





# BC Integrated *Salmonella* Surveillance Annual Report

# 2012

BC Centre for Disease Control

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BRITISH COLUMBIA

Ministry of Agriculture

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# 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 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 third annual report arising from integrated surveillance data. It covers data from 2012 and includes some data reported since 2008 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.

New in 2012 Report

- Human isolates differentiated by travel status to focus on those that were locally-acquired
- Additional time series analysis of *Salmonella* Enteritidis

# Methods - Data Sources

## Human

Human salmonellosis cases are reportable in BC. All *Salmonella* isolates are forwarded to the BCCDC Public Health Microbiology and Reference Laboratory (BCCDC 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). Between 2008-March 2012, phage type (PT) was available for isolates 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 (http://www.bccdc.ca/NR/rdonlyres/0B227280-6193-4A7B-9B8C-CF-8C41A5538C/0/Salmonella_March2012.pdf). The travel information is self-reported. This information was linked to the Integrated *Salmonella* Surveillance data for the first time in 2012 but retrospective travel information was available for 2008-2011 and was also linked for analysis purposes. 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 Table 1, are based on isolates reported as locally-acquired.

The data available for analysis include identification number, lab typing information and date of submission; no identifying information is used in this analysis.

## Food

Most *Salmonella* isolates from food originate from meat samples collected as part of the Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS) (PHAC). In 2012, 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) as well as black silkie chicken (started in 2009) were also collected in 2012 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 BCCDC PHMRL and through samples submitted and tested by the CFIA in BC.

The data available for analysis include 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,

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 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 identification number and species. The *Salmonella* typing data available are shown in Table 1. 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. 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 or industry monitoring programs

The data available for analysis include 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 Appendix 1. From April 2008 to present, isolates were serotyped and phage typed by LFZ-PHAC; prior to April 2008 isolates were serotyped and had PFGE run at the BCCDC-PHMRL.

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

# Methods - Data Analysis

All data for the report were extracted between February 8-18, 2013 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 at least 2 sectors over the year, additional data analysis was conducted. In 2012, *S.* Enteritidis and *S.* Heidelberg met these criteria.

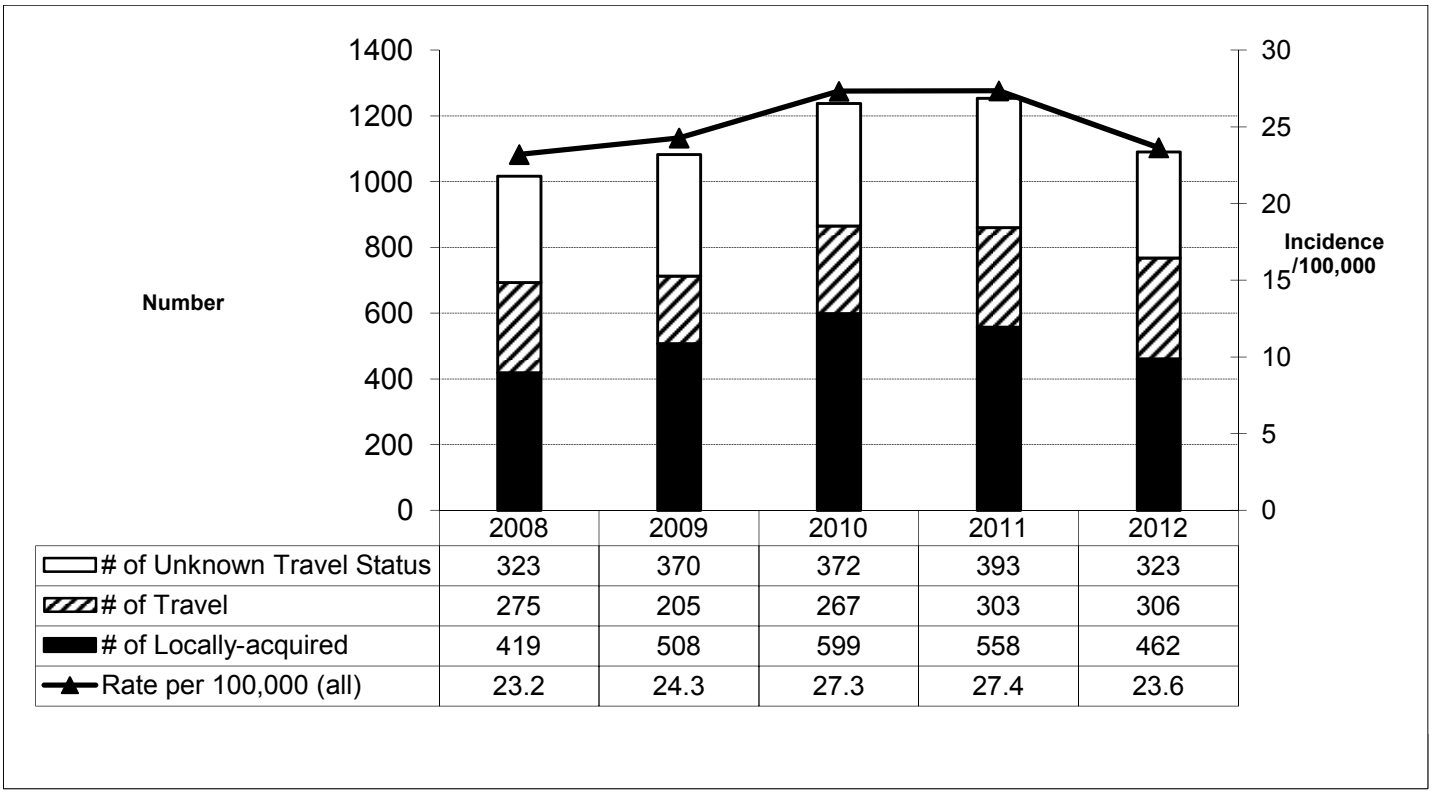
If a cluster that spanned more than one sector was identified, further investigation was initiated and results are reported here.

Further analyses were conducted for *S.* Enteritidis, given the relatively large number of cases observed for this serotype. Regression methods were used to investigate the seasonal cycle and trend for locally-acquired *S.* Enteritidis isolates reported during 2008-2012.

# Findings - Human

Between 2008 and 2011, there was an increase in the overall number of isolates and rate of human salmonellosis in BC (Figure 1). However, in 2012 the number of infections and incidence decreased and were similar to 2008. From 2008-2012, an average of 65.2% (2546/3902) of *Salmonella* cases with travel information available were locally-acquired (range by year: 60.2%-71.2%). The number of locally-acquired human isolates peaked in 2010 and has been declining since.

**Figure 1: Human *salmonellosis* cases and rates by travel status, BC, 2008-2012**




| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| # of Unknown Travel Status | 323 | 370 | 372 | 393 | 323 |
| # of Travel | 275 | 205 | 267 | 303 | 306 |
| # of Locally-acquired | 419 | 508 | 599 | 558 | 462 |
| Rate per 100,000 (all) | 23.2 | 24.3 | 27.3 | 27.4 | 23.6 |

# Findings - Human

In 2012, the proportion of *S.* Enteritidis decreased to 42.0%, the lowest proportion observed across the five years of data. *S.* Heidelberg was the second most common serotype observed in 2012; it represented 16.7% of all *Salmonella* isolates, over two times the proportion observed in 2011. Other *Salmonella* serotypes that have been reported previously were excluded (e.g., *S.* Typhi and *S.* Paratyphi) due to the removal of travel-related isolates. The increase in *S.* Braenderup during 2012 was due to an outbreak associated with mangoes reported in August (Table 1).

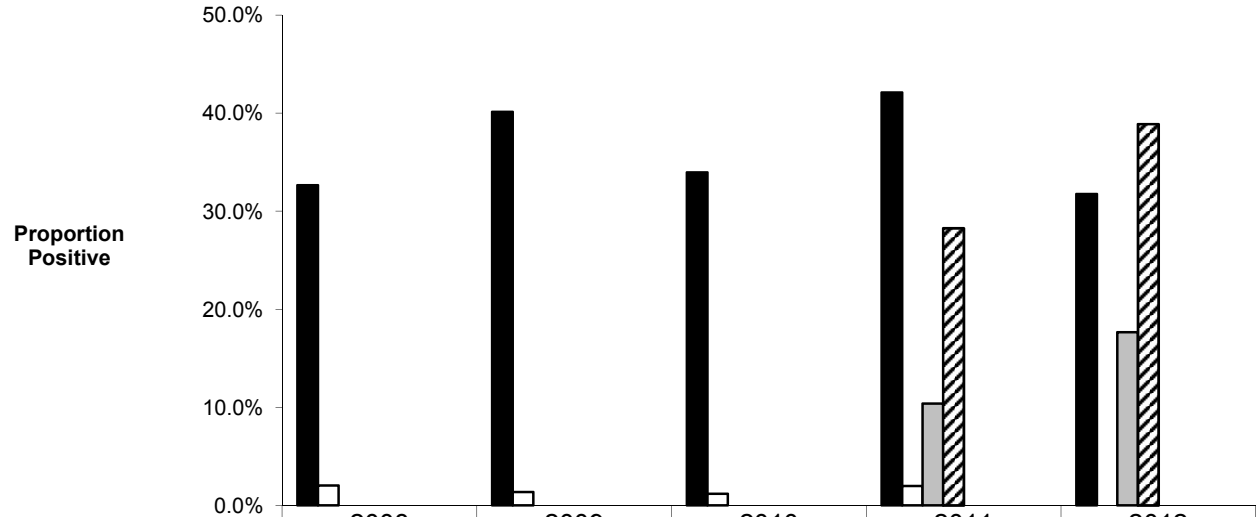
**Table 1: Isolates from locally-acquired human cases of *Salmonella* by serotype, BC, 2008-2012**

| Serotype | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Enteritidis | 211 | 50.4% | 257 | 50.6% | 321 | 53.6% | 356 | 63.8% | 194 | 42.0% | 1339 |
| Typhimurium | 57 | 13.6% | 58 | 11.4% | 58 | 9.7% | 37 | 6.6% | 41 | 8.9% | 251 |
| Heidelberg | 18 | 4.3% | 25 | 4.9% | 47 | 7.8% | 42 | 7.5% | 77 | 16.7% | 209 |
| 4,5,12:i:- | 23 | 5.5% | 23 | 4.5% | 29 | 4.8% | 12 | 2.2% | 6 | 1.3% | 93 |
| Hadar | 9 | 2.1% | 9 | 1.8% | 4 | 0.7% | 9 | 1.6% | 7 | 1.5% | 38 |
| Infantis | 2 | 0.5% | 3 | 0.6% | 7 | 1.2% | 8 | 1.4% | 9 | 1.9% | 29 |
| Braenderup | 3 | 0.7% | 0 | 0.0% | 4 | 0.7% | 1 | 0.2% | 18 | 3.9% | 26 |
| Javiana | 1 | 0.2% | 3 | 0.6% | 2 | 0.3% | 5 | 0.9% | 6 | 1.3% | 17 |
| Anatum | 1 | 0.2% | 4 | 0.8% | 2 | 0.3% | 0 | 0.0% | 6 | 1.3% | 13 |
| SS I enterica | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 10 | 2.2% | 10 |
| Other | 94 | 22.4% | 126 | 24.8% | 125 | 20.9% | 88 | 15.8% | 88 | 19.0% | 521 |
| **Total** | **419** | 100.0% | **508** | 100.0% | **599** | 100.0% | **558** | 100.0% | **462** | 100.0% | **2546** |

# Findings - Food

In 2012, *Salmonella* was isolated from 31.7% (53/167) of retail chicken meat samples purchased in BC. No *Salmonella* isolates were recovered from retail pork. Since 2008, *Salmonella* has been consistently recovered from over 30% of retail chicken samples, while recovery from retail pork has remained below 2%. Forty-nine percent (53/108) of all *Salmonella* isolates recovered from retail meat in 2012 were from chicken (Figure 2); consequently, the serotype data presented in Table 2 are for retail chicken meat only. In 2012, *S.* Enteritidis remained the most common serotype recovered from retail chicken and made up 28.3% (15/53) of all *Salmonella* isolates recovered in 2012 (Table 2). This is similar to the proportion seen in 2008 and much lower than the proportion observed in 2009-2011 (Table 2). *S.* Kentucky continued to be the second most commonly isolated serotype making up 26.4% (14/53) of all *Salmonella* isolates from retail chicken in 2012. More isolates (n=7) of *S.* Heidelberg were recovered from retail chicken in 2012 than in any year.

**Figure 2: Number and proportion of *Salmonella* isolates recovered from CIPARS retail meat samples (chicken, pork, turkey and chicken nuggets) purchased in BC, 2008-2012**




| | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|
| % of Chicken (+) | 32.6% | 40.1% | 33.9% | 42.1% | 31.7% |
| % of Pork (+) | 2.0% | 1.4% | 1.2% | 2.0% | 0.0% |
| % of Turkey (+) | | | | 10.4% | 17.6% |
| % of Chicken nuggets (+) | | | | 28.3% | 38.9% |
| # of Chicken (+) | 47 | 59 | 56 | 64 | 53 |
| # of Pork (+) | 3 | 2 | 2 | 3 | 0 |
| # of Turkey (+) | | | | 8 | 27 |
| # of Chicken nuggets (+) | | | | 13 | 28 |

Note: Turkey and nugget sampling began in March 2011

**Table 2: *Salmonella* isolates by serotype from CIPARS retail chicken meat*, purchased in BC, 2008-2012**

| Serotype | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Enteritidis | 14 | 29.8% | 30 | 50.8% | 24 | 42.9% | 30 | 46.9% | 15 | 28.3% | **113** |
| Kentucky | 13 | 27.7% | 10 | 16.9% | 18 | 32.1% | 20 | 31.3% | 14 | 26.4% | **75** |
| Heidelberg | 3 | 6.4% | 6 | 10.2% | 4 | 7.1% | 6 | 9.4% | 7 | 13.2% | **26** |
| Hadar | 3 | 6.4% | 8 | 13.6% | 3 | 5.4% | 3 | 4.7% | 5 | 9.4% | **22** |
| Mbandaka | 3 | 6.4% | 1 | 1.7% | 0 | 0.0% | 0 | 0.0% | 2 | 3.8% | **6** |
| 4,5,12:i:- | 2 | 4.3% | 0 | 0.0% | 1 | 1.8% | 0 | 0.0% | 1 | 1.9% | **4** |
| Infantis | 0 | 0.0% | 0 | 0.0% | 1 | 1.8% | 0 | 0.0% | 2 | 3.8% | **3** |
| Braenderup | 0 | 0.0% | 0 | 0.0% | 1 | 1.8% | 1 | 1.6% | 0 | 0.0% | **2** |
| I Rough:g,m:- | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 1.9% | **1** |
| I 6,8:-:e,n,x | 0 | 0.0% | 0 | 0.0% | 1 | 1.8% | 0 | 0.0% | 0 | 0.0% | **1** |
| Pending | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 6 | 11.3% | **6** |
| Other | 9 | 19.1% | 4 | 6.8% | 3 | 5.4% | 4 | 6.3% | 0 | 0.0% | **20** |
| **Totals** | **47** | 100.0% | **59** | 100.0% | **56** | 100.0% | **64** | 100.0% | **53** | 100.0% | **279** |

*Does not include pork, chicken nuggets, turkey or black silkies

*Salmonella* was recovered from 17.6% (27/153) of BC ground turkey samples purchased at retail. The most common *Salmonella* serotypes recovered from turkey were *S.* Enteritidis and *S.* Kentucky (7 isolates each), followed by 5 *S.* Hadar, 2 *S.* Heidelberg and 1 each of *S.* Johannesburg and *S.* Schwarzengrund isolates. Six isolates were still pending serotype data at the time the data were extracted for this report.

*Salmonella* was also recovered from 28 chicken nugget samples (38.9% of 72 samples). These included: 12 *S.* Heidelberg, 8 *S.* Enteritidis, 4 *S.* Kentucky, 2 *S.* Hadar and 1 each of *S.* Infantis and *S.* Mbandaka. Two *Salmonella* isolates were also recovered from black silkie chickens at retail: 1 *S.* Kentucky and 1 *S.* Newport.

Between 2008 and 2012, 42 food samples tested positive for *Salmonella* by BCCDC PHMRL (n=37) and CFIA (n=5). Eight (19.0%) of these were reported in 2012 and all were tested by BC PHMRL. One (12.5%) was from a chicken sample and 1 (12.5%), a turkey sample. The other 6 isolates were from unknown sources. The most common serotypes were *S.* Hadar (3 isolates, 37.5%) and *S.* Heidelberg (2, 25.0%). Single isolates of *S.* Virchow, *S.* Anatum and *S.* Liverpool were also reported.

# Findings - Abattoir

In 2012, 19 *Salmonella* isolates (13.5% of 141 samples) were recovered from chickens at slaughter; this is lower than the recovery proportion observed in 2011 (21.6% (29/134)). The most commonly observed serotypes in 2012 were 5 *S.* Enteritidis and 4 *S.* Hadar; 6 isolates are pending serotype results (Table 5).

No samples were obtained from abattoir pigs raised in BC in 2012.

# Findings - Animals

Samples from chicken and their environment continue to make up the largest proportion of *Salmonella* isolates from animals (Table 3). In 2012, 20 (11.0%) of the 181 isolates from chicken were from diagnostic samples (e.g., from actual birds). The remaining 161 (89.0%) isolates were contributed by government or industry monitoring programs that collect samples from the environments in which the birds live.

In 2012, there was an increase in isolates from wildlife (Table 3). These were primarily pine siskins (n=19) and were associated with an outbreak of salmonellosis due to *S.* Typhimurium (Table 4).

**Table 3: *Salmonella* isolates by animal species, BC, 2008-2012**

| Species | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
|---|---|---|---|---|---|---|
| Cat | 2 | 1 | 3 | 1 | 2 | 9 |
| Cattle | 10 | 17 | 12 | 9 | 5 | 53 |
| Chicken and environment° | 176 | 257 | 166 | 213 | 181 | 993 |
| Dog | 3 | 1 | 1 | 3 | 1 | 9 |
| Domestic duck/goose | 1 | 0 | 0 | 1 | 0 | 2 |
| Reptile - Exotic/Zoo | 5 | 3 | 5 | 7 | 3 | 23 |
| Horse | 3 | 4 | 0 | 3 | 1 | 11 |
| Sheep | 0 | 0 | 1 | 1 | 0 | 2 |
| Swine | 6 | 11 | 6 | 6 | 4 | 33 |
| Turkey | 1 | 12 | 3 | 17 | 13 | 46 |
| Wildlife* | 7 | 9 | 12 | 13 | 30 | 71 |
| Other^ | 1 | 6 | 8 | 2 | 0 | 17 |
| **Total** | **215** | **321** | **217** | **276** | **240** | **1269** |

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

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

^other—includes species where it was unspecified if wild or domestic, goat, unknown

# Findings - Animals

The *Salmonella* serotypes reported in 2012 from animals differed from chicken & chicken environment from previous years, with *S.* Enteritidis representing 30.4% (n=55) of isolates in 2012, less than half of 2011 (Table 4). There was a slight increase in the proportion of other serotypes compared to the previous year, although in most cases the actual number of isolates changed only slightly. The exceptions were for *S.* Cerro, with five isolates and for *S.* Thompson with 13 isolates, all from chicken industry monitoring programs.

**Table 4: *Salmonella* animal isolates from chicken & chicken environment by serotype, BC, 2008-2012**

| Serotype | 2008 | | 2009 | | 2010 | | 2011 | | 2012 | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Enteritidis | 48 | 27.3% | 125 | 48.6% | 96 | 57.8% | 131 | 61.5% | 55 | 30.4% | 455 |
| Kentucky | 60 | 34.1% | 67 | 26.1% | 41 | 24.7% | 51 | 23.9% | 54 | 29.8% | 273 |
| Heidelberg | 21 | 11.9% | 22 | 8.6% | 0 | 0.0% | 5 | 2.3% | 6 | 3.3% | 54 |
| Mbandaka | 7 | 4.0% | 5 | 1.9% | 3 | 1.8% | 8 | 3.8% | 10 | 5.5% | 33 |
| 4,5,12:i:- | 22 | 12.5% | 4 | 1.6% | 3 | 1.8% | 0 | 0.0% | 2 | 1.1% | 31 |
| Thompson | 0 | 0.0% | 1 | 0.4% | 0 | 0.0% | 0 | 0.0% | 13 | 7.2% | 14 |
| Infantis | 1 | 0.6% | 2 | 0.8% | 2 | 1.2% | 3 | 1.4% | 3 | 1.7% | 11 |
| Braenderup | 0 | 0.0% | 1 | 0.4% | 1 | 0.6% | 3 | 1.4% | 5 | 2.8% | 10 |
| Worthington | 0 | 0.0% | 1 | 0.4% | 1 | 0.6% | 2 | 0.9% | 4 | 2.2% | 8 |
| Cerro | 1 | 0.6% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 5 | 2.8% | 6 |
| Other | 16 | 9.1% | 29 | 11.3% | 19 | 11.4% | 10 | 4.7% | 24 | 13.3% | 98 |
| **Total** | **176** | 100.0% | **257** | 100.0% | **166** | 100.0% | **213** | 100.0% | **181** | 100.0% | **993** |

# Findings - Integrated

A total of 15 serotypes were common across two or more sectors in 2012 (Table 5); this is less than in 2010 and 2011, when there were 22 serotypes reported across two or more sectors. Three serotypes (*S.* Enteritidis, *S.* Kentucky, *S.* Hadar) were found in all four sectors, five serotypes (*S.* Heidelberg, *S.* Mbandaka, *S.* Infantis, *S.* 4,5,12:i:-, *S.* Schwarzengrund), in three sectors and seven, in two sectors. As in previous years, serotypes overlapped primarily between humans, chicken meat and chicken at slaughter and on farm, likely due to the large number of isolates from these sources.

A reported previously, there was a large number of *S.* Typhimurium isolates in wild birds in 2012.

**Table 5: *Salmonella* serotypes reported in two or more sectors (human, food, abattoir, animal), BC, 2012**

| | Human-Local | Food+ | | | | Abattoir | Animal | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Serotype | | Chicken | Chicken Nuggets | Turkey | Other^ | Chicken | Cattle | Chicken and environment° | Swine | Turkey | Wildlife* | Other^^ | |
| Enteritidis | 194 | 15 | 8 | 7 | | 5 | 1 | 55 | | | 1 | 3 | 289 |
| Heidelberg | 77 | 7 | 12 | 2 | 1 | | | 6 | | | | | 105 |
| Kentucky | 2 | 14 | 4 | 7 | 1 | 1 | | 54 | | | | | 83 |
| Typhimurium | 41 | | | | | | 1 | 2 | 2 | | 25 | 1 | 72 |
| Hadar | 7 | 5 | 2 | 5 | | 4 | | 1 | | 1 | 1 | | 26 |
| Braenderup | 18 | | | | | | | 5 | | | | | 23 |
| Mbandaka | 5 | 2 | 1 | | | | | 10 | | 3 | | | 21 |
| Thompson | 2 | | | | | | | 13 | | | 3 | | 18 |
| Infantis | 9 | 2 | 1 | | | | | 3 | | | | | 15 |
| 4,5,12:i:- | 6 | 1 | | | | | | 2 | | | | | 9 |
| Schwarzengrund | 3 | | | 1 | | 2 | | | | | | | 6 |
| Agona | 3 | | | | | | | | | 2 | | | 5 |
| Newport | 4 | | | | 1 | | | | | | | | 5 |
| Senftenberg | 3 | | | | | | | 2 | | | | | 5 |
| Johannesburg | | | | 1 | | | | 1 | | | | | 2 |

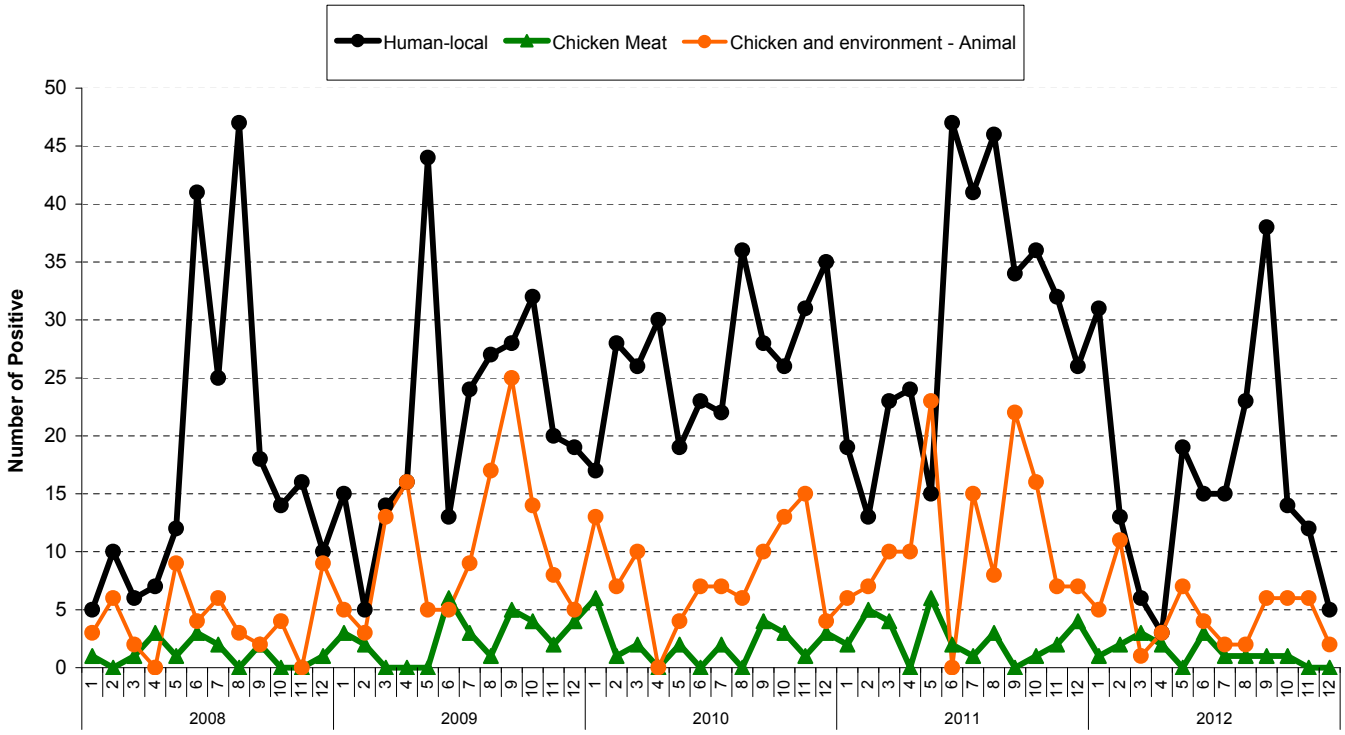
Note: only animals that had 3 or more positive *Salmonella* isolates of any serotype in 2012 are included as separate columns. Some serotypes may not be presented in this table.

°Chicken and environment—in 2012, includes 108 diagnostic isolates from chickens, and 73 environmental samples taken from the chicken hatchery/farm
*wildlife – includes birds, wild reptiles/amphibians, land mammals, and marine mammals
^Food Other includes shrimp and silkie black chickens.
^^Animal Other includes cat, dog, horse.
+Food only includes data from CIPARS, PHAC.

# Findings - Integrated

The number of *S.* Enteritidis isolates from humans and chickens and their environment decreased in 2012 (Figure 3). Chicken meat isolates also appear to have decreased in 2012. The large *S.* Enteritidis outbreak affecting humans and chickens since 2008 seems to have decreased. This decrease is associated with an overall decline in the rate of *Salmonella* in humans.

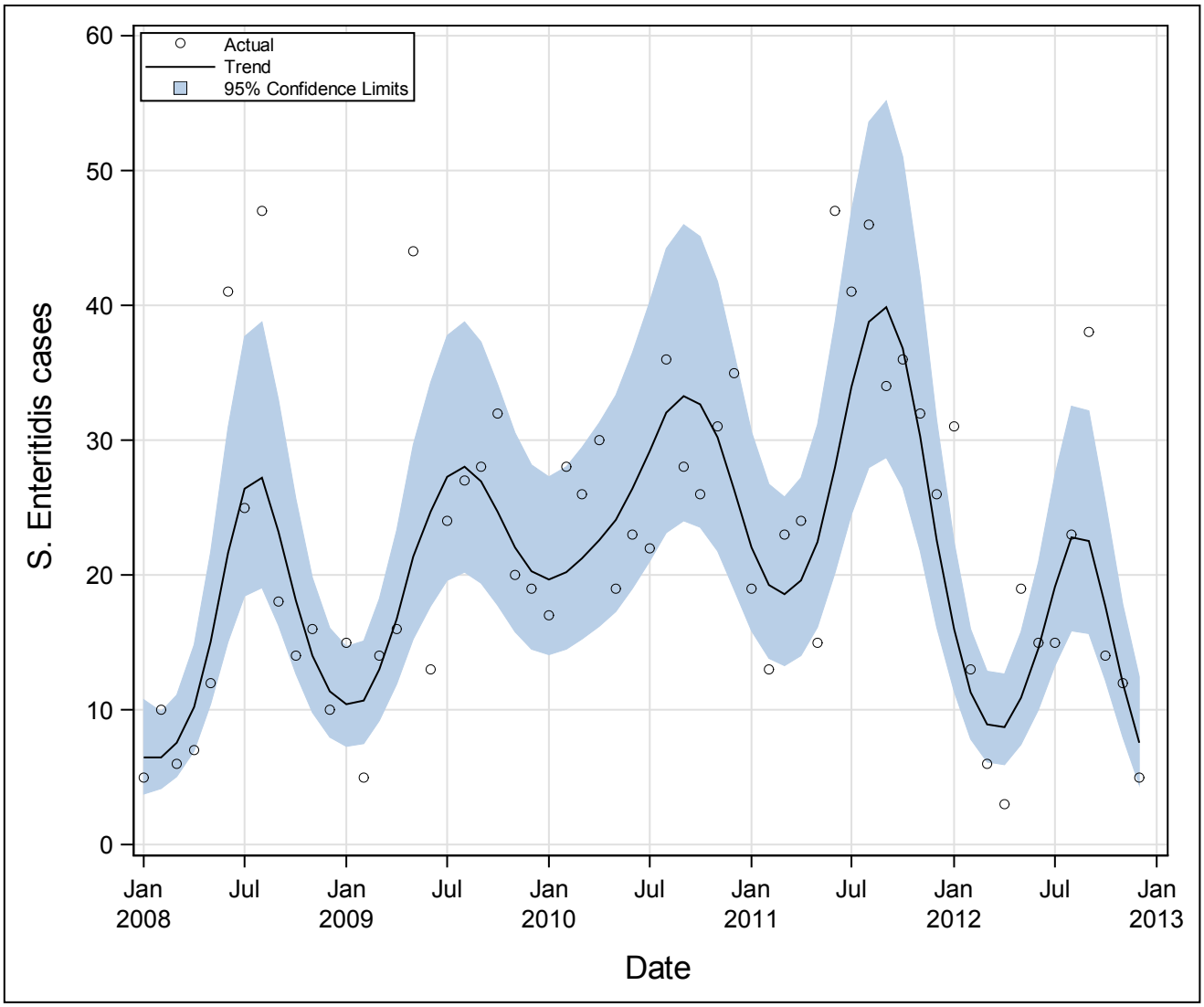
**Figure 3: *S.* Enteritidis isolates from humans, retail chicken meat, and animal isolates from chicken and their environment, BC, 2008-2012**




Note: excludes chicken nuggets, turkey and silkies

Additional time series analysis of locally-acquired human infections of *S.* Enteritidis showed the seasonal trends more clearly. A seasonal cycle of 11.9 (± 0.82) months (p=0.01) was identified. The annual summer peak was lower in 2012 than in 2008-2011. The number reported in winter was lower than in the previous three years. This decrease in 2012 may indicate a change towards a lower baseline of human infections (Figure 4).

**Figure 4: Incidence and trend for locally-acquired human cases of *S.* Enteritidis, BC, 2008-2012.**



# Findings - Integrated

Phage type (PT) 8 remained the most common *S.* Enteritidis strain, accounting for 39.1% (97/248) of all typed strains overall (Table 6). It was the most common strain in all sources except in chicken nuggets from which PT13 was more frequently isolated. PT8 has been the most common strain since 2008 and was associated with the large poultry-related human outbreak. PT13 had been seen sporadically in the last few years but was more common in 2012, especially in humans and in chicken and their environment.

**Table 6: *S.* Enteritidis phage types reported in two or more sectors (human-local, food, animal, abattoir), BC, 2012**

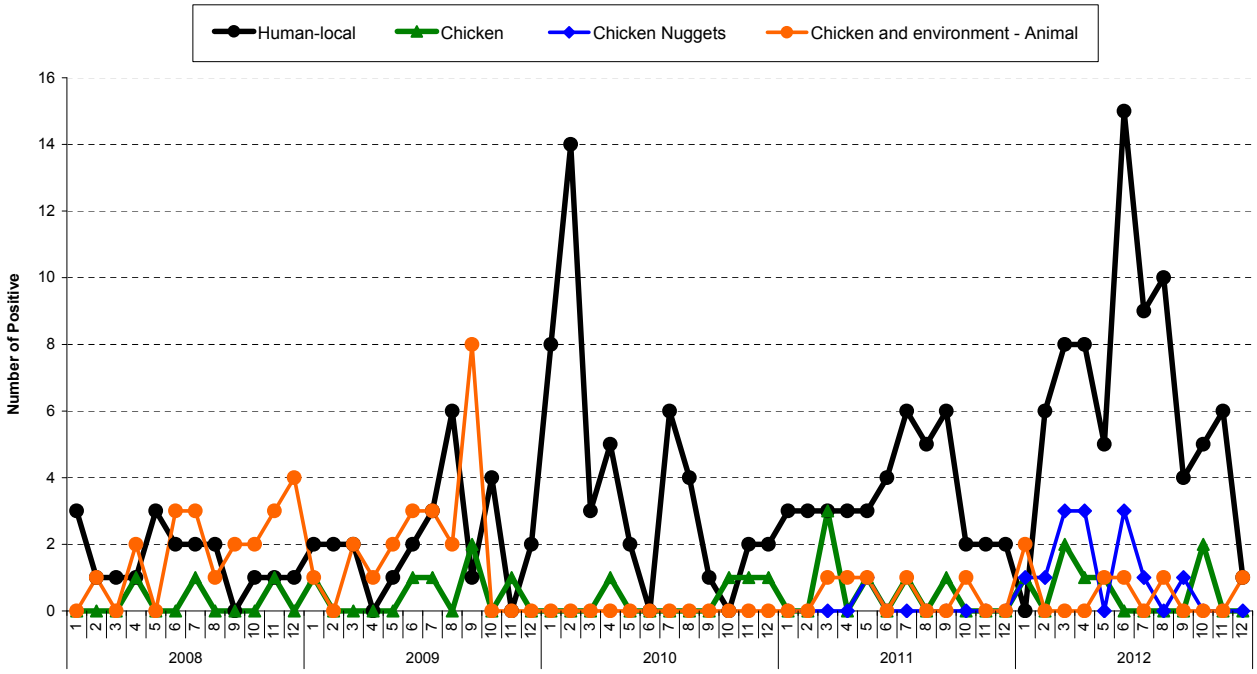
| Phagetype | Human local | Chicken-food | Chicken Nuggets | Turkey - food | Chicken and environment - Animal | Chicken - abattoir | Total |
|---|---|---|---|---|---|---|---|
| **8** | 69 | 6 | 1 | 3 | 15 | 3 | **97** |
| **13** | 34 | 2 | 3 | 2 | 7 | 1 | **49** |
| **13a** | 23 | 1 | 0 | 0 | 3 | 1 | **28** |
| **51** | 6 | 4 | 1 | 1 | 4 | 0 | **16** |
| **19** | 3 | 1 | 0 | 0 | 0 | 0 | **4** |
| **23** | 2 | 0 | 0 | 0 | 2 | 0 | **4** |
| **Other** | 21 | 1 | 3 | 1 | 24 | 0 | **50** |
| **Total** | **158** | **15** | **8** | **7** | **55** | **5** | **248** |

Note: 36 human isolates without PT have been excluded

# Findings - Integrated

For the first time, we are presenting integrated results on *S.* Heidelberg. *S.* Heidelberg rates have increased dramatically in humans since 2010, and particularly in 2012 (Figure 5).

**Figure 5: *S.* Heidelberg isolates from humans, retail chicken meat, chicken nuggets and animal isolates from chicken or chicken environments, BC, 2008-2012**



The highest number of *S.* Heidelberg isolates in a non-human source was found in chicken nuggets (Table 7). Phagetypes 19, 29 and 18 were found in humans. Chicken nuggets contained mostly PT 19 and chicken meat contained mostly PT 29. Different phage types in different chicken food sources may reflect the different sources of these two products (i.e. fresh chicken meat is usually sourced locally whereas processed chicken may be imported from other jurisdictions). Very few *S.* Heidelberg isolates were found in turkey meat and chicken and their environment.

**Table 7: *S.* Heidelberg phage types reported in two or more sectors (human-local, food, animal), BC, 2012**

| Phagetype | Human local | Chicken-food | Chicken Nuggets | Turkey - food | Chicken and environment - Animal | Total |
|---|---|---|---|---|---|---|
| **19** | 12 | 0 | 10 | 0 | 2 | **24** |
| **29** | 16 | 4 | 1 | 1 | 1 | **23** |
| **18** | 19 | 1 | 0 | 0 | 0 | **20** |
| **58** | 1 | 1 | 0 | 0 | 0 | **2** |
| **Other** | 7 | 1 | 1 | 1 | 3 | **13** |
| **Total** | **55** | **7** | **12** | **2** | **6** | **82** |

Note: 22 human isolates without PT have been excluded.

# Investigations

1. *S.* Typhimurium PT 43

The increase in wild bird *S.* Typhimurium isolates was primarily among pine siskins (n=19). The samples were associated with an outbreak of *S.* Typhimurium (Table 4 and 5) associated with backyard bird feeders at multiple locations throughout the Lower Mainland. The outbreak was sustained over several months (Feb – April, 2012) and additional cases occurred in the late summer (Aug-Sept, 2012). Many of the isolates of *S.* Typhimurium were phage typed as 43 (n=12), which has not been observed previously. There were no *S.* Typhimurium PT 43 in food or abattoir isolates; there were 2 human isolates of *S.* Typhimurium PT 43. This PT had only been reported in 2012 among the human isolates. The human cases occurred in March and July, which corresponds with the same general time period as the outbreak associated with bird feeders. No association with bird feeders was reported among the human cases.

2. *S.* Braenderup

Sixteen human cases of *S.* Braenderup with a matching PFGE pattern were reported in BC in 2012. In addition, 5 cases were reported in residents of Alberta; 3/5 had visited BC during the exposure period. Symptom onset date ranged from July 6 to August 6, 2012. Case and food safety investigations identified mangos as the likely source of illness. Traceback investigation along with the epidemiological evidence collected led to recalls of fresh mangoes. http://www.inspection.gc.ca/english/corpaffr/recarapp/2012/20120828e.shtml An outbreak investigation in the US of the same strain of *S.* Braenderup at the same time also identified fresh mangoes as the likely source of illness and led to additional recalls and actions. *S.* Braenderup identified in chickens from the animal sector were not associated with this outbreak.

3. *S.* Heidelberg

In July, an increase in human cases of *S.* Heidelberg PT 18 was identified. Case follow-up forms for 8 cases were reviewed. The most commonly reported exposures were eggs, chicken, lettuce and pets. No common source was identified. PT 18 was not common in food isolates from fresh chicken or chicken nuggets (Table 7).

4. *S.* Cerro and *S.* Thompson

An increased number of *S.* Cerro (n=5) and *S.* Thompson (n=13) isolates were observed from chicken and the environment. Despite this increase, there were no human or food isolates of *S.* Cerro and only 4 *S.* Thompson isolates reported in human isolates. No link between the sectors was identified.

Although the BC Integrated *Salmonella* Surveillance system does not identify all sources of *Salmonella* outbreaks in BC, the information has been useful during investigations to see if serotypes are associated with a specific food product or animal species.

# Conclusion

- In 2012, the inclusion of travel status for human isolates allowed for the exclusion of travel related cases in order to focus the analysis and interpretation on locally-acquired human isolates. Annually, since 2008, approximately 30% of human salmonellosis is travel-related. This proportion is consistent over the five years of data. Removing travel-related cases changed some of the commonly reported serotypes previously included in the report. Focusing on locally-acquired isolates will allow us to improve our understanding of local surveillance trends in BC and can help improve interventions.
- New time series analysis has been used as a method to further explore and analyse the data. This analysis has led to an improved understanding of seasonal and long term trends. Further exploration of these methods is planned for future analysis.
- There were notable changes in the trends reported in 2012 compared to previous years.
  - *S.* Enteritidis decreased across all sectors. PT 8 which had been investigated as part of an ongoing outbreak also decreased.
  - *S.* Heidelberg increased among human isolates and food isolates in 2012. The most common phage type reported among humans was rarely observed in food. The increase was not seen in the animal sector. The specific reason for this increase is unknown.
- Although *S.* Enteritidis decreased in 2012, 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 PT 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.
- In order to attain the goal of source attribution and improvements to 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.
- 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.

# Appendix

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

<table>
<tr><th>Sector</th><th>Species</th><th>Data Source</th><th>Typing Method</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th></tr>
<tr><td rowspan="2">Animal</td><td rowspan="2">All</td><td rowspan="2">BC AGRI</td><td>Serotype</td><td colspan="5">LFZ-PHAC</td></tr>
<tr><td>Phage type</td><td colspan="5">LFZ-PHAC</td></tr>
<tr><td rowspan="2">Animal/Abattoir</td><td rowspan="2">Poultry<br><br>Swine</td><td rowspan="2">CIPARS</td><td>Serotype</td><td colspan="3"></td><td>LFZ-PHAC</td><td></td></tr>
<tr><td>Phage type</td><td colspan="3"></td><td>LFZ-PHAC</td><td></td></tr>
<tr><td rowspan="6">Food</td><td rowspan="2">Chicken<br><br>Pork</td><td rowspan="2">CIPARS</td><td>Serotype</td><td colspan="5">LFZ-PHAC</td></tr>
<tr><td>Phage type</td><td colspan="5">LFZ-PHAC</td></tr>
<tr><td rowspan="2">Other</td><td rowspan="2">CFIA and BC PHMRL‡</td><td>Serotype</td><td colspan="5">BCCDC PHMRL</td></tr>
<tr><td>Phage type</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Turkey and Chicken nuggets*</td><td rowspan="2">CIPARS</td><td>Serotype</td><td colspan="3"></td><td>LFZ-PHAC</td><td></td></tr>
<tr><td>Phage type</td><td colspan="3"></td><td>LFZ-PHAC</td><td></td></tr>
<tr><td rowspan="2">Human</td><td rowspan="2">Human</td><td rowspan="2">BCCDC</td><td>Serotype</td><td colspan="5">BCCDC PHMRL</td></tr>
<tr><td>Phage type†</td><td colspan="5">NML-PHAC</td></tr>
</table>

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

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

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

†2007-March 2012: Only human isolates recovered in the first 15 days of each month reported with phage type. As of April 2012, all *Salmonella* Enteritidis and *Salmonella* Heidelberg isolates have phage type completed.

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