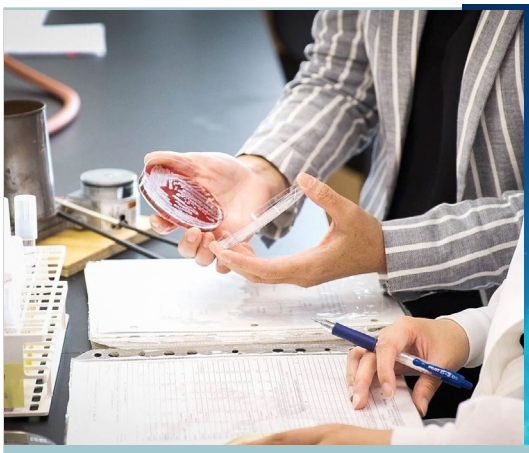

British Columbia Integrated Surveillance of Foodborne Pathogens (BCISFP) Annual Summary of *Salmonella* Findings

2011

Date of Publication: April, 2012



BC Centre for Disease Control

An agency of the Provincial Health Services Authority

Public Health Agency of Canada

Agence de la santé publique du Canada

BRITISH COLUMBIA

Ministry of Agriculture

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2011 Introduction

Following a food safety stakeholder meeting in December 2005, representatives from the British Columbia Center for Disease Control (BCCDC), the British Columbia Ministry of Agriculture (BC AGRI), 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. Integrated surveillance was initiated in October 2006.
The goals and objectives of the program are to:

1) Identify 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) Support 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 second annual report arising from integrated surveillance data. It covers data reported in 2011 and includes some data reported since 2007 for historical trend analysis. The purpose of the report is to inform stakeholders of the occurrence of *Salmonella* in parts of the food chain in BC and of the results of investigations that ensued.

Methods - Data Sources

Human

Human salmonellosis is reportable in BC and all *Salmonella* isolates originated from samples submitted by BC residents for diagnostic purposes. In BC, all isolates are forwarded to the BCCDC Public Health Microbiology and Reference Laboratory (BCCDC PHMRL) for further characterisation. The *Salmonella* typing data available are shown in Table 1. Phage typing is done on isolates identified in the first 15 days of the month at the National Microbiology Laboratory of the Public Health Agency of Canada (NML-PHAC); pulsed-field gel electrophoresis (PFGE) is completed on all isolates by the BCCDC PHMRL.

The data available for analysis include identification number, lab typing information and date of submission; no identifying information is used in analysis. Human data include both travel and locally acquired infections.

Food

Most *Salmonella* isolates originated from fresh chicken and pork samples collected as part of the Canadian Integrated Program on Antimicrobial Resistance Surveillance (CIPARS*) Retail Meat Program (PHAC). In 2011, fresh turkey samples as well as black silkie chickens and chicken nuggets were also tested for *Salmonella*.; the data presented do not represent a full year of sampling. Additional *Salmonella* isolates from food were provided from samples collected through outbreak investigations or routine food quality programs submitted to the BCCDC PHMRL and through samples submitted and tested by the CFIA in BC.

The data available for analysis included identification number, date of purchase (or submission) and food type (e.g. chicken). The *Salmonella* typing data available are shown in Table 1. Primary isolation, serotyping and phage typing of the CIPARS isolates were completed by the Laboratory for Foodborne Zoonoses of the Public Health Agency of Canada (LFZ-PHAC).

Abattoir

CIPARS* 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 identification number and species. The *Salmonella* typing data available are shown in Table 6 & 7. Primary isolation, serotyping and phage typing of the CIPARS abattoir isolates were completed by LFZ-PHAC.

Animal

All *Salmonella* isolates originated from samples submitted to the Animal Health Centre, BC AGRI. Data are available from these areas:

- Diagnostic: isolates recovered from sick or dead animals
- Monitoring: isolates from apparently healthy animals through government or industry monitoring programs. In 2010, all the *Salmonella* data from monitoring programs originated from poultry.
- Project: isolates recovered from samples collected through research studies

All project data were excluded from the results presented in this report because they were collected over short time periods and from targeted species and commodities. The data available for analysis included submission identification number, date of submission, type of sample (e.g. fecal, tissue), category (see above) and animal species; no identifying information was included. The *Salmonella* typing data available are shown in Table 1. Most notable is that from April 2008 to present, isolates were submitted for phage type (PT) analysis whereas PFGE information had been available previous to April 2008.

Animal data may include multiple isolates of *Salmonella* from the same submission.

* For more information about CIPARS: http://www.phac-aspc.gc.ca/cipars-picra/index-eng.php

Methods - Data Analysis

All data for the report were extracted between Jan 24-27, 2012 and compiled into a single MS Access database at BCCDC. Data tables were prepared and reviewed by the BC Integrated Surveillance Epidemiology Sub-Group which is made up of representatives from BCCDC, BC AGRI and CIPARS (PHAC). Each sector's data were reviewed individually and integrated data were reviewed to identify common strains and trends over time. When more than 10 isolates of a specific serotype were recovered from each sector over the year, additional data analysis was conducted using further typing information. In 2011, only S. Enteritidis (SE) met this reporting threshold. If a cluster that spanned more than one sector was identified, further investigation was initiated.

Table 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	2006	2007	2008	2009	2010	2011
Animal	All	BC AGRI	Serotype	BC AGRI		LFZ-PHAC			
			Phage type			LFZ-PHAC			
			PFGE	BCCDC					
Animal/Abattoir	Poultry swine	CIPARS	Serotype						LFZ-PHAC
			Phage type						LFZ-PHAC
			PFGE						
Food	Chicken Pork^	CIPARS	Serotype	LFZ-PHAC					
			Phage type	LFZ-PHAC					
			PFGE			LFZ-PHAC*			
	Other	CFIA and BCCDC‡	Serotype	BCCDC PHMRL					
			Phage type						
			PFGE	BCCDC PHMRL					
Human	Human	BCCDC	Serotype	BCCDC PHMRL					
			Phage type†	NML-PHAC					
			PFGE	BCCDC PHMRL					

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

*PFGE data for *Salmonella* isolates from CIPARS retail meat samples only available for selected serovars recovered from chicken

‡BCCDC isolates originate from the Food Quality Check Program or outbreak related isolates

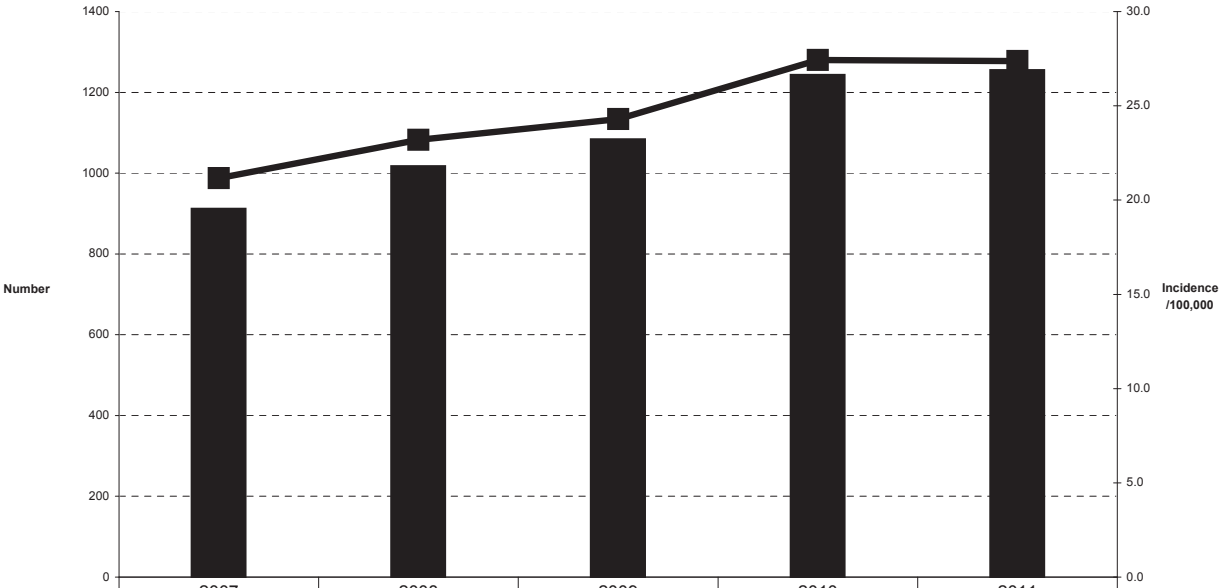
†Only human isolates recovered in the first 15 days of each month reported with phage type determination

^In 2011 fresh turkey, black silkies and chicken nuggets were also tested

Results - Human

Since 2007, there has been a steady increase in the number and rate of human salmonellosis in BC (Figure 1) although the increase between 2010 and 2011 was smaller. The number and proportion of SE continued to increase and made up 50% of all *Salmonella* isolates in 2011. Other *Salmonella* serotypes have remained stable or decreased over this time period (Table 2). The increase in S. Infantis in 2011 was due to a cluster of cases associated with a common establishment in one geographic area.

Figure 1: Human *salmonellosis* and rates, BC, 2007 to 2011



	2007	2008	2009	2010	2011
# of Salmonella (+)	912	1017	1084	1243	1255
Rate per 100,000	21.2	23.2	24.3	27.4	27.4

Results - Human

Table 2: Human *Salmonella* isolates by serotype, BC, 2007 to 2011

Serotype	2007		2008		2009		2010		2011		Total
Enteritidis	316	34.6%	427	42.0%	469	43.3%	581	46.7%	630	50.2%	2423
Typhimurium	103	11.3%	101	9.9%	100	9.2%	100	8.0%	81	6.5%	485
Heidelberg	52	5.7%	30	2.9%	46	4.2%	65	5.2%	59	4.7%	252
Typhi	35	3.8%	67	6.6%	46	4.2%	45	3.6%	49	3.9%	242
Infantis	12	1.3%	9	0.9%	10	0.9%	16	1.3%	34	2.7%	81
Paratyphi A	27	3.0%	38	3.7%	36	3.3%	28	2.3%	32	2.5%	161
4,5,12:i:-	44	4.8%	39	3.8%	43	4.0%	45	3.6%	31	2.5%	202
Newport	20	2.2%	21	2.1%	18	1.7%	19	1.5%	19	1.5%	97
Paratyphi B var Java	10	1.1%	12	1.2%	26	2.4%	15	1.2%	17	1.4%	80
Stanley	24	2.6%	20	2.0%	15	1.4%	17	1.4%	16	1.3%	92
Other	269	29.5%	253	24.9%	275	25.4%	312	25.1%	287	22.9%	1396
Total	**912**	100.0%	**1017**	100.0%	**1084**	100.0%	**1243**	100.0%	**1255**	100.0%	**5511**

Results - Food

Since 2008, *Salmonella* isolates have been recovered from over 30% of all retail chicken meat samples purchased in BC. Over the same time period, *Salmonella* recovery from retail pork has remained below 2%. Ninety six percent (64/67) of all *Salmonella* isolates recovered from retail meat in 2011 were from chicken (Figure 2). As a result, the food data presented in Table 3 are for retail chicken meat only. Since 2008, SE has been the most common serotype recovered from retail chicken, representing 30%, 51% , 43% and 41% of all *Salmonella* isolates recovered in 2008, 2009, 2010 and 2011, respectively (Table 3). S. Kentucky continues to be the second most commonly isolated serotype making up 32% and 31% of all *Salmonella* isolates from retail chicken in 2010 and 2011, respectively.

In addition to core CIPARS retail meat sampling in 2011, *Salmonella* was also recovered from:

1. 8 retail turkey samples (11% of 71 samples)
    - 1 SE, 1 S. Hadar, 1 S. Johannesburg, 1 S. Mbandaka, 2 S. Schwarzengrund, 1 S. Uganda, 1 S. Worthington
2. 1 black silkie chicken (4% of 26 samples)
    - 1 SE
3. 3 chicken nuggets (28% of 46 samples)
    - 7 SE, 2 S. Heidelberg, 4 S. Kentucky

Thirty-seven food samples were submitted and tested by BCCDC PHRML (n=28) and CFIA (n=9) that were positive for *Salmonella* between 2007 and 2011. Seventeen (46%) of these were reported in 2011 and all were tested by BC PHMRL. Ten (59%) were chicken samples, three (18%) were egg or products containing eggs, 3 (18%) were from pet environment and 1 was unknown source. Four (24%) of the samples in 2011 were reported as S. Kentucky.

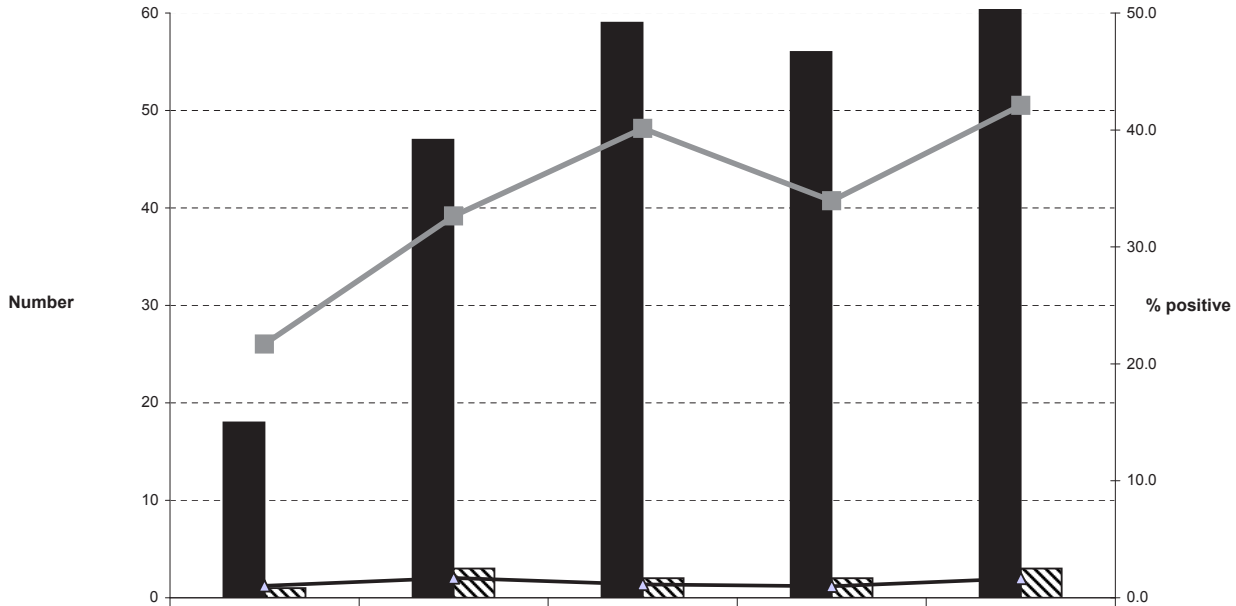
Abattoir

In 2011, 29 *Salmonella* isolates (22% of 134 samples) were recovered from chickens at slaughter:

- 13 SE, 5 S. Hadar, 4 less common serotypes and pending results (Table 6).

One S. Derby isolate was recovered from a pig at slaughter

Figure 2: *Salmonella* isolates recovered from CIPARS retail meat samples (chicken and pork) purchased in BC, 2007 to 2011



	2007	2008	2009	2010	2011
# of Chicken (+)	18	47	59	56	64
# of Pork (+)	1	3	2	2	3
% of Chicken (+)	21.7	32.6	40.1	33.9	42.1
% of Pork (+)	1.2	2.0	1.4	1.2	2.0

Table 3: *Salmonella* isolates from CIPARS retail chicken meat by serotype, purchased in BC, 2007 to 2011

Serotype	2007		2008		2009		2010		2011		Total
Enteritidis	0	0.0%	14	29.8%	30	50.8%	24	42.9%	26	40.6%	**94**
Kentucky	4	22.2%	13	27.7%	10	16.9%	18	32.1%	20	31.3%	**65**
Heidelberg	4	22.2%	3	6.4%	6	10.2%	4	7.1%	6	9.4%	**23**
Hadar	1	5.6%	3	6.4%	8	13.6%	3	5.4%	3	4.7%	**18**
Braenderup	0	0.0%	0	0.0%	0	0.0%	1	1.8%	1	1.6%	**2**
Johannesburg	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.6%	**1**
Orion	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	1.6%	**1**
Schwarzengrund	1	5.6%	1	2.1%	0	0.0%	1	1.8%	1	1.6%	**4**
4,5,12:i:-	0	0.0%	2	0.0%	0	0.0%	1	0.0%	0	0.0%	**3**
Brandenburg	2	11.1%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	**2**
Other	6	33.3%	11	23.4%	5	8.5%	4	7.1%	0	0.0%	**26**
Pending	0	0.0%	0	0.0%	0	0.0%	0	0.0%	5	7.8%	**5**
Totals	**18**	100.0%	**47**	95.7%	**59**	100.0%	**56**	98.2%	**64**	100.0%	**244**

Results - Animal

In 2011, the animal sources of *Salmonella* continue to represent a wide range of species (Table 4). There is an increase in the number of samples from both turkeys and chicken compared to 2010. This may be in part due to an increased awareness of SE in poultry, and additional testing of poultry and poultry environment samples. The 17 turkey isolates yielded ten different serotypes, but did not yield Enteritidis. Chicken and the chicken environment make up the greatest proportion of the submissions (77%), and these are represented in Table 5. In 2011, the percentage of isolates that were SE continued to increase, following the trend set in previous years; the percentage that were Kentucky has been decreasing over the past five years.

Table 4: *Salmonella* isolates by animal species, BC, 2007 to 2011

Species	2007	2008	2009	2010	2011	Total
Cat	2	2	1	3	1	9
Cattle	14	10	17	12	9	62
Chicken and environment°	185	176	260	166	213	1000
Dog	1	3	1	1	3	9
Domestic duck/goose	0	1	0	0	1	2
Reptile - Exotic/Zoo	4	4	3	5	7	23
Horse	1	3	4	0	3	11
Sheep	0	0	0	1	1	2
Swine	6	6	11	6	6	35
Turkey	10	1	12	3	17	43
Wildlife*	30	7	9	12	13	71
Other^	1	2	3	8	2	16
Total	**254**	**215**	**321**	**217**	**276**	**1283**

°Chicken and environment—includes 177 diagnostic isolates from chickens, and 36 environmental samples taken from the chicken hatchery/farm

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

^other—includes species where it was unspecified or less than 3 positive isolates (cat, duck, goat, sheep, goose)

+Food-only includes data from CIPARS retail meat program PHAC

Results - Animal

Table 5: *Salmonella* isolates from chicken and chicken environment by serotype, BC, 2007 to 2011

Serotype	2007		2008		2009		2010		2011		Total
Enteritidis	25	13.5%	48	27.3%	125	48.6%	96	57.8%	131	61.5%	425
Kentucky	65	35.1%	60	34.1%	67	26.1%	41	24.7%	51	23.9%	284
Heidelberg	42	22.7%	21	11.9%	22	8.6%	0	0.0%	5	2.3%	90
Rissen	8	4.3%	2	1.1%	11	4.3%	2	1.2%	0	0.0%	23
Mbandaka	5	2.7%	7	4.0%	5	1.9%	3	1.8%	8	3.8%	28
Typhimurium	2	1.1%	4	2.3%	5	1.9%	1	0.6%	1	0.5%	13
4,5,12:i:-	11	5.9%	22	12.5%	4	1.6%	3	1.8%	0	0.0%	40
Hadar	8	4.3%	3	1.7%	3	1.2%	0	0.0%	0	0.0%	14
Infantis	1	0.5%	1	0.6%	2	0.8%	2	1.2%	3	1.4%	9
Tennessee	0	0.0%	0	0.0%	2	0.8%	1	0.6%	0	0.0%	3
Other	18	9.7%	8	4.5%	11	4.3%	17	10.2%	14	6.6%	68
Total	**185**	100.0%	**176**	100.0%	**257**	100.0%	**166**	100.0%	**213**	100.0%	**997**

Results - Integrated

A total of 22 serotypes were common across two or more sectors in 2011, the same number reported in 2010. Fourteen serotypes were common across two sectors, three across three sectors and five were common across all four sectors. Serotypes common across all four sectors were: Enteritidis, Hadar, Heidelberg, Kentucky and Schwarzengrund (Table 6). All serotypes common across all 4 sectors were also identified across all sectors in 2010. However, Typhimuirum, 4,5,12:i:-, Infantis, Branderup and Tenessee were not common across all sectors as reported last year.
As in 2010, the overlap in serotypes was seen most often between human, chicken meat, chicken abattoir and animal isolates from chicken or chicken environments. This overlap was likely due to the large number of isolates reported from these three sources.

Table 6: *Salmonella* serotypes reported in two or more sectors (human, food, abattoir, animal), BC, 2011

		Food+		Abattoir	Animal								
Serotype	Human	Chicken	Pork	Chicken	Cattle	Chicken and environment°	Dog	Exotic/ Zoo	Horse	Swine	Turkey	Wildlife*	Other^	Total
Enteritidis	630	26	0	13	0	131	0	2	1	0	0	1	1	805
Typhimurium	81	0	0	0	1	1	0	0	0	0	0	2	1	86
Kentucky	5	20	0	2	0	51	0	0	0	0	0	2	0	80
Heidelberg	59	6	0	1	0	5	0	0	1	0	5	0	0	77
Infantis	34	0	0	0	0	3	1	0	0	0	0	0	0	38
4,5,12:i:-	31	0	0	1	0	0	0	0	0	0	1	1	1	35
Newport	19	0	0	0	1	0	0	0	0	0	1	2	0	23
Hadar	11	3	0	5	0	0	0	1	0	0	2	1	0	23
Mbandaka	10	0	0	0	0	8	0	0	0	2	1	0	0	21
Agona	14	0	0	0	0	0	1	1	0	0	0	0	0	16
Oranienburg	14	0	0	0	0	1	0	0	1	0	0	0	0	16
Anatum	12	0	0	0	0	1	0	0	0	0	1	0	0	14
Schwarzengrund	5	1	0	1	0	3	0	0	0	0	1	1	0	12
Braenderup	4	1	0	0	0	3	0	0	0	0	0	0	0	8
Worthington	1	0	0	0	1	2	0	0	0	2	0	0	0	6
Rissen	4	0	0	0	0	0	0	0	0	0	1	0	0	5
Albany	4	0	0	0	0	0	0	0	0	0	1	0	0	5
Kiambu	3	0	0	0	0	0	0	0	0	0	2	0	0	5
Brandenburg	2	0	2	0	0	0	0	0	0	1	0	0	0	5
Derby	2	0	0	0	0	0	1	0	0	0	0	0	0	4
Reading	2	0	0	0	0	0	0	0	0	0	0	2	0	4

°Chicken and environment—includes 177 diagnostic isolates from chickens, and 36 environmental samples taken from the chicken hatchery/farm

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

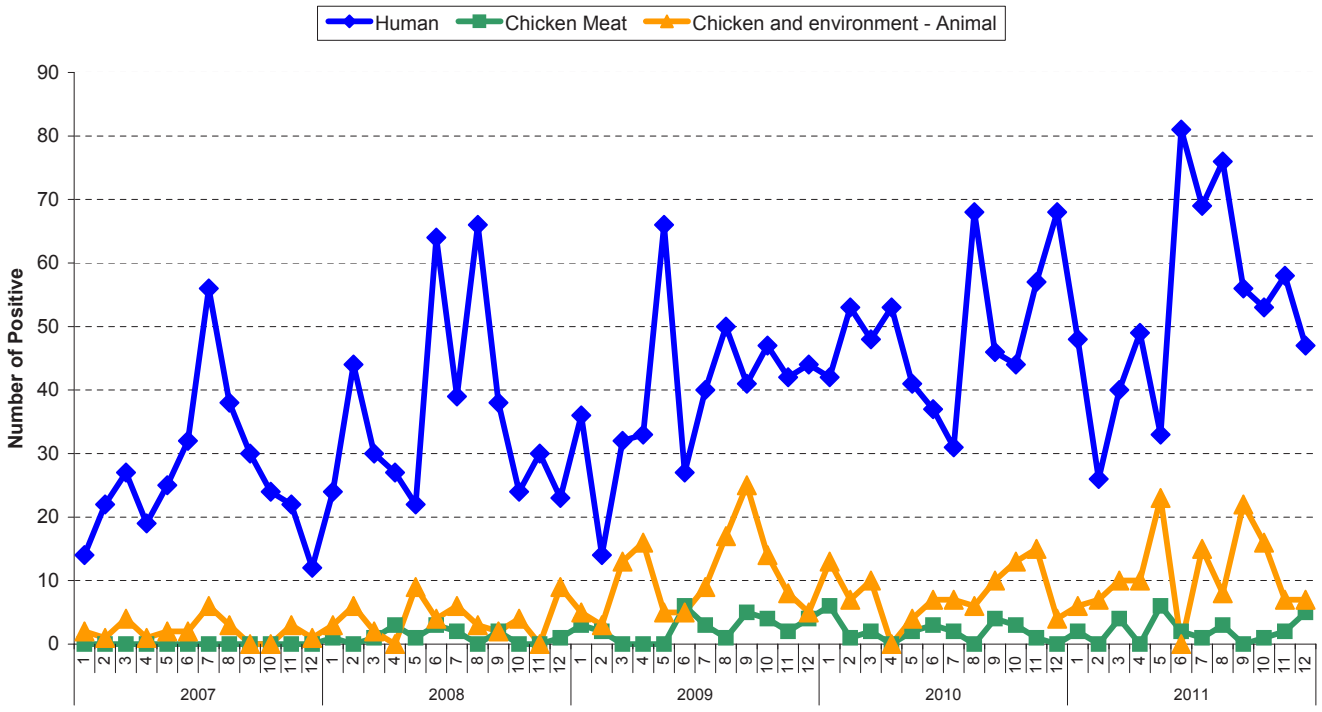
^other—includes species where it was unspecified or less than 3 positive isolates (cat, duck, goat, sheep, goose)

+Food-only includes data from CIPARS retail meat program PHAC

Results - Integrated

Among human and animal isolates of SE there has been an increasing trend over time and a consistent number of isolates in food (Figure 3). The peaks in the number of human isolates occurred in summer months and coincided with clusters investigated as part of the ongoing human investigations. Temporal peaks in the food and animal sector are not as well defined and peaks among the three sectors do not consistently coincide at the same time.

Figure 3: S. Enteritidis isolates from humans, retail chicken meat, and animal isolates from chicken or chicken environments, BC, 2007 to 2011



°Chicken and environment—includes diagnostic isolates from chickens, and environmental samples taken from the chicken hatchery/farm

Results - Integrated

In 2011, the most common PT overall was PT 8 and it was seen in all four sectors (Table 7). This PT has been investigated as part of an outbreak in humans and concurrent increase among animal isolates from chicken or chicken environments since 2008 in BC. PT 8 was the most common pattern among human isolates and isolates from chicken or chicken environments (Table 7). PT 8 has been consistently high among human isolates since 2008, although it peaked in 2009 and has been decreasing since. In 2011, the proportion of PT 8 in food and animal isolates increased after a decrease seen in 2010 and was comparable with 2009 (Figure 4).

PT 51 was the most common pattern among food isolates in 2011 which is a shift from 2010 when PT 13a was most common (Figure 4). PT 51 continues to be seen rarely in human isolates and the proportion from animal isolates from chicken or chicken environments decreased in 2011 compared to 2010 (Figure 4).

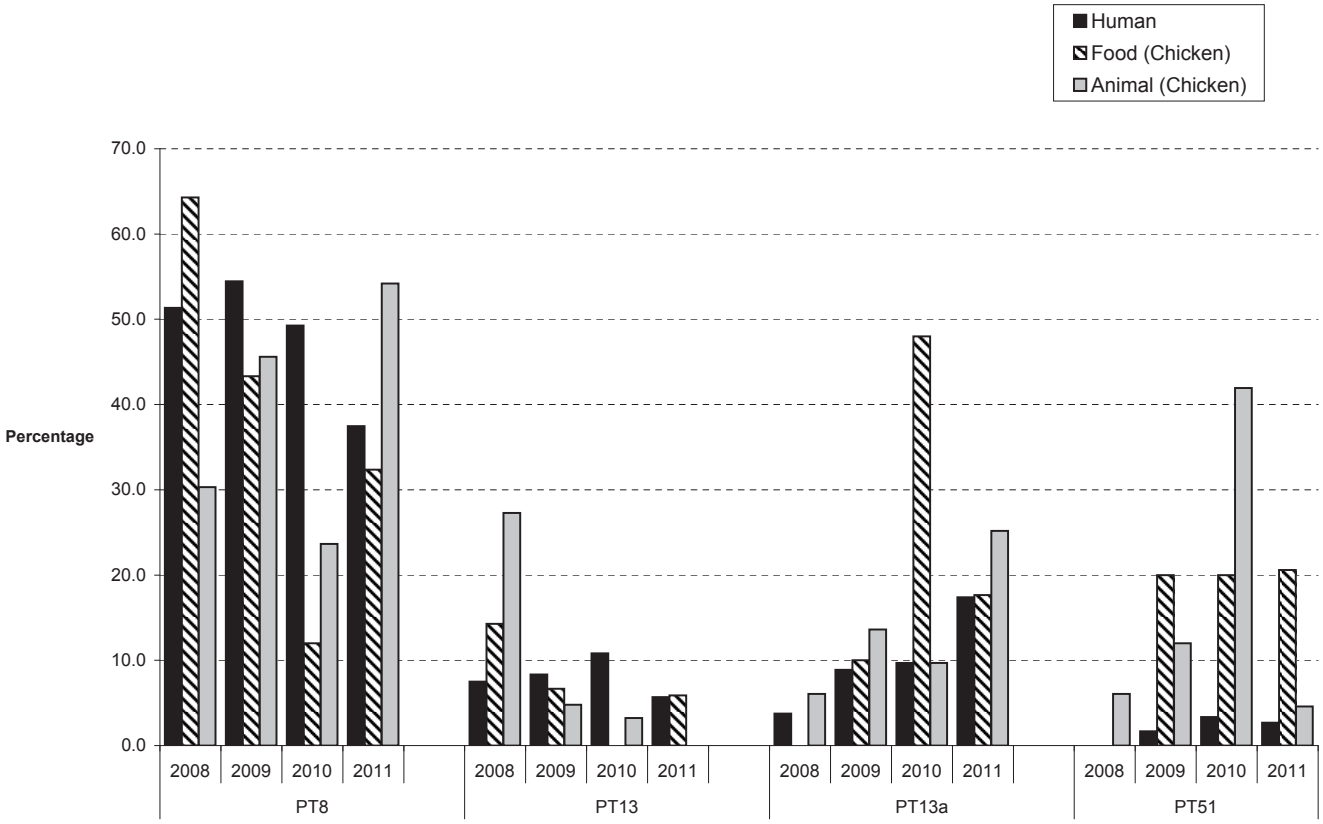
PT13a which had been common among retail chicken isolates in 2010 was the second most common PT among all 4 sectors overall and the most common pattern from abattoir samples in 2011 (Table 7). PT 13a increased in both the human and animal sectors in 2011. This pattern was associated with a large human investigation in the fall of 2011, but this pattern has increased among sporadic human isolates as well.

PT 13 was the cause of a human outbreak in 2007 and has only been seen sporadically since then. In 2011, it was only seen in human and food isolates and not in isolates from chicken or chicken environments.

Table 7: S. Enteritidis phage types reported in human, food, animal, and abattoir, BC, 2011

Phagetype	Human		Chicken (food)		Chicken (animal)		Chicken (abattoir)		Total
8	112	37.5%	5	19.2%	71	54.2%	3	23.1%	**191**
51	8	2.7%	7	26.9%	6	4.6%	4	30.8%	**25**
13a	52	17.4%	5	19.2%	33	25.2%	5	38.5%	**95**
13	17	5.7%	1	0.0%	0	0.0%	0	0.0%	**18**
19	0	0.0%	3	11.5%	0	0.0%	0	0.0%	**3**
23	1	0.3%	0	0.0%	3	2.3%	1	7.7%	**5**
Other	109	36.5%	5	19.2%	18	13.7%	0	0.0%	**132**
Total	**299**	100.0%	**26**	96.2%	**131**	100.0%	**13**	100.0%	**469**

Figure 4: Distribution of selected SE PT in humans, chicken meat and animal isolates from chicken or chicken environments, BC, 2008 to 2011



Cross-sectoral clusters of interest

S. Enteritidis PT 8/ PFGE pattern SENXAI.0003

The number of human cases associated with SENXAI.0003/PT 8 remained high throughout 2011. Similar to previous years a summer peak was identified which coincided with time periods when clusters associated with food service establishments were reported. The majority of the cases continued to be reported in the Lower Mainland. The number of clusters increased in 2011 to seven, five were associated with food service establishments. Eggs, poultry products and exposure to restaurants continue to be consistently reported by cases. This particular strain of SE has been under investigation since 2008 in BC. Collaboration between public health and animal health is ongoing.

The identification of a human outbreak associated with PT 13a and identification of this pattern in other sectors indicates the need to continue to monitor for shifts in patterns among all sectors over time.

Conclusions

- Many of the trends in 2011 were similar to those reported in 2010.

- SE continues to be the most common serotype across all sectors; it is the cause of the increase in *Salmonella* cases observed in humans 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 PT over time and across sectors to improve our knowledge about *Salmonella* across the farm to fork continuum in BC.

- Integrated surveillance continues to be a priority for BC stakeholders. 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. Identification of new data sources, partnerships and data sharing is required to provide a more complete and representative picture of *Salmonella* in BC in order to attain the goal of source attribution and improvements to food safety in BC.

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