3.6 Salmonella

Summary

Number of confirmed cases: 324
Number of probable cases: 0
Crude incidence rate: 7.1/100,000

Salmonellosis

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 amongst vulnerable populations such as infants, the immunocompromised and the elderly, may be severe. Invasive infection occurs in a proportion of cases. *S.* Typhi and *S.* Paratyphi can cause enteric fever, a severe systemic life threatening condition, but these are not common in Ireland and are almost invariably travel-associated.

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. The organism may also be transmitted through direct contact with infected animals or humans or faecally contaminated environments. Infected food handlers may also act as a source of contamination for foodstuffs.[1] Of particular concern is the number of cases of infection associated with direct contact with reptiles kept as companion animals.

Incidence and clinical features

There were 324 cases of salmonellosis notified in 2013, up 3% compared to 2012 (Figure 1). Among cases with information on symptoms, 96.8% were reported to have diarrhoea (274/283), 30.4% bloody diarrhoea (78/257), 52.5% vomiting (134/255), 65.7% nausea (140/213), 79.8% abdominal pain (194/243), 70.6% fever (156/221) and 38.0% headache (65/171). Almost 40% of cases required hospital admission (119/299), with no reported fatalities.

This equates to a national crude incidence rate (CIR) for salmonellosis of 7.1 per 100,000 population. The annual CIR has remained consistently low over the last five years (mean 7.2 per 100,000; range 6.8-7.8 per 100,000) compared to the previous five years (mean CIR 9.9 per 100,000 range 8.1-10.8).

Figure 2 illustrates the regional variation in CIR during 2013 compared to 2012. The highest CIR in 2013 occurred in HSE MW and the lowest in HSE E and HSE SE. However, the rates were not statistically significantly different either between HSE areas in 2013, or comparing between 2013 and 2012 by region.

The number of male cases was marginally higher than

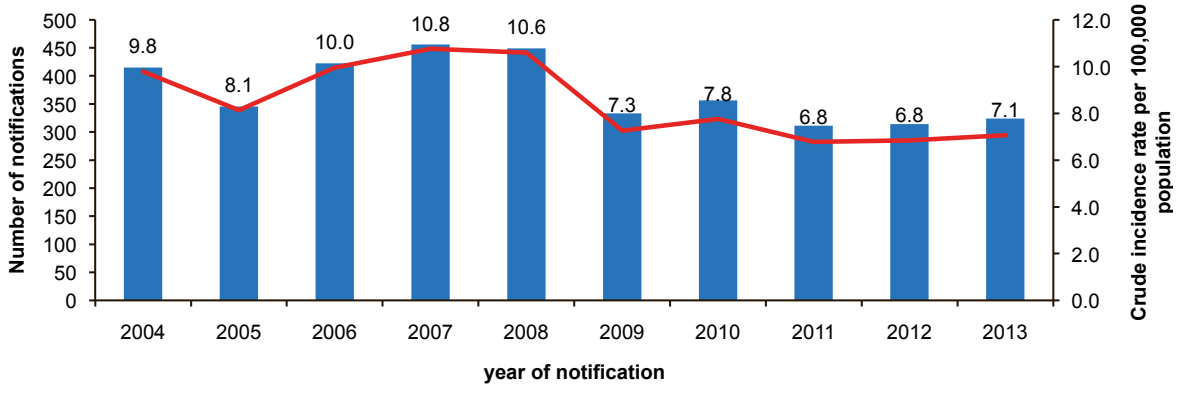

Figure 1: Salmonellosis notifications and crude incidence rate per 100,000 population by year of notification, Ireland 2004-2013. [Data source: CIDR]

for females in 2013 (male:female ratio=1.13:1.0); this is consistent with previous years.

Overall, the highest age-specific incidence rate was in children under 5 years of age; this is likely to be, at least in part, a reflection of clinicians more readily seeking clinical samples in that age group. Specifically, the incidence rates were higher in males than females in all age groups less than 15 years; among adults, age-specific incidence rates were comparable between the sexes except in the age group 25-34 years where females predominated.

NSSLRL data:
The National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory (NSSLRL) based in Galway has been providing reference services nationally since 2000. In 2013, the NSSLRL analysed 332 human non-typhoidal *Salmonella* isolates referred for further typing. Table 1 lists the top 12 serotypes detected during 2013. *S.* Typhimurium* (n=129) was the most common serotype, followed by *S.* Enteritidis (n=49). *S.* Typhimurium has been the most common serotype since 2008.

Figure 4 shows the trend in referral of isolates to NSSLRL by organism over time. S Enteritidis case numbers have been in steep decline since 2008, and in 2013, these decreased by further 12% (Figure 4). In contrast, both S Typhimurium and Other serotypes increased by 6% and 20% respectively relative to 2012, although numbers of both have been relatively stable the last four years.

The NSSLRL conducted phage typing analysis on all 129 *S.* Typhimurium and all 53 *S.* Enteritidis isolates.

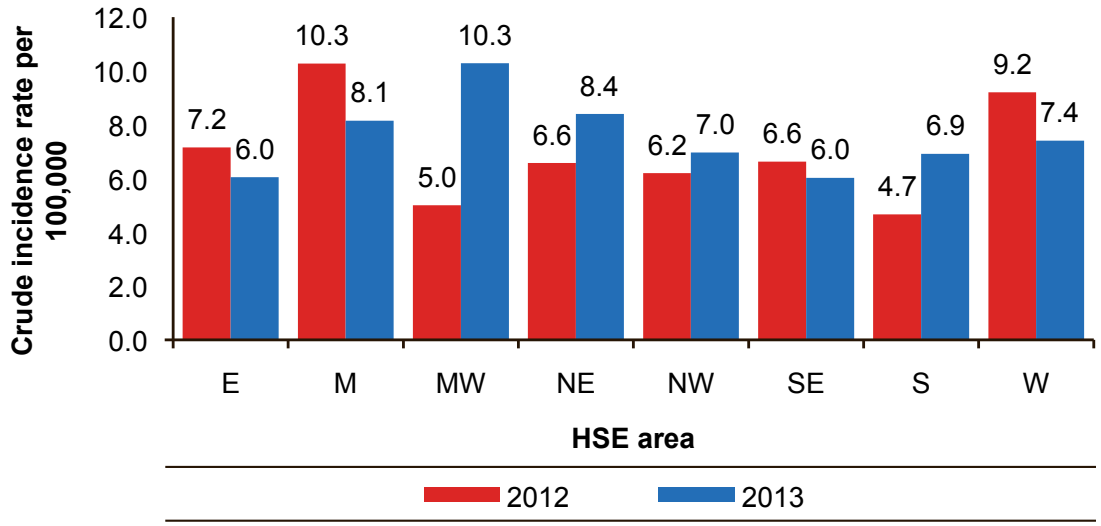

Figure 2. Regional CIR 2013 vs 2012, salmonellosis. [Data source: CIDR]

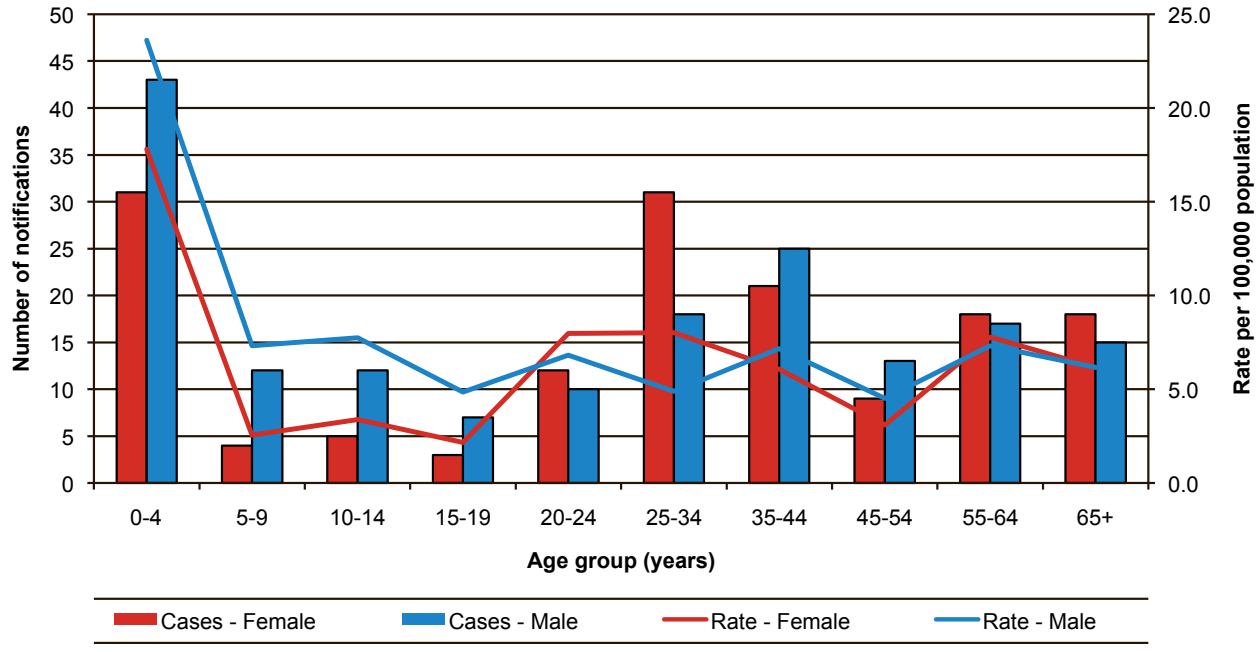

Figure 3: Salmonellosis notifications and age specific incidence rate per 100,000 population by age group (years) and sex, Ireland 2013. [Data source: CIDR]

*This includes 53 monophasic *S.* Typhimurium isolates with serotype 4,5,12:1

Phage type DT193 (n=39) comprised over 30% of all S. Typhimurium strains; this is the highest annual total of phage type DT193 cases reported since records began in 2000 (Figure 5). Other currently important S Typhimurium phage types included Untypable (14.0%) and DT104b (8.5%). Both DT193 and Untypable have increased gradually over the last 5-6 years, while the numbers of DT104b and DT104 in 2013 represent a substantial reduction compared to 10 years ago.

Phage types PT14b (22.4%), PT8 (16.3%), and PT1 (16.3%) were the most common types observed among *S.* Enteritidis isolates (Figure 6).

Of the 332 non-typhoidal isolates analysed for antimicrobial resistance, 191 (57.5%) were fully susceptible to all antimicrobials tested. The remaining 151 isolates exhibited some degree of antimicrobial resistance. 39 isolates exhibited resistance to five or more antimicrobials, the most common pattern of which was ampicillin, chloramphenicol, streptomycin, sulphadiazine and tetracycline (ACSSuT, n=20). The majority of isolates exhibiting this level of resistance were *S.* Typhimurium (32/39, 82%). Overall, the commonest resistance pattern[†] seen was resistance to ampicillin, streptomycin, sulphadiazine and tetracycline (ASSuT, n=42, 12.7% of isolates); this pattern was almost exclusively identified in *S.* Typhimurium isolates (41/42 ASSuT resistant strains were S. Typhimurium). Resistance to nalidixic acid (Na, n=21, 6.3% of isolates) was the most common AMR profile among *S.* Enteritidis isolates (30.6% of *S.* Enteritidis strains).

The NSSLRL's Annual Report 2013 provides a more detailed analysis of clinical *Salmonella* typing results and a comparison with isolates from non-human sources.[2]

Table 1: Number and percentage of non-typhoidal human Salmonella isolates by serotype, Ireland 2013

Salmonella serotype	Number of isolates	*% Isolates*
Typhimurium	76	*22.9%*
Monophasic Typhimurium[a]	53	*16.0%*
Enteritidis	49	*14.9%*
Infantis	14	*4.2%*
Dublin	12	*3.6%*
Newport	11	*3.2%*
Unnamed	10	*3.0%*
Agama	6	*1.8%*
Montevideo	5	*1.5%*
Stanley	5	*1.5%*
Virchow	5	*1.5%*
Anatum	5	*1.5%*
Other	81	*24.4%*
Total	**332**	***100.0***

aThis terms is applied for this table to isolates with the antigenic formula 4,[5],12:i:- as there is persuasive evidence that these are overwhelmingly comprised of variants of S. Typhimurium
[Data source: NSSLRL]

Foreign travel as a risk factor for salmonellosis in Ireland

The variable 'Country of infection' was completed on CIDR for over 90% of notifications in 2013, up from 86% in 2012 and 78% in 2011. In the following analyses, we have defined travel-associated cases as those where a country of infection other then Ireland was reported, and indigenous as those where the country of infection was recorded as Ireland.

Travel abroad during the incubation period is a strong risk factor for salmonellosis in Ireland. Of the two hundred and ninety-three cases where the 'country of infection' variable was completed, 177 cases were acquired in Ireland (65.5%); this compares with 2012 when 55.5% of cases with known travel status were indigenous. Among cases acquired abroad, the most common countries of infection reported were: Spain (n=27), Thailand (n=14), India (n=8) and Nigeria (n=7). The popularity of a country as a travel destination is likely to be an important factor in determining the

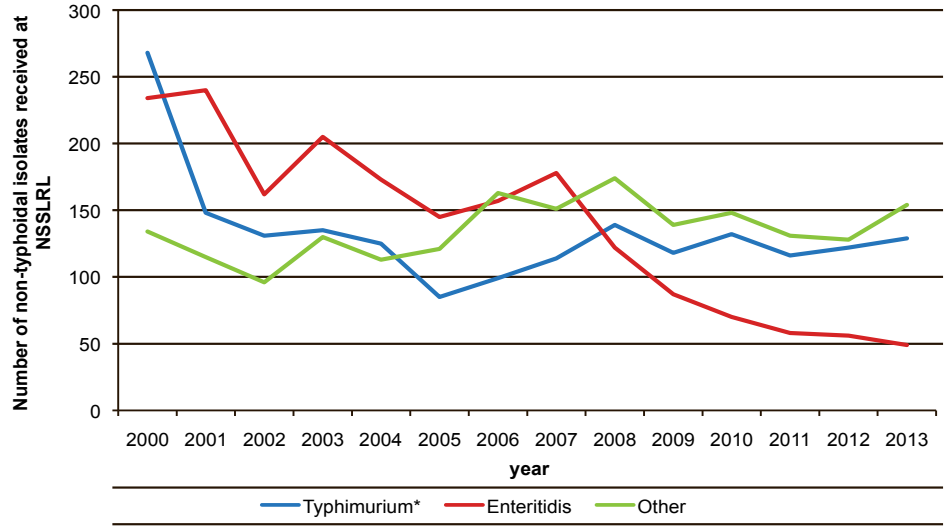

Figure 4. Annual number of non-typhoidal Salmonella isolates referred to NSSLRL by serotype, 2000-2013. [Data source: NSSLRL]

[†]Where A= Ampicillin, C= Chloramphenicol, Na = Nalidixic acid, S= Streptomycin, Su= Sulphonamide and T= Tetracycline

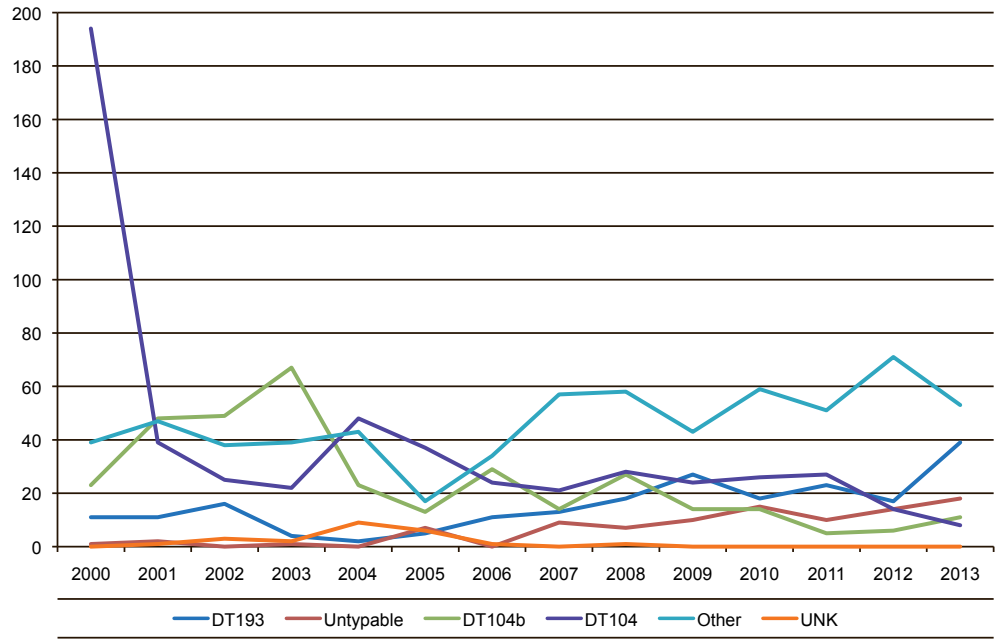

Figure 5. Annual number of S. Typhimurium isolates referred to NSSLRL by phage type, 2000-2013. [Data source: NSSLRL]

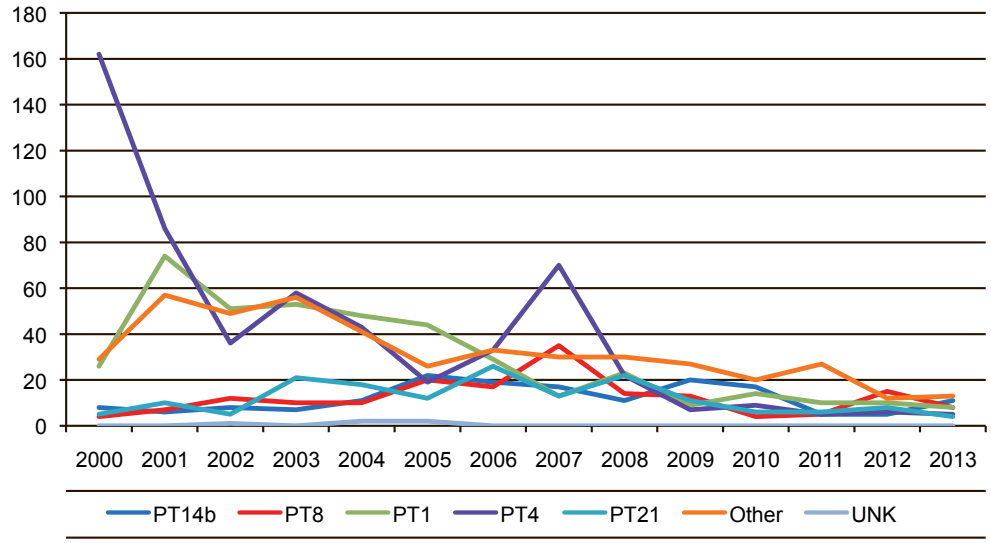

Figure 6. Annual number of S. Enteritidis isolates referred to NSSLRL by phage type, 2000-2013. [Data source: NSSLRL]

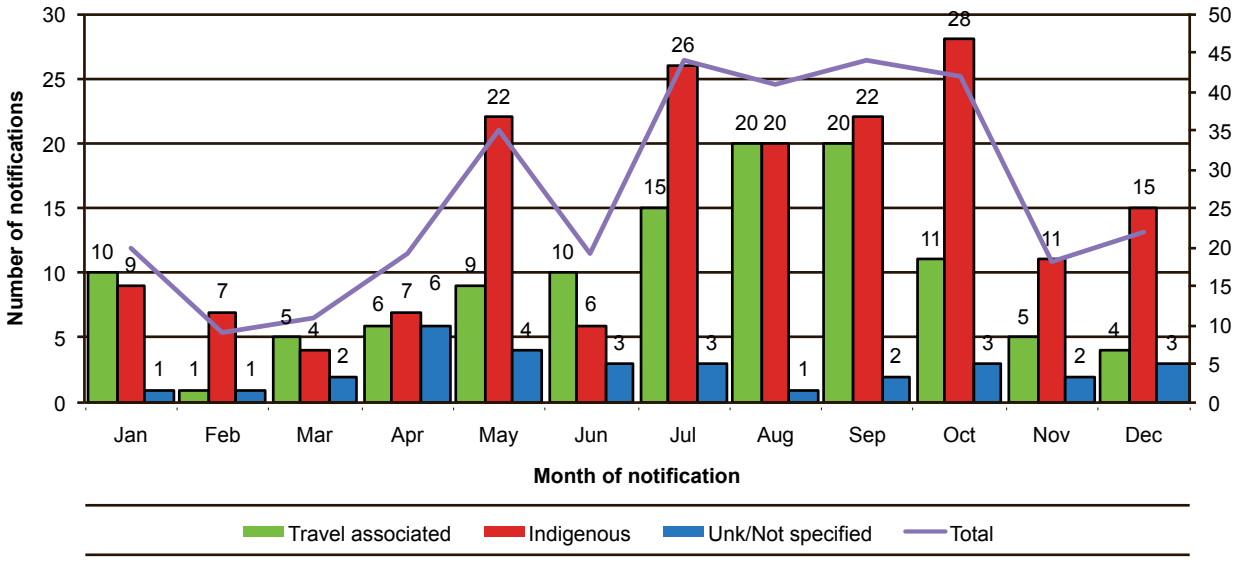

Figure 7: Salmonellosis notifications by month of notification and travel history, 2013 [Data source: CIDR]

number of cases associated with each country. *Salmonella* notifications peaked in the period July to October; with highest numbers of both indigenous and travel-associated cases occurring during this period (Figure 7). A second shorter peak in May comprised largely indigenous cases.

Indigenous cases were more common in quarter 4 than at this time of year than in the previous two years (Figure 8), in part due to a number of general indigenous outbreaks during Q4 2013 –see outbreak section below.

When serotyping data were analysed by travel history, almost half of all indigenous cases were infected with *S.* Typhimurium (or monophasic *S.* Typhimurium), with 'Other' serotypes making up a further 43.5% of cases (Table 2). Just 7.3% of indigenous cases were due to *S.* Enteritidis. In contrast, *S.* Enteritidis features more prominently among travel-associated cases (25.9%).

Specifically, cases with travel to Spain were more evenly split between Typhimurium, Enteritidis and 'Other' serotypes (9:10:8), whereas 'Other' serotypes featured exclusively among infections associated with India and Nigeria.

Travel-associated cases were also notable in that they formed a higher proportion of cases in adult age groups between 20 and 64 years (Figure 9).

Other risk factor data

As travel-associated cases are likely to have different exposures to indigenous cases, the analyses undertaken of other risk factor information focuses solely on known indigenous cases (n=177). It should be noted that in most instances, there are no comparable data for the population as a whole in order to make inferences about the relative importance of these factors as risks for salmonellosis in Ireland, however, some observations can be made.

In general, the quality of public water supplies in Ireland is better than that of domestic wells and other private water supplies (EPA). The difference in the proportion of salmonellosis cases served by non-public water supplies

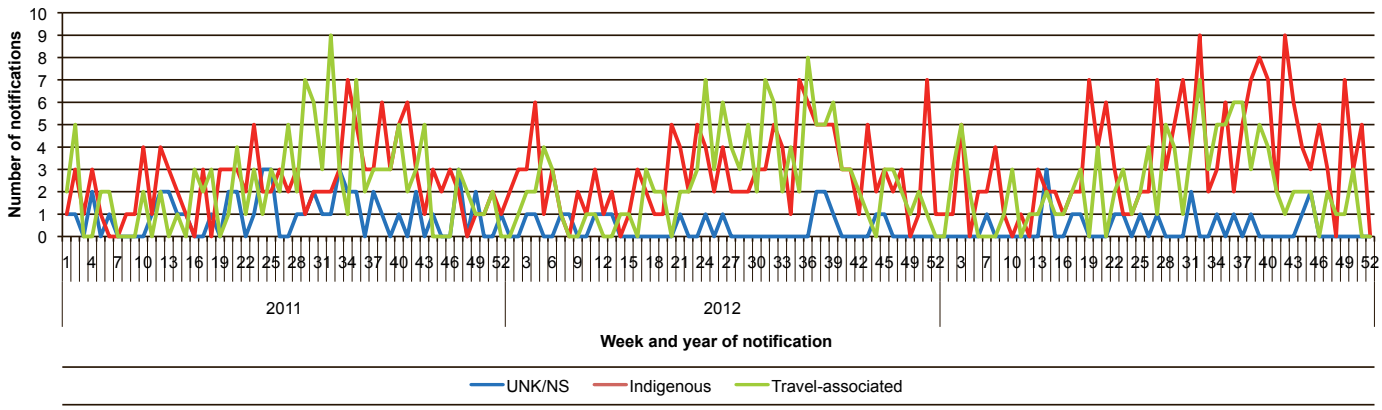

Figure 8. Salmonellosis notifications by week of notification and travel history, 2011-2013. [Data source: CIDR]

Table 2: Number and percentage Salmonellosis notifications by serotype and travel history, 2013 [Data source: CIDR]

Salmonella serotype	Indigenous N (%)	Travel associated N (%)	Travel history unknown N (%)
S. Typhimurium*	85 (48.0%)	27 (23.3%)	13 (41.9%)
S. Enteritidis	13 (7.3%)	30 (25.9%)	5 (16.1%)
Other serotypes	77 (43.5%)	58 (50.0%)	12 (50.0%)
Serotype not specified	2 (1.1%)	1 (0.9%)	1 (3.2%)
All serotypes (n)	177 (100%)	116 (100.0%)	31 (100%)

Table 3. Number of cases of indigenous salmonellosis cases (and percentage where known) for selected risk factors, Ireland 2013

	Yes (% of Known)	No (% of Known)	Unk/not specified	Total
Did case eat outside home 3 days PTO?	66 (46.5%)	76 (53.5%)	35	**177**
Contact with person with GI symptoms in 3 days PTO?	19 (12.4%)	134 (77.6%)	24	**177**
Contact with pet animals 3 days PTO?	84 (51.2%)	80 (48.8%)	13	**177**
Contact with farm animals 3 days PTO?	24 (15.3%)	133 (84.7%)	20	**177**
Home not on public water supply	33 (20.4%)	129 (79.6%)	15	**177**
Attends pre-school	10 (6.1%)	153 (93.9%)	14	**177**
Attends pre-school (cases under 5 yrs only)[a]	10 (23.3%)	33 (76.7%)	2	**45**

[a]Based on public health risk group variable.
PTO =prior to onset
[Data source: CIDR]

(20.4%) compared to the proportion of households in the general population with non public supplies (22.1% -CSO census 2011) was not statistically significant (X^2=0.2813, P =0.596), suggesting that waterborne transmission from lower quality drinking water is not a strong risk factor for salmonellosis in Ireland (Table 3).

Similarly, the proportion of indigenous salmonellosis cases attending childcare (23.3%) is below the norm (42%) [CSO quarterly survey re use of non-parental childcare], suggesting that transmission between young children at childcare facilities is not a strong risk factor either.

The proportion of indigenous cases reporting contact with farm animals is lower (15%) than for pathogens such as VTEC and *Cryptosporidium* (38%), both of which have a more rural distribution in incidence, suggesting that exposure to farm animals is not as significant a pathway for *Salmonella* transmission to humans in Ireland.

Contact with pets occurred in 51% of cases, however, we are unaware of comparable data for the general population. From the literature it would appear that particular pets confer a high risk of salmonellosis, e.g. reptiles, especially to young children. In 2013, 6/45 (13%) indigenous cases under 5 years of age reported exposure to a reptile compared with 3/132 (2%) indigenous cases 5 years of age or more. Reptile associated salmonellosis is generally associated with specific and otherwise unusual variants of salmonella which supports the causality of the association.

Outbreaks

Salmonellosis notifications in Ireland are largely comprised of sporadic cases; in 2013, only 53 of the 324 (16.3%) notified cases were linked to outbreaks. The 18 outbreaks notified in 2013 is a three-fold increase on the number notified in 2012 (n=6), but the number in 2012 was atypically low. Eight outbreaks in 2013 were general outbreaks (the highest number of general outbreaks since 2008) and ten were family outbreaks (Figure 10).

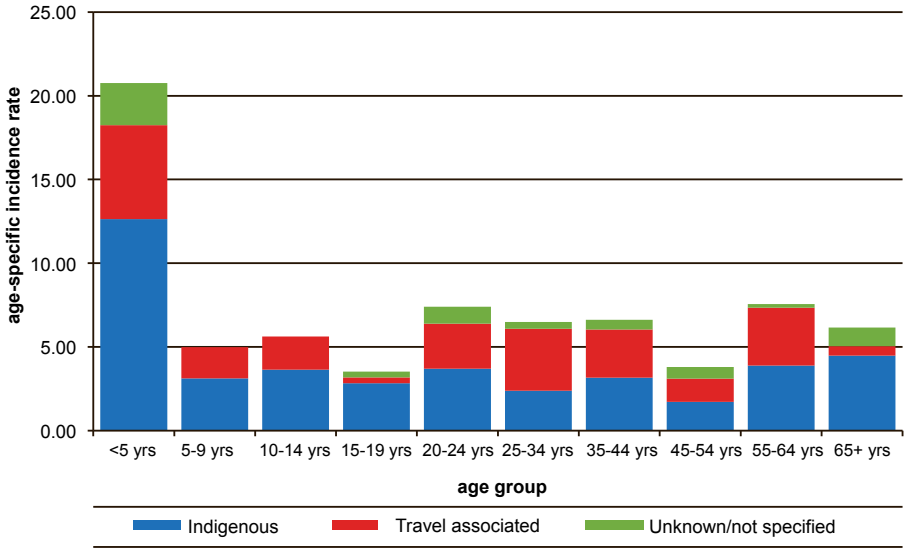

Figure 9. Salmonellosis notifications by age group and travel history, 2013 [Data source: CIDR]

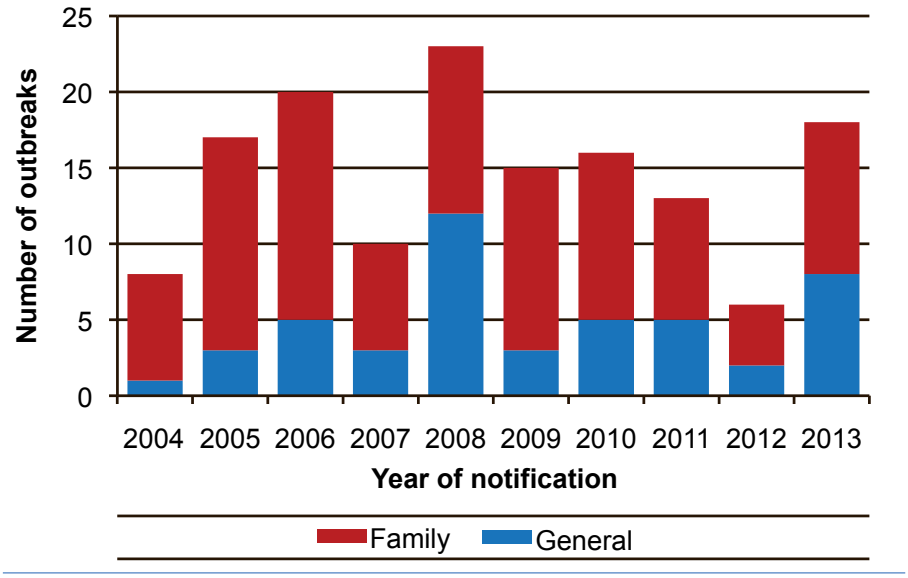

Figure 10. Annual number salmonella outbreaks by type, Ireland 2004-2013 [Data source: CIDR]

These outbreaks resulted in 56 cases of illness (median=3, range 2-9 ill per outbreak) and an associated hospitalisation rate of 34.0% (n=19 cases). Eight outbreaks occurred in private houses, five occurred in community settings, three were extended family outbreaks, one was in a crèche, and one occurred in a summer camp.

Figure 11 compares the number of outbreaks by transmission route with data from previous years. Consistently foodborne and person-to-person transmission are reported most commonly. This year, among the outbreaks with a transmission route reported, 45% were reported as foodborne and 55% as person-to-person spread. Animal contact outbreaks are reported less frequently and none were reported in 2013.

The largest salmonellosis outbreak in Ireland in 2013 was a national outbreak of *S.* Dublin. The outbreak consisted of nine cases of salmonellosis with disease onsets over a period of six weeks in October – November 2013. Cases were atypical relative to previously identified sporadic *S.* Dublin cases in Ireland in that the ratio of females to males was higher than normal (78% vs 33%), and the cases more frequently characterised by symptoms of gastrointestinal disease rather than bloodstream infections (100% vs 55%). The age-sex distribution of cases suggested that the exposure which caused the outbreak was more common among adults than children, and more common among females than males. The wide geographical distribution and absence of a common exposure to other possible non-food sources suggested the likelihood that the outbreak was caused by a widely distributed food item, with the shape of the epidemic curve being consistent with a continuous source outbreak, possibly a food product that was on the market (or had a shelf life) of approximately six weeks. The strong association between *S.* Dublin and cattle may suggest that a dairy or beef based product is more likely. However despite the use of extensive outbreak trawling questionnaires and a novel method employing supermarket loyalty cards, no single food source was identified which might account for the outbreak.

Four other community outbreaks were reported, three with transmission route unknown and one reported as foodborne although no specific food was implicated. The serotypes involved were *S.* Agama, *S.* Ball, *S.* Infantis and *S.* Montevideo, and the outbreaks were in all instances recognised in consequence of detailed typing at NSSLRL.

The remaining three general outbreaks were caused by *S.* Typhimurium: they included a person-person outbreak in a childcare facility resulted in 4 persons ill; a person-person outbreak in a private house, and an outbreak of two persons in a summer camp with unknown transmission route.

For the 10 family outbreaks, six were caused by S Typhimurium, and one each by *S.* Enteritidis, *S.* Braenderup, *S.* Telelkebir and *S.* Unnamed. Four were transmitted person-person, three were reported as foodborne and for three the transmission routes were unknown. No evidence implicating any food source was reported for any of the three foodborne outbreaks, although chicken brought in from abroad by a relative was suspected in the family outbreak of *S.* Enteritidis.

Typhoid/Paratyphoid:

In 2013 there were ten cases of *S.* Typhi notified and two cases of *S.* Paratyphi, all of whom reported a history of recent travel outside Ireland. Of the ten *S.* Typhi cases, five had travelled to Pakistan, three to India, and one each to Indonesia and Nigeria. Half of typhoid cases were reported in children under 15 years of age.

Among the *S.* Paratyphi cases, one reported travel to Pakistan and one to South America. The isolates were identified as Paratyphi A and Paratyphi B respectively. Both were adults.

Summary

The crude incidence rate of human salmonellosis in Ireland in 2013 was similar to that reported over the previous four years. The age and regional distribution of cases in 2013 was also similar to 2012, however, indigenous cases made up a higher proportion of

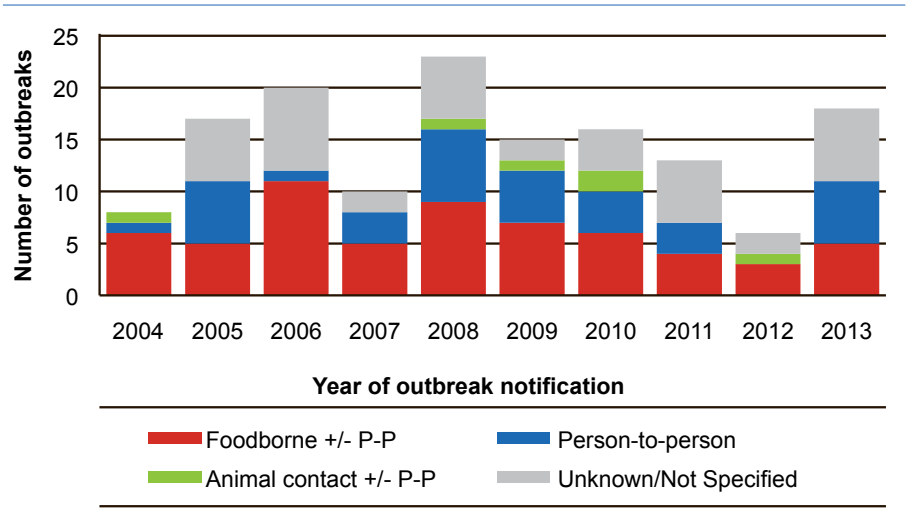

Figure 11: Annual number of outbreaks of salmonellosis by reported transmission route, Ireland 2004-2013. [Data source: CIDR]

total case numbers in 2013 than in 2012, in part due to a number of indigenous general outbreaks in the last quarter of the year. Ireland's crude incidence rate at 7.1 per 100 000 is consistently and substantially lower that the overall rate for the EU (22.2 per 100,000 population in 2012-EFSA report), but the age and seasonal distributions mirror those seen for the EU as a whole.

S. Typhimurium (including monophasic Typhimurium) remained the most common serovar in Ireland in 2013 making up almost 40% of cases. Case numbers of S. Enteritidis have been in decline for many years, such that, in 2013, *S.* Enteritidis comprised only 15% of cases, with other serovars responsible for 45% of cases. This contrasts with the picture across the EU where *S.* Enteritidis remained the top serovar at just over 40% in 2012, with *S.* Typhimurium (incl monophasic Typhimurium) at just under 30%, and 'Others' making up the remaining 30%.[1] Case numbers of *S.* Enteritidis across Europe are on the decline, contributing to a decrease also in overall case numbers over the last five years. New EU legislation concerning salmonella control programs for laying hens, which came into effect on 1 January 2009, is believed to have contributed to the reduction in *Salmonella* contaminated laying hens in the EU in recent years.[1]

In 2013, the transmission routes reported for salmonellosis outbreaks in Ireland were consistent with previous years: foodborne or person-to-person spread only were reported, although the evidence for the foodborne route was not strong in any instance, and no specific food items were implicated. The EU Zoonoses report reports that eggs and egg products continued to be the most common vehicles implicated in the salmonellosis outbreaks at EU level in 2012, however, this was strongly influenced by the fact that half of all salmonellosis outbreaks at EU level were associated with *S.* Enteritidis.[1] Pork products were the most common food vehicle in *S.* Typhimurium outbreaks in the EU in 2012.

In consequence of the increasing recognition in recent years of fresh produce as a cause of gastrointestinal disease outbreaks, the National *Salmonella* Outbreak Trawling Questionnaire was recently expanded and updated. The form is available at http://www.hpsc.ie/A-Z/Gastroenteric/Salmonellosis/SurveillanceInvestigativeForms/

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