




BC Integrated Surveillance of Foodborne Pathogens (BCISFP)

Salmonella Findings

2013

BC Centre for Disease Control

An agency of the Provincial Health Services Authority

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Table of Contents

Introduction.....5

Methods.....6

Data sources.....6

Human.....6

Food.....6

Abattoir.....7

Animal.....7

Data Analysis.....8

Findings.....9

Human.....9

Food.....11

Abattoir.....12

Animals.....14

Integrated.....16

Conclusions.....22

Appendix.....23

Contributors.....24

Introduction

Following a food safety stakeholder meeting in December 2005, representatives from the British Columbia Centre for Disease Control (BCCDC), the British Columbia Ministry of Agriculture (BC MAGRI), the Public Health Agency of Canada (PHAC), the Canadian Food Inspection Agency (CFIA) and the Centre for Coastal Health (CCH) decided to implement integrated surveillance of foodborne pathogens along the food chain in British Columbia (BC). *Salmonella* was selected as the first pathogen under surveillance because it is cultured within all sectors (animal, food and humans), is recovered at high rates, has several subtyping methods available, and affects a great variety of food commodities. The BC Integrated Surveillance of Foodborne Pathogens (BCISFP) was initiated in October 2006.

The goals and objectives of BCISFP are:

To decrease the burden of human disease in BC commonly associated with foodborne pathogens by:

1. Identifying sources and patterns of endemic and emerging disease caused by foodborne pathogens
    a. Monitor the occurrence of pathogens along the food chain
    b. Investigate the association between pathogens isolated from food and animal sources and human disease
2. Supporting an efficient and coordinated multi-agency response to health risks along the food chain
    a. Formalize inter and intra-agency partnerships required to respond to health risks along the food chain
    b. Identify, investigate and respond to health risks along the food chain by sharing information from human, food and animal sources

This is the fourth annual report arising from integrated surveillance data. It highlights data from 2013 and includes some data reported since 2009 for historical trend analysis. The purpose of the report is to inform stakeholders of the occurrence of *Salmonella* at select points along the food chain in BC and of the results of investigations that ensued.

Methods - Data Sources

Human

Human salmonellosis cases are reportable in BC. All *Salmonella* isolates are forwarded to the BC Public Health Microbiology and Reference Laboratory (BC PHMRL) for further characterisation, including serotyping and pulsed-field gel electrophoresis (PFGE). Phage typing is done on isolates that are forwarded to the National Microbiology Laboratory of the Public Health Agency of Canada (NML-PHAC). Until March 2012, phage type (PT) was available for isolates of select serotypes from the first 15 days of the month. As of April 2012, phage typing was expanded to include all *S.* Enteritidis and *S.* Heidelberg isolates. The *Salmonella* typing data available are shown in Appendix 1.

During follow-up with salmonellosis cases, Environmental Health Officers in BC ask about travel during the exposure period (for further details see http://www.bccdc.ca/NR/rdonlyres/0B227280-6193-4A7B-9B8C-CF8C41A5538C/0/Salmonella_March2012.pdf).

Travel status was classified into three groups:

- Locally-acquired: isolates from cases who did not travel outside of Canada during their exposure period.
- Travel: isolates from cases who had spent any time during their exposure period outside of Canada.
- Unknown: no travel information was available (E.g., case could not be reached; information was not collected or entered, etc.).

All human analyses, except for Figure 1, are based only on isolates from cases reported as locally-acquired. *Salmonella* Typhi and Paratyphi (except for Paratyphi B var. Java) are rarely locally acquired and rarely foodborne and are excluded from the analyses in this report.

The data available for analysis include isolate identification number, laboratory typing results and date of submission; no personal identifying information is used in this analysis. PFGE data were not included in the data analysis since it was not consistently obtained across sectors.

Food

Most *Salmonella* isolates from food originated from meat samples collected in BC as part of the Canadian Integrated Program on Antimicrobial Resistance Surveillance (CIPARS-PHAC). In 2013, samples of fresh chicken and pork (started in 2008) and fresh, ground turkey (started in March 2011) were collected as part of the core CIPARS Retail Meat Program. In addition, samples of chicken nuggets (started in March 2011), black silkie chicken (started in 2009), and seafood (started in 2009) were also collected in 2013 although the number of samples collected is routinely lower than the core retail commodities. Additional *Salmonella* isolates from food were provided from samples collected through outbreak investigations or routine food quality programs submitted to the BC PHMRL. In 2013, no data on *Salmonella* isolates

recovered from samples submitted and tested by the CFIA in BC were provided to BCISFP.

The data available for analysis include isolate identification number, date of purchase (or submission) and food type (e.g. chicken). The *Salmonella* typing data available are shown in Appendix 1. Primary isolation and serotyping of all CIPARS isolates were completed by the Laboratory for Foodborne Zoonoses of the Public Health Agency of Canada (LFZ-PHAC); similarly LFZ-PHAC performed phage typing of select serotypes. The CIPARS data also included the number of samples tested for *Salmonella* (denominator data).

Abattoir

CIPARS routinely tests for *Salmonella* in cecal content samples collected from pigs and chickens slaughtered at federally inspected abattoirs across Canada. The BC data represent animals that were located in BC prior to slaughter; they do not reflect the location of the abattoirs.

The data available for analysis include isolate identification number and species. The *Salmonella* typing data available are shown in Appendix 1. Primary isolation, serotyping and phage typing (select serotypes only) of the CIPARS abattoir isolates were completed by LFZ-PHAC.

Animal

All *Salmonella* isolates originated from samples submitted to the Animal Health Centre, BC MAGRI. Two categories of data are included:

- Diagnostic: isolates recovered from sick or dead animals
- Monitoring: isolates from apparently healthy animals sampled as part of government monitoring or industry monitoring and research programs

The data available for analysis include submission identification number, date of submission, type of sample (e.g. fecal, tissue), category (i.e. diagnostic or monitoring) and animal species; no identifying information was included. The *Salmonella* typing data available are shown in Appendix 1. Isolates were serotyped and phage typed (select serotypes only) by LFZ-PHAC.

Animal data may include multiple isolates of *Salmonella* from the same animal or premises.

Methods - Data Analysis

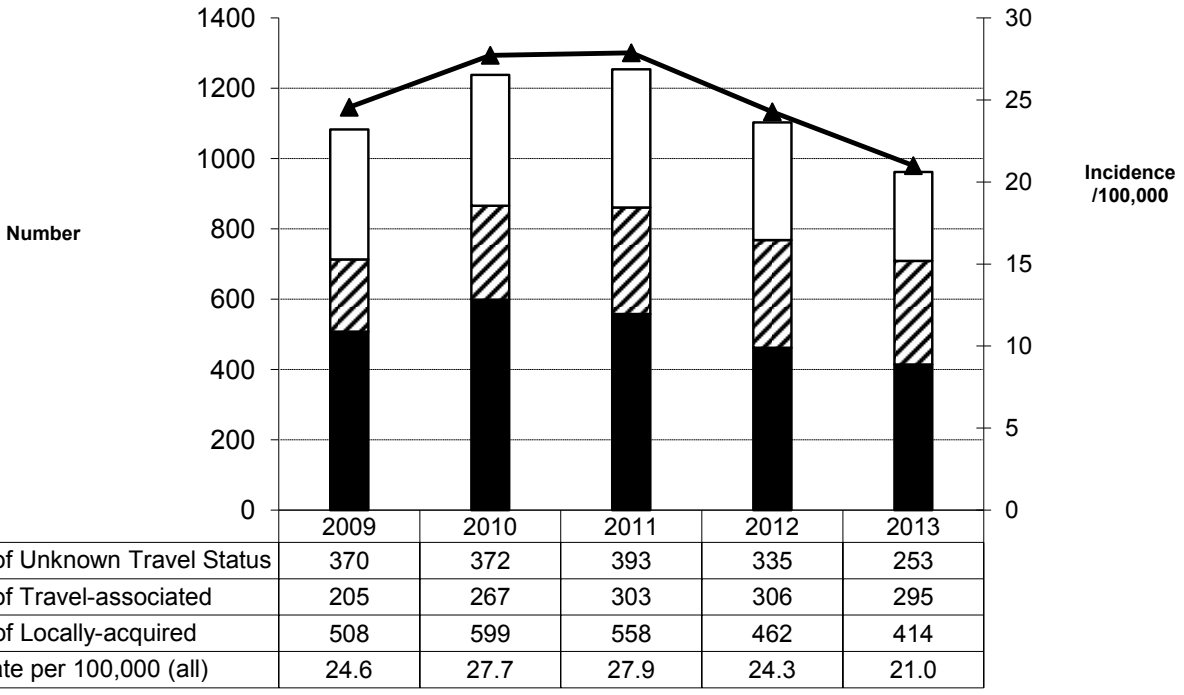
All data for the report were extracted between April 9 and May 12, 2014 and compiled into a single MS Access database at BCCDC. Additional data from CIPARS (abattoir and non-core retail data) were provided to BCCDC on April 28, 2014. Data tables were prepared and reviewed by the BC Integrated Surveillance Epidemiology Sub-Group which is made up of representatives from BCCDC, BC MAGRI and CIPARS-PHAC. Each sector's data were reviewed individually and then all data were integrated together and reviewed to identify common strains and trends over time. When more than 10 isolates of a specific serotype were recovered from each of 2 or more sectors over the year, additional data analysis was conducted. In 2013, *S*. Enteritidis, *S*. Heidelberg, *S*. Typhimurium and *S*. Kentucky met these criteria.

If a cluster (defined as an increase in the number of cases above expected in time and space) that spanned more than one sector was identified, further investigation was initiated. In 2013, no clusters were identified.

Findings - Human

In 2013, there were 962 *Salmonella* isolates (21.0/100,000 population) reported in BC. This is the lowest number of infections and incidence rate of disease in the last 5 years. From 2009 to 2013, 64.9% of *Salmonella* isolates with travel information available were locally-acquired (range by year: 58.4%-71.2%). Between 2009 and 2011, there was an increase in the overall number of isolates and incidence rate of human salmonellosis in BC (Figure 1). However, in 2012 and 2013 the number of infections and the incidence rate decreased. The number of locally-acquired human isolates peaked in 2010 and has been declining since.

Figure 1: Human salmonellosis isolates and incidence rates by travel status, BC, 2009-2013



	2009	2010	2011	2012	2013
# of Unknown Travel Status	370	372	393	335	253
# of Travel-associated	205	267	303	306	295
# of Locally-acquired	508	599	558	462	414
Rate per 100,000 (all)	24.6	27.7	27.9	24.3	21.0

Findings - Human

Among locally-acquired *Salmonella* cases in 2013, the proportion of isolates that were *S*. Enteritidis (44.2%) was similar to 2012 and lower than in 2009 to 2011 (Table 1). *S*. Typhimurium was the second most common serotype observed in 2013. Similarly to 2012, it represented 8.5% of all *Salmonella* isolates. *S*. Heidelberg represented 8.2% of all *Salmonella* isolates in 2013. This was half the proportion observed in 2012 and similar to 2010-2011. The increase in *S*. Newport in 2013 was related to an outbreak associated with a restaurant that was reported in July. As part of the outbreak investigation, 15 laboratory confirmed cases were identified.

The proportion of all *Salmonella* infections due to *S*. Agona was also higher than in other years. This increase was related to an outbreak reported in November, which included 4 laboratory confirmed cases within the same Health Authority.

Table 1: **Top 10 *Salmonella* isolates* by serotype from locally-acquired human cases of *Salmonella*, BC, 2009-2013**

Serotype	2009		2010		2011		2012		2013		Total
Enteritidis	257	50.6%	321	53.6%	356	63.8%	194	42.0%	**183**	**44.2%**	1311
Typhimurium	58	11.4%	58	9.7%	37	6.6%	41	8.9%	**35**	**8.5%**	229
Heidelberg	25	4.9%	47	7.8%	42	7.5%	77	16.7%	**34**	**8.2%**	225
4,5,12:i:-	23	4.5%	29	4.8%	12	2.2%	6	1.3%	**11**	**2.7%**	81
Newport	4	0.8%	8	1.3%	6	1.1%	4	0.9%	**28**	**6.8%**	50
Infantis	3	0.6%	7	1.2%	8	1.4%	9	1.9%	**8**	**1.9%**	35
Hadar	9	1.8%	4	0.7%	9	1.6%	7	1.5%	**5**	**1.2%**	34
Paratyphi B var Java	9	1.8%	3	0.5%	6	1.1%	2	0.4%	**7**	**1.7%**	27
Stanley	7	1.4%	5	0.8%	4	0.7%	3	0.6%	**7**	**1.7%**	26
Agona	1	0.2%	2	0.3%	3	0.5%	3	0.6%	**10**	**2.4%**	19
Other	112	22.0%	115	19.2%	75	13.4%	116	25.1%	**86**	**20.8%**	504
Total	508	100.0%	599	100.0%	558	100.0%	462	100.0%	**414**	**100.0%**	2541

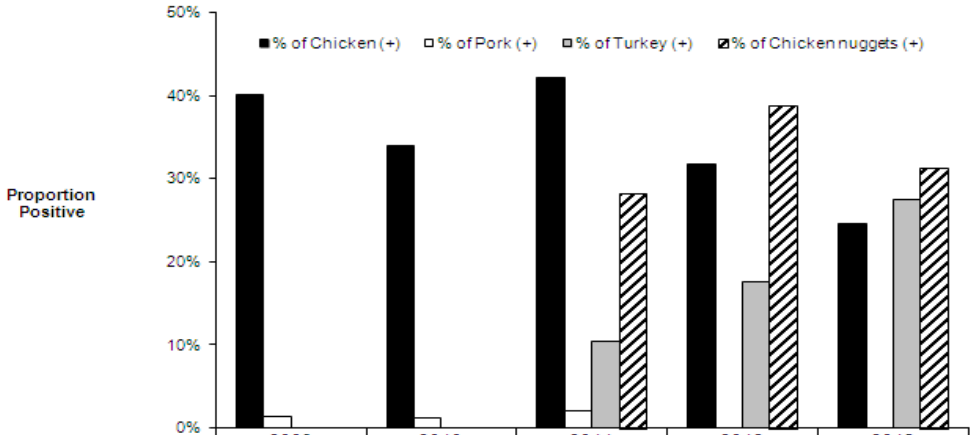
*All serotypes not included in the top 10 are presented together as "Other"

Findings - Food

In 2013, *Salmonella* was isolated from 24.6% (33/134) of retail chicken meat samples and 27.5% (36/131) of retail turkey meat purchased in BC (Figure 2). No *Salmonella* isolates were recovered from retail pork (0/134) (Figure 2). Since 2009, *Salmonella* has been recovered from over 30% of retail chicken samples; 2013 was the first year that *Salmonella* recovery in BC dipped below 30%. Since retail turkey meat sampling started in 2011, the proportion of samples that tested positive has been increasing each year. No *Salmonella* was recovered from retail pork in 2012 or 2013 and since 2009 less than 1% of pork samples tested have yielded a *Salmonella* isolate. Thirty-seven percent (33/89) of all *Salmonella* isolates recovered from retail meat in 2013 were from chicken and 40% (36/89) were from turkey (Figure 2); consequently, the serotype data presented are for retail chicken meat (Table 2) and retail turkey meat (Table 3) only.

In 2013, *S*. Enteritidis remained the most common serotype recovered from retail chicken and made up 45.5% of all *Salmonella* isolates recovered in 2013 (Table 2). This is similar to the proportion observed in 2009-2011 and higher than the proportion observed in 2012. *S*. Kentucky continued to be the second most commonly isolated serotype making up 24.2% of all *Salmonella* isolates from retail chicken in 2013. The most common *Salmonella* serotypes recovered from retail turkey meat in 2013 were *S*. Newport and *S*. Kentucky (6 isolates each) (Table 3).

Figure 2: Proportion of samples that tested positive for *Salmonella* and the total number of isolates recovered from CIPARS retail meat samples (chicken, pork, turkey and chicken nuggets) purchased in BC, 2009-2013



	2009	2010	2011	2012	2013
# of Chicken (+)	59	56	64	53	33
# of Pork (+)	2	2	3	0	0
# of Turkey (+)			8	27	36
# of Chicken nuggets (+)			13	28	20

Table 2: Top 10 *Salmonella* isolates* by serotype from CIPARS retail chicken meat^, purchased in BC, 2009-2013

Serotype	2009		2010		2011		2012		2013		Total
Enteritidis	30	50.8%	24	42.9%	30	46.9%	18	34.0%	**15**	**45.5%**	117
Kentucky	10	16.9%	18	32.1%	20	31.3%	15	28.3%	**8**	**24.2%**	71
Heidelberg	6	10.2%	4	7.1%	6	9.4%	7	13.2%	**5**	**15.2%**	28
Hadar	8	13.6%	3	5.4%	3	4.7%	5	9.4%	**0**	**0.0%**	19
Schwarzengrund	0	0.0%	1	1.8%	1	1.6%	1	1.9%	**1**	**3.0%**	4
Infantis	1	1.7%	0	0.0%	0	0.0%	2	3.8%	**0**	**0.0%**	3
Mbandaka	0	0.0%	1	1.8%	0	0.0%	2	3.8%	**0**	**0.0%**	3
4,5,12:i:-	0	0.0%	1	1.8%	0	0.0%	1	1.9%	**1**	**3.0%**	3
I Rough:g,m:-	0	0.0%	1	1.8%	0	0.0%	1	1.9%	**0**	**0.0%**	2
Braenderup	0	0.0%	0	0.0%	0	0.0%	1	1.9%	**0**	**0.0%**	1
Other	4	6.8%	3	5.4%	4	6.3%	0	0.0%	**3**	**9.1%**	14
Total	59	100.0%	56	100.0%	64	100.0%	53	100.0%	**33**	**100.0%**	265

*All serotypes not included in the top 10 are presented together as "Other"

^ Does not include chicken nuggets or black silkies

Table 3: Top 10 *Salmonella* isolates* by serotype from CIPARS retail turkey meat, purchased in BC, 2011-2013

Serotype	2011		2012		2013		Total
Kentucky	0	0.0%	7	22.6%	**6**	**16.7%**	13
Enteritidis	1	12.5%	7	22.6%	**4**	**11.1%**	12
Hadar	1	12.5%	5	16.1%	**3**	**8.3%**	9
Schwarzengrund	2	25.0%	1	3.2%	**5**	**13.9%**	8
Newport	0	0.0%	1	3.2%	**6**	**16.7%**	7
Reading	0	0.0%	0	0.0%	**5**	**13.9%**	5
Liverpool	0	0.0%	0	0.0%	**4**	**11.1%**	4
Johannesburg	1	12.5%	1	3.2%	**1**	**2.8%**	3
Heidelberg	0	0.0%	3	9.7%	**0**	**0.0%**	3
Mbandaka	1	12.5%	0	0.0%	**1**	**2.8%**	2
Other	2	25.0%	2	6.5%	**1**	**2.8%**	5
Total	8	100.0%	27	87.1%	**36**	**100.0%**	71

*All serotypes not included in the top 10 are presented together as "Other"

In addition to core retail sampling, *Salmonella* was also recovered from 20 chicken nugget samples (31.3% of 64 samples) (Figure 2). These included: 8 *S*. Heidelberg, 6 *S*. Enteritidis, 3 *S*. Hadar and 1 each of *S*. Kentucky, *S*. Kiambu and *S*. Mbandaka. Three *Salmonella* isolates were recovered from black silkie chickens at retail (11.5% of 26 samples): 2 *S*. Senftenburg and 1 *S*. I Rough:g,m,s:-. Finally, 64 retail seafood samples (shrimp and salmon) were tested in 2013; no *Salmonella* isolates were recovered.

Between 2009 and 2013, 71 food samples tested positive for *Salmonella* by BC PHMRL. In 2013, 19 *Salmonella* isolates were identified; all were from unknown food sources. The most common serotype was *S*. Kentucky (14 isolates, 73.7%); single isolates of *S*. Reading, *S*. Liverpool, *S*. Hadar, *S*. Derby and *S*. Agona were also reported

Findings - Abattoir

In 2013, 13 *Salmonella* isolates (8.7% of 149 samples) were recovered from chickens at slaughter; this is lower than the recovery proportion observed in 2012 (13.5%). The most commonly observed serotype in 2013 was *S*. Enteritidis (7 isolates); other serotypes recovered were *S*. Cubana and *S*. Kentucky (2 isolates each) and single isolates of *S*. Infantis and *S*. Orion.

No samples were obtained from abattoir pigs raised in BC in 2013.

Findings - Animals

The animal data represent a wide variety of species and the proportion of isolates by animal species has remained relatively consistent over the years (Table 4).

As in previous years, samples from chickens and their environment continue to be largest contributor to isolates of *Salmonella* from animals in 2013 representing 72.7% of the total isolates (Table 4). Twenty-four (11.0%) of these isolates were from diagnostic samples (i.e. from sick or dead birds) while the remaining 194 isolates (89.0%) were contributed by either government or industry monitoring programs providing samples from the environments in which the birds live.

There was an increase in the proportion of *S.* Enteritidis (44.5%) from chickens and their environment in 2013 over 2012 (Table 5). There was also an increase in the proportion of *S.* Liverpool but the reason for this increase is unknown (Table 5). These *S.* Liverpool isolates were from poultry industry monitoring programs.

Similar to 2012, the majority of wildlife submissions in 2013 were from wild birds (Table 4); these were primarily pine siskins (n=19) and were associated with *S.* Typhimurium (Table 6).

Table 4: ***Salmonella*** **isolates by animal species, BC, 2009-2013**

Species	2009	2010	2011	2012	2013	Total
Cat	1	3	1	2	**1**	8
Cattle	17	12	9	5	**17**	60
Chicken and environment°	257	166	213	181	**218**	1035
Dog	1	1	3	1	**2**	8
Domestic duck/goose	0	0	1	0	**1**	2
Reptile - Exotic/Zoo	3	5	7	3	**2**	20
Horse	4	0	3	1	**1**	9
Sheep and goat	0	1	2	0	**0**	3
Swine	11	6	6	4	**10**	37
Turkey	12	3	17	13	**14**	59
Wildlife*	10	12	13	30	**34**	99
Unspecified^	5	8	1	0	**0**	14
Total	321	217	276	240	**300**	1354

°Chicken and environment—diagnostic isolates from chickens and environmental samples collected as part of monitoring programs

*wildlife—includes birds, wild reptiles and amphibians, land mammals, marine mammals, and unknown species

^unspecified—cases where animals species was not indicated, or it was unspecified if the animal was wild or domestic

Table 5: Top 10 *Salmonella* isolates by serotype from chickens and their environment, BC, 2009-2013

Serotype	2009		2010		2011		2012		**2013**		Total
Enteritidis	125	48.6%	96	57.8%	131	61.5%	55	30.4%	**97**	**44.5%**	504
Kentucky	67	26.1%	41	24.7%	51	23.9%	54	29.8%	**56**	**25.7%**	269
Mbandaka	5	1.9%	3	15.0%	8	3.8%	10	5.5%	**9**	**4.1%**	35
Braenderup	1	0.4%	1	0.6%	3	1.4%	5	2.8%	**7**	**3.2%**	17
4,5,12:i:-	4	1.6%	3	1.8%	0	0.0%	2	1.1%	**7**	**3.2%**	16
Rissen	11	4.3%	2	1.2%	0	0.0%	1	0.6%	**2**	**0.9%**	16
Liverpool	0	0.0%	0	0.0%	0	0.0%	2	1.1%	**12**	**5.5%**	14
Mbandaka Var. 14+	0	0.0%	0	0.0%	2	0.9%	1	0.6%	**3**	**1.4%**	6
Hadar	3	1.2%	0	0.0%	0	0.0%	1	0.6%	**2**	**0.9%**	6
Livingstone	0	0.0%	0	0.0%	0	0.0%	2	1.1%	**3**	**1.4%**	5
Other	41	16.0%	20	12.0%	18	8.5%	48	26.5%	**20**	**9.2%**	147
Total	257	100.0%	166	113.2%	213	100.0%	181	100.0%	**218**	**100.0%**	1035

Findings - Integrated

A total of 24 serotypes were common across two or more sectors in 2013 (Table 6); this is higher than in 2012 (15 serotypes) but similar to 2010 and 2011 (22 serotypes each). Two serotypes (*S.* Enteritidis and *S.* Kentucky) were found in all four sectors (human, food, abattoir and animal), 13 serotypes were found in three sectors and seven serotypes in two sectors. As in previous years, serotypes overlapped primarily between humans, poultry meat (chicken and turkey), chickens at slaughter and poultry on farm, likely due to the large number of isolates from these sources.

Table 6: ***Salmonella*** **serotypes reported in two or more sectors (human, food, abattoir, animal), BC, 2013**

	Human-Local	Food+				Abattoir	Animal						Total
Serotype		Chicken	Chicken Nuggets	Turkey	Silkie Black Chicken	Chicken	Cattle	Chicken and environment°	Swine	Turkey	Wildlife*	Other^	
Enteritidis	182	15	6	4		7		97		2	3		316
Kentucky	1	8	1	6		2		56			7		81
Typhimurium	35	1					5	2	2		21	1	67
Heidelberg	34	5	8						1	1	1	1	51
Newport	28			6									34
Liverpool	3			4				12	3	6			28
4,5,12:i:-	11	1						7				1	20
Hadar	5		3	3				2				1	14
Mbandaka	2		1	1				9	1				14
Dublin	1						12					1	14
Agona	10	1								1			12
Infantis	8					1		1					10
Braenderup	3							7					10
Schwarzengrund	3	1		5									9
Reading				5						1			6
Senftenberg					2			2			1		5
Thompson	3							1					4
Rissen	2							2					4
Cubana		1				2		1					4
Brandenburg	2								1				3
Saintpaul	2									1			3
Worthington	1							2					3
Anatum	1			1									2
Kiambu			1							1			2

Note: Only sources within a sector (e. g. food – chicken; animal – chicken and environment) that had 3 or more positive *Salmonella* isolates in 2013 are included as separate columns. Therefore, some serotypes and some isolates within a sector source are not presented in this table

+ Food only includes data from CIPARS retail meat surveillance program (PHAC)

° Chicken and environment includes both diagnostic and monitoring samples

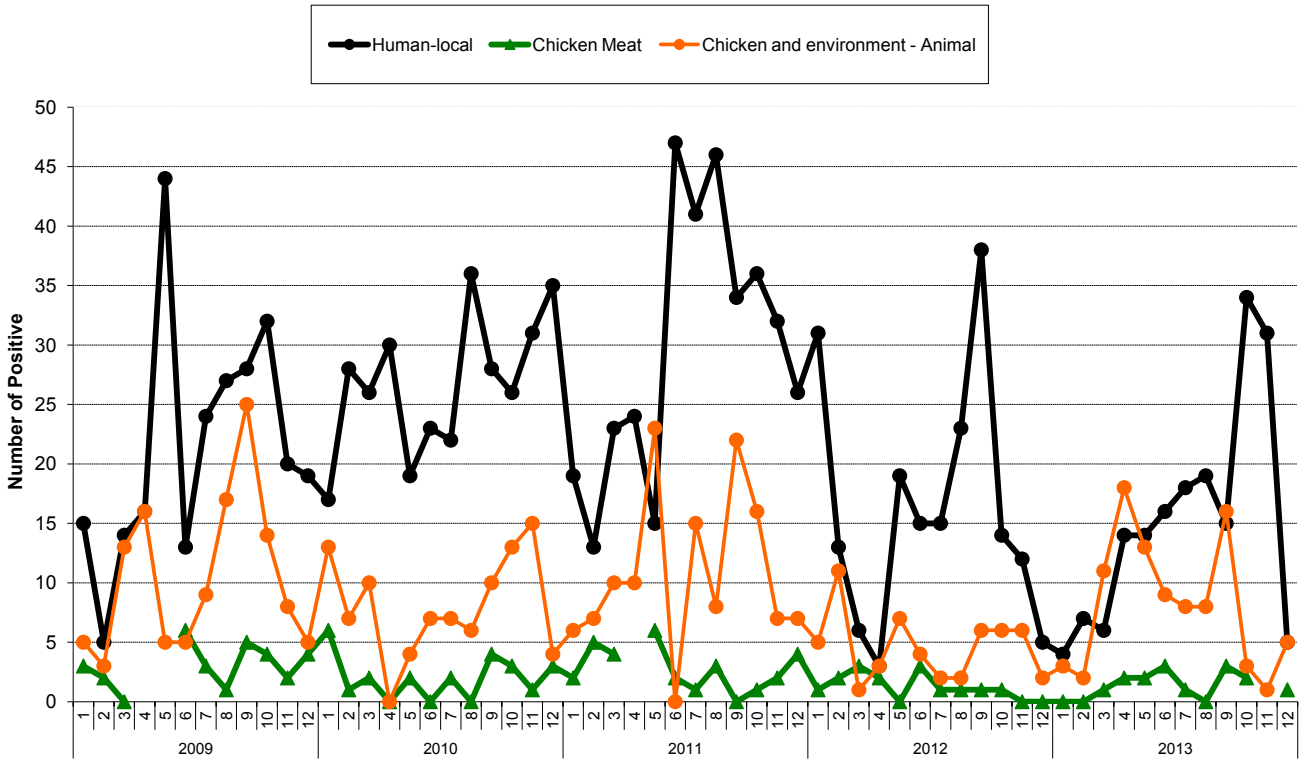
* Wildlife includes birds, wild reptiles/amphibians, land mammals, and marine mammals

^ Animal-Other combines isolates from cats, dogs, horses

Findings - Integrated

Similar to 2012, the number of human *S.* Enteritidis isolates peaked in the fall (Figure 3). In 2013, this fall peak coincided with an outbreak associated with poor quality table eggs in November, which included 8 laboratory-confirmed cases of *S.* Enteritidis. The peaks in the number of isolates from chickens and their environment did not coincide with the peak in human isolates, and there were no peaks or seasonal patterns in the case of chicken meat isolates in 2013. The large province-wide *S.* Enteritidis outbreak affecting humans and chickens from 2008 to 2012 seems to have decreased.

Figure 3: **Monthly *S.* Enteritidis isolates from humans, retail chicken meat*, and animal isolates from chicken and their environment, BC, 2009-2013**



Note: excludes chicken nuggets, turkey and silkies.

*Missing data in chicken meat are due to discontinuation of sampling.

Phage type (PT) 8 remained the most common *S.* Enteritidis strain in 2013, accounting for 30.4% of all typed strains overall (Table 7). PT 8 has been the most common strain since 2009 and was associated with a large poultry-related human outbreak that started in 2008. PT 13 and PT 13a were the second most common phage types in 2013, each accounting for 22.9% of all typed strains. The number of PT 13 and 13a isolates has been increasing since 2012, particularly in humans and in chickens and their environment (data not shown). PT 51 was the most common PT in chicken meat, and was also found in humans and chickens and their environment but less commonly.

Table 7: ***S.* Enteritidis phage types reported in two or more sectors (human-local, food, animal, abattoir), BC, 2013**

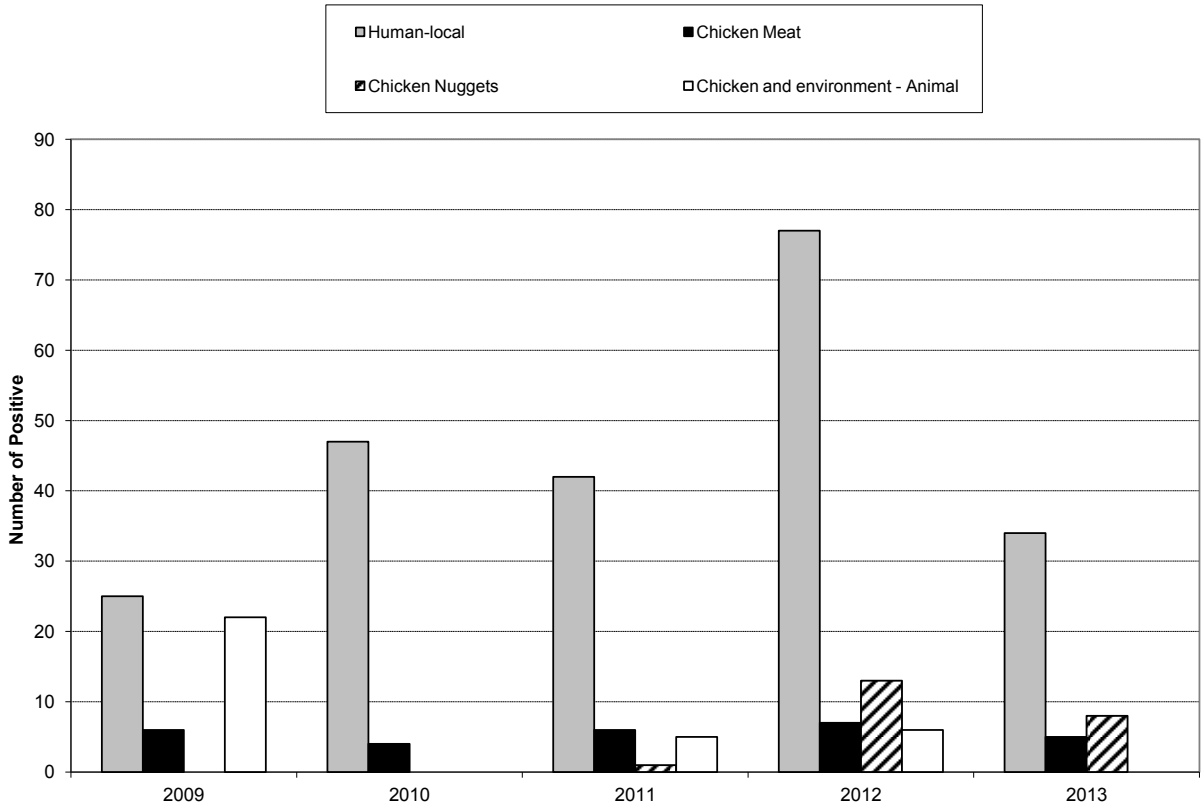
		Food			Animal				
Phagetype	Human Local	Chicken	Chicken Nuggets	Turkey	Chicken and environment	Turkey	Wildlife	Chicken - abattoir	Total
8	51	2	4	0	21	1	2	0	**81**
13	40	2	0	0	19	0	0	0	**61**
13a	34	2	1	2	18	0	0	4	**61**
atypical	5	2	1	1	11	0	0	2	**22**
51	8	5	0	0	2	0	0	0	**15**
19	1	1	0	0	0	0	0	1	**3**
11b	2	0	0	0	1	0	0	0	**3**
Other	15	1	0	1	2	0	1	0	**20**
Total	**156**	**15**	**6**	**4**	**74**	**1**	**3**	**7**	**266**

Note: 27 human cases without PT have been excluded

Findings - Integrated

This is the second year we are presenting integrated results about *S*. Heidelberg. *S*. Heidelberg rates had increased in humans since 2010, particularly in 2012, but were lower again in 2013 (Figure 4). No *S*. Heidelberg isolates were detected in chickens and their environment in 2013.

Figure 4: *S*. Heidelberg isolates from humans, retail chicken meat, chicken nuggets and animal isolates from chicken or chicken environments, BC, 2009-2013



The highest number of *S*. Heidelberg isolates in non-human sources was observed in chicken nuggets (Table 8). Phage types 19 and 29 were the most common PT found in humans, followed by PT 18 and 58. Chicken nuggets contained mostly PT 18 and 19 and chicken meat contained mostly PT 18 and 29, suggesting human infections might be caused by both chicken nuggets and chicken meat consumption. Different phage types in different chicken meats may reflect the different sources of these two products (i.e. fresh chicken meat is usually sourced locally whereas processed chicken (nuggets) may be imported from other jurisdictions). Very few *S*. Heidelberg isolates were found in turkey meat, wildlife animals, dogs and swine.

Table 8: *S.* Heidelberg phage types reported in two or more sectors (human-local, food, animal), BC, 2013

Phagetype	Human Local	Food		Animal				Total
		Chicken	Chicken Nuggets	Turkey	Wildlife	Dog	Swine	
19	12	0	3	0	1	0	0	**16**
29	10	2	1	0	0	0	0	**13**
18	4	2	3	0	0	0	0	**9**
58	2	1	0	0	0	0	0	**3**
Other	3	0	1	1	0	1	1	**7**
Total	**31**	**5**	**8**	**1**	**1**	**1**	**1**	**48**

Note: 3 human isolates without PT have been excluded.

As reported previously, there was a large number of *S.* Typhimurium isolates from wild birds in 2013 (19 isolates from Pine Siskins). The most common PT in these birds were PT 51 (12 isolates) and PT 43 (6 isolates). The most common PT in birds in 2012 was PT 43 (12/19 isolates). There were also 35 *S.*Typhimurium isolates from humans; PT information was only available for 11 isolates and none were PT 51 or PT 43.

S. Kentucky was most often isolated from the chickens' environment (52 isolates from environmental samples as opposed to 4 isolates from samples taken directly from the chicken (e.g. feces, tissues or organs). There were also 7 *S.* Kentucky isolates from rodents sampled as part of routine poultry facility monitoring. *S.* Kentucky was commonly isolated from chicken and turkey meat. Although *S.* Kentucky is common in chickens' environment, it rarely causes clinical signs of disease in chickens and human infections are rare. There was one local human infection detected in 2013.

Conclusion

- The number of *Salmonella* isolates recovered from humans, retail chicken meat and abattoir samples decreased in 2013, whereas it increased in samples from retail turkey meat and chickens and their environment.
- Although *S*. Enteritidis decreased in 2012 and 2013, it continues to be the most common serotype across all sectors (human – local, retail chicken, abattoir chicken, chicken and the environment) and remains an important serotype to monitor in the food and animal sectors.
- Ongoing monitoring across sectors is important in order to assess changes and trends in *Salmonella* serotypes and phage types over time to improve our knowledge about *Salmonella* across the farm to fork continuum in BC.
- Successful collaboration between human health, food safety and animal health continues to improve surveillance, outbreak investigation and sharing of information.
- The current model of integrated surveillance in BC continues to be a good platform for data sharing, integration and analysis across human, food and animal sectors for *Salmonella*. Successful surveillance depends on a strong and supported network of individuals and agencies. The connectivity among partners in this system supports surveillance of *Salmonella* but also identification and investigation of other emerging health issues that span the animal-food-human spectrum.
- In order improve food safety in BC, identification of new data sources and partnerships is needed to provide a more complete and representative picture of *Salmonella* in BC.

Appendix

Appendix 1: Bacterial typing data available for each sector and species indicating the laboratory that generated the data by year

Sector	Species	Data Source	Typing Method	2009	2010	2011	2012	2013
Animal	All	BC MAGRI	Serotype	LFZ-PHAC				
			Phage type	LFZ-PHAC				
Animal/Abattoir	Poultry swine	CIPARS	Serotype			LFZ-PHAC		
			Phage type			LFZ-PHAC		
Food	Chicken, Pork	CIPARS	Serotype	LFZ-PHAC				
			Phage type	LFZ-PHAC				
	Other	CFIA and BC PHMRL‡	Serotype	BC PHMRL				
			PFGE	BC PHMRL				
	Turkey and Chicken nuggets*	CIPARS	Serotype			LFZ-PHAC		
			Phage type			LFZ-PHAC		
Human	Human		Serotype	BC PHMRL				
		BC PHMRL	PFGE¥	BC PHMRL				
			Phage type†	NML-PHAC				

Partial data only | *Data not generated* | *Full data available*

* Turkey and chicken nugget surveillance started in February 2011; Black silkie surveillance started in 2009

‡ BC PHMRL isolates originate from the Food Quality Check Program or outbreak investigations

¥ As of April 2012, PFGE is not completed for *Salmonella* Enteritidis and *Salmonella* Heidelberg

†Until March 2012, only human isolates recovered in the first 15 days of each month had phage type completed. As of April 2012, all *Salmonella* Enteritidis and *Salmonella* Heidelberg isolates have phage type completed.

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