Unknown		1									1
	Water		7									7
		Subtotal	0	46	2	0	86	3	0	2	0	0
S. Hartford	Animal Feed					1						1
	Turkey					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
S. Havana	Animal Feed		2			1	2					5
	Canine					1						1
	Chicken										3	3
	Porcine				1		4					5
	Subtotal	0	2	0	1	2	6	0	0	0	3	14
S. Heidelberg	Animal (Unknown)					27						27
	Animal Feed					1	3					4
	Avian		6	2		5	6	25				44
	Bovine		2	1		5	2	1		1		12
	Camelid										1	1
	Canine			2		1						3
	Cervid					2						2
	Chicken	6	101			961	16	10	12	5		1111
	Chicken Fluff	2	3	13								18
	Chicken Litter		13									13
	Duck					2						2
	Environmental Swab	4	5			2	1					12
	Equine					18						18
	Food (Chicken)		1									1
	Food (Lamb)		1									1
	Food (Lettuce)					1						1
	Food (Mushrooms)					1						1
	Food (Potato)					1						1
	Food (Poultry)								1			1
	Food (Unspecified)		1			1						2
Owl		1										1

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Heidelberg	Porcine		2	9		4	69					84
(continued)	Poultry		2	1			13					16
	Turkey	4	3			149						156
	Unknown		1			3	25					29
	Water		38									38
	Subtotal	16	180	28	0	1184	135	36	13	6	1	1599
S. Indiana	Chicken		8			3						11
	Duck					5						5
	Subtotal	0	8	0	0	8	0	0	0	0	0	16
S. Infantis	Animal (Unknown)					1						1
	Animal Feed	2				1	2					5
	Avian						1	8				9
	Bovine		1			1						2
	Chicken				1	11		2	1	1	1	17
	Chicken Fluff			5								5
	Environmental Swab			6								6
	Food (Chicken)					1						1
	Pet Food		1									1
	Pet Food (Dog Treat)		1									1
	Porcine	1		18		1	56					76
	Water		9			1						10
	Subtotal	3	12	29	1	17	59	10	1	1	1	134
S. Javiana	Bovine					4						4
	Chicken					4						4
	Equine					1						1
	Turkey					2						2
	Subtotal	0	0	0	0	11	0	0	0	0	0	11
S. Johannesburg	Animal (Unknown)						1					1
	Animal Feed		1		1							2
	Chicken				3							3
	Chicken Fluff			6								6
	Environmental Swab						1					1
	Subtotal	0	1	6	4	0	2	0	0	0	0	13
S. Kentucky	Animal Feed						1					1
	Avian					2	1					3
	Bovine					91	6					97
	Canine					1						1
	Chicken		18			360	1	3	6	11		399
	Chicken Litter		1									1
	Equine					1						1
	Food (Basil)						1					1
	Food (Chicken)					5						5
	Food (Milk)					1						1
	Food (Unspecified)					1						1
	Porcine					1	20					21
	Subtotal	0	19	0	0	463	30	3	6	11	0	532

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Kiambu	Chicken					3						3
S. Kottbus	Unknown					1						1
S. Krefeld	Chicken					1						1
	Porcine					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
S. Lexington (a)	Animal Feed					10					10	
S. Livingstone (b)	Chicken					7						7
	Environmental Swab			1								1
	Porcine			3			8					11
	Turkey					3						3
	Subtotal	0	0	4	0	10	8	0	0	0	0	22
S. London	Chicken					1						1
	Duck					4						4
	Unknown					1						1
	Subtotal	0	0	0	0	6	0	0	0	0	0	6
S. Manhattan	Avian			1								1
	Porcine						4					4
	Subtotal	0	0	1	0	0	4	0	0	0	0	5
S. Matadi	Food (Pepper)					1					1	
S. Mbandaka	Animal (Unknown)					1						1
	Animal Feed					2	29					31
	Avian								1			1
	Bovine					3						3
	Caprine					1						1
	Cervid			1								1
	Chicken		60		1	15		3	2			81
	Environmental Swab			1								1
	Porcine			1		1	2					4
	Reptile					6						6
	Turkey					2						2
	Water		6									6
	Subtotal	0	66	3	1	31	31	3	3	0	0	138
S. Meleagridis	Animal Feed		2			1						3
	Bovine					6						6
	Equine					1						1
	Porcine					1						1
	Subtotal	0	2	0	0	9	0	0	0	0	0	11
S. Mikawasima	Food (Italian seasoning)						1					1

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL	
S. Minnesota	Animal (Unknown)						1					1	
	Animal Feed		1									1	
	Subtotal	0	1	0	0	0	1	0	0	0	0	2	
S. Molade	Animal Feed					2			1			3	
S. Montevideo	Animal (Unknown)					2	3					5	
	Animal Feed				1	1	6					8	
	Avian								1		1	2	
	Bovine					1				1		2	
	Chicken		25			15		6		2		48	
	Food (Basil)						1					1	
	Turkey					6						6	
	Unknown						1					1	
	Water		44										44
	Subtotal	0	69	0	1	25	11	6	1	3	1	117	
S. Muenster (a)	Animal Feed		1									1	
	Bovine					20						20	
	Chicken					2	1					3	
	Environmental Swab					2						2	
	Fertilizer					1						1	
	Porcine					1						1	
	Turkey					6						6	
	Unknown					1						1	
	Water		6										6
	Subtotal	0	7	0	0	33	1	0	0	0	0	41	
S. Newport	Animal (Unknown)					4						4	
	Animal Feed		1									1	
	Bovine					10		1				11	
	Chicken					4						4	
	Environmental Swab					1						1	
	Food (Unspecified)		1									1	
	Pet Food		1									1	
	Pet Food (Dog Treat)		1									1	
	Reptile		1									1	
	Snake		1									1	
	Turkey					5						5	
	Subtotal	0	6	0	0	24	0	1	0	0	0	31	
S. Ohio (b)	Animal Feed		1			1	5					7	
	Avian						2	1				3	
	Bovine						4					4	
	Chicken					2						2	
	Porcine			1		1	73					75	
	Subtotal	0	1	1	0	4	84	1	0	0	0	91	

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Oranienburg	Animal (Unknown)		1									1
	Animal Feed				1		1					2
	Chicken								1			1
	Feline			2								2
	Food (Chocolate)					31						31
	Food (Unspecified)					1						1
	Porcine					1	1					2
	Primate		2									2
	Reptile		1									1
	Snake		1									1
	Subtotal		0	5	2	1	33	2	0	1	0	0
S. Orion (a)	Animal (Unknown)					1						1
	Animal Feed						11				1	12
	Avian								1		3	4
	Bovine					1						1
	Chicken					1			6	1	1	9
	Equine								1			1
	Pet Food		1									1
	Porcine					1						1
	Subtotal	0	1	0	0	4	11	0	8	1	5	30
S. Ouakam	Turkey					2						2
S. Panama	Python	1										1
S. Paratyphi B var. Java	Canine			1								1
	Porcine						14					14
	Poultry						1					1
	Unknown		1				2					3
	Water	2					1					3
	Water (Aquarium)	2					1					3
Subtotal	4	1	1	0	0	19	0	0	0	0	0	25
S. Poano	Environmental Swab					1						1
	Reptile							2				2
	Subtotal	0	0	0	0	1	0	2	0	0	0	3
S. Pomona	Water		3								3	
S. Pona	Canine					1					1	
S. Putten	Chicken					3						3
	Porcine			9			8					17
	Subtotal	0	0	9	0	3	8	0	0	0	0	20
S. Reading	Bovine					1					1	
S. Rissen	Animal Feed		1									1
	Chicken Fluff			1								1
	Unknown					1						1
	Subtotal	0	1	1	0	1	0	0	0	0	0	3

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Rubislaw	Animal Feed						1					1
	Camelid		1									1
	Chicken		11									11
	Equine		1									1
	Food (Pepper)					1						1
	Water		427									427
	Subtotal		0	440	0	0	1	1	0	0	0	0
S. Saintpaul	Avian						3					3
	Bovine					3						3
	Turkey					24						24
	Subtotal	0	0	0	0	27	3	0	0	0	0	30
S. Sandiego	Food (Pepper)					3						3
	Water		66									66
	Subtotal	0	66	0	0	3	0	0	0	0	0	69
S. Schwarzengrund	Animal Feed					9	3					12
	Avian					3						3
	Bovine					12						12
	Chicken		21			42			15	4	2	84
	Environmental Swab					3						3
	Equine					3						3
	Mink								3			3
	Porcine		1									1
	Subtotal	0	22	0	0	72	3	0	18	4	2	121
S. Senftenberg	Animal (Unknown)					6						6
	Animal Feed		7			3	90		3			103
	Bovine					12						12
	Chicken		3			72						75
	Environmental Swab		1									1
	Mollusc	3										3
	Porcine						27					27
	Turkey					63			3			66
	Subtotal	3	11	0	0	156	117	0	6	0	0	293
S. Singapore	Reptile						3					3
S. Stanleyville	Chicken					9						9
S. Tennessee	Animal Feed						8					8
	Bovine					12						12
	Chicken		5			2						7
	Environmental Swab		1				2					3
	Fertilizer										1	1
	Porcine						13					13
	Soil					1						1
	Unknown					1						1
	Subtotal	0	6	0	0	16	23	0	0	0	1	46

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL	
S. Thompson	Animal Feed					2	1					3	
	Avian					2	3					5	
	Bovine					1						1	
	Canine			13		1						14	
	Chicken		2			58	2	2	5			69	
	Chicken Fluff			1								1	
	Equine					2						2	
	Food (Chicken)					3						3	
	Poultry		1									1	
	Unknown					1	1					2	
	Water		4									4	
	Subtotal		0	7	14	0	70	7	2	5	0	0	105
	S. Typhimurium	Animal (Unknown)		1			9	5					15
Animal Feed		1	3				3					7	
Avian		5	6	24	16	64	29	3	1			148	
Bison				1								1	
Bovine		18	113	19	20	56	51	2				279	
Canine						3						3	
Cervid			1									1	
Chicken		1	33		18	66	4	5	17	9		153	
Chicken Fluff				2								2	
Chicken Litter			1									1	
Compost						1						1	
Cormorant				2								2	
Duck						2						2	
Environmental Swab		3	3			3	1					10	
Equine			1			10	2					13	
Feline			4			10	7					21	
Ferret						1						1	
Food (Basil)							2					2	
Food (Bean Sprouts)							1					1	
Food (Beef)			1				3					4	
Food (Bovine)		1	1									2	
Food (Chicken)			2									2	
Food (Eel)						1						1	
Food (Eggs)		4										4	
Food (Pork)							198					198	
Food (Unspecified)							3					3	
Hedgehog			3									3	
Ovine		1	2	1								4	
Pet Food			5			1						6	
Pet Food (Dog Treat)			5			1						6	
Pigeon		3										3	
Pine Siskin		2										2	
Porcine			4	19	18	54	164		1			260	
Poultry							15					15	
Quail						1					1		
Reptile		1									1		

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Typhimurium	Snake		1									1
(continued)	Sparrow		4	2								6
	Tiger	1										1
	Turkey		2			2						4
	Unknown		2			1	150					153
	Water		26									26
	Subtotal	40	225	70	72	285	639	10	19	9	0	1369
S. Uganda	Animal (Unknown)					1						1
	Animal Feed						1					1
	Chicken					4						4
	Subtotal	0	0	0	0	5	1	0	0	0	0	6
S. Vejle	Pet Food		1									1
	Pet Food (Dog Treat)		1									1
	Subtotal	0	2	0	0	0	0	0	0	0	0	2
S. Weltevreden	Mollusc	1										1
S. Westhampton (a)	Chicken					5						5
	Turkey					1						1
	Subtotal	0	0	0	0	6	0	0	0	0	0	6
S. Worthington	Animal Feed						1					1
	Bovine		1									1
	Chicken		10			6						16
	Environmental Swab		1									1
	Porcine			2			2					4
	Water		16									16
	Subtotal	0	28	2	0	6	3	0	0	0	0	39
S. Yoruba	Animal Feed					1						1
	Fish	1										1
	Subtotal	1	0	0	0	1	0	0	0	0	0	2
<i>Salmonella</i> ssp I 4,12:-	Aquatic Animal										1	1
	Avian							1				1
	Chicken					1						1
	Equine					1						1
	Porcine						6					6
	Subtotal	0	0	0	0	2	6	1	0	0	1	10
<i>Salmonella</i> ssp I 4,5,12:-	Chicken					3						3
	Equine					2						2
	Porcine						2					2
	Subtotal	0	0	0	0	5	2	0	0	0	0	7
<i>Salmonella</i> ssp I 4,12:-:1,2	Avian		1									1
	Chicken		1									1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
<i>Salmonella</i> ssp I 4,12:-:1,2	Porcine						1					1
(continued)	Subtotal	0	2	0	0	0	1	0	0	0	0	3
<i>Salmonella</i> ssp I 4,5,12:-:1,2	Porcine						2					2
<i>Salmonella</i> ssp I 4,12:-:e,n,x	Porcine						1					1
<i>Salmonella</i> ssp I 4,12:-:e,n,z15	Porcine						2					2
<i>Salmonella</i> ssp I 4,5,12:b:-	Bovine					1						1
	Lizard						2					2
	Mouse						1					1
	Porcine						1					1
	Turkey					1						1
	Subtotal	0	0	0	0	2	4	0	0	0	0	6
<i>Salmonella</i> ssp I 4,12:d:-	Chicken					8						8
<i>Salmonella</i> ssp I 4,12:i:-	Avian			1		1					1	3
	Bovine		5									5
	Chicken	1										1
	Chicken Fluff	2										2
	Porcine		1			1	1					3
	Raccoon	1										1
	Water		1									1
	Subtotal	4	7	1	0	2	1	0	0	0	1	16
<i>Salmonella</i> ssp I 4,5,12:i:-	Avian			3		2						5
	Bovine			13		2						15
	Chicken		6	1		2						9
	Chicken Fluff			1								1
	Chicken Litter		1									1
	Environmental Swab	2	2									4
	Ovine			1								1
	Porcine	1		1								2
	Turkey			1		1						2
	Subtotal	3	9	21	0	7	0	0	0	0	0	40
<i>Salmonella</i> ssp I 4,12:r:-	Avian		1				1					2
	Bovine			1								1
	Chicken		1			3						4
	Porcine						1					1
	Turkey			1								1
	Subtotal	0	2	2	0	3	2	0	0	0	0	9
<i>Salmonella</i> ssp I 4,5,12:r:-	Chicken		1									1
	Porcine						1					1
	Water		1									1
	Subtotal	0	2	0	0	0	1	0	0	0	0	3

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
<i>Salmonella</i> ssp I 4,12:l,v:-	Porcine						1					1
<i>Salmonella</i> ssp I 6,7,14:-:-	Animal Feed						2					2
	Chicken						1					1
	Porcine						1					1
	Subtotal	0	0	0	0	0	4	0	0	0	0	4
<i>Salmonella</i> ssp I 6,7:-:-	Porcine						1					1
<i>Salmonella</i> ssp I 6,7:-:1,5	Chicken					1						1
<i>Salmonella</i> ssp I 6,7:-:l,w	Porcine					1						1
<i>Salmonella</i> ssp I 6,7,14:-:l,w	Porcine					1	2					3
<i>Salmonella</i> ssp I 6,7:r:-	Porcine						1					1
<i>Salmonella</i> ssp I 6,7:z10:-	Avian							1				1
	Animal Feed						1					1
	Chicken		2						1			3
	Porcine					1						1
	Subtotal	0	2	0	0	1	1	1	1	0	0	6
<i>Salmonella</i> ssp I 6,7:z4,z23:-	Animal Feed						1					1
<i>Salmonella</i> ssp I 6,8:-:-	Chicken					2						2
<i>Salmonella</i> ssp I 6,8:-:1,2	Water		1									1
<i>Salmonella</i> ssp I 6,8:-:e,n,x	Animal (Unknown)					1						1
	Chicken					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
<i>Salmonella</i> ssp I 8,20:-:z6	Chicken					2						2
<i>Salmonella</i> ssp I 8,20:i:-	Bovine					4	1					5
	Chicken					3						3
	Subtotal	0	0	0	0	7	1	0	0	0	0	8
<i>Salmonella</i> ssp I 11:r:-	Porcine			1								1
	Water		36									36
	Subtotal	0	36	1	0	0	0	0	0	0	0	37
<i>Salmonella</i> ssp I 18:-:-	Bovine					4						4
<i>Salmonella</i> ssp I 23:-:-	Chicken					1						1
<i>Salmonella</i> ssp I 3,10:-:-	Porcine						2					2

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
<i>Salmonella</i> ssp I 3,10:-:1,6	Porcine						7					7
<i>Salmonella</i> ssp I 3,15:l,v:-	Chicken					1						1
<i>Salmonella</i> ssp I 3,15:z10:-	Animal Feed							1				1
<i>Salmonella</i> ssp I 3,19:-:-	Animal Feed					2	1					3
	Mollusc	1										1
	Subtotal	1	0	0	0	2	1	0	0	0	0	4
<i>Salmonella</i> ssp I 40:-:e,n,x	Animal Feed		1									1
<i>Salmonella</i> ssp I 42:z4,z23:-	Animal Feed						1					1
<i>Salmonella</i> ssp I 47:z4,z23:-	Animal Feed					1	1					2
<i>Salmonella</i> ssp I Rough-O:-:-	Animal Feed					1						1
	Bovine					4						4
	Chicken		2			6						8
	Equine					1						1
	Porcine					1	3					4
	Turkey					2						2
	Subtotal	0	2	0	0	15	3	0	0	0	0	20
<i>Salmonella</i> ssp I Rough-O:-:l,w	Chicken					1						1
	Porcine						3					3
	Subtotal	0	0	0	0	1	3	0	0	0	0	4
<i>Salmonella</i> ssp I Rough-O:b:l,w	Porcine						3					3
<i>Salmonella</i> ssp I Rough-O:d:-	Chicken					1						1
<i>Salmonella</i> ssp I Rough-O:d:1,7	Chicken								1			1
<i>Salmonella</i> ssp I Rough-O:d:l,w	Chicken					1						1
	Porcine						2					2
	Turkey					1						1
	Subtotal	0	0	0	0	2	2	0	0	0	0	4
<i>Salmonella</i> ssp I Rough-O:e,h:1,2	Turkey					1						1
<i>Salmonella</i> ssp I Rough-O:e,h:1,6	Porcine						2					2
<i>Salmonella</i> ssp I Rough-O:g,m,s:-	Chicken		1									1
	Water		1									1
	Subtotal	0	2	0	0	0	0	0	0	0	0	2
<i>Salmonella</i> ssp I Rough-O:i:-	Bovine		1									1

Non-Human *Salmonella* 2002

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
<i>Salmonella</i> ssp I Rough-O:i:1,2	Avian						1					1
	Bovine					1						1
	Chicken					1						1
	Food (Pork)						1					1
	Subtotal	0	0	0	0	2	2	0	0	0	0	4
<i>Salmonella</i> ssp I Rough-O:i:z6	Chicken					3						3
	Chicken Litter		1									1
	Subtotal	0	1	0	0	3	0	0	0	0	0	4
<i>Salmonella</i> ssp I Rough-O:k:1,5	Chicken					1						1
	Unknown						1					1
	Subtotal	0	0	0	0	1	1	0	0	0	0	2
<i>Salmonella</i> ssp I Rough-O:r:-	Avian		1					1				2
	Chicken					1						1
	Porcine						1					1
	Subtotal	0	1	0	0	1	1	1	0	0	0	4
<i>Salmonella</i> ssp I Rough-O:r:1,2	Avian					1						1
	Chicken		8			50		2	1			61
	Chicken Litter		1									1
	Owl		1									1
	Porcine						2					2
	Poultry			1								1
	Turkey					14						14
	Water		7									7
	Subtotal	0	17	1	0	65	2	2	1	0	0	88
	<i>Salmonella</i> ssp I Rough-O:r:1,5	Porcine			1							
<i>Salmonella</i> ssp I Rough-O:z10:e,n,x	Chicken		1			2						3
	Chicken Litter		2									2
	Subtotal	0	3	0	0	2	0	0	0	0	0	5
<i>Salmonella</i> ssp I Rough-O:z10:e,n,z15	Avian							1				1
<i>Salmonella</i> ssp I Rough-O:z29:-	Animal Feed						1					1
<i>Salmonella</i> ssp I Rough-O:z4,z23:-	Bovine					2						2
<i>Salmonella</i> ssp I Rough-O:z:-	Food (Pepper)						1					1
<i>Salmonella</i> ssp I Rough-O:g,s,t:-	Chicken					2						2
	Turkey					1						1
	Subtotal	0	0	0	0	3	0	0	0	0	0	3
<i>Salmonella</i> ssp I Rough-O:l,v:e,n,z15	Porcine						2					2
<i>Salmonella</i> ssp II 30:l,z28:z6	Gecko		1									1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
<i>Salmonella</i> ssp IIIa 38:-:-	Food (Alfalfa Sprouts)					1						1
<i>Salmonella</i> ssp IIIa 41:z4,z23:-	Water		1									1
<i>Salmonella</i> ssp IIIa 42:g,z51:-	Water		8									8
<i>Salmonella</i> ssp IIIb	Porcine			1								1
<i>Salmonella</i> ssp IIIb	Poultry						1					1
<i>Salmonella</i> ssp IIIb 11:k:z53	Water		1									1
<i>Salmonella</i> ssp IIIb 16:z10:e,n,x	Water		1									1
<i>Salmonella</i> ssp IIIb 16:z10:e,n,x,z15	Water		1									1
<i>Salmonella</i> ssp IIIb 60:r:e,n,x,z15	Water		1									1
<i>Salmonella</i> ssp IIIb 61:-:1,5	Ovine		81									81
<i>Salmonella</i> ssp IIIb 61:-:1,5	Porcine		1									1
<i>Salmonella</i> ssp IIIb 61:k:1,5	Environmental Swab					1						1
<i>Salmonella</i> ssp IIIb 61:k:1,5	Ovine		85								2	87
<i>Salmonella</i> ssp IIIb 61:k:1,5,7	Ovine			2								2
<i>Salmonella</i> ssp IIIb 65:z10:e,n,x,z15	Snake	2										2
<i>Salmonella</i> ssp IV 44:z4,z23:-	Reptile											
<i>Salmonella</i> ssp IV 44:z4,z32:-	Reptile			1							1	2
<i>Salmonella</i> ssp IV 50:g,z51:-	Reptile					1						1
<i>Salmonella</i> ssp IV Rough-O:-:-	Porcine						2					2
<i>Salmonella</i> ssp IV Rough-O:-:l,w	Porcine						3					3
Total Non Human <i>Salmonella</i> 2002		90	1633	230	87	2934	1859	84	107	101	20	7145

Footnotes: (a) = var. 15+ and var. 15+34+ have been combined into a single serovar. (b) = var. 14+ have been combined into parent serovar totals.

Table 4 : Salmonella from Non-Human Sources, 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Adelaide	Gecko			1								1
	Reptile					1						1
	Unknown					1						1
	Subtotal	0	0	1	0	2	0	0	0	0	0	3
S. Agona	Animal (Unspecified)					2						2
	Animal Feed				1		5					6
	Avian					1						1
	Chicken		11			15	1			8		35
	Chicken Litter		1									1
	Environmental Swab					2						2
	Equine					3						3
	Food (Bovine)		1			2						3
	Food (Chicken)					2			1			3
	Food (Porcine)							1				1
	Food (Turkey)					20						20
	Food (Unspecified)				1		1					2
	Porcine		1			3	8					12
	Turkey					8						8
Subtotal	0	14	0	2	58	16	0	1	8	0	99	
S. Alachua	Unknown					1						1
S. Albany	Food (Unspecified)						1					1
S. Amsterdam (a)	Avian			1								1
	Bovine					1						1
	Subtotal	0	0	1	0	1	0	0	0	0	0	2
S. Anatum (a)	Animal Feed	2					3					5
	Bovine					3						3
	Chicken					1				1		2
	Fertilizer					1						1
	Food (Bovine)					1						1
	Food (Turkey)					5						5
	Porcine	1		2	1		31					35
	Subtotal	3	0	2	1	11	34	0	0	1	0	52
S. Bareilly	Chicken					1						1
S. Berta	Chicken					1						1
	Porcine						30					30
	Subtotal	0	0	0	0	1	30	0	0	0	0	31
S. Blockley	Chicken					1						1
	Chicken Litter		1									1
	Food (Chicken)					1						1
	Food (Dill Weed)						2					2
	Subtotal	0	1	0	0	2	2	0	0	0	0	5

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Bovismorbificans	Porcine		2		3	11						16
	Water		8									8
	Subtotal	0	10	0	3	11	0	0	0	0	0	24
S. Braenderup	Animal Feed						1					1
	Avian			1								1
	Chicken		2			10	7	2	3	68		92
	Environmental Swab						1					1
Subtotal	0	2	1	0	10	9	2	3	68	0	0	95
S. Brandenburg	Bovine					1						1
	Chicken					1	1					2
	Environmental Swab					1						1
	Food (Porcine)					1						1
	Porcine			1	4	29	117	1				152
	Turkey					4						4
Subtotal	0	0	1	4	37	118	1	0	0	0	0	161
S. Bredeney	Food (Bovine)						1					1
	Turkey					4						4
	Subtotal	0	0	0	0	4	1	0	0	0	0	5
S. Budapest	Food (Unspecified)					1						1
S. Butantan	Unknown					1						1
S. California	Porcine	1		10		3						14
S. Cerro	Animal Feed						2					2
	Bovine					2						2
	Chicken					2						2
	Chicken Fluff			1								1
	Food (Bovine)						2					2
	Lizard		1									
Subtotal	0	1	1	0	4	4	0	0	0	0	0	10
S. Chester	Fertilizer				1							1
S. Choleraesuis	Porcine			2								2
S. Concord	Food (Unspecified)					1						1
S. Cubana	Animal Feed		1				1					2
	Chicken							2				2
	Food (Sesame Seeds)		2									2
	Porcine			1								1
Subtotal	0	3	1	0	0	1	2	0	0	0	0	7

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total	
S. Derby	Animal Feed						1					1	
	Bovine					1						1	
	Chicken						1					1	
	Porcine	1	18	9	8	40	63		1		1	141	
	Turkey					2						2	
	Water		3			1						4	
	Subtotal		1	21	9	8	44	65	0	1	0	1	150
S. Dublin	Bovine		1									1	
	Unknown					1						1	
	Water		1									1	
Subtotal		0	2	0	0	1	0	0	0	0	0	3	
S. Ebrie	Canine		1									1	
S. Edinburg	Unknown					1						1	
S. Eko	Porcine			1								1	
S. Enteritidis	Avian						1					1	
	Bovine					1						1	
	Cervid		1									1	
	Chicken		1			5	6					12	
	Chicken Fluff		1									1	
	Chicken Litter		1									1	
	Duck	1										1	
	Environmental Swab	1	1				1					3	
	Equine					1						1	
	Food (Chicken)						1					1	
	Food (Unspecified)						4					4	
	Hedgehog		2									2	
	Porcine		4	1	1							6	
	Poultry		1									1	
	Quail		1									1	
	Reptile										1	1	
	Turkey						3					3	
	Unknown	1					1	12					14
	Water		2										2
Subtotal		3	15	1	1	11	25	0	0	0	1	57	
S. Essen	Porcine						1					1	
S. Fluntern	Unknown	1										1	
S. Friedenau	Reptile					1						1	
S. Give (a)	Animal Feed		1				2					3	
	Chicken					2	1					3	
	Duck					8						8	
	Porcine		3	2		4	4					13	
	Water		11									11	
Subtotal		0	15	2	0	14	7	0	0	0	0	38	

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Hadar	Avian					1						1
	Bovine					2						2
	Canine			1		1						2
	Chicken	1	6	4		77				1		89
	Chicken Litter		3									3
	Duck					4						4
	Food (Bovine)						1					1
	Food (Chicken)						2					2
	Food (Unspecified)		1									1
	Mink					2						2
	Porcine					2						2
	Poultry		1									1
	Turkey		1			2						3
	Subtotal		1	12	5	0	91	3	0	0	1	0
S. Havana	Animal Feed						2					2
	Porcine					5						5
	Subtotal	0	0	0	0	5	2	0	0	0	0	7
S. Heidelberg	Animal (Unspecified)		1				2					3
	Aquatic Animal	1										1
	Avian					17	9	2				28
	Bovine	1	4						3			8
	Canine		2								1	3
	Chicken	4	27	2	5	658	15	17	7	22		757
	Chicken Fluff		3									3
	Chicken Litter		15									15
	Duck					2						2
	Environmental Swab					13		9				22
	Equine					8				1		9
	Food (Bovine)					8						8
	Food (Chicken)					19	14			1		34
	Food (Milk)					3						3
	Food (Pea Sprouts)					1						1
	Food (Turkey)		2			7						9
	Food (Unspecified)	7	2		4	1	2					16
	Mink								1			1
	Porcine	1	5	1	5	5	24					41
	Poultry		10			4	4					18
	Turkey	1	2			66			3			72
	Unknown	15				3	10					28
Water		13									13	
Subtotal	30	86	3	14	815	80	28	14	24	1	1095	
S. Hofit	Food (Sage)						1					1
S. Indiana	Avian		1									1
	Caprine										1	1
	Chicken		1									1
	Duck					6						6
	Unknown					1						1

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Infantis	Animal (Unspecified)					1						1
	Animal Feed			1			4	1	1			7
	Avian					1						1
	Bovine					1						1
	Chicken		1	1		25						27
	Environmental Swab					2	1	6				9
	Equine					1						1
	Food (Chicken)					3				1		4
	Food (Porcine)					1						1
	Porcine		4	3	7	33	20	1				68
	Water			10								10
	Subtotal		0	15	5	7	68	25	8	1	1	0
S. Javiana	Chicken					26						26
S. Johannesburg	Animal Feed		2									2
	Chicken Fluff			1								1
	Food (Parsley)						4					4
	Food (Unspecified)		1				1					2
	Porcine				3	2						5
	Turkey					3						3
Subtotal		0	3	1	3	5	5	0	0	0	0	17
S. Kentucky	Avian					4						4
	Bovine					55						55
	Camelid										1	1
	Chicken		11	2		244	6		7	9		279
	Chicken Fluff			1								1
	Chicken Litter		1									1
	Environmental Swab							4				4
	Food (Bovine)					7	6					13
	Food (Chicken)					8						8
	Food (Turkey)						1					1
	Food (Unspecified)						3					3
	Turkey					5						5
	Unknown	1										1
Subtotal	1	12	3	0	323	16	4	7	9	1	376	
S. Kiambu	Animal Feed					1						1
	Chicken					3						3
	Subtotal	0	0	0	0	4	0	0	0	0	0	4
S. Kingabwa	Lizard		1								1	
S. Krefeld	Porcine				1	3					4	
S. Lexington	Chicken Fluff			1								1
	Food (Unspecified)		1									1
	Subtotal	0	1	1	0	0	0	0	0	0	0	2

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Lille	Animal Feed					1						1
	Chicken					1						1
	Food (Sesame Seeds)		1									1
	Subtotal	0	1	0	0	2	0	0	0	0	0	3
S. Litchfield	Bovine					1						1
	Chicken					1						1
	Food (Porcine)					1						1
	Turkey					1						1
	Subtotal	0	0	0	0	4	0	0	0	0	0	4
S. Livingstone (b)	Chicken					1						1
	Porcine					12	5					17
	Turkey					1						1
	Subtotal	0	0	0	0	14	5	0	0	0	0	19
S. London	Bovine					9						9
	Food (Bovine)					3						3
	Porcine					13						13
	Water		1									1
	Subtotal	0	1	0	0	25	0	0	0	0	0	26
S. Manhattan	Avian			1								1
	Bovine					2						2
	Porcine			1								1
	Subtotal	0	0	2	0	2	0	0	0	0	0	4
S. Mbandaka	Animal Feed				3		7					10
	Avian							1				1
	Bovine					3						3
	Chicken		8		1	13		4				26
	Environmental Swab					1		1				2
	Equine					12						12
	Fertilizer					1						1
	Food (Bovine)		1			4						5
	Food (Unspecified)						1					1
	Porcine			2	2	3	9	1	2			19
	Unknown	1										1
	Water		11									11
	Subtotal	1	20	2	6	37	17	7	2	0	0	92
	S. Meleagridis	Animal Feed					1					
Bovine						8						8
Food (Bovine)						1						1
Porcine						2						2
Subtotal		0	0	0	0	12	0	0	0	0	0	12

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Minnesota	Animal Feed						1					1
	Chicken					2						2
	Food (Bovine)					1						1
	Food (Milk)						1					1
	Subtotal	0	0	0	0	3	2	0	0	0	0	5
S. Molade	Animal Feed					1						1
	Unknown					2						2
	Subtotal	0	0	0	0	3	0	0	0	0	0	3
S. Monshau	Canine		1									1
S. Montevideo	Animal Feed		2		2	1	24					29
	Chicken		20			14						34
	Environmental Swab					5						5
	Food (Bovine)					12						12
	Food (Coriander)						1					1
	Food (Oregano)						1					1
	Food (Porcine)					1						1
	Porcine					3	2					5
	Turkey					17						17
	Water		3									3
	Subtotal	0	25	0	2	53	28	0	0	0	0	108
S. Muenchen	Bovine					1						1
	Equine					1						1
	Food (Bovine)					3						3
	Porcine					9						9
	Subtotal	0	0	0	0	14	0	0	0	0	0	14
S. Muenster (a)	Bovine					12						12
	Chicken					1						1
	Food (Bovine)					7	2					9
	Food (Turkey)					5						5
	Subtotal	0	0	0	0	27	2	0	0	0	0	29
S. Mundonobo	Reptile					1						1
	Unknown					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
S. Newport	Animal (Unspecified)					1						1
	Animal Feed					12						12
	Bovine					127						127
	Caprine					1						1
	Chicken					6						6
	Chicken Litter					1						1
	Environmental Swab					29						29
	Equine					10						10

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Newport	Food (Beef)					1						1
(continued)	Food (Bovine)					2						2
	Food (Raw Meat)					13						13
	Food (Snail)					1						1
	Food (Turkey)					12						12
	Food (Unspecified)					13						13
	Turkey					113						113
	Unknown	1										1
	Water					2						2
	Subtotal	1	0	0	0	344	0	0	0	0	0	345
S. Nima	Reptile		1									1
S. Ohio (b)	Animal Feed		1				11					12
	Bovine					1						1
	Chicken	3				4	1		1			9
	Fertilizer					1						1
	Porcine		1	7	2	3	23					36
	Turkey		1									1
	Unknown					1						1
	Subtotal	3	3	7	2	10	35	0	1	0	0	61
S. Onderstepoort	Reptile					1						1
S. Oranienburg	Animal Feed								1			1
	Chicken								1			1
	Food (Unspecified)						2					2
	Porcine						1					1
	Primate		1									1
	Reptile										1	1
	Subtotal	0	1	0	0	0	3	0	2	0	1	7
S. Orion (a)	Animal Feed								2			2
	Canine					1						1
	Chicken								2		2	4
	Environmental Swab										1	1
	Turkey					1						1
	Subtotal	0	0	0	0	2	0	0	4	0	3	9
S. Ouakam	Chicken					8						8
S. Panama	Animal (Unspecified)		1									1
S. Paratyphi B	Unknown						4					4
S. Paratyphi B var. Java	Porcine						1					1
	Python		1									1
	Snake		1									1
	Unknown						29					29
	Subtotal	0	2	0	0	0	30	0	0	0	0	32

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Pomona	Animal Feed					1	1					2
	Bovine					1						1
	Canine			1								1
	Reptile		2									2
	Turkey					2						2
	Subtotal	0	2	1	0	4	1	0	0	0	0	8
S. Poona	Food (Pepper)						1					1
S. Putten	Chicken					2						2
	Porcine			9		2	1					12
	Subtotal	0	0	9	0	4	1	0	0	0	0	14
S. Rissen	Animal Feed	1					2					3
	Chicken	1										1
	Subtotal	2	0	0	0	0	2	0	0	0	0	4
S. Rubislaw	Animal Feed	1	1	1			2					5
	Canine		1									1
	Chicken		6									6
	Equine		2									2
	Food (Unspecified)		1									1
	Porcine		1	2								3
	Poultry		2									2
	Unknown		1			1						2
	Water		407									
	Subtotal	1	422	3	0	1	2	0	0	0	0	429
S. Saintpaul	Environmental Swab					3						3
	Equine					2						2
	Turkey					25						25
	Subtotal	0	0	0	0	30	0	0	0	0	0	30
S. Sandiego	Animal Feed						2					2
	Poultry		1									1
	Water		7									7
	Subtotal	0	8	0	0	0	2	0	0	0	0	10
S. Schwarzengrund	Animal Feed					1	12					13
	Bovine								1		1	2
	Chicken	1				39			6	1		47
	Food (Bovine)					7	3					10
	Food (Zucchini)					1						1
	Food (Eggplant)					1						1
	Porcine		1		5	2	1		1			10
	Subtotal	1	1	0	5	51	16	0	8	1	1	84

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Senftenberg	Animal Feed	1	1		1	1	30		1			35
	Avian					1						1
	Bovine					1						1
	Chicken					18						18
	Food (Celery Seeds)						1					1
	Food (Milk)					1						1
	Porcine					1	9					10
	Turkey					25						25
	Water		6									6
	Subtotal		1	7	0	1	48	40	0	1	0	0
S. Sorenga	Animal Feed						5					5
S. Szentos	Animal Feed						1					1
S. Tennessee	Animal Feed	1			2		13					16
	Canine			1								1
	Chicken						1					1
	Chicken Fluff			1								1
	Food (Chicken)								1			1
	Food (Sesame Seeds)		1									1
	Porcine						17					17
	Water		13									13
	Subtotal		1	14	2	2	0	31	0	1	0	0
S. Thompson	Animal Feed					1	1	1				3
	Avian			2		1		1	1			5
	Bovine					21						21
	Canine					1						1
	Chicken		1		1	30	1	3	3			39
	Environmental Swab					1						1
	Equine					3						3
	Food (Bovine)					15	3					18
	Food (Chicken)					1			2			3
	Food (Unspecified)						1					1
	Porcine						1					1
Subtotal		0	1	2	1	74	7	5	6	0	0	96
S. Tokoin	Poultry						1					1
S. Typhimurium	Animal (Unspecified)					3	1					4
	Animal Feed					1	3	2	2			8
	Avian		1	1	10	7	2	3		1	1	26
	Bison					1						1
	Bovine	4	68		48	52	25	2	2			201
	Canine				2							2
	Chicken	1	8	1	2	64	7	3	1	2		89
	Chicken Fluff			1								1
Chicken Litter		4									4	

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium	Duck					4						4
(continued)	Environmental Swab	1	4		1	13	2					21
	Equine		1		2	21						24
	Feline		3		2		1					6
	Food (Bovine)					4	1					5
	Food (Broccoli)					1						1
	Food (Cauliflower)					2						2
	Food (Crab)								3			3
	Food (Porcine)					3						3
	Food (Shrimp)					1						1
	Food (Unspecified)	1			7		210					218
	Hedgehog		1									1
	Mouse		1									1
	Ovine		1	5	1	2						9
	Porcine		14	33	22	171	131		1		1	373
	Porcupine		1									1
	Poultry		2				27					29
	Snake		1									1
	Turkey					1						1
	Unknown	17					44					61
	Water		53									53
	Subtotal	24	163	41	97	351	454	10	9	3	2	1154
S. Uganda	Bovine					3						3
S. Vejle	Food (Unspecified)					1						1
S. Westhampton (a)	Animal Feed						1					1
	Turkey					2						2
	Subtotal	0	0	0	0	2	1	0	0	0	0	3
S. Worthington	Animal Feed					1	1					2
	Bovine					1						1
	Chicken					1						1
	Environmental Swab					9						9
	Equine					1						1
	Food (Unspecified)						1					1
	Porcine				2		3					5
	Water		9									9
	Subtotal	0	9	0	2	13	5	0	0	0	0	29
S. Yoruba	Unknown					1						1
S. Zega	Lizard		1									1
<i>Salmonella</i> ssp I 4,12:-:-	Animal (Unspecified)					1						1
	Chicken					2						2
	Equine					1						1
	Porcine		2	2								4
	Subtotal		2	2		4						8

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
<i>Salmonella</i> ssp I 4,5,12:-:-	Chicken					1						1
	Porcine	2										2
	Subtotal	2	0	0	0	1	0	0	0	0	0	3
<i>Salmonella</i> ssp I 4,12:-:1,2	Chicken					1						1
<i>Salmonella</i> ssp I 4,5,12:-:1,2	Chicken					3						3
<i>Salmonella</i> ssp I 4,12:-:1,7	Porcine					1						1
<i>Salmonella</i> ssp I 4,12:-:e,n,z15	Porcine		1									1
<i>Salmonella</i> ssp I 4,5,12:b:-	Turkey					2						2
<i>Salmonella</i> ssp I 4,12:d:-	Chicken					6						6
<i>Salmonella</i> ssp I 4,12:i:-	Avian	4				2					2	8
	Chicken Litter		1									1
	Porcine		1									1
	Turkey					2						2
	Unknown	1										1
	Water		1									1
	Subtotal	5	3	0	0	4	0	0	0	0	2	14
<i>Salmonella</i> ssp I 4,5,12:i:-	Animal Feed		1				2					3
	Aquatic Animal	4										4
	Avian										6	6
	Bovine					1						1
	Chicken	2	5			6						13
	Equine					1						1
	Feline								1			1
	Food (Bovine)					15						15
	Food (Chicken)									1		1
	Porcine		1	2	1							4
	Unknown											
Subtotal	6	7	2	1	23	2	0	0	2	6	49	
<i>Salmonella</i> ssp I 4,12:l,v:-	Porcine						2					2
<i>Salmonella</i> ssp I 4,12:r:-	Turkey					1						1
<i>Salmonella</i> ssp I 4,5,12:r:-	Chicken					2						2
	Porcine						1					1
	Subtotal	0	0	0	0	2	1	0	0	0	0	3
<i>Salmonella</i> ssp I 6,7:-:-	Animal Feed						1					1
<i>Salmonella</i> ssp I 6,7,14:-:-	Animal Feed						1					1

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
<i>Salmonella</i> ssp I 6,7:-:1,5	Bovine					1						1
	Porcine					2						2
	Subtotal	0	0	0	0	3	0	0	0	0	0	3
<i>Salmonella</i> ssp I 6,7,14:-:1,5	Food (Bovine)						1					1
<i>Salmonella</i> ssp I 6,7:-:l,w	Porcine						1					1
<i>Salmonella</i> ssp I 6,7:z10:-	Bovine					1						1
<i>Salmonella</i> ssp I 6,7,14:z10:-	Animal Feed		1									1
<i>Salmonella</i> ssp I 6,7:z4,z23:-	Animal Feed						1					1
<i>Salmonella</i> ssp I 6,14,18:-:-	Bovine					2						2
<i>Salmonella</i> ssp I 6,8:-:1,2	Water		3									3
<i>Salmonella</i> ssp I 6,8:-:e,n,x	Avian						1					1
	Chicken					2						2
	Porcine					1						1
	Subtotal	0	0	0	0	3	1	0	0	0	0	4
<i>Salmonella</i> ssp I 6,8:d:-	Bovine					1						1
<i>Salmonella</i> ssp I 8,20:e,h:-	Reptile										1	1
<i>Salmonella</i> ssp I 8,20:i:-	Chicken					1						1
<i>Salmonella</i> ssp I 9,12:-:-	Chicken					1						1
<i>Salmonella</i> ssp I 11:r:-	Water		54									54
<i>Salmonella</i> ssp I 17:-:-	Porcine					1						1
<i>Salmonella</i> ssp I 18:-:-	Bovine					12						12
	Porcine					1						1
	Subtotal	0	0	0	0	13	0	0	0	0	0	13
<i>Salmonella</i> ssp I 18:z4:z23:-	Bovine				1							1
<i>Salmonella</i> ssp I 3,10:e,h:-	Chicken					1						1
	Food (Bovine)					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2

Non-Human *Salmonella* 2003

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
<i>Salmonella</i> ssp I 3,10:l,v:-	Porcine					1						1
<i>Salmonella</i> ssp I 3,15:e,h:-	Bovine					1						1
<i>Salmonella</i> ssp I 3,19:-:-	Animal Feed						1					1
	Chicken					1						1
	Environmental Swab		1									1
	Subtotal	0	1	0	0	1	1	0	0	0	0	3
<i>Salmonella</i> ssp I 28:y:-	Bovine					1						1
<i>Salmonella</i> ssp I 42:z4,z23:-	Animal Feed						2					2
	Porcine						1					1
	Subtotal	0	0	0	0	0	3	0	0	0	0	3
<i>Salmonella</i> ssp I 47:z4,z23:-	Food (Ovine)											
<i>Salmonella</i> ssp I Rough-O:-:-	Bovine					1						1
	Unknown		1									1
	Subtotal	0	1	0	0	1	0	0	0	0	0	2
<i>Salmonella</i> ssp I Rough-O:-:1,5	Bovine					1					1	
<i>Salmonella</i> ssp I Rough-O:d:1,2	Porcine					1					1	
<i>Salmonella</i> ssp I Rough-O:d:e,n,x	Food (Sage)						1					1
<i>Salmonella</i> ssp I Rough-O:d:l,w	Canine					1						1
	Chicken					2						2
	Porcine						4					4
	Subtotal	0	0	0	0	3	4	0	0	0	0	7
<i>Salmonella</i> ssp I Rough-O:e,h:-	Food (Bovine)					1						1
	Turkey					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
<i>Salmonella</i> ssp I Rough-O:e,h:1,2	Bovine					1					1	
<i>Salmonella</i> ssp I Rough-O:g,m,s:-	Food (Cumin Seeds)						1					1
<i>Salmonella</i> ssp I Rough-O:i:-	Food (Crab)								1			1
<i>Salmonella</i> ssp I Rough-O:i:1,2	Bovine					2						2
<i>Salmonella</i> ssp I Rough-O:i:z6	Chicken		1			6						7
	Chicken Litter		1									1
	Subtotal	0	2	0	0	6	0	0	0	0	0	8

Non-Human *Salmonella* 2003

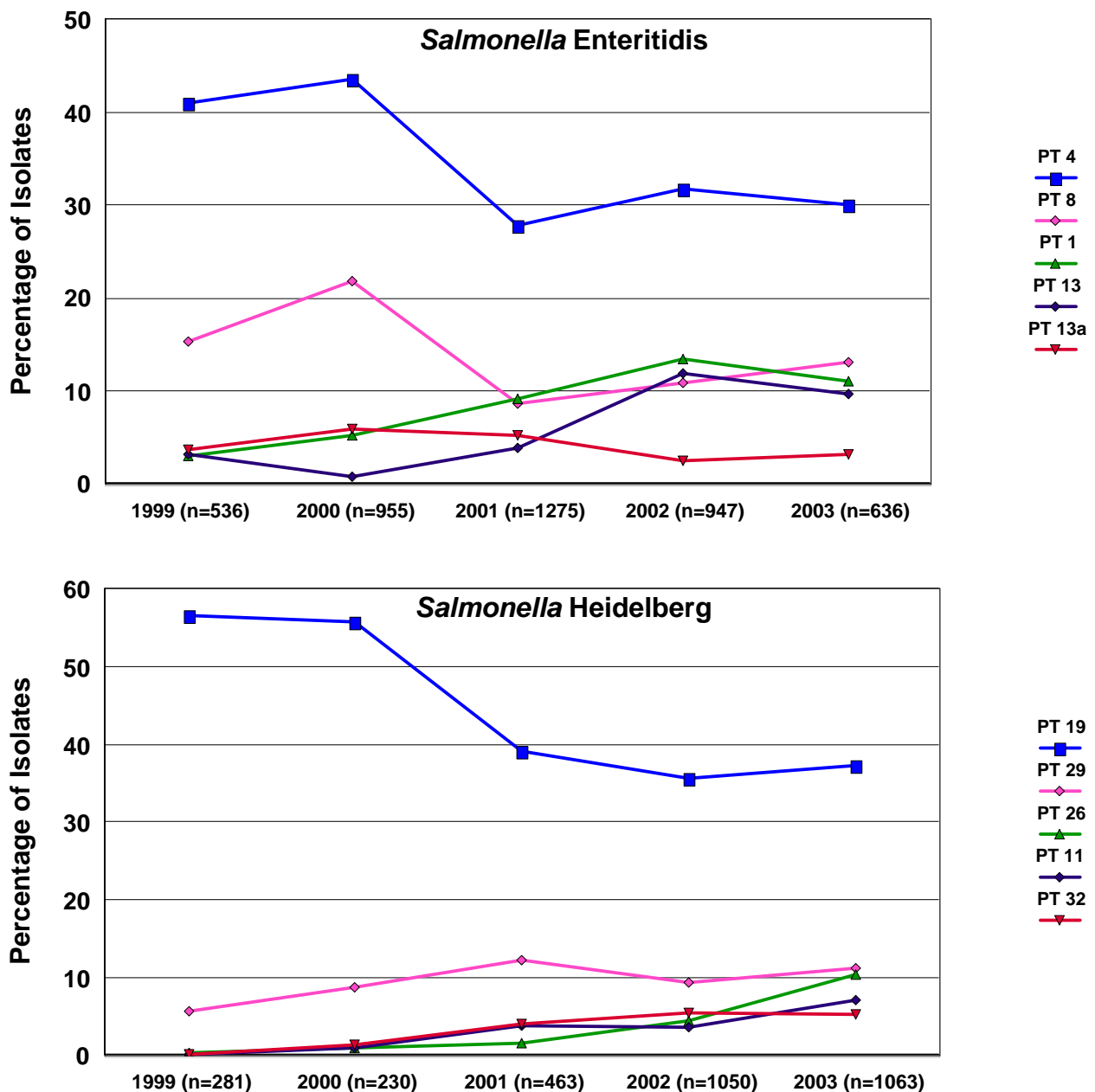
Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
<i>Salmonella</i> ssp I Rough-O:k:1,5	Bovine					2						2
	Chicken					5						5
	Subtotal	0	0	0	0	7	0	0	0	0	0	7
<i>Salmonella</i> ssp I Rough-O:r:-	Chicken					2						2
	Chicken Litter		1									1
	Subtotal	0	1	0	0	2	0	0	0	0	0	3
<i>Salmonella</i> ssp I Rough-O:r:1,2	Chicken		3			9						12
	Chicken Litter		2									2
	Food (Chicken)					1						1
	Turkey					4						4
	Unknown	1										1
	Subtotal	1	5	0	0	14	0	0	0	0	0	20
<i>Salmonella</i> ssp I Rough-O:z10:-e,n,z15	Chicken		1									1
<i>Salmonella</i> ssp I Rough-O:z10:e,n,x	Chicken					1						1
<i>Salmonella</i> ssp I Rough-O:z29:-	Animal Feed	1	1									2
	Water		1									1
	Subtotal	1	2	0	0	0	0	0	0	0	0	3
<i>Salmonella</i> ssp I Rough-O:z4,z23:-	Bovine					1						1
	Chicken					1						1
	Subtotal	0	0	0	0	2	0	0	0	0	0	2
<i>Salmonella</i> ssp I Rough-O:z4,z24:-	Reptile		1									1
<i>Salmonella</i> ssp I Rough-O:z:l,w	Environmental Swab					1						1
<i>Salmonella</i> ssp I Rough:l,v:e,n,z15	Porcine						1					1
<i>Salmonella</i> ssp II 6,7,14:m,t:-	Food (Unspecified)					1						1
<i>Salmonella</i> ssp II 30:g,t:-	Food (Sage)						1					1
<i>Salmonella</i> ssp II 50:b:z6	Reptile			1								1
<i>Salmonella</i> ssp IIIa 18:-:-	Turkey					1						1
<i>Salmonella</i> ssp IIIa 18:z4,z32:-	Chicken					2						2
<i>Salmonella</i> ssp IIIa Rough-O:z4,z23:-	Unknown	1										1
<i>Salmonella</i> ssp IIIa Rough-O:z4,z24:-	Unknown	1										1
<i>Salmonella</i> ssp IIIa Rough-O:z4,z32:-	Chicken					2						2
<i>Salmonella</i> ssp IIIa Rough-O:z4,z32:-	Turkey					1						1
<i>Salmonella</i> ssp IIIb 60:r:e,n,x,z15	Water		3									3
<i>Salmonella</i> ssp IIIb 60:r:e,n,z15	Equine			1								1
<i>Salmonella</i> ssp IIIb 61:-:1,5,7	Bovine		1									1
<i>Salmonella</i> ssp IIIb 61:-:1,5,7	Ovine	1										1
<i>Salmonella</i> ssp IIIb 61:-:1,5,7	Unknown	1										1

Serovar	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
<i>Salmonella</i> ssp IIIb 61:k:1,5	Bovine	1										1
<i>Salmonella</i> ssp IIIb 61:k:1,5	Ovine										2	2
<i>Salmonella</i> ssp IIIb 61:k:1,5,7	Ovine			1								1
<i>Salmonella</i> ssp IIIb:16:z10:e,n,x,z15	Water		2									2
<i>Salmonella</i> ssp IV 21:-:-	Porcine					1						1
<i>Salmonella</i> ssp IV 40:g,t:-	Gecko			1								1
<i>Salmonella</i> ssp IV 43:z4,z24:-	Reptile					1						1
<i>Salmonella</i> ssp IV 44:z4,z24:-	Reptile					2						2
<i>Salmonella</i> ssp IV 48:g,z51:-	Water		3									3
<i>Salmonella</i> ssp IV 50:z4,z23:-	Unknown											
<i>Salmonella</i> ssp IV Rough-O:-:-	Porcine					1						1
<i>Salmonella</i> ssp VI 6,14,25:a:e,n,x	Unknown						1					1
Total Non-Human <i>Salmonella</i> 2003		96	995	128	165	2850	1166	67	62	118	23	5670

Phage Types of *Salmonella* Serovars in Canada

Phage typing data are 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. Table 5 lists *Salmonella* phage types identified from human strains forwarded to the NML and non-human strains identified by the LFZ and NML.

Figure 15: Five Most Prevalent Phage Types of Various *Salmonella* Serovars Isolated from Humans in Canada, 1999 to 2003



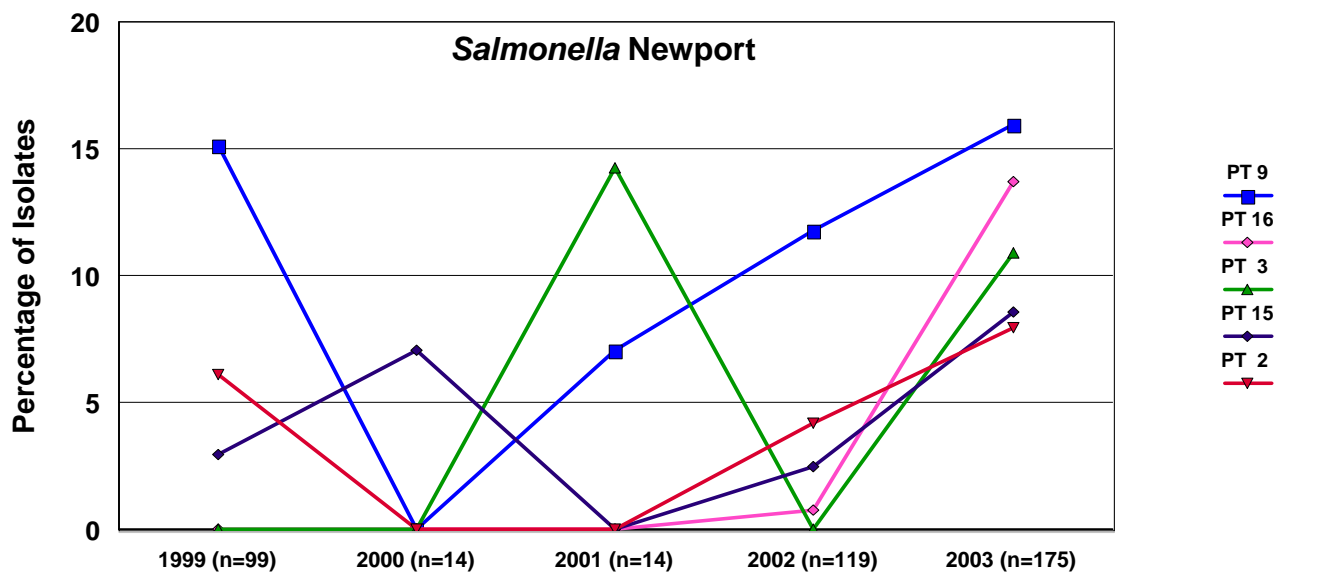
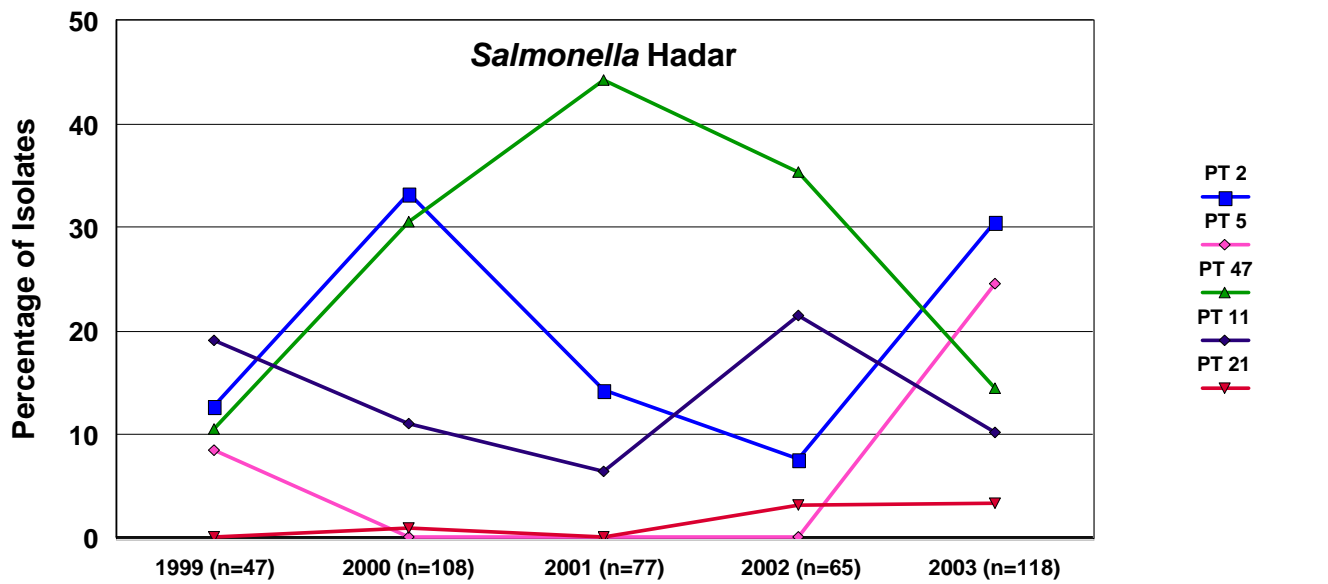
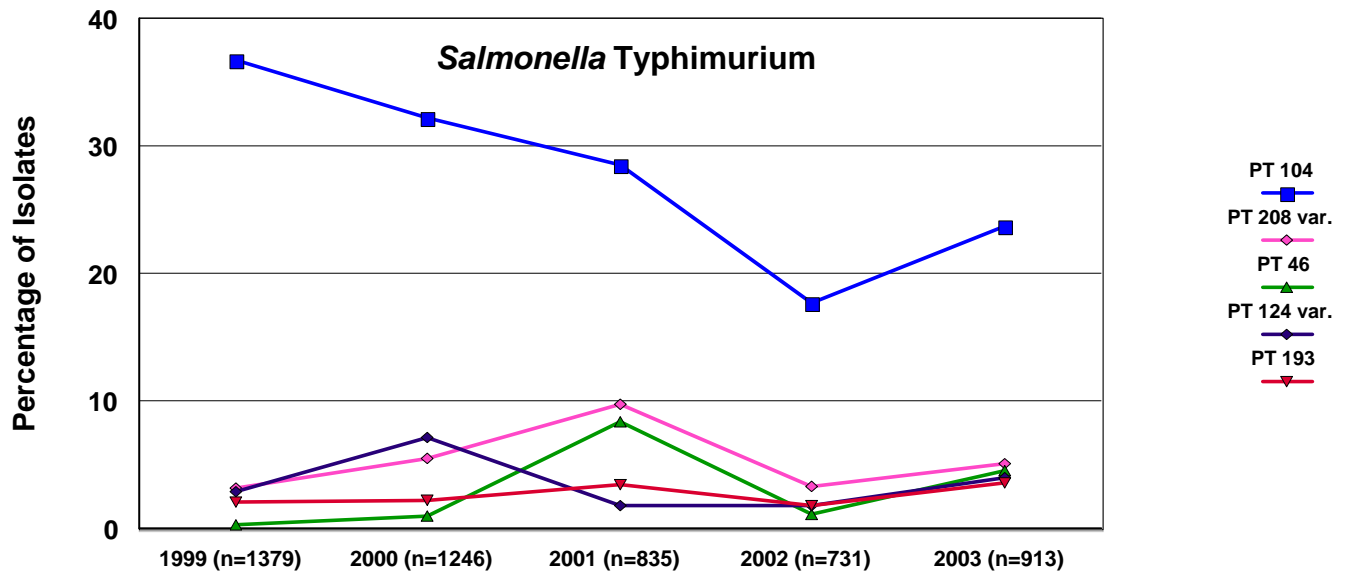


Table 5: Phage Types of Various *Salmonella* Serovars in Canada, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Enteritidis	1	Human	7	10	2	5	90	13		1			128
	1	Unknown					1						1
	1a	Human								2			2
	1b	Human				1	1						2
	2	Human		10			4			2	1		17
	3	Human		1		2							3
	3	Unknown					1						1
	3 var.	Human					1						1
	4	Emu						3					3
	4	Food (Chicken)	1										1
	4	Human	28	51	12	8	144	42	3	12	1		301
	4a	Human	1	3	1		13	2					20
	4b	Human	2				2						4
	5a	Human	3	1			5			1		1	11
	5b	Human		2			33	23		5		1	64
	5c	Human		1			3	1					5
	6	Human	1	1	1		13	2					18
	6a	Human	4	4			9			1			18
	6b	Human	1	1				2					4
	7	Human		1			1	1					3
	7a	Human					2						2
	8	Animal (Unspecified)						1					1
	8	Chicken	1	15			3						19
	8	Environmental Swab	1	1									2
	8	Food (Pork)	2										2
	8	Food (Poultry)	1										1
	8	Human	7	15		2	55	17	2	5			103
	8	Rodent								2			2
	8	Turkey					1						1
	8	Unknown						2					2
	8a	Human											0
	9a	Human		1			1						2
	9b	Human	1										1
	9c	Human		1	1								2
	11	Human					1						1
	11b	Bovine			1								1
	11b	Human		1	3			2					6
	13	Chicken		1				2					3
	13	Human	6	4	2	2	55	24	6	17	1		117
	13	Poultry						2					2
	13	Unknown						2					2
	13a	Chicken		1									1
	13a	Human		1		1	19	2		1			24
	14b	Human		3			5	1					9
	18	Human		1									1
	19	Unknown						1					1
	20	Human				1							1
	21	Human	2	1			7	2					12
	24	Human	3	2			2		3	4	1	2	17

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Enteritidis	24 var.	Human					1						1
(continued)	24a	Human	1										1
	28	Human					3						3
	29	Human		4			3						7
	29	Porcine								3			3
	29a	Human	1					1					2
	30	Human		1			3		2				6
	34	Human					4						4
	35	Human	1										1
	36	Human					1						1
	43	Human		2									2
	911	Human	1				5	1					7
	Atypical	Hedgehog		1									1
	Atypical	Human	4	4	2		12	8					30
	Untypable	Fish	1										1
	Untypable	Human	2	2			3	1			1		9
		Human Total	76	129	24	22	501	145	16	51	5	4	973
		Non Human Total	7	19	1	0	6	13	0	5	0	0	51
S. Hadar	2	Food (Chicken)		1									1
	2	Human	1	4									5
	4	Human			1								1
	10	Human		3	2								5
	11	Chicken			1								1
	11	Chicken Litter		1									1
	11	Human	2	11	1								14
	13	Human		2									2
	19	Human		1									1
	21	Human		2									2
	26	Human		1									1
	33	Chicken		1									1
	33	Human		1									1
	40	Human		1									1
	43	Chicken		1									1
	43	Human		2			1						3
	47	Bovine		1									1
	47	Canine		1									1
	47	Food (Chicken)		1									1
	47	Human		19	4								23
	47	Poultry		1									1
	47	Unknown		1									1
	56	Canine			1								1
	56	Chicken		1									1
	56	Human		1									1
	58	Human		1									1
	Atypical	Human	1										1
	Untypable	Human		2							1		3
		Human Total	4	51	8	0	1	0	0	0	1	0	65
		Non Human Total	0	10	2	0	0	0	0	0	0	0	12

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	1	Human	1			1	3						5
	2	Human	2	1									3
	3	Chicken								1			1
	4	Chicken						6					6
	4	Human	1	5			31	67	4				108
	4	Porcine						5					5
	4	Poultry						3					3
	4	Unknown						3					3
	5	Chicken Litter		1									1
	5	Human	15	11		3	46	5		1	2		83
	5	Water		1									1
	6	Animal (Unspecified)					2						2
	6	Environmental Swab		1									1
	6	Human	1	1			19	21		1			43
	6	Turkey		1			3						4
	6	Unknown						2					2
	7	Chicken					2						2
	7	Human					1	1					2
	8	Chicken					102	1					103
	8	Human					5	8	2				15
	8	Porcine					1						1
	9	Chicken					1						1
	9	Human						1					1
	9	Porcine						7					7
	9	Poultry		1				1					2
	10	Human			1		6		1				8
	11	Avian		1									1
	11	Human	2	2			28	5					37
	11	Porcine					1						1
	11	Turkey					1						1
	12	Poultry						1					1
	13	Chicken		3									3
	13	Turkey					6						6
	17	Chicken		3									3
	17	Chicken Litter		3									3
	17	Human	1	1			1	3					6
	18	Canine			1								1
	18	Chicken	1										1
	18	Human	1	1			2	2	1				7
	18	Water		1									1
	19	Avian		3									3
	19	Bovine		2	1			1					4
	19	Chicken	7	11			10	3	1				32
	19	Chicken Litter		1									1
	19	Environmental Swab	1	3									4
	19	Food (Chicken)		1									1
	19	Food (Lamb)		1									1

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	19	Food (Unspecified)		1			1						2
(continued)	19	Human	26	73	9	16	144	96	6	1	4		375
	19	Porcine			1								1
	19	Poultry		1				3					4
	19	Unknown		1			1	4					6
	19	Water		5									5
	20	Human				1	2	2					5
	20	Porcine						1					1
	21	Environmental Swab	1										1
	21	Human					1	1					2
	22	Human		7		2	1	1					11
	22	Porcine		1									1
	23	Human				1	1						2
	23	Turkey					1						1
	24	Human						5					5
	25	Human		2									2
	26	Chicken					1						1
	26	Food (Lettuce)					1						1
	26	Food (Potato)					1						1
	26	Human	12	3	1	2	20	6	2				46
	26	Poultry						2					2
	26	Turkey					2						2
	26	Unknown					1						1
	29	Animal (Unspecified)					2						2
	29	Chicken		12			8	2					22
	29	Chicken Litter		4									4
	29	Equine					8						8
	29	Human	7	13	1	2	36	34	4	1		1	99
	29	Porcine						45					45
	29	Poultry						2					2
	29	Turkey	1				2						3
	29	Unknown						10					10
	29	Water		7									7
	30	Animal (Unspecified)					1						1
	30	Human					1						1
	30	Turkey		1			1						2
	32	Animal (Unspecified)					14						14
	32	Bovine						1					1
	32	Chicken					4	2					6
	32	Human	2	5		4	31	14	1		1		58
	32	Poultry						1					1
	32	Turkey	7				23						30
	32	Unknown						3					3
	35	Camelid									1		1
	35	Human						1					1
	36	Chicken		1			7						8
	36	Chicken Litter		4									4
	36	Human		2			1						3
	36	Owl		1									1

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	36	Turkey					1						1
(continued)	37	Human					1						1
	37	Porcine						2					2
	39	Human		1	1	2		2					6
	39	Poultry			1								1
	40	Avian						1					1
	40	Human				1							1
	41	Avian			2								2
	41	Chicken			12								12
	41	Environmental Swab	2	1									3
	41	Human	5	1		2	6	10					24
	41	Poultry						1					1
	41	Unknown						1					1
	42	Human					1						1
	44	Canine			1								1
	44	Human						1					1
	45	Animal (Unspecified)					3						3
	45	Human					6	2					8
	47	Animal (Unspecified)					1						1
	47	Avian						1					1
	47	Chicken						1					1
	47	Food (Poultry)								1			1
	47	Human		1			7			5			13
	47	Porcine						1					1
	47	Turkey					12						12
	48	Human					1						1
	49	Human		1									1
	53	Unknown						1					1
	54	Human					1						1
	55	Human					2						2
Atypical		Avian						1					1
Atypical		Bovine					1						1
Atypical		Chicken			1					2			3
Atypical		Human	2	6		4	23	8	4		1		48
Atypical		Porcine			8			5					13
Atypical		Turkey					4						4
Atypical		Unknown					1						1
Atypical		Water		24									24
Untypable		Chicken		3			1						4
Untypable		Human	4		1		3	3	3				14
Untypable		Porcine						1					1
Untypable		Unknown						1					1
		Human Total	82	137	14	41	431	299	28	9	8	1	1050
		Non Human Total	20	105	28	0	232	126	1	4	1	0	517

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total	
S. Infantis	4	Chicken			2								2	
	4	Pet Food		1									1	
	7	Chicken			3								3	
	7	Human			1								1	
	13	Environmental Swab			6								6	
	13	Porcine			18								18	
	29	Human		1									1	
			Human Total	0	1	1	0	0	0	0	0	0	0	2
			Non Human Total	0	1	29	0	0	0	0	0	0	0	30
S. Newport	1	Human	1				3						4	
	2	Food (Unspecified)		1									1	
	2	Human		1			3		1				5	
	4	Environmental Swab					2						2	
	4	Human		3			9		3				15	
	4	Unknown					1						1	
	7	Animal (Unspecified)					1						1	
	7	Bovine					1						1	
	7	Environmental Swab					1						1	
	7	Turkey					3						3	
	7	Unknown					1						1	
	8	Human		1						1			2	
	9	Human	2	2			10						14	
	10	Human		2							1		3	
	13	Human		2			13	1				1	17	
	14	Human		1			4				1		7	
	14a	Bovine					9						9	
	14a	Chicken					2						2	
	14a	Human	2	8			8						18	
	14a	Pet Food		1									1	
	14b	Bovine					2						2	
	14b	Human	1										1	
	14c	Chicken					2						2	
	14c	Human					1	1					2	
	14r	Human					18						18	
	15	Human	1	2									3	
	15	Snake		1									1	
	16	Human					1						1	
	17	Human					5						5	
	17a	Human					1						1	
	17c	Human					1						1	
	Atypical	Animal (Unspecified)					1						1	
	Atypical	Bovine					1						1	
Atypical	Human	1										1		
Atypical	Turkey					2						2		
Untypable	Human		1									1		
		Human Total	8	23	0	1	77	2	5	2	1	0	119	
		Non Human Total	0	3	0	0	29	0	0	0	0	0	32	

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total	
S. Oranienburg	1	Human	12	80	25	5	37						159	
	4	Food (Chocolate)					28						28	
	4	Food (Unspecified)					1						1	
	4a	Food (Chocolate)					3						3	
	4a	Human					1						1	
	5	Human					1						1	
	6	Human		1			1						2	
	8	Feline			2									2
	15	Animal (Unspecified)		1										1
	15	Human					1	1						2
	16	Snake		1										1
	17	Human								1				1
	Untypable	Human									1			1
			Human Total	12	81	25	5	41	1	1	1	0	0	167
		Non Human Total	0	2	2	0	32	0	0	0	0	0	36	
S. Panama	G	Human		2									2	
	H	Human		1									1	
	H	Python	1										1	
	Atypical	Human	1	1					1				3	
	Untypable	Human								1			1	
S. Paratyphi B	Taunton	Human	1										1	
S. Paratyphi B	1 var. 2	Human					1						1	
var. Java	1 var. 3	Human	1				1						2	
	3a1 var. 4	Human						1					1	
	3b var.	Human				1					1		2	
	3b var. 3	Human					3						3	
	3b var. 7	Human		12				1					13	
	Atypical	Human	7	2			3	13					25	
	Atypical	Unknown						1					1	
	Atypical	Water	2					1					3	
	Battersea	Human		1	4								5	
	Battersea	Unknown		1									1	
	Dundee	Human			1		2		1				4	
	Dundee	Unknown						1					1	
	Untypable	Human			1								1	
	Untypable	Poultry						1					1	
		Human Total	8	15	6	1	10	15	1	0	1	0	57	
		Non Human Total	2	1	0	0	0	4	0	0	0	0	7	

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
<i>Salmonella</i> ssp I	1 var. 6	Human						1					1
4,[5],12:b:-	3b var. 2	Human					5	2					7
	3b var. 3	Human						1					1
	B.A.O.R.	Human					2						2
	Battersea	Human		2			11	3					16
	Atypical	Human		1				7					8
	Atypical	Mouse						1					1
	Untypable	Human	3	3			3	7					16
	Untypable	Lizard						2					2
		Human Total	3	6	0	0	21	21	0	0	0	0	51
		Non Human Total	0	0	0	0	0	3	0	0	0	0	3
S. Thompson	1	Human		3	1		18	16	1	1			40
	1	Unknown						1					1
	2	Human		11			2		1	1			15
	3	Chicken			1								1
	3	Human		1									1
	4	Human		1									1
	5	Human		3			3	3			1		10
	5	Poultry		1									1
	13	Human		1									1
	25	Human		1			1				1		3
	26	Human		1			2	1			5		9
	27	Human		1	2								3
		Human Total	0	23	3	0	26	20	2	2	7	0	83
		Non Human Total	0	1	1	0	0	1	0	0	0	0	3
S. Typhi	A	Human					4	3	6				13
	B1	Human	1				3						4
	B2	Human					2	3					5
	B3	Human					1						1
	C1	Human						1					1
	C4	Human						1					1
	D1	Human					5						5
	D2	Human					4						4
	DVS	Human	1				3						4
	E1	Human	6	7			32	1				1	47
	E2	Human	1										1
	E9	Human	1				1	1					3
	E14	Human					1						1
	J1	Human					1						1
	O	Human	1	1			2						4
	28	Human	1										1
	45	Human					1						1
	46	Human	1				1						2
	UVS	Human	1				3						4
	UVS-(I+IV)	Human	3	1		1	5	2					12
	Untypable	Human					2	1					3
		Human Total	17	9	0	1	71	13	6	0	0	1	118

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	1	Avian			1								1
	1	Chicken		1	2								3
	1	Human	1	7	9	6		9			1	1	34
	1	Poultry						1					1
	1	Unknown						1					1
	2	Avian		1		6	5	9					21
	2	Bovine	1				2	2					5
	2	Canine					1						1
	2	Chicken		2			2						4
	2	Equine					2						2
	2	Food (Eggs)	4										4
	2	Human	43	23	2	2		8					78
	2	Pigeon	3										3
	2	Porcine					1	1					2
	2	Poultry						4					4
	2	Turkey		1									1
	3 aerogenic	Human		1				1					2
	4	Human		1									1
	9	Human						1					1
	10	Bovine					2						2
	10	Ferret					1						1
	10	Human	3			1		5					9
	10	Poultry						3					3
	10	Turkey					1						1
	10	Unknown						1					1
	11	Human		1									1
	12	Bovine						1					1
	12	Food (Pork)						40					40
	12	Human	2	4	1	1		15		1			24
	12	Porcine				4		2					6
	12	Unknown						5					5
	12a	Bovine						8					8
	12a	Human						2					2
	12a	Unknown						1					1
	15a	Human	1	3									4
	20	Animal Feed		1									1
	21	Bovine						2					2
	22	Bovine			1								1
	22	Chicken				2	2					1	5
	22	Human	1	2	1			2		4			10
	22	Pet Food		1			1						2
	22	Poultry						1					1
	23	Human						2					2
	27	Human	1	1				1		1			4
	27	Porcine					2						2

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	35	Equine					4						4
	35	Environmental Swab					3						3
	35	Human						1					1
	35	Porcine					1						1
	36	Avian					1						1
	36	Chicken	1										1
	39	Avian			1								1
	39	Human						1					1
	39	Pigeon	1										1
	40	Animal Feed	1										1
	40	Avian			1		3						4
	40	Human		1		1		2					4
	40	Unknown						2					2
	41	Human	1	1		3		2					7
	43	Human		1									1
	46	Avian						1					1
	46	Human	1	6				1					8
	46	Poultry						4					4
	49	Human	6	1									7
	65	Unknown						1					1
	66	Bovine						1					1
	66	Chicken					1						1
	66	Porcine					1						1
	67	Human		1									1
	69	Human						4					4
	80	Human		1				1					2
	82	Bovine						1					1
	82	Human			1								1
	82 var.	Human						1					1
	96	Human		2									2
	99	Animal Feed						1					1
	99	Avian					1						1
	99	Chicken		2									2
	99	Duck					1						1
	99	Food (Basil)						2					2
	99	Human		1							1		2
	104	Animal (Unspecified)					5						5
	104	Avian					2						2
	104	Bison			1								1
	104	Bovine	5	40	18	1	17	16	2				99
	104	Canine					1						1
	104	Cervid		1									1
	104	Chicken		9			37						46
	104	Equine		1				1					2
	104	Environmental Swab	1				1						2
	104	Feline					5						5
	104	Food (Beef)		1				3					4

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	104	Food (Pork)						55					55
(continued)	104	Human	16	48	12	3	6	45					130
	104	Ovine			1								1
	104	Pigeon	1										1
	104	Porcine		2	11	4	21	71					109
	104	Poultry						1					1
	104	Unknown						9					9
	104	Water		7									7
	104a	Bovine					2						2
	104a	Equine						1					1
	104a	Food (Pork)						41					41
	104a	Human	3					7					10
	104a	Porcine		1			4	23					28
	104a	Unknown						5					5
	104b	Bovine		5			5	3					13
	104b	Chicken					1						1
	104b	Feline					1						1
	104b	Food (Pork)						8					8
	104b	Human	1	5				9	1				16
	104b	Porcine			1		11	3					15
	104b	Quail						1					1
	104b	Unknown						3					3
	107	Avian				9							9
	107	Bovine					1						1
	107	Chicken				16	2		2	1		1	22
	107	Human		2		3		3	6	2	1		17
	107	Poultry						1					1
	107	Unknown					1	1					2
	108	Bovine					1	1					2
	108	Chicken					1						1
	108	Food (Pork)						3					3
	108	Human						2					2
	108	Porcine				3	1	7					11
	110b	Avian							2				2
	110b	Chicken					4		1			2	7
	110b	Food (Chicken)		1									1
	110b	Human	1			1		1		1			4
	110b	Porcine				1		6					7
	110b	Unknown		1									1
	120	Avian			1		1						2
	120	Chicken		1									1
	120	Cormorant			1								1
	120	Human	1					1					2
	120	Porcine					1	1					2
	120	Unknown						1					1

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	121	Cormorant			1								1
(continued)	121	Food (Pork)						1					1
	121	Hedgehog		2									2
	121	Human	1	12									13
	124	Avian					4						4
	124	Duck					1						1
	124	Equine					1						1
	124	Porcine			1			1					2
	124 var.	Human	1	1		3		4	1		3		13
	124 var.	Unknown						1					1
	132	Animal (Unspecified)					3	4					7
	132	Bovine		1									1
	132	Chicken		4			3						7
	132	Environmental Swab	1	1				1					3
	132	Food (Eel)					1						1
	132	Ovine		1									1
	132	Turkey		1									1
	132	Water		7									7
	135	Chicken					1						1
	135	Human	2	2	1			1					6
	140	Human	1										1
	143	Human				1							1
	146	Water		3									3
	146a var.	Human		1									1
	151	Human		1				4					5
	151	Porcine			1								1
	153	Human	1										1
	160	Avian		3	5		5						13
	160	Feline		1									1
	160	Human		5				3					8
	160	Sparrow		4	1								5
	164	Porcine			3								3
	170	Animal Feed						1					1
	170	Bovine					15	3					18
	170	Canine					1						1
	170	Chicken					5	1					6
	170	Food (Pork)						8					8
	170	Human		1		1		27		1			30
	170	Porcine						18		1			19
	170	Unknown						2					2
	171	Human	1	2		1							4
	186	Bovine					2						2
	186	Chicken					1						1
	186	Porcine					3						3
	191	Human	1	3	1	2		1					8
	192	Human	1										1

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	193	Avian						3					3
(continued)	193	Food (Chicken)		1									1
	193	Food (Pork)						21					21
	193	Human	2	7				4					13
	193	Porcine						4					4
	193	Poultry						1					1
	193	Unknown						3					3
	194	Avian			1								1
	194	Chicken								1			1
	194	Porcine				1							1
	195	Avian						1					1
	195	Human				1		4	2		1		8
	204	Human		1									1
	204a	Food (Pork)						1					1
	204c	Environmental Swab		1									1
	204c	Human						1					1
	208	Bovine		2		2	3	10					17
	208	Chicken						2					2
	208	Food (Bean Sprouts)						1					1
	208	Food (Pork)						9					9
	208	Human	7	5		1		10				2	25
	208	Ovine		1									1
	208	Porcine					1	1					2
	208	Unknown						1					1
	208	Water		4									4
	208 var.	Avian				1							1
	208 var.	Bovine	11	44		12							67
	208 var.	Chicken		6			1						7
	208 var.	Environmental Swab		1									1
	208 var.	Food (Bovine)	1	1									2
	208 var.	Human	7	31	3	10		1					52
	208 var.	Porcine					2	1					3
	208 var.	Tiger	1										1
	208 var.	Water		1									1
	812	Human	13										13
	Atypical	Avian			3		1						4
	Atypical	Bovine	1	1		3	1						6
	Atypical	Chicken					2		2	14			18
	Atypical	Human	7	17	2	5		4	1		1		37
	Atypical	Porcine		1									1
	Atypical	Water		3									3
	U276	Chicken	1										1
	U284	Avian	2		3		2	13					20
	U284	Environmental Swab	1										1
	U284	Feline						6					6
	U284	Human	7						1				8
	U284	Pine Siskin	2										2
	U284	Sparrow			1								1
	U284	Unknown						1					1

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	U284 var.	Animal Feed						1					1
(continued)	U284 var.	Avian	3	2	11		37	1	1	1			56
	U284 var.	Bovine					2						2
	U284 var.	Feline		2			4	1					7
	U284 var.	Hedgehog		1									1
	U284 var.	Human	2	9		1		9			1		22
	U284 var.	Unknown						109					109
	U284 var.	Water		1									1
	U285	Bovine						1					1
	U285	Chicken		1									1
	U285	Human	1			1							2
	U285	Unknown						1					1
	U291	Chicken					1						1
	U292	Human		1									1
	U295	Human									1		1
	U297	Snake		1									1
	U301	Chicken								1			1
	U302	Animal (Unspecified)					1						1
	U302	Avian					2						2
	U302	Bovine		1			2	2					5
	U302	Chicken					1						1
	U302	Equine					1						1
	U302	Food (Pork)						10					10
	U302	Food (Unspecified)						3					3
	U302	Human	1	3				24					28
	U302	Porcine			1	3	2	18					24
	U302	Unknown						2					2
	Untypable	Animal (Unspecified)						1					1
	Untypable	Animal Feed		1									1
	Untypable	Bovine		8		2	1						11
	Untypable	Chicken		2				1					3
	Untypable	Equine					1						1
	Untypable	Porcine			1	1	2	6					10
	Untypable	Turkey					1						1
	UT 1	Animal (Unspecified)		1									1
	UT 1	Animal Feed		1									1
	UT 1	Bovine		9									9
	UT 1	Chicken	2										2
	UT 1	Feline		1									1
	UT 1	Human	3	10	1			2					16
	UT 1	Poultry						1					1
	UT 1	Unknown		1									1
	UT 2	Bovine	2	1									3
	UT 2	Chicken Litter		1									1
	UT 2	Human	2	9				2					13
	UT 2	Ovine	1										1
	UT 3	Avian						1					1
	UT 3	Human	1										1

Salmonella Phage Types, 2002

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	UT 5	Bovine		1									1
(continued)	UT 5	Pet Food		1									1
	UT 6	Human		1									1
	UT 6	Pet Food		2									2
	UT 7	Human		1									1
	UT 7	Pet Food		1									1
	UT 8	Food (Pork)						1					1
		Human Total	144	236	34	48	6	228	12	10	10	3	731
		Non Human Total	47	214	73	71	281	640	10	19	0	4	1359
<i>Salmonella</i> ssp I	2	Avian					3						3
4,[5],12:i:-	10	Human		1									1
	35	Human	1										1
	41	Human				2							2
	82	Human		1									1
	104a	Porcine					1						1
	116	Human	1										1
	120	Chicken		2									2
	121	Chicken	3										3
	121	Human	1										1
	121	Raccoon	1										1
	146	Avian								1			1
	146a var.	Chicken			1		1						2
	146a var.	Human	1			7							8
	160	Avian			1								1
	160	Turkey					1						1
	191	Bovine			9								9
	191	Chicken		4									4
	191	Chicken Litter		1									1
	191	Environmental Swab	2	1									3
	191	Human	12	13	1	2							28
	191	Porcine	1		1								2
	191 var.	Bovine			2								2
	191 var.	Ovine			1								1
	193	Environmental Swab		1									1
	193	Human	1										1
	208	Human	1										1
	Atypical	Bovine			2		1						3
	Atypical	Chicken			1								1
	Atypical	Human	1	4	3								8
	Atypical	Turkey			1								1
	U284 var.	Avian			3								3
	U284 var.	Human			1								1
	U291	Bovine		5			1						6
	U291	Human	1	5	1			1		1		1	10
	U302	Chicken					1						1
	U302	Human							1				1

Organism	PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
<i>Salmonella</i> ssp I	Untypable	Porcine		1				1					2
4,[5],12:i-	Untypable	Water		1									1
(continued)	UT 2	Human		1									1
		Human Total	20	25	6	11	0	1	1	1	0	1	66
		Non Human Total	7	16	22	0	9	1	0	0	1	0	56

Table 6: Phage Types of Various *Salmonella* Serovars in Canada, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Enteritidis	1	Human	4	6	1	3	44	13	2			1	74
	1a	Human					1						1
	2	Human		18									18
	2	Porcine			1								1
	3	Human		1			2				1		4
	4	Avian						1					1
	4	Food (Eggs)						4					4
	4	Human	12	21	2	3	104	41	2	6		2	193
	4	Unknown						9					9
	4a	Human	1				9	1					11
	4b	Human					1	2					3
	5	Human						1					1
	5a	Human		1			2	1					4
	5b	Human					11	3					14
	5c	Human					1						1
	6	Human	1	3			2	4	1				11
	6a	Human		3			5	1					9
	6b	Human					1						1
	7	Human					1						1
	7	Unknown						1					1
	8	Cervid		1									1
	8	Chicken		1			5						6
	8	Chicken Litter		1									1
	8	Environmental Swab	1	1									2
	8	Human	5	32		1	28	14		3			83
	8	Human				1							1
	8	Porcine		4									4
	8	Poultry		1									1
	8	Turkey					1						1
	8	Unknown	1				1	1					3
	8	Water		2									2
	9	Human					1						1
	9c	Human		1									1
	11	Human	1										1
	11b	Human		1	6	1							8
	11b	Porcine				1							1
	13	Human	6	4		1	19	31	1	1			63
	13	Poultry		1									1
	13	Quail		1									1
	13	Reptile									1		1
	13a	Human	1	3			14	2			1		21
	14b	Chicken						1					1
	14b	Human	1	6			6	1					14
	14b	Turkey					1						1
	19	Equine					1						1
	20	Human			2								2
	21	Human	2	2			6	5	1	1			17
	23	Turkey					1						1
	24	Bovine					1						1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Enteritidis	24	Human					3						3
(continued)	28	Human					7	2					9
	29	Human	2	2			4	2					10
	30	Human		1			1						2
	33	Human	1	1			1						3
	34	Human					5						5
	35	Human			1		1	1					3
	45	Human	1										1
	911	Chicken						5					5
	911	Food (Chicken)						1					1
	911	Human	8					1					9
	Atypical	Environmental Swab						1					1
	Atypical	Hedgehog		2									2
	Atypical	Human	4	5	1	1	9	2					22
	Atypical	Unknown						1					1
	Untypable	Human	2	4			4	1					11
		Human Total	52	115	13	11	293	129	7	11	2	3	636
		Non Human Total	2	15	1	1	11	25	0	0	1	0	56
S. Hadar	2	Human		4	2		16	11	2	1			36
	2	Turkey		1									1
	4	Human					1						1
	5	Chicken Litter		1									1
	5	Human	1	11	10	1	3	2		1			29
	9	Human	1										1
	10	Human		1									1
	11	Human	3	5			3				1		12
	11	Pet Food		1									1
	18	Human	1				1						2
	21	Human	2				2						4
	26	Human						4					4
	47	Chicken Litter		2									2
	47	Human	2	7	3	1	3	1					17
	47	Poultry		1									1
	51	Human		1									1
	55	Human					2						2
	56	Human	2	1									3
	58	Human	1	1			1						3
	Atypical	Human					1						1
	Untypable	Human					1						1
		Human Total	13	31	15	2	34	18	2	2	1	0	118
		Non Human Total	0	6	0	0	0	0	0	0	0	0	6
S. Heidelberg	1	Human	1				1						2
	2	Human				3	1	1	2				7
	2	Unknown	1										1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	4	Avian						1					1
(continued)	4	Food (Chicken)					1	4					5
	4	Human		3			12	25	7				47
	4	Porcine						1					1
	5	Chicken					1						1
	5	Chicken Litter		1									1
	5	Environmental Swab							1				1
	5	Human		1		1	2	2					6
	5	Poultry		1									1
	6	Chicken					1			1			2
	6	Human		1	1		8	3	2				15
	6	Porcine						1					1
	6	Turkey					1						1
	6	Unknown						1					1
	7	Human							1				1
	8	Chicken					6	1					7
	8	Food (Chicken)					1						1
	8	Human			2		4	1					7
	8	Porcine					1						1
	8	Turkey					1						1
	8	Unknown	1										1
	9	Avian					1						1
	9	Chicken				1	3		1				5
	9	Equine					1						1
	9	Human					2						2
	9	Porcine						3					3
	9	Turkey					1						1
	10	Human			1	3							4
	10	Porcine		2									2
	11	Animal (Unspecified)		1									1
	11	Avian					3						3
	11	Chicken					102	2					104
	11	Human	1	3		2	57	11					74
	12	Chicken		2			20						22
	12	Food (Turkey)					2						2
	12	Human						1					1
	12	Turkey					1						1
	13	Avian					1						1
	13	Chicken					3						3
	13	Human					2						2
	16	Human					1	1					2
	17	Avian					1						1
	17	Chicken		2			3						5
	17	Human				1	2						3
	17	Poultry		2									2
	17	Unknown					2						2
	17	Water		10									10

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	18	Avian					4	1					5
(continued)	18	Bovine		1									1
	18	Chicken		3	1		6	1		1			12
	18	Food (Chicken)					2	2					4
	18	Human		2	1		2						5
	18	Porcine		2		1							3
	18	Water		1									1
	19	Avian					5		1				6
	19	Canine		2									2
	19	Chicken		9			166	2	3	2		1	183
	19	Chicken Litter		10									10
	19	Duck					1						1
	19	Equine					2						2
	19	Environmental Swab							1				1
	19	Food (Bovine)					8						8
	19	Food (Chicken)					4						4
	19	Food (Milk)					3						3
	19	Food (Turkey)					1						1
	19	Human	38	69	6	20	138	108	8	5	4	1	397
	19	Porcine				1	1						2
	19	Poultry		5			2						7
	19	Turkey		1			1						2
	19	Unknown	9				1	4					14
	19a	Food (Chicken)					1						1
	19a	Human					3	2					5
	20	Canine									1		1
	20	Chicken					1						1
	20	Food (Chicken)	1										1
	20	Human					1	2					3
	21	Human		2									2
	21	Unknown						1					1
	22	Human		3									3
	23	Chicken					1						1
	24	Human						1					1
	25	Chicken						1					1
	26	Avian						1					1
	26	Chicken					34	1					35
	26	Food (Chicken)	6	1									7
	26	Human	20	16		4	30	35	1	2	1		109
	26	Turkey					1						1
	27	Porcine					2						2
	27	Turkey					1						1
	29	Avian					1	2					3
	29	Chicken	1	2			41			3		1	48
	29	Equine					5						5
	29	Environmental Swab					1						1
	29	Food (Chicken)		1			3	5					9
	29	Food (Turkey)					1						1
	29	Food (Unspecified)						1					1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	29	Human	3	17	1	4	38	55	1				119
(continued)	29	Porcine					1	15					16
	29	Poultry		1				2					3
	29	Turkey					1						1
	30	Chicken					1						1
	32	Chicken					9	5					14
	32	Chicken Litter		1									1
	32	Duck					1						1
	32	Food (Chicken)						1					1
	32	Food (Turkey)					1						1
	32	Human		9	3		12	17	14	1			56
	32	Poultry		2				1					3
	32	Turkey	1	2			34						37
	32	Unknown						1					1
	35	Chicken					6						6
	35	Equine										1	1
	35	Environmental Swab							1				1
	35	Food (Chicken)						1					1
	35	Human		1		2	9	21	13		7		53
	35	Poultry						1					1
	36	Chicken				1	8		2			2	13
	36	Chicken Litter		2									2
	36	Environmental Swab							1				1
	36	Human			1			3					4
	36	Unknown	2					1					3
	37	Human					1						1
	37	Porcine						2					2
	39	Human		3					1				4
	39	Turkey					6						6
	40	Chicken					13					10	23
	40	Food (Chicken)										1	1
	40	Human	1			1							2
	41	Chicken					20					3	23
	41	Human	1	2	2		36	10	1				52
	41	Turkey					1						1
	41	Unknown	1										1
	42	Human		2			1						3
	44	Chicken					1						1
	44	Chicken Litter		1									1
	44	Human		1		1		2					4
	45	Human			1	1							2
	46	Chicken					1						1
	46	Food (Chicken)					1						1
	46	Porcine			1								1
	46	Water		2									2
	47	Bovine								1			1
	47	Chicken							1				1
	47	Human					2	6		2			10

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Heidelberg	47	Porcine						1					1
(continued)	47	Turkey					1			3			4
	51	Chicken					1						1
	51	Food (Chicken)					1						1
	52	Chicken				1							1
	52	Food (Chicken)					1						1
	52	Human		1				2					3
	52	Unknown						1					1
	53	Human		1			1	4	2				8
	54	Bovine	1										1
	54	Human	11	2	2			1					16
	54	Unknown	2										2
	55	Human					1	1					2
	56	Human		3									3
Atypical		Avian					1						1
Atypical		Chicken	2	3	1		55	2	2			2	67
Atypical		Food (Chicken)					3						3
Atypical		Food (Turkey)					1						1
Atypical		Human	2	2			7	6	3	1			21
Atypical		Porcine		1		3		1					5
Atypical		Poultry					2						2
Atypical		Turkey					6						6
Atypical		Unknown						7					1
Untypable		Chicken	1			1	7						9
Untypable		Human	1				1						2
		Human Total	79	144	21	43	375	321	56	11	12	1	1063
		Non Human Total	29	74	3	9	641	72	14	11	1	21	875
S. Infantis	1	Human	1				1	1					3
	3	Human		1			2	1					4
	4	Human	3	4			3	1					11
	5	Human					1						1
	6	Human					2						2
	7	Human	2	1	1	1	5	3		1		1	15
	8	Human	1		2		7				1		11
	9	Human		1			2						3
	10	Human	1					1					2
	11	Human		1									1
	13	Human	2				2						4
	26	Human	1				3	2					6
		Human Total	11	8	3	1	28	9	0	1	1	1	63
S. Newport	1	Human	1				1			1			3
	2	Human	1	1		1	11						14
	3	Human	3				14	1	1				19
	4	Human	4	1	1		5	1				1	13
	6	Human		2			2						4

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Newport	9	Human	2	2			16	6		2			28
(continued)	10	Human	1	1			7						9
	13	Human	1	1			10	1		1			14
	14	Human	1				6						7
	14a	Bovine					27						27
	14a	Human		3		1	5		1			1	11
	14b	Human				1							1
	14c	Human	1				1						2
	15	Human	2	2		2	6			3			15
	16	Human	1	4			13	3	1	1		1	24
	17a	Human				1							1
	17b	Human					2						2
	17c	Human					1						1
	Atypical	Human			1		3	2					6
	Untypable	Human	1										1
	Untypable	Unknown	1										1
		Human Total	19	17	2	6	103	14	3	8	0	3	175
		Non Human Total	1	0	0	0	27	0	0	0	0	0	28
S. Oranienburg	1	Human	1		2		1						4
	2	Human		1						5			6
	6	Human	2	2		1	2			1			8
	7	Human							1				1
	8	Human	1	1		1	4			35		2	44
	13	Human	2										2
	15	Human			1		1	2					4
	17	Human					1						1
	Atypical	Human					1						1
		Human Total	6	4	3	2	10	2	1	41	0	2	71
S. Panama	A	Human						3					3
	D	Human					1						1
	G	Animal (Unspecified)		1									1
	G	Human					1						1
	Untypable	Human	1										1
		Human Total	1	0	0	0	2	3	0	0	0	0	6
		Non Human Total	0	1	0	0	0	0	0	0	0	0	1

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Paratyphi B	1 var. 1	Human					1						1
	var. Java	Human						1					1
		Unknown						4					4
		Human						2					2
		Human					1						1
		Human						2					2
		Human						1					1
	Battersea	Human		1				1					2
	Dundee	Human	1				1	1					3
	Dundee	Unknown						6					6
	Worksop	Human		1		3	2	1					7
	Atypical	Human	1	1			4	21	1		1	1	30
	Atypical	Python			1								1
	Atypical	Snake			1								1
	Atypical	Unknown						23					23
	Human Total		2	3	0	3	9	30	1	0	1	1	50
	Non Human Total		0	2	0	0	0	33	0	0	0	0	35
Salmonella ssp I 4,[5],12:b:-	1 var. 5	Human					2						2
	3 var.	Human					1						1
	3b var. 2	Human					9	1					10
	Battersea	Human				1	2						3
	Dundee	Human					1						1
	Dundee var.2	Human					21		1				22
	Untypable	Human	5				1	2					8
	Worksop	Human					2						2
	Atypical	Human				1	3						4
		Human Total		5	0	0	2	42	3	1	0	0	0
S. Thompson	1	Human		1		1	2	8					12
	2	Human		2			2						4
	3	Human	1	3		1	19	8	2				34
	5	Human	1				10			2			13
	8	Human					1						1
	25	Human	1	1				3					5
	26	Avian			2								2
	26	Chicken		1									1
	26	Human	1			2	1	1		13			18
	Atypical	Human							1				1
		Human Total	4	7	0	4	35	20	3	15	0	0	88
	Non Human Total	0	1	2	0	0	0	0	0	0	0	3	
S. Typhi	A	Human	3	1			3	1	1				9
	B1	Human					5						5
	B2	Human	1	1				1					3

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhi	C1	Human					1						1
(continued)	D1	Human					2	2					4
	D2	Human					1						1
	DVS	Human	1				2						3
	E1	Human	14	5		1	26	5					51
	E2	Human	1										1
	E9	Human	6	1			1						8
	E14	Human	4	1			1	1					7
	F9	Human						1					1
	J1	Human						2					2
	K1	Human	1										1
	M1	Human		3				1					4
	O	Human	2	1			3						6
	36	Human					1						1
	38	Human		1									1
	40	Human					1						1
	46	Human						1					1
	53	Human						1					1
	54	Human					1						1
	UVS-(I+IV)	Human					2	1					3
	Untypable	Human	3				5	1					9
		Human Total	36	14	0	1	55	18	1	0	0	0	125
S. Typhimurium	1	Avian			1						1		2
	1	Bovine					1						1
	1	Equine				1							1
	1	Food (Pork)						1					1
	1	Human	1	5	3	3	2	4					18
	1	Poultry						1					1
	1	Water		7									7
	2	Animal (Unspecified)						1					1
	2	Avian					2						2
	2	Bovine					6						6
	2	Chicken					1						1
	2	Human	2	9		4	9	5		1	1		31
	2	Unknown	2										2
	3 aerogenic	Human					1						1
	4	Human	1										1
	5	Human							1				1
	8	Human					1						1
	10	Avian						1					1
	10	Chicken					21						21
	10	Environmental Swab	1										1
	10	Human	1	2			18			1			22
	10	Poultry						2					2
	10	Unknown	1					2					3
	12	Bovine						5					5
	12	Food (Pork)						35					35

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	12	Human				1	2	10					13
(continued)	12	Porcine				8	3	10					21
	12	Unknown						5					5
	12a	Bovine						1					1
	12a	Human			1			1					2
	20	Human		1									1
	21	Bovine								1			1
	21	Human				1	1						2
	21	Porcine					1						1
	22	Avian				1							1
	22	Human							1		1		2
	22	Porcine		3	6								9
	22	Unknown						2					2
	27	Human					1	3					4
	27	Porcine			1								1
	29	Human					1						1
	35	Chicken						1					1
	35	Environmental Swab					4						4
	35	Equine					5						5
	35	Porcine		1			3						4
	36	Human					1						1
	37	Bovine					2						2
	39	Food (Unspecified)						1					1
	40	Animal Feed							1	1			2
	40	Human	1	1			2						4
	40	Poultry						1					1
	41	Avian							1				1
	41	Chicken						1					1
	41	Human				1	6				1		8
	41a	Human		1									1
	42	Human					1						1
	42 var.	Porcine					1						1
	46	Chicken							1				1
	46	Human	1	35		1	2	1	2				42
	46	Poultry		1				1					2
	46	Unknown						2					2
	49	Human	8					1					9
	51	Human		1			1						2
	56	Human		2									2
	66	Bovine					1						1
	66	Human					1	1					2
	69	Chicken					1						1
	69	Human					7	1					8
	69	Porcine					1						1
	73 var.	Porcine					1	2					3
	76	Human					1						1
	82	Human					2						2
	94	Human		4			2						6
	94	Poultry						1					1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	95	Human				1							1
(continued)	97 var.	Environmental Swab					1						1
	97 var.	Porcine					1						1
	99	Duck					3						3
	99	Equine					1						1
	99	Feline				1							1
	99	Human					2	1					3
	99	Porcine					1	1					2
	100	Porcine					1						1
	104	Animal (Unspecified)					2						2
	104	Avian					1						1
	104	Bison					1						1
	104	Bovine	3	20		3	32	4					62
	104	Canine				1							1
	104	Chicken		5			28						33
	104	Chicken Litter		2									2
	104	Environmental Swab		2			2						4
	104	Equine		1			9						10
	104	Feline				1		1					2
	104	Food (Beef)						1					1
	104	Food (Bovine)					3	1					4
	104	Food (Porcine)					3						3
	104	Food (Pork)						66					66
	104	Food (Unspecified)						1					1
	104	Human	9	59	9	14	77	39	4	4		2	217
	104	Mouse		1									1
	104	Ovine			5		2						7
	104	Porcine		6	9	4	71	22					112
	104	Poultry		1									1
	104	Snake		1									1
	104	Unknown	4					6					10
	104	Water		23									23
	104a	Bovine							1	1			2
	104a	Chicken						1					1
	104a	Food (Broccoli)					1						1
	104a	Food (Pork)						43					43
	104a	Human					7	11		1			19
	104a	Porcine			1		17	30					48
	104a	Unknown						3					3
	104b	Animal (Unspecified)					1						1
	104b	Bovine						1					1
	104b	Environmental Swab					2						2
	104b	Equine					2						2
	104b	Food (Pork)						5					5
	104b	Human		1		1	14	4	1				21
	104b	Porcine				1	18	1					20
	104b	Unknown						1					1
	104c	Equine					1						1
	104c	Human					2						2

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	106	Human		1				1					2
(continued)	106 var.	Human						1					1
	107	Avian				9			2				11
	107	Bovine						4					4
	107	Chicken				2	2	3	2				9
	107	Human	1	1	1	6	8	13		1			31
	107	Poultry						18					18
	107	Unknown						6					6
	108	Avian					2						2
	108	Bovine					3						3
	108	Chicken					1						1
	108	Food (Pork)						2					2
	108	Human					13	9		2	1		25
	108	Porcine			15	6	5	11					37
	108	Unknown						2					2
	110	Human		3									3
	110	Porcine		1									1
	110b	Chicken					1						1
	110b	Food (Pork)						5					5
	110b	Human	1	2			1	4					8
	110b	Porcine						1					1
	110b	Unknown						1					1
	120	Equine					1						1
	120	Food (Pork)						1					1
	120	Human		1				2					3
	120	Unknown						1					1
	120	Water		1									1
	121	Unknown	1										1
	124	Animal Feed							1				1
	124	Avian					1						1
	124	Human					1						1
	124	Porcine				1							1
	124 var.	Food (Pork)						1					1
	124 var.	Human	1	7		3	21	3			1	1	37
	124 var.	Unknown						1					1
	125	Human		1									1
	127	Human								2			2
	132	Animal Feed						3					3
	132	Bovine					2						2
	132	Chicken						1					1
	132	Environmental Swab		1				2					3
	132	Food (Bovine)					1						1
	132	Food (Crab)								3			3
	132	Food (Shrimp)					1						1
	132	Unknown						1					1
	132	Water		9									9
	135	Human	6			1	3	1					11
	135	Porcine					1						1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	136	Human					1						1
(continued)	140 var.	Bovine				37	2						39
	140 var.	Environmental Swab				1							1
	140 var.	Ovine				1							1
	146	Human	1				1	1					3
	146	Porcine					1						1
	146 var.	Porcine					1						1
	146a	Human		2									2
	146a var.	Human		2	1	1	1						5
	146a var.	Unknown						1					1
	151	Human		1									1
	160	Feline		2									2
	160	Human		9	1		3	1					14
	160	Poultry						2					2
	160	Turkey					1						1
	162 var.	Human					1						1
	164	Food (Unspecified)	1										1
	164	Human	18	1									19
	164	Unknown	1										1
	169	Porcine						2					2
	170	Bovine					1	3					4
	170	Chicken					1						1
	170	Food (Pork)						6					6
	170	Human	1	1			12	14	3	1			32
	170	Porcine					2	17		1			20
	170	Unknown						2					2
	171	Human		1									1
	186	Porcine					1	2					3
	191	Chicken			1								1
	191	Human		1			1						2
	193	Bovine						1					1
	193	Canine				1							1
	193	Chicken					2						2
	193	Food (Pork)						14					14
	193	Human	2	2			12	16				1	33
	193	Porcine					1	3					4
	193	Unknown	1					2					3
	195	Animal Feed								1			1
	195	Avian										1	1
	195	Bovine						3					3
	195	Human					9	4					13
	203	Food (Eggs)						1					1
	203	Human				1							1
	204c	Animal Feed					1						1
	204c	Human						1					1
	204c	Porcine					1						1
	206	Human			1								1
	206 var.	Environmental Swab		1									1

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
S. Typhimurium	208	Bovine		3		3	1		1				8
(continued)	208	Food (Pork)						2					2
	208	Human	1	4			11	7	1				24
	208	Ovine		1									1
	208	Porcine		1			22	14			1		38
	208	Unknown						1					1
	208	Water		4									4
	208 var.	Bovine	1	18		4		1					24
	208 var.	Chicken		1									1
	208 var.	Equine				1							1
	208 var.	Food (Pork)						3					3
	208 var.	Human	1	25		2	16		1		2		47
	208 var.	Porcine						2					2
	208 var.	Unknown	1										1
	208 var.	Water		3									3
	812	Human		1									1
	U275 var.	Porcine					3						3
	U276	Human	9	4	1	1	1	2			1		19
	U276	Unknown	4										4
	U279	Human					1						1
	U284	Human		1									1
	U284 var.	Avian					1						1
	U284 var.	Hedgehog		1									1
	U284 var.	Human	5	5					1				11
	U284 var.	Water		3									3
	U285	Chicken										2	2
	U285	Human			1		6	1					8
	U285	Poultry						1					1
	U285	Unknown						2					2
	U291	Bovine					1						1
	U291	Porcine				1		1					2
	U292	Chicken			1								1
	U292	Human		1	2								3
	U301	Chicken		1			3			1			5
	U302	Bovine						2					2
	U302	Chicken					1						1
	U302	Duck					1						1
	U302	Food (Pork)						21					21
	U302	Human		2			10	15					27
	U302	Porcine				1	6	10					17
	U302	Unknown						3					3
	Atypical	Equine					2						2
	Atypical	Human	2	5		3	9	10	1	2			32
	Atypical	Unknown	1										1
	Untypable	Avian		1									1
	Untypable	Bovine		14		1							15
	Untypable	Chicken	1	1			1						3
	Untypable	Feline		1									1

Salmonella Phage Types, 2003

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total	
S. Typhimurium (continued)	Untypable	Food (Pork)						1					1	
	Untypable	Human						1					1	
	Untypable	Porcine		2	1		5	2					10	
	Untypable	Water		3									3	
	UT 1	Bovine		7									7	
	UT 1	Environmental Swab		1									1	
	UT 1	Human	2	12		1	1	3					19	
	UT 1	Unknown	1											1
	UT 2	Bovine		2										2
	UT 2	Human		5			2			1			8	
	UT 3	Avian						1						1
	UT 5	Bovine		4										4
	UT 7	Human		2			1							3
			Human Total	75	224	21	46	310	192	16	16	8	4	912
			Non Human Total	24	161	41	90	341	454	10	9	2	3	1135
Salmonella ssp I 4,[5],12:i:-	1	Avian									3		3	
	1	Human		1									1	
	2	Avian					2						2	
	20	Animal Feed		1									1	
	22	Porcine		1									1	
	104	Human	1										1	
	104b	Turkey					1						1	
	107	Human								1			1	
	120	Chicken		5									5	
	121	Avian	3										3	
	121	Human	2										2	
	146	Human	1										1	
	146a var.	Chicken					1						1	
	191	Avian									2		2	
	191	Chicken	2				4						6	
	191	Equine					1						1	
	191	Feline										1	1	
	191	Food (Chicken)										1	1	
	191	Human	1	8	2	1	5	2	2				21	
	191 var.	Porcine			2									2
	193	Chicken Litter		1										1
	193	Human										1	1	
	195	Human				2								2
	206	Human	1											1
	208 var.	Human						1						1
U284 var.	Avian									3			3	
U284 var.	Human	1	3										4	
U284 var.	Unknown	1											1	

Organism	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
<i>Salmonella</i> ssp I	U291	Animal Feed						2					2
4,[5],12:i:-	U291	Bovine					1						1
	U291	Food (Bovine)					15						15
	U291	Human		1		5	2	1					9
	U291	Porcine				1							1
	U291 var.	Human		1									1
	Atypical	Human		1		1	1	3		1			7
	Atypical	Turkey					1						1
	Untypable	Avian	1										1
	Untypable	Chicken					1						1
	Untypable	Porcine		1									1
	Untypable	Water		1									1
	UT 7	Human					2						2
		Human Total	7	15	2	9	10	7	2	2	0	1	55
		Non Human Total	7	10	2	1	27	2	0	0	8	2	59

SECTION 3: PATHOGENIC *ESCHERICHIA COLI*

Population based rates of *E. coli* O157 isolation for each province are shown in Figure 16 and total provincial isolations from each province for 2002 and 2003 are shown in Figures 17 and 18. Although Ontario had the highest number of *E. coli* O157 isolated, due to the large population, the province ranked 5th overall in isolation rate per 100,000 population in 2002. Total *E. coli* O157 isolations are based largely on NESP and supplemented with identifications from NML reference services and include *E. coli* O157:H7, *E. coli* O157:NM, *E. coli* O157 VT+ and *E. coli* O157. Due to differing disease reporting procedures from province to province, high rates of *E. coli* O157 isolation may not necessarily reflect incidence of disease, but different sampling and reporting structures.

Figure 16 shows the isolation rates per 100,000 population of *E. coli* O157 from 1999 to 2003. Nationally, the isolation rates for *E. coli* O157 have declined from 8.8 isolations per 100,000 population in 1999 to 3.2 isolations per 100,000 population in 2003. Prince Edward Island had the highest rates in 2002 and 2003 with rates of 22.6 and 9.5 isolations per 100,000 residents. Other provinces with the highest rates per 100,000 population in 2003 were Manitoba (6.5), Alberta (5.8), Saskatchewan (4.0) and Ontario (3.3). Lower isolation rates were observed in British Columbia (2.7), Quebec (1.6), New Brunswick (2.5), Northwest Territories (2.4), Nova Scotia (1.7) and Newfoundland (1.0).

Other than in Manitoba, there have been no major increases in the rates of *E. coli* O157 infection in 2003. The largest year-to-year increase has been observed in Manitoba where the rate has increased from 3.5 to 6.5 isolates per 100,000 population.

Figure 16: Rate of *E. coli* O157 Isolation in Canada, 1999 to 2003*

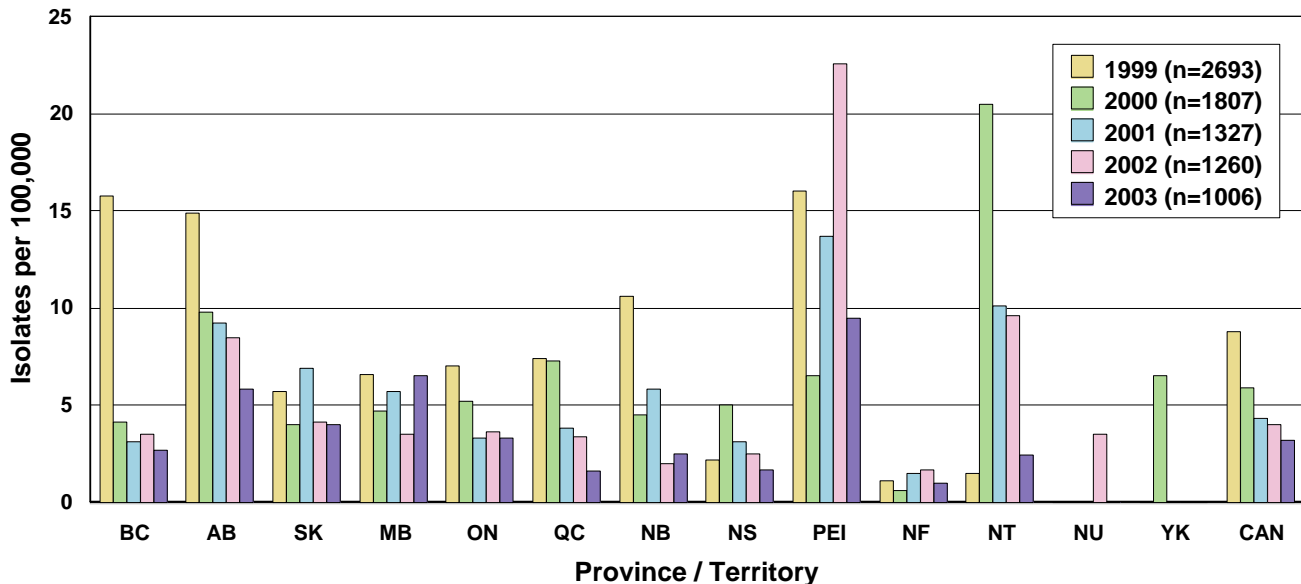


Figure 17: Number of *E. coli* O157 Isolations from Humans in Canada, 2002

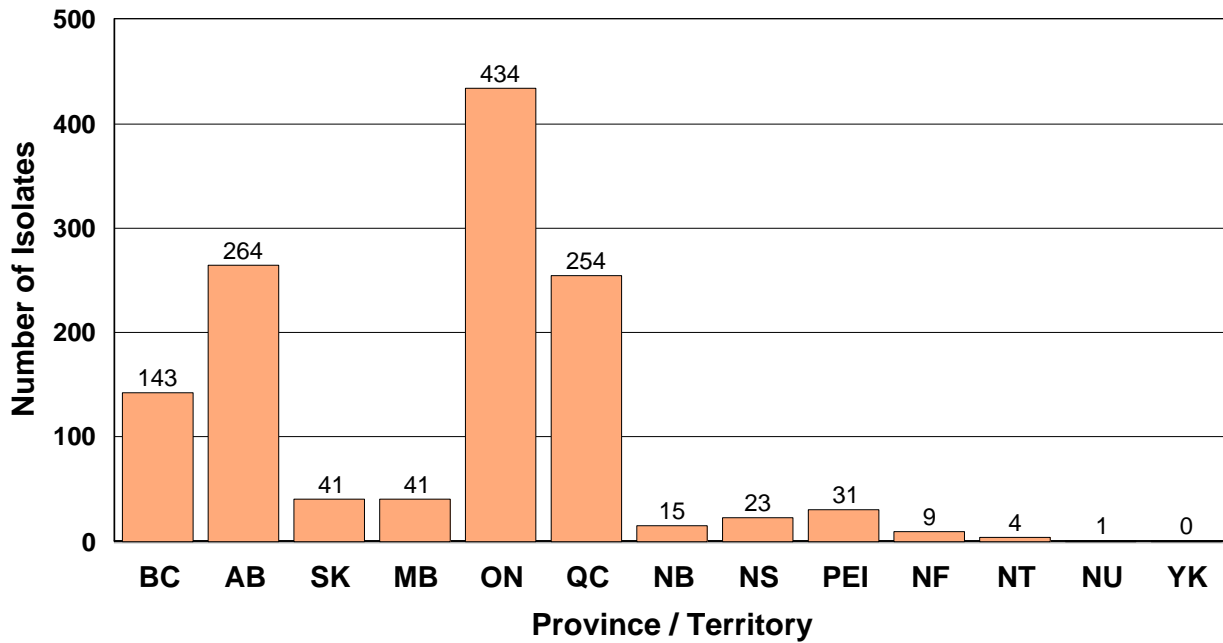


Figure 18: Number of *E. coli* O157 Isolations from Humans in Canada, 2003

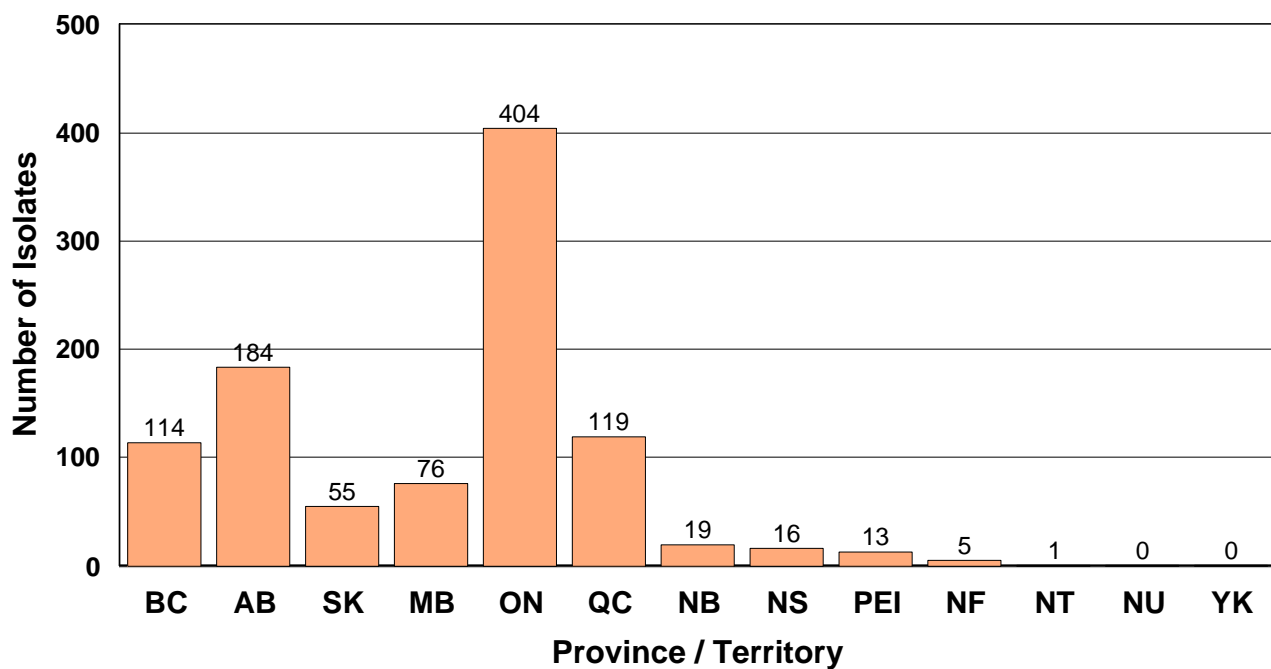


Table 7: *E. coli* Serotypes Isolated from Humans in Canada, 2002

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	Total
<i>E. coli</i> Inactive		8		3	1	2		15	3	32			64
<i>E. coli</i> O1:K1:H7									1				1
<i>E. coli</i> O1:NM			1										1
<i>E. coli</i> O2:H1									1				1
<i>E. coli</i> O2:H7						1							1
<i>E. coli</i> O5:NM	1												1
<i>E. coli</i> O5:H11					1								1
<i>E. coli</i> O6:H31	1							1					2
<i>E. coli</i> O6:NM				1				1					2
<i>E. coli</i> O18ac:H1									1				1
<i>E. coli</i> O19:NM		1											1
<i>E. coli</i> O26				5									5
<i>E. coli</i> O26:H11	7												7
<i>E. coli</i> O26:NM				1									1
<i>E. coli</i> O28:NM	2												2
<i>E. coli</i> O40:NM									1				1
<i>E. coli</i> O44				13									13
<i>E. coli</i> O55				1									1
<i>E. coli</i> O68:NM		1											1
<i>E. coli</i> O68:H18									1				1
<i>E. coli</i> O75:H7		1											1
<i>E. coli</i> O75:NM		1		1					1				3
<i>E. coli</i> O83:H42								1					1
<i>E. coli</i> O86a				1									1
<i>E. coli</i> O98:NM							7						7
<i>E. coli</i> O103:H2	1			1									2
<i>E. coli</i> O103:H25	1			1									2
<i>E. coli</i> O111:H8								1					1
<i>E. coli</i> O111:NM	3												3
<i>E. coli</i> O117:H7	3												3
<i>E. coli</i> O117:H25							1						1
<i>E. coli</i> O121:H19	1			3									4
<i>E. coli</i> O125				4									4
<i>E. coli</i> O127				1									1
<i>E. coli</i> O128				5									5
<i>E. coli</i> O132:H34								1					1
<i>E. coli</i> O135:NM									1				1
<i>E. coli</i> O142				1									1
<i>E. coli</i> O145:H34		1											1
<i>E. coli</i> O145:NM	3												3
<i>E. coli</i> O146:H21	1												1
<i>E. coli</i> O148:NM	2												2
<i>E. coli</i> O153:H-Untypeable	1												1
<i>E. coli</i> O157 VTEC (includes H7)	142	261	39	41	421	246	14	30	23	9	4	1	1231
<i>E. coli</i> O157:NM	1	3	2		12	8	1	1					28
<i>E. coli</i> O157:H45					1								1
<i>E. coli</i> O165:H25	1												1
<i>E. coli</i> O174:H8	1												1
<i>E. coli</i> O174:H28	1												1

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	Total
<i>E. coli</i> O179:H8	1												1
<i>E. coli</i> Non-Typed VTEC				12									12
<i>E. coli</i> O-Untypeable:NM	3	3				1	3			10			20
<i>E. coli</i> O-Untypeable:H1							1						1
<i>E. coli</i> O-Untypeable:H27					1								1
Total <i>E. coli</i> 2002	177	280	42	95	437	258	27	51	33	51	4	1	1456

* Data represented in this table is not representative of true incidence. It is provided here to give a general overview of the various serotypes *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: *E. coli* Serotypes Isolated from Humans in Canada, 2003

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	Total
<i>E. coli</i> Inactive						1	17		6			24
<i>E. coli</i> O4:H5							1					1
<i>E. coli</i> O5:NM	3			1								4
<i>E. coli</i> O6:H1	1					1						2
<i>E. coli</i> O6:H34				1								1
<i>E. coli</i> O8:H49					1							1
<i>E. coli</i> O8:NM					1							1
<i>E. coli</i> O11:H25						1						1
<i>E. coli</i> O18(ac):K1:H7	1											1
<i>E. coli</i> O25:K1:NM								1				1
<i>E. coli</i> O25:NM				2								2
<i>E. coli</i> O26				2								2
<i>E. coli</i> O26:H11	10			4								14
<i>E. coli</i> O26:NM	4			5								9
<i>E. coli</i> O44				15								15
<i>E. coli</i> O55				1								1
<i>E. coli</i> O68:NM	1											1
<i>E. coli</i> O74:H28	1											1
<i>E. coli</i> O86:H8	1											1
<i>E. coli</i> O91:H21	1											1
<i>E. coli</i> O98:NM	1						4					5
<i>E. coli</i> O103:H11				1								1
<i>E. coli</i> O103:H2	1											1
<i>E. coli</i> O103:H25	1			2	1							4
<i>E. coli</i> O111				2								2
<i>E. coli</i> O111:NM	1			2								3
<i>E. coli</i> O114				1								1
<i>E. coli</i> O115:H25	1											1
<i>E. coli</i> O117:H27				1								1
<i>E. coli</i> O121:H19	6			2	1							9
<i>E. coli</i> O125				8								8
<i>E. coli</i> O126				3								3
<i>E. coli</i> O128				4								4
<i>E. coli</i> O128:H45	1											1
<i>E. coli</i> O135:NM				1								1
<i>E. coli</i> O145:NM	1			2								3
<i>E. coli</i> O146:H21				1								1
<i>E. coli</i> O157 VTEC (Includes H7)	99	179	54	75	394	119	19	16	12	5	1	973
<i>E. coli</i> O157:H16			1		1							2
<i>E. coli</i> O157:NM	15	5		1	9				1			31
<i>E. coli</i> O174:H21	1											1
<i>E. coli</i> O175:H27								1				1
<i>E. coli</i> O177:NM	1											1
<i>E. coli</i> Non-O157 VTEC	7											7
<i>E. coli</i> Non-typed VTEC				10								10
<i>E. coli</i> O-Untypeable:H1									1			1
<i>E. coli</i> O-Untypeable:H18									1			1
<i>E. coli</i> O-Untypeable:NM	2											2
Total	161	184	55	147	408	122	41	18	21	5	1	1163

Table 9: Phage Types of E. coli O157:H7 Isolated in Canada, 2002

PhageType	Source	BC	AB	SA	MB	ON	QC	NB	NS	NF	PE	Total
1	Human			2	4	3	2	1				12
2	Human					24	5					29
4	Human		2	1	2	9	13					27
8	Human		1	3	1	38	24		1	3		71
10	Human				1							1
14	Human			3	4	39	6	1			5	58
14a	Human	8	7	13	7	152	75	4			7	273
14b	Human		7	11	12	65	56		4		1	156
14c	Human			1	1	1						3
21	Human			2	1	15	1					19
23	Human		2		1	10	1					14
31	Human					9	9				2	20
32	Human					12	4				23	39
33	Human		5	1		11	7					24
34	Human					12	1					13
40	Human					2						2
42	Human					2						2
45	Human					2	4					6
54	Human					1	1					2
73	Human						2					2
74	Human			1		1	1					3
87	Human					1	1					2
Atypical	Human					5	3					8
Untypable	Human					1						1
	Total	8	24	38	34	415	216	6	5	3	38	787
8	Food (Beef)					3						3
14	Food (Beef)		2									2
14	Food (Unspecified)					5						5
14	Unknown						1					1
14a	Food (Beef)		2	4		17						23
14a	Food (Meat)					11						11
14a	Food (Poultry)					1						1
14a	Food (Unspecified)						3					3
14a	Poultry					1						1
14a	Unknown					2						2
14b	Food (Beef)						4					4
14b	Unknown						3					3
21	Animal (Unspecified)					4						4
32	Animal (Unspecified)					3						3
33	Food (Meat)					2						2
63	Unknown						1					1
Atypical	Bovine					1						1
	Total	0	4	4	0	50	12	0	0	0	0	70

Table 10: Phage Types of E. coli O157:H7 Isolated in Canada, 2003

Phagetype	Source	BC	AB	SK	MB	ON	QC	NB	NS	NF	PE	Total
1	Human			3		4					1	8
2	Human		2			22	24					48
4	Human		2	1	2	8	2					15
8	Human		2	1	3	81	6	1	2			96
10	Human					1						1
14	Human				1	17	2				2	22
14a	Human		15	40	26	188	56	5			3	333
14b	Human			5	4	26	8	11			1	55
21	Human			1		1	2					4
23	Human				2	5	3				1	11
31	Human		2		1	9	5					17
32	Human			1		12	3					16
33	Human		2		2	1	2					7
34	Human					3						3
38	Human					3		1				4
42	Human						1					1
45	Human		1			1	1					3
49	Human		1									1
51	Human					2						2
54	Human					1						1
74	Human					1					1	2
79	Human			1								1
81	Human					3						3
Atypical	Human				1	8	2	1			1	13
	Total		27	53	42	397	117	19	2		10	667
1	Unknown					1						1
14	Bovine					1						1
14	Food (Beef)					3						3
14	Food (Unspecified)					1						1
14a	Unknown					4	2					6
	Total		0			10	2					12

*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 2002. Updated totals for the province of Québec were supplied directly from Laboratoire de santé publique du Québec for the Ministère de la santé et des services sociaux du Québec. At the time of publication, the NDRS data have not been finalized and thus, should be considered preliminary.

Data regarding cases of laboratory confirmed gastro-intestinal illness in Canada are generated along two concurrent paths, an epidemiology arm and a laboratory arm (see Appendix 1). Within the epidemiology arm, NDRS receives data that are collected on a mandatory basis by the local health units for an established set of communicable diseases. Eight provinces and territories (British Columbia, Alberta, Saskatchewan, Ontario, Québec, Newfoundland and Labrador, Yukon and Nunavut) provide case-by-case reports that include demographic, clinical, laboratory (minimal) and additional epidemiologic data. The remaining provinces and territories (New Brunswick, Nova Scotia, Prince Edward Island, Manitoba and the Northwest Territories) report aggregate data. With regard to campylobacteriosis, differences exist between numbers of reported *Campylobacter* isolates/cases in the epidemiology arm (i.e. NDRS database) and the laboratory arm (i.e. NML/NESP database). The low frequency with which *Campylobacter* isolates are sent or reported from local laboratories to the provincial/territorial laboratories contributes to the differences between the databases.

Population-based rates of campylobacteriosis for each province and territory are shown in Figure 21. By representing the data as cases per 100,000, the data provide a more accurate reflection of the relative levels of reported campylobacteriosis among the provinces and territories. For example, although Ontario reported the highest number of cases in 2002 (Figure 20), due to its large population, the province ranked 3rd overall in the rate of reported campylobacteriosis with 37.8 cases per 100,000 population after British Columbia (49.6) and Alberta (44.8). Nationally, rates of reported campylobacteriosis have declined from 48.6 isolations per 100,000 in 1998 to 36.7 in 2002. A slight increase was observed in Prince Edward Island with rates increasing from 28.8 cases per 100,000 in 2001 to 36.5 cases per 100,000 in 2002 and in Alberta from 40.3 to 44.8 cases per 100,000. Newfoundland has had the largest decrease in isolation rates from 16.3 in 2001 to 8.7 in 2002.

Table 11 shows the *Campylobacter* species reported in 2002. *Campylobacter jejuni* represented the majority of the isolates reported (2084 of 11508), followed by *C. coli* with 203 isolates reported.

Figure 19: Rate of Reported Cases of Campylobacteriosis in Canada, 1998 to 2002

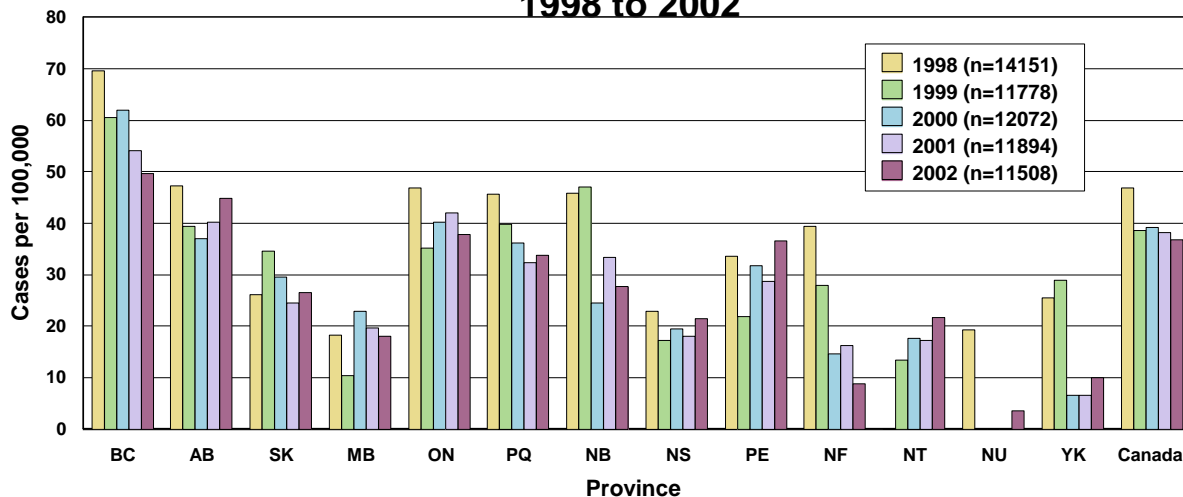


Figure 20: Number of Reported Cases of Campylobacteriosis in Canada, 2002

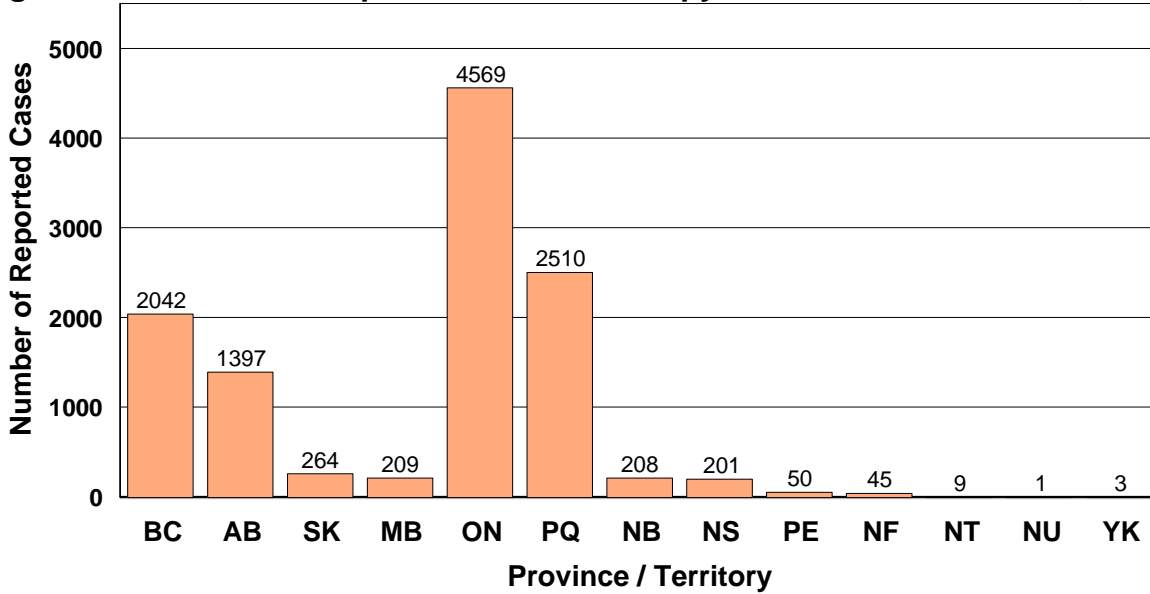


Figure 21: Campylobacter Isolations in Canada by Age Group and Gender Distribution

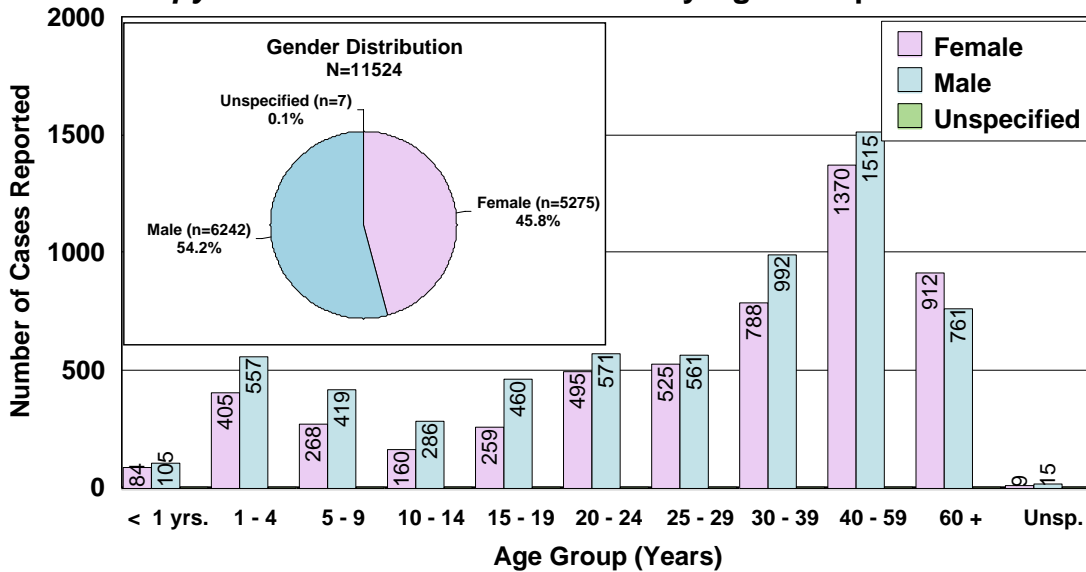


Table 11: Campylobacter Species Isolated from Humans in Canada, 2002

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NT	NU	YK	Total
<i>C.coli</i>		1	15	8		156	2			21				203
<i>C. fetus ssp fetus</i>		1	1		5	14								21
<i>C. hyointestinalis</i>						2								2
<i>C. jejuni</i>			240			1839	4			1				2084
<i>C. jejuni/coli</i>	115	450		92	330		170	72	48	13	8	1	2	1301
<i>C. lari</i>	1		3		10	2	1		2					19
<i>C. upsaliensis</i>	2	7	5		22	4	1							41
<i>Campylobacter sp</i>	1924	938		109	4202	493	30	129		10	1		1	7837
Total	2042	1397	264	209	4569	2510	208	201	50	45	9	1	3	11508

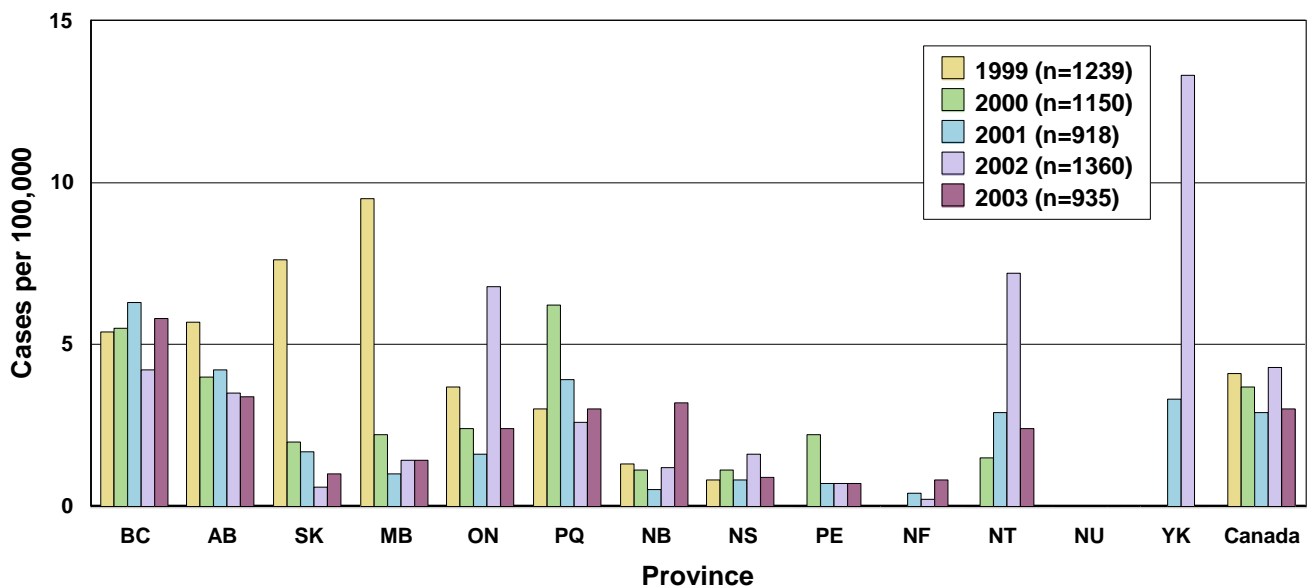
SECTION 5: SHIGELLA

Population-based isolation rates of *Shigella* isolations for each province since 1999 are shown in Figure 22 and the total number of *Shigella* isolations in 2002 and 2003 are shown in Figures 23 and 24. Ontario reported the highest number of isolates (827) however British Columbia had the highest isolation rate of 5.8 isolates per 100,000 population.

Data is largely from the NESP and is supplemented with reference services provided by the NML. The data is based on laboratory identifications and should not be confused with incidence of disease. 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.

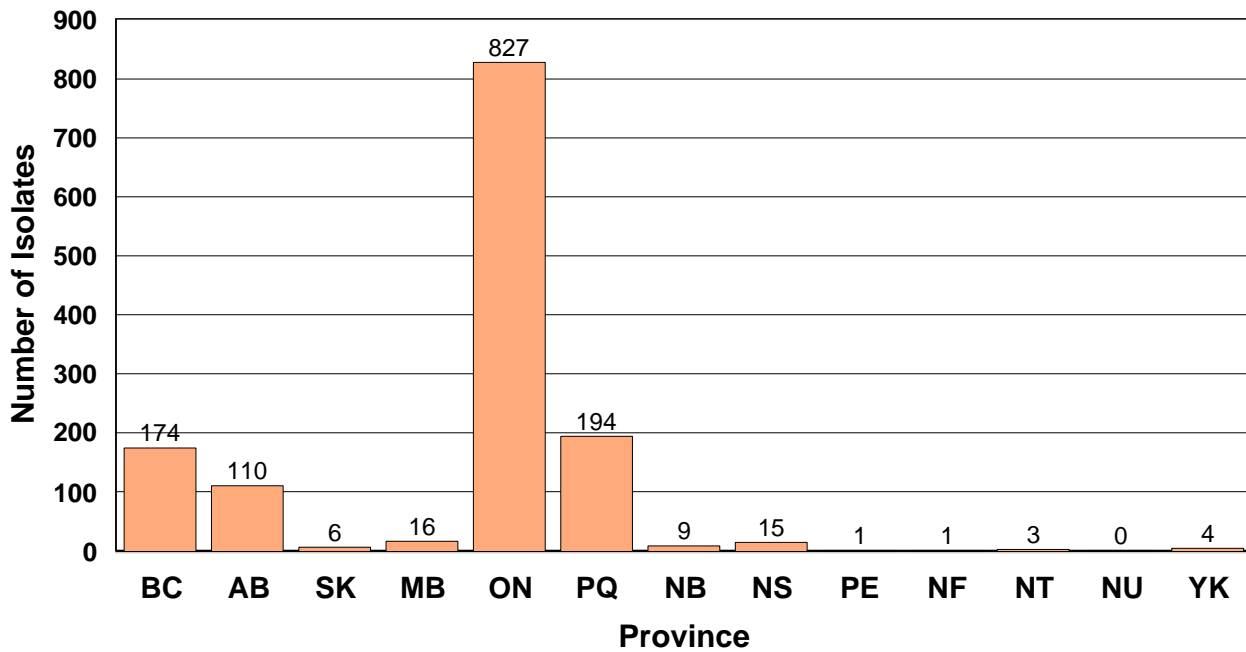
Rates have generally varied little in most provinces between 1999 and 2003 if outbreaks of disease are considered in specific years (i.e. the 426 isolates that were associated with an outbreak linked to Greek style pasta salad in Ontario in 2002). A decrease has been observed in Alberta from 5.7 isolations per 100,000 population in 1999 to 3.5 isolations per 100,000 population in 2003.

Figure 22: Rate of *Shigella* Isolations in Canada, 1999 to 2003*



*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.

Figure 23: Number of *Shigella* Isolations from Humans in Canada, 2002



Note: Total *Shigella* isolations in Ontario include 426 *S. sonnei* isolates related to a single outbreak associated with Greek style pasta salad.

Figure 24: Number of *Shigella* Isolations from Humans in Canada, 2003

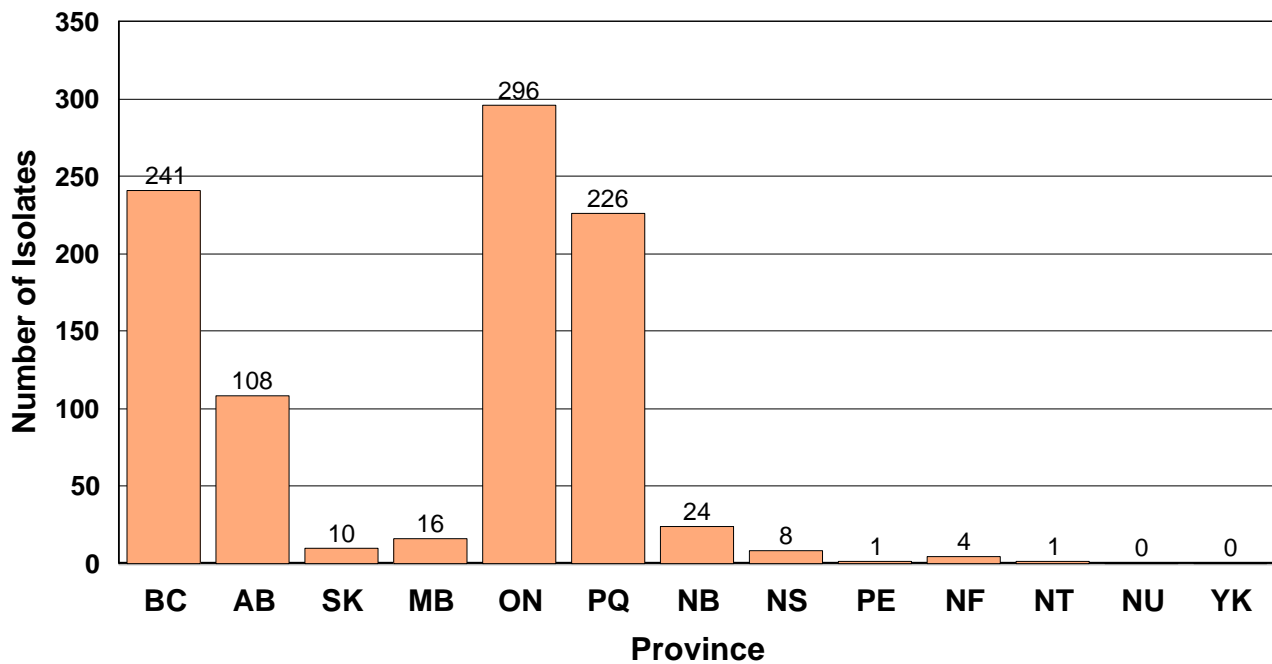


Table 12: *Shigella* Isolated from Humans in Canada, 2002

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	TOTAL
<i>Shigella boydii</i>					16	2								18
<i>Shigella boydii</i> 1	2	1				1								4
<i>Shigella boydii</i> 2	1	1												2
<i>Shigella boydii</i> 4	3				1									4
<i>Shigella boydii</i> 8	1	1												2
<i>Shigella boydii</i> 10	2													2
<i>Shigella boydii</i> 12		1												1
<i>Shigella boydii</i> 14		1												1
<i>Shigella boydii</i> 18	1													1
<i>Shigella boydii</i> 19	2					1								3
<i>Shigella boydii</i> 20	2	1			2	2		1						8
Total <i>Shigella boydii</i>	14	6	0	0	19	6	0	1	0	0	0	0	0	46
<i>Shigella dysenteriae</i>					3	4								7
<i>Shigella dysenteriae</i> 2		1												1
<i>Shigella dysenteriae</i> 4		1				1								2
<i>Shigella dysenteriae</i> 9	1	1												2
<i>Shigella dysenteriae</i> 15	1													1
<i>Shigella dysenteriae</i> 16	1			1	1	2								5
<i>Shigella dysenteriae</i> Prov. SH-103					1									1
<i>Shigella dysenteriae</i> Prov. 111	1	2												3
Total <i>Shigella dysenteriae</i>	4	5	0	1	5	7	0	0	0	0	0	0	0	22
<i>Shigella flexneri</i>				6	60	48	4	5						123
<i>Shigella flexneri</i> 1	3	8				5					2			18
<i>Shigella flexneri</i> 1a						4								4
<i>Shigella flexneri</i> 1b	1													1
<i>Shigella flexneri</i> 2	17	12	1			10								40
<i>Shigella flexneri</i> 2a		2				14								16
<i>Shigella flexneri</i> 2b					4	2								6
<i>Shigella flexneri</i> 3	5	2				1								8
<i>Shigella flexneri</i> 3a	4													4
<i>Shigella flexneri</i> 3b						5								5
<i>Shigella flexneri</i> 4a	2													2
<i>Shigella flexneri</i> 6	4	10				4								18
<i>Shigella flexneri</i> Prov. SH104	3	1			3	3								10
<i>Shigella flexneri</i> var. Y		2				2								4
Total <i>Shigella flexneri</i>	39	37	1	6	67	98	4	5	0	0	2	0	0	259
<i>Shigella sonnei</i>	117	62	3	6	634	76	5	8	1	1	1	0	1	915
<i>Shigella</i> sp.	0	0	2	3	102	7	0	1	0	0	0	0	3	118
Total 2002	174	110	6	16	827	194	9	15	1	1	3	0	4	1360

Table 13: *Shigella* Isolated from Humans in Canada, 2003

Organism	BC	AB	SA	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	TOTAL
<i>Shigella boydii</i>					14	3								17
<i>Shigella boydii</i> 1	1													1
<i>Shigella boydii</i> 2	3	4			1	1		1						10
<i>Shigella boydii</i> 4	1	1			1									3
<i>Shigella boydii</i> 5					1									1
<i>Shigella boydii</i> 8		1				1								2
<i>Shigella boydii</i> 12	2													2
<i>Shigella boydii</i> 13					2									2
<i>Shigella boydii</i> 14	1		1											2
<i>Shigella boydii</i> 18	1													1
<i>Shigella boydii</i> 19	1	1			1									3
<i>Shigella boydii</i> 20	3	1												4
Total <i>Shigella boydii</i>	13	8	1	0	20	5	0	1	0	0	0	0	0	48
<i>Shigella dysenteriae</i>					10									10
<i>Shigella dysenteriae</i> 1	1													1
<i>Shigella dysenteriae</i> 2	1				3	2								6
<i>Shigella dysenteriae</i> 3	1	2			1	2								6
<i>Shigella dysenteriae</i> 4	4	1												5
<i>Shigella dysenteriae</i> 9		1												1
<i>Shigella dysenteriae</i> 16	2	1			2	2								7
<i>Shigella dysenteriae</i> Prov 111	3				1									4
Total <i>Shigella dysenteriae</i>	12	5	0	0	17	6	0	0	0	0	0	0	0	40
<i>Shigella flexneri</i>			1	5	60	27		2		3				98
<i>Shigella flexneri</i> 1	10	3	1			1								15
<i>Shigella flexneri</i> 1a						3								3
<i>Shigella flexneri</i> 1b	2													2
<i>Shigella flexneri</i> 2	24	13	1											38
<i>Shigella flexneri</i> 2a	5					16	1							22
<i>Shigella flexneri</i> 2b						3								3
<i>Shigella flexneri</i> 3	9	5												14
<i>Shigella flexneri</i> 3a	3	1												4
<i>Shigella flexneri</i> 3b						4								4
<i>Shigella flexneri</i> 4	2	3				1								6
<i>Shigella flexneri</i> 4a						1								1
<i>Shigella flexneri</i> 4b						1								1
<i>Shigella flexneri</i> 6	9	9			1			1			1			21
<i>Shigella flexneri</i> Provisional SH-101	2				1									3
<i>Shigella flexneri</i> Provisional SH-104	1				1	3								5
<i>Shigella flexneri</i> X variant					1									1
<i>Shigella flexneri</i> Y variant					1	3								4
Total <i>Shigella flexneri</i>	67	34	3	5	65	63	1	3	0	3	1	0	0	245
<i>Shigella sonnei</i>	148	61	6	6	193	146	21	4	1	1				587
<i>Shigella</i> sp	1			5	1	6	2							15
Total 2003	241	108	10	16	296	226	24	8	1	4	1	0	0	935

Tables 14 and 15 list *Shigella* phage types identified from human strains isolated in 2002 and 2003. The data represented is from isolates forwarded to the NML by the provincial health laboratories for reference services, passive surveillance, surveys or outbreak and cluster investigations. The proportion of specimens forwarded may differ from province to province and should be interpreted with caution, however the subset of data collected from each province remains fairly consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide an overview of the subtypes found in Canada.

PT1 is the predominant phage type of *S. sonnei* accounting for 85 of 246 isolates. Further surveillance is required to establish whether the prevalence of this sub type is transitory. Isolates from other parts of the country may provide a substantially different phage type distribution. As more data are gathered, the typing databases for this organism will become more reliable and outbreaks of public health significance can be identified with greater precision and accuracy.

Table 14: Phage Types of *Shigella boydii* and *Shigella sonnei* from Humans in Canada, 2002

Organism	Phage Type	BC	AB	ON	QC	NB	NS	Total
<i>Shigella boydii</i>	4			1				1
<i>Shigella boydii</i>	12		1					1
<i>Shigella boydii</i>	19	2						2
<i>Shigella boydii</i>	20	2	1				1	4
	Total	4	2	1	0	0	1	8
<i>Shigella sonnei</i>	1	30	3	40		2	1	76
	2			13				13
	3		1					1
	5	20	3	17				40
	6	1	1	1				3
	7	1	1	7				9
	8	1					1	2
	9			1				1
	10	2		1				3
	12	11	5	3				19
	14	1		1				2
	15	5	3	458	1	1		468
	16	2	1	1				4
	17	6		4				10
	18	10	4				1	15
	19	8	1	24				33
	20	3		5		1		9
	Atypical	16	5	46	1			68
	Total	117	28	622	2	4	3	776

Table 15: Phage Types of *Shigella boydii* and *Shigella sonnei* from Humans in Canada, 2003

Organism	Phage Type	BC	AB	ON	QC	NB	NS	PE	Total
<i>Shigella boydii</i> 19	3	1	1						2
<i>Shigella boydii</i> 20	3	4							4
<i>Shigella boydii</i> 4	5		1						1
<i>Shigella boydii</i> 4	6	1		1					2
	Total	6	2	1	0	0	0	0	9
<i>Shigella sonnei</i>	1	40	9	25	8	2		1	85
	2		3	3		2			8
	3		1						1
	5	56	1		2				59
	6	6		1					7
	7	4	1	1					6
	8	8							8
	10	7							7
	11		2	1			1		4
	13			2					2
	14	1							1
	15	5	6	19					30
	17	2		2					4
	18			2					2
	19	2		6					8
	20	4		4					8
	Atypical	3	3						6
	Total	138	26	66	10	4	1	1	246

* Totals are laboratory confirmed isolates based on information supplied to the NESP and supplemented with identifications from NML reference services. Data is representative of laboratory confirmed isolates only, and should not be confused with incidence of disease. See Appendix 1 for details.

SECTION 6: PARASITES

Figure 25 shows the isolation rates of *Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia* strains isolated by each province since 1999 for which national data has been available and the total number of parasitic isolations from each province for 2002 and 2003 are shown in Figures 26 and 27. The data is collected through the NESP and is supplemented with NDRS data. *Cryptosporidium* and *Cyclospora* were not nationally notifiable until January 2000. *Entamoeba* is currently not notifiable and numbers of cases of illness are those reported to the NESP and may be under-reported.

Rates have declined nationally from 18.4 cases per 100,000 population in 2000 to 14.3 cases per 100,000 population in 2003. Although rates have declined in most provinces, Prince Edward Island has seen an increase from 13.7 cases per 100,000 population in 2000 to 18.2 cases per 100,000 population in 2003. The greatest decrease in isolation rates was seen in Northwest Territories from 29.3 cases per 100,000 population to 9.5 cases per 100,000 population and in the Yukon from 81.7 to 29.4 over the last four years.

Figure 25: Rates of Parasite Identifications (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2000 to 2003*

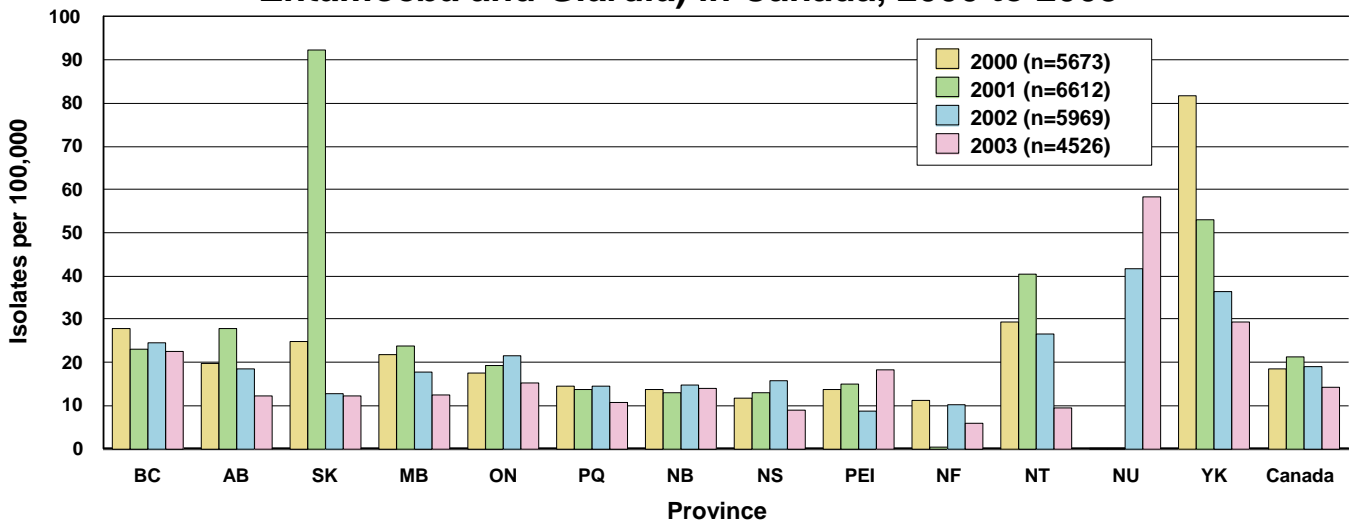


Figure 26: Number of Parasite Identifications (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2002

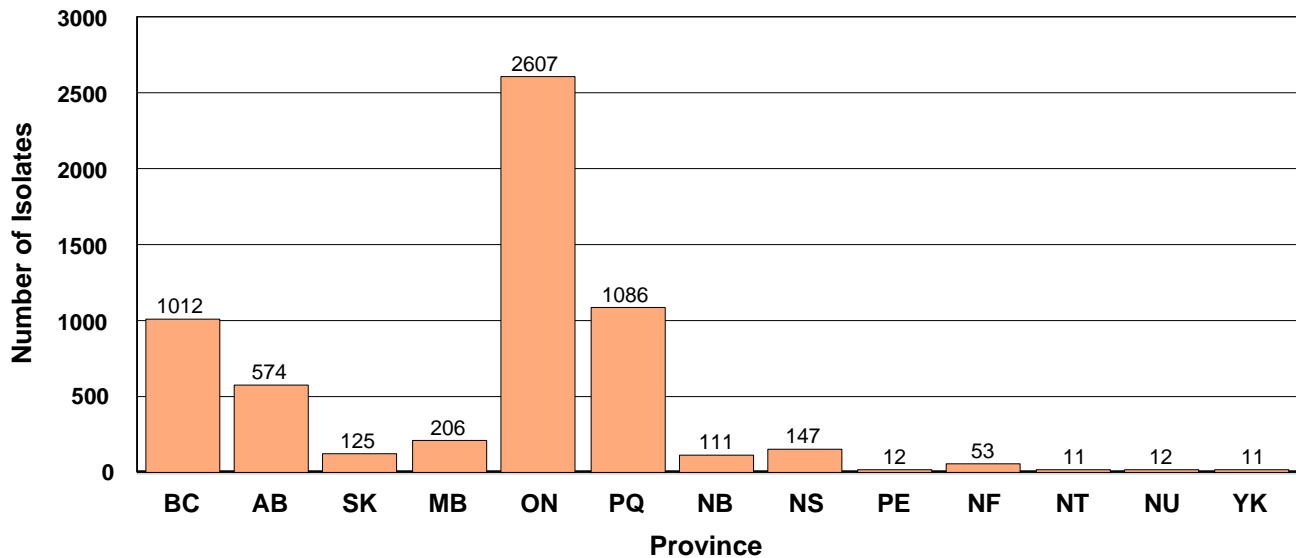


Figure 27: Number of Parasite Identifications (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2003

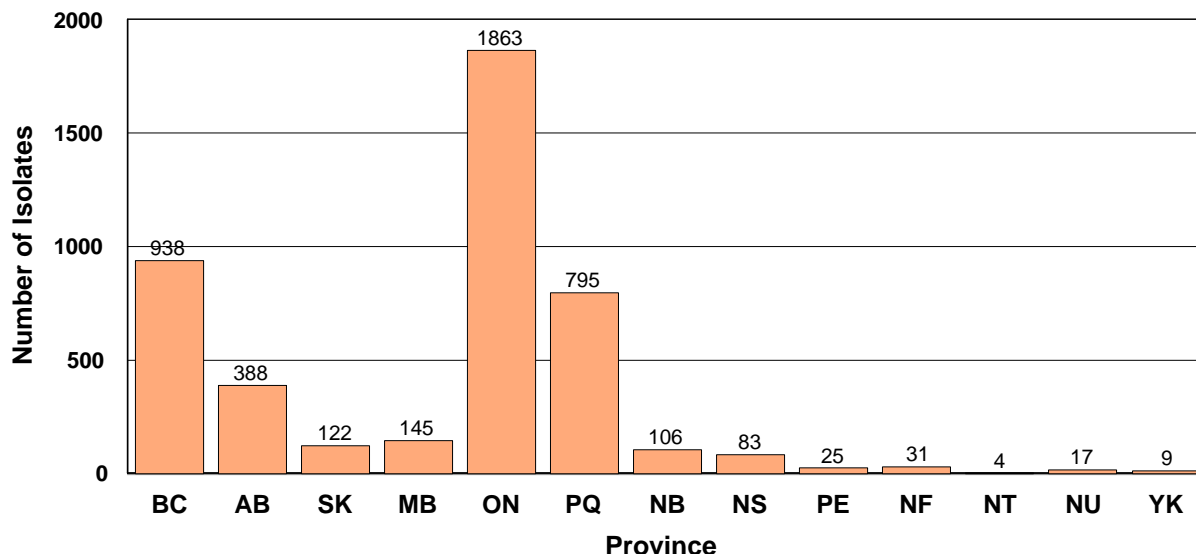


Table 16: Parasite Identifications (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2002

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	TOTAL
<i>Cryptosporidium</i>	127	130	34	35	222	3	11	8	3	1				574
<i>Cyclospora</i>	47				72	3		2						126
<i>Entamoeba histolytica/dispar</i>	133	1	12	18	443	140	3	15	2	15	1		1	784
<i>Giardia</i>	705	443	79	153	1870	940	97	122	7	37	10	12	10	4485
Total	1012	574	125	206	2607	1086	111	147	12	53	11	12	11	5969

Table 17: Parasite Identifications (*Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2003

Organism	BC	AB	SA	MB	ON	QC	NB	NS	PE	NF	NT	NU	YK	TOTAL
<i>Cryptosporidium</i>	132	92	32	30	128	8	14	7	7	1			2	453
<i>Cyclospora</i>	39				39									78
<i>Entamoeba histolytica/dispar</i>	94	1	6	19	444	98		15	1	1				679
<i>Giardia</i>	673	295	84	96	1252	689	92	61	17	29	4	17	7	3316
Total	938	388	122	145	1863	795	106	83	25	31	4	17	9	4526

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

SECTION 7: YERSINIA

The population-based rate of *Yersinia* isolation for each province is shown in Figure 28 and the total number of *Yersinia* isolations for 2002 and 2003 are shown in Figures 29 and 30. Ontario had the highest number of isolations (n=437) as well as the highest isolation rate of 1.9 isolates per 100,000 population after the Yukon Territory with 6.5 isolates per 100,000 population.

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, high rates of isolation may not necessarily reflect incidence of disease, but rather different sampling and reporting structures (see Appendix 1 for details). The proportion of specimens reported 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 emergent or re-emergent strains and to provide an overview of the subtypes found in Canada.

Nationally, the rate of isolation of *Yersinia* has declined from 2.7 isolates per 100,000 population in 1999 to 2.1 cases per 100,000 population in 2003 (Figure 28). An increase has been observed in New Brunswick where isolations have increased from 0.4 cases per 100,000 population in 2000 to 1.6 cases per 100,000 population in 2003.

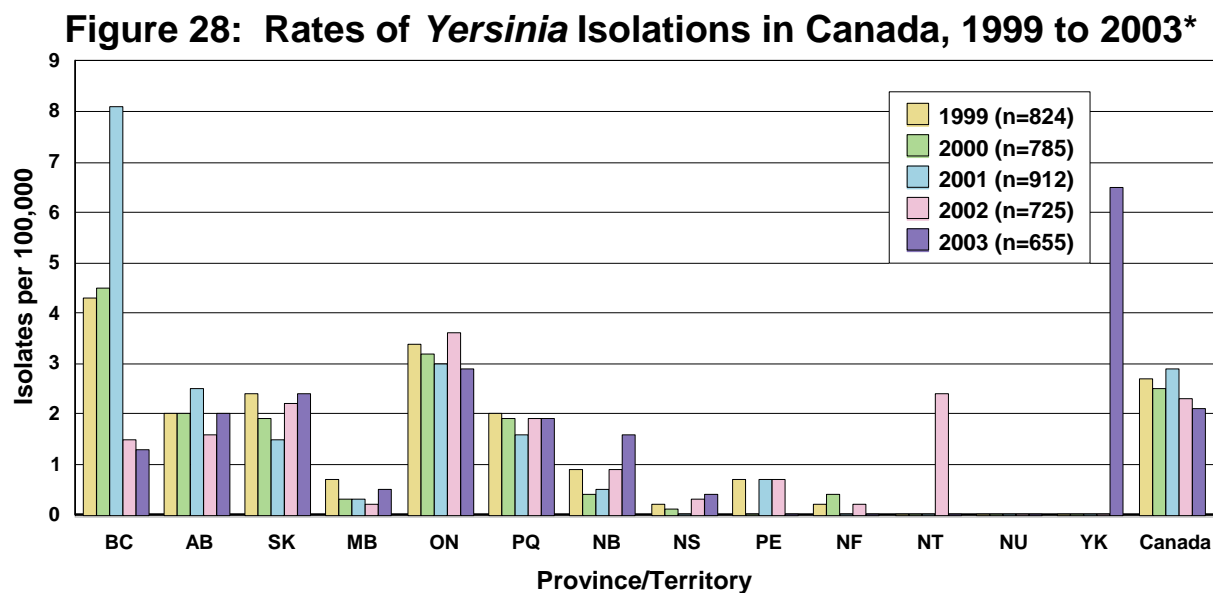


Figure 29: Number of *Yersinia* Isolations in Canada, 2002

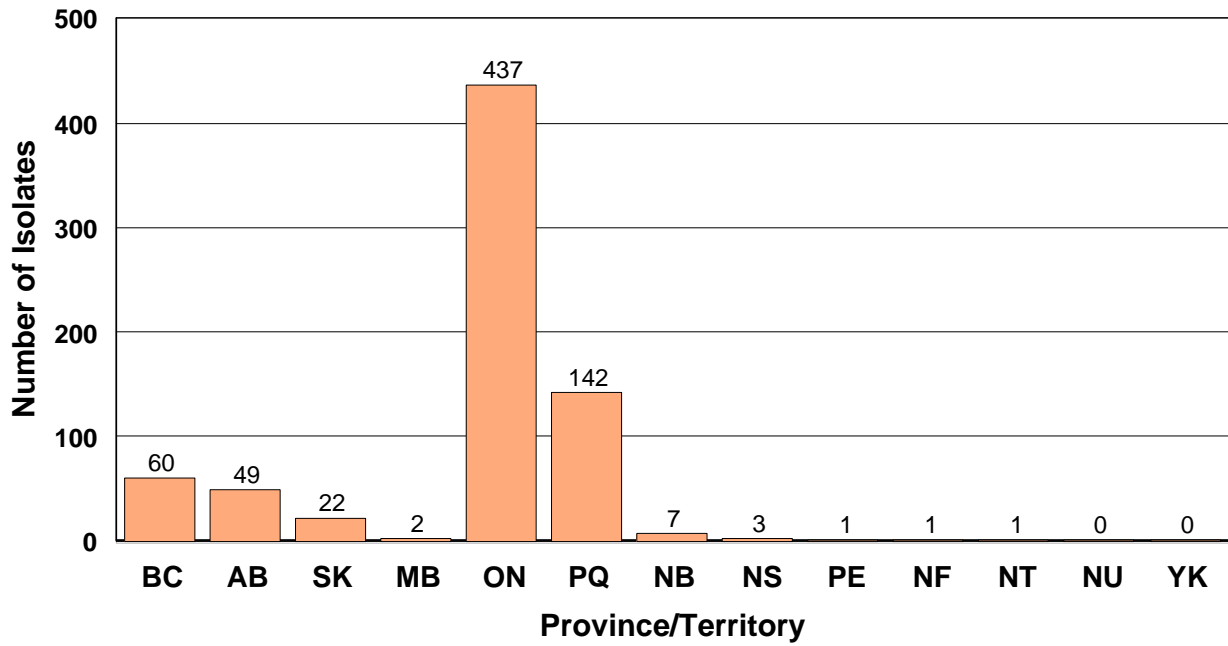


Figure 30: Number of *Yersinia* Isolations in Canada, 2003

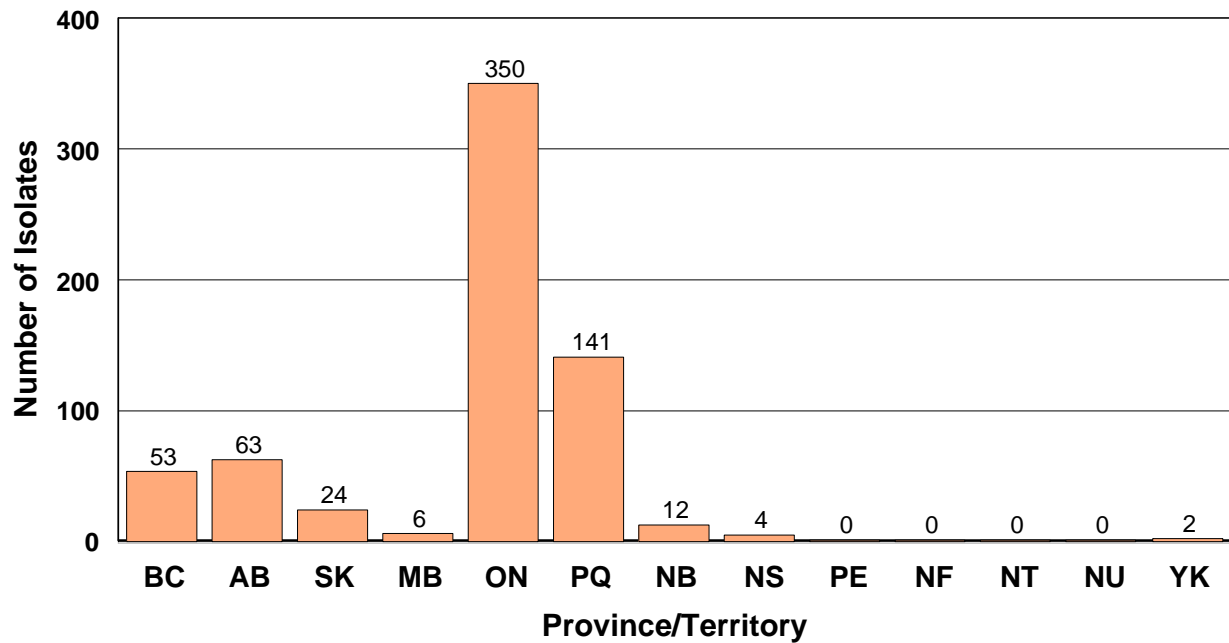


Table 18: Yersinia Isolates in Canada, 2002

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	TOTAL
<i>Y. enterocolitica</i>	55	44		2	436	141	5	3		1	1	688
<i>Y. enterocolitica</i> bio 1A			9									9
<i>Y. enterocolitica</i> bio 2 sero O:9			1									1
<i>Y. enterocolitica</i> bio 4 sero O:3			2									2
Total <i>Y. enterocolitica</i>	55	44	12	2	436	141	5	3	0	1	1	700
<i>Y. frederiksenii</i>	1	2	2		1	1			1			8
<i>Y. intermedia</i>	1		7									8
<i>Y. kristensenii</i>	1	1	1									3
<i>Y. mollaretii</i>	1											1
<i>Y. pseudotuberculosis</i>	1											1
<i>Yersinia</i> sp.		2					2					4
Total <i>Yersinia</i>	60	49	22	2	437	142	7	3	1	1	1	725

Table 19: Yersinia Isolates in Canada, 2003

Organism	BC	AB	SA	MB	ON	QC	NB	NS	YK	TOTAL
<i>Y. bercovieri</i>					1					1
<i>Y. enterocolitica</i>	35	48	6	6	328	141	12	4	2	582
<i>Y. enterocolitica</i> bio 1A			8							8
<i>Y. frederiksenii</i>	5	8	5		10					28
<i>Y. intermedia</i>	5	2	5		7					19
<i>Y. kristensenii</i>	3	1			4					8
<i>Y. mollaretii</i>	2									2
<i>Y. rohdei</i>	3	4								7
<i>Yersinia</i> sp.										
Total	53	63	24	6	350	141	12	4	2	655

* Totals are laboratory confirmed isolates based on information supplied to the NESP and supplemented with identifications from NML reference services. This data is representative of laboratory confirmed isolates only, and should not be confused with incidence of disease. See Appendix 1 for details.

SECTION 8: OUTBREAKS

Table 20 summarizes major outbreaks of enteric disease reported for the years 1999 to 2003 through various surveillance systems such as the NESP, PulseNet Canada and cluster investigations that the NML and CIDPC have provided assistance. This is not an exhaustive list of all outbreaks that have occurred in Canada. Some outbreaks are limited to a geographical location and are not reported by the PPHLs to current federal outbreak management systems. Outbreaks are grouped by causative organism and outbreak type. Outbreak types classify the outbreaks into general categories of community, family, institutional, restaurant and travel. Community outbreaks include those events involving a group of individuals with common exposure to specific events (banquets, weddings and parties) or products (ground beef from large retail outlets). Family outbreaks are small events consisting of immediate family members and friends and generally consist of person-to-person spread of the infectious agent within a household. Institutional outbreaks include hospitals, long-term care facilities, schools and other events in which individuals are in close contact and share exposures. Day care outbreaks are a sub-set of the institutional category, but because of the extra concerns of young children being affected these events are described separately. Restaurant outbreaks involve events related to commercial distribution of prepared meals. Travel related outbreaks involve those events where the original infection is thought to have occurred outside the country but symptoms are displayed after returning to Canada.

There were 78 outbreaks reported in Canada during 2002 involving 1154 cases of illness. *Salmonella* accounted for 55% (43/78) of the reported outbreaks and 40% (461/1154) of all outbreak-related illnesses (Table 20). Verotoxigenic *E. coli* was implicated in 25 outbreaks (33%) and included 245 (21%) associated cases. Although only 6 *Shigella*-related outbreaks were recorded in 2002, a single *S. sonnei* outbreak accounted for one third (426/11154) of all the outbreak-related cases.

In 2003, there were 68 outbreaks with 625 cases of illness recorded. *Salmonella* infections accounted for 49% (34/68) of the outbreaks and 48% (302/625) of all outbreak-related illnesses. Verotoxigenic *E. coli* accounted for 26% (18/68) of outbreaks and 37% (234/625) of outbreak-related cases. *Shigella* was responsible for 19% (13/68) of outbreaks and 13% (18/625) of outbreak-related cases identified.

Outbreaks 2002

Salmonella

There were 43 *Salmonella*-associated outbreaks in 2002 that included 18 different serovars and a total of 461 cases of illness (Table 21). *S. Oranienburg* caused the largest *Salmonella* outbreak in 2002 resulting in 189 illnesses between January and April. Strains of *S. Oranienburg* PT 1 and PFGE pattern ORXAI.0002 were isolated in all provinces from British Columbia east to Ontario as well as in Nunavut. From October to November 2001, 373 cases of *S. Oranienburg* associated with imported German chocolate had been identified in Europe and the CFIA had recalled the company's products that were imported into Canada. The phage type associated with the German chocolate was different from that identified from human cases in Canada. Despite several investigations and case-control studies, the source of the infections could not be determined.

There were 7 outbreaks of *S. Typhimurium* infections making this serovar the most frequently confirmed outbreak-related serovar accounting for 14% (64/461) of all outbreak-related *Salmonella* infections. In August and September, British Columbia reported 32 cases

of *S. Typhimurium* PT 2 among the passengers and crew of a cruise ship traveling from Vancouver to Alaska. A second outbreak of 13 isolates of PT 812 was also identified in British Columbia in September and was associated with a deli on Vancouver Island. Another cluster reported among five family members in Saskatchewan was linked to well water contaminated by cattle grazing in a field. Two community outbreaks (5 cases each) were seen in Québec in September and October and one outbreak in a household setting (2 cases) was noted in British Columbia during this same time.

There were 5 outbreaks of *S. Heidelberg* infections associated with 19 cases of illness in 2002. Three of the outbreaks were in Quebec and were family related with 2 cases each, a community outbreak in New Brunswick involved 6 cases, and an outbreak associated with a curry restaurant in Alberta resulted in 7 illnesses.

Six outbreaks of *S. Enteritidis* infection were reported in 2002 with 20 related isolations recorded. In Alberta, there was a community-related outbreak (6 cases) and one linked to a restaurant (2 cases). A community outbreak in Ontario involved 5 infections of *S. Enteritidis* PT 5b / PFGE pattern SENXAI.0008 and family related outbreaks were reported in New Brunswick, Nova Scotia and Quebec.

During August to September, there were three community-related outbreaks in which multi-drug resistant *S. Newport* PT 14a was identified as the agent of infection. Four cases from two households in Alberta were linked to contaminated dog treats imported from the United States. Eight isolates from Manitoba were identical to the strain characterized in Alberta but the source of these infections was not confirmed. In Ontario, 22 people were reported ill following two birthday parties held in the Muskoka-Parry Sound area in late September. The illnesses were epidemiologically linked to containers of fresh cut fruit purchased at a local grocery store. Although the *S. Newport* isolates in Ontario were also PT 14a and had the same resistance pattern (ACSSuT) as those identified in Alberta and Manitoba, the PFGE analysis confirmed that the Ontario strain was unrelated to the others.

In July, community-based outbreaks of *S. Thompson* were reported in Newfoundland (6 cases), Québec (10 cases), Alberta (7 cases) and Ontario (13 cases). The same PT 1 / STHXAI.0002 strain was seen in both the Ontario and Quebec outbreaks whereas the organism involved in the Newfoundland outbreak was PT 26 / STHXAI.0001. Isolates from the fourth community outbreak in Alberta were PT2 and PFGE pattern STHXAI.0008. A fifth outbreak of *S. Thompson* consisted of 3 household cases in Québec during October.

From mid-April to mid-May, an increase in the number of *S. Poona* isolations reported in British Columbia, Saskatchewan, Manitoba, Ontario and the United States was observed. Identical PFGE patterns were identified in all jurisdictions and a U.S.-led case-control study linked these infections to the consumption of cantaloupe imported from Mexico, which was recalled from the market. Multi-state outbreaks of *S. Poona* related to cantaloupe had been identified in April and May of the past three years. As a result, the FDA in the United States halted the importation of cantaloupe from Mexico until a food-safety program to improve sanitation had been developed with the Mexican government.

Fifteen other outbreaks involving 11 serovars were also reported. Two of them were associated with family pets, with 2 cases of *S. Paratyphi* B var. Java being linked to a turtle and 5 cases of *Salmonella* ssp I 4,5,12:b:- linked to a lizard. The Québec Ministry of Health also reported that 10 *S. Paratyphi* B var. Java infections identified in that province during the year had recent contact with tropical fish aquariums. Investigations conducted in Québec in 2000 and 2001 had found that contact with tropical fish and aquariums was a common source for many of the *S. Paratyphi* B infections in that province (CCDR - June 1, 2002). In June several cases of *S. Stanley* infection in British Columbia and Alberta were linked to a brand of imported peanuts that was associated with an outbreak in May of 2001.

Table 20: Summary of Outbreaks in Canada, 1999 to 2003

Organism	Outbreak Type	1999		2000		2001		2002		2003	
		#OB(a)	Cases	#OB	Cases	#OB	Cases	#OB	Cases	#OB	Cases
<i>Salmonella</i>	Community	12	246	12	199	16	360	19	381	12	155
	Day Care	0	0	0	0	1	35	0	0	0	0
	Family	25	53	40	94	17	39	21	58	10	23
	Institutional	2	11	2	16	0	0	0	0	5	26
	Restaurant	1	15	2	71	3	162	3	22	7	99
	Travel	0	0	1	11	1	3	0	0	0	0
	Total	40	325	57	391	38	599	43	461	34	303
<i>E. coli</i> O157 VTEC	Community	4	39	7	256	2	7	7	166	9	206
	Day Care	1	3	2	9	1	3	5	35	1	4
	Family	5	11	24	60	7	16	11	30	7	19
	Institutional	1	5	0	0	0	0	1	12	0	0
	Restaurant	0	0	0	0	1	15	1	2	1	5
	Total	11	58	33	325	11	41	25	245	18	234
<i>Campylobacter jejuni</i>	Community	0	0	0	0	0	0	2	4	0	0
	Family	2	10	1	2	0	0	2	4	2	5
	Total	2	10	1	2	0	0	4	8	2	5
<i>Campylobacter</i> sp.	Family	1	2	2	6	0	0	0	0	0	0
<i>Shigella boydii</i>	Family	1	2	0	0	0	0	1	2	1	2
<i>Shigella dysenteriae</i>	Family	0	0	0	0	0	0	0	0	1	3
<i>Shigella flexneri</i>	Family	1	2	1	3	0	0	3	6	0	0
<i>Shigella sonnei</i>	Community	0	0	3	121	1	26	1	426	6	40
	Day Care	0	0	1	6	0	0	0	0	0	0
	Family	10	25	3	6	1	2	0	0	4	18
	Institutional	0	0	0	0	0	0	0	0	1	15
	Travel	0	0	1	2	0	0	1	6	0	0
Total	10	25	8	135	2	28	2	432	11	73	
<i>Yersinia enterocolitica</i>	Family	0	0	0	0	0	0	0	0	1	2
<i>Cryptosporidium</i>	Community	0	0	0	0	0	0	0	0	1	4
<i>Giardia</i>	Family	0	0	1	2	0	0	0	0	0	0
Total		66	424	103	864	51	668	78	1154	69	626

(a) = Number of Outbreaks.

Verotoxigenic *E. coli* (VTEC)

E. coli O157 VTEC (includes serotypes reported as O157, O157:H7 and O157:NM) was associated with 25 outbreaks including 245 cases of illness.

Household related infections accounted for 11 of the outbreaks with 2 or 3 cases each for a total of 30 illnesses. There were two daycare centre outbreaks in Alberta during June and August, two in Ontario during May and August, and one in Prince Edward Island in December resulting in a combined total of 35 illnesses (CCDR, February 1, 2003).

A community outbreak involved 45 cases of *E. coli* O157:H7 infections among 250 attendees at a youth bowling league banquet in Ontario in May. In November, salads and sandwiches prepared in an institutional kitchen in Prince Edward Island were linked to 12 illnesses. A multi-provincial cluster of 87 isolates with a PFGE pattern of ECXA1.0508 was identified during May and June and was traced to ground beef distributed and sold through a large retail chain.

Shigella

There were six *Shigella* outbreaks reported in 2002 with a total of 440 cases of illness. The majority of these cases were from a single outbreak of *Shigella sonnei* where 426 isolates were characterized as PT 15 / PFGE pattern SSOXA1.0088. Onset dates of illness ranged between May 11 to May 28 and 95% of confirmed cases investigated had a history of eating one specific brand of Greek Style Pasta Salad produced in Toronto. The CFIA issued an Urgent Outbreak Notification on May 18 and a voluntary recall of the salad was initiated.

Household clusters of *S. boydii* and *S. flexneri* in British Columbia and Quebec represented 4 outbreaks of 2 cases each, and 6 cases of *S. sonnei* PT 2 / PFGE pattern SSOXA1.0124 from Ontario were associated with travel to the Turks and Caicos Islands.

Table 21 presents the major national and international enteric pathogen outbreaks reported in 2002 through the various surveillance systems used for monitoring outbreaks of gastroenteritis in Canada such as NESP, PulseNet Canada and cluster investigations which the NML and the CIDPC have provided assistance. The outbreaks reported are community, institutional, restaurant, travel and familial types. The data does not cover all outbreaks occurring in Canada and exact case counts for each outbreak were not possible to verify, however the table provides a general overview of enteric pathogens and their subtypes commonly circulating within the population and causing outbreaks of disease.

Table 21: Outbreaks in Canada During 2002

Organism	Month	Province	No. Cases	PT (a)	PFGE (b)	Comments
S. Anatum	Jul	ON	20	PT 4	- (c)	Community - Birthday Party - Meat Loaf
S. Brandenburg	Jul	QC	18	-	-	Community - Barbeque
S. Enteritidis	Jan	NB	3	PT 24	SENXAI.0003	Family
	Apr	AB	6	-	-	Community
	Apr	ON	5	PT 5b	SENXAI.0008	Community
	May	AB	2	-	-	Restaurant
	Jun	QC	2	-	-	Family
	Sep	NS	2	PT 13	SENXAI.0062	Family
S. Hadar	Feb	QC	2	-	-	Family
S. Heidelberg	May	NS	6	PT 47	SHEXAI.0001	Community
	May	QC	2	-	-	Family
	Aug	QC	2	-	-	Family
	Sep	QC	2	-	-	Family
	Oct	AB	7	PT 19	-	Restaurant - Curry Chicken and Lamb
S. Indiana	Aug	BC	2	-	-	Family
S. Infantis	Aug	BC	2	-	-	Family
S. Newport	Aug	AB	4	PT 14a	-	Family - Imported Dog Treats - USA
	Sep	MB	8	PT 14a	NewpXAI.0037	Community
	Sep	ON	22	PT 14a	-	Community - Birthday Party - Fruit Tray
S. Oranienburg	Jan - Apr	BC, AB, SK, MB, ON, NU	189	PT1	ORXAI.0002	Community
S. Poona	Apr - May	BC, SK, MB, ON	10	-	POOXAI.0008	Community - Imported Canteloupe - Mexico
S. Paratyphi B	Jan - Dec	QC	10	Atypical	-	Community - Aquarium Contact
var. Java	Apr	AB	3	PT 3b var. 7	-	Family
	Apr	BC	2	-	-	Family - Pet Turtle
S. Stanley	Jun	BC, AB	2+	-	-	Community - Imported Peanuts - China

Organism	Month	Province	No. Cases	PT (a)	PFGE (b)	Comments
S. Thompson	Jul	NF	6	PT 26	STHXAI.0001	Community
	Jul	QC	10	PT 1	STHXAI.0002	Community - Family Gathering
	Jul	AB	7	PT 2	STHXAI.0008	Community
	Jul	ON	13	PT 1	STHXAI.0002	Community
	Aug	QC	3	PT 5	-	Family
S. Typhimurium	Jan	BC	2	PT U284	-	Family
	Jul	SK	5	PT 104	STXAI.0029	Family - Well water
	Aug - Sep	BC	32	PT 2	-	Community Cruise Ship
	Sep	BC	13	PT 812	-	Restaurant - Deli
	Sept	QC	5	-	-	Community
	Oct	BC	2	-	-	Family
	Oct	QC	5	-	-	Community
S. Typhi	Apr	ON	3	PT D1	-	Family
	Sep - Oct	NB	2	PT A	-	Family
S. ssp 4,12:b:-	Aug	QC	6	-	-	Family
S. ssp 4,5,12:b:-	Oct - Nov	QC	5	Atypical	-	Family - Pet Lizard
S. ssp 4,5,12:i:-	Jul	MB	7	PT 146a var.	STXAI.0128	Community
S. ssp 4,5,12:i:-	Dec	BC	2	-	-	Family
<i>E.coli</i> O157 VTEC	May	AB	5	-	-	Family
	May	ON	5	PT 14a	ECXAI.0146	Daycare - Hamburger
	May	ON	45	PT 14a	-	Community - Bowling League Banquet
	May	QC	15	PT 14a	-	Community - Hamburger
	May - Jun	National	87	PT 14a	ECXAI.0508	Community - Hamburger
	Jun	AB	12	PT 14b	-	Daycare
	Jul	AB	2	-	-	Restaurant
	Jul	BC	3	-	-	Family
	Jul	ON	4	-	-	Community - Hamburger
	Aug	AB	5	-	-	Daycare
	Aug	ON	10	-	-	Daycare
	Aug	ON	3	-	-	Community - Wedding Reception
	Aug	PEI	2	PT 14a	ECXAI.0484	Community - Church Camp
	Aug	QC	2	-	-	Family
	Sep	NF	3	PT 14b	ECXAI.0508	Family
	Sep	QC	2	-	-	Family

Organism	Month	Province	No. Cases	PT (a)	PFGE (b)	Comments
<i>E. coli</i> VTEC (continued)	Oct - Dec	AB	10	-	-	Community - Unpasteurized Cheese
	Oct	BC	2	-	-	Family
	Oct	MB	2	PT 1	-	Family
	Oct	QC	2	-	-	Family
	Nov	ON	5	PT 33	-	Family - Hamburger
	Nov - Dec	PEI	2	PT 14	ECXAI.0776	Family
	Nov	PEI	12	PT 32	ECXAI.0756	Institutional - Psychiatric Hospital
	Dec	BC	2	-	-	Family
	Dec	PEI	3	PT 14	ECXAI.0767	Daycare
<i>Shigella boydii</i> 4	Mar	BC	2	-	-	Family
<i>Shigella sonnei</i>	May	ON	426	PT 15	SSOXAI.0088	Community - Greek Style Pasta Salad
	Nov	ON	6	PT 2	SSOXAI.0124	Travel - Turks and Caicos
<i>Shigella flexneri</i> 6	Jun	QC	2	-	-	Family
<i>Shigella flexneri</i>	Oct	BC	2	-	-	Family
<i>Shigella flexneri</i> 2	Dec	BC	2	-	-	Family
<i>Campylobacter jejuni</i>	Mar	AB	2	-	-	Community
	Jul	ON	2	-	-	Family
	Jul	BC	2	-	-	Family
	Nov	QC	2	-	-	Community

(a) = Predominant Phage Type, (b) = Predominant *xbal* PFGE pattern, (c) = Not available.

Outbreaks 2003

Salmonella

Thirty-three outbreaks of *Salmonella* involving 15 serovars and 302 cases of illnesses were identified in 2003. The largest *Salmonella* outbreak in 2003 occurred in Nova Scotia during August where 40 cases of *S. Oranienburg* PT 8 / OranXAI.0020 infections were associated with the consumption of hamburgers at a fast food restaurant.

S. Typhimurium, the most frequently confirmed serovar, was associated with 10 outbreaks and accounted for 30% (92/302) of all outbreak *Salmonella* cases. A large outbreak in Alberta in August was associated with a restaurant located in a shopping mall and consisted of 20 cases of *S. Typhimurium* PT46 / PFGE pattern STXAI.0214. Another large outbreak of 17 cases of PT164 / PFGE pattern STXAI.0019 occurred at a wedding reception in British Columbia in September. Other community-based outbreaks included a pig roast picnic in Manitoba in June (7 cases), a house party in British Columbia (3 cases) in August and a birthday party in Ontario (34 cases). A bakery was involved with another outbreak of 3 cases in October in British Columbia and 4 outbreaks were in household settings in British Columbia, Saskatchewan and Quebec with 2 cases of infection each.

There were 4 outbreaks of *S. Enteritidis* infection with 21 related cases of illness in 2003. In January, Alberta identified 8 cases associated with a fast-food restaurant at a prominent shopping mall and 9 illnesses in British Columbia were linked to a catered social event in June. There was also one family outbreak (2 cases) in British Columbia in February and a small conference hotel outbreak of 2 cases in British Columbia in June.

Despite the increase in number of *S. Heidelberg* isolations in 2003, only 4 outbreaks were recognized causing a total 28 cases of illness. During the month of March, 5 members of one British Columbia family were confirmed with *S. Heidelberg* PT 26 and an investigation identified frozen chicken nuggets and strips as the likely source of infection. A multi-provincial case-control study of *S. Heidelberg* cases identified between January and May was conducted and statistically significant associations were observed between gastroenteritis and the consumption of improperly home-prepared chicken nuggets/strips and undercooked eggs. *S. Heidelberg* PT 35 was identified in 8 illnesses among residents of a convent in New Brunswick in March and 7 cases in a nursing home in Manitoba in June. A community outbreak in New Brunswick during July, August and September consisted of 8 PT32 isolations that had PFGE pattern SHEXAI.0116.

A cluster of 12 cases of *S. Thompson* PT 26 / PFGE pattern STHAXI.0001 was identified in Nova Scotia between May and September 2003. The cases were distributed through five different districts and no common source was identified. Another *S. Thompson* outbreak was observed in Quebec during February involving 8 cases of infection in an institutional setting.

Two outbreaks of *S. Newport* were seen in 2003 with one in Ontario consisting of 5 cases of PT3, and the second was a family related outbreak in Quebec with 2 cases.

Other outbreaks of note included 27 cases of *Salmonella* ssp. I 4,5,12:b:- PT Dundee var. 2 (27 cases) in Ontario in July and August, 16 cases of *S. Hartford* in Québec in June and July, 15 cases of *S. Berta* in Ontario in May, and 17 cases of *S. Minnesota* in New Brunswick in July.

Verotoxigenic *E. coli* (VTEC)

There were 18 outbreaks associated with verotoxigenic *E. coli* O157 (includes H7, NM and non-typed) with 234 related cases in 2003. The largest outbreak involved at least 65 visitors of a petting zoo in British Columbia in November. Two other large event-related outbreaks were identified in Ontario last year. In January, 60 people attending a Robbie Burns party and who had consumed improperly prepared haggis became ill. During the month of June, 44 cases of *E. coli* O157:H7 PT8 were identified among attendees of a high school graduation banquet.

A community outbreak in April was associated with frozen beef-filled pastries in Ontario and consisted of 7 infections of *E. coli* O157:H7 PT14 / PFGE pattern ECXAI.0023. Among the other outbreaks listed for 2003, 5 cases of PT14a were linked to a fast food restaurant in Ontario in March, 3 cases with PFGE pattern ECXAI.0381 to a hotel conference in Alberta during July, 2 cases linked to a calf at a petting zoo in Ontario in July, 8 cases of PT 14b / PFGE pattern ECXAI.0052 from a community outbreak in New Brunswick during August, and a day care outbreak of 4 cases in June in Alberta.

Shigella

There were 13 *Shigella* outbreaks in 2003, 11 of them related to *S. sonnei*. *S. sonnei* outbreaks in Québec included an outbreak of 15 illnesses among hospital staff in July that were associated with consumption of food from the salad bar of the hospital cafeteria, a community outbreak of 3 illnesses in January, a camping event held in August with 3 cases, as well as 3 family clusters of 2 cases each during April and May. *Shigella sonnei* was also linked to two community outbreaks, one with 4 cases and the other with 8, in Alberta in June. A youth camp in Ontario saw 12 cases during August and another 12 cases were identified among members of two New Brunswick families that attended the same family event in October.

Shigella dysenteriae was reported among 3 family members in Ontario in March and 2 cases of *S. boydii* 2 were associated with family contact in Alberta in November.

Cryptosporidium

In British Columbia 4 *Cryptosporidium* infections were identified between October and December 2003 that were likely associated with a public swimming pool.

Table 22 presents the major national and international enteric pathogen outbreaks reported in 2003 through the various surveillance systems used for monitoring outbreaks of gastroenteritis in Canada such as NESP, PulseNet Canada and cluster investigations in which the NML and the CIDPC have provided assistance. The outbreaks reported are community, institutional, restaurant, travel and familial types. The data does not cover all outbreaks occurring in Canada and exact case counts for each outbreak were not possible to verify, however the table provides general overview of enteric pathogens and their subtypes commonly circulating within the population and causing outbreaks of disease.

Table 22: Outbreaks In Canada During 2003

Organism	Month	Province	No. Cases	PT (a)	PFGE (b)	Comments
S. Agona	Jan	BC	2	- (c)	-	Family
S. Berta	May	ON	15	-	-	Community - Family Dinner
S. Enteritidis	Jan	AB	8	-	-	Restaurant - Fast Food - Hamburger
	Jun	BC	9	-	-	Community - Catered Event
	Feb	BC	2	-	-	Family
	Jun	BC	2	PT 911	-	Community - Hotel Conference
	Dec	AB	1	-	-	Institution - Elementary School
S. Hartford	Jun	QC	16	-	-	Community
S. Heidelberg	Mar	BC	5	PT 26	-	Family - Chicken Nuggets
	May - Jun	NB	8	PT 35	SHEXAI.0060	Institution - Convent
	Jun	MB	7	PT 35	-	Institution - Nursing Home
	Jul - Sep	NB	8	PT 32	SHEXAI.0116	Community
S. Minnesota	Jul	NB	17	-	-	Restaurant - Fast Food
S. Newport	Mar	ON	5	PT 3	-	Community
	May	QC	2	-	-	Family
S. Oranienburg	Aug	NS	40	PT 8	OranXAI.0020	Restaurant - Fast Food - Hamburger
S. Paratyphi B var. Java	Sep	QC	2	-	-	Family
S. Rubislaw	Jun	BC	2	-	-	Family
S. Saintpaul	Jul	AB	9	-	SainAXI.0008	Restaurant
S. Thompson	Feb	QC	8	PT 1	-	Institution
	May - Sep	NS	12	PT 26	STHAXI.0001	Community
S. Typhimurium	Mar	SK	2	-	-	Family
	Jun	MB	7	PT 104	-	Community - Pig Roast Picnic
	Aug	AB	20	PT 46	STXAI.0214	Restaurant
	Aug	BC	3	-	-	Community - House Party
	Aug	ON	34	-	-	Community - Birthday Party
	Aug	QC	2	-	-	Family
	Sep	BC	17	PT 164	STXAI.0019	Community - Wedding Reception
	Sep	BC	2	-	-	Family
	Sep	QC	2	-	-	Family
	Oct	BC	3	-	-	Bakery

Organism	Month	Province	No. Cases	PT	PFGE	Comments
<i>S. ssp</i> 4,5,12:b:-	Jul - Aug	ON	27	Dundee var.2	-	Community
<i>S. ssp</i> 4,5,12:i:-	Aug	BC	2	-	-	Restaurant - Steamed Chicken
	Nov	AB	2	-	-	Institution - Long Term Care
<i>E. coli</i> O157 VTEC	Jan	ON	60	PT 14a	-	Community - Robbie Burns Banquet - Haggis
	Mar	ON	5	PT 14a	-	Restaurant - Fast Food
	Apr	ON	7	PT 14	ECXAI.0023	Community - Beef Pastries
	May	ON	3	-	ECXAI.0801	Community
	May	SK	3	PT 14a	ECXAI.0001	Family – Hamburger
	Jun	AB	4	-	-	Day Care
	Jun	ON	53	PT 8	-	Community - School Graduation Banquet
	Jul	AB	3	-	ECXAI.0381	Community - Hotel Conference
	Jul	BC	2	-	-	Family
	Jul	ON	2	-	-	Community - Petting Farm – Calf
	Aug	NB	8	PT 14b	ECXAI.0052	Community
	Aug	NB	5	PT 14a	ECXAI.0010	Family
	Aug	SK	2	PT 14a	ECXAI.0073	Family
	Oct	BC	3	-	-	Family
	Oct	ON	2	-	-	Family
	Nov	BC	65	-	-	Community - Petting Zoo
	Nov	QC	2	-	-	Family
	Dec	BC	5	-	-	Community
<i>Campylobacter jejuni</i>	Aug	SK	3	-	-	Family
	Oct	SK	2	-	-	Family
<i>Shigella boydii</i> 2	Nov	AB	2	PT 6	-	Family
<i>Shigella sonnei</i>	Apr	QC	2	-	-	Family
	Apr	QC	2	-	-	Family
	May	QC	2	-	-	Family
	Jan	QC	3	-	-	Community
	Aug	QC	3	-	-	Community - Camping Event
	Jul	QC	15	-	-	Hospital - Staff - Salad Bar
	Jun	AB	4	-	-	Community
	Jun	AB	8	-	-	Community
	Aug	ON	12	-	-	Community - Youth Camp
	Oct	NB	12	-	-	Family Event
	Dec	QC	10	PT 1	-	Community - Gay Males
<i>Shigella dysenteriae</i>	Mar	ON	3	-	-	Family
<i>Yersinia enterocolitica</i>	Feb	BC	2	-	-	Family
<i>Cryptosporidium</i>	Oct - Dec	BC	4	-	-	Community - Public Swimming Pool

(a) = Predominant Phage Type, (b) = Predominant xbaI PFGE pattern, (c) = Not available.

SECTION 9: MISCELLANEOUS INFORMATION

Table 23: Travel Related Enteric Pathogen Infections, 2002

Organism	Country of Travel
<i>C. coli</i>	1 Mexico, 1 Thailand.
<i>C. jejuni</i>	1 Bali, 1 Boliva, 2 Cuba, 2 India, 1 Jamaica, 6 Mexico, 1 Russia, 1 United Kingdom.
<i>Cryptosporidium</i>	1 Kenya.
<i>Cyclospora cayetanensis</i>	1 Columbia, 1 Mexico, 1 Morocco.
<i>Entamoeba histolytica/dispar</i>	1 Africa, 1 Asia, 1 China, 1 Egypt, 1 Haiti, 1 Mexico, 1 Pakistan.
<i>Giardia</i>	2 Africa, 1 Asia, 2 Brazil, 1 China, 2 Columbia, 1 Haiti, 1 India, 1 Mexico, 1 Thailand.
<i>E. coli</i> O157 VTEC	1 Africa, 1 Mexico, 1 United Kingdom.
<i>S. Agona</i>	1 Bali, 1 Cuba, 1 Mexico.
<i>S. Albany</i>	1 Brazil.
<i>S. Bonariensis</i>	1 Jamaica.
<i>S. Bredeney</i>	1 Cuba.
<i>S. Choleraesuis</i>	1 Dominican Republic, 1 Thailand.
<i>S. Eastbourne</i>	1 Cuba.
<i>S. Enteritidis</i>	1 Australia, 5 Cuba, 9 Dominican Republic, 1 Kenya, 9 Mexico, 2 Spain, 2 United States of America.
<i>S. Give</i>	1 Pakistan.
<i>S. Hadar</i>	1 China.
<i>S. Heidelberg</i>	1 Costa Rica, 1 Jamaica, 1 Thailand.
<i>S. Javiana</i>	1 Mexico.
<i>S. Kentucky</i>	1 Indonesia, 1 Middle East.
<i>S. Newport</i>	1 Cuba, 1 Thailand, 1 United States of America.
<i>S. Oranienburg</i>	1 Africa, 2 Mexico.
<i>S. Panama</i>	1 Costa Rica, 2 Mexico, 2 Nicaragua.
<i>S. Paratyphi A</i>	1 Asia, 1 China, 5 India.
<i>S. Paratyphi B</i>	1 India.
<i>S. Paratyphi B var. Java</i>	1 Thailand.
<i>S. Poona</i>	1 Bahamas.
<i>S. Richmond</i>	1 China.
<i>S. Rissen</i>	1 Thailand.
<i>S. Rubislaw</i>	1 Venezuela.
<i>S. Saintpaul</i>	1 Africa.
<i>S. Stanley</i>	1 Malaysia.
<i>S. Typhi</i>	6 India, 1 Pakistan.
<i>S. Typhimurium</i>	4 Mexico, 1 Peru, 1 United States of America.
<i>S. Umbilo</i>	1 Africa.
<i>S. Virchow</i>	2 Thailand.
<i>S. Weltevreden</i>	1 Cook Islands, 1 Indonesia, 1 Philippines.
<i>Salmonella</i> ssp I 4,5,12:b:-	1 Kampuchea, 1 Thailand.
<i>S. boydii</i> 1	1 India.
<i>S. boydii</i> 4	1 India.
<i>S. boydii</i> 10	1 Bangladesh.
<i>S. boydii</i> 19	1 Bangladesh.
<i>S. boydii</i> 20	2 Cuba, 1 Guatemala.
<i>S. dysenteriae</i> 16	1 Haiti
<i>S. flexneri</i> 1	1 Mexico, 1 Peru and 1 Sudan.
<i>S. flexneri</i> 2	1 Caribbean, 1 Dominican Republic.
<i>S. flexneri</i> 3	1 India.
<i>S. flexneri</i> 6	1 Brazil, 1 India, 1 Mexico, 1 Pakistan.
<i>S. flexneri</i> Prov. SH104	2 Haiti.

Organism	Country of Travel
<i>S. sonnei</i>	1 Costa Rica, 1 Dominican Republic, 1 Egypt, 3 India, 13 Mexico, 1 Pakistan, 1 Russia, 1 Venezuela.
<i>Shigella</i> sp.	1 Cuba.
<i>V. cholerae</i> O1	1 Bangladesh.
<i>V. cholerae</i> non-O1/O139	1 Cuba, 3 Mexico, 1 Thailand.
<i>V. parahaemolyticus</i>	1 Vietnam.
<i>Y. enterocolitica</i>	2 Cuba, 2 Mexico.

Table 24: Travel Related Enteric Pathogen Infections, 2003

Organism	Country of Travel
<i>C. coli</i>	1 Asia, 2 Dominican Republic, 1 India, 2 Mexico.
<i>C. jejuni</i>	1 Cuba, 1 Dominican Republic, 1 Ecuador, 1 India, 1 Mexico, 1 United States of America.
<i>C. jejuni/coli</i>	1 Morocco.
<i>Campylobacter</i> sp.	1 Romania.
<i>Cryptosporidium</i>	1 Mexico.
<i>E. coli</i> O157 VTEC	1 Mexico, 1 United States of America.
<i>Entamoeba histolytica/dispar</i>	1 Africa, 2 Haiti, 2 Mexico, 1 Romania, 2 Thailand, 1 Tunisia.
<i>Giardia</i>	1 Africa, 1 Asia, 2 Brazil, 4 Haiti, 1 India.
<i>Hymenolepis nana</i>	1 Somalia.
<i>S. Agona</i>	1 Dominican Republic.
<i>S. Albany</i>	1 Asia.
<i>S. Anatum</i>	1 Cuba.
<i>S. Arechavaleta</i>	1 St. Lucia.
<i>S. Enteritidis</i>	8 Cuba, 1 Dominican Republic, 1 Indonesia, 7 Mexico, 1 Thailand, 1 United States of America.
<i>S. Heidelberg</i>	1 Greece, 1 Mexico.
<i>S. Infantis</i>	1 Mexico.
<i>S. Jamaica</i>	1 Costa Rica.
<i>S. Javiana</i>	1 Cuba.
<i>S. Kibusi</i>	1 Cameroon.
<i>S. Lagos</i>	1 Africa.
<i>S. London</i>	1 Mexico.
<i>S. Mississippi</i>	1 Caribbean.
<i>S. Muenster</i>	1 Kenya.
<i>S. Newport</i>	2 Egypt, 1 El Salvador, 1 United States of America.
<i>S. Paratyphi A</i>	2 India, 1 Pakistan.
<i>S. Rissen</i>	1 Hong Kong, 1 Thailand.
<i>S. Saintpaul</i>	1 Congo, 1 Hong Kong, 1 Mexico.
<i>S. Stanley</i>	1 Thailand.
<i>S. Telekebir</i>	1 Caribbean.
<i>S. Typhi</i>	1 Bangladesh, 1 India, 1 Nepal, 1 Pakistan.
<i>S. Typhimurium</i>	1 Costa Rica, 1 Cuba, 1 Czech Republic, 1 Mexico, 1 Morocco, 1 St. Lucia, 1 Thailand.
<i>S. Uganda</i>	1 Dominican Republic, 1 Mexico.
<i>S. Weltevreden</i>	1 Haiti.
<i>S. ssp</i> I 9,12:-:e,n,z15	1 Cuba.
<i>S. boydii</i>	2 Mexico.
<i>S. boydii</i> 8	1 India.
<i>S. boydii</i> 12	1 India.
<i>S. boydii</i> 14	1 India.
<i>S. boydii</i> 20	1 Chile.
<i>S. flexneri</i>	3 Dominican Republic, 1 India, 1 Pakistan.
<i>S. flexneri</i> 1	1 Mexico.
<i>S. flexneri</i> 2	2 Dominican Republic, 1 Mexico, 1 Pakistan, 1 Uganda.
<i>S. flexneri</i> 3	1 India, 1 Africa, 4 Congo, 1 India, 2 Mexico.
<i>S. sonnei</i>	3 Costa Rica, 4 Cuba, 1 Ecuador, 1 Ghana, 1 India, 5 Mexico, 1 Morocco, 1 Tansania, 1 Togo.
<i>Shigella</i> sp.	1 India.
<i>V. cholerae</i> non O1	1 Mexico.
<i>V. cholerae</i> non-O1/O139	1 Cuba, 1 Dominican Republic, 1 Ecuador, 1 India, 1 Mexico.
<i>V. mimicus</i>	1 Mexico.
<i>V. parahaemolyticus</i>	1 Mexico.
<i>Y. enterocolitica</i>	2 Cuba, 1 Ecuador, 1 France, 1 Poland, 1 Tonga Islands.

Travel information in Tables 23 and 24 is supplied to the NESP and supplemented with data submitted with specimens forwarded to the NML for reference services.

Table 25: Unusual Isolation Sites of Enteric Pathogen Infections, 2002

Isolation Site	Organism	Total	Isolation Site	Organism	Total
Abcess	S. Heidelberg	1	Sinus	S. Paratyphi A	1
Abdomen	S. Blockley	1	Sputum	S. Litchfield	1
Blood	<i>C. coli</i>	1	Urine	<i>E. coli</i> Inactive	1
	<i>C. jejuni</i>	2		<i>E. coli</i> O6:HM	1
	<i>C. fetus</i> ssp fetus	2		<i>E. coli</i> O75:NM	1
	<i>C. upsaliensis</i>	2		S. Adelaide	2
	S. Berta	1		S. Albany	1
	S. Bredeney	1		S. Anatum	2
	S. Dublin	2		S. Baildon	1
	S. Enteritidis	21		S. Brandenburg	2
	<i>S. flexneri</i> 2a	1		S. Bredeney	1
	S. Heidelberg	79		S. Enteritidis	6
	S. Hithergreen	1		S. Give	1
	S. Muenster	1		S. Hadar	2
	S. Newport	1		S. Heidelberg	28
	S. Oranienburg	5		S. Infantis	3
	S. Panama	1		S. Javiana	1
	S. Paratyphi A	4		S. Mbandaka	1
	S. Paratyphi B	1		S. Newport	3
	S. Paratyphi B var. Java	1		S. Oranienburg	7
	S. Saintpaul	3		S. Paratyphi B	1
	S. Sandiego	1		S. Paratyphi B var. Java	2
	S. Schwarzengrund	1		S. Rubislaw	1
	S. Stanley	1		S. Saintpaul	2
	S. Thompson	3		S. Sandiego	2
	S. Typhi	61		S. sonnei	1
	S. Typhimurium	13		S. Thompson	1
	S. Virchow	1		S. Tilene	1
	S. spp I 4,5,12:i:-	2		S. Typhimurium	13
	<i>S. sonnei</i>	1		S. Typhi	1
	<i>Y. enterocolitica</i>	2		<i>Salmonella</i> ssp I 4,12:-:-	1
				<i>Salmonella</i> ssp I 4,5,12:i:-	3
				<i>Salmonella</i> ssp I Rough-O:i:1,2	1
Bone	S. Typhimurium	1		<i>Salmonella</i> ssp IIIb 50:-:-	1
Cerebral Spinal Fluid	S. Oranienburg	1		<i>Salmonella</i> ssp IIIb 60:r:e,n,z15	1
				<i>Y. enterocolitica</i>	2
Ear	<i>V. cholerae</i> non-O1/O139	2			
Gall Bladder	S. Heidelberg	1	Vaginal Swab	S. Heidelberg	1
Peritoneal Fluid	S. Heidelberg	1			
	S. Oranienburg	1	Wound	S. Enteritidis	1
				S. Muenster	1
				S. Schwarzengrund	1

Table 26: Unusual Isolation Sites of Enteric Pathogen Infections, 2003

Isolation Site	Organism	Total	Isolation Site	Organism	Total
Abdominal cyst	S. Virchow	1	Expectoration	<i>Salmonella</i> ssp IIIb 61:k:1,5,7	1
Abscess (Breast)	S. Heidelberg	3	Gall Bladder	<i>Salmonella</i> ssp I Rough-O:e,h:1,2	1
Abscess (Chest Wall)	S. Heidelberg	1	Joint Fluid	S. Enteritidis	1
Abscess (Liver)	S. Uganda	1	Leg	S. Typhimurium	1
Abscess (Spleen)	S. Heidelberg	1	Peritoneum	<i>Campylobacter fetus</i> ssp fetus	1
Aspirate	S. Oranienburg	1		S. London	1
Appendicitis	S. Heidelberg	1		S. Mikawasima	1
Blood	<i>C. fetus</i> ssp fetus	1		S. Thompson	1
	<i>C. jejuni</i>	1	Sputum	S. Bredeney	1
	S. Agona	1		<i>Salmonella</i> ssp IIIb 61:k:1,5	1
	S. Bergen	1	Urine	<i>E. coli</i> O25:NM	2
	S. Berta	1		<i>E. coli</i> O157 VTEC	3
	S. Brandenburg	2		S. Agona	6
	S. Bredeney	1		S. Albany	1
	S. Dublin	1		S. Amager	1
	S. Enteritidis	19		S. Amsterdam	2
	S. Haardt	1		S. Anatum	2
	S. Hadar	4		S. Apapa	1
	S. Heidelberg	122		S. Bareilly	1
	S. Indiana	1		S. Berta	1
	S. Infantis	1		S. Braenderup	3
	S. Lomalinda	1		S. Brandenburg	3
	S. Minnesota	4		S. Brazzaville	1
	S. Muenchen	2		S. Dublin	1
	S. Newport	3		S. Enteritidis	6
	S. Paratyphi A	10		S. Eschberg	1
	S. Paratyphi B	2		S. Hadar	6
	S. Paratyphi B var. Java	2		S. Havana	1
	S. Rubislaw	2		S. Heidelberg	46
	S. Saintpaul	2		S. Infantis	3
	S. Schwarzengrund	1		S. Javiana	3
	S. Stanley	1		S. Kentucky	1
	S. Thompson	2		S. Kintambo	1
	S. Typhi	51		S. Manhattan	1
	S. Typhimurium	19		S. Mbandaka	1
	S. Virchow	2		S. Montevideo	1
	<i>Salmonella</i> ssp I 4,5,12:b:-	3		S. Muenchen	2
	<i>Salmonella</i> ssp IV 16:z4,z32:-	1		S. Newport	8
	<i>Shigella flexneri</i> 2	1		S. Oranienburg	4
	<i>Shigella sonnei</i>	1		S. Paratyphi B var. Java	1
Biopsy	S. Dublin	1		S. Pomona	1
Bowel	<i>Salmonella</i> ssp I 4,5,12:i:-	1		S. Potsdam	1
Cerebral Spinal Fluid	S. Heidelberg	1		S. Richmond	1
Dialysis Line	<i>Y. enterocolitica</i>	1		S. Rissen	1
Ear	<i>V. alginolyticus</i>	3		S. Saintpaul	1
	<i>V. cholerae</i> non-O1/O139	3		S. Schwarzengrund	1
				S. Stanley	1
				S. Stanleyville	1
				S. Thompson	1

Isolation Site	Organism	Total
Urine	S. Typhi	1
(continued)	S. Typhimurium	10
	S. Uganda	1
	S. Urbana	1
	<i>Salmonella</i> ssp I Rough-O:-	3
	<i>Salmonella</i> ssp I Rough-O:e,h:1,2	1
	<i>Salmonella</i> ssp I 4,5,12:i-	1
	<i>Salmonella</i> ssp I Rough-O:m,t-	1
	<i>Salmonella</i> ssp I Rough-O:r:1,2	1
	<i>Salmonella</i> ssp IIIb 60:r:z	1
	<i>Salmonella</i> ssp IIIb 61:i:z	1
	<i>V. cholerae</i> Non O1/Non O139	1
Uterus	S. Lomalinda	1
Umbilical cord	<i>Salmonella</i> ssp I 3,15:l,v-	1
Wound	S. Typhi	1

APPENDIX 1 : DISCUSSION OF DATA SOURCES

The past few issues of the Annual Summary have been part of an effort to update and formalize this report series. Annual Summaries for 1995 and earlier years were data reports with tables and figures. Beginning in 1996, we adopted a descriptive report format and the 1997 Annual Summary saw an improvement in the textual information, even though the contents continued to be aimed at directing the reader to find the raw numbers of interest; very little interpretation was given. Production of the 1998 Annual Summary involved a fundamental shift in our handling of enteric data. Notably, the component data sets began to be stored by source, allowing a more balanced set of estimates of the number of lab-confirmed isolates in Canada. A simple estimator, the maximum value among the overlapping data sets, was introduced, based on the assumption that over-estimation is not likely. All of this work made the information easier to access, and organized the available data sets in anticipation of their more effective use. The 1999 and 2000 were completed with further enhancements and data clarification early in 2002. The 2001 Annual Summary attempted to redesign some of the figures and tables to convey more meaningful information. Footnotes and explanations have been added to help the reader understand the data sets and limitations of the information presented. This combined 2002 and 2003 Annual Summary will allow the reporting processes to be up to date and address data acquisition issues involved in the compilation of the *Campylobacter* reporting. To facilitate the production of this report quickly, the 2003 *Campylobacter* data will be included in the 2004 annual summary.

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

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

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

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

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

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

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

Human *Salmonella*

The reported number of isolates in the provincial reports and NESP are very similar. The individual differences are quite unique: both *Salmonella* sp. and *Salmonella* ssp. I are consistently higher in NESP and this may be a product of the timely reporting inherent in the design of NESP. By subtracting numbers, for example of *S. Heidelberg* and *S. Typhimurium* found in the LDMS/CIPHS database (as a result of reference services provided by NML) from the total reported *Salmonella* serogroup B numbers, a more accurate estimate can be achieved. As well, by adding a number of a generic group of *Salmonella* sp. to the totals to adjust level to those reported by the NDRS database, and thereby maintaining a constant

denominator, the relative proportions of organisms can be compared from year to year. Differing identification procedures and antisera availability across provinces affect accuracy of the data, however proficiency testing is improving testing comparability.

Salmonella phage types

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

Non-human *Salmonella* serovars

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

Escherichia coli

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

It is difficult to assess the importance to human disease in Canada of the non-O157 *E. coli* organisms. The independent submission of isolates with the same serotype from different provinces suggests that laboratory surveillance may be detecting events occurring over larger geographical areas. However, the limited number of reported isolates makes it difficult to separate possible events or trends from chance associations, or to follow up on such cases epidemiologically. It is likely that the number of illnesses caused by these organisms is higher than the available data indicate. For example, the provincial laboratory in British Columbia currently reports the majority of human infections of non-O157 VTEC in Canada. Increased detection of these organisms in some provinces appears to be the result of enhanced surveillance through the use of testing protocols specific for VTEC. Assuming that non-O157 VTEC are found in the same ratio to the population as in the rest of Canada, this *E. coli* virulence group contributes significantly to morbidity due to enteric pathogens throughout the country. Since the disease symptoms of a subset of the non-O157:H7 VTEC are as severe as those for *E. coli* O157:H7, it would seem that future surveillance systems should consider testing for all VTEC across Canada.

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

Campylobacter, Arcobacter, and Helicobacter

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

Arcobacter and *Helicobacter* are no longer included in the summary because of improved laboratory identification methods have resulted in the mis-identification of *Campylobacter* is now a rarity and information on these other organisms is no longer deemed necessary to gain a full picture of the isolation of *Campylobacter* in Canada.

Shigella

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

Yersinia

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

Parasites

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

Viruses

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

The Future

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

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

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

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