Key Facts

- 363 salmonellosis cases notified in 2018 (crude incidence rate of 7.6 per 100,000)
- Overall increasing trend in salmonellosis since 2014 (40% increase in four years)
- More than half of salmonellosis notifications were associated with international travel
- Most common serotypes reported were S. Enteritidis and S. Typhimurium (incl. monophasic Typhimurium), with S. Typhimurium the most prevalent serotype among cases acquired in Ireland
- Increasing incidence of S Enteriditis, both travel-associated and domestically acquired
- The largest outbreak reported this year was travel-related, and was suspected to be foodborne
- WGS confirmed majority of cases diagnosed in Ireland genetically unrelated to one another, but enabled case clusters and sporadic cases in Ireland to be recognised as being part of larger EU incidents
## Table of Contents

- **Background** .................................................................................................................. 3
- **Methods** ........................................................................................................................ 3
  - Disease notification ........................................................................................................ 3
  - Typing of *Salmonella* isolates ....................................................................................... 3
- **Results** ........................................................................................................................... 4
  - Salmonellosis .................................................................................................................. 4
  - Overall incidence ........................................................................................................... 4
  - Strain characteristics ...................................................................................................... 4
  - Geographical and age distribution .................................................................................... 4
  - Disease severity ............................................................................................................... 5
  - Animal contact as a risk factor ....................................................................................... 6
  - Foreign travel as a risk factor for salmonellosis in Ireland ............................................. 6
  - Trends .............................................................................................................................. 7
  - Outbreaks and clusters of salmonellosis ........................................................................ 9
  - Typhoid/Paratyphoid: .................................................................................................... 10
- **Discussion** ..................................................................................................................... 10
- **Further information available on HPSC website** ......................................................... 11
- **Acknowledgements** ..................................................................................................... 11
- **Report prepared by:** ..................................................................................................... 11
- **References** ..................................................................................................................... 11
Background

Salmonellosis typically presents clinically as an acute enterocolitis, with sudden onset of abdominal pain, diarrhoea, nausea, headache and occasionally vomiting. Fever is almost always present. Dehydration, especially among vulnerable populations such as infants, the immunocompromised and the elderly, may be severe. Invasive infection occurs in a proportion of cases.

The common reservoirs for non-typhoidal Salmonella are the intestinal tract of domestic and wild animals (including birds), which may result in a variety of foodstuffs, of both animal and plant origin, becoming contaminated with faecal organisms either directly or indirectly. Infected food handlers may also act as a source of contamination for foodstuffs. The organism may also be transmitted through direct contact with infected animals or humans or faecally contaminated environments. Companion animals are increasingly being reported as sources of infection, in particular for children.

Typhoid (caused by S. Typhi) and paratyphoid (caused by S. Paratyphi) cause enteric fever, a severe systemic life threatening condition; when reported in Ireland, these are almost invariably travel-associated.

Methods

Disease notification

Salmonellosis, typhoid and paratyphoid are notifiable diseases in Ireland under Infectious Disease Regulations. Consequently, all medical practitioners, including clinical directors of diagnostic laboratories, are required to notify the regional Medical Officer of Health (MOH) of all cases of salmonellosis, typhoid or paratyphoid. Notifications are reported using the Computerised Infectious Disease Reporting system (CIDR) which is described here. Further information on the process of reporting notifiable infectious diseases is available here. The case definitions in use in 2018 are available here. For this report, data on notified cases of salmonellosis reported to CIDR in 2018 were extracted from CIDR as of 27th September 2019, and data on typhoid and paratyphoid cases were extracted on October 3rd 2019.

Typing of Salmonella isolates

The National Salmonella, Shigella and Listeria Reference Laboratory (NSSLRL) undertake whole genome sequencing (WGS) on all Salmonella isolates referred from primary laboratories, enabling antimicrobial sensitivities to be predicted and genetically-related clusters to be detected.
Results

Salmonellosis

Overall incidence

During 2018, 363 cases of salmonellosis were notified (349 confirmed and 14 probable). Overall this corresponds to a crude incidence rate (CIR) of 7.6 per 100,000 population.

Strain characteristics

The NSSLRL analysed 351 human non-typhoidal Salmonella isolates referred for further typing in 2018.

The top 10 non-typhoidal serotypes identified in 2018 are displayed in Table 1. As usual, S. Enteritidis (27%) and S. Typhimurium (including monophasic Typhimurium) (31%) were the most common serotypes.

<table>
<thead>
<tr>
<th>Serotype</th>
<th>Number of human isolates</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enteritidis</td>
<td>95</td>
<td>27.1%</td>
</tr>
<tr>
<td>Monophasic Typhimurium</td>
<td>53</td>
<td>15.1%</td>
</tr>
<tr>
<td>Typhimurium</td>
<td>56</td>
<td>16.0%</td>
</tr>
<tr>
<td>Newport</td>
<td>18</td>
<td>5.1%</td>
</tr>
<tr>
<td>Agona</td>
<td>9</td>
<td>2.6%</td>
</tr>
<tr>
<td>Kentucky</td>
<td>8</td>
<td>2.3%</td>
</tr>
<tr>
<td>Infantis</td>
<td>7</td>
<td>2.0%</td>
</tr>
<tr>
<td>Stanley</td>
<td>6</td>
<td>1.7%</td>
</tr>
<tr>
<td>Branderup</td>
<td>6</td>
<td>1.7%</td>
</tr>
<tr>
<td>Virchow</td>
<td>6</td>
<td>1.7%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>24.8%</td>
</tr>
</tbody>
</table>

Data source: NSSLRL

More detail on the typing of human Salmonella isolates and their resistance to antimicrobials is reported in the National Salmonella, Shigella & Listeria Reference Laboratory of Ireland, Annual Report.

Geographical and age distribution

The crude incidence rates varied very little by HSE-area, with all except the HSE-NE being between 5.7 and 8.1 per 100,000 (Figure 1). The elevated rate in the NE was strongly
influenced by the inclusion of several HSE-NE cases in a travel-associated outbreak described below.

Similar to earlier years, the highest age-specific incidence rate was in children under 5 years of age (19.3/100,000). This is likely to be influenced by clinicians more readily seeking clinical samples in that age group. The next highest rate was in the 20-24 years age group (11.7 per 100,000); the lowest rate this year was in the 15-19 years age group (2.6 per 100,000).

**Figure 1: Annual crude incidence rate per 100,000 by HSE area, Ireland 2018**

![Annual crude incidence rate per 100,000 by HSE area, Ireland 2018](image)

Data source: CIDR

**Disease severity**

Diarrhoea was the most common symptom (97%) among notified cases in 2018 (Table 2), followed by abdominal pain (84%). Bloody diarrhoea occurred among 32% of cases. Median duration of illness was eight days (range 1-67 days), based on observations for 192 cases. Where recorded, thirty-eight per cent of cases (135/358) were hospitalised.

**Table 2: Disease severity of notified *Salmonella* cases in Ireland, 2018**

<table>
<thead>
<tr>
<th>Symptom/disease feature</th>
<th>Number with symptom</th>
<th>Number without symptom</th>
<th>Number symptom unknown</th>
<th>Percentage of cases with symptom (among known)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhoea</td>
<td>323</td>
<td>11</td>
<td>29</td>
<td>97%</td>
</tr>
<tr>
<td>Bloody diarrhoea</td>
<td>94</td>
<td>204</td>
<td>65</td>
<td>32%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>135</td>
<td>174</td>
<td>54</td>
<td>44%</td>
</tr>
<tr>
<td>Nausea</td>
<td>171</td>
<td>93</td>
<td>99</td>
<td>65%</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>241</td>
<td>47</td>
<td>75</td>
<td>84%</td>
</tr>
<tr>
<td>Fever</td>
<td>228</td>
<td>63</td>
<td>72</td>
<td>78%</td>
</tr>
<tr>
<td>Headache</td>
<td>91</td>
<td>129</td>
<td>143</td>
<td>41%</td>
</tr>
<tr>
<td>Myalgia</td>
<td>65</td>
<td>140</td>
<td>158</td>
<td>32%</td>
</tr>
</tbody>
</table>

Data source: CIDR
Animal contact as a risk factor

Contact with pets (e.g. reptiles), with pet food (e.g. frozen rodents, pig ear treats), with wildlife (e.g. hedgehogs), and with cattle, have all been associated with an increased risk of salmonellosis. Where recorded on CIDR, 32% (97/307) of salmonellosis cases reported contact with pets (four of which were reptiles), 9% (25/288) reported contact with farm animals, 3% (7/202) reported contact with wildlife, and 14% (32/235) reported contact with pet feed (none with frozen feeder rodents or pig ear treats).

Foreign travel as a risk factor for salmonellosis in Ireland

Where country of infection was reported, 51% (166/328) of cases were travel-associated. Travel-associated cases peaked between July and October coinciding with the peak summer holiday period. The seasonal variation among domestically acquired cases was less pronounced (data not shown).

Among travel associated cases (n=166), the most common countries of infection reported were Spain (n=31), Bosnia & Herzegovina (n=27), Thailand (n=13), and India (n=10). The popularity of a country as a travel destination is likely to be an important factor in determining the number of cases associated with each country. In 2018 the atypically high number of notifications linked with travel to Bosnia & Herzegovina represent an outbreak.

Table 3: Salmonellosis notifications acquired in Ireland, Europe and Rest of the World by age group, serotype and quarter, 2018

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Ireland</th>
<th>Europe</th>
<th>Rest of the world</th>
<th>Unknown/Not Specified</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15 yrs</td>
<td>56</td>
<td>10</td>
<td>16</td>
<td>14</td>
<td>96</td>
</tr>
<tr>
<td>15-44 yrs</td>
<td>57</td>
<td>23</td>
<td>46</td>
<td>13</td>
<td>139</td>
</tr>
<tr>
<td>45-64 yrs</td>
<td>23</td>
<td>24</td>
<td>19</td>
<td>6</td>
<td>72</td>
</tr>
<tr>
<td>65+ yrs</td>
<td>26</td>
<td>24</td>
<td>3</td>
<td>2</td>
<td>55</td>
</tr>
<tr>
<td><strong>Serotype</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typhimurium</td>
<td>33</td>
<td>12</td>
<td>6</td>
<td>6</td>
<td>57</td>
</tr>
<tr>
<td>Monophasic Typhimurium</td>
<td>25</td>
<td>14</td>
<td>7</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>Enteritidis</td>
<td>34</td>
<td>32</td>
<td>16</td>
<td>6</td>
<td>88</td>
</tr>
<tr>
<td>Other</td>
<td>62</td>
<td>14</td>
<td>51</td>
<td>11</td>
<td>138</td>
</tr>
<tr>
<td>Not specified*</td>
<td>8</td>
<td>10</td>
<td>4</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td><strong>Quarter</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>26</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>42</td>
</tr>
<tr>
<td>Q2</td>
<td>40</td>
<td>11</td>
<td>22</td>
<td>4</td>
<td>77</td>
</tr>
<tr>
<td>Q3</td>
<td>51</td>
<td>50</td>
<td>36</td>
<td>12</td>
<td>149</td>
</tr>
<tr>
<td>Q4</td>
<td>45</td>
<td>19</td>
<td>17</td>
<td>14</td>
<td>95</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>162</td>
<td>82</td>
<td>84</td>
<td>35</td>
<td>363</td>
</tr>
</tbody>
</table>

Data source: CIDR

*includes 14 probable cases and 18 notifications for which this variable was not completed

Disease acquired in Ireland was more commonly caused by S. Typhimurium and monophasic Typhimurium strains (38%) than by S. Enteritidis strains (22%), with other strains making up the remaining 40% of cases (Table 3). By contrast, disease acquired in
Europe was most commonly associated with S. Enteritidis (44%), followed this year by S. Typhimurium (incl. monophasic Typhimurium) strains (36%), with other strains accounting for 19% of cases. For cases associated with acquisition in the Rest of the World, non-Enteritidis, non-Typhimurium cases predominated (64%), with S. Enteritidis accounting for 20% and S. Typhimurium (incl. monophasic Typhimurium) strains accounting for 23% of cases (Table 3).

**Trends**

The 363 cases notified in 2018 represent a 12% decrease compared to 2017; when only confirmed cases are compared, the 349 cases in 2018 represent an 8% decrease on the number in 2017 (Figure 2). Overall, notifications have increased 40% from a low of 260 cases notified in 2014, but remain well below levels notified in 2007-2008.

**Figure 2:** Annual number of notifications and crude incidence rate per 100,000, Ireland 2004-2018

The increase in notifications since 2014 is more pronounced among travel-associated cases (up 113%), with a more modest increase of 22% among domestically-acquired cases (Figure 3).
Figure 3: Salmonellosis notifications by year of notification and travel-status, 2010-2018

Data source: CIDR

Figure 4 shows the distribution of serotypes identified by NSSLRL over the period 2000-2018. Compared to 2017, the number of cases due to S. Enteritidis increased by 14%, S. Typhimurium remained similar (up 2%), while those due to other serotypes decreased by 22%. The increasing trend in S. Enteritidis cases since 2014 is observed among both domestically-acquired and travel-associated notifications (Figure 5).

Figure 4: Annual number of non-typhoidal Salmonella isolates referred to NSSLRL by serotype in Ireland, 2000-2018

Data source: NSSLRL data
Figure 5: Annual number of S. Enteritidis isolates by country of infection and year, 2008-2018

Outbreaks and clusters of salmonellosis

During 2018, two general outbreaks and three family outbreaks of salmonellosis were notified. The largest was an international outbreak of Salmonella monophasic Typhimurium, sequence type 19 identified initially by the HSE NE among members of a pilgrimage group returning from Medjugorje, Bosnia and Herzegovina in September 2018. Further cases of salmonellosis in travellers returning from Medjugorje were reported from five other HSE areas, and from another EU Member State, indicating this was a wider event. In total 29 outbreak cases were identified among Irish residents; 18 (62%) of whom were laboratory-confirmed. The source was not identified, but a continuing foodborne source was suspected given the distribution of cases over a one month period.

The second largest outbreak notified was a foodborne family outbreak in the HSE-E with seven reported ill; a family meal was the suspected vehicle of transmission.

The three remaining outbreaks were small in size (2-3 cases each); two were suspected foodborne travel-related outbreaks and person-to-person transmission was reported for the remaining outbreak.

While WGS at NSSLRL has confirmed that the majority of non-typhoidal Salmonella isolates are not genetically linked, a further 24 non-typhoidal salmonella genetic clusters were identified by NSSLRL in 2018 in addition to the five notified outbreaks. The median number of cases in these clusters was two, and cases in eleven of these clusters reported foreign travel. Many clusters were too diffuse geographically or temporally to require further public health action. However, one cluster of six cases of S. Enteritidis in 2018 was genetically linked to a salmonellosis outbreak at European level associated with Polish

Data source: CIDR
eggs.⁴ In addition, two apparently sporadic salmonellosis cases were genetically linked to other international outbreaks identified in Europe.⁴,⁵

**Typhoid/Paratyphoid:**

In 2018, eleven cases of typhoid were notified. Eight were associated with travel to Asia, principally Pakistan (n=3), India (n=2), and Bangladesh (n=2), one was associated with Africa. Country of infection was not specified for one case. Six cases occurred in children aged 15 years or less.

Five paratyphoid cases were notified; all were adults and all were associated with travel to India.

**Discussion**

The overall incidence of salmonellosis in Ireland remains low compared to other parts of Europe.⁵ Although the CIR reported in 2018 decreased slightly compared to 2017, there was a large outbreak in 2017 which temporarily elevated the rate, and the rate in 2018 is consistent with an overall increasing trend since 2014.

The occurrence of travel-associated cases of salmonellosis remains a large contributor to the overall burden of salmonellosis in Ireland, in particular in summer months. This year, for the first time, the number of travel acquired salmonellosis cases exceeded the number of domestically acquired cases, coinciding with increasing foreign travel among Irish residents as the economic recession recedes.

Because a high proportion of Irish salmonellosis cases are travel-related, they can appear to be sporadic when viewed in isolation in the Irish dataset. However, WGS has enabled some travel-associated Irish cases to be linked with outbreaks at European level.³,⁴ Collaboration with European colleagues is key for identifying and solving such internationally distributed outbreaks.

Between 2009 and 2014, the number of S. Enteritidis cases was much lower than the number of S. Typhimurium cases, but in recent years, there has been an increasing number of infections due S. Enteritidis reported such that now they almost match the number reported for S. Typhimurium. The increase in S. Enteritidis was observed among both domestically-acquired and travel-associated infections.

Food remains an important transmission route for salmonellosis. Eggs and egg products’ were a significant source of human infection due to *Salmonella* in Europe and accounted for over a third of outbreaks reported to the European Food Safety Authority for 2017.⁶ Various meat and meat products, and bakery products accounted for another one third of outbreaks between them at European level. ⁶ In the United States in 2019, foodborne salmonellosis outbreaks have been associated with tahini, pre-cut melon, papayas, and minced turkey.⁷
Contact with pets (e.g. reptiles), with pet food (e.g. frozen rodents), with wildlife (e.g. hedgehogs), and with cattle, have all been associated with an increased risk of salmonellosis. In the United States in 2019, pig ear dog treats, contact with pet hedgehogs, and chicks and ducks kept as pets have been implicated in outbreaks. In the UK, frozen mice produced as feed for pet reptiles have also been reported as a source of salmonellosis in humans.

Further information available on HPSC website

Further information about salmonellosis is available at https://www.hpsc.ie/a-z/gastroenteric/salmonellosis/

Publications on salmonellosis in Ireland available at https://www.hpsc.ie/a-z/gastroenteric/salmonellosis/publications/

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References

1. National Salmonella Shigella & Listeria Reference Laboratory of Ireland, Annual Reports. Available at: http://www.saolta.ie/documents/
4. Patricia Garvey, Niall DeLappe, Mark MaGuire, Joanne King, Paul McKeown, Martin Cormican. 2019. The Added Value of Routine Whole Genome Sequencing to Public Health Investigation of
Salmonellosis in Ireland, 2017-2018 Poster abstract One Health EJP ASM Dublin, 2019
https://docs.wixstatic.com/ugd/c416fd_ab7cf6709f424a0ca26b4f1c3cd73b22.pdf


