BC Integrated *Salmonella* Surveillance Annual Report 2010

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Contributors

Dr. Nancy de With, BC Ministry of Agriculture
Dr. Eleni Galanis, BC Centre for Disease Control
Dr. Mira Leslie, BC Ministry of Agriculture
Sophie Li, BC Centre for Disease Control
Dr. Jane Parmley, Public Health Agency of Canada
Marsha Taylor, BC Centre for Disease Control

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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 first annual report arising from integrated surveillance data. It covers data reported in 2010 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). 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. Phage typing of the CIPARS isolates was completed at the Laboratory for Foodborne Zoonoses of the Public Health Agency of Canada (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.

Data analysis

All data for the report were extracted between Feb 10-15, 2011 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 contains 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 2010, 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
Animal	All	BC AGRI	Serotype	BC AGRI		LFZ-PHAC		
			Phage type			LFZ-PHAC		
			PFGE	BCCDC PHMRL				
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*

†*Only human isolates recovered in the first 15 days of each month are submitted for phage type determination*

Findings

Human

Figure 1: Human salmonellosis and rates, BC, 2007 to 2010

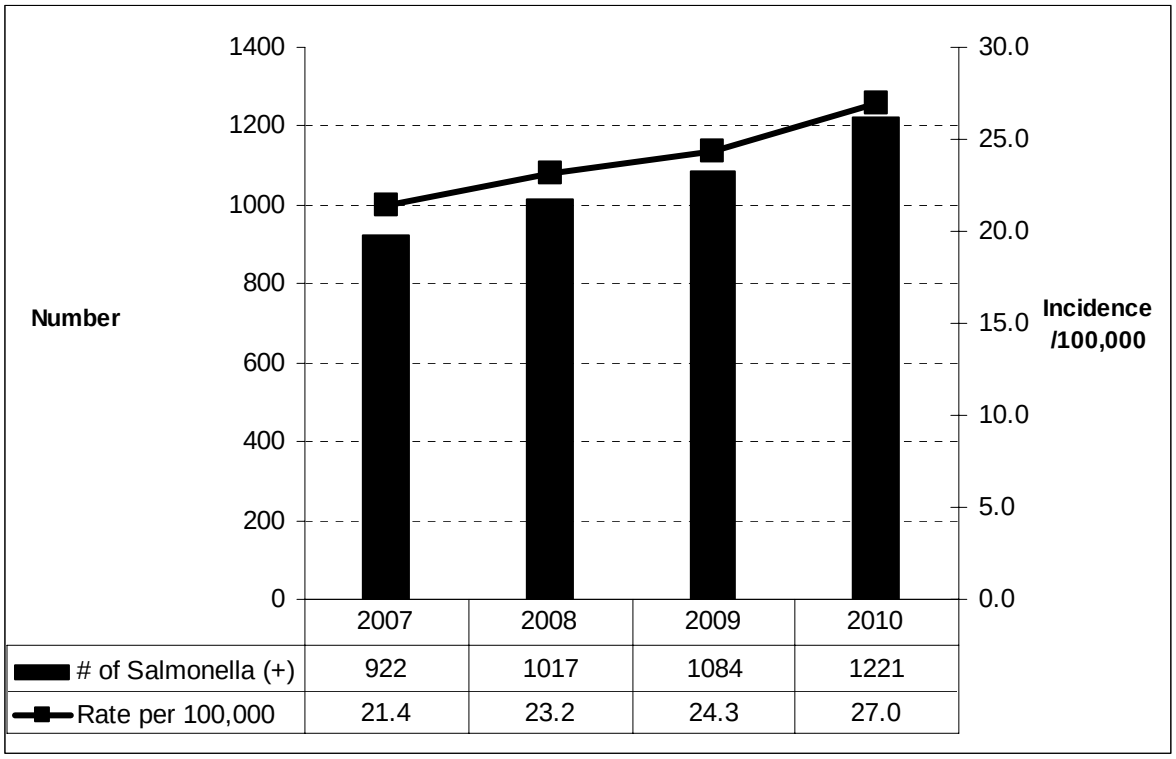


Table 2: Human *Salmonella* isolates by serotype, BC, 2007-2010

Serotype	2007		2008		2009		2010		Total
Enteritidis	321	34.8%	427	42.0%	469	43.3%	574	47.0%	1791
Typhimurium	103	11.2%	101	9.9%	100	9.2%	100	8.2%	404
Typhi	36	3.9%	67	6.6%	46	4.2%	44	3.6%	193
Heidelberg	52	5.6%	30	2.9%	46	4.2%	64	5.2%	192
4,5,12:i:-	44	4.8%	39	3.8%	44	4.1%	36	2.9%	163
Paratyphi A	27	2.9%	38	3.7%	36	3.3%	28	2.3%	129
Newport	20	2.2%	21	2.1%	18	1.7%	18	1.5%	77
Saintpaul	26	2.8%	9	0.9%	22	2.0%	13	1.1%	70
Paratyphi B var Java	10	1.1%	12	1.2%	26	2.4%	15	1.2%	63
Other	283	30.7%	273	26.8%	277	25.6%	329	26.9%	1162
Total	**922**	100.0%	**1017**	100.0%	**1084**	100.0%	**1221**	100.0%	**4244**

Since 2007, there has been a steady increase in the number and rate of human salmonellosis in BC (Figure 1). The increase in human salmonellosis has been due to the increase in SE over this time period. In 2007, 35% of the human *Salmonella* isolates were SE compared to 47% in 2010. Other *Salmonella* serotypes have remained stable (Table 2). Serotypes such as Typhi and Paratyphi associated with international travel are common in human isolates however are not seen in the other sectors (food and animal).

Food

Figure 2: *Salmonella* isolates recovered from CIPARS retail meat samples (chicken and pork) purchased in BC, 2007-2010

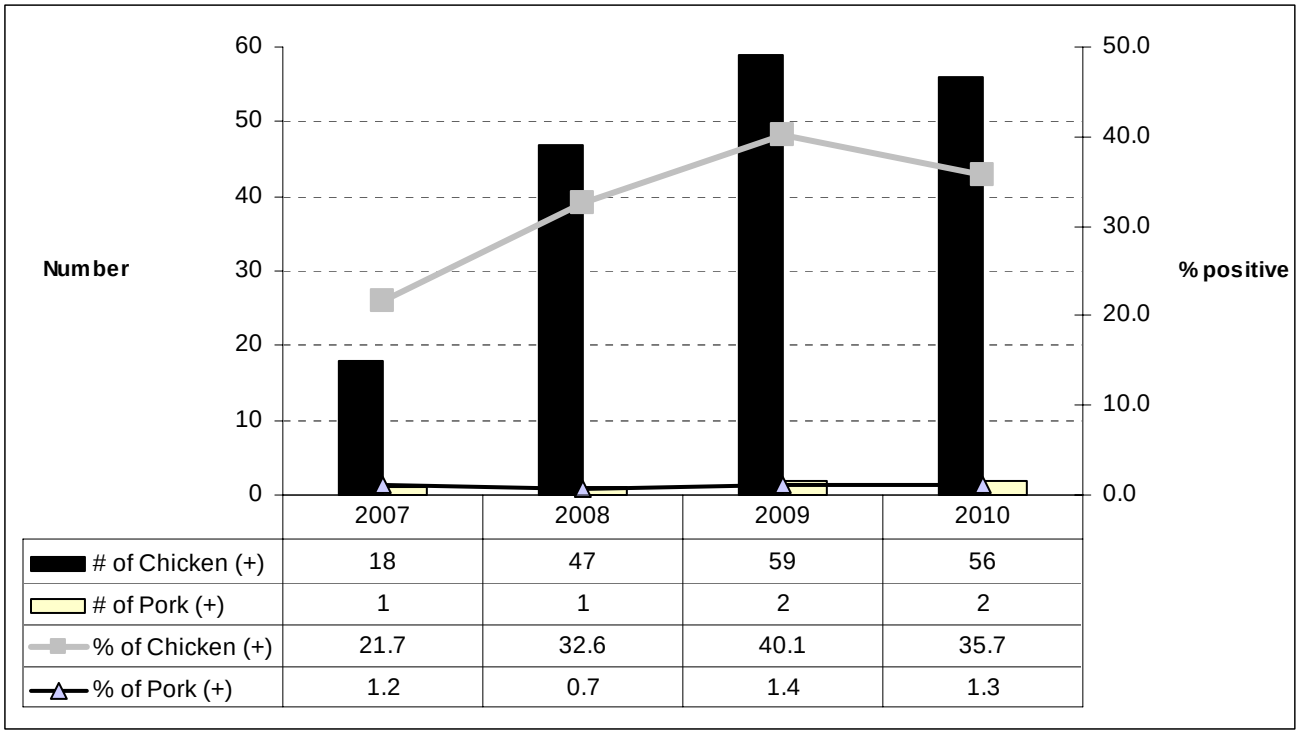


Table 3: *Salmonella* isolates from CIPARS retail chicken meat by serotype, purchased in BC, 2007-2010

	Chicken								
Serotype	2007		2008		2009		2010		**Total**
Enteritidis	0	0	14	29.8%	30	50.8%	21	37.5%	**65**
Kentucky	4	22.2%	13	27.7%	10	16.9%	16	28.6%	**43**
Heidelberg	4	22.2%	3	6.4%	6	10.2%	2	3.6%	**15**
Hadar	1	5.6%	3	6.4%	8	13.6%	3	5.4%	**15**
Typhimurium	0	0.0%	3	6.4%	1	1.7%	1	1.8%	**5**
Mbandaka	0	0.0%	3	6.4%	1	1.7%	0	0.0%	**4**
Thompson	1	5.6%	1	2.1%	1	1.7%	0	0.0%	**3**
4,[5],12:i:-	0	0.0%	2	4.3%	0	0.0%	1	1.8%	**3**
Worthington	0	0.0%	0	0.0%	2	3.4%	0	0.0%	**2**
Other	8	44.4%	5	10.6%	0	0.0%	6	10.7%	**19**
Pending	0	0.0%	0	0.0%	0	0.0%	6	10.7%	**6**
Totals	**18**	100.0%	**47**	100.0%	**59**	100.0%	**56**	100.0%	**180**

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 seven percent (56/58) of all *Salmonella* isolates recovered from retail meat in 2010 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% and 38% of all *Salmonella* isolates recovered in 2008, 2009 and 2010, respectively (Table 3). *S*. Kentucky continues to be the second most commonly isolated serotype making up 29% of all *Salmonella* isolates from retail chicken in 2010.

In addition to CIPARS retail meat sampling, there were a total of 20 food samples tested by BCCDC PHRML (n=11) and CFIA (n=9) that were positive for *Salmonella* between 2007 and 2010. Six (30%) of these were reported in 2010, all were chicken samples tested by BC PHMRL. Four (67%) of the samples in 2010 were reported as *S*. Kentucky.

Animals

Table 4: *Salmonella* isolates by animal species, BC, 2007-2010

Species	2007	2008	2009	2010	Total
Cat	2	2	1	3	8
Cattle	14	10	17	12	53
Chicken and environment°	185	176	260	162	783
Dog	1	3	1	1	6
Domestic duck/goose	0	1	0	0	1
Reptile - Exotic/Zoo	4	4	3	5	16
Horse	1	3	4	0	8
Sheep	0	0	0	1	1
Swine	6	6	11	6	29
Turkey	10	1	12	3	26
Wildlife*	30	7	9	13	59
Other^	1	2	3	7	13
Total	**254**	**215**	**321**	**213**	**1003**

°Chicken and environment—in 2010 includes 43 diagnostic isolates from chickens, and 119 environmental samples taken from the chicken hatchery/farm

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

^other—includes species for which it was unspecified whether wild or captive (Ex. finch, reptile, pigeon, etc.)

Table 5: *Salmonella* isolates from chicken and chicken environment by serotype, BC, 2007-2010

Serotype	2007		2008		2009		2010		Total
Enteritidis	25	13.5%	48	27.3%	125	48.1%	96	59.3%	294
Kentucky	65	35.1%	60	34.1%	68	26.2%	41	25.3%	234
Heidelberg	42	22.7%	21	11.9%	22	8.5%	0	0.0%	85
Rissen	8	4.3%	2	1.1%	11	4.2%	2	1.2%	23
Mbandaka	5	2.7%	7	4.0%	5	1.9%	3	1.9%	20
4,[5],12:i:-	11	5.9%	22	12.5%	4	1.5%	3	1.9%	40
Hadar	8	4.3%	3	1.7%	3	1.2%	0	0.0%	14
Typhimurium	2	1.1%	4	2.3%	5	1.9%	1	0.6%	12
Infantis	1	0.5%	1	0.6%	2	0.8%	2	1.2%	6
Other	18	9.7%	8	4.5%	15	5.8%	14	8.6%	55
Total	**185**	100.0%	**176**	100.0%	**260**	100.0%	**162**	100.0%	**783**

The animal data represented a wide variety of species (Table 4). In 2010, 76% (162/213) of the isolates from animals were from chicken and the chicken environment, so only serotypes from this category were presented in Table 5. The percentage of chicken and the chicken environment isolates that were SE has been steadily increasing since 2007, in spite of a variable number of total isolates each year. In contrast, the number and percentage of isolates that were *S*. Heidelberg has steadily decreased over the same time period, with no isolates reported in 2010.

Table 6: *Salmonella* serotypes reported in two or more sectors (human, food, animal), BC, 2010

Serotype	Human	Food+		Animal										Total
		Pork	Chicken	Cat	Cattle	Chicken and environment°	Dog	Reptile - Exotic/Zoo	Sheep	Swine	Turkey	Wildlife*	Other^	
Enteritidis	574		21	2		96		1					1	**695**
Typhimurium	100		1	1	8	1	1		1	3		5	3	**124**
Heidelberg	64		2									1		**67**
Kentucky	8		16			41								**65**
4,[5],12:i:-	36		1			3							1	**41**
Hadar	16		3								1	2		**22**
Mbandaka	17					3				1				**21**
Infantis	16		1			2								**19**
Newport	18											1		**19**
Braenderup	13	1	1			1						1		**17**
Agona	14					1								**15**
Schwarzengrund	4		1		1	1					2			**9**
Senftenberg	5					3								**8**
Albany	3					1						1	1	**6**
Bovismorbificans	4					1								**5**
Derby	3									2				**5**
Oranienburg	4					1								**5**
Tennessee	3		1			1								**5**
Litchfield	3											1		**4**
Rissen	2					2								**4**
Bareilly	2											1		**3**
Worthington	1					1								**2**

°Chicken and environment—in 2010 includes 43 diagnostic isolates from chickens, and 119 environmental samples taken from the chicken hatchery/farm

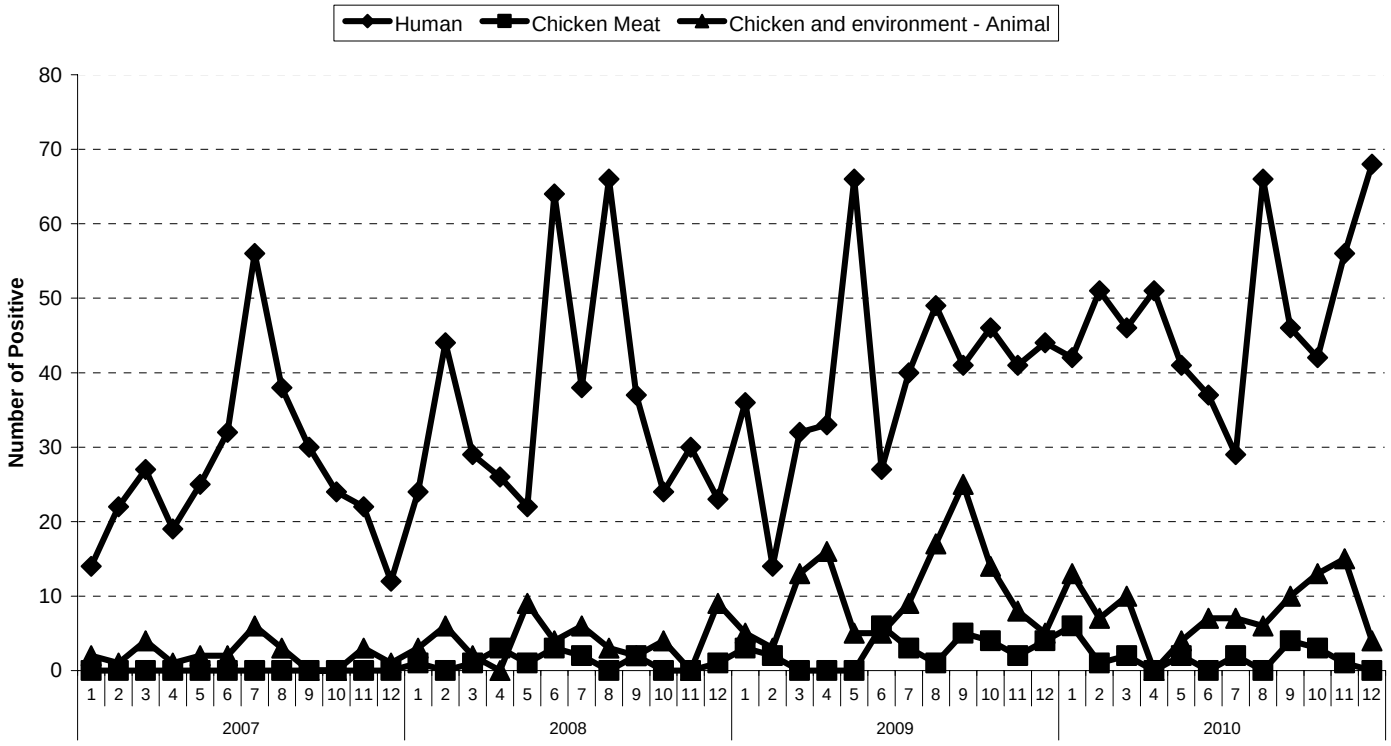
*wildlife – includes birds, wild reptiles/amphibians, land mammals, and marine mammals

^other—includes species where it was unspecified if wild or domestic (Ex. finch, reptile, pigeon, etc.)

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

A total of 22 serotypes were common across two or more sectors in 2010. Twelve serotypes were common across two sectors and ten were common across all three sectors. Serotypes common across all three sectors were: Braenderup, Enteritidis, Hadar, Heidelberg, Infantis, Kentucky, Schwarzengrund, Tenessee and Typhimurium, 4,5,12:i:- (Table 6). The overlap in serotypes was seen most often between human, chicken meat and animal isolates from chicken or chicken environments. This overlap was likely due to the large number of isolates reported from these three sources.

Figure 3: *S*. Enteritidis isolates from humans, retail chicken meat, and animal isolates from chicken or chicken environments, BC, 2007-2010

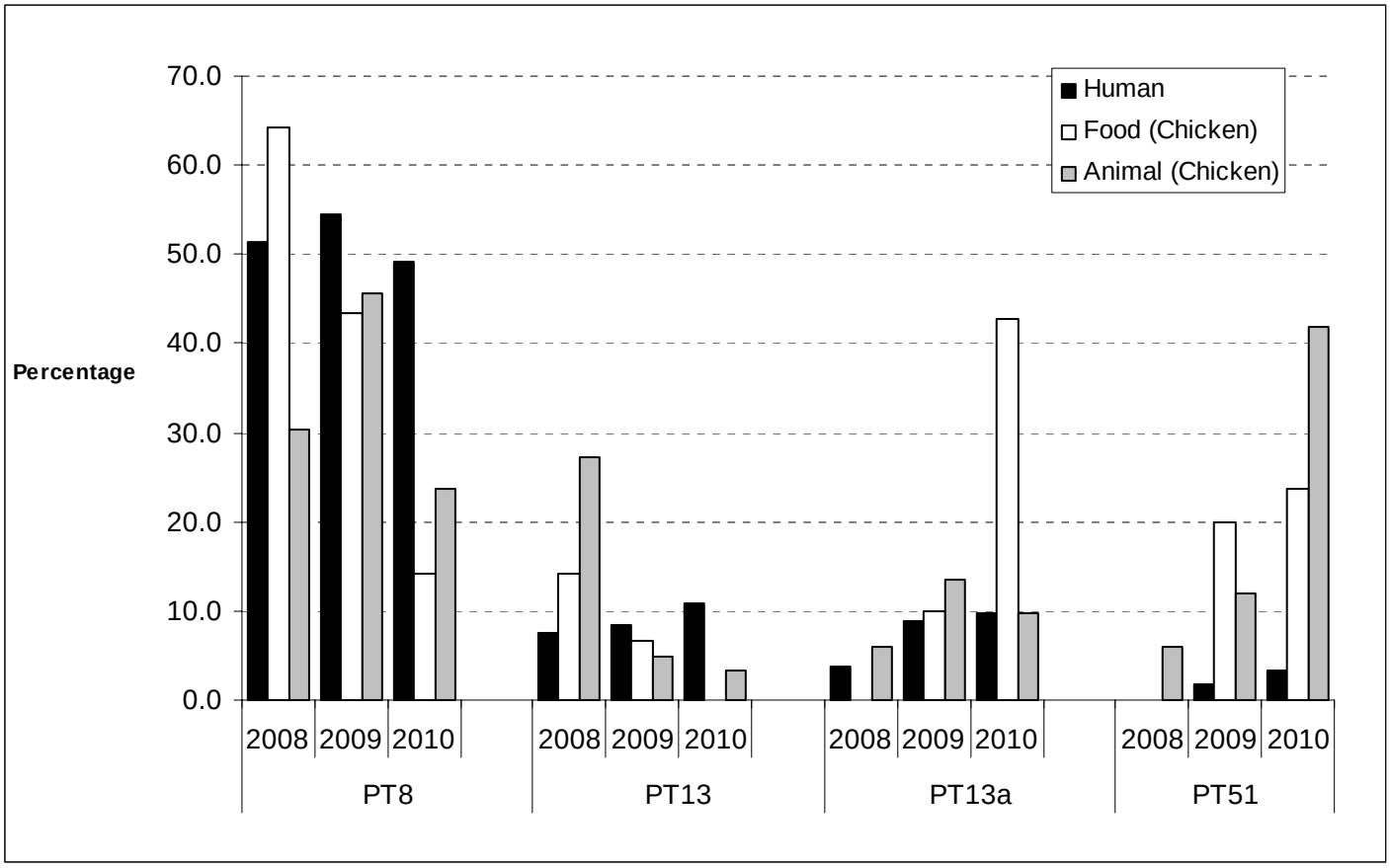


Among isolates of SE there has been an increasing trend over time in all three sectors, most notably among human isolates (Figure 3). The peaks in the number of human isolates occurred in summer months and coincided with clusters investigated as part of the ongoing human outbreak amongst cases of SE with PFGE pattern SENXAI.0003. The peak seen in December 2010 was caused by cases associated with international travel to holiday destinations such as Mexico and the Caribbean. Amongst the animal isolates (chicken and chicken environment), while the total number of isolates of SE was higher in 2009, the percentage of all isolates that were SE was actually greater in 2010 as shown in Table 5.

Table 7: *S*. Enteritidis phage types reported in two or more sectors (human, food, animal), BC, 2010

Phagetype	Human		Chicken (food)		Chicken (animal)		Total
8	132	46.2%	3	14.3%	22	23.7%	**157**
51	9	3.1%	5	23.8%	39	41.9%	**53**
13a	26	9.1%	9	42.9%	9	9.7%	**44**
13	29	10.1%	0	0.0%	3	3.2%	**32**
19	0	0.0%	1	4.8%	6	6.5%	**7**
23	1	0.3%	0	0.0%	1	1.1%	**2**
Other	89	31.1%	3	14.3%	13	14.0%	**105**
Total	**286**	100.0%	**21**	100.0%	**93**	100.0%	**400**

Figure 4: Distribution of selected SE PT in humans, chicken meat and animal isolates from chicken or chicken environments, BC, 2008-2010



Note: PT started in April 2008 for animal data

In 2010, the most common PT overall was PT 8 and was seen in all three 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 has been consistently high among human isolates since 2008 and was also common among isolates from chicken meat and chicken or chicken environments in 2008 and 2009, however this PT accounted for a smaller proportion of isolates in these sectors in 2010 (Figure 4).

Individually, each sector had a different PT that was most common in 2010. PT 8 was most common among human isolates, PT 13a was most common among chicken meat from CIPARS and PT 51 was most common among animal isolates from chicken or chicken environments (Table 7). Previously, PT 13a made up a small proportion of isolates from all three sectors; however in 2010 this pattern emerged among isolates from chicken meat (Figure 4). PT 51 had previously been seen in low numbers from animal isolates from chicken or chicken environments. This PT was also seen in chicken meat isolates from CIPARS, however this pattern was only seen sporadically among human isolates in 2010.

PT 19 was identified in both chicken meat and animal isolates from chicken or chicken environments isolates; however it was not reported in humans. PT 13 was the cause of a human outbreak in 2007 and has only been seen sporadically in all three sectors since then.

Cross-sectoral clusters of interest

S. Enteritidis PT 8/ PFGE pattern SENXAI.0003 and the emergence of PT 51

The number of human cases associated with SENXAI.0003/PT 8 remained high throughout 2010. Unlike previous years when a summer peak was identified, the number of human cases remained high throughout the entire year. The majority of the cases continued to be reported in the Lower Mainland and, based on the data from the outbreak investigation, eggs were considered to be the most likely source. Three environmental clusters were reported in 2010 associated with restaurants. PT 51 increased among the animal and food sectors in 2010. Ninety percent of PT 51 isolates had PFGE pattern SENXAI.0003. Human cases of PT 51 were only sporadically reported in 2010. It will be important to continue to monitor for the changes in PT across sectors over time.

S. Heidelberg PT 19, PFGE pattern SHEXAI.0009

PT19/PFGE pattern SHEXAI.0009 isolates were reported in animal isolates from chicken or chicken environments, retail chicken and humans between September 2009 and March 2010, with a noted increase in human isolates between January and March 2010. Due to the increase in human cases and the cross-sectoral clustering, human cases were further investigated. Fifteen human cases (SHEXAI.0009) were reported between January 1 and March 1, 2010. Chicken was the most common exposure reported among primary, locally-acquired cases, 8/11 (73%). This was the second time that a cross-sectoral cluster of *S.* Heidelberg was identified through review of integrated surveillance data, the previous cluster occurring in fall 2007.

Conclusions

- SE is 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.