Feidhmeannacht na Seirbhíse Sláinte
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Epidemiology of Salmonellosis in Ireland, 2007

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For further information on salmonellosis in Ireland, please see:
http://www.ndsc.ie/hpsc/A-Z/Gastroenteric/Salmonellosis/

Summary

- The crude incidence rate for 2007 was 10.7 per 100,000, similar to 2006.
- The zero to four age group experienced highest incidence rate.
- The *S.* Enteritidis followed by *S.* Typhimurium were the dominant serotypes. The next most commonly isolated serotypes were *S*. Newport and *S*. Kentucky.
- 38% of cases had a known history of travel outside of Ireland.
- Five cases of *S*. Paratyphi A were reported in 2007.

Introduction

Salmonellosis is one of the most common zoonotic diseases in humans in Ireland and worldwide. At present, over 2,460 serotypes of Salmonella have been identified[i]. Two serotypes, however, *S. enterica* serotype Enteritidis and *S. enterica* serotype Typhimurium have accounted for the majority of cases of human salmonellosis in recent years.

Salmonellosis presents clinically as an acute enterocolitis, with sudden onset of headache, abdominal pain, diarrhoea, nausea and occasionally vomiting. Fever is almost always present. Dehydration, especially amongst vulnerable populations such as infants, the immunocompromised and the elderly, may be severe. *S*. Typhi and *S*. Paratyphi can cause enteric fever, a severe systemic life threatening condition, but this is very rare in Ireland and mainly travel-associated.

Salmonella is a zoonoses and a wide range of domestic and wild animals and birds, as well as humans, can act as the reservoir for this pathogen. Prevention, surveillance and control of Salmonella infections are of major public health importance.

Case Definitions

Clinical description

Clinical picture compatible with salmonellosis e.g. diarrhoea, abdominal pain, nausea, and sometimes vomiting. Cases may also be asymptomatic. The organism may cause extra-intestinal infections.

Laboratory criteria for diagnosis

Isolation of Salmonella sp. (non-typhi, non-paratyphi) from a clinical specimen

Case classification

Possible:	N/A
Probable:	A laboratory confirmed isolate without clinical information or a case with clinical symptoms that has an epidemiological link
Confirmed:	A clinically compatible case that is laboratory confirmed

Taken from Case Definitions for Notifiable Diseases. Infectious Diseases (Amendment No. 3) Regulations 2003 (SI No. 707 of 2003). Available at HHUUhttp://www.hpsc.ieUU

Materials and Methods

The National Salmonella Reference Laboratory (NSRL) was established in 2000 in the Department of Medical Microbiology, University College Hospital, Galway. This laboratory accepts *S. enterica* isolates from all clinical and food laboratories for serotyping, phage typing and antimicrobial sensitivity testing.

This report reviews data available from the National Salmonella Reference Laboratory (NSRL) and weekly events of salmonellosis extracted from the CIDR system for the year 2007. These data enable us to provide an overview of the epidemiology and burden of disease caused by Salmonella infections in Ireland today.

Data analysis for this report was performed using Business Objects Reporting in CIDR and MS Excel. Census of Population 2006 figures were used as denominator data in the calculation of incidence rates. The salmonellosis data from CIDR presented in this report are based on data extracted from the CIDR system on August 2008. These figures may differ from those published previously, due to ongoing updating of notification data on CIDR.

Results

Demographic information

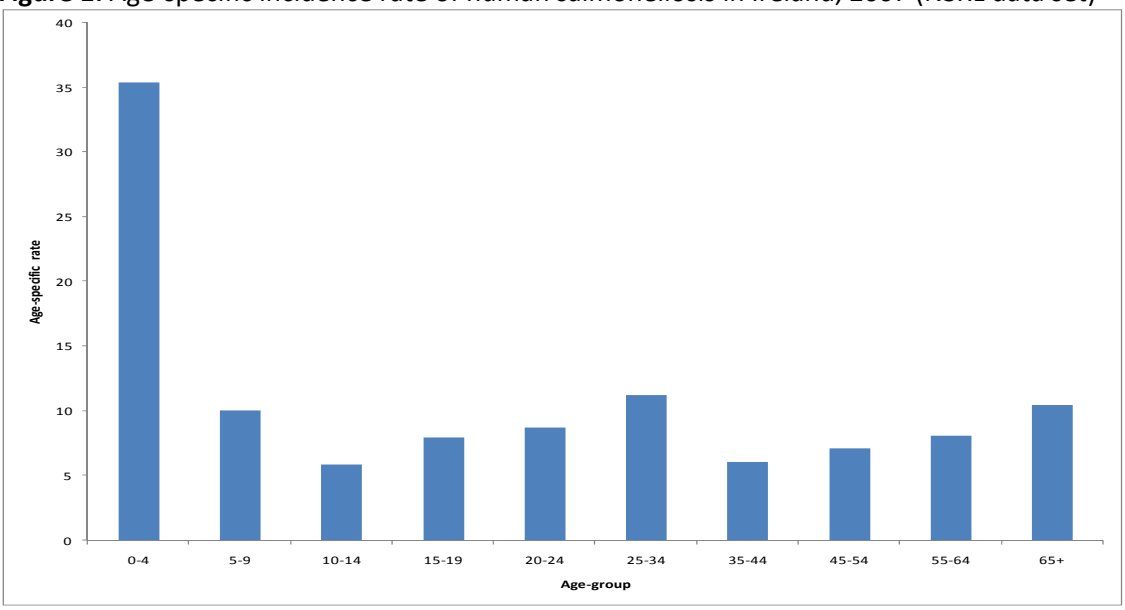
In 2007, 456 cases of salmonellosis were notified in Ireland. Of these, 440 cases were laboratory confirmed. Probable cases are notifiable under the amended Infectious Disease Regulations (2003) if clinical symptoms or epidemiological links are identified. This resulted in 16 probable cases notified in 2007. All probable cases were linked to Salmonella outbreaks on CIDR. Four hundred and fifty seven *Salmonella* isolates were referred to the National Salmonella Reference Laboratory (NSRL).

In 2007 there was a slight preponderance in males, unlike 2006. The female: male ratio in 2007 was 1:1.1. In terms of age distribution the highest number of cases was seen in children under five years of age with 24% of cases occurring in this age category (table 1). The weighting of the incidence rate in younger children is evident in Figure 1.

Table 1: Analysis of clinical isolates of *S. enterica* (n=444) referred to NSRL, 2007, by age group and gender.

Age Group	No of Isolates (%)	Female	Male	Unknown
0-4	107 (24)	44	58	5
5-9	29 (7)	12	13	4
10-14	16 (4)	7	9	0
15-19	23 (5)	10	13	0
20-24	30 (7)	14	16	0
25-29	49 (11)	27	22	0
30-34	32 (7)	14	18	0
35-39	18 (4)	7	11	0
40-44	20 (5)	8	12	0
45-49	18 (4)	8	10	0
50-54	19 (4)	8	11	0
55-59	22 (5)	10	12	0
60-64	11 (2)	5	6	0
65+	49 (11)	21	28	0
Unknown	1 (0)	1	0	0
Total	**444**	**196**	**239**	**9**

Figure 1: Age-specific incidence rate of human salmonellosis in Ireland, 2007 (NSRL data set)



The national crude incidence rate for 2006 was 10.0/100'000. During 2007 there was a slight increase observed to 10.7/100'000. However when CIR is analysed by region annual variation becomes evident (Table 2). Most significantly the CIR of the HSE-S region increased from 8.3 in 2006 to 21.1 in 2007. This may be attributed to an outbreak of *S* Enteritidis with fifty-two associated cases in the region which produced a peak in figures in weeks 29 and 30 (discussed further in the outbreaks section).

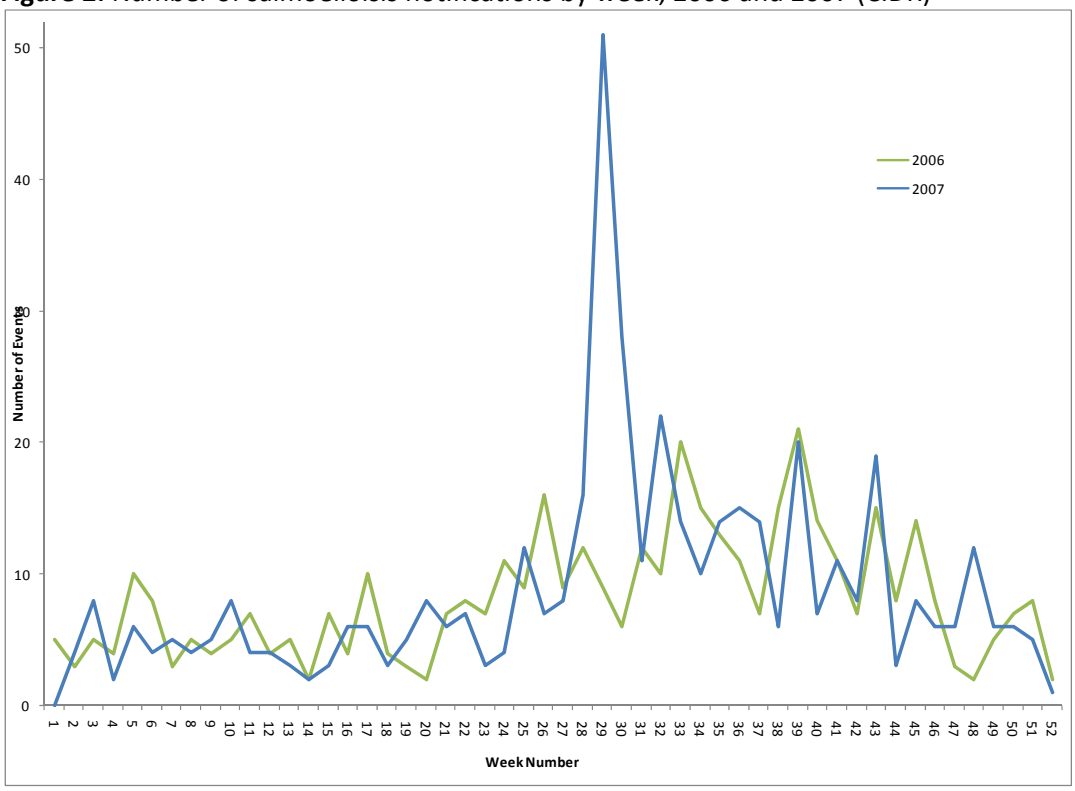
Table 2: Number of cases and CIR of human salmonellosis in Ireland, 2006 and 2007 (CIDR)

HSE Area	No Cases	CIR incl. 95% CI 2007	CIR incl. 95% CI 2006
HSE - E	143	9.5 [8.0 - 11.1]	10.5 [8.8 - 12.1]
HSE - M	23	9.1 [5.4 - 12.9]	14.3 [9.6 - 19.0]
HSE - MW	29	8.0 [5.1 - 11.0]	8.6 [5.6 - 11.6]
HSE - NE	29	7.4 [4.7 - 10.0]	8.1 [5.3 - 11.0]
HSE - NW	21	8.9 [5.1 - 12.6]	16.0 [11.0 - 21.1]
HSE - SE	37	8.0 [5.4 - 10.6]	7.1 [4.7 - 9.6]
HSE - S	131	21.1 [17.5 - 24.7]	8.3 [6.1 - 10.6]
HSE - W	43	10.4 [7.23 - 13.5]	10.4 [7.2 - 13.4]
Total	**456**	**10.8 [9.8 - 11.7]**	**10.0 [9.0 - 11.0]**

Seasonality

Figure 2 illustrates the seasonality of salmonellosis in Ireland as notified on CIDR. A significant peak is evident in weeks 29 and 30 (as a result of cases of the *S.* Enteritidis outbreak notified during the second week if July until the 1st of August). Irrespective of these weeks it is evident that notifications throughout 2007 show a similar seasonal trend to 2006. The expected seasonal increases during the mid to late summer through to mid autumn are also seen.

Figure 2: Number of salmoelloisis notifications by week, 2006 and 2007 (CIDR)



Serotyping, phage typing and antibiotic susceptibility results

Serotyping

Analysis of serotyping data provided from NSRL in 2007 show that 64 different serotypes were identified from the 457 isolates tested by the reference laboratory. As has been the trend in recent years, the predominant serotype causing human illness in 2006 was *S.* Enteritidis (n=179), followed by *S.* Typhimurium (n=114). After *S.* Enteritidis and *S.* Typhimurium, the next most commonly isolated serotypes were *S*. Newport (n=13) and *S*. Kentucky (n=9) (Table 3).

Table 4 summarises serotyping data from 2000 until 2007. Of note there were no *S*. Hadar isolates identified in 2007. Table 3 presents a complete breakdown of all serotypes by region.

There were eight cases of *S*. Typhi and five isolates of *S*. Paratyphi A detected in 2007. Six of the eight *S*. Typhi cases reported a history travel. Visited countries include Pakistan (n=2), India (n=2), Asia (n=1) and Nepal (n=1). In the seventh case the patient gave no history of travel outside of Ireland. However one

relative tested positive and it is likely that person to person spread resulted in acquisition of the disease in Ireland. No travel information was available in the eight case. All cases of *S* Paratyphi A reported a history of travel to either India (n=3) or Pakistan (n=2).

Table 3: Serotypes of *Salmonella* enterica by health board, 2007 (NSRL)

Serotype	HSE-E	HSE-M	HSE-MW	HSE-NE	HSE-S	HSE-NW	HSE-SE	HSE-W	Total
Agama	0	0	1	0	0	0	0	0	1
Agona	1	0	0	0	1	0	0	1	3
Alachua	0	0	0	0	1	0	0	0	1
Anatum	1	0	0	0	0	0	0	0	1
Bere	0	0	1	0	0	0	0	0	1
Blockley	1	0	0	1	0	0	0	0	2
Brandenburg	1	0	0	0	0	0	1	0	2
Bredeney	3	0	0	0	0	0	0	0	3
Bury	1	0	0	0	0	0	0	0	1
Chester	3	0	0	0	0	0	0	0	3
Chomedey	0	0	0	0	0	1	0	0	1
Colindale	0	0	0	0	0	0	1	0	1
Corvallis	0	1	0	0	0	0	0	0	1
Derby	1	0	0	0	0	1	0	0	2
Dublin	0	1	0	1	1	0	0	1	4
Durban	1	0	0	0	0	0	0	0	1
Eastbourne	1	0	0	0	0	0	0	0	1
Ebrie	1	0	0	0	0	0	0	0	1
Ekotedo	0	0	0	0	1	0	0	0	1
Enteritidis	51	5	13	11	65	6	9	19	179
Fareham	1	0	0	0	0	0	0	0	1
Florida	1	0	0	0	1	0	0	0	2
Give	2	0	0	0	0	0	1	0	3
Grumpensis	1	0	0	1	0	0	0	0	2
Haifa	0	0	1	0	0	0	0	1	2
Havana	1	0	0	0	0	0	0	0	1
Heidelberg	3	0	0	0	0	0	0	0	3
Hull	1	0	0	0	0	0	0	0	1
Ibadan	0	0	0	0	0	0	1	0	1
Indiana	0	0	0	0	0	0	0	1	1
Infantis	2	0	0	0	4	0	0	2	8
Java	1	2	1	0	2	0	0	2	8
Kentucky	4	2	0	0	1	0	1	1	9
Kottbus	1	0	0	0	0	0	2	0	3
Litchfield	0	0	0	0	0	0	1	0	1
London	1	0	0	0	0	0	0	0	1
Manhattan	0	0	0	0	0	0	1	0	1
Mbandaka	0	1	0	0	0	0	0	0	1
Mikawasima	1	0	0	0	0	0	0	0	1
Montevideo	2	0	0	0	0	1	1	1	5
Muenchen	1	0	0	0	1	0	0	0	2
Newport	7	0	0	2	2	0	0	2	13
Oranienburg	0	0	1	0	1	1	0	0	3
Panama	0	0	0	0	5	0	2	0	7
Pomona	0	0	0	0	0	0	1	0	1
Poona	0	0	1	0	0	0	0	0	1
Richmond	0	0	0	0	0	0	0	1	1
Saarbruecken	0	0	0	0	0	0	0	1	1
Saintpaul	0	0	0	0	1	0	0	1	2

Sangera	1	0	0	0	0	0	0	0	1
Schwarzengrund	2	0	0	0	0	1	0	0	3
Senftenberg	0	0	0	0	1	0	0	0	1
Soerenga	0	0	0	0	0	1	0	0	1
Stanley	3	0	0	0	1	0	0	0	4
Stanleyville	0	0	0	0	1	0	0	0	1
Sundsvall	1	0	0	0	0	0	0	0	1
Telelkebir	2	0	0	0	0	0	0	0	2
Thompson	0	0	0	0	0	0	2	0	2
Typhimurium	43	8	9	7	20	7	12	8	114
Unnamed	3	0	0	0	4	1	2	1	11
Virchow	3	0	0	1	1	0	0	0	5
Wandsworth	1	0	0	0	0	0	0	0	1
Worthington	0	0	0	0	1	0	0	0	1
Total	**155**	20	**28**	**24**	**116**	**20**	**38**	**43**	**444**

Table 4: Serotypes of *S. enterica* referred to NSRL (2000-2007)

Serotype	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
S. Enteritidis	239 (36)	248 (46)	165 (40)	205 (42)	172 (41)	145 (41)	158 (37)	179 (39)
S. Typhimurium	284 (43)	165 (30)	140 (34)	135 (28)	125 (30)	85 (24)	101 (23)	114 (25)
S. Agona	6 (1)	2 (0)	5 (1)	5 (1)	2 (0.5)	10 (3)	5 (1)	3 (1)
S. Virchow	9 (1)	16 (3)	10 (2)	10 (2)	10 (2)	9 (3)	10 (2)	5 (1)
S. Hadar	11 (2)	4 (1)	6 (1)	21 (4)	4 (1)	8 (2)	11 (3)	0 (0)
S. Dublin	10 (1.5)	12 (2)	9 (2)	5 (1)	4 (1)	5 (1)	4 (1)	4 (1)
S. Kentucky	15 (2)	4 (1)	1 (0.2)	10 (2)	7 (2)	4 (1)	4 (1)	9 (2)
S. Bredeney	24 (4)	11 (2)	2 (0.5)	3 (1)	11 (3)	3 (1)	6 (2)	3 (1)
All others	63 (10)	81 (15)	78 (19)	92 (19)	83 (20)	88 (25)	131 (30)	127 (29)
Total	661	543	416	486	418	357	430	444

Phage Typing

Phage typing was conducted by the NSRL on all *S*. Enteritidis and *S.* Tyhimurium isolates. Among *S*. Enteritidis isolates PT4 was the most prevalent page type identified (n=71), primarily due to the outbreak in the HSE-S region during July. PT8 was the second most widespread *S*. Enteritidis phage type identified (n=35), (table 5). Among *S*. Typhimurium, DT104 was the most common phage type (n=21), followed by *S*. Typhimurium DT120 (n=19) (table 6).

Table 5: Phage types of *S.* Enteritidis in human isolates 2007

Phage Type	No of Isolates (%)
PT4	71 (40)
PT8	35 (20)
PT14b	17 (9)
PT1	13 (7)
PT21	13 (7)
PT6	12 (7)
PT12	2 (1)
PT6a	2 (1)
PT13a	1 (1)
PT1d	1 (1)
PT2	1 (1)
PT23	1 (1)
PT29	1 (1)
PT34	1 (1)
PT35	1 (1)
PT47	1 (1)
PT4b	1 (1)
PT5c	1 (1)
Unknown	1 (1)
Untypable	3 (2)
Total	**179**

Table 6: Phage types of *S.* Typhimurium in human isolates (2007)

Phage Type	Number of Isolates
DT104	21 (18)
DT120	19 (17)
DT104b	14 (12)
DT193	13 (11)
RDNC	6 (5)
DT56	5 (4)
U302	4 (4)
DT1	3 (3)
DT132	2 (2)
DT56 var	2 (2)
DT12	2 (2)
DT135	2 (2)
Other	12 (11)
Untypable	9 (8)
Total	114

Travel-association

One hundred and seventy four out of 457 isolates (38%) reported to NSRL in 2007 were found to be associated with travel outside of Ireland. This is almost double the rate reported during 2006 (21%). The most commonly reported countries were Spain (n=38), Turkey (n=15), Thailand (n=12), Portugal (n=10), India (n=10) and Nigeria (n=6).

Antimicrobial resistance

The antimicrobial susceptibility patterns of the most commonly isolated serotypes in 2007 are presented Table 7. Of the 444 isolates S. Enterica human specimens received in the NSRL, 147 exhibited some degree of antibiotic resistance. The commonest antibiotic pattern was ACSSuT (n=35). Thirty three isolates with this pattern were of the serotype Typhimurium, one was of serotype Java and one of Stanley. The percentage of associated Typhimurium phage types with this pattern are shown in Table 8.

Table 7: Antimicrobial susceptibilities of human *Salmonella enteric* serotypes isolated in Ireland in 2007 (NSRL)

	% resistance						
Serotype	**Amp**	**Chl**	**Strep**	**Sulph**	**Tet**	**Trim**	**Nal**
Typhimurium (114)	63	41	61	64	71	14	9
Enteritidis (179)	3	0	1	1	2	1	11
Kentucky (9)	44	11	56	67	33	22	33
Agona (3)	67	33	33	67	33	33	0
Blockley (2)	50	0	100	0	100	0	100
Newport (13)	8	8	0	8	15	8	8
Worthington (1)	100	100	100	0	0	0	100
Panama (7)	14	14	14	14	14	14	0
Java (8)	13	13	13	13	13	0	0
Stanley (4)	25	25	25	25	25	0	0
Virchow (5)	20	0	0	0	0	0	80
Infantis (8)	13	0	0	0	0	0	13
Montevideo (5)	20	0	0	0	0	0	0

Amp = Ampicillin, Chl = Chloramphenicol, Strep = Streptomycin, Sulph = Sulphonamide, Tet = Tetracylcine, Trim = Trimethoprim, Nal = Naladixic acid.

Table 8: Percent of S. Typhimurium Phage Types with ACSSuT Antibiotic Resistance Profile

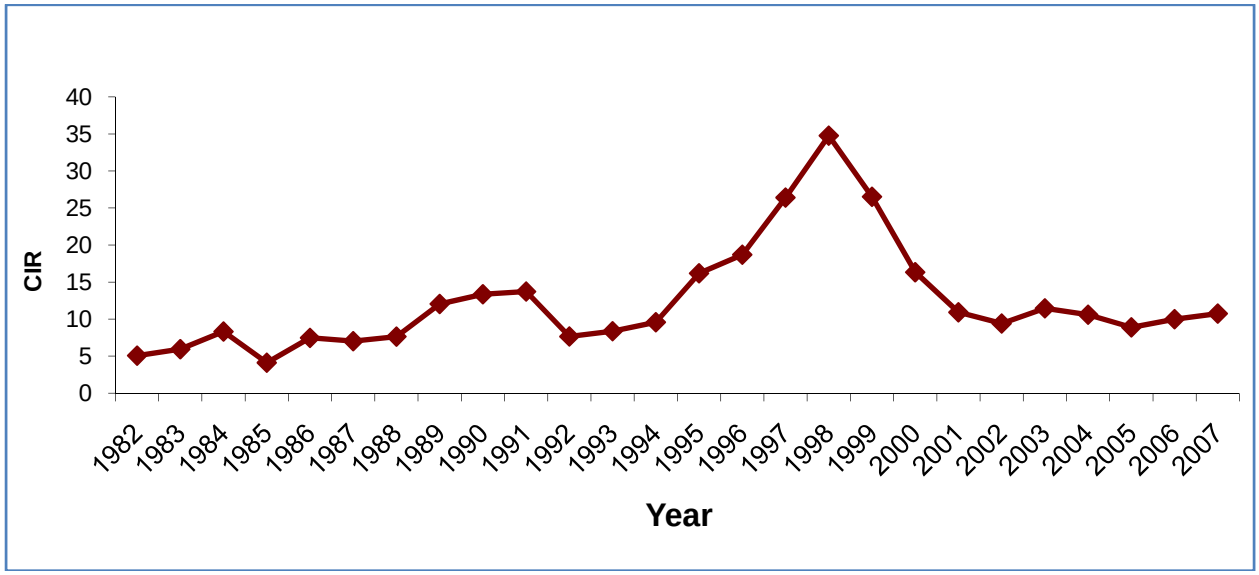
Phage type	Percent Resistant
DT104 (n=16)	76.2%
DT104b (n=14)	107.7%
U302 (n=2)	50.0%
Untypable (n=1)	11.1%

Twenty two of the 179 S. Enteritidis isolates exhibited some degree of antibtiotic resistance. Only one isolate, of phage type 29, exhibited multi-drug resistance with an antibiotic profile of ASTNa. The case had a known history of travel to Spain.

Clinical notification data

There were 456 (including 16 probable's) cases notified via CIDR in 2007. This gives a CIR for the year of 10.8 per 100,000 population, a marginal increase on the 2006 rate. Regional CIR's are shown in Table 2. Figure 3 below trends then national CIR since 1982.

Figure 3. Crude incidence rate of Salmonellosis in Ireland per 100,000 population, 1982-2007.



Outbreaks

In 2007, there were 10 outbreaks of salmonellosis notified via CIDR to the HPSC; three general and seven family outbreaks. Of the seven family outbreaks, one was travel associated and the remaining six were located in private houses. The three general outbreaks had a total of 65 ill. Two of these were small outbreaks, one located in a crèche and the other in a community with 13 associated cases.

The third general outbreak was notified in mid-July of 2007 in HSE-S. There were 52 cases with a 31% hospitalisation rate. The cases were notified from the 2nd week of July until the 1st of August. The peak onset of illness was 6th-9th July. The outbreak phage type was identified as S Enteritidis PT4. The outbreak was epidemiologically linked to a local bakery, bakery X. Results from the analytical study indicated a strong statistical association between illness and eating food from bakery X and/or eating food from outlets supplied by bakery X. Investigators concluded that it was not possible to definitively

state how Salmonella Enteritidis was introduced to bakery X. However, the evidence appeared to support the introduction of S. Enteritidis by either pigeons or by foodhandlers. Once introduced, conditions and practices in the premises could then have contributed to the spread of infection within the premises. Department of Agriculture and Food trace back to the supplying flocks revealed no evidence of supply of contaminated raw eggs to the premises. The bakery closed voluntarily.

Discussion

The crude incidence rate of salmonellosis cases in Ireland during 2007 remained similar to that of 2006. However with further investigation into regional rates this statement is no longer accurate. The CIR in the regions of HSE-M, HSE-NW and HSE-S all experienced a change in rate of greater than one case per 100,000. The midlands region and the north-west region both experience a decline in incidence, from 14.3 to 19.1 per 100,000 in the midlands and 16.0 to 8.9 per 100,000 in the north-west. The CIR of the southern region increased from 8.3 per 100,000 to 21.1 per 100,000. As mentioned previously this increase is probably due to an outbreak of *S.* Enteritidis PT4. The CIR in Northern Ireland was slightly lower with an estimated rate of 9.0 per 100,000 likely for the year[ii]. The Health Protection Scotland reported a CIR 20.1 per 100,000, similar to their rate in 2006[iii]. Provisional data supplied by colleagues in the Health Protection Agency in London indicate that the annual CIR was approximately 22 per 100,000 in England and 18 per 100,000 in Wales. These figures reflect non-typhoidal Salmonellosis cases only and include infections which were acquired abroad.

Episodes of Salmonellosis were seen in all age categories. However there was a higher incidence in the 0-4 age bracket. This is similar to previous years and is likely to be a reflection of the greater likelihood of clinicians seeking clinical samples in children under five. Gender balance has been similar in past years with a female:male ratio of 1:1 in 2007, 1.3:1.0 in 2006 and 1:0.9 in 2005.

Serotyping data provided by the NSRL show *S* Typhimurium and *S* Enteritidis remain the most prominent strains. There were 64 serotypes identified by the NRSL 2007. Although in previous years underestimation of foreign history travel was evident, the figures for 2007 shows more detailed information is being reported with 38% of cases reported having a known history of travel. The number of *S*. Typhi (n = 8) and *S.* Paratyphi A (n =5) cases in 2007 were a lot higher than those of previous years. There were nine cases of *S*. Typhi in 2003, five cases in both 2004 and 2005, and, seven in 2006. There was only one case of *S*. Paratyphi A in 2006. These higher rates may be due to more exotic travel of cases and the changing cultural dynamics in the Irish population.

Phage typing data provided by the NSRL showed the commonest phage type of the *S*. Enteritidis remained PT4, accounting for 40% of all *S*. Enteridiidis isolates. This is an increase of 19% since 2006, which as mentioned previously, is most likely to the outbreak in HSE-S and also to the notification of

probable cases associated with the outbreak. The prevalent phage type of *S*. Typhimurium isolates was DT104, which accounted for 18% of all such isolates.

Review of European data shows a decreasing trend in the notification rate of salmonellosis cases in humans continuing in 2007[iv]. Salmonellosis remained the second most commonly reported zoonotic disease in the EU.

The view that the major sources of human *Salmonella* infections are eggs and meat from pigs andpoultry was supported by the data reported in 2007. There were 151,995 confirmed cases notified on the European Surveillance System (TESSy), the European equivalent to CIDR, in 2007. This equates to a European CIR of 31.1 cases per 100,000. CIR's varied by country by as much as 2.9 confirmed cases per 100,000 to 171.6 confirmed cases per 100,000. Such variation highlights obvious differences in identification and surveillance methods between countries and must be accounted for when interpreting results. *S.* Enteritidis and *S*. Typhimurium were the most frequently reported serovars accounting for 81% of all known serovars in reported human cases.

This report shows that data quality is continually improving, as seen in increased documentation of associated travel history and notification of probable cases in 2007. Research conducted by colleagues at the NSRL into evolving laboratory methods enables a greater degree of differentiation between strains and sub-strains of *Salmonella* species. This enhanced surveillance of salmonellosis facilitates more timely intervention and control of spread not only nationally but also at a European level.

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