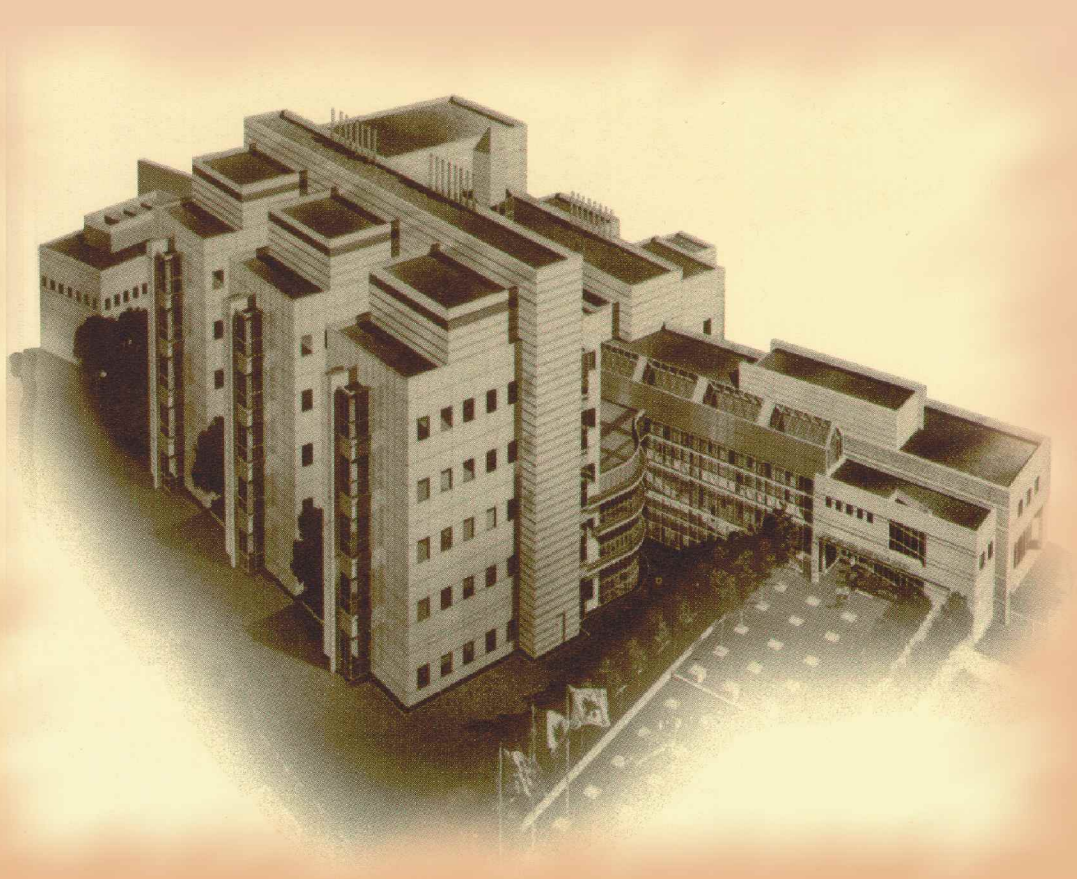
Health Canada Santé Canada

Laboratory Surveillance Data for Enteric Pathogens in Canada

1999



Annual Summary

Canada

Our mission is to help the people of Canada maintain and improve their health.

Health Canada

This report summarizes information received from federal, provincial and public health agencies and the Health of Animals Laboratory on enteric pathogens identifed in Canada during 1999. The information is intended primarily for those with responsibilities 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 Laboratory for Enteric Pathogens**.

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Laboratory Surveillance Data for Enteric Pathogens in Canada

Annual Summary 1999

This issue is dedicated to Rasik Khakhria, in his retirement, for his contributions and committment to the Public Service of Canada through his devoted efforts in the field of laboratory based surveillance of enteric pathogens.

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Foreword

As the decade draws to a close, Canadians have become more aware of the issues related to food safety. Globalization of the food supply is a reality with an increase in the movement and volume of fruit, vegetables, and meat products across national and international borders. Of course, with this comes a greater risk of both mishandling and cross-contamination of food products. Many high risk foods are coming from developing contries, where, because of infrastructure problems, the potential for contamination of foods may be greater. This can result in major outbreaks of food borne illness associated with pathogenic enteric bacteria.

Thirty years ago, bacterial organisms such as *Escherichia coli* O157 VTEC and *Campylobacter* were not commonly associated with human foodborne enteric disease. Today, these pathogens are among the most common cause of food borne illness in Canada. In 1999, *Campylobacter* was associated with more than 11,000 cases of human disease, *Salmonella* with 7,338 cases and *E. coli* O157 VTEC with 2,494 cases. *Campylobacter* and *Salmonella* infections are usually traced to poultry, beef, and pork products. *E. coli* O157 VTEC has emerged as a major public health threat causing hemolytic uremic syndrome in 7% of infected patients, resulting in kidney failure and death in children and the elderly. Implicated sources of infection have included ground beef, unpasteurized milk, unpasteurized apple juice, alfalfa sprouts, lettuce, salami, farm animals in petting zoos, untreated drinking water, recreational water, including swimming pools, and daycare centres for children.

Food safety is now recognized as a number one major priority health concern in Canada. It has been estimated that there are 2.2 million cases of food borne disease occurring annually with an impact on both Canada's health care system and economy. The estimated impact of food borne disease is at least $1.3 B to the economy due to health care costs and lost productivity (6). Initiatives launched at the National Laboratory for Enteric Pathogens, Winnipeg, Manitoba, include hazard identification, acute response, networking, electronic communication and surveillance used to target, control, and prevent these outbreaks of human enteric disease.

Introduction

Each Annual Summary is an evaluation and compilation of a variety of data sets. Component data sets include: 1) those generated by provincial governments in their monthly/annual/*ad hoc* reports; 2) that from the annual report of the Laboratory for Foodborne Zoonoses (LFZ, formerly HAL) in Guelph; 3) those from the National Laboratory for Enteric Pathogens (NLEP) in Winnipeg; 4) the National Enterics Surveillance Program (NESP); and 5) National Notifiable Disease data, which is jointly collected and collated by all provincial Public Health Laboratories (PHL's), the NLEP, and the Centre for Infectious Disease Prevention and Control (CIDPC).

Taken together, these component data sets represent a diverse and complex group. Since the information in this report is used as a reliable estimate of the number of reported cases of foodborne and waterborne illness in Canada, it is important that these data sets are collated so as to supply good estimates. Over time, as data is collected consistantly, broad national trends can be indicated.

In the early 1980's the collection and interpretation of surveillance information was simpler. An instructive publication, *An Overview of the Salmonella Surveillance System in Canada*[1], described the flow of human salmonellosis data from patients to physicians, epidemiologists, laboratories (regional or central provincial, private, hospital, and federal), Statistics Canada, and finally all information was forwarded to NLEP. It was easier to identify issues such as under-reporting at the physician level or regional non-uniformity among laboratories.

Twenty years later much has changed. With the widespread introduction of the personal computer, there has been a proliferation of electronic databases, information management systems and reporting vehicles. The collation and interpretation of the data sets has become more challenging. The data are used for diverse purposes such as: identifying types and subtypes of organisms; identifying unusual events or trends in types and subtypes of organisms found in Canada; identifying gaps where more data need to be collected, or collected in a better way; identifying knowledge gaps requiring research; etc. This year the quality of the each database was considered in detail, so that the tables presented herein will represent the best possible compilation of the available infomation.

This report presents the annual summary of the number of laboratory-confirmed identifications of *Salmonella*, pathogenic *E. coli*, *Campylobacter*, *Shigella*, *Aeromonas, Plesiomonas,* and other enteric pathogens for 1999. These data summarize isolates from both human and non-human samples.

Methods and Materials

The information presented in this report represents a compilation of various data sets. The aim of the compilation is to determine the number of laboratory-confirmed isolates of enteric pathogens identified in Canada in 1999. Tables were constructed as follows:

Table 1 Human *Salmonella* serotypes:
Each datum presented in the table is the maximum value from the relevant provincial report, the NESP database, and EDSS.

Table 2 Human and non-human *Salmonella* phagetypes:
Data are first a merge of the largely non-human LFZ and the largely human CIPHS, the operational database of NLEP. The maximum from EDSS and this merged data set is then calculated.

Table 3 Nonhuman *Salmonella* serotypes:
Data are from LFZ.

Table 4 Human and non-human *Escherichia coli* serotypes:
Data are from the maximum of human data from provincial reports, NESP, and EDSS; this maximum is then supplemented with non-human data from the sum of the provincial reports and EDSS.

Table 5 Human and non-human *Escherichia coli* O157:H7 phagetypes:
Data are from the maximum of EDSS and CIPHS.

Table 6 *Escherichia coli* O157:H7 serotypes, PCR-VT genotypes:
Data are from CIPHS.

Table 7 Human and non-human *Escherichia coli* O157:H7 phagetypes and VT genotypes:
Data are from CIPHS.

Table 8 Human non-O157:H7 verotoxigenic *Escherichia coli*:
This table was compiled by the molecular typing section of NLEP.

Table 9 Human non-Stx-producing (verotoxigenic) *Escherichia coli*:
This table was compiled by the molecular typing section of NLEP.

Table 10 Human disease attributed to *Escherichia coli*, no virulence factors were detected:
This table was compiled by the molecular typing section of NLEP.

Table 11 Human & non-human *Arcobacter, Campylobacter*, and *Helicobacter*:
Data are from the maximum of human and non-human data from provincial reports, NESP, and EDSS. Human *Campylobacter* species numbers are adjusted upwards using data from the Notifiable Diseases database held by the Centre for Infectious Disease Prevention and Control (CIDPC) in Ottawa.

Table 12 *Shigella* species:
Data are from the maximum of provincial reports, NESP, and EDSS.

Table 13 *Aeromonas* and *Plesiomonas* :
Data are from the maximum of provincial reports, NESP, and EDSS.

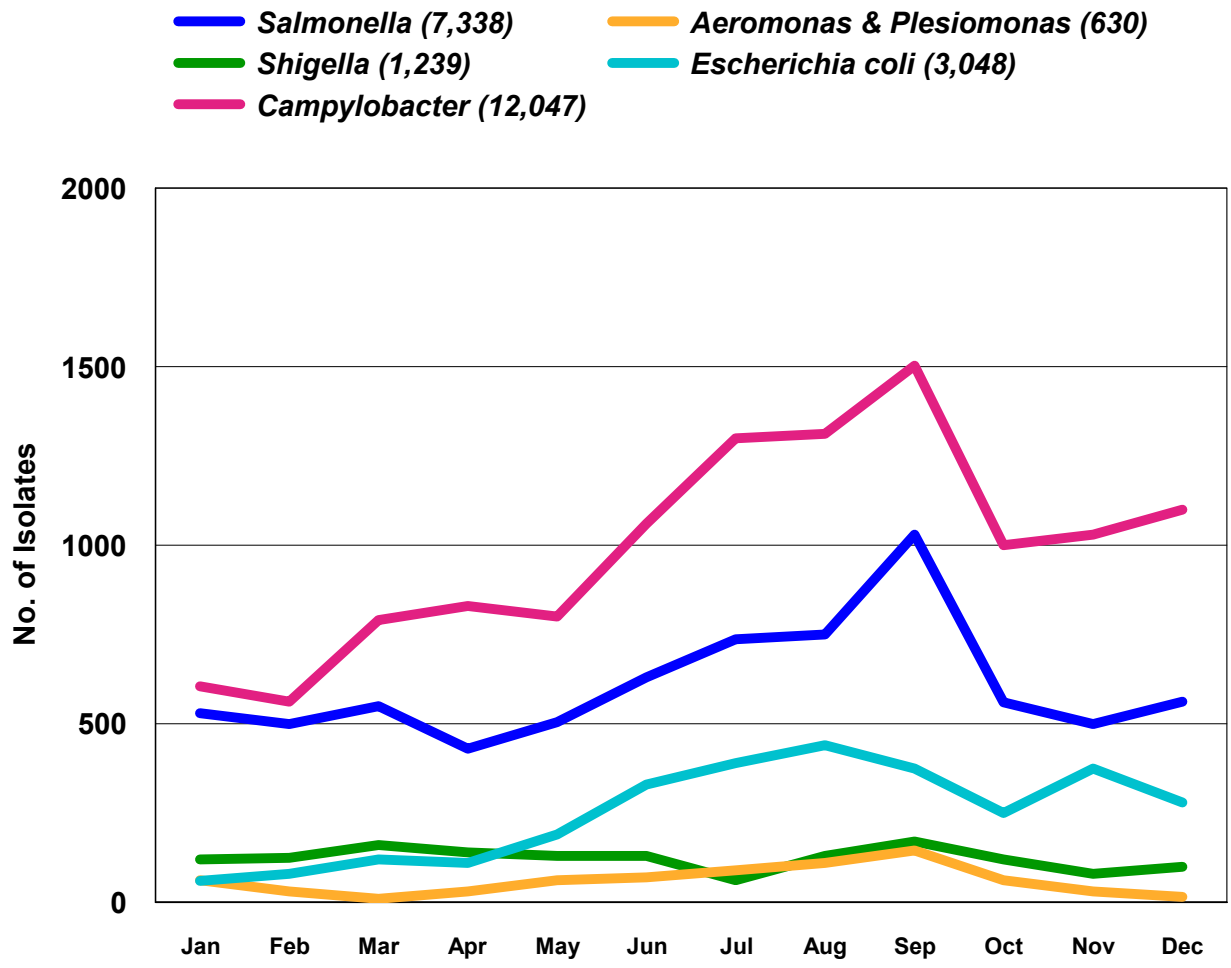
Table 14 Outbreaks:
This table was compiled by the phagetyping section of NLEP.

Nomenclature as standardized for this report series is presented in Appendix I.

Section 1 - Major Enteric Pathogens

Figure 1 compares the number of isolates collected for each month in 1999 of the most important bacterial enteric pathogens of humans: *Salmonella, Escherichia coli, Campylobacter, Shigella*, and *Aeromonas* and *Plesiomonas*. The graph not only shows the number of cases of these organisms, but also illustrates seasonal trends of enteric disease in Canada. There was a total of 11,940 human *Campylobacter, Helicobacter,* and *Arcobacter* isolates and 107 non-human, 12,047 combined (Table 11); 7,338 human *Salmonella* isolates (Table 1) and 5,244 non-human (Table 3), 12,581 combined; 3,048 combined *Escherichia coli* isolates (Table 4) and 2,989 human isolates; 1,239 human *Shigella* isolates (Table 12); and 630 human *Aeromonas* and *Plesiomonas* isolates (Table 13). Most of the data for Figure 1 are from the NESP database, scaled up to match the totals presented in the tables of this report and summarized in the legend. Ontario monthly reports were used for *Aeromonas* & *Plesiomonas.*

Figure 1
Laboratory isolates of human enteric pathogens identified in Canada, 1999



* These data represent total laboratory isolations and should not be confused with incidence

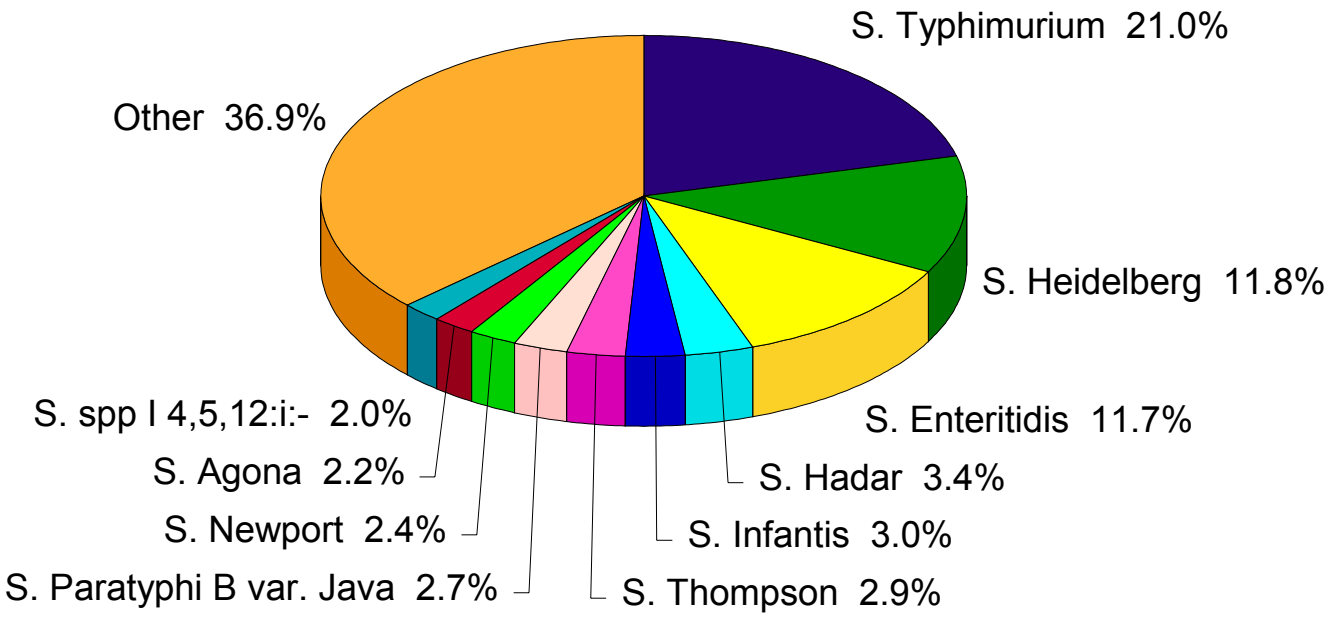
Section 2 - *Salmonella*

Salmonella isolates of human origin in Canada, 1999

Figure 2 illustrates the relative frequency of the top 10 human *Salmonella* serotypes reported in Canada and Figure 3 provides the provincial frequency distribution of human *Salmonella* for the year 1999. Illustration 1 shows the relative frequency of the top 10 human *Salmonella* serotypes for each province. Table 1 lists the number of laboratory identifications of human *Salmonella* by province and territory. Organisms are listed alphabetically by serotype.

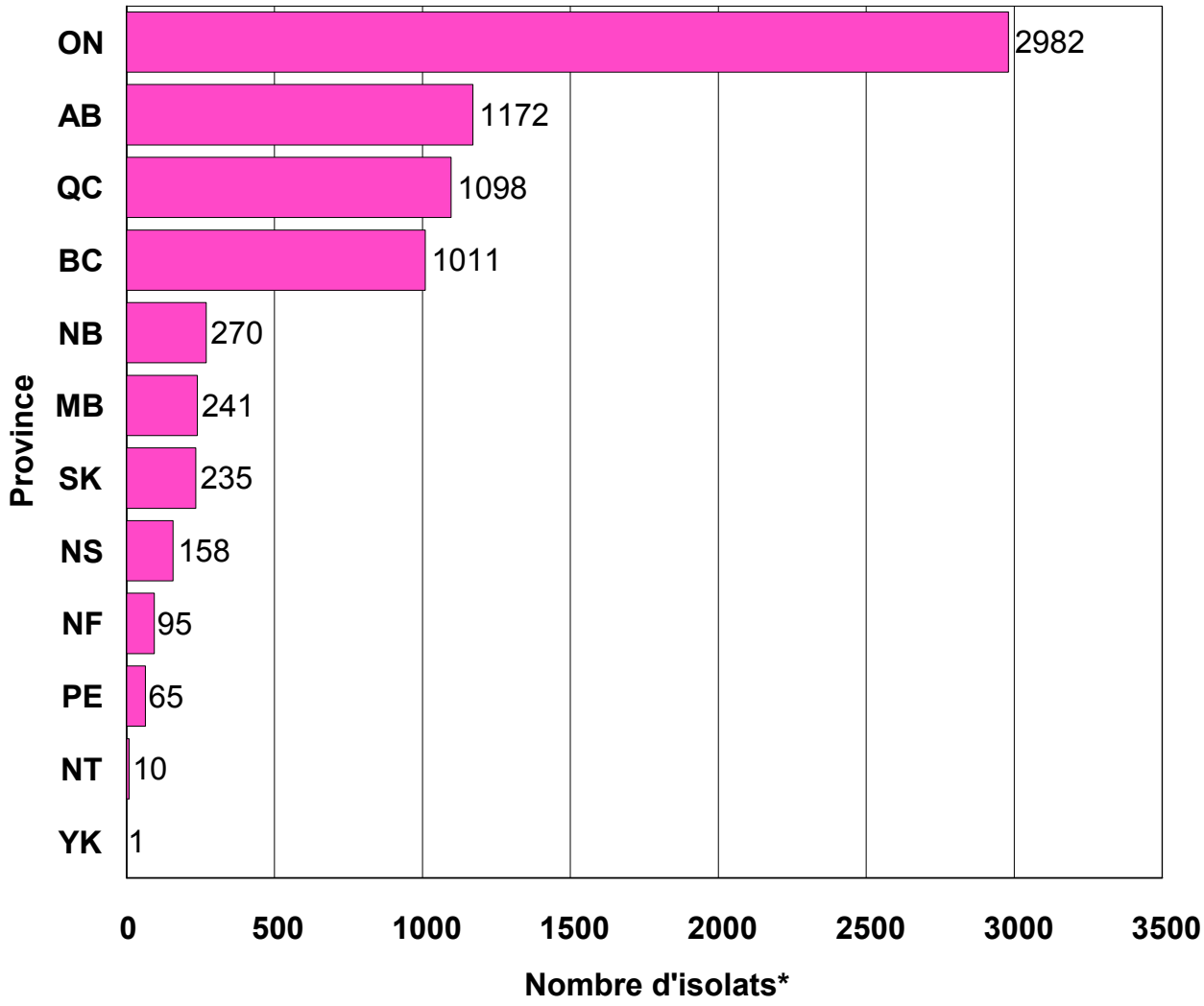
S. Typhimurium ranked first (1,542) among the *Salmonella* serotypes reported from human sources reported in Canada. It ranked first in British Columbia, Alberta, Manitoba, Ontario, and the northern Territories (N.W.T. and Nunavut). *S*. Heidelberg was second (868) and *S.* Enteritidis a close third (858) in Canada.

Figure 2
Top Ten *Salmonella* serotypes of human origin in Canada, 1999



Salmonella Heidelberg ranked first in Saskatchewan, New Brunswick, Nova Scotia Prince Edward Island and Newfoundland. *Salmonella* Enteritidis ranked first in Quebec this year. Only one isolate from identified from the Yukon and that was *S.* Hadar. The emergence of *Salmonella* ssp I 4,5,12:i:- in Canada should be noted. Biochemcial and phage typing of this serovar indicates that this organism is a distinct population from *Salmonella* Typhimurium.

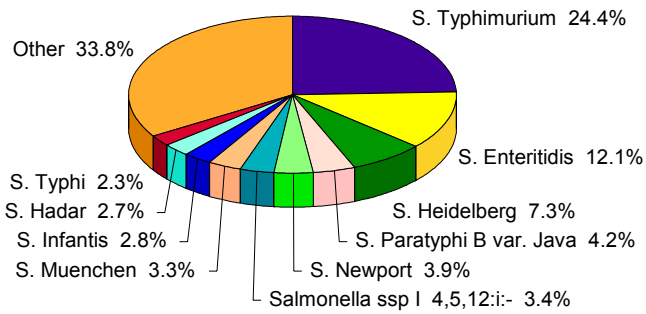
Figure 3
***Salmonella* isolates of human origin in Canada, 1999**



* These data represent total laboratory isolations and should not be confused with incidence

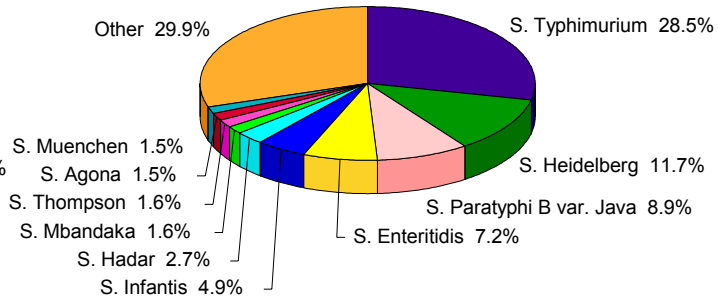
Illustration 1
Top ten *Salmonella* serotypes identified from isolates of human origin in Canada: by Province, 1999

British Columbia



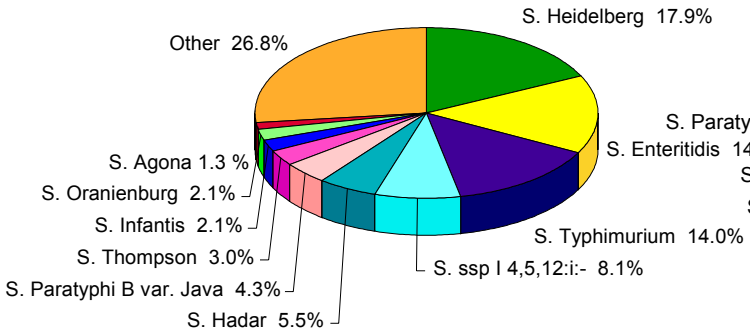
	Isolates	%
S. Typhimurium	247	24.4%
S. Enteritidis	122	12.1%
S. Heidelberg	74	7.3%
S. Paratyphi B var. Java	42	4.2%
S. Newport	39	3.9%
S. ssp I 4,5,12:i:-	34	3.4%
S. Muenchen	33	3.3%
S. Infantis	28	2.8%
S. Hadar	27	2.7%
S. Typhi	23	2.3%
Other	342	33.8%
TOTAL	1011	100.0%

Alberta



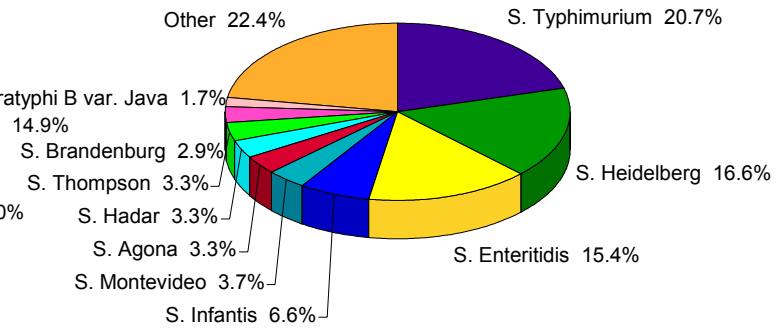
	Isolates	%
S. Typhimurium	334	28.5%
S. Heidelberg	137	11.7%
S. Paratyphi B var. Java	104	8.9%
S. Enteritidis	84	7.2%
S. Infantis	57	4.9%
S. Hadar	32	2.7%
S. Mbandaka	19	1.6%
S. Thompson	19	1.6%
S. Agona	18	1.5%
S. Muenchen	17	1.5%
Other	351	29.9%
TOTAL	1172	100.0%

Saskatchewan



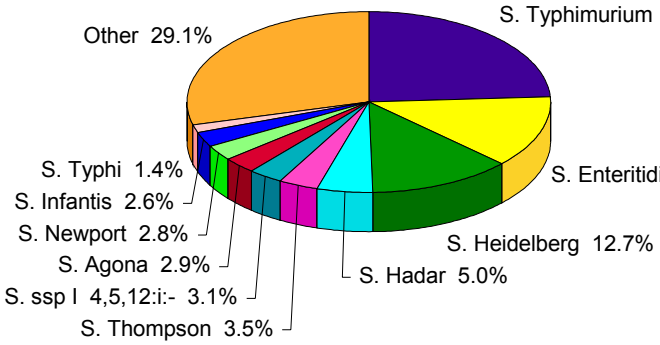
	Isolates	%
S. Heidelberg	42	17.9%
S. Enteritidis	35	14.9%
S. Typhimurium	33	14.0%
S. ssp I 4,5,12:i:-	19	8.1%
S. Hadar	13	5.5%
S. Paratyphi B var. Java	10	4.3%
S. Thompson	7	3.0%
S. Infantis	5	2.1%
S. Oranienburg	5	2.1%
S. Agona	3	1.3%
Other	63	26.8%
TOTAL	235	100.0%

Manitoba



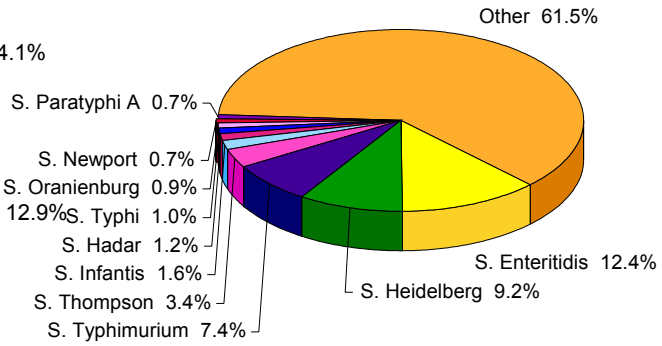
	Isolates	%
S. Typhimurium	50	20.7%
S. Heidelberg	40	16.6%
S. Enteritidis	37	15.4%
S. Infantis	16	6.6%
S. Montevideo	9	3.7%
S. Agona	8	3.3%
S. Hadar	8	3.3%
S. Thompson	8	3.3%
S. Brandenburg	7	2.9%
S. Paratyphi B var. Java	4	1.7%
Other	54	22.4%
TOTAL	241	100.0%

Ontario



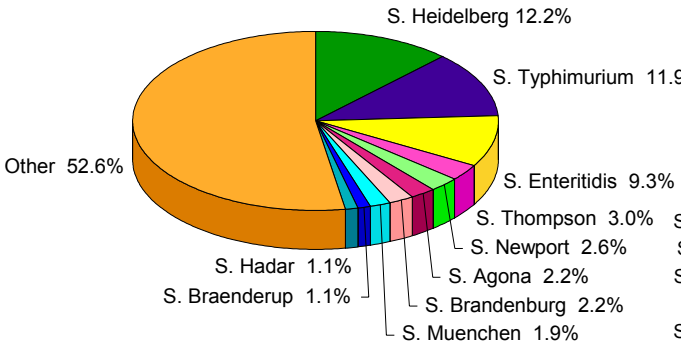
	Isolates	%
S. Typhimurium	718	24.1%
S. Enteritidis	384	12.9%
S. Heidelberg	379	12.7%
S. Hadar	148	5.0%
S. Thompson	104	3.5%
S. ssp I 4,5,12:i:-	91	3.1%
S. Agona	87	2.9%
S. Newport	83	2.8%
S. Infantis	79	2.6%
S. Typhi	41	1.4%
Other	868	29.1%
TOTAL	2982	100.0%

Quebec



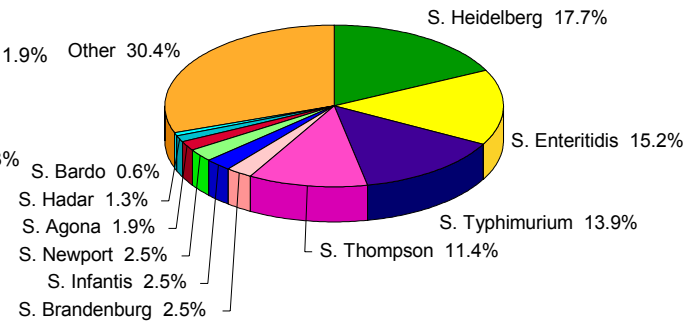
	Isolates	%
S. Enteritidis	136	12.4%
S. Heidelberg	101	9.2%
S. Typhimurium	81	7.4%
S. Thompson	37	3.4%
S. Infantis	18	1.6%
S. Hadar	13	1.2%
S. Typhi	11	1.0%
S. Oranienburg	10	0.9%
S. Newport	8	0.7%
S. Paratyphi A	8	0.7%
Other	675	61.5%
TOTAL	1098	100.0%

New Brunswick



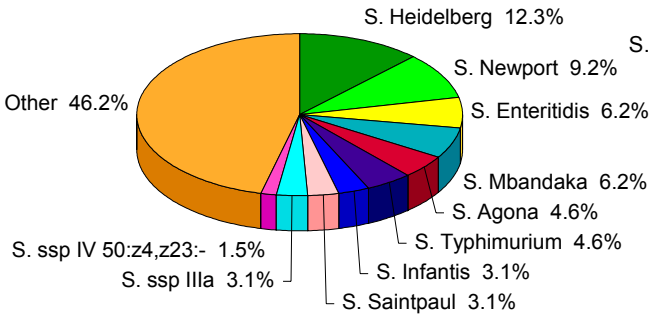
	Isolates	%
S. Heidelberg	33	12.2%
S. Typhimurium	32	11.9%
S. Enteritidis	25	9.3%
S. Thompson	8	3.0%
S. Newport	7	2.6%
S. Agona	6	2.2%
S. Brandenburg	6	2.2%
S. Muenchen	5	1.9%
S. Braenderup	3	1.1%
S. Hadar	3	1.1%
Other	142	52.6%
TOTAL	270	100.0%

Nova Scotia



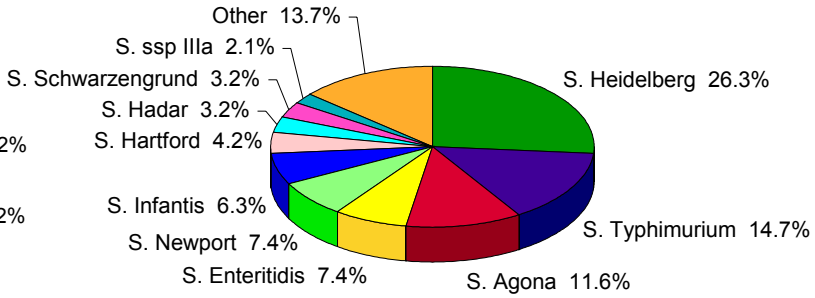
	Isolates	%
S. Heidelberg	28	17.7%
S. Enteritidis	24	15.2%
S. Typhimurium	22	13.9%
S. Thompson	18	11.4%
S. Brandenburg	4	2.5%
S. Infantis	4	2.5%
S. Newport	4	2.5%
S. Agona	3	1.9%
S. Hadar	2	1.3%
S. Bardo	1	0.6%
Other	48	30.4%
TOTAL	158	100.0%

Prince Edward Island



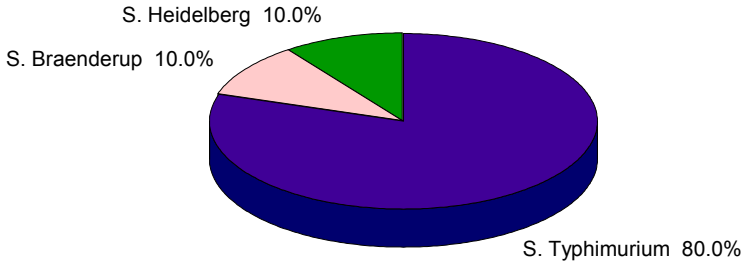
	Isolates	%
S. Heidelberg	8	12.3%
S. Newport	6	9.2%
S. Enteritidis	4	6.2%
S. Mbandaka	4	6.2%
S. Agona	3	4.6%
S. Typhimurium	3	4.6%
S. Infantis	2	3.1%
S. Saintpaul	2	3.1%
S. ssp IIIa	2	3.1%
S. ssp IV 50:z4,z23:-	1	1.5%
Other	30	46.2%
TOTAL	65	100.0%

Newfoundland



	Isolates	%
S. Heidelberg	25	26.3%
S. Typhimurium	14	14.7%
S. Agona	11	11.6%
S. Enteritidis	7	7.4%
S. Newport	7	7.4%
S. Infantis	6	6.3%
S. Hartford	4	4.2%
S. Hadar	3	3.2%
S. Schwarzengrund	3	3.2%
S. ssp IIIa	2	2.1%
Other	13	13.7%
TOTAL	95	100.0%

Northwest Territories



	Isolates	%
S. Typhimurium	8	80.0%
S. Braenderup	1	10.0%
S. Heidelberg	1	10.0%
TOTAL	10	100.0%

Table 1
***Salmonella* serotypes identified from isolates of human origin in Canada, 1999**

SEROTYPE	PROVINCES												TOTAL
	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Aberdeen					1								**1**
S. Adelaide	1				1								**2**
S. Agona	13	18	3	8	87	6	6	3	3	11			**158**
S. Agoueve						1							**1**
S. Alachua	1												**1**
S. Albany					5								**5**
S. Amager	1												**1**
S. Amersfoort					1								**1**
S. Anatum	5	4	1		19	1							**30**
S. Arechavaleta		1			3		1						**5**
S. Bardo								1					**1**
S. Bareilly	7	2			6								**15**
S. Berta					11								**11**
S. Birkenhead	4												**4**
S. Blockley	1	1			2	1							**5**
S. Bonariensis				1	1								**2**
S. Bovismorbificans	10	11	1	1	5								**28**
S. Braenderup	8	4	1		22		3				1		**39**
S. Brandenburg	4	2		7	26	6	6	4					**55**
S. Bredeney	10	1											**11**
S. Breukelen					1								**1**
S. California			1										**1**
S. Carrau						5							**5**
S. Cerro		1			1	2							**4**
S. Chandans	1												**1**
S. Chester					3			1					**4**
S. Chicago		1											**1**
S. Choleraesuis					2	2							**4**
S. Daytona	7												**7**
S. Denver		1			1								**2**
S. Derby	2	2		2	20	3	2			1			**32**
S. Drypool						1							**1**
S. Dublin	2	2	1		1	2							**8**
S. Dugbe					1								**1**
S. Durban	6	1											**7**
S. Durham		1											**1**
S. Eastbourne	1				1								**2**
S. Emek				1	2								**3**
S. Enteritidis	122	84	35	37	384	136	25	24	4	7			**858**
S. Escanaba							1						**1**
S. Finkenwerder					1								**1**
S. Gaminara					3								**3**
S. Gatuni					1								**1**
S. Give	1	1		1	3			1					**7**
S. Glostrup		4			2								**6**
S. Goldcoast					2								**2**
S. Grumpensis					1								**1**
S. Haardt		1											**1**
S. Hadar	27	32	13	8	148	13	3	2	1	3		1	**251**
S. Hagenbeck	1												**1**
S. Haifa					2								**2**
S. Hartford		1			5	1	1			4			**12**
S. Havana					5								**5**
S. Heidelberg	74	137	42	40	379	101	33	28	8	25	1		**868**
S. Ibadan						1							**1**
S. Idikan					1	1							**2**
S. Indiana	3	1			3	1							**8**

SEROTYPE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	TOTAL
S. Infantis	28	57	5	16	79	18	3	4	2	6			**218**
S. Inverness			1										**1**
S. Isangi		1											**1**
S. Istanbul	1			1	1	2							**5**
S. Itami	2												**2**
S. Jangwani		1											**1**
S. Javiana	4	6	1	1	24	2							**38**
S. Johannesburg		1		1	4								**6**
S. Kentucky	5	1			4	3							**13**
S. Kintambo					1	1							**2**
S. Kottbus			2										**2**
S. Lexington		2			1								**3**
S. Litchfield	3	8	2		6	7							**26**
S. Livingstone					1								**1**
S. London	2	1			3								**6**
S. Manchester					1								**1**
S. Manhattan	1				3								**4**
S. Matadi						1							**1**
S. Matopeni						1							**1**
S. Mbandaka	18	19	1	1	17	4		1	4				**65**
S. Meleagridis	2	1			1	1							**5**
S. Minnesota		2											**2**
S. Mississippi		1			3								**4**
S. Monschaui	1												**1**
S. Montevideo	12	10	2	9	20	5							**58**
S. Muenchen	33	17	1	1	20	4	5			1			**82**
S. Muenster		1			6					1			**8**
S. Naestved					1								**1**
S. Nessziona	7				1								**8**
S. Newbrunswick		1											**1**
S. Newport	39	16	2	3	83	8	7	4	6	7			**175**
S. Nima		1											**1**
S. Nottingham						1							**1**
S. Ohio	8	1	2	1	6	2							**20**
S. Oranienburg	12	15	5	3	30	10	1	1					**77**
S. Oslo	2	3											**5**
S. Panama	11	5	3	3	11	4				1			**38**
S. Paratyphi A	7	5	1		26	8							**47**
S. Paratyphi B	3	2			2	6							**13**
S. Paratyphi B var. Java	42	104	10	4	38	1		1					**200**
S. Pensacola	1				1	1							**3**
S. Perth								1					**1**
S. Pomona					2			1					**3**
S. Poona	2	3		2	7	1							**15**
S. Potsdam	2				2								**4**
S. Pretoria					1								**1**
S. Reading	4	1		1	1								**7**
S. Richmond	2				1								**3**
S. Rissen	1	1			1			1					**4**
S. Romanby					1								**1**
S. Rubislaw		2				1							**3**
S. Saintpaul	5	8	3	3	27	3	2	1	2				**54**
S. Sandiego	3	1			11								**15**
S. Schwarzengrund	3	8	1	4	25	7		1		3			**52**
S. Senftenberg	3	3	1		8	1							**16**
S. Seremban	1												**1**
S. Stanley	8	3	1		11	1	1						**25**
S. Stanleyville		1			1								**2**
S. Telelkebir	3	1											**4**
S. Tennessee	4				3	2	1						**10**
S. Thompson	10	19	7	8	104	37	8	18	1	1			**213**

SEROTYPE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	TOTAL
S. Tilene	1												**1**
S. Toucra								1					**1**
S. Typhi	23	7	1	2	41	11			1				**86**
S. Typhimurium	247	334	33	50	718	81	32	22	3	14	8		**1542**
S. Uganda	2	3	1	1	5			1					**13**
S. Urbana	1	1		1	2	1							**6**
S. Virchow	6	1			11	2							**20**
S. Weltevreden	4		1		6	1							**12**
S. Wien		1											**1**
S. Worthington	19	2			4					1			**26**
Salmonella ssp I	38	148	22	12	50	89	121	33		3			**516**
Salmonella ssp I Group B	2	1	4	1	146	301	1	1	17	1			**475**
Salmonella ssp I 4,12:-:-						1							**1**
Salmonella ssp I 4,5,12:-:-					4	3							**7**
Salmonella ssp I 4,5,12:-:1,2					9								**9**
Salmonella ssp I 4,5,12:b:-		2			24	2							**28**
Salmonella ssp I 4,5,12:d:-					3								**3**
Salmonella ssp I 4,12:i:-		4	1	2		1							**8**
Salmonella ssp I 4,5,12:i:-	34	1	19	2	91								**147**
Salmonella ssp I 4,12:l,v:-					1								**1**
Salmonella ssp I 4,5,12:l,v:-				1									**1**
Salmonella ssp I Group C					3	9	2		3				**17**
Salmonella ssp I Group C1		1			24	40	1		1				**67**
Salmonella ssp I 6,7:-:-					1								**1**
Salmonella ssp I 6,7:-:1,5		1		1	13								**15**
Salmonella ssp I 6,7:b:-					2								**2**
Salmonella ssp I 6,7:d:-					1								**1**
Salmonella ssp I 6,7:eh:-					1								**1**
Salmonella ssp I 6,7:k:-					2								**2**
Salmonella ssp I 6,7:y:-					6								**6**
Salmonella ssp I Group C2					5	56			1				**62**
Salmonella ssp I 6,8:-:1,2					2								**2**
Salmonella ssp I 6,8:d:-					1								**1**
Salmonella ssp I 6,8:eh:-					1								**1**
Salmonella ssp I 6,8:k:-					1								**1**
Salmonella ssp I Group C3						7							**7**
Salmonella ssp I Group D			1		2	35	1		5				**44**
Salmonella ssp I Group D1							1						**1**
Salmonella ssp I Group E					4	4							**8**
Salmonella ssp I Group E1					1	6							**7**
Salmonella ssp I 3,10:-:-	3				1								**4**
Salmonella ssp I 3,10:r:-	2												**2**
Salmonella ssp I 3,10:l,v:-	1				1								**2**
Salmonella ssp I 3,10:l,w:-	2				2								**4**
Salmonella ssp I 3,10:l,z13:-	1				1								**2**
Salmonella ssp I Group E2	1					1							**2**
Salmonella ssp I 3,15:l,v,:-	1												**1**
Salmonella ssp I Group F						1							**1**
Salmonella ssp I Group G1						3							**3**
Salmonella ssp I Group G2					2	2							**4**
Salmonella ssp I 16:l,v:-		1											**1**
Salmonella ssp I Group H						1							**1**
Salmonella ssp I Group I						1							**1**
Salmonella ssp I 1,13,23:z:-					1								**1**

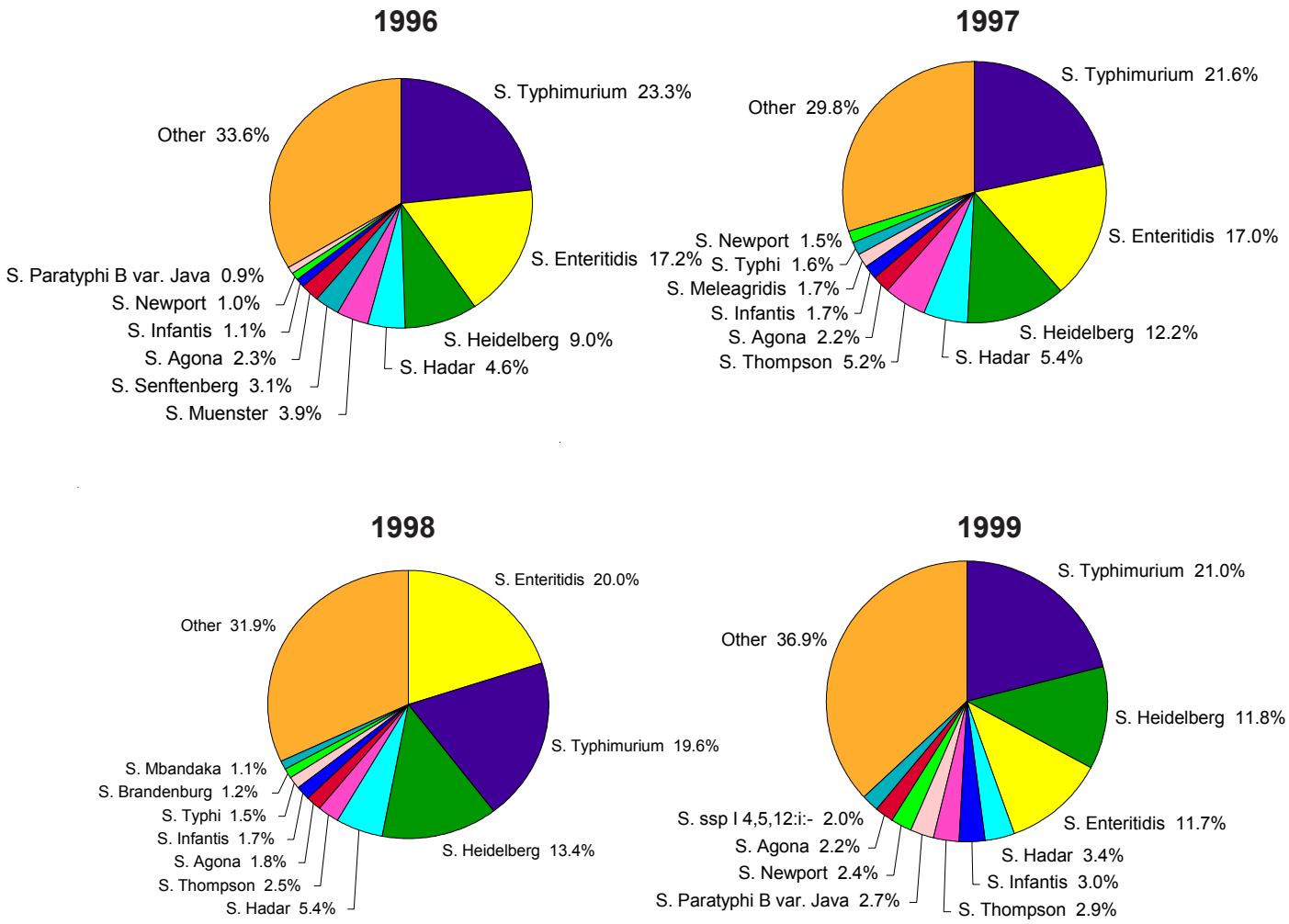
SEROTYPE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	TOTAL
Salmonella ssp I Group M						1							**1**
Salmonella ssp I Group O						3							**3**
Salmonella ssp I Group Y						1							**1**
Salmonella ssp I Rough-O:-:1,2					1								**1**
Salmonella ssp I Rough-O:b:e,n,x					1								**1**
Salmonella ssp I Rough-O:f,g:-		2											**2**
Salmonella ssp I Rough-O:g,m,t:-	1												**1**
Salmonella ssp I Rough-O:k:1,5					1								**1**
Salmonella ssp I Rough-O:l,v:-					1								**1**
Salmonella ssp I Rough-O:l,v:1,7						1							**1**
Salmonella ssp I Rough-O:l,w:-	1												**1**
Salmonella ssp I Rough-O:z:1,6					1								**1**
Salmonella ssp I Rough-O:z6:-					1								**1**
Salmonella ssp I Rough-O:z10:enx			1										**1**
Salmonella ssp II	1												**1**
Salmonella ssp II 13,23:z:1,5					1								**1**
Salmonella ssp II 41:z10:1,2					1								**1**
Salmonella ssp II 48:d:z6	1												**1**
Salmonella ssp IIIa		4	2		2			1	2	2			**13**
Salmonella ssp IIIa 13,23:g,z51:-					1								**1**
Salmonella ssp IIIa 41:z4,z23:-		1											**1**
Salmonella ssp IIIb	4	6				1							**11**
Salmonella ssp IIIb 48:i:z	1				1								**2**
Salmonella ssp IIIb 48:l,v:1,5,7	4												**4**
Salmonella ssp IIIb 48:z:z52		1											**1**
Salmonella ssp IIIb 50:k:z	1				1								**2**
Salmonella ssp IIIb 53:k:z	1												**1**
Salmonella ssp IIIb 60:r:e,n,x,z15					1								**1**
Salmonella ssp IIIb 60:r:z	1												**1**
Salmonella ssp IIIb 60:z52:z53					1								**1**
Salmonella ssp IIIb 61:k:1,5,7						1							**1**
Salmonella ssp IV		2			2	1	1			2			**8**
Salmonella ssp IV 6,7:z4,z24:-								1					**1**
Salmonella ssp IV 11:z4z23:-					1								**1**
Salmonella ssp IV 16:z4,z32:-		1			2								**3**
Salmonella ssp IV 44:z4,z23:-					1								**1**
Salmonella ssp IV 48:g,z51:-					3	1	1						**5**
Salmonella ssp IV 50:g,z51:-					1	2				1			**4**
Salmonella ssp IV 50:z4,z23:-					1				1				**2**
TOTALS	**1011**	**1172**	**235**	**241**	**2982**	**1098**	**270**	**158**	**65**	**95**	**10**	**1**	**7338**

Changes in the occurrence of *Salmonella* serotypes of human origin over time

The changes in the relative frequency of the top 10 *Salmonella* serotypes over the last four years are shown in Figure 4 for isolates of human origin.

S. Typhimurium ranked first in number of isolates received during 1999 after being second last year. *S.* Newport and *S.* Paratyphi B var. Java are back in the top ten in 1999. *Salmonella* ssp I 4,5,12:i:- is a new entry in this top ten list and is recognized as a newly emerging pathogen.

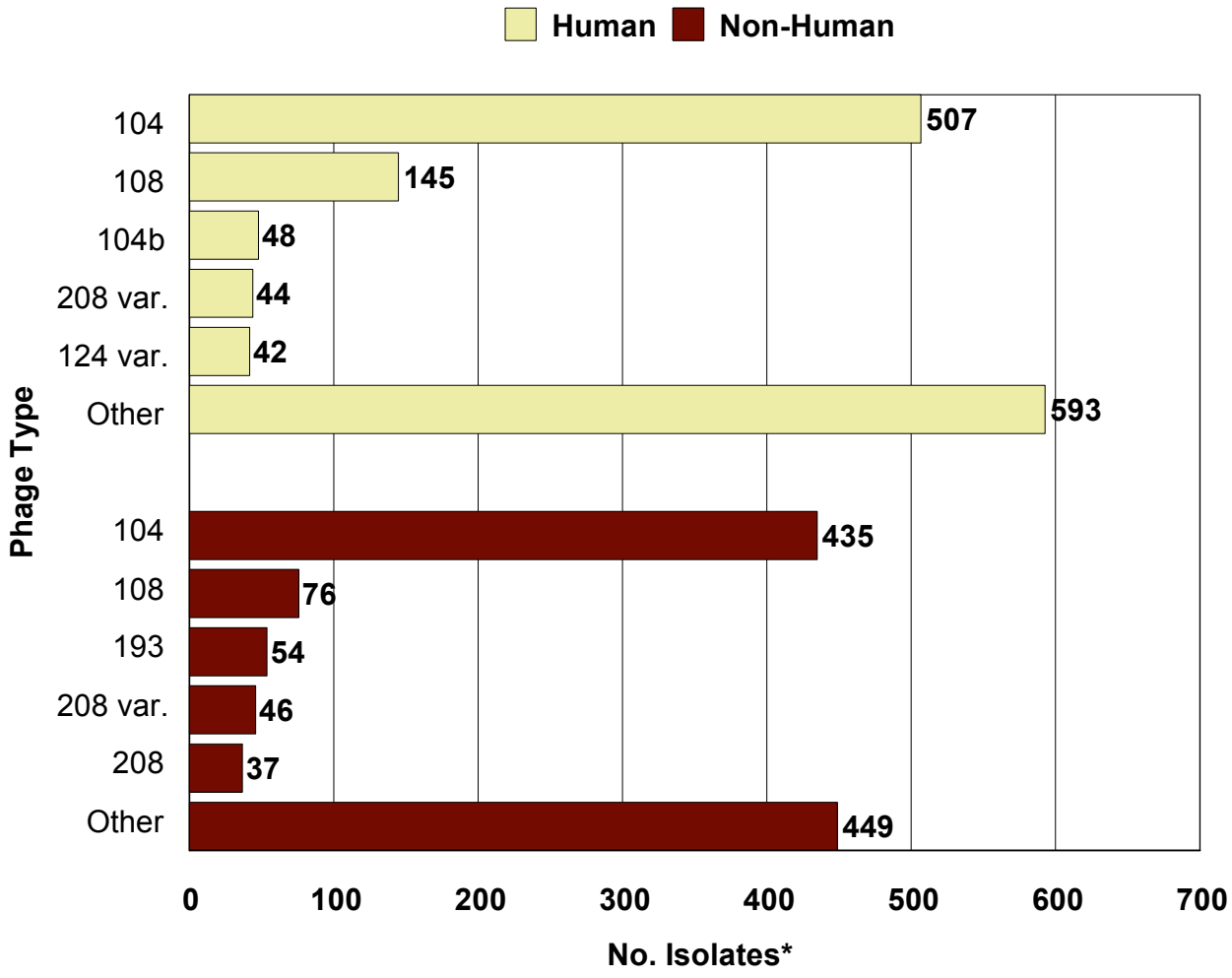
Figure 4
Top ten *Salmonella* serotypes identified from isolates of human origin in Canada 1996, 1997, 1998, and 1999



Salmonella phagetypes identified from isolates of human and non-human origin in Canada, 1999

Figure 5 presents the five most common *S*. Typhimurium phagetypes isolated from human and non-human sources in 1999. Figure 6 illustrates the five most common phagetypes for *S*. Enteritidis, *S*. Heidelberg, *S*. Hadar, and *S*. Newport from human and non-human sources. (In both figures, rare types "Atypical" and "Untypable" were included in Other.)

Figure 5
Top five *S*. Typhimurium phagetypes identified from isolates of human and non-human origin in Canada, 1999



* These data represent total laboratory isolations and should not be confused with incidence

Figure 6
Top five *Salmonella* phagetypes identified from isolates of human and non-human origin in Canada, 1999

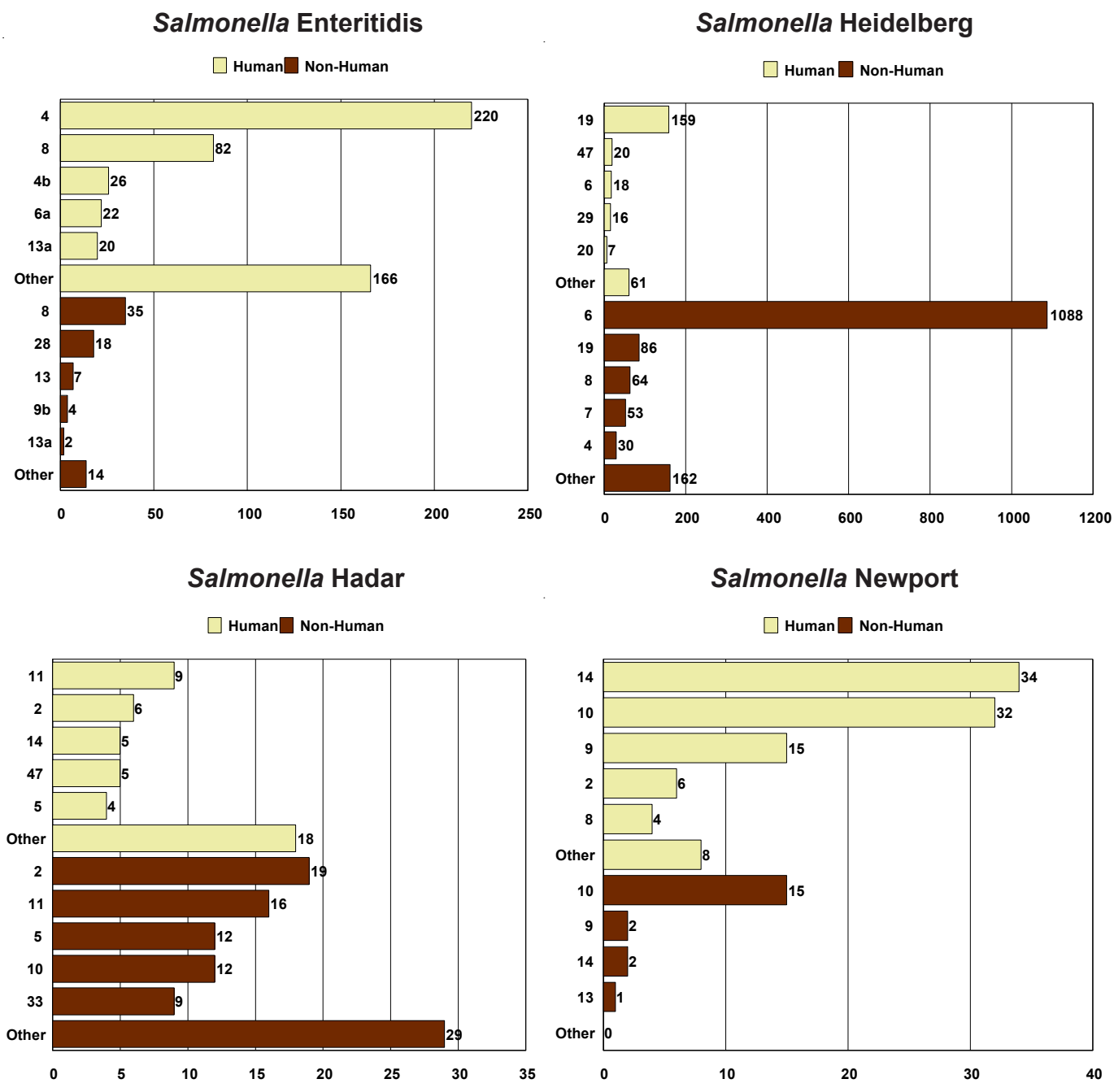


Table 2 lists the phagetypes identified within each of a set of *Salmonella* serotypes. Data are further classified by source (human and non-human) and province.

Table 2
Salmonella phagetypes identified from isolates of human and non-human origin in Canada, 1999

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Enteritidis	1	Human	7	2			4	3							**16**
	1a	Human	1												**1**
	1b	Human	4	1											**5**
	4	Human	48	32	6	12	48	60	1	9	4				**220**
	4a	Human		2		2	1	2		6					**13**
	4b	Human	2	5		1	5	10		3					**26**
	5	Human						2							**2**
	5a	Human					1			2					**3**
	6	Human	1				2	3							**6**
	6a	Human	2	8	4	2	2	4							**22**
	7	Human	1												**1**
	7a	Human	1				1								**2**
	7a var.	Human						1							**1**
	8	Avian	1					1							**2**
	8	Bovine		1											**1**
	8	Canine					2								**2**
	8	Chicken	1	7			1								**9**
	8	Duck	1												**1**
	8	Eggs	7												**7**
	8	Feed & Ingredients						4							**4**
	8	Human	14	13	4	12	21	16		2					**82**
	8	Porcine		4			1								**5**
	8	Quail						2							**2**
	8	Seal					1								**1**
	8	Turkey	1												**1**
	9a	Human		6	3			2		2					**13**
	9b	Feed & Ingredients						4							**4**
	11b	Chicken			1										**1**
	11b	Human			12		1								**13**
	13	Animal						1							**1**
	13	Chicken					5								**5**
	13	Human	9	1			2	5							**17**
	13	Porcine		1											**1**
	13a	Avian						2							**2**
	13a	Human	2	3	1		5	9							**20**
	14b	Human	6	2	3	2		3							**16**
	14b	Porcine						1							**1**
	18	Human					1		1						**2**
	20	Human		1											**1**
	21	Human					2	1							**3**
	21a	Human					1								**1**
	21b	Human		1											**1**
	22	Human						1							**1**
	23	Human						5							**5**
	24	Human	1												**1**
	26	Human		1						1					**2**
	28	Avian						9							**9**
	28	Chicken					4	4							**8**
	28	Eggs	1												**1**
	28	Human	1	2	1	2	1	1		3					**11**
	29	Human					1	1							**2**
	29a	Human						1							**1**
	34	Chicken					1								**1**
	34	Human			1			5							**6**
	35	Human						1							**1**
	36	Human						2							**2**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES											TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Enteritidis	38	Human	1												**1**
(continued)	911	Human	2	1		2		1							**6**
	912	Human	1	1		1		1							**4**
	Atypical	Chicken	1												**1**
	Atypical	Equine			2										**2**
	Atypical	Feed & Ingredients						1							**1**
	Atypical	Human	1				1	3							**5**
	Atypical	Other		1				3							**4**
	Atypical	Porcine							1						**1**
	Atypical	Unknown						1							**1**
	Untypable	Feed & Ingredients						1							**1**
	Untypable	Human		1											**1**
	Subtotal		**118**	**97**	**38**	**36**	**115**	**177**	**2**	**29**	**4**				**616**
S. Hadar	2	Avian						7							**7**
	2	Chicken		4	1		5								**10**
	2	Feed & Ingredients						1							**1**
	2	Human		6											**6**
	2	Unknown						1							**1**
	4	Chicken					2				1				**3**
	4	Human					1								**1**
	4	Turkey					4								**4**
	5	Avian						3							**3**
	5	Canine		1											**1**
	5	Chicken		3			2								**5**
	5	Human		2	2										**4**
	5	Turkey					3								**3**
	7	Human			1										**1**
	10	Avian					1		1						**2**
	10	Chicken		2			7								**9**
	10	Human		2				1							**3**
	10	Ovine					1								**1**
	11	Chicken		3			4	1							**8**
	11	Human		7	2										**9**
	11	Poultry Farm						1							**1**
	11	Turkey					6								**6**
	11	Water		1											**1**
	12	Avian					1								**1**
	13	Human		2	2										**4**
	14	Chicken					1								**1**
	14	Human		5											**5**
	17	Bovine					1								**1**
	17	Chicken					1								**1**
	17	Porcine						1							**1**
	18	Human		1											**1**
	18	Turkey		1			5								**6**
	23	Human		1											**1**
	24	Human		1											**1**
	27	Human						1							**1**
	33	Bovine					2								**2**
	33	Chicken		5			2								**7**
	47	Human		2	2	1									**5**
	55	Chicken					1								**1**
	56	Chicken					1								**1**
	56	Human		1											**1**
	56	Turkey					3								**3**
	58	Chicken					1								**1**
	58	Human			2										**2**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			PE	NF	NT	YK	BC	AB	SK	MB	ON	QC	NB	NS	
S. Hadar (continued)	Atypical	Chicken		4			1								**5**
	Untypable	Human			2										**2**
	Subtotal		**54**	**14**	**1**	**56**	**15**	**2**	**1**		**1**			**144**	
S. Heidelberg	1	Bovine	1												**1**
	1	Human	1												**1**
	1	Unknown						1							**1**
	2	Human				1									**1**
	4	Avian						11							**11**
	4	Chicken		2											**2**
	4	Porcine						17							**17**
	5	Chicken		1											**1**
	5	Human									2				**2**
	6	Avian					6	36	17						**59**
	6	Bovine		2			14								**16**
	6	Chicken	2	72			455	4	7	9	1	21			**571**
	6	Eggs	3												**3**
	6	Feed & Ingredients					7	3							**10**
	6	Gull					1								**1**
	6	Human	4	2		2	7	3							**18**
	6	Porcine		9			6	7							**22**
	6	Turkey	3	6			397								**406**
	7	Bovine		3											**3**
	7	Chicken		3			34		3	2					**42**
	7	Human						4							**4**
	7	Turkey					8								**8**
	8	Avian					1								**1**
	8	Bovine					1								**1**
	8	Chicken					16					5			**21**
	8	Feed & Ingredients						4							**4**
	8	Meat						4							**4**
	8	Mouse		1											**1**
	8	Porcine					20	1							**21**
	8	Turkey					11								**11**
	9	Chicken					1								**1**
	9	Human		1											**1**
	10	Bovine		6											**6**
	10	Chicken					1								**1**
	10	Human	1								1				**2**
	10	Porcine		2											**2**
	10	Turkey					7								**7**
	10	Unknown						1							**1**
	11	Chicken		1											**1**
	13	Human		1		1									**2**
	13	Poultry		1											**1**
	13	Poultry Farm						1							**1**
	13	Turkey		2											**2**
	17	Chicken		3											**3**
	17	Eggs	6												**6**
	17	Human	1		1										**2**
	17	Porcine		1											**1**
	18	Chicken	1	4											**5**
	18	Human	2		3										**5**
	19	Chicken	4	36	2										**42**
	19	Chicken Litter	1	7	1										**9**
	19	Eggs	22												**22**
	19	Environmental		7											**7**
	19	Human	31	58	27	30	4				8		1		**159**
	19	Meat		1											**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Heidelberg	19	Pet Food (Dog Treat)					1				1				**2**
(continued)	19	Porcine		1	1										**2**
	19	Poultry Farm					1								**1**
	20	Avian	1												**1**
	20	Chicken		2											**2**
	20	Human	1	4			1			1					**7**
	20	Mouse		1											**1**
	20	Pigeon	1												**1**
	20	Porcine		1											**1**
	21	Chicken		1											**1**
	21	Human	1												**1**
	22	Human	1	2		1									**4**
	23	Chicken		1											**1**
	26	Human					1								**1**
	27	Human	1	1											**2**
	29	Chicken	2	3											**5**
	29	Eggs	4												**4**
	29	Human	1	11	1	3									**16**
	29	Turkey	1												**1**
	30	Human	1		1										**2**
	32	Porcine					1								**1**
	35	Chicken		3											**3**
	35	Chicken Litter		1											**1**
	35	Enviro		1											**1**
	35	Human		1	5										**6**
	36	Chicken	1	12			2								**15**
	36	Eggs	3												**3**
	36	Human		2		1									**3**
	36	Porcine		1											**1**
	37	Human		1											**1**
	40	Eggs	1												**1**
	40	Human		1											**1**
	41	Eggs	1												**1**
	41	Human	1												**1**
	46	Human	1												**1**
	47	Chicken	1	14											**15**
	47	Egg Process. Plant							1						**1**
	47	Human	4	13	1		2								**20**
	47	Turkey	1	5											**6**
	48	Human		1	1										**2**
	48	Poultry		1											**1**
	49	Human		1											**1**
	49	Chicken		1											**1**
	49	Porcine		1											**1**
	Atypical	Chicken	1	8			10								**19**
	Atypical	Eggs	2												**2**
	Atypical	Human	5	2	4	2	1	1							**15**
	Atypical	Meat						1							**1**
	Atypical	Porcine					1								**1**
	Atypical	Turkey					3								**3**
	Untypable	Chicken		2			15								**17**
	Untypable	Feed & Ingredients						3							**3**
	Untypable	Turkey					4								**4**
	Untypable	Unknown						1							**1**
	Subtotal		**120**	**332**	**48**	**41**	**1037**	**106**	**27**	**12**	**13**	**27**	**1**		**1764**
S. Infantis	3	Human					1								**1**
	3	Meat						1							**1**
	4	Human	8	27	4	3	7	7			2				**58**
	4	Meat						1							**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES											TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Infantis	4	Pet Food (Dog Treat)		16		1		8		2		1			**28**
(continued)	4	Porcine		20	2										**22**
	4	Poultry		1											**1**
	7	Human		3			3	1							**7**
	7	Meat						1							**1**
	7	Pet Food (Dog Treat)					1								**1**
	7	Porcine		2											**2**
	8	Egg Process. Plant							1						**1**
	8	Human		1			1	7							**9**
	8	Iguana							1						**1**
	8	Pet Food (Dog Treat)						1							**1**
	9	Human					1								**1**
	9	Poultry		4											**4**
	10	Human		4			3	1							**8**
	13	Human		1			2	2							**5**
	26	Bovine		1											**1**
	26	Chicken		1											**1**
	26	Human		12			5		1						**18**
	26	Meat						1							**1**
	26	Pet Food (Dog Treat)						2							**2**
	26	Porcine		2											**2**
	29	Human						1	1						**2**
	Atypical	Porcine		1											**1**
	Untypable	Human		1											**1**
	Subtotal		**8**	**97**	**6**	**4**	**24**	**34**	**2**	**4**	**2**	**1**			**182**
S. Newport	2	Human	5				1								**6**
	8	Human	2	1			1								**4**
	9	Alfalfa Sprouts		2											**2**
	9	Human	8	4			3								**15**
	10	Beef					15								**15**
	10	Human					32								**32**
	13	Alfalfa Sprouts		1											**1**
	13	Human	1	1			2								**4**
	14	Bovine					1								**1**
	14	Chicken		1											**1**
	14	Human	8	4	1		12			2	7				**34**
	15	Human	3												**3**
	Untypable	Human		1											**1**
	Subtotal		**27**	**15**	**1**		**67**			**2**	**7**				**119**
S. Panama	A	Human		1											**1**
	G	Human		2											**2**
	G	Pet Food (Dog Treat)				1									**1**
	G	Porcine		1											**1**
	H	Human					1								**1**
	Untypable	Pet Food (Dog Treat)									1				**1**
	Subtotal			**4**		**1**	**1**				**1**				**7**
S. Paratyphi B	1 var. 3	Human		1											**1**
	3b var. 3	Human	1												**1**
	3al var. 4	Human					1		1						**2**
	Dundee	Human	1	1											**2**
	Dundee var. 2	Human		1				2							**3**
	Subtotal		**2**	**3**			**1**	**2**		**1**					**9**
S. Paratyphi B	1 var.	Human		2											**2**
var. Java	1 var. 3	Human	5	2					1						**8**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES											TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Paratyphi B	3b var.	Human	1				2								**3**
var. Java	3b var. 3	Human	3	1			1								**5**
(continued)	Atypical	Human					3								**3**
	Atypical	Pet Food (Dog Treat)		3											**3**
	B.A.O.R.	Human					1								**1**
	Battersea	Human	2												**2**
	Dundee	Human	1												**1**
	Sterling	Human					1								**1**
	Worksop	Alfalfa Sprouts		2											**2**
	Worksop	Human	7	44	4	2									**57**
	Subtotal		**19**	**54**	**4**	**2**	**8**		**1**						**88**
Salmonella	1 var.	Human						6							**6**
ssp I 4,4,12:b:-	3b var. 3	Human					2								**2**
	Battersea	Human		1			2	1							**4**
	Dundee	Human					2								**2**
	Sterling	Human					1								**1**
	Untypable	Human	1				1								**2**
	Subtotal		**1**	**1**			**8**	**1**	**6**						**17**
S. Thompson	1	Alfalfa Sprouts		1											**1**
	1	Human		2	2			9							**13**
	2	Egg Process. Plant							1						**1**
	2	Environmental				1									**1**
	2	Human		11	2	1	1	4	5	1					**25**
	3	Human			1			1							**2**
	5	Chicken		7											**7**
	5	Human		2		1									**3**
	5	Meat		1											**1**
	5	Turkey		2											**2**
	8	Human				1									**1**
	8	Turkey		1											**1**
	13	Human		1											**1**
	22	Human		1											**1**
	25	Chicken		1											**1**
	25	Human		1				1							**2**
	26	Human						1	1	16					**18**
	Atypical	Chicken		4											**4**
	Atypical	Human		1	1	1		1		1					**5**
	Subtotal			**36**	**6**	**5**	**1**	**17**	**6**	**18**	**1**				**90**
S. Typhi	A	Human	1	2	1		2	1							**7**
	B2	Human								1					**1**
	B3	Human					1								**1**
	D1	Human		1		1	2								**4**
	D6	Human					1								**1**
	D8	Human					1								**1**
	E1	Human	5	2			14	3							**24**
	E3	Human	1				1								**2**
	E7	Human	1												**1**
	E9	Human	1				4	1							**6**
	E12	Human					1								**1**
	E-Degraded	Human					1								**1**
	F1	Human						1							**1**
	J1	Human						2							**2**
	M1	Human	5	1			2	1							**9**
	O	Human		2			1								**3**
	T	Human	3												**3**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES											TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhi	35	Human	2												**2**
(continued)	40	Human					2								**2**
	46	Human					1								**1**
	47	Human	2												**2**
	54	Human						1							**1**
	DVS	Human					1								**1**
	UVS-(I+IV)	Human		1		1	6	2							**10**
	Subtotal		**21**	**9**	**1**	**2**	**41**	**12**			**1**				**87**
S. Typhimurium	1	Bovine		15											**15**
	1	Equine					2								**2**
	1	Human	4	21	2	3	6	1			1				**38**
	2	Avian	1						2						**3**
	2	Bovine					1							**1**	
	2	Human	1			1	11	4							**17**
	2	Pigeon	6				5								**11**
	2	Porcine					1								**1**
	2	Turkey					1								**1**
	3 aerogenic	Bovine						1							**1**
	3 aerogenic	Human	1				4								**5**
	5	Human		3											**3**
	6	Human		1			2								**3**
	8	Human	3												**3**
	10	Bovine					7	3							**10**
	10	Chicken		1					1						**2**
	10	Equine						4							**4**
	10	Human	1	5		1	15	6							**28**
	10	Porcine					1								**1**
	10	Reptile					1								**1**
	10	Turkey					1								**1**
	12	Human	1	1			4		1						**7**
	12	Pet Food (Dog Treat)	2	1				1			2				**6**
	12	Porcine		1	4	4		4		1					**14**
	12a	Human		1											**1**
	15a	Human		2	1	1									**4**
	17	Human					1								**1**
	20	Human	1	1											**2**
	21	Bovine	2	3				1							**6**
	21	Caprine	2												**2**
	21	Human	5	4			2								**11**
	21	Porcine	1												**1**
	21	Unknown		1											**1**
	22	Human		1	1		2								**4**
	22	Porcine			1			1							**2**
	26	Human		1											**1**
	27	Human		1	1		1								**3**
	27	Mussels		1											**1**
	27	Porcine						1							**1**
	29	Human					5	2							**7**
	32	Human	3	1		1	1								**6**
	37	Human					1								**1**
	39	Avian	2												**2**
	39	Human	1				1								**2**
	39	Pigeon	1												**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhimurium	40	Avian	1	2	1										**4**
(continued)	40	Human				1		1							**2**
	41	Human		1		1									**2**
	41	Mouse		1											**1**
	41a	Human					1								**1**
	45	Bovine		1											**1**
	45	Porcine						2							**2**
	46	Human			1	2	1	2							**6**
	46	Pigeon					1								**1**
	46	Poultry						1							**1**
	46a	Human											1		**1**
	49	Human	1	1				1							**3**
	49 var.	Porcine		2											**2**
	49a	Human			2										**2**
	51	Human	3							1					**4**
	66	Human	1	2			2								**5**
	66	Porcine						6							**6**
	67	Bovine						1							**1**
	67	Equine						8							**8**
	67	Guinea Pig							1						**1**
	67	Human	2	2		1	12								**17**
	68 var.	Bovine					1								**1**
	69	Bovine					1								**1**
	69	Human	1				13								**14**
	73	Porcine		8											**8**
	74	Human					1								**1**
	80	Human	1												**1**
	80	Sparrow									4				**4**
	81	Human					1								**1**
	82	Chicken		5											**5**
	82	Human					5	1							**6**
	86	Human					1								**1**
	93	Human					1								**1**
	94	Human					2								**2**
	96	Human		7											**7**
	96	Mouse		1											**1**
	104	Avian						3							**3**
	104	Beef		1											**1**
	104	Bovine	10	24	2		31	23							**90**
	104	Canine		5	1	1									**7**
	104	Caprine						1							**1**
	104	Cheese					3								**3**
	104	Chicken	2	32			43								**77**
	104	Chicken Litter		2											**2**
	104	Eggs	3												**3**
	104	Environmental		6			3								**9**
	104	Equine		1		1	5								**7**
	104	Feed & Ingredients					1	1							**2**
	104	Feline					1	1							**2**
	104	Filtration						1							**1**
	104	Finch						1							**1**
	104	Milk						4							**4**
	104	Human	59	88	6	24	295	28	1		1		4	1	**507**
	104	Lapine					1								**1**
	104	Meat						1							**1**
	104	Other		1											**1**
	104	Ovine			1		1								**2**
	104	Parrot						1							**1**
	104	Pet Food (Dog Treat)						2							**2**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhimurium	104	Pet Food (Dog Treat)					8	3							**11**
(continued)	104	Pigeon						1							**1**
	104	Porcine	4	22	7	9	55	55			1				**153**
	104	Pork				1									**1**
	104	Poultry	2	16		1		1							**20**
	104	Turkey					3	1							**4**
	104	Unknown		6			10	8							**24**
	104a	Avian						1							**1**
	104a	Bovine					2	2	1						**5**
	104a	Canine					1								**1**
	104a	Feed & Ingredients		1											**1**
	104a	Human		2	1		9	2		1					**15**
	104a	Pet Food (Dog Treat)		1											**1**
	104a	Porcine					4	5		2					**11**
	104a	Unknown						1							**1**
	104b	Avian						2							**2**
	104b	Bovine	3												**3**
	104b	Feed & Ingredients						1							**1**
	104b	Feline		1											**1**
	104b	Human	2	7	1		33	5							**48**
	104b	Meat						2							**2**
	104b	Porcine		1	2		10	3							**16**
	104b	Unknown					3	4							**7**
	104c	Human					1								**1**
	106	Human					1								**1**
	107	Bovine						1							**1**
	107	Human	3	4	1		5								**13**
	108	Bovine					7	1		4					**12**
	108	Chicken						1							**1**
	108	Equine							1						**1**
	108	Feed & Ingredients						1							**1**
	108	Human	2	16	4	7	96	20							**145**
	108	Milk						1							**1**
	108	Pet Food (Dog Treat)	3	1				1							**5**
	108	Porcine				5	28	18		1					**52**
	108	Unknown		1				2							**3**
	109	Human		2											**2**
	109	Pet Food (Dog Treat)									1				**1**
	109	Porcine						1							**1**
	110	Bovine		1											**1**
	110	Human					1								**1**
	110b	Avian						1							**1**
	110b	Human	1	5	1		20								**27**
	110b	Porcine						3							**3**
	110b	Poultry		1											**1**
	110b	Water		2											**2**
	111	Human					1								**1**
	114	Human					2								**2**
	115	Human				1									**1**
	120	Bovine	1												**1**
	120	Human	2	2		1	1								**6**
	120	Porcine						4							**4**
	120	Turkey						1							**1**
	121	Avian		1											**1**
	121	Chicken		1											**1**
	121	Human	1												**1**
	122	Human						1							**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhimurium (continued)	124	Human	1		1		3								**5**
	124 var.	Gull		1											**1**
	124 var.	Human	2	7			30	3							**42**
	125	Human					1								**1**
	126	Human					1								**1**
	135	Bovine		1											**1**
	135	Human	3	2	3	1	4	2							**15**
	135	Porcine						16							**16**
	135	Unknown						1							**1**
	136	Human	1				1								**2**
	145	Human		1											**1**
	146	Canine			1										**1**
	146	Human			3										**3**
	146	Porcine			1										**1**
	153	Human					1								**1**
	160	Avian			1			1							**2**
	160	Bovine						2							**2**
	160	Human		6	2		7	1							**16**
	160	Ratite				1									**1**
	160	Sparrow					1	1			2				**4**
	169	Human	1				1								**2**
	170	Human		7	1		4								**12**
	170a	Chicken		1											**1**
	176	Bovine						1							**1**
	181	Human		1											**1**
	182	Bovine	1												**1**
	186	Porcine					2								**2**
	188	Human		1											**1**
	191	Chicken	5	2											**7**
	191	Eggs	1												**1**
	191	Human	14	11			1								**26**
	191	Porcine	1												**1**
	192	Human					1								**1**
	193	Avian			1			1							**2**
	193	Bovine		1			1								**2**
	193	Chicken		9			1		1						**11**
	193	Human	3	9	2		15								**29**
	193	Porcine						36							**36**
	193	Turkey					2								**2**
	193	Unknown						1							**1**
	194	Chicken		2											**2**
	194	Human		2											**2**
	195	Equine					1								**1**
	195	Human	1			1	4	1	1						**8**
	195	Pet Food (Dog Treat)							2						**2**
	195	Turkey					5								**5**
	202	Bovine		1											**1**
	202	Human		1											**1**
	202	Porcine			1										**1**
	204	Chicken		4											**4**
	204	Human		2											**2**
	204	Porcine						1							**1**
	204b	Human	1				1								**2**
	204c	Chicken			1										**1**
	204c	Human					2								**2**
	204c	Meat						1							**1**
	204c	Pet Food (Dog Treat)					1	1							**2**
	204d	Human					1								**1**
	206	Human	1												**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhimurium (continued)	206	Porcine						1							**1**
	208	Animal			1										**1**
	208	Bovine		6			9	7							**22**
	208	Eggs	1												**1**
	208	Human	3	3			12	3					1		**22**
	208	Meat						1							**1**
	208	Pet Food (Dog Treat)						2							**2**
	208	Porcine					4	3							**7**
	208	Turkey					1								**1**
	208	Unknown						2							**2**
	208 var.	Animal		2											**2**
	208 var.	Bovine	7	26				2							**35**
	208 var.	Chicken	2												**2**
	208 var.	Human	8	25	3	1	6						1		**44**
	208 var.	Llama		1											**1**
	208 var.	Meat						1							**1**
	208 var.	Porcine	1					1							**2**
	208 var.	Unknown		3											**3**
	288	Human		2	1										**3**
	721	Bovine							1						**1**
	721	Chicken		1											**1**
	721	Porcine				1									**1**
	721	Unknown						2							**2**
	Atypical	Avian	1					2	2						**5**
	Atypical	Bovine					7	1							**8**
	Atypical	Chicken	2	5		1	4					3			**15**
	Atypical	Eggs	2												**2**
	Atypical	Equine					2								**2**
	Atypical	Gull		1											**1**
	Atypical	Human	12	8	2	2	35	12							**71**
	Atypical	Porcine		12		1	4	6							**23**
	Atypical	Turkey		1			3								**4**
	U 14	Human	1												**1**
	U284	Avian	3	1											**4**
	U284	Porcine	1												**1**
	U284	Chicken	1	1											**2**
	U284	Finch	3												**3**
	U284	Human	7												**7**
	U284 var.	Avian		1											**1**
	U284 var.	Chicken		1											**1**
	U285	Human				1	2								**3**
	U285	Poultry						1							**1**
	U286	Human		1			1								**2**
	U287	Human		1											**1**
	U290	Human					1								**1**
	U291	Human	1												**1**
	U291	Pet Food (Dog Treat)						2							**2**
	U296	Human	1												**1**
	U297	Human		1											**1**
	U302	Bovine	1	1											**2**
	U302	Poultry						1							**1**
	U302	Chicken Litter		1											**1**
	U302	Environmental		1				1							**2**
	U302	Human	1	3		1	5	7							**17**
	U302	Pet Food (Dog Treat)						1							**1**
	U302	Pig Bedding						1							**1**
	U302	Porcine					1	9							**10**
	U302	Unknown						1							**1**

SEROTYPE	PHAGETYPE	SOURCE	PROVINCES												TOTAL
			BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
S. Typhimurium	Untypable	Avian						4							**4**
(continued)	Untypable	Bovine	2	27			2	1							**32**
	Untypable	Poultry		1											**1**
	Untypable	Duck					1								**1**
	Untypable	Equine						1							**1**
	Untypable	Feed & Ingredients						1							**1**
	Untypable	Gull					1								**1**
	Untypable	Human	4	11	1	1	10	2							**29**
	Untypable	Pet Food (Dog Treat)	1					2							**3**
	Untypable	Porcine		9			5	15		1					**30**
	Untypable	Unknown		1											**1**
	Untypable	Human		1											**1**
	Subtotal		**248**	**575**	**67**	**79**	**1010**	**441**	**9**	**16**	**4**	**12**	**7**	**1**	**2469**
Salmonella	191	Human	1												**1**
ssp I 4,12:i:-	U291	Eggs	1												**1**
	Subtotal		**2**												**2**
Salmonella	1	Human					1								**1**
ssp I 4,5,12:i:-	29	Human					2								**2**
	104	Human					6								**6**
	104	Porcine					2								**2**
	104c	Human					1								**1**
	108	Human					2								**2**
	110b	Human					1								**1**
	124 var.	Human					1								**1**
	134	Human					1								**1**
	191	Bovine	1		2										**3**
	191	Chicken	1												**1**
	191	Eggs	1												**1**
	191	Equine			3										**3**
	191	Human	31	1	8	1	28				1				**70**
	191	Partridge	2												**2**
	193	Human	2				6								**8**
	197	Human					1								**1**
	206	Human					1								**1**
	208	Human	1				2		2						**5**
	209	Human					1								**1**
	U278	Human				1	8								**9**
	U291	Human			2		18	1	1						**22**
	U291	Pet Food (Dog Treat)						1							**1**
	U291	Poultry			1										**1**
	U302	Human		1			1								**2**
	Untypable	Human		1			1								**2**
	Subtotal		**39**	**3**	**16**	**2**	**84**	**2**	**3**			**1**			**150**
	Total		**605**	**1289**	**201**	**173**	**2454**	**806**	**57**	**84**	**32**	**43**	**8**	**1**	**5753**

Salmonella isolates of non-human origin in Canada, 1999

Figure 7 illustrates the relative frequency of the top 10 non-human *Salmonella* serotypes for the year 1999.

Figure 7
Top ten *Salmonella* serotypes identified from isolates of non-human origin in Canada, 1999

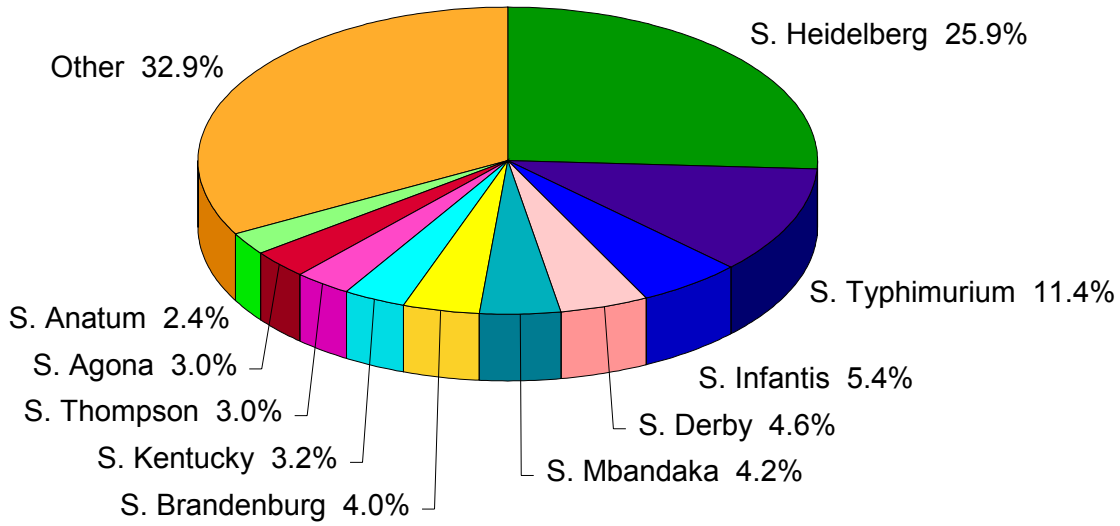
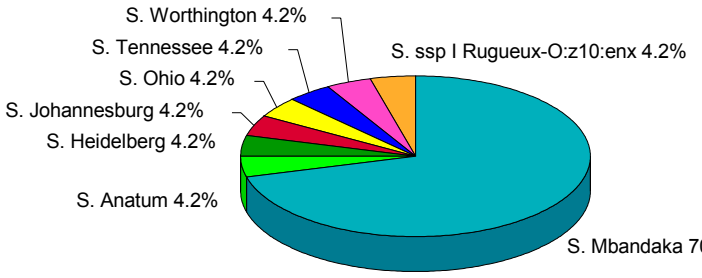


Illustration 2 shows the relative frequency of the top ten non-human *Salmonella* serotypes reported for each province. Illustration 3 shows the relative frequency of the top ten non-human *Salmonella* serotypes from specific sources (chicken, turkey, bovine, and feed & ingredients).

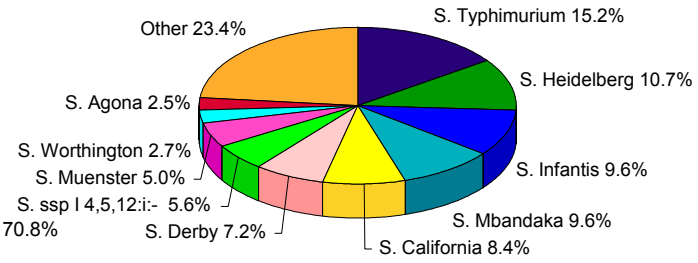
Illustration 2
Top Ten Salmonella serotypes identified from isolates of non-human origin in Canada: by Province, 1999

British Columbia



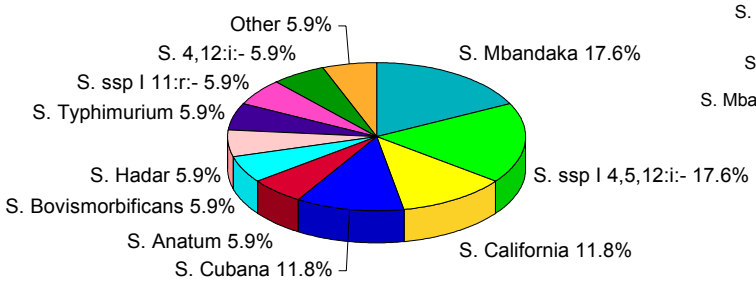
	Isolates	%
S. Mbandaka	17	70.8%
S. Anatum	1	4.2%
S. Heidelberg	1	4.2%
*S.*Johannesburg	1	4.2%
S. Ohio	1	4.2%
S. Tennessee	1	4.2%
S. Worthington	1	4.2%
S. ssp I Rough-O:z10:e,n,x	1	4.2%
TOTAL	24	100.0%

Alberta



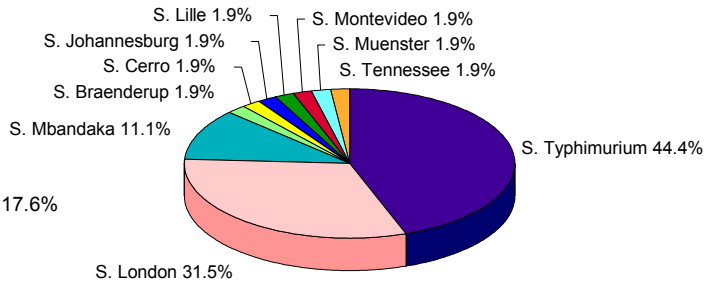
	Isolates	%
S. Typhimurium	145	15.2%
S. Heidelberg	102	10.7%
S. Infantis	92	9.6%
S. Mbandaka	92	9.6%
S. California	80	8.4%
S. Derby	69	7.2%
S. ssp I 4,5,12:i:-	53	5.6%
S. Muenster	48	5.0%
S. Worthington	26	2.7%
S. Agona	24	2.5%
Other	223	23.4%
TOTAL	954	100.0%

Saskatchewan



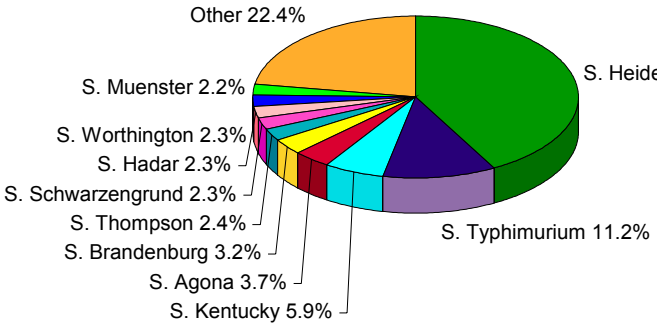
	Isolates	%
S. Mbandaka	3	17.6%
S. ssp I 4,5,12:i:-	3	17.6%
S. California	2	11.8%
S. Cubana	2	11.8%
S. Anatum	1	5.9%
S. Bovismorbificans	1	5.9%
S. Hadar	1	5.9%
S. Typhimurium	1	5.9%
S. ssp I 11:r:-	1	5.9%
S. ssp I 4,12:i:-	1	5.9%
Other	1	5.9%
TOTAL	17	100.0%

Manitoba



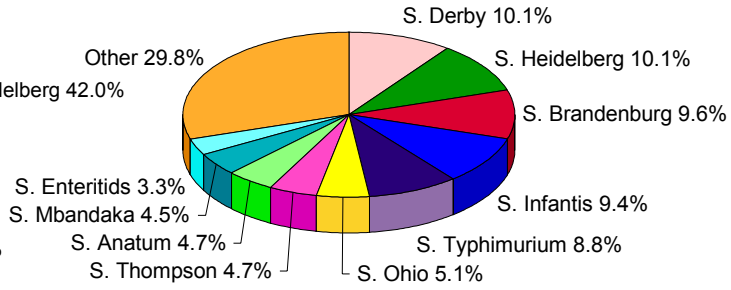
	Isolates	%
*S.*Typhimurium	24	44.4%
S. London	17	31.5%
S. Mbandaka	6	11.1%
S. Braenderup	1	1.9%
S. Cerro	1	1.9%
S. Johannesburg	1	1.9%
S. Lille	1	1.9%
S. Montevideo	1	1.9%
S. Muenster	1	1.9%
S. Tennessee	1	1.9%
TOTAL	54	100.0%

Ontario



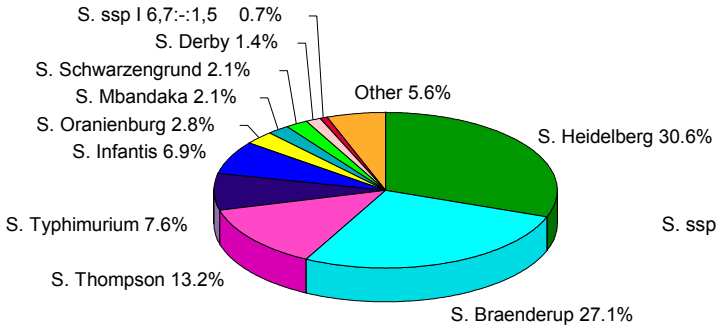
	Isolates	%
S. Heidelberg	1026	42.0%
S. Typhimurium	274	11.2%
S. Kentucky	145	5.9%
S. Agona	91	3.7%
S. Brandenburg	78	3.2%
S. Thompson	58	2.4%
S. Schwarzengrund	57	2.3%
S. Hadar	57	2.3%
S. Worthington	56	2.3%
S. Muenster	53	2.2%
Other	547	22.4%
TOTAL	2442	100.0%

Quebec



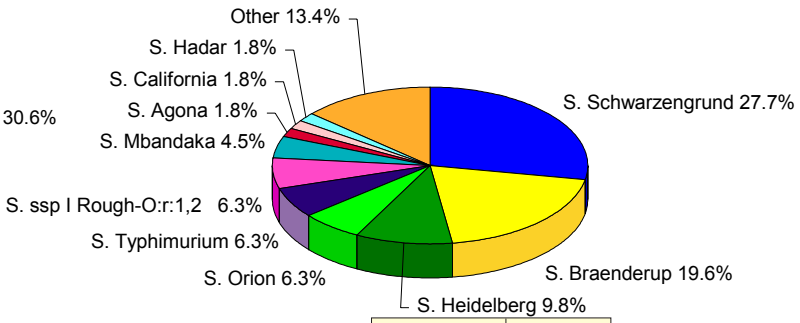
	Isolates	%
S. Derby	136	10.1%
S. Heidelberg	136	10.1%
S. Brandenburg	129	9.6%
S. Infantis	127	9.4%
S. Typhimurium	119	8.8%
S. Ohio	69	5.1%
S. Thompson	63	4.7%
S. Anatum	63	4.7%
S. Mbandaka	60	4.5%
S. Enteritidis	44	3.3%
Other	401	29.8%
TOTAL	1347	100.0%

New Brunswick



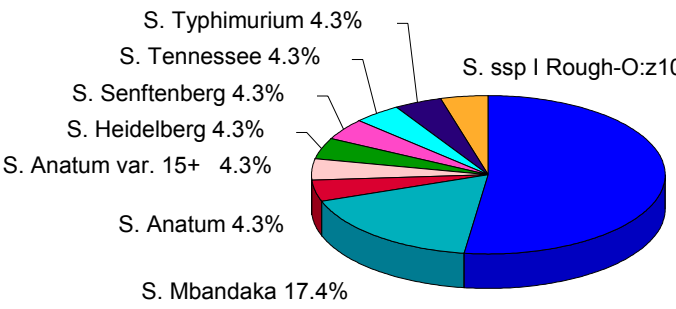
	Isolates	%
S. Heidelberg	44	30.6%
S. Braenderup	39	27.1%
S. Thompson	19	13.2%
S. Typhimurium	11	7.6%
S. Infantis	10	6.9%
S. Oranienberg	4	2.8%
S. Mbandaka	3	2.1%
S. Schwarzengrund	3	2.1%
S. Derby	2	1.4%
S. ssp I 6,7:-:1,5	1	0.7%
Other	8	5.6%
TOTAL	144	100.0%

Nova Scotia



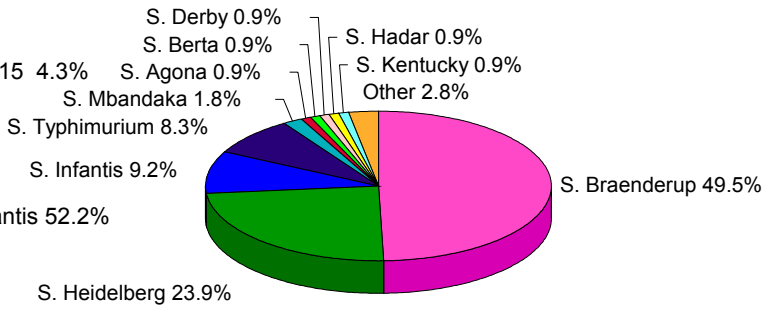
	Isolates	%
S. Schwarzengrund	31	27.7%
S. Braenderup	22	19.6%
S. Heidelberg	11	9.8%
S. Orion	7	6.3%
S. Typhimurium	7	6.3%
S. ssp I Rough-O:r:1,2	7	6.3%
S. Mbandaka	5	4.5%
S. Agona	2	1.8%
S. California	2	1.8%
S. Hadar	2	1.8%
Other	15	13.4%
TOTAL	112	100.0%

Prince Edward Island



	Isolates	%
S. Infantis	12	52.2%
S. Mbandaka	4	17.4%
S. Anatum	1	4.3%
S. Anatum var 15+	1	4.3%
S. Heidelberg	1	4.3%
S. Senftenberg	1	4.3%
S. Tennessee	1	4.3%
S. Typhimurium	1	4.3%
S. ssp I Rough-O:z10:e,n,z15	1	4.3%
TOTAL	23	100.0%

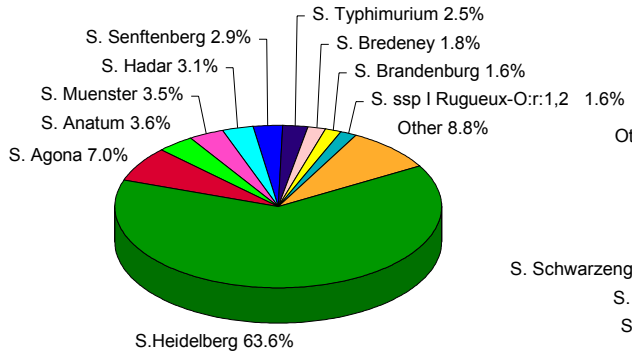
Newfoundland



	Isolates	%
S. Braenderup	54	49.5%
S. Heidelberg	26	23.9%
S. Infantis	10	9.2%
S. Typhimurium	9	8.3%
S. Mbandaka	2	1.8%
S. Agona	1	0.9%
S. Berta	1	0.9%
S. Derby	1	0.9%
S. Hadar	1	0.9%
S. Kentucky	1	0.9%
Other	3	2.8%
TOTAL	109	100.0%

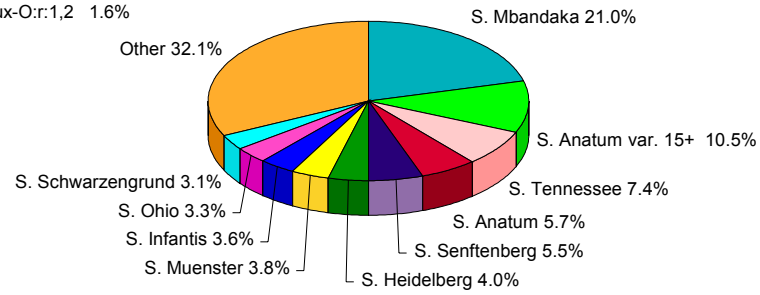
Illustration 3
Top Ten Salmonella serotypes identified from isolates of non-human origin in Canada: by Source, 1999

Turkey



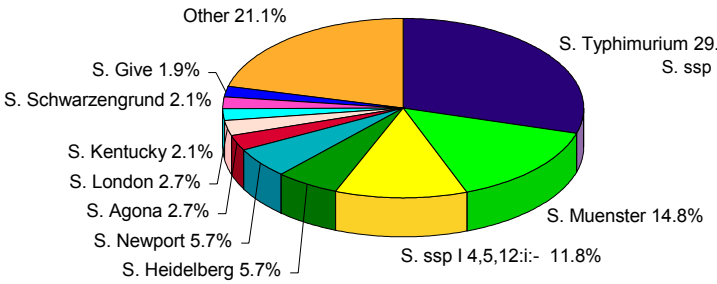
	Isolates	%
S. Heidelberg	436	63.6%
S. Agona	48	7.0%
S. Anatum	25	3.6%
S. Muenster	24	3.5%
S. Hadar	21	3.1%
S. Senftenberg	20	2.9%
S. Typhimurium	17	2.5%
S. Bredeney	12	1.8%
S. Brandenburg	11	1.6%
S. ssp I Rough-O:r:1,2	11	1.6%
Other	60	8.8%
TOTAL	685	100.0%

Feed and Ingredients



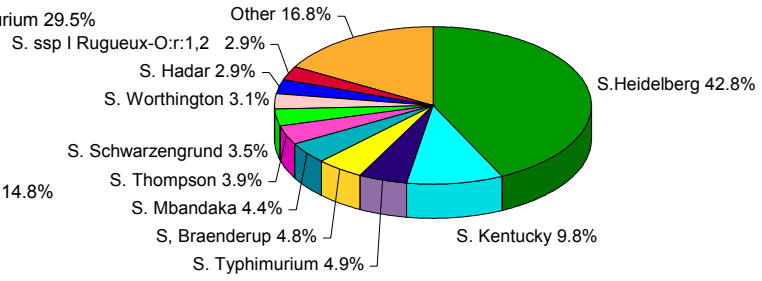
	Isolates	%
S. Mbandaka	88	21.0%
S. Anatum var 15+	44	10.5%
S. Tennessee	31	7.4%
S. Anatum	24	5.7%
S. Senftenberg	23	5.5%
S. Heidelberg	17	4.0%
S. Muenster	16	3.8%
S. Infantis	15	3.6%
S. Ohio	14	3.3%
S. Schwarzengrund	13	3.1%
Other	135	32.1%
TOTAL	420	100.0%

Bovine



	Isolates	%
S. Typhimurium	140	29.5%
S. Muenster	70	14.8%
S. ssp I 4,5,12:i:-	56	11.8%
S. Heidelberg	27	5.7%
S. Newport	26	5.7%
S. Agona	13	2.7%
S. London	13	2.7%
S. Kentucky	10	2.1%
S. Schwarzengrund	10	2.1%
S. Give	9	1.9%
Other	100	21.1%
TOTAL	474	100.0%

Chicken



	Isolates	%
S. Heidelberg	658	42.8%
S. Kentucky	151	9.8%
S. Typhimurium	76	4.9%
S. Braenderup	74	4.8%
S. Mbandaka	68	4.4%
S. Thompson	60	3.9%
S. Schwarzengrund	54	3.5%
S. Worthington	48	3.1%
S. Hadar	45	2.9%
S. ssp I Rough-O:r:1,2	44	2.9%
Other	258	16.8%
TOTAL	1536	100.0%

Table 3 lists the number of laboratory identifications of *Salmonella* serotypes from isolates of non-human origin by source and province. The following sources reported in the LFZ Guelph report are not included here: “External Proficiency”and “Reference Culture”.

Table 3
***Salmonella* serotypes identifed from isolates of non-human origin in Canada, 1999**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Agona	Avian						5					5
	Bovine		9			4						13
	Chicken		1			16					1	18
	Feed & Ingredients					2	2		2			6
	Porcine		13			21	24					58
	Turkey					48						48
	Unknown						8					8
	Water		1									1
	Subtotal	**0**	**24**	**0**	**0**	**91**	**39**	**0**	**2**	**0**	**1**	**157**
S. Alachua	Feed & Ingredients						2					2
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Albany	Chicken					1						1
	Feed & Ingredients						5					5
	Subtotal	**0**	**0**	**0**	**0**	**1**	**5**	**0**	**0**	**0**	**0**	**6**
S. Anatum	Bovine		3			4						7
	Chicken		4			1						5
	Feed & Ingredients	1	3	1			19					24
	Porcine		5			11	44	1	1	1		63
	Turkey					25						25
	Subtotal	**1**	**15**	**1**	**0**	**41**	**63**	**1**	**1**	**1**	**0**	**124**
S. Anatum var. 15+												
	Bovine					5						5
	Avian						1					1
	Chicken					1						1
	Equine					1						1
	Feed & Ingredients						43			1		44
	Porcine					3						3
	Turkey					1						1
	Unknown					1	1					2
	Subtotal	**0**	**0**	**0**	**0**	**12**	**45**	**0**	**0**	**1**	**0**	**58**
S. Berta	Bovine					4						4
	Canine										1	1
	Chicken					13						13
	Porcine					1	2					3
	Subtotal	**0**	**0**	**0**	**0**	**18**	**2**	**0**	**0**	**0**	**1**	**21**
S. Bovismorbificans												
	Bovine					1						1
	Porcine		5	1								6
	Subtotal	**0**	**5**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**7**
S. Braenderup	Avian							19	5			24
	Bovine					2						2
	Chicken		1		1	5		1	12		54	74
	Unknown							19	5			24
	Subtotal	**0**	**1**	**0**	**1**	**7**	**0**	**39**	**22**	**0**	**54**	**124**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Brandenburg	Porcine					30	129					159
	Bovine					1		1				2
	Chicken					36						36
	Turkey					11						11
	Subtotal	**0**	**0**	**0**	**0**	**78**	**129**	**1**	**0**	**0**	**0**	**208**
S. Bredeney	Turkey		3			9						12
	Chicken								1			1
	Subtotal	**0**	**3**	**0**	**0**	**9**	**0**	**0**	**1**	**0**	**0**	**13**
S. California	Avian								1			1
	Feed & Ingredients			2								2
	Porcine		80			1						81
	Unknown								1			1
	Subtotal	**0**	**80**	**2**	**0**	**1**	**0**	**0**	**2**	**0**	**0**	**85**
S. Cerro	Bovine					1						1
	Chicken		2									2
	Feed & Ingredients		1		1		2					4
	Subtotal	**0**	**3**	**0**	**1**	**1**	**2**	**0**	**0**	**0**	**0**	**7**
S. Choleraesuis var. Kunzendorf												
	Porcine						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Cubana	Chicken		3									3
	Feed & Ingredients			2			1					3
	Porcine		2									2
	Turkey					3						3
	Subtotal	**0**	**5**	**2**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**11**
S. Derby	Bovine					1						1
	Canine								1		1	2
	Chicken					2						2
	Duck					1						1
	Feed & Ingredients						11					11
	Porcine		69			27	125	2				223
	Turkey					1						1
	Subtotal	**0**	**69**	**0**	**0**	**32**	**136**	**2**	**1**	**0**	**1**	**241**
S. Dublin	Bovine		3									3
	Subtotal	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Emek	Fertilizer		1									1
	Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
S. Enteritidis	Avian						12					12
	Bovine		1									1
	Chicken		1			11	4					16
	Feed & Ingredients						10					10
	Other		1				3					4
	Quail						2					2
	Porcine		5			1			1			7
	Unknown						13					13
	Seal					1						1
	Subtotal	**0**	**8**	**0**	**0**	**13**	**44**	**0**	**1**	**0**	**0**	**66**
S. Give	Bovine					8	1					9
	Feed & Ingredients						1					1
	Porcine		2			4	4					10

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Give	Unknown						5					5
(continued)	**Subtotal**	**0**	**2**	**0**	**0**	**12**	**11**	**0**	**0**	**0**	**0**	**25**
S. Give var. 15+	Chicken		5									5
	Feed & Ingredients						1					1
	Porcine		2			1						3
	Turkey					1						1
	Water		1									1
	Subtotal	**0**	**8**	**0**	**0**	**2**	**1**	**0**	**0**	**0**	**0**	**11**
S. Hadar	Avian					2	10		1			13
	Bovine					3						3
	Chicken		14	1		28	1				1	45
	Feed & Ingredients						1					1
	Ovine					1						1
	Turkey					21						21
	Unknown					2	11		1			14
	Water		1									1
	Porcine						1					1
	Subtotal	**0**	**15**	**1**	**0**	**57**	**24**	**0**	**2**	**0**	**1**	**100**
S. Hartford	Feed & Ingredients						1					1
	Porcine		1									1
	Subtotal	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**
S. Havana	Chicken					2			1			3
	Feed & Ingredients					1	8					9
	Quail					5						5
	Porcine					1	1					2
	Subtotal	**0**	**0**	**0**	**0**	**9**	**9**	**0**	**1**	**0**	**0**	**19**
S. Heidelberg	Avian					7	47	17				71
	Bovine	1	11			15						27
	Chicken		74			532	4	10	11	1	26	658
	Feed & Ingredients					7	10					17
	Gull					1	1					2
	Porcine		11			27	24					62
	Turkey		6			430						436
	Unknown					7	50	17				74
	Subtotal	**1**	**102**	**0**	**0**	**1026**	**136**	**44**	**11**	**1**	**26**	**1347**
S. Indiana	Chicken		5									5
	Porcine					1						1
	Water		1									1
	Subtotal	**0**	**6**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**7**
S. Infantis	Avian						1					1
	Bovine					8						8
	Chicken		7			5		10		2	10	34
	Equine					1						1
	Feed & Ingredients						15					15
	Ovine					2						2
	Porcine		85			13	110		2	8		218
	Unknown						1			2		3
	Subtotal	**0**	**92**	**0**	**0**	**29**	**127**	**10**	**2**	**12**	**10**	**282**
S. Johannesburg												
	Chicken					2						2
	Feed & Ingredients	1			1	1						3
	Porcine					1						1
	Unknown						1					1
	Subtotal	**1**	**0**	**0**	**1**	**4**	**1**	**0**	**0**	**0**	**0**	**7**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Kentucky	Avian						1					1
	Bovine					8	2					10
	Chicken		15			134			1		1	151
	Feed & Ingredients						4					4
	Parrot					1						1
	Turkey					2						2
	Unknown						1					1
	Subtotal	**0**	**15**	**0**	**0**	**145**	**8**	**0**	**1**	**0**	**1**	**170**
S. Kiambu	Porcine						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Krefeld	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Larochelle	Bovine					1						1
	Chicken										1	1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**2**
S. Lexington	Bovine						1					1
	Unknown						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
S. Lexinton var. 15+												
	Feed & Ingredients						3					3
	Subtotal	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**3**
S. Lille	Chicken					1						1
	Feed & Ingredients				1	1	1					3
	Subtotal	**0**	**0**	**0**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**4**
S. Litchfield	Chicken		3									3
	Feed & Ingredients						4					4
	Other					3						3
	Subtotal	**0**	**3**	**0**	**0**	**3**	**4**	**0**	**0**	**0**	**0**	**10**
S. Livingstone	Chicken					4						4
	Feed & Ingredients								1			1
	Porcine					5	6					11
	Subtotal	**0**	**0**	**0**	**0**	**9**	**6**	**0**	**1**	**0**	**0**	**16**
S. London	Bovine					13						13
	Porcine		3		17	1	3					24
	Subtotal	**0**	**3**	**0**	**17**	**14**	**3**	**0**	**0**	**0**	**0**	**37**
S. Manhattan	Porcine		2									2
	Subtotal	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Mbandaka	Avian						1	1	2			4
	Bovine					4						4
	Chicken	2	52	3	2	6		1			2	68
	Feed & Ingredients	15	2		4	8	55			4		88
	Fertilizer					1						1
	Porcine		35			2	3					40
	Snake					3						3
	Turkey		3			3						6
	Unknown						1	1	3			5
	Subtotal	**17**	**92**	**3**	**6**	**27**	**60**	**3**	**5**	**4**	**2**	**219**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Meleagridis	Bovine					4						4
	Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**
S. Minnesota	Other						3					3
	Bovine						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**
S. Montevideo	Avian					1						1
	Bovine		3			4	1					8
	Chicken		8		1	17					1	27
	Feed & Ingredients		2			1	1	1				5
	Turkey					6						6
	Unknown					1						1
	Subtotal	**0**	**13**	**0**	**1**	**30**	**2**	**1**	**0**	**0**	**1**	**48**
S. Muenchen	Ovine					1						1
	Vegetable		2									2
	Subtotal	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**3**
S. Muenster	Bovine		41			27	2					70
	Feed & Ingredients				1		15					16
	Feline		5									5
	Pigeon		1									1
	Porcine					3	2		1			6
	Turkey		1			23						24
	Unknown							1				1
	Subtotal	**0**	**48**	**0**	**1**	**53**	**19**	**1**	**1**	**0**	**0**	**123**
S. Muenster var. 15+												
	Bovine					1						1
	Turkey					2						2
	Feed & Ingredients					1						1
	Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**4**
S. Muenster var. 15+34+												
	Feed & Ingredients						1					1
	Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Newport	Bovine					26						26
	Chicken					1						1
	Feed & Ingredients						1					1
	Turkey					3						3
	Subtotal	**0**	**0**	**0**	**0**	**30**	**1**	**0**	**0**	**0**	**0**	**31**
S. Ohio	Canine								2			2
	Chicken					1						1
	Feed & Ingredients	1				6	7					14
	Porcine		1			3	62					66
	Subtotal	**1**	**1**	**0**	**0**	**10**	**69**	**0**	**2**	**0**	**0**	**83**
S. Ohio var. 14+	Turkey					1						1
	Porcine		2			1	20					23
	Subtotal	**0**	**2**	**0**	**0**	**2**	**20**	**0**	**0**	**0**	**0**	**24**
S. Oranienberg	Avian							2				2
	Chicken					2						2
	Feed & Ingredients						1					1
	Unknown							2				2
	Subtotal	**0**	**0**	**0**	**0**	**2**	**1**	**4**	**0**	**0**	**0**	**7**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Orion	Avian								2			2
	Chicken								1			1
	Feed & Ingredients					2			2			4
	Porcine		6									6
	Unknown								2			2
	Subtotal	**0**	**6**	**0**	**0**	**2**	**0**	**0**	**7**	**0**	**0**	**15**
S. Orion var. 15+	Chicken					1						1
	Feed & Ingredients						1					1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
S. Orion var. 15+34+												
	Turkey					1						1
	Chicken					2						2
	Feed & Ingredients						3					3
	Porcine		2									2
	Subtotal	**0**	**2**	**0**	**0**	**3**	**3**	**0**	**0**	**0**	**0**	**8**
S. Panama	Porcine						4					4
	Subtotal	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**
S. Putten	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Reading	Bovine		4									4
	Porcine					3						3
	Turkey					3						3
	Subtotal	**0**	**4**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**10**
S. Rissen	Chicken		5									5
	Feed & Ingredients		1									1
	Subtotal	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
S. Rubislaw	Feed & Ingredients						1					1
	Porcine		5									5
	Water		6									6
	Subtotal	**0**	**11**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**12**
S. Saintpaul	Chicken					1						1
	Turkey					1						1
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. Schwarzengrund												
	Avian							1	10			11
	Bovine		1			9						10
	Chicken		6			41			7			54
	Feed & Ingredients		1				7	1	4			13
	Other					1						1
	Porcine		4			5						9
	Turkey		1			1						2
	Unknown							1	10			11
	Subtotal	**0**	**13**	**0**	**0**	**57**	**7**	**3**	**31**	**0**	**0**	**111**
S. Senftenberg	Bovine					1	2					3
	Chicken		4			18						22
	Feed & Ingredients					5	17			1		23
	Porcine					1	9					10
	Turkey					20						20
	Unknown						1					1
	Subtotal	**0**	**4**	**0**	**0**	**45**	**29**	**0**	**0**	**1**	**0**	**79**

SEROTYPE	SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
S. Stanley	Porcine					1						1
	Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Tamale	Porcine				1							1
	Subtotal	**0**	**0**	**0**	**1**		**0**	**0**	**0**	**0**	**0**	**1**
S. Tennessee	Bovine					8	1					9
	Chicken		3			5		1		1		10
	Feed & Ingredients	1			1	1	28					31
	Other						2					2
	Quail						1					1
	Ovine					1						1
	Porcine		6			2	1					9
	Turkey					4						4
	Unknown						1					1
	Subtotal	**1**	**9**	**0**	**1**	**21**	**34**	**1**	**0**	**1**	**0**	**68**
S. Thompson	Avian						28	9				37
	Bovine					2			1			3
	Chicken		9			47	1	1	1		1	60
	Equine					1						1
	Feed & Ingredients					1	6					7
	Gull					2						2
	Porcine					3						3
	Turkey		1			2						3
	Unknown						28	9				37
	Subtotal	**0**	**10**	**0**	**0**	**58**	**63**	**19**	**2**	**0**	**1**	**153**
S. Typhimurium	Avian		2				6	4				12
	Bovine		67			67		2	4			140
	Canine		3		1							4
	Chicken		22		1	48			2		3	76
	Duck					1						1
	Equine				1	10		1				12
	Feed & Ingredients		1			1	4					6
	Feline					1						1
	Guinea Pig						1					1
	Gull		1			1						2
	Lapine					1						1
	Other		1									1
	Ovine					1						1
	Pigeon					6						6
	Porcine		39	1	20	109	96		1	1		267
	Ratite				1							1
	Reptile					1						1
	Sparrow					1	1				6	8
	Turkey		1			16						17
	Unknown		7			10	11	4				32
	Water		1									1
	Subtotal	**0**	**145**	**1**	**24**	**274**	**119**	**11**	**7**	**1**	**9**	**591**
S. Uganda	Feed & Ingredients					1						1
	Porcine						6					6
	Subtotal	**0**	**0**	**0**	**0**	**1**	**6**	**0**	**0**	**0**	**0**	**7**
S. Worthington	Bovine					3						3
	Chicken		5			43						48
	Equine					1						1
	Feed & Ingredients					4	2					6
	Fertilizer	1										1
	Ovine					1						1

SEROTYPE / SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
Porcine		21			4	4					29
Unknown						1					1
Subtotal	**1**	**26**	**0**	**0**	**56**	**7**	**0**	**0**	**0**	**0**	**90**
Salmonella ssp I 4,12:-:-											
Chicken					1						1
Porcine		2									2
Turkey					2						2
Subtotal	**0**	**2**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I 4,5,12:-:-											
Chicken					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 4,12:-:1,2											
Chicken					1						1
Porcine					1						1
Turkey					1						1
Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I 4,5,12:-:1,2											
Bovine		1			1						2
Porcine					2						2
Subtotal	**0**	**1**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 4,5,12:b:-											
Bovine					1						1
Feed & Ingredients					1						1
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 4,12:d:-											
Porcine					2						2
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 4,12:i:-											
Bovine					1						1
Chicken					1						1
Porcine		3	1			2					6
Unknown						1					1
Subtotal	**0**	**3**	**1**	**0**	**2**	**3**	**0**	**0**	**0**	**0**	**9**
Salmonella ssp I 4,5,12:i:-											
Chicken		4			2						6
Bison		1									1
Bovine		47			8	1					56
Equine			2								2
Feed & Ingredients						1					1
Other			1								1
Porcine		1									1
Unknown						1					1
Subtotal	**0**	**53**	**3**	**0**	**10**	**3**	**0**	**0**	**0**	**0**	**69**
Salmonella ssp I 4,12:r:-											
Turkey					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 6,7:-:-											
Feed & Ingredients						1					1
Porcine					5	4					9
Turkey					1						1
Subtotal	**0**	**0**	**0**	**0**	**6**	**5**	**0**	**0**	**0**	**0**	**11**

SEROTYPE / SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
Salmonella ssp I 6,7:-:1,5											
Avian							1				1
Bovine					3						3
Chicken					1						1
Unknown							1				1
Subtotal	**0**	**0**	**0**	**0**	**4**	**0**	**2**	**0**	**0**	**0**	**6**
Salmonella ssp I 6,7:-:I,w											
Porcine		2									2
Subtotal	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 6,7:z10:-											
Avian							1				1
Bovine					2						2
Unknown							1				1
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**0**	**0**	**0**	**4**
Salmonella ssp I 6,8:-:-											
Bovine		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 6,8:-:e,n,x											
Bovine		3									3
Subtotal	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I 6,8:I,v:-											
Chicken		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 8,20:-:-											
Chicken		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 8,20:-:z6											
Chicken		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 8,20:i:-											
Bovine					1						1
Porcine						1					1
Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 3,10,eh:-											
Feed & Ingredients						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 3,10:-:-											
Turkey					2						2
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 3,15:z10:-											
Feed & Ingredients					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 19:-:-											
Feed & Ingredients						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

SEROTYPE / SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
Salmonella ssp I 11:r:-											
Feed & Ingredients			1			1					2
Water		2									2
Subtotal	**0**	**2**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I 18:-:-											
Bovine					2						2
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 23:-:-											
Porcine		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 28:y:-											
Turkey					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 42:z4,z23:-											
Turkey								1			1
Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**
Salmonella ssp I Rough-O:-:-											
Chicken		1			1						2
Quail					2						2
Porcine		2									2
Subtotal	**0**	**3**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I Rough-O:-:1,2											
Chicken					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I Rough-O:b:-											
Turkey					3						3
Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:b:l,w											
Porcine						4					4
Subtotal	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I Rough-O:eh:1,5											
Turkey					3						3
Subtotal	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
Salmonella ssp I Rough-O:eh:e,n,z15											
Porcine					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I Rough-O:f,g:-											
Quail					1						1
Porcine		1				2					3
Subtotal	**0**	**1**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**4**
Salmonella ssp I Rough-O:f,g,s:-											
Porcine						2					2
Subtotal	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:f,g,t:-											

SEROTYPE / SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
Porcine						5					5
Subtotal	**0**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**5**
Salmonella ssp I Rough-O:g,m,t:-											
Porcine		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I Rough-O:i:-											
Chicken					1						1
Porcine						1					1
Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:i:1,2											
Bovine		3									3
Chicken					1						1
Porcine		2				11					13
Subtotal	**0**	**5**	**0**	**0**	**1**	**11**	**0**	**0**	**0**	**0**	**17**
Salmonella ssp I Rough-O:i:z6											
Chicken					2						2
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:k:1,5											
Chicken					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I Rough-O:l,v:-											
Chicken					2						2
Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:l,v:e,n,z15											
Chicken					2						2
Porcine					1	2					3
Turkey					1						1
Subtotal	**0**	**0**	**0**	**0**	**4**	**2**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I Rough-O:r:-											
Chicken					2						2
Feed & Ingredients		1									1
Turkey					3						3
Subtotal	**0**	**1**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I Rough-O:r:1,2											
Chicken		4			32		1	7			44
Feed & Ingredients						11					11
Porcine		1			1						2
Turkey					11						11
Subtotal	**0**	**5**	**0**	**0**	**44**	**11**	**1**	**7**	**0**	**0**	**68**
Salmonella ssp I Rough-O:r:1,5											
Chicken		1									1
Porcine		3				5					8
Subtotal	**0**	**4**	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**9**
Salmonella ssp I Rough-O:z10:e,n,x											
Fertilizer	1										1
Turkey					1						1
Subtotal	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I Rough-O:z10:e,n,z15											
Porcine		1							1		2

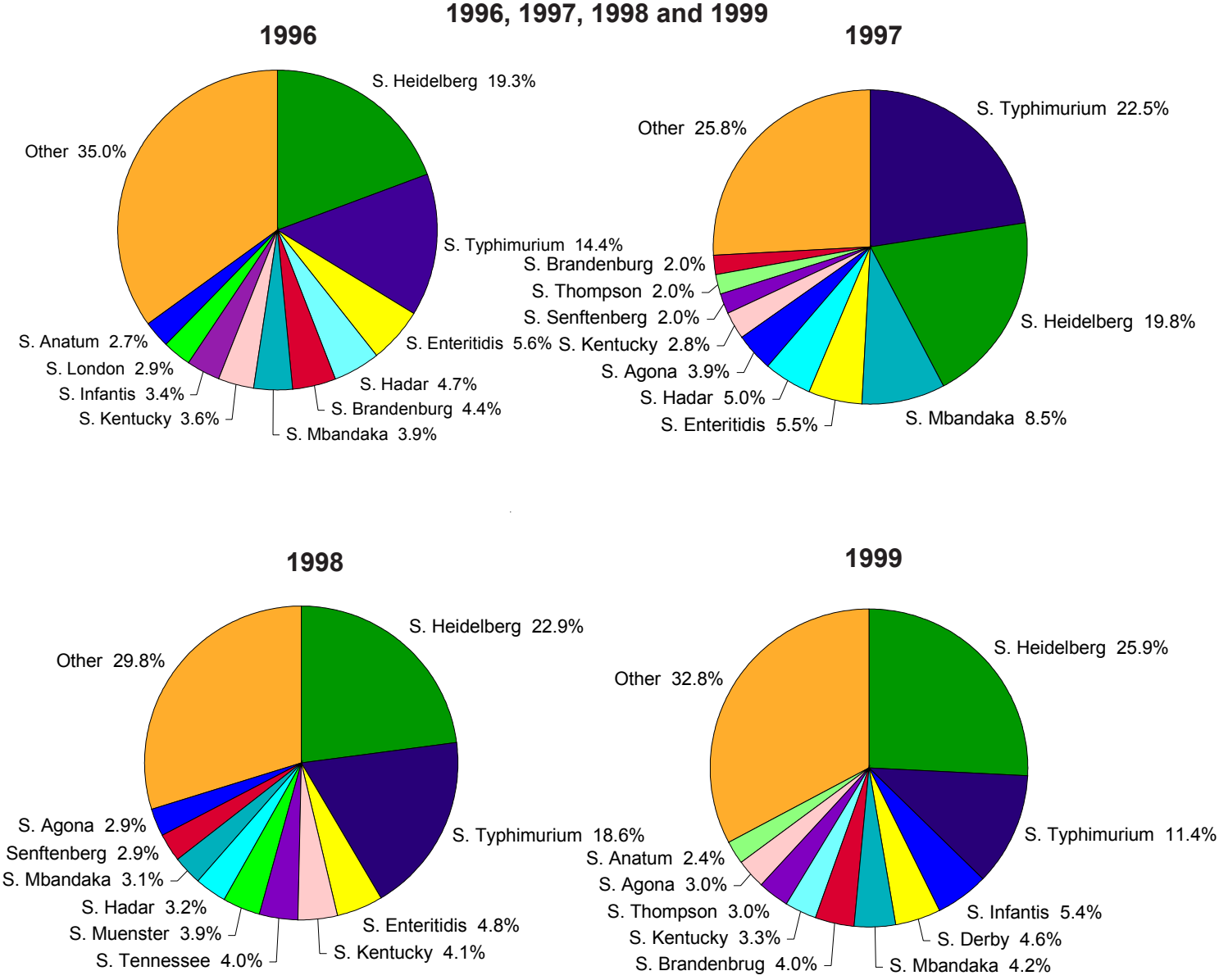
SEROTYPE / SOURCE	PROVINCES BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	TOTAL
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**
Salmonella ssp I Rough-O:z10:z6											
Feed & Ingredients						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I Rough-O:z29:-											
Feed & Ingredients						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IIIb 16:zl0:e,n,x,z15											
Snake					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IIIb 53:k:z											
Snake	1										1
Subtotal	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IIIb 53:k:e,n,x,z15											
Lizard			1								1
Subtotal	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IIIb 60:r:e,n,x,z15											
Water		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IIIb 61:-:1,5											
Ovine		1									1
Subtotal	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IV											
Porcine					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IV 40:z4,z23:-											
Reptile					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp IV 42:g,z51:-											
Porcine					1						1
Other						1					1
Subtotal	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp IV Rough-O:z4,z23:-											
Iguana					1						1
Subtotal	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp V 64:z41:-											
Bovine						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp V 66:z41:-											
Unknown						1					1
Subtotal	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Total	**25**	**954**	**17**	**55**	**2438**	**1321**	**145**	**111**	**23**	**109**	**5198**

Changes in the occurence of *Salmonella* serotypes of non-human origin over time

The changes in the relative frequency of the top 10 *Salmonella* serotypes over the last four years are shown in Figure 8 for non-human sources.

S. Derby was newly ranked among the top ten non-human laboratory isolates in 1999. *S*. Enteritidis, *S*. Hadar, *S*. Tennessee, *S*. Muenster and *S*. Senftenberg are no longer on the list of top ten serotypes isolated, as they were in 1998.

Figure 8
Top ten *Salmonella* serotypes identified from isolates of non-human origin in Canada,
1996, 1997, 1998 and 1999



Salmonella outbreaks, 1999

Refer to Section 7 - **Outbreak of Enteric Pathogens in Canada,** on page 73.

New *Salmonella* serotypes in Canada

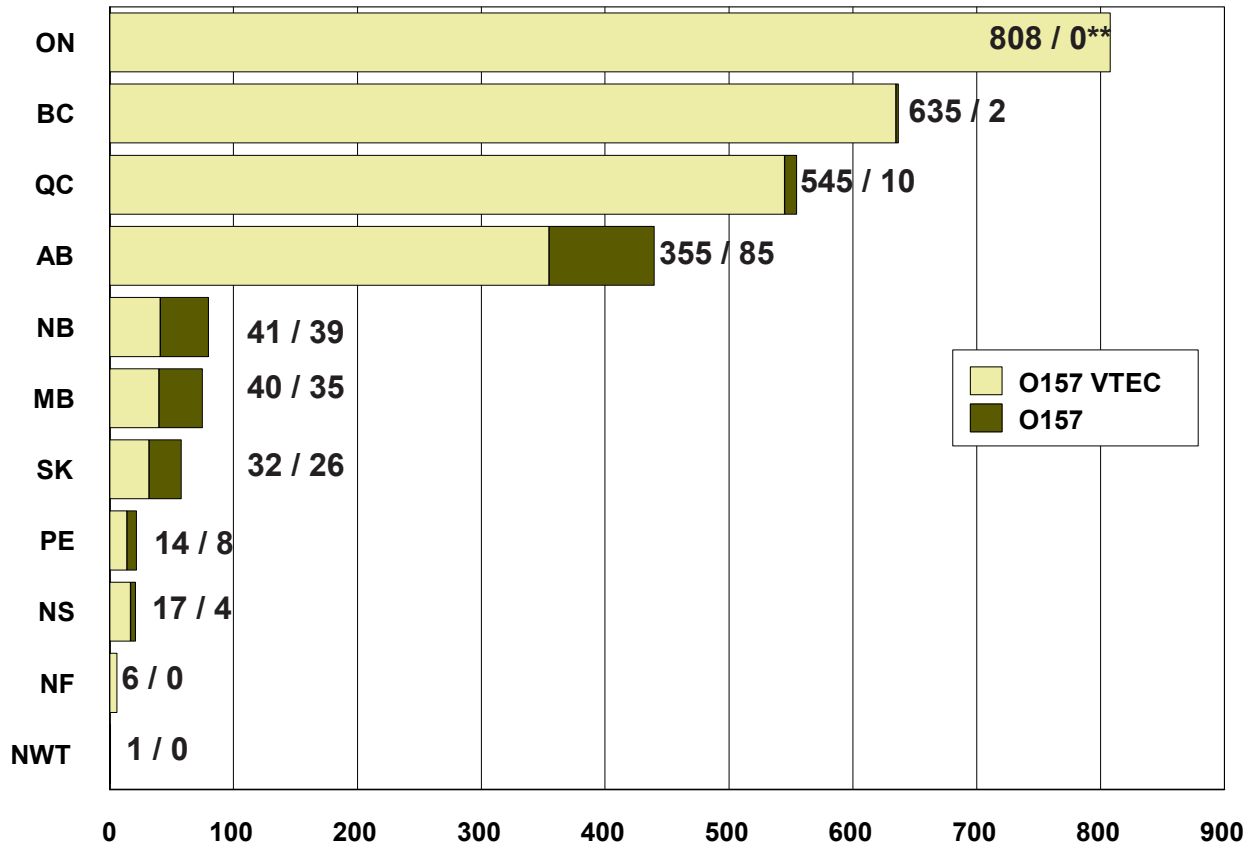
- *Salmonella* Tamale (8,20:z29:-) in Manitoba isolated from a pig's intestine.
- *Salmonella S.* Pretoria (11:k:1,2) in Ontario during month of September isolated from a 44 year old male.
- *Salmonella S.* Amersfoort (6,7:d:e,n,x), in Ontario during the month of December isolated from a 1 year old female.
- *Salmonella* ssp II 13,23:z:1,5 in Ontario during month of April isolated from a 14 year old female.
- *Salmonella* ssp IIIa 13,23:g,z51:- in Ontario during the month of August isolated from a male of unknown age.
- *Salmonella* ssp IIIb 53:k:z in British Columbia during the month of April isolated from a snake.

Section 3 - Pathogenic *Escherichia coli*

Escherichia coli isolates of humans and non-humans in Canada, 1999

Figure 9 provides the provincial frequency distribution of human and non-human *Escherichia coli* O157 and O157 VTEC in Canada, 1999. Please note that the data are from Table 4; in the construction of this table, *Escherichia coli* reported as O157:H7, O157 VT(+), or O157:H7 VT+ were combined into *Escherichia coli* O157 VTEC (see Appendix I).

Figure 9
***Escherichia coli* O157 isolates of human and non-human origin in Canada, 1999**



* These data represent total laboratory isolations and should not be confused with incidence.
**No. 0157 VTEC / No. O157.

Table 4 lists human and non-human *Escherichia coli* isolates. Organisms are listed in increasing numeric order of serotypes.

Table 4
***Escherichia coli* isolates of human and non-human origin in Canada, 1999**

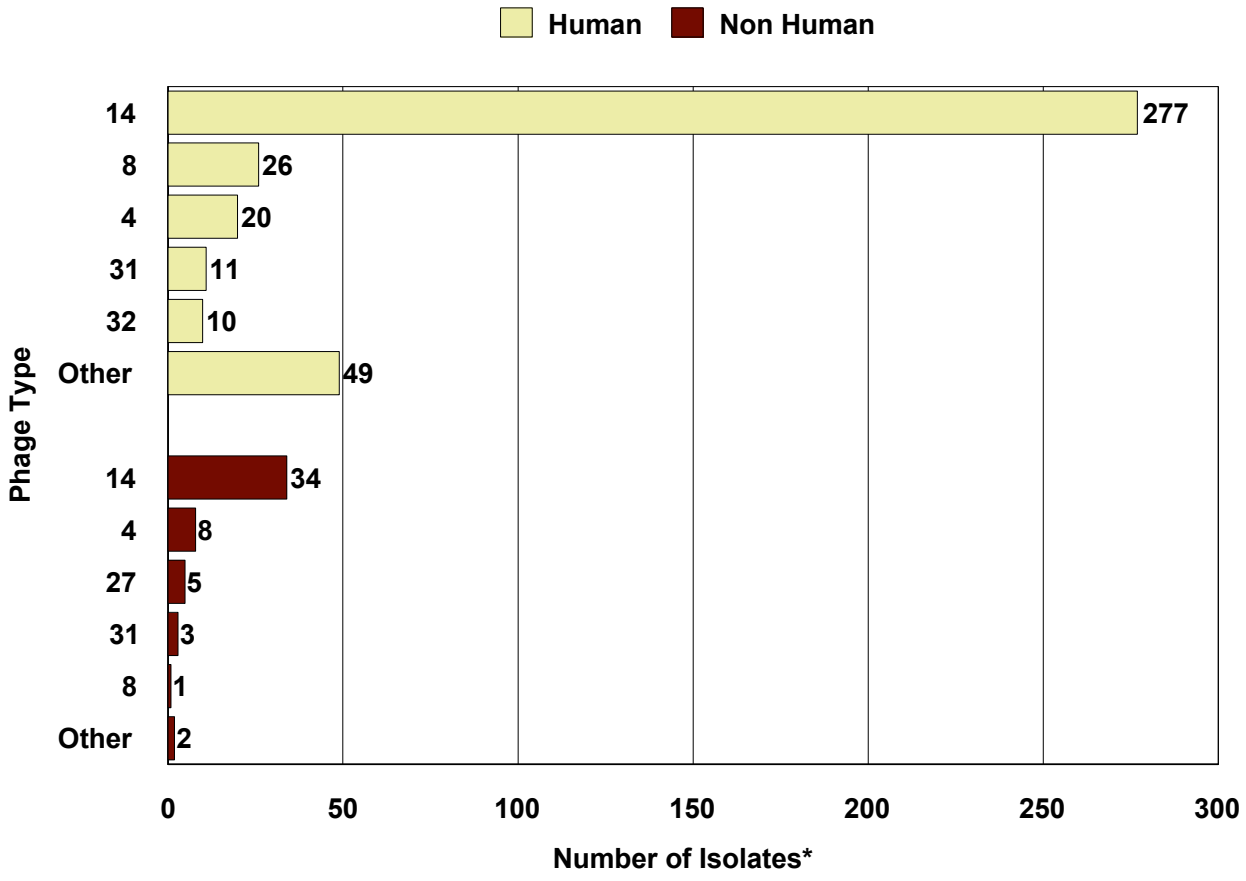
ORGANISM		PROVINCES											TOTAL
		BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	
Escherichia coli	O1			2	1		1						4
Escherichia coli	O2		1	2			4						7
Escherichia coli	O3			1									1
Escherichia coli	O4	1	1										2
Escherichia coli	O4:H5	1											1
Escherichia coli	O6	1											1
Escherichia coli	O6:H2	1											1
Escherichia coli	O6:H7					1							1
Escherichia coli	O7						1						1
Escherichia coli	O11:H15					2							2
Escherichia coli	O12			1			1						2
Escherichia coli	O16		1										1
Escherichia coli	O18						2						2
Escherichia coli	O19	1											1
Escherichia coli	O19:H44	1											1
Escherichia coli	O20	1											1
Escherichia coli	O20:Non-motile	1											1
Escherichia coli	O21						1						1
Escherichia coli	O25						2						2
Escherichia coli	O25:H1					1							1
Escherichia coli	O26	4		1									5
Escherichia coli	O26:H11	4											4
Escherichia coli	O26:K60 (VT Neg)				2								2
Escherichia coli	O26:K60 (VTEC)				1								1
Escherichia coli	O32			1									1
Escherichia coli	O44:K74				1								1
Escherichia coli	O45:H21	1											1
Escherichia coli	O46						1						1
Escherichia coli	O49			1									1
Escherichia coli	O55			1									1
Escherichia coli	O55:K59				3								3
Escherichia coli	O68:H Nontypeable	1											1
Escherichia coli	O75			2									2
Escherichia coli	O83			1			1						2
Escherichia coli	O103	1											1
Escherichia coli	O103:H2	1											1
Escherichia coli	O110	1											1
Escherichia coli	O110:H2	1											1
Escherichia coli	O111:K58				6								6
Escherichia coli	O111:NM	1											1
Escherichia coli	O113	2											2
Escherichia coli	O113:H21	2											2
Escherichia coli	O117						3						3
Escherichia coli	O119:K69				1								1
Escherichia coli	O121	2											2
Escherichia coli	O121:Non-motile	1											1
Escherichia coli	O125:K70				2								2
Escherichia coli	O126:K60 VT(+)				1								1
Escherichia coli	O126:K71				2								2
Escherichia coli	O127:K63				2								2
Escherichia coli	O128:K67				3								3
Escherichia coli	O132						1						1
Escherichia coli	O145	2					1						3

ORGANISM		PROVINCES											TOTAL
		BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	
Escherichia coli	O145:NM	1											1
Escherichia coli	O148						1						1
Escherichia coli	O157:H1					1							1
Escherichia coli	O157	2	85	26	35		10	39	4	8			209
Escherichia coli	O157 VTEC	635	355	32	40	808	545	41	17	14	6	1	2494
Escherichia coli	O157:H39	1				1							2
Escherichia coli	O157:NM (VTEC)	3				7							10
Escherichia coli	O157:NM	8	2	1		2							13
Escherichia coli	Non-O157 VTEC	12											12
Escherichia coli	O181:H49	1											1
Escherichia coli	Rough-O:NM	1					2						3
Escherichia coli	EPEC[1]				26			3					29
Escherichia coli	VTEC (VT+ stool)	4			43				1				48
Escherichia coli	Anaerogenic:NM						1						1
Escherichia coli	Inactive				1								1
Escherichia coli	Untypable	3	7	21	8		82	3	2				126
	TOTAL	**703**	**452**	**93**	**178**	**823**	**660**	**86**	**24**	**22**	**6**	**1**	**3048**

[1]It must be noted that EPEC in this table were designated as such ONLY on the basis of serotype, not on the basis of the FAS test or presence of the *eae* gene in the absence of VT genes.

Figure 10 shows the top five human and non-human *Escherichia coli* O157:H7 phagetypes. PT 14 is most prevalent in human as well as non-human sources. PT 4, 8 and 31 are also prevelant in both sources.

Figure 10
Top five *Escherichia coli* O157:H7 phagetypes identified from isolates of human and non-human origin in Canada, 1999



* These data represent total laboratory isolations and should not be confused with incidence

Table 5 lists the number of phagetype identifications of *Escherichia coli* O157:H7 in Canada in 1999. Data are classified by source and province. Phagetypes are numerically ordered.

Table 5
Escherichia coli O157:H7 phagetypes identified from isolates of human and non-human origin in Canada, 1999

PHAGETYPE	SOURCE	PROVINCES												TOTAL
		BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
1	Human		3	1	2	3								9
2	Human					2								2
4	Beef						5							5
4	Meat						3							3
4	Human		2		2	2	14							20
8	Human		2	1	4	14	5							26
8	Unknown					1								1
10	Human						2							2
14	Canine								1					1
14	Beef				6	1			4					11
14	Meat					6	1							7
14	Salami	2	1											3
14	Human	2	144	15	25	56	4	16	4	11				277
14	Unknown					2			10					12
21	Human		3					2						5
21	Unknown					1								1
23	Human		1		2	1								4
27	Caprine					5								5
27	Human	1	1			6								8
28	Human		1											1
31	Beef					2								2
31	Human		10	1										11
31	Unknown					1								1
32	Human		3	1		4	1					1		10
33	Human				1	2								3
34	Human					1								1
45	Human						1			1				2
47	Human		1											1
52	Human				1									1
54	Human		1			1								2
65	Human		1											1
83	Human					1								1
87	Human		1											1
87	Unknown					1								1
Atypical	Human		4		1									5
	TOTAL	**5**	**179**	**19**	**44**	**113**	**36**	**18**	**19**	**12**		**1**		**446**

Escherichia coli O157:H7 VT genotyping by polymerase chain reaction

Table 6 lists the number of verotoxin (VT) genotypes of human and non-human *Escherichia coli* O157:H7 identified by PCR (polymerase chain reaction). Data are classified by genotype and province.

Table 6
PCR-VT genotyping profile of human and non-human *Escherichia coli* O157:H7 isolates in Canada, 1999

VT Type	PROVINCES											TOTAL	%
	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT		
VT1 + VT2	4	162	16	41	104	12	18	17	11		1	**386**	**87%**
VT2 + VT2va		5	1		1	23						**30**	**7%**
VT2		8	1	3	2	1		2				**17**	**4%**
VT1		2			4							**6**	**1%**
VT1 + VT2 + VT2va		1			1				1			**3**	**1%**
VT Negative			1									**1**	**0%**
VT1 + VT2va		1										**1**	**0%**
Not specified	1				1							**2**	**0%**
TOTAL	**5**	**179**	**19**	**44**	**113**	**36**	**18**	**19**	**12**	**0**	**1**	**446**	**100%**

Escherichia coli O157:H7 PCR-VT genotyping and phagetyping

Table 7 gives the distribution of human and non-human *Escherichia coli* O157:H7 by phagetype and VT genotype.

Table 7
***Escherichia coli* O157:H7 phagetypes and VT genotypes identified from isolates of human and non-human origin in Canada, 1999**

Phagetype	VT1	VT1 +VT2	VT1+VT2 +VT2va	VT1 +VT2va	VT2	VT2 +VT2va	Neg. specified	Not Total	%	
1		9							**9**	**2.0%**
2		1			1				**2**	**0.4%**
4		5			1	22			**28**	**6.3%**
8		25	1			1			**27**	**6.1%**
10						2			**2**	**0.4%**
14	2	294			13	1	1		**311**	**69.7%**
21		5			1				**6**	**1.3%**
23		2	1	1					**4**	**0.9%**
27		11				1		1	**13**	**2.9%**
28		1							**1**	**0.2%**
31	3	10			1				**14**	**3.1%**
32		9				1			**10**	**2.2%**
33		3							**3**	**0.7%**
34		1							**1**	**0.2%**
45		1	1						**2**	**0.4%**
47		1							**1**	**0.2%**
52		1							**1**	**0.2%**
54		1				1			**2**	**0.4%**
65		1							**1**	**0.2%**
83 (Prov.)		1							**1**	**0.2%**
87		1						1	**2**	**0.4%**
Atypical	1	3				1			**5**	**1.1%**
TOTAL	**6**	**386**	**3**	**1**	**17**	**30**	**1**	**2**	**446**	**100.0%**

Some of the non-O157:H7 *E. coli* isolated in Canada each year are submitted to NLEP for further characterization. Information on pathogenic *E. coli* as processed by NLEP is summarized in Table 8.

Table 8
Non-O157:H7 Verotoxigenic *Escherichia coli* from human sources in Canada, 1999

Genotype	Serotype	Province	Number of Isolates
VT2	O-Untypable:NM	QC	1
	O113:H21	BC	2
	O181:H49*	BC	1
VT1	O103:H2	BC	1
VT1, *eae*	O26:H11	BC	4
	O145:H21	BC	1
	OR:NM	BC	1
	O157:NM	QC	1
VT2, *eae*	O121:NM	BC	2
VT1, VT2	O121:H19	BC	1
	O145:NM	BC	1
VT2va, *eae*	O68:NM	BC	1
VT1, VT2va *eae*	O157:NM	BC	1
Total non-O157:H7 *E. coli* isolates received in 1999			18

* First Isolation of this serotype in Canada.

Some of the *E. coli* submitted to NLEP each year do not carry the *stx* genes and therefore belong to other virulence groups. These strains are subjected to cell culture assays and neutralization with specific antisera for the detection of toxins. They may also be tested using cell culture adherence and invasion assays. Detection of specific virulence genes or phenotypes is used to assign isolates into one of the known *E. coli* virulence groups. This information is summarized in Table 9.

Table 9
Non-Stx-producing (non-verotoxigenic) *E. coli* from human sources in Canada, 1999

	Genotype	Serotype	Province	Number of isolates
Enteropathogenic *E. coli* (EPEC)	*eae*	Not determined	MB	1
	eae, cdt I	O3:NM	SK	1
	eae	O49:H10	SK	1
	eae	O55:NM	SK	1
	eae	O76:H51	SK	1
	eae	O132:H19	QC	1
	eae	O132:H34	AB	1
	eae	O145:H23	QC	1
	eae	O157:H45	SK	1
	eae	O-Untypable:H45	SK	1
	Total EPEC			10
Enteroinvasive *E. coli* (EIEC)	*inv*	Inactive	BC	1
Enteroaggregative *E. coli* (EaggEC)		O-Untypable:NM	SK	1
		O32:H21	SK	1
E. coli positive for other toxins	*cnf1*	O4:H5	BC	4
		O75:NM	SK	1
	cnf1, cnf2	O4:H5	BC	1
	cdt-I	O83:NM	QC	1
		O83:H-Untypable	SK	1
	cdt-II	O-Untypable:NM	QC	1
K1 capsule positive *E. coli*		O1:K1:NM	QC	1

Some of the *E. coli* strains isolated from human patients and tested at NLEP do not carry any of the virulence phenotypes or genes currently tested. Serotype information for these strains is summarized in Table 10.

Table 10
Human disease in Canada attributed to *E. coli* strains for which no virulence factors were detected.

Serotype	Province(s) of Origin	Number of isolates
O(untypable):H10	SK	2
O(untypable):H4	SK	1
O(untypable):H41	SK	1
O(untypable):H(untypable)	SK	2
	QC	1
O(untypable):NM	SK	3
OR:H18	NB	1
OR:H(untypable)	SK	2
	QC	2
OR:H55	SK	1
OR:NM	SK	1
	QC	4
O1:NM	MB	1
	SK	2
O2:H6	QC	3
O2:H7	SK	1
O2:H42	SK	1
O2:NM	AB	1
	SK	1
O4:H27	AB	1
O7:NM	QC	1
O8:H4	NS	1
O11:H15	ON	1
O12:NM	QC	2
	SK	2
O15:H12	QC	2
O15:NM	SK	1
	AB	1
O18:H31	QC	2
O18:NM	QC	1
O19:H44	BC	1
O21:H55	QC	1
	SK	1
O25:H12	QC	2
O26:H32	SK	1
O29:H4	QC	1
O40:H37	QC	1
O46:H35	QC	1
O48:H21	AB	1
O64:H(untypable)	QC	1
O75:NM	SK	1
O95:NM	QC	1
O117:H28	QC	1
O117:H?	QC	1
O148:NM	QC	1
O157	SK	1
O157:NM	SK	1
O177:H7	QC	1

All isolates were tested for the following virulence factors: *Stx*1, *Stx*2 (and variants), *Stx*2e, CNF 1, CNF 2, *eae*, LT 1, ST 1, ST II, invasion genes (EIEC virulence group), enteroaggregative factor (PCR test), *cdt*-I, *cdt*-II, and *cdt*-III. They were also checked by cell culture for uncharacterized cytotoxic activity. Adherence tests for diffuse adherence (DA), localized adherence (LA), and enteroaggregative adherence (EAgg) were not routinely performed. Testing for the EAST-1 toxin was not done.

Escherichia coli O157:H7 outbreaks

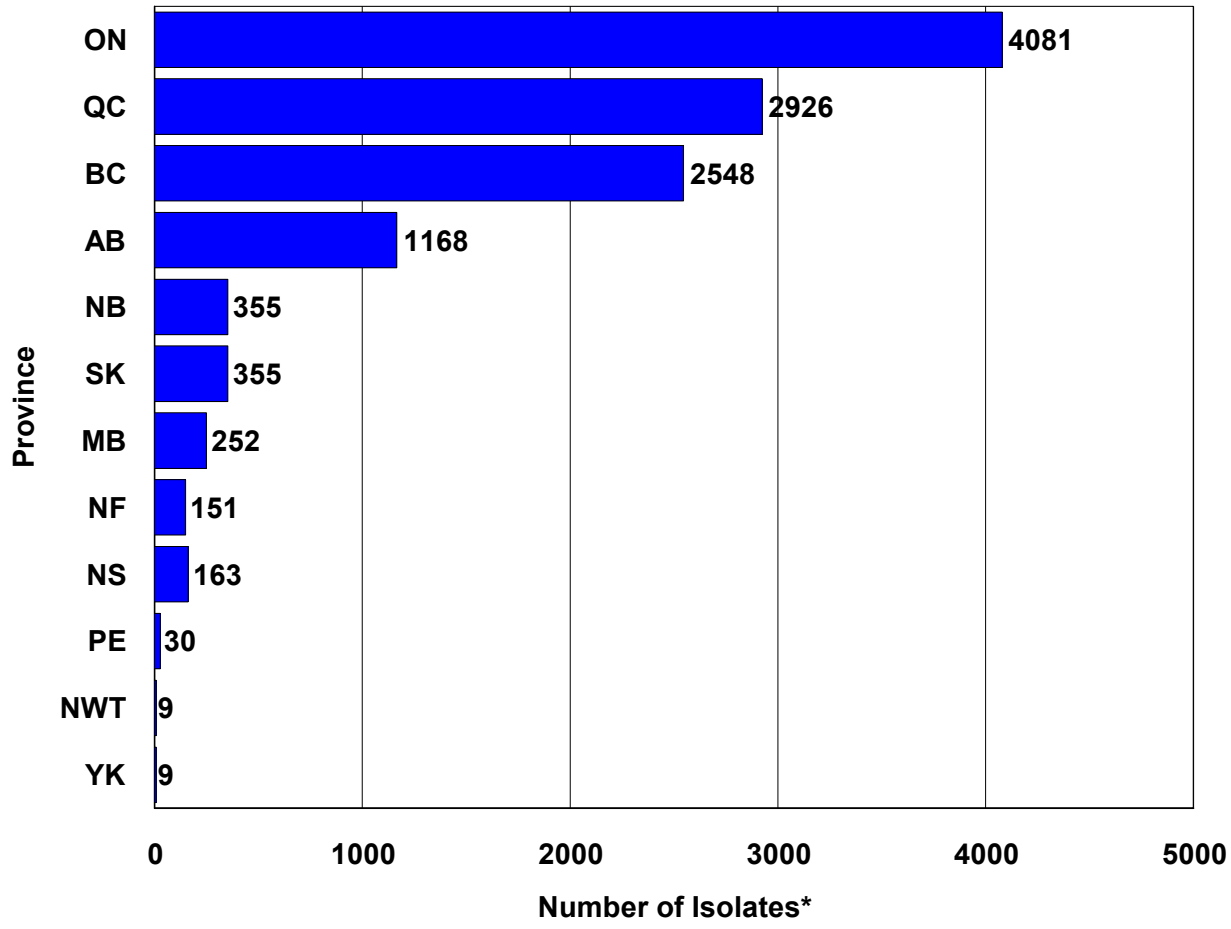
Refer to Section 7 - Outbreaks of Enteric Pathogens in Canada, 1999. See page 73

Section 4 - *Campylobacter*

Campylobacter isolates of human and non-human origin in Canada, 1999

Figure 11 provides the provincial frequency distribution of human *Arcobacter, Campylobacter,* and *Helicobacter* in Canada, 1999.

Figure 11
***Arcobacter, Campylobacter,* and *Helicobacter* isolates of human and non-human origin in Canada, 1999**



* These data represent total laboratory isolations and should not be confused with incidence

Table 11 lists the number of laboratory identifications of human and non-human *Arcobacter*, *Campylobacter,* and *Helicobacter* by province. Organisms are listed alphabetically first by genus and then by species.

Table 11
Arcobacter, Campylobacter, and *Helicobacter* isolates of human and non-human origin in Canada, 1999

ORGANISM	SOURCE	PROVINCE												TOTAL
		BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
Arcobacter sp.	Non-Human	2												**2**
A. butzleri	Human					12								**12**
A. cryaerophilus	Human					1								**1**
Campylobacter sp.*	Human	1998	731	35	1	3723	645	59	110	1	2	4	2	**7311**
C. coli	Human	4	22	17	9	73	120	10						**255**
C. coli	Non-Human	4												**4**
C. concisus	Human					1	1							**2**
C. curvus	Human						1							**1**
C. jejuni/coli	Human	199	180	113	3	162	66	142	53	29	99	3	5	**1054**
C. jejuni	Human	234	222	186	104	88	2060	142			50	2	2	**3090**
C. jejuni	Non-Human	96												**96**
C. fetus	Human					1	10							**11**
C. fetus ssp *fetus*	Human		3	1		2	17							**23**
C. fetus	Non-Human	2												**2**
C. hyointestinalis	Human		1											**1**
C. lari	Human	3	2			2	2	1						**10**
C. upsaliensis	Human	2	6	3	1	4	3	1						**20**
Helicobacter sp.	Human	1	1		1									**3**
Helicobacter sp.	Non-Human	3												**3**
H. pullorum	Human						1							**1**
H. pylori	Human				133	12								**145**
	TOTAL	**2548**	**1168**	**355**	**252**	**4081**	**2926**	**355**	**163**	**30**	**151**	**9**	**9**	**12047**

* Of the total (7311), 6526 were allocated from the National Notifiable Diseases database.

Campylobacter outbreaks, 1999

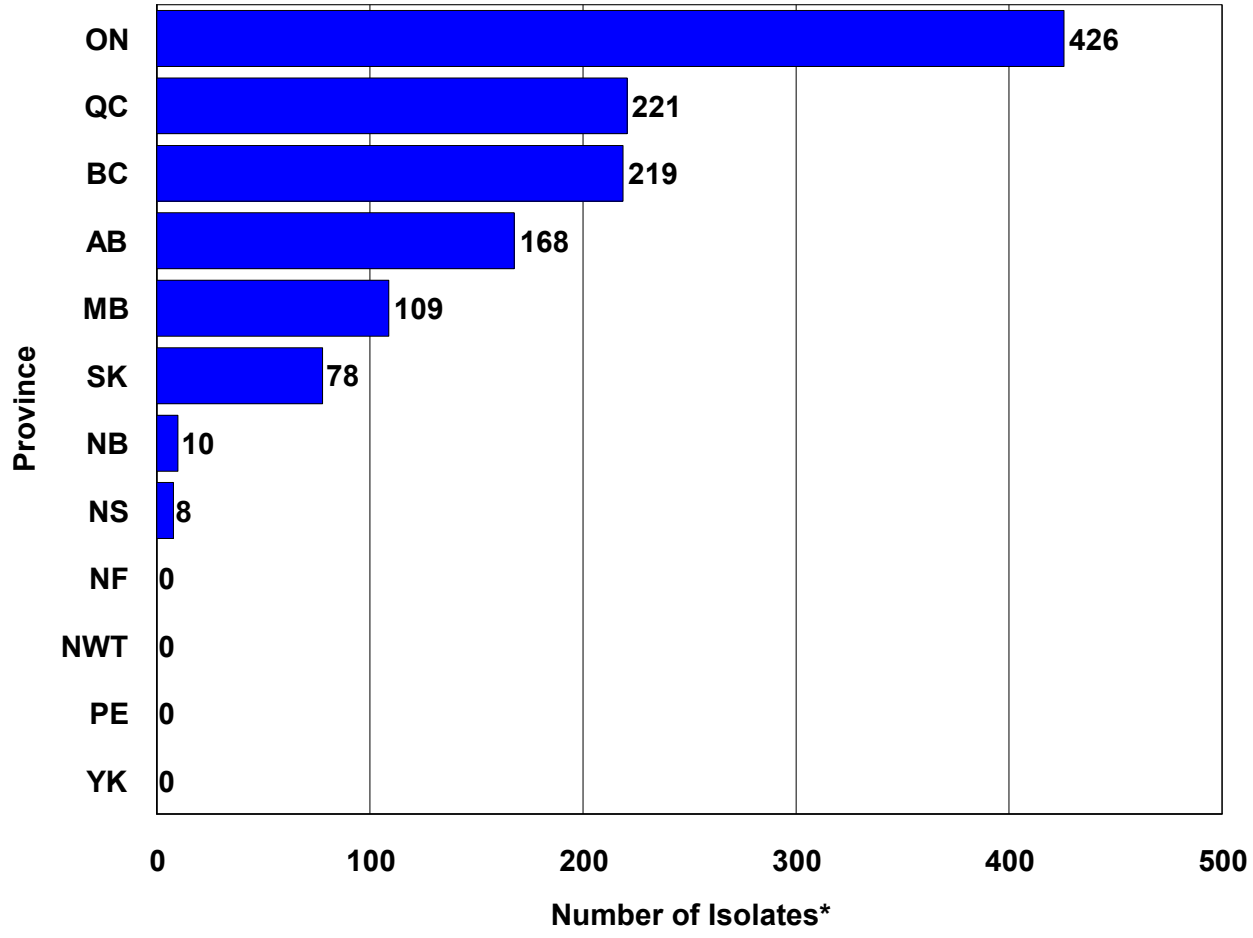
Refer to Section 7 - **Outbreaks for Enteric Pathogens in Canada**. See page 73

Section 5 - *Shigella*

Shigella isolates of human origin in Canada, 1999

Figure 12 provides the provincial frequency distribution of human *Shigella* in Canada, 1999.

Figure 12
***Shigella* isolates of human origin in Canada, 1999**



* These data represent total laboratory isolations and should not be confused with incidence.

Table 12 lists the number of laboratory identifications of *Shigella* from human patients by province. Organisms are listed first by species (*Shigella dysenteria*e, *Shigella flexneri*, etc) and then by serotype.

Table 12
***Shigella* isolates of human origin in Canada, 1999**

ORGANISM	PROVINCE												TOTAL
	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
Shigella boydii	1	2		2	20	5	1						**31**
Shigella boydii 1	1												**1**
Shigella boydii 2	7	2			7		2						**18**
Shigella boydii 4	6	1			4	2							**13**
Shigella boydii 5					2								**2**
Shigella boydii 7						1							**1**
Shigella boydii 8	2	1			2								**5**
Shigella boydii 13	1												**1**
Shigella boydii 14		2			3								**5**
Shigella boydii 18	1				1	1							**3**
Shigella boydii 19						1							**1**
Shigella boydii Prov. E16553						1							**1**
Total *S. boydii*	**19**	**8**		**2**	**39**	**11**	**3**						**82**
Shigella dysenteriae	1	1			7	8							**17**
Shigella dysenteriae 2	1	3			3	3							**10**
Shigella dysenteriae 3	1												**1**
Shigella dysenteriae 4	1	1				1							**3**
Shigella dysenteriae 7					1								**1**
Shigella dysenteriae 9	2												**2**
Shigella dysenteriae 13	1												**1**
Shigella dysenteriae prov.105					2								**2**
Shigella dysenteriae prov.106		1			4	3							**8**
Total *S. dysenteriae*	**7**	**6**			**17**	**15**							**45**
Shigella flexneri	12	12	2	10	106	61	4	3					**210**
Shigella flexneri 1	5	2	1	1		8	1						**18**
Shigella flexneri 1a					1								**1**
Shigella flexneri 1b					19								**19**
Shigella flexneri 2	28	11		6		11							**56**
Shigella flexneri 2a					24								**24**
Shigella flexneri 2b					6								**6**
Shigella flexneri 3	12	2		1		7							**22**
Shigella flexneri 3a	1				14								**15**
Shigella flexneri 3b	2				2								**4**
Shigella flexneri 4	2	1											**3**
Shigella flexneri 4a	2	2			6	4							**14**
Shigella flexneri 4c	1				6								**7**
Shigella flexneri 5	1												**1**
Shigella flexneri 6	8	7			21	5		1					**42**
Shigella flexneri 6 Hertfordshire					1								**1**
Shigella flexneri prov. 101					3	1							**4**
Shigella flexneri prov. 104					2	2							**4**
Shigella flexneri prov. SH104		1				2							**3**
Shigella flexneri type 6					2								**2**
Shigella flexneri var. X	1	5											**6**
Shigella flexneri var. Y	2	4			3								**9**
Total *S. flexneri*	**77**	**47**	**3**	**18**	**216**	**101**	**5**	**4**					**471**

ORGANISM	PROVINCE												TOTAL
	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	NT	YK	
Total *S. sonnei*	**101**	**106**	**75**	**89**	**143**	**71**	**2**	**3**					**590**
Shigella sp.	15	1			11	23		1					**51**
TOTAL *SHIGELLA*	**219**	**168**	**78**	**109**	**426**	**221**	**10**	**8**					**1239**

Shigella outbreaks, 1999

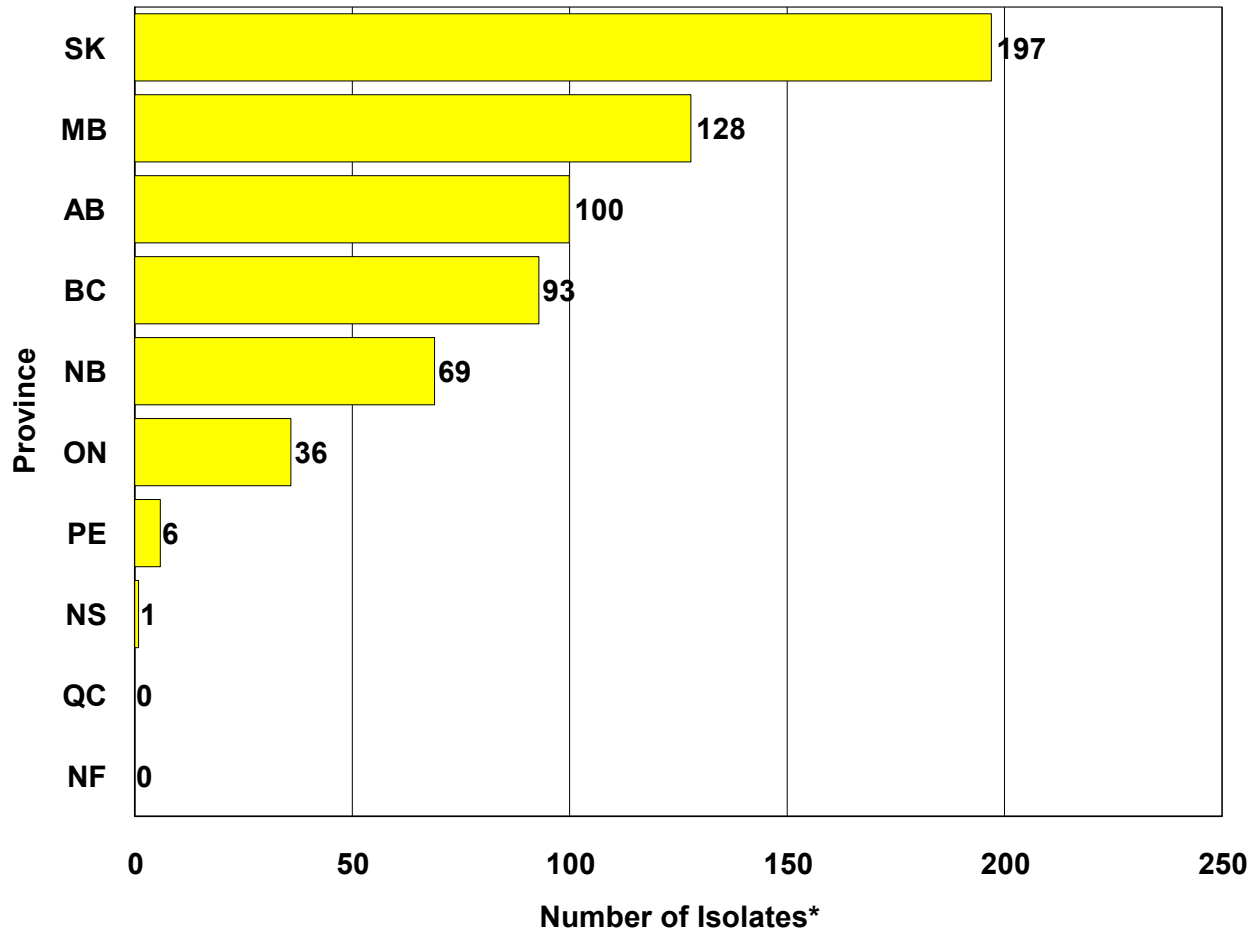
Refer to Section 7 - **Outbreaks for Enteric Pathogens in Canada**. See page 73.

Section 6 - *Aeromonas* and *Plesiomonas*

Aeromonas and *Plesiomonas* isolates of human origin in Canada, 1999

Figure 13 provides the provincial frequency distribution of human *Aeromonas* and *Plesiomonas* in Canada, 1999.

Figure 13
***Aeromonas* and *Plesiomonas* isolates of human origin in Canada, 1999**



* These data represent total laboratory isolations and should not be confused with incidence.

Table 13 lists the number of laboratory identifications of *Aeromonas* and *Plesiomonas* from human patients by province. Organisms are listed alphabetically by genus first (*Aeromonas, Plesiomonas*) and then by species (e.g. *caviae*).

Table 13
Aeromonas and *Plesiomonas* isolates of human origin in Canada, 1999

ORGANISM	PROVINCE										TOTAL
	BC	AB	SK	MB	ON	QC	NB	NS	PE	NF	
Aeromonas sp.			2	123			5				**130**
Aeromonas caviae	50	49	149		19		27		4		**298**
Aeromonas hydrophila	19	22	31		14		30				**116**
Aeromonas hydrophila/caviae							1				**1**
Aeromonas media			1								**1**
Aeromonas schubertii	2										**2**
Aeromonas trota	1	1									**2**
Aeromonas veronii biovar *sobria*		26	7				1		1		**35**
Aeromonas veronii biovar *veronii*	17	1	5		1		1				**25**
Plesiomonas sp.							1				**1**
Plesiomonas shigelloides	4	1	2	5	2		3	1	1		**19**
TOTAL	**93**	**100**	**197**	**128**	**36**		**69**	**1**	**6**		**630**

Aeromonas outbreaks, 1999

Refer to Section 7 - **Outbreaks for Enteric Pathogens in Canada**. See page 73.

Section 7 - Outbreaks of Enteric Pathogens in Canada

Salmonella

A total of 40 outbreaks involving 343 isolates belonging to 13 different *Salmonella* serotypes were reported in 1999. There were 11 community outbreaks in 1999, the same number as as last year . There were 2 National outbreaks, 2 associated with nursing homes and 25 familial contact outbreaks.

Number of Outbreaks	Type of Outbreak	No. of Isolates
11	Community	143
25	Family	53
2	National	139
2	Nursing Home	8
40		**343**

Escherichia coli O157:H7

A total of 87 isolates of *Escherichia coli* O157:H7 were characterized from 89 outbreaks.

Number of Outbreaks	Type of Outbreak	No. of Isolates
3	Community	32
6*	Family	13
1	National	36
1	Daycare	3
1	Nursing Home	5
12		**89**

* includes 1 family outbreak with 2 cases of *E. coli* 0113.

Campylobacter

A total of 12 isolates of *Campylobacter* were implicated in 6 family outbreaks.

Shigella

A total of 29 isolates of *Shigella* were implicated in 12 family outbreaks.

Table 14 provides details of all outbreaks of enteric pathogens classified by causative organism, outbreak type (Community, Family, National, *etc.*), food source (or other information), province, phagetype, number of outbreaks, and number of cases.

Table 14
Outbreaks of Enteric Pathogens

Causative Organism	Outbreak Type	Descripton	Province	Phage Type	Source (# Isolates)	# OB	# CASES. ISOLATES
Campylobacter jejuni	Family		NB	NA	Human (4)	2	4
	Family		SK	NA	Human (6)	3	6
					Subtotal	**5**	**10**
Campylobacter sp.	Family		SK	NA	Human (2)	1	2
E. coli O113	Family		BC	NA	Human (2)	1	2
E. coli O157:H7	Commnunity		ON	14	Human (5), Food* (6)	1	11
	Commnunity	Hamburger	MB	14	Human (5), Ground Beef (6)	1	11
	Family		AB	14	Human (3)	1	3
	Family		AB	14	Human (2)	1	2
	Commnunity	Petting Zoo	ON	27	Human (5), Caprine (5)	1	10
	Commnunity	Salami	AB, BC, ON	14	Human (24), Salami(12)	1	36
	Family		ON	8	Human (2)	1	2
	Family		ON	8	Human (2)	1	2
	Family		ON	14	Human (2)	1	2
	Commnunity	Day Care	AB	14	Human (3)	1	3
	Commnunity	Nursing Home	PQ	8	Human (5)	1	5
					Subtotal	**11**	**87**
S. Agona	Community	Cluster Investigation	ON	Pattern A	Human (14)	1	14
S. Enteritidis	Family		MB	4	Human (2)	1	2
	Family		MB	8	Human (2)	1	2
	Community	Restaurant	ON	8	Human (15)	1	15
					Subtotal	**3**	**19**
S. Hartford	Family		NF	NA	Human (2)	1	2
S. Heidelberg	Family		MB	6	Human (2)	1	2
	Family		BC	6	Human (3)	1	3
	Community	Nursing Home	ON	6	Human (3)	1	3
					Subtotal	**3**	**8**
S. Infantis**	National	Pig's Ear Dog Snack	All	9, 10, 13,	Human (53), Dog Snack (34)	1	87
S. Javiana	Community		ON	Pattern A	Human (3)	1	3
S. Mbandaka	Family		PEI	Pattern A	Human (4)	1	4
S. Muenchen	Community	Orange Juice	AB, ON	Pattern A	Human (11)	1	11
S. Newport	Community	Cluster Investigation	ON	10	Human (28), Raw Meat (15)	1	43

Causative Organism	Outbreak Type	Descripton	Province	Phage Type	Source (# Isolates)	# OB.s	# CASES. ISOLATES
S. Paratyphi B	National	Alfalfa Sprouts	AB, BC	Worksop	Human (50), Alfalfa Sprouts (2)	1	52
var. Java	Family		BC	1 var. 3	Human (2)	1	2
					Subtotal	**2**	**54**
S. Typhi	Community		ON	E1	Human (4)	1	4
S. Typhimurium	Family		AB	21	Human (2)	1	2
	Community	Nursing Home	ON	104	Human (5)	1	5
	Family		ON	104	Human (22)	11	22
	Family		BC	104	Human (2)	1	2
	Family		ON	104b	Human (2)	1	2
	Family		ON	108	Human (4)	2	4
	Family		BC	124 var.	Human (2)	1	2
	Community	New Year's Dinner	ON	170	Human (4)	1	4
	Family		AB	208 var.	Human (2)	1	2
					Subtotal	**20**	**45**
Salmonella ssp I	Community	Banquet	ON	191	Human (18)	1	18
4,5,12:i:-	Community		SK	191	Human (5), Bovine (2)	1	7
	Community		SK	U291	Human (2), Cooked Poultry (1)	1	3
	Community		BC	191	Human (20), Chicken (1)	1	21
					Subtotal	**4**	**49**
Shigella boydii 14	Family		AB	NA	Human (2)	1	2
Shigella flexneri	Family		BC	NA	Human (2)	1	2
Shigella sonnei	Family		SK	NA	Human (25)	10	25
					Total	**70**	**473**

*Ready-to-eat meat.
**Grossly contaminated product. Other organisms isolated: *S.* Derby (23), *S.* Typhimurium (20), *S.* Mbandaka (2), *S.* Worthington (3), *S.* Anatum (1), **Grossly contaminated product. Other organis isolated: *S.* Derby (23), *S.* Typhimurium (20), *S.* Mbandaka (2), s. Worthington (3), *S.* Anatum (1).

NA=Not Applicable, AT=Atypical and UT=Untypeable.

Section 8 - Miscellaneous Information

Unusual enteric pathogen infection sites

In EDSS, there were 20 isolates of enteric pathogens isolated from unusual sources. They were: anatomy 3; stool (blood) 2; wound 2; and abscess, CSF also from blood, diarrhea, fluid (knee), labia, peritoneal dialysate, pus, rectal, stool (turkey & pork bbq), swab (rectal), urine (stool), wound (femur), each 1. In addition, in NESP there were reported: colon biopsy 1; right kidney with renal mass, abscess 1; penis 1; incision 1; and blood culture & sputum 1.

Travel related enteric pathogen infections

As reported by NESP, 387 isolates of enteric pathogens were acquired abroad by travellers. They included isolates from different organisms from the following countries or regions: Africa 8, Asia 3, Australia 2, Bahamas 8, Bangladesh 8, Bolivia 4, Brazil 8, Brunei 1, Cambodia 1, China 14, Costa Rica 11, Cuba 12, Dominican Republic 16, Egypt 4, Ethiopia 1, Germany 1, Haiti 9, Hungary 10, India 65, Indonesia 2, Israel 4, Jamaica 6, Jordan 4, Kampuchea 2, Kosovo 5, Mexico 35, Nepal 8, New Zealand 5, Nicaragua 2, Overseas 2, Pakistan 4, Panama 7, Peru 2, Philippines 4, Russia 1, South America 3, Sri Lanka 1, Sudan 7, Thailand 14, United States 12, Vietnam 1, and Yugoslavia 69.

Contaminated imported products

Imported Product	Country of Origin	Organism
Raw Shrimp	India	*S.* Perth 38:y:e,n,x

Discussion

The seasonal variations and relative numbers of laboratory reported major enteric pathogens is similar to patterns observed over the last several years. *Salmonella* Typhimurium has returned as the most frequently isolated serovar from humans, followed by *S*. Heidelberg and then *S*. Enteritidis. Although the number of *S*. Heidelberg isolations has remained relatively constant, a decrease in number of *S*. Enteritidis has elevated *S*. Heidelberg to the second most frequently isolated serovar this year. Two new organisms that entered the top ten list are *S*. Paratyphi B var. Java and *Salmonella* ssp I 4,5,12:i:-. The sudden emergence of *Salmonella* ssp I 4,5,12:i:- as a significant agent of infection at this time may be because in prior years this organism may have been grouped and reported with *S*. Typhimurium (4,[5],12:i:1,2) isolates. Characterization by bio-typing (the majority fail to ferment dulcitol), phage typing and serotyping has shown the population to be distinct from *S*. Typhimurium, and more than just a mono-phasic variant. *S*. Heidelberg continues to be most prevalent from human sources in Saskatchewan and in the Atlantic provinces and second in Alberta, Manitoba and Quebec.

Interpretation of prevalence of *Salmonellae* from non-human sources is difficult due to under representation in some provinces. Overall this year, *S*. Heidelberg and *S*. Typhimurium are the most prevalent serovars from non-human sources and *S*. Enteritidis is absent from the top ten. Other prevalent non-human serovars include *S*. Braenderup, *S*. Mbandaka, *S*. Thompson and *S*. Brandenburg. *Salmonella* Heidelberg continues to be most prevalent in both chicken and turkey sources, *S*. Typhimurium and *S*. Muenster are most prevalent from bovine sources and *S*. Mbandaka now tops the list from Feed and Ingredients sources. As well as being absent from the top ten non-human serovars in Quebec this year, *S*. Tennessee is also absent from the Feed and Ingredient after topping the list last year.

Phage type (PT) 104 continues to be the most prevalent *S*. Typhimurium phage type isolated from human and non-human sources. PT4 is the most prevalent *S*. Enteritidis phage type isolated from humans accounting for more that twice the number of the next most prevalent phage type, PT8. *S*. Enteritidis PT8 however has re-emerged as the most prevalent serovar from non-human sources. *S*. Heidelberg PT 19 continues to be the most prevalent among human isolates and PT 6 was the most prevalent among non-human isolates. The most prevalent phage types of human and non-human *S*. Hadar continue this year to be PT11, PT2 and PT5. PT 14 remains the most prevalent phage type of *S*. Newport from human sources but PT10 has increased considerably and is the most prevalent non-human phage type this year.

There has been an overall increase in the number of *E. coli* O157 isolations this year with the largest increases seen in Ontario, British Columbia, Quebec and Alberta. PT 14 continues to be the most prevalent phage type from both human and non-human sources and PT8, PT4 and PT31 remain in the top 5 human phage types. The large majority of *E.coli* O157:H7 strains have the PCR verotoxin genotype VT1 + VT2, however there has been a considerable increase in the number of isolates with the VT2 + VT2va genotype.

Little change has been observed in *Campylobacter* this year where Ontario, Quebec and British Columbia have again reported the largest number of isolations. A dramatic increase in *Helicobacter pylori* isolates has been observed in Manitoba. Despite a decrease in the number of isolations of *Shigella* this year, Ontario still ranks first in the number of isolations in Canada followed by Quebec and British Columbia. Saskatchewan has reported lower numbers of *Aeromonas* and *Plesiomonas* this year, but has still the most isolations, followed by Manitoba, Alberta, British Columbia, New Brunswick and Ontario.

Three large multi-provincial outbreaks of Salmonellosis occurred this year. The largest and most wide-spread outbreak was associated with nationally distributed pig's ear dog snacks (7). The pet treats were grossly contaminated with *S*. Derby, *S*. Typhimurium, *S*. Mbandaka, *S*. Worthington and *S*. Anatum isolated from patients and product, however the main organism responsible was *Salmonella* Infantis PT 9, PT10 and PT13. Another outbreak in British Columbia and Alberta was associated with the consumption of alfalfa sprouts in which *S*. Paratyphi B var. Java PT Worksop was identified as the causative agent. Orange juice was implicated in an outbreak of *Salmonella* Muenchen in Alberta and Ontario which involved 11 cases of illness.

The first outbreak to be recognized as being caused by the newly emergent *Salmonella* ssp I 4,5,12:i:- involved 18 patients who attended the Black History Month banquet in Ontario. An outbreak of *Salmonella* ssp I 4,5,12:i:- in British Columbia where 20 people fell ill was associated with cooked poultry and smaller outbreak was reported in Saskatchewan involving 5 cases of illness. Although all 3 outbreaks were considered separate and distinct from each other epidemiologically, all isolates were determined to be PT191 using the *Salmonella*

Typhimurium phage typing scheme. A smaller outbreak in Saskatchewan was also reported and the isolates sub-typed as PT U291.

The largest *E. coli* O157:H7 outbreak this year was associated with nationally distributed Hungarian salami sausage and involved 24 cases of illness in Alberta, British Columbia and Ontario. Another, smaller, outbreak in Ontario, associated with a children's petting zoo (8), caused 5 cases of illness and 2 other outbreaks with ground beef implicated as the source, in Ontario and Manitoba each involved 5 cases. There was also an outbreak in a Quebec nursing home with 5 cases and a daycare outbreak in Alberta with 3 cases.

Appendix I - Interpretation of Data Sets

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. 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.

Now we have begun to explicitly address the following questions: What is the nature of the component data sets? What is the quality of the data, within and among the data sets? What do the data sets estimate, or at least represent? These are critical questions because the Annual Summary is a compilation of various data sets that are volumnous and diverse.

Eleven 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 LFZ and we select and interpret data relevant to this compilation. The CIDPC in Ottawa sends us *Campylobacter* information from their database of notifiable diseases. Data from NLEP is collected from various paper and electronic sources: from CIPHS, our current operational database, from an older “enhanced operational” card system of data, EDSS; from specialized custom electronic databases (e.g., data from the Molecular Typing Laboratory and Phage Typing, Antimicrobial Resistance and Surveillance Laboratory); as well as from hand-written laboratory notebooks.

Given the size of some tables, it is clear that the data matrices are very large. The component and collated data matrices have many blanks, with the further requirement for careful handling of the numbers. There are published, general standards regarding nomenclature of some groups of organisms, but the general use of a common nomenclature in the component data sets still awaits us. The large number of component data sets, the size of the data matrices, and the lack of standard naming conventions presents a major challenge to the accurate and timely production of this report.

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/absense) 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 differences have to be addressed. For example, some databases result as isolates are submitted at the good will of the submiting 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 component 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 component dataset, with as much knowledge about their origin and characteristics as available. This, at least, will ensure the best possible estimates. Now that the component datasets are stored separately, it is possible to evaluate them. This is done below, by type of organism.

Human *Salmonella* serotypes

The total difference between the provincial reports and NESP (in Table 1) was less than 1%, relative to either database. The individual differences are quite unique: in the case of *S.* Heidelberg, the provincial value for B.C. was higher than NESP but less for virtually every other province. Regardless of our standardization (Table 15), both *S*. Java and *S*. Paratyphi *B v*ar. Java were used in the component data sets. *S*. Java was consistently higher than *S*. Paratyphi *B v*ar. Java in EDSS and in the provincial reports, but *S.* Paratyphi *B v*ar. Java occurred almost exclusively in NESP. Both *Salmonella* sp. and *Salmonella* ssp I Group B are consistently higher in NESP and this may be a product of the timely reporting inherent in the design of NESP. EDSS contributes additional isolate counts for the Maritime Provinces and Newfoundland, relative to both the provincial reports and NESP.

Salmonella phagetypes

Analysis showed that the overlap between the CIPHS and the LFZ data are miminal, with CIPHS 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 CFIA laboratories and Health Canada research laboratories. The few human samples that are recorded in LFZ's reports are mainly from research projects. EDSS adds new information for only 2% of the data set, and in 80% of these cases the two databases differ only by a value of one. Hence EDSS data do not contribute much to the table and can be omitted in constructing Table 2 for future Annual Summaries.

Non-human *Salmonella* serotypes

Provincial distributions of LFZ data (Table 3) are considered reasonable approximations of what is actually happening in the field, with the possible exception of *S.* Heidelberg (Anne Muckle, *pers. comm*). In the instance of Saskatchewan it is possible to compare the number of non-human *Salmonella* reported by LFZ. The following ratios give "serotype:number non-human *Salmonella* isolates reported by LFZ:number of non-human *Salmonella* isolates reported by Provincial Laboratory in Regina": *S.* Mbandaka:3:36, *S.* Typhimurium:1:17, *S.* Agona:0:5, *Salmonella* ssp I 4,5,12:i:-:0:5, *S.* California:2:4, *S.* Heidelberg:0:3, *S.* Infantis:0:3, *S.* Give:0:3, *S.* diarizonae (ssp IIIb):-:0:3, *S.* Schwarzengrund:0:3. LFZ reported a total number of isolates of 17 from Saskatchewan; the Provincial Laboratory reported 101. While this comparison may not provide support to the view that the LFZ data are "reasonable approximations" of what is happening in Saskatchewan, this comparison is probably more important in illustrating the gap between our best estimates and what is actually happening.

Escherichia coli

There were many differences between the provincial and NESP databases used to construct Table 4. *Escherichia coli* 0157:H7 was only reported in the provincial data; except for Manitoba, *Escherichia coli* 0157 VT(+) was only reported in NESP. Significantly, however, the total difference was only 16%, relative to the provincial database. *Escherichia coli* 0157:H7 was not reported in the EDSS data set but *Escherichia coli* 0157

was - although it was generally not reported in the provincial reports, Saskatchewan and New Brunswick being the exceptions. The total difference between EDSS and provincial data sets was 78%, relative to the provincial database. There were a number of serotypes for which EDSS added significantly to the overall dataset. It appears that all the human datasets are needed for providing national figures.

There were only 36 non-human isolates from the provincial reports and 23 from EDSS. British Columbia, Alberta, and Ontario reported a few non-human *E. coli* O157:H7 and Ontario reported a few *E. coli* O157:H7 VT+. The EDSS database contained non-human isolates from Manitoba, Quebec, New Brunswick, and Nova Scotia. The non-human data do not usefully contribute to Table 4 and their inclusion in the subsequent Annual Summaries will be reviewed.

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 two provinces (eg. O15:NM; O21:H55) 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. Non-O157:H7 VT-producing *E. coli* (VTEC) are also not commonly reported in Canada (Table 9). However, it appears likely that the number of cases of these organisms is higher than the available data indicate. The B.C. provincial laboratory currently reports the majority of human infections of non-O157:H7 VTEC in Canada (Table 4). Increased detection of these organisms in B.C. appears to be the result of enhanced surveillance through the use of testing protocols specific for VTEC. Assuming that non-O157:H7 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 organisms 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 desirable that testing for all VTEC be conducted across Canada.

Finally, please note that the EPEC in Table 4 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 VT genes.

Campylobacter, Arcobacter, and *Helicobacter*

Non-human data came only from the B.C. provincial reports, and so its future inclusion should be reconsidered. Alternate data sources, including LFZ, could be used to supplement the data reported by British Columbia. During the construction of Table 11, it was noticed that there were many differences between the provincial and NESP databases, but these were numerically large only for human *C. jejuni/coli,* where NESP reported 1054 more isolates than the provincial reports; for human *C. jejuni,* where the provincial reports reported 2731 more isolates than NESP; and *Campylobacter* sp where the results were mixed (provincial reports larger in Quebec and *vise versa* for many of the other provinces). The total difference was 64%, relative to the provincial database. There were also many differences between provincial reports and the EDSS database, but these were almost always in favour of the former. Only with respect to human *Helicobacter* sp did EDSS add qualitative information. The percentage difference was large (89% of the provincial reports), with the major numerical differences being for human *C. coli* (222), human *C. jejuni* (2654), and human *Campylobacter* sp (646). EDSS did not provide much useful information beyond that reported by the provinces and need not be included in future Annual Summaries.

As pointed out in the Methods and Materials, the laboratory data were supplemented with CIDPC's National Notifiable Diseases data. The differences in numbers between the two data sets is very large. For example, the total number of isolates reported by provincial reports, EDSS, and NESP in 1999 was only 37%, 4%, and 13%, respectively, of the numbers reported by the Notifiable Diseases database. Our human maximums varied across provinces from 18% to 150%. This is because most laboratory-confirmed isolates are not

sent from primary laboratories to provincial laboratories, and information pertaining to these isolates is therefore made available only by reporting of cases through Health Units to provincial epidemiologists.

Shigella

There were many differences between the provincial and NESP databases (Table 12). Significantly, however, the total difference was only 15%, relative to the provincial database. It could be that the differences are due to reporting, but is not clear which are the most accurate data. There were also many differences between provincial reports and the EDSS database; the total difference was 87% with the provincial reports providing the larger values. Notably, of the total difference of 905 isolates, 502 were *Shigella sonnei.* The EDSS did not provide serotypes beyond that reported by the provinces so its inclusion in future Annual Summaries needs to be evaluated.

Aeromonas and *Plesiomonas*

The most complete data were found to exist in the provincial reports (Table 13). NESP does not contribute much additional data, but EDSS does contribute to qualitative completeness of the set of observed types. Except for *Aeromonas caviae,* New Brunswick reported similarly in both their provincial reports and EDSS. P.E.I. reported some isolates through EDSS but none through NESP. From such observations it has been possible, and will continue to be possible, to obtain a better estimate of the national surveillance of enteric pathogens.

Another fundamental problem is that of nomenclature where standards are being set for this report series (see Table 15). However, this still leaves open the question about whether an organism has different names in different provincial databases.

Progress is now underway with regards to dealing with such problems. An annual meeting of NESP stakeholders was initiated in 2001 and this is an important step in the process of obtaining a shared understanding of Canadian enteric disease reporting. There have recently been national meetings concerned with laboratory standardization and new initiatives by the CIDPC in conjunction with the NLEP, the LFZ, and the Bureau of Microbial Hazards, Ottawa, are aimed at developing a more comprehensive and complete national surveillance system. Co-operation and co-ordination between the various contributors to enteric surveillance in Canda continues to improve.

By waying of placing the Canadian experience[2] in an international perspective, it is useful to note that systems in use in the U.S.[3, 4] and Australia[4] 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.[5]. 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[6].

Information pertaining to isolates from animals suffers from similar deficiencies. There has never existed a nation-wide network for obtaining a statistically valid sample of enteric bacteria infecting animals[1]. 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 givew 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 identifiies knowledge gaps requiring further research. We trust that this report will be both informative and useful to you.

For consistency certain changes were made to data as reported in the specific data source(s) used to compile the numbers presented herein. The following changes were made. The left column gives the reported name and the right column the name used in this report.

Table 15
In-house modifications to data sources

Salmonella:	
Any *formula*	Any *Salmonella formula*
Any *Salmonella* ssp*x*	Any *Salmonella* ssp *x*
Any *Salmonella x* ...	Any Salmonela ssp *x* ...
Any *Salmonella* ... gr. *x*	Any *Salmonella* ... Gr. *x*
Any *Salmonella* Gr*x formula*	Any *Salmonella formula*
Any *Salmonella* Group *x formula*	Any *Salmonella formula*
Any *Salmonella* SS *x name formula*	Any *Salmonella* ssp *x formula*
Any *Salmonella* ssp*x* Gr*x formula*	Any *Salmonella* ssp *x formula*
Any *Salmonella* ssp*x formula*	Any *Salmonella* ssp *x formula*
Any ... H2S-	Any ...
Any ... var 15+	Any ...
Any ... Non-motile ...	Any ... NM ...
Same rules if SSP used in place of SS	
formulae are not enclosed by braces or brackets	
subspecies are not enclosed in brackets: e.g., not (IV) but ssp IV	
Use roman numerals for subspecies designations (i.e., ssp IV, not ssp 4)	
S. Atlanta	*S.* Mississippi
S. Diarizonae	*Salmonella* diarizonae (ssp IIIb)
S. Infantis & *S.* Give	*S.* Infantis, *S.* Give
S. Houtenae	*S.* Houtenae ssp IV
S. Java	*S.* Paratyphi B var. Java
S. Marina	*Salmonella* ssp IV 48:g,z51:-
S. Marina ssp IV	*Salmonella* ssp IV 48:g,z51:-
S. Paratyphi	*S.* Paratyphi A
S. ssp IV marina	*Salmonella* ssp IV 48:g,z51:-
S. Newington	*S.* Anatum
S. Ohio var 14+	*S.* Ohio
S. Thielallee	*S.* Oranienburg
S. Typhi/Paratyphi	*S.* Typhi, *S.* Paratyphi A
S. Typhimurium var.cophgn	*S.* Typhimurium
S. Wassenaar ssp. IV	*Salmonella* ssp IV 50:g,z51:-
Salmonella	*Salmonella* enterica
Salmonella arizonae	*Salmonella* arizonae (ssp III)
Salmonella arizonae sspIIIb 61:-:1,5	*Salmonella* ssp IIIb 61:-:1,5
Salmonella choleraesuis var. kunzendorf	*Salmonella* Choleraesuis
Salmonella enterica ssp diarizonae	*Salmonella* diarizonae (ssp IIIb)
Salmonella SS I enterica	*Salmonella* ssp I
Salmonella 4,5,12:H:b*	*Salmonella* 4,5,12:b:-
Salmonella 4,5,12:H:i*	*Salmonella* 4,5,12:i:-
Salmonella 4,5,12:H:n*	*Salmonella* 4,5,12:en...
Salmonella 4,5,12:n:-	*Salmonella* 4,5,12:en...:-
Salmonella 4,5,12,27:i:-	*Salmonella* 4,12,27:i:-
Salmonella 4,5,27:-:-	*Salmonella* 4,5,12:-:-
Salmonella 4,5,27:b:-	*Salmonella* 4,5,12:b:-
Salmonella 4,5,27:i:-	*Salmonella* 4,5,12:i:-
Salmonella 4,12:b:- ssp1	*Salmonella* ssp I 4,12:b:-
Salmonella 6,7,14:H*	*Salmonella* 6,7,14:-:-
Salmonella 6,7:H Z41*	*Salmonella* 6,7:z41:-*
Salmonella 6,8,:non*	*Salmonella* 6,8,:-:-
Salmonella 13, 23:H b*	*Salmonella* 13,23:b:-
Salmonella 16:h l,v:H -	*Salmonella* 16:lv:-
Salmonella 50:H k:Hz	*Salmonella* 50:k:z
Salmonella 53:H, z10:H-	*Salmonella* 53:z10:-
Salmonella 58:H r:H z53*	*Salmonella* 58:r:z53
Salmonella 60:H r:H e,n*	*Salmonella* 60:r:e,n
Salmonella NS:H z4, z23:H-	*Salmonella* NS:z4,z23:-
Salmonella O-60	*Salmonella* 60
Salmonella Group O60	*Salmonella* O-60
Salmonella ssp I OR—UT	*Salmonella* ssp I OR:UT
Salmonella IIIb O38:-:Z55	*Salmonella* ssp IIIb 38:-:Z55
Escherichia:	
Any E.E.C. *formula*	Any Escherichia coli *formula*
Any E.P.E.C. *formula*	Any Escherichia coli *formula*
Any ... -:H ...	Any Escherichia coli Not Typed
Any ... H- ...	Any ... NM ...
Any ... VT+	Any ... VTEC ...
Any ... vt+	Any ... VTEC ...
Escherichia coli O157:H7	*Escherichia coli* O157 VTEC
Escherichia coli O157 VT(+)	*Escherichia coli* O157 VTEC
Escherichia coli O157:H7 VT(+)	*Escherichia coli* O157 VTEC
Escherichia coli	Escherichia coli Not Typed
Escherichia coli non-O157:H7	Escherichia coli Not Typed
Escherichia coli VT+	Escherichia coli VTEC Not Typed
Shigella:	
Any Shigella ... SH	Any Shigella ...
Any prov. *number*	Any Shigella flexneri prov. *number*
Any type *number*	Any Shigella flexneri type *number*
serotype designation uses lower case characters: e.g., not 4A but 4a	
Shigella dysenteriae prov. 105	Shigella dysenteriae 16
Shigella dysenteriae prov. 106	Shigella dysenteriae 16
Shigella flexneri 3b III:...6...	Shigella flexneri 3b
Other:	
3 aerogenic	3/aerogenic
Unknown Avian	Avian
Mets Chico	Other

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