Laboratory Surveillance Data for Enteric Pathogens in Canada

2000 Annual Summary

Health Canada Santé Canada

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Annual Summary 2000

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"The National Laboratory for Enteric Pathogens is committed to maintaining and improving the health of Canadians by identifying, characterizing, and conducting surveillance and research on enteric pathogens for the prevention and control of diarrheal diseases."

National Laboratory For Enteric Pathogens
Health Canada

This report summarizes the information received from federal, provincial and public health agencies on enteric pathogens identified in Canada during 2000. The information is intended primarily for those with responsiblitities for the control and prevention of enteric foodborne pathogens.

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

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Table of Contents

List of Figures and Illustrations

List of Tables

Forward:

Public health microbiology is something like a good suspense novel. Though you may anticipate the general outlines of the plot, the details are often very much a surprise. The big surprise in the year 2000 was the water-borne outbreak of *E. coli* O157:H7 and *Campylobacter* sp. that centred on the town of Walkerton, Ontario, the largest of its kind in Canadian history. This event proved a turning point, in that Canadians no longer assume their water and food supplies are safe. Indeed, the public is increasingly turning to public health professionals for long-term solutions to food and water safety issues. Some answers may result from the ongoing laboratory and epidemiologic analysis of the outbreak, one of the most extensive public health collaborations in recent history.

Other aspects of enteric infectious disease appear to be relatively constant from year to year. *Campylobacter* still causes more human enteric disease in Canada than any other bacterial pathogen, and the same three *Salmonella* serotypes - Typhimurium, Enteritidis, and Heidleberg - are once again responsible for over half of all *Salmonella* infections. *Shigella* and *Aeromonas* sp. continue to be important, though unheralded, human pathogens.

Some interesting trends may be appearing against this background in enteric disease. The number of *Salmonella* spp I 4,5,12:i- isolations from humans continues to rise, and is especially high in both humans and animals in Saskatchewan. Enhanced surveillance in British Columbia for non-O157:H7 Verotoxigenic/Shiga-toxigenic *E. coli* has resulted in a sharp increase in the number of isolates recovered from human illness, suggesting that similar increases could be found in other parts of Canada if similar methods were applied. It became apparent that the antibiotic multi-resistant phenotype, shown previously to be common in *Salmonella* Typhimurium DT104, was also expressed in other *S*. Typhimurium phage types and other *Salmonella* serotypes.

Several of the observations contained within this annual report represent a call for action. Indeed, in the past, responses to such calls have included the creation of the National Enteric Surveillance Program (NESP) to collect and collate data on the incidence of various pathogens throughout Canada and the initiation of PulseNet North (PNN) to disseminate molecular typing data across Canada in situations of potential outbreaks. These data can and should be used to support further applied and basic research as well as enhanced surveillance to inform policy and to influence planning that will shape public health programs in the arena of enteric diseases. It is hoped that the reader will find this report both interesting and useful for all these reasons and more. As always, feedback and suggestions for improvement are welcomed and encouraged. A deep thanks to all stakeholders, partners, and collaborators who have made this report possible. A complete listing can be found on page 78 of this report. To make the annual summary processes current as possible, we have two competing teams working on the 1999 and 2000 annual reports. Please do not be surprised if the 2000 report is published before the 1999 report, but rest assured that they will follow each other very closely. We look forward to continuing these collaborations and helping to solve the public health challenges that arise in the future in Canada.

Dr. Frank Rodgers, Chief
National Laboratory for Enteric Pathogens
Winnipeg
December, 2001

Introduction

In the wake of an increasing number of food and waterborne infections in Canada, the surveillance of enteric pathogens has become essential to prevent and control enteric disease outbreaks. It is through surveillance that we understand the epidemiology of enteric infections. To effectively target preventive measures we need detailed, specific and accessible information in a centralized manner to facilitate effective management of enteric disease outbreaks.

In Canada, surveillance data are collected at regional and provincial levels and compiled at the national level. The National Laboratory for Enteric Pathogens (NLEP) collects and disseminates laboratory-based weekly acute surveillance data on enteric foodborne pathogens (bacterial, viral and parasitic) causing human disease. This activity represents an effort to identify risk factors, and enable early intervention, and reduce the burden of illness. Such data sharing may reduce the risk of outbreaks and lower the economic burden of disease through the rapid exchange of information on outbreak investigations. Data is compiled weekly at NLEP and disseminated in the form of a weekly news letter entitled "National Enteric Surveillance Program (NESP) News". Some of the weekly data which have presumptive or incomplete identifications are adjusted the following week or annually depending upon each provincial data management system. Another source of enteric data is reportable disease data obtained through physicians. NLEP receives data from all sources and selects the most suitable data sets to develop an annual summary. The NLEP has limited control over when the data is available from the various sources and therefore publication dates may be delayed.

The year 2000 saw a continuation of the process of evaluation of data quality and data sources. As a group, Canadian public health laboratory and epidemiology professionals met to discuss improving the acquisition and reporting of public health information related to human infections with enteric bacteria, viruses, and parasites. This group identified differences in laboratory tests used within different locations or jurisdictions and began working toward either increased standardization of the methods used or improved interpretation of results when different methods were in place. Work began on a laboratory manual to be used as a reference for laboratory testing in public health laboratories across Canada. Minor differences in reporting practice were identified and will be addressed. Though several challenges remain, we are confident that improvements in the quality of this report will be evident as the recommended changes are implemented. Periodic review of methods used to generate the data used for this report has become part of the process of laboratory surveillance.

Methods and Materials

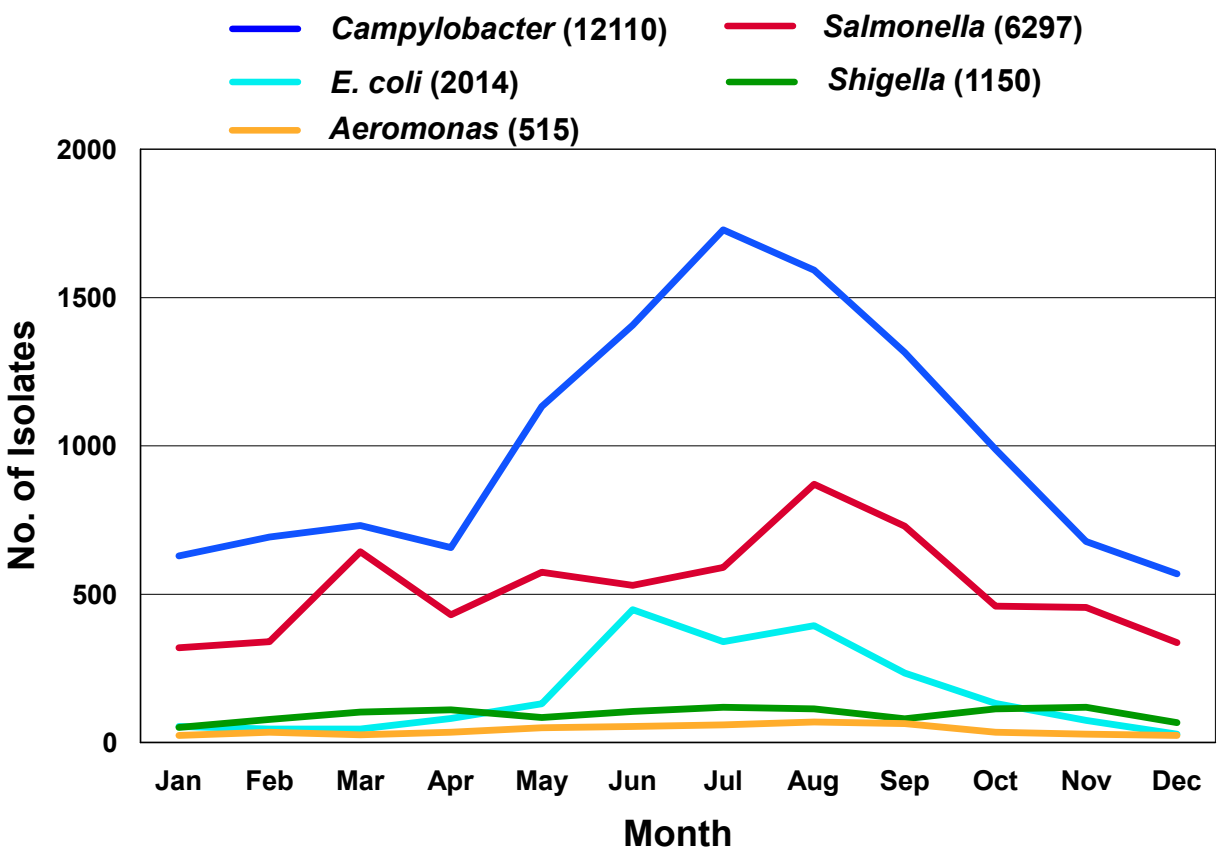
The information presented in this report represents a compilation of available data sets useful in estimating the number of laboratory-confirmed isolates of enteric pathogens identified in Canada in 2000. Canadian provinces have kindly provided us with their monthly and annual reports, and these data form the basis of our estimates of isolates. We also have another system of weekly data collection from the provinces called the National Enteric Surveillance Program (NESP). In general, where the NESP numbers are higher than those reported in the provincial reports, we have used the NESP numbers. Data from our own operations as a reference centre and the resulting Enterics Disease Surveillance System (EDSS) database are used mostly in a confirmatory manner. Other relelevant data sets are also used, such as those shared by the Centre for Infectious Disease Prevention and Control (CIDPC), formerly the Bureau of Infectious Diseases.

The Laboratory for Food-borne Zoonosis (LFZ) in Guelph, Ontario provides monthly and annual reports on non-human *Salmonella* isolates. The EDSS database also contains some information about non-human isolates. LFZ has strong connections with veterinary laboratories, reflecting its previous association with Agriculture Canada and the Canadian Food Inspection Agency. NLEP obtains its isolates from the provincial health laboratories, and hence most isolates are from human sources.

Section 1 - Major Enteric Pathogens

Figure 1 compares the number of isolates for each month in 2000 of the most important pathogens of humans: *Salmonella*, *Campylobacter*, *Escherichia coli, Shigella* and *Aeromonas*. The graph not only shows the number of cases of these organims, but also illustrates seasonal trends of enteric disease in Canada. There were a total of 6,297 *Salmonella* isolates, 12,110 *Campylobacter* isolates, 2014 *E. coli* isolates, 1150 *Shigella* isolates and 515 *Aeromonas* isolates. The data for this figure are from the NESP database, provinicial public health laboratory monthly and annual reports and CIDPC.

Figure 1
Laboratory Isolates of Enteric Pathogens Identified in Canada, 2000



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

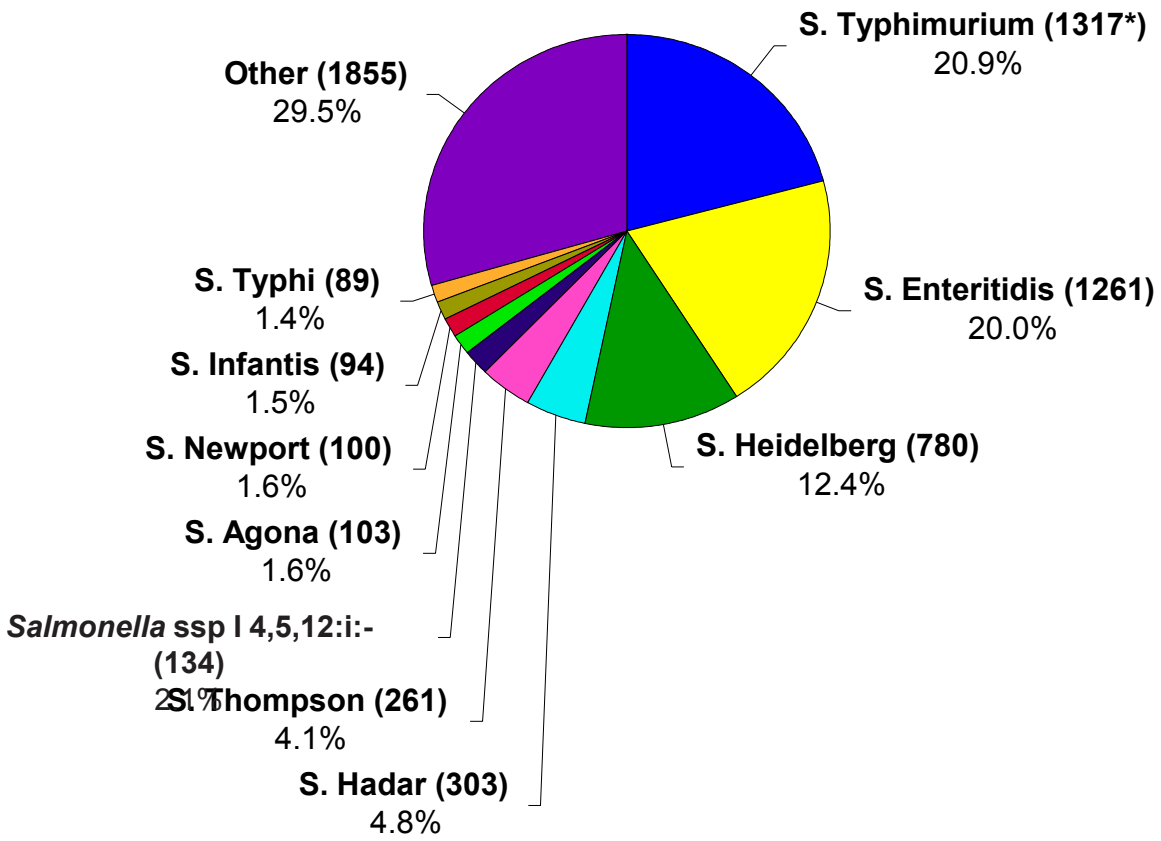
Section 2 - *Salmonella*

Salmonella Isolates of Human Origin in Canada, 2000

Figure 2 illustrates the relative frequency of the top 10 human *Salmonella* serotypes in Canada and Figure 3 provides the provincial frequency distribution of human *Salmonella* for the year 2000. 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. Organisms are listed alphabetically by serotype.

The relative frequency of the top10 *Salmonella* serotypes of human origin in Canada is represented in Figure 2. Overall, *Salmonella* Typhimurium at 20.9% of the total ranked as the most common among all *Salmonella* serotypes followed by *S.* Enteritidis (20.0%), *S.* Heidelberg (12.4%), *S.* Hadar (4.8%), *S.* Thompson (4.2%), *S.* 4,5,12:i:- ssp I (2.1%), *S.* Agona (1.6%), *S.* Newport (1.6%), *S.* Infantis (1.5%), *S.* Typhi (1.4%) and other serotypes (29.5%).

Figure 2
Ten Most Prevalent *Salmonella* Serotypes of Human Origin in Canada, 2000

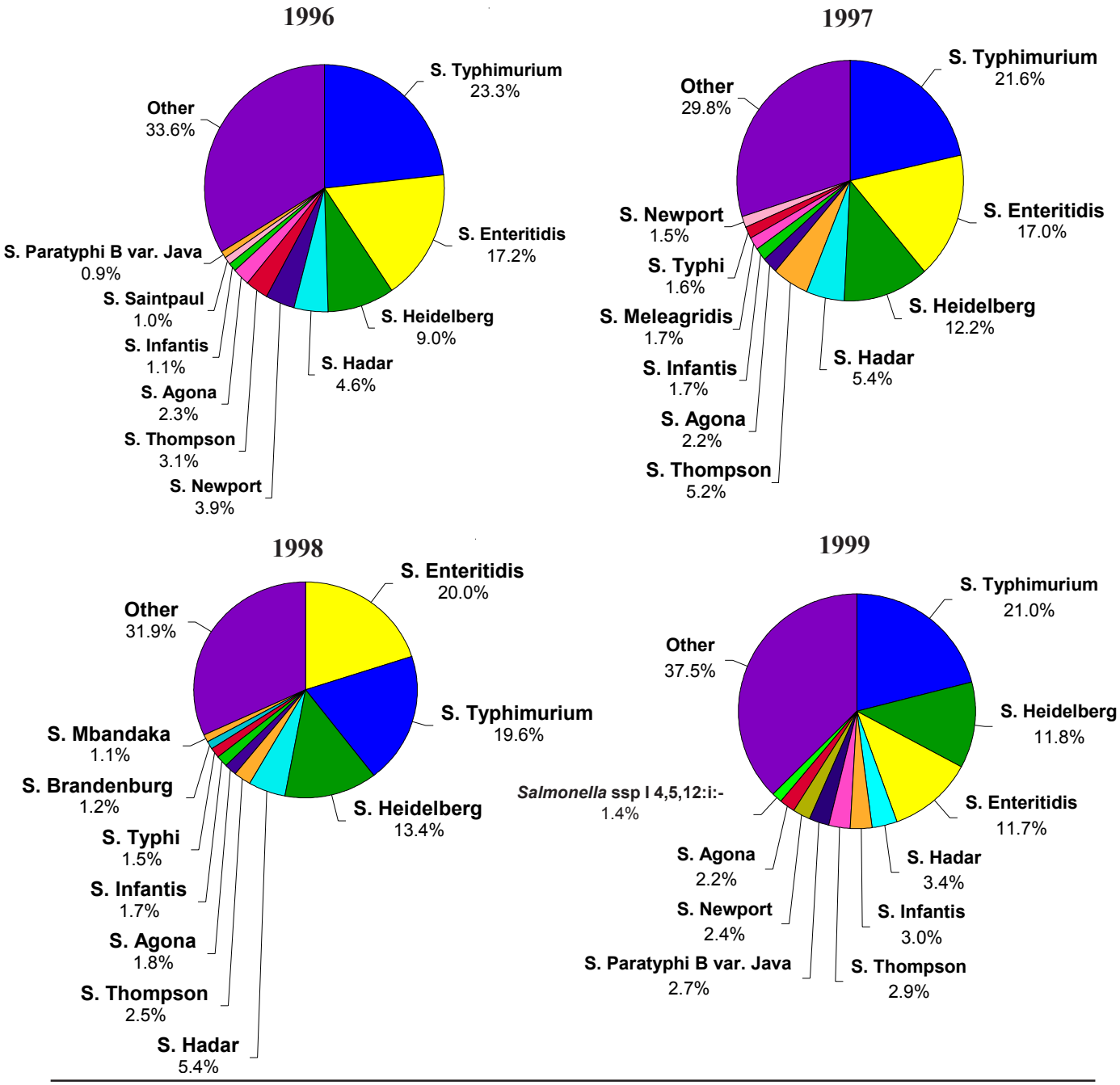


* Number of Isolates.

Changes in the Occurance of *Salmonella* Serotypes of Human Origin

Changes in the relative frequency of the top 10 *Salmonella* serotypes of human origin over the last four years are shown in Figure 3. In 1998, *S.* Enteritidis (20.0%) replaced *S.* Typhimurium (19.6%) and ranked first among all serotypes, for that particular year. In 1997, *S.* Meleagridis (1.7%) and in 1998, *S.* Brandenburg (1.2%) and *S.* Mbandaka (1.1%) appeared in the top ten serotypes due to increased numbers associated with outbreaks. In 1999, *Salmonella* ssp I 4,5,12:i:- (1.4%) also first appeared as a new emerging serotype among the top 10 described. *S.* Typhi in 1997 (1.6%) and in 1998 (1.5%) was travel related.

Figure 3
Ten Most Prevalent *Salmonella* Serotypes of Human Origin in Canada, 1996 to 1999

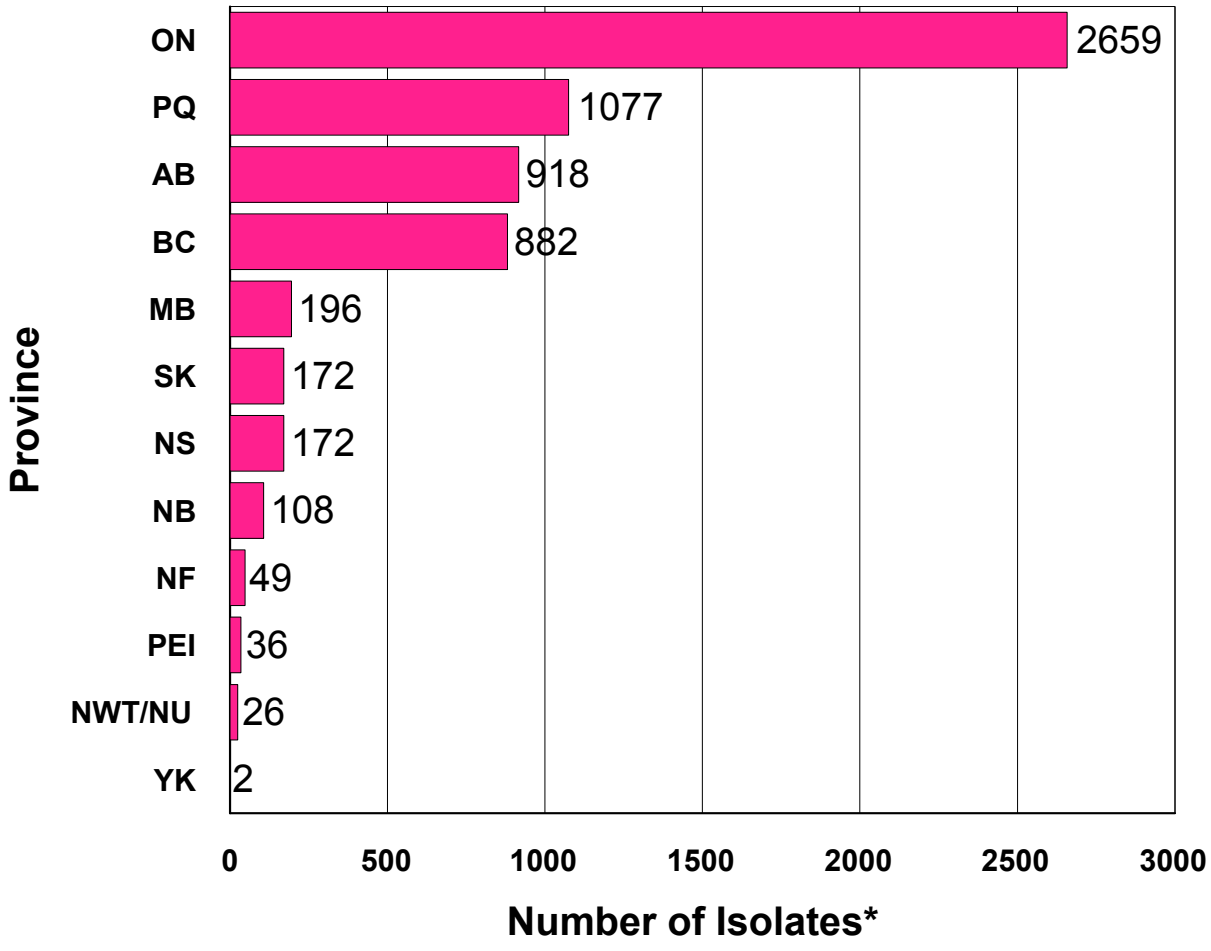


Provincial Distribution of *Salmonella* Serotypes of Human Origin

The frequency of the provincial distribution of *Salmonella* isolates of human origin in Canada is shown in Figure 4. The ten most common *Salmonella* serotypes of human origin in Canada by province are shown in Illustration 1. *S.* Typhimurium ranked first in Alberta (24.7%), Saskatchewan (16.9%), Manitoba (25.5%), Ontario (21.7%), Nova Scotia (37.8%) and Newfoundland (40.8%). *S.* Enteritidis ranked first in British Columbia (27.7%), Quebec (17.3%) and Prince Edward Island (13.9%). *S.* Heidelberg ranked first in New Brunswick (29.5%).

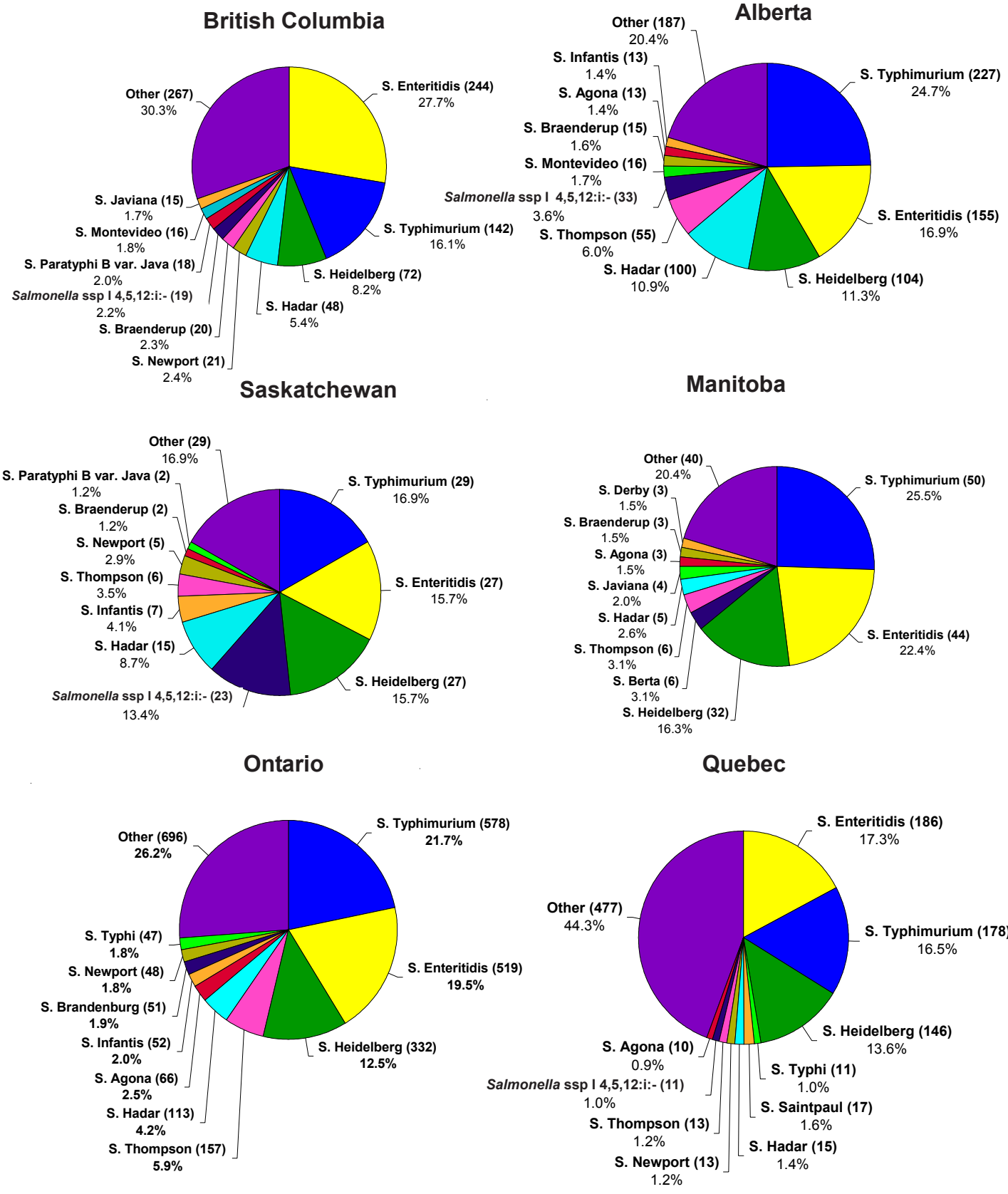
The provincial distribution of *Salmonella* serotypes identified from isolates of human origin is shown in Table 1. This represents a total of 6284 *Salmonella* isolates belonging to over 130 serotypes.

Figure 4
***Salmonella* Isolates of Human Origin in Canada, 2000**

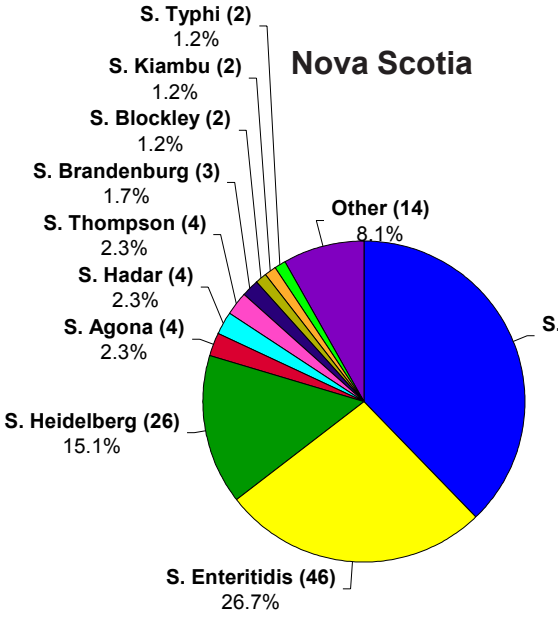


* These data represent total laboratory isolations and should not be confused with incidence.

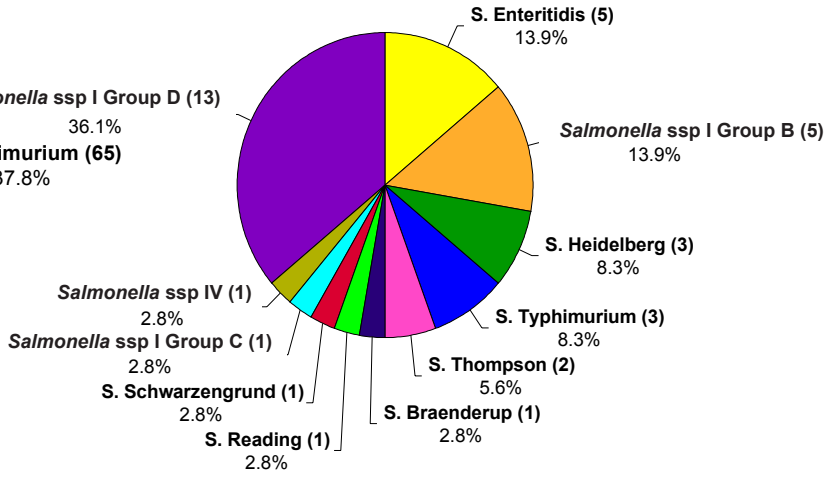
Illustration 1
Ten Most Prevalent *Salmonella* Serotypes of Human Origin in Canada by Province, 2000



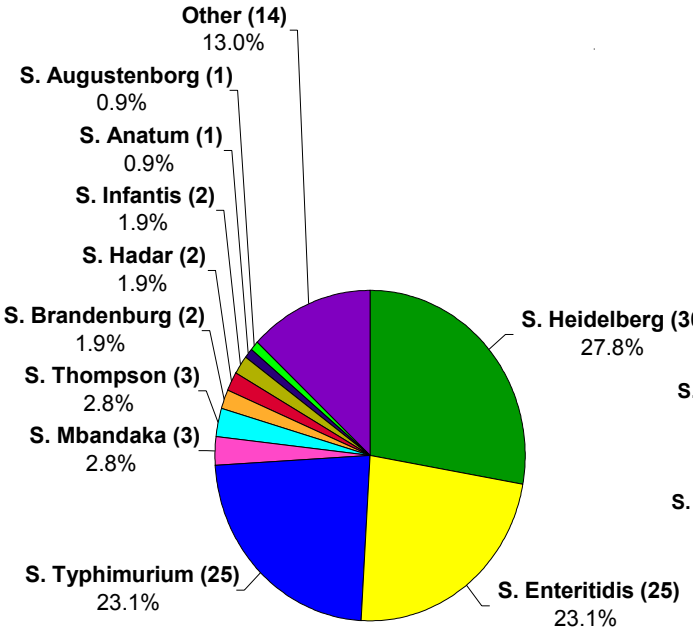
Nova Scotia



Prince Edward Island



New Brunswick



Newfoundland

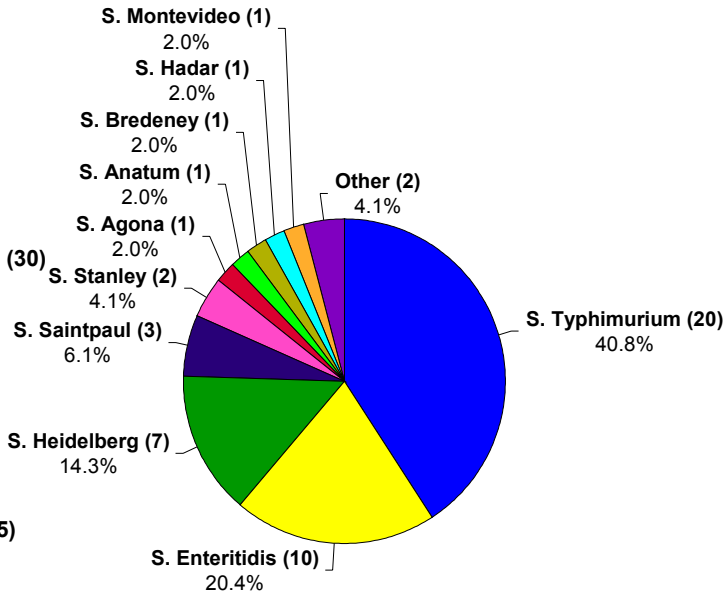


Table 1
Salmonella Serotypes of Human Origin in Canada, 2000

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
S. Adelaide	1				1								2
S. Ago					1								1
S. Agona	6	13		3	66	10		4		1			103
S. Alachua		2											2
S. Albany	3	1			4			1					9
S. Amsterdam					4								4
S. Anatum	5	2		1	6	3	1			1			19
S. Augustenborg							1						1
S. Baildon					1								1
S. Bardo				1	1								2
S. Bareilly	1				3	1							5
S. Berta	6	10		6	29	3	1	1					56
S. Blockley	3	1			7	1		2					14
S. Bonariensis			1										1
S. Bonn	1												1
S. Bovismorbificans	13	1		1	7	1							23
S. Braenderup	20	15	2	3	24	3		1	1				69
S. Brandenburg	4	3		1	51	9	2	3					73
S. Bredeney	4				4					1			9
S. California			1	1									2
S. Cannstatt	1												1
S. Cerro					5								5
S. Chester	2				3								5
S. Choleraesuis					2	1							3
S. Chomedey				1	1								2
S. Colindale							1						1
S. Corvallis					1								1
S. Cubana		1			3								4
S. Curacao					1								1
S. Daytona	6												6
S. Derby	5	3		3	21	4							36
S. Dublin					2								2
S. Durham	1												1
S. Ealing					1	1							2
S. Emek	1	2											3
S. Enteritidis	244	155	27	44	519	186	25	46	5	10			1261
S. Gaminara					1								1
S. Gatuni					2								2
S. Give	2	1			3								6
S. Glostrup		1			2								3
S. Goldcoast					1								1
S. Haardt		4			3								7
S. Hadar	48	100	15	5	113	15	2	4		1			303
S. Haifa					1	1							2
S. Hartford	1				8	3							12
S. Havana		1			3	1							5
S. Heidelberg	72	104	27	32	332	146	30	26	3	7	1		780
S. Hvittingfoss	1				1								2
S. Indiana	1		1		1								3

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
S. Infantis	12	13	7	3	52	5	2						94
S. Isangi					1								1
S. Istanbul	1			1	6								8
S. Itami		1			1								2
S. Ituri		1											1
S. Javiana	15	4	1	4	28	6		1					59
S. Johannesburg	1				1	4							6
S. Kaolack						1							1
S. Kedougou	1												1
S. Kentucky	1	5		1	9	3							19
S. Kiambu		1	1		4			2					8
S. Kingabwa		1											1
S. Kingston	1												1
S. Kottbus						1							1
S. Krefeld					3								3
S. Kumasi					2								2
S. Lagos					1								1
S. Landau					1								1
S. Langenhorn					1								1
S. Lexington	1	1											2
S. Litchfield				2	6	1							9
S. Livingstone					2	1							3
S. Lomalinda		7									7		14
S. London			1		2	1							4
S. Manhattan		1			3								4
S. Marina ssp IV					2								2
S. Matadi		1											1
S. Mbandaka	8	10	1		25	1	3						48
S. Meleagridis	1				4								5
S. Miami					3		1						4
S. Mikawasima	1												1
S. Milwaukee	1				2								3
S. Minnesota		1			4	1							6
S. Mississippi					2								2
S. Miyazaki	1												1
S. Monschaui					1								1
S. Montevideo	16	16	1	1	10	5	1			1			51
S. Muenchen	6	3			18	1		1		1	1		31
S. Muenster	3	2			7	2							14
S. Napoli	1												1
S. Newbrunswick		1											1
S. Newport	21	10	5	2	48	13	1						100
S. Norwich					1								1
S. Ohio	1	2			5								8
S. Onderstepoort			1										1
S. Oranienburg	11	1		1	12	3	1						29
S. Orion					1								1
S. Oslo	1	5			10								16
S. Ouakam	5												5
S. Overschie						1							1
S. Panama	3	4		2	20	1	1						31
S. Paratyphi A	7	7			20	3		1					38
S. Paratyphi B	2					7	1						10
S. Paratyphi B var. Java	18		2		12								32

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
S. Pomona					2	2							4
S. Poona	7	1		1	8	2		1					20
S. Reading		3		1	2	1			1				8
S. Richmond	1				2								3
S. Rissen	1				4								5
S. Rubislaw	2	1			2			1					6
S. Ruiru	1				1								2
S. Saintpaul	15	10	1	3	24	17				3	1		74
S. Sandiego	4	1	1		15	1	1						23
S. Schwarzengrund	4	7			12	4			1				28
S. Senftenberg	4	4		2	7	2							19
S. Singapore	1				2	1							4
S. Stanley	5	6		1	21	4	1			2			40
S. Stanleyville		1											1
S. Sundsvall					1								1
S. Takoradi					2								2
S. Telelkebir					5								5
S. Tennessee	1	1			4								6
S. Thompson	14	55	6	6	157	13	3	4	2	1			261
S. Tilene		1											1
S. Typhi	15	9	1	3	47	11	1	2					89
S. Typhimurium	142	227	29	50	578	178	25	65	3	20			1317
S. Tyresoe								1					1
S. Uganda	3	1			8	1							13
S. Urbana	1	1											2
S. Virchow	6	3	1		16								26
S. Weltevreden	5	10	1	1	4								21
S. Worthington	2				1	1							4
S. Zanzibar					1								1
Salmonella ssp I			7	4		272	2	4			15	2	306
Salmonella ssp I Group B			3	5		44			5				57
Salmonella ssp I 4,12:-:-						1							1
Salmonella ssp I 4,12:i:-	13	5				4							22
Salmonella ssp I 4,12:-:1,2		1											1
Salmonella ssp I 4,5,12:-:-					1								1
Salmonella ssp I 4,5,12:a:-					1								1
Salmonella ssp I 4,5,12:b:-		2	2		35								39
Salmonella ssp I 4,5,12:d:-					2								2
Salmonella ssp I 4,5,12:i:-	19	33	23		47	11					1		134
Salmonella ssp I 4,5,12:l,v:-					1								1
Salmonella ssp I 4,5,12:r:-		2			1								3
Salmonella ssp I 4,5,12:z:-					1								1
Salmonella ssp I 4,5,12:-:1,2	1				1								2
Salmonella ssp I 4,12,27:g,t:-	1												1
Salmonella ssp I Group C			2						1				3
Salmonella ssp I Group C1						20							20
Salmonella ssp I 6,7:-:-					1								1
Salmonella ssp I 6,7:b:-					1								1
Salmonella ssp I 6,7:k:-					4								4
Salmonella ssp I 6,7:y:-					3								3
Salmonella ssp I 6,7:-:1,5		1			1								2
Salmonella ssp I 6,7:-:z6					2								2
Salmonella spp I Group C2					1	20							21
Salmonella ssp I 6,8:-:-					1								1

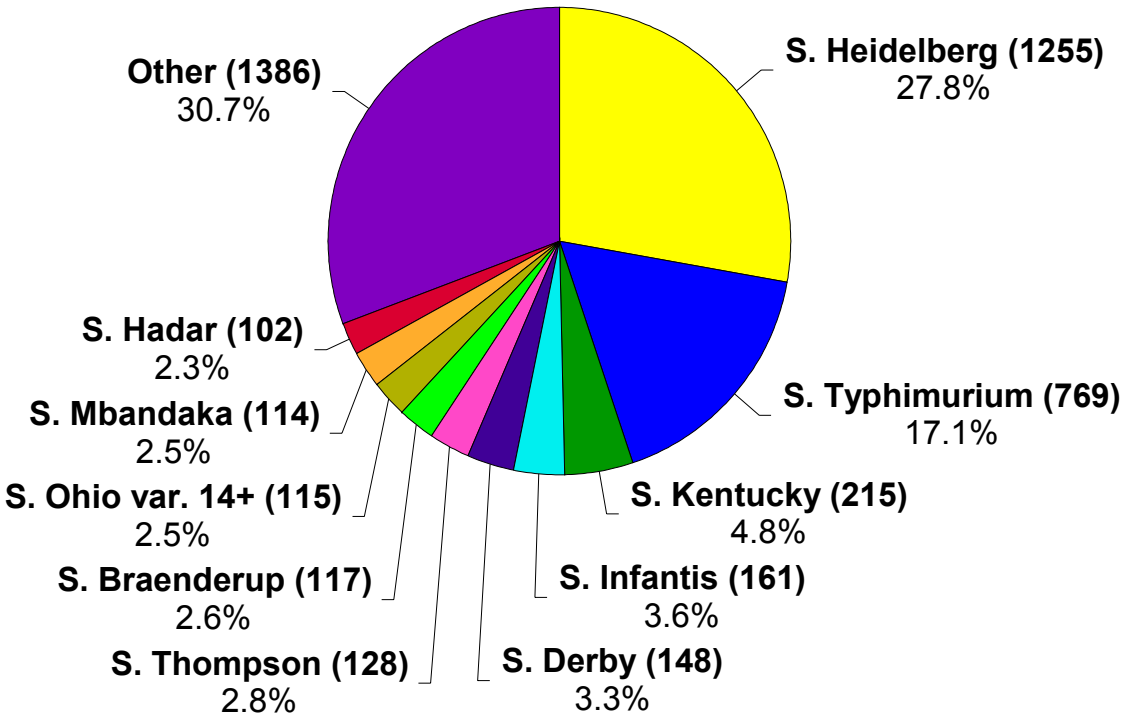
Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Salmonella ssp I 6,8:d:-					1								1
Salmonella ssp I 6,8:e,h:-					1								1
Salmonella ssp I 6,8:z10:-					1								1
Salmonella ssp I 8,20:i:-					1								1
Salmonella ssp I Group D						7			13				20
Salmonella ssp I 9,12:-:-					5								5
Salmonella ssp I 9,12:-:1,5					1								1
Salmonella ssp I Group E					1								1
Salmonella ssp I Group E1						3							3
Salmonella ssp I Group E2						2							2
Salmonella ssp I 3,10:eh:-		4			3								7
Salmonella ssp I 3,10:r:-					1								1
Salmonella ssp I Group G1						1							1
Salmonella ssp I 16:e,h:-	1				2								3
Salmonella ssp I 13,22:z:-					2								2
Salmonella ssp I Rough-O	3	1			2	1		1					8
Salmonella ssp I Rough-O:-:-					2								2
Salmonella ssp I Rough-O:b:-					1								1
Salmonella ssp I Rough-O:b:l,w		1											1
Salmonella ssp I Rough-O:z:-					1								1
Salmonella ssp I Rough-O:z10:1,5		1											1
Salmonella ssp II	3	1											4
Salmonella ssp II 4,12:b:e,n,x		1											1
Salmonella ssp II 21:z10:z6	1												1
Salmonella ssp II 40:-:1,5,7		1											1
Salmonella ssp II 48:d:z6	1												1
Salmonella ssp II 50:b:z6					1								1
Salmonella ssp II 55:k:z39					1								1
Salmonella ssp II 58:l,z13,z28:z6		1											1
Salmonella ssp IIIa	2	1			2								5
Salmonella ssp IIIa 21:g,z51:-						1							1
Salmonella ssp IIIa 48:z4,z24:-	1												1
Salmonella ssp IIIb	3	2			2								7
Salmonella ssp IIIb 11:k:z53					1								1
Salmonella ssp IIIb 21:l,v:z					1								1
Salmonella ssp IIIb 60:r:e,n,x,z15					2								2
Salmonella ssp IIIb 61:k:1,5	1												1
Salmonella ssp IIIb 61:k:1,5,7					1	1							2
Salmonella ssp IIIb 61:z52:z53					1								1
Salmonella ssp IV	3		1		1		1		1				7
Salmonella ssp IV 6,7:z4:z24:-					1								1
Salmonella ssp IV 16:z4,z32:-	3												3
Salmonella ssp IV 48:z4,z:32:-					3								3
Salmonella ssp IV 48:g,z51:-					3	1							4
Salmonella ssp IV 50:g,z51:-					1								1
Total *Salmonella*	**882**	**918**	**172**	**196**	**2659**	**1077**	**108**	**172**	**36**	**49**	**26**	**2**	**6297**

NWT represents combined totals of Nunavut and Northwest Territories.

Salmonella Isolates of Non-Human Origin in Canada, 2000

The relative frequency of the 10 most prevelant *Salmonella* serotypes of non-human origin in Canada is represented in Figure 5. Overall, *Salmonella* Heidelberg at 27.8% of the total ranked as the most common among all *Salmonella* serotypes followed by *S.* Typhimurium (17.1%), *S.* Kentucky (4.8%), *S.* Infantis (3.6%), *S.* Derby (3.3%), *S.* Thompson (2.8%), *S.* Braenderup (2.6%), *S.* Ohio var. 14+ (2.5%), *S.* Mbandaka (2.5%), *S.* Hadar (2.3%) and other serotypes (30.7%).

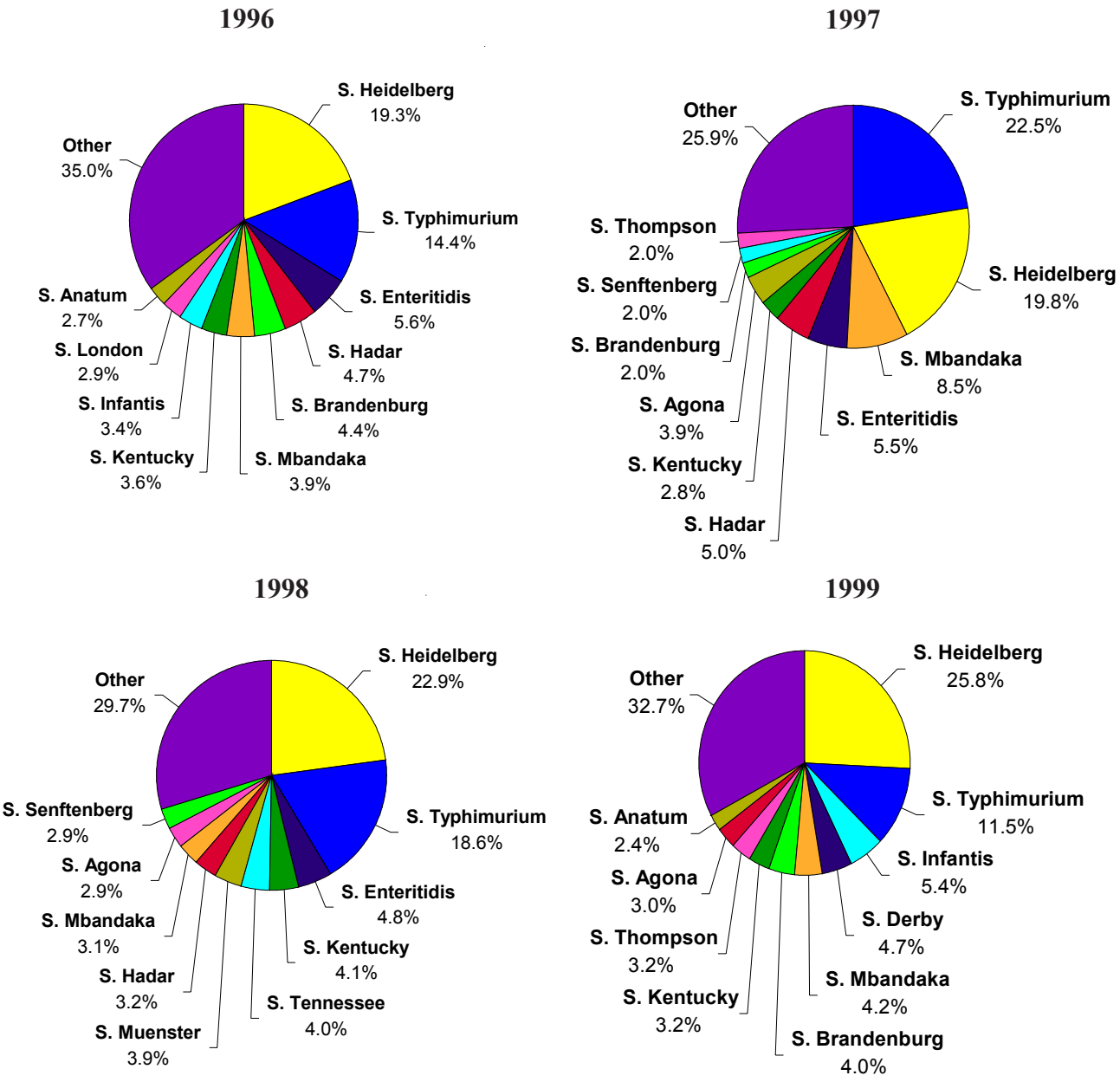
Figure 5
Ten Most Prevalent *Salmonella* Serotypes of Non-Human Origin in Canada, 2000



Changes in the Occurence of *Salmonella* Serotypes of Non-Human Origin

Changes in the relative frequency of the 10 most prevalent *Salmonella* serotypes of non-human origin over the last 4 years are shown in Figure 6. In 1997, *S.* Typhimurium (22.5%) replaced *S.* Heidelberg (19.8%) and ranked first among all serotypes for that particular year. *S.* Heidelberg ranked first among serotypes of non-human origin in 1996 (19.3%), 1998 (22.9%) and 1999 (25.8%).

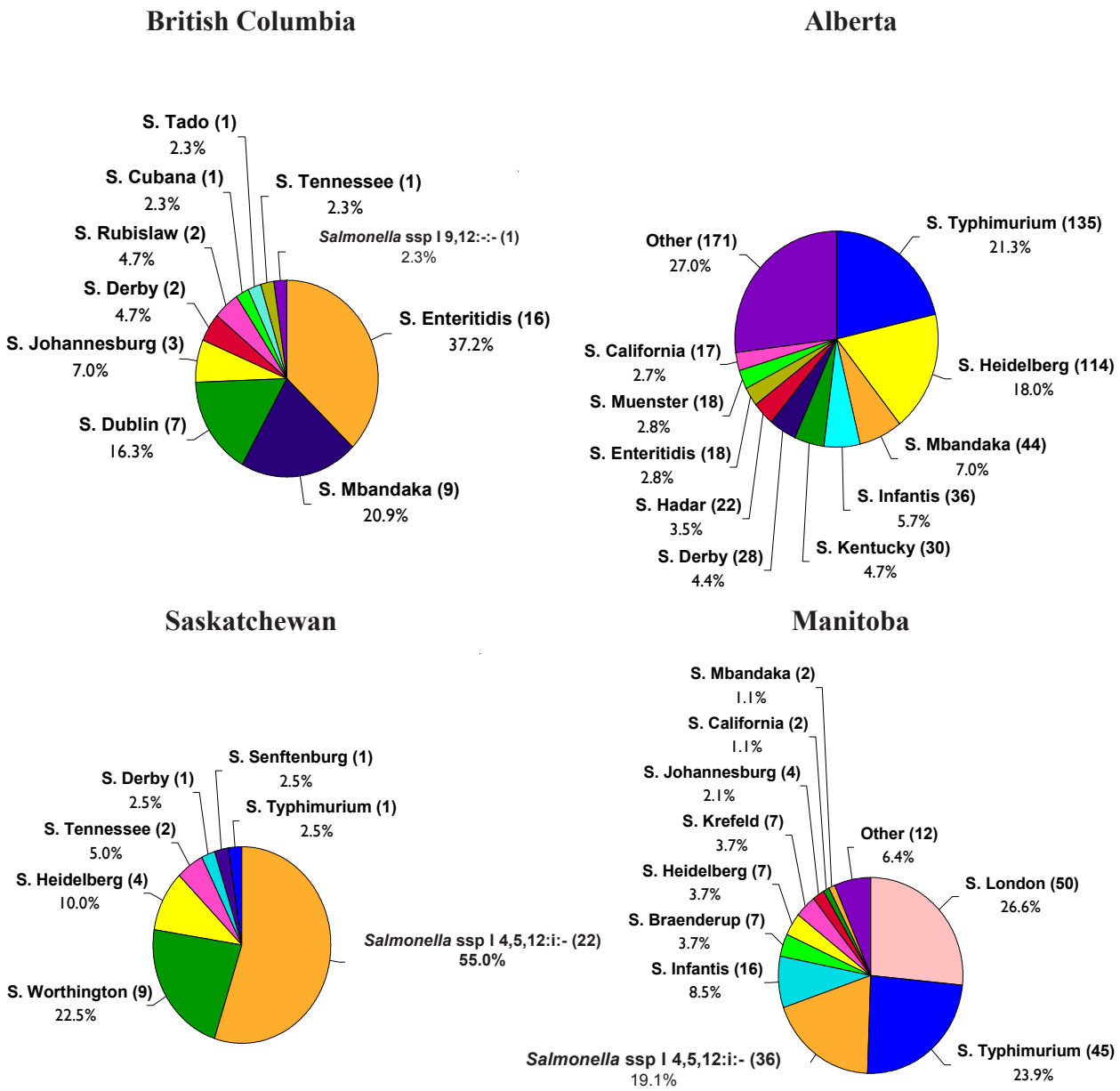
Figure 6
Ten Most Prevalent *Salmonella* Serotypes of Non-Human Origin in Canada, 1996 to 1999



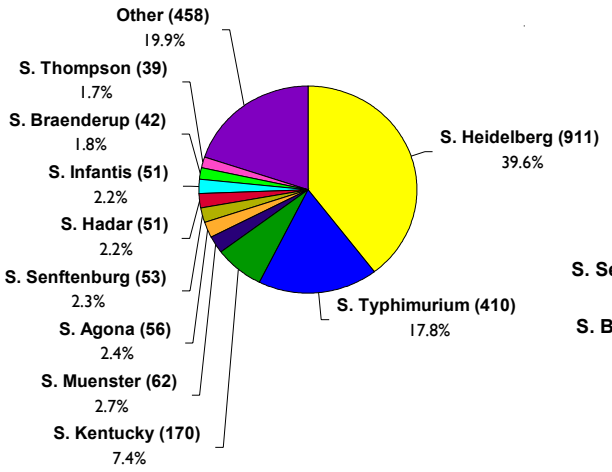
Provincial Distribution of *Salmonella* Serotypes of Non-Human Origin

The 10 most common *Salmonella* serotypes of non-human origin in Canada by province are shown in Illustration 2. *S.* Heidelberg ranked first in Ontario (39.6%), Quebec (12.8%), New Brunswick (42.2%), Nova Scotia (23.6%) and Newfoundland (37.8%). *S.* Typhimurium ranked first in Alberta (21.3%) and Prince Edwaard Island (66.0%). *S.* Enteritidis ranked first in British Columbia (37.2%). *Salmonella* ssp I 4,5,12:i:- (55.0%), an emerging serotype, ranked first in Saskatchewan and *S.* London (26.6%) ranked first in Manitoba.

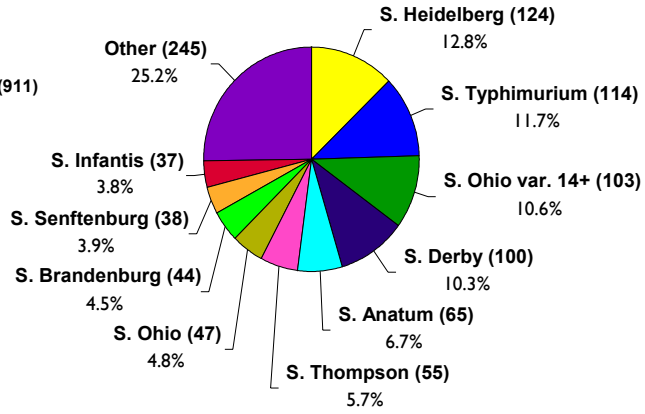
Illustration 2
Ten Most Prevalent *Salmonella* Serotypes of Non-Human Sources in Canada by Province, 2000



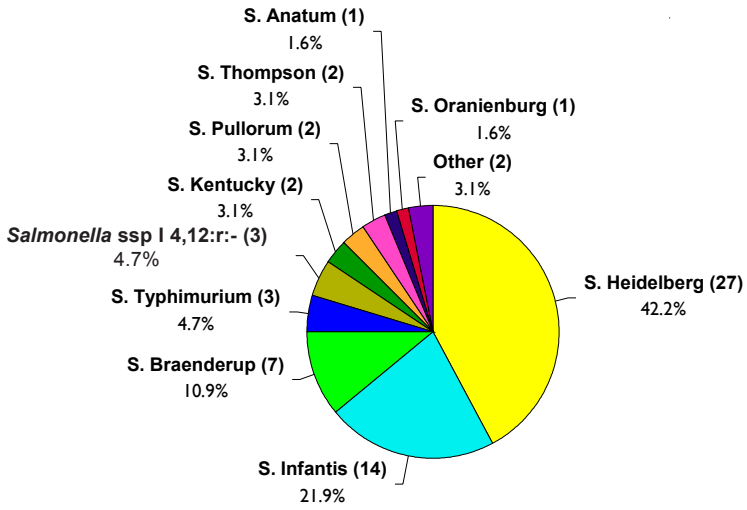
Ontario



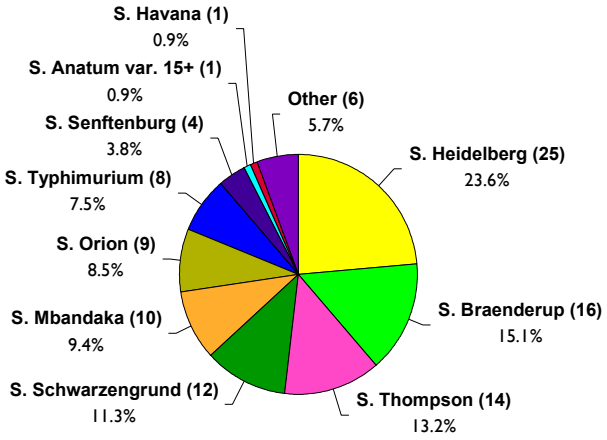
Quebec



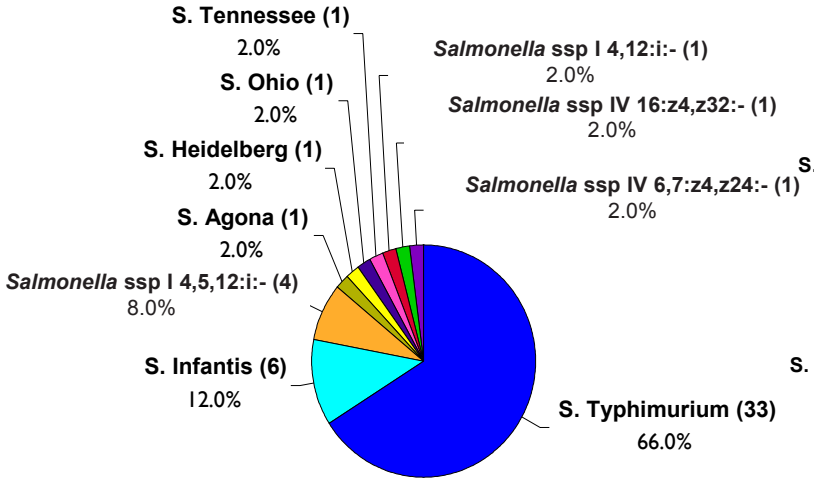
New Brunswick



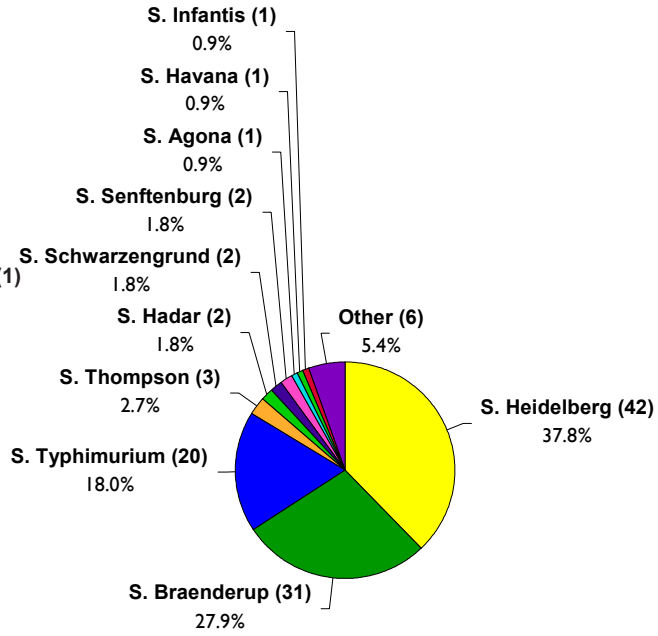
Nova Scotia



Prince Edward Island



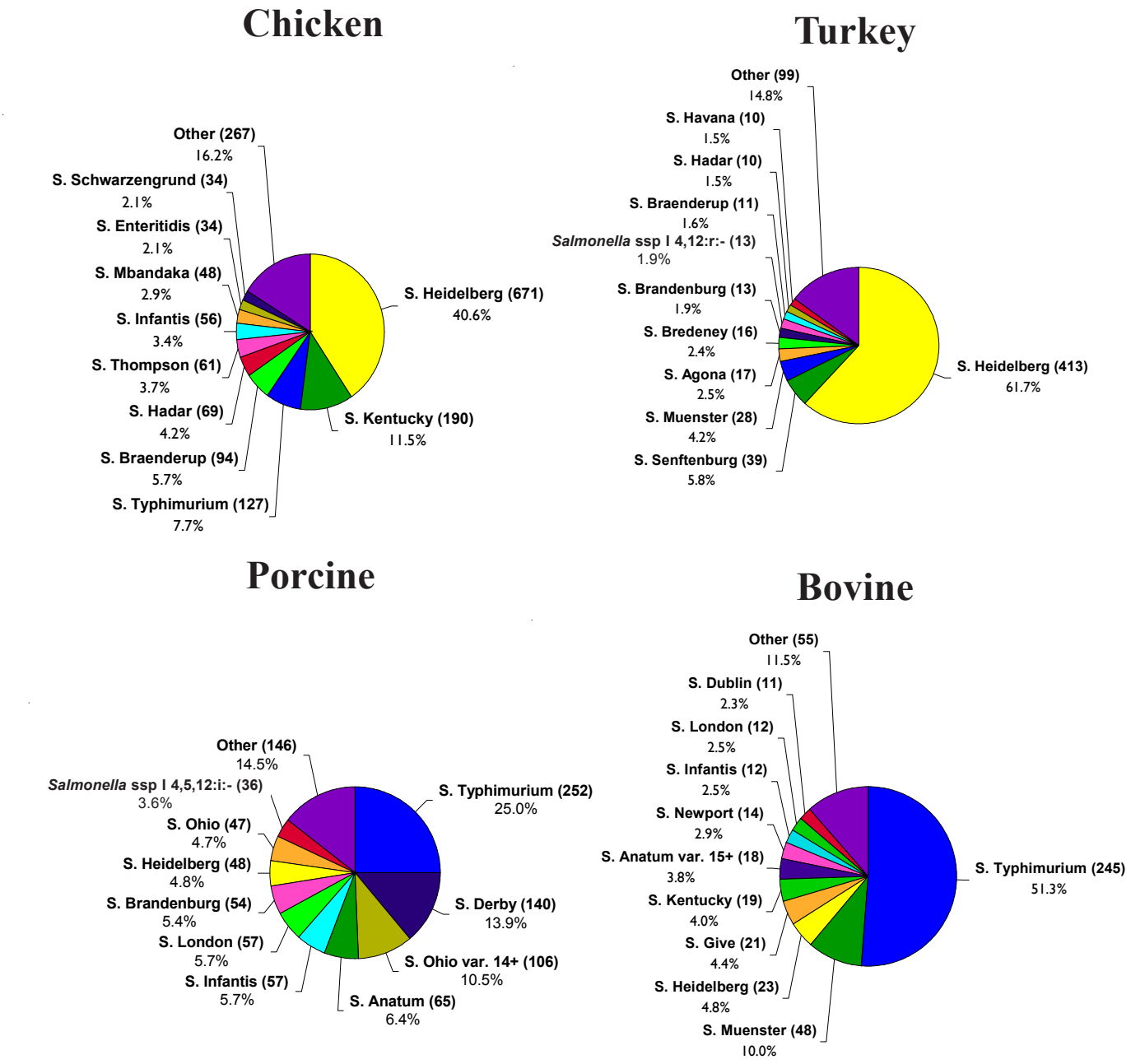
Newfoundland



Source Distribution of *Salmonella* Serotypes of Non-Human Origin

The 10 most prevalent *Salmonella* serotypes found in chicken, turkey, porcine and bovine sources are shown in Illustration 3. *S.* Heidelberg ranked first in chicken (40.6%) and turkey (61.7%). *S.* Typhimurium ranked first in porcine (25.0%) and bovine (51.3%).

Illustration 3
Ten Most Prevalent *Salmonella* Serotypes of Non-Human Origin in Canada by Source of Isolation, 2000



The provincial distribution of *Salmonella* serotypes identified from isolates of human origin is shown in Table 2. This represents a total of 4510 isolates belonging to over 65 serotypes

Table 2

Salmonella Serotypes of Non-Human Origin in Canada, 2000

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Agona	Bovine					7				1		**8**
	Canine					1					1	**2**
	Chicken		5			27	1					**33**
	Feed		1				6					**7**
	Porcine		5		1	7						**13**
	Turkey		3			14						**17**
	Unknown Avian						6					**6**
	Subtotal	**0**	**14**	**0**	**1**	**56**	**13**	**0**	**0**	**1**	**1**	**86**
S. Alachua	Feed	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Albany	Turkey					3						**3**
	Unknown Avian						13					**13**
	Subtotal	**0**	**0**	**0**	**0**	**3**	**13**	**0**	**0**	**0**	**0**	**16**
S. Anatum	Bovine		1			1						**2**
	Chicken		8					1				**9**
	Porcine						65					**65**
	Turkey					8						**8**
	Subtotal	**0**	**9**	**0**	**0**	**9**	**65**	**1**	**0**	**0**	**0**	**84**
S. Anatum var. 15+	Bovine					18						**18**
	Chicken								1			**1**
	Feed						22					**22**
	Turkey					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**19**	**22**	**0**	**1**	**0**	**0**	**42**
S. Berta	Bovine					6						**6**
	Chicken					4	1					**5**
	Porcine					1						**1**
	Turkey					3						**3**
	Subtotal	**0**	**0**	**0**	**0**	**14**	**1**	**0**	**0**	**0**	**0**	**15**
S. Bludorp	Chameleon	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Bovismorbificans	Porcine	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**4**
S. Braenderup	Chicken		6		7	29		5	16		31	**94**
	Equine					1						**1**
	Feed						1					**1**
	Porcine					1						**1**
	Turkey					11						**11**
	Unknown						2					**2**
	Unknown Avian						5	2				**7**
	Subtotal	**0**	**6**	**0**	**7**	**42**	**8**	**7**	**16**	**0**	**31**	**117**
S. Brandenburg	Bovine					2						**2**
	Chicken					6						**6**
	Compost					3						**3**
	Porcine					10	44					**54**
	Turkey					13						**13**
	Subtotal	**0**	**0**	**0**	**0**	**34**	**44**	**0**	**0**	**0**	**0**	**78**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Bredeney	Other					1						**1**
	Turkey					16						**16**
	Subtotal	**0**	**0**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**17**
S. California	Porcine	**0**	**17**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**19**
S. Cerro	Bovine					3						**3**
	Feed					1	3					**4**
	Subtotal	**0**	**0**	**0**	**0**	**4**	**3**	**0**	**0**	**0**	**0**	**7**
S. Cubana	Chicken		5									**5**
	Feed	1	1			4	1					**7**
	Fertilizer						1					**1**
	Porcine		2									**2**
	Turkey					4						**4**
	Subtotal	**1**	**8**	**0**	**0**	**8**	**2**	**0**	**0**	**0**	**0**	**19**
S. Derby	Bovine					1						**1**
	Feed					1						**1**
	Porcine	2	28	1		9	100					**140**
	Turkey					6						**6**
	Subtotal	**2**	**28**	**1**	**0**	**17**	**100**	**0**	**0**	**0**	**0**	**148**
S. Dublin	Bovine	**7**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**11**
S. Emek	Fertilizer	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Enteritidis	Bovine					1						**1**
	Chicken	14	15			4	1					**34**
	Duck						3					**3**
	Feed						2					**2**
	Mouse					4						**4**
	Other					1	2					**3**
	Porcine	2	3									**5**
	Quail						1					**1**
	Subtotal	**16**	**18**	**0**	**0**	**10**	**9**	**0**	**0**	**0**	**0**	**53**
S. Falkensee	Feed	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Gaminara	Other	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Give	Bovine					15	6					**21**
	Chicken		5									**5**
	Feed						1					**1**
	Porcine		1			1						**2**
	Turkey					1						**1**
	Subtotal	**0**	**6**	**0**	**0**	**17**	**7**	**0**	**0**	**0**	**0**	**30**
S. Give var. 15+	Water	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
S. Hadar	Bovine					1						**1**
	Chicken		20			42	5				2	**69**
	Turkey		2			8						**10**
	Unknown Avian						22					**22**
	Subtotal	**0**	**22**	**0**	**0**	**51**	**27**	**0**	**0**	**0**	**2**	**102**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Havana	Chicken					13			1		1	**15**
	Crustacean		1									**1**
	Feed					**2**	**2**					**4**
	Porcine					1						**1**
	Turkey					10						**10**
	Subtotal	**0**	**1**	**0**	**0**	**26**	**2**	**0**	**1**	**0**	**1**	**31**
S. Heidelberg	Bovine					20	1		1	1		**23**
	Caprine					1						**1**
	Chicken		114			472	6	26	11		42	**671**
	Feed						10					**10**
	Other				7	2	2					**11**
	Ovine					**2**						**2**
	Porcine			4		8	36					**48**
	Turkey					400			13			**413**
	Unknown						8					**8**
	Unknown Avian					6	61	1				**68**
	Subtotal	**0**	**114**	**4**	**7**	**911**	**124**	**27**	**25**	**1**	**42**	**1255**
S. Indiana	Chicken	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
S. Infantis	Bovine		2			10						**12**
	Canine									1		**1**
	Chicken		12			27	1	13		2	1	**56**
	Elk		1									**1**
	Feed		1				8	1				**10**
	Porcine		20		16	12	6			3		**57**
	Soil						8					**8**
	Turkey					1						**1**
	Unknown Avian					1	12					**13**
	Vegetable						2					**2**
	Subtotal	**0**	**36**	**0**	**16**	**51**	**37**	**14**	**0**	**6**	**1**	**161**
S. Johannesburg	Chicken				2	2	1					**5**
	Feed	3			2	5						**10**
	Fertilizer					1						**1**
	Other						3					**3**
	Unknown						3					**3**
	Unknown Avian					1						**1**
	Subtotal	**3**	**0**	**0**	**4**	**9**	**7**	**0**	**0**	**0**	**0**	**23**
S. Kentucky	Bovine					12	7					**19**
	Chicken		30			158	1	1				**190**
	Fertilizer						1					**1**
	Unknown Avian						4	1				**5**
	Subtotal	**0**	**30**	**0**	**0**	**170**	**13**	**2**	**0**	**0**	**0**	**215**
S. Krefeld	Porcine	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**7**
S. Lexington	Other	**0**	**0**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	**0**	**3**
S. Lexington var.15+ 34+	Feed	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Lille	Chicken	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**3**
S. Litchfield	Bovine					2						**2**
	Chicken					4						**4**
	Subtotal	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**6**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Livingstone	Chicken	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Livingstone var. 14+	Feed					1						**1**
	Porcine					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. London	Bovine					11	1					**12**
	Canine					1						**1**
	Porcine		6		50	1						**57**
	Vegetable						2					**2**
	Subtotal	**0**	**6**	**0**	**50**	**13**	**3**	**0**	**0**	**0**	**0**	**72**
S. London var. 15+	Feed	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Mbandaka	Bovine					1						**1**
	Chicken		34		1	1	2		9		1	**48**
	Feed	9	1		1	4	27		1			**43**
	Porcine		5			2						**7**
	Quail		1									**1**
	Snake		1									**1**
	Turkey					4						**4**
	Unknown Avian						7					**7**
	Water		2									**2**
	Subtotal	**9**	**44**	**0**	**2**	**12**	**36**	**0**	**10**	**0**	**1**	**114**
S. Meleagridis	Feed	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
S. Minnesota	Chicken					1						**1**
	Compost					1						**1**
	Other						3					**3**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**0**	**5**
S. Molade	Feed	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Montevideo	Bovine					1	2					**3**
	Chicken		10			9					1	**20**
	Feed				1	3						**4**
	Fertilizer					1	4					**5**
	Turkey					8						**8**
	Subtotal	**0**	**10**	**0**	**1**	**22**	**6**	**0**	**0**	**0**	**1**	**40**
S. Muenchen	Bovine					1						**1**
	Turkey					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. Muenster	Bovine		18			29	1					**48**
	Chicken					3						**3**
	Feed					1						**1**
	Porcine					1						**1**
	Turkey					28						**28**
	Unknown						2					**2**
	Subtotal	**0**	**18**	**0**	**0**	**62**	**3**	**0**	**0**	**0**	**0**	**83**
S. Muenster var.15+ 34+	Feed	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Newport	Bovine					14						**14**
	Chicken		1									**1**
	Turkey					2						**2**
	Unknown					1						**1**
	Water		2									**2**
	Subtotal	**0**	**3**	**0**	**0**	**17**	**0**	**0**	**0**	**0**	**0**	**20**
S. Ohio	Chicken					1				1		**2**
	Porcine		2				45					**47**
	Unknown Avian						2					**2**
	Subtotal	**0**	**2**	**0**	**0**	**1**	**47**	**0**	**0**	**1**	**0**	**51**
S. Ohio var. 14+	Chicken		4			1						**5**
	Feed		1				1					**2**
	Other						1					**1**
	Porcine		1			4	101					**106**
	Turkey					1						**1**
	Subtotal	**0**	**6**	**0**	**0**	**6**	**103**	**0**	**0**	**0**	**0**	**115**
S. Oranienburg	Chicken					3						**3**
	Feed					4		1				**5**
	Subtotal	**0**	**0**	**0**	**0**	**7**	**0**	**1**	**0**	**0**	**0**	**8**
S. Orion	Chicken	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**9**
S. Orion var. 15+	Chicken	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Orion var. 15+ 34+	Chicken					2						**2**
	Feed						2					**2**
	Porcine		2									**2**
	Turkey					2						**2**
	Subtotal	**0**	**2**	**0**	**0**	**4**	**2**	**0**	**0**	**0**	**0**	**8**
S. Panama	Canine	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
S. Pomona	Bovine					1						**1**
	Feed					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. Pullorum	Chicken	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**
S. Reading	Turkey	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. Rubislaw	Feed						1					**1**
	Wheat	2										**2**
	Subtotal	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**
S. Saintpaul	Chicken					1						**1**
	Turkey					1						**1**
	Subtotal	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
S. Schwarzengrund	Bovine					1						**1**
	Chicken		5			16			11		2	**34**
	Feed		1			3			1			**5**
	Quail					1						**1**
	Turkey		2									**2**
	Unknown Avian					1						**1**
	Subtotal	**0**	**8**	**0**	**0**	**22**	**0**	**0**	**12**	**0**	**2**	**44**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Senftenburg	Chicken					13			1		2	**16**
	Feed			1	1	2	2					**6**
	Fertilizer						1					**1**
	Porcine				1		34					**35**
	Porcupine								1			**1**
	Turkey					37			2			**39**
	Unknown Avian					1	1					**2**
	Subtotal	**0**	**0**	**1**	**2**	**53**	**38**	**0**	**4**	**0**	**2**	**100**
S. Tado	Feed	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
S. Tennessee	Bovine					2						**2**
	Chicken		11			1						**12**
	Feed	1		2	1	1	19			1		**25**
	Other						1					**1**
	Ovine		1									**1**
	Unknown					1						**1**
	Unknown Avian						2					**2**
	Subtotal	**1**	**12**	**2**	**1**	**5**	**22**	**0**	**0**	**1**	**0**	**44**
S. Thompson	Bovine					5						**5**
	Chicken		14			30	1	2	14			**61**
	Feed					1	12					**13**
	Gull										1	**1**
	Mink										2	**2**
	Turkey		1			3						**4**
	Unknown Avian						42					**42**
	Subtotal	**0**	**15**	**0**	**0**	**39**	**55**	**2**	**14**	**0**	**3**	**128**
S. Typhimurium	Bovine		49			189	1		2	4		**245**
	Canine		1									**1**
	Chicken		39	1		64		3	5		15	**127**
	Cormorant									4		**4**
	Duck					2						**2**
	Elk		1									**1**
	Equine		2			22			1	7		**32**
	Feed					8						**8**
	Finch		1			4						**5**
	Goose		1									**1**
	Gull		1			2						**3**
	Heron									1		**1**
	Mouse					1						**1**
	Ostrich		7									**7**
	Other		3			3	2			5		**13**
	Ovine					2						**2**
	Pigeon					9						**9**
	Porcine		28		34	90	100					**252**
	Quail					1						**1**
	Sparrow					1					5	**6**
	Turkey					7						**7**
	Unknown				2	5	2			10		**19**
	Unknown Avian				9		9			2		**20**
	Water		2									**2**
	Subtotal	**0**	**135**	**1**	**45**	**410**	**114**	**3**	**8**	**33**	**20**	**769**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Uganda	Bovine					1						**1**
	Feed				1							**1**
	Porcine					2						**2**
	Turkey					1						**1**
	Subtotal	**0**	**0**	**0**	**1**	**4**	**0**	**0**	**0**	**0**	**0**	**5**
S. Worthington	Bovine					4						**4**
	Chicken		1			6						**7**
	Feed					1						**1**
	Porcine		3	9								**12**
	Turkey					2						**2**
	Subtotal	**0**	**4**	**9**	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**26**
Salmonella ssp I 15:z10:-	Feed	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 18:-:-	Bovine	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 19:-:-	Porcine	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 4,12:-:-	Chicken					1						**1**
	Porcine				1							**1**
	Subtotal	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
Salmonella ssp I 4,12:-:1,2	Turkey	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**
Salmonella ssp I 4,5,12:-:1,2	Porcine	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**
Salmonella ssp I 4,12:i:-	Chicken					4						**4**
	Finch					1						**1**
	Pigeon					1						**1**
	Porcine						2					**2**
	Unknown				1							**1**
	Unknown Avian				1					1		**2**
	Water		2									**2**
	Subtotal	**0**	**2**	**0**	**2**	**6**	**2**	**0**	**0**	**1**	**0**	**13**
Salmonella ssp I 4,5,12:i:-	Bovine					2		1				**3**
	Chicken		4			2					1	**7**
	Cormorant									2		**2**
	Equine			22								**22**
	Finch		1									**1**
	Gull									1		**1**
	Porcine				36							**36**
	Unknown Avian									1		**1**
	Subtotal	**0**	**5**	**22**	**36**	**4**	**0**	**1**	**0**	**4**	**1**	**73**
Salmonella ssp I 4,12:r:-	Chicken							3				**3**
	Turkey					13						**13**
	Unknown Avian						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**13**	**1**	**3**	**0**	**0**	**0**	**17**
Salmonella ssp I 6,7,14:-:-	Chicken					1						**1**
	Porcine						5					**5**
	Subtotal	**0**	**0**	**0**	**0**	**1**	**5**	**0**	**0**	**0**	**0**	**6**
Salmonella ssp I 6,7:-:-	Chicken	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

Serotype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
Salmonella ssp I 6,7:-:l,w	Porcine	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp I 6,7:b:-	Turkey	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp I 6,8:e,h:-	Water	0	1	0	0	0	0	0	0	0	0	1
Salmonella ssp I 8,20:i:-	Bovine	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp I 9,12:-:-	Bovine	1										1
	Turkey					1						1
	Subtotal	1	0	0	0	1	0	0	0	0	0	2
Salmonella ssp I Rough-O	Bovine					2	1					3
	Chicken		18			44		1	4		2	69
	Chinchilla								1			1
	Crustacean		1									1
	Feed					1	3					4
	Other				1							1
	Porcine		4		1	2	13					20
	Sparrow										1	1
	Turkey					30						30
	Unknown				1							1
	Unknown Avian						3					3
	Water		12									12
	Subtotal	0	35	0	3	79	20	1	5	0	3	146
Salmonella ssp II 40:-:1,5	Nut	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp IIIa 41:z4,z23:-	Water	0	1	0	0	0	0	0	0	0	0	1
Salmonella ssp IIIa 48:g,z51:-	Snake	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp IIIa 51:z4,z23:-	Bovine						1					1
	Unknown						1					1
	Subtotal	0	0	0	0	0	2	0	0	0	0	2
Salmonella ssp IIIb 17:z10:e,n,x,z15	Snake	0	0	0	0	1	0	0	0	0	0	1
Salmonella ssp IIIb 60:r:e,n,x,z15	Water	0	1	0	0	0	0	0	0	0	0	1
Salmonella ssp IIIb 61:-:1,5	Ovine	0	2	0	0	0	0	0	0	0	0	2
Salmonella ssp IIIb 61:k:1,5	Ovine	0	1	0	0	0	0	0	0	0	0	1
Salmonella ssp IV 16:z4,z32:-	Iguana	0	0	0	0	0	0	0	0	1	0	1
Salmonella ssp IV 6,7:z4,z24:-	Unknown Avian	0	0	0	0	0	0	0	0	1	0	1
TOTAL		43	633	40	188	2303	972	64	106	50	111	4510

New and Unique *Salmonella* Serotypes in Canada

Known serotypes new to Canada:

-*Salmonella* Ago 30:z38:- in Ontario during the month of December isolated from a stool sample of a 1 year old male.

-*Salmonella* Baildon 9,46:a:e,n,x in Ontario during the month of May isolated from a stool sample of a 33 year old male.

-*Salmonella* Kingston 4,12:g,s,t:- in British Columbia during the month of September isolated from a stool sample of a 51 year old female.

-*Salmonella* Langenhorn 18:m,t:- in Ontario during the month of August isolated from a stool sample of a 69 year old female.

-*Salmonella* Miyazaki 9,12:l,z13:1,7 in British Columbia during the month of August isolated from a stool sample of a 5 year old female.

-*Salmonella* Toucra 48:z:1,5 in Nova Scotia during the month of February isolated from a stool sample of a 2 month old baby boy.

-*Salmonella* ssp II 40:-:1,5,7 in Alberta during the month of April isolated from a 79 year old male.

-*Salmonella* ssp IIIa 21:g,z51:- in Quebec during the month of September isolated from a blood sample of a 56 year old male.

-*Salmonella* ssp IIIb 42:k:z35 in British Columbia during the month of December isolated from a bull snake.

-*Salmonella* ssp IIIb 47:z:z52 in Saskatchewan during the month of December isolated from porcine intestines.

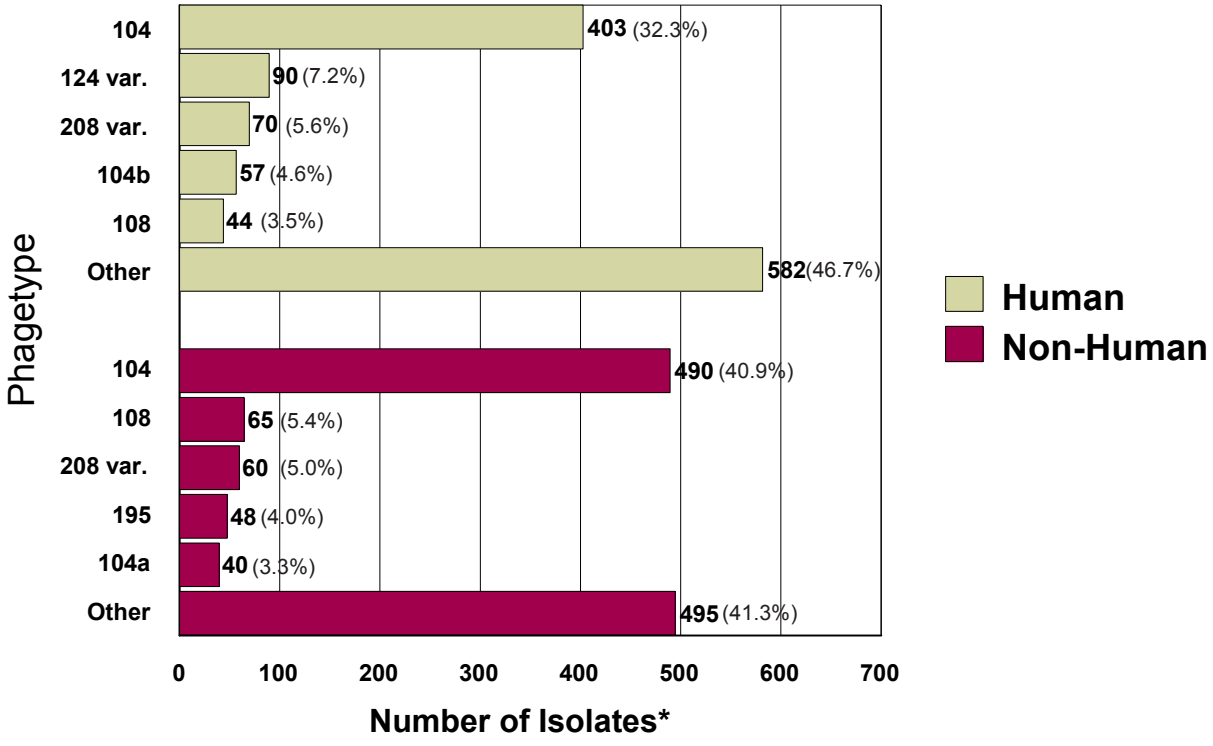
-*Salmonella* ssp IIIb 61:k:z35 in Alberta during the month of September isolated from a urine sample of a 13 year old female.

-*Salmonella* ssp IV 44:z4,z32:- in Ontario during the month of October isolated from a 6 year old male.

Salmonella Phage Types of Human and Non-Human Origin in Canada, 2000

Figure 7 presents the five most common *S*. Typhimurium phagetypes isolated from human and non-human sources in 2000. Figure 8 illustrates the five most common phagetypes for *S*. Enteritidis, *S*. Heidleberg, *Salmonella* ssp I 4,5,12:i:- and *S*. Hadar from human and non-human sources.

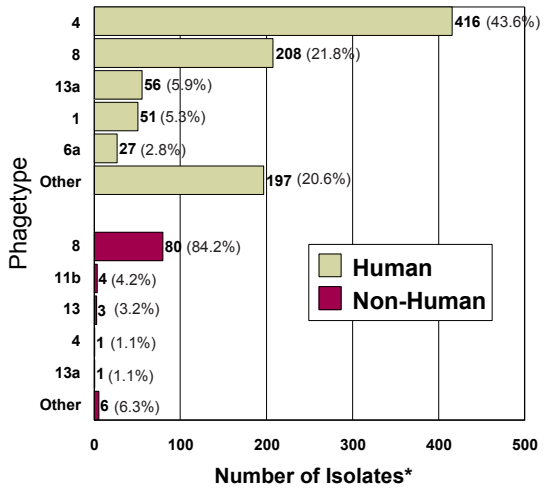
Figure 7
Five Most Prevalent *S.* Typhimurium Phage Types
in Canada, 2000



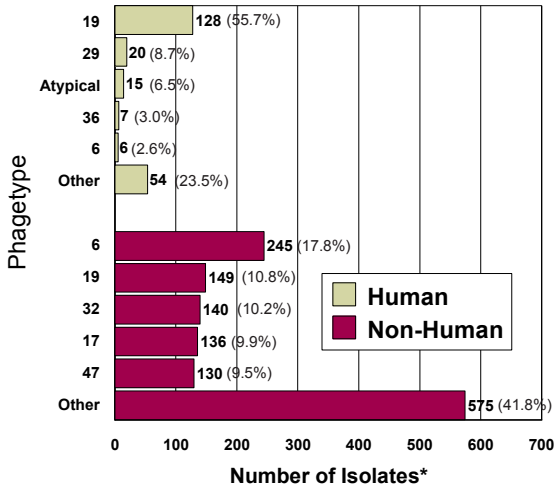
* These data represent total laboratory isolations and should not be confused with incidence.

Figure 8
Five Most Prevalent *Salmonella* Phage Types of Various Serovars in Canada, 2000

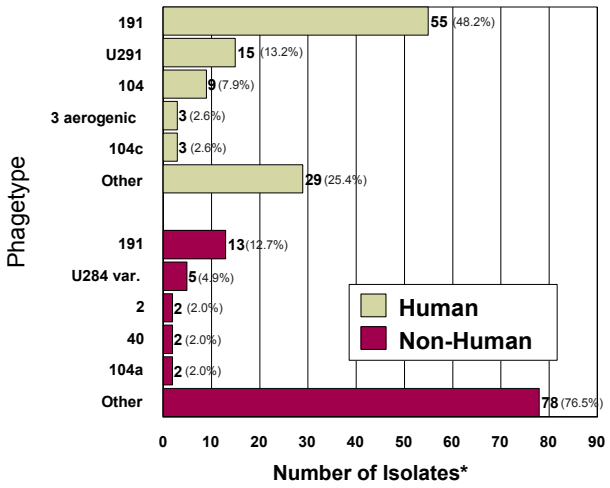
Salmonella Enteritidis



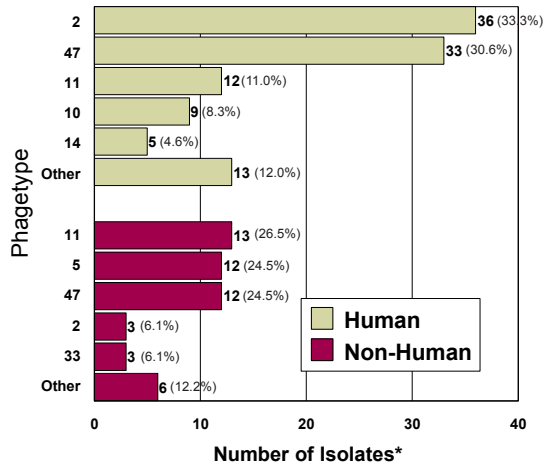
Salmonella Heidelberg



Salmonella ssp I 4,5,12:i:-



Salmonella Hadar



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

Tables 3, 4 and 5 list phagetypes of some specific *Salmonella* serotypes of human, animal and environmental sources, respectively. Data are classified by province. The data in these tables were derived from LFZ and NLEP, Winnipeg.

Table 3
Salmonella Phage Types of Human Origin in Canada, 2000

Serotype	Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Brandenburg	1					13	1					**14**
	2					1	1					**2**
	3					1						**1**
	4					1	2					**3**
	5						1					**1**
	Subtotal	**0**	**0**	**0**	**0**	**16**	**5**	**0**	**0**	**0**	**0**	**21**
S. Enteritidis	1	6	7	1		26	7	1	3			**51**
	1b		1						1			**2**
	1c					1						**1**
	2	1	9									**10**
	3					4						**4**
	4	46	52	11	26	139	110	2	18	12		**416**
	4a		1			6						**7**
	4b		1			1	2		1			**5**
	5a		1									**1**
	5b	1				2	4					**7**
	6		2		1	10	7		4			**24**
	6a	12	8	2		4	1					**27**
	6b					2						**2**
	7	1										**1**
	7a					4	2					**6**
	8	114	26	1	8	32	21		6			**208**
	8a					3						**3**
	9 var.			1								**1**
	9a var.						1					**1**
	11b		7	7		1	1					**16**
	13	2				1	1	1	2			**7**
	13a	3	11	1	5	12	13		9	2		**56**
	14b	5	7	1	1	2	2					**18**
	16				1							**1**
	21	3	1			3	1		1			**9**
	21b	1					1					**2**
	21c					1						**1**
	23	1							1			**2**
	26			1								**1**
	28		5				2					**7**
	30					10		3	3			**16**
	33						6					**6**
	34	1				2						**3**
	35		1									**1**
	42 var.					1						**1**
	911	3	2			2			1			**8**
	913					1						**1**
	Atypical	2	4			2	2					**10**
	Untypeable	2	4	1		3	2					**12**
	Subtotal	**204**	**150**	**27**	**42**	**275**	**186**	**7**	**50**	**14**	**0**	**955**
S. Hadar	2		31	3		2						**36**
	4		1	1								**2**
	10		5	4								**9**

Serotype	Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Hadar (Continued)	11		10	2								**12**
	14		5									**5**
	18					1						**1**
	19		1									**1**
	21			1								**1**
	23		1									**1**
	33		2									**2**
	43		1									**1**
	47	1	28	3	1							**33**
	51		1	1								**2**
	55		1									**1**
	Atypical		1									**1**
	Subtotal	**1**	**88**	**15**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**108**
S. Heidelberg	5		1		1							**2**
	6	3				2				1		**6**
	8	2	3	1								**6**
	11		1						1			**2**
	12				1							**1**
	13	1	1									**2**
	18		1		2							**3**
	19	37	54	14	18				5			**128**
	20		2									**2**
	24	1										**1**
	26	1	1									**2**
	29	4	10	6								**20**
	30			1								**1**
	32		1		1					1		**3**
	35	2	1		2				1			**6**
	36		5	2								**7**
	39		2									**2**
	40	2	3		1							**6**
	41		2									**2**
	42		2									**2**
	43		1									**1**
	44	2										**2**
	46			1								**1**
	47		2		1			1	1	1		**6**
	Atypical	5	6	1	3							**15**
	Untypeable									1		**1**
	Subtotal	**60**	**99**	**26**	**30**	**2**	**0**	**1**	**8**	**4**	**0**	**230**
S. Infantis	4			3								**3**
	7			1					1			**2**
	8			3								**3**
	10			1								**1**
	26				1							**1**
	Subtotal	**0**	**0**	**8**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**10**
S. Newport	8		1						1			**2**
	10	1										**1**
	14		4						1			**5**
	15				1							**1**
	Untypeable	1	2						2			**5**
	Subtotal	**2**	**7**	**0**	**1**	**0**	**0**	**0**	**4**	**0**	**0**	**14**

Serotype	Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Panama	A		1									**1**
	Atypical		1		1							**2**
	Subtotal	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
S. Paratyphi B	Dundee	1					1					**2**
	Taunton	1										**1**
	Untypeable		1									**1**
	Subtotal	**2**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**4**
S. Paratyphi B var. Java	1 var.	1	1									**2**
	3b var.	2			1							**3**
	Dundee	1			1		9					**11**
	Dundee var. 1	2										**2**
	Subtotal	**6**	**1**	**0**	**2**	**0**	**9**	**0**	**0**	**0**	**0**	**18**
S. Thompson	1		5	2	1	34			1			**43**
	2		43			19						**62**
	3					1						**1**
	5		2			1				2		**5**
	23		2									**2**
	26			1		1			1			**3**
	27		1	1		1						**3**
	Atypical		3	2		2						**7**
	Subtotal	**0**	**56**	**6**	**1**	**59**	**0**	**0**	**2**	**2**	**0**	**126**
S. Typhi	A	2	1		1		1					**5**
	B1			1		2						**3**
	B2					1	2					**3**
	B2 - Degraded					1						**1**
	D 1						1					**1**
	DVS	1				2						**3**
	E 1	4	5		2	23	3					**37**
	E 2					3						**3**
	E 7					1						**1**
	E 9					3						**3**
	F6					1						**1**
	J1							1				**1**
	M1	2				1						**3**
	N					1						**1**
	O	1	3			1	1					**6**
	T						1					**1**
	40					1						**1**
	53					1						**1**
	54						1					**1**
	UVS					2						**2**
	Untypeable	1	1			2	1					**5**
	Subtotal	**11**	**10**	**1**	**3**	**46**	**11**	**1**	**0**	**0**	**0**	**83**
S. Typhimurium	1	4	10	3		1			1			**19**
	2	2	2		1	9	4					**18**
	6	1	1									**2**
	8	3	1				1					**5**
	9		1			1						**2**
	10	5	4			18	5					**32**
	12	2	3	1	1	5	1					**13**
	12a					2	2					**4**

Serotype	Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Typhimurium	15		1									1
(Continued)	20					1						1
	20 var.					1						1
	21	1	1			2	5					9
	22	1	1	1	1		1		34			39
	27					1	8					9
	32		1									1
	35					1	1					2
	36						1					1
	40	1	2		1	1	2			1		8
	41	1				2						3
	41a						1					1
	46		2			6	4					12
	46a		1									1
	49	1	2	5	2	4						14
	49a	1										1
	54					1						1
	64		1									1
	66					5	17					22
	66 var.						1					1
	69				1	5						6
	73 var.		1									1
	82					3						3
	94	1				2	1					4
	96		4									4
	99	1	2			3						6
	104	25	63	7	16	235	52	1		4		403
	104a	2	1	1	1	5	9					19
	104b	2	4			37	14					57
	106					1						1
	107		6			16	1					23
	108		1		1	35	7					44
	110					1						1
	110b			1		4	2					7
	111					1						1
	115					1						1
	120		1									1
	124				2	3						5
	124 var.	4	6	1	4	66	7		2			90
	127	1										1
	132		1		1	4						6
	133 var.				1							1
	135	1	10	1		1	1					14
	136	1										1
	146					1			1			2
	146a	1										1
	153	1										1
	160		1		3	5	1					10
	164	1					1					2
	170	2			1	8	2		2			15
	186						1					1
	189					2						2
	190		1									1
	192					1						1
	193	4	6	1	3	7	6			2		29
	195	2		1		5	2					10

Serotype	Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Typhimurium	204		1									**1**
(Continued)	204a					1						**1**
	204c		1				2					**3**
	208	4	5	2		9	3					**23**
	208 var.	13	54	1		2						**70**
	Atypical	11	2	2	3	17	4					**39**
	U276					2	1					**3**
	U283					1	1					**2**
	U284			1								**1**
	U284 var.	3	2	1	1	3	3					**13**
	U285	2		1	2		1		1			**7**
	U295					1						**1**
	U297		1									**1**
	U301					6						**6**
	U302	4	2			14	9					**29**
	UT 1	5	3			2						**10**
	UT 2	2	2									**4**
	UT 4		1									**1**
	UT 5		3		1	13	1					**18**
	Untypeable	5	7			1	1					**14**
	Subtotal	**121**	**226**	**31**	**47**	**585**	**187**	**1**	**41**	**7**	**0**	**1246**
Salmonella ssp I 4,5,12:i:-	1		1									**1**
	3 aerogenic		3									**3**
	8	2										**2**
	18				1							**1**
	64		1									**1**
	98			1								**1**
	99					1						**1**
	104			1		8						**9**
	104b		1									**1**
	104c					3						**3**
	116					1						**1**
	120		2									**2**
	143				1							**1**
	146			1								**1**
	146 var.					1						**1**
	191	13	21	17		3		1				**55**
	192					1						**1**
	193								1			**1**
	U284			1								**1**
	U291		4			10	1					**15**
	UT 2		1									**1**
	Untypeable		1									**1**
	Atypical	2		1	1	6						**10**
	Subtotal	**17**	**35**	**22**	**3**	**34**	**1**	**1**	**1**	**0**	**0**	**114**
Salmonella ssp I 4,5,12:b:-	3b var.							1				**1**
	Battersea			2			1					**3**
	Dundee				1							**1**
	Dundee var. 1		1			1						**2**
	Untypeable	6		1	1	2	1					**11**
	Subtotal	**6**	**1**	**3**	**2**	**3**	**2**	**1**	**0**	**0**	**0**	**18**
	Total	**430**	**676**	**139**	**134**	**1023**	**402**	**12**	**107**	**27**	**0**	**2950**

Table 4
Salmonella Phage Types of Animal Origin in Canada, 2000

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Enteritidis	4	Poultry						1					**1**
	8	Chicken	15	22			3						**40**
	8	Duck						3					**3**
	8	Mouse					4						**4**
	8	Porcine	2	2									**4**
	8	Quail						1					**1**
	9	Porcine		1									**1**
	11b	Chicken			1								**1**
	11b	Porcine		1									**1**
	13	Bovine					1						**1**
	13	Chicken		1			1						**2**
	14b	Bovine					1						**1**
	Atypical	Chicken						1					**1**
		Subtotal	**17**	**27**	**1**	**0**	**10**	**6**	**0**	**0**	**0**	**0**	**61**
S. Hadar	2	Chicken	1	2									**3**
	5	Chicken		9			1						**10**
	5	Turkey		2									**2**
	10	Chicken		1									**1**
	11	Chicken		7									**7**
	14	Chicken		1									**1**
	18	Chicken		1									**1**
	22	Chicken		1									**1**
	33	Chicken		3									**3**
	43	Chicken		1									**1**
	47	Bovine		1									**1**
	47	Chicken		8	1								**9**
		Subtotal	**1**	**37**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**40**
S. Heidelberg	1	Avian						1					**1**
	2	Avian						1					**1**
	2	Bovine					3						**3**
	2	Chicken						1					**1**
	3	Avian						1					**1**
	3	Porcine						2					**2**
	4	Chicken		2									**2**
	4	Bovine					1						**1**
	4	Porcine			1			5					**6**
	5	Avian						1					**1**
	5	Chicken		14	2		37						**53**
	5	Poultry		1									**1**
	5	Turkey					1						**1**
	6	Avian						26					**26**
	6	Chicken		35			61		16	1		12	**125**
	6	Turkey	3				84						**87**
	7	Avian					1						**1**
	7	Chicken		13			13		1	2			**29**
	7	Turkey					7						**7**
	8	Avian						2					**2**
	8	Bovine					4						**4**
	8	Chicken	1	1			8		2			8	**20**
	8	Porcine					3	15					**18**
	8	Turkey	1				24						**25**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Heidelberg	9	Chicken		2			6						**8**
(continued)	9	Pheasant					1						**1**
	9	Porcine						2					**2**
	9	Turkey					7						**7**
	10	Chicken					1						**1**
	10	Turkey					1						**1**
	11	Chicken					5						**5**
	11	Turkey					2						**2**
	12	Avian			1								**1**
	12	Chicken		8	2								**10**
	12	Poultry		1									**1**
	13	Chicken		1			2						**3**
	13	Turkey					9			2			**11**
	16	Chicken					1						**1**
	17	Avian						13					**13**
	17	Chicken		14			84		1	4		8	**111**
	17	Bovine					2						**2**
	17	Turkey					3						**3**
	18	Chicken		1									**1**
	18	Bovine					1						**1**
	19	Avian					2	4					**6**
	19	Bovine					2				1		**3**
	19	Chicken	2	26			81	3				5	**117**
	19	Poultry		1									**1**
	19	Porcine						2					**2**
	19	Turkey					5						**5**
	20	Chicken					13						**13**
	20	Porcine					1						**1**
	20	Turkey					1						**1**
	23	Chicken		3			1		1				**5**
	23	Porcine		1									**1**
	23	Turkey					10						**10**
	24	Porcine					1						**1**
	25	Chicken					6						**6**
	26	Avian						1					**1**
	26	Chicken					18						**18**
	26	Porcine						2					**2**
	26	Turkey					2			2			**4**
	27	Bovine								1			**1**
	27	Turkey					1						**1**
	29	Chicken	3	10			38	1				1	**53**
	29	Porcine			4			1					**5**
	29	Turkey					12						**12**
	30	Turkey					1						**1**
	32	Avian					1						**1**
	32	Caprine					1						**1**
	32	Chicken					1						**1**
	32	Pheasant					1						**1**
	32	Porcine					2	2					**4**
	32	Turkey					131						**131**
	33	Turkey	1										**1**
	35	Chicken		4			14					3	**21**
	36	Avian					1	3					**4**
	36	Chicken		10			23		4	1		2	**40**
	36	Turkey					1						**1**
	39	Chicken		1									**1**
	39	Turkey					2						**2**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Heidelberg	40	Chicken					13						**13**
(continued)	41	Chicken					2						**2**
	46	Chicken					1						**1**
	47	Avian					1	3	1				**5**
	47	Chicken		4	1		15	1					**21**
	47	Porcine						2					**2**
	47	Turkey					91			9			**100**
	49	Chicken		11	1		3						**15**
	Atypical	Avian						4					**4**
	Atypical	Bovine						1					**1**
	Atypical	Chicken	3	23			25		1	3		3	**58**
	Atypical	Porcine			4		1	2					**7**
	Atypical	Turkey	1				4						**5**
		Subtotal	**15**	**187**	**16**	**0**	**901**	**102**	**27**	**25**	**1**	**42**	**1316**
S. Infantis	4	Chicken			1								**1**
	4	Porcine			17								**17**
	7	Avian			1								**1**
	7	Chicken			1								**1**
	24	Porcine			1								**1**
		Subtotal	**0**	**0**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**21**
S. Thompson	1	Chicken		1									**1**
	1	Porcine			1								**1**
	3	Equine			2								**2**
	25	Chicken		2									**2**
	26	Chicken		3									**3**
	Atypical	Bovine			1								**1**
	Atypical	Chicken		2									**2**
	Atypical	Poultry		1									**1**
		Subtotal	**0**	**9**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**13**
S. Typhimurium	1	Avian			1								**1**
	1	Bovine					1						**1**
	1	Cormorant			1								**1**
	1	Heron									1		**1**
	1	Pelican			1								**1**
	1	Porcine			1								**1**
	2	Pigeon	5				7						**12**
	10	Bovine					1	4					**5**
	10	Equine						1					**1**
	12	Chicken					1						**1**
	12	Porcine						2					**2**
	12	Pork						1					**1**
	12a	Bovine						1					**1**
	13	Avian						1					**1**
	15	Bovine		1									**1**
	21	Bovine					1						**1**
	27	Porcine						1					**1**
	36	Chicken								1			**1**
	39	Pigeon	1										**1**
	40	Avian						6			1		**7**
	40	Chicken					2						**2**
	40	Feline						7					**7**
	40	Poultry						1					**1**
	45	Porcine						3					**3**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Typhimurium	45 var.	Porcine						1					**1**
(continued)	46	Avian				1		1					**2**
	46	Chicken					3					2	**5**
	46	Porcine				1							**1**
	46	Poultry						8					**8**
	49	Chicken	1										**1**
	69	Bovine					5						**5**
	82	Bovine			1								**1**
	82	Chicken		5									**5**
	99	Pigeon						1					**1**
	104	Alpaca	1										**1**
	104	Avian			1			9					**10**
	104	Bovine	7	23	6		119	27		2	4		**188**
	104	Chicken		50			13						**63**
	104	Duck					1						**1**
	104	Elk		2									**2**
	104	Equine		3			19			1	7		**30**
	104	Mouse					1						**1**
	104	Ostrich		7									**7**
	104	Ovine					2						**2**
	104	Porcine	1	26	7	14	37	56					**141**
	104	Poultry		1				4					5
	104	Quail					1						**1**
	104	Reptile					2						**2**
	104	Water						1					**1**
	104a	Bovine		1			1	1					**3**
	104a	Equine					2						**2**
	104a	Feline						10					**10**
	104a	Porcine		6		3	6	10					**25**
	104b	Bovine		13									**13**
	104b	Canine		1									**1**
	104b	Porcine					2	8					10
	108	Bovine					16						**16**
	108	Chicken					5						**5**
	108	Equine					1						**1**
	108	Porcine				1	22	19					**42**
	110	Avian			2								**2**
	110b	Bison		1									**1**
	110b	Bovine		2									**2**
	110b	Goose		1									**1**
	110b	Porcine		1				1					**2**
	110b	Poultry						2					2
	120	Bovine					10						**10**
	120	Porcine		1				1					**2**
	124 var.	Bovine						1					**1**
	132	Bovine		1									**1**
	132	Porcine		3									**3**
	146	Equine			1								**1**
	146	Turkey			1								**1**
	160	Avian			4			1					**5**
	160	Crow			1								**1**
	160	Finch					1						1
	160	Sparrow										5	**5**
	170	Bovine					1						**1**
	170	Porcine					3	2					**5**
	192	Porcine						1					**1**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Typhimurium	193	Bovine					1						**1**
(continued)	193	Chicken		2			1						**3**
	193	Pelican			1								**1**
	193	Porcine		1				19					**20**
	193	Quail					1						**1**
	193	Turkey					5						**5**
	194	Porcine						1					**1**
	195	Avian				2					1		**3**
	195	Bovine					1						**1**
	195	Chicken					33		1				**34**
	195	Cormorant									4		**4**
	195	Gull		1			2						**3**
	195	Porcine						2					**2**
	204	Porcine						1					**1**
	208	Avian						1					**1**
	208	Bovine	2	5			20						**27**
	208	Chicken		1			2						**3**
	208	Duck					1						**1**
	208	Porcine					1	3					**4**
	208	Poultry		1									**1**
	208	Snake		1									**1**
	208 var.	Bovine		1									**1**
	208 var.	Bovine	22	20	3								**45**
	208 var.	Canine		1									**1**
	208 var.	Chicken		3									**3**
	208 var.	Gerbil		1									**1**
	208 var.	Porcine	1										**1**
	Atypical	Avian			1	6		1					**8**
	Atypical	Bovine					6						**6**
	Atypical	Chicken	1	8			4		2	4		13	**32**
	Atypical	Equine						1					**1**
	Atypical	Finch					1						**1**
	Atypical	Ovine			1								**1**
	Atypical	Pigeon					2						**2**
	Atypical	Porcine			1	15	6	4					**26**
	Atypical	Poultry						1					**1**
	Atypical	Sparrow					1						**1**
	Atypical	Turkey					2						**2**
	Atypical	Unknown				2	4						**6**
	U284 var.	Avian			2			9					**11**
	U284 var.	Chicken		1									**1**
	U284 var.	Feline		1	1			6					**8**
	U284 var.	Finch		1			4						**5**
	U285	Chicken			2								**2**
	U285	Porcine						1					**1**
	U302	Bovine		1			2						**3**
	U302	Bovine	1	3				1					**5**
	U302	Porcine			1		4	23					**28**
	U302	Poultry		1									**1**
	U302	Unknown						2					**2**
	U302 var.	Porcine						1					**1**
	UT 1	Bovine	1	5									**6**
	UT 2	Bovine	1	4									**5**
	UT 2	Chicken		1									**1**
	UT 2	Poultry						1					**1**
	UT 5	Bovine	1										**1**
	UT 5	Porcine						2					**2**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Typhimurium	Untypeable	Bovine	6	27			5						**38**
(continued)	Untypeable	Canine						1					**1**
	Untypeable	Chicken		3	1								**4**
	Untypeable	Porcine					9	16					**25**
		Subtotal	**52**	**243**	**42**	**45**	**404**	**290**	**3**	**8**	**18**	**20**	**1125**
Salmonella ssp I	1	Chicken					1						**1**
4,5,12:i:-	2	Avian									1		**1**
	2	Pigeon					1						**1**
	36	Gull					1						**1**
	40	Avian				1							**1**
	40	Finch					1						**1**
	104a	Porcine						2					**2**
	104b	Avian			1								**1**
	191	Avian	1										**1**
	191	Bison	1										**1**
	191	Bovine			5								**5**
	191	Chicken	3		1								**4**
	191	Partridge	1										**1**
	191	Porcine			1								**1**
	193	Bovine					1						**1**
	195	Chicken					1						**1**
	U284 var.	Cormorant			3								**3**
	U284 var.	Finch		1			1						**2**
	U291	Chicken		2									**2**
	Atypical	Avian									1		**1**
	Atypical	Bovine			1		1		1				**3**
	Atypical	Chicken		2			4					1	**7**
	Atypical	Cormorant									2		**2**
	Atypical	Equine			22								**22**
	Atypical	Porcine				36							**36**
		Subtotal	**6**	**5**	**34**	**37**	**12**	**2**	**1**	**0**	**4**	**1**	**102**
		Total	**91**	**508**	**119**	**82**	**1328**	**400**	**31**	**33**	**23**	**63**	**2678**

Table 5
Salmonella Phage Types of Environmental and Food Origin in Canada, 2000

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Enteritidis	8	Egg Processing Plant	3										**3**
	8	Coconut	1										**1**
	8	Animal Feed						2					**2**
	8	Eggs	21										**21**
	8	Unknown					1						**1**
	11b	Eggs	2										**2**
	13a	Chicken Meat						1					**1**
	24	Chicken Litter		1									**1**
	Atypical	Unknown						2					**2**
		Subtotal	**27**	**1**	**0**	**0**	**1**	**5**	**0**	**0**	**0**	**0**	**34**
S. Hadar	11	Chicken Litter		5									**5**
	11	Animal Feed (Canine)		1									**1**
	47	Chicken Litter		2									**2**
	51	Animal Feed (Canine)		1									**1**
		Subtotal	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**
S. Heidelberg	1	Unknown				1							**1**
	2	Eggs	1										**1**
	5	Chicken		2									**2**
	5	Animal Feed						1					**1**
	6	Animal Feed						3					**3**
	6	Unknown				1		3					**4**
	7	Unknown						3					**3**
	8	Other				1							**1**
	17	Chicken Litter		2									**2**
	17	Eggs	3										**3**
	17	Animal Feed						2					**2**
	18	Chicken		1									**1**
	18	Eggs	1										**1**
	19	Chicken Litter		6									**6**
	19	Eggs	7										**7**
	19	Animal Feed						1					**1**
	19	Unknown				1							**1**
	20	Eggs	1										**1**
	26	Animal Feed						1					**1**
	26	Unknown											
	29	Unknown				1	1						**2**
	30	Eggs	1										**1**
	32	Unknown				1							**1**
	35	Chicken Litter		1									**1**
	36	Eggs	3										**3**
	36	Unknown				1							**1**
	40	Unknown						1					**1**
	41	Eggs	1										**1**
	47	Chicken Litter		1									**1**
	47	Animal Feed						1					**1**
	Atypical	Chicken Litter		1									**1**
	Atypical	Unknown					1	2					**3**
		Subtotal	**18**	**14**	**0**	**7**	**2**	**18**	**0**	**0**	**0**	**0**	**59**

Serotype	Phagetype	Source	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	Total
S. Infantis	4	Animal Feed (Canine)					2			2	7		**11**
S. Paratyphi B	Dundee	Animal Feed (Fish)						1					**1**
var. Java													
S. Typhimurium	2	Eggs	1										**1**
	2	Unknown						1					**1**
	27	Unknown						1					**1**
	66	Chicken Meat						1					**1**
	73 var.	Chicken Litter		1									**1**
	99	Shrimp	1										**1**
	104	Beef						3					**3**
	104	Animal Feed					7						**7**
	104	Raw Milk						1					**1**
	104	Unknown		9			1				15		**25**
	104b	Filter (Milk)		1									**1**
	104b	Pork						1					**1**
	108	Beef						1					**1**
	120	Unknown					2						**2**
	132	Eggs	4										**4**
	132	Unknown					1						**1**
	186	Unknown						1					**1**
	193	Pork						2					**2**
	195	Animal Feed					1						**1**
	208	Unknown		3									**3**
	208	Water		1									**1**
	208 var.	Chicken Litter		4									**4**
	208 var.	Unknown	1	3									**4**
	U285	Beef						1					**1**
	U302	Animal Feed (Canine)		3									**3**
	UT 3	Eggs	1										**1**
	Untypeable	Water		1									**1**
		Subtotal	**8**	**26**	**0**	**0**	**12**	**13**	**0**	**0**	**15**	**0**	**74**
Salmonella ssp I	191	Eggs	2										**2**
4,5,12:i:-	208	Water		1									**1**
	U291	Eggs	1										**1**
	Atypical	Unknown				1							**1**
	Atypical	Water		1									**1**
		Subtotal	**3**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
		Total	**56**	**52**	**0**	**8**	**17**	**37**	**0**	**2**	**22**	**0**	**194**

Antimicrobial Resistance and Phage Types of *Salmonella*

Table 6 lists the antimicrobial resistance patterns (R-Types) of various *Salmonella* serotypes. The table is arranged to show the number of isolates of each phage type that is resistant to a particular series of antimicrobial agents. Antimicrobial activity has been determined by disc diffusion techniques. R-Type designations are concatenated letters representing resistance to a specific antibiotic: A = Ampicillin, C = Chloramphenicol, Ci = Ciprofloxacin, S = Streptomycin, Su=Sulfadiazine, T = Tetracycline, Tm = Trimethoprim/Sulfamethoxazole.

Table 6
Antimicrobial Resistance Profiles and Phage Types of *Salmonella* in Canada, 2000

Organism	R-Type	Phage Type (No. Isolates)	Total
S. Enteritidis	A	6a (3), 1c (1), 14b (1)	5
	ACSSuT	21b (1), AT*(1)	2
	ASSu	42 var. (1)	1
	ASSuTTm	14b (1)	1
	ASSuTm	1 (1)	1
	ASTTm	28 (1)	1
	ASuTTm	1 (1)	1
	AT	13a (2)	2
	SSu	4 (4), 14b (2), 1 (1)	7
	SSuT	4 (2), 5a (1), 1 (1)	4
	Su	4 (70), 8 (15), 13a (11), 11b (6), UT (6), 1 (5), 2 (3), 4a (2), 6 (2), 6a (2), 8a (2), 14b (2), 28 (2), 30 (2), 911 (2), 7a (1), 16 (1), 26 (1), 33 (1), AT (1)	137
	SuT	8 (3), 4(2), 14b (1), 13a (1), 6b (1)	8
	SuTTm	1 (1), 6a (1), 21b (1), AT (1)	4
	SuTm	4 (6), 8(4), 1 (1), 5b (1), 11b (1), 13a (1), 30 (1), AT (1)	16
	T	8 (2), 13a (2), 28 (1)	5
	Sensitive	4 (280), 8 (136), 13a (37), 1 (36), 6a (17), 6 (16), 30 (13), 14b (10), 11b (9), 21 (8), 5b (6), 13 (6), 911 (6), AT (6), 4b (5), UT* (5), 33 (4), 7a (4), 4a (4), 3 (4), 28 (3), 34 (3), 2 (2), 1b (1), 6b (1), 7 (1), 9 var. (1), 9a var. (1), 21c (1), 23 (1), 913 (1)	628
	Subtotal		**823**
S. Heidelberg	A	19 (26), AT (4), 41 (2), 18(1), 20 (1), 24 (1), 26 (1), 29 (1), 30 (1), 35 (1), 36 (1), 43 (1), 47 (1)	42
	AS	19 (3), 29 (2)	5
	ASSu	19 (4), 29 (2), 6 (1), 44 (1)	8
	ASSuT	29 (2), 6 (1), 19 (1)	4
	AST	19 (1)	1
	ASu	19 (2), 20 (1), 29 (1), 39 (1), 46 (1)	6
	S	29 (3), 13 (1), 19 (1), 42 (1)	6
	SSu	29 (4), 19 (2), 13 (1), 47 (1)	8
	SSuT	19 (3), 29 (2), 6 (1), 35 (1)	7
	ST	29 (1), 42 (1)	2
	Su	19 (2), 35 (2), AT (2), 8 (1), 11 (1), 36 (1), 40 (1), 47 (1)	11
	SuT	32 (1)	1
	SuTm	19 (2), 8 (1)	3
	T	19 (3), 8 (2), 29 (1), 32 (1), 44 (1), UT (1)	9
	Tm	19 (1)	1
	Sensitive	19 (56), AT (9), 36 (5), 40 (4), 6 (3), 47 (3), 5 (2), 8 (2), 35 (2), 11 (1), 12 (1), 18 (1), 26 (1), 32 (1), 39 (1)	92
	Subtotal		**206**

Organism	R-Type	Phage Type (No. Isolates)	Total
S. Hadar	A	10 (1)	1
	ASSuTTm	47 (1)	1
	ASSuT	18 (1)	1
	AST	2 (1), 4 (1), 47 (1)	3
	ASTTm	47 (2), 2 (1)	3
	S	2 (1)	1
	SSuT	10 (2), 47 (2), 23 (1)	5
	ST	2 (32), 47 (26), 11 (11), 10 (4), 14 (4), 33 (2), 51 (2), 19 (1), 43 (1), 55 (1)	84
	Su	10 (1)	1
	SuT	AT (1)	1
	T	47 (1)	1
	Subtotal		**102**
S. Infantis	SSu	8(1)	1
	Su	7 (1)	1
	SuT	10 (1)	1
	Sensitive	4 (2), 8 (2), 7 (1)	5
	Subtotal		**8**
S. Newport	Su	14 (1)	1
	SuT	14 (1)	1
	Sensitive	UT (5), 14 (3), 8 (2), 10 (1), 15 (1)	12
	Subtotal		**14**
S. Paratyphi B	ACSSuT	Dundee (1)	1
	Sensitive	Taunton (1)	1
	Subtotal		**2**
S. Paratyphi B var. Java	ACSSuT	1 var. (1), 3b var. (1)	2
	Su	Dundee (7), 3b var. (1), Dundee var. 1 (1)	9
	T	3b var. (1)	1
	Sensitive	Dundee (2), 1 var. (1), Dundee var. 1 (1)	4
	Subtotal		**16**
S. Thompson	SSu	3 (1)	1
	Su	2 (10), 1 (4)	14
	SuT	1 (1), 5 (1)	2
	SuTm	AT (1)	1
	Sensitive	2 (52), 1 (37), 5 (4), AT (4), 27 (3), 26 (2), 23 (1)	103
	Subtotal		**121**
S. Typhimurium	A	208 (2), 193 (2), 94 (1), 104 (1), 107 (1), 208 var. (1)	8
	ACSSuT	104 (336), 104b (51), U302 (20), 104a (17), 108 (5), 170 (3), 208 var. (3), 193 (2), UT1 (2), UT (2), 12 (1), 15 (1), 21 (1), 120 (1), U276 (1), U301 (1)	447
	ACSSuTTm	UT1 (7), UT (7), 104 (4), U302 (3), 193 (2), 104a (2), 104b (2), 208 (2), 208 var. (2), 10 (1)	32
	AS	193 (2)	2
	ASSu	21 (2), 208 (2), 208 var. (1)	5
	ASSuT	208 var. (55), 208 (12), UT5 (5), 193 (4), 104 (3), UT2 (3), 21 (2), UT (2), 35 (1), 49 (1), 108 (1), UT4 (1)	90
	ASSuTTm	193 (3), 208 (1), UT (1)	5
	ASSuTm	193 (2)	2

Organism	R-Type	Phage Type (No. Isolates)	Total
S. Typhimurium (continued)	AST	208 var. (4), 12 (1), UT2 (1)	6
	ASu	104 (4), 12 (1), 94 (1)	6
	ASuTm	U295 (1)	1
	AT	U302 (1)	1
	CSSuT	21 (1)	1
	CST	193 (1)	1
	S	49 (1), U285 (1), UT (1)	3
	SSu	104 (9), 104b (3), 8 (1), 49 (1), 107 (1)	15
	SSuT	208 (3), 12 (2), 204c (2), 1 (1), 20 var. (1), 66 (1), 104 (1), 110b (1), U285 (1), UT (1)	14
	SSuTTm	27 (3), 193 (2), 186 (1)	6
	ST	6 (2), 204 (1), 1 (1)	4
	Su	124 var. (15), AT (10), 1 (7), 2 (6), 108 (6), 135 (6), 49 (5), 160 (4), 10 (3), 40 (3), 104 (3), 46 (2), 107 (2), U276 (2), 9 (1), 64 (1), 82 (1), 96 (1), 99 (1), 110 (1), 110b (1), 132 (1), 189 (1), 204a (1), 208 var. (1), U284 var. (1), U285 (1), U297 (1), UT5 (1)	89
	SuT	135 (2), 8 (1), 54 (1), 108 (1), 192 (1), 193 (1), 195 (1), 204c (1)	9
	SuTTm	27 (5), U302 (1)	6
	SuTm	12 (1)	1
	T	193 (5), 104 (3), 195 (2), 8 (1), 22 (1), 46 (1), 146a (1), U302 (1), UT1 (1)	16
	Sensitive	124 var. (68), 104 (32), 108 (31), AT (29), 10 (28), 66 (19), 107 (19), 22 (18), 2 (12), U284 var. (12), 170 (11), UT5 (11), 1 (10), 46 (9), 12 (7), 195 (7), 49 (6), 69 (6), 160 (6), 110b (5), 124 (5), 132 (5), U301 (5), 12a (4), 40 (4), 99 (4), 135 (4), U285 (4), 21 (3), 41 (3), 96 (3), U302 (3), 8 (2), 82 (2), 146 (2), 164 (2), 193 (2), U283 (2), 9 (1), 20 (1), 27 (1), 32 (1), 36 (1), 41a (1), 46a (1), 49a (1), 66 var. (1), 73 var. (1), 94 (1), 104b (1), 106 (1), 111 (1), 115 (1), 127 (1), 133 var. (1), 136 (1), 153 (1), 189 (1), 190 (1), 208 (1), U284 (1)	428
	Subtotal		**1198**
S. Brandenburg	SuTm	1 (1)	1
	T	2 (1)	1
	Sensitive	1 (12), 4 (3), 2 (1), 3 (1), 5 (1)	18
	Subtotal		**20**
S. Hartford	Senstive		1
S. Muenchen	Sensitive		1
S. Poona	SSu		1
S. Saintpaul	Su		1
Salmonella ssp I 4,5,12:i:-	ACSSuT	104 (8)	8
	AS	AT (1)	1
	CSSuTTm	191 (1)	1
	S	191 (2)	2
	SSu	191 (5), U291 (2), UT2 (1), UT (1)	9
	SSuT	191 (2)	2

Organism	R-Type	Phage Type (No. Isolates)	Total
Salmonella ssp I 4,5,12:i:-	ST	191 (1)	1
(continued)	Su	191 (14), 3 aerogenic (1), 64 (1), 120 (1), 193 (1), AT (1), U291 (1)	20
	SuT	143 (1)	1
	SuTm	191 (2)	2
	T	192 (1), AT (1)	2
	Sensitive	191 (26), U291 (12), AT (6), 104c (3), 3 aerogenic (2), 8 (2), 1 (1), 18 (1), 98 (1), 99 (1), 104 (1), 104b (1), 116 (1), 120 (1), 146 (1), 146 var. (1), U284 (1)	62
	Subtotal		**111**
	Total		**2625**

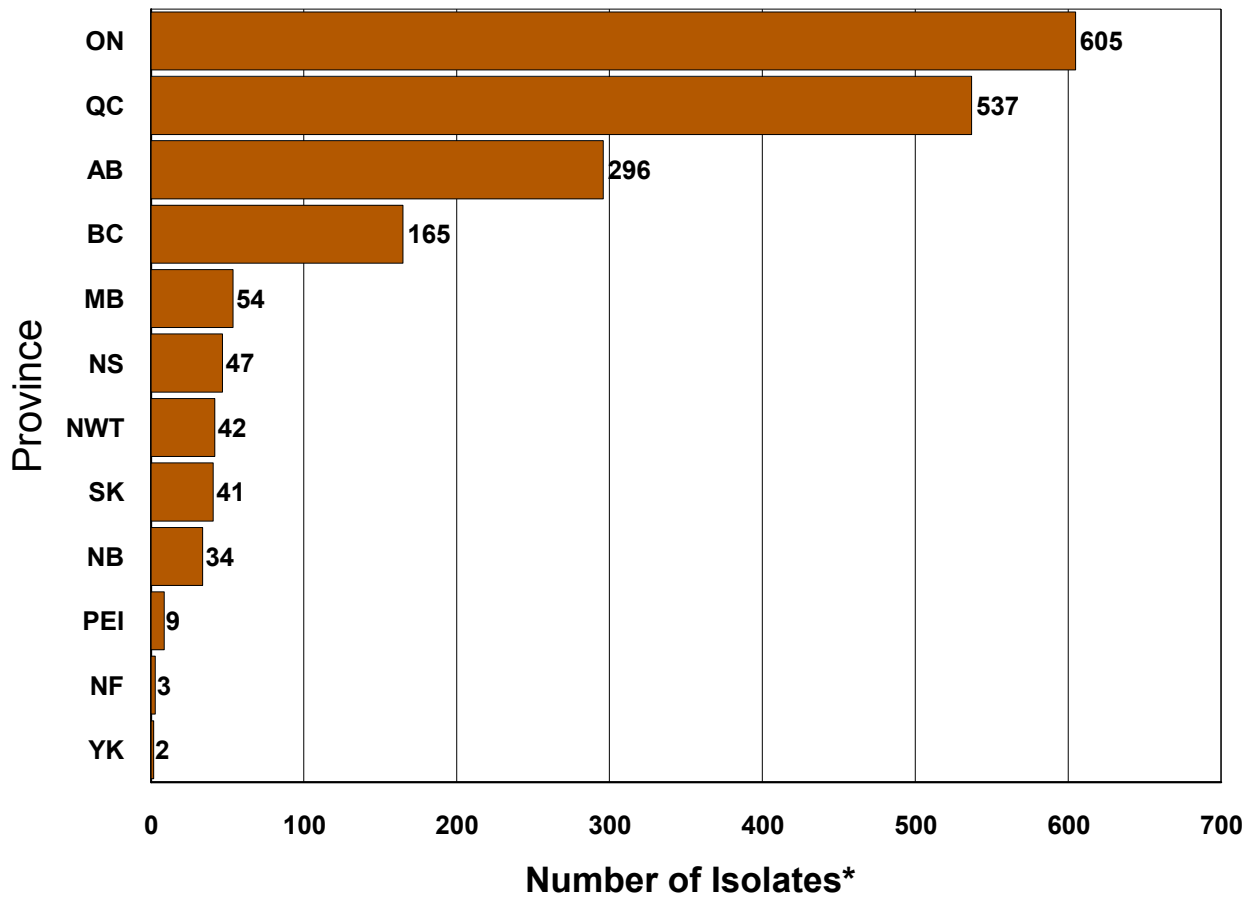
*AT = Atypical and UT = Untypeable.

Section 3 - Pathogenic *Escherichia coli*

Escherichia coli Isolates of Human Origin in Canada, 2000

Figure 9 provides the provincial frequency distribution of human and non-human *Eshcerichia coli* O157 in Canada, 2000. Typing of *Escherichia coli* O157 isolates does not necessarily include determination of the H antigen or production of verotoxin (Shiga-toxin). It is extremely rare to find *Escherichia coli* O157:H7 lacking any *stx* genes for verotoxin production. We have therefore assumed all strains typed as *Escherichia coli* O157:H7 are toxin producers. Any isolate not typed as O157:H7 or as verotoxin-positive *Escherichia coli* has not been included.

Figure 9
***Escherichia coli* O157 Isolates of Human Origin in Canada, 2000**



* These data represent total laboratory isolations and should not be confused with incidence. Number of Isolates includes *E.coli* O157, O157 (VTEC), O157:H7, O157:NM, and Not Typed (VTEC).

Table 7 lists the serotypes of human and non-human *Escherichia coli* isolates identified in Canada during the year 2000. Organisms are listed in order of serotype. Strains designated as enteropathogenic *Escherichia coli* in this table were identified as such based solely on serotype, not by the flourescent actin staining (FAS) test or by screening for the presence of the *eae* gene. More detailed information on *E. coli* virulence groups can be found in Table 9.

Table 7
Escherichia coli Isolates of Human Origin in Canada, 2000

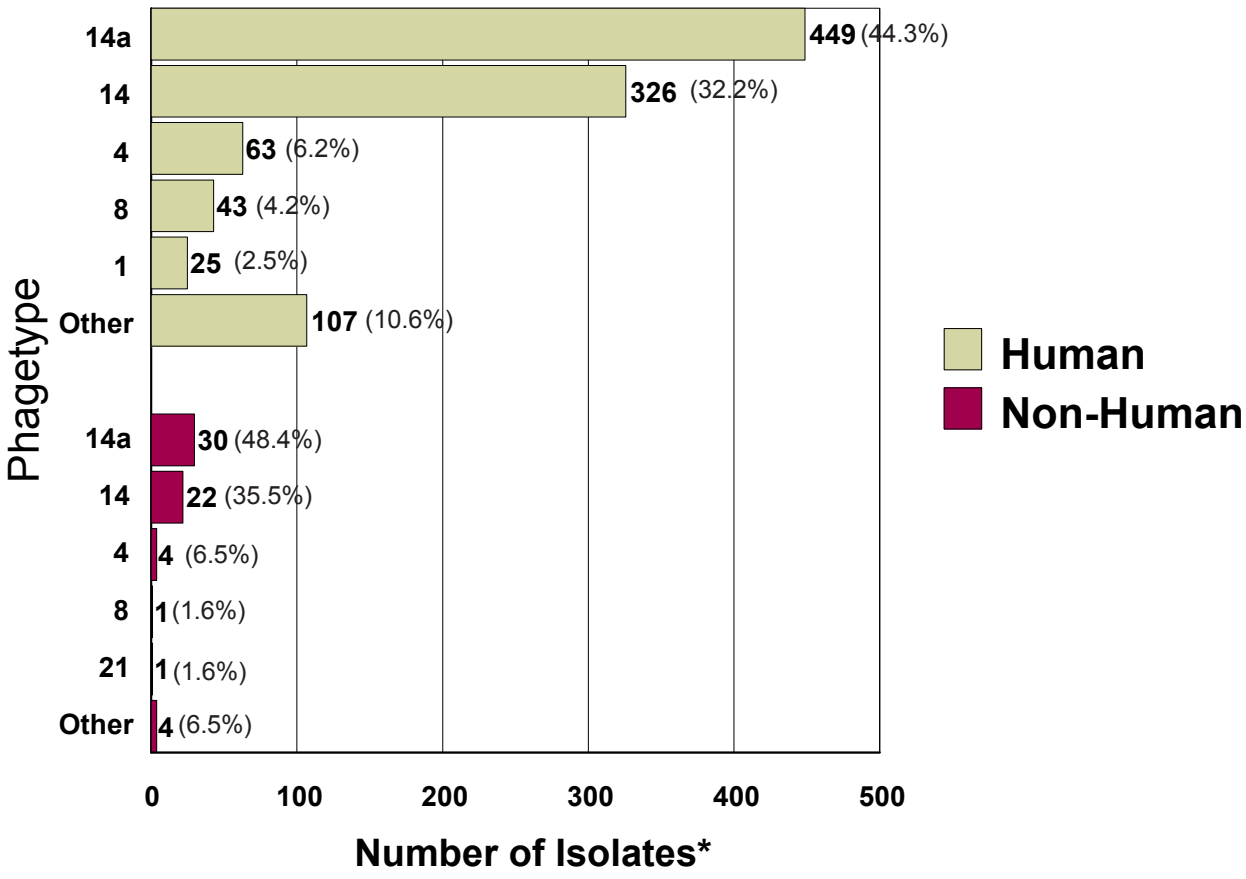
Organism		BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Escherichia coli	O2							1						**1**
Escherichia coli	O2:H4	1												**1**
Escherichia coli	O5:NM	2												**2**
Escherichia coli	O6	1				1								**2**
Escherichia coli	O7						2							**2**
Escherichia coli	O18			1				11						**12**
Escherichia coli	O20						1							**1**
Escherichia coli	O21						1							**1**
Escherichia coli	O26	1		2	3									**6**
Escherichia coli	O26:H11	2												**2**
Escherichia coli	O28ac:NM	1												**1**
Escherichia coli	O44				8									**8**
Escherichia coli	O48:H45	1												**1**
Escherichia coli	O55				4									**4**
Escherichia coli	O86a				2									**2**
Escherichia coli	O103:H Untypeable	2												**2**
Escherichia coli	O103:H2	1												**1**
Escherichia coli	O103:H25	1												**1**
Escherichia coli	O111	2			5	1								**8**
Escherichia coli	O111:NM	6												**6**
Escherichia coli	O111:NM VT Negative					1								**1**
Escherichia coli	O114				2									**2**
Escherichia coli	O121	1	1											**2**
Escherichia coli	O121:H19	12												**12**
Escherichia coli	O125				2									**2**
Escherichia coli	O126				3									**3**
Escherichia coli	O128				4									**4**
Escherichia coli	O145:NM	3												**3**
Escherichia coli	O157:H7	156	291	40		602								**1089**
Escherichia coli	O157 VTEC				54		537	34	47	9	3	42	2	**728**
Escherichia coli	O157 VT Negative			1		3								**4**
Escherichia coli	O157:NM	9	5											**14**
Escherichia coli	O165:H25	1												**1**
Escherichia coli	O165:NM VT Negative					2								**2**
Escherichia coli	O-Untypable:H19	1												**1**
Escherichia coli	O-Untypable:H21	1												**1**
Escherichia coli	O-Untypable:NM	1												**1**
Escherichia coli	EPEC				29			1	1					**31**
Escherichia coli	VTEC (Non O157)	26		2	3	1								**32**
Escherichia coli	Not Typed		9		8									**17**
	TOTAL	**232**	**306**	**46**	**127**	**611**	**541**	**47**	**48**	**9**	**3**	**42**	**2**	**2014**

NWT represents combined totals of Nunavut and Northwest Territories.

Phage Types of *Escherichia coli* O157:H7 Isolates of Human and Non-Human Origin in Canada, 2000

Figure 10 shows the top five human and non-human *Escherichia coli* O157:H7 phage types. Note that Phage Type (PT) 14 that has been reported previously, has this year been sub-divided into PT14, PT14a and PT14b. To compare with previous years' data, the total of all three phage types should be used.

Figure 10
Five Most Prevalent *Escherichia coli* O157:H7 Phage Types in Canada, 2000



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

Table 8 lists the number of phage type identifications of *Escherichia coli* O157:H7 of human origin in Canada in 2000 according to province of isolation.

Table 8
Escherichia coli O157:H7 Phage Types of Human Origin in Canada, 2000

Phagetype	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NWT	Total
1		18	1	2	2		1		1		**25**
2		2			12						**14**
4		26	6	1	26	3		1			**63**
8		22	1		18	1	1				**43**
10		2									**2**
14	1	57	9	6	246	1	2	3	1		**326**
14a		175	10	35	132	30	23	16	6	22	**449**
14b				1							**1**
21		3		1							**4**
23		5	1		3		1	1			**11**
24					1						**1**
26					1						**1**
27		2									**2**
28		4		2	1						**7**
31		2			7	12					**21**
32		8			5						**13**
33		5			1	1					**7**
34		1			2	1					**4**
38					2						**2**
42		1			1				1		**3**
54					1						**1**
59 var.					1						**1**
64 var.					1						**1**
65		1									**1**
65 var.							1				**1**
70					3						**3**
87		1			1						**2**
Atypical		1			2						**3**
Total	**1**	**336**	**28**	**48**	**469**	**49**	**29**	**21**	**9**	**22**	**1012**

NWT represents combined totals of Nunavut and Northwest Territories.

Table 9 lists the number of phage type identifications of *Escherichia coli* O157:H7 of non-human origin in Canada in 2000 according to province of isolation.

Table 9
Escherichia coli O157:H7 Phage Types of Non-Human Origin in Canada, 2000

Phage Type	Source	BC	AB	MB	ON	PQ	NS	Total
4	Bovine				2			**2**
4	Meat (Beef)					1		**1**
4	Unknown		1					**1**
8	Meat (Beef)					1		**1**
14	Bovine				9			**9**
14	Farm (Environmental)				1			**1**
14	Salami	9						**9**
14	Unknown				3			**3**
14a	Bovine				4			**4**
14a	Meat (Beef)				10	7		**17**
14a	Spinach						5	**5**
14a	Unknown		3					**3**
14a	Water (Ditch)				1			**1**
21	Meat (Beef)			1				**1**
38	Unknown		1					**1**
59 var.	Unknown		1					**1**
Atypical	Bovine				1			**1**
Atypical	Unknown		1					**1**
	TOTAL	**9**	**7**	**1**	**31**	**9**	**5**	**62**

Escherichia coli O157:H7 Verotoxin Genotyping by Polymerase Chain Reaction of Human Isolates

Table 10 lists the number of verotoxin (VT) genotypes of *Escherichia coli* O157:H7 identified by PCR (polymerase chain reaction). Data are classified by genotype in each province. The proportion of isolates carrying only the *stx*2 gene encoding VT2 (stx2) was much higher that normal in 2000 due to the large number of isolates from the *E. coli* O157:H7 outbreak in Walkerton, Ontario. The strain predominating in this outbreak carried *stx*2 only.

Table 10
PCR-VT Genotyping Profiles of *Escherichicia coli* O157:H7 Isolates of Human Origin in Canada, 2000

VT Type	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NWT	Total	%
VT1 + VT2		290	24	46	222	44	25	19	8	23	**701**	**69.7%**
VT2	1	21	2		216	2	2	1			**245**	**24.4%**
VT2 + VT2va		7	1	1	18	2					**29**	**2.9%**
VT1+ VT2+ VT2va		5		1	6		1	1			**14**	**1.4%**
VT1		6			1	1					**8**	**0.8%**
VT Negative					3		1				**4**	**0.4%**
VT1 + VT2va					1				1		**2**	**0.2%**
VT1 + VT2 + VT2v Atypical		1									**1**	**0.1%**
VT1 + VT2 + VT2vb					1						**1**	**0.1%**
VT2Va					1						**1**	**0.1%**
Total	**1**	**330**	**27**	**48**	**469**	**49**	**29**	**21**	**9**	**23**	**1006**	**100%**

NWT represents combined totals of Nunavut, Northwest Territories and Yukon Territories.

Escherichia coli O157:H7 Verotoxin Genotyping and Phage Typing

Table 11 summarizes the correlation of phage type and *stx* genotype. No particular genotype appears to be characteristic of any phage type.

Table 11
Escherichicia coli O157:H7 Phage Types and Verotoxin Genotypes of Human Origin in Canada, 2000

Phage Type	VT1	VT1 +VT2	VT1 +VT2 +VT2va	VT1 +VT2va	VT1 +VT2 +VT2v Atypical	VT1 +VT2 +VT2vb	VT2	VT2 +VT2va	VT2Va	VT Neg	Total	%
1		25									**25**	**2.5**
2							14				**14**	**1.4**
4		29	1				14	17			**61**	**6.1**
8		39					1	3			**43**	**4.3**
10		2									**2**	**0.2**
14	1	115					203	4		3	**326**	**32.4**
14a	6	437				1				1	**445**	**44.2**
14b		1									**1**	**0.1**
21		3					1				**4**	**0.4**
23		1	9		1						**11**	**1.1**
24							1				**1**	**0.1**
26								1			**1**	**0.1**
27		2									**2**	**0.2**
28		7									**7**	**0.7**
31		20					1				**21**	**2.1**
32	1	4	1	1			4	2			**13**	**1.3**
33		7									**7**	**0.7**
34		1					2		1		**4**	**0.4**
38		1					1				**2**	**0.2**
42			2	1							**3**	**0.3**
54								1			**1**	**0.1**
59 var.		1									**1**	**0.1**
64 var.		1									**1**	**0.1**
65		1									**1**	**0.1**
65 var.		1									**1**	**0.1**
70							2	1			**3**	**0.3**
87		2									**2**	**0.2**
Atypical		1	1				1				**3**	**0.3**
Total	**8**	**701**	**14**	**2**	**1**	**1**	**245**	**29**	**1**	**4**	**1006**	**100.0**

Non-O157:H7 Verotoxigenic *Escherichia coli* Isolates of Human Origin In Canada, 2000

Non-O157:H7 verotoxigenic *E. coli* (VTEC; also designated Shiga-toxigenic *E. coli*, or STEC) are not actively sought by most provincial Public Health Laboratories. In spite of that, isolates are identified each year, and these are summarized in Table 12 for the year 2000. The British Columbia PHL actively screens for non-O157:H7 VTEC strains, accounting for the predominance of these organisms from British Columbia (27/42 VTEC strains submitted to the NLEP for confirmation or further analysis). Saskatchewan also identified a proportionally higher number of non-O157:H7 VTEC than many other provinces, though the reasons for this are not known.

The cluster of O121:H19 isolates in British Columbia was extremely interesting. This serotype was not reported to the NLEP in 1998 or 1999, though two VT2, *eae* positive O121:NM strains were isolated in British Columbia in 1999. This cluster may represent an unrecognized outbreak.

Well-defined human pathogenic enterohemorrhagic *E. coli* (EHEC) strains found in Canada in 2000 were: O26:H11; O103:H2, H25, and H(Untypeable); O111:NM; O113:H21; O145:NM; and O157:NM. Other serotypes, though not traditionally considered EHEC strains, did carry the *eae* gene thought to be extremely important for human virulence and considered an accessory virulence factor associated with severe disease sequelae such as the hemolytic uremic syndrome (HUS). Testing for the EHEC hemolysin gene was begun during the year 2000, and results will be included in the 2001 Annual Report.

Laboratories are encouraged to test for non-O157:H7 VTEC. Results from the year 2000 suggest they may contribute significantly to human disease in Canada.

Table 12
Non-O157:H7 Verotoxigenic *Escherichicia coli* Isolates of Human Origin in Canada, 2000

Serotype	Genotype	Province(s)	Number of Isolates
O5:NM	VT1 + *eae*	BC	2
O26:H11	VT1 + *eae*	BC, SA	3
O70:H11	VT1 + *eae*	SA	1
O103:H2	VT1 + *eae*	BC, SA	2
O103:H25	VT1 + *eae*	BC	1
O103:H Untypeable	VT1 + *eae*	BC	1
O111:NM	VT1 + *eae*	BC	2
O111:NM	VT1VT2v + *eae*	BC	1
O111:NM	VT1VT2 + *eae*	SA	1
O113:H21	VT2VT2v	BC	1
O121:H19	VT2 + *eae*	BC	11
O145:NM	VT1	BC	2
O145:NM	VT1VT2 + *eae*	BC	1
O145:NM	VT2 + *eae*	BC	1
O146:NM	VT2	SA	1
O156:H25	VT1 + *eae*	SA	1
O157:NM	VT2 + *eae*	AB	2
O157:NM	VT1VT2 + *eae*	QC	1
O157:NM	VT1VT2va + *eae*	AB	1
O165:H25	VT2va + *eae*	BC	1
OR:H2	VT1 + *eae*	SA	2
OR:H47	VT1 + *eae*	SA	1
O(New):H(Not Typed)	VT1	MB	1

Note that the O(New) serotype pattern was evident in molecular O serotyping, but has not been confirmed serologically.

Strains that do not carry *stx* genes 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, PCR or other genetic methods. 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 Table13. It should be noted that the isolates received by the NLEP and tested in this manner are likely only a very small fraction of the strains from each virulence group circulating in the Canadian population.

Table 13
Other Non-O157:H7 Non-Verotoxigenic *Escherichia coli* Isolates in Canada, 2000

Serotype	Province	Number of Isolates	Comments
Enteropathogenic *E. coli* (EPEC; *eae* gene positive, no VT genes detected)			
O28ac:NM	ON	1	
O49:NM	ON	1	also carries ST1 gene
O145:H34	ON	1	bovine isolate
O157:H16	SA	2	
O157:H39	BC	1	
O160:H8	NB	2	
Inactive	SA	1	
Inactive	SA	1	also carries *cdt*-II
Enteroaggregative *E. coli (EAggEC; EAgg* gene PCR positive or enteroaggregative on HEp-2 cells)			
O(New):NM*	SA	2	
Enteroinvasive *E. coli* (EIEC; invasive in cell culture or positive for *ial* locus, *ipaH, or inv* PCR product)			
O28ac:NM	BC	1	
Enterotoxigenic *E. coli* (ETEC; PCR positive for LT1 or ST1 or positive in cell culture and suckling mouse assays)			
O49:NM	SA	1	ST1 +ve; also has *eae*, as shown above
Cytotoxic necrotizing factor (CNF)-producing *E. coli*			
O4:H5	NB	1	CNF 1
O6:H1	BC	1	CNF 1
O18:H17	SA	1	CNF 1
O18:K1:H7	NB	1	CNF 1, also has K1 antigen
O18:K1:H7	NB	1	CNF 1, CNF 2, also has K1 antigen
OR:H(Untypeable)	SA	1	CNF 1
O(New):NM*	NB	1	CNF 1
Cytolethal distending toxin (CDT)-positive *E. coli*			
O52:H45	SA	1	*cdt*-II
Inactive	SA	1	*cdt*-II
Inactive	SA	1	*cdt*-II, *eae* (as shown above)
K1 capsule positive *E. coli*			
O1:K1:NM	SA	1	
O18:K1:H7	NB	1	also carried CNF 1 and CNF 2, as shown above
OR:K1:NM	SA, QC	3	

*O(New) patterns were designated on the basis of molecular typing of O-antigen genes by using PCR-RFLP.

Escherichia coli Isolates With No Virulence Phenotypes or Genes

Some of the *Escherichia coli* strains tested at the NLEP do not carry any of the virulence phenotypes or genes currently tested. Serotype information for these strains is summarized in Table 14.

Table 14
Escherichicia coli Isolates Without Detectable Virulence Phenotypes or Genes

Serotype	Province(s)	Source (No. Isolates)	Total Isolates
O2:H Untypeable	NF	human	1
O2:H4	BC	human	1
O2:H7	NB	human	1
O2a/O50:H34	QC	human	1
O6:NM	SA	human	1
O7:H Untypeable	QC	unknown	1
O7:NM	QC	human (2), unknown (1)	3
O8:H4	BC	human	2
O8:H49	QC	unknown	1
O8:NM	QC	unknown	1
O12:H Untypeable	ON	human	1
O15:H Untypeable	AB	human	1
O17:H18	ON	human	1
O20:NM	BC, SA	human	2
O20:H Untypeable	QC	human	1
O21:H7	ON	human	3
O24:H26	SA	human	1
O25:NM	QC	unknown	1
O29:NM	SA	human	1
O52:H45	ON, SA	human	2
O60:H Untypeable	SA	human	1
O71:H Untypeable	QC	unknown	2
O75:H55	ON	human	1
O99:H Untypeable	ON	human	1
O115:H16	NB	human	2
O144:H Untypeable	QC	human	1
O148:NM	AB	human	1
O154:NM	AB	human	1
O157:H Untypeable	ON, QC	human, unknown	2
O157:NM	QC, AB	human	2
O170:H Untypeable	QC	unknown	1
O179:H8	QC	unknown	1
O(New):NM	QC, SA	human	2
OR:NM	QC	human	1
OR:H4	BC	human	1
OR:H Untypeable	ON	human	2
O Untypeable:NM	NB	human	1
O Untypeable:H Untypeable	ON	human	1
Inactive	SA	human	1

Antimicrobial Resistance and Phage Types of *Escherichia coli* O157:H7 in Canada, 2000

Table 15 lists the antimicrobial resistance patterns (R-Types) of *E. coli* O157:H7. The table is arranged to show the number of isolates of each phage type that is resistant to a particular series of antimicrobial agents. Antimicrobial activity has been determined by disc diffusion techniques. R-Type designations are concatenated letters representing resistance to a specific antibiotic: A = Ampicillin, C = Chloramphenicol, Ci = Ciprofloxacin, S = Streptomycin, Su=Sulfadiazine, T = Tetracycline, Tm = Trimethoprim/Sulfamethoxazole.

Table 15
Antimicrobial Resistance Profiles and Phage Types of *Escherichia coli* O157:H7 in Canada, 2000

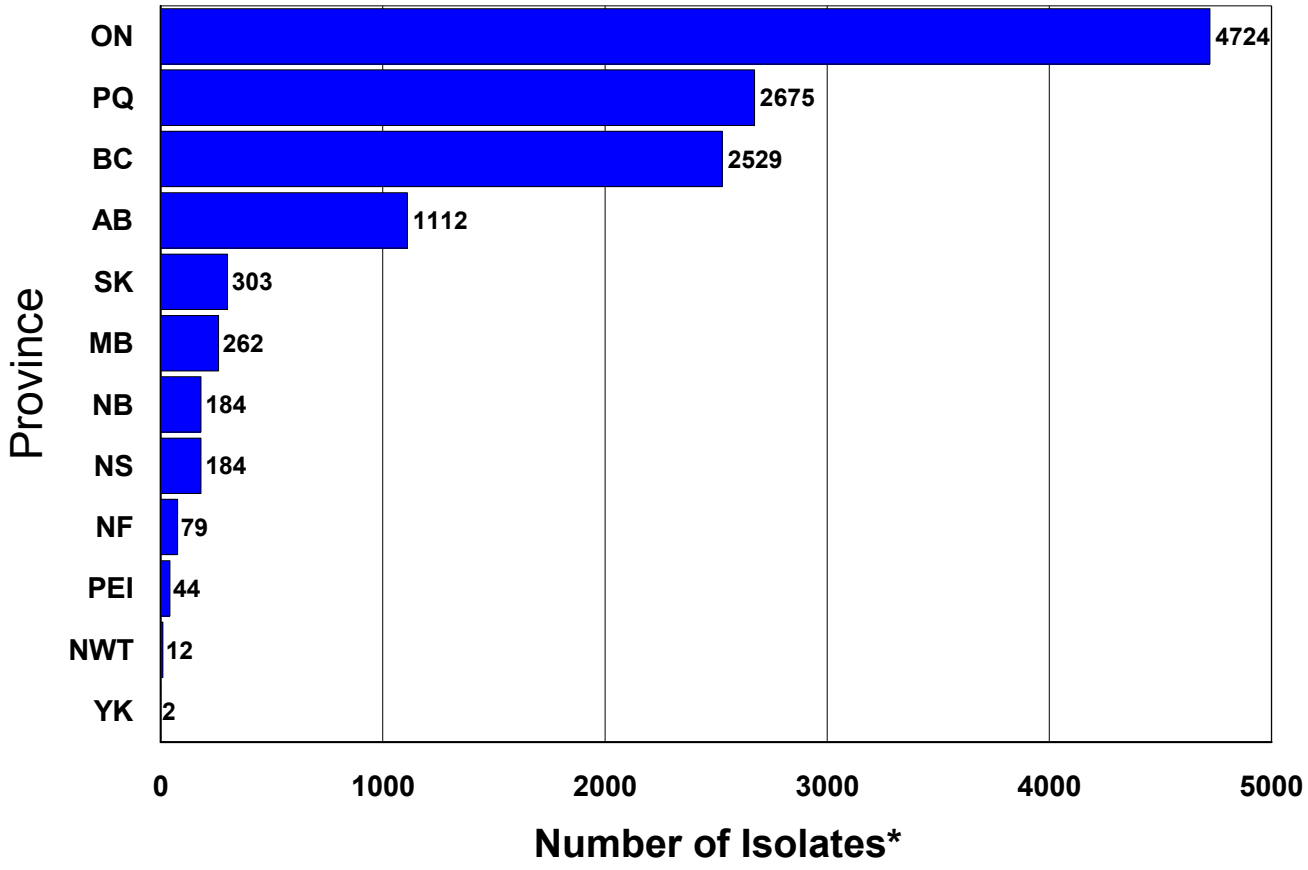
Organism	R-Type	Phagetype (No. Isolates)	Total
E. coli O157:H7	A	14 (2), 14a (1)	3
	ACSSu	14a (1)	1
	ASSu	14a (3)	3
	ASSuT	14a (2), 31 (2)	4
	ASSuTTm	14 (1)	1
	ASu	14a (1)	1
	ASuT	14a (1)	1
	ASuTTm	8 (1)	1
	CSu	27 (1)	1
	CSuT	31 (1)	1
	SSu	4 (1), 87 (1)	2
	SSuT	23 (6), 14 (3), 14a (3), 42 (3), 14b (1), AT (1)	17
	SSuTTm	14 (1)	1
	ST	14a (1), 23 (1)	2
	STTm	14a (1)	1
	Su	14a (8), 14 (7)	15
	SuT	14a (1), 21 (1)	2
	SuTTm	8 (1), 14a (1)	2
	T	4 (2), 8 (1), 10 (1), 38 (1)	5
	Tm	8 (1)	1
	Sensitive	14a (397), 14 (303), 4 (57), 8 (38), 1 (25), 31 (18), 2 (14), 32 (12), 33 (7), 28 (6), 34 (4), 21 (3), 23 (3), 70 (3), AT (2), 10 (1), 24 (1), 26 (1), 27 (1), 38 (1), 54 (1), 59 var. (1), 64 var. (1), 65 (1), 65 var. (1)	902
	Total		**967**

Section 4 - *Campylobacter*

Campylobacter Isolates of Human Origin in Canada, 2000

Figure 11 provides the provincial frequency distribution of human *Arcobacter*, *Campylobacter*, and *Helicobacter* in Canada in the year 2000.

Figure 11
***Arcobacter*, *Campylobacter* and *Helicobacter* Isolates of Human Origin in Canada, 2000**



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

Table 16 lists the number of laboratory identifications of human and non-human *Arcobacter*, *Campylobacter* and *Helicobacter* by province. Organisms are listed alphabetically by genus and species.

This table summarizes the number of *Campylobacter* isolates characterized by the National Laboratory for Enteric Pathogens in Winnipeg, Manitoba. Data included in the human *Campylobacter* numbers in Table 16 are from the provincial reports only. As in previous years, however, CIDPC in Ottawa, Ontario, has kindly provided information from their Notifiable Diseases database and these data have been merged into the table. We have used their total number of isolates and allocated the difference to *Campylobacter* sp.

Table 16
Arcobacter, *Campylobacter* and *Helicobacter* Isolates of Human Origin in Canada, 2000

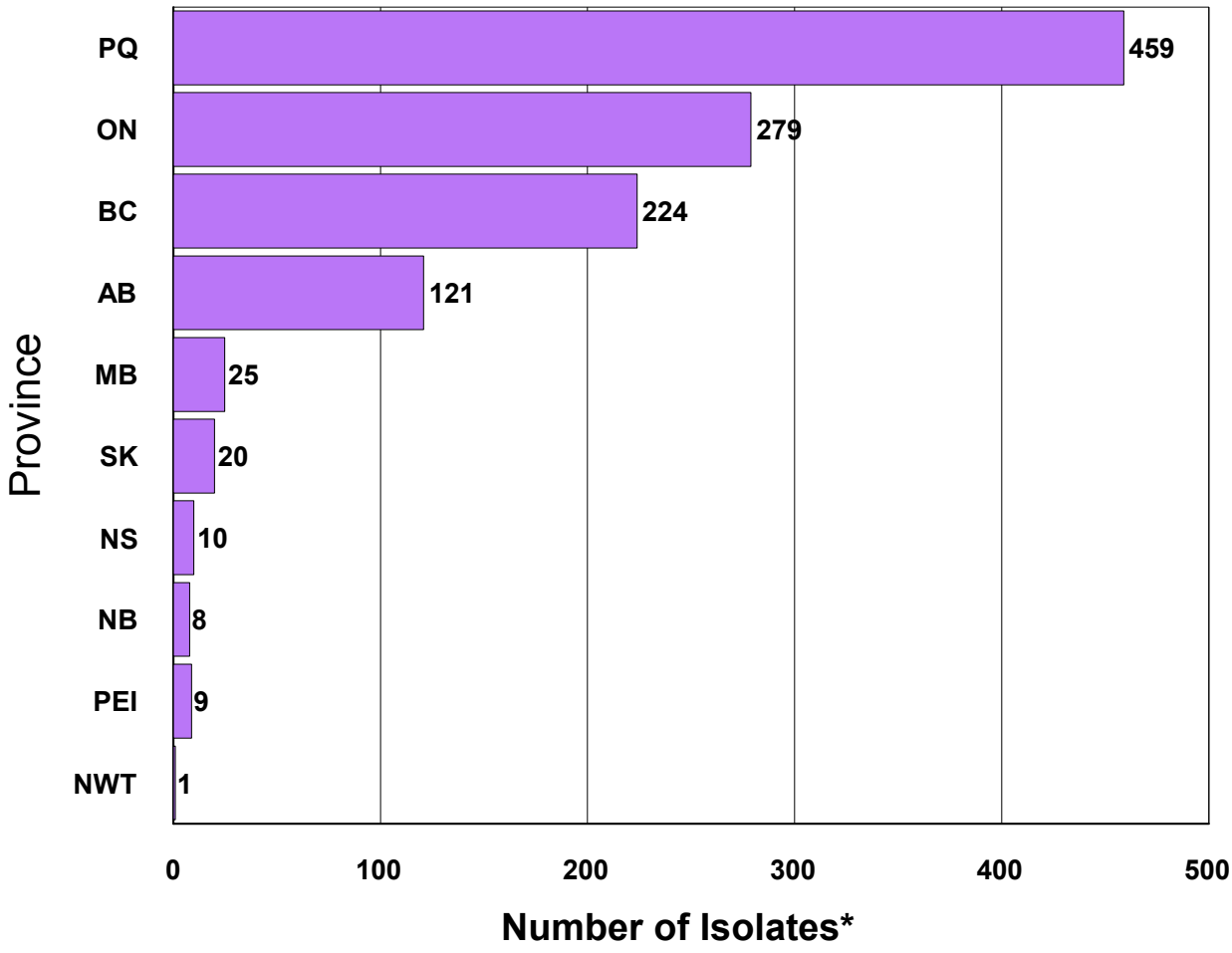
Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Arcobacter butzleri	2				9	5							**16**
Arcobacter cryaerophilus					4								**4**
Campylobacter coli	8	53	25	11	85	26	3			1			**212**
C. concisus					1								**1**
C. fetus ssp *fetus*		4			6	11							**21**
C. hyointestinalis	1						4						**5**
C. jejuni	222	356	239	125	303	67	133			18	7	1	**1471**
C. jejuni ssp *doylei*						1							**1**
C. jejuni / coli	166	131		3				63	42	52	3	1	**461**
C. lari	2	2				2	2		2				**10**
C. upsaliensis	2	4	4	1	6	2	2						**21**
Campylobacter sp	2118	561	35	122	4301	2561	40	121		8	2		**9869**
Helicobacter canadensis		1											**1**
H. cinaedi					1								**1**
H. pullorum	4												**4**
H. pylori					7								**7**
Helicobacter sp	4				1								**5**
TOTAL	**2529**	**1112**	**303**	**262**	**4724**	**2675**	**184**	**184**	**44**	**79**	**12**	**2**	**12110**

Section 5 - *Shigella*

Shigella Isolates of Human Origin in Canada, 2000

Figure 12 provides the provincial frequency distribution of human *Shigella* in Canada for the year 2000.

Figure 12
***Shigella* Isolates of Human Origin in Canada, 2000**



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

Table 17 lists the number of laboratory identifications of *Shigella* from human patients by province.

Table 17
Shigella Isolates of Human Origin in Canada, 2000

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Shigella dysenteriae	2	1		1									**4**
Shigella dysenteriae 1	1				1								**2**
Shigella dysenteriae 2	4				1	2							**7**
Shigella dysenteriae 3						1							**1**
Shigella dysenteriae 4	4	2			1								**7**
Shigella dysenteriae 6	1												**1**
Shigella dysenteriae 10	1												**1**
Shigella dysenteriae Prov. SH106	1				4								**5**
TOTAL *S. dysenteriae*	**14**	**3**		**1**	**7**	**3**							**28**
Shigella flexneri	4	6	1	8			2	1	1				**23**
Shigella flexneri 1	4	4				2							**10**
Shigella flexneri 1a					1								**1**
Shigella flexneri 1b					6				1				**7**
Shigella flexneri 2	24	7	1			11							**43**
Shigella flexneri 2a					17		1						**18**
Shigella flexneri 2b					4								**4**
Shigella flexneri 3	12	3	1		1	9							**26**
Shigella flexneri 3a	1	1	1		11								**14**
Shigella flexneri 3b					1								**1**
Shigella flexneri 4	1	3				2							**6**
Shigella flexneri 4a	1	1			8								**10**
Shigella flexneri 5b					2								**2**
Shigella flexneri 6	9	9			15	7							**40**
Shigella flexneri 6 hertfordshire					1								**1**
Shigella flexneri Prov. 101		2											**2**
Shigella flexneri Prov. SH104	2	1			6	5							**14**
Shigella flexneri var. X		2											**2**
Shigella flexneri var.Y					1	1							**2**
TOTAL *S. flexneri*	**58**	**39**	**4**	**8**	**74**	**37**	**3**	**1**	**2**				**226**
Shigella boydii	3	3					2						**8**
Shigella boydii 1	1				1								**2**
Shigella boydii 2	5	1			5	4							**15**
Shigella boydii 3	1												**1**
Shigella boydii 4	4	2				1							**7**
Shigella boydii 8	2	2											**4**
Shigella boydii 9		1											**1**
Shigella boydii 12	1				1								**2**
Shigella boydii 14	1	1			2								**4**
Shigella boydii 18	1				1								**2**
Shigella boydii Prov. 108	1				6	3							**10**
Shigella boydii Prov. E16553						1							**1**
TOTAL *S. boydii*	**20**	**10**			**16**	**9**	**2**						**57**
Shigella sonnei	132	69	16	9	182	164	2	3					**577**
Shigella fluvialis							1						**1**
Shigella sp				7		246		6	1		1		**261**
TOTAL *Shigella*	**224**	**121**	**20**	**25**	**279**	**459**	**8**	**10**	**3**	**0**	**1**	**0**	**1150**

Phage Types of *Shigella* Isolates of Human Origin in Canada, 2000

Table 18 lists the number of phage type identifications of *Shigella* sp. of human origin in Canada in 2000 according to province of isolation.

Table 18
Phage Types of *Shigella* Isolates of Human Origin in Canada, 2000

Organism	Phagetype	AB	BC	ON	PQ	Total
Shigella flexneri	F 1	2	2	1		**5**
	F 3	1				**1**
	F 4	1	1			**2**
	Subtotal	**4**	**3**	**1**		**8**
Shigella sonnei	Atypical	1	1		3	**5**
	S 1			23	2	**25**
	S 2			1		**1**
	S 3			1		**1**
	S 4			2		**2**
	S 5	3	1	6	6	**16**
	S 7			1		**1**
	S 8	1	1	1		**3**
	S 12		5		4	**9**
	S 15			3		**3**
	S 16	13				**13**
	S 17		3			**3**
	Atypical			2	1	**3**
	Subtotal	**18**	**11**	**40**	**16**	**85**

Antimicrobial Resistance and Phage Types of *Shigella* of Human Origin in Canada, 2000

Table 19 lists the antimicrobial resistance patterns (R-Types) of some specific serotypes of *Shigella* sp. The table is arranged to show the number of isolates of each phage type that is resistant to a particular series of antimicrobial agents. Antimicrobial activity has been determined by disc diffusion techniques. R-Type designations are concatenated letters representing resistance to a specific antibiotic: A = Ampicillin, C = Chloramphenicol, Ci = Ciprofloxacin, S = Streptomycin, Su=Sulfadiazine, T = Tetracycline, Tm = Trimethoprim/Sulfamethoxazole.

Table 19
Antimcirobial Resistance Profiles and Phage Types of *Shigella* of Human Origin in Canada, 2000

Organism	R-Type	Phagetype (No. Isolates)	Total
Shigella boydii	ACSSuTTm	AT (1)	1
Shigella flexnerii	ACSSuTTm	F1 (3), F3 (1), F4 (1)	5
Shigella flexnerii	ACST	F1 (1), F4 (1)	2
Shigella flexnerii	ASSuT	F1 (1)	1
Shigella sonnei	A	S5 (1)	1
Shigella sonnei	ACSSuTTm	S4 (2), S5 (1), S8 (1)	4
Shigella sonnei	ASSuTTm	S12 (3), S15 (3), S17 (3), S1 (2), S8 (2), S3 (1), AT (1)	15
Shigella sonnei	ASSuTm	S5 (3), S7 (1), AT (1)	5
Shigella sonnei	CST	AT (1)	1
Shigella sonnei	SSuT	S16 (8), AT (1)	9
Shigella sonnei	SSuTTm	S12 (6), S5 (5), AT (3)	14
Shigella sonnei	Su	S5 (3)	3
Shigella sonnei	SuT	S16 (5)	5
Shigella sonnei	Sensitive	S1 (23), S5 (3), S2 (1), AT (1)	28

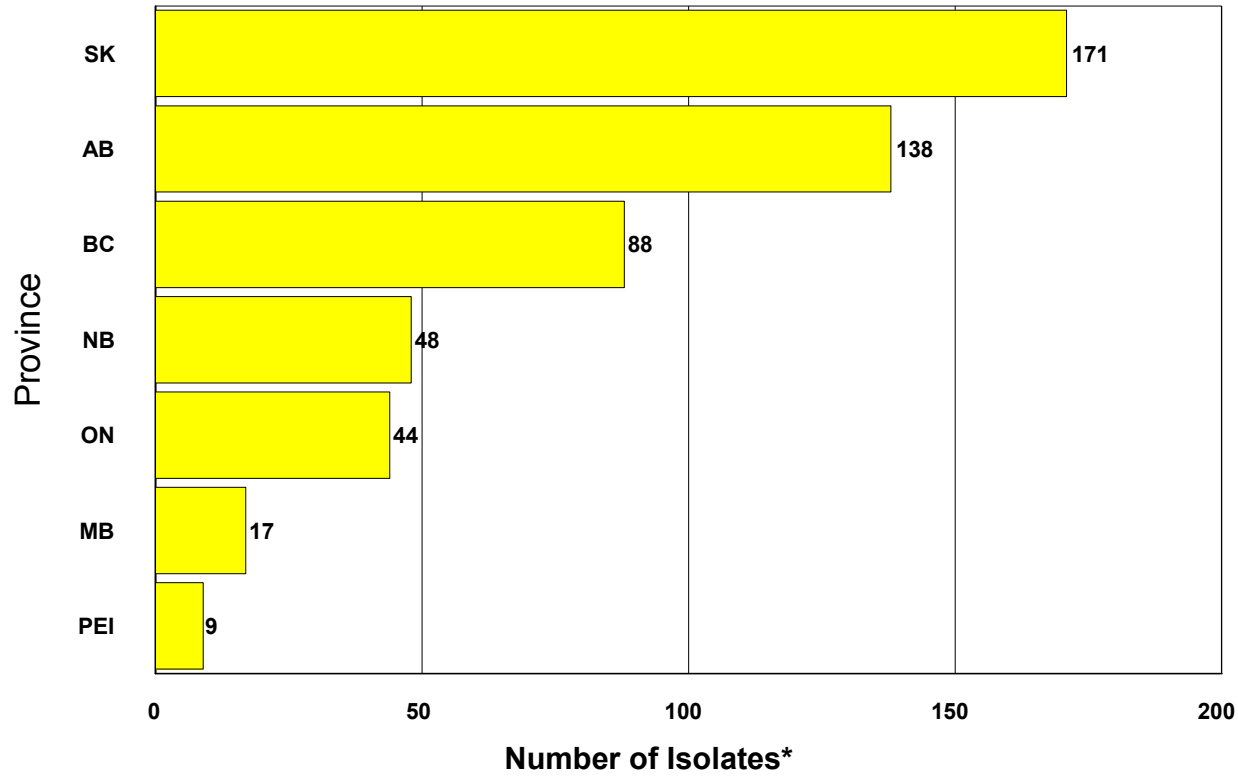
AT = Atypical

Section 6 - *Aeromonas* and *Plesiomonas*

Aeromonas and *Plesiomonas* Isolates of Human Origin in Canada, 2000

Figure 13 provides the provincial frequency distribution of human *Aeromonas* and *Plesiomonas* in Canada for the year 2000.

Figure 13
***Aeromonas* and *Plesiomonas* Isolates of Human Origin in Canada, 2000**



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

Table 20 lists the number of laboratory identifications of *Aeromonas* and *Plesiomonas* from human patients by province.

Table 20
***Aeromonas* and *Plesiomonas* Isolates of Human Origin in Canada, 2000**

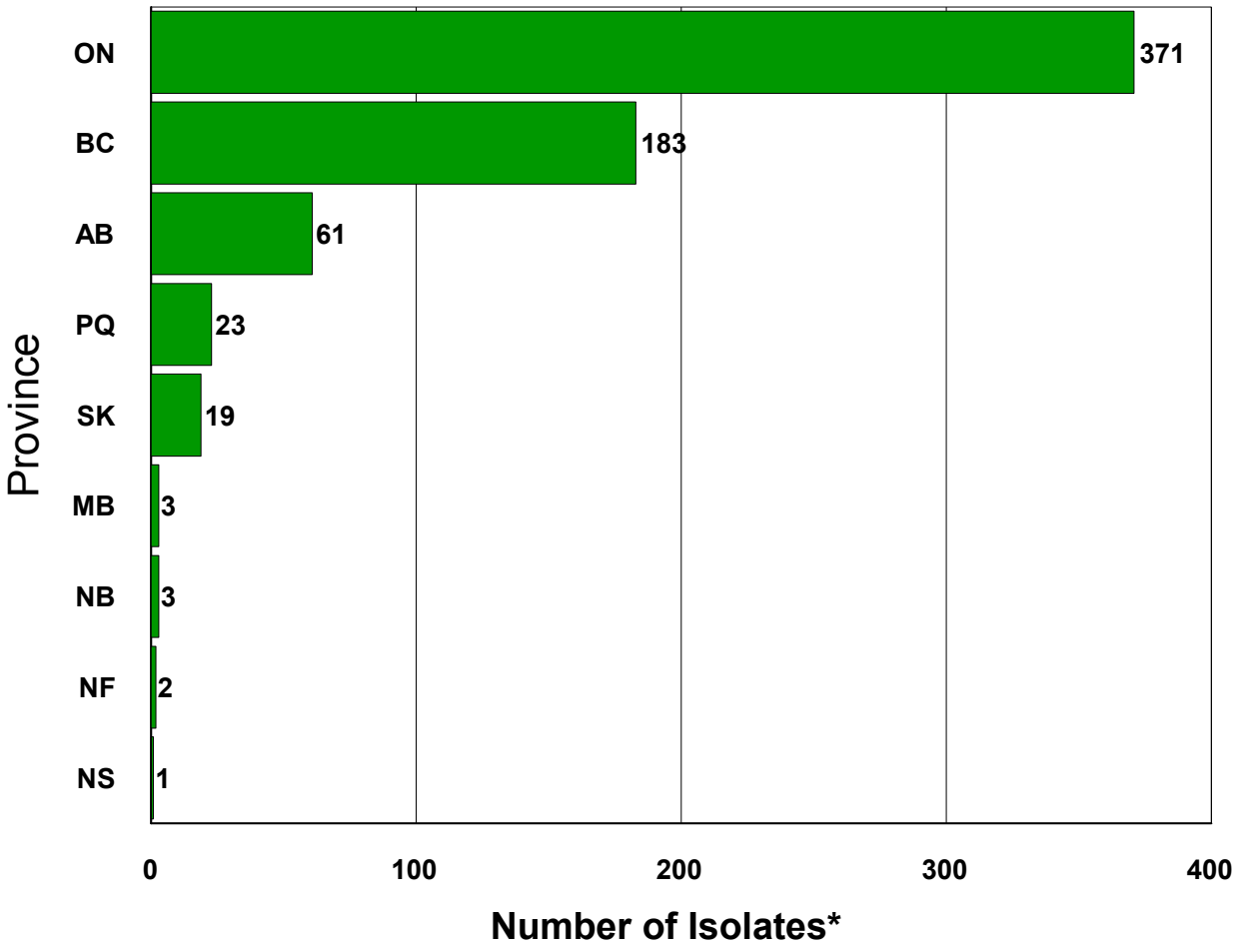
Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Aeromonas sp				17			3						**20**
A. allosaccharophila			1										**1**
A. caviae	53	68	135		23		12		7				**298**
A. eucrenophila							1						**1**
A. hydrophila	6	25	25		13		27						**96**
A. hydrophila-like		5											**5**
A. jandaei					1								**1**
A. schubertii	1												**1**
A. veronii biovar *sobria*	1	33	7		1		1						**43**
A. veronii biovar *veronii*	18		1		1								**20**
Plesiomonas shigelloides	9	7	2		5		4		2				**29**
TOTAL	**88**	**138**	**171**	**17**	**44**	**0**	**48**	**0**	**9**	**0**	**0**	**0**	**515**

Section 7 - *Yersinia*

Yersinia Isolates of Human Origin in Canada, 2000

Figure 14 provides the provincial frequency distribution of *Yersinia* in humans in Canada for the year 2000.

Figure 14
***Yersinia* Isolates of Human Origin in Canada, 2000**



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

Table 21 lists the number of laboratory identifications of *Yersinia* from humans by province.

Table 21
Yersinia Isolates of Human Origin in Canada, 2000

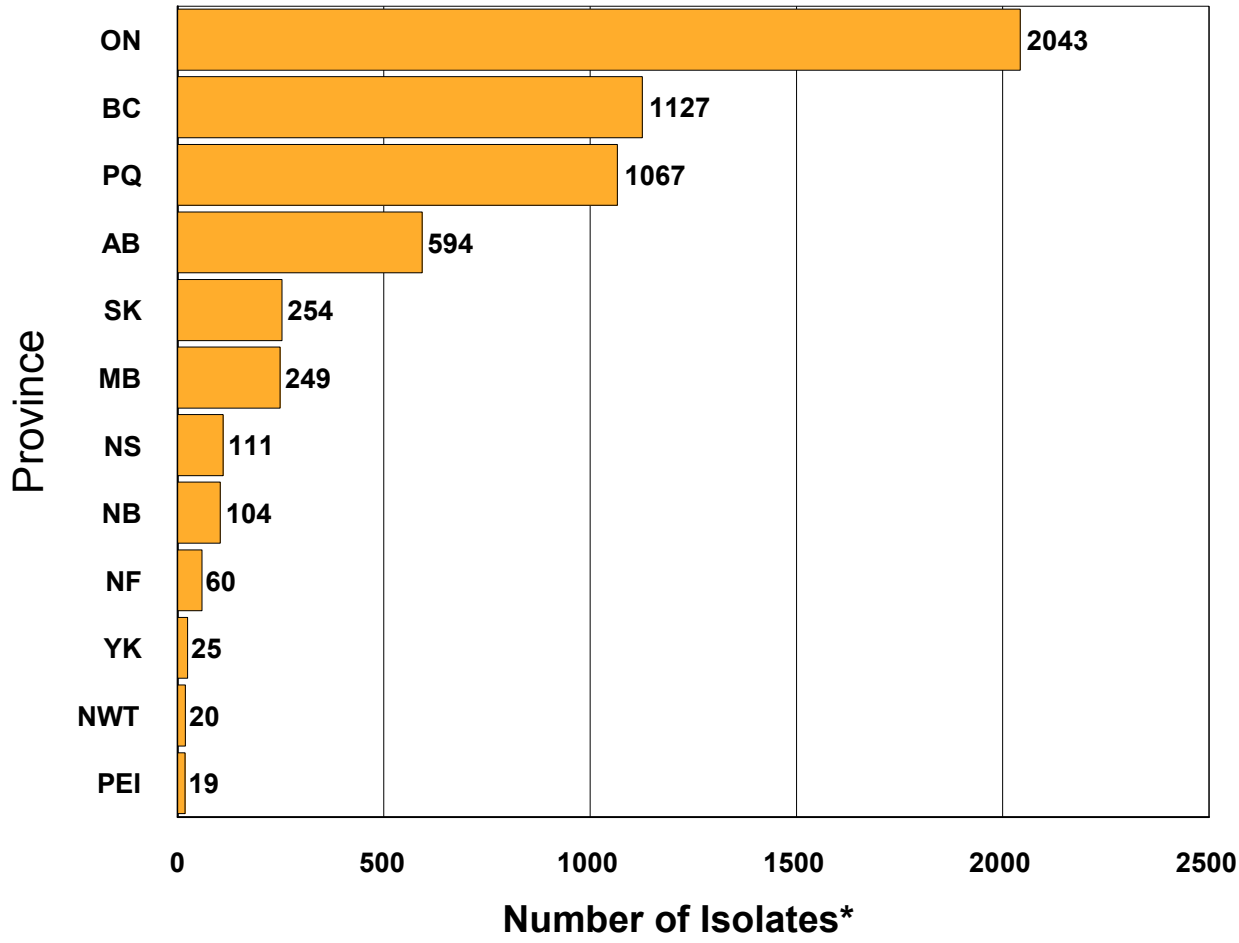
Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Y. bercovieri					2								**2**
Y. enterocolitica	97	7	6	3	32	23	2			2			**172**
Y. enterocolitica bio 1A			9		3								**12**
Y. enterocolitica bio 1A O:41,42		6											**6**
Y. enterocolitica bio 1A O:41,43		3			4								**7**
Y. enterocolitica bio 1A O:5		4			5								**9**
Y. enterocolitica bio 1A O:5,27					1								**1**
Y. enterocolitica bio 1A O:6,30		1			2								**3**
Y. enterocolitica bio 1A O:6,31		1			1								**2**
Y. enterocolitica bio 1A O:7,8		1			2								**3**
Y. enterocolitica bio 1A O:7,13		2			4								**6**
Y. enterocolitica bio 1A O-Untypable		2			3								**5**
Y. enterocolitica bio 1B O:8		1			1								**2**
Y. enterocolitica bio 2 O:5,27		1			2								**3**
Y. enterocolitica bio 2 O:9		1											**1**
Y. enterocolitica bio 3 O:1,2,3					1								**1**
Y. enterocolitica bio 3 O:3					1								**1**
Y. enterocolitica bio 3 O:5,27		1											**1**
Y. enterocolitica bio 4 O:3		21			299								**320**
Y. frederiksenii	35	3	1		1		1						**41**
Y. intermedia	30	2	1		6			1					**40**
Y. kristensenii	6	4	1										**11**
Y. pseudotuberculosis	3												**3**
Y. rohdei	11		1		1								**13**
Yersinia sp	1												**1**
TOTAL *Yersinia*	**183**	**61**	**19**	**3**	**371**	**23**	**3**	**1**	**0**	**2**	**0**	**0**	**666**

Section 8 - Parasites

Parasitic Infections of *Cryptosporidium*, *Cyclospora*, *Entamoeba* and *Giardia* in Canada, 2000

Figure 15 provides the provincial frequency distribution of human *Crytptosporidium, Cyclospora, Entamoeba* and *Giardia* in Canada for the year 2000.

Figure 15
***Crytptosporidium, Cyclospora, Entamoeba* and *Giardia* Isolates of Human Origin in Canada, 2000**



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

Table 22 lists the number of laboratory identifications of *Crytptosporidium, Cyclospora, Entamoeba* and *Giardia* from human patients by province.

Table 22
Cryptosporidium, Cyclospora, Entamoeba and *Giardia* Isolates of Human Origin in Canada, 2000

Organism	BC	AB	SK	MB	ON	PQ	NB	NS	PEI	NF	NWT	YK	Total
Cryptosporidium	169	90	34	66	202	6	20	7	2	1	1	5	**603**
Cyclospora cayatenis	7	0	0	0	0	0	0	2	0	0	0	0	**9**
Entamoeba dispar	0	1	0	0	0	0	0	0	0	0	0	0	**1**
Entamoeba histolytica	21	12	4	0	0	10	4	8	2	0	0	1	**62**
Entamoeba histolytica/dispar	30	1	3	0	0	119	0	5	0	0	0	0	**158**
Giardia	900	490	213	183	1841	932	80	89	15	59	19	19	**4840**
Total Parasites	**1127**	**594**	**254**	**249**	**2043**	**1067**	**104**	**111**	**19**	**60**	**20**	**25**	**5673**

Section 9 - Outbreaks of Enteric Pathogens in Canada

Salmonella

A total of 57 outbreaks involving 394 isolates belonging to 19 different *Salmonella* serotypes were reported in 2000. There were 15 community outbreaks, approximately the same as in 1998 (11 outbreaks) and 1997 (13 outbreaks).

Number of Outbreaks	Outbreak Type	Number of Isolates
15	Community	287
40	Family	94
1	Hospital	2
1	Travel	11
Totals **57**		**394**

Escherichia coli O157:H7

A total of 358 isolates of *Escherichia coli* O157:H7 were characterized from 33 outbreaks. The number of family (or contact related) type outbreaks has increased from 7 outbreaks with 15 cases in 1998 to 24 outbreaks with 62 cases in 2000. The number of community outbreaks has increased from 3 outbreaks with 59 cases in 1998 to 7 outbreaks with 287 cases in 2000. The large increase in the number of isolates is due to a large, water associated outbreak in Walkerton, Ontario.

Number of Outbreaks	Outbreak Type	Number of Isolates
7	Community	287
24	Family	62
2	Daycare	9
Totals **33**		**358**

Shigella sonnei

A total of 135 isolates of *Shigella sonnei* were implicated in 8 outbreaks.

Number of Outbreaks	Outbreak Type	Number of Isolates
3	Community	121
3	Family	6
1	Travel	2
1	Day Care	6
Totals **8**		**135**

Other Enteric Pathogens

In addition to the above organisms, there were 3 family outbreaks of *Campylobacter* sp involving a total of 8 isolates, 2 *Giardia* isolates from a family outbreak, 3 isolates of *Shigella flexneri* 3 associated with a family outbreak, and 2 isolates of *Vibrio cholera* Non-O1 associated with a travel related outbreak.

Table 23 provides details of outbreaks of enteric pathogens classified by causative organism, outbreak type (Community, Family, National, etc.), food source, province, phagetype and number of culture-confirmed cases. It should be noted that the actual numbers of cases may have been much higher than indicated.

Table 23
Summary of Outbreaks in Canada, 2000

Causative Organism	Outbreak Type	Description	Province	PT	Source (No. Isolates)	Total
Campylobacter jejuni	Family		NB	n/a**	Human (2)	2
Campylobacter jejuni / coli	Family		NS	n/a	Human (2)	2
	Family		AB	n/a	Human (4)	4
					Subtotal	**8**
Escherichia coli O157:H7	Community	Niagara Falls	ON	14	Human (24)	24
	Community	Walkerton	ON	14	Human (165), Bovine (9), Water (3), Environmental (1)	178*
	Family		MB	14a	Human (2)	2
	Family		AB	14a	Human (2)	2
	Family		AB	14	Human (2)	2
	Community	Hamburger	PQ, NWT	14a	Human (25), Ground Beef (6)	31
	Family		AB	14	Human (4)	4
	Community	Ready to Eat Spinach	NS	14a	Human (11), Spinach (5)	16
	Community		NB	14a	Human (7)	7
	Community	Hamburger	NU, NWT	14a	Human (16)	16
	Family		AB	4	Human (2)	2
	Family		AB	14a	Human (2)	2
	Community	Daycare	MB	14a	Human (7)	7
	Family		AB	14a	Human (2)	2
	Family		NB	14a	Human (2)	2
	Family		AB	14a	Human (2)	2
	Family		MB	14a	Human (2)	2
	Family		AB	14a	Human (2)	2
	Family		AB	14a	Human (2)	2
	Family		AB	14a	Human (4)	4
	Family		MB	14a	Human (2)	2
	Family		ON	14a	Human (6), Ground Beef (2)	8
	Family		AB	4	Human (2)	2
	Family		AB	14a	Human (3)	3
	Family		AB	14a	Human (4)	4
	Family		AB	14a	Human (2)	2
	Family		PEI	14a	Human (2)	2
	Family		AB	4	Human (2)	2
	Community	Daycare	ON	14a	Human (2)	2
	Family		AB	14a	Human (2)	2
	Family		AB	8	Human (3)	3
	Community		PQ	31	Human (11)	11
	Family		AB	14a	Human (2)	2
					Subtotal	**354**
Giardia	Family		AB	n/a	Human (2)	2
Salmonella Bovismorbificans	Family		BC	n/a	Human (2)	2
Salmonella Brandenburg	Community	Nursing Home	ON	1	Human (14)	14

Causative Organism	Outbreak Type	Description	Province	PT	Source (No. Isolates)	Total
Salmonella Enteritidis	Community	Nosocomial	ON	4	Human (2)	2
	Community		ON	4	Human (43)	43
	Community	Travel - Portugal	ON	1	Human (11)	11
	Family		AB	8	Human (2)	2
	Community		SK	11b	Human (3)	3
	Family		BC	8	Human (2)	2
	Family		BC	8	Human (3)	3
	Family		BC	8	Human (2)	2
	Community	Chinese Restaurant	BC	8	Human (65), Coconut (1), Eggs (2)	68
	Family		AB	1	Human (2)	2
	Family		AB	13a	Human (2)	2
	Family		BC	8	Human (3)	3
	Community		PQ	33	Human (6)	6
	Community		PQ	4	Human (20)	20
					Subtotal	**179**
Salmonella Hadar	Commnunity		AB	47	Human (8)	8
	Family		AB	11	Human (2)	2
	Family		AB	11	Human (2)	2
	Commnunity		AB	2	Human (15)	15
					Subtotal	**27**
Salmonella Hartford	Family		PQ	nd**	Human (3)	3
Salmonella Heidelberg	Family		BC	19	Human (2)	2
	Family		AB	Atypical	Human (2)	2
	Family		AB	41	Human (2)	2
	Family		AB	29	Human (2)	2
	Family		SK	19	Human (2)	2
	Family		AB	19	Human (2)	2
	Community		NS	19	Human (5)	5
	Family		PQ	nd	Human (2)	2
Salmonella ssp I 4,5,12:r:-	Family		AB	19	Human (2)	2
					Subtotal	**21**
Salmonella Infantis	Family		BC	nd	Human (2)	2
Salmonella Javiana	Family		BC	n/a	Human (2)	2
	Community	Orange Juice	ON	n/a	Human (8)	8
					Subtotal	**10**
Salmonella Johannesburg	Family		PQ	n/a	Human (2)	2
Salmonella Paratyphi A	Community		BC	n/a	Human (3)	3
Salmonella Paratyphi B var. Java	Family		PQ	Dundee	Human (6)	6
Salmonella Schwarzengrund	Family	Oriental Duck	AB	n/a	Human (5)	5
	Family		BC	n/a	Human (2)	2
					Subtotal	**7**

Causative Organism	Outbreak Type	Description	Province	PT	Source (No. Isolates)	Total
Salmonella Thompson	Community	Restaurant	ON	2	Human (6)	6
	Community	Wedding	AB	2	Human (41)	41
	Family		AB	2	Human (4)	4
	Family		PEI	5	Human (2)	2
	Family		AB	1	Human (2)	2
					Subtotal	**55**
Salmonella Typhi	Family		AB	E1	Human (3)	3
	Family		AB	O	Human (3)	3
					Subtotal	**6**
Salmonella Typhimurium	Family		ON	104	Human (2)	2
	Family		BC	Atypical	Human (2)	2
	Family		AB	104	Human (2)	2
	Family		MB	104	Human (2)	2
	Community		NS	22	Human (35)	35
	Family		MB	104	Human (2)	2
	Family		BC	8	Human (2)	2
	Community		AB, ON	107	Human (12)	12
					Subtotal	**59**
Salmonella ssp I 4,5,12:i:-	Family		SK	191	Human (2)	2
	Family		BC	nd	Human (2)	2
					Subtotal	**4**
Salmonella ssp IV 16:z4, z32:-	Family		BC	n/a	Human (2)	2
Salmonella ssp I Group B	Family		PEI	n/a	Human (2)	2
Shigella flexneri 3	Family		BC	n/a	Human (3)	3
Shigella sonnei	Community		ON	S1	Human (22)	22
	Family		AB	S16	Human (2)	2
	Community		PQ	nd	Human (84)	84
	Community		PQ	nd	Human (15)	15
	Family		BC	nd	Human (2)	2
	Family		PQ	nd	Human (2)	2
	Community	Travel - Egypt	ON	nd	Human (2)	2
	Community	Day Care	AB	nd	Human (6)	6
					Subtotal	**135**
Vibrio cholera Non-O1	Community	Travel - Bali	BC	n/a	Human (2)	2

* 196 human and 49 bovine isolates of *Campylobacter jejuni / coli* were also associated with the Walkerton outbreak.
** n/a = Not Applicable, nd = Not Done.

Section 10 - Miscellaneous Information

Table 24
Unusual Enteric Pathogen Infection Sites by Organism

Organism	Source (Number Isolates)	Total
S. Agona	urine (1)	1
S. Anatum	urine (1)	1
S. Berta	blood (1)	1
S. Brandenburg	blood (2), urine (1)	3
S. Derby	urine (1)	1
S. Enteritidis	blood (8), urine (1), wound (1), sputum (1)	11
S. Glostrup	urine (1)	1
S. Hadar	blood (1), urine (2)	3
S. Heidelberg	blood (41), urine (11)	52
S. Javiana	blood (2)	2
S. Johannesberg	blood (1)	1
S. Lomalinda	blood (1)	1
S. Montevideo	blood (1)	1
S. Newport	urine (1)	1
S. Oranienburg	eye (1)	1
S. Panama	urine (1)	1
S. Paratyphi A	blood (3), urine (1)	4
S. Paratyphi B	blood (1)	1
S. Paratyphi B var Java	blood (2)	2
S. Saintpaul	blood (1), urine (1)	2
S. Schwarzengrund	blood (1), urine (1)	2
S. Stanley	rectal abcess (1)	1
S. Thompson	blood (1), urine (1)	2
S. Typhi	blood (12), urine (1)	13
S. Typhimurium	blood (7), urine (5), foot (1), peritoneal fluid (1), pleural fluid (1)	15
S. Worthington	urine (1)	1
Salmonella ssp I 4,5,12:b:-	blood (1)	1
Salmonella ssp I 4,5,12:i:-	blood (1)	1
Salmonella ssp I 6,7:-:1,5	urine (1)	1
Salmonella ssp I 3,10:e,h:-	urine (1)	1
Salmonella ssp I Group B	blood (1), urine (1), bile (1)	3
Salmonella ssp I Rough-O:Non-Motile	urine (1)	1
Salmonella ssp IIIb 61:k:1,5	urine (1)	1
Salmonella sp	blood (2)	2
Aeromonas sp	eye swab (1)	1
Campylobacter coli	blood (1)	1
Campylobacter fetus ssp *fetus*	blood (1)	1
Campylobacter jejuni	blood (1)	1
Giardia	duodenal fluid (1)	1
Shigella dysenteriae 7	urine (1)	1
Shigella flexneri 2	blood (1)	1
Shigella sonnei	blood (1), urine (1)	2
Shigella spp.	urine (1)	1
Yersinia enterocolitica	facial carbuncle (1), blood (2)	3
Total		**149**

Table 25
Unusual Enteric Pathogen Infection Sites by Source

Source	Organism (Number of Isolates)	Total
Bile	*Salmonella* ssp I Group B (1)	1
Blood	S. Berta (1), S. Brandenburg (2), S. Enteritidis (8), S. Hadar (1), S. Heidelberg (41), S. Javiana (2), S. Johannesberg (1), S. Lomalinda (1), S. Montevideo (1), S. Paratyphi A (3), S. Paratyphi B (1), S. Paratyphi B var. Java (2), S. Saintpaul (1), S. Schwarzengrund (1), S. Thompson (1), S. Typhi (12), S. Typhimurium (7), *Salmonella* ssp I 4,5,12:b:- (1), *Salmonella* ssp I 4,5,12:i:- (1), *Salmonella* ssp I Group B (1), *Salmonella* sp (2), *Campylobacter coli* (1), *Campylobacter fetus* ssp *fetus* (1), *Campylobacter jejuni* (1), *Shigella flexneri* 2 (1), *Shigella sonnei* (1), *Yersinia enterocolitica* (2).	98
Eye	S. Oranienburg (1), *Aeromonas* sp (1)	2
Facial Carbuncle	*Yersinia enterocolitica* (1)	1
Foot	S. Typhimurium (1)	1
Duodenal Fluid	*Giardia* (1)	1
Peritoneal Fluid	S. Typhimurium (1)	1
Pleural Fluid	S. Typhimurium (1)	1
Rectal Abcess	S. Stanley (1)	1
Sputum	S. Enteritidis (1)	1
Urine	S. Agona (1), S. Anatum (1), S. Brandenburg (1), S. Derby (1), S. Enteritidis (1), S. Glostrup (1), S. Hadar (2), S. Heidelberg (11), S. Newport (1), S. Panama (1), S. Paratyphi A (1), S. Saintpaul (1), S. Schwarzengrund (1), S. Thompson (1), S. Typhi (1), S. Typhimurium (5), S. Worthington (1), *Salmonella* ssp I 3,10:e,h:- (1), *Salmonella* ssp I 6,7:-:1,5 (1), *Salmonella* ssp IIIb 61:k:1,5 (1), *Salmonella* ssp I Group B (1), *Salmonella* ssp I Rough-O:Non-Motile (1), *Shigella dysenteriae* 7 (1), *Shigella sonnei* (1), *Shigella* sp (1).	40
Wound	S. Enteritidis (1)	1
Total		**149**

Contaminated Imported Products

Imported Product	Country of Origin	Number of Isolates
Poultry (Duck)	Vietnam	*Salmonella* Schwarzengrund (5 isolates)

One hundred and thirty seven isolates of enteric pathogens were known to be acquired abroad by travellers. They included 31 different organisms from 42 regions and/or countries.

Table 26
Travel Related Enteric Pathogen Infections by Organism

Organism	Country of Travel (Total Cases)	Total
S. Albany	Vietnam, Hong Kong and Thailand (1)	1
S. Colindale	Africa (1)	1
S. Durham	Africa (1)	1
S. Emek	Thailand (1)	1
S. Enteritidis	Malaysia (1), Mexico (6), Thailand (2), Dominican Republic (5), Portugal (11), Cuba (1) , Singapore and Bali (1), England and France (1)	28
S. Haardt	Egypt (1)	1
S. Newport	Unknown (1)	1
S. Ohio	Haiti (1)	1
S. Paratyphi A	India (1)	1
S. Poona	Mexico (1)	1
S. Typhi	Morocco (1)	1
S. Typhimurium	Mexico (2) , South Africa and Mozambique (1), USA (1)	4
Salmonella ssp I 4,5,12:b:-	Thailand (1)	1
Salmonella ssp I 4,5,12:i:-	Costa Rica (1)	1
Salmonella ssp I O-Rough:b:l,w	Haiti (1)	1
Total *Salmonella* sp		**45**
Campylobacter coli	India (1)	1
Campylobacter jejuni	Thailand (1) , Cuba (1), Australia (1), Ireland, England and Spain (1), Africa (2), Spain (2), Spain and Morocco (2), Scotland (1), Hong Kong and Bali (1), Bangladesh (1), Mexico (1)	14
C. jejuni/coli	Thailand (1)	1
Total *Campylobacter* sp		**16**
Shigella boydii	Unknown (1) , India (2)	3
Shigella boydii 14	Mexico (1)	1
Shigella dysenteriae	Mexico (1), India (1), Burundi, Africa (2), Congo, Africa (3)	7
Shigella flexneri	Mexico (1), Africa (2), Ivory coast, Kenya (1)	4
Shigella flexneri 2	India (2)	2
Shigella flexneri 3	Cuba (1) , Nigeria, Africa (2)	3
Shigella flexneri 4	Pakistan and Netherlands (1)	1
Shigella sonnei	India (2), Egypt (3), Africa and Middle East (1)	6
Total *Shigella* sp		**27**
E. coli O157 VTEC	Mexico (1)	1
Aeromonas hydrophila	Mexico (1)	1
V. cholerae Non O1	Bali (3), Dominican Republic (1)	4
V. cholerae Non O1/Non O139	India (1)	1
V. parahaemolyticus	Mexico (1)	1
Total *Vibrio* sp		**6**
Yersinia frederiksenii	East Africa (1)	1

Organism	Country of Travel (Total cases)	Total
Cryptosporidium	Mexico (2), Dominican Republic (1) , Grenada (1)	4
Giardia	Syria (11), Haiti (1), Cuba (1) , Guatemala (1), Peru (3), Dominican Republic (1), Cambodia (1), India (1), Hawaii (1)	21
Entamoeba histolytica	Brazil (1), Syria (3), India (1), Grenada (1)	6
Entamoeba histolytica/dispar	Nepal, Malaysia, Guatemala and Honduras (1), Africa (1), Tunisia (1), Guatemala (1), India (1), Nepal (2), Thailand (1)	8
Total *Entamoeba* sp		**14**
Strongyloices stencoralis and Hookworm	Africa (1)	1

Table 27
Travel Related Enteric Pathogen Infections by Country of Travel

Country of Travel	Organism (Total Cases)	Total
Africa	*S.* Colindale (1), *S.* Durham (1), *Campylobacter jejuni* (2), *Shigella flexneri* (2), *Yersinia frederiksenii* (1), *Entamoeba histolytica/dispar* (1), *Strongyloices stencoralis* and hookworm (1)	9
Africa and Middle East	*Shigella sonnei* (1)	1
Australia	*Campylobacter jejuni* (1)	1
Bali	*Vibrio cholerae* Non O1 (3)	3
Bangladesh	*Campylobacter jejuni* (1)	1
Brazil	*Entamoeba histolytica* (1)	1
Burundi	*Shigella dysenteriae* (2)	2
Cambodia	*Giardia* (1)	1
Costa Rica	*Salmonella* ssp I 4,5,12:i:- (1)	1
Congo	*Shigella dysenteriae* (3)	3
Cuba	*S.* Enteritidis (1), *Campylobacter jejuni* (1), *Shigella flexneri* 3 (1), *Giardia* (1)	4
Dominican Republic	*S.* Enteritidis (5), *Vibrio cholera* Non O1 (1), *Cryptosporidium* (1), *Giardia* (1)	8
Egypt	*S.* Haardt (1), *Shigella sonnei* (3)	4
England and France	*S.* Enteritidis (1)	1
Grenada	*Cryptosporidium* (1), *Entamoeba histolytica* (1)	2
Guatemala	*Giardia* (1), *Entamoeba histolytica/dispar* (1)	2
Haiti	*S.* Ohio (1), *Salmonella* ssp I O-Rough:b:l,w (1), *Giardia* (1)	3
Hong Kong and Bali	*Campylobacter jejuni* (1)	1
India	*S.* Paratyphi A (1), *Campylobacter coli* (1), *Shigella boydii* (2), *Shigella dysenteriae* (1), *Shigella flexneri* 2 (2), *Shigella sonnei* (2), *Vibrio cholerae* Non O1/Non O39 (1), *Giardia* (1), *Entamoeba histolytica* (1), *Entamoeba histolytica/dispar* (1)	13
Ireland, England and Spain	*Campylobacter jejuni* (1)	1
Ivory Coast and Kenya	*Shigella flexneri* (1)	1
Malaysia	*S.* Enteritidis (1)	1
Mexico	*S.* Enteritidis (6), *S.* Poona (1), *S.* Typhimurium (2), *Campylobacter jejuni* (1), *Shigella boydii* 14 (1), *Shigella dysenteriae* (1), *Shigella flexneri* (1), *E.coli* O157 VTEC (1), *Aeromonas hydrophila* (1), *Vibrio parahaemolyticus* (1), *Cryptosporidium* (2)	18
Morocco	*S.* Typhi (1)	1
Nepal	*Entamoeba histolytica/dispar* (2)	2
Nepal, Malaysia, Guatemala and Honduras	*Entamoeba histolytica/dispar* (1)	1
Nigeria	*Shigella flexneri* (2)	2
Pakistan and Netherlands	*Shigella flexneri* 4 (1)	1
Peru	*Giardia* (3)	3
Portugal	*S.* Enteritidis (11)	11
Scotland	*Campylobacter jejuni* (1)	1
Singapore and Bali	*S.* Enteritidis (1)	1
Spain	*Campylobacter jejuni* (2)	2
Spain and Morocco	*Campylobacter jejuni* (2)	2
South Africa and Mozambique	*S.* Typhimurium (1)	1
Syria	*Giardia* (11), *Entamoeba histolytica* (3)	14
Thailand	*S.* Emek (1), *S.* Enteritidis (2), *Salmonella* ssp I 4,5,12:b:- (1), *Campylobacter jejuni* (1), *Campylobacter jejuni/coli* (1), *Entamoeba histolytica/dispar* (1)	7
Tunisia	*Entamoeba histolytica/dispar* (1)	1
Vietnam, Hong Kong and Thailand	*S.* Albany (1)	1
United States	*S.* Typhimurium (1), *Giardia* (1)	2
Unknown	*S.* Newport (1), *Shigella boydii* (1)	2

Discussion

The preparation of our Annual Summary involves the continual re-evaluation of the methods used to estimate the number of isolates reported. This helps ensure the data represented is a reliable estimator of enteric pathogen activity for the year. The data reported here is a compilation of annual reports from each province, the National Enteric Surveillance Program (NESP) system, the Laboratory for Food-borne Zoonosis annual report, our Enteric Disease Surveillance System (EDSS) database, databases maintained by specific sections within the National Laboratory for Enteric Pathogens (NLEP), and a database maintained by the Centre for Infectious Disease Prevention and Control (CIDPC) formerly known as the Bureau of Infectious Diseases (BID) in Ottawa. Due to the wide range of data sets used, numbers of isolates were compared on a case by case (or organism by organism) basis.

Typically, the numbers of cases of disease reported to CIDPC are larger than the numbers of laboratory confirmed cases and are not sub-typed below a genus level. In these cases, it is assumed that the laboratory confirmed isolates are part of the CIDPC number and therefore numbers attributed to genus level only in this report are the difference between the CIDPC number and the laboratory confirmed number.

In some cases the NESP data contain partial identifications, whereas the provincial annual reports have these partial identifications replaced with full organism identifications. Here it is assumed that the provincial laboratory annual reports will have more sub-typed isolates. The final numbers used in these situations is the result of a comparisons of partially identified organisms in NESP and the fully identified organisms in a provincial annual report.

In response to a consensus reached at a stakeholders meeting held in Toronto this year, we are now reporting on human parasitic and *Yersinia* infections in this report. The data in these sections may be under- reported; however, it will provide a good base and starting point for future reports.

Also new to this report are sections reporting antimicrobial resistance of selected enteric pathogens. Antimicrobial resistance has been determined on strains submitted to NLEP by disc diffusion techniques. Although the majority of strains submitted to the national laboratory are outbreak related, enough sporadic isolates are also included to provide a rough estimate of the extent of antimicrobial resistance in selected enteric pathogens in Canada. By including additional sub-typing information, such as phage type, inferences may be made concerning the importance of various organism sub-types to the health of the Canadian population.

Some data sets are absent from this report which if provided, would be of a great benefit to all those who use this publication. All stakeholders are encouraged to continue to contribute and provide more specimen related data to make this report as accurate and representative of enteric disease in Canada as possible.

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