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Infectious Intestinal Diseases on the Island of Ireland
2000 - 2010

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Infectious Intestinal Diseases on the Island of Ireland 2000-2010

ISBN: 978-1-905767-27-4

Publication date: May 2012

Foreword

This safefood report catalogues the epidemiology of four selected infectious intestinal disease bacteria over the decade 2000-2010 on the island of Ireland. It follows on from the first safefood report on infectious intestinal disease on the island of Ireland in 2002. Since the publication of the 2002 report, substantial developments in surveillance on the island of Ireland and in Europe have occurred.

This report has identified trends in infectious intestinal disease across the island of Ireland and allows for ease of comparison for the selected organisms between Northern Ireland and the Republic of Ireland.

The burden of infectious intestinal disease on the island of Ireland is substantial and provides a continuous challenge for *safe*food and its colleague food safety agencies on the island. These infections are a common cause of illness in the community and result in considerable demands on General Practice health services and preventable absenteeism from school and work.

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Acknowledgements

***safe*food** would like to offer a sincere thank you to Dr Paul McKeown, Dr Brian Smyth, Dr Patricia Garvey, and Ms Eileen Corey and their colleagues in the Health protection Surveillance Centre and the Public Health Agency for their assistance in writing this report.

***safe*food** would also like to acknowledge clinicians, Public Health professionals and microbiology laboratories in both the Republic of Ireland and Northern Ireland who supply data to surveillance centres.

1 Executive Summary

It is increasingly recognised that the burden of infectious intestinal diseases (IID) in a population is an important indicator of food safety (1). This report has examined four bacterial infections that frequently cause IID on the island of Ireland (IOI). Over the decade covered by this report, levels of *Salmonella* have declined substantially while levels of *Campylobacter* remain a real problem for Food Safety professionals on the IOI. Although much less common, the verocytotoxigenic *Escherichia coli* O157 (VTEC O157) and *Listeria* infections present an on-going challenge because of their severity and associated long-term sequelae. Northern Ireland (NI) has a higher reported crude incidence rate of three of the included pathogens (*Salmonella*, *Campylobacter* and *Listeria*) than the Republic of Ireland (ROI), while VTEC 0157 was the exception. This may reflect differences in health seeking behaviour and reporting between the two jurisdictions and/or actual differences in incidence rates.

Campylobacter

Since 2000, the crude incidence rate of campylobacteriosis has been consistently higher in NI than in ROI, and levels have remained reasonably consistent throughout the ten year period. In both jurisdictions it has been found that the seasonal peak in *Campylobacter* is quite predictable in that the peak incidence rates have been reported in May and June throughout the ten years and that the 0-4 year age group is the most affected.

Salmonella

Since 2000, the crude incidence rate of salmonellosis has been consistently higher in NI than in ROI, although rates have generally decreased in both ROI and NI since 2000. In both jurisdictions it has been found that the seasonal trend in *Salmonella* is quite predictable in that peak incidence rates have been reported in August and September throughout the ten years and that the 0-4 year age group is most affected. The most frequently isolated serotype of *Salmonella* in NI was *Salmonella* Enteritidis while *Salmonella* Typhimurium was the most common in ROI. The most common phage type of *Salmonella* Enteritidis was PT4 which has been associated with poultry products. The most common phage type of *Salmonella*

Typhimurium was DT104 which is commonly associated with pork. When examining the travel history of salmonella cases on IOI in 2010, foreign travel was documented in 38% of cases.

VTEC O157

The crude incidence rate of *VTEC O157* has varied over the ten year period, 2000-2010. While incidence increased from 2004-2009 in ROI it has remained constant in NI over the last number of years and has consistently remained lower than ROI. Similar to the pattern seen in *Campylobacter* and *Salmonella*, the 0-4 year age group has the highest rate of illness.

Listeria

In comparison to the other infectious intestinal diseases detailed in this report, *Listeria* has contributed to a relatively small number of cases of human illness since 2000, although there was a considerable increase in cases in both jurisdictions in 2007 and 2008.

The burden of IID on the IOI provides an on-going challenge for ***safe***food in its role in food safety promotion on the IOI. The messages of "Cook; Clean; Chill and avoid Cross contamination" are age-old but the task of communicating them effectively and supporting good food hygiene practice remains relevant today. Ongoing study of IID trends advance the epidemiologic understanding of food borne disease on IOI and help to underpin future prevention strategies for ***safe***food and its colleague Food Safety agencies.

2 Introduction

This summary report on trends in IID on the IOI details the epidemiology of the four selected bacterial infections over the decade 2000-2010. It provides collated data from the two jurisdictions. It was decided to focus on these four infections as sentinel markers because of their clinical severity and/or their relative frequency of occurrence. It should be noted that the vast majority of cases of these four infections are sporadic and therefore not outbreak related, however there is potential for source attribution studies to be carried out in the future.

There is international recognition that the burden of IID in a population is an important indicator of food safety (1, 2). IID is a group of infections caused by a number of different pathogens which can produce characteristic gastrointestinal symptoms including diarrhoea and vomiting typically. Food borne transmission is an important route of human bacterial IID spread. Foodborne infections result from the consumption of food contaminated with bacteria, viruses and parasites. Most food borne infections cause gastrointestinal symptoms and are classified as cases of IID

It has been well recorded that most cases of IID are not reported to the national surveillance systems, thereby making it difficult to determine the true extent of the burden in the community (3). National statistics underestimate the incidence, because only a fraction of IID presents to health services and many presenting cases are not investigated further. Reported cases are not a random subset of all cases, as seeking healthcare is related to factors such as greater disease severity, recent foreign travel, sickness certification for work and the financial cost of accessing health care services. Therefore, national statistics (in this case from the Health Protection Surveillance Centre (HPSC) in the ROI and the Public Health Agency (PHA) in NI) have inherent limitations but are very useful for monitoring trends.

***safe*food** is the all-island government agency tasked with the promotion of food safety from farm through the food chain to the table. Foodborne infectious disease arises from improper handling, preparation or storage of food. Therefore levels of IID on IOI are an important gauge of food safety standards, as promoted by ***safe*food**, over the past decade. These trends advance the epidemiologic understanding of food borne disease on IOI and help to underpin future prevention strategies for ***safe*food** and its colleague Food Safety agencies.

3 Methodology

For this report, key IID data for the decade 2000 to 2010 were collated from the relevant surveillance centres in NI and ROI, the PHA and the HPSC respectively. The data gathered from these centres was then analysed for trends. Crude incidence rates were calculated using denominator data from census figures and population estimates from the Central Statistics Office (CSO) and Northern Ireland Statistics and Research Agency (NISRA) for ROI and NI, respectively.

The four bacterial pathogens included in this report are *Salmonella*, *Campylobacter*, *Listeria* and VTEC O157. The rationale for their inclusion is their relative frequency of occurrence and/or the severity of clinical infections or its sequelae. It was decided to exclude *Norovirus* and *Cryptosporidium*, although they are common infections and food borne transmission is well documented. The primary mode of transmission of infection for *Norovirus* is person to person and while human cryptosporidiosis spread by contaminated water is important, person to person transmission has been the most common mode in outbreaks in ROI in recent years (4-7).

4 Description of Infectious Intestinal Disease Surveillance Systems on the island of Ireland

4.1 Organisation of systems for surveillance of human infectious intestinal disease in Northern Ireland and Republic of Ireland

Since publication of the first *safe*food report on infectious intestinal diseases on the IOI in 2002 (8), there have been significant developments in surveillance both on the IOI and in Europe. Many of these developments have overtaken and superseded a number of the recommendations made in the 2002 report and are part of European- and EU-led initiatives.

The developments which have taken place on the IOI are briefly described below, with more detail in the *safe*food report, 'Surveillance of Foodborne Pathogens on the island of Ireland' (9).

4.1.1 Northern Ireland

Since October 2009 the Communicable Disease Surveillance Centre (NI) has been incorporated into the Health Protection Service of the PHA. The Health Protection Service encompasses surveillance, prevention and control of infection and environmental hazards; outbreak management; emergency preparedness and response.

The PHA has a health protection duty room into which are received all notifications, laboratory reports and potential incidents requiring urgent public health action and follow up. All such notifications/reports are logged onto a bespoke information system (HPZone) and are triaged and actioned accordingly by a duty team of health protection nurses and consultants. This is irrespective of the geographical location of the case or incident.

4.1.2 Republic of Ireland

In ROI, since 1999 the HPSC has overall responsibility for human infectious disease surveillance. The centre's six main areas of responsibility are:

- Surveillance of the major communicable diseases;
- Operational support to departments of public health or hospitals;
- Training for professionals working in communicable disease control;
- Identifying and developing best practice in communicable disease;
- Policy advice to government departments and appropriate agencies in relation to the development of standards, guidelines and practices, and promoting the adaption of best practice by different agencies; and,
- Public information on infectious diseases to the public and the media

The Departments of Public Health in the ROI regional areas are charged with the prevention and control of notifiable infectious diseases. Teams led by Consultants in Public Health Medicine undertake this responsibility.

4.2 Sources of information for surveillance

In both NI and ROI information on food borne disease is generated from one or more of the following sources:

- Statutory notifications from medical practitioners (NI and ROI);
- Statutory notifications from laboratory directors (ROI);
- Voluntary reporting by laboratories (NI);
- Reference laboratory reporting (NI and ROI);
- Reported outbreaks of foodborne disease (voluntary (NI), statutory (ROI));
- Enhanced surveillance systems for specific diseases, e.g. Verocytotoxigenic *Escherichia coli* (VTEC) in ROI and VTEC O157 in NI;
- *Informal reports from business operators (e.g. hotels) and members of the public;
- *Alerts from international warning systems: Early Warning Response System (EWRS), Food and Waterborne Disease Network etc.[1]

[1] These type of reports may alert PH to outbreaks and form part of the overall epidemic intelligence but do not necessarily form part of formal surveillance in themselves

4.2.1 Statutory Notifications

In both jurisdictions if a medical practitioner becomes aware of, or suspects that, an attending patient is suffering from a notifiable infectious intestinal disease the practitioner is legally required to notify the relevant medical officer. The list of notifiable infectious intestinal diseases is set in Table 1.

Table 1: Notifiable diseases and pathogens potentially transmitted through food in NI and ROI, respectively.

NI	ROI
Cholera	Cholera
Hepatitis A	Hepatitis A
Paratyphoid	Paratyphoid
Typhoid	Typhoid
Dysentery	*Bacillus cereus* foodborne intoxication
Food Poisoning[2]	Botulism
Gastroenteritis (<2 yrs)	Brucellosis
	Campylobacter infection
	Clostridium perfringens (type A)
	Cryptosporidiosis
	Echinococcosis
	Giardiasis
	Listeriosis
	Noroviral infection
	Salmonellosis
	Shigellosis
	Staphylococcal food poisoning
	Tuberculosis due to Mycobacterium bovis
	Trichinosis
	Variant Creutzfeldt-Jakob Disease (vCJD)
	Yersiniosis
	Carbapenem-resistant enterobacteriaceae infection (invasive)
	Clostridium Difficile
	Rotavirus
	Enterohaemorrhagic *E. Coli*

[2] In NI food poisoning notifications reported include those formally notified by clinicians and reports of *Salmonella*, *campylobacter*, *cryptosporidiosis*, *Giardia*, *Listeria* and *E. coli* O157 informally ascertained from laboratories.

The systems in NI and ROI for clinical notification are manual, with doctors completing a short form that is then sent to the PHA and Health Service Executive (HSE), respectively. Cases requiring urgent public health action are usually notified by phone. The dataset collected in both jurisdictions is presented in Table 2

Table 2: Dataset collected for clinical notification in NI and ROI

NI	ROI
Case details	Case details
Date of birth	Date of birth
Gender	Sex
Address	Age
Name of the notifiable disease	Disease
Other information such as vaccination status (if relevant) and onset of illness as available	Vaccination status (if vaccine preventable)
Date of notification	Date of onset
	Date of diagnosis
	Laboratory Results
	Type of specimen
	Occupation
	Country of birth
	Case classification
	Additional information through such linkage is available at local level.

In the PHA in NI, all notifications of foodborne illness are entered onto a bespoke web based case management system onto which details of risk exposures and all public health actions are entered. This now makes it possible to link individual notification details with laboratory reports at a regional level; this was not possible under previous organizational structures (http://hpzoneinfo.in-fact.com/).

In ROI case-based reporting has been in place since July 2000. Since 2004, clinical and laboratory data have been linked at Department of Public Health level and made available

electronically via a national electronic web-based information system called Computerised Infectious Disease Reporting (CIDR). Laboratory directors, medical scientists in clinical laboratories, public health doctors, surveillance scientists and other relevant staff in public health departments have secure regulated access to CIDR for the management of surveillance and control of infectious diseases. General practitioners and hospital clinicians do not have direct access to the system at present. Reports based on information in CIDR are available to these groups however, via the HPSC website.

4.2.2 Laboratory reporting

In NI clinical laboratories provide information on laboratory isolation/detections of microorganisms of public health significance to the PHA for local public health action and for regional surveillance. This is done on a voluntary basis. Using software developed and used by the Health Protection Agency (HPA), clinical laboratories electronically forward reportable organisms to the PHA. This information is then sent to the HPA Centre for Infections in London for incorporation into the United Kingdom (UK) national database.

In ROI the clinical laboratory director is legally required to report all notifiable pathogens to regional department of Public Health, and this is linked to clinical epidemiological data on CIDR, and is available for analysis on a local and national level.

The use of electronic reporting in NI and ROI allows production of data in a standard format for each jurisdiction. Such information can be used to provide similar outputs and allows the comparison of NI and ROI data.

4.3 Outbreak surveillance

Outbreak surveillance systems operate in both NI and ROI. In ROI there is a legal requirement to report outbreaks to the MOH since 2004, whereas this is not the case in NI where such reporting is voluntary. Standard forms for the reporting of outbreaks have been developed in both jurisdictions. In general, in both jurisdictions, the data collected include: information on the source of reporting of the outbreak, the extent of the outbreak, mode of transmission, location, pathogen(s) involved, laboratory investigation, morbidity and mortality data, suspect vehicle and factors contributing to the outbreak. For the purpose of this report and to allow comparability between jurisdictions, all outbreaks referred to from here on in will represent general outbreaks only.

4.3.1 Enhanced surveillance

Enhanced surveillance of selected pathogens that are considered to be a unique public health risk is a key tool for surveillance purposes. It is generally undertaken for diseases of major public health concern, where the extra effort required to collect the information is balanced by the advantages of having this information available for public health action.

In ROI an enhanced surveillance system for VTEC O157 was established in 1999 and for all VTEC cases in 2004. Each case identified is investigated thoroughly, contacts are screened as appropriate, potential links between cases are investigated, and a comprehensive standard dataset of information is collected and collated nationally via CIDR by HPSC. In addition to a specialised system for VTEC O157, there is also an enhanced surveillance system for listeriosis (http://www.hpsc.ie/hpsc/A-Z/Gastroenteric/Listeriosis/SurveillanceForms/) in place since 2001, for cryptosporidiosis (http://www.hpsc.ie/hpsc/AZ/Gastroenteric/Cryptosporidiosis/SurveillanceForms/) since 2010, and for salmonellosis (http://www.hpsc.ie/hpsc/A-Z/Gastroenteric/Salmonellosis/SurveillanceForms/) since 2011 in ROI.

In NI when cases of VTEC O157 are identified a similar thorough investigation is undertaken, and enhanced information is collated locally. This information has been collated at NI level since 2005 using a VTEC O157 specific questionnaire.

4.4 Reference laboratory information

Reference services provide crucial data for surveillance by confirming the diagnosis, and further characterisation of pathogens. Using appropriate sub-typing protocols, enteric reference laboratories can detect/confirm clusters and outbreaks of human disease and subsequently investigate the similarities/differences between clinical isolates and between isolates of food or animal origin.

4.4.1 Northern Ireland

The Centre for Infections (CFI) at Colindale, London provides an enteric reference service for NI. All *Salmonella*, *Listeria* and VTEC O157 isolates from NI are submitted for further in-depth laboratory investigation and the information is returned to the submitting laboratory.

Information from the reference service is forwarded to local submitting laboratories and the PHA, where it is collated and published in its monthly bulletin and incorporated into relevant tables on its website.

4.4.2 Republic of Ireland

In ROI three pathogen specific human reference laboratories services exist. The National Salmonella, Shigella and Listeria Reference Laboratory (NSSLRL) was established in 2000 in the Department of Medical Microbiology, University College Hospital, Galway, and undertakes confirmation, serotyping, phage typing (*Salmonella* Typhimurium and Enteritidis), antimicrobial resistance testing and molecular typing of *Salmonella, Shigella* and *Listeria* isolates as appropriate. The NSSLRL liaises closely with HPSC, regional Public Health Departments and Food Safety Authority of Ireland (FSAI) to alert them to potential clusters of salmonellosis, shigellosis and listeriosis cases and to facilitate the investigation of suspect outbreaks. NSSLRL contributes data also through the CIDR system and circulates monthly summary reports of isolates received and typed.

The HSE Dublin Mid Leinster-Public Health Laboratory at Cherry Orchard Hospital, Dublin has established a VTEC O157 and non-O157 diagnostic service for clinical and some food samples, including *E. coli* serotyping, verotoxin detection, and VTEC molecular typing. PFGE is performed routinely on all sporadic and outbreak cases. For all laboratory confirmed VTEC cases, serotyping and verotoxin typing results from Cherry Orchard are inputted by the laboratory to CIDR, where it is integrated with public health information.

The National Virus Reference Laboratory located at the University College Dublin (UCD) Centre for Research in Infectious Diseases (CRID), provides a national diagnostic service for Ireland in relation to virus detection and epidemiology using a wide range of methods to identify viral infections in humans. Its' main role in relation to foodborne illness is in relation to Norovirus and Hepatitis A. A number of primary hospital laboratories in the ROI have availed of the services of the UK *Cryptosporidium* Reference Laboratory in Swansea for speciation of human specimens found positive for *Cryptosporidium*.

4.5 Regional and local clinical laboratories in Northern Ireland and Republic of Ireland

Ensuring quality and comparability of data between laboratories is an important feature of laboratory surveillance. Throughout the IOI, this is accomplished through involvement in quality assurance schemes, proficiency testing and accreditation.

In ROI, variability exists in sampling strategies and test protocols used by primary laboratories and there are also differences in the range of tests performed. However HPSC have made recommendations for standardisation, particularly in relation to *Cryptosporidium*, and *Norovirus*. In NI some variability persists in test protocols but this has been substantially reduced following a series of province-wide audits. Laboratory amalgamations have also led to greater uniformity.

4.6 Publications of surveillance

Regular reporting of surveillance information is performed in both NI and ROI.

4.6.1 Northern Ireland

Transmit is a monthly bulletin of the PHA Health Protection Service. This provides up-to-date and topical information on a range of health protection issues, with in-depth coverage of a different work area each month. In addition, it also describes the range of issues being managed by the health protection duty room and provides updated information and guidance where it is thought to be appropriate (see http://www.publichealth.hscni.net/publications).

4.6.2 Republic of Ireland

The HPSC publishes, in its electronically disseminated Weekly Infectious Disease Report, figures on notifiable infectious diseases by HSE area. HPSC also publishes, on a weekly basis, data on outbreaks of infectious diseases. A report on “Infectious intestinal, zoonotic, and vectorborne disease, and outbreaks of infectious disease” is also published quarterly.

EPI-Insight is published by the HPSC and contains data on infectious diseases and informative articles for use locally, regionally and nationally. EPI-Insight is distributed electronically and is available on the HPSC website. HPSC publishes annual statistics on infectious diseases in its annual report (see http://www.hpsc.ie/hpsc/EPI-Insight/).

5 Infectious Intestinal Disease on the Island of Ireland – Analysis of Data from 2000-2010

This section describes the results of the analysis of the 2000-2010 data obtained from HPSC (ROI) and PHA (NI) for the following infectious diseases:

1. Campylobacteriosis

2. Salmonellosis

3. VTEC O157 Infection

4. Listeriosis

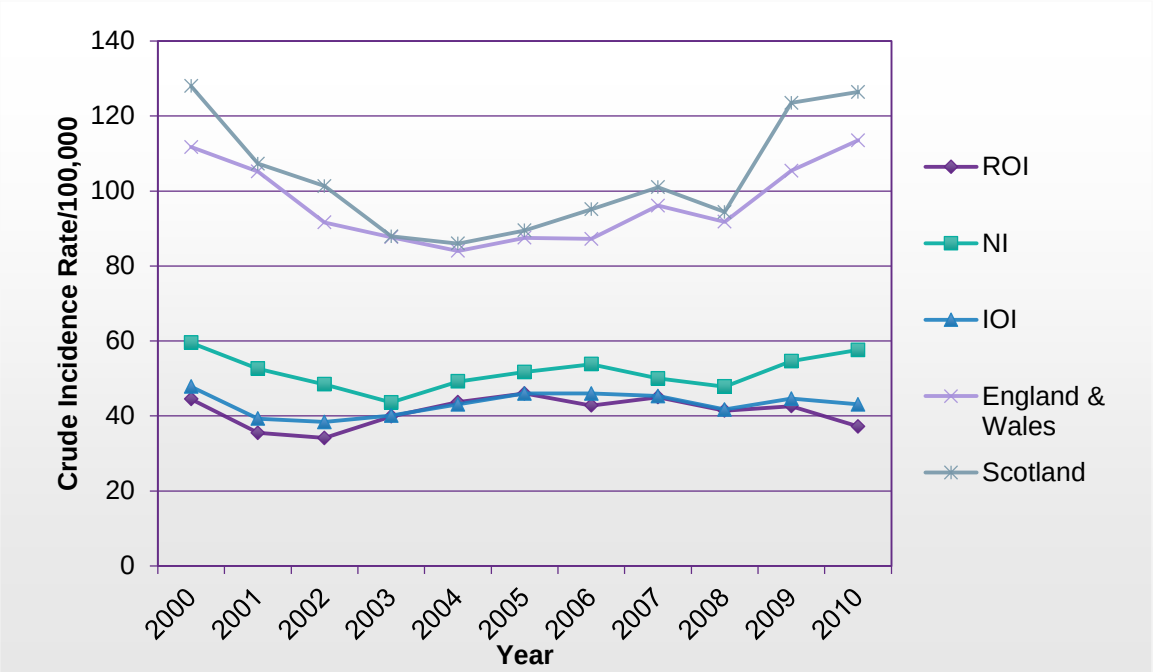
5.1 Campylobacterosis

5.1.1 Crude Incidence rate of *Campylobacter* infection

In 2010, as in previous years, *Campylobacter* remained the single most common cause of bacterial gastrointestinal infection in both jurisdictions, with 2,702 (43.09/100,000) laboratory reports on the whole island (nearly four times more than *Salmonella*). However, this rate is consistently lower than the rate observed (about 2-3 fold) in England, Wales and Scotland as is demonstrated below for 2000 to 2010 (Figure 1).

With regard to the two jurisdictions on IOI in 2010, 1040 cases of campylobacteriosis were notified to the PHA and 1662 cases were notified to the HPSC. While the crude incidence rate has been decreasing in ROI, the rates have increased in recent years in NI and in Great Britain (Figure 1). Since 2000, the reported crude incidence rate has been consistently slightly higher in NI than in ROI. However the trends in rate were similar for 2000- 2008 and then diverged (Figure 1).

Figure 1: Crude incidence rate of campylobacteriosis for ROI, NI, IOI, England and Wales, and Scotland, 2000-2010



5.1.2 Age Distribution

By far the highest burden of illness in 2010 was seen in children in the 0-4 year age group in both jurisdictions (Table 3). This has been documented as a feature of the illness worldwide, and is a pattern also witnessed on IOI over the last decade. It is noteworthy that the excess reported incidence in NI is associated with adult cases (>15 years of age). There is also an excess in incidence in children under 5 years between 2000 and 2009 in ROI relative to NI.

Table 3: Age-specific incidence rate (per 100,000 population) of cases of campylobacteriosis in, ROI and NI, 2000-2010

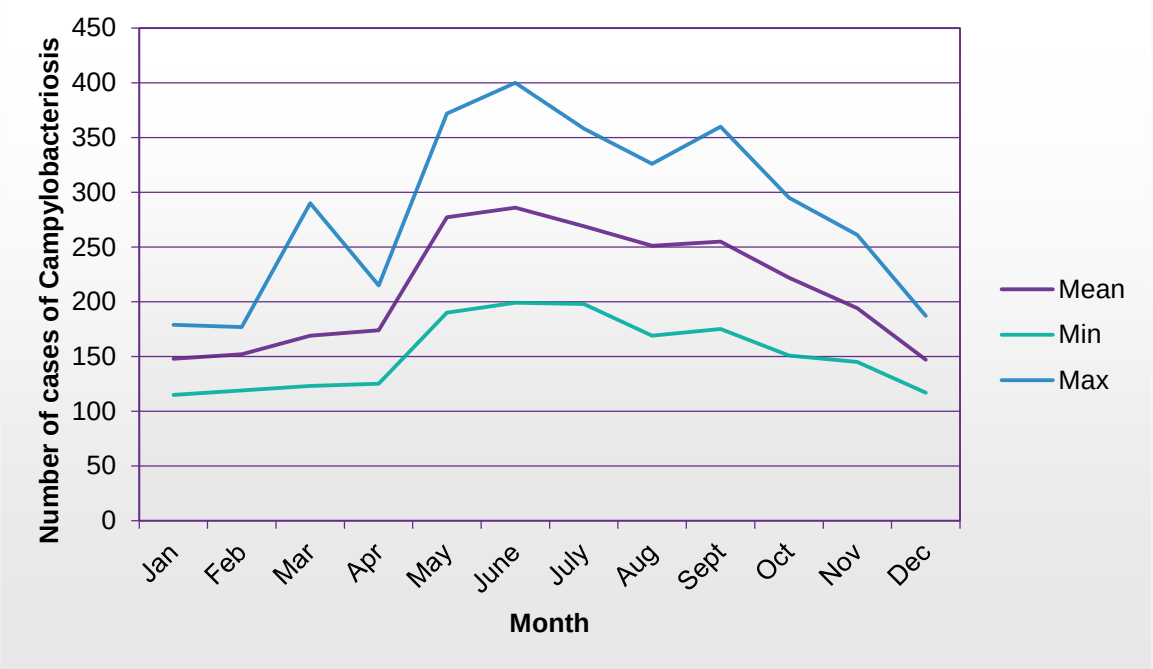
Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0-4	182.6	125.2	142.3	148.1	164.4	152.8	134.0	153.7	128.4	146.1	118.1
	152.6	149.1	111.1	94.9	97.2	93.4	89.2	111.9	92.2	98.9	113.4
5-9	39.4	33.8	26.9	31.6	38.6	44.2	39.2	40.9	38.2	43.5	35.0
	34.3	22.0	41.0	30.5	25.0	33.6	33.3	25.2	30.0	36.5	34.6
10-14	23.0	12.0	14.4	22.7	21.6	23.2	25.2	20.7	19.9	25.0	24.5
	24.0	20.4	11.4	13.9	20.4	19.8	27.3	15.3	11.4	20.4	24.0
15-44	29.4	28.0	29.3	33.8	35.0	36.1	40.0	37.4	35.6	31.3	31.8
	60.3	54.8	50.7	42.2	53.4	52.0	59.7	51.8	45.9	55.1	56.9
45-64	19.5	19.8	18.6	24.0	25.9	30.4	30.3	29.8	24.2	28.9	25.6
	59.6	46.1	45.8	48.0	48.2	55.3	55.8	53.5	55.0	57.4	60.2
65+	24.7	27.7	25.2	34.4	31.8	40.1	30.9	36.1	35.3	36.4	32.6
	37.1	29.5	32.6	33.0	34.3	40.2	35.5	40.3	46.2	51.9	55.3

Key: ROI, NI

c. Seasonality

As can be seen from Figure 2, *Campylobacter* has followed a seasonal trend over the years on IOI. This has been illustrated for the years 2000 to 2010 with a seasonal peak seen usually in the early summer.

Figure 2: Seasonal trends in campylobacterosis on the IOI, 2000 to 2010



d. Species of *Campylobacter*

The most common species isolated on IOI from 2000 to 2010 was *Campylobacter jejuni* (21% in 2010). However the majority of isolates (62% in ROI and 99% in NI for 2010) were not speciated.

e. Outbreaks of *Campylobacter*

Outbreaks of *Campylobacter* infection have been rare on IOI (Table 4), where foodborne transmission accounted for the majority of cases. However, *Campylobacter* in 2010 was the leading cause of foodborne outbreaks in England and Wales (10).

Table 4: Number of general outbreaks and associated cases of campylobacteriosis in ROI and NI, 2000- 2010

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ROI	No. of Outbreaks	-	1	1	2	0	0	0	1	0	0	1
	No. ill in outbreaks	-	14	7	25	0	0	0	3	0	0	5
NI	No. of Outbreaks	0	1	0	0	0	0	0	0	0	0	0
	No. ill in outbreaks	0	3	0	0	0	0	0	0	0	0	0

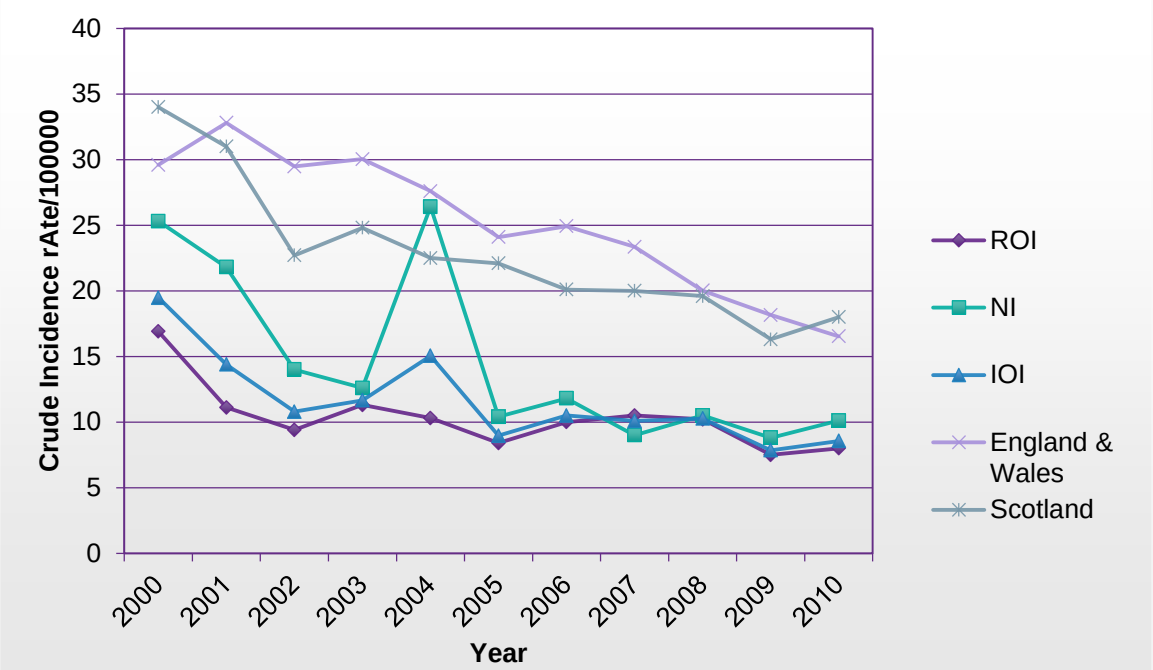
5.2 Salmonellosis

a. Crude incidence rate of *Salmonella* infection

In 2010, *Salmonella* was isolated in 537 cases of IID on IOI. When compared to England and Wales for 2000 to 2010, the rate on IOI is approximately half the rate that was observed for those countries (Figure 3).

In 2010 there were 356 cases of salmonellosis reported in ROI and 181 in NI. The crude incidence rates of *Salmonella* have been consistently higher in NI compared to ROI with the exception of 2007 when it was slightly lower (Figure 3). The incidence rates have been generally decreasing in both jurisdictions since 2000, although both jurisdictions reported an increase in crude incidence rates in 2010 compared to 2009. The spike in cases noted in NI in 2004 was associated with four *Salmonella* outbreaks.

Figure 3: Crude incidence rate of salmonellosis for ROI, NI, IOI, England and Wales, and Scotland, 2000-2010



b. Age distribution

The highest incidence rate of salmonellosis in 2010 was recorded among young children (Table 5). This pattern was similar in both jurisdictions for the past ten years. Twenty-one per cent of cases (75/356) in ROI and 17% (31/181) in NI in 2010 occurred in the 0-4 year age group.

Table 5: Age-specific incidence rate (per 100,000 population) of cases of salmonellosis in ROI and NI, 2000-2010

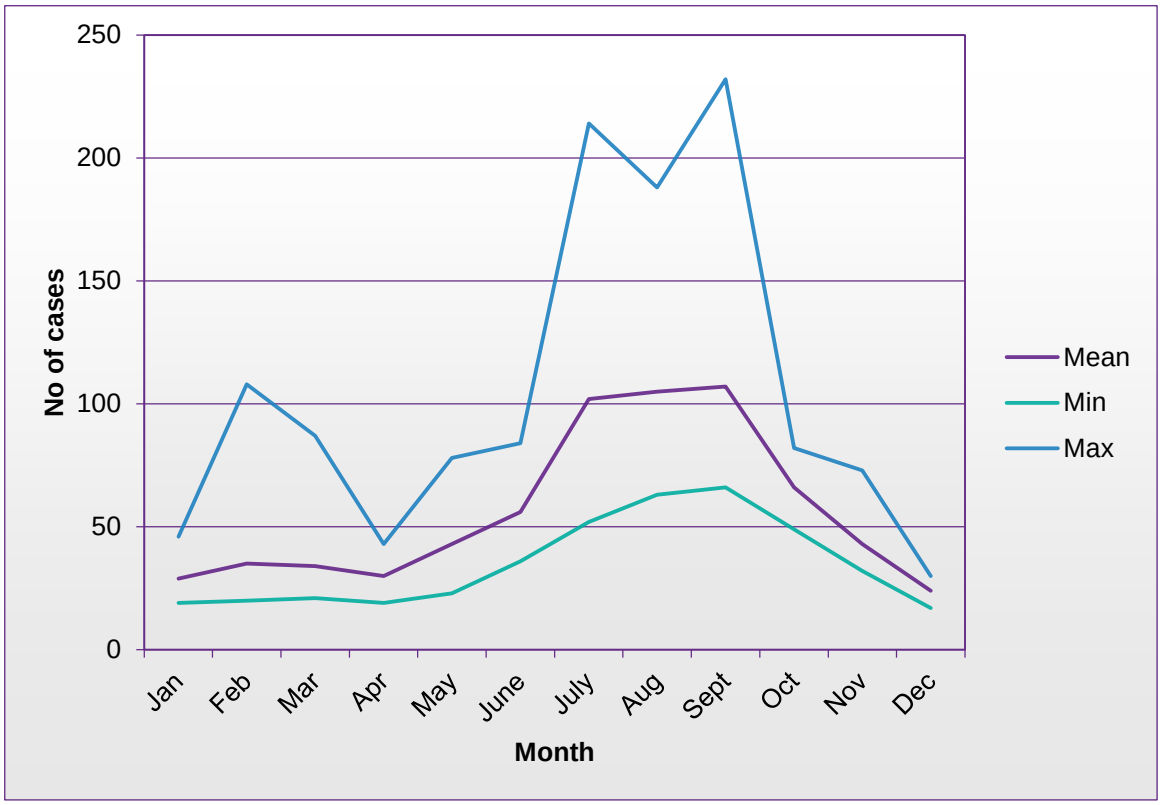
Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0-4	22.9	32.9	33.1	31.3	27.9	28.0	31.1	34.6	31.1	21.1	21.2
	48.6	31.4	31.1	20.8	27.5	17.3	20.5	28.6	21.8	19.6	24.9
5-9	9.4	14.0	6.4	11.9	11.6	6.1	13.2	9.1	9.9	9.1	5.5
	28.0	22.0	12.3	9.1	16.6	10.9	11.9	7.0	9.7	6.2	5.3
10-14	6.1	7.6	5.6	8.5	6.1	6.9	5.8	5.8	6.1	5.9	8.2
	19.5	12.8	6.1	7.7	18.8	6.3	8.0	6.5	4.1	2.4	2.5
15-44	7.9	10.2	7.5	10.6	9.4	7.0	8.2	8.9	9.2	6.8	7.1
	26.7	24.6	15.0	13.9	34.5	11.1	12.3	8.3	9.7	9.2	10.1
45-64	5.1	6.8	8.3	7.8	8.7	6.1	8.1	7.7	7.0	4.6	5.9
	19.0	20.6	12.1	13.2	20.7	10.4	12.9	8.5	11.7	9.9	9.5
65+	6.4	8.4	6.0	7.9	7.1	7.8	7.4	10.8	8.7	6.5	7.9
	11.8	12.5	7.5	6.5	15.0	6.3	5.9	5.3	8.8	5.1	9.2

Key: ROI; NI

c. Seasonal distribution

There is a marked seasonality in the number of human cases of salmonellosis reported on IOI during 2000- 2010 with peak incidence rates seen in August and September (Figure 4).

Figure 4: Seasonal trends in reported cases of salmonellosis on the IOI, 2000- 2010



d. Serotypes

In ROI in 2010, *Salmonella* Typhimurium (*S.* Typhimurium) was the predominant serotype associated with human salmonellosis. In NI for the same year, *Salmonella* Enteritidis (*S.* Enteritidis) was the predominant serotype (Figure 5).

These two serotypes have been the two most common types isolated in both jurisdictions over the last decade (Table 6). This is a trend which is also seen in Europe (11). However, there has been an overall downward trend in the total number of *Salmonella* isolates on IOI, although the numbers of *S.* Typhimurium isolates have increased during the last five years (Figures 6 and 7). In addition to *S.* Typhimurium and *S.* Enteritidis, serotypes such as Virchow, Hadar, Bredeney, Kentucky, Dublin and Dundee have been isolated on IOI since 2000.

Figure 5: Percentage of *Salmonella* isolates reported in ROI and NI, 2010

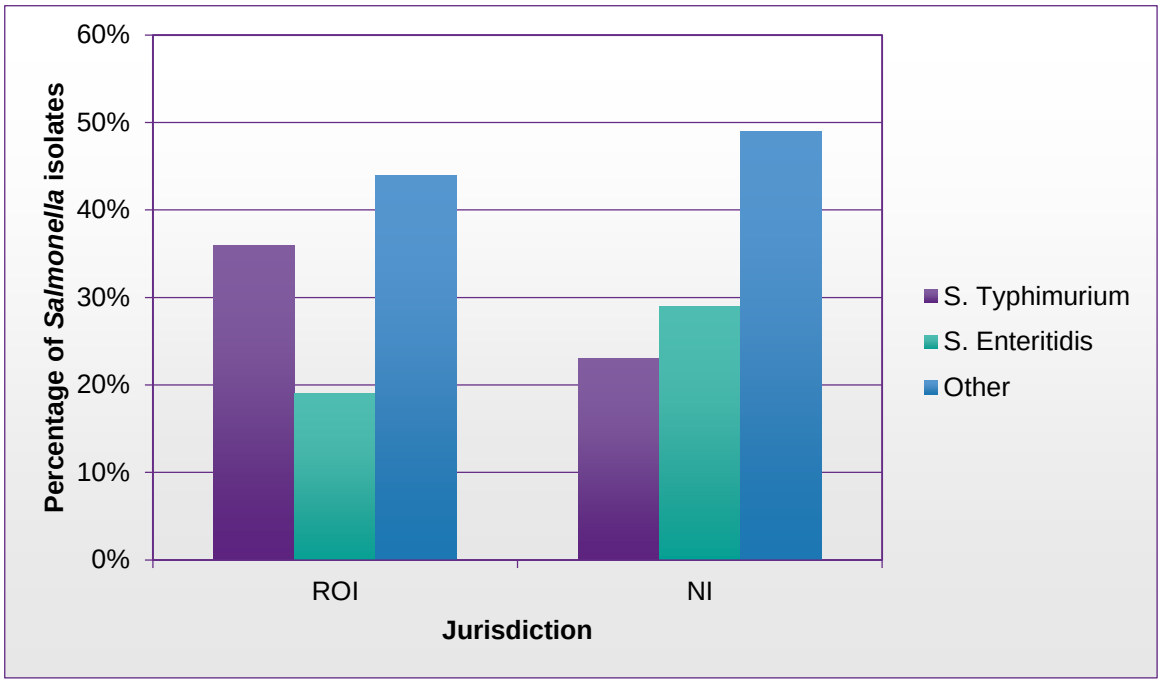


Table 6: Number and percentage of *Salmonella* serotypes reported on IOI, 2000-2010

Serotype	IOI
Enteritidis	2855 (41.3%)
Typhimurium	2184 (31.6%)
Newport	210 (3.0%)
Virchow	172 (2.5%)
Other	1496 (21.6%)
Total	6917 (100%)

Figures 6 and 7 below highlight the crude incidence rate of *S.* Enteritidis and *S.* Typhimurium by jurisdiction from 2000 to 2010.

e. Phage types

The most frequently isolated phage type of *S.* Enteritidis on IOI over the last decade has been PT 4 which represents 26% of cases on IOI (see Table 7). The most frequently isolated phage type of *S.* Typhimurium in IOI over the last decade has been DT104 which represents 35% of the cases on IOI (see Table 8).

Figure 6: Crude incidence rate of *S.* Enteritidis isolates, ROI and NI, 2000- 2010

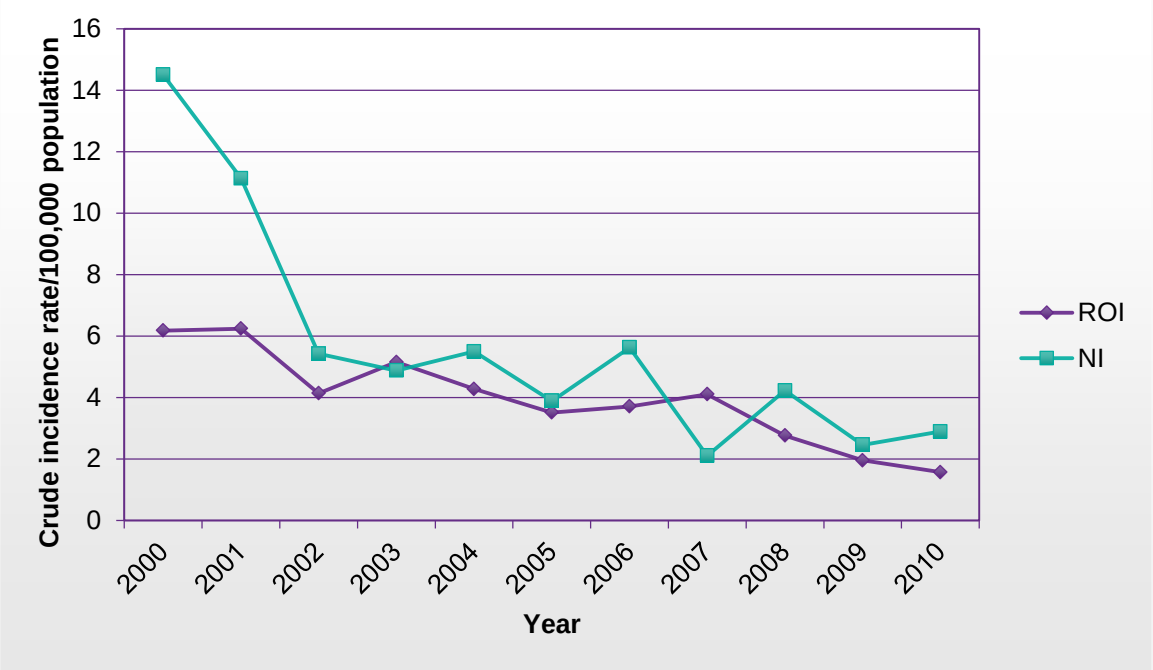


Figure 7: Crude incidence rate of *S.* Typhimurium isolates, ROI and NI, 2000- 2010

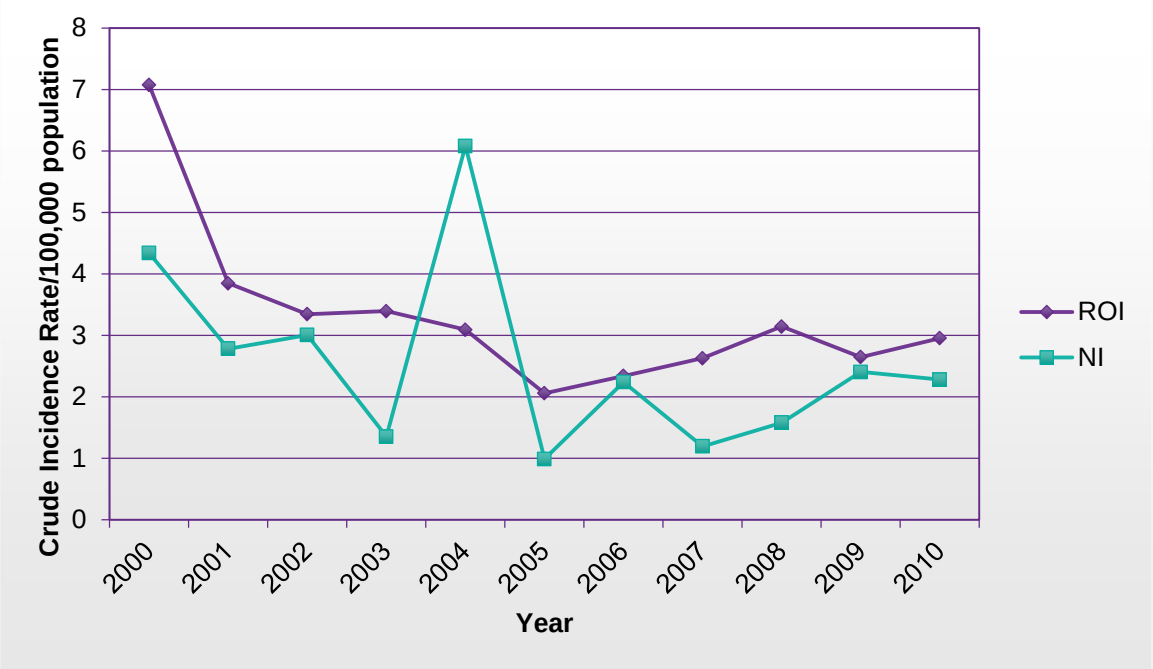


Table 7: Common S. Enteritidis Phage Types, ROI, NI and IOI, 2000-2010

	Phage type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
ROI	PT4	162	86	36	58	43	19	33	70	22	7	9	545
NI		160	95	32	18	15	13	13	4	10	4	5	369
ROI	PT1	26	74	51	53	48	44	29	13	23	9	14	384
NI		31	30	22	20	26	24	35	3	7	5	12	215
ROI	PT21	5	10	5	21	18	12	26	13	22	11	6	149
NI		7	5	2	7	12	9	11	4	11	3	3	74
ROI	PT14b	8	6	8	7	11	22	19	17	11	20	17	146
NI		1	5	2	2	4	6	13	8	9	5	0	55
ROI	PT8	4	7	12	10	10	20	17	35	14	13	4	146
NI		4	6	4	6	24	4	3	5	11	3	12	82
ROI	other	29	57	50	56	43	28	33	30	30	27	20	403
NI		32	38	36	41	8	27	17	24	23	25	16	287
Total		469	419	260	299	262	228	249	226	193	132	118	2855

Table 8: Common *S.* Typhimurium Phage Types, ROI, NI and IOI, 2000-2010

	Phage type	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
ROI	DT104	194	39	25	22	48	37	24	21	28	24	26	488
NI		37	20	16	10	95	4	11	0	5	5	5	208
ROI	DT104b	23	48	49	67	23	13	29	14	27	14	14	321
NI		4	19	18	7	2	2	12	5	11	0	2	82
ROI	DT193	11	11	16	4	2	5	11	13	18	27	18	136
NI		13	3	4	2	1	3	6	6	5	6	10	59
ROI	Other	40	50	41	42	52	30	35	66	66	53	74	549
NI		39	34	32	24	48	24	17	29	15	43	36	341
Total		361	224	201	178	271	118	145	154	175	172	185	2184

f. Travel History

For all of the 537 *Salmonella* cases reported on IOI in 2010, 38% were recorded as being travel related. As can be seen from Figure 8 and 9 however for a large proportion of cases of *Salmonella* it was not recorded whether they were acquired either at home or abroad. Figure 8 illustrates that the recording of recent foreign travel has improved over the past decade.

Figure 8: Travel history of salmonellosis cases in ROI, NI, and IOI 2010

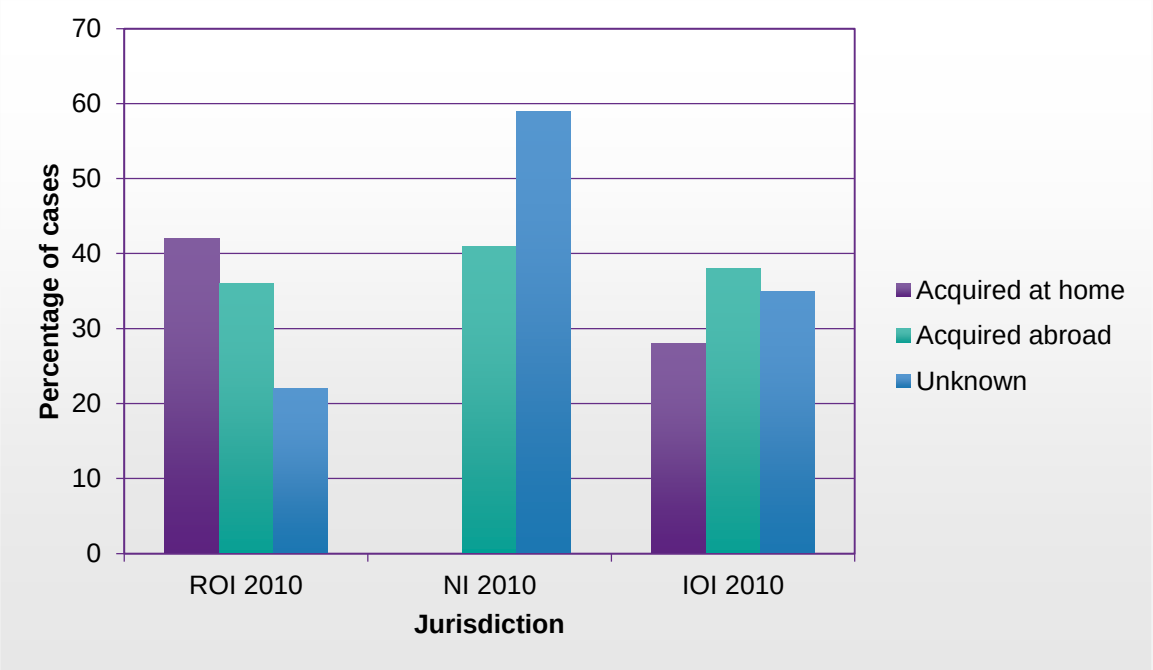
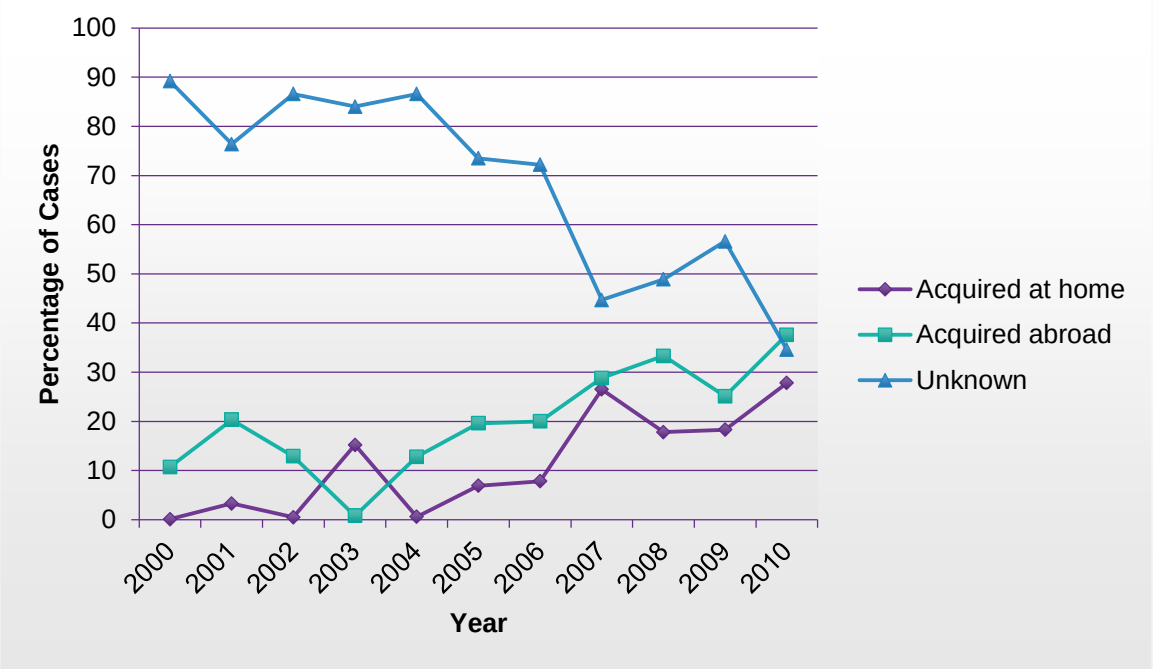


Figure 9: Distribution of salmonellosis cases by travel status and year, IOI 2000-2010



g. Outbreaks

Table 9 highlights *Salmonella* outbreaks that have occurred in each jurisdiction since 2000. The most common mode of transmission reported in these outbreaks was foodborne transmission with person to person spread also contributing to cases.

Table 9: Number of general outbreaks and associated cases of salmonellosis in ROI and NI, 2000-2010

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ROI	No. of Outbreaks	-	2	2	3	1	3	5	3	12	3	5
	No. ill in outbreaks	-	9	13	28	10	11	13	65	53	66	59
NI	No. of Outbreaks	1	1	0	0	4	0	1	1	0	0	0
	No. ill in outbreaks	12	15	0	0	269	0	4	1	0	0	0

5.3 VTEC O157 Infection

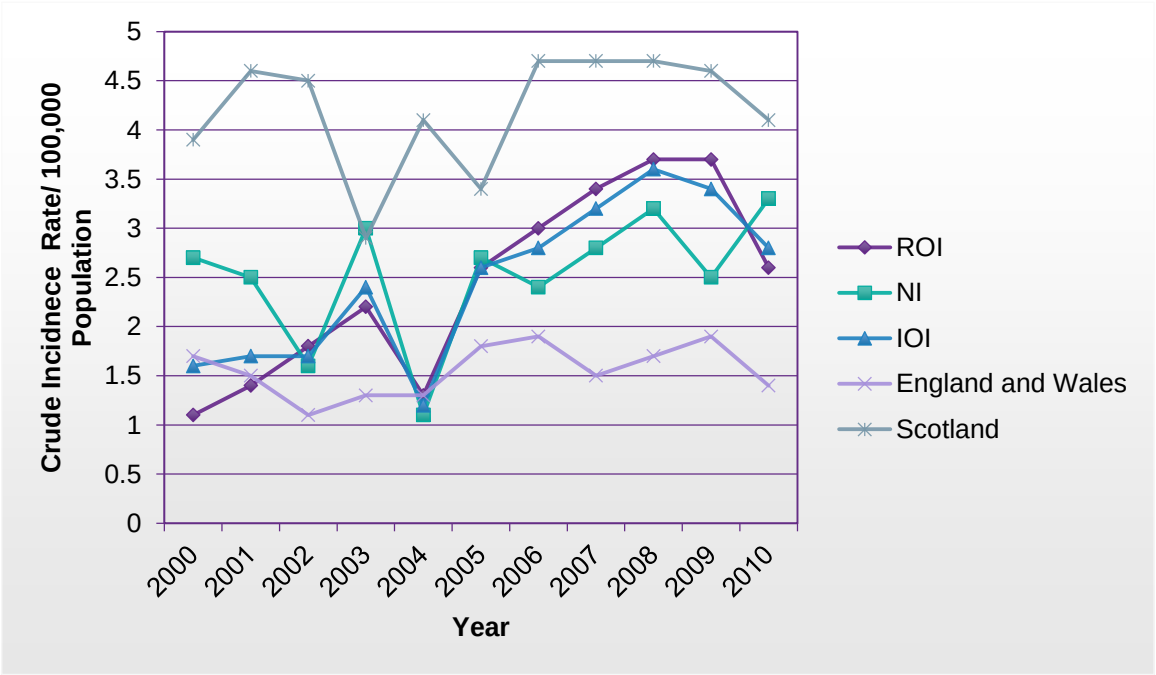
Although all VTEC are notifiable in ROI since 2004, this section will focus on VTEC O157 only, as comparable data are available in both jurisdictions for this serogroup.

a. Crude incidence rate of VTEC O157 infection

In 2010, 177 laboratory confirmed cases of VTEC O157 infection were reported on the IOI. This equates to a crude incidence rate of 2.8/100,000. The rate observed in 2010 for the IOI was higher than that in England and Wales, as was the case since 2000 with the exception of 2004 (Figure 10), but lower than the reported incidence rates for Scotland.

The crude incidence rate of VTEC O157 in both jurisdictions on IOI shows considerable variation from year to year, with rates in ROI higher than those in NI from 2004-2009 (Figure 10).

Figure 10: Crude incidence rate of VTEC O157 infection in ROI, NI, IOI, England and Wales and Scotland, 2000-2010



b. Age Distribution

The highest incidence rate in both jurisdictions was recorded in the 0-4 year age group (Table 10), and this is a similar pattern to that seen in previous years. There is notable variation from year to year in the rates in NI for the 0-4 year age group when compared to the rates in ROI for that age group and this relates to the effects of fluctuations of small numbers of cases in calculating rates.

Table 10: Age-specific incidence rate (per 100,000 population) of cases of VTEC O157 infection in ROI and NI, 2000-2010

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0-4	6.38	5.85	9.36	9.14	4.81	13.49	14.55	11.2	19.82	18.73	8.19
	15.34	13.07	5.33	19.89	3.66	7.26	14.27	9.54	11.73	11.44	16.89
5-9	1.49	2.65	1.51	2.23	1.45	3.92	7.27	4.39	9.55	6.81	4.49
	3.99	4.88	0	4.12	2.49	3.36	1.7	1.74	7.06	1.77	4.44
10-14	0.67	1.37	1.05	1.77	1.07	2.53	2.18	2.9	0.71	3.81	3.4
	0	1.51	0.76	1.54	1.56	3.17	1.6	2.42	3.24	3.26	2.47
15-44	0.45	0.89	0.98	1.13	0.85	1.66	1.86	1.52	1.99	2.07	1.81
	2.74	1.64	1.63	1.22	0.4	2.16	1.87	2.39	2.12	1.86	2.8
45-64	0.76	0.74	1.08	1.98	1.02	1.21	0.75	1.57	1.33	1.8	1.76
	0.83	1.64	1.34	2.37	0.77	0.5	0.74	2.43	1.91	1.64	1.85
65+	1.17	0.46	2.29	0.9	1.33	1.52	1.73	2.54	3.11	2.22	1.96
	0	0.44	1.31	1.3	0.42	5.5	1.67	1.64	2.41	1.17	0.76

Key: ROI, NI

c. Outbreaks

Table 11 highlights VTEC O157 outbreaks that have occurred in both jurisdictions since 2000. The most common transmission route reported on the IOI was person to person spread.

Table 11: Number of general outbreaks and associated cases of VTEC O157 infection in ROI and IOI, 2000-2010

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ROI	No. of Outbreaks	-	1	0	3	1	4	2	3	7	3	2
	No. ill in outbreaks	-	15	0	172	4	15	5	65	25	8	5
NI	No. of Outbreaks	1	1	0	2	0	2	0	0	1	0	1
	No. ill in outbreaks	8	16	0	18	0	16	0	0	17	0	14

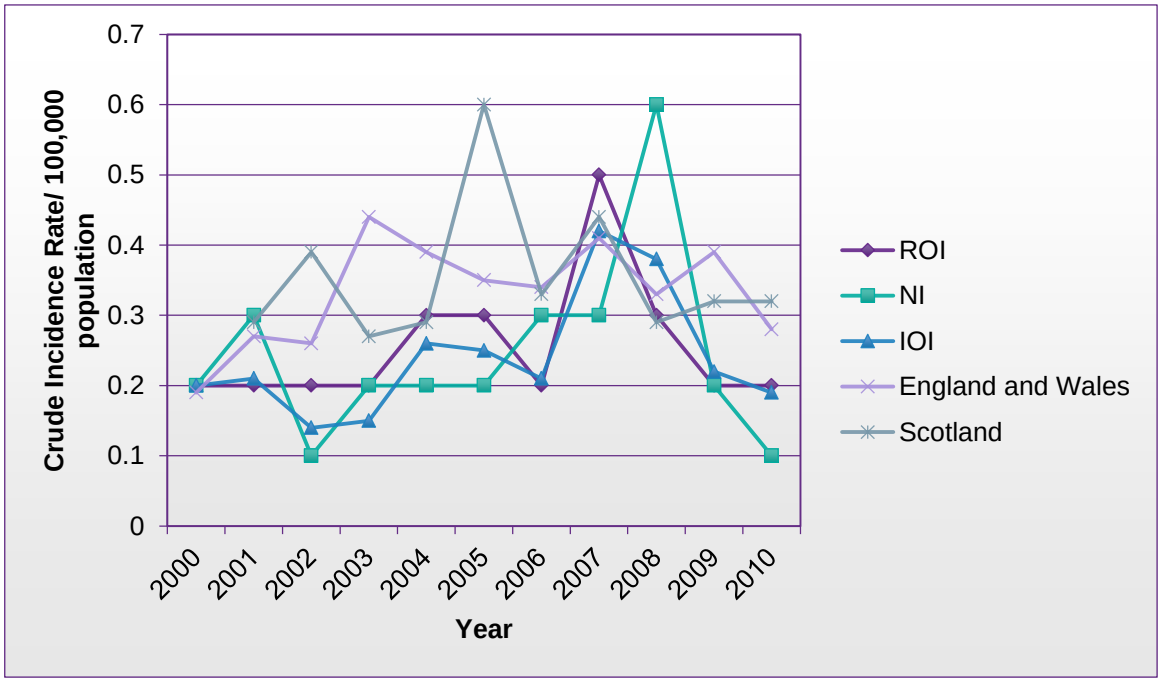
5.4 Listerosis

a. Crude Incidence Rate of *Listeria* Infection

There have been very few cases of infection from *Listeria* in either ROI or NI over the last ten years. The crude incidence rate on IOI has been lower than that for England and Wales (Figure 11) for the same years, with the exception of 2007 and 2008.

As can be seen from Figure 11, the crude incidence rate of *Listeria* fluctuates from year to year in both ROI and NI. There was a peak in incidence rate in 2007 in ROI and in 2008 in NI.

Figure 11: Crude incidence rates of listerosis in ROI, NI, IOI, Scotland, and England and Wales 2000-2010



b. Age Distribution

The number of all reported cases of *Listeria* on IOI for 2000 to 2010, classified by age groups is reported in Table 12. Overall there have been very few cases of listeriosis on IOI for these years. Apart from neonatal cases *Listeria* is more likely to be associated with an older age group compared to the other three organisms where age specific incidence rates were highest in those under five years.

c. Clusters

Twenty one listeriosis cases were reported in ROI in 2007, three times the number of cases that were notified in 2006. This increase came at a time when there has been increased reporting of human listeriosis in the EU over the last number of years. Specifically in ROI, there was a significant increase in the reported number of pregnancy-associated and neonatal cases. A total of nine pregnancy-related/neonatal cases were notified in 2007 compared to five pregnancy-related/ neonatal cases for the entire period 2004- 2006. In addition there were also 12 non-pregnancy associated adult cases notified in 2007, all except one of which were reported as elderly and/or suffering from an underlying illness which predisposed them to listeriosis. There were also eight cases affected by a foodborne outbreak of listeriosis in NI in 2008.

Table 12: Number of cases of listerosis by age group in ROI and NI, 2000-2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
0-4	N/A	4	1	2	0	0	1	3	2	0	1
	0	0	0	0	1	0	0	0	0	0	1
5-9	N/A	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
10-14	N/A	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
15-44	N/A	1	2	0	4	0	1	7	4	1	4
	0	1	0	0	0	0	0	1	0	0	0
45-64	N/A	0	1	3	3	4	1	3	2	4	2
	1	2	1	0	0	0	3	1	2	0	0
65+	N/A	2	2	0	3	8	3	8	5	5	3
	3	2	1	3	3	2	3	3	9	1	1
Unknown	N/A	0	0	1	1	0	1	0	0	0	0
	0	0	0	0	0	1	0	0	0	3	0

Key: ROI, NI

6 Conclusions

1. *Campylobacter* causes the highest number of cases of reported bacterial foodborne illness in both jurisdictions, although reported incidences are 2-3 fold lower in both jurisdictions than in Great Britain.
2. A notable difference between ROI and NI data for campylobacteriosis is that, in most years, there has been a higher reported incidence among adults and a lower reported incidence in children in NI than in ROI.
3. The incidence of salmonellosis in IOI has decreased significantly in both jurisdictions since the late nineties, after *Salmonella* control programmes in poultry were introduced by the respective Departments of Agriculture, with reported incidence rates in both ROI and NI now being consistently lower than reported rates in GB.
4. *S.* Enteritidis remains the most common serotype reported among human cases in NI, whereas *S.* Typhimurium has emerged as the most common serotype in ROI in recent years.
5. Both jurisdictions have experienced a sustained decrease in the reported incidence of salmonellosis due to *S.* Enteritidis since 2000, however, since 2001, the reported incidence rates for salmonellosis due to *S.* Typhimurium have remained largely unchanged.
6. In comparison to other foodborne pathogens, a relatively high proportion of salmonellosis cases are acquired abroad. However this may be an artefact of reporting arrangements.
7. With minor deviations, the trend in VTEC O157 incidence has been similar between NI and ROI, although slightly higher in ROI between 2006 and 2009.

7 Recommendations

1. In relation to campylobacteriosis it would be helpful to establish if the differing incidence among adults and children in NI and ROI represents a true difference in epidemiology between the two jurisdictions or if these differences reflect surveillance artefacts.
2. Because there are few outbreaks of campybacteriosis reported, additional studies such as sporadic case-control studies have the potential to make an important contribution to our understanding of the key transmission routes for campybacteriosis on IOI.
3. Further analyses could be undertaken to compare the distribution of cases of *S.* Enteritidis and *S.* Typhimurium by age, season and travel status in each of the jurisdictions, which might provide insight into the reason for the difference between the distribution of these two serotypes by jurisdiction.
4. Further reductions in human salmonellosis incidence might be most successfully achieved by focusing prevention messages towards transmission routes typically associated with *S.* Typhimurium infection.
5. There is a wealth of speciation and typing data available on human *Salmonella* isolates for over a decade on IOI. These data have the potential to be used in source attribution studies to add to the understanding of the epidemiology of salmonellosis on the IOI.
6. More focused analyses could be undertaken to clarify the strain distribution and likely transmission routes specifically for indigenous *Salmonella* cases/outbreaks.
7. A comparison of the trend in hemolytic uremic syndrome (HUS) incidence in ROI and NI using an alternative data source such as the Hospital In-Patient Enquiry Scheme (HIPE) should be considered.

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Appendix 1: List of Abbreviations

CIDR	Computerised Infectious Disease Reporting
CFI	Centre for Infections
CRID	Centre for Research in Infectious Diseases
CSO	Central Statistics Office
EWRS	Early Warning and Response System
FSAI	Food Safety Authority of Ireland
GB	Great Britain
HIPE	Hospital In-Patient Enquiry Scheme
HPA	Health Protection Agency
HPSC	Health Protection Surveillance Centre
HUS	Hemolytic Uremic Syndrome
HSE	Health Service Executive
IID	Infectious Intestinal Diseases
IOI	Island of Ireland
MOH	Medical Officer of Health
NHS	National Health Service
NI	Northern Ireland
NISRA	Northern Ireland Statistics and Research Agency

NSSLRL	National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory
PHA	Public Health Agency
ROI	Republic of Ireland
S. Enteritidis	*Salmonella* Enteritidis
S. Typhimurium	*Salmonella* Typhimurium
UCD	University College Dublin
UCD-CFS	University College Dublin Centre for Food Safety
UK	United Kingdom
VTEC	Verocytotoxigenic *Escherichia coli*

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