Laboratory Surveillance Data for Enteric Pathogens In Canada

2001 Annual Summary

Health Canada Santé Canada

Canada

Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 2001

Walter Demczuk, Rafiq Ahmed, David Woodward, Clifford Clark, Lai King Ng,
Kathryn Dore[1] , Nadia Ciampa[1] and Anne Muckle[2]
Enteric Disease Program
National Microbiology Laboratory
The Canadian Science Centre for Human and Animal Health
1015 Arlingtion Street
Winnipeg, Manitoba, Canada
R3E 3R2

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

[1]Foodborne, Waterborne and Zoonotic Infections Division, Centre for Infectious Disease Prevention and Control, 4th Floor, OMAFRA Building, 1 Stone Road W., Guelph, Ontario, N1G 4Y2.
[2]Laboratory for Foodborne Zoonoses, 110 Stone Rd. West, Guelph, Ontario, N1G 3W4.

"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 diarrheal diseases."

Enteric Disease Program
National Microbiology Laboratory
Health Canada

This report summarizes the information received from federal, provincial and public health agencies on enteric pathogens identified in Canada during 2001. The information is intended primarily for those with responsiblitities for the control and prevention of enteric foodborne pathogens.

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

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Introduction

Data presented in this report is based on laboratory confirmed enteric pathogens associated with disease isolated from humans, foods, animals and environments. Annual data for this report is received from a variety of sources and the most suitable data is selected and developed into an annual summary. In Canada, surveillance data is collected at regional and provincial levels and compiled at national level. The laboratory based surveillance data summarized in this report provides overall trends with respect to each enteric pathogen and does not describe incidence of disease. 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, and this data can be used to target potential preventative measures. The laboratory based surveillance data summarized here should 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 incidence of disease.

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

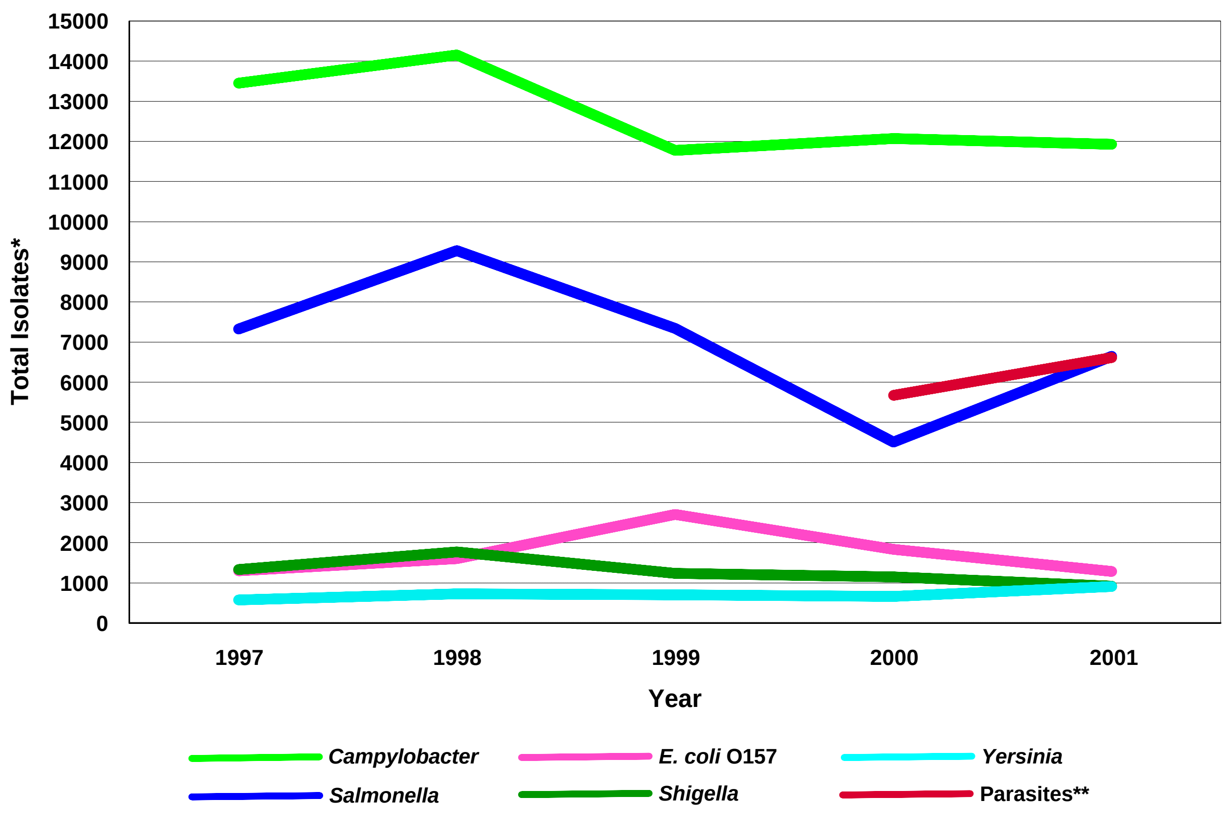
Provincial reports and NESP are summarized aggregated data in the form of weekly, monthly or annual reports of isolates forwarded to the PHL's for analysis and characterization. The data sets of LFZ and NML are acquired through reference services for the confirmation, identification and characterization 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 recevies 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 PHL's 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 foodborne infection do not seek medical attention. Although the proportion of specimens forwarded may differ from province to province the subset of data from each province presented in this report remains consistent from year to year and can be useful to establish general trends.

Section 1 - Major Enteric Pathogens Summary 2001

Figure 1 illustrates the isolation trends of the 6 major pathogen groups over the last 5 years. *Campylobacter* continues to be the most prevalent pathogen in Canada in 2001 distantly followed by Salmonella and parasitic infections. The number of *Campylobacter*, *E. coli* O157 VTEC, *Yersinia* and *Shigella* isolations have remained constant or decreased slightly over the previous few years whereas *Salmonella* isolations have increased slightly in 2001 after a decline in 2000.

Figure 1: Major Enteric Pathogens from Humans in Canada*, 1997 to 2001



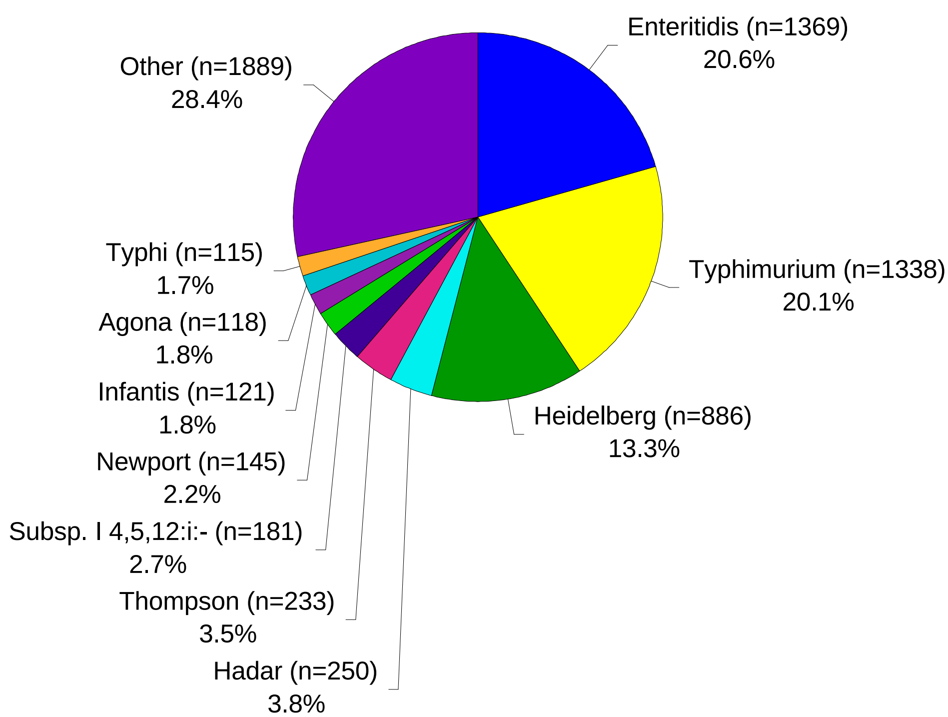
* Totals of *Campylobacter* and parasitic isolations are largely based on data supplied by the NDRS database whereas the total number of isolations of other organisms relies on NESP data.
***Cryptosporidium* and *Cyclospora* were not nationally notifiable until January 2000. *Entamoeba* is not notifiable and numbers of cases of illness are those reported to NESP which may be under-reported.

Section 2: *Salmonella*

Salmonella Isolates from Humans in Canada

Figure 2 illustrates the relative frequency of isolation of the ten most prevalent *Salmonella* serovars from patients in Canada in 2001. *S.* Enteritidis, accounting for 20.6% (n=1369) has once again this year overtaken *S*. Typhimurium with 20.1% (n=1338) as the most prevalent serovar isolated. The third most prevalent serovar in 2001 was *S*. Heidelberg (13.3%) followed by *S*. Hadar (3.8%), *S*. Thompson (3.5%), *Salmonella* subsp. I 4,5,12:i:- (2.7%), *S*. Newport (2.2%), *S*. Infantis (1.8%), *S*. Agona (1.8%) and *S*. Typhi (1.7%). Other serovars accounted for 28.4% of all *Salmonella* reported in 2001.

Figure 2: Most Prevalent *Salmonella* Serovars from Humans in Canada, 2001* (n=6645)

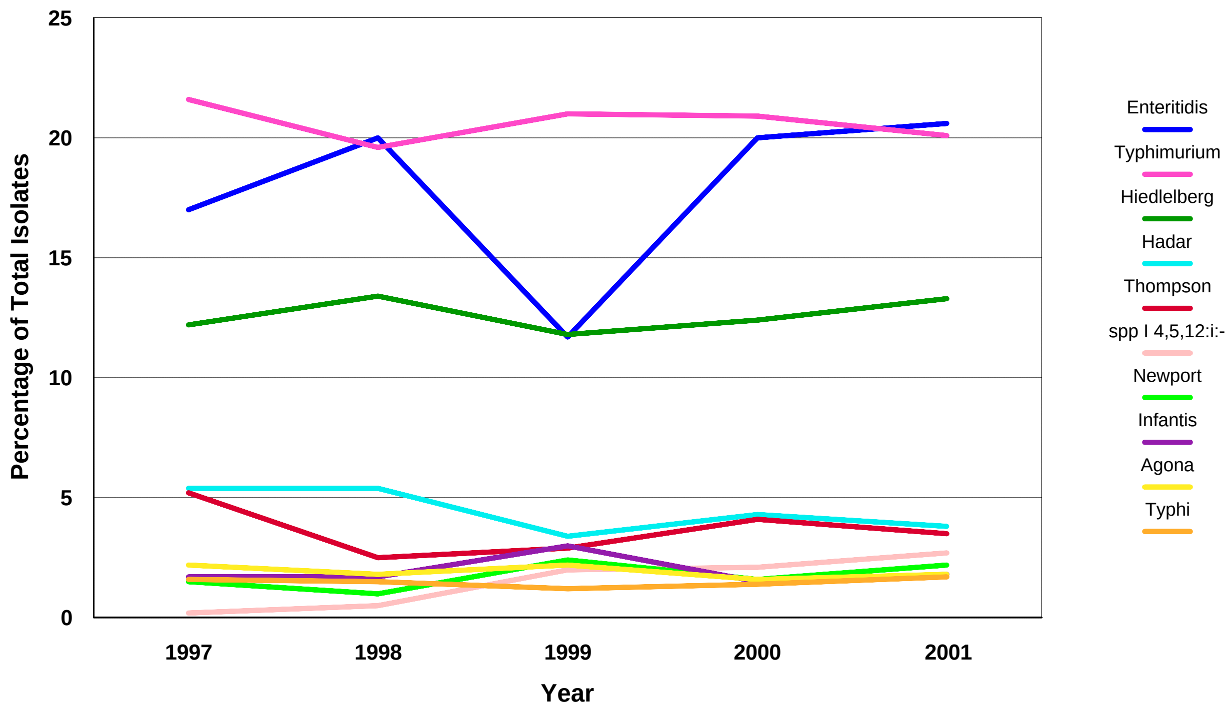


* Serovar totals are laboratory confirmed *Salmonella* based on information supplied to the NESP (includes outbreak isolates) with supplemented identifications from NML reference services.

Changes in the Occurance of *Salmonella* Serovars from Humans in Canada, 1997 to 2001

The relative frequencies of the 10 most prevalent *Salmonella* of human origin for each of the previous 5 years are shown in Figure 3. In 2001, numbers of *S*. Enteritidis increased to rank first from a decline in 1999 where it was ranked 3rd after *S*. Heidelberg and *S*. Typhimurium. These 3 serovars form a group that has consistently been elevated above the rest of the top ten serovars over the last 5 years. Serovars of the group that makes up the next 7 most prevalent serovars each represent less than 5% of all *Salmonella* isolated. Serovars included in this group remains relatively constant from year to year. The number of *Salmonella* subsp. I 4,5,12:i:- isolates has increased from ranking 10th overall in 1999, when it first made the top ten, to 6th this year.

Figure 3: Ten Most Prevalent *Salmonella* Serovars from Humans in Canada, 1997 to 2001*



* 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 representive of laboratory confirmed isolates only which is consistantly 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 isolations of *Salmonella* from each province are shown in Figure 4 and population based rates of *Salmonella* isolation for each province are shown in Figure 5. 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 in the number of *Salmonella* isolated (Figure 4), due to a large population, the province ranks 9th overall in population based isolation rate.

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

Figure 4 : Number of *Salmonella* Isolations in Canada in 2001

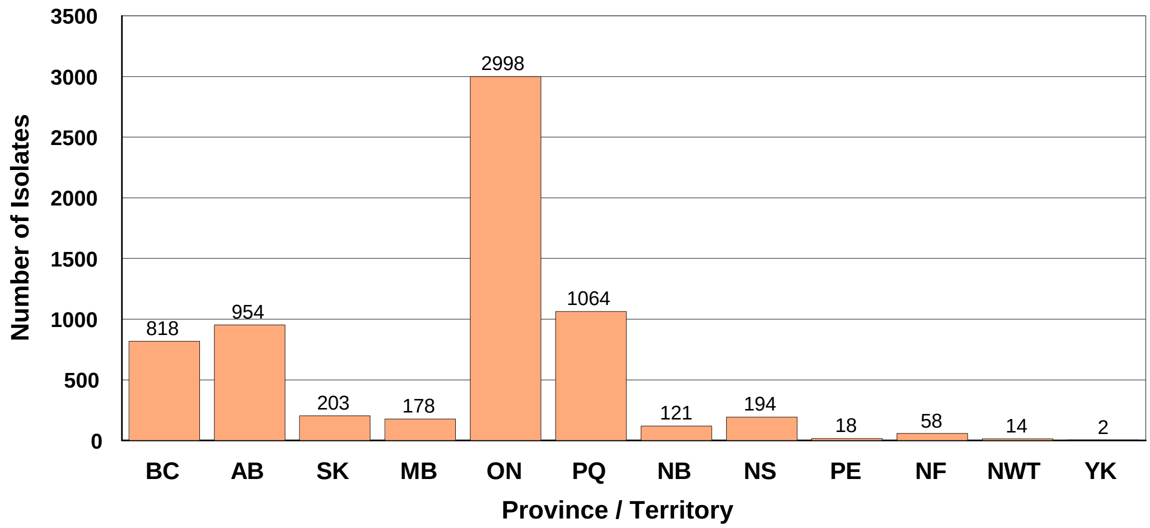
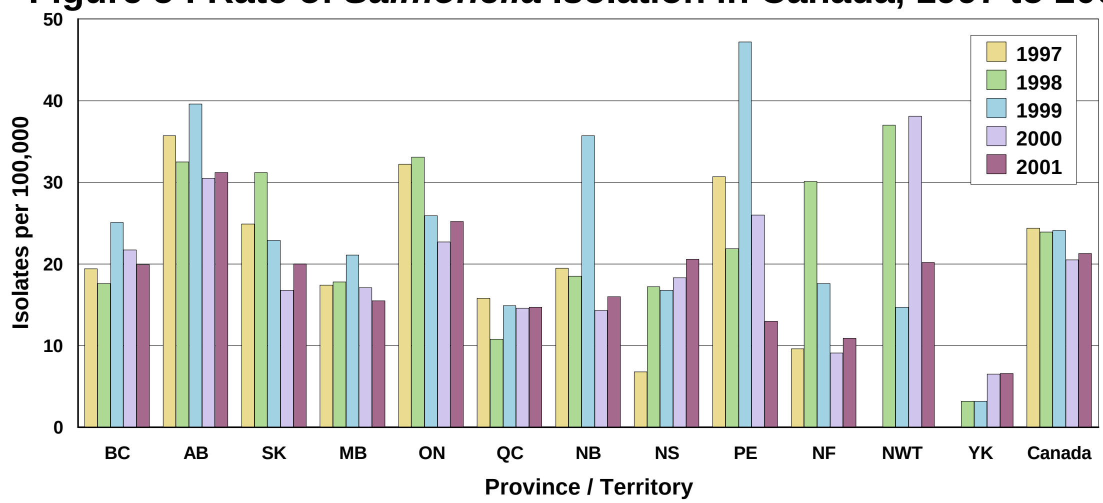


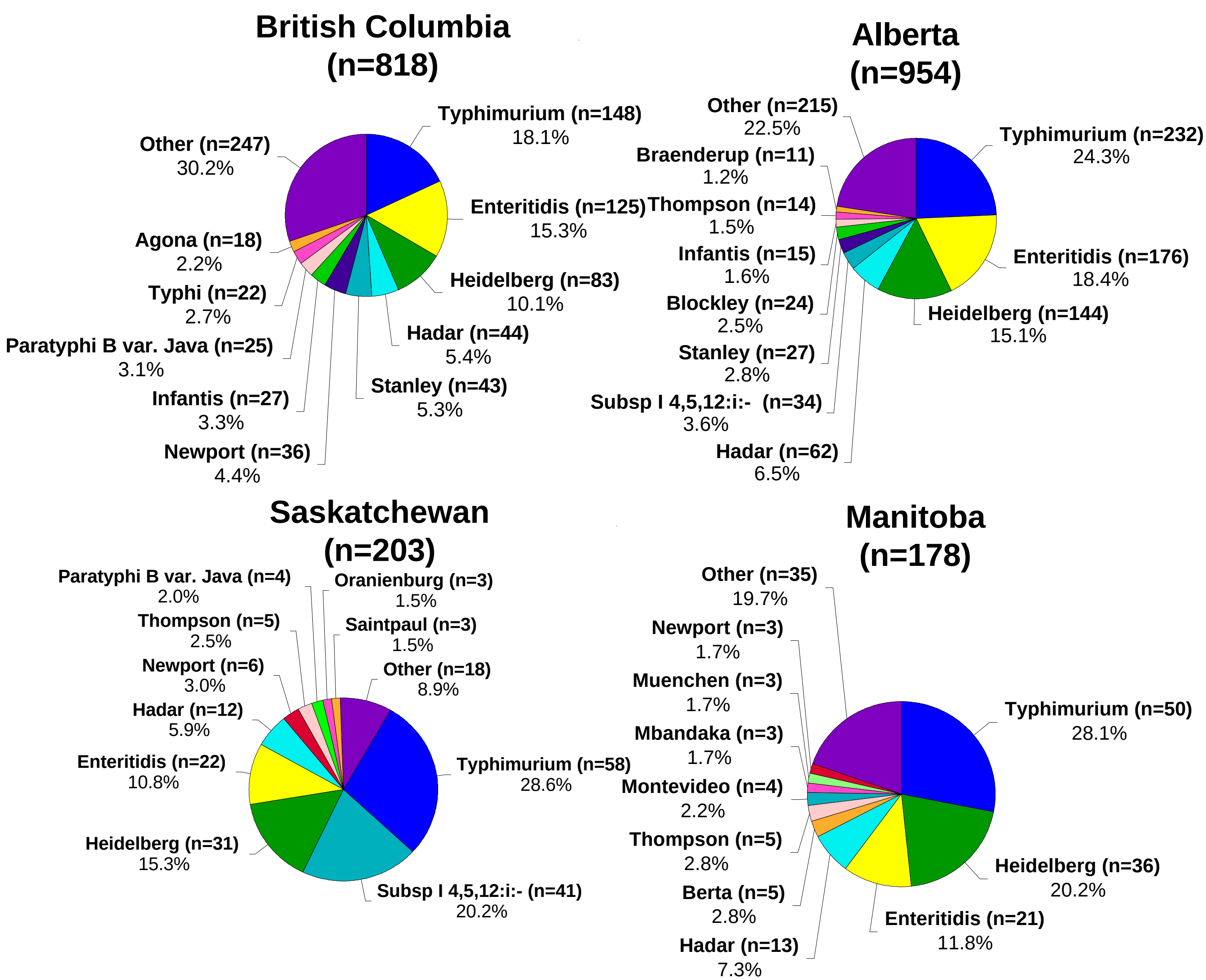
Figure 5 : Rate of *Salmonella* Isolation in Canada, 1997 to 2001*



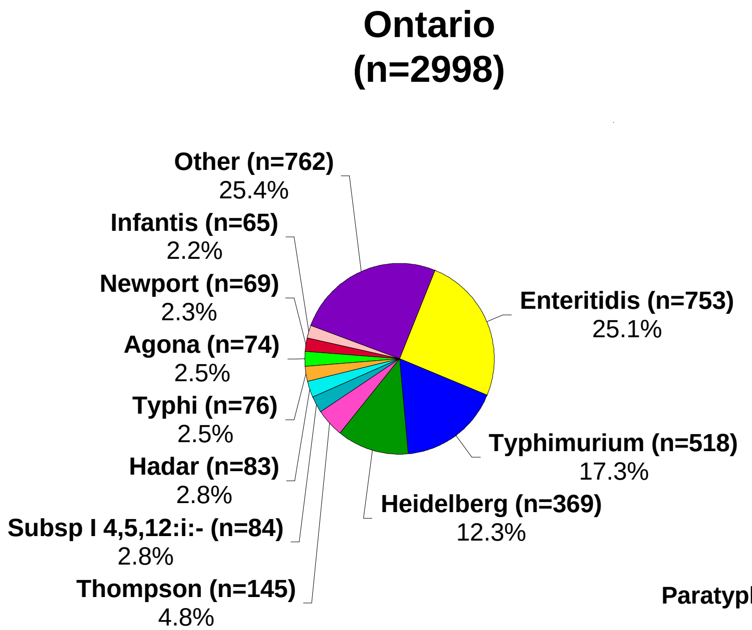
*Provincial population estimates used to calculate isolation rates are taken from the Statistics Canada website. Total *Salmonella* is based largely on NESP reports and includes cluster and outbreak cases but not duplicate isolates from the same patient. High numbers of *Salmonella* isolations may not 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, NWT = Northwest Territories (includes Nunavut, NN), YK = Yukon Territory.

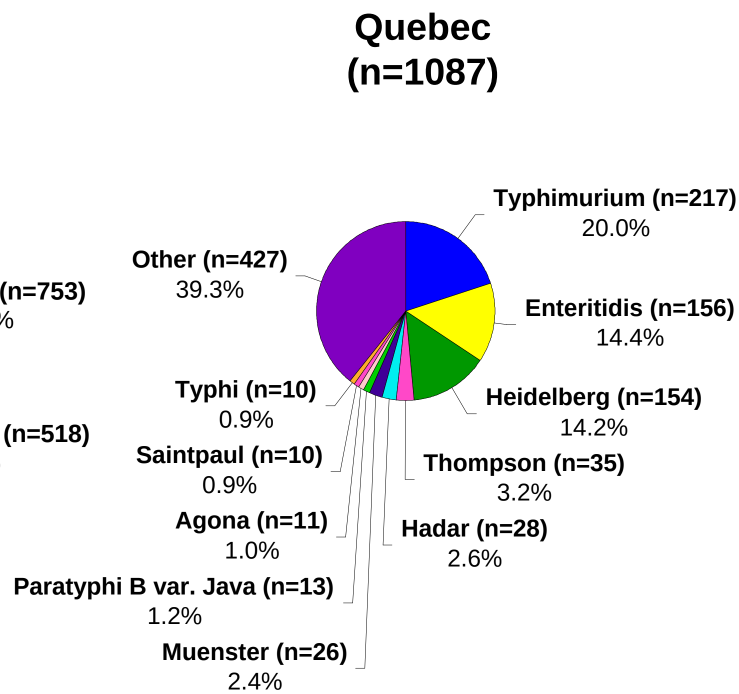
The ten most prevalent human *Salmonella* serovars isolated for each province is illustrated in Figure 6. *S*. Typhimurium is the most prevalent serovar in British Columbia accounting for 18% of all *Salmonella* identified in that province, Alberta with 24%, Saskatchewan with 29%, Manitoba with 28%, Quebec with 20% and Nova Scotia with 36%. *S*. Enteritidis was most prevalent in Ontario (25%) and New Brunswick (30%). *S.* Heidelberg was most prevalent in Newfoundland (31%) and Northwest Territories/Nunavut (57%).

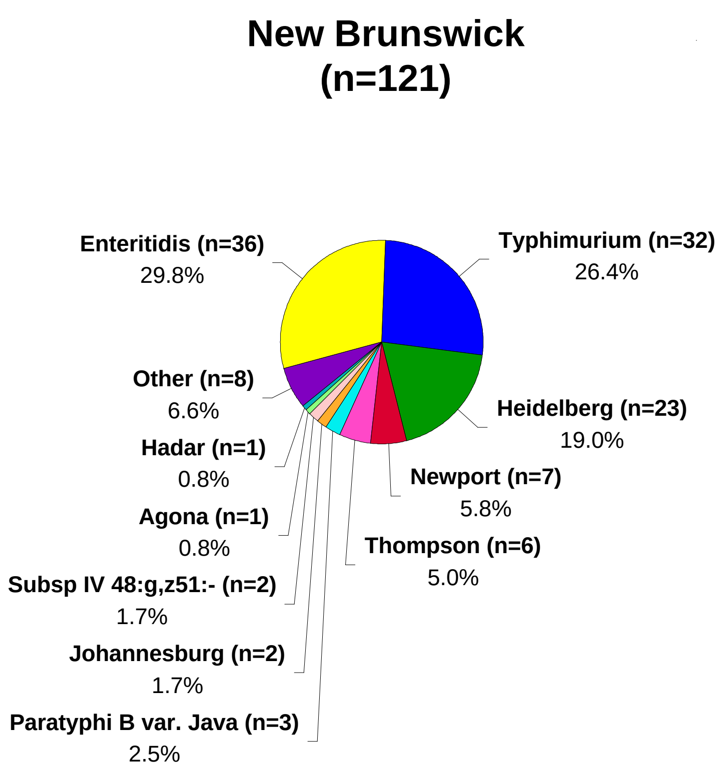
Figure 6: Ten Most Prevalent *Salmonella* Serovars from Humans in Each Province, 2001

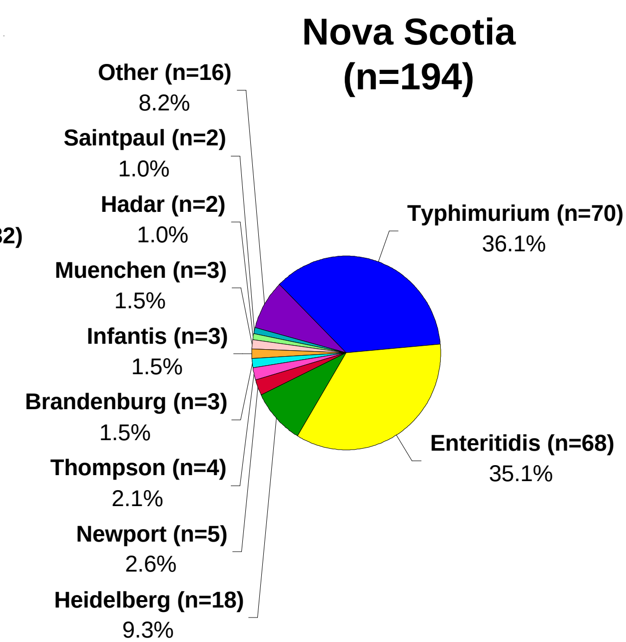


* Serovar totals are laboratory confirmed isolates based on information supplied to the NESP with supplemented identifications from NML reference services. Although this data is representive of laboratory confirmed isolates only and should not be confused with incidence of disease, this subset of data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

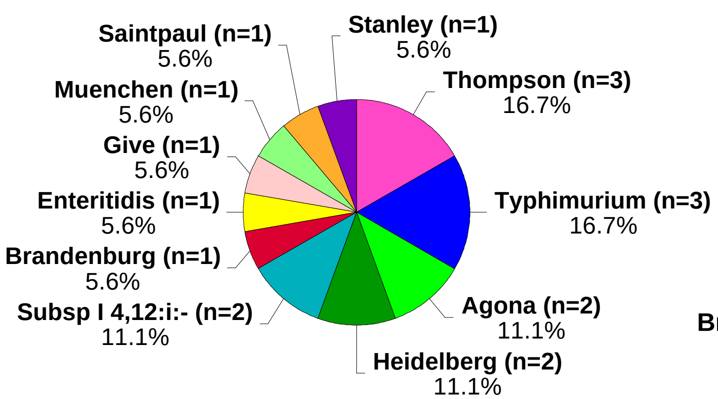

Ontario
(n=2998)
Other (n=762)
25.4%
Infantis (n=65)
2.2%
Newport (n=69)
2.3%
Agona (n=74)
2.5%
Typhi (n=76)
2.5%
Hadar (n=83)
2.8%
Subsp I 4,5,12:i:- (n=84)
2.8%
Thompson (n=145)
4.8%
Enteritidis (n=753)
25.1%
Typhimurium (n=518)
17.3%
Heidelberg (n=369)
12.3%


Quebec
(n=1087)
Typhimurium (n=217)
20.0%
Other (n=427)
39.3%
Enteritidis (n=156)
14.4%
Typhi (n=10)
0.9%
Heidelberg (n=154)
14.2%
Saintpaul (n=10)
0.9%
Thompson (n=35)
3.2%
Agona (n=11)
1.0%
Hadar (n=28)
2.6%
Paratyphi B var. Java (n=13)
1.2%
Muenster (n=26)
2.4%

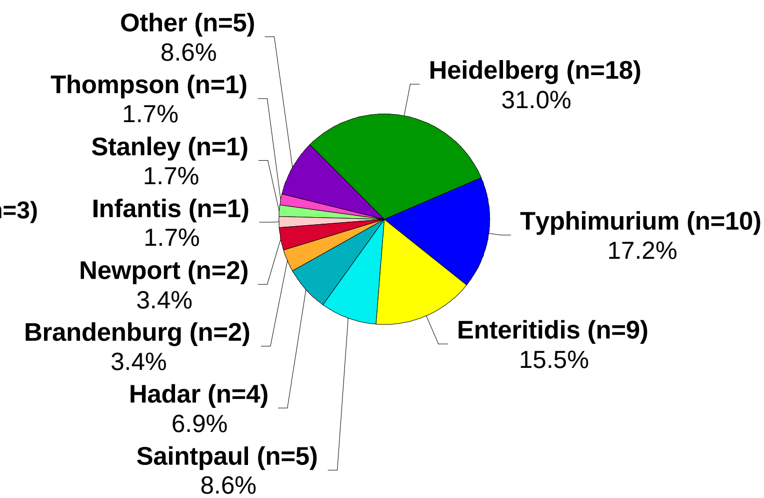

New Brunswick
(n=121)
Enteritidis (n=36)
29.8%
Typhimurium (n=32)
26.4%
Other (n=8)
6.6%
Heidelberg (n=23)
19.0%
Hadar (n=1)
0.8%
Newport (n=7)
5.8%
Agona (n=1)
0.8%
Thompson (n=6)
5.0%
Subsp IV 48:g,z51:- (n=2)
1.7%
Johannesburg (n=2)
1.7%
Paratyphi B var. Java (n=3)
2.5%


Nova Scotia
(n=194)
Other (n=16)
8.2%
Saintpaul (n=2)
1.0%
Hadar (n=2)
1.0%
Typhimurium (n=70)
36.1%
Muenchen (n=3)
1.5%
Infantis (n=3)
1.5%
Brandenburg (n=3)
1.5%
Enteritidis (n=68)
35.1%
Thompson (n=4)
2.1%
Newport (n=5)
2.6%
Heidelberg (n=18)
9.3%

Prince Edward Island (n=18)



Newfoundland (n=58)



Northwest Territories/Nunavut (n=14)

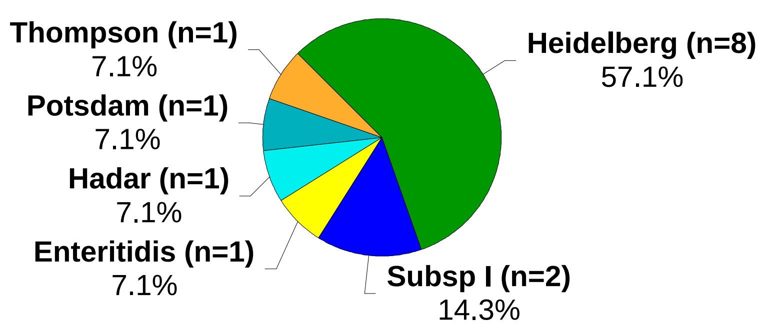
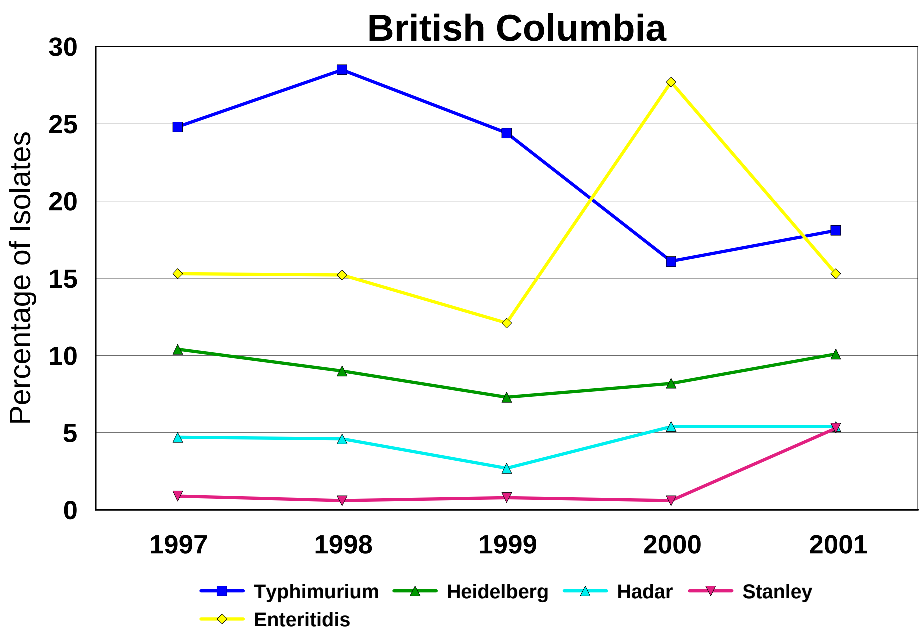
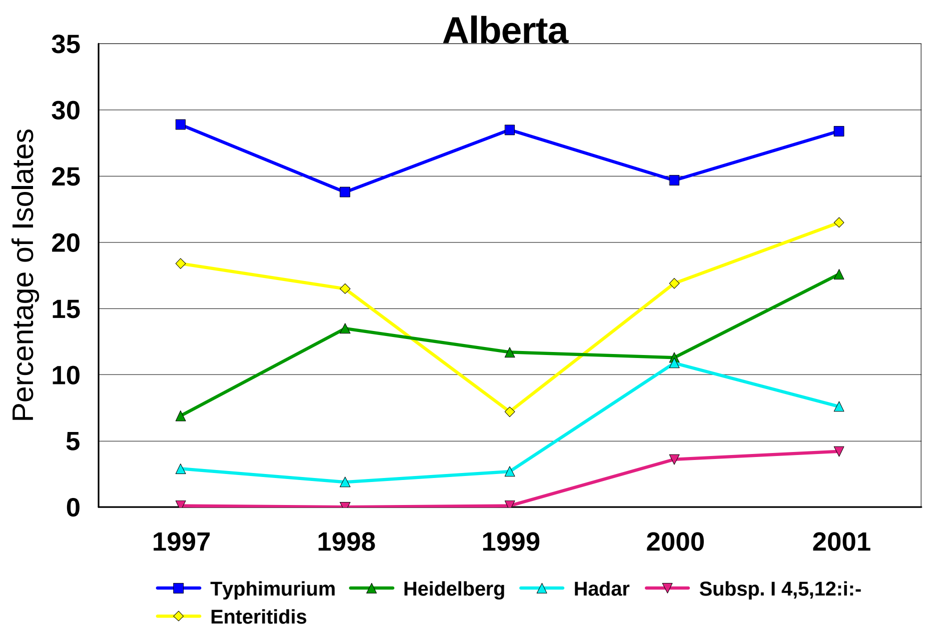
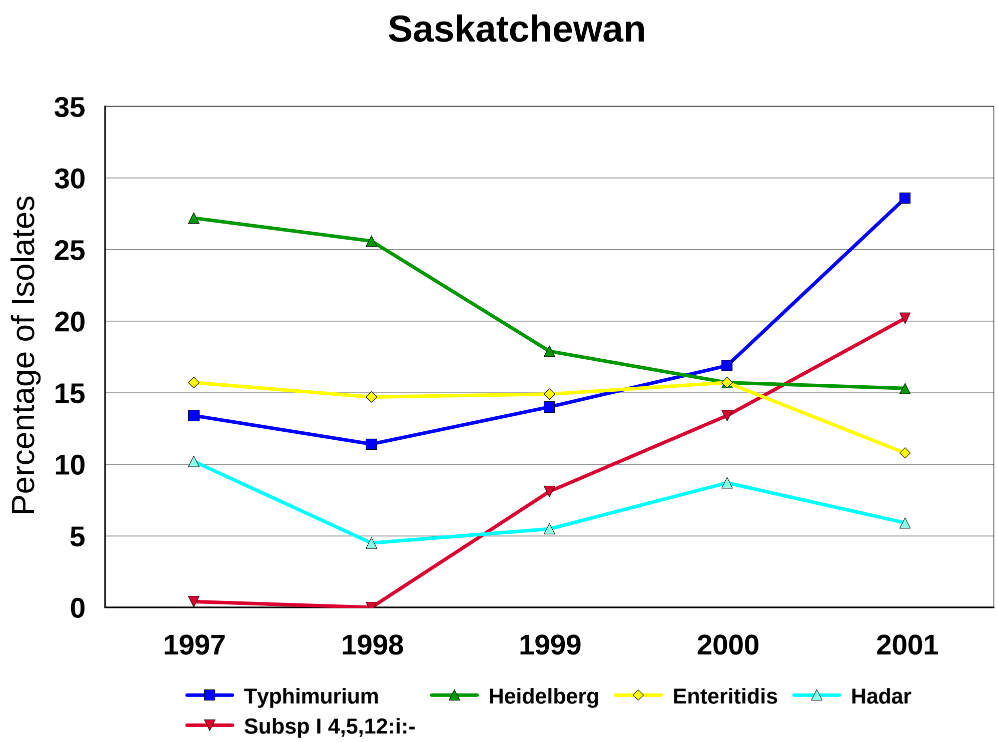


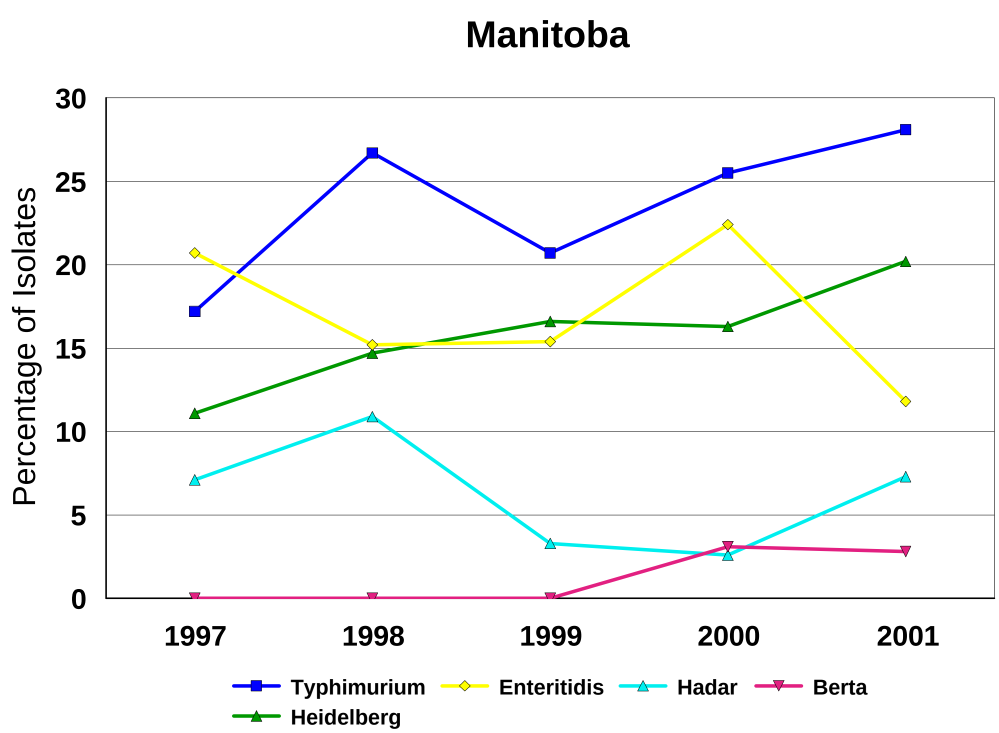
Figure 7 illustrates the variation of the five most prevalent serovars of 2001 from each province over the last 5 years. Data for previous years is taken from previous annual summaries which is based on information supplied to the NESP and supplemented with identifications from the NML reference services. Although 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. Most year to year fluctuations in prevalence can be attributed to outbreaks of gastroenteritis however longer trends such as the increase in *S*. subsp. I 4,5,12:i:- in Saskatchewan may indicate the emergence or recognition of a new pathogen.

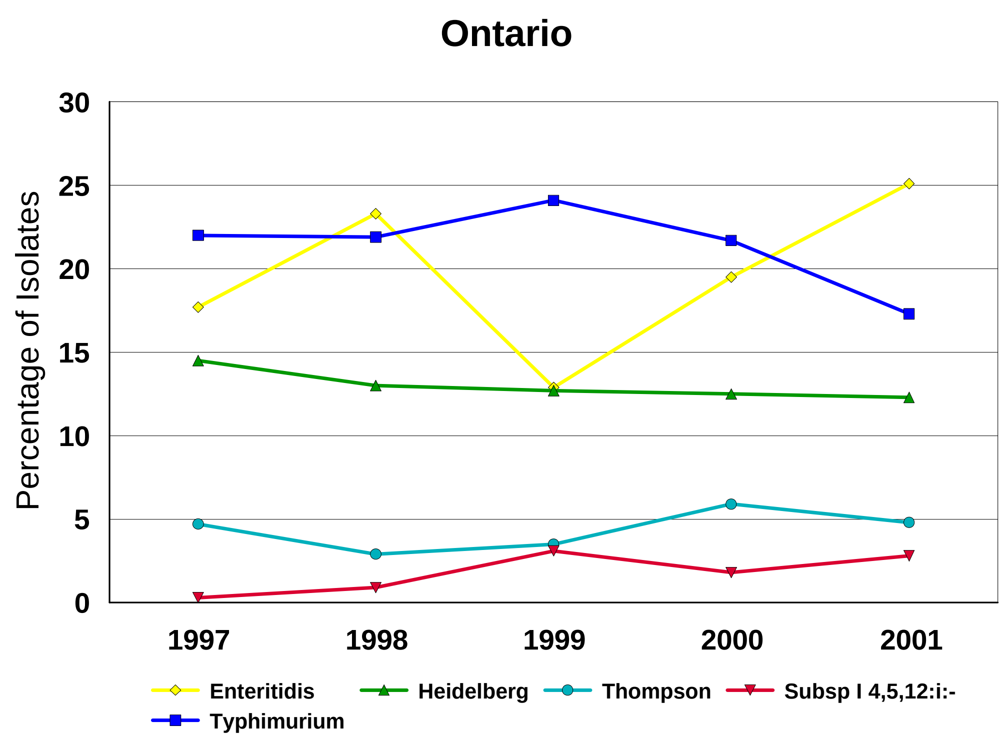
Figure 7: Five Most Prevalent *Salmonella* Serovars from Humans by Province, 1997 to 2001

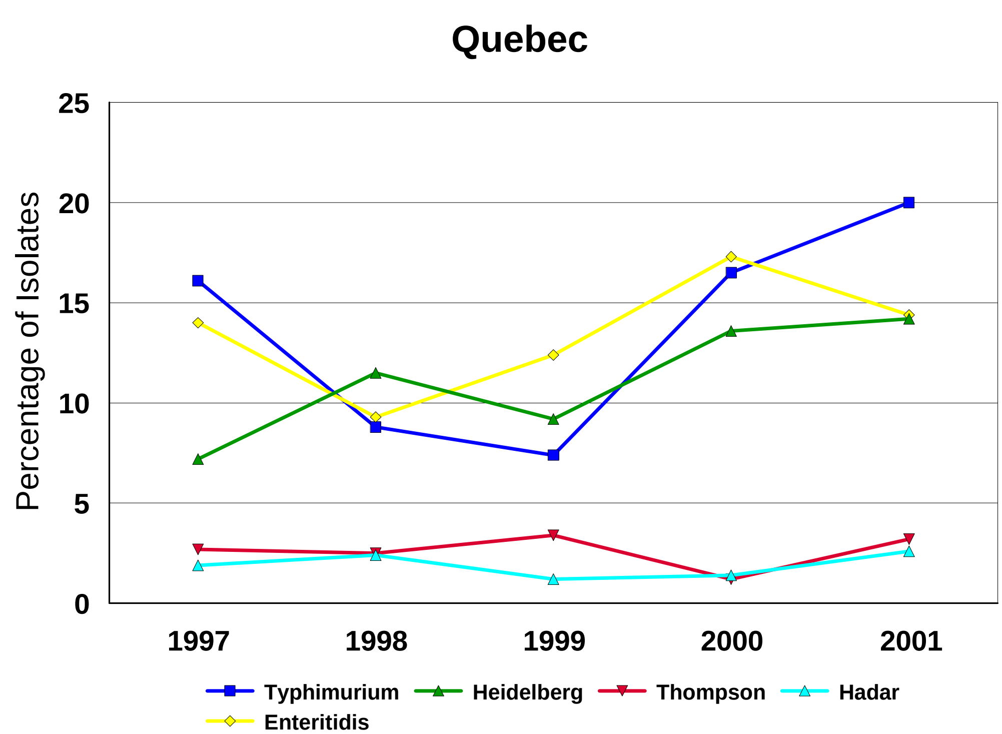


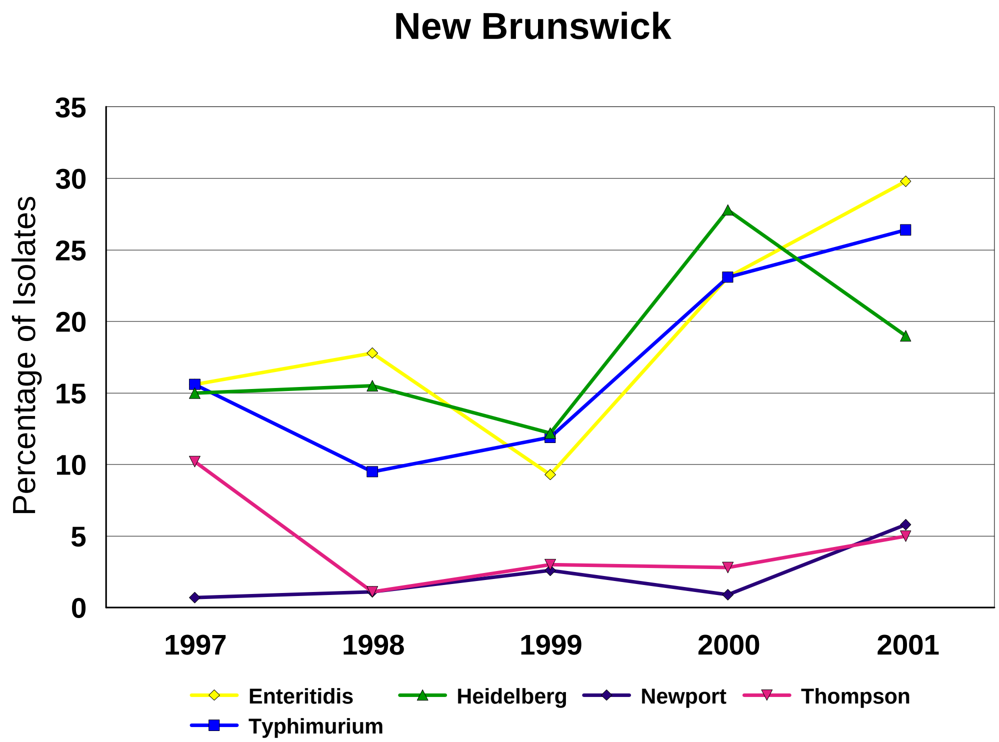


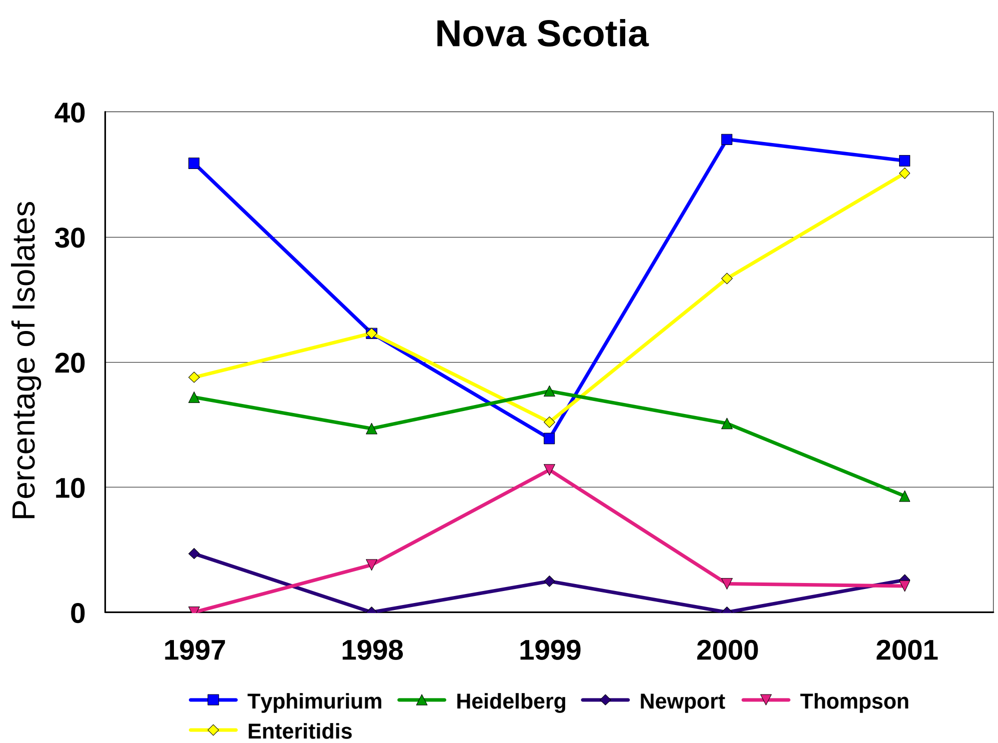

Saskatchewan
Percentage of Isolates
35
30
25
20
15
10
5
0
1997
1998
1999
2000
2001
Typhimurium
Heidelberg
Enteritidis
Hadar
Subsp I 4,5,12:i:-


Manitoba
Percentage of Isolates
30
25
20
15
10
5
0
1997
1998
1999
2000
2001
Typhimurium
Enteritidis
Hadar
Berta
Heidelberg

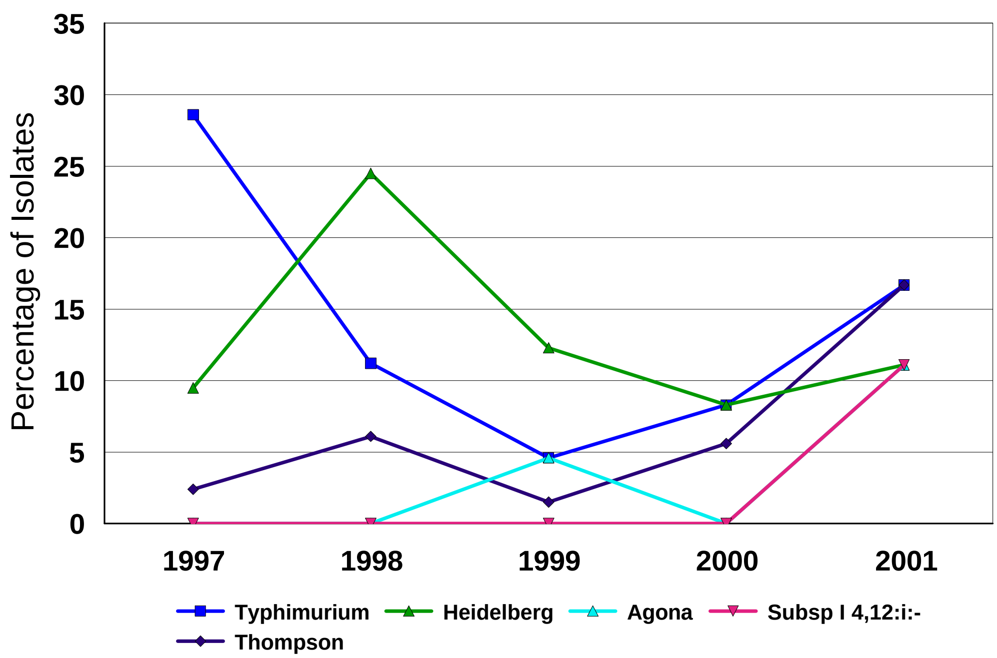

Ontario
Percentage of Isolates
0
5
10
15
20
25
30
1997
1998
1999
2000
2001
Enteritidis
Heidelberg
Thompson
Subsp I 4,5,12:i:-
Typhimurium


Quebec
Percentage of Isolates
0
5
10
15
20
25
1997
1998
1999
2000
2001
Typhimurium
Heidelberg
Thompson
Hadar
Enteritidis


New Brunswick
Percentage of Isolates
35
30
25
20
15
10
5
0
1997
1998
1999
2000
2001
Enteritidis
Heidelberg
Newport
Thompson
Typhimurium


Nova Scotia
Percentage of Isolates
40
30
20
10
0
1997
1998
1999
2000
2001
Typhimurium
Heidelberg
Newport
Thompson
Enteritidis

Prince Edward Island



Newfoundland

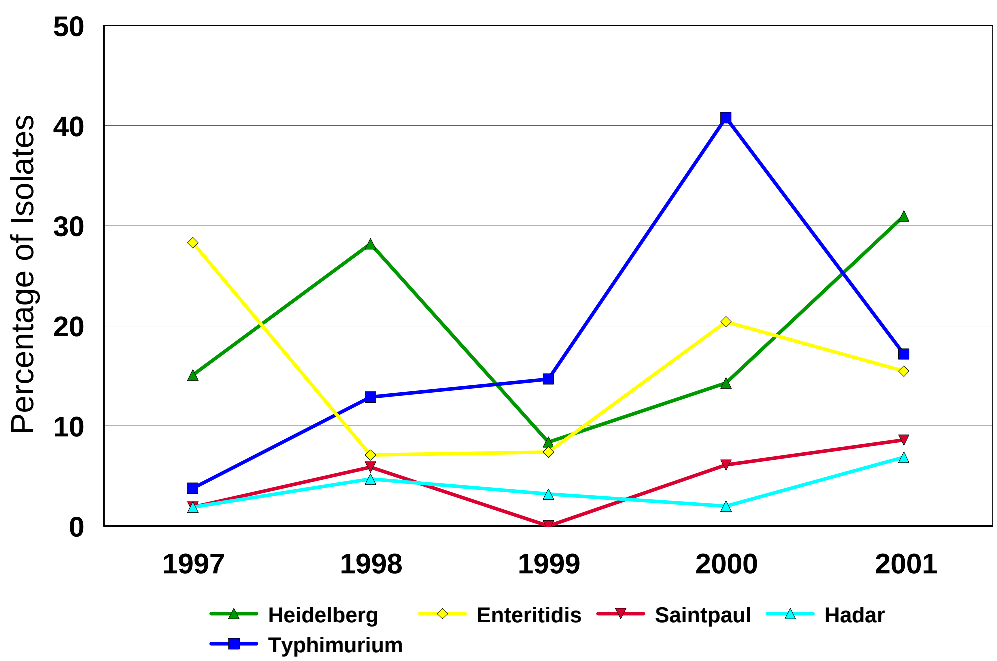


Table 1: *Salmonella* Serovars from Humans in Canada, 2001*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NWT	YK	Total
S. Aberdeen		1			2							1	4
S. Adelaide					4								4
S. Agbeni					1								1
S. Agona	18	10		1	74	11	1	1	2				118
S. Alachua	7	2			1								10
S. Albany					8	1							9
S. Amager		1											1
S. Amsterdam					2								2
S. Anatum	10	3			14	4							31
S. Arechavalcta		1											1
S. Bardo	1					1							2
S. Bareilly	2	1		1	3								7
S. Berta		1		5	39	4							49
S. Blockley	1	24	2		7	1							35
S. Bonariensis			1		1								2
S. Bonn	1												1
S. Bovismorbificans	1	3			9								13
S. Braenderup	1	11			18	4							34
S. Brandenburg	3	6			29	5		3	1	2			49
S. Bredeney	1				1								2
S. Bsilla				1									1
S. Butantan					2								2
S. California			1										1
S. Carmel						1							1
S. Cerro	1												1
S. Chester	10				3			1					14
S. Choleraesuis					3	1							4
S. Colindale	1												1
S. Corvallis		1											1
S. Coeln					1								1
S. Cremieu							1						1
S. Cubana	2	2			1								5
S. Daytona	3												3
S. Denver					2								2
S. Derby	3	4			19	1		1					28
S. Dublin	2	2			1								5
S. Duesseldorf	1							1					2
S. Durban					2								2
S. Eastbourne	1												1
S. Ealing						1							1
S. Elisabethville					2								2
S. Emek	1	2			2	1							6
S. Enteritidis	125	176	22	21	753	156	36	68	1	9	1	1	1369
S. Fluntern		1											1
S. Fresno	2												2
S. Galiema		2			1								3
S. Gaminara		1											1
S. Gatuni								1					1
S. Give	1	4	1		6				1				13
S. Goldcoast					1								1
S. Grumpensis	1					1							2
S. Haardt					1								1
S. Hadar	44	62	12	13	83	28	1	2		4	1		250
S. Haifa					2								2
S. Hartford					10	1							11
S. Havana		1			11	1							13

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NWT	YK	Total
S. Heidelberg	83	144	31	36	369	154	23	18	2	18	8		886
S. Hindmarsh													
S. Hvittingfoss		1			4	1							6
S. Ibadan						1							1
S. Indiana					2								2
S. Infantis	27	15	1	1	65	8		3		1			121
S. Inverness					1								1
S. Irumu	3												3
S. Istanbul				1	2	3							6
S. Itami	2				1								3
S. Jangwani								2					2
S. Javiana	6	5			17	5				1			34
S. Johannesburg		1			5		2						8
S. Kaapstad					1								1
S. Kapemba	1												1
S. Kedougou					2								2
S. Kentucky	2	4		1	5	2							14
S. Kiambu	1	2			2	1		2					8
S. Kintambo					3								3
S. Kottbus	3				1								4
S. Krefeld					1								1
S. Litchfield	2				13	1							16
S. Livingstone					3								3
S. Lomalinda				1									1
S. London		1			1								2
S. Manhattan	1	1		1	1					1			5
S. Mbandaka	7	4		3	15	1							30
S. Meleagridis					2								2
S. Memphis	1												1
S. Menston					1								1
S. Mgulani					1								1
S. Miami	2				2		1						5
S. Mikawasima	1	2											3
S. Milwaukee		1											1
S. Minnesota		2			1	1							4
S. Mississippi		3			8			1					12
S. Monschaui	1				1	1							3
S. Montevideo	12	10		4	23	4							53
S. Muenchen	5	3		3	18	7		3	1	1			41
S. Muenster	2	2			9	26	1						40
S. Newbrunswick		1											1
S. Newport	36	9	6	3	69	8	7	5		2			145
S. Nima					1								1
S. Norwich	1												1
S. Ohio	4	4		1	5	1							15
S. Oranienburg	8	6	3	2	14	1		1					35
S. Orion					2								2
S. Oslo	1	1	1		5								8
S. Ouakam					1								1
S. Pakistan						1							1
S. Panama	3	4	1	2	11	6				1			28
S. Paratyphi A	9	6		1	22	5		1					44
S. Paratyphi B			1		2	2	1			1			7
S. Paratyphi B var. Java	25	6	4	1	12	13	3						64
S. Paratyphi C						1							1
S. Pomona		2			1								3
S. Poona	4	4			2	2							12

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NWT	YK	Total
S. Potsdam		2									1		3
S. Putten					3								3
S. Ramatgan					1								1
S. Reading		1				1	1						3
S. Richmond					1								1
S. Rissen	2	3			1								6
S. Romanby	1												1
S. Rubislaw	1	4											5
S. Saintpaul	10	9	3	2	55	10		2	1	5			97
S. Sandiego	4	9	1	3	13	6							36
S. Scarborough					1								1
S. Schwarzengrund	1	2			7	2							12
S. Senftenberg	9	5	2		14			1					31
S. Stanley	43	27		2	21	9	1		1	1			105
S. Stanleyville		2			3								5
S. Tallahassee					1								1
S. Teko	1												1
S. Telelkebir					2								2
S. Tennessee	1	1			3	1							6
S. Thompson	14	14	5	5	145	35	6	4	3	1	1		233
S. Typhi	22	4		3	76	10							115
S. Typhimurium	148	232	58	50	518	217	32	70	3	10			1338
S. Uganda	2	1		1	33	4							41
S. Uno					1								1
S. Urbana	2	2	1		4	3							12
S. Virchow	8	6			22	3		1					40
S. Virginia	1												1
S. Welikade		1											1
S. Weltevreden	6	5		2	13								26
S. Worthington			1		1	3							5
S. Zanzibar					2								2
Salmonella ssp I 4,12:-:-				2		1							3
Salmonella ssp I 4,5,12:-:-					10								10
Salmonella ssp I 4,5,12:-:1,2					1								1
Salmonella ssp I 4,5,12:-:1,7		1											1
Salmonella ssp I 4,12:b:-	1	1											2
Salmonella ssp I 4,5,12:b:-		5	1	1	33	5							45
Salmonella ssp I 4,5,12:d:-					3								3
Salmonella ssp I 4,5,12:eh:-					3								3
Salmonella ssp I 4,12:i:-					1	2		1	2				6
Salmonella ssp I 4,5,12:i:-	17	34	41	3	84		1	1					181
Salmonella ssp I 4,5,12:r:-					3								3
Salmonella ssp I 4,5,12:z:-					2								2
Salmonella ssp I 4,12:z10:-	1												1
Salmonella Group B						54							54
Salmonella Group C						15							15
Salmonella ssp I 6,7:-:-							1						1
Salmonella ssp I 6,7:-:1,6	1												1
Salmonella ssp I 6,7:b:-					2								2
Salmonella ssp I 6,7:eh:-					8								8
Salmonella ssp I 6,7:k:-					1								1
Salmonella ssp I 6,7:z4,z24:-			1										1
Salmonella ssp I 6,7:z10:-	4				1								5
Salmonella Group C1						68							68
Salmonella ssp I 6,8:-:-					1								1
Salmonella ssp I 6,8:d:-					4								4
Salmonella ssp I 6,8:e,h:-					8								8

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NWT	YK	Total
Salmonella ssp I 6,8:k:-					1								1
Salmonella ssp I 6,8:z10:-		1			3								4
Salmonella Group C2						40							40
Salmonella ssp I 8,20:-:z6					1								1
Salmonella ssp I 8,20:d:-					1								1
Salmonella ssp I 8,20:i:-					3								3
Salmonella Group C3						2							2
Salmonella ssp I 9,12:-:-					3								3
Salmonella ssp I 9,12:-:1,5					2								2
Salmonella ssp I 9,12:-:e,n,z15					1								1
Salmonella ssp I 9,12:l,v:-		2			2								4
Salmonella ssp I 9,12:l,z28:-	3		1										4
Salmonella Group D						9							9
Salmonella ssp I 3,10:-:-	3												3
Salmonella ssp I 3,10:-:1,5	3				1								4
Salmonella ssp I 3,10:eh:-	1	1			2								4
Salmonella Group E						6							6
Salmonella ssp I 3,15:eh:-		2			1								3
Salmonella Group E4						1							1
Salmonella ssp I 13,22:z:-					1								1
Salmonella ssp I 13,23:b:-					1								1
Salmonella Group I (O:16)						2							2
Salmonella ssp I 30:b:-					1								1
Salmonella ssp I 44:z10:-					1								1
Salmonella ssp I Rough-O:-:e,n,z15		1											1
Salmonella ssp I Rough-O:d:1,7					2								2
Salmonella ssp I Rough-O:e,h:-		1											1
Salmonella ssp I Rough-O:k:1,5				1		2							3
Salmonella ssp I Rough-O:r:1,2						2							2
Salmonella ssp I Rough-O:z10:e,n,z15						1							1
Salmonella ssp I Rough-O:z29:-		1			2								3
Salmonella ssp I	4					82					2		88
Salmonella ssp II 18:z4,z23:-	1												1
Salmonella ssp II 58:l,z13,z28:z6					1								1
Salmonella ssp IIIb 14:z10:z		1											1
Salmonella ssp IIIb 48:z52:z					1								1
Salmonella ssp IIIb 50:k:z	4				1								5
Salmonella ssp IIIb 58:z10:e,n,x,z15					1								1
Salmonella ssp IIIb 61:c:z35						1							1
Salmonella ssp IIIb 61:k:1,5					2	2							4
Salmonella ssp IIIb 61:l,v:1,5,7					1								1
Salmonella ssp IIIb 65:l,v:z		1											1
Salmonella ssp IIIb		1											1
Salmonella ssp IV 11:z4,z23:-					2	1							3
Salmonella ssp IV 16:z4,z32:-	1				1	2							4
Salmonella ssp IV 21:z4,23:-					1								1
Salmonella ssp IV 43:z36,z38:-						1							1
Salmonella ssp IV 44:z4,z23:-		2			1	2							5
Salmonella ssp IV 45:g,z51:-					2								2
Salmonella ssp IV 48:g,z51:-		2			3	2	2						9
Salmonella ssp IV 50:g,z51:-	1					1							2
Salmonella ssp IV 50:z4,z23:-		1											1
Salmonella ssp IV			1										1
TOTAL	**818**	**954**	**203**	**178**	**2998**	**1087**	**121**	**194**	**18**	**58**	**14**	**2**	**6645**

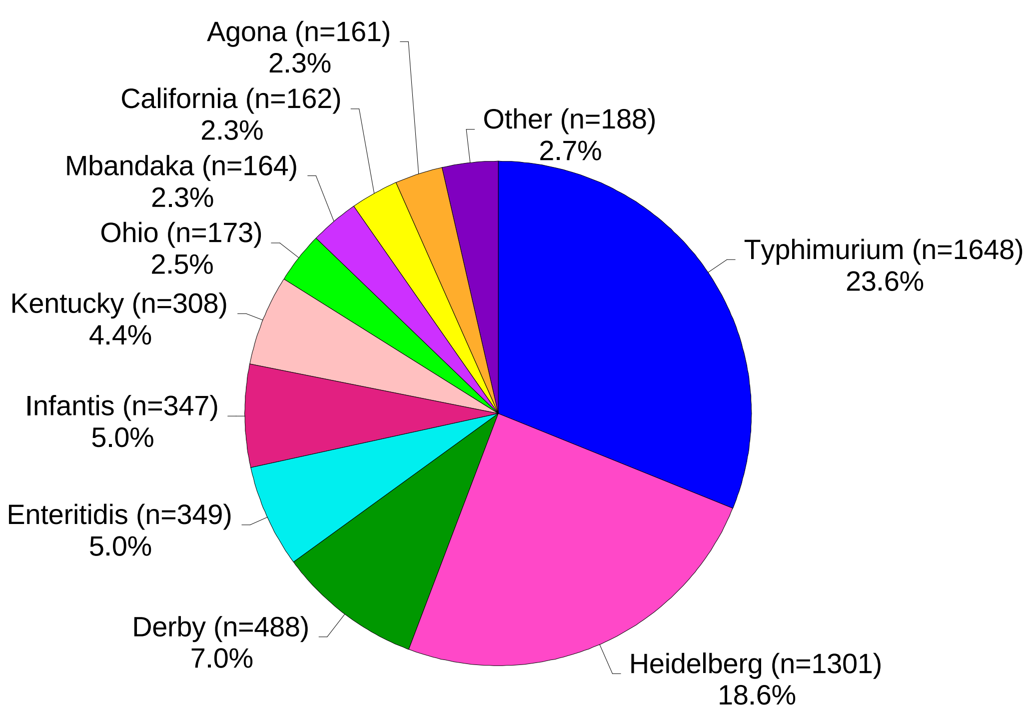
* Serovar totals are laboratory confirmed isolates based on information supplied to the NESP and supplemented with identifications from NML reference services. Numbers of provincial isolates are adjusted by adding enough *Salmonella* sp. to bring totals to those of the national notifiable disease data. Data is representive of laboratory confirmed isolates only, and should not be confused with incidence of disease. See Appendix 1 for details.

Salmonella Isolates from Non-Human Sources in Canada, 2001

Non-human sources include animal, food environmental or water and 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. Figure 8 shows the relative frequency of isolation of the most prevalent *Salmonella* serovars isolated from non-human sources in Canada. Data is collected by passive surveillance systems at LFZ and NML through reference services and outbreak investigations. The bulk of the data is from the annual report of the LFZ *Salmonella* Serotyping unit. Provincial totals are combined data of the non-human isolates identified by the LFZ and NML. For details of serovars from selected sources refer to Figure 11 on page 23 and Table 2 on page 25.

Overall, *S.* Typhimurium was the most prevalent serovar from non-human sources this year accounting for 31.2% of *Salmonella* isolations. *S*. Heidelberg has dropped to second this year accounting for 24.6% of the isolates after ranking first last year. *S*. Derby ranked third this year with 9.2% of the isolates, followed by *S*. Enteritidis and *S.* Infantis with 6.6%, *S*. Kentucky with 5.8% and then *S.* Ohio, *S.* Mbandaka, *S*. California and *S*. Agona with approximately 3%.

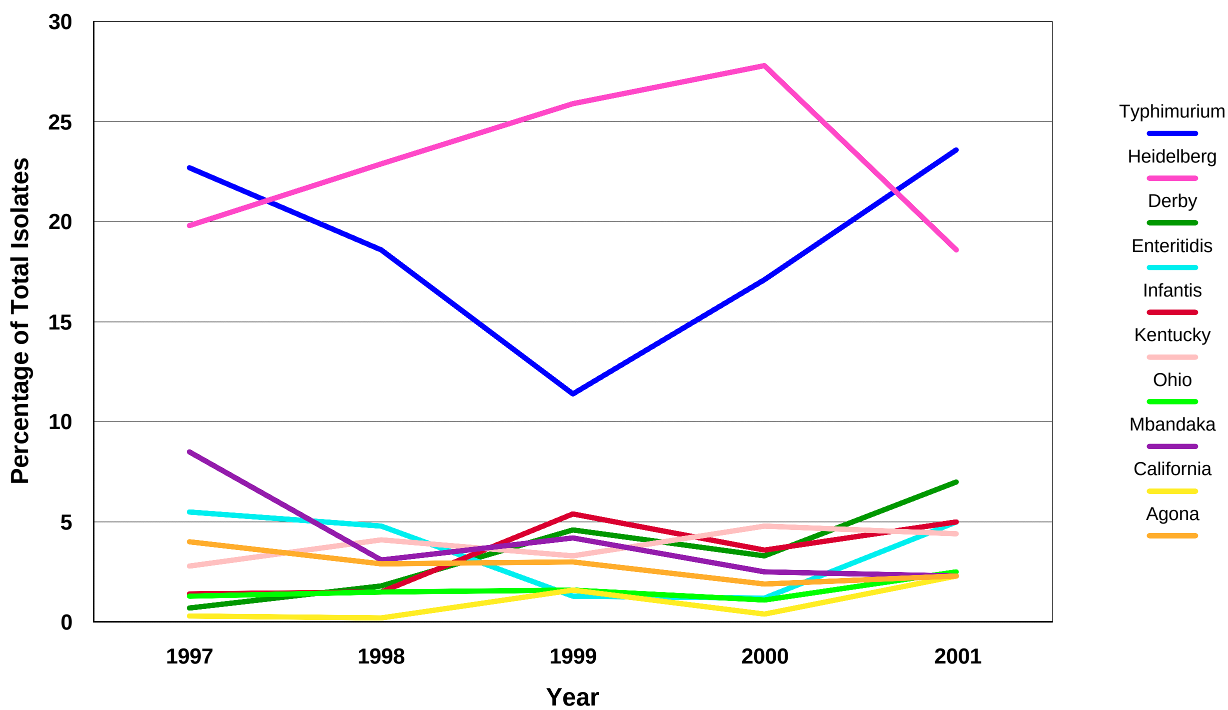
Figure 8: Ten Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 2001 (N=6989)



Changes in the Occurance of *Salmonella* Serovars from Non-Human Sources in Canada, 1997 to 2001

The relative frequencies of the 10 most prevalent *Salmonella* from non-human sources for each of the previous 5 years are shown in Figure 9. After a decline in 1999, *S*. Typhimurium isolations have once again surpassed *S*. Heidelberg and ranked as the most frequently isolated serovar. These two serovars have consistently been the most prevalent serovars isolated over the last 5 years. The other 8 most prevalent serovars remain below approximately 5% of total *Salmonella*. *S*. Kentucky has dropped to fifth most prevalent from third last year and *S.* Derby and *S*. Enteritidis isolations have increased to 3rd and 4th, respectively, in 2001. New to the top ten this year is *S*. California and *S*. Ohio.

Figure 9: Ten Most Prevalent *Salmonella* Serovars from Non-Human Sources in Canada, 1997 to 2001*



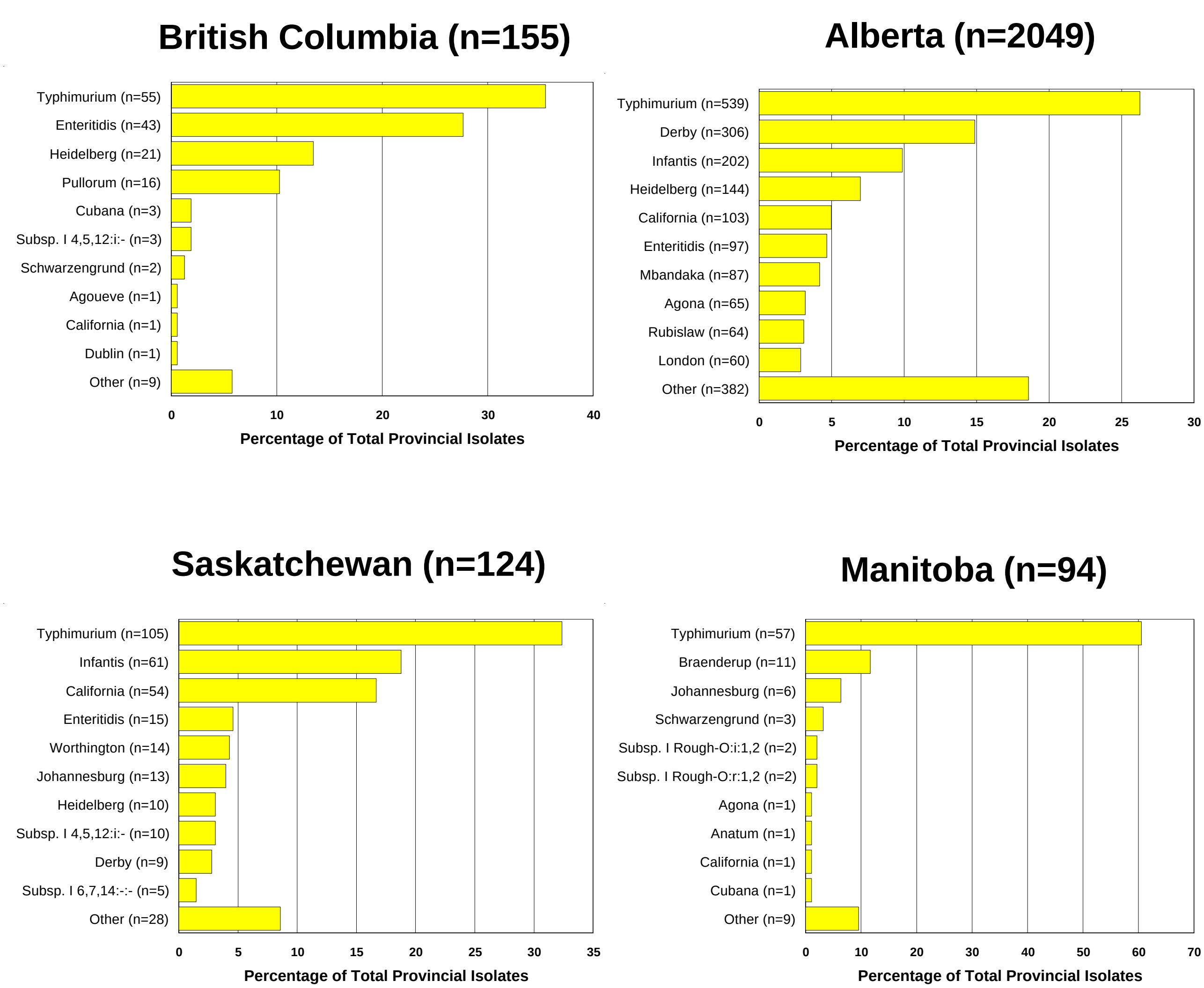
* Non-human sources include food, water, animal and environmental sources. Serovar totals are laboratory confirmed isolates based on information gathered through passive surveillance at the LFZ and NML through routine reference services. Although data is representive of laboratory confirmed isolates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

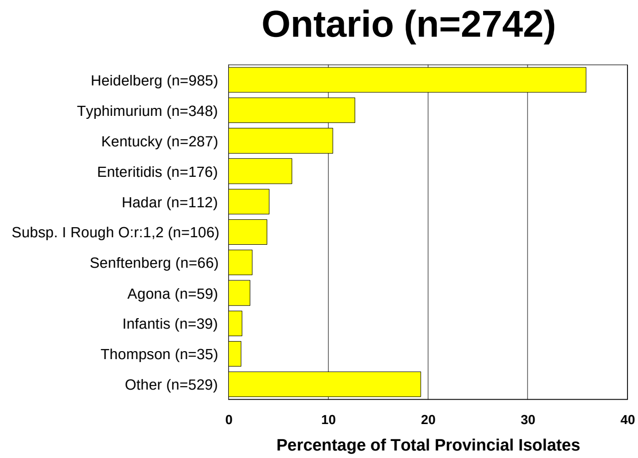
Provincial Distribution of *Salmonella* Serovars from Non-Human Sources in 2001

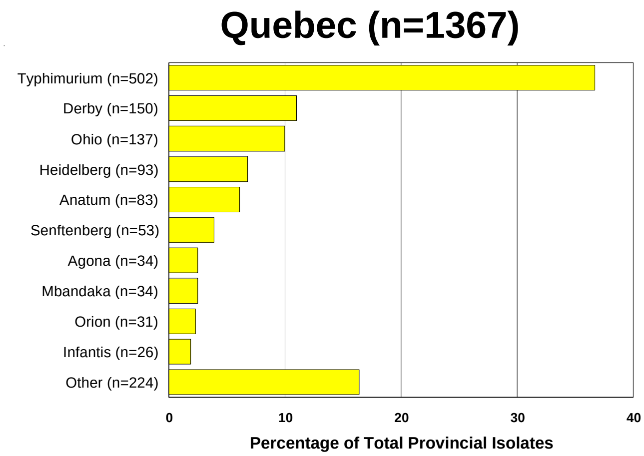
Non-human data is gathered through passive surveillance systems of the LFZ and NML in the course of reference services, special studies and outbreak investigations. There is no control of the relative numbers forwarded by a province. Large numbers of isolates should not be interpreted as incidence of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

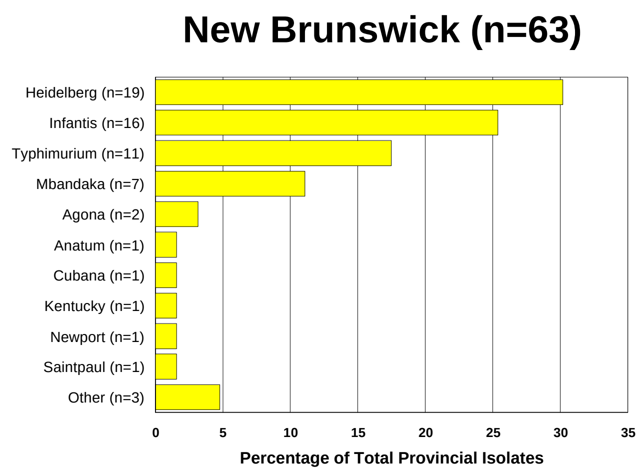
The most common *Salmonella* serovars from non-human origin in Canada by province are shown in Figure 10. *S.* Typhimurium ranked first in British Columbia, Alberta, Saskatchewan, Manitoba, Quebec and Nova Scotia. *S*. Heidelberg ranked first in Ontario, New Brunswick and Prince Edward Island. A large number of samples associated with a survey of chicken farms in Newfoundland resulted in *S.* Braenderup ranking first in that province.

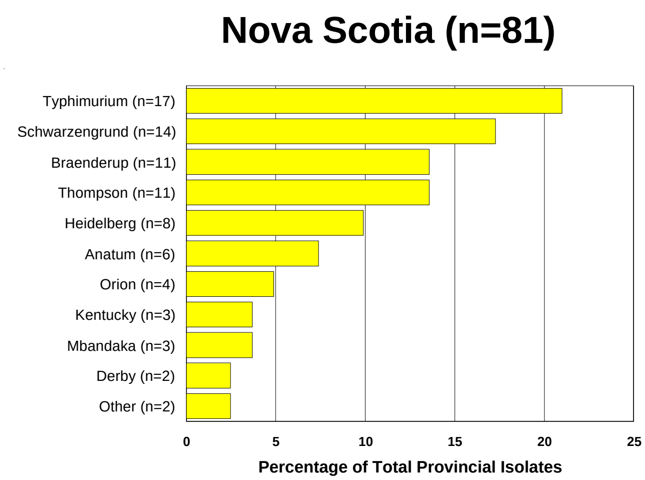
Figure 10: Ten Most Prevalent *Salmonella* Serovars of Non-Human Origin in Each Province, 2001

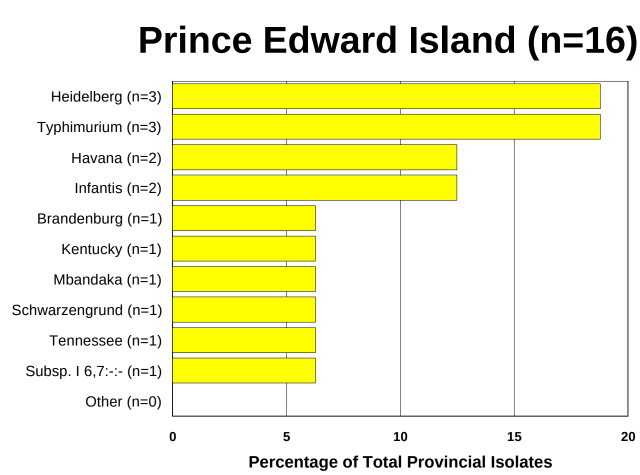


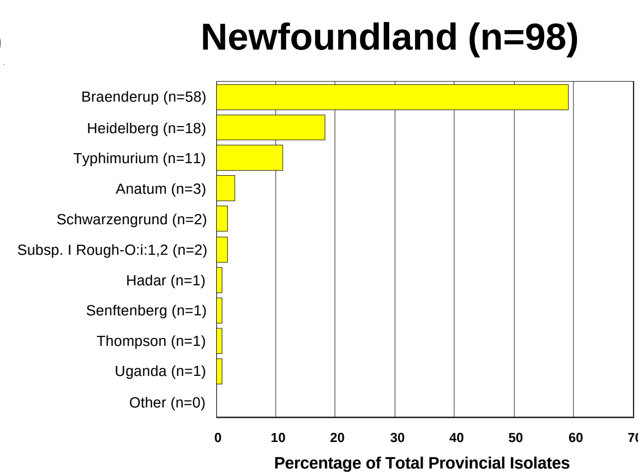

Ontario (n=2742)
Heidelberg (n=985)
Typhimurium (n=348)
Kentucky (n=287)
Enteritidis (n=176)
Hadar (n=112)
Subsp. I Rough O:r:1,2 (n=106)
Senftenberg (n=66)
Agona (n=59)
Infantis (n=39)
Thompson (n=35)
Other (n=529)
0
10
20
30
40
Percentage of Total Provincial Isolates


Quebec (n=1367)
Typhimurium (n=502)
Derby (n=150)
Ohio (n=137)
Heidelberg (n=93)
Anatum (n=83)
Senftenberg (n=53)
Agona (n=34)
Mbandaka (n=34)
Orion (n=31)
Infantis (n=26)
Other (n=224)
0
10
20
30
40
Percentage of Total Provincial Isolates


New Brunswick (n=63)
Heidelberg (n=19)
Infantis (n=16)
Typhimurium (n=11)
Mbandaka (n=7)
Agona (n=2)
Anatum (n=1)
Cubana (n=1)
Kentucky (n=1)
Newport (n=1)
Saintpaul (n=1)
Other (n=3)
0
5
10
15
20
25
30
35
Percentage of Total Provincial Isolates


Nova Scotia (n=81)
Typhimurium (n=17)
Schwarzengrund (n=14)
Braenderup (n=11)
Thompson (n=11)
Heidelberg (n=8)
Anatum (n=6)
Orion (n=4)
Kentucky (n=3)
Mbandaka (n=3)
Derby (n=2)
Other (n=2)
0
5
10
15
20
25
Percentage of Total Provincial Isolates

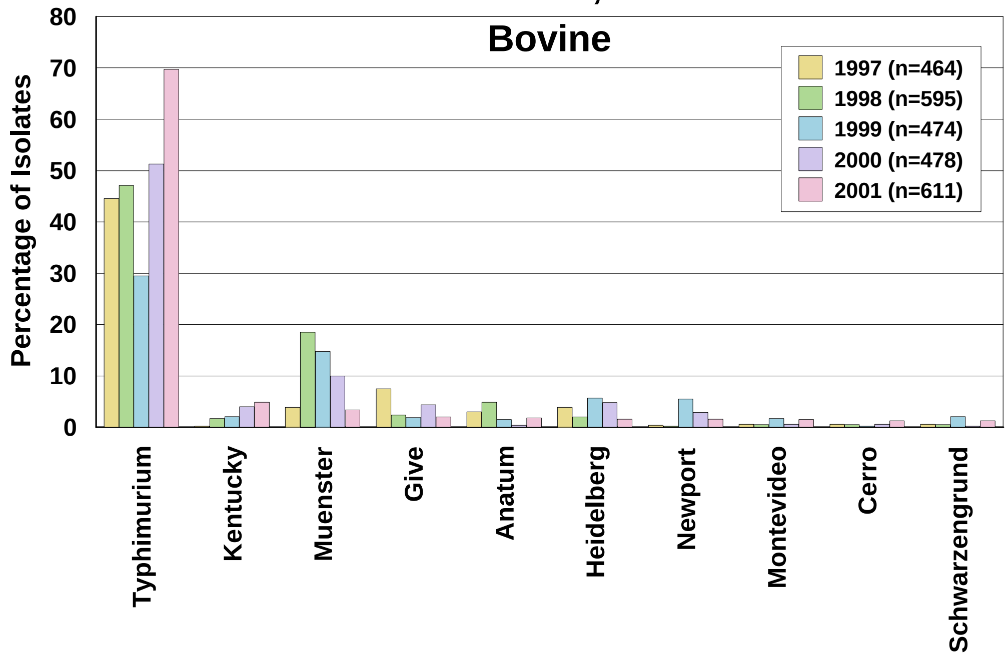

Prince Edward Island (n=16)
Heidelberg (n=3)
Typhimurium (n=3)
Havana (n=2)
Infantis (n=2)
Brandenburg (n=1)
Kentucky (n=1)
Mbandaka (n=1)
Schwarzengrund (n=1)
Tennessee (n=1)
Subsp. I 6,7:-:- (n=1)
Other (n=0)
0
5
10
15
20
Percentage of Total Provincial Isolates

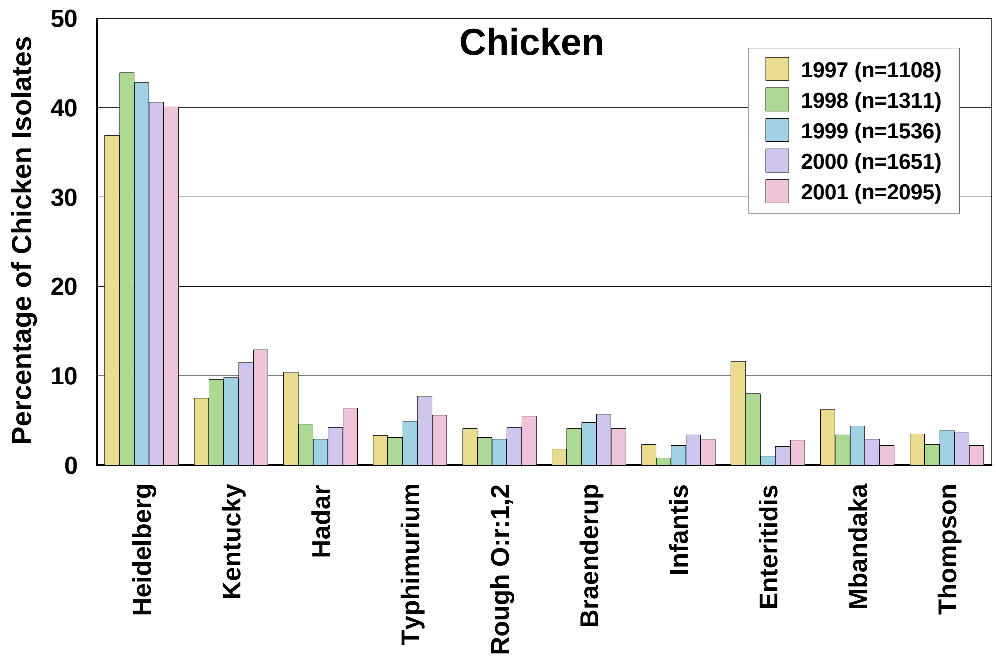

Newfoundland (n=98)
Braenderup (n=58)
Heidelberg (n=18)
Typhimurium (n=11)
Anatum (n=3)
Schwarzengrund (n=2)
Subsp. I Rough-O:i:1,2 (n=2)
Hadar (n=1)
Senftenberg (n=1)
Thompson (n=1)
Uganda (n=1)
Other (n=0)
0
10
20
30
40
50
60
70
Percentage of Total Provincial Isolates

Source Distribution of *Salmonella* Serovars in Canada, 1997 to 2001

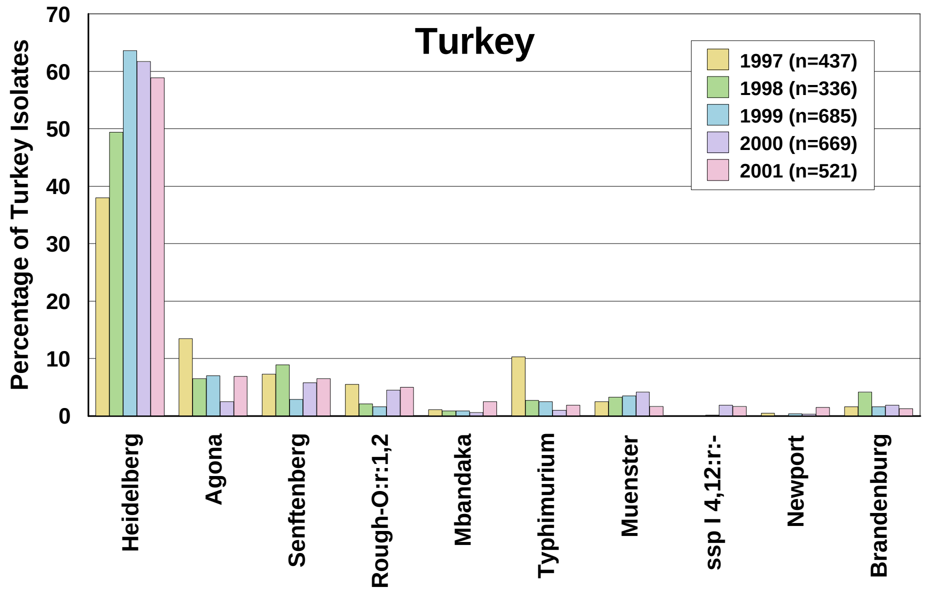
The ten most prevalent *Salmonella* serovars found in bovine, chicken, turkey, porcine and feed sources are shown in Figure 11. *S*. Heidelberg was the most prevalent serovar in turkey and chicken sources, whereas *S*. Typhimurium was most prevalent in bovine and porcine sources. In feed and feed ingredients *S.* Brandenburg has become the most prevalent serovar this year and *S*. Mbandaka has now ranked second.

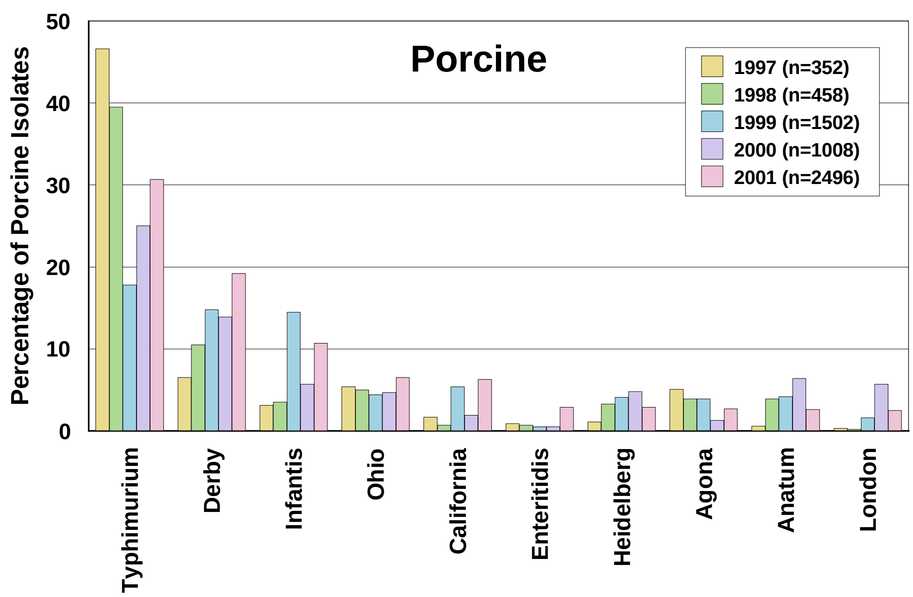
Figure 11: Ten Most Prevalent *Salmonella* Serovars from Selected Sources in Canada, 1997 to 2001*





* 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 representive of laboratory confirmed isolates and should not be confused with incidence of disease in animals. The subset of data is consistantly gathered and standardized from year to year and can indicate emerging or re-emerging trends. See Appendix 1 for details.


Turkey
Percentage of Turkey Isolates
0
10
20
30
40
50
60
70
1997 (n=437)
1998 (n=336)
1999 (n=685)
2000 (n=669)
2001 (n=521)
Heidelberg
Agona
Senftenberg
Rough-O:r:1,2
Mbandaka
Typhimurium
Muenster
ssp I 4,12:r:-
Newport
Brandenburg


Porcine
Percentage of Porcine Isolates
0
10
20
30
40
50
1997 (n=352)
1998 (n=458)
1999 (n=1502)
2000 (n=1008)
2001 (n=2496)
Typhimurium
Derby
Infantis
Ohio
California
Enteritidis
Heidelberg
Agona
Anatum
London

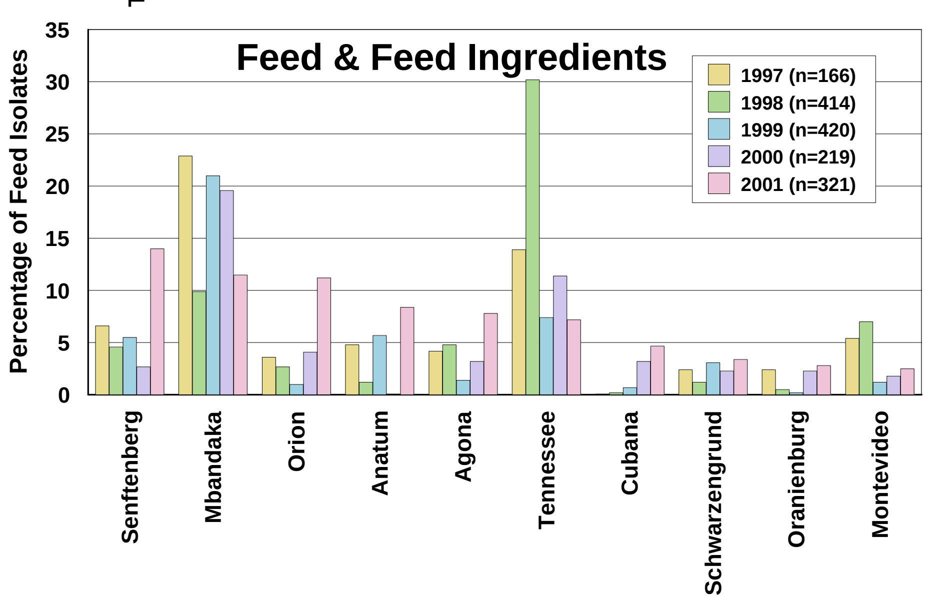

Feed & Feed Ingredients
Percentage of Feed Isolates
0
5
10
15
20
25
30
35
1997 (n=166)
1998 (n=414)
1999 (n=420)
2000 (n=219)
2001 (n=321)
Senftenberg
Mbandaka
Orion
Anatum
Agona
Tennessee
Cubana
Schwarzengrund
Oranienburg
Montevideo

Table 2: *Salmonella* Serovars from Non-Human Sources in Canada, 2001*

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Abaetetuba	Feed					1						1
S. Afula	Chicken			1								1
S. Agona	Avian							1				1
	Bovine					6						6
	Chicken		12			10		1				23
	Feed					2	23					25
	Parrot					1						1
	Porcine		52		1	6	9					68
	Turkey					34	2					36
	Water		1									1
	Subtotal	**0**	**65**	**0**	**1**	**59**	**34**	**2**	**0**	**0**	**0**	**161**
S. Agoueve	Snake	1										1
S. Alachua	Snake					1						1
S. Albany	Chicken					4						4
S. Amsterdam	Feed						1					1
S. Anatum	Bovine					10	1					11
	Chicken		5	1		1		1	6		3	17
	Equine					2						2
	Feed		1	1	1		24					27
	Other						1					1
	Porcine		5	1		1	57					64
	Turkey					4						4
	Subtotal	**0**	**11**	**3**	**1**	**18**	**83**	**1**	**6**	**0**	**3**	**126**
S. Bere	Feed					2						2
S. Berta	Canine					1						1
	Chicken					1						1
	Other					2						2
	Porcine					1	6					7
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**12**
S. Blockley	Unknown		1									1
S. Bludorp	Chameleon					1						1
S. Bovismorbicicans	Porcine					1						1
S. Braenderup	Avian						2					2
	Chicken		2		11	1	2		11		58	85
	Feed					1						1
	Porcine					1						1
	Poultry		1									1
	Turkey					1						1
	Unknown						1					1
	Subtotal	**0**	**3**	**0**	**11**	**4**	**5**	**0**	**11**	**0**	**58**	**92**

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Brandenburg	Canine					2						2
	Chicken					2						2
	Feed					4	1					5
	Fertilizer					1	1					2
	Porcine					8	20			1		29
	Turkey					7						7
	Subtotal	**0**	**0**	**0**	**0**	**24**	**22**	**0**	**0**	**1**	**0**	**47**
S. Bredeney	Turkey					2						2
S. California	Feed	1		1	1							3
	Porcine		100	53		1	2					156
	Water		3									3
	Subtotal	**1**	**103**	**54**	**1**	**1**	**2**	**0**	**0**	**0**	**0**	**162**
S. Carrau	Reptile		2									2
S. Cerro	Bovine					8						8
	Chicken					1						1
	Feed						1					1
	Porcine					2						2
	Subtotal	**0**	**0**	**0**	**0**	**11**	**1**	**0**	**0**	**0**	**0**	**12**
S. Cubana	Chicken		4					1				5
	Feed	3	4	1	1	5	1					15
	Porcine		14									14
	Water		1									1
	Subtotal	**3**	**23**	**1**	**1**	**5**	**1**	**1**	**0**	**0**	**0**	**35**
S. Derby	Chicken			2								2
	Compost					3						3
	Feed					1						1
	Porcine		306	7		15	150		2			480
	Turkey					1						1
	Unknown					1						1
	Subtotal	**0**	**306**	**9**	**0**	**21**	**150**	**0**	**2**	**0**	**0**	**488**
S. Dublin	Bovine		5									5
	Python	1										1
	Subtotal	**1**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
S. Eastbourne	Reptile			1								1
S. Emek	Fertilizer					1						1
S. Enteritidis	Almonds	15				149			1			165
	Avian					1	1					2
	Chicken	14	21	1		17	6					59
	Chicken Litter		1									1
	Chinchilla						1					1
	Egg Environmental	6										6
	Eggs						2					2
	Elk		1									1
	Environmental						2					2
	Equine			14								14
	Nut	4										4
	Other					3	4					7

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Enteritidis cont'd	Porcine		72									72
	Unknown	4	1			5	1					11
	Water		1			1						2
	Subtotal	**43**	**97**	**15**	**0**	**176**	**17**	**0**	**1**	**0**	**0**	349
S. Fluntern	Gecko		1									1
S. Give	Avian						1					1
	Bovine					12						12
	Chicken					5	1					6
	Porcine		4				1					5
	Turkey					1						1
	Water		5									5
	Subtotal	**0**	**9**	**0**	**0**	**18**	**3**	**0**	**0**	**0**	**0**	30
S. Glostrup	Chicken					1						1
S. Hadar	Bovine					2						2
	Chicken		26			105	3				1	135
	Chicken Litter		7									7
	Environmental		1									1
	Feed					1	1					2
	Poultry		1									1
	Turkey					3	1					4
	Unknown		2									2
	Vegetable					1						1
	Water		1									1
	Subtotal	**0**	**38**	**0**	**0**	**112**	**5**	**0**	**0**	**0**	**1**	156
S. Hartford	Turkey					1						1
S. Havana	Chicken									2		2
	Feed						6					6
	Porcine					1	1					2
	Subtotal	**0**	**0**	**0**	**0**	**1**	**7**	**0**	**0**	**2**	**0**	**10**
S. Heidelberg	Alpaca									1		1
	Avian					4	13	1				18
	Bovine		3			7						10
	Chicken	10	98	5		680	7	14	8		18	840
	Chicken Litter		29									29
	Egg Environmental	6										6
	Environmental		1									1
	Feed						3					3
	Mink	1										1
	Porcine		5	5		5	57					72
	Poultry	1										1
	Raccoon	1										1
	Turkey	1	1			289	12	4				307
	Unknown	1	5				1			2		9
	Water		2									2
	Subtotal	**21**	**144**	**10**	**0**	**985**	**93**	**19**	**8**	**3**	**18**	1301
S. Hvittingfoss	Crocodile					1						1
S. Indiana	Avian						7					7
	Chicken		1			8						9

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Indiana cont'd	Duck					3						3
	Other					1						1
	Subtotal	**0**	**1**	**0**	**0**	**12**	**7**	**0**	**0**	**0**	**0**	**20**
S. Infantis	Avian						2					2
	Bovine					1		1				2
	Chicken		15	5		24		15		2		61
	Feed				1		4					5
	Porcine		187	56		14	10					267
	Soil						10					10
	Subtotal	**0**	**202**	**61**	**1**	**39**	**26**	**16**	**0**	**2**	**0**	**347**
S. Istanbul	Other					1						1
S. Johannesburg	Avian			8								8
	Chicken			4	5	2						11
	Feed				1	2						3
	Poultry Farm			1								1
	Unknown						1					1
	Subtotal	**0**	**0**	**13**	**6**	**4**	**1**	**0**	**0**	**0**	**0**	**24**
S. Kentucky	Bovine					28	2					30
	Chicken		8			256	2	1	3			270
	Equine						1			1		2
	Feed			1		1						2
	Porcine					2						2
	Turkey						2					2
	Subtotal	**0**	**8**	**1**	**0**	**287**	**7**	**1**	**3**	**1**	**0**	**308**
S. Kiambu	Bovine					1						1
	Chicken					6						6
	Subtotal	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**7**
S. Krefeld	Porcine					4	2					6
S. Lexington	Feed						4					4
	Other						2					2
	Unknown					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**6**	**0**	**0**	**0**	**0**	**7**
S. Lille	Feed						1					1
	Turkey					4						4
	Subtotal	**0**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**5**
S. Litchfield	Chicken					3	2					5
	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**4**	**2**	**0**	**0**	**0**	**0**	**6**
S. Livingstone	Canine			1								1
	Feed					4	1					5
	Porcine					2	1					3
	Turkey					1						1
	Subtotal	**0**	**0**	**1**	**0**	**7**	**2**	**0**	**0**	**0**	**0**	**10**
S. London	Bovine					3						3
	Porcine		60	1		1						62
	Turkey					1						1
	Subtotal	**0**	**60**	**1**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**66**

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Manhattan	Avian			1								1
S. Mbandaka	Avian							1				1
	Bovine		1			1						2
	Canine		1									1
	Chicken		36			2		6	2	1		47
	Equine					1						1
	Feed				1	4	32					37
	Porcine		46			4	2		1			53
	Reptile					2						2
	Snake					3						3
	Turkey					13						13
	Unknown					1						1
	Water		3									3
	Subtotal	**0**	**87**	**0**	**1**	**31**	**34**	**7**	**3**	**1**	**0**	**164**
S. Meleagridis	Feed				1	1	1					3
S. Minnesota	Feed					1						1
	Other						2					2
	Subtotal	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**3**
S. Molade	Feed					1	1					2
S. Montevideo	Avian						3					3
	Bovine					8	1					9
	Chicken		5	1		3						9
	Feed		1		1	6						8
	Fertilizer			1								1
	Turkey					5						5
	Subtotal	**0**	**6**	**2**	**1**	**22**	**4**	**0**	**0**	**0**	**0**	**35**
S. Muenchen	Chicken					1						1
	Feline					3						3
	Porcine					2						2
	Turkey					2						2
	Subtotal	**0**	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**8**
S. Muenster	Bovine					20			1			21
	Feed					1	1					2
	Turkey					8	1					9
	Subtotal	**0**	**0**	**0**	**0**	**29**	**2**	**0**	**1**	**0**	**0**	**32**
S. Newport	Bovine					9		1				10
	Chicken					2						2
	Equine					2						2
	Feed					3	1					4
	Gecko		1									1
	Nut					1						1
	Peanuts		1									1
	Snake		1			1						2
	Turkey					8						8
	Water		1									1
	Subtotal	**0**	**4**	**0**	**0**	**26**	**1**	**1**	**0**	**0**	**0**	**32**
S. Ohio	Avian						1					1
	Chicken Litter		2	1								3

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Ohio cont'd	Feed			1	1	1	2					5
	Fertilizer	1										1
	Porcine		22	1		5	133					161
	Turkey					1						1
	Unknown						1					1
	Subtotal	**1**	**24**	**3**	**1**	**7**	**137**	**0**	**0**	**0**	**0**	**173**
S. Oranienburg	Feed				1	6	2					9
S. Orion	Bovine					2			1			3
	Chicken					2			3			5
	Equine					1						1
	Feed					5	31					36
	Porcine		9									9
	Turkey					1						1
	Subtotal	**0**	**9**	**0**	**0**	**11**	**31**	**0**	**4**	**0**	**0**	**55**
S. Panama	Porcine		2									2
S. Paratyphi B	Unknown						4					4
S. Paratyphi B var. Java	Elk			1								1
	Unknown						14					14
	Water						1					1
	Subtotal	**0**	**0**	**1**	**0**	**0**	**15**	**0**	**0**	**0**	**0**	**16**
S. Pullorum	Chicken	16										16
S. Putten	Chicken					17						17
	Feed					1						1
	Porcine						4					4
	Turkey					3						3
	Subtotal	**0**	**0**	**0**	**0**	**21**	**4**	**0**	**0**	**0**	**0**	**25**
S. Reading	Turkey		2									2
S. Rissen	Chicken		17									17
	Porcine		1									1
	Subtotal	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**
S. Rubislaw	Chicken		10									10
	Feed		1	1								2
	Porcine		10									10
	Water		43									43
	Subtotal	**0**	**64**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**65**
S. Ruiru	Feed					1						1
S. Saintpaul	Feed							1				1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**2**
S. Schwarzengrund	Bovine					7	1					8
	Chicken		10		2	16	1	1	13	1	2	46
	Feed	2	1	3	1	4						11
	Porcine						2		1			3
	Quail					1						1

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Schwartzengrund	Turkey		2				1					3
cont'd	Water		1									1
	Subtotal	**2**	**14**	**3**	**3**	**28**	**5**	**1**	**14**	**1**	**2**	**73**
S. Senftenberg	Avian					1	1					2
	Canine		1								1	2
	Chicken		2			22						24
	Feed					9	36					45
	Other						1					1
	Porcine						15					15
	Turkey		1			33						34
	Unknown					1						1
	Water		1									1
	Subtotal	**0**	**5**	**0**	**0**	**66**	**53**	**0**	**0**	**0**	**1**	**125**
S. Stanley	Bovine					8						8
	Nut					1						1
	Unknown						5					5
	Subtotal	**0**	**0**	**0**	**0**	**9**	**5**	**0**	**0**	**0**	**0**	**14**
S. Tennessee	Bovine					3	3					6
	Chicken		5							1		6
	Feed				1	7	15					23
	Other						4					4
	Turkey					3						3
	Unknown					3						3
	Subtotal	**0**	**5**	**0**	**1**	**16**	**22**	**0**	**0**	**1**	**0**	**45**
S. Thompson	Chicken		1	3		31	1		10		1	47
	Chicken Litter		1									1
	Feed						1					1
	Porcine		9			1			1			11
	Turkey					3	1					4
	Water		2									2
	Subtotal	**0**	**13**	**3**	**0**	**35**	**3**	**0**	**11**	**0**	**1**	**66**
S. Typhimurium	Avian	1	2	9	14	1	16	3				46
	Beef						3					3
	Bison	2	1	1								4
	Bovine	26	176	47	10	105	57	2	1	2		426
	Canine		1				2					3
	Caprine					2						2
	Chicken	8	29		1	52		3	14		11	118
	Chicken Litter		1									1
	Duck	2				6	1					9
	Egg Environmental	2										2
	Elk		1									1
	Environmental		3									3
	Equine		2	3		23	16					44
	Feed					1	1					2
	Feline					1						1
	Finch		1	1		3						5
	Gerbil		1									1
	Gull						1		2			3
	Hamster		1									1
	Lapine					1						1
	Milk						22					22

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium cont'd	Other					3	3					6
	Ovine		2		3							5
	Parrot					1						1
	Pigeon	2	1			4	8					15
	Pine Siskin	6										6
	Pork	3	302	25	27	115	292	3				767
	Poultry	2	1				29					32
	Quail					2	8					10
	Raw						22					22
	Reptile		4									4
	Snake		2			2						4
	Sparrow			1		4						5
	Turkey				2	8						10
	Turtle									1		1
	Unknown		2	18		14	21					55
	Water		6									6
	Wolf	1										1
	Subtotal	**55**	**539**	**105**	**57**	**348**	**502**	**11**	**17**	**3**	**11**	**1648**
S. Uganda	Chicken										1	1
	Pet Food (Pig's Ear)					2						2
	Poultry					1						1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**1**	**5**
S. Urbana	Porcine						2					2
S. Westhampton	Chicken					4						4
S. Worthington	Chicken		5			6						11
	Feed						1					1
	Porcine		17	14		1	6					38
	Subtotal	**0**	**22**	**14**	**0**	**7**	**7**	**0**	**0**	**0**	**0**	**50**
Salmonella ssp I 4,12:-:-	Chicken		1			1						2
	Porcine		3	1			2					6
	Turkey					1						1
	Unknown					1						1
	Subtotal	**0**	**4**	**1**	**0**	**3**	**2**	**0**	**0**	**0**	**0**	**10**
Salmonella ssp I 4,5,12:-:-	Chicken		1									1
	Porcine						2					2
	Turkey					1						1
	Subtotal	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 4,12:-:1,2	Bovine					1						1
	Porcine						1					1
	Subtotal					**1**	**1**					**2**
Salmonella ssp I 4,12:-:e,n,z15	Feed					1						1
Salmonella ssp I 4,5,12:b:-	Turkey					3						3
Salmonella ssp I 4,12:d:-	Chicken					2						2
	Fish						1					1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**3**

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I 4,12:i:-	Avian			1								1
	Bovine		4			3						7
	Chicken					4						4
	Pigeon					3						3
	Porcine		4									4
	Water		3									3
	Subtotal	**0**	**11**	**1**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**22**
Salmonella ssp I 4,5,12:i:-	Alpaca			3								3
	Beef		2									2
	Bovine			4		1						5
	Canine			1								1
	Chicken					2						2
	Chicken	1					2					3
	Chinchilla					1						1
	Environmental	2										2
	Equine			1		1						2
	Feed				1							1
	Porcine						1					1
	Unknown		1	1								2
	Water		1									1
	Subtotal	**3**	**4**	**10**	**1**	**5**	**3**	**0**	**0**	**0**	**0**	**26**
Salmonella ssp I 4,12:r:-	Chicken					1		1				2
	Turkey		2			7						9
	Subtotal	**0**	**2**	**0**	**0**	**8**	**0**	**1**	**0**	**0**	**0**	**11**
Salmonella ssp I 4,5,12:r:-	Bovine					1						1
	Chicken		1			2						3
	Porcine						1					1
	Turkey					1						1
	Subtotal	**0**	**1**	**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I 6,7,14:-:-	Chicken		4									4
	Porcine			5		2	5					12
	Subtotal	**0**	**4**	**5**	**0**	**2**	**5**	**0**	**0**	**0**	**0**	**16**
Salmonella ssp I 6,7,14:-:1,2	Turkey					1						1
Salmonella ssp I 6,7,14:b:-	Chicken		1									1
Salmonella ssp I 6,7:-:-	Porcine					2				1		3
	Porcine	1										1
	Subtotal	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**4**
Salmonella ssp I 6,7:-:1,6	Chicken Litter		1									1
	Porcine	1										1
	Subtotal	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 6,7:-:l,w	Bovine					1						1
	Porcine					3	1					4
	Subtotal	**0**	**0**	**0**	**0**	**4**	**1**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I 6,7:d:-	Porcine					2						2
Salmonella ssp I 6,7:r:-	Porcine					1						1

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I 6,7:z10:-	Feed						2					2
	Porcine		2									2
	Subtotal	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 6,8:-:-	Bovine					2						2
Salmonella ssp I 6,8:l,v:-	Chicken			1								1
Salmonella ssp I 8,20:-:-	Chicken					1						1
Salmonella ssp I 8,20:i:-	Chicken					1						1
Salmonella ssp I 10:-:-	Avian						4					4
Salmonella ssp I 10:-:1,5	Equine					1						1
Salmonella ssp I 10:eh:-	Porcine						1					1
Salmonella ssp I 10:-l,w	Chicken		1									1
Salmonella ssp I 10:l,v:-	Feed					1						1
Salmonella ssp I 11:r:-	Bovine		1									1
Salmonella ssp I 18:-:-	Bovine					3						3
Salmonella ssp I 3,19:-:-	Poultry						1					1
	Feed					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 21:-:-	Feed					1						1
Salmonella ssp I 23:-:	Porcine		1									1
Salmonella ssp I 40:-:-	Feed				1							1
Salmonella ssp I Rough O:-:-	Chicken					1						1
	Feed					2						2
	Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:-:1,2	Porcine						1					1
Salmonella ssp I Rough-O:-:1,5	Porcine		2									2
Salmonella ssp I Rough-O:b:-	Porcine		1									1
Salmonella ssp I Rough-O:b:l,w	Porcine						3					3
Salmonella ssp I Rough-O:d:l,w	Porcine						5					5
	Turkey					3						3
	Subtotal	**0**	**0**	**0**	**0**	**3**	**5**	**0**	**0**	**0**	**0**	**8**
Salmonella ssp I Rough O:eh:1,2	Bovine					2						2
Salmonella ssp I Rough-O:f,g:-	Porcine		9									9
Salmonella ssp I Rough O:f,g,t:-	Bovine					2						2

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp I Rough O:g,m:-	Chicken						2					2
	Mouse					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough O:g,s,t:-	Chicken					1						1
Salmonella ssp I Rough-O:m,t:-	Feed					1						1
Salmonella ssp I Rough-O:i:1,2	Avian				2							2
	Bovine	1				1						2
	Chicken										2	2
	Porcine		17				2					19
	Subtotal	**1**	**17**	**0**	**2**	**1**	**2**	**0**	**0**	**0**	**2**	**25**
Salmonella ssp I Rough O:i:z6	Chicken		1									1
Salmonella ssp I Rough O:k:1,5	Chicken					3						3
Salmonella ssp I Rough O:r:-	Chicken					8						8
	Chicken Litter		1									1
	Porcine		3									3
	Turkey					1						1
	Subtotal	**0**	**4**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**13**
Salmonella ssp I Rough O:r:1,2	Avian				1		1					2
	Chicken		10			106						116
	Chicken Litter		4									4
	Porcine		6									6
	Turkey				1	25						26
	Subtotal	**0**	**20**	**0**	**2**	**131**	**1**	**0**	**0**	**0**	**0**	**154**
Salmonella ssp I Rough O:r:1,5	Porcine		3			1						4
Salmonella ssp I Rough O:l,v:-	Porcine		5									5
Salmonella ssp I Rough O:z:1,7	Chicken		1									1
Salmonella ssp I Rough O:z10:e,n,x	Avian						1					1
	Bovine		1									1
	Chicken					5						5
	Other					1	1					2
	Turkey					1	1					2
	Subtotal	**0**	**1**	**0**	**0**	**7**	**3**	**0**	**0**	**0**	**0**	**11**
Salmonella ssp II 58:l,z13,z28:z6	Unknown						1					1
Salmonella ssp II 9,12:-:1,7	Reptile						1					1
Salmonella ssp IIIa 41:z4,z23,z32:-	Feline		1									1
Salmonella ssp IIIa 41:z4,z23:-	Water		1									1
Salmonella ssp IIIa 42:g,z51:-	Water		2									2
Salmonella ssp IIIa 47:z4,z23:-	Feed						1					1

Serotype	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
Salmonella ssp IIIb 11:k:z53	Feed						1					1
Salmonella ssp IIIb 16:z10:e,n,x,z15	Reptile		1									1
	Water		6									6
	Subtotal	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**
Salmonella ssp IIIb 35:i:-	Snake	1										1
Salmonella ssp IIIb 38:k:z35	Snake		1									1
Salmonella ssp IIIb 38:l,v:z53	Python	1										1
Salmonella ssp IIIb 38:r:z	Snake		1									1
Salmonella ssp IIIb 47:z10:z35	Python	1										1
Salmonella ssp IIIb 50:-:-	Snake	1										1
Salmonella ssp IIIb 53:z10:z	Chameleon					1						1
Salmonella ssp IIIb 58:z10:e,n,x,z15	Reptile		2									2
Salmonella ssp IIIb 60:r:-	Water		1									1
Salmonella ssp IIIb 60:r:e,n,x,z15	Water		2									2
Salmonella ssp IIIb 60:r:z	Snake		1									1
Salmonella ssp IIIb 61:-:1,5	Ovine		14									14
Salmonella ssp IIIb 61:k:1,5	Ovine		17									17
Salmonella ssp IIIb 61:k:1,5,7	Ovine	1	2	2								5
	Porcine		1									1
	Subtotal	**1**	**3**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp IIIb 61:l,v:1,5	Porcine		1									1
Salmonella ssp IIIb 61:l,v:1,5,7	Porcine		1									1
Salmonella ssp IIIb 61:z52:z53	Snake		1									1
Salmonella ssp IV 44:z4,z32:-	Snake		1									1
Salmonella ssp IV 48:g,z51:-	Iguana		1				1	1				3
	Total	**155**	**2049**	**324**	**94**	**2742**	**1367**	**63**	**81**	**16**	**98**	**6989**

* 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 routine reference services. Data is representive of laboratory confirmed isolates only and should not be confused with incidence of disease. See Appendix 1 for details.

New and Unique *Salmonella* Serovars in Canada

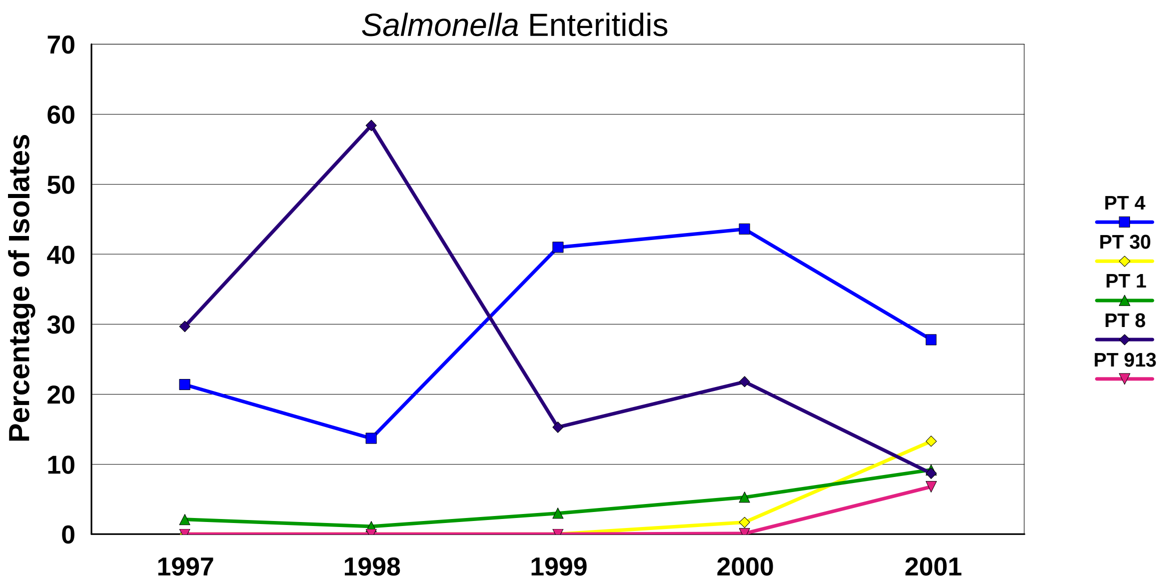
Serotype	Province	Source	Month
Salmonella ssp IIIb 38:r:z	Alberta	Snake Feces	January
Salmonella Scarborough***** (ssp I 30:k:l,z13,z28)	Ontario	Human	April
Salmonella Afula (ssp I 6,7:f,g,t:e,n,x)	Saskatchewan	Chicken Fluff	August
Salmonella ssp IIIb 58:z10:e,n,x,z15	Alberta	Chameleon	June
Salmonella Memphis (ssp I 18:k:1,5)	British Columbia	Human	September
Salmonella ssp IIIa 45:g,z51:-	Ontario	Human	September
Salmonella ssp IIIb 47:z10:z35	British Columbia	Python	October
Salmonella Zanzibar (ssp I 3,10:k:1,5)	Ontario	Human	November

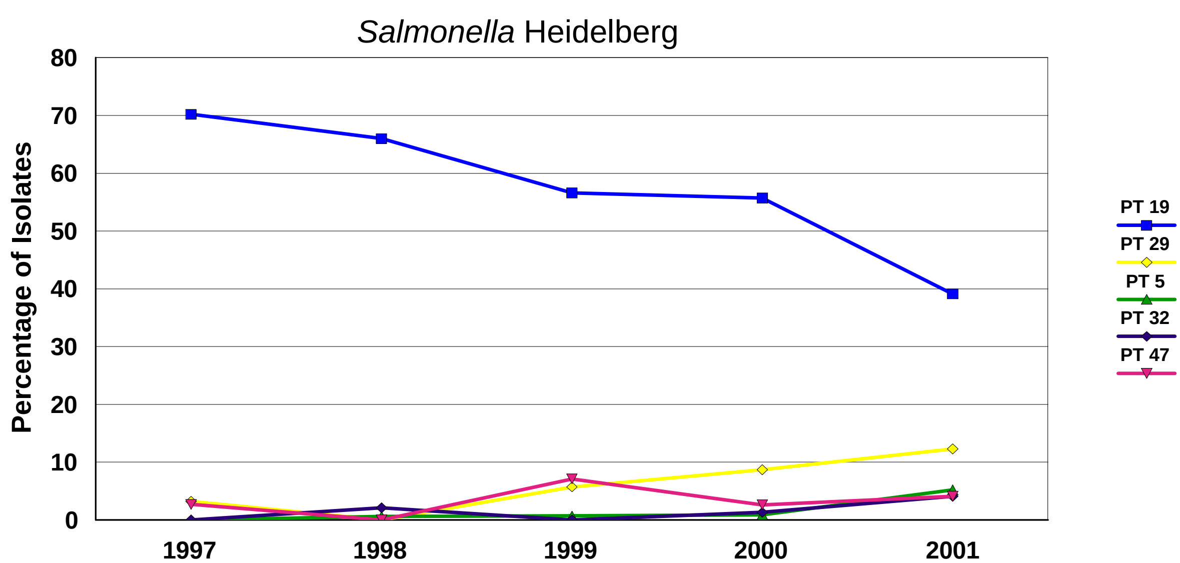
*****The NML, in collaboration with Institut Pasteur, has designated this as a new *Salmonella* serovar.

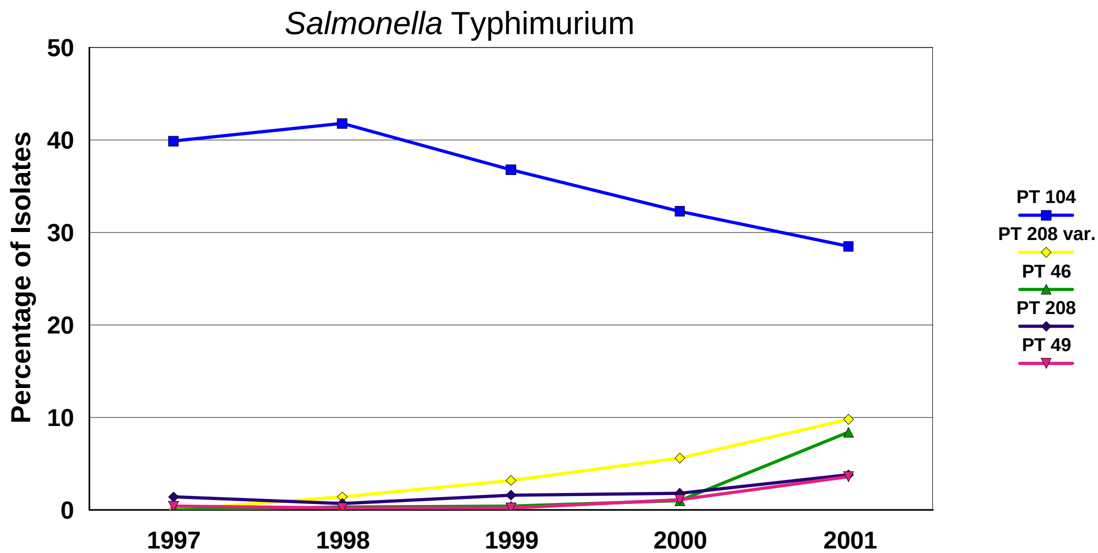
Phage Types of *Salmonella* Serovars in Canada

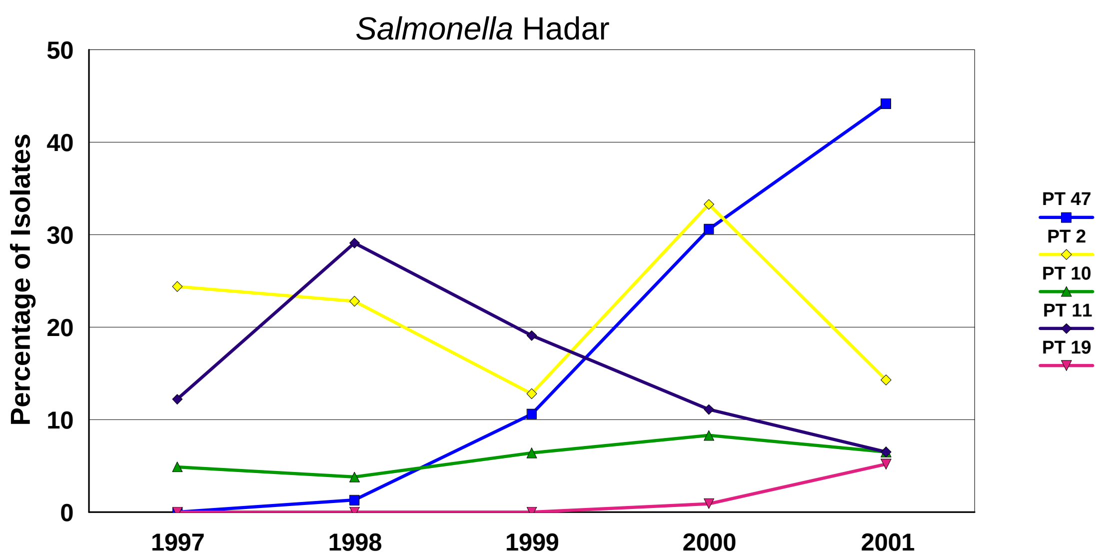
Phage typing data is collected from isolates forwarded to the NML and LFZ by the provincial public health, agriculture, veterinary, university and CFIA laboratories as part of reference requests, passive surveillance, surveys or outbreak and cluster investigations. The proportion of specimens forwarded may differ from province to province and should be interpreted with caution, however the subset of data from each province remains consistent from year to year and can be useful to establish general trends, recognize emerging or re-emerging phage types and to provide a overview of the various subtypes found in Canada. Table 3 lists *Salmonella* phage types identified from human strains forwarded to the NML and Table 4 on page 44 lists the non-human strains identified by the LFZ and NML.

Figure 12: Five Most Prevalent *Salmonella* Phage Types of Various Serovars Isolated from Humans in Canada, 1997 to 2001






Salmonella Typhimurium
Percentage of Isolates
50
40
30
20
10
0
1997
1998
1999
2000
2001
PT 104
PT 208 var.
PT 46
PT 208
PT 49


Salmonella Hadar
Percentage of Isolates
50
40
30
20
10
0
1997
1998
1999
2000
2001
PT 47
PT 2
PT 10
PT 11
PT 19

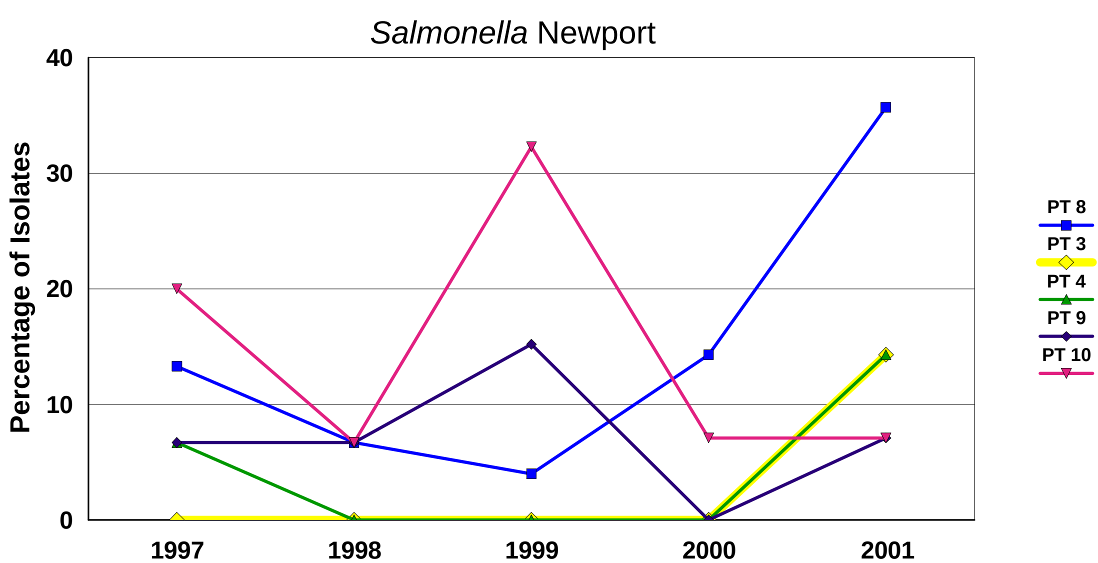

Salmonella Newport
Percentage of Isolates
40
30
20
10
0
1997
1998
1999
2000
2001
PT 8
PT 3
PT 4
PT 9
PT 10

Table 3: Phage Types of *Salmonella* from Humans in Canada, 2001

Serovar	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
S. Enteritidis	1	12	5	2	2	73	15	1	6	1			**117**
	1 var.					1							**1**
	1a					3							**3**
	1b	1	2	1		8							**12**
	2	1	4			4	3						**12**
	3	1				2							**3**
	4	37	39	7	3	173	63	10	18		4		**354**
	4a	3	1			6	1	1					**12**
	4b	1				3		1					**5**
	5					1							**1**
	5a					1	1						**2**
	5b		1			4	1						**6**
	5c		1										**1**
	6	3	4		3	6							**16**
	6 var.					1							**1**
	6a	7	3			11	3	1					**25**
	6b					2							**2**
	7			1			2						**3**
	8	16	17		4	57	13	2	1		1		**111**
	8 var.	1											**1**
	9a var.					1							**1**
	11b			5	1	1							**7**
	12					1							**1**
	13	1	1			28	3	1	14				**48**
	13a	3	4	1	1	54	5						**68**
	14					2							**2**
	14b	6	5		2	3	3						**19**
	18	3	1										**4**
	19				1		2						**3**
	20a						1						**1**
	21	2	4	1		4	5						**16**
	22						1						**1**
	22 var.						1						**1**
	23		1			2							**3**
	24		1			24	9	2	8		2		**46**
	24 var.						1						**1**
	28					4	1	1					**6**
	29					1							**1**
	30	8				143	1	9	9				**170**
	31	1				2							**3**
	33					1							**1**
	34					7	5						**12**
	36		1										**1**
	38	1				1							**2**
	39	3											**3**
	43			1		1							**2**
	911		1		1	6	4						**12**
	912					4	2						**6**
	913	3	83	1									**87**
	Atypical	5				26	12	2	2		1		**48**
	Untypable	1		2	1	3	1		2		1		**11**
	Subtotal	**120**	**179**	**22**	**19**	**675**	**159**	**31**	**60**	**1**	**9**	**0**	**1275**

Serovar	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
S. Hadar	2		8	3									**11**
	10		4								1		**5**
	11		5										**5**
	14		1										**1**
	18		1										**1**
	19		3									1	**4**
	24		1										**1**
	33		2										**2**
	43		3	1									**4**
	47		27	6	1								**34**
	51			1									**1**
	56		1										**1**
	58		1										**1**
	Atypical		3										**3**
	Untypable		2	1									**3**
	Subtotal	**0**	**62**	**12**	**1**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**77**
S. Heidelberg	1					1							**1**
	2		1				1						**2**
	3						1						**1**
	4			1		6							**7**
	5	4	3	5		7					5		**24**
	6	4	1		1	2							**8**
	8					3	2	2					**7**
	9			2									**2**
	11					18							**18**
	12	1	7										**8**
	17		1							1			**2**
	18		1										**1**
	19	34	49	8	25	49	8		1		2	5	**181**
	20	1	1			2							**4**
	22	1	15										**16**
	26	3	1		1	1					1		**7**
	28		1										**1**
	29	13	23	2	1	15	2			1			**57**
	32	4	1	3		9	2						**19**
	35		2	2	1	3							**8**
	36	3	5	4	1								**13**
	37	1											**1**
	39	1				1							**2**
	40				1	1	1						**3**
	41		2			5	2						**9**
	44			1									**1**
	45					1							**1**
	46					1							**1**
	47	1	6	1	1	5	1		1		3		**19**
	49		1										**1**
	50	6	4										**10**
	51					2							**2**
	Atypical	5	9	2	5	4			1				**26**
	Subtotal	**82**	**134**	**31**	**37**	**136**	**20**	**2**	**3**	**2**	**11**	**5**	**463**
S. Newport	3		1						1				**2**
	4		1						1				**2**
	8		3		1				1				**5**
	9		1										**1**
	10		1										**1**

Serovar	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
S. Newport	14								1				**1**
continued	Untypable				2								**2**
	Subtotal	**0**	**7**	**0**	**3**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**14**
S. Oranienburg	1		3										**3**
	3						1						**1**
	4					1							**1**
	6			1									**1**
	Subtotal	**0**	**3**	**1**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**6**
S. Panama	A		2										**2**
	Atypical		1										**1**
	Untypable				1								**1**
	Subtotal	**0**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
S. Paratyphi B	1 var.			1									**1**
	1 var. 3						1						**1**
	Subtotal	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Paratyphi B var. Java	1 var.	3											**3**
	1 var. 2					1							**1**
	1 var. 3	2					4						**6**
	1 var. 4						1						**1**
	3b var.	3											**3**
	3b var. 3	3	3					3					**9**
	3b var. 7				2								**2**
	Battersea	1											**1**
	Dundee	1					4	1					**6**
	Dundee var. 1		1										**1**
	Worksop	2											**2**
	Atypical	1	3				5						**9**
	Untypable			1									**1**
	Subtotal	**16**	**7**	**1**	**2**	**1**	**14**	**4**	**0**	**0**	**0**	**0**	**45**
S. ssp I 4,5,12:b:-	3b var.		1										**1**
	B.A.O.R.						1						**1**
	Battersea	1					1						**2**
	Atypical		1										**1**
	Untypable	10	5	1	1		3						**20**
	Subtotal	**11**	**7**	**1**	**1**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**25**
S. Thompson	1		5	3		40	10	1					**59**
	2		5			2	1						**8**
	5		2	2		8							**12**
	26		1			34	1		1	3			**40**
	Atypical		1		1	3	1		1			1	**8**
	Subtotal	**0**	**14**	**5**	**1**	**87**	**13**	**1**	**2**	**3**	**0**	**1**	**127**
S. Typhi	A				1	4	2						**7**
	B1	1				2							**3**
	B1(Degraded)					1							**1**
	B2					2							**2**
	D 1	1				1							**2**
	D 2	1				2							**3**
	DVS					3							**3**
	E 1	8	2		2	26	5						**43**

Serovar	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
S. Typhi	E 2					1							**1**
continued	E 7					3							**3**
	E 9	1				1	1						**3**
	E14	5	1			2							**8**
	F1					2							**2**
	F6					1							**1**
	J1					1							**1**
	M1					3							**3**
	O		1			2	1						**4**
	29					1							**1**
	35	1											**1**
	36					1							**1**
	46					4							**4**
	UVS	1				2							**3**
	UVS-(I+IV)					1							**1**
	Untypable					3							**3**
	Subtotal	**19**	**4**	**0**	**3**	**69**	**9**	**0**	**0**	**0**	**0**	**0**	**104**
S. Typhimurium	1	2	1	1			3						**7**
	2	1		1	3		9						**14**
	4	1					1						**2**
	6	1	1										**2**
	8	1											**1**
	10	3			1	1	4						**9**
	12	4	2		1	1	6						**14**
	12a						1						**1**
	17						1						**1**
	20						1						**1**
	20 var.		1				1						**2**
	21						1						**1**
	22	1	6										**7**
	27		1			8	1						**10**
	40	2	2	1			3						**8**
	41	2	2										**4**
	46			3					66	1			**70**
	49	20	9		1								**30**
	51							5					**5**
	56					1	1						**2**
	63			1									**1**
	66					1	3						**4**
	69						1						**1**
	80		1										**1**
	80 var.	1											**1**
	94		1	1									**2**
	96		2										**2**
	98		1										**1**
	99	1	1	1									**3**
	104	34	57	32	12	19	84						**238**
	104a	1	1			1	6						**9**
	104b	3	3		1	9	9						**25**
	106	1											**1**
	107		3		2		7	1			1		**14**
	108						4						**4**
	110b	1	1	2		3							**7**
	120		1		2	1	1						**5**
	124 var.	4	3				4		2		2		**15**
	132	1											**1**

Serovar	Phage Type	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
S. Typhimurium	135	1	1		1	1							**4**
continued	135 var.						1						**1**
	136	1											**1**
	140 var.				1								**1**
	146		4	1			3						**8**
	151						1						**1**
	160		2										**2**
	170					3	9						**12**
	186						2						**2**
	188	1											**1**
	191	2	7	2	6	3							**20**
	191 var.		1										**1**
	193	3	7		1	3	15						**29**
	195				1	1	2						**4**
	204						2						**2**
	204 var.		1										**1**
	204a			1									**1**
	204c		1	1									**2**
	206	1	1										**2**
	208	9	11	2			9			1			**32**
	208 var.	6	64	2	8		1			1			**82**
	812	4											**4**
	U284 var.	2	2										**4**
	U285	1	11			2	1						**15**
	U290				1								**1**
	U291								1				**1**
	U296			1									**1**
	U298						1						**1**
	U302	1	1			2	11						**15**
	UT 1	11	11				2						**24**
	UT 2		2										**2**
	UT 3					1							**1**
	UT 4			1									**1**
	UT 5		2				1						**3**
	Untypable	1	1				1		1				**4**
	Atypical	12	4		2		5						**23**
	Subtotal	**141**	**234**	**54**	**44**	**61**	**219**	**6**	**70**	**3**	**3**	**0**	**835**
S. ssp I 4,5,12:i:-	2					1							**1**
	8					2							**2**
	21					1							**1**
	22		1										**1**
	35	3	1										**4**
	46		1										**1**
	104					1							**1**
	107		1										**1**
	116					2							**2**
	120	1				1							**2**
	146	1				5							**6**
	146a var.		1										**1**
	160					1							**1**
	191	6	24	35	3	2							**70**
	191 var.			3									**3**
	Atypical			1		9							**10**
	U291		1	1		4		1					**7**
	U302	1											**1**
	UT 1			1									**1**
	Untypable		1										**1**
	Subtotal	**12**	**31**	**41**	**3**	**29**	**0**	**1**	**0**	**0**	**0**	**0**	**117**

Table 4: Phage Types of *Salmonella* from Non-Human Sources in Canada, 2001

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Enteritidis	4	Eggs						2					**2**
	4	Environmental						1					**1**
	4	Unknown		1			2						**3**
	4a	Water					1						**1**
	8	Avian (Unknown)						1					**1**
	8	Chicken	9	11			4	5					**29**
	8	Chicken Fluff	1	1									**2**
	8	Chicken Litter		1									**1**
	8	Chinchilla						1					**1**
	8	Egg (Environmental)	5										**5**
	8	Elk		1									**1**
	8	Environmental	4					1					**5**
	8	Other									2		**2**
	8	Porcine		28									**28**
	8	Water		1									**1**
	10	Chicken	2										**2**
	11b	Equine			14								**14**
	11b	Porcine		19									**19**
	13	Chicken					3						**3**
	13	Unknown					2						**2**
	23	Chicken	2					1					**3**
	24	Chicken		8									**8**
	24	Unknown						1					**1**
	28	Avian (Unknown)					1						**1**
	28	Chicken					10						**10**
	29	Poultry Farm		1									**1**
	30	Almonds	15				137			1			**153**
	30	Nut	4										**4**
	Atypical	Chicken Fluff			1								**1**
	Atypical	Other					3	2					**5**
	Atypical	Porcine		11									**11**
	Atypical	Unknown					1						**1**
	Untypable	Almonds					7						**7**
	Untypable	Egg (Environmental)	1										**1**
	Untypable	Porcine		14									**14**
	Total		**43**	**97**	**15**	**0**	**171**	**15**	**0**	**1**	**2**	**0**	**344**
S. Hadar	2	Chicken		1									**1**
	2	Poultry		1									**1**
	11	Chicken		1									**1**
	11	Chicken Litter		2									**2**
	11	Environmental		1									**1**
	19	Chicken Litter		1									**1**
	43	Chicken		1									**1**
	47	Chicken		5									**5**
	47	Chicken Litter		2									**2**
	47	Unknown		1									**1**
	56	Chicken Litter		1									**1**
	56	Environmental		1									**1**
	Untypable	Chicken Litter		1									**1**
	Total		**0**	**19**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**19**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Heidelberg	2	Avian (Unknown)						1					**1**
	2	Chicken					1						**1**
	2	Environmental		1									**1**
	2	Porcine						2					**2**
	4	Chicken Fluff			1								**1**
	4	Porcine			3			1					**4**
	4	Turkey						3					**3**
	5	Chicken		5			21	1				1	**28**
	6	Chicken		1			4			1			**6**
	6	Poultry	1										**1**
	6	Turkey					8						**8**
	8	Bovine					2						**2**
	8	Chicken					162						**162**
	8	Porcine					3						**3**
	8	Turkey					3						**3**
	9	Chicken					7						**7**
	9	Chicken Fluff		1									**1**
	9	Porcine						7					**7**
	9	Turkey					3						**3**
	10	Porcine						1					**1**
	11	Chicken		1			31			2			**34**
	12	Chicken Fluff			1								**1**
	12	Egg (Environmental)	1										**1**
	13	Avian (Unknown)						1					**1**
	13	Chicken	1				10	3	2	1			**17**
	13	Feed						2					**2**
	13	Porcine						1					**1**
	13	Turkey					2	2	1				**5**
	17	Chicken		1			5			3		2	**11**
	17	Chicken Litter		1									**1**
	18	Chicken					10					5	**15**
	19	Alpaca									1		**1**
	19	Avian (Unknown)						10					**10**
	19	Bovine					2						**2**
	19	Chicken	5	42			153	1	2			8	**211**
	19	Chicken Fluff	1	6									**7**
	19	Chicken Litter		9									**9**
	19	Egg (Environmental)	2										**2**
	19	Environmental		1									**1**
	19	Porcine						2					**2**
	19	Poultry Farm		1									**1**
	19	Raccoon	1										**1**
	19	Raw Meat (Chicken)		1									**1**
	19	Turkey		1			5	1					**7**
	19	Unknown		1							2		**3**
	20	Avian (Unknown)					1						**1**
	20	Chicken		1			15						**16**
	20	Chicken Fluff		1									**1**
	20	Chicken Litter		1									**1**
	20	Porcine						17					**17**
	20	Raw Meat (Chicken)		1									**1**
	20	Turkey					2						**2**
	20	Water		2									**2**
	21	Chicken					1						**1**
	22	Chicken					1						**1**
	22	Porcine					2						**2**
	23	Chicken		1			2						**3**
	23	Turkey						1					**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Heidelberg	24	Porcine						1					**1**
continued	25	Chicken					11						**11**
	25	Porcine						7					**7**
	25	Turkey					1						**1**
	26	Chicken		2			58	2	7				**69**
	26	Chicken Fluff			2								**2**
	26	Chicken Litter		1									**1**
	26	Porcine						1					**1**
	26	Turkey					3						**3**
	27	Chicken					3						**3**
	27	Chicken Litter		1									**1**
	29	Avian (Unknown)					1						**1**
	29	Bovine		3			1						**4**
	29	Chicken	1	10			17						**28**
	29	Chicken Fluff		1									**1**
	29	Chicken Litter		6									**6**
	29	Feed						1					**1**
	29	Porcine		5	2			15					**22**
	29	Raw Meat (Chicken)	1										**1**
	29	Turkey					12						**12**
	30	Chicken					2						**2**
	30	Turkey					1						**1**
	32	Avian (Unknown)					1						**1**
	32	Bovine					1						**1**
	32	Chicken		1			18						**19**
	32	Mink	1										**1**
	32	Turkey	1				213	2					**216**
	35	Bovine					1						**1**
	35	Chicken		7			19		1			1	**28**
	35	Chicken Litter		3									**3**
	36	Chicken					28						**28**
	36	Chicken Litter		4									**4**
	36	Egg (Environmental)	1										**1**
	36	Turkey					1						**1**
	37	Chicken					1						**1**
	37	Porcine						1					**1**
	37	Turkey					1						**1**
	39	Chicken					1						**1**
	39	Porcine						1					**1**
	39	Turkey					5						**5**
	40	Chicken	1				2						**3**
	40	Chicken Litter		1									**1**
	40	Egg (Environmental)	1										**1**
	40	Environmental	1										**1**
	40	Unknown						1					**1**
	41	Chicken					31						**31**
	41	Egg (Environmental)	1										**1**
	41	Environmental		1									**1**
	43	Chicken					1						**1**
	45	Chicken		2			2						**4**
	45	Turkey						1					**1**
	46	Turkey					3						**3**
	47	Avian (Unknown)					1		1				**2**
	47	Chicken					12		2	1			**15**
	47	Turkey					15	2	3				**20**
	49	Chicken		1			4						**5**
	49	Chicken Fluff		1									**1**
	55	Chicken		1									**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Heidelberg	Atypical	Avian (Unknown)						1					**1**
continued	Atypical	Chicken		7	1		32					1	**41**
	Atypical	Chicken Litter		2									**2**
	Atypical	Environmental		2									**2**
	Atypical	Turkey					10						**10**
	Untypable	Chicken		2			2						**4**
	Total		**21**	**144**	**10**	**0**	**971**	**93**	**19**	**8**	**3**	**18**	**1287**
S. Infantis	4	Chicken Fluff			3								**3**
	4	Porcine			1								**1**
	7	Chicken Fluff			2								**2**
	7	Porcine			1								**1**
	Total		**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**
S. Newport	1	Turkey					1						**1**
	2	Chicken					1						**1**
	2	Turkey					3						**3**
	2	Feed					3						**3**
	2	Nuts					2						**2**
	4	Chicken					1						**1**
	4	Turkey					2						**2**
	8	Peanuts		1									**1**
	9	Equine					2						**2**
	9	Turkey					1						**1**
	9	Feed					1						**1**
	13	Gecko		1									**1**
	13	Snake		1			1						**2**
	14a	Bovine					3						**3**
	14a	Turkey					1						**1**
	17	Bovine					4						**4**
	17a	Bovine					1						**1**
	17b	Bovine					3						**3**
	Total		**0**	**3**	**0**	**0**	**30**	**0**	**0**	**0**	**0**	**0**	**33**
S. Paratyphi B	Dundee	Unknown						4					**4**
S. Paratyphi B	1 var. 3	Unknown						7					**7**
var. Java	3b var. 3	Unknown						1					**1**
	Atypical	Unknown						4					**4**
	Dundee	Unknown						2					**2**
	Dundee	Water						1					**1**
	Worksop	Elk			1								**1**
	Total		**0**	**0**	**1**	**0**	**0**	**15**	**0**	**0**	**0**	**0**	**16**
S. Thompson	1	Chicken Litter		1									**1**
	3	Chicken Fluff			2								**2**
	27	Chicken Fluff			1								**1**
	Total		**0**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**
S. Typhimurium	1	Egg (Enviornmental)	1										**1**
	1	Environmental		1									**1**
	1	Equine					8						**8**
	1	Unknown					3						**3**
	2	Avian (Unknown)						1					**1**
	2	Bovine					2						**2**
	2	Chicken					12					2	**14**
	2	Duck	1										**1**
	2	Equine					1						**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium	2	Lapine					1						**1**
continued	2	Other						3					**3**
	2	Pigeon	2	1			3	8					**14**
	2	Porcine		6									**6**
	2	Avian (Unknown)				1							**1**
	3	Bovine					1						**1**
	3	Feed						1					**1**
	6	Equine			1								**1**
	10	Bovine					2						**2**
	10	Porcine					3						**3**
	10	Poultry						1					**1**
	10	Snake					2						**2**
	12	Bovine					1						**1**
	12	Caprine					1						**1**
	12	Porcine		96	4	2	1	33	2				**138**
	12a	Bovine						1					**1**
	15a	Chicken					1						**1**
	15a	Equine					2	1					**3**
	21	Bovine					2	1	2		1		**6**
	22	Chicken							2			1	**3**
	22	Avian (Unknown)							3				**3**
	27	Porcine					6	3					**9**
	27	Unknown					1						**1**
	35	Chicken					1						**1**
	35	Porcine					1						**1**
	36	Chicken					1			1			**2**
	36	Porcine						2					**2**
	40	Bovine				2							**2**
	40	Chicken	2										**2**
	40	Avian (Unknown)			1								**1**
	45	Porcine						1					**1**
	46	Avian (Unknown)						4					**4**
	46	Chicken					1						**1**
	46	Poultry						6					**6**
	46	Raw Meat (Chicken)						4					**4**
	46	Turkey				1							**1**
	46	Avian (Unknown)				4							**4**
	49	Chicken	5										**5**
	49	Raw Meat (Chicken)	1										**1**
	49b	Chicken	1										**1**
	66	Bovine					16						**16**
	73 var.	Porcine						1					**1**
	95	Hamster		1									**1**
	96	Reptile		1									**1**
	99	Porcine						1					**1**
	104	Bovine	1	40	32		30	28					**131**
	104	Canine						1					**1**
	104	Caprine					1						**1**
	104	Chicken		14			17						**31**
	104	Chicken Fluff		2									**2**
	104	Duck					4						**4**
	104	Egg (Environmental)	1										**1**
	104	Elk		1									**1**
	104	Environmental		2									**2**
	104	Equine		1	1		6	5					**13**
	104	Feline					1						**1**
	104	Ovine				3							**3**
	104	Porcine	2	125	11	12	37	80	1				**268**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium	104	Poultry	1										**1**
continued	104	Quail						3					**3**
	104	Raw Meat (Beef)		2				1					**3**
	104	Turkey					3						**3**
	104	Turtle									1		**1**
	104	Avian (Unknown)						2					**2**
	104	unknown			14		6	3					**23**
	104	Water		1									**1**
	104a	Other					1						**1**
	104a	Porcine		34	3	3	10	21					**71**
	104a	Unknown					1						**1**
	104b	Bovine		2			3	4					**9**
	104b	Chicken					3						**3**
	104b	Equine					1						**1**
	104b	Porcine					3	15					**18**
	104b	Poultry						3					**3**
	104b	Quail						5					**5**
	104c	Unknown					2						**2**
	107	Avian (Unknown)			1			3					**4**
	107	Bovine								1			**1**
	107	Chicken					1			5		8	**14**
	107	Duck					1						**1**
	107	Other					1						**1**
	107	Porcine		5									**5**
	107	Poultry						8					**8**
	107	Raw Meat (Beef)						2					**2**
	107	Turkey				1							**1**
	107	Unknown						11					**11**
	107	Avian (Unknown)				9							**9**
	108	Bovine				1	19	1					**21**
	108	Feed					1						**1**
	108	Pork		1		7	11	29					**48**
	108	Turkey					1						**1**
	108	Unknown						1					**1**
	110b	Avian (Sparrow)			1								**1**
	110b	Bison		1									**1**
	110b	Chicken								1			**1**
	110b	Porcine		6				2					**8**
	110b	Poultry						1					**1**
	120	Bovine					1						**1**
	120	Porcine		4				1					**5**
	120	Turkey					2						**2**
	120	Avian (Unknown)					1						**1**
	124	Avian (Unknown)			3								**3**
	124 var.	Avian (Unknown)						1					**1**
	124 var.	Duck						1					**1**
	124 var.	Gull						1					**1**
	124 var.	Poultry						1					**1**
	124 var.	Raw Meat (Chicken)						1					**1**
	124 var.	Unknown						1					**1**
	126	Equine						4					**4**
	132	Other					1						**1**
	132	Ovine		1									**1**
	132	Porcine		6									**6**
	146	Equine					1						**1**
	160	Avian (Unknown)						1					**1**
	160	Avian (Sparrow)					4						**4**
	160	Avian (Unknown)					1						**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium	170	Bovine					1	11					**12**
continued	170	Chicken					4						**4**
	170	Porcine					2	22					**24**
	170	Raw Food						9					**9**
	170	Unknown						3					**3**
	186	Porcine					5						**5**
	191	Porcine			1								**1**
	191	Raw Meat (Beef)		1									**1**
	193	Bovine						3					**3**
	193	Chicken					2						**2**
	193	Duck					1						**1**
	193	Equine					1						**1**
	193	Porcine					1	29					**30**
	193	Poultry						1					**1**
	193	Quail					1						**1**
	193	Raw Food						13					**13**
	193	Raw Meat (Chicken)						1					**1**
	193	Unknown						1					**1**
	194	Avian (Parrot)					1						**1**
	194	Porcine					4	1					**5**
	194	Quail					1						**1**
	194	Turkey					1						**1**
	195	Avian (Unknown)						1					**1**
	195	Porcine					1						**1**
	195	Poultry						1					**1**
	195	Water		1									**1**
	208	Bovine		5			10	5			1		**21**
	208	Chicken					2						**2**
	208	Ovine		1									**1**
	208	Porcine		1			15	5					**21**
	208	Unknown						1					**1**
	208	Water		1									**1**
	208 var.	Bison	2		2								**4**
	208 var.	Bovine	25	94	4	4	2	1					**130**
	208 var.	Chicken		5									**5**
	208 var.	Chicken Fluff		2									**2**
	208 var.	Duck	1										**1**
	208 var.	Environmental		1									**1**
	208 var.	Equine			1								**1**
	208 var.	Porcine	1					1					**2**
	208 var.	Reptile		1									**1**
	208 var.	Snake		2									**2**
	208 var.	Unknown		1									**1**
	208 var.	Water		3									**3**
	U284 var.	Animal (Unknown)			4								**4**
	U284 var.	Avian (Finch)		1	1		3						**5**
	U284 var.	Avian (Pine Siskin)	5										**5**
	U284 var.	Avian (Unknown)			3								**3**
	U285	Avian (Unknown)		1				1					**2**
	U285	Chicken		1									**1**
	U301	Avian (Unknown)	1										**1**
	U302	Bovine						2					**2**
	U302	Canine						1					**1**
	U302	Porcine			3		2	28					**33**
	Untypable	Bovine		28		2	10						**40**
	Untypable	Canine		1									**1**
	Untypable	Chicken		5									**5**
	Untypable	Equine					1						**1**

Serovar	Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
S. Typhimurium	Untypable	Gerbil		1									**1**
continued	Untypable	Avian (Gull)								2			**2**
	Untypable	Porcine		5	1	2	2	6					**16**
	UT 1	Bovine		4	11								**15**
	UT 1	Chicken Litter		1									**1**
	UT 1	Porcine			2			3					**5**
	UT 2	Bovine						1					**1**
	UT 2	Wolf	1										**1**
	UT 5	Porcine		1									**1**
	Atypical	Avian (Pine Siskin)	1										**1**
	Atypical	Avian (Unknown)						1					**1**
	Atypical	Bovine		1		1	3						**5**
	Atypical	chicken		1		1	6		1	7			**16**
	Atypical	Equine		1				6					**7**
	Atypical	Pigeon					1						**1**
	Atypical	porcine		12		1	2	8					**23**
	Atypical	Poultry						1					**1**
	Atypical	Avian (Unknown)		1	1								**2**
	Total		**55**	**538**	**106**	**57**	**333**	**480**	**11**	**17**	**3**	**11**	**1611**
S. ssp I 4,5,12:i:-	98	Canine			1								**1**
	99	Water		1									**1**
	125	Raw Meat (Beef)		1									**1**
	146a var.	Bovine			2								**2**
	146a var.	Unknown			1								**1**
	191	Alpaca			3								**3**
	191	Bovine			2								**2**
	191	Chicken	1										**1**
	191	Chinchilla					1						**1**
	191	Environmental	2										**2**
	191	Equine			1								**1**
	191	Feed				1							**1**
	191	Unknown		1									**1**
	208 var.	Avian (Unknown)						1					**1**
	U291	Chicken					1						**1**
	U291	Equine					1						**1**
	U302	Bovine					1						**1**
	U302	Chicken					1	2					**3**
	Atypical	Porcine						1					**1**
	Total		**3**	**3**	**10**	**1**	**5**	**4**	**0**	**0**	**0**	**0**	**26**

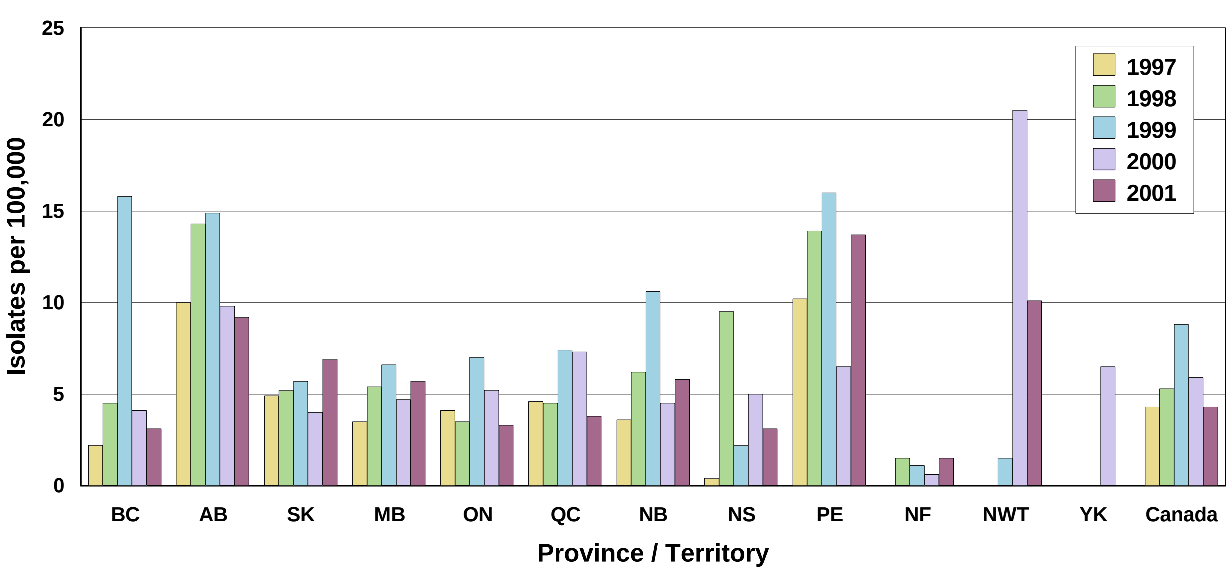
Section 3: Pathogenic *Escherichia coli*

Total provincial isolations of *E. coli* O157 from each province is shown in Figure 14 and population based rate of *E. coli* O157 isolation for each province are shown in Figure 13. By representing the data as isolations per 100,000, the data is a more accurate reflection of the relative isolation levels among the provinces. Although Ontario had the highest number of *E. coli* O157 isolated, due to the large population, the province ranks 7th overall in isolation rate this year.

Total *E. coli* O157 isolations is based largely on NESP and supplemented with identifications from NML reference services and includes *E. coli* O157:H7, *E. coli* O157:NM, *E. coli* O157, *E. coli* O157 VT+ and verotoxigenic *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 13 shows the population based rates of *E. coli* O157 isolation for each of the last 5 years. There have been no major increases in the rates of *E. coli* O157 infection in provinces in 2001. Rates of isolation have declined slightly in British Columbia, Alberta, Ontario, Quebec, Nova Scotia and Northwest Territories/Nunavut. The largest year to year increase has been observed in Prince Edward Island were the rate has increased from 6.5 to 13.7 isolates per 100,000, however this is lower than in 1999 where 16 isolates per 100,000 were observed.

Figure 13: Rate of *E. coli* O157 Isolation from Humans in Canada, 1997 to 2001*



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

Figure 14: Number of *E. coli* O157 Isolations from Humans in Canada, 2001*

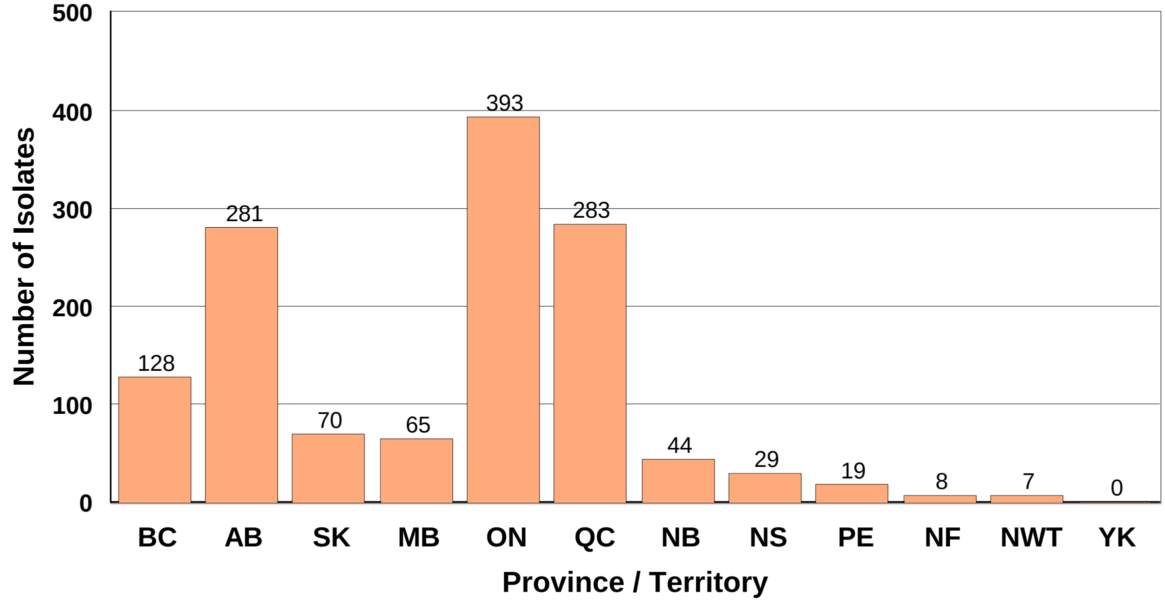


Table 5: *E. coli* Isolates From Humans in Canada, 2001*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
E. coli	11											**11**
E. coli Inactive		3										**3**
E. coli O1:H7			1		1							**2**
E. coli O1:K1:NM		1										**1**
E. coli O2			1			1						**2**
E. coli O2:H7						1						**1**
E. coli O6				3		1	1					**5**
E. coli O6:H1						1						**1**
E. coli O6:NM				2								**2**
E. coli O18		1		1								**2**
E. coli O18:NM				1		2						**3**
E. coli O18ac:H-Untypable		1										**1**
E. coli O25				1								**1**
E. coli O25:H2				1								**1**
E. coli O25:H7				1								**1**
E. coli O26				1								**1**
E. coli O26:H6				1								**1**
E. coli O26:H11	6		2	1				2	1			**12**
E. coli O26:NM	1		1									**2**
E. coli O41:H8				1								**1**
E. coli O44				15								**15**
E. coli O48:H45							1					**1**
E. coli O55				1								**1**
E. coli O69:H11	1											**1**
E. coli O71:H4							1					**1**
E. coli O71:NM		2										**2**
E. coli O75:H55						1						**1**
E. coli O75:NM				1								**1**
E. coli O86				2								**2**
E. coli O86:H8				1								**1**
E. coli O91:NM	1											**1**
E. coli O103:H2	2		1									**3**

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	Total
E. coli O103:NM					1							**1**
E. coli O111	1			5								**6**
E. coli O111:NM	8		4									**12**
E. coli O114				3								**3**
E. coli O114:H8				1								**1**
E. coli O118:H16										1		**1**
E. coli O118:NM	1											**1**
E. coli O117:H7	2											**2**
E. coli O119:NM				1								**1**
E. coli O121	1	1										**2**
E. coli O121:H19			1									**1**
E. coli O125				4								**4**
E. coli O126				5								**5**
E. coli O126:H27			1	1								**2**
E. coli O128				4								**4**
E. coli O136:H12	1											**1**
E. coli O142				1								**1**
E. coli O145:NM	1											**1**
E. coli O148:NM								1				**1**
E. coli O154:NM		1					1					**2**
E. coli O157		18	1	9	18		9	24	4	4	7	**94**
E. coli O157:H7	122	251	67	15	370	281	35	5	15	3		**1164**
E. coli O157:NM	6	12	1		5	2						**26**
E. coli O157:H45			1							1		**2**
E. coli O Untypeable:H2	1											**1**
E. coli O Untypeable:H4			1									**1**
E. coli O Untypeable:H7							1					**1**
E. coli O Untypeable:K1:H7							1					**1**
E. coli O Untypeable:H14						1						**1**
E. coli O Untypeable:H19			1									**1**
E. coli O Untypeable:H34	1											**1**
E. coli O Untypeable:H45	1											**1**
E. coli O Untypeable:NM	1	1										**2**
EPEC	1			46								**47**
Non-O157 VTEC	26						1					**27**
E. coli Non-typed VTEC				41								**41**
Total	**196**	**292**	**84**	**170**	**395**	**293**	**51**	**32**	**20**	**9**	**7**	**1549**

*Data represented in this table is under 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 6: Phage Types* of *E. coli* O157:H7 from Human and Non-Human Sources in Canada, 2001

Phage Type	Source	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	Total
1	Human	3	1	1		3						**8**
2	Human	1	1	1		16		1				**20**
4	Human		3	2		5	3					**13**
8	Human	1	2		4	60		3			1	**71**
10	Human					1						**1**
14	Human		4	3	1	9		7		1		**25**
14a	Human	13	58	35	10	129	14	17	5	8	2	**291**
14b	Human					27		1		1		**29**
21	Human	2	2	16		2	1					**23**
23	Human			2	2	5		2		1		**12**
31	Human	1	2	2		16	6					**27**
32	Human	1		2	1	26		6		1		**37**
33	Human	1		1		1					1	**4**
34	Human	4	1			5						**10**
38	Human					1						**1**
45	Human					1				4		**5**
49	Human					1						**1**
51	Human					1						**1**
54	Human	1			1	5						**7**
59	Human			2								**2**
73	Human						1					**1**
74	Human		1			1						**2**
Atypical	Human					7						**7**
	Total	**28**	**75**	**67**	**19**	**322**	**25**	**37**	**5**	**16**	**4**	**598**
2	Bovine					1						**1**
8	Animal					1						**1**
8	Bovine					1						**1**
14	Food (Chicken)					8						**8**
14	Food (Poultry)					6						**6**
14a	Water		1									**1**
14a	Food (Beef)	1	11	5		5						**22**
14a	Food (Stew)		1									**1**
14b	Unknown					2						**2**
21	Food (Pork Ribs)			1								**1**
27	Bovine					1						**1**
34	Food (Cheese)					3						**3**
82	Bovine					1						**1**
Atypical	Bovine					5						**5**
Atypical	Water					2						**2**
	Total	**1**	**13**	**6**	**0**	**36**	**0**	**0**	**0**	**0**	**0**	**56**

*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 particluar province remains consistant from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide a general overview of the subtypes found in Canada.

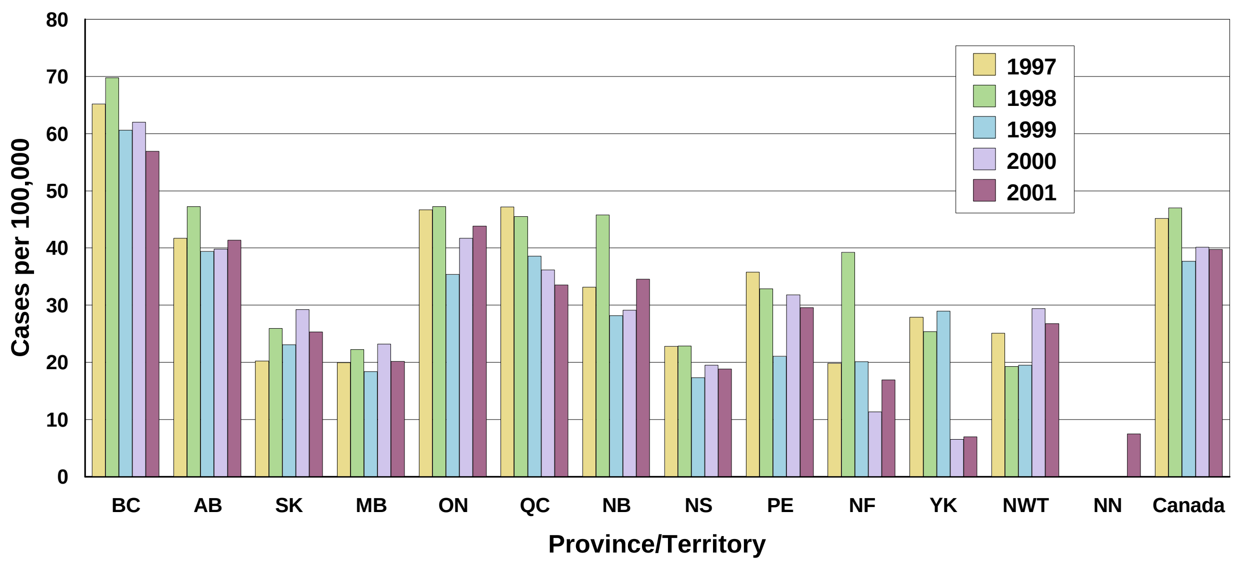
Section 4: *Campylobacter*

This section summarizes data on both case-by-case reports and aggregate data of reported campylobacteriosis captured in the National Notifiable Diseases Reporting System (NDRS) for 2001. 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). 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 [Health Canada (CIDPC). Canadian Integrated Surveillance Report: *Salmonella*, *Campylobacter*, pathogenic *E. coli* and *Shigella*, from 1996 to 1999. Canada Communicable Disease Report, Volume 29 S1, January 2003]. 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 15. 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

Figure 15: Rate of Reported Campylobacteriosis in Canada, 1997 to 2001



territories. For example, although Ontario reported the highest number of cases in 2001 (Figure 16), due to its large population, the province ranked 2nd overall in the rate of reported campylobacteriosis. There were no major increases in rates of reported campylobacteriosis in 2001 compared to the previous year. However in Newfoundland and Labrador, the rate rose from 11 cases per 100, 000 in 2000 to 17 cases per 100, 000 in 2001. A slight increase was also observed in New Brunswick with rates increasing from 29 cases per 100, 000 in 2000 to 34 cases per 100, 000 in 2001, in Ontario from 42 to 44 cases per 100, 000, and in Alberta from 40 to 41 cases per 100, 000.

Table 7 shows the number and percentage of the main *Campylobacter* species reported in the NDRS. In 2001, *Campylobacter jejuni* represented the majority (61.3%) of isolates reported. In addition to the NDRS data shown in Table 7, the NESP and NML datasets record other rare species identified through the laboratory arm of the surveillance structure that are not shown. These include 3 isolates of *C. concisus* and 1 *C. lanienae* in Ontario, 1 *C. curvus* in Alberta and 2 *C. hyointestinalis* in British Columbia. There were also 34 *C. lari* isolates reported in Canada in 2001; 16 in Québec, 9 in Ontario, 2 each in Alberta, New Brunswick and Prince Edward Island, and 1 each in Saskatchewan, Manitoba and the Northwest Territories.

Figure 16: Number of Reported Cases of Campylobacteriosis, by Province / Territory, 2001 (N=11892)

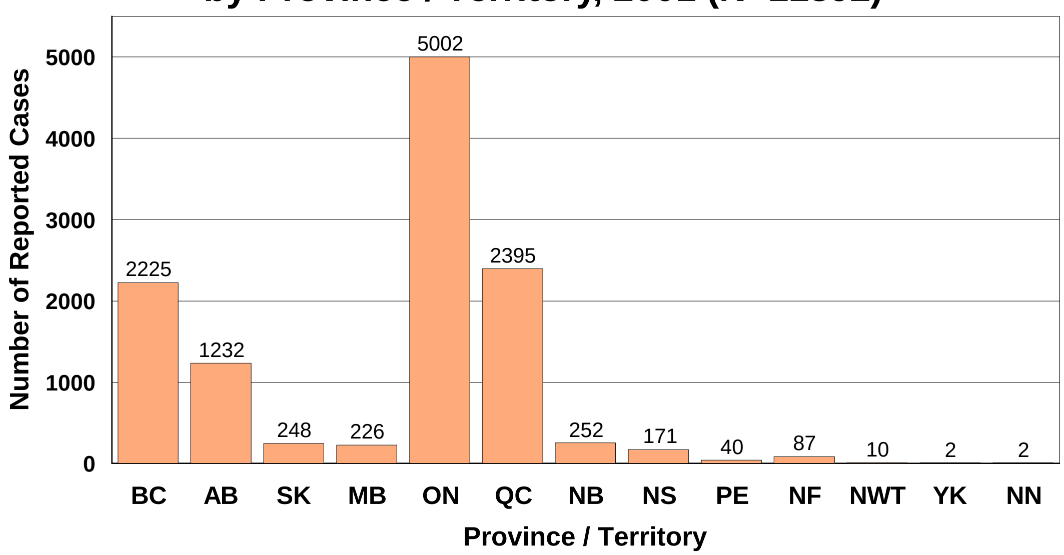


Table 7: *Campylobacter* Species from Humans in Canada, 2001 (N=11225)*

Organism	Number of Reported Cases	Percent (%) of Isolates
C. jejuni	6884	61.33
C. coli	217	1.93
C. fetus spp *fetus*	16	0.14
C. lari	5	0.04
C. upsaliensis	3	0.03
Other	187	1.67
Not Specified	3913	34.86
Total	**11225**	**100.00**

*NDRS data is not available for New Brunswick, Nova Scotia, Prince Edward Island, Manitoba and Northwest Territories.

Section 5: *Shigella*

The total number of *Shigella* isolated from each province is shown in Figure 17 and population based rates of *Shigella* isolation for each province is shown in Figure 18. By representing the data as cases per 100,000, the data is a more accurate reflection of the relative isolation levels among the provinces. Although Quebec had the highest number isolated, British Columbia had the highest isolation rate per 100,000 population.

Data is largely from the NESP and 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 consistant from year to year and can be useful to establish general

Figure 17: Number of *Shigella* Isolations from Humans in Canada, 2001

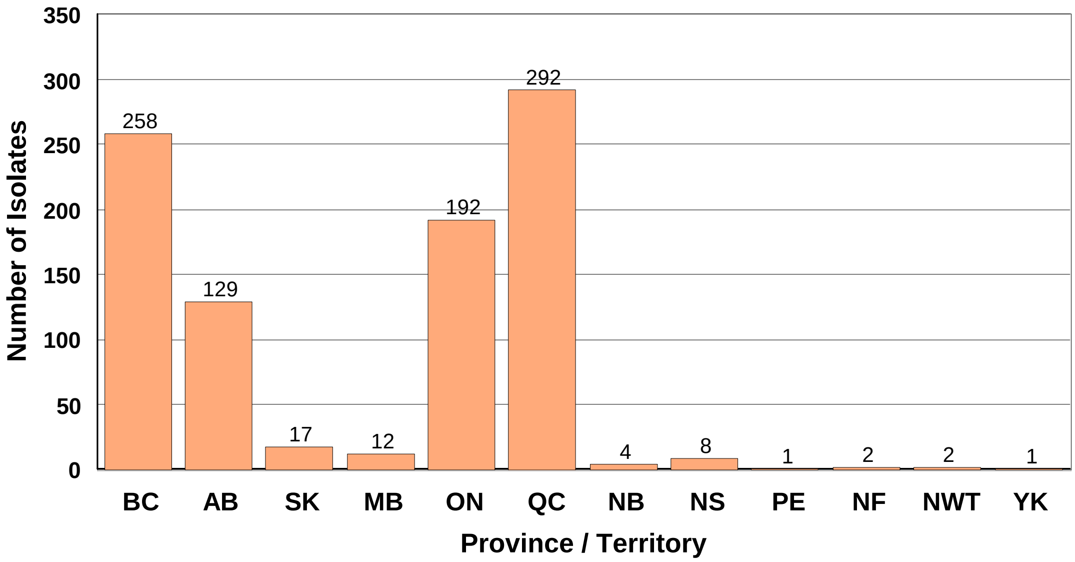
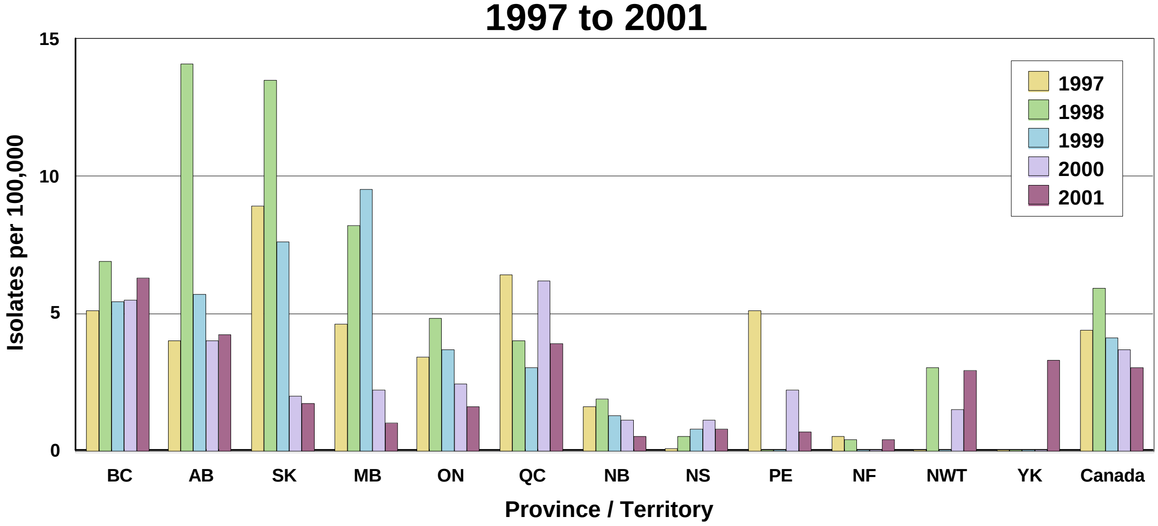


Figure 18: Rate of *Shigella* Isolation from Humans in Canada, 1997 to 2001



*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.

trends, recognize emerging or re-emerging strains and to provide an overview of the sub-types found in Canada.

Figure 18 shows rates of *Shigella* isolation for each of the last 5 years in Canada. Rates have generally decreased in most provinces in 2001 however a slight increase has been observed in British Columbia, Alberta and in the Territories.

Table 8: *Shigella* Isolates from Humans in Canada, 2001*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PEI	NF	NWT	YK	Total
Shigella boydii	2												**2**
Shigella boydii 1	2	3			3								**8**
Shigella boydii 2	2	3	1		2								**8**
Shigella boydii 4	1				1								**2**
Shigella boydii 5						1							**1**
Shigella boydii 8		1			1								**2**
Shigella boydii 14	2												**2**
Shigella boydii 19		3											**3**
Shigella boydii Prov. 108 / 20	9	8		2	7	2	1						**29**
Total *Shigella boydii*	**18**	**18**	**1**	**2**	**14**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**57**
Shigella dysenteriae						4							**4**
Shigella dysenteriae 2	2					2							**4**
Shigella dysenteriae 3					1			1					**2**
Shigella dysenteriae 4	1	1											**2**
Shigella dysenteriae 9		1											**1**
Shigella dysenteriae 12	1	1			1								**3**
Shigella dysenteriae 16 / Prov. 105	6	1			1	3							**11**
Shigella dysenteriae Prov. 103	2												**2**
Total *Shigella dysenteriae*	**12**	**4**	**0**	**0**	**3**	**9**	**0**	**1**	**0**	**0**	**0**	**0**	**29**
Shigella flexneri				4		49		4					**57**
Shigella flexneri 1	3	1				5							**9**
Shigella flexneri 1b					6								**6**
Shigella flexneri 2	28	11				14							**53**
Shigella flexneri 2a					12								**12**
Shigella flexneri 2b					5								**5**
Shigella flexneri 3	6	1				5							**12**
Shigella flexneri 3a	1	1			7								**9**
Shigella flexneri 3b	2												**2**
Shigella flexneri 4		3				2	1						**6**
Shigella flexneri 4a	3				3								**6**
Shigella flexerni 5a					1								**1**
Shigella flexneri 6	10	3			13								**26**
Shigella flexneri 6 hertfordshire					3								**3**
Shigella flexneri var.Y		1			4								**5**
Shigella flexneri Prov. 101	2				3								**5**
Shigella flexneri Prov. SH104		2			3	1							**6**
Shigella flexneri var.X					3								**3**
Total *Shigella flexneri*	**55**	**23**	**0**	**4**	**63**	**76**	**1**	**4**	**0**	**0**	**0**	**0**	**226**
Shigella sonnei	**173**	**84**	**12**	**6**	**112**	**193**	**0**	**3**	**1**	**2**	**2**	**1**	**589**
***Shigella* sp**	**0**	**0**	**4**	**0**	**0**	**11**	**2**	**0**	**0**	**0**	**0**	**0**	**17**
Total *Shigella*	**258**	**129**	**17**	**12**	**192**	**292**	**4**	**8**	**1**	**2**	**2**	**1**	**918**

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

Tables 8 lists *Shigella* phage types identified from human strains isolated in 2001. The data is collected 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 consistant from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide a overview of the subtypes found in Canada.

PT1 is the predominant phage type of *S. sonnei* accounting for 103 of 156 isolates from British Columbia and 12 of the 30 isolates from Alberta. Further surveillance is required to establish whether this sub type is a permanent aspect of the Canadian flora or whether its high prevelance 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 orghanism will become more reliable and outbreaks of public health significacnace can be identified with greather precision and accuracy.

Table 9: Phage Types of *Shigella boydii* and *Shigella sonnei* from Humans in Canada, 2001

Organism	Phage Type	BC	AB	MB	ON	QC	NB	PEI	Total
Shigella boydii	1						1		1
	2	1							1
	3	5	1		2				8
	4	2	4	1	3	1			11
	5			1					1
	6				1				1
	9		1						1
	Untypable	2				1			3
	Total	**10**	**6**	**2**	**6**	**2**	**1**	**0**	**27**
Shigella sonnei	1	103	12		4			1	120
	2	1	1						2
	6	6	2						8
	9		1		1				2
	10	22							22
	15	4	7		2				13
	17	9							9
	18	2							2
	19	5	1		1				7
	20	4	3						7
	21		1						1
	Atypical		2		1				3
	Total	**156**	**30**	**0**	**9**	**0**	**0**	**1**	**196**

*Phage type data is generated from isolates forwarded to the NML by the provincial health 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 particluar province remains consistant from year to year and can be useful to establish general trends, recognize emerging or re-emerging strains and to provide a general overview of the subtypes found in Canada.

Section 6: Parasites

The total number of parasite isolations from each province is shwon in Figure 19 and Figure 20 shows the isolation rates of *Cryptosporidium*, *Cylcospora, Entamoeba* and *Giardia* strains isolated by each province over the last two years. The data is collected through the NESP and supplemented with NDRS data.

Figure 19: Number of Parasite Isolations (*Crytptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2001

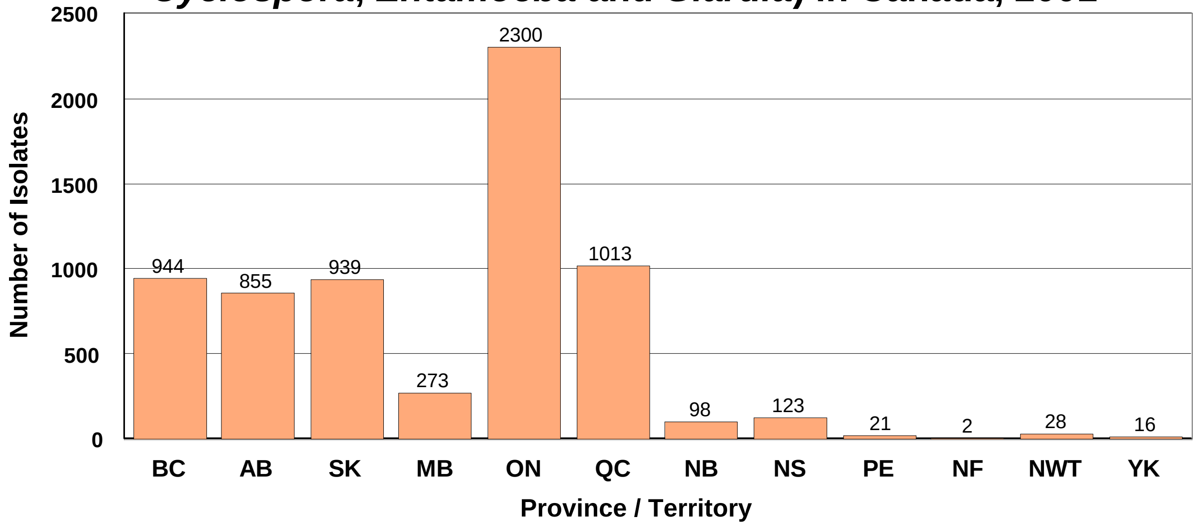


Figure 20: Rate of Parasite Isolations (*Crytptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia*) in Canada, 2000 to 2001

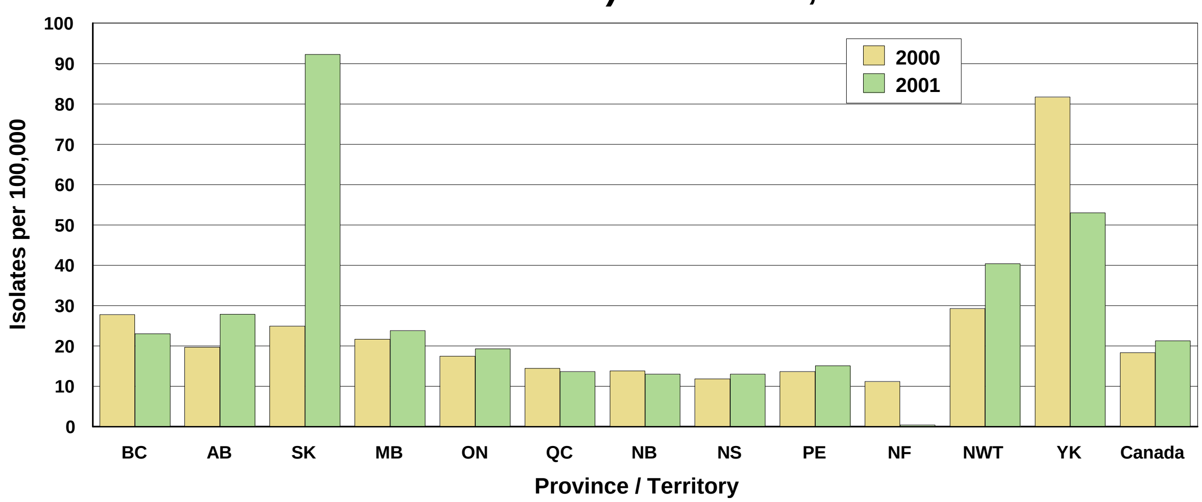


Table 10: Parasite Isolations from Humans in Canada, 2001*

Organism	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NWT	YK	Total
Cryptosporidium	131	404	764	100	218	1	14	10	9	1	13	2	**1667**
Cyclospora cayetanensis	35		1		49	3		8					**96**
Entamoeba histolytica/dispar	85	9	9	21	384	129	2	16	1	1			**657**
Giardia	693	442	165	152	1649	880	82	89	11		15	14	**4192**
Total	**944**	**855**	**939**	**273**	**2300**	**1013**	**98**	**123**	**21**	**2**	**28**	**16**	**6612**

**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 totalnumber of *Yersinia* isolated from each province is shown if Figure 21 and population based rates of *Yersinia* isolation for each province is shown in Figure 22. By representing the data as cases per 100,000, the data is a more accurate reflection of the relative isolation levels among the provinces. Although Ontario had the highest number of isolated, British Columbia had the highest isolation rate per 100,000 population.

Data is from the NESP and 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

Figure 21: Number of *Yersinia* Isolations from Humans in Canada, 2001*

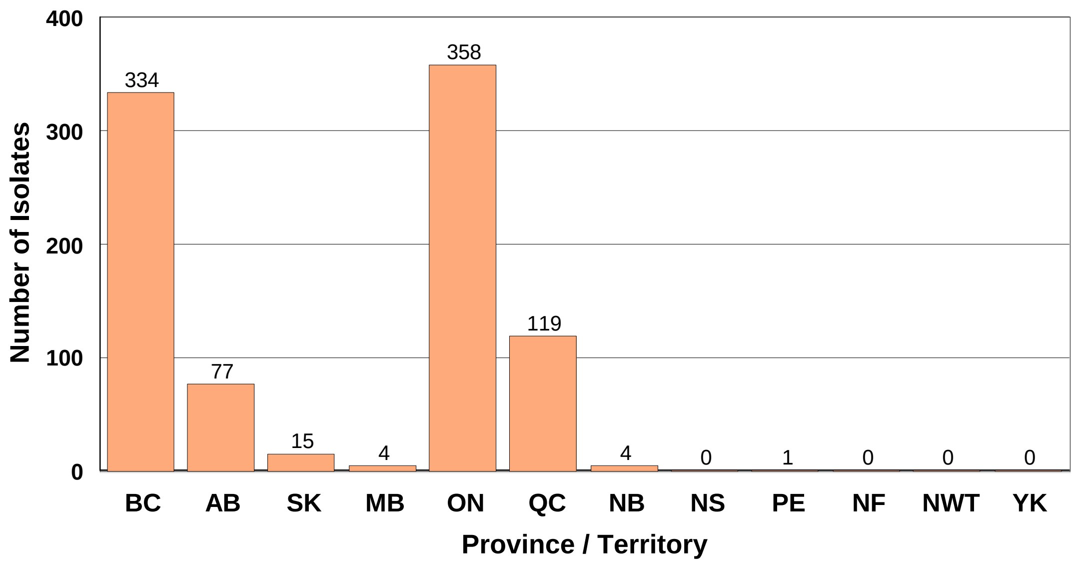
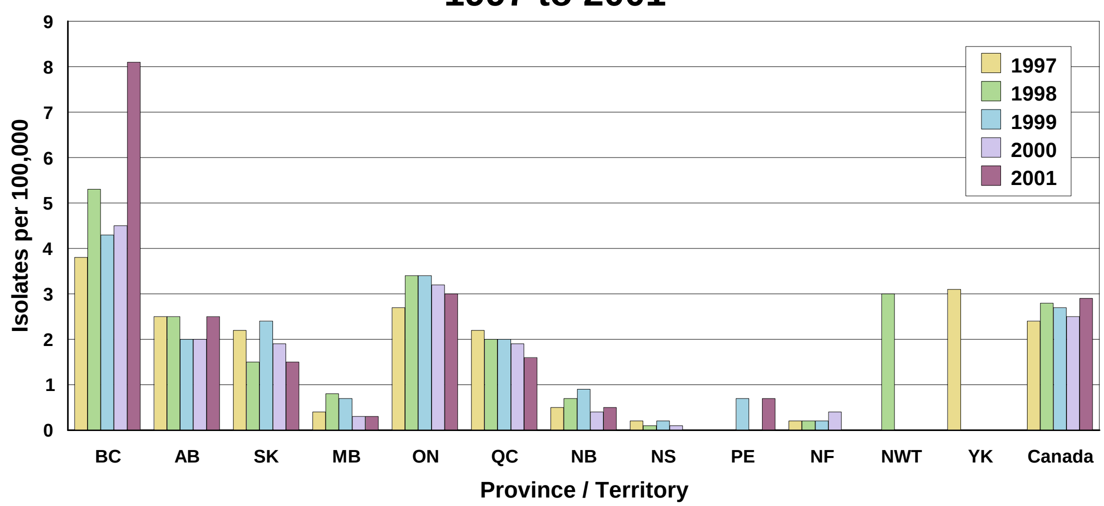


Figure 22: Rate of *Yersinia* Isolations from Humans in Canada, 1997 to 2001*



*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.

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 consistant 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.

Figure 22 shows the rates of *Yersinia* isolation for each province for each of the last 5 years. An increases in isolation rate has been observed in British Columbia where isolations have increased from 4.5 cases per 100,000 last year to 8 cases this year.

Table 11: *Yersinia* Isolates from Humans in Canada, 2001*

Organism	BC	AB	SK	MB	ON	QC	NB	PEI	Total
Yersinia enterocolitica	255	10	2	4	31	119	4	1	**426**
Y. enterocolitica bio 1A			8		2				**10**
Y. enterocolitica bio 1A sero O:34					1				**1**
Y. enterocolitica bio 1A sero O:36					1				**1**
Y. enterocolitica bio 1A sero O:41,42		4			1				**5**
Y. enterocolitica bio 1A sero O:41,43		2			1				**3**
Y. enterocolitica bio 1A sero O:5		4			1				**5**
Y. enterocolitica bio 1A sero O:5,27		2							**2**
Y. enterocolitica bio 1A sero O:6,30		1			3				**4**
Y. enterocolitica bio 1A sero O:6,31		2							**2**
Y. enterocolitica bio 1A sero O:7,13		2			1				**3**
Y. enterocolitica bio 1A sero O:7:8		2			9				**11**
Y. enterocolitica bio 1A sero O:NT		5			4				**9**
Y. enterocolitica bio 1A sero rough					3				**3**
Y. enterocolitica bio 1B sero O:8		2							**2**
Y. enterocolitica bio 1B sero O:9					3				**3**
Y. enterocolitica bio 2 sero O:5,27		2			2				**4**
Y. enterocolitica bio 2 sero O:9					1				**1**
Y. enterocolitica bio 3 sero O:5,27		1							**1**
Y. enterocolitica bio 3 sero O:1,2,3		1			1				**2**
Y. enterocolitica bio 4 sero O:3		22			284				**306**
Total *Yersina enterocolitica*	**255**	**62**	**10**	**4**	**349**	**119**	**4**	**1**	**804**
Y. frederiksenii	16	5			4				**25**
Y. intermedia	24	5	5		2				**36**
Y. kristensenii	4	3			1				**8**
Y. mollaretii	20	2							**22**
Y. pseudotuberculosis					1				**1**
Y. rohdei	15				1				**16**
Total	**334**	**77**	**15**	**4**	**358**	**119**	**4**	**1**	**912**

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

Section 8: Outbreaks

Table 12 presents characterization of strains by phage typing and PFGE from major national and international enteric pathogen outbreaks in which the NML has provided assistance. The national outbreaks investigated were of community, institutional, restaurant and familial types. The data does not cover all outbreaks occurring in Canada, however, it provides general overview of enteric pathogens and their subtypes commonly circulating within the population and causing outbreaks of disease.

Table 12: Laboratory Confirmed Isolates of *Salmonella*, *Escherichia coli* O157:H7 and *Shigella sonnei* from Outbreaks, 2001

Organism	OutbreakType	Description	Province	Phage Type	PFGE Pattern (No. Isolates)	Source (No. Isolates)	Total
E. coli O157:H7	Community	Hamburger	SK	14a	ECXAI.0146 (10), n/a* (1), ECXAI.0148(1)	Raw Beef (9), Human (3)	12
	Family		SK	14a	ECXAI.0001	Human	4
	Family		SK	14a	n/a	Human	2
	Family		SK	14a	n/a	Human	2
	Community		PEI	45	ECXAI.0105	Human	4
	Family		PEI	14a	ECXAI.0518	Human	2
	Day Care	Daycare	NB	32	ECXAI.0606(1), 0614 (1), 0615(1)	Human	3
	Restaurant	Christmas party	SK	21	ECXAI.0001(1), 0017(10), 0058(3), 0616(1), 0619(1)	Pork Ribs (1), Human (15)	16
	Family		NB	14	ECXAI.0001	Human	2
	Family		NB	32	ECXAI.0607	Human	2
	Family		SK	4	n/a	Human	2
S. ssp I 4,5,12:i:-	Family		SK	191	n/a	Human	5
	Community	Dried Moose Meat	SK	191	n/a (12), STXAI.0054(2), 0064(8), 0065(1)	Human	23
	Family		BC	191	n/a	Human	3
S. Agona	Community	Wedding party	ON	AG06	n/a	Human	14
S. Enteritidis	National	Bulk Almonds	BC, NS, ON, NB, QC	30	n/a (261), SENXAI.0025 (34), 0026 (2), 0027(1), 0028(1)	Almonds (153), Human (197)	350
	Restaurant	Mung Bean Sprouts	BC, SK	913	n/a (75), SENXAI.0023 (11), 0024(1)	Human	87
	Family		NS	4	n/a	Human	2
	Travel	Dominican Republic	NB	4	SENXAI.0001	Human	3
	Cluster Investigation		NF, NS, ON, QC	24	n/a (27), SENXAI.0003(5)	Human	32
	Cluster Investigation		NS	13	SENXAI.0038	Human	6
	Day Care		ON	13a	n/a	Human	35
	Family		NS	1	n/a	Human	2
S. Heidelberg	Family		SK	9	n/a	Human	2
	Family		SK	19	n/a	Human	2
	Community	Asian	BC	50	n/a	Human	4
	Cluster Investigation		NF	5	n/a	Human	5
	Cluster Investigation		NWT	19	n/a	Human	5
	Cluster Investigation		QC	19	n/a	Human	6
S. Paratyphi B var. Java	Family		BC	3b var.	n/a	Human	2
S. Thompson	Cluster Investigation		ON	1	n/a	Human	10
	Cluster Investigation		ON	1	n/a	Human	12
	Restaurant	Asian Noodles	ON	1	n/a	Human	11

Organism	OutbreakType	Description	Province	Phage Type	PFGE Pattern (No. Isolates)	Source (No. Isolates)	Total
S. Typhi	Contact Cases		BC	E 1	n/a	Human	2
	Family		BC	E 1	n/a	Human	2
S. Typhimurium	Family		MB	208 var.	n/a	Human	2
	Family		SK	104	n/a	Human	2
	Cluster Investigation		QC	104	STXAI.0001	Human	3
	Cluster Investigation		SK	104	STXAI.0029 (15)	Bovine (2), Human (13)	15
	Family		MB	104	n/a	Human	2
	Family		MB	120	n/a	Human	2
	Family		MB	104	n/a	Human	3
	Family		SK	104	n/a	Human	2
	Restaurant		NS	46	n/a (45), STXAI.0090 (19)	Human	64
	Community	Hunting Lodge	QC	107	n/a	Raw Meat (2), Human (5), Unknown 11	18
	Community		NB	51	STXAI.0112	Human	5
	Family		BC	49	n/a	Human	2
	Family		SK	104	n/a	Human	2
S. Uganda	Cluster Investigation		ON	UG01b	n/a	Poultry (1), Human (20)	21
Shigella sonnei	Community	Cluster	BC	S 1	n/a	Human	26
	Family		BC	S 1	n/a	Human	2

*n/a = Not Available. Phage type data is generated from isolates forwarded to the NML by the PHL's as part of reference requests, passive surveillance, surveys and/or outbreak and cluster investigations. The proportion of specimens forwarded and the extent of PFGE testing differs from province to province and should be interpreted with caution, however the subset of data from each particluar province remains consistant from year to year and can be useful to establish general trends, recognize emergent or re-emergent strains and to provide a general overview of the subtypes found in Canada. Outbreak data for Alberta was unavailable at time of printing and can be obtained by contacting the provincial office within Alberta Health and Wellness.

Section 9: Miscellaneous Information

Table 13: Unusual Enteric Pathogen Infection Sites, 2001

Isolation Site	Organism (Number of Isolates)
Abcess	*S.* Enteritidis (1)
Blood	*C. jejuni* (4), *E. coli* O157 VTEC (1), *S.* Chester (1), *S.* Choleraesuis (1), *S.* Enteritidis (9), *S.* Hadar (1), *S.* Heidelberg (30), *S.* Muenster (4), *S.* Pakistan (1), *S.* Paratyphi A (6), *S.* Paratyphi B (1), *S.* Paratyphi B var Java (1), *S.* Sandiego (1), *S.* Saintpaul (1), *S.* Thompson (5), *S.* Typhimurium (11), *S.* Virchow (1), *Salmonella* sp (1), *Salmonella* ssp I 4,5,12:i:- (1), *Salmonella* ssp I 4,5,12:b:- (2) and *Y. enterocolitica* (1)
Bone	*S.* Javiana (1), *S.* Paratyphi C (1)
Breast Prosthesis	*S.* Heidelberg (1)
Dianeal fluid	*Salmonella* ssp IIIa 18:z4,z23:- (1)
Ear	*V. cholerae* non O1/non O139 (2)
Eye Swab	*S.* Panama (1)
Facial Cyst	*S.* Typhimurium (1)
Gallbladder	*S.* Oranienburg (1)
Neck Abscess	*S.* Enteritidis (1)
Peritoneal Fluid	*S.* Enteritidis (1), *S.* Stanley (1)
Pleural Liquid	*S.* Montevideo (1)
Sputum	*S.* Brandenburg (1)
Urine	*S.* Agona (1), *S.* Bardo (1), *S.* Berta (1), *S.* Blockley (1), *S.* Braenderup (1), *S.* Brandenburg (1), *S.* Enteritidis (6), *S.* Hadar (4), *S.* Heidelberg (13), *S.* Infantis (2), *S.* Muenchen (2), *S.* Muenster (1), *S.* Potsdam (1), *S.* Reading (1), *S.* Sandiego (1), *S.* Senftenberg (1), *S.* Typhimurium (12), *S.* Uganda *(1), Salmonella* Group B (1), *Salmonella* sp. (1), *Salmonella* ssp I (2), *Salmonella* 4,12:-:- ssp I (2), *Salmonella* O(UT):z10:e,n,z15 (1), *Salmonella* ssp I 9,12:l,z28:- (1), *Salmonella* ssp I Rough-O:r:1,2 (1) *Salmonella* ssp IIIb 61:c:z35(1) and *Shigella sonnei* (1).
Vaginal Swab	*S.* Enteritidis (1)
Wound Swab	*S.* Typhimurium (1)

Table 14: Travel Related Enteric Pathogen Infections, 2001

Country of Travel	Organism (Number of Cases)
Africa	*Giardia* (2), *Shigella boydii* (1), *Shigella* sp. (1)
Asia	*Cryptosporidium* (1), *S.* Enteritidis (1), *Shigella sonnei* (1)
Australia	*Shigella flexneri* 2 (1)
Bali	*C. jejuni* (1), *S.* London (1), *S.* Virchow (1)
Bangkok	*S*. Enteritidis (1)
Bangladesh	*Giardia* (1)
Cayman Islands	*Entamoeba histolytica/dispar* (1)
China	*Giardia* (1)
Cuba	*C. jejuni* (1), *S.* Cerro (1), *S.* Enteritidis (1), *S.* Heidelberg, *S.* Infantis (2), *V. cholerae* non O1 (1)
Dominican Republic	*Cryptosporidium* (1), *Cyclospora* (1), *S.* Enteritidis (2), *Shigella flexneri* 2 (1), *Shigella flexneri* 3a (1), *V. chorerae* non O1 (1)
Ecuador	*Shigella sonnei* (1)
Egypt	*Cryptosporidium* (1), *S*. Haifa (1), *Shigella flexneri* 6 (1)
Europe	*S.* Enteritidis (1), *Shigella* sp. (1)
Fiji	*C. jejuni* (1)
Greece	*S.* Enteritidis (1)
Guatemala	*Cyclospora cayetanensis* (1)
Haiti	*Entamoeba histolytica/dispar* (1), *Giardia* (2), *Shigella dysenteriae* 16 (1)
Holland	*S.* Enteritidis (1)
Honduras	*Shigella sonnei* (1)
Hong Kong	*C. jejuni* (1), *S.* Hadar (1), *S.* London (1)
India	*C. jejuni* (2), *Giardia* (1), *S.* Braenderup (1), *S*. Typhi (3), *S*. Virchow (1), *Shigella boydii* 1 (1), *Shigella flexneri* 2 (1), *Shigella sonnei* (2), *V. cholerae* O1 (1)
Indonesia	*Entamoeba histolytica/dispar* (1), *Shigella flexneri* 2 (1)
Iran	*Giardia* (1)
Kampuchea	*Giardia* (1)
Korea	*Giardia* (1)
Mali	*Shigella boydii* (1)
Mexico	*C. jejuni* (6), *E. coli* O157 VTEC (1), *S.* Bredeney (1), *S.* Enteritidis (5), *S.* Infantis (1), *S.* Montevideo (1), *S.* Newport (1), *S*. Weltevreden (1), *Shigella boydii* 20 (2), *Shigella sonnei* (1), *V. fluvialis* (1)
Morocco	*S.* Grumpensis (1)
Nepal	*C. coli* (1), *Giardia* (2), *Shigella flexneri* 2 (1)
Nicaragua	*C. jejuni* (1)
Pakistan	*Cryptosporidium* (1)
Peru	*Cyclospora cayetanensis* (1), *Entamoeba histolytica/dispar* (1), *Shigella dysenteriae* 16 (1)
Phillipines	*S.* Typhi (1)
Thailand	*C. coli* (1), *Giardia* (2), *S*. Panama (1), *Shigella flexneri* 2 (1)
Turkey	*S.* Enteritidis (1)
United Arab Emirates	*S.* Grumpensis (1)
USA	*C. jejuni* (1), *E. coli* O157 VTEC (1), *S.* Typhimurium (1)
Vietnam	*Giardia* (1)

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Appendix 1: Discussion of Data Sources

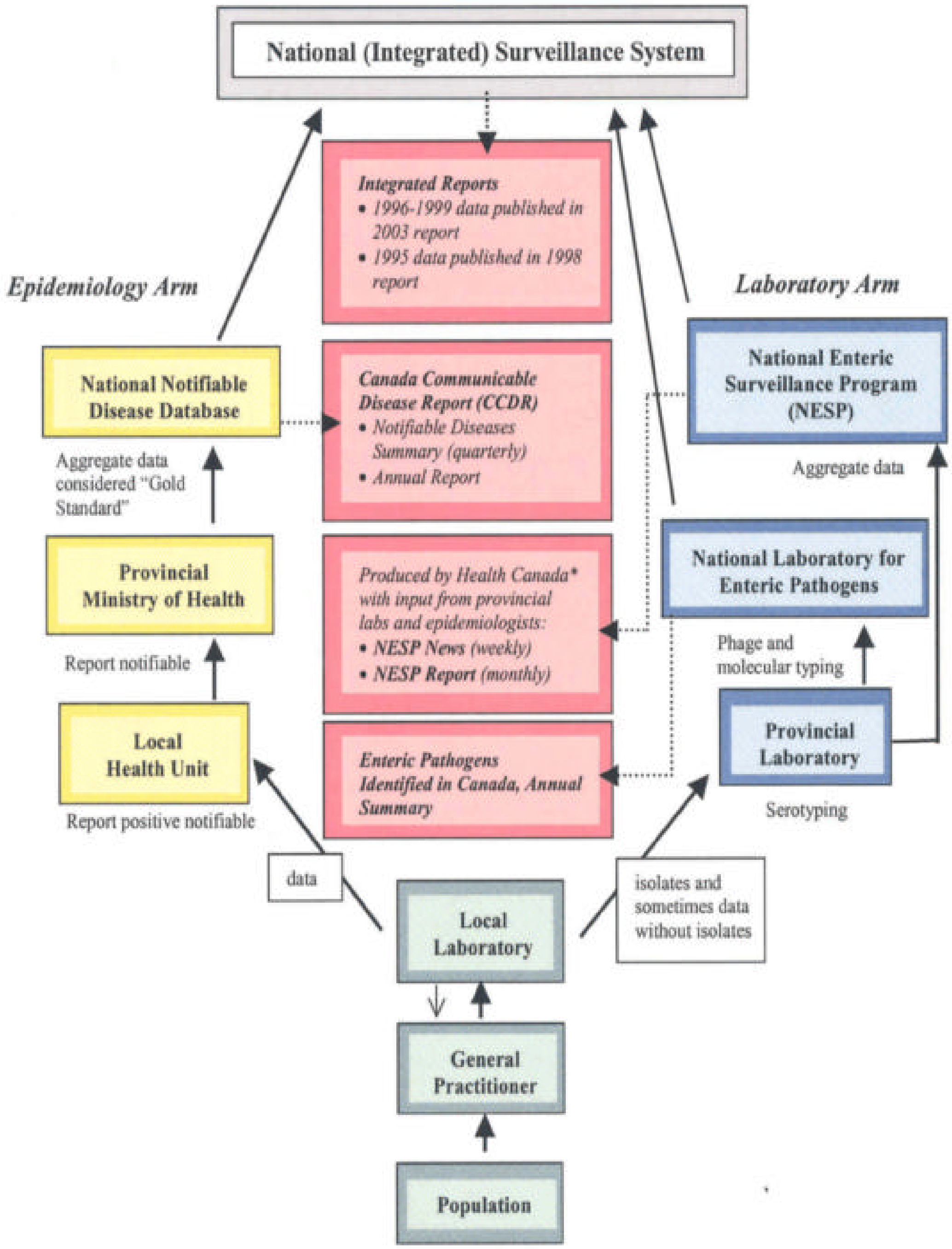
The past few issues of the Annual Summary have been part of an effort to update and formalize this report series. Annual Summaries for 1995 and earlier years were data reports with tables and figures. Beginning in 1996, we adopted a descriptive report format and the 1997 Annual Summary saw an improvement 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. This 2001 Annual Summary attempts 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.

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 complimentary systems: a laboratory based and an epidemiologically based method of collecting data (figure). 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 Enterics 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 NWT) 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* subsp. I 4,5,12:i:- isolations). Discrepancies in numbers between the two surveillance systems can be largely attributed to

Figure 23: Canada's National Enteric Disease Reporting Chain



*Foodborne, Waterborne and Zoonotic Infections Division and the National Laboratory for Enteric Pathogens, Health Canada.

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; 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 sickness, 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* subsp. I serogroups are consistently higher in NESP and this may be a product of the timely reporting inherent in the design of NESP. By subtracting numbers of say, *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

Analysis 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; a lot of 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. 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 in the rest of Canada, this *E. coli* virulence group contributes significantly to morbidity due to enteric pathogens throughout the country. Because 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. Because 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, 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 *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 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 *Crpytosporidium*, *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 only outbreak or cluster related specimens are forwarded to 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 in future annual summaries.

The Future

Progress is now under way with regards to 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. 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 foodborne 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.

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

This report gives an estimate of the types of organisms circulating within Canada; identify broad trends in populations of bacteria; 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.