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ANNUAL REPORT

Foodborne disease in New Zealand

2013

Prepared for the Ministry of Primary Industries
under project MRP/13/02 as part of an overall contract for scientific services
by the Institute of Environmental Science and Research Limited

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ANNUAL REPORT CONCERNING FOODBORNE DISEASE IN NEW ZEALAND 2013

Prepared for Ministry for Primary Industries under
project MRP/13/02 – Systematic reporting of epidemiology of potentially
foodborne disease in New Zealand for year 2013,
as part of overall contract for scientific services

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INTRODUCTION

INTRODUCTION

One of the aims of the Ministry for Primary Industries (MPI) is to protect New Zealand from biological risks, including reducing food-related risks to human health. Human health surveillance is an essential element of the monitoring and review component of MPI's risk management framework. In addition, evidence from notifications, case enquiries, outbreak investigations and other epidemiological studies of human enteric diseases are used as sources of data for risk profiles and assessments. There is ongoing interest in foodborne disease statistics within MPI and its stakeholders.

This report for the calendar year 2013 is intended to be part of a series providing a consistent source of data and method of presentation to allow monitoring of foodborne illness in New Zealand.

Human health surveillance data and foodborne disease

The information in this report concerns reported cases of notifiable disease and reported outbreaks collected in the EpiSurv database (for a description of EpiSurv, see Methods section of this report). There are a number of notifiable illnesses which may be caused by transmission of pathogens in foods, but it is important to remember that most of the information concerns the illness, not the mode of transmission. The information needs to be considered with two caveats:

1. Notified cases of illness and reported outbreaks represent a subset of all the cases and outbreaks that occur in New Zealand each year. Many sick individuals do not visit a GP or otherwise come to the attention of the medical system. By using these data as indicators, we are assuming that they are representative of all the cases and outbreaks that occur (see section on the Acute Gastrointestinal Illness study for a further discussion of this issue).

2. Foodborne transmission is only one of the routes by which humans are exposed to pathogens; other routes include water, animal contact and person to person. There are a number of indicators from which we can get information on the proportion of cases caused by foodborne transmission:
    - Reported risk factors: for a proportion of the notified cases, supplemental information is obtained by public health units (PHUs) on risk factors. This information should be interpreted with some caution as it is self-reported by cases, no external validation of this information is undertaken, and often the cases will report several potentially important risk factors. The quality of information from notifiable disease surveillance as an indication for foodborne disease transmission has been reviewed in more detail [1].
    - Outbreak reports: the circumstances of an outbreak (multiple cases from a single event) mean that an investigation is more likely to identify a source of exposure to the pathogen than investigation of sporadic cases. However, only a small proportion of outbreaks are reported, and experience shows that outbreaks associated with foodservice premises are more likely to be reported and investigated than outbreaks associated with other settings.
    - Expert opinion: based on their experience in laboratories and epidemiological investigations, as well as knowledge of factors influencing the risk, experts can provide estimates of the proportion of cases caused by foodborne transmission. Estimates for New Zealand have been developed for some foodborne diseases [2], as presented in relevant report sections. These are not fixed values; future changes to the New Zealand food chain may require the values to be amended.

- Overseas analyses and estimates: information for countries with similar food supplies to New Zealand can be helpful, especially for illnesses where a foodborne estimate was not developed from other studies. Four sets of published estimates are given in Table 1, for the USA [3], Australia [4], England and Wales [5] and the Netherlands [6]. The estimates for Australia and the Netherlands are based on expert opinion, the estimates for England and Wales are based on outbreak analysis, while the US estimates are based on data from surveillance, risk factor studies and a literature review. It is worth noting that, although for most of the diseases included in this report foodborne transmission is considered significant, there are several illnesses (shigellosis, giardiasis, cryptosporidiosis, hepatitis A) where it is considered to be only a small proportion of the total.

Table 1. Overseas estimates of the food attributable proportion of selected illnesses due to microbial hazards

Hazard	Percentage foodborne (%)			
	USA (2011)	Australia (2005)	England and Wales (2002)	Netherlands[a] (2008)
Bacteria				
Bacillus cereus	100	100	100	90
Campylobacter spp.	80	75	80	42
Clostridium perfringens	100	100	94	91
Shiga toxin-producing *Escherichia coli* (STEC) O157:H7	68	65	63	40
STEC non-O157	82	NE	63	42
Listeria monocytogenes	99	98	99	69
Salmonella non-typhoidal	94	87	92	55
Shigella spp.	31	10	8	NE
Staphylococcus aureus	100	100	96	87
Yersinia enterocolitica	90	75	90	NE
Parasites				
Cryptosporidium parvum	8	10	6	12
Giardia lamblia	7	5	10	13
Viruses				
Hepatitis A virus	7	10	11	11
Norovirus	26	25	NE	17
Sapovirus	<1	NE	0	NE

[a] The Dutch study also collected opinions on the proportion of disease due to travel. A proportion of this will also be foodborne.
NE = not estimated

This report considers information for the 2013 calendar year. Information from the scientific literature and other sources concerning food safety in New Zealand for that year has been summarised. However, the time taken to publish scientific information is often lengthy, and it may be that additional information becomes available in the future.

Conditions included in this report

The conditions that have been selected for inclusion in the report are those that have:

1. The potential to be caused by foodborne transmission; and,
2. Available historical and current national data sources.

The potentially foodborne conditions included in this report are listed in Table 2. Data have been drawn from a number of sources including disease notification, hospitalisation, outbreak reports and laboratory surveillance databases.

Notifiable conditions were selected for inclusion in the report where it was considered that a significant proportion would be expected to be foodborne or the disease organism has been reported as the cause of foodborne outbreaks. Typhoid and paratyphoid fever are not included as the majority of cases acquire their infection overseas.

For some conditions (intoxications from the bacteria; *Bacillus cereus*, *Clostridium perfringens* and *Staphylococcus aureus*, and norovirus and sapovirus infections) not every case is notifiable; only those that are part of a common source outbreak or from a person in a high risk category (e.g. food handler, early childhood service worker, etc.). Such cases are notified under the heading of acute gastroenteritis.

For some conditions (campylobacteriosis, listeriosis, salmonellosis, VTEC/STEC infection, yersiniosis) the attribution of disease incidence to foodborne transmission was estimated by an expert consultation held on 5 June 2013 [2]. In the current report these food-attributable proportions have been used to estimate the number of food-associated cases of relevant diseases. Travel-associated cases were subtracted from the total cases before application of the food-associated proportion. Travel-associated cases are those where the individual reported being outside New Zealand during the incubation period for the disease.

Table 2. Potentially foodborne conditions included in the report

Disease	Type	Source(s)	ICD-10 code[a]
Bacillus cereus intoxication	Bacterium	N, O, H	A05.4 Foodborne *Bacillus cereus* intoxication
Campylobacteriosis	Bacterium	N, O, H	A04.5 *Campylobacter* enteritis
Ciguatera fish poisoning	Toxin	N, O, H	T61.0 Toxic effect: Ciguatera fish poisoning
Clostridium perfringens intoxication	Bacterium	N, O, H	A05.2 Foodborne *Clostridium perfringens* [*Clostridium welchii*] intoxication
Cryptosporidiosis	Protozoan	N, O, H	A07.2 Cryptosporidiosis
Giardiasis	Protozoan	N, O, H	A07.1 Giardiasis [lambliasis]
Histamine (scombroid) fish poisoning	Toxin	N, O, H	T61.1 Toxic effect: scombroid fish poisoning
Hepatitis A infection	Virus	N, O, H	B15 Acute hepatitis A
Listeriosis (total and perinatal)	Bacterium	N, O, H	A32 Listeriosis
Norovirus infection	Virus	N, O, H, L	A08.1 Acute gastroenteropathy due to Norwalk agent
Salmonellosis	Bacterium	N, O, H, L	A02.0 Salmonella enteritis
Sapovirus infection	Virus	N, O, L	No specific ICD-10 code
Shigellosis	Bacterium	N, O, H, L	A03 Shigellosis
Staphylococcus aureus intoxication	Bacterium	N, O, H	A05.0 Foodborne staphylococcal intoxication
Toxic shellfish poisoning	Toxin	N, O, H	T61.2 Other fish and shellfish poisoning
VTEC/STEC infection	Bacterium	N, O, H, L	A04.3 Enterohaemorrhagic *Escherichia coli* infection
Yersiniosis	Bacterium	N, O, H, L	A04.6 Enteritis due to *Yersinia enterocolitica*

Data sources: EpiSurv notifications (N), EpiSurv outbreaks (O), Ministry of Health hospitalisations (H), ESR laboratory data (L).
VTEC = Verotoxin-producing *Escherichia coli* STEC = Shiga toxin-producing *Escherichia coli.*
[a] International statistical classification of disease and related health problems 10th revision [7].

This report includes both notifiable diseases in the form of acute gastrointestinal illness and sequelae which are considered to result from these preceding infections (Table 3). The two sequelae included in the report, haemolytic uraemic syndrome (HUS) and Guillain-Barré syndrome (GBS), are severe illnesses and occasionally life threatening.

Table 3. Sequelae to potentially foodborne conditions included in the report

Disease	Source(s)	Comment
Guillain-Barré syndrome (GBS)	H (G61.0 Guillain-Barré syndrome)	Sequela to infection with *Campylobacter* [a]
Haemolytic uraemic syndrome (HUS)	H (D59.3 Haemolytic-uraemic syndrome)	Sequela to infection with VTEC / STEC

Data Sources: Ministry of Health hospitalisations (H).

[a] While there is evidence that GBS can be triggered by other microbial infections (e.g. cytomegalovirus, Epstein-Barr virus, *Mycoplasma pneumonia*), *Campylobacter* infection is the only recognised triggering organism that is potentially foodborne.

METHODS

METHODS

This section includes descriptions of the data sources, analytical methods used and comments on quality of data, including known limitations.

The report uses the calendar year, 1 January to 31 December 2013, for the reporting period.

Data sources

The key sources of data used in this report are detailed in the following sections. The data sources have been selected on the basis of availability of data for the specified reporting period and their accessibility within the timeframe required for the report.

Some data, such as official cause of death, are not published until several years after the end of the year in which the event occurred (although deaths may be reported as part of the case notification data recorded in EpiSurv). For this reason these data are not available for inclusion in a report published soon after the end of the calendar year.

EpiSurv - the New Zealand notifiable disease surveillance system

Under the Health Act 1956 health professionals are required to inform their local Medical Officer of Health of any suspected or diagnosed notifiable disease. Since December 2007, laboratories have also been required to report notifiable disease cases to their local Medical Officer of Health.

Notification data are recorded using a web-based application (EpiSurv) available to staff at each of the 20 Public Health Units (PHUs) in New Zealand. The EpiSurv database is maintained and developed by the Institute of Environmental Science and Research (ESR) Ltd., which is also responsible for the collation, analysis and reporting of disease notifications on behalf of the Ministry of Health (MoH).

Data collected by PHUs depends on the specific disease, but usually includes demography, outcome, basis of diagnosis, risk factors and some clinical management information. Data on risk factors reflect the frequency of exposure in the incubation period for illness, and are not a measure of association with illness in comparison with the general population.

Further information about notifiable diseases can be found in the Notifiable and Other Diseases in New Zealand: Annual Report 2013 [8].

Laboratory-based surveillance

For a number of organisms (e.g. *Salmonella*, *Escherichia coli*), clinical laboratory isolates are forwarded to reference laboratories at ESR for confirmation and typing. The number of isolates forwarded differs by DHB and organism (e.g. almost all isolates are forwarded for *Salmonella* typing but not all *Yersinia* isolates are forwarded).

Prior to the introduction of processes for matching notifications and laboratory records, the number of laboratory-reported salmonellosis cases had always exceeded the number of notifications. The implementation of data integration processes in 2004 for notifications and laboratory results at ESR has addressed this problem.

Ministry of Health (MoH)

MoH collates national data on patients admitted and discharged from publicly funded hospitals. These data are stored as part of the National Minimum Dataset (NMDS). Cases are assigned disease codes using the tenth revision of the International Classification of Diseases (ICD-10) coding system [7]. Up to 99 diagnostic, procedure, and accident codes may be assigned to each admission. The first of these is the principal or primary diagnosis, which is the condition that actually led to admission. This may differ from the underlying diagnosis.

Hospital admission data are only added to the NMDS after the patient is discharged. The number of hospitalisations presented for the reported year may be under-reported due to the delay in receiving discharge summaries.

Hospital admission data includes repeated admissions for patients with chronic notifiable diseases or diseases which have long-term health impacts (e.g. GBS). For some diseases, the criteria for notification (clinical and laboratory or epidemiological evidence) do not match those required for diagnostic coding. For these reasons hospitalisation numbers and notifications may differ.

In this report all hospitalisations, including readmissions, have been reported for all primary diseases. For the disease sequelae (GBS and HUS), readmissions within the calendar year were removed with reported case numbers representing unique cases, rather than total admissions.

Outbreak surveillance

ESR has operated an outbreak surveillance system as an additional module in EpiSurv since mid-1997. This enables PHUs to record and report outbreaks for national reporting and analysis. It should be noted that, due to the practicalities of collecting information and laboratory resource constraints, not all cases associated with outbreaks are recorded as individual cases of notifiable disease in EpiSurv. The terms ‘setting’ and ‘suspected vehicle’ are both used in outbreak reporting to describe likely implicated sources of exposure found in epidemiological or environmental investigations.

A new outbreak report form was introduced in October 2010. As a result, some variables reported previously are no longer available for analysis. For example, coding indicating the strength of evidence for concluding that an outbreak is foodborne was changed.

An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. More information about the outbreak reporting system can be found in the Annual Summary of Outbreaks in New Zealand 2013 [9].

Laboratory investigation of outbreaks

PHUs may submit clinical, food or environmental samples associated with single cases or outbreaks of suspected food poisoning to ESR’s Public Health Laboratory (PHL). While faeces are the most common human clinical sample, on occasions other clinical samples, such as vomit, urine or breast milk, may be submitted. Wherever possible, samples are linked to associated EpiSurv records. Samples are analysed for possible causative agents, based on information on symptoms and incubation period. In this report, laboratory investigations are reported only for outbreaks classified as foodborne in EpiSurv.

The laboratory investigation section in this report only includes reports on samples submitted to ESR’s PHL. It should be noted that human faecal samples associated with outbreaks and sporadic cases may be tested by community laboratories, following submission by general practitioners or PHUs. If the pathogen identified is a notifiable disease, a notification will be generated and a case reported in EpiSurv. No information is available from community laboratories on the number of samples submitted for which no pathogen is detected.

Level of evidence for outbreaks

Foodborne outbreaks have been classified as having weak or strong evidence for any given suspected vehicle. Outbreaks with strong evidence included those with a statistically significant elevated risk ratio or odds ratio (95% confidence) from an epidemiological investigation and/or laboratory evidence with the same organism and sub type detected in both disease cases and vehicle (to the highest available level of identification).

Outbreaks were classified as having weak evidence when they met one or more of the following criteria:

- Compelling evidence with symptoms attributable to specific organism e.g. scrombrotoxin, ciguatoxin etc.
- Other association but no microbial evidence for causal link i.e. organism detected at source but not linked directly to the vehicle or indistinguishable DNA or PFGE profiles.
- Raised but not statistically significant relative risk or odds ratio.
- No evidence found but logical deduction given circumstances.

Statistics New Zealand

Data from the Statistics New Zealand website www.stats.govt.nz were used to calculate notification and hospitalisation population rates of disease. See analytical methods section for further details.

MPI project reports and other publications

MPI project reports, prepared by ESR or other providers, and publications from the general literature were used to provide specific contextual information on the prevalence of selected pathogens in specific food types.

Risk attribution

Information from a project on risk ranking was used to estimate the proportion of disease due to specific pathogens that can be attributed to transmission by food [2]. Attributable proportions were determined by expert consultation, using a modified double-pass Delphi, with a facilitated discussion between passes. Each expert was asked to provide a minimum ('at least'), a most likely and a maximum ('not more than') estimate of the proportion of a number of microbial diseases that were due to transmission by food. Estimates presented in the current report are mean values from the second pass, incorporating a weighting scheme based on a self-assessment of expertise for each pathogen. The 2013 expert consultation did not consider *Bacillus cereus* intoxication. The estimate for the proportion of *Bacillus cereus* intoxication due to transmission by food is taken from the previous expert consultation which took place in 2005 [10].

Analytical methods

Key analytical methods used include:

Dates

Notification and outbreak data contained in this report are based on information recorded in EpiSurv as at 11 February 2014 and 26 February 2014, respectively. Changes made to EpiSurv data by PHU staff after these dates will not be reflected in this report. Consequently, future analyses of these data may produce revised results. Disease numbers are reported according to the date of notification. Laboratory results are reported according to the date the specimen was received.

Data used for calculating rates of disease

All population rates use Statistics New Zealand 2013 mid-year population estimates and are crude rates unless otherwise stated. At 30 June 2013, the New Zealand population was estimated to be 4 471 040. Rates have not been calculated where there are fewer than five notified cases or hospitalisations in any category. Calculating rates from fewer than five cases produces unstable rates.

Geographical breakdown

This report provides rates for current District Health Boards (DHBs). The DHB populations have been derived from the Statistics New Zealand mid-year population estimates for Territorial Authorities in New Zealand.

Map classification scheme

The map classification break points for the disease have been selected to divide the data into three bands to show the range of rates among DHBs. The darkest colour represents the highest rates and the lightest colour the lowest rates. The grey speckled colour shows where there are insufficient data to calculate a rate (fewer than 5 cases).

Risk factors and source of infection

For many diseases an analysis of risk factors for the cases is reported. These risk factors are those included in the current EpiSurv case report forms. Often more than one risk factor is reported for each case. For some diseases the number of cases for which risk factors are unknown can be high.

The reporting of exposure to a risk factor does not imply that this was the source of the infection.

Statistical tests

Confidence intervals have been calculated for the disease rates and displayed on the graphs. The historical mean is calculated from the previous three years data (2010−2012).

Interpreting data

Data in this report may differ from those published in other reports depending on:

- the date of extraction of data
- the date used to aggregate data (e.g. date reported or date of onset of illness)
- filters used to extract the data

The information in this report shows disease trends by age group, sex, and place of residence (DHB).

Because of the low numbers of cases for some conditions and age groups, etc. the rates calculated in this report may be highly variable from year to year and it is necessary to interpret trends with caution.

THE AGI STUDY

THE ACUTE GASTROINTESTINAL ILLNESS (AGI) STUDY

The Acute Gastrointestinal Illness (AGI) Study was a set of three linked surveys, with the following objectives:

- To determine the magnitude and distribution of self-reported AGI in the New Zealand population;
- To estimate the burden of disease associated with AGI;
- To describe and estimate the magnitude of under-ascertainment of AGI at each stage in the national communicable disease surveillance process; and,
- To identify modifiable factors affecting under-ascertainment that, if altered, could reduce case loss throughout the AGI component of the surveillance system.

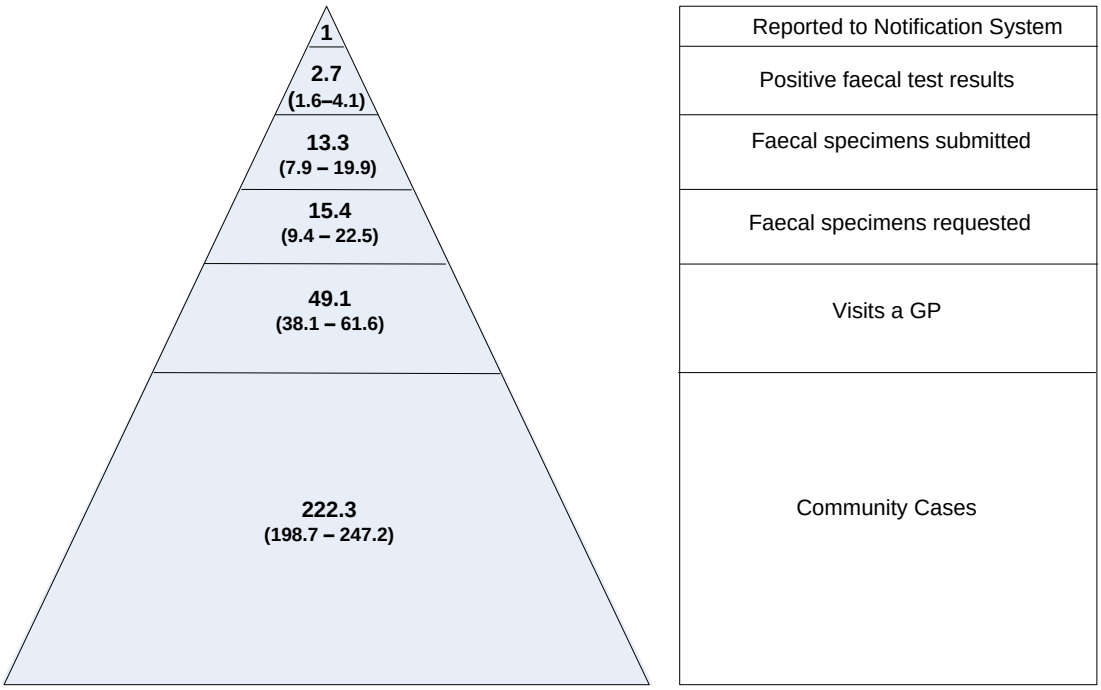
The three study elements were completed during 2005−2007 and each has been reported separately:

- Community study: a twelve month telephone survey conducted from February 2006–January 2007 and reported as "Acute Gastrointestinal Illness (AGI) Study: Community Survey" [11],
- General practice study: a nationwide incidence study conducted over seven weeks from May – July 2006, using selected practices via a computer network practice management system, supplemented by a postal survey conducted in July 2006. This study has been reported as "Acute Gastrointestinal Illness (AGI) Study: General Practice Study" [12], and
- Laboratory study: a postal survey of 45 community and hospital laboratories conducted in June 2006, and reported as "Acute Gastrointestinal Illness (AGI) Study: Laboratory Survey" [13].

The results from the community survey indicated that the incidence of AGI was 1.1 per person year, representing 4.66 million cases in New Zealand in one year. These illnesses are caused by microbial hazards that may be transmitted by a number of routes, including foods. However, at this stage it is not possible to identify the total fraction of AGI caused by foodborne transmission.

A final report amalgamating results from the three studies was produced to construct a reporting pyramid for AGI in New Zealand, as shown in Figure 1 [14]. It is important to recognise that this pyramid applies to AGI in its entirety, and cannot be applied to AGIs caused by individual pathogens, which may have quite different ratios.

Figure 1. Reporting pyramid (areas to scale) for New Zealand showing ratios of cases in the community, general practice, and clinical laboratory levels relative to notifiable diseases, 2006 (mean, 5th and 95th percentiles)



The reporting pyramid is constructed from data reported from the community survey [11]; GP survey [12]; and laboratory survey [13]. Note that not all positive faecal test results will be for diseases that are notifiable.

REPORTING

REPORTING

Reporting against targets

In 2013, the Ministry for Primary Industries established three performance targets for potentially foodborne diseases.

Performance targets

- Campylobacteriosis: maintain the 50% reduction in the incidence of foodborne campylobacteriosis over the period 2013-2014
- Salmonellosis: maintain the 30% reduction in the incidence of foodborne salmonellosis over the period 2013-2014
- Listeriosis: no increase in the incidence of foodborne listeriosis over the period 2013-2014

Rationale

The above diseases include the two most commonly notified, potentially foodborne diseases in New Zealand plus listeriosis, one of the most severe. This selection is based, in part, on the ESR foodborne illness attribution work which identified campylobacteriosis and listeriosis as creating the highest human health burden within New Zealand [15]. The inclusion of salmonellosis will also allow for New Zealand comparability with US and UK monitoring programmes. For the period 2004−2007 there were approximately 13 600 notified cases of campylobacteriosis, 1150 of salmonellosis and 23 of listeriosis annually in New Zealand. Foodborne illness due to VTEC/STEC infections is not included as there are only about 10 cases per year that could be attributable to foodborne sources. Norovirus is not incorporated at this stage because of the large fluctuations that occur in annual statistics (norovirus infection is not a notifiable disease but may be notified as acute gastroenteritis during investigation of a common source outbreak) and, for most cases, a major transmission route (person-to-person) is likely to be outside of the influence of MPI.

Methodology, tools and reporting

Historical baseline data on the number of reported cases of the targeted foodborne diseases are available and MPI is supporting projects to increase the quality of data. The source of the data is the *Notifiable and Other Diseases in New Zealand Annual Report*, by ESR [16]. MPI is funding active surveillance projects that provide primary information on food attribution such as the advanced attribution study conducted by Massey University and Mid-Central Health within the Manawatu.

The measurement is adjusted for the proportion of cases reported as having travelled overseas during the likely incubation period. It is adjusted also for the proportion of disease estimated to be due to foodborne transmission. Estimates for the proportion of disease due to foodborne transmission were revised in 2013, through an expert elicitation process. The new estimates differ slightly from those used previously and have been applied retrospectively to all disease rate estimates presented in this section.

The annual incidence of campylobacteriosis and salmonellosis is reported in terms of calendar year totals of cases per 100 000-people (*Notifiable and Other Diseases in New Zealand Annual Report*, ESR [16]). This allows for demographic changes within the New Zealand population to be appropriately captured. The proportion of cases acquired abroad is estimated through the EpiSurv programme administered by ESR and MoH[*]. Estimates of the foodborne proportion of selected communicable diseases determined by the expert elicitation are approximately 0.6, 0.6 and 0.9 respectively for campylobacteriosis, salmonellosis and listeriosis.

[*] Assuming that the cases for which travel information was provided are representative of all cases, a Poisson distribution can be used to estimate the total number of potentially travel related cases

From year to year, fluctuations in disease rates may occur due to modifications in clinical, laboratory and notification practices as well as changes in food exposures. These are highlighted and corrected for where possible.

Campylobacteriosis

Performance target

- maintain the 50% reduction in the incidence of foodborne campylobacteriosis over the period 2013-2014

Measurement

The measurement used is the annual (calendar year) number (per 100 000 mid-year population estimate) of notified cases of human campylobacteriosis, with the baseline being the target set for 2008-2012. This target was a 50% reduction in the average incidence for 2004−2007. The estimated foodborne campylobacteriosis in 2013 is given in Table 4.

Table 4. Estimated proportion of foodborne campylobacteriosis for 2013

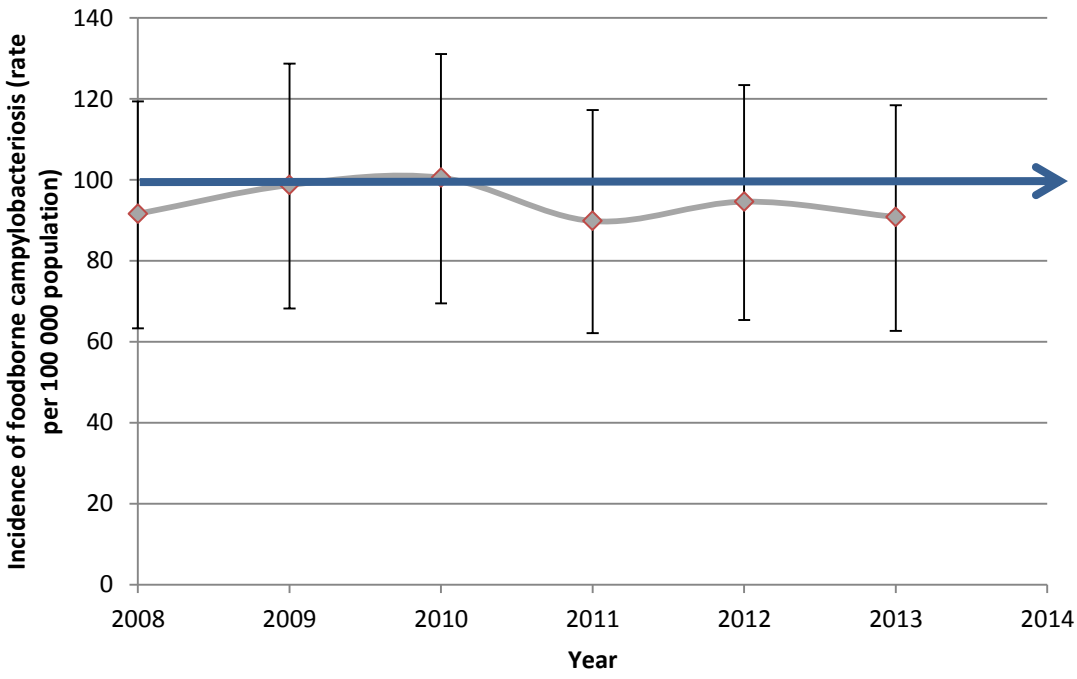
	Cases	Proportion (%)	Rate (per 100 000, mid year estimated population)
Total notified	6837		152.9
Estimated not travelled overseas	6361	93.0	142.2
Estimated foodborne transmission proportion	4058	63.8 (44.1-83.2)[a]	90.8 (62.7-118.4)[b]

[a] Most likely (95th percentile credible interval) estimates of proportion foodborne, from expert consultation
[b] Most likely (95th percentile credible interval) estimates of foodborne rate

Presentation

The trend in relative rates (and ranges) compared with the 2013-2014 goal is shown in Figure 2.

Figure 2. Incidence of foodborne campylobacteriosis



The blue arrowed line represents the target proportion for the 2013 and 2014 years and is a continuation of the target for 2008-2012

Salmonellosis

Performance target

- Maintain the 30% reduction in the incidence of foodborne salmonellosis over the period 2013-2014

Measurement

The measurement used is the annual (calendar year) number (per 100 000 mid-year population estimate) of notified cases of human salmonellosis, with the baseline being 70% of the average rate for 2004−2007. The estimated foodborne salmonellosis in 2013 is given in (Table 5).

Table 5. Estimated proportion of foodborne salmonellosis for 2013

	Cases	Proportion (%)	Rate (per 100 000, mid year estimated population)
Total notified	1143		25.6
Estimated not travelled overseas	828	72.5	18.5
Estimated foodborne transmission proportion	514	62.1 (35.2-86.4)[a]	11.5 (6.5-16.0)[b]

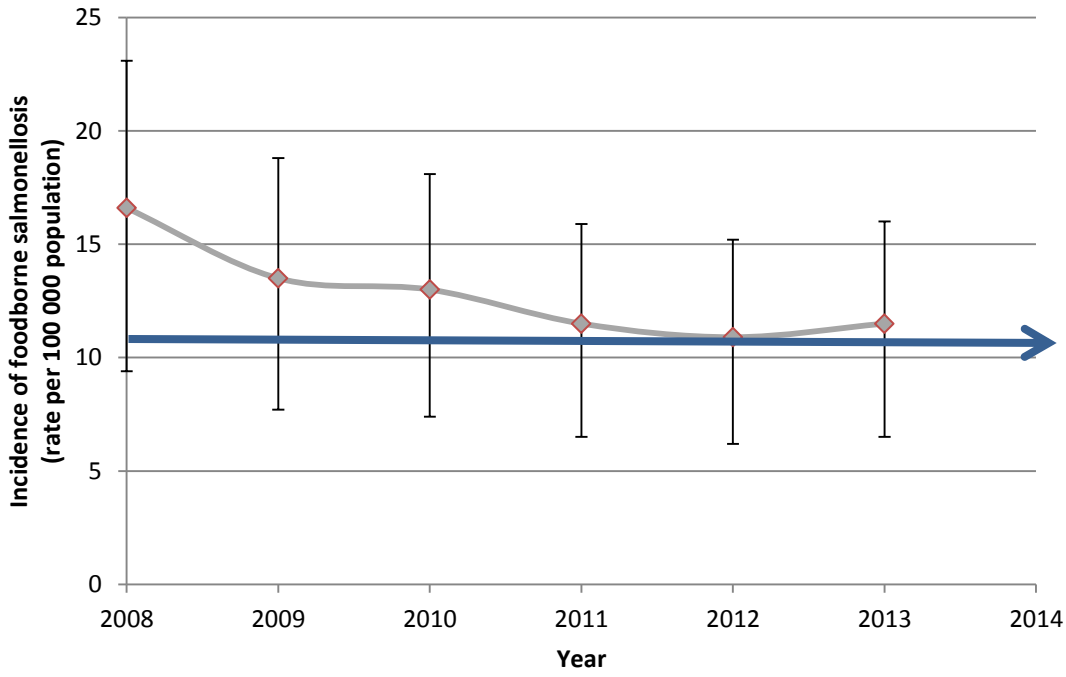
[a] Most likely (95th percentile credible interval) estimates of proportion foodborne, from expert consultation

[b] Most likely (95th percentile credible interval) estimates of foodborne rate

Presentation

The trend in relative rates (and ranges) compared with the baseline and five year goal is shown in Figure 3.

Figure 3. Incidence of foodborne salmonellosis



The blue arrowed line represents the target proportion for the 2013 and 2014 years and is a continuation of the target for 2008-2012

Listeriosis

Performance target

- No increase in the incidence of foodborne listeriosis over the period 2013-2014

Measurement

The measurement used is the annual (calendar year) number (per 100 000 population) of notified cases of human listeriosis, with the baseline being the average rate for 2004−2007. The estimated foodborne listeriosis in 2013 is given in (Table 6).

Table 6. Estimated proportion of foodborne listeriosis for 2013

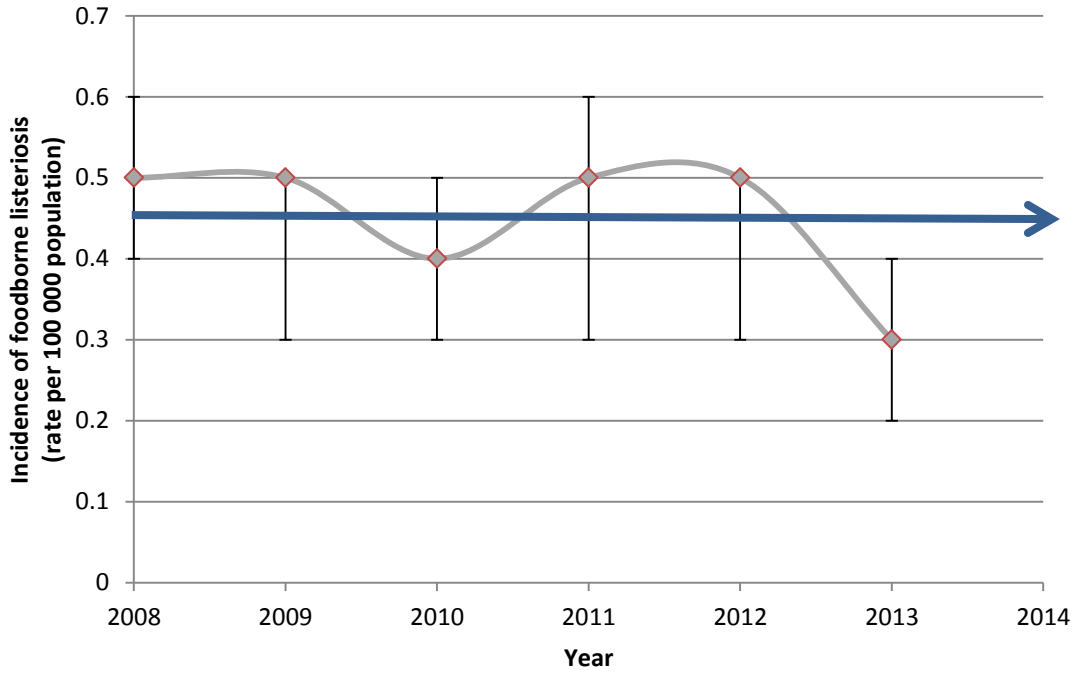
	Cases	Proportion (%)	Rate (per 100 000, mid year estimated population)
Total notified	19		0.42
Estimated not travelled overseas	16	84.2	0.36
Estimated foodborne transmission proportion	14	87.8 (57.9-98.5)[a]	0.31 (0.21-0.35)[b]

[a] Most likely (95th percentile credible interval) estimates of proportion foodborne, from expert consultation
[b] Most likely (95th percentile credible interval) estimates of foodborne rate

Presentation

The trend in relative rates (and ranges) compared with the baseline and five year goal is shown in Figure 4.

Figure 4. Incidence of foodborne listeriosis



The blue arrowed line represents the target proportion for the 2013 and 2014 years and is a continuation of the target for 2008-2012

Incidence and severity of selected foodborne conditions

This section includes a summary for each potentially foodborne condition. For conditions with sufficient numbers (approximately 100 cases or more per year) a full analysis, drawn from notification, hospitalisation, mortality, and laboratory data has been carried out. For conditions with a smaller number of cases a more limited examination has been performed.

These data are followed by contextual information on the foodborne proportion of the overall incidence of illness. This section will include information on the following topics, where available:

- Statement of estimated foodborne percentage and range provided by an expert elicitation process conducted in 2013. Note that these estimates are only available for some of the conditions included in this report;
- Statement of estimated foodborne percentage and range for any specific foods provided by the same expert elicitation process;
- Information on pathogen typing (principally from data generated by ESR's Enteric Reference Laboratory), where it is available and informative about foodborne disease;
- Comments on specific food related incidents or outbreaks of the condition that were reported to the notification system during the calendar year;
- Studies on foodborne attribution for the specific conditions conducted or published during the calendar year;
- Information on the prevalence of the toxin or microbial hazard in particular foods as a result of surveys conducted during the calendar year; and,
- Regulatory or other risk management actions in New Zealand that might be expected to affect the foodborne disease data.

Bacillus cereus intoxication

Case definition

Clinical description:	Gastroenteritis where either vomiting or profuse watery diarrhoea dominate.
Laboratory test for diagnosis:	Isolation of ≥10^3/g *Bacillus cereus* from a clinical specimen or ≥10^4 *B. cereus* from leftover food or detection of diarrhoeal toxin in a faecal sample.

Case classification:

Probable	A clinically compatible illness.
Confirmed	A clinically compatible illness that is laboratory confirmed, OR a clinically compatible illness and a common exposure associated with a laboratory confirmed case.

Bacillus cereus intoxication cases reported in 2013 by data source

During 2013, five notifications of *B. cereus* intoxication were reported in EpiSurv. Note that not all cases of *B. cereus* intoxication are necessarily notifiable; only those where there is a suspected common source.

The ICD-10 code A05.4 was used to extract *B. cereus* intoxication hospitalisation data from the MoH NMDS database. There were no hospital admissions recorded in 2013 with *B. cereus* intoxication as the primary or other relevant diagnosis.

Expert consultation estimated that 97% (minimum = 90%, maximum = 100%) of *B. cereus* intoxication will be due to foodborne transmission [10]. The expert consultation also estimated that approximately 60% of the foodborne transmission would be due to consumption of rice.

Outbreaks reported as caused by *Bacillus cereus*

During 2013, a single outbreak of *B. cereus* was reported in EpiSurv, with four associated cases. This outbreak was associated with a food service setting. Testing by ESR's Public Health Laboratory found *B. cereus* toxin in rice samples and high *B. cereus* counts in two of the clinical samples submitted.

Table 7. *B. cereus* outbreak reported, 2013

Measure	Foodborne *B. cereus* outbreaks	All *B. cereus* outbreaks
Outbreaks	1	1
Cases	4	4
Hospitalised cases	0	0

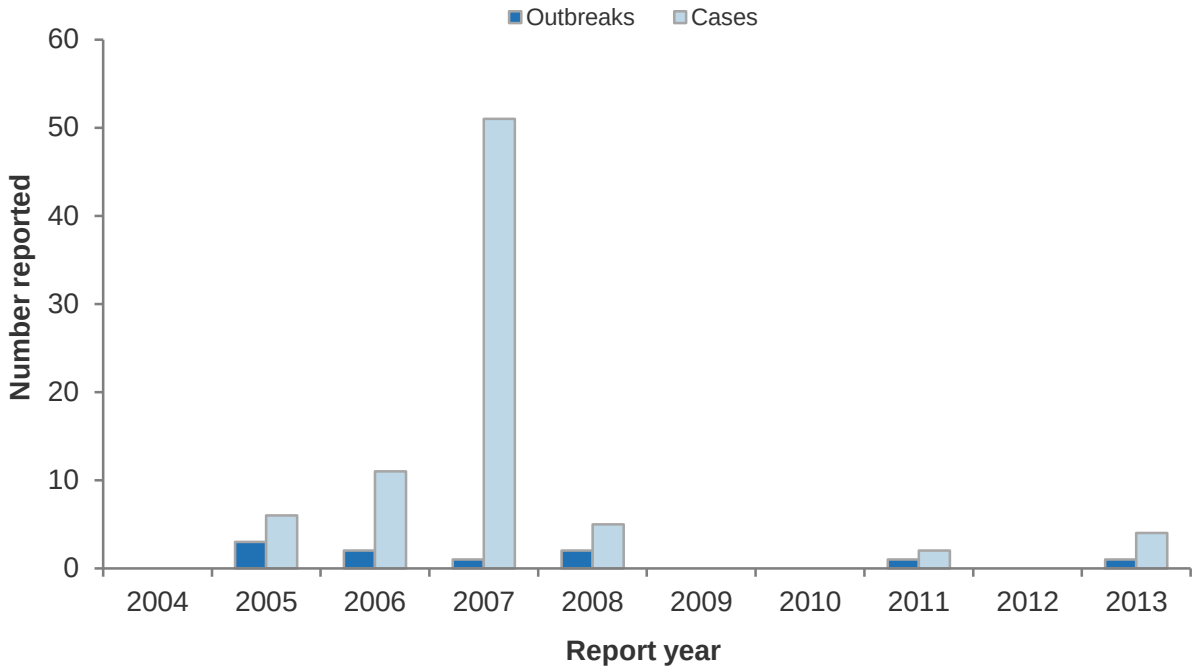
Table 8. Details of foodborne *B. cereus* outbreak, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Auckland	Jun	Rice/Chicken Meal	Restaurant/cafe/bakery	Restaurant/cafe/bakery	4P

PHU: Public Health Unit, C: confirmed, P: probable.

Outbreaks of *B. cereus* are rare, with two outbreaks reported in the last five years (Figure 5). Between 2005 and 2008 there were one to three outbreaks reported a year. The largest outbreak, with 51 associated cases, was reported in 2007.

Figure 5. Foodborne *B. cereus* outbreaks and associated cases reported by year, 2004−2013



Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Campylobacteriosis

Summary data for campylobacteriosis in 2013 are given in Table 9.

Table 9. Summary of surveillance data for campylobacteriosis, 2013

Parameter	Value in 2013	Source
Number of notified cases	6837	EpiSurv
Notification rate (per 100 000)	152.9	EpiSurv
Hospitalisations (% of notifications)[a]	709 (10.4%)	MoH NMDS, EpiSurv
Deaths (%)[a]	1 (0.014%)	EpiSurv
Estimated travel-related cases (%)[a]	476 (7.0%)	EpiSurv
Estimated food-related cases (%)[b]	4058 (63.8%)	Expert consultation

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

[b] For estimation of food-related cases the proportions derived from expert consultation exclude travel-related cases.

Case definition

Clinical description: An illness of variable severity with symptoms of abdominal pain, fever and diarrhoea, and often bloody stools.

Laboratory test for diagnosis: Isolation of *Campylobacter* from a clinical specimen.

Case classification:

Probable: A clinically compatible illness that is either a contact of a confirmed case of the same disease, or has had contact with the same common source - that is, is part of a common-source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Campylobacteriosis cases reported in 2013 by data source

During 2013, 6837 notifications (152.9 cases per 100 000 population) of campylobacteriosis and one resulting death were reported in EpiSurv.

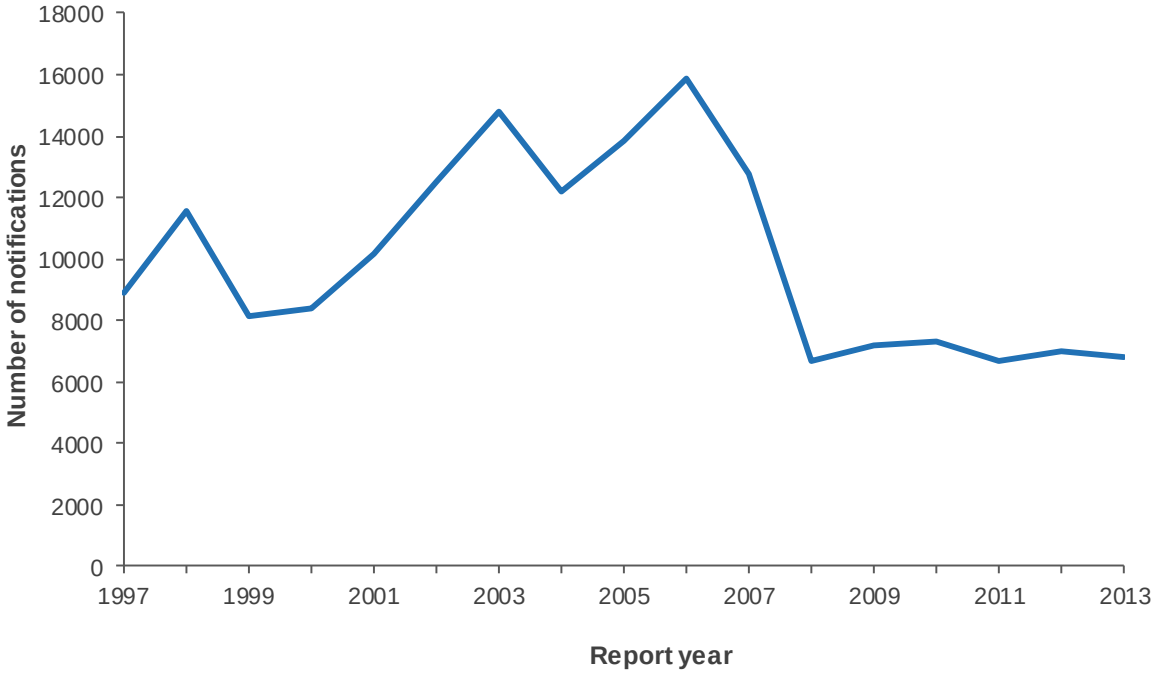
The ICD-10 code A04.5 was used to extract campylobacteriosis hospitalisation data from the MoH NMDS database. Of the 709 hospital admissions (15.9 admissions per 100 000 population) recorded in 2013, 585 were reported with campylobacteriosis as the primary diagnosis and 124 with campylobacteriosis as another relevant diagnosis.

It has been estimated by expert consultation that 63.8% (95th percentile credible interval: 44.1% to 83.2%) of campylobacteriosis incidence is due to foodborne transmission. It was further estimated that 75.4% of foodborne transmission would be due to transmission via poultry.

Notifiable disease data

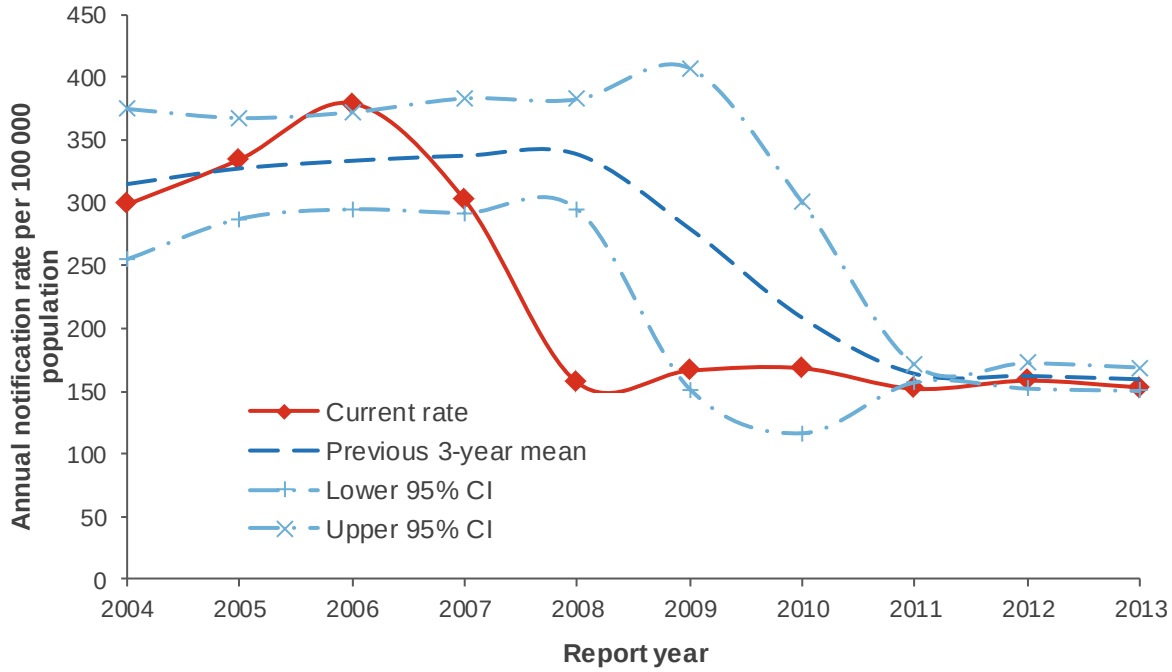
The number of campylobacteriosis notifications reported each year generally increased from 1997, up to the highest number recorded in 2006 (15 873 cases). Since 2006, there has been a significant decrease in the number of cases reported (Figure 6). The number of notifications has remained fairly stable each year since 2008.

Figure 6. Campylobacteriosis notifications by year, 1997–2013



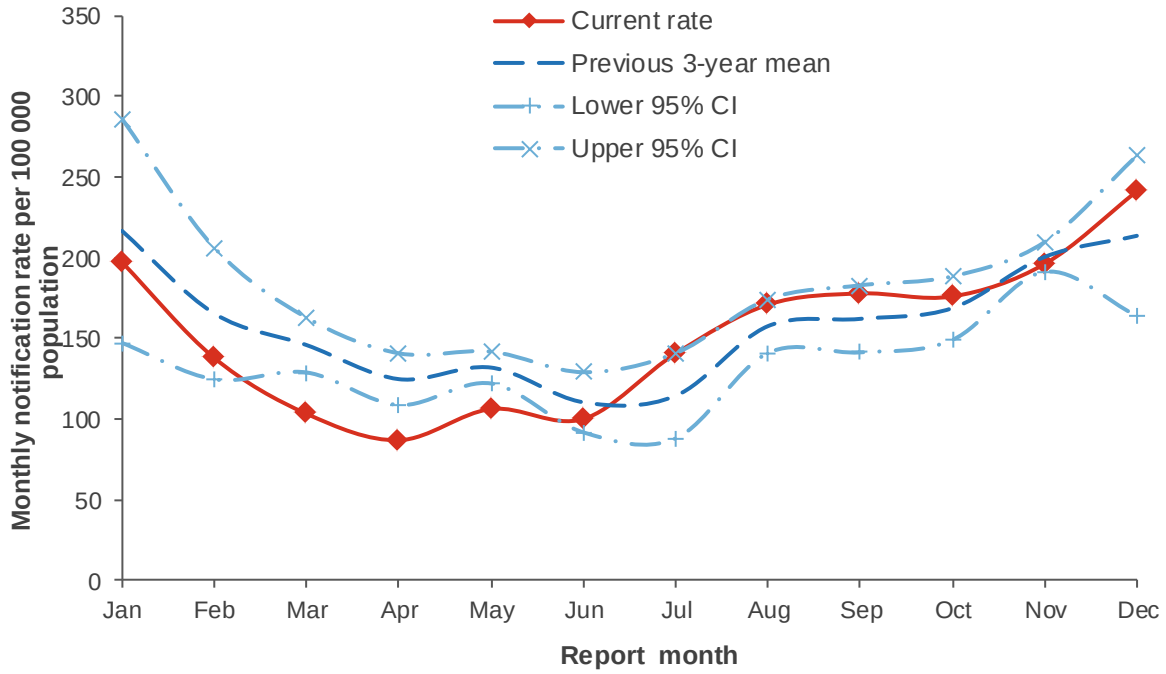
The campylobacteriosis annual rate trend (Figure 7) was very similar to the corresponding annual notification trend; with high notification rates observed over the period 2004−2006, followed by a sudden decrease in 2008. The notification rate has been fairly stable since 2008.

Figure 7. Campylobacteriosis notification rate by year, 2004–2013



The number of notified cases of campylobacteriosis per 100 000 population by month for 2013 is shown in Figure 8. The monthly number of notifications in 2013 ranged from 324 notifications (April) to 899 notifications (December). The minimum notification rate occurred in April in 2013, which is earlier than usual.

Figure 8. Campylobacteriosis monthly rate (annualised), 2013



Campylobacteriosis rates varied throughout the country as shown in Figure 9. The highest DHB rate was in South Canterbury DHB (292.9 per 100 000 population, 167 cases) which was higher than the other DHBs in the South Island (range 133.1-211.3 per 100 000 population). Hawkes Bay (216.1 per 100 000, 336 cases), Taranaki (213.2 per 100 000 population, 236 cases) and Waikato (207.6 per 100 000, 774 cases) DHBs had the highest rates for the North Island. The lowest rates were for Counties-Manukau (104 per 100 000, 536 cases) and Hutt Valley (104.9 per 100 000, 151 cases) DHBs. South Canterbury and Hawke's Bay DHBs have frequently featured in the highest quantile of campylobacteriosis notification rates between 2009 and 2013.

In 2013, the rate of notifications and hospitalisations for campylobacteriosis was higher for males (174.1 cases per 100 000 population, 17.9 admissions per 100 000) compared with females (132.3 per 100 000, 13.9 admissions per 100 000) (Table 10).

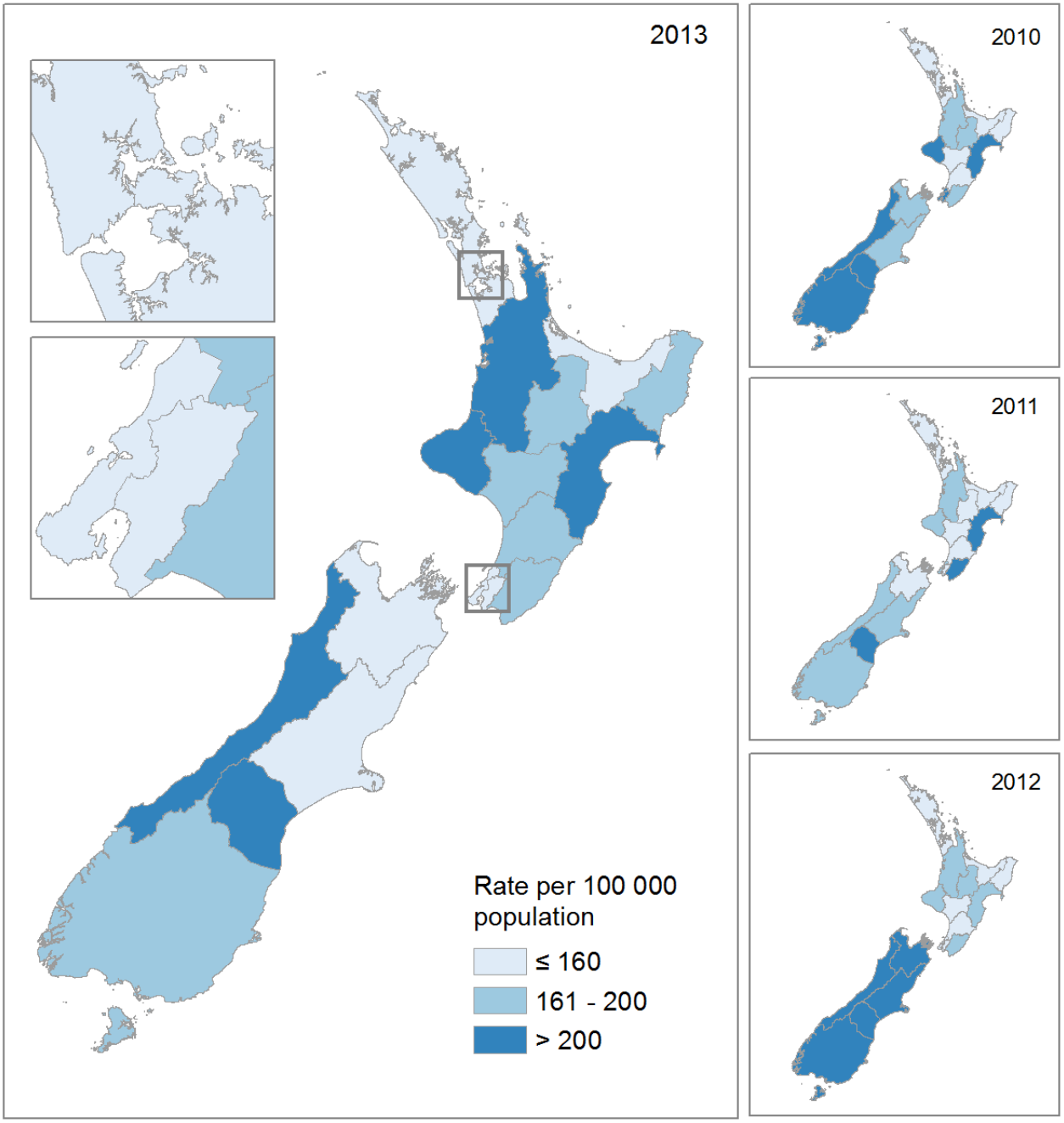
Table 10. Campylobacteriosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	3833	174.1	393	17.9
Female	3004	132.3	316	13.9
Total	**6837**	**152.9**	**709**	**15.9**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 population

Figure 9. Geographic distribution of campylobacteriosis notifications, 2010–2013



The highest age-specific notification rates for campylobacteriosis in 2013 were for the 1 to 4 years (281.7 per 100 000 population, 698 cases) and the less than 1 year (230.5 per 100 000, 138 cases) age groups. The highest hospitalisation rate was for the 70 years and over age group, which was three times the rate for the 15-29 year olds and 60-69 year olds who had similar notification rates and five times the hospitalisation rate for 4 years old and younger. (Table 11).

Table 11. Campylobacteriosis cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	138	230.5	6	10.0
1 to 4	698	281.7	28	11.3
5 to 9	253	84.9	15	5.0
10 to 14	221	77.4	16	5.6
15 to 19	464	151.7	47	15.4
20 to 29	1091	170.7	108	16.9
30 to 39	754	134.7	55	9.8
40 to 49	862	139.2	82	13.2
50 to 59	877	150.7	62	10.7
60 to 69	744	167.7	78	17.6
70+	735	170.8	212	49.3
Total	**6837**	**152.9**	**709**	**15.9**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

The risk factors recorded for campylobacteriosis notifications in 2013 are shown in Table 12. The most common risk factors reported were consumption of food from retail premises (43.9%) and contact with farm animals (41.8%).

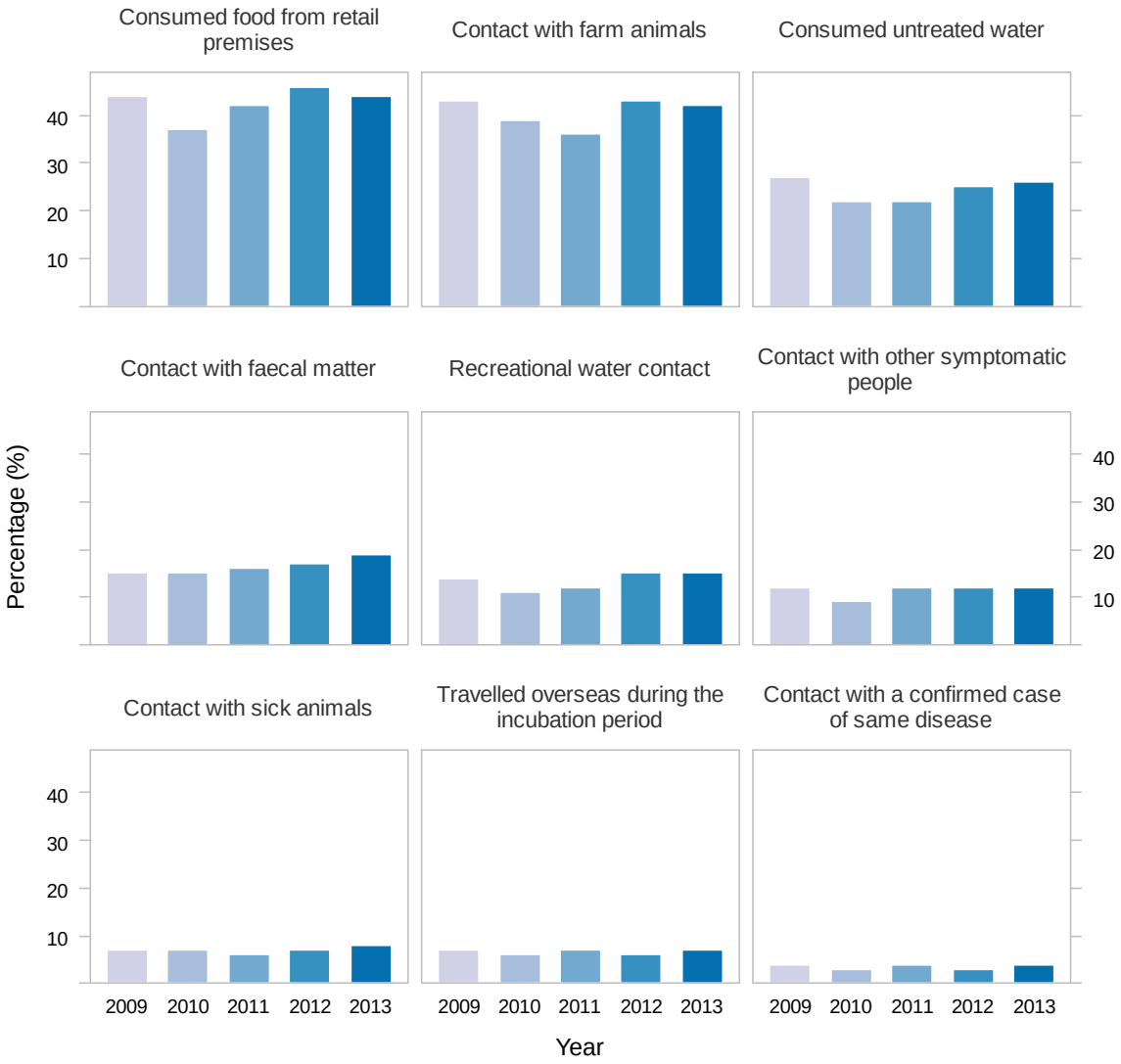
Table 12. Exposure to risk factors reported for campylobacteriosis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Consumed food from retail premises	1034	1324	4479	43.9
Contact with farm animals	1109	1546	4182	41.8
Consumed untreated water	579	1645	4613	26.0
Contact with faecal matter	447	1941	4449	18.7
Recreational water contact	360	2074	4403	14.8
Contact with other symptomatic people	287	2148	4402	11.8
Contact with sick animals	180	2097	4560	7.9
Travelled overseas during the incubation period	212	2836	3789	7.0

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Between 2009 and 2013, consumption of food from retail premises, contact with farm animals, and consumption of untreated water were consistently the most commonly reported risk factors for campylobacteriosis. The percentages of cases exposed to the most commonly reported risk factors was similar in 2013 compared to 2012 (Figure 10).

Figure 10. Percentage of cases with exposure to risk factors reported for campylobacteriosis and year, 2009−2013



For cases where information on travel was provided in 2013, 7.0% (95% CI 6.1-7.9%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all campylobacteriosis cases, a Poisson distribution can be used to estimate the total number of potentially travel-related cases of campylobacteriosis in 2013. The resultant distribution has a mean of 476 cases (95% CI 401-555).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism was 6.8% (95% CI 6.3-7.2%).

Outbreaks reported as caused by *Campylobacter* spp.

In 2013, 16 (34.4%) of the *Campylobacter* outbreaks and 77 (18.1%) of the associated cases were reported as foodborne (Table 13). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. *Campylobacter* outbreaks accounted for 6.1% (40/652) of all enteric outbreaks and 2.4% (170/7137) of all associated cases reported in 2013.

Table 13. *Campylobacter* spp. outbreaks reported, 2013

Measure	Foodborne *Campylobacter* spp. outbreaks	All *Campylobacter* spp. outbreaks
Outbreaks	16	40
Cases	77	170
Hospitalised cases	3	5

Since 2007 the number of reported foodborne *Campylobacter* spp. outbreaks has decreased, ranging from 7 to 16 outbreaks reported each year with between 36 and 77 annual outbreak-associated cases. From 2004 to 2006 the annual number of foodborne *Campylobacter* spp. outbreaks reported ranged from 17 to 32 with the number of annual outbreak associated cases ranging from 81 to 135 (Figure 11).

Figure 11. Foodborne *Campylobacter* spp. outbreaks and associated cases reported by year, 2004–2013

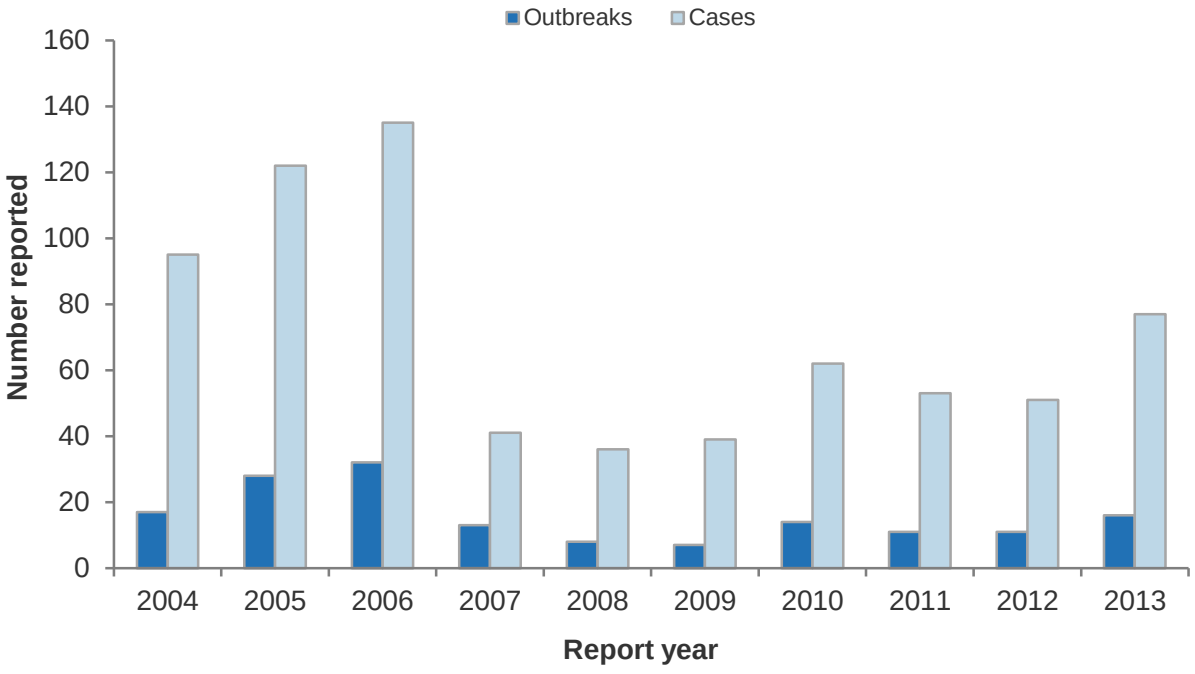


Table 14 contains details of the 16 foodborne *Campylobacter* spp. outbreaks reported in 2013.

Table 14. Details of foodborne *Campylobacter* spp. outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Taranaki	Feb	Raw Milk	Unknown	Unknown	2C, 2P
Wellington	Feb	Unknown	Restaurant/cafe/bakery	Unknown	7C, 5P
Waikato	Apr	Unknown	Private home	Unknown	2C
Waikato	Apr	Unknown	Private home	Private home	9C
Waikato	Apr	Unpasteurised milk	Private home	Farm	1C, 1P
Waikato	May	Chicken, steak, potato salad	Restaurant/cafe/bakery – Private home	Unknown	1C, 1P
Waikato	May	Chicken pate	Restaurant/cafe/bakery	Unknown	4C, 6P
Wellington	May	Chicken liver pate	Restaurant/cafe/bakery	Unknown	4C
Waikato	Aug	Raw milk	Private home	Private home	2C
Manawatu	Oct	Unknown	Restaurant/cafe/bakery	Unknown	2C
Auckland	Nov	Unknown	Farm	Farm	4C,
Tauranga	Dec	Unknown	Restaurant/cafe/bakery	Unknown	1C, 4P
Waikato	Dec	Unknown	Private home	Unknown	1C, 4P
Waikato	Dec	Unknown	Private home	Unknown	2C, 1P
Waikato	Dec	Unknown	Unknown	Unknown	2C
Tauranga	Dec	Raw chicken liver smoothies	Temporary or mobile service	Unknown	3C, 4P

PHU: Public Health Unit, C: confirmed, P: probable.

The evidence was strong for the suspected food vehicle for the raw chicken liver smoothies outbreak, where seven out of eight people who drank the smoothie became ill. For the other six *Campylobacter* spp. outbreaks with a suspected food vehicle (Table 14), the evidence for the implicated food was weak.

During investigation of suspected foodborne illness outbreaks by ESR's Public Health Laboratory in 2013, a single faecal sample was received from the foodborne outbreaks in Table 14. Both *Campylobacter* and norovirus were isolated from this clinical specimen, associated with the first food service exposure outbreak from Tauranga PHU in December.

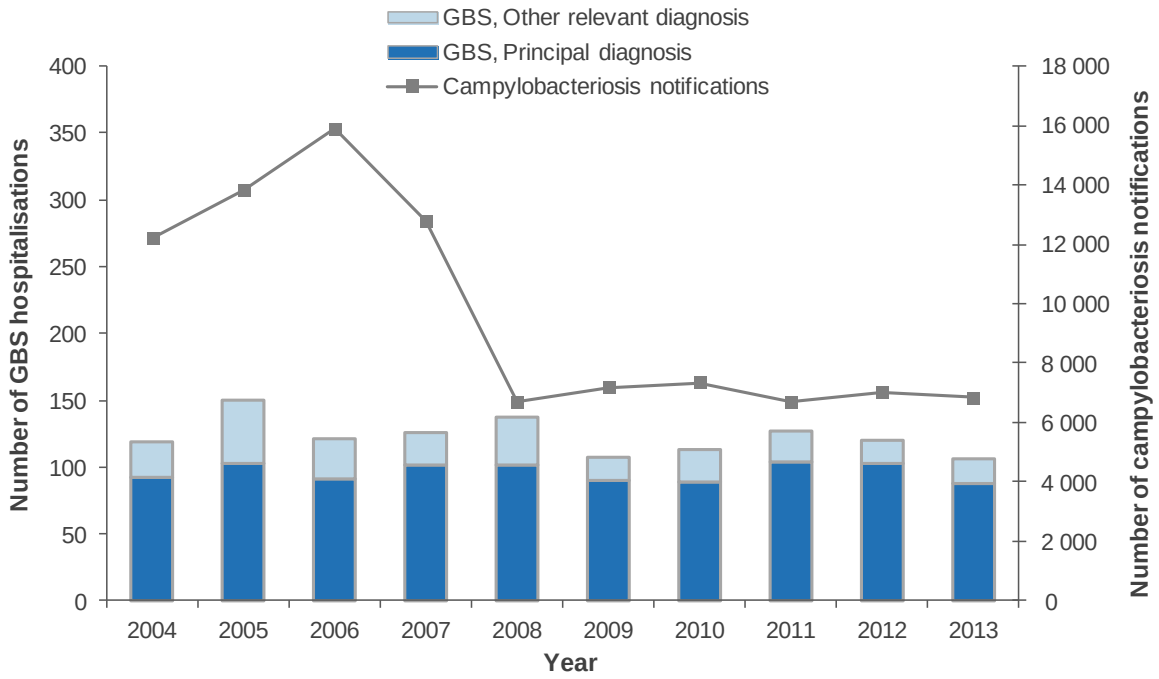
Disease sequelae - Guillain-Barré syndrome

Guillain-Barré syndrome (GBS) may be preceded by an infection with *Campylobacter jejuni*. Other respiratory or intestinal illnesses and other triggers may also precede an episode of GBS.

The ICD-10 code G61.0 was used to extract GBS hospitalisation data from the MoH NMDS database. There were 107 hospitalised cases recorded in 2013 (2.4 admissions per 100 000 population), 88 were reported with GBS as the primary diagnosis and 19 with this condition as another relevant diagnosis.

This is the lowest number of recorded hospitalisations in the last ten years. Between 2004 and 2013, the number of hospitalised cases (any diagnosis code) for GBS ranged from 107 to 150 (Figure 12). The numbers of campylobacteriosis notifications during the same period are also included in Figure 12 for comparison.

Figure 12. Guillain-Barré syndrome hospitalised cases, 2004–2013



In 2013, the number of hospitalised cases due to GBS was higher for males than for females (Table 15).

Table 15. Guillain-Barré syndrome hospitalised cases by sex, 2013

Sex	Hospitalised cases[a]	
	No.	Rate[b]
Male	60	2.7
Female	47	2.1
Total	**107**	**2.4**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 population

In 2013, the highest rates of hospitalisation for GBS were in the 70 years and over age group, followed by the 50 to 59 years age group (Table 16).

Table 16. Guillain-Barré syndrome hospitalised cases by age group, 2013

Age group (years)	Hospitalised cases	
	No.	Rate[b]
<5	5	1.6
5 to 9	3	-
10 to 14	4	-
15 to 19	2	-
20 to 29	10	1.6
30 to 39	8	1.4
40 to 49	8	1.3
50 to 59	26	4.5
60 to 69	15	3.4
70+	26	6.0
Total	**107**	**2.4**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

Recent surveys

A microbiological survey was conducted on pre-packaged fresh leafy salads available at retail in New Zealand [17]. A total of 307 samples were collected from three major cities over a one-year period. Products purchased were those packaged by the producer and not known to be handled or re-packaged by the retailer. Samples were tested at the end of the 'best before' date. No *Campylobacter* spp. were detected in any of the samples.

Relevant New Zealand studies and publications

Journal papers

The use of molecular-based surveillance of campylobacteriosis in New Zealand and its contribution to reductions in notified and hospitalised cases has been reviewed [18].

Pulsed-field gel electrophoresis genotypes of *Campylobacter* isolates from 603 human patients were compared with 485 isolates from retail offal (primarily chicken and lamb) from the Canterbury region of New Zealand, to identify temporal clusters and possible sources of campylobacteriosis [19]. Detailed epidemiological information was collected from 364 of the patients, and when combined with genotyping data allowed a putative transmission pathway of campylobacteriosis to be assigned for 88% of patients. The sources of infection were 47% food, 28% direct animal contact, 7% overseas travel, 4% person-to-person transmission and 3% water-related. A significant summer increase in campylobacteriosis cases was primarily attributed to an increase in food-related cases.

Relevant regulatory developments

Nil.

Ciguatera fish poisoning

Case definition

Clinical description:	Gastroenteritis, possibly followed by neurologic symptoms.
Laboratory test for diagnosis:	Demonstration of ciguatoxin in implicated fish.
Case classification:	Not applicable.

Ciguatera fish poisoning cases reported in 2013 by data source

During 2013, one notification of ciguatera fish poisoning was reported in EpiSurv. Note that not all cases of ciguatera fish poisoning are necessarily notifiable, only those where there is a suspected common source.

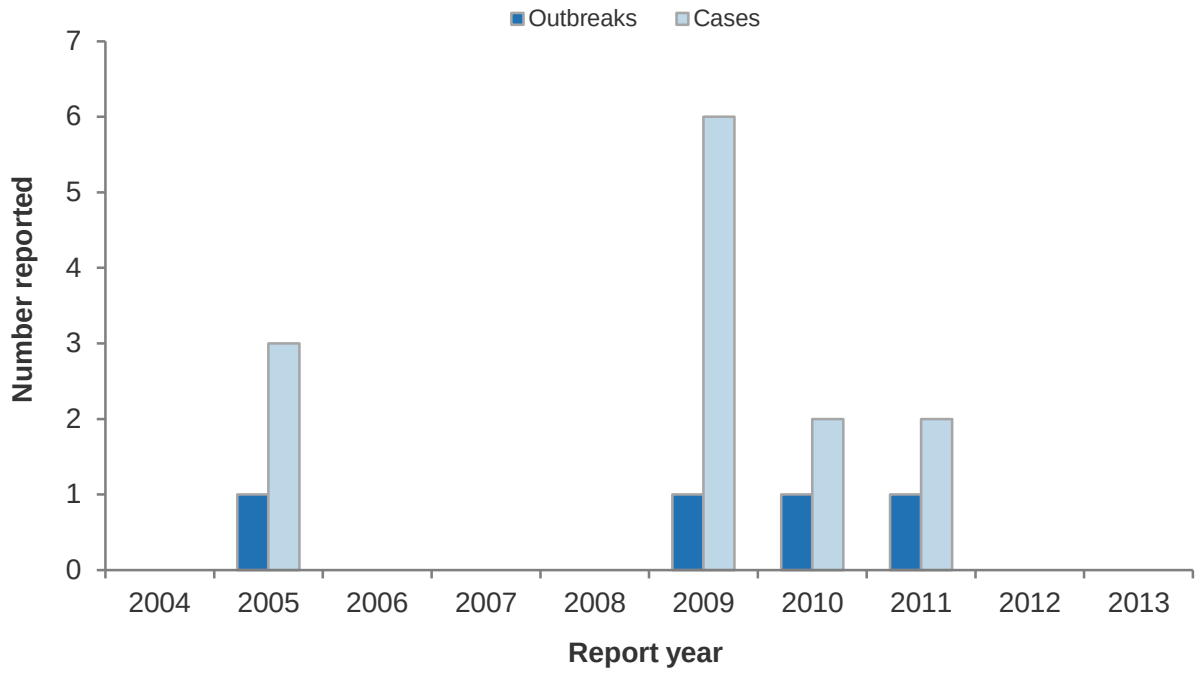
The ICD-10 code T61.0 was used to extract ciguatera fish poisoning hospitalisation data from the MoH NMDS database. Of the five hospital admissions (0.1 admissions per 100 000 population) recorded in 2013, all five were reported with ciguatera fish poisoning as the primary diagnosis. It should be noted that EpiSurv and the MoH NMDS database are separate systems and hospital admission can occur without cases being notified.

Outbreaks reported as caused by ciguatera fish poisoning

No outbreaks of ciguatera fish poisoning were reported in 2013. It should be noted that all ciguatera fish poisoning outbreaks will be categorised as foodborne, as consumption of contaminated seafood is the only currently recognised transmission route for this disease.

Over the 10-year period from 2004 to 2013, very few outbreaks of ciguatera fish poisoning were reported, with no more than two outbreaks of ciguatera fish poisoning reported in any year (Figure 13).

Figure 13. Ciguatera fish poisoning outbreaks and associated cases reported by year, 2004–2013



In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to ciguatera fish poisoning outbreaks.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Clostridium perfringens intoxication

Case definition

Clinical description:	Gastroenteritis with profuse watery diarrhoea.
Laboratory test for diagnosis:	Detection of enterotoxin in faecal specimen or faecal spore count of ≥10^6/g or isolation of ≥10^5/g *Clostridium perfringens* in leftover food.
Case classification:	
Probable	A clinically compatible illness.
Confirmed	A clinically compatible illness that is laboratory confirmed, OR a clinically compatible illness and a common exposure associated with a laboratory confirmed case.

Clostridium perfringens intoxication cases reported in 2013 by data source

During 2013, four notifications of *C. perfringens* intoxication and no resulting deaths were reported in EpiSurv.

The ICD-10 code A05.2 was used to extract foodborne *C. perfringens* intoxication hospitalisation data from the MoH NMDS database. There was one hospital admission recorded in 2013 with *C. perfringens* intoxication as a secondary diagnosis.

Outbreaks reported as caused by *Clostridium perfringens*

There were nine *C. perfringens* outbreaks with 208 associated cases reported in 2013, all were associated with a suspected or known foodborne source (Table 17). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 17. *C. perfringens* outbreaks reported, 2013

Measure	Foodborne *C. perfringens* outbreaks	All *C. perfringens* outbreaks
Outbreaks	9	9
Cases	208	208
Hospitalised cases	1	1

Between 2004 and 2013, the number of foodborne outbreaks associated with *C. perfringens* ranged from three (in 2009) to 13 outbreaks (in 2006) (Figure 14). The number of cases associated with *C. perfringens* outbreaks has also varied markedly over time. The highest number of cases associated with foodborne outbreaks due to *C. perfringens* occurred in 2008 (215 cases). The second highest number of cases (208 cases) was reported in 2013.

Figure 14. Foodborne *C. perfringens* outbreaks and associated cases reported by year, 2004–2013

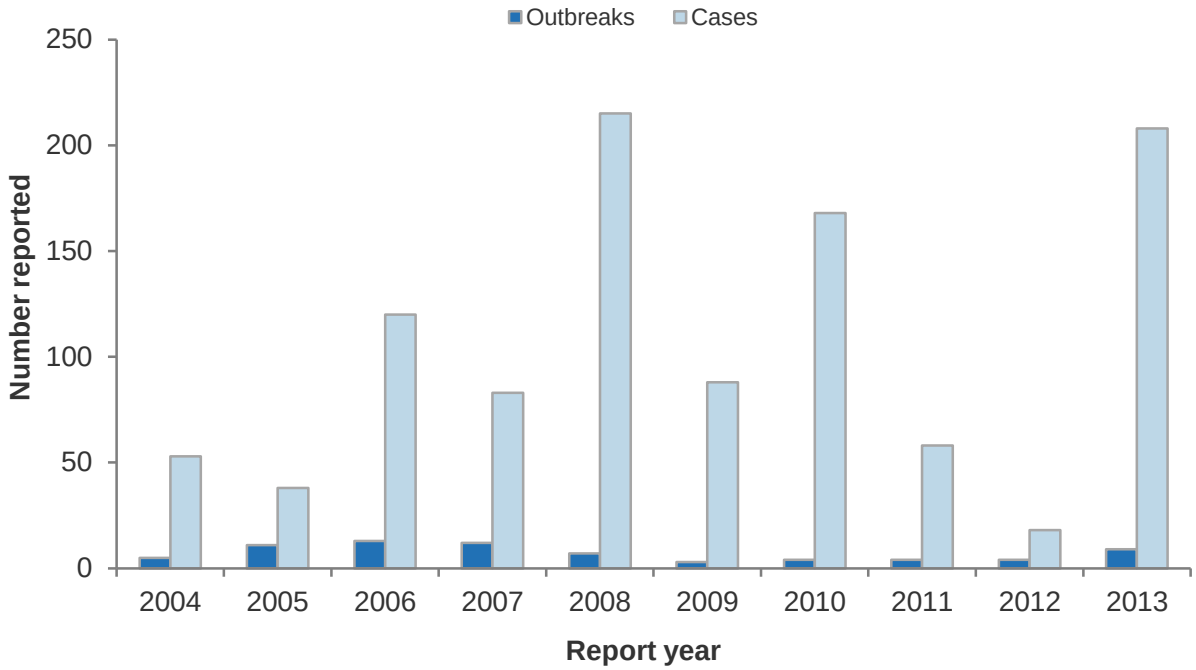


Table 18 contains details of the nine foodborne *C. perfringens* outbreaks reported in 2013.

Of the six *C. perfringens* outbreaks with a suspected food vehicle (Table 18), strong evidence was found to implicate the suspected food vehicle (meat kebabs) for the May 2013 outbreak in Auckland. In this outbreak investigation, *C. perfringens* was isolated from both the food and faecal samples. Evidence implicating suspected food vehicles for the remaining outbreaks was weak.

Table 18. Details of foodborne *C. perfringens* outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Manawatu	Mar	Hot box meal - chicken dish	Other setting	Unknown	3C, 17P
Auckland	Mar	Meat-based curries	Restaurant/cafe/bakery	Unknown	1C, 6P
Auckland	Apr	Roast pork	Caterers	Unknown	3C, 28P
Auckland	May	Meat kebabs	Community, church, sports gathering	Community, church, sports gathering	3C, 40P
Auckland	Jul	Meal of lamb shanks with gravy, peas, carrots and roast pumpkin	Takeaway	Unknown	1C, 1P
Otago	Aug	Unknown	Restaurant/cafe/bakery	Unknown	6C
Auckland	Aug	Chicken pasta	Caterers/Community, church, sports gathering	Community, church, sports gathering	4C, 74P
Wellington	Sep	Unknown	Restaurant/cafe/bakery	Unknown	10C
Wellington	Oct	Unknown	Restaurant/cafe/bakery	Unknown	1C, 10P

PHU: Public Health Unit, C: confirmed, P: probable.

During investigation of suspected foodborne illness outbreaks by ESR's Public Health Laboratory in 2013, samples were received from all outbreaks listed in Table 18. *C. perfringens* was detected in faecal samples from all of the nine outbreaks. *C. perfringens* enterotoxin was detected in faecal samples from six of these outbreaks. *C. perfringens* was also isolated from s sample of meat kebabs submitted in relation to the May outbreak in Auckland.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Cryptosporidiosis

Summary data for cryptosporidiosis in 2013 are given in Table 19.

Table 19. Summary of surveillance data for cryptosporidiosis, 2013

Parameter	Value in 2013	Source
Number of notified cases	1384	EpiSurv
Notification rate (per 100 000)	30.1	EpiSurv
Hospitalisations (% of notifications)[a]	59 (4.3%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	117 (8.5%)	EpiSurv
Estimated food-related cases (%)	NE	

NE = not estimated, no information is available on the food attributable proportion of cryptosporidiosis in New Zealand.

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

Case definition

Clinical description: An acute illness that includes symptoms of diarrhoea (may be profuse and watery) and abdominal pain. The infection may be asymptomatic.

Laboratory test for diagnosis: Detection of *Cryptosporidium parvum* oocysts in a faecal specimen.

Case classification:

Probable: A clinically compatible illness that is either a contact of a confirmed case of the same disease, or has had contact with the same common source i.e., is part of an identified common source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Cryptosporidiosis cases reported in 2013 by data source

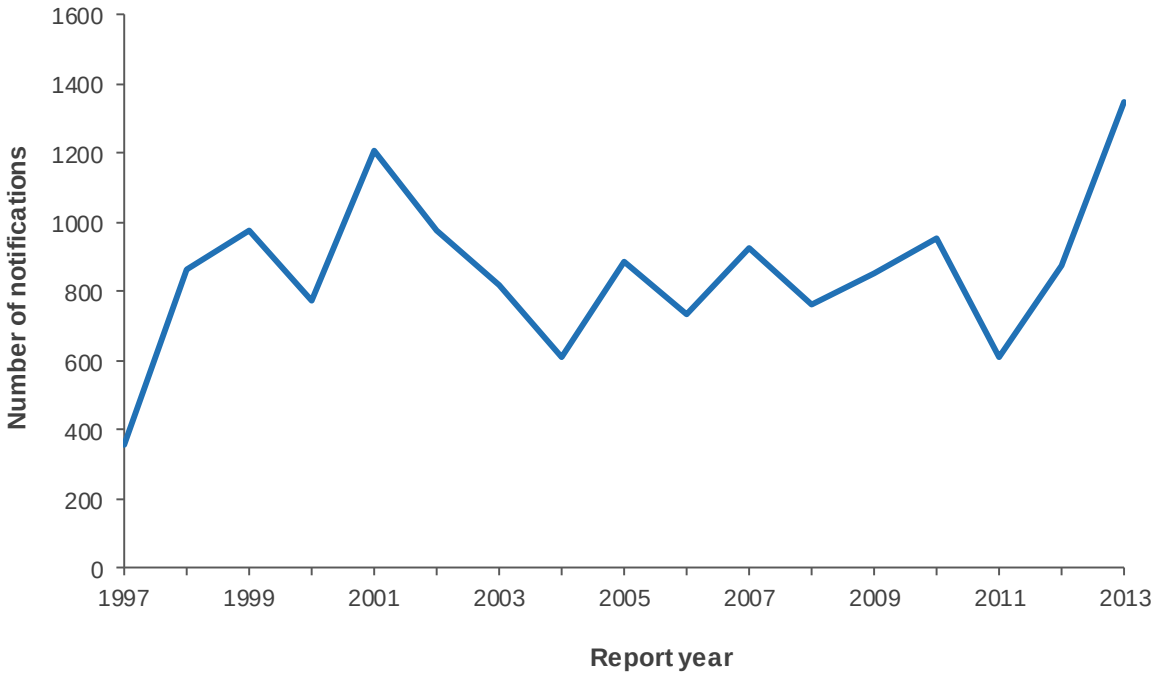
During 2013, 1348 notifications (30.1 cases per 100 000 population) of cryptosporidiosis and no resulting deaths were reported in EpiSurv.

The ICD-10 code A07.2 was used to extract cryptosporidiosis hospitalisation data from the MoH NMDS database. Of the 59 hospital admissions (1.3 admissions per 100 000 population) recorded in 2013, 38 were reported with cryptosporidiosis as the primary diagnosis and 21 with cryptosporidiosis as another relevant diagnosis.

Notifiable disease data

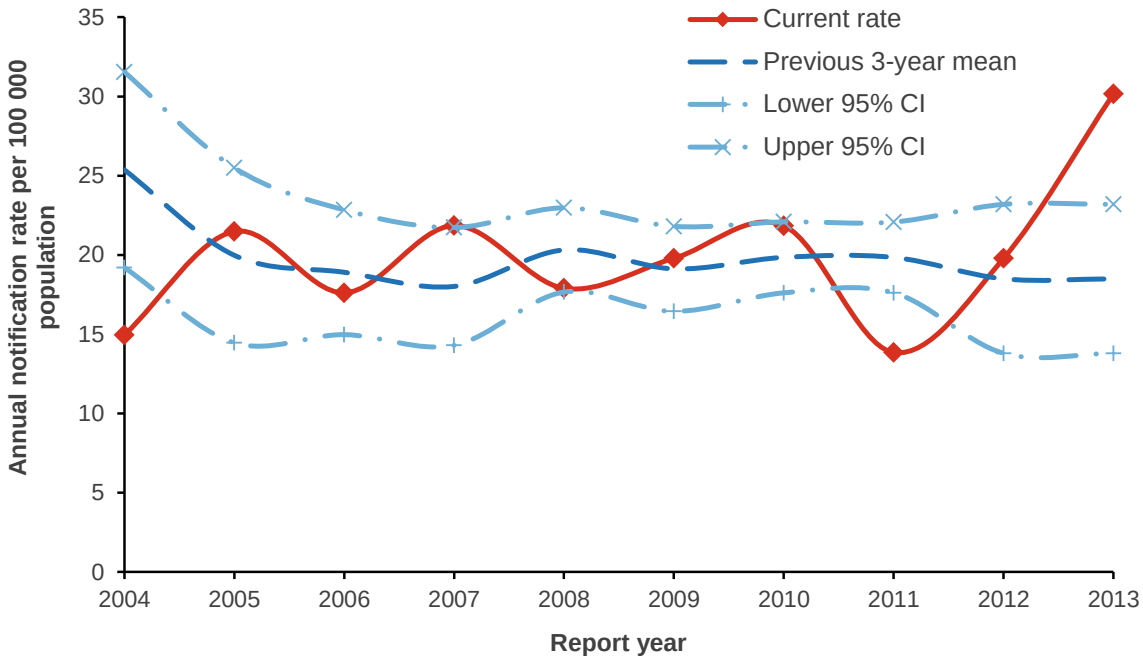
The number of notifications of cryptosporidiosis in 2013 was the highest recorded since cryptosporidiosis became a notifiable disease in 1996. The annual number of notifications previously peaked at 1208 cases in 2001 and then decreased to 611 in 2004. Between 2004 and 2012, the number of notifications has ranged between 610 and 954 each year (Figure 15).

Figure 15. Cryptosporidiosis notifications by year, 1997–2013



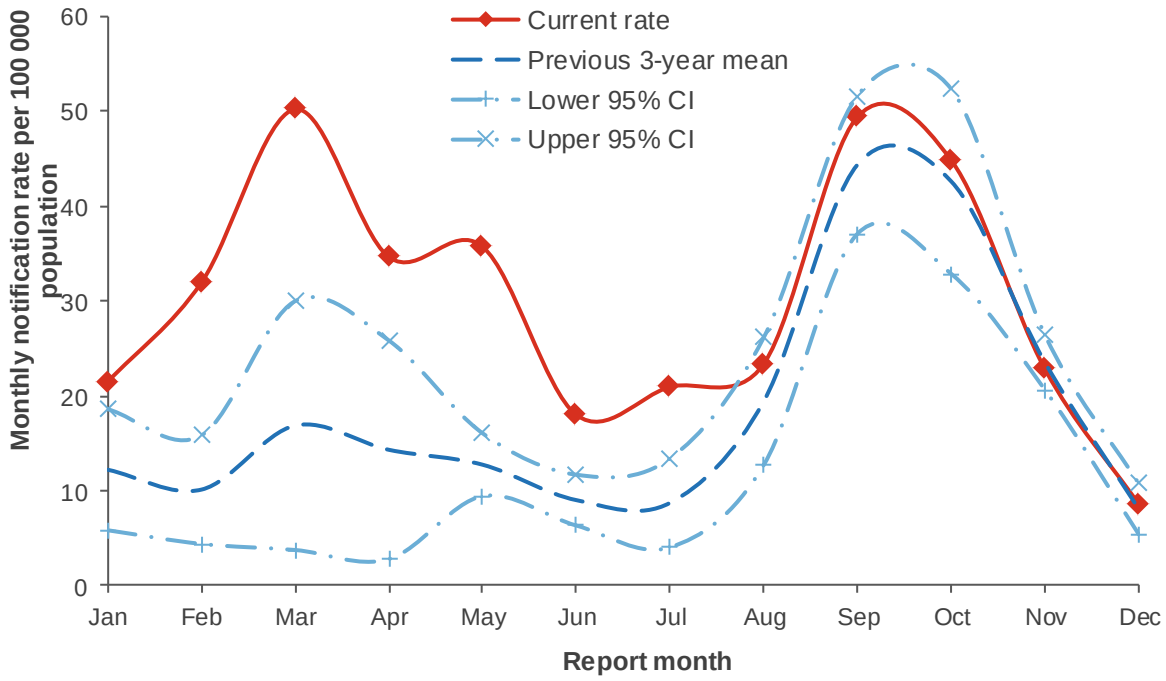
In 2013, notification rates were higher than the mean of the previous 3 years. The cryptosporidiosis annual population rate trend was very similar to the notification trend (Figure 16).

Figure 16. Cryptosporidiosis notification rate by year, 2004–2013



The number of notified cases of cryptosporidiosis reported per 100 000 population by month for 2013 was different compared to previous years. The spring peak in September/October was consistent with previous years, however the notification rate in the first half of 2013 was consistently higher than previous years with a marked peak in March comparable to the spring peak (Figure 17).

Figure 17. Cryptosporidiosis monthly rate (annualised), 2013



In 2013, the highest rates were for Hawke's Bay (87.5 per 100 000 population, 136 cases) and South Canterbury (66.7 per 100 000, 38 cases) DHBs. South Canterbury and Waikato DHBs have consistently recorded higher rates of notification over the period 2010 to 2013 (Figure 18).

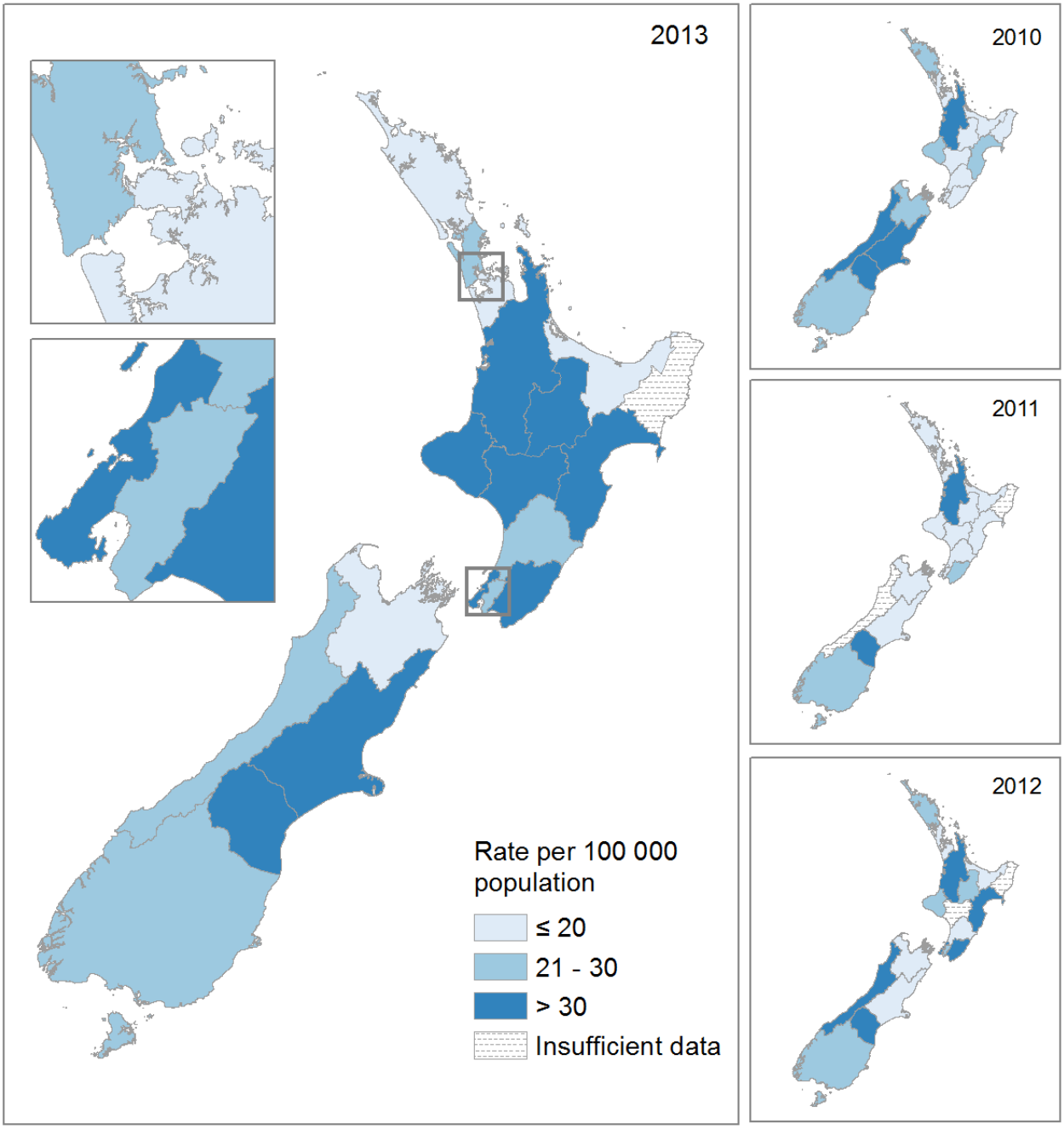
In 2013, the number of notifications and rates for cryptosporidiosis were higher for females (32.1 per 100 000 population, 729 cases) compared to males (28.1 per 100 000, 618 cases). The number and rate of hospitalisations were similar for males and females (Table 20).

Table 20. Cryptosporidiosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	618	28.1	31	1.4
Female	729	32.1	28	1.2
Unknown	1			
Total	**1348**	**30.1**	**59**	**1.3**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

Figure 18. Geographic distribution of cryptosporidiosis notifications, 2010-2013



During 2013, the highest cryptosporidiosis age specific notification rates were for the 1 to 4 years age group (168.7 per 100 000 population, 418 cases), followed by the less than 1 year (65.1 per 100 000, 39 cases) and the 5 to 9 years (62.1 per 100 000, 185 cases) age groups (Table 21). The hospitalisation rate was also highest in the 1 to 4 years age group.

Table 21. Cryptosporidiosis cases by age group, 2013

Age group	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	39	65.1	3	-
1 to 4	418	168.7	19	7.7
5 to 9	185	62.1	5	1.7
10 to 14	81	28.4	4	-
15 to 19	61	19.9	2	-
20 to 29	163	25.5	10	1.6
30 to 39	210	37.5	7	1.3
40 to 49	86	13.9	3	-
50 to 59	48	8.3	1	-
60 to 69	38	8.6	2	-
70+	19	4.4	3	-
Total	**1348**	**30.1**	**59**	**1.3**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

During 2013, the most commonly reported risk factors for cryptosporidiosis were recreational water contact (44.9%) and contact with farm animals (44.2%) (Table 22).

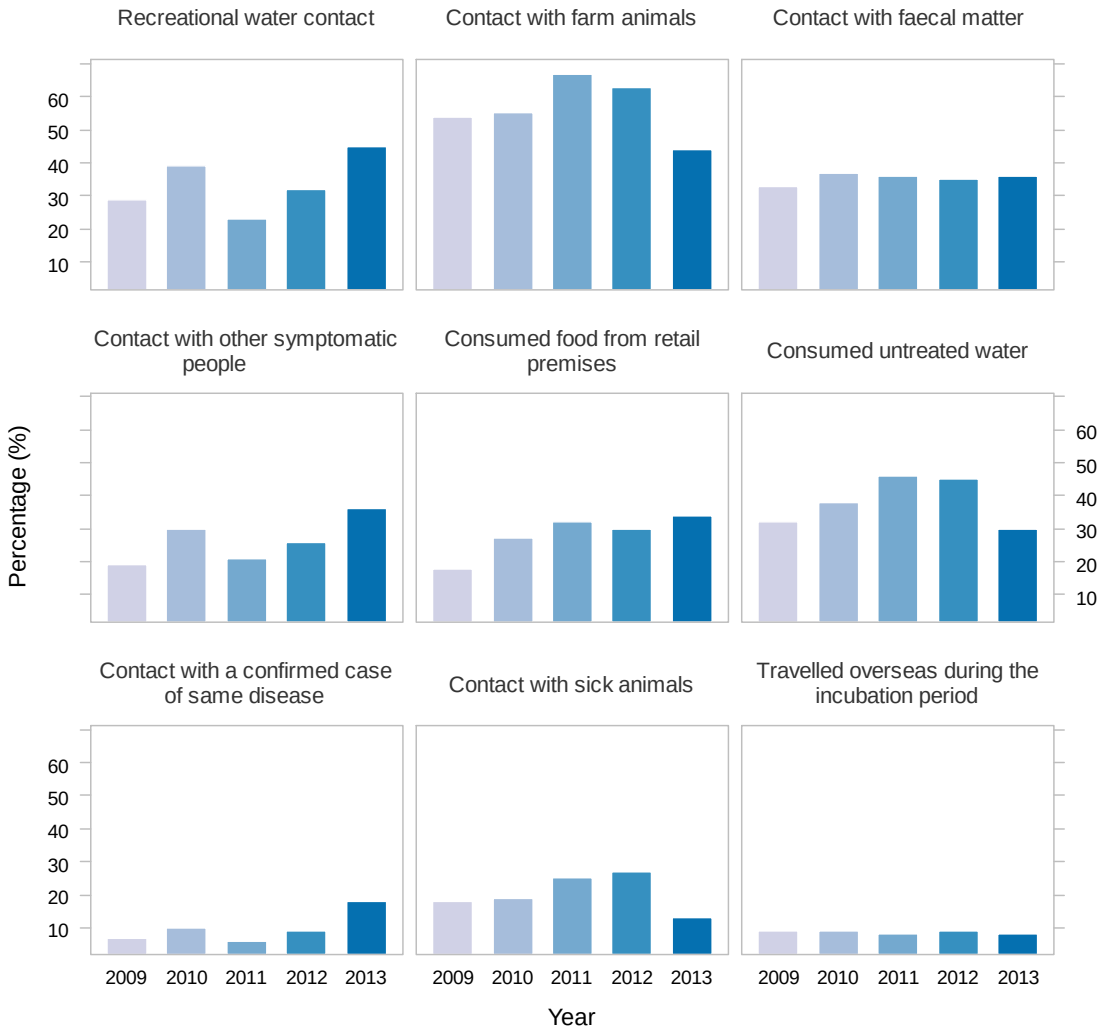
Table 22. Exposure to risk factors reported for cryptosporidiosis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Recreational water contact	385	472	491	44.9
Contact with farm animals	395	499	454	44.2
Contact with other symptomatic people	296	519	533	36.3
Contact with faecal matter	288	510	550	36.1
Consumed food from retail premises	267	519	562	34.0
Consumed untreated water	232	531	585	30.4
Contact with sick animals	101	686	561	12.8
Travelled overseas during the incubation period	81	877	390	8.5

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Between 2009 and 2013, the most commonly reported risk factors for cryptosporidiosis were contact with farm animals, consumption of untreated water, and contact with faecal matter (Figure 19). The percentage of cases reporting recreational water contact was lowest in 2011, but has increased in both 2012 and 2013 to be similar to the reporting rate of contact with farm animals. There was also an increasing trend in the percentage of reported contact with symptomatic people. Reporting of contact with farm animals, contact with sick animals and consumption of untreated water have all reduced in 2013 compared to 2012.

Figure 19. Percentage of cases with exposure to risk factors reported for cryptosporidiosis and year, 2009–2013



For cases where information on travel was provided, 8.5% (95% CI 6.8-10.4%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all cryptosporidiosis cases, a Poisson distribution can be used to estimate the total number of potentially travel-related cases of cryptosporidiosis in 2013. The resultant distribution has a mean of 117 cases (95% CI 86-152).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism was 8.6% (95% CI 7.6-9.8%).

Outbreaks reported as caused by *Cryptosporidium* spp.

In 2013, three (3.1%) of the *Cryptosporidium* spp. outbreaks and 11 (2.0%) of the associated cases were reported as foodborne (Table 23). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. *Cryptosporidium* spp. outbreaks accounted for 15.0% (98/652) of all outbreaks and 7.7% (547/7137) of all associated cases.

Table 23. *Cryptosporidium* spp. outbreaks reported, 2013

Measure	Foodborne *Cryptosporidium* spp. outbreaks	All *Cryptosporidium* spp. outbreaks
Outbreaks	3	98
Cases	11	547
Hospitalised cases	1	12

Foodborne transmission is rarely reported for *Cryptosporidium* spp. outbreaks, with not more than four outbreaks reported each year in the ten year period, 2004−2013. The largest number of outbreaks, with 11 associated cases, was reported in 2011 (Figure 20).

Figure 20. Foodborne *Cryptosporidium* spp. outbreaks and associated cases reported by year, 2004–2013

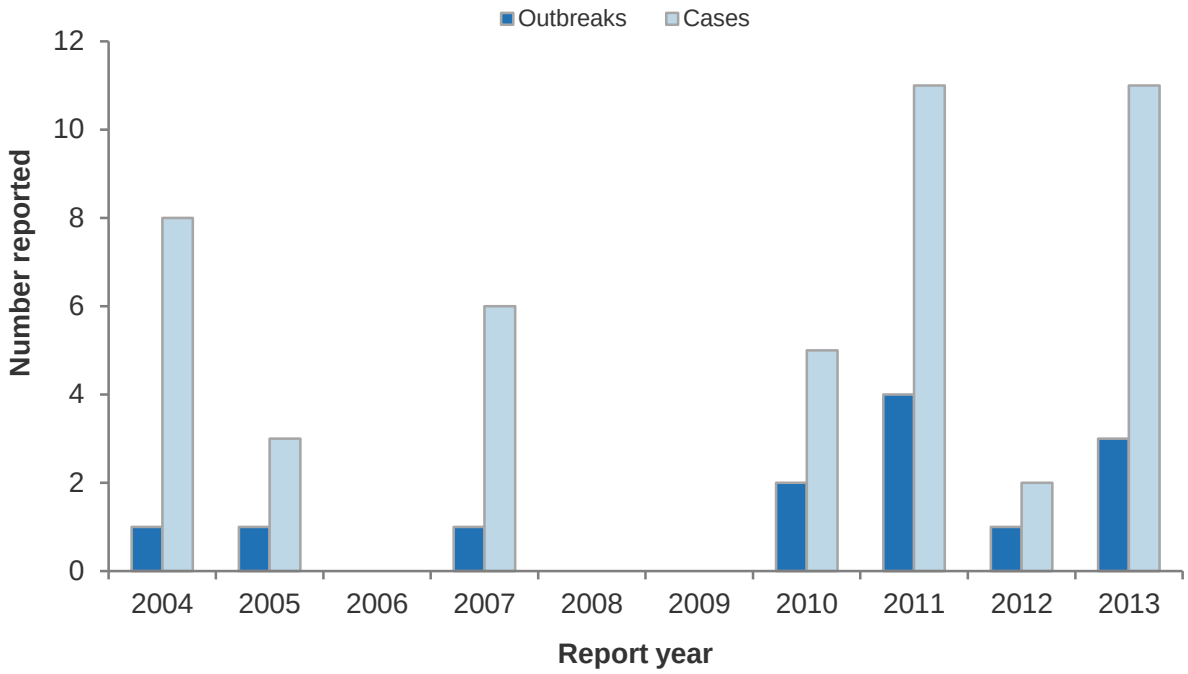


Table 24 contains details of the three foodborne *Cryptosporidium* spp. outbreaks reported in 2013. All outbreaks were household related. Raw milk was a possible food vehicle in one *Cryptosporidium* spp. outbreak, however there were multiple possible risk factors on the farm and the evidence for the implicated food was weak.

Table 24. Details of foodborne *Cryptosporidium* spp. outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Waikato	Mar	Unknown	Childcare centre/ private home	Private home	3C
Waikato	May	Unknown	Private home	Unknown	1C, 2P
Wellington	Aug	Raw milk	Private home	Farm	5C

PHU: Public Health Unit, C: confirmed, P: probable.

In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to food-associated *Cryptosporidium* spp. outbreaks.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Giardiasis

Summary data for giardiasis in 2013 are given in Table 25.

Table 25. Summary of surveillance data for giardiasis, 2013

Parameter	Value in 2013	Source
Number of notified cases	1729	EpiSurv
Notification rate (per 100 000)	38.7	EpiSurv
Hospitalisations (% of notifications)[a]	47 (2.7%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	360 (20.8%)	EpiSurv
Estimated food-related cases	NE	

NE = not estimated, no information is available on the food attributable proportion of giardiasis in New Zealand.

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

Case definition

Clinical description: An illness characterised by diarrhoea, abdominal cramps, bloating, flatulence, nausea, weight loss or malabsorption. The infection may be asymptomatic.

Laboratory test for diagnosis: Detection of *Giardia* cysts or trophozoites in a specimen from the human intestinal tract OR detection of *Giardia* antigen in faeces.

Case classification:

Probable: A clinically compatible illness that is either a contact of a confirmed case of the same disease, or has had contact with the same common source – that is, is part of a common-source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Giardiasis cases reported in 2013 by data source

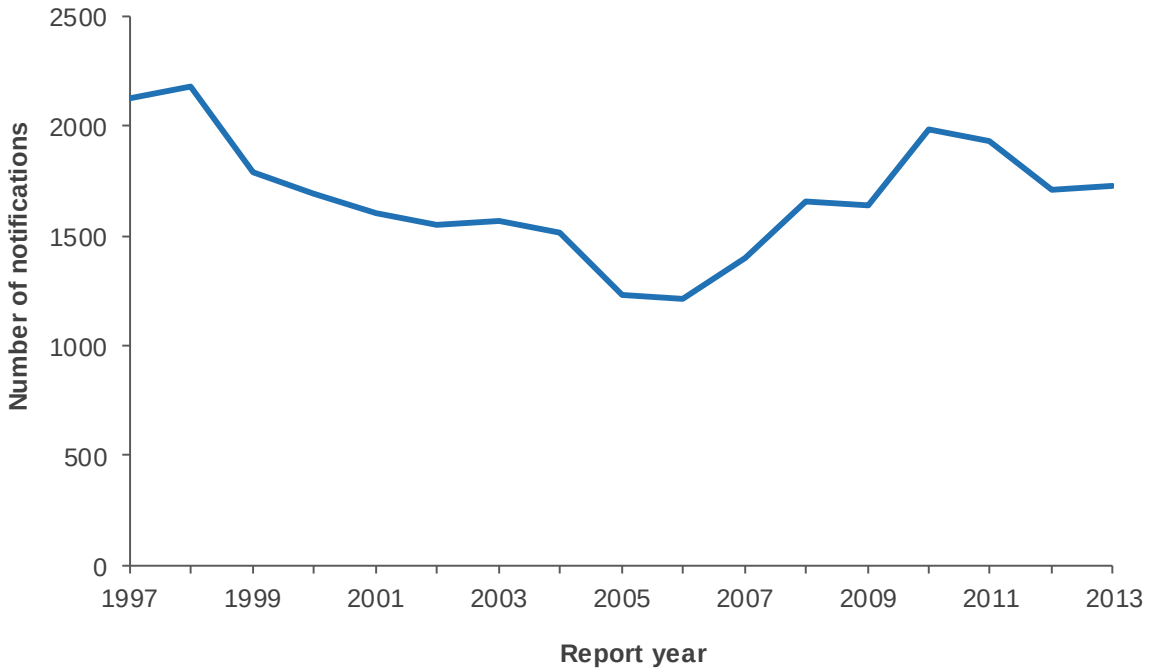
During 2013, 1729 notifications (38.7 cases per 100 000 population) of giardiasis and no resulting deaths were reported in EpiSurv.

The ICD-10 code A07.1 was used to extract giardiasis hospitalisation data from the MoH NMDS database. Of the 47 hospital admissions (1.1 admissions per 100 000 population) recorded in 2013, 24 were reported with giardiasis as the primary diagnosis and 23 with giardiasis as another relevant diagnosis.

Notifiable disease data

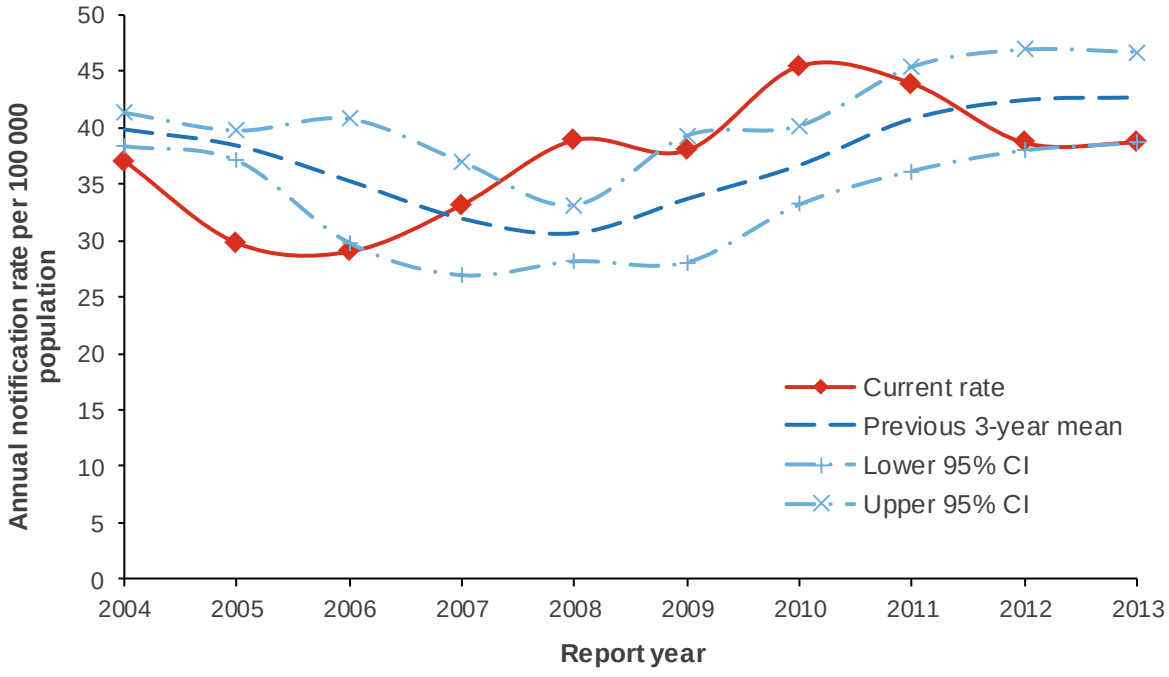
There was a steady decrease in the number of giardiasis cases reported each year from 1998 to 2006. Since 2006, an increasing trend in the number of notifications was observed although there has been a decrease in the number of notifications since 2010. The highest number of notifications since 1999 was reported in 2010 (1985 cases), followed by 2011 (1934 cases) (Figure 21).

Figure 21. Giardiasis notifications by year, 1997–2013



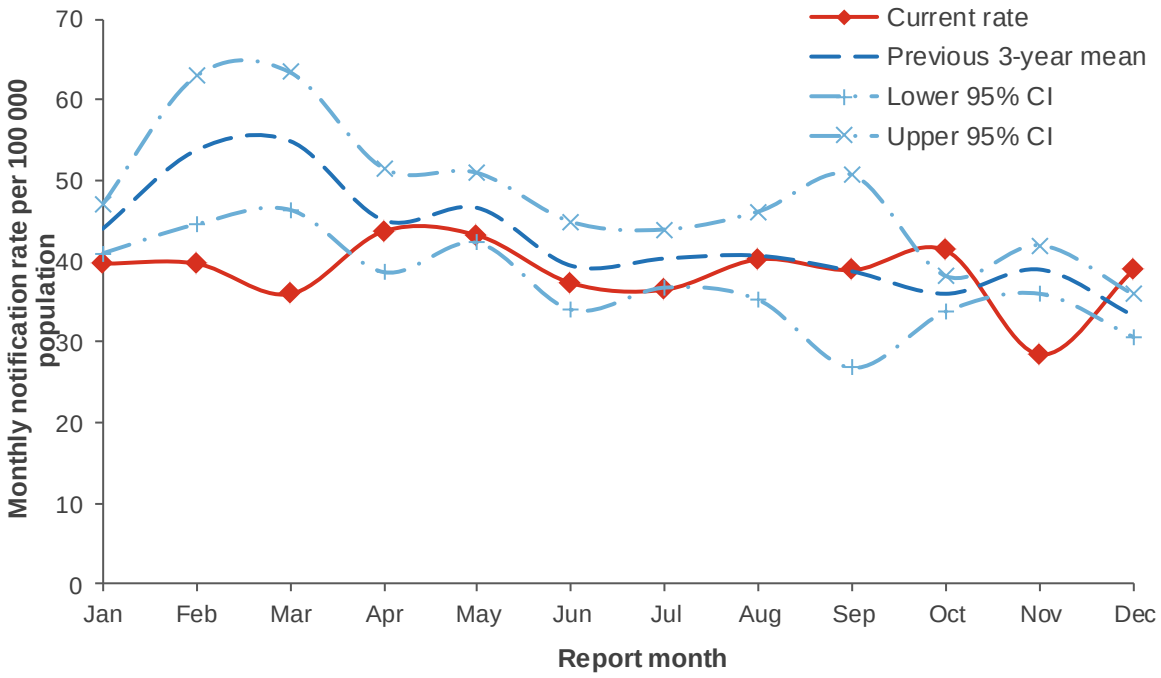
The giardiasis annual population rate trend was very similar to the corresponding annual notification trend. The 2013 notification rate was similar to 2012 and maintained the downward trend since 2010. Between 2006 and 2010 there had been a generally increasing trend (Figure 22).

Figure 22. Giardiasis notification rate by year, 2004–2013



There was no strong seasonal pattern in the population rate of giardiasis notifications reported by month either historically or in 2013 (Figure 23).

Figure 23. Giardiasis monthly rate (annualised), 2013



Giardiasis rates varied throughout the country during 2013 (Figure 24). The highest rate was for Lakes DHB (55.3 per 100 000 population, 57 cases), followed by Capital & Coast (54.7 per 100 000, 164 cases) DHB. The lowest rates were for Whanganui (17.6 per 100 000 population, 11 cases), MidCentral (22.4 per 100 000, 38 cases) and South Canterbury (22.8 per 100 000 population, 13 cases) DHBs. Lakes, Waikato and Capital & Coast DHBs have consistently been in the highest quantile in the last four years.

The 2013 number and rate for both notifications and hospitalisations were similar for females and males (Table 26).

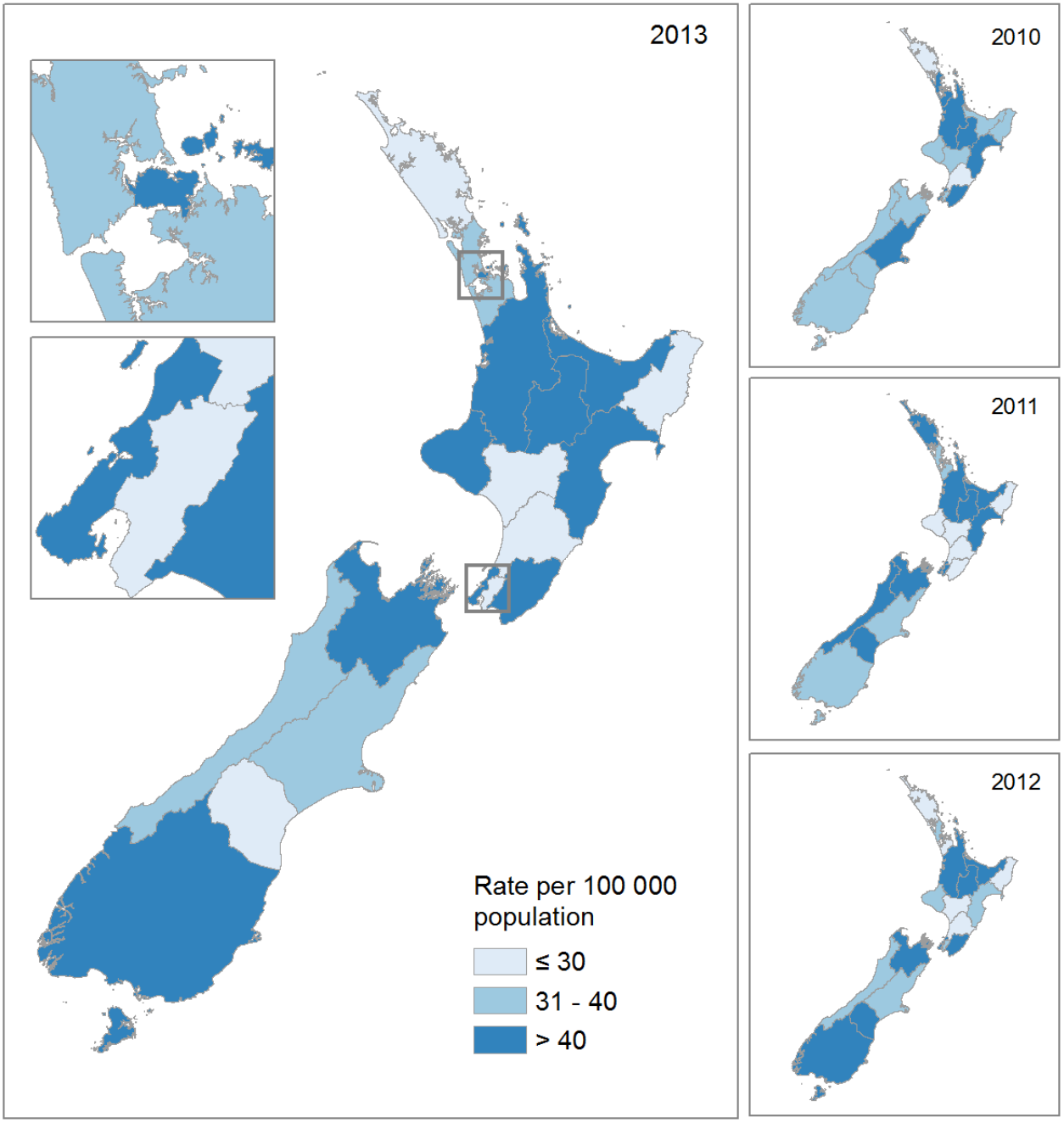
Table 26. Giardiasis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	858	39.0	21	1.0
Female	871	38.4	26	1.1
Total	**1729**	**38.7**	**47**	**1.1**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population

Figure 24. Geographic distribution of giardiasis notifications, 2010–2013



In 2013, the highest notification rate was for the 1 to 4 years age group (151.0 per 100 000 population, 374 cases), followed by the 30 to 39 years (67.0 per 100 000, 375 cases) (Table 27). The highest hospitalisation rate was also for the 1 to 4 years age group.

Table 27. Giardiasis cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	30	50.1	1	-
1 to 4	374	151.0	7	2.8
5 to 9	140	47.0	4	-
10 to 14	38	13.3	1	-
15 to 19	30	9.8	0	-
20 to 29	168	26.3	8	1.3
30 to 39	375	67.0	5	0.9
40 to 49	242	39.1	6	1.0
50 to 59	140	24.1	5	0.9
60 to 69	140	31.5	7	1.6
70+	51	11.9	3	-
Unknown	1			
Total	**1729**	**38.7**	**47**	**1.1**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

In 2013, the most commonly reported risk factors for notified giardiasis cases were contact with faecal matter (42.0%), contact with other symptomatic people (37.5%) and contact with recreational water (35.2%) (Table 28).

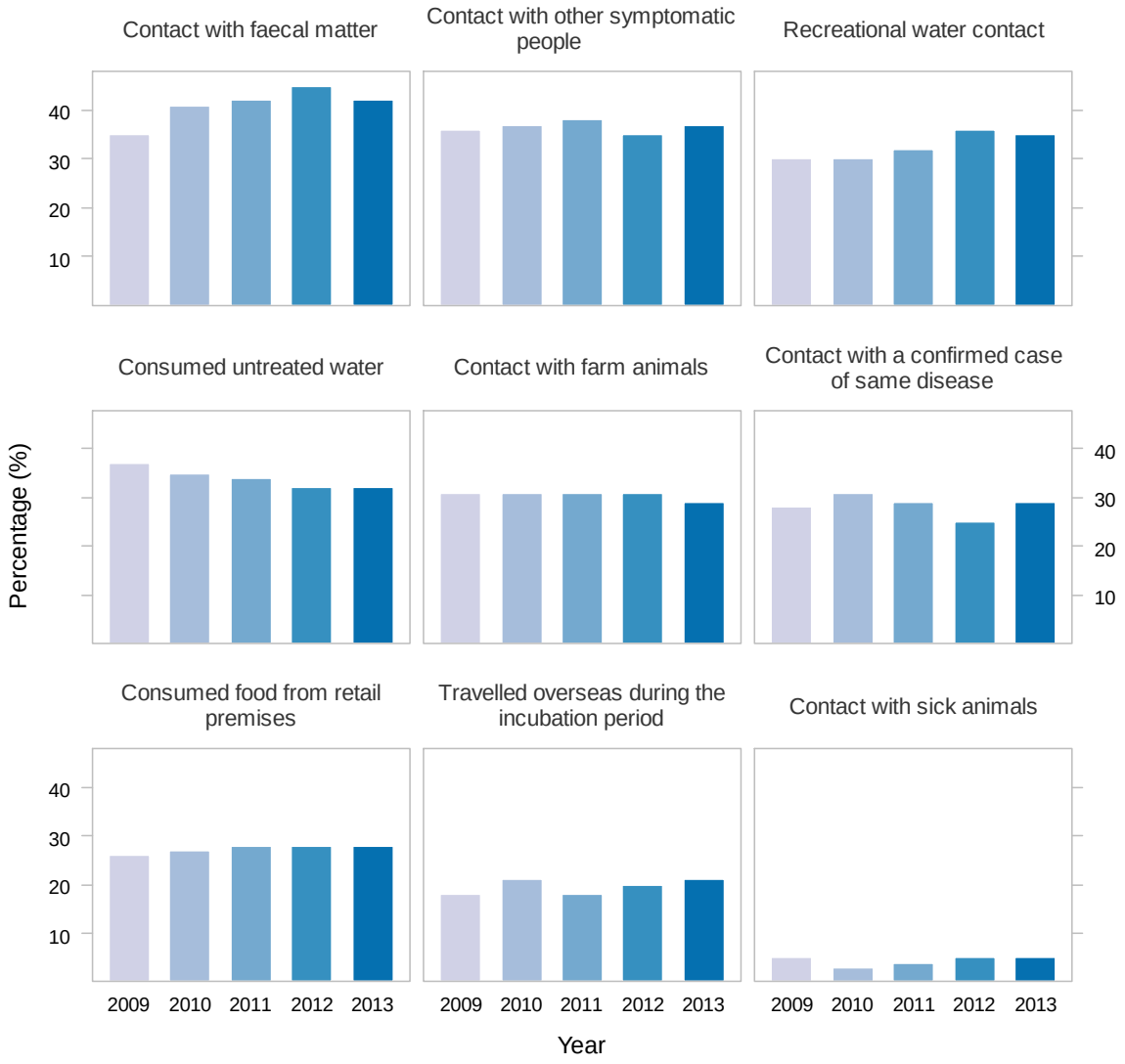
Table 28. Exposure to risk factors reported for giardiasis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Contact with faecal matter	335	463	961	42.0
Contact with other symptomatic people	303	506	920	37.5
Recreational water contact	293	539	897	35.2
Consumed untreated water	237	509	983	31.8
Contact with farm animals	246	599	884	29.1
Consumed food from retail premises	203	522	1004	28.0
Travelled overseas during the incubation period	193	734	802	20.8
Contact with sick animals	39	741	494	5.0

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Over the period 2009 to 2013 there has been a slight increase in the reported contact with faecal matter and recreational water contact. There was a decreasing trend in the percentage of cases reporting consumption of untreated water.

Figure 25. Percentage of cases with exposure to risk factors reported for giardiasis and year, 2009−2013



For cases where information on travel was provided, 20.8% (95% CI 18.3-23.6%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all giardiasis cases, a Poisson distribution can be used to estimate the total number of potentially travel-related cases of giardiasis in 2013. The resultant distribution has a mean of 360 cases (95% CI 299-425).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism was 19.9% (95% CI 18.6-21.2%).

Outbreaks reported as caused by *Giardia* spp.

In 2013, there were 78 *Giardia* spp. outbreaks reported. Ten of these were associated with a suspected or known foodborne source (Table 29). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 29. Giardia spp. outbreaks reported, 2013

Measure	Foodborne *Giardia* spp. outbreaks	All *Giardia* spp. outbreaks
Outbreaks	10	78
Cases	36	333
Hospitalised cases	2	3

The highest number of foodborne *Giardia* spp. outbreaks and associated cases reported in the period from 2004 to 2013 was in 2013 (10 outbreaks and 36 associated cases). Between 2004 and 2012, one to six foodborne *Giardia* spp. outbreaks were reported each year, with the exception of 2009 when no outbreaks were reported (Figure 26).

Figure 26. Foodborne *Giardia* spp. outbreaks and associated cases of reported by year, 2004–2013

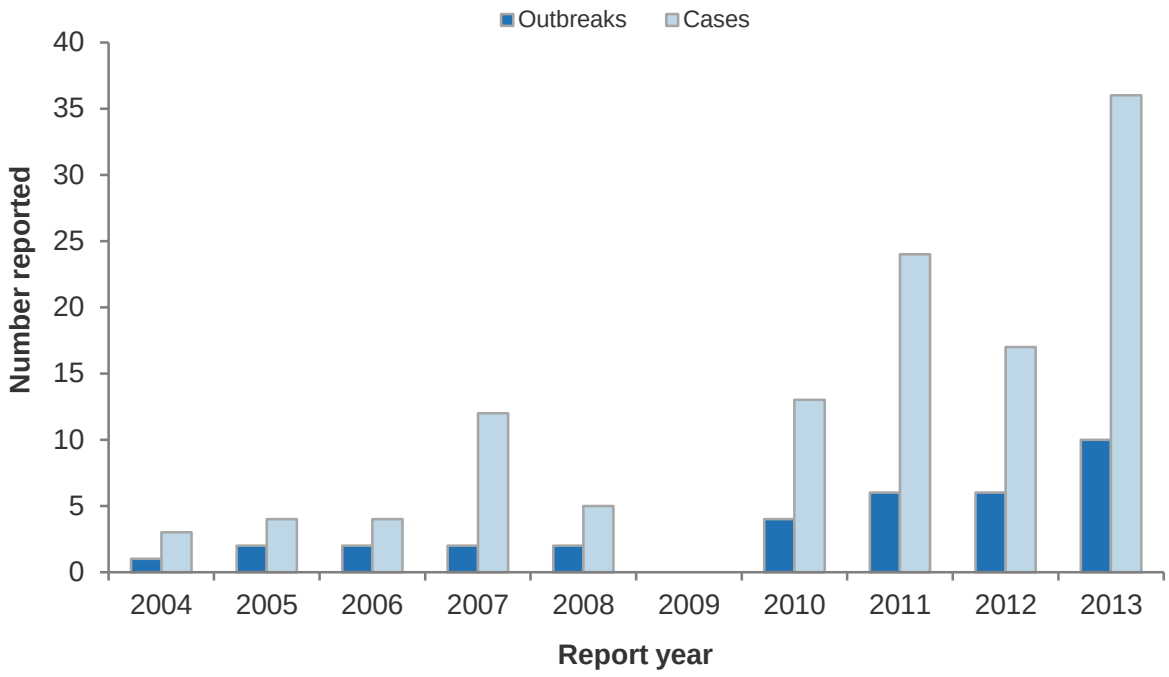


Table 30 contains details of the ten foodborne *Giardia* spp. outbreaks reported in 2013. For all ten outbreaks with a suspected food vehicle, the evidence for foodborne transmission was weak.

Table 30. Details of foodborne *Giardia* spp. outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Waikato	Feb	Unknown	Private home	Private home	2C
Waikato	Mar	Raw milk	Private home	Private home	4C, 2P
Waikato	Apr	Unknown	Private home/Childcare centre	Private home	2C, 1P
Waikato	May	Unknown	Private home/motel	Overseas	2C, 1P
Waikato	Jun	Unknown	Unknown	Overseas	2C
Waikato	Aug	Unknown	Unknown	Overseas	5C
Auckland	Aug	Unknown	Other institution	Overseas	1C, 2P
Manawatu	Aug	Raw milk	Private home	Farm	5C
Auckland	Sep	Unknown	Private home	Private home	5C
Waikato	Oct		Private home	Private home	1C, 1P

PHU: Public Health Unit, C: confirmed, P: probable.

In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to food-associated *Giardia* spp. outbreaks.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Hepatitis A

Summary data for hepatitis A in 2013 are given in Table 31.

Table 31. Summary of surveillance data for hepatitis A, 2013

Parameter	Value in 2013	Source
Number of notified cases	91	EpiSurv
Notification rate (per 100 000)	2.0	EpiSurv
Hospitalisations (% of notifications)[a]	39 (42.9%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Travel-related cases (%)[a]	31 (34.1%)	EpiSurv
Estimated food-related cases	NE	

NE = not estimated, no information is available on the food attributable proportion of hepatitis A in New Zealand.

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

Case definition

Clinical description: Following a prodrome of fever, malaise, anorexia, nausea or abdominal discomfort, there is jaundice, elevated serum aminotransferase levels and sometimes an enlarged tender liver. Children are often asymptomatic and occasionally present with atypical symptoms, including diarrhoea, cough, coryza or arthralgia. Jaundice is very unusual in children younger than 4 years, and 90% of cases in the 4–6 years age group are anicteric.

Laboratory test for diagnosis: Positive hepatitis A-specific IgM in serum (in the absence of recent vaccination).

Case classification:

Probable: A clinically compatible illness that is epidemiologically linked to a confirmed case.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Hepatitis A cases reported in 2013 by data source

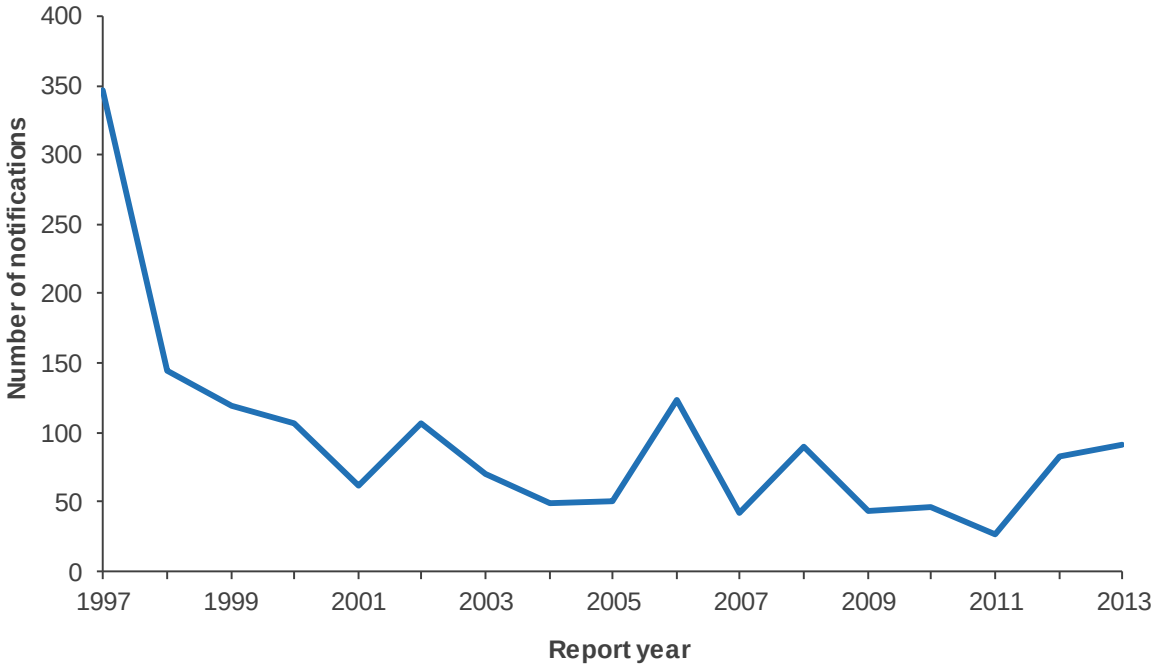
During 2013, 91 notifications (2.0 cases per 100 000 population) of hepatitis A and no resulting deaths were reported in EpiSurv.

The ICD-10 code B15 was used to extract acute hepatitis A hospitalisation data from the MoH NMDS database. Of the 39 hospital admissions (0.9 admissions per 100 000 population) recorded in 2013, 29 were reported with acute hepatitis A as the primary diagnosis and 10 with acute hepatitis A as another relevant diagnosis.

Notifiable disease data

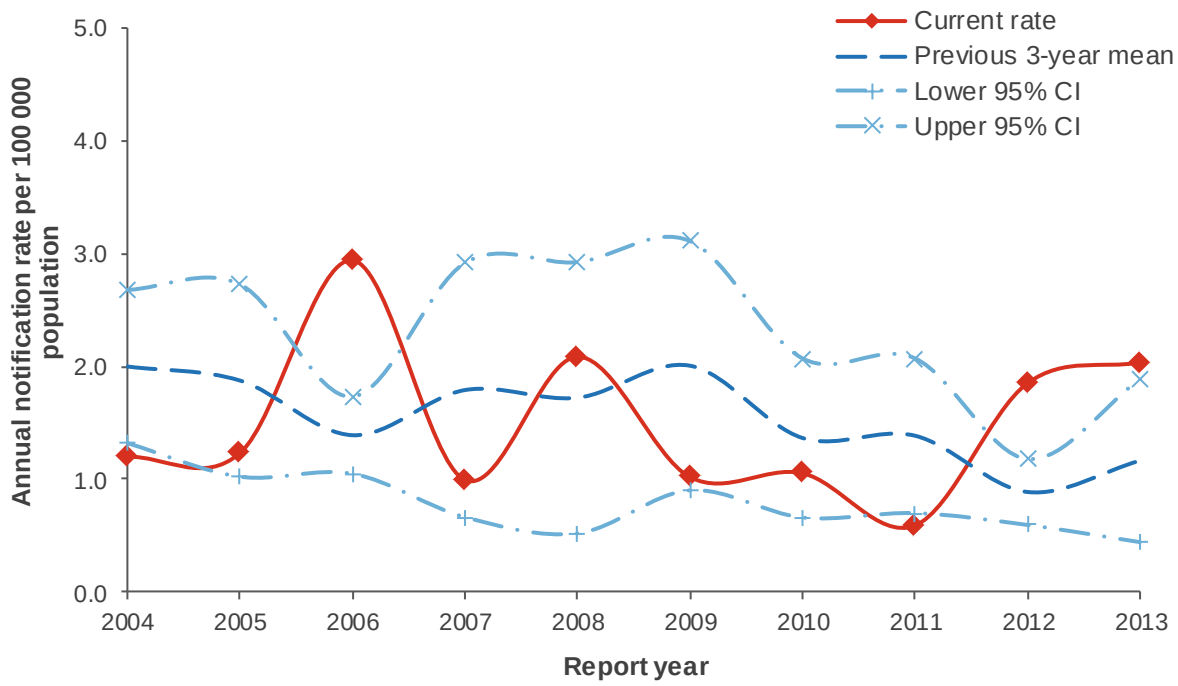
Between 2001 and 2013, the annual number of notifications has remained in the range of 26 (2011) to 123 (2006), having decreased from 347 in 1997 (Figure 27).

Figure 27. Hepatitis A notifications by year, 1997–2013



Hepatitis A notification rates varied throughout the 10-year period, 2004–2013 (Figure 28). The notification rate trend is very similar to the corresponding annual notification trend, showing an increasing trend in 2012 and 2013 following the lowest rate for the ten year period in 2011. The highest hepatitis A notification rate for the period was in 2006 (2.9 per 100 000 population).

Figure 28. Hepatitis A notification rate by year, 2004–2013



In 2013, the number and rate of hepatitis A notifications and hospitalisations were higher for females compared to males (Table 32).

Table 32. Hepatitis A cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	41	1.9	18	0.8
Female	50	2.2	21	0.9
Total	**91**	**2.0**	**39**	**0.9**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population

In 2013, the highest notification rate was for the less than 20 years age group (4.3 per 100 000 population, 51 cases), followed by the 20 to 39 years age group (2.1 per 100 000, 25 cases). The hospitalisation rate was similar for the less than 20 years age group, 20 to 39 and 40 to 59 age groups (11-12 cases) (Table 33).

Table 33. Hepatitis A cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<20	51	4.3	11	0.9
20 to 39	25	2.1	12	1.0
40 to 59	11	0.9	11	0.9
60+	4	-	5	0.6
Total	**91**	**2.0**	**39**	**0.9**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

The most commonly reported risk factor for hepatitis A in 2013 was contact with a confirmed case in the previous three months (49.3%) (Table 34).

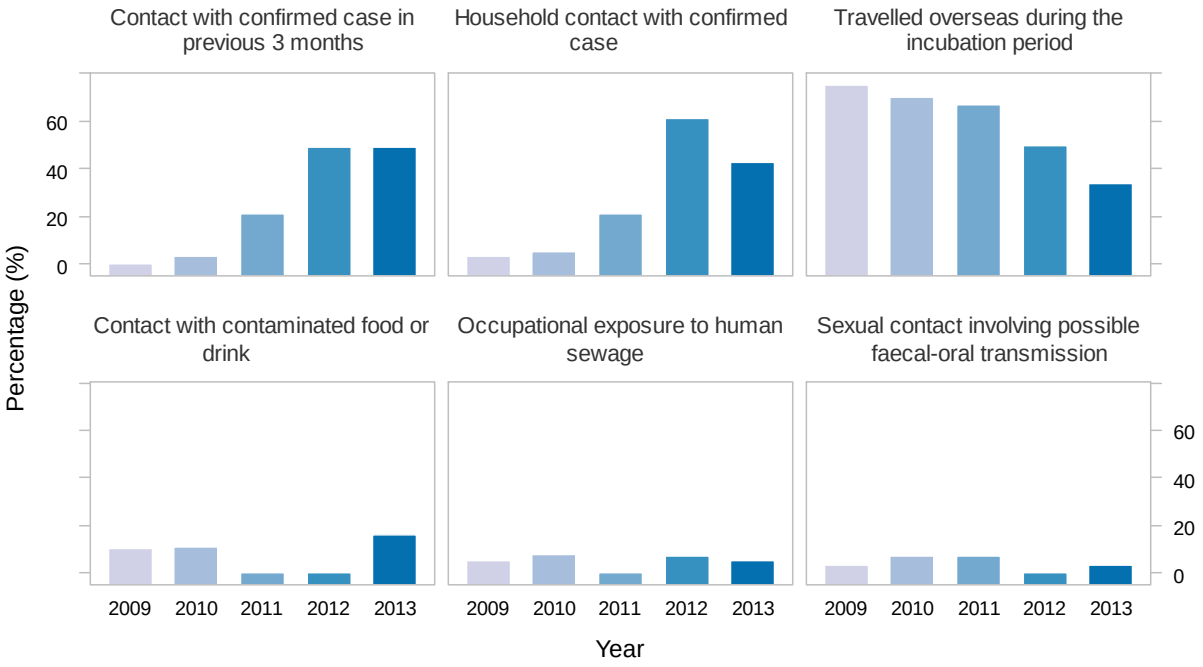
Table 34. Exposure to risk factors reported for hepatitis A notifications, 2013

Risk Factor	Notifications			
	Yes	No	Unknown	%[a]
Contact with confirmed case in previous 3 months	33	34	24	49.3
Household contact with confirmed case	31	41	19	43.1
Travelled overseas during the incubation period	31	60	0	34.1
Contact with contaminated food or drink	6	32	53	15.8
Occupational exposure to human sewage	3	61	27	4.7
Sexual contact involving possible faecal-oral transmission	2	66	23	2.9

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

A decreasing trend in cases reporting overseas travel during the incubation period was seen in the period 2009 to 2013 (Figure 29). In 2012 and 2013, the percentage of cases reporting household contact with a confirmed case and contact with a confirmed case in the previous three months showed an increase compared to previous years. Contact with contaminated food or drink or occupational exposure to human sewage has been reported by a very small proportion of cases each year.

Figure 29. Hepatitis A risk factors by percentage of cases and year, 2009−2013



All cases provided information on international travel, and 34.1% (95% CI 24.7-44.8%) had travelled overseas during the incubation period. If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism was 49.0% (95% CI 42.8-55.9%).

Outbreaks reported as caused by hepatitis A virus

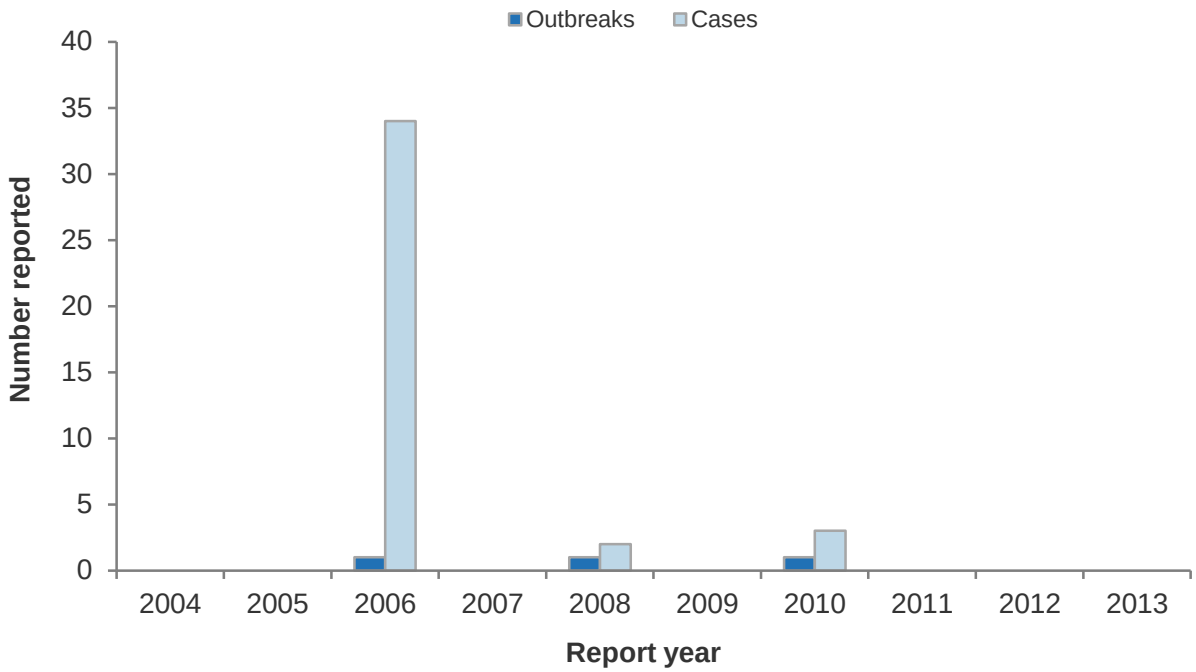
Five outbreaks of hepatitis A virus with 54 cases was reported in 2013. None of the outbreaks were associated with a suspected or known foodborne source (Table 35). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 35. Hepatitis A outbreaks reported, 2013

Measure	Foodborne Hepatitis A outbreaks	All Hepatitis A outbreaks
Outbreaks	0	5
Cases	0	54
Hospitalised cases	0	1

Foodborne hepatitis A virus outbreaks are rare with only three outbreaks reported in the period 2004 to 2013 (2006, 2008 and 2010) (Figure 30). Although occurring infrequently, foodborne outbreaks of hepatitis A virus can be associated with many cases (34 cases for the outbreak reported in 2006), although this was not so for the food-associated outbreaks in 2008 and 2010 (2 cases and 3 cases respectively).

Figure 30. Foodborne hepatitis A virus outbreaks and associated cases reported by year, 2004–2013



In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to food-associated hepatitis A virus outbreaks.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Histamine (scombroid) fish poisoning

Case definition

Clinical description:	Tingling and burning sensation around mouth, facial flushing, sweating, nausea and vomiting, headache, palpitations, dizziness and rash.
Laboratory test for diagnosis:	Detection of histamine levels ≥ 50mg/100 g fish muscle.
Case classification:	Not applicable.

Histamine (scombroid) fish poisoning cases reported in 2013 by data source

Nine cases of histamine (scombroid) fish poisoning and no resulting deaths were reported in EpiSurv during 2013. Note that not every case of histamine (scombroid) fish poisoning is necessarily notifiable, only those where there is a suspected common source.

The ICD-10 code T61.1 was used to extract scombroid fish poisoning hospitalisation data from the MoH NMDS database. All of the 8 hospital admissions recorded in 2013 were reported with scombroid fish poisoning as the primary diagnosis.

Outbreaks reported as caused by histamine (scombroid) fish poisoning

Three histamine (scombroid) fish poisoning outbreaks were reported in 2013 involving 21 associated cases, including one case which was hospitalised (Table 36). It should be noted that all histamine (scombroid) fish poisoning outbreaks will be categorised as foodborne, as consumption of contaminated fish is the only currently recognised transmission route for this disease.

Table 36. Histamine (scombroid) fish poisoning outbreaks reported, 2013

Measure	Foodborne histamine fish poisoning outbreaks	All histamine fish poisoning outbreaks
Outbreaks	3	3
Cases	21	21
Hospitalised cases	1	1

Between 2004 and 2013 the number of histamine (scombroid) fish poisoning outbreaks reported each year ranged from one to six (Figure 31). The highest number of outbreaks was reported in 2004 (6 outbreaks, 21 cases) and the highest total number of associated cases was reported in 2004 and 2013 (21 cases).

Figure 31. Histamine (scombroid) fish poisoning outbreaks and associated cases reported by year, 2004–2013

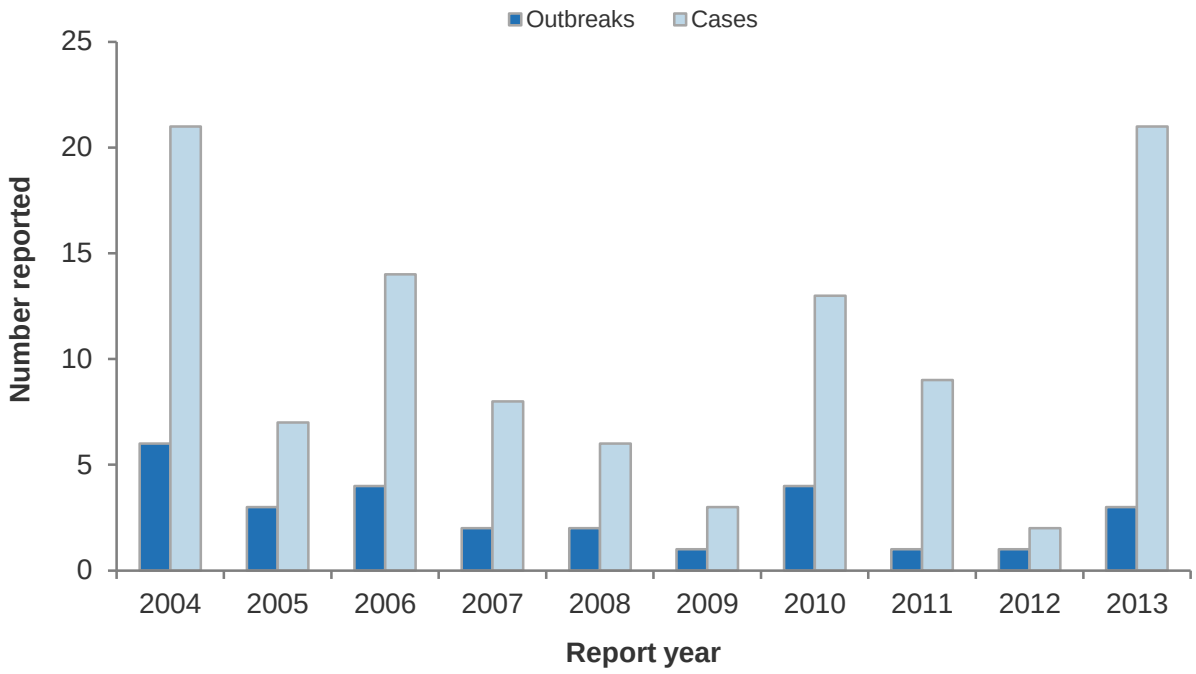


Table 37 contains details of the three histamine fish poisoning outbreak reported in 2013.

Table 37. Details of histamine (scombroid) fish poisoning outbreak, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Tauranga	Feb	Kahawai fish	Private home	Private home	4C, 7P
Auckland	Mar	Trevally fish	Supermarket/ delicatessen	Commercial food	6P
Auckland	Jun	Smoked kingfish and tarakihi	Other setting	Restaurant/cafe/bakery	4C

PHU: Public Health Unit, C: confirmed, P: probable.

In 2013, one left-over fish sample was submitted to ESR's Public Health Laboratory relating to the Tauranga histamine fish poisoning outbreak. The left over fish had high levels of histamine present (520-2000 mg/kg). The fish was caught during recreational fishing activities.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Listeriosis

Summary data for listeriosis in 2013 are given in Table 38.

Table 38. Summary of surveillance data for listeriosis, 2013

Parameter	Value in 2013	Source
Number of notified cases[a]	19	EpiSurv
Notification rate (per 100 000)	0.42	EpiSurv
Hospitalisations (% of notifications)[b]	24 (126%)	MoH NMDS, EpiSurv
Deaths (%)[b]	5 (24%)	EpiSurv
Travel-related cases (%)[b]	4 (20.0%)	EpiSurv
Estimated food-related cases (%)[c]	13 (87.8%)	Expert consultation

[a] Includes non-perinatal (14) and perinatal cases (5).
[b] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.
[c] For estimation of food-related cases the proportions derived from expert consultation exclude travel-related cases.

Case definition

Clinical description: Listeriosis most commonly presents with diarrhoea, often associated with fever, myalgia and vomiting. Bacteraemia most often occurs in pregnant women (usually in the third trimester), the elderly and immunosuppressed. In pregnant women, the foetus may become infected, sometimes leading to miscarriage, stillbirth, premature delivery, newborn septicaemia or meningitis. The elderly and immunosuppressed may present with septicaemia, meningitis or pyogenic foci of infection.

Laboratory test for diagnosis: Isolation of *Listeria monocytogenes* from a normally sterile site, including the foetal gastrointestinal tract.

Case classification:

Probable — Not applicable.

Confirmed — A clinically compatible illness that is laboratory confirmed.

Cases can be further classified, if appropriate, as follows:

Perinatal — A case occurring in an infant from 7 days before birth until 7 days after birth.

Listeriosis cases reported in 2013 by data source

During 2013, 19 notifications (0.4 cases per 100 000 population) of listeriosis were reported in EpiSurv, of which five were perinatal. Nineteen cultures of *L. monocytogenes* were received by the ESR Special Bacteriology Laboratory.

The ICD-10 code A32 was used to extract listeriosis hospitalisation data from the MoH NMDS database. Of the 24 hospital admissions (0.5 admissions per 100 000 population) recorded in 2013, 13 were reported with listeriosis as the primary diagnosis and 11 with listeriosis as another relevant diagnosis.

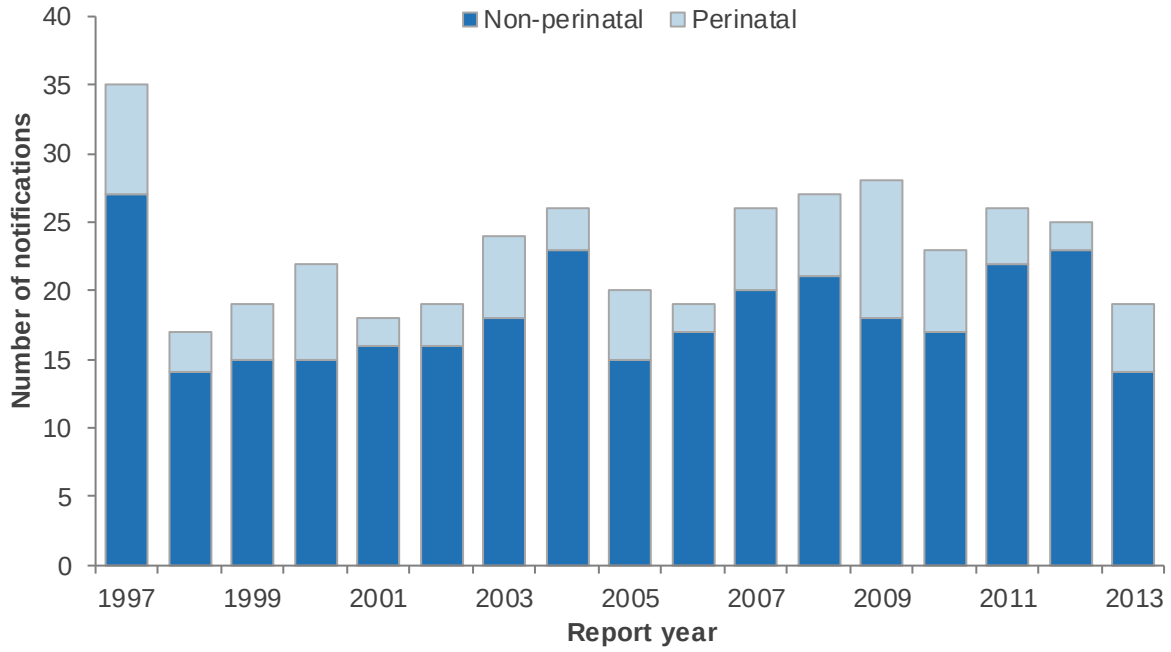
Two deaths resulting from non-perinatal listeriosis and three perinatal deaths were recorded in EpiSurv in 2013.

It has been estimated by expert consultation that 87.8% (95th percentile credible interval: 57.9% to 98.5%) of listeriosis incidence is due to foodborne transmission. It was further estimated that approximately 55% of foodborne transmission was due to consumption of ready-to-eat meats.

Notifiable disease data

Between 1997 and 2013, the number of listeriosis notifications has fluctuated between 17 (1998) and 28 (2009) each year, with the exception of 35 notifications reported in 1997 (Figure 32). In 2013, five notifications were reported as perinatal, which is comparable to previous years.

Figure 32. Listeriosis non-perinatal and perinatal notifications by year, 1997–2013



In 2013, the rate of notifications for listeriosis was higher for females (0.5 per 100 000 population, 12 cases) than males (0.3 per 100 000, 7 cases). The number and rate of hospitalisations were also higher for females than males (Table 39). It should be noted that case details for perinatal cases are those for the mother, so the female cases will include all 5 perinatal cases.

Table 39. Listeriosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	7	0.3	9	0.4
Female	12	0.5	15	0.7
Total	**19**	**0.4**	**24**	**0.5**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

In 2013, notification rates for listeriosis were highest in the 60 years and over age group for both the notifications (1.0 per 100 000 population, 9 cases) and hospitalisations (0.9 per 100 000, 8 admissions) (Table 40). The two non-perinatal deaths reported in 2013 were in the 70 years and over age group.

Table 40. Listeriosis cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.[b]	Rate[c]	No.	Rate[c]
<20	1	-	1	-
20 to 39	6	0.5	10	0.8
40 to 59	3	-	5	0.4
60+	9	1.0	8	0.9
Total	**19**	**0.4**	**24**	**0.5**

[a] MoH NMDS data for hospital admissions
[b] For perinatal cases the age reported is the mother's age
[c] per 100 000 of population (rate not calculated when fewer than five cases reported)

During 2013, the most common risk factors reported for non-perinatal listeriosis cases were having an underlying illness (64.3%) and received immunosuppressive drugs (61.5%) (Table 41).

Table 41. Exposure to risk factors reported for listeriosis (non-perinatal) notifications, 2013

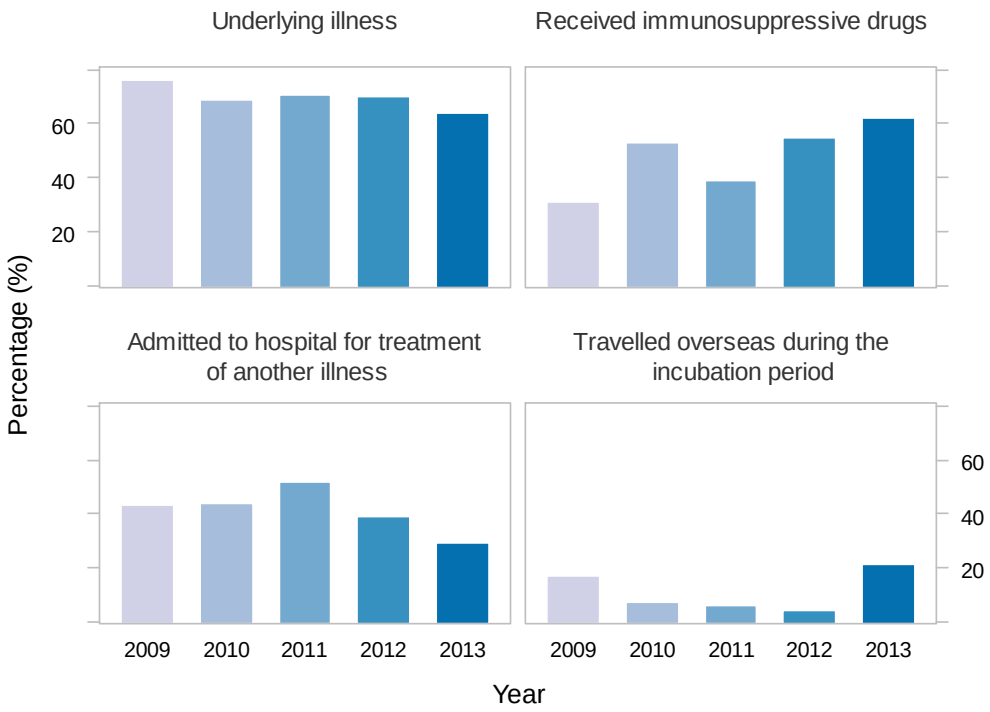
Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Underlying illness	9	5	0	64.3
Received immunosuppressive drugs	8	5	1	61.5
Admitted to hospital for treatment of another illness	4	10	0	28.6
Travelled overseas during the incubation period[b]	3	12	4	21.4

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

[b] Travel information is collected for all cases, while information on other risk factors is only collected for non-perinatal cases.

Having an underlying illness was the risk factor most commonly associated with listeriosis cases each year between 2009 and 2013. There is an increasing trend over the last five years in the percentage of cases reporting having received immunosuppressive drugs (Figure 33).

Figure 33. Percentage of cases with exposure to risk factors reported for listeriosis (non-perinatal) and year, 2009−2013



For cases where information on travel was provided, 20.0% (95% CI 4.3-48.1%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all listeriosis cases, a Poisson distribution can be used to estimate the total number of potentially travel related cases of listeriosis in 2013. The resultant distribution has a mean of 4 cases (95% CI 0-11).

Outbreaks reported as caused by *Listeria* spp.

There were no *Listeria* spp. outbreaks reported in 2013. Since 2004 there have been two *Listeria* spp. outbreaks reported. There was an outbreak with two associated cases in 2009 and a foodborne outbreak with six associated cases in 2012. An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Listeria monocytogenes types commonly reported

ESR's Special Bacteriology Laboratory reported a total of 19 cases infected with *L. monocytogenes* during 2013.

Table 42 shows the number of cases and percentage of *L. monocytogenes* serotypes reported by the Special Bacteriology Laboratory at ESR between 2009 and 2013. The number of cases with serotype O4 has decreased each year in the period 2009 to 2013.

Table 42. *L. monocytogenes* serotypes identified by the Special Bacteriology Laboratory, 2009–2013

Serotype	2009		2010		2011		2012		2013	
	No.	%	No.	%	No.	%	No.	%	No.	%
O4	25	86.2	16	72.7	15	57.7	12	48.0	7	36.8
O1/2	4	13.8	6	27.3	11	42.3	13	52.0	12	63.2
Total	**29**		**22**		**26**		**25**		**19**	

Recent surveys

Microbiological survey of pre-packaged fresh leafy salads at retail in New Zealand

A microbiological survey was conducted on pre-packaged fresh leafy salads available at retail in New Zealand [17]. A total of 307 samples were collected from three major cities over a one-year period. Products purchased were those packaged by the producer and not known to be handled or re-packaged by the retailer. Samples were tested at the end of the 'best before' date. No *L. monocytogenes* were detected in any of the samples. Nineteen samples (6.2%) were positive for other *Listeria* spp., including *L. innocua, L. seeligeri, L. welshimeri, L. ivanovii* and *L. grayi*.

A microbiological survey of New Zealand produced ready-to-eat poultry meat – A pilot study

A pilot microbiological survey was undertaken on packaged ready-to-eat (RTE) poultry meats available at retail in New Zealand [20]. A total of 104 single samples were collected according to a market share-based sampling plan. Fifty-two samples were collected from each of two sampling strata consisting of 'large' and 'medium' processors (3 processors) in stratum one and 'small' processors (15 processors) in stratum two. Samples collected were predominately smoked chicken products and were all packaged by the processor and were not known to be handled or re-packaged by the retailer.

One sample was found to be positive for *L. monocytogenes* (<50 CFU/g) and this sample was produced by one of the small processors in stratum two. Nine samples (17.4%) from six processors in stratum two were also found to contain other *Listeria* spp., while none of the products from processors in stratum one contained *Listeria* spp. When adjusted for market share, the survey results suggest a product prevalence in retail RTE poultry meats of 0.15% (0-0.46%: 2.5-97.5th percentile range) for *L. monocytogenes* and 1.4% (0.6-2.3%: 2.5-97.5th percentile range) for *Listeria* spp.

Comparison of processors of different size, based on throughput of product, with the prevalence of samples positive for any *Listeria* spp. suggested that RTE product produced by the smaller processors in stratum two had statistically greater risk of contamination ($P<0.003$) than product from the larger processors in stratum one. The *L. monocytogenes* strain isolated was serotype 1/2 and was pulsotype

Asc0031:Apa0001 which has previously been observed in RTE ham and clinical cases in New Zealand.

Microbiological survey of ready-to-eat red meats at retail in New Zealand

A microbiological survey was undertaken on packaged ready-to-eat (RTE) red meats available at retail in New Zealand [21]. A total of 1485 samples (297 lots of 5 samples) were collected according to a sampling plan based on market share and regulatory regimes (Animal Products Act (APA) 1999 and Food Act 1981) and tested against the microbiological limits specified in Australia New Zealand Food Standards Code (FSC) 1.6.1.

Products collected were predominantly made from pork, beef or venison and included cooked, cured or salted meats such as hams, corned beef and other roasted meats, luncheon-type sausages, cooked salamis and dried meats. Products purchased were packaged by the producer and where possible were not known to be handled or re-packaged by the retailer. The five samples in each lot were tested as a composite for the presence/absence of *Listeria monocytogenes* and other *Listeria* spp. at the end of the manufacturers' stated shelf lives. Individual samples within a positive lot were subsequently enumerated for *L. monocytogenes*.

When adjusted for market share and regulatory regime, the survey results suggest a national prevalence of *L. monocytogenes* in retail RTE red meats of 3% (1.9-4.1%: 2.5-97.5th percentile range). Enumeration of *L. monocytogenes* in individual samples from positive lots gave results below the countable range (<50 CFU/g) in 82 out of 95 samples. Thirteen samples were found to contain between 50 and 500 CFU/g *L. monocytogenes* but all of these samples were manufactured by one operator. Pulsed field gel electrophoresis (PFGE) typing of all of the *L. monocytogenes* strains obtained from the survey identified 12 different pulsotypes. Different pulsotypes were often identified in samples from the same operator sampled on separate occasions. A total of 46 lots (15.5%) contained *Listeria* spp. (including *L. monocytogenes*).

Relevant New Zealand studies and publications

Reports

PFGE typing data using two restriction enzymes were obtained for 503 isolates of *L. monocytogenes* obtained from food, food contact surfaces and human clinical cases [22]. Isolates originated from samples taken in 1999 to 2013, although for the first five years of that period only clinical isolates are available. A database of the typing data has been produced and forms the basis of reference information to assist with future investigations of foodborne disease. Twenty-five PFGE types were represented by five or more isolates. Seven of these 25 profiles were only found among human case isolates whereas another four profiles were only found among food isolates. Fourteen of the 25 profiles therefore were represented by isolates from both clinical and food samples.

Relevant regulatory developments

During 2013, MPI published a further guidance document for the control of *Listeria monocytogenes* in ready-to-eat foods [23].

Norovirus infection

Case definition

Clinical description:	Gastroenteritis usually lasting 12-60 hours.
Laboratory test for diagnosis:	Detection of norovirus in faecal or vomit specimen or leftover food.
Case classification:	
Probable	A clinically compatible illness.
Confirmed	A clinically compatible illness that is laboratory confirmed, OR a clinically compatible illness and a common exposure associated with a laboratory confirmed case.

Norovirus infection cases reported in 2013 by data source

During 2013, 73 notifications (1.6 cases per 100 000 population) of norovirus and no resulting deaths were reported in EpiSurv. It should be noted that not every case of norovirus infection is notifiable; only those that are part of a common source outbreak or from a person in a high risk category.

The ICD-10 code A08.1 was used to extract norovirus infection hospitalisation data from the MoH NMDS database. Of the 104 hospital admissions (2.3 admissions per 100 000 population) recorded in 2013, 45 were reported with norovirus infection as the primary diagnosis and 59 with norovirus infection as another relevant diagnosis.

It has been estimated by expert consultation that 32.7% (95th percentile credible interval: 10.0% to 66.4%) of norovirus infections are due to foodborne transmission. It was further estimated that approximately 24% of norovirus infections due to foodborne transmission were due to consumption of seafood.

Outbreaks reported as caused by norovirus

In 2013, 16 (9.5%) of the norovirus outbreaks and 172 (4.7%) of the associated cases were reported as foodborne (Table 43). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. Norovirus outbreaks accounted for 25.9% (169/652) of all outbreaks and 51.6% (3685/7137) of all associated cases reported in 2013. There were two deaths associated with norovirus outbreaks.

Table 43. Norovirus outbreaks reported, 2013

Measure	Foodborne norovirus infection outbreaks	All norovirus infection outbreaks
Outbreaks	16	169
Cases	172	3685
Hospitalised cases	7	43

Between 2004 and 2013 the number of foodborne norovirus outbreaks reported each year was variable, ranging from 10 (2007) to 30 (2009) (Figure 34).The total number of cases associated with these outbreaks each year ranged from 131 (2005) to 618 cases (2008).

Figure 34. Foodborne norovirus outbreaks and associated cases reported by year, 2004–2013

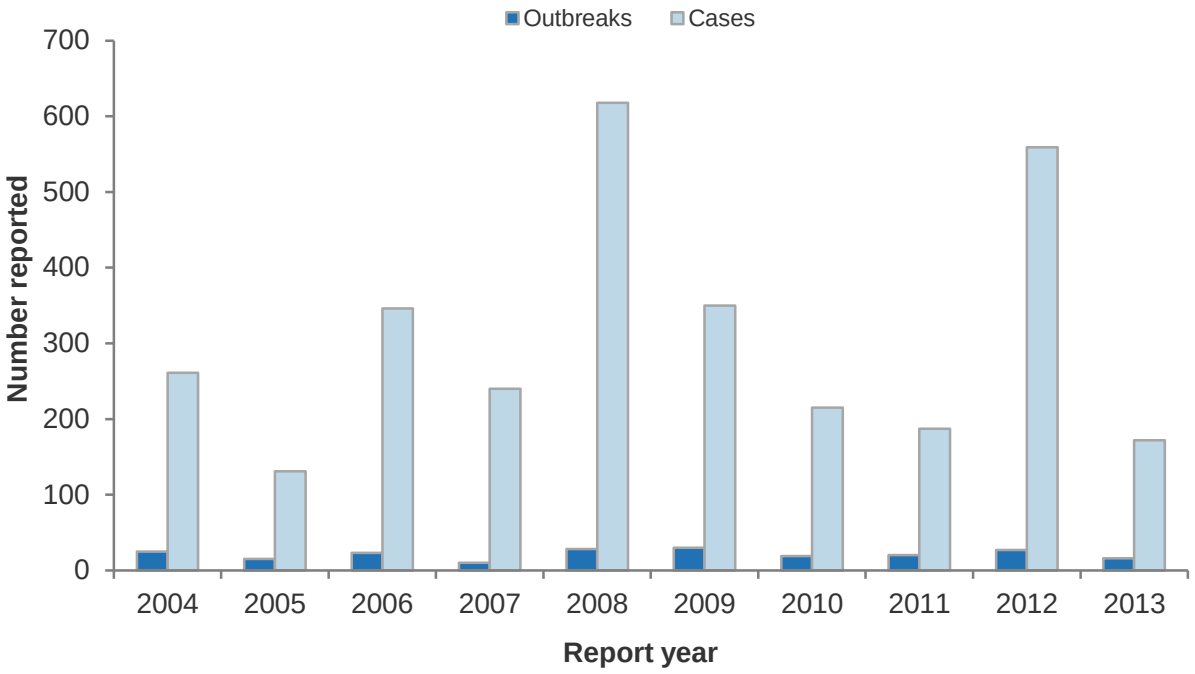


Table 44 contains details of the 16 foodborne norovirus outbreaks reported in 2013, including two with a suspected food vehicle identified. The evidence was weak for the suspected food vehicle in these outbreaks.

Table 44. Details of foodborne norovirus outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Otago	Jan	Unknown	Hospital (acute care)	Private home	1C, 3P
Wellington	Jan	Unknown	Other food outlet	Unknown	3C, 4P
Auckland	Mar	Unknown	Home	Unknown	1C, 1P
Auckland	Apr	Unknown	Restaurant/cafe/bakery	Unknown	3C, 5P
Napier	Apr	Unknown	Takeaway	Unknown	3C
Auckland	May	Unknown	Camp	Unknown	2C, 10P
Auckland	Jun	Meat pizza, vegetarian pizza, prawns and seafood with tuna and salmon	Restaurant/cafe/bakery	Unknown	4C, 2P
Otago	Jun	Contaminated food (avocado sandwiches & chocolate cake) prepared by an infected food handler	Other setting	Unknown	6C, 2P
Otago	Jul	Unknown	Restaurant/cafe/bakery	Unknown	3C, 42P
West Coast	Aug	Unknown	Long term care facility	Unknown	22C
Auckland	Sep	Unknown	Restaurant/cafe/bakery	Unknown	1C, 2P
Waikato	Sep	Unknown	Restaurant/cafe/bakery	Unknown	2C, 24P
Otago	Oct	Unknown	Restaurant/cafe/bakery-Private home	Unknown	2C, 12P
Wellington	Oct	Unknown	Restaurant/cafe/bakery	Unknown	2C, 2P
Auckland	Oct	Unknown	Restaurant/cafe/bakery-private home	Unknown	3P
Tauranga	Dec	Unknown	Restaurant/cafe/bakery	Unknown	1C, 4P

PHU: Public Health Unit, C: confirmed, P: probable.

Table 45 shows the number of hospitalised cases and total cases by genotypes for the 16 foodborne norovirus outbreaks reported during 2013. The majority of the outbreaks were due to GII.4 (5 outbreaks, 62 cases) and GII.7 (3 outbreaks, 41 cases). Six of the seven cases who were hospitalised were from a single outbreak in Otago in July.

Table 45. Norovirus genotypes reported in foodborne outbreaks, 2013

Norovirus	Outbreaks	Hospitalised cases	Total cases
GII.4	5	62	6
GII.7	3	41	1
GII.2	1	22	0
GII.22/GII.5	1	14	0
GII.7/GII.6	1	8	0
GI.1	1	8	0
GI.9	1	6	0
GI.6	1	4	0
GII.16/GII.13	1	2	0
Genotype unknown	1	0	5

During investigation of suspected foodborne illness outbreaks by ESR's Public Health Laboratory in 2013, samples were received relating to 9 of the 16 food-associated norovirus outbreaks identified in Table 44. Norovirus was detected in faecal samples from cases associated with all of these 9 foodborne

outbreaks. Faecal specimens from food handlers associated with two outbreaks were submitted for analysis, norovirus was not detected. No food samples were submitted for analysis for these outbreaks.

Norovirus types commonly reported

Norovirus genotyping data from ESR's Norovirus Reference Laboratory are shown in Table 46. Note that the data relate to outbreaks not individual cases.

In 2013, genogroup II (GII) was identified in 110/157 (70.1%) outbreaks compared to 208/221 (94.1%) in 2012. Over the period 2008 to 2012, 90.0% (± 3.7) of outbreaks were associated with GII strains. In 2013, genogroup I (GI) was identified in 45/157 (28.7%) outbreaks. Both norovirus GI and GII were identified in two outbreaks. As in previous years, GII.4 was the predominant norovirus genotype identified (57/157, 36.3% outbreaks), followed by GI.4 (23/157 outbreaks, 14.6%) and GII.7 (18/157 outbreaks, 11.5%).

Table 46. Norovirus genotypes identified in outbreaks by the Norovirus Reference Laboratory, 2008–2013

Genotype	2008	2009	2010	2011	2012	2013
Genogroup I	**21**	**25**	**17**	**10**	**9**	**45**
GI untyped	3	2	1	0	1	0
GI.1	0	0	0	0	0	1
GI.2	0	0	0	1	5	1
GI.3	15	0	2	3	0	12
GI.4	1	19	3	1	1	23
GI.5	0	0	0	1	0	1
GI.6	0	4	10	4	2	4
GI.7	0	0	0	0	0	1
GI.8	2	0	1	0	0	0
GI.9	0	0	0	0	0	2
Genogroup II	**147**	**244**	**106**	**149**	**208**	**110**
GII untyped	8	3	7	2	2	0
GII.1	0	0	1	1	1	0
GII.2	0	11	3	3	1	13
GII.3	3	1	11	2	0	0
GII.4	84	214	58	111	160	55
GII.5	0	0	1	0	0	1
GII.6	17	10	5	3	30	4
GII.7	8	1	14	5	1	18
GII.13	0	2	2	2	0	0
GII.17	1	0	0	0	0	0
GII.20	0	0	4	0	0	0
GII.b/GII.3	9	1	0	3	2	0
GII.c/GII.12	15	1	0	2	0	0
GII.12/GII.3	0	0	0	14	3	2
GII.16/GII.2	0	0	0	0	5	0
GII.16/GII.13	0	0	0	0	0	9
Other GII recombinants	2	0	0	1	3	8
Mixed GI and GII	**3**	**2**	**0**	**2**	**4**	**2**[a]
Total	**171**	**271**	**123**	**161**	**221**	**157**

[a] The GII in each of these outbreaks were identified as GII.4

Recent surveys

A microbiological survey was conducted on pre-packaged fresh leafy salads available at retail in New Zealand [17]. A total of 307 samples were collected from three major cities over a one-year period. Products purchased were those packaged by the producer and not known to be handled or re-packaged by the retailer. Samples were tested at the end of the 'best before' date. Norovirus was detected in three samples (1%).

Relevant New Zealand studies and publications

Journal papers

Multiple norovirus outbreaks following catered events in Auckland, New Zealand, in September 2010 were linked to the same catering company and investigated [24]. Retrospective cohort studies were undertaken with attendees of two events: 38 (24.1%) of 158 surveyed attendees developed norovirus-compatible illness. Attendees were at increased risk of illness if they had consumed food that had received manual preparation following cooking or that had been prepared within 45 hours following end of symptoms in a food handler with prior gastroenteritis. All food handlers were tested for norovirus. A recombinant norovirus GII.e/GII.4 was detected in specimens from event attendees and a convalescent food handler.

Relevant regulatory developments

Nil.

Salmonellosis

Summary data for salmonellosis in 2013 are given in Table 47.

Table 47. Summary of surveillance data for salmonellosis, 2013

Parameter	Value in 2013	Source
Number of notified cases	1143	EpiSurv
Notification rate (per 100 000)	25.6	EpiSurv
Hospitalisations (% of notifications)[a]	146 (12.8%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	315 (27.5%)	EpiSurv
Estimated food-related cases (%)[b]	514 (62.1%)	Expert consultation

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.
[b] For estimation of food-related cases the proportions derived from expert consultation exclude travel-related cases.

Case definition

Clinical description: Salmonellosis presents as gastroenteritis, with abdominal pains, diarrhoea (occasionally bloody), fever, nausea and vomiting. Asymptomatic infections may occur.

Laboratory test for diagnosis: Isolation of *Salmonella* species from any clinical specimen.

Case classification:

Probable: A clinically compatible illness that is either a contact of a confirmed case of the same disease, or has had contact with the same common source – that is, is part of a common-source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Salmonellosis cases reported in 2013 by data source

The salmonellosis cases presented here exclude disease caused by *S.* Paratyphi and *S.* Typhi.

During 2013, 1143 notifications (25.6 cases per 100 000 population) of salmonellosis and no resulting deaths were reported in EpiSurv. The Enteric Reference Laboratory at ESR reported 1141 cases infected with non-typhoidal *Salmonella* (25.5 cases per 100 000).

The ICD-10 code A02.0 was used to extract salmonellosis hospitalisation data from the MoH NMDS database. Of the 146 hospital admissions (3.3 admissions per 100 000 population) recorded in 2013, 116 were reported with salmonellosis as the primary diagnosis and 30 with salmonellosis as another relevant diagnosis.

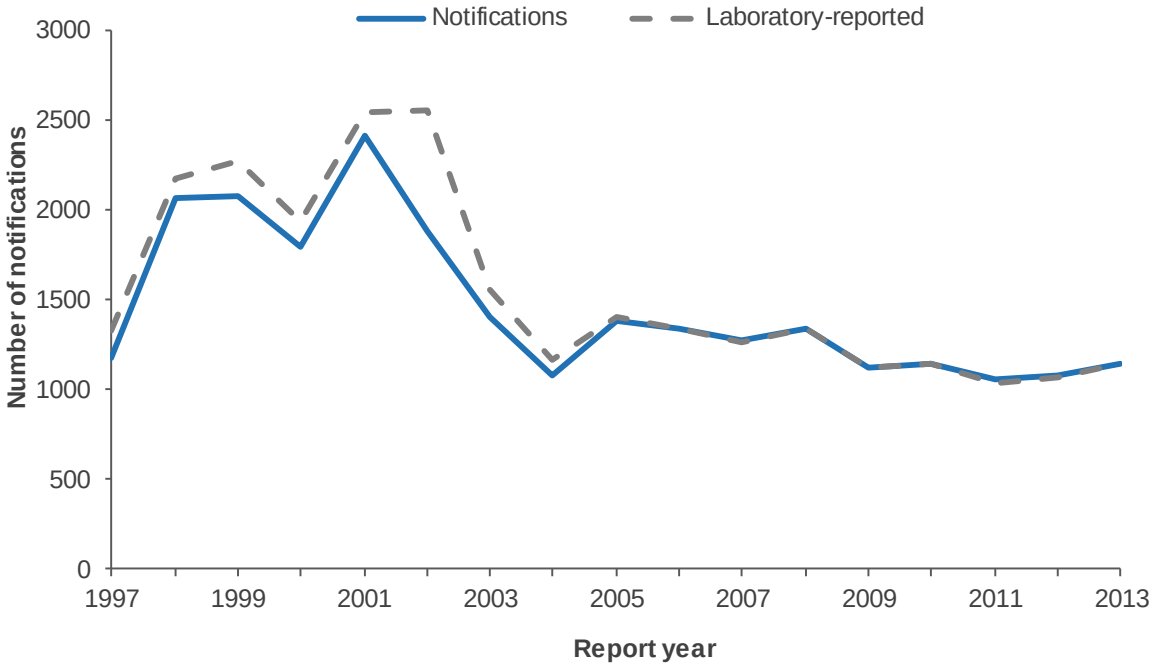
It has been estimated by expert consultation that 62.1% (95th percentile credible interval: 35.2% to 86.4%) of salmonellosis incidence is due to foodborne transmission. It was further estimated that approximately 19% of foodborne transmission was due to transmission via poultry.

Notifiable disease data

Annual notifications have been stable between 2009 and 2013. Following a generally increasing trend of salmonellosis notifications from 1997 to 2001 there was a sharp fall in notifications between 2001 and 2004. The notifications continued to decline until 2009, but at a slower rate. The lowest number of notifications was reported in 2011 (1056 cases) (Figure 35).

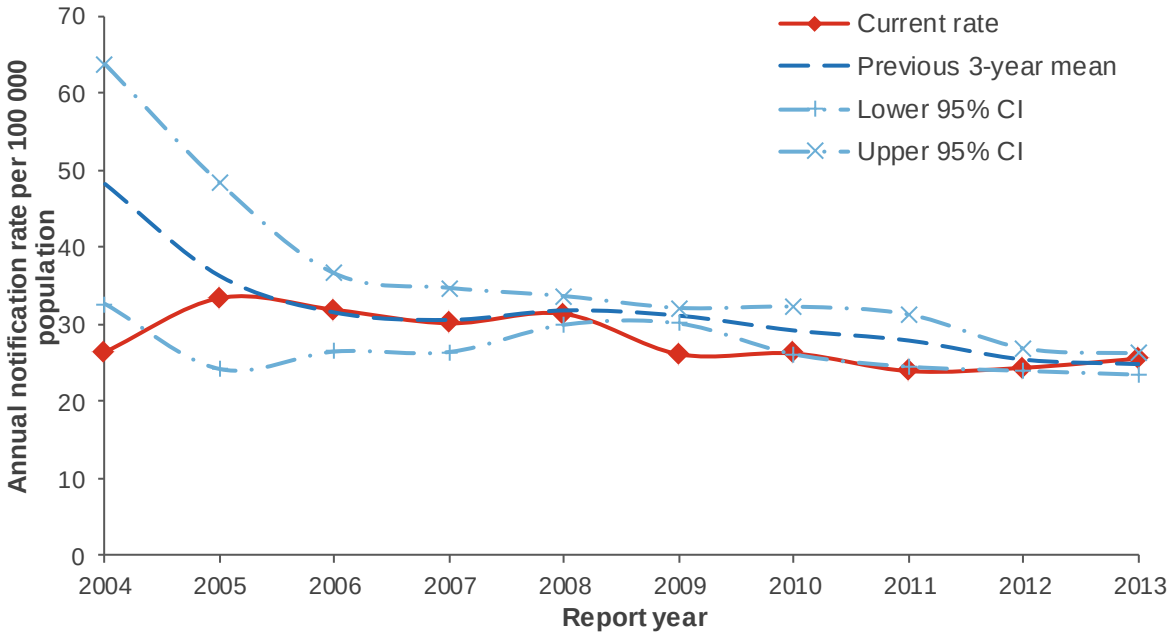
Integration of notification and laboratory data at ESR and the introduction of electronic laboratory reporting of notifiable diseases have reduced the differences between the number of notifications and laboratory reported cases seen prior to 2005.

Figure 35. Salmonellosis notifications and laboratory-reported cases by year, 1997–2013



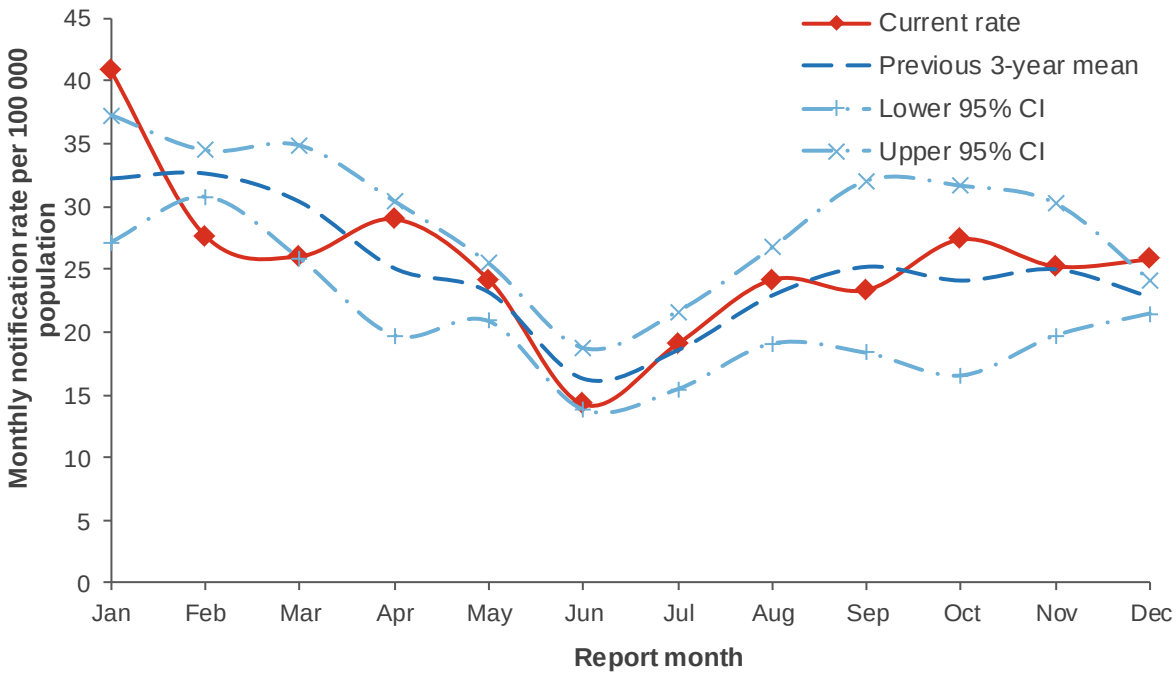
Between 2004 and 2013, the salmonellosis annual notification rate followed a generally decreasing trend with the lowest notification rate in 2011 (23.9 per 100 000 population) (Figure 36).

Figure 36. Salmonellosis notification rate by year, 2004–2013



The number of notified cases of salmonellosis per 100 000 population by month for 2013 is shown in Figure 37. The overall pattern was similar to the historical mean with a higher rate seen in mid summer but lower rates in late summer and early autumn.

Figure 37. Salmonellosis monthly rate (annualised), 2013



Rates of salmonellosis varied throughout the country as illustrated in Figure 38. The highest salmonellosis notification rate in 2013 was for Southern DHB (53.9 per 100 000 population, 167 cases), followed by South Canterbury DHB (36.8 per 100 000, 21 cases), Nelson and Marlborough DHB (36.8 per 100 000, 52 cases) and Tairawhiti DHB (36.4 per 100 000, 17 cases). South Canterbury and Southern DHBs had consistently high salmonellosis notification rates between 2010 and 2013 compared to the rest of the country.

In 2013, the number and rate of notifications were slightly higher for males compared to females. Hospitalisation numbers and rates for salmonellosis showed a similar pattern to the notifications (Table 48).

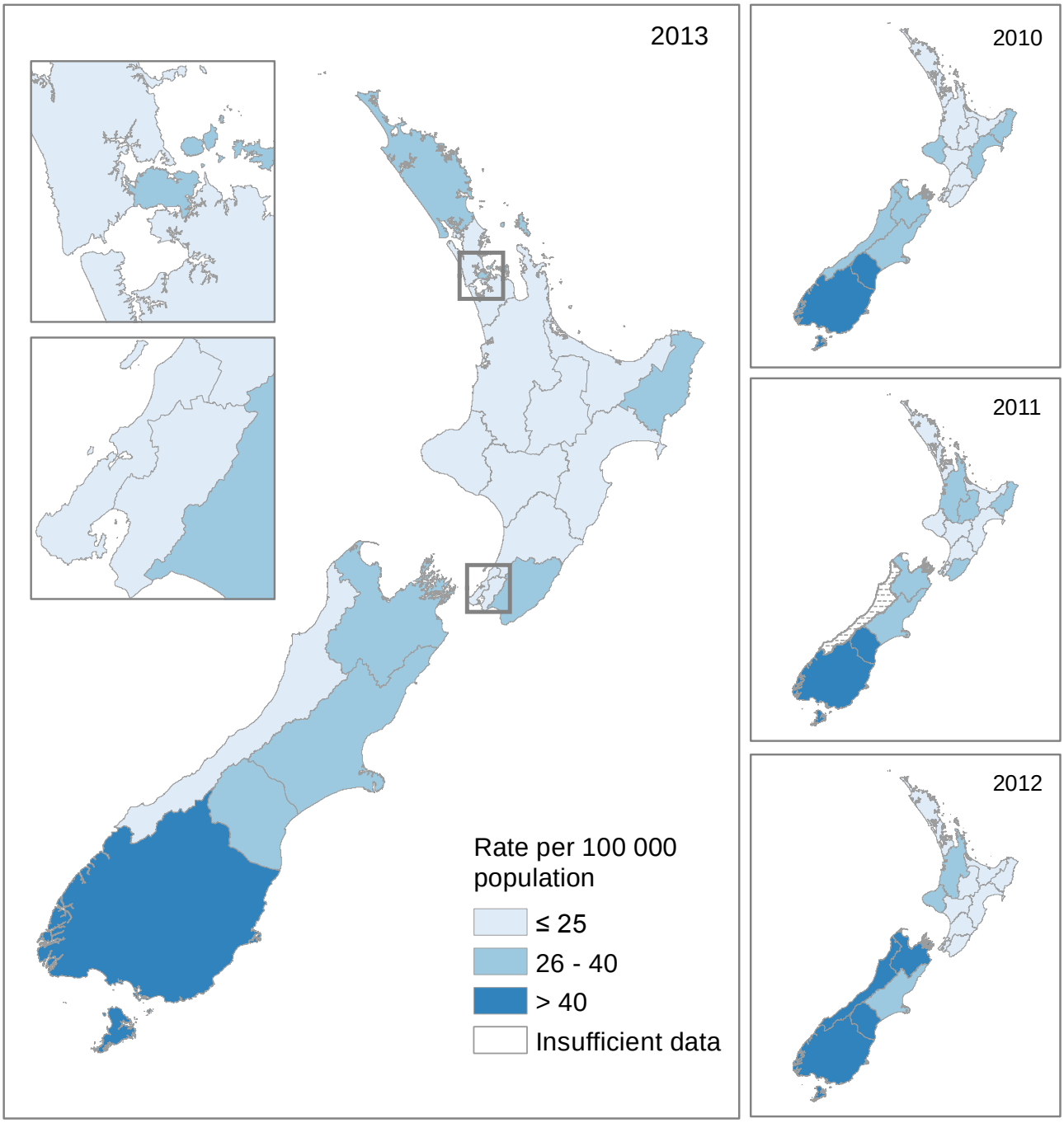
Table 48. Salmonellosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	582	26.4	86	3.9
Female	561	24.7	60	2.6
Total	**1143**	**25.6**	**146**	**3.3**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population

Figure 38. Geographic distribution of salmonellosis notifications, 2010–2013



In 2013, both notification and hospitalisation rates of salmonellosis were highest for the less than 1 year age group (106.9 cases per 100 000 population, 21.7 admissions per 100 000) (Table 49). The 1 to 4 years age group also had high salmonellosis notification rates compared to other age groups.

Table 49. Salmonellosis cases by age group, 2013

Age group	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	64	106.9	13	21.7
1 to 4	202	81.5	14	5.7
5 to 9	66	22.1	7	2.3
10 to 14	40	14.0	1	-
15 to 19	65	21.2	5	1.6
20 to 29	166	26.0	19	3.0
30 to 39	117	20.9	13	2.3
40 to 49	142	22.9	13	2.1
50 to 59	112	19.3	14	2.4
60 to 69	94	21.2	23	5.2
70+	75	17.4	24	5.6
Total	**1143**	**25.6**	**146**	**3.3**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

The most commonly reported risk factors for salmonellosis cases notified during 2013 were consumption of food from retail premises (42.1%) and contact with farm animals (32.3%) (Table 50).

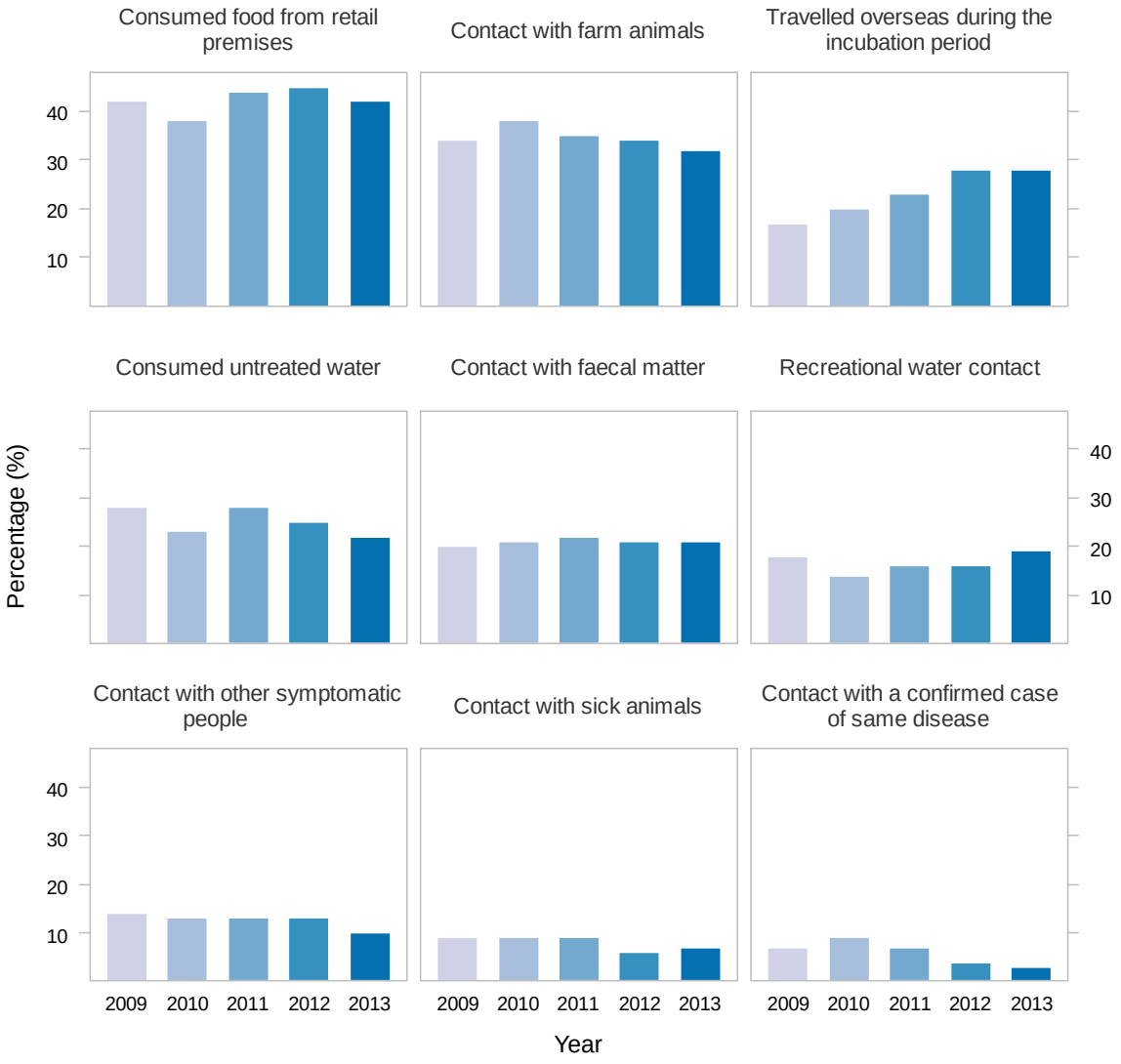
Table 50. Exposure to risk factors reported for salmonellosis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Consumed food from retail premises	238	327	578	42.1
Contact with farm animals	189	397	557	32.3
Travelled overseas during the incubation period	188	495	460	27.5
Consumed untreated water	112	390	641	22.3
Contact with faecal matter	118	437	588	21.3
Recreational water contact	109	465	569	19.0
Contact with other symptomatic people	57	490	596	10.4
Contact with sick animals	34	488	621	6.5

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Between 2009 and 2013 the risk factors associated with salmonellosis have generally occurred in the same order of importance and to a similar magnitude each year (Figure 39). The most commonly reported risk factors for salmonellosis cases each year were consumption of food from retail premises, and contact with farm animals. In the past five years there was an increasing trend in the percentage of cases reporting overseas travel during the incubation period. In contrast to previous years, overseas travel was more common than consumption of untreated water in 2012 and 2013. The percentage of cases reporting contact with farm animals has decreased over the last three years.

Figure 39. Percentage of cases with exposure to risk factors reported for salmonellosis and year, 2009−2013



For cases where information on travel was provided, 27.5% (95% CI 24.2-31.1%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all salmonellosis cases, a Poisson distribution can be used to estimate the total number of potentially travel related cases of salmonellosis in 2013. The resultant distribution has a mean of 315 cases (95% CI 260-373).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism is 24.7% (95% CI 23.1-26.4%).

Outbreaks reported as caused by *Salmonella*

In the following sections the term *Salmonella* refers to serotypes of *Salmonella enterica* subspecies *enterica*, excluding *S.* Typhi and *S.* Paratyphi.

In 2013, there were 18 *Salmonella* outbreaks reported, of which 9 were reported as foodborne (Table 51). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. Four of the seven hospitalisations due to *Salmonella* were associated with foodborne outbreaks.

Table 51. *Salmonella* outbreaks reported, 2013

Measure	Foodborne *Salmonella* spp. outbreaks	All *Salmonella* spp. outbreaks
Outbreaks	9	18
Cases	45	98
Hospitalised cases	4	7

The number of foodborne *Salmonella* outbreaks reported between 2004 and 2013 ranged from zero (2004) to 18 (2005), (Figure 40). The total number of cases associated with the outbreaks has varied over the same period with peaks in 2005, 2008 and 2012.

Figure 40. Foodborne *Salmonella* outbreaks and associated cases reported by year, 2004–2013

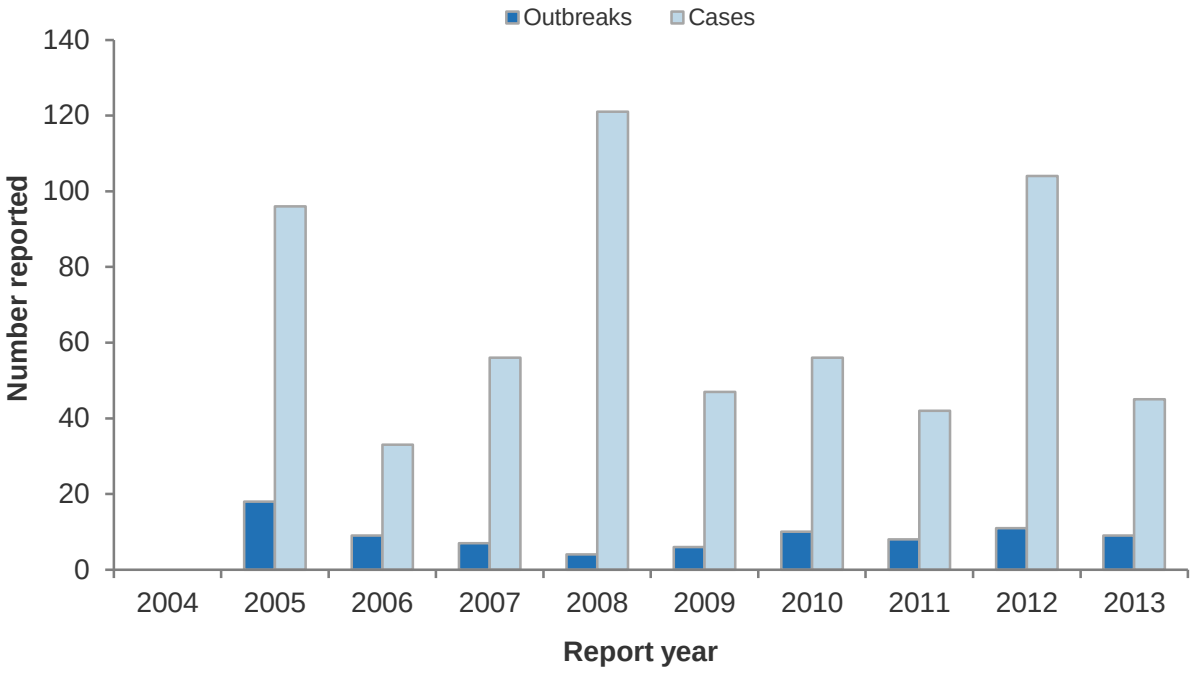


Table 52 contains details of the nine foodborne *Salmonella* outbreaks reported in 2013.

For most outbreaks the evidence linking the outbreak to a suspected food was weak. However, for the outbreaks summarised in Table 52, two (Northland April and West Coast September) were considered to have strong evidence. For one outbreak, *Salmonella* was isolated from the suspected food, while for a second outbreak a food handler at the implicated premises tested positive for *Salmonella*.

Table 52. Details of foodborne *Salmonella* outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Manawatu	Feb	Unknown	Takeaway	Unknown	6C
Otago	Mar	Unknown	Restaurant/cafe/bakery	Unknown	3C
Auckland	Apr	Unknown	Restaurant/cafe/bakery-Private home	Private home	3C
Northland	Apr	Boiled egg and ham sandwich	Restaurant/cafe/bakery	Unknown	10C
Waikato	May	Unknown	Caterers	Unknown	1C, 1P
Auckland	Aug	Unknown	Takeaway/other food outlet	Unknown	1C, 1P
West Coast	Sep	Unknown	Restaurant/cafe/bakery	Unknown	2C
Tauranga	Dec	Unknown	Takeaway	Unknown	5C
Wellington	Dec	Unknown	Workplace-restaurant/café/bakery	Unknown	3C, 9P

PHU: Public Health Unit, C: confirmed, P: probable.

During investigation of suspected foodborne illness outbreaks by ESR's Public Health Laboratory in 2013, samples were submitted relating to six of the foodborne *Salmonella* outbreaks identified in Table 52. *Salmonella* was detected in a boiled egg and ham sandwich related to the Northland outbreak. In three other outbreaks food samples of tahini, herbs and spices, vegetables and Middle Eastern ingredients were tested for *Salmonella*, but with no significant findings. Faecal samples were received from three outbreaks, with *Salmonella* detected in one sample from the September outbreak on the West Coast.

Salmonella types commonly reported

1. Human isolates

Isolates from 1141 cases infected with non-typhoidal *Salmonella* were typed by the ESR Enteric Reference Laboratory during 2013. Of these cases, 433 (38.0%) were *Salmonella* Typhimurium.

Table 53 shows the number of cases by *Salmonella* type reported by the Enteric Reference Laboratory at ESR. The most common serotypes identified in 2013 were *S.* Typhimurium phage type 56 (prior to 2012 known as RDNC-May 06 (122 cases), *S.* Infantis (70 cases) and *S.* Typhimurium phage type 160 (69 cases).

Table 53. *Salmonella* serotypes and subtypes identified by the Enteric Reference Laboratory, 2009–2013

Serotype[a]	2009	2010	2011	2012	2013
S. Typhimurium	**661**	**594**	**495**	**459**	**481**
1	94	36	54	35	30
12a	28	35	28	26	15
56 variant[b]	43	85	73	73	122
101	56	70	50	26	26
160	106	107	66	58	69
135	20	48	47	44	48
156	54	35	29	21	17
Other or unknown	220	152	134	157	134
S. Enteritidis	**95**	**113**	**134**	**125**	**137**
1	3		10	6	19
1b	4	5	8	9	14
11[c]	39	49	56	52	27
Other or unknown	49	59	60	58	77
Other serotypes	**366**	**437**	**410**	**460**	**523**
S. Agona	10	12	20	11	11
S. Brandenburg	36	47	34	34	52
S. Infantis	71	54	65	52	70
S. Mississippi	14	9	13	12	20
S. Montevideo	9	13	1	26	11
S. Saintpaul	26	34	31	27	43
S. Stanley	9	28	28	22	31
S. Virchow	12	16	18	17	15
S. Weltevreden	10	23	16	24	28
S. enterica (I) ser. 4,[5],12 : i : -	8	21	21	38	27
Other or unknown	163	169	157	195	199
Total	**1122**	**1144**	**1039**	**1044**	**1141**

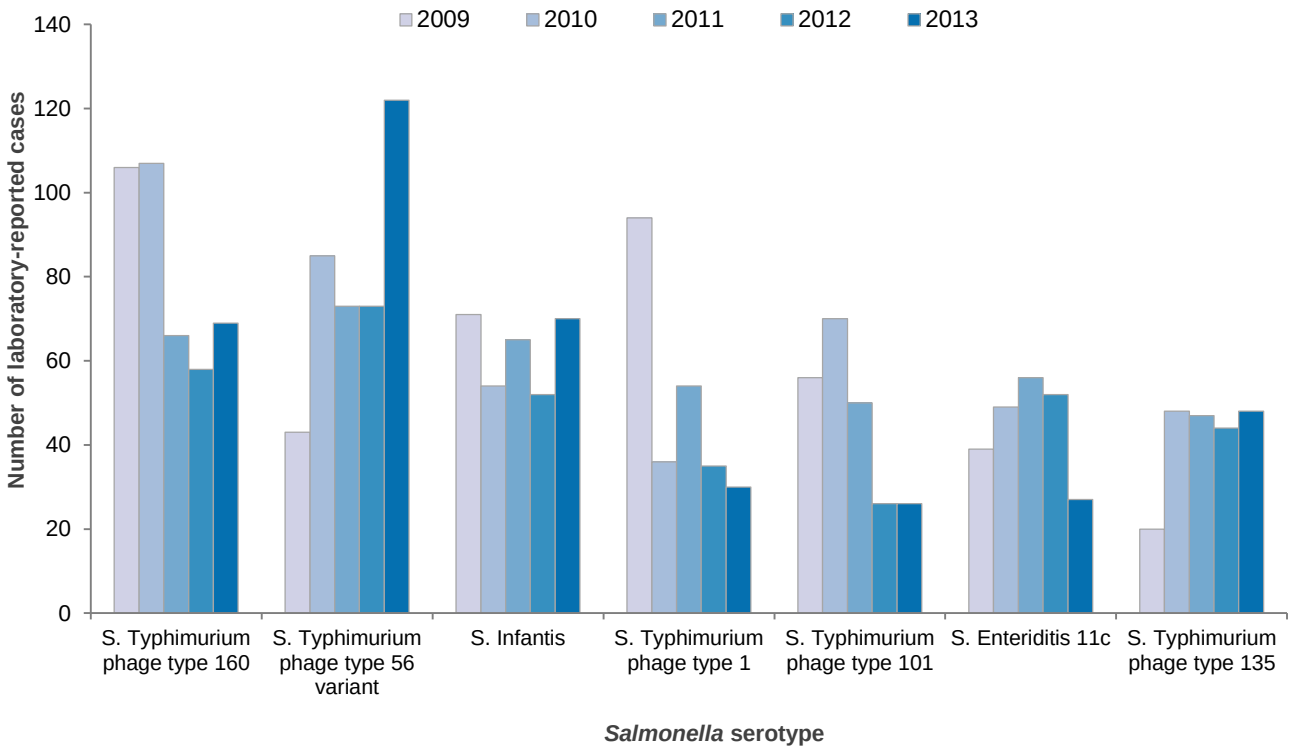
[a] Excludes *S.* Paratyphi and *S.* Typhi.

[b] Prior to 2013, *S.* Typhimurium phage type 56 variant was known as *S.* Typhimurium RDNC-May 06.

[c] Prior to 2012, *S.* Enteritidis phage type 11 was known as a 9a. Further typing was performed on isolates previously confirmed as *S.* Enteritidis phage type 9a, however, typing results revealed that some isolates previously reported as *S.*Enteritidis phage type 9a were phage type 11.

Figure 41 shows the annual trend for selected *Salmonella* serotypes in recent years. *S.* Typhimurium phage type 56 variant showed a large increase in 2013. Serotypes with a decreasing trend in the last five years were *S.* Typhimurium phage type 160, *S.* Typhimurium phage type 1 and *S.* Typhimurium phage type 101.

Figure 41. Percentage of laboratory-reported cases for selected Salmonella types by year, 2009–2013



2. Non-human isolates

A total of 967 non-human *Salmonella* isolates were typed by the Enteric Reference Laboratory during 2013. *S.* Brandenburg was the most commonly isolated serotype in non-human samples during 2013. Some caution should be exercised with respect to trends in non-human typing data as the basis for sample selection may differ from year to year (Table 54).

Table 54. *Salmonella* serotypes and subtypes from non-human sources identified by the Enteric Reference Laboratory, 2009–2013

Serotype	2009	2010	2011	2012	2013	Major sources, 2013
S. Typhimurium	**388**	**574**	**656**	**421**	**358**	
56 variant[a]	22	39	42	33	79	Feline (26), equine (19), bovine (13)
101	48	88	91	53	57	Bovine (42)
9	32	45	23	9	39	Bovine (23)
RDNC	45	41	38	33	32	Bovine (21)
1	42	57	39	57	26	Bovine (17)
Unknown or other	199	304	423	236	125	
Other serotypes	**500**	**646**	**783**	**600**	**609**	
S. Brandenburg	137	238	203	113	197	Environmental (70), ovine (58), bovine (46),
S. Infantis	30	34	78	78	67	Meat/bone meal (37), ovine (9)
S. Hindmarsh	46	56	65	77	56	Ovine (47)
S. Agona	36	25	77	26	42	Poultry: Environmental (17)
S. Montevideo	19	8	4	18	29	Meat/bone meal (21)
S. Anatum	13	6	6	10	28	Environmental (22)
S. Mbandaka	9	16	25	35	26	Food (11), Poultry: Environmental (8)
Other or unknown serotypes	210	263	325	243	164	
Total	**888**	**1220**	**1439**	**1021**	**967**	

[a] *Salmonella* Typhimurium phage type 56 variant was previously known as *S.* Typhimurium phage type RDNC-May 06. Further characterisation by the *Salmonella* Reference Unit at Colindale (Public Health England) identified this phage type to be a 56 variant.

3. Outbreak types

Table 55 shows the number of hospitalised cases and total cases by subtype for the nine foodborne *Salmonella* outbreaks reported during 2013. Two outbreaks were due to *S.* Infantis and the remaining outbreaks were associated with unique subtypes. The largest outbreak was due to *S.* Infantis (10 cases) followed by *S.* Typhimurium phage type 56 (12 cases).

Table 55. *Salmonella* subtypes reported in foodborne outbreaks, 2013

Pathogen and subtype	Outbreaks	Hospitalised cases	Total cases
S. Infantis	2	2	13
S. Typhimurium phage type 56 variant	1	0	12
S. Typhimurium phage type untypable-PN13	1	1	6
S. Montevideo	1	0	5
S. Typhimurium phage type 160	1	0	3
S. Typhimurium phage type 191	1	0	2
S. Typhimurium phage type 23	1	1	2
Unknown	1	0	2

Recent surveys

Microbiological survey of pre-packaged fresh leafy salads at retail in New Zealand

A microbiological survey was conducted on pre-packaged fresh leafy salads available at retail in New Zealand [17]. A total of 307 samples were collected from three major cities over a one-year period. Products purchased were those packaged by the producer and not known to be handled or re-packaged by the retailer. Samples were tested at the end of the 'best before' date. No *Salmonella* spp. were detected in any of the samples.

A microbiological survey of New Zealand produced ready-to-eat poultry meat – A pilot study

A pilot microbiological survey was undertaken on packaged ready-to-eat (RTE) poultry meats available at retail in New Zealand [20]. A total of 104 single samples were collected according to a market share-based sampling plan. Fifty-two samples were collected from each of two sampling strata consisting of 'large' and 'medium' processors (3 processors) in stratum one and 'small' processors (15 processors) in stratum two. Samples collected were predominately smoked chicken products and were all packaged by the processor and were not known to be handled or re-packaged by the retailer. None of the samples contained *Salmonella* spp.

Microbiological survey of ready-to-eat red meats at retail in New Zealand

A microbiological survey was undertaken on packaged ready-to-eat (RTE) red meats available at retail in New Zealand [21]. A total of 1,485 samples (297 lots of 5 samples) were collected. Products collected were predominantly made from pork, beef or venison and included cooked, cured or salted meats such as hams, corned beef and other roasted meats, luncheon-type sausages, cooked salamis and dried meats. Products purchased were packaged by the producer and where possible were not known to be handled or re-packaged by the retailer. The five samples in each lot were tested as a composite for the presence/absence of *Salmonella* spp. None of the samples contained *Salmonella* spp.

A survey of dried and edible nuts, seeds, and nut and seed products available in New Zealand

Between December 2011 and August 2012 a total of 805 dried and edible nut, seed and combined nut and seed products available in New Zealand were collected and analysed for the presence of *Salmonella* species[25]. *Salmonella* was not detected in any of the samples.

Relevant New Zealand studies and publications

Journal papers

A cluster of salmonellosis cases caused by *Salmonella* Typhimurium phage type 42 (STM42) was identified in New Zealand in October 2008 [26]. Initial investigations indicated that eating uncooked baking mixture was associated with illness. A case-control study of 39 cases and 66 controls found cases had 4.5 times the odds of consuming uncooked baking mixture as controls (95% confidence interval [CI] 1.6-12.5, p-value 0.001). STM42 was recovered from flour taken from four cases' homes, two unopened packs purchased from retail stores and packs from three batches of retrieved (recalled) product.

Relevant regulatory developments

In 2013, an updated document describing the MPI *Salmonella* risk management strategy for 2013–2014 was released [27]. The document specifically spells out the work programme aligned to the Risk Management Framework that will be achieved over the period 2013-2014.

Sapovirus

Case definition

Clinical description:	Gastroenteritis usually lasting 2-6 days.
Laboratory test for diagnosis:	Detection of sapovirus in faecal or vomit specimen or leftover food.
Case classification:	
Probable	A clinically compatible illness.
Confirmed	A clinically compatible illness that is laboratory confirmed, OR a clinically compatible illness and a common exposure associated with a laboratory confirmed case.

Sapovirus infection cases reported in 2013 by data source

In 2013, one notification of sapovirus and no resulting deaths were reported in EpiSurv. It should be noted that not every case of sapovirus infection is notifiable; only those that are part of a common source outbreak or from a person in a high risk category.

Outbreaks reported as caused by sapovirus

In 2013, eight sapovirus outbreaks were reported in EpiSurv with 159 associated cases and two deaths. One of the outbreaks was reported to be foodborne (Table 56). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Laboratory testing for sapovirus began in New Zealand in 2009. Since 2009 specimens from gastroenteritis outbreaks found to be negative for norovirus have been tested for the presence of sapovirus. In 2013, sapovirus was identified in eight (10.7%) of the reported 75 norovirus-negative gastroenteritis outbreaks. This was lower than the number of sapovirus outbreaks reported in 2011 (12 outbreaks from 98 norovirus-negative outbreaks) and 2010 (14 outbreaks from 90 norovirus-negative outbreaks), but higher than the three outbreaks reported in 2012 (3 outbreaks from 84 norovirus-negative outbreaks.

Table 56. Sapovirus outbreaks reported, 2013

Measure	Foodborne sapovirus outbreaks	All sapovirus outbreaks
Outbreaks	1	8
Cases	2	159
Hospitalised cases	0	0

There were no foodborne sapovirus outbreaks in 2012, two foodborne sapovirus outbreaks reported in 2010 with 24 associated cases and one outbreak in 2011 with 14 cases.

The single foodborne outbreak in 2013 (Table 56) had no suspected food vehicle. Two clinical samples were investigated by ESR's Public Health Laboratory and found to be positive for sapovirus.

Shigellosis

Summary data for shigellosis in 2013 are given in Table 57.

Table 57. Summary of surveillance data for shigellosis, 2013

Parameter	Value in 2013	Source
Number of notified cases	137	EpiSurv
Notification rate (per 100 000)	3.1	EpiSurv
Hospitalisations (% of notifications)[a]	29 (21.2%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	70 (50.8%)	EpiSurv
Estimated food-related cases (%)	NE	

NE = not estimated, no information is available on the food attributable proportion of shigellosis in New Zealand.

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

Case definition

Clinical description: Acute diarrhoea with fever, abdominal cramps, blood or mucus in the stools and a high secondary attack rate among contacts.

Laboratory test for diagnosis: Isolation of any *Shigella* spp. from a stool sample or rectal swab and confirmation of genus.

Case classification:

Probable: A clinically compatible illness that is either a contact of a confirmed case of the same disease, or has had contact with the same common source i.e., is part of an identified common source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Shigellosis cases reported in 2013 by data source

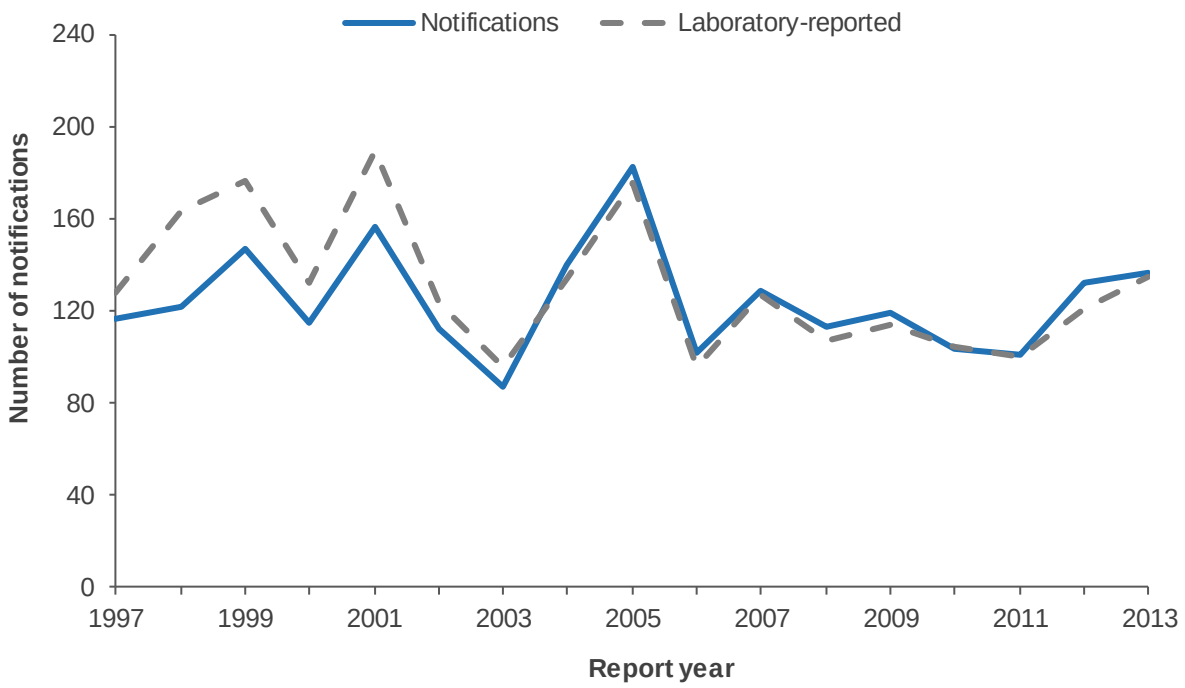
During 2013, 137 notifications (3.1 cases per 100 000 population) of shigellosis and no resulting deaths were reported in EpiSurv. The Enteric Reference Laboratory at ESR reported 135 cases (3.0 per 100 000 population) infected with *Shigella* in 2013.

The ICD-10 code A03 was used to extract shigellosis hospitalisation data from the MoH NMDS database. Of the 29 hospital admissions (0.6 admissions per 100 000 population) recorded in 2013, 26 were reported with shigellosis as the primary diagnosis and three with shigellosis as another relevant diagnosis.

Notifiable disease data

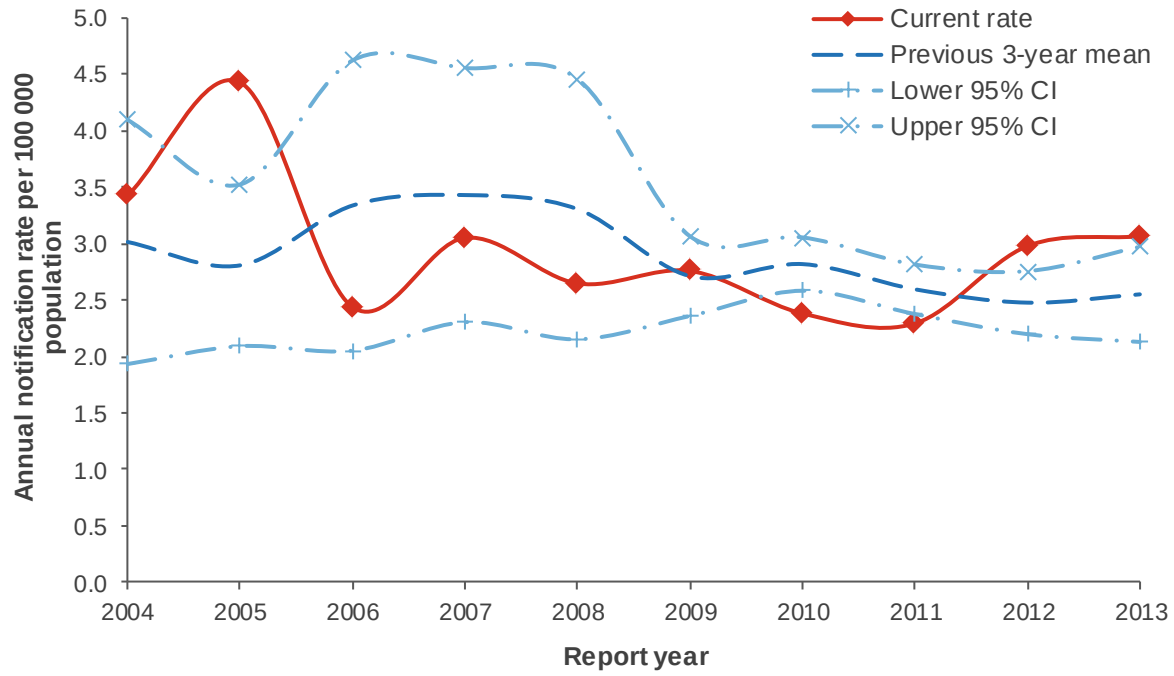
The number of notifications and laboratory reported cases of shigellosis was highly variable with the highest peak in cases in 2005 (183 cases). Between 2006 and 2013 the number of notifications has stayed in the range of 102 to 137 cases (Figure 42).

Figure 42. Shigellosis notifications and laboratory-reported cases by year, 1997–2013



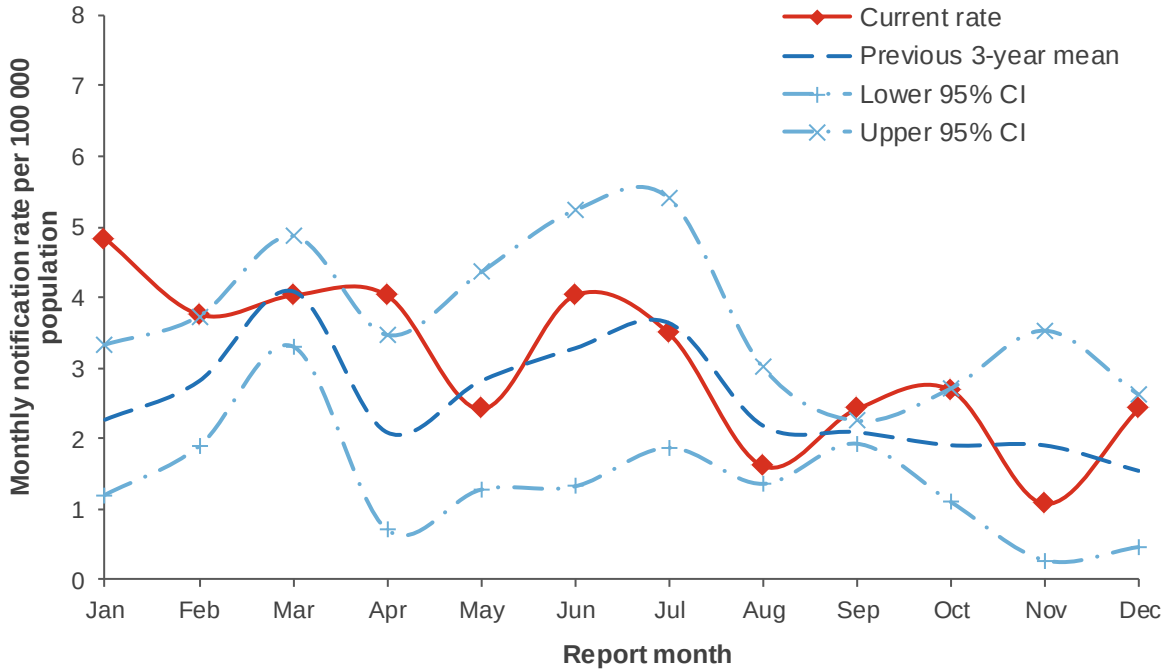
An increase in the shigellosis rate above the previous 3-year mean has been seen in last two years (2012 and 2013) (Figure 43).

Figure 43. Shigellosis notification rate by year, 2004–2013



The number of notified cases of shigellosis per 100 000 population by month for 2013 is shown in Figure 44. In 2013, the shigellosis notification rate was higher than the previous 3-year mean in January and April.

Figure 44. Shigellosis monthly rate (annualised), 2013



In 2013, the rates of notification and hospitalisation for shigellosis were higher for females compared to males (Table 58).

Table 58. Shigellosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	58	2.6	14	0.6
Female	79	3.5	15	0.7
Total	**137**	**3.1**	**29**	**0.6**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

Shigellosis rates of notification and hospitalisation were highest for those in the 1 to 9 years and 20 to 39 years age groups. The hospitalisation rates were only defined for the 70+ age group due to the small number of cases in all other groups (Table 59).

Table 59. Shigellosis cases by age group, 2013

Age group	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	3	-	1	-
1 to 4	12	4.8	3	-
5 to 9	17	5.7	4	-
10 to 14	3	-	1	-
15 to 19	8	2.6	3	-
20 to 29	28	4.4	1	-
30 to 39	22	3.9	3	-
40 to 49	14	2.3	3	-
50 to 59	16	2.8	2	-
60 to 69	7	1.6	3	-
70+	7	1.6	5	1.2
Total	**137**	**3.1**	**29**	**0.6**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

The most commonly reported risk factor for shigellosis cases in 2013 was overseas travel during the incubation period (50.8%), followed by consumption of food from retail premises (50.0%) and contact with other symptomatic people (48.8%) (Table 60).

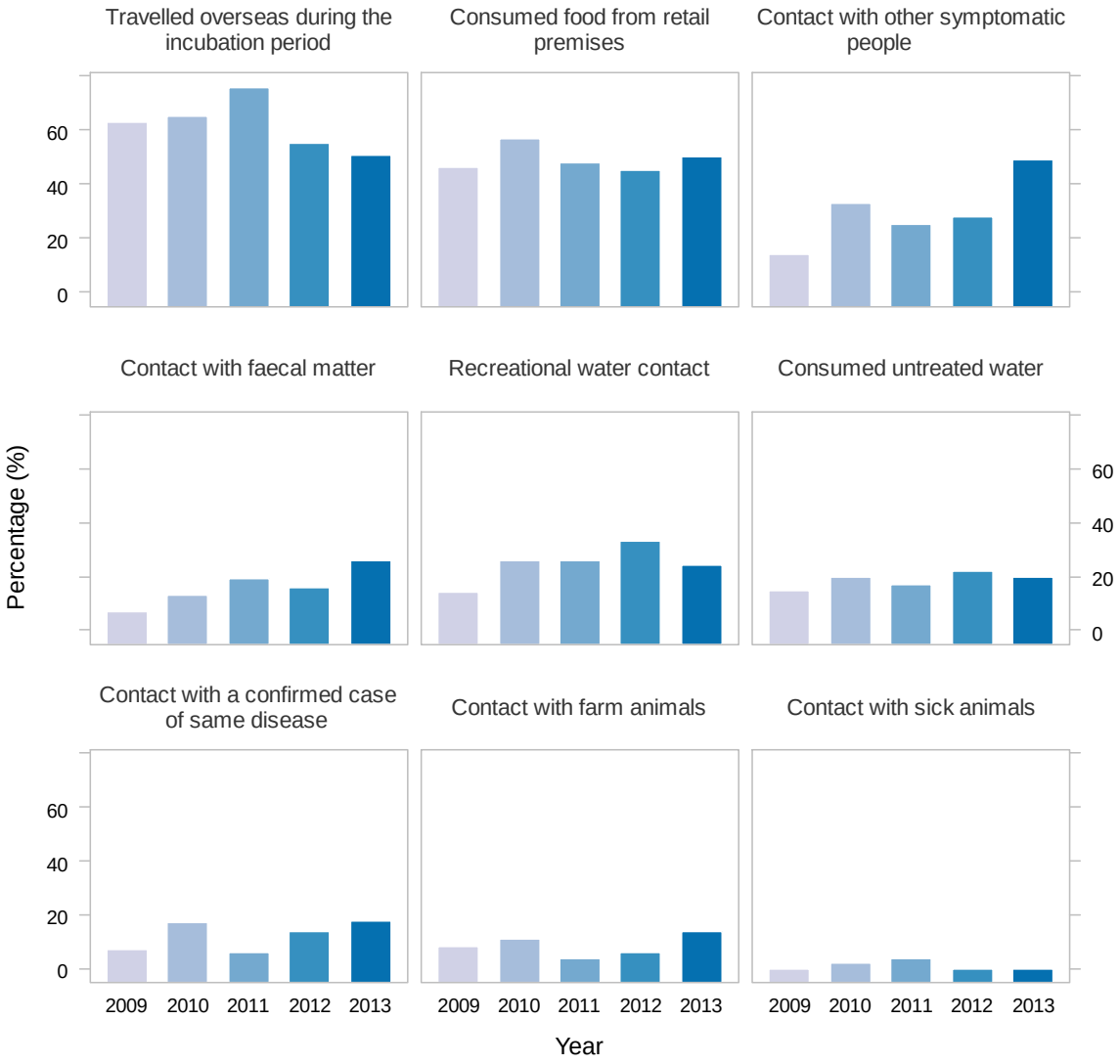
Table 60. Exposure to risk factors reported for shigellosis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Travelled overseas during the incubation period	66	64	7	50.8
Consumed food from retail premises	16	16	105	50.0
Contact with other symptomatic people	20	21	96	48.8
Contact with faecal matter	9	26	102	25.7
Recreational water contact	9	28	100	24.3
Consumed untreated water	6	24	107	20.0
Contact with farm animals	5	31	101	13.9
Contact with sick animals	0	34	103	0.0

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Since 2011 overseas travel during the incubation period decreased as a reported risk factor, while the reporting of contact with other symptomatic people increased (Figure 45). There is a slight increasing trend of cases reporting contact with faecal matter over the last five years.

Figure 45. Percentage of cases by exposure to risk factors associated with shigellosis and year, 2009–2013



For cases where information on travel was provided, 50.8% (95% CI 41.9-59.6%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all shigellosis cases, a Poisson distribution can be used to estimate the total number of potentially travel related cases of shigellosis in 2013. The resultant distribution has a mean of 70 cases (95% CI 48-94).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism is 57.9% (95% CI 52.7-63.0%).

Outbreaks reported as caused by *Shigella* spp.

In 2013, there were 10 *Shigella* spp. outbreaks reported and four of these were reported to be foodborne (Table 61). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted. None of the three hospitalisations due to *Shigella* spp. were associated with foodborne outbreaks.

Table 61. *Shigella* spp. outbreaks reported, 2013

Measure	Foodborne *Shigella* spp. outbreaks	All *Shigella* spp. outbreaks
Outbreaks	4	10
Cases	21	40
Hospitalised cases	0	3

Foodborne shigellosis outbreaks are rare. In the three year period 2011–2013, four outbreaks have been reported each year (with 27, 10 and 21 cases, respectively). From 2004 to 2010 there were no more than two outbreaks reported each year (Figure 46).

Figure 46. Foodborne *Shigella* spp. outbreaks and associated cases reported by year, 2004–2013

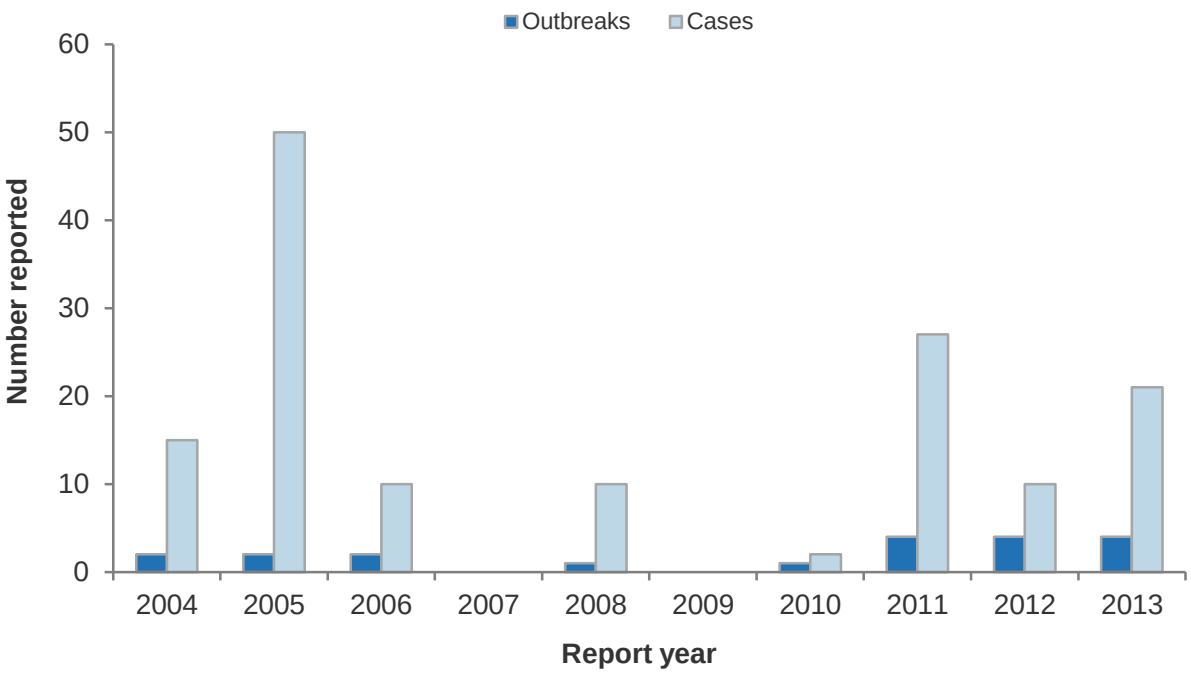


Table 62 contains details of the foodborne *Shigella* spp. outbreaks reported in 2013. The evidence linking any of these outbreaks to specific foods or food in general was weak.

Table 62. Details of foodborne *Shigella* spp. outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Auckland	May	Self-imported seafood from Samoa (raw sea cucumber and clams)	Private home	Unknown	1C, 2P
Auckland	May	Unknown		Overseas	6C, 8P
Auckland	Jun	Unknown	Private home	Private home	2C
Auckland	Sep	Unknown	Private home	Private home/commercial	2C

PHU: Public Health Unit, C: confirmed, P: probable.

Clinical samples were submitted to ESR's Public Health Laboratory relating to the overseas food-associated *Shigella* spp. outbreak in May 2013, but *Shigella* spp. were not detected.

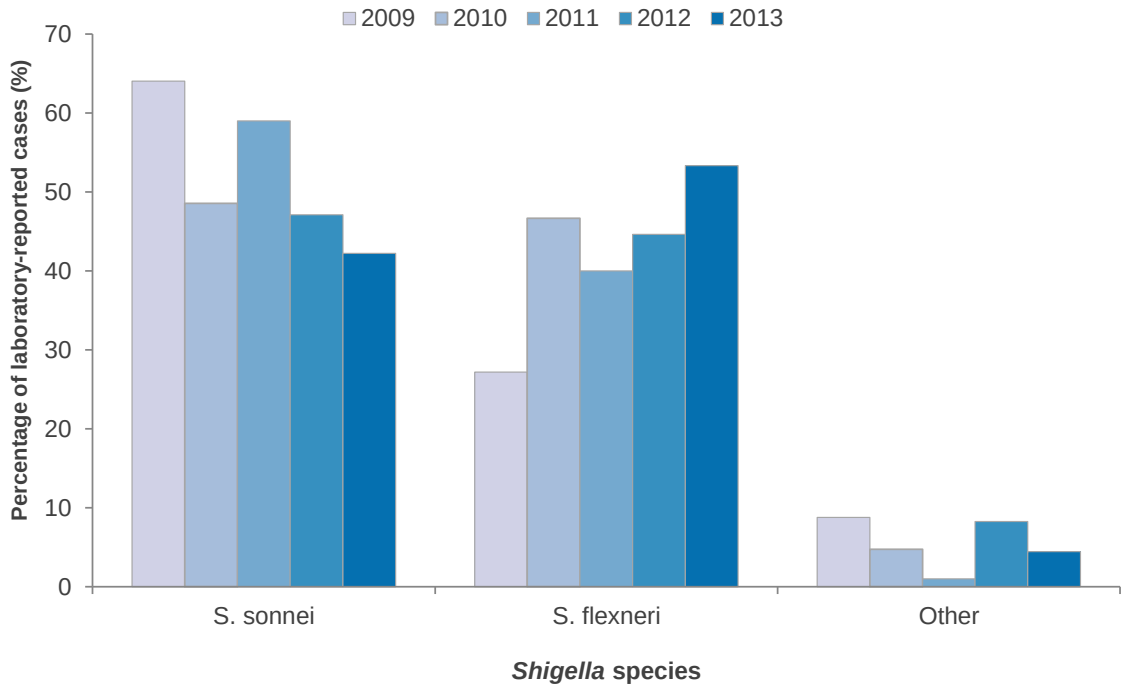
Shigella types commonly reported

In 2013, the Enteric Reference Laboratory at ESR reported 135 cases infected with *Shigella* spp.. *Shigella sonnei* biotype a and biotype g were the predominant subtypes confirmed in 2013 (Table 63). Between 2008 and 2013 there has been an increasing trend in the percentage of cases infected with *S. flexneri* and a decreasing trend for infection with *S. sonnei*. In contrast to previous years, infection with *S. flexneri* was more common than *S. sonnei* in 2013 (Figure 47).

Table 63. Shigella species and subtypes identified by the Enteric Reference Laboratory, 2009–2013

Species	2009	2010	2011	2012	2013
S. sonnei	**73**	**51**	**59**	**57**	**57**
biotype a	33	27	38	27	35
biotype f	4	1	1	3	1
biotype g	36	23	20	27	21
S. flexneri	**31**	**49**	**40**	**54**	**72**
1	3	4	4	1	6
2a	13	21	15	10	12
2b	2	10	1	3	2
3a	6	6	5	3	10
4a	2	1	3	1	5
6	3	4	6	7	5
Other	7	8	13	31	32
Other	**10**	**5**	**1**	**10**	**6**
S. boydii	8	4	0	7	5
S. dysenteriae	0	1	1	3	1
Shigella species not identified	2	0	0	0	0
Total	**114**	**105**	**100**	**121**	**135**

Figure 47. Percentage of laboratory-reported cases by *Shigella* species and year, 2009–2013



Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Staphylococcus aureus intoxication

Case definition

Clinical description:	Gastroenteritis with sudden severe nausea and vomiting.
Laboratory test for diagnosis:	Detection of enterotoxin in faecal or vomit specimen or in leftover food or isolation of ≥10^3/gram coagulase-positive *S. aureus* from faecal or vomit specimen or ≥10^5 from leftover food.
Case classification:	
Probable	A clinically compatible illness.
Confirmed	A clinically compatible illness that is laboratory confirmed, OR a clinically compatible illness and a common exposure associated with a laboratory confirmed case.

Staphylococcus aureus intoxication cases reported in 2013 by data source

During 2013, there was one notification of *S. aureus* intoxication and no resulting deaths reported in EpiSurv. Note that not every case of *S. aureus* intoxication is necessarily notifiable, only those where there is a suspected common source.

The ICD-10 code A05.0 was used to extract foodborne staphylococcal intoxication hospitalisation data from the MoH NMDS database. There were no hospitalisations recorded in 2013.

Outbreaks reported as caused by *Staphylococcus aureus*

In 2013, one foodborne *S. aureus* outbreak was reported with two cases (Table 64). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 64. *S. aureus* outbreaks reported, 2013

Measure	Foodborne *S. aureus* outbreaks	All *S. aureus* outbreaks
Outbreaks	1	1
Cases	2	2
Hospitalised cases	0	0

The number of foodborne outbreaks associated with *S. aureus* reported each year between 2004 and 2013 ranged from zero to five (Figure 48). No *S. aureus* outbreaks were reported in EpiSurv in four of the last eight years.

Figure 48. Foodborne *S. aureus* outbreaks and associated cases reported by year, 2004–2013

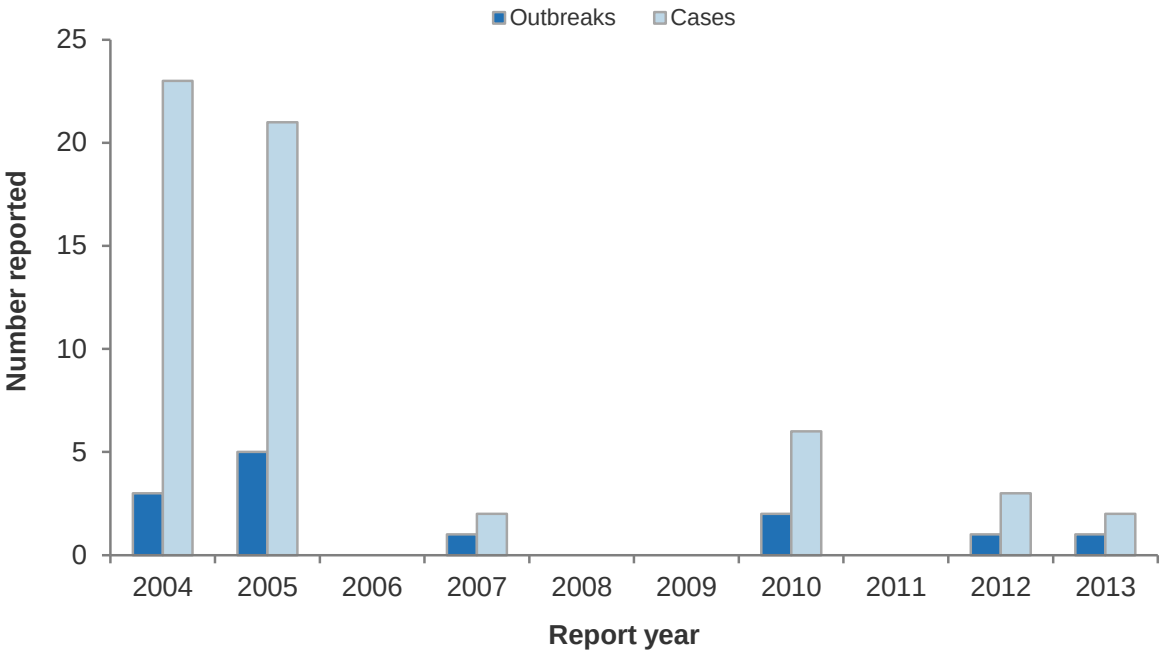


Table 65 contains details of the single foodborne *S. aureus* outbreak reported in 2013. No suspected food vehicle was listed for this outbreak.

Table 65. Details of foodborne *S. aureus* outbreaks, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Auckland	Dec	Unknown	Restaurant/cafe/bakery	Unknown	1C, 1P

PHU: Public Health Unit, C: confirmed, P: probable.

In 2013, clinical samples were submitted to ESR's Public Health Laboratory relating to the food-associated *S. aureus* outbreak listed in Table 65. Staphylococcal enterotoxin was detected in one sample.

Recent surveys

A microbiological survey of New Zealand produced ready-to-eat poultry meat – A pilot study

A pilot microbiological survey was undertaken on packaged ready-to-eat (RTE) poultry meats available at retail in New Zealand [20]. A total of 104 single samples were collected according to a market share-based sampling plan. Fifty-two samples were collected from each of two sampling strata consisting of 'large' and 'medium' processors (3 processors) in stratum one and 'small' processors (15 processors) in stratum two. Samples collected were predominately smoked chicken products and were all packaged by the processor and were not known to be handled or re-packaged by the retailer. None of the samples contained Coagulase-positive staphylococci (CPS) counts above 50 CFU/g.

Microbiological survey of ready-to-eat red meats at retail in New Zealand

A microbiological survey was undertaken on packaged ready-to-eat (RTE) red meats available at retail in New Zealand [21]. A total of 1,485 samples (297 lots of 5 samples) were collected. Products collected were predominantly made from pork, beef or venison and included cooked, cured or salted meats such as hams, corned beef and other roasted meats, luncheon-type sausages, cooked salamis and dried meats. Products purchased were packaged by the producer and where possible were not known to be handled or re-packaged by the retailer. All individual samples within a lot were also enumerated for CPS at the end of shelf life. None of the samples contained CPS counts above the acceptable level specified in Australia New Zealand Food Standards Code, Standard 1.6.1 (>100 CFU/g).

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

Toxic shellfish poisoning

Case definition

Due to the diverse nature of toxins that may cause toxic shellfish poisoning, no consistent clinical description is provided for this condition. Depending on the toxin involved, toxic shellfish poisoning may result in various combinations of gastrointestinal, neurosensory, neurocerebellar/neuromotor, general neurological and other symptoms.

Suspected:

Amnesic shellfish poisoning (ASP): Vomiting or diarrhoea occurring within 24 hours of consuming shellfish AND no other probable cause identified by microbiological examination of faecal specimen from the case or microbiological testing of leftover food AND/OR one or more of the neurological symptoms from group C (see below) occurring within 48 hours of consuming shellfish.

Diarrhoeic shellfish poisoning (DSP): Vomiting or diarrhoea occurring within 24 hours of consuming shellfish AND no other probable cause identified by microbiological examination of faecal specimen from the case or microbiological testing of leftover food.

Neurotoxic shellfish poisoning (NSP): Two or more of the neurological symptoms from groups A and B (see below) occurring within 24 hours of consuming shellfish.

Paralytic shellfish poisoning (PSP): Paraesthesia occurring within 12 hours of consuming shellfish AND one of the neurological symptoms from group B (see below).

Toxic shellfish poisoning type unspecified (TSP): Vomiting or diarrhoea occurring within 24 hours of consuming shellfish AND no other probable cause identified by microbiological examination of faecal specimen from the case or microbiological testing of leftover food OR any of the neurological symptoms from groups A and B (see below) occurring within 24 hours of consuming shellfish OR one or more of the neurological signs/symptoms from group C (see below) occurring within 48 hours of consuming shellfish.

Clinical symptoms for assigning status

Group A

- paraesthesia - i.e. numbness or tingling around the mouth, face or extremities
- alteration of temperature sensation

Group B

- weakness such as trouble rising from seat or bed
- difficulty swallowing
- difficulty breathing
- paralysis
- clumsiness
- unsteady walking
- dizziness/vertigo
- slurred/unclear speech
- double vision

Group C

- confusion
- memory loss
- disorientation
- seizure
- coma

Probable:

Meets case definition for suspect case AND detection of relevant biotoxin at or above the regulatory limit in shellfish obtained from near or same site (not leftovers) within seven days of collection of shellfish consumed by case. Current levels are as follows:

ASP: 20 ppm domoic acid/100 g shellfish
DSP: 20 g/100 g or 5 MU/100 g shellfish
(MU = mouse units)
NSP: 20 MU/100 g shellfish
PSP: 80 g/100 g shellfish

Confirmed:

Meets case definition for suspect case AND detection of TSP biotoxin in leftover shellfish at a level resulting in the case consuming a dose likely to cause illness. Current dose levels are as follows:

ASP: 0.05 mg/kg body weight	NSP: 0.3 MU/kg body weight
DSP: ingestion of 48 µg or 12 MU	PSP: 10 MU/kg body weight (≅ 2µg/kg body weight)

Toxic shellfish poisoning cases reported in 2013

During 2013, one notification (0.02 cases per 100 000 population) of toxic shellfish poisoning and no resulting deaths were reported in EpiSurv. The notification related to a female case of paralytic shellfish poisoning. The case had consumed raw tuatuas collected from the Bay of Plenty coastline.

The ICD-10 code T61.2 was used to extract hospitalisation data for 'other fish and shellfish poisoning' from the MoH NMDS database. Of the 11 hospital admissions (0.25 admissions per 100 000 population) reported in 2013, 9 were reported with 'other fish and shellfish poisoning' as the primary diagnosis and two with this condition as another relevant diagnosis. Note that this ICD-10 code includes shellfish and other fish. It should be noted that EpiSurv and the MoH NMDS database are separate systems and hospital admission can occur without cases being notified.

Outbreaks reported as caused by toxic shellfish poisoning

In 2013, no toxic shellfish poisoning outbreaks were reported and no food or clinical samples were submitted to ESR's Public Health Laboratory relating to toxic shellfish poisoning outbreaks. It should be noted that all toxic shellfish poisoning outbreaks will be categorised as foodborne, as consumption of contaminated shellfish is the only currently recognised transmission route for this disease.

Recent surveys

Nil.

Relevant New Zealand studies and publications

Journal papers

The diatom genus *Pseudo-nitzschia* blooms throughout New Zealand's coastal waters [28]. Between January 2000 and August 2011, 8.4% of 29,000 seawater samples analysed for *Pseudo-nitzschia* exceeded the voluntary trigger level for biotoxin testing (10×10^4 cells/L). *Pseudo-nitzschia fraudulenta* and *P. pseudodelicatissima* (low domoic acid producers) were the dominant bloom formers throughout New Zealand (each contributing 25%) followed by the highly toxic *P. australis* (10%). Shellfish flesh testing for domoic acid was triggered on 8477 occasions between 2000 and 2011, but no samples exceeded the regulatory limit (20 mg/kg); the maximum concentration was 13 mg/kg (Marlborough Sounds, mid-winter 2010).

Relevant regulatory developments

Nil.

VTEC/STEC infection

Summary data for VTEC/STEC infection in 2013 are given in Table 66.

Table 66. Summary of surveillance data for VTEC/STEC infection, 2013

Parameter	Value in 2013	Source
Number of notified cases	207	EpiSurv
Notification rate (per 100 000)	4.6	EpiSurv
Hospitalisations (% of notifications)[a]	27 (13%)	MoH NMDS, EpiSurv
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	8 (3.9%)	EpiSurv
Estimated food-related cases (%)[b]	60 (29.9%)	Expert consultation

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.

[b] For estimation of food-related cases the proportions derived from expert consultation exclude travel-related cases. The expert elicitation derived separate estimates of the foodborne proportion for O157 VTEC/STEC and non-O157 VTEC/STEC. The estimate for O157 VTEC/STEC, the dominant serotype, has been used to estimate the number of food-related cases.

Case definition

Clinical description: Diarrhoea resulting from infection with VTEC/STEC may range from mild, watery and non-bloody to almost pure bloody diarrhoea with abdominal cramping. The disease is distinguishable from other causes of gastroenteritis by its high incidence of bloody diarrhoea (profuse rectal bleeding without fever sometimes clouds the diagnosis), severity (approximately 40 percent of cases are hospitalised) and frequency of complications. Haemolytic uraemic syndrome (HUS) complicates 8–10% of VTEC/STEC infections in children; this syndrome includes haemolytic anaemia, thrombocytopenia and acute renal failure. Of children with HUS, 12–30% will have severe sequelae, including renal and cerebral impairment. Elderly patients with VTEC infections may suffer thrombotic thrombocytopenic purpura (TTP), which is similar to HUS but with greater neurological involvement.

Laboratory test for diagnosis: Isolation of Shiga toxin (verotoxin) producing *Escherichia coli* OR detection of the genes associated with the production of Shiga toxin in *E. Coli.*

Case classification:

Probable Not applicable.

Confirmed A clinically compatible illness that is laboratory confirmed.

VTEC/STEC infection cases reported in 2013 by data source

During 2013, 207 notifications (4.6 cases per 100 000 population) of VTEC/STEC infection and no resulting deaths were reported in EpiSurv. The Enteric Reference Laboratory at ESR reported 215 cases (4.8 cases per 100 000) infected with VTEC/STEC in 2013.

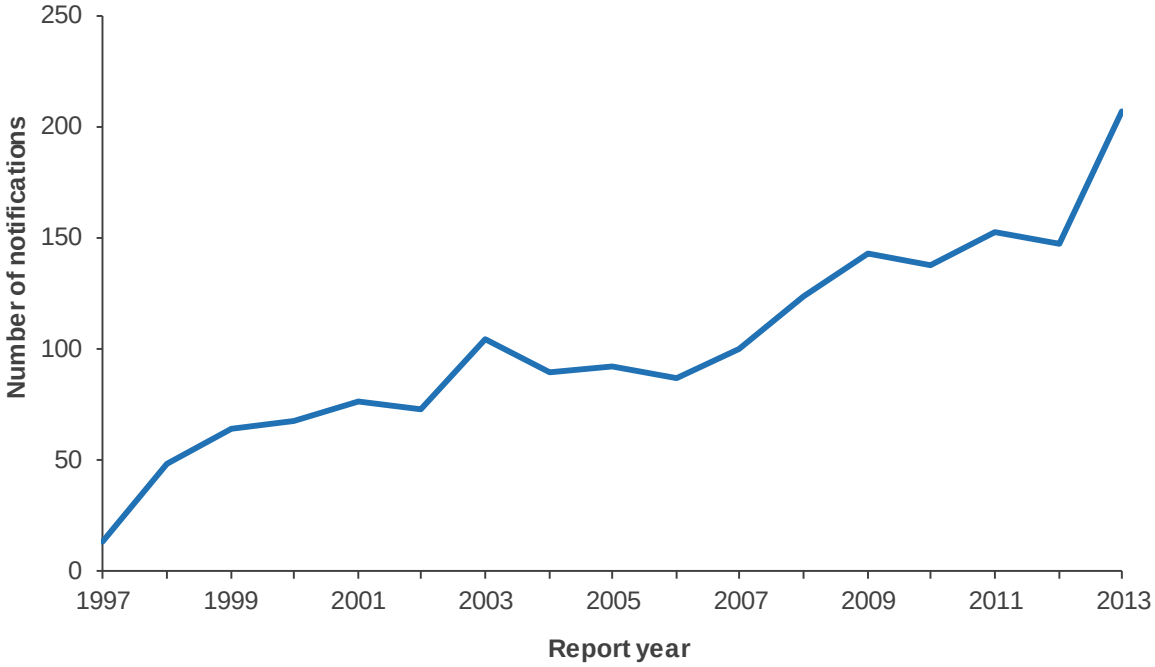
The ICD-10 code A04.3 was used to extract enterohaemorrhagic *E. coli* infection hospitalisation data from the MoH NMDS database. Of the 27 hospital admissions (0.6 admissions per 100 000 population) recorded in 2013, 19 were reported with enterohaemorrhagic *E. coli* infection as the primary diagnosis and 8 with enterohaemorrhagic *E. coli* infection as another relevant diagnosis.

It has been estimated by expert consultation that 29.9% (95th percentile credible interval; 3.5% to 60.7%) of O157 VTEC/STEC incidence and 34.0% (95th percentile credible interval: 3.5% to 63.5%) of non-O157 incidence is due to foodborne transmission. The expert consultation also estimated that approximately 30% of foodborne VTEC/STEC transmission was due to red meat, irrespective of serotype.

Notifiable disease data

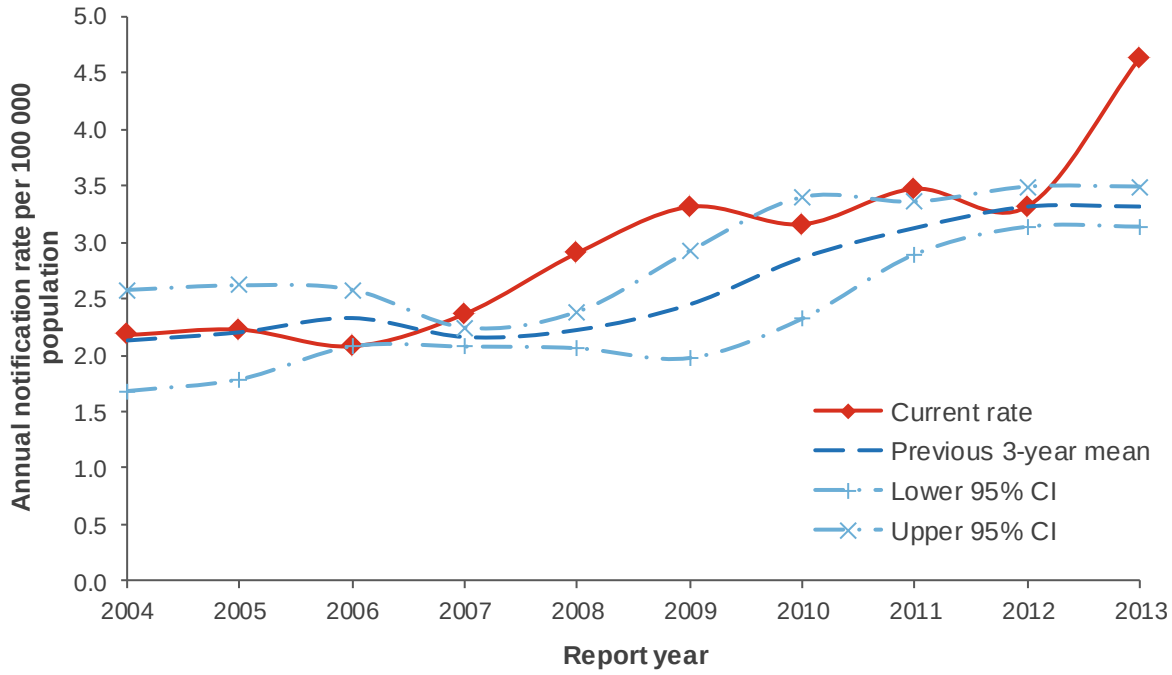
There has been an increasing trend in the number of VTEC/STEC infection notifications reported, with the highest number of notifications since 1997 reported in 2013 (207 cases) (Figure 49).

Figure 49. VTEC/STEC infection notifications by year, 1997–2013



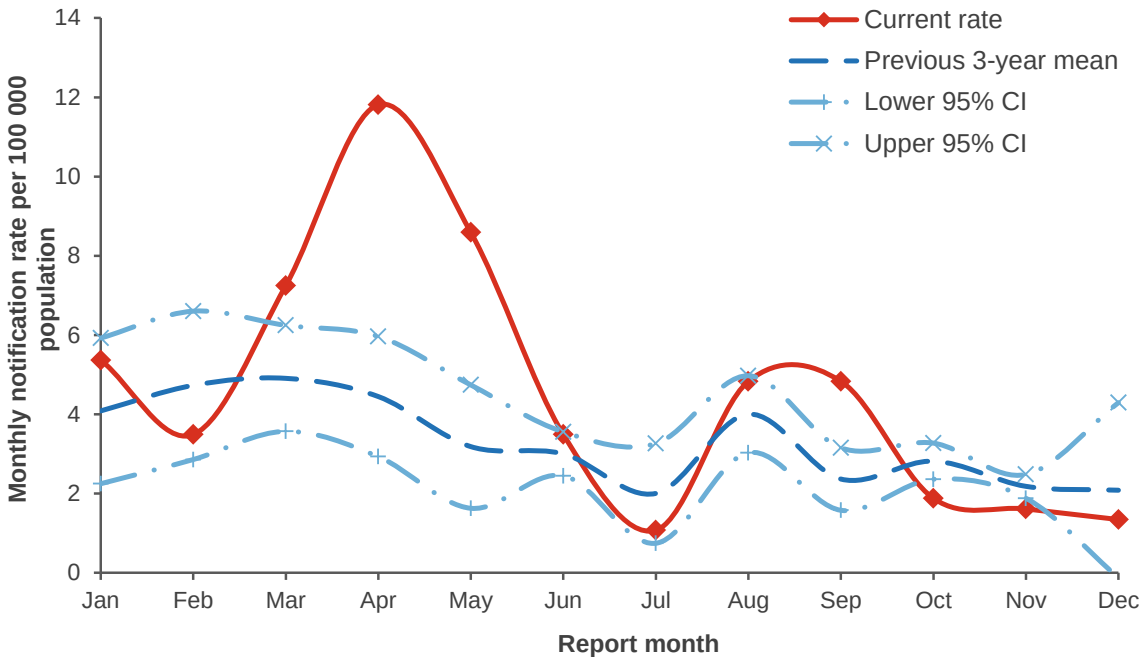
A marked increase in VTEC/STEC infection annual notification rate was seen in 2013 compared to the previous three years (Figure 50).

Figure 50. VTEC/STEC infection notification rate by year, 2004–2013



The number of notified cases of VTEC/STEC infection per 100 000 population by month for 2013 are shown in Figure 51. The 2013 monthly notification rate trend was similar to the trend in recent years with the exception of a defined peak in autumn that was three times higher than the previous 3-year mean.

Figure 51. VTEC/STEC infection monthly rate (annualised), 2013



Rates of VTEC/STEC infection varied throughout the country as illustrated in Figure 52. In 2013, the highest rates of VTEC/STEC infection were for Waikato (11.8 per 100 000, 44 cases), South Canterbury (8.8 per 100 000, 5 cases), and Taranaki (8.1 per 100 000, 9 cases) DHBs. Note that rates were not calculated for 11 DHBs where there were insufficient (less than 5) cases notified in 2013.

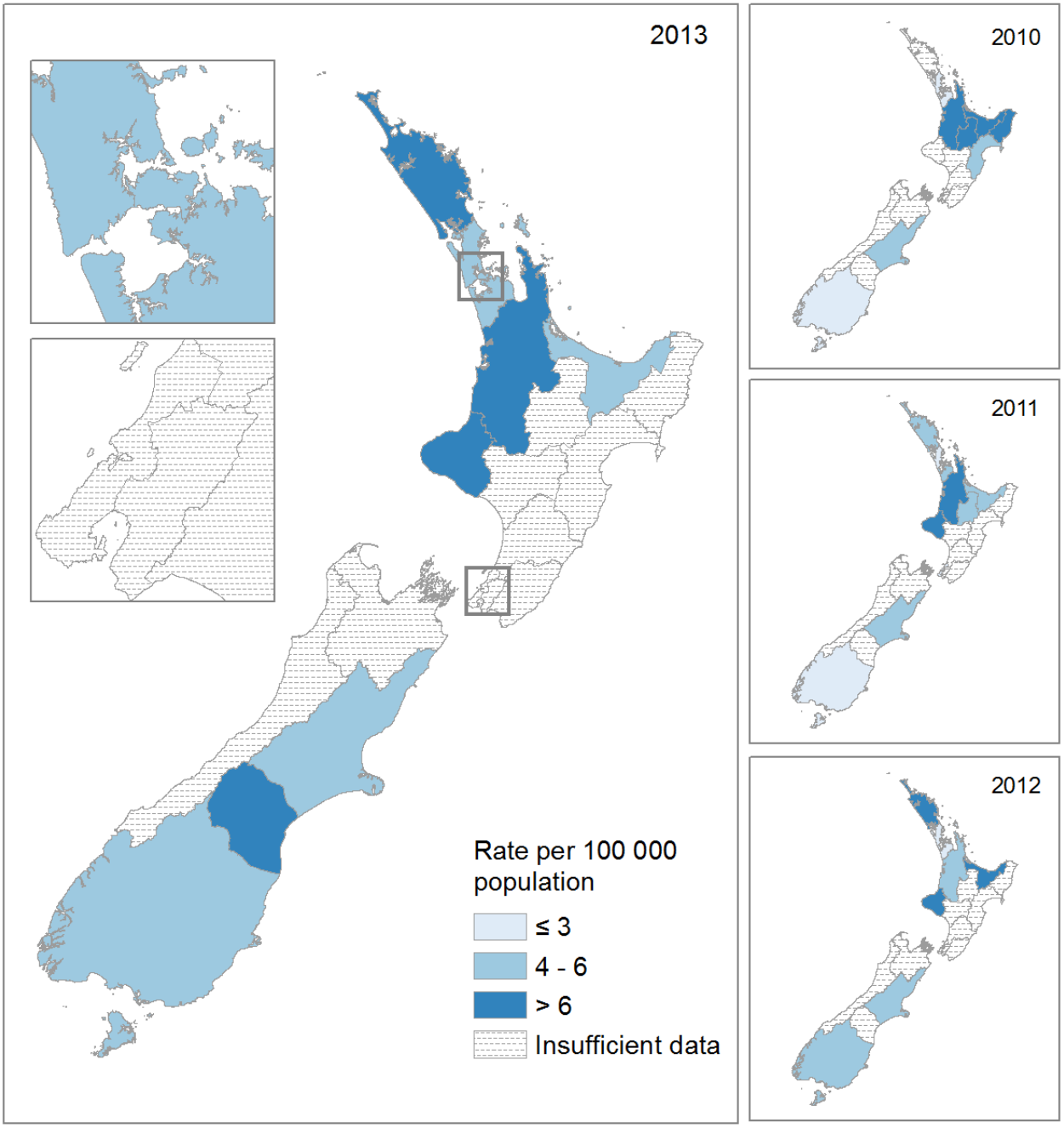
In 2013, notification rates were higher for females than males. Hospitalisation rates were also higher for females than for males (Table 67).

Table 67. VTEC/STEC infection cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	86	3.9	11	0.5
Female	121	5.3	16	0.7
Total	**207**	**4.6**	**27**	**0.6**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

Figure 52. Geographic distribution of VTEC/STEC infection notifications, 2010–2013



In 2013, VTEC/STEC infection notification rate was highest for the 1 to 4 years age group (20.7 per 100 000 population, 66 cases), followed by the less than 1 year age group (20.0 per 100 000, 12 cases). The number of hospitalisations ranged between 0 and 4 for each of the age groups except the 70 years and over group with 6 hospitalisations (Table 68).

Table 68. VTEC/STEC infection cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	12	20.0	0	-
1 to 4	66	26.6	4	-
5 to 9	21	7.0	3	-
10 to 14	16	5.6	1	-
15 to 19	13	4.2	4	-
20 to 29	20	3.1	2	-
30 to 39	10	1.8	2	-
40 to 49	8	1.3	0	-
50 to 59	12	2.1	3	-
60 to 69	14	3.2	2	-
70+	15	3.5	6	1.4
Total	**207**	**4.6**	**27**	**0.6**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

It should be noted that VTEC/STEC infection cases are reported using a different report form to other enteric diseases, resulting in an expanded range of risk factors. In 2013, the most commonly reported risk factors for VTEC/STEC infection cases were consumption of raw fruit/vegetables (93.9%), consumption of dairy products (87.7%), and contact with household pets (87.1%) (Table 69).

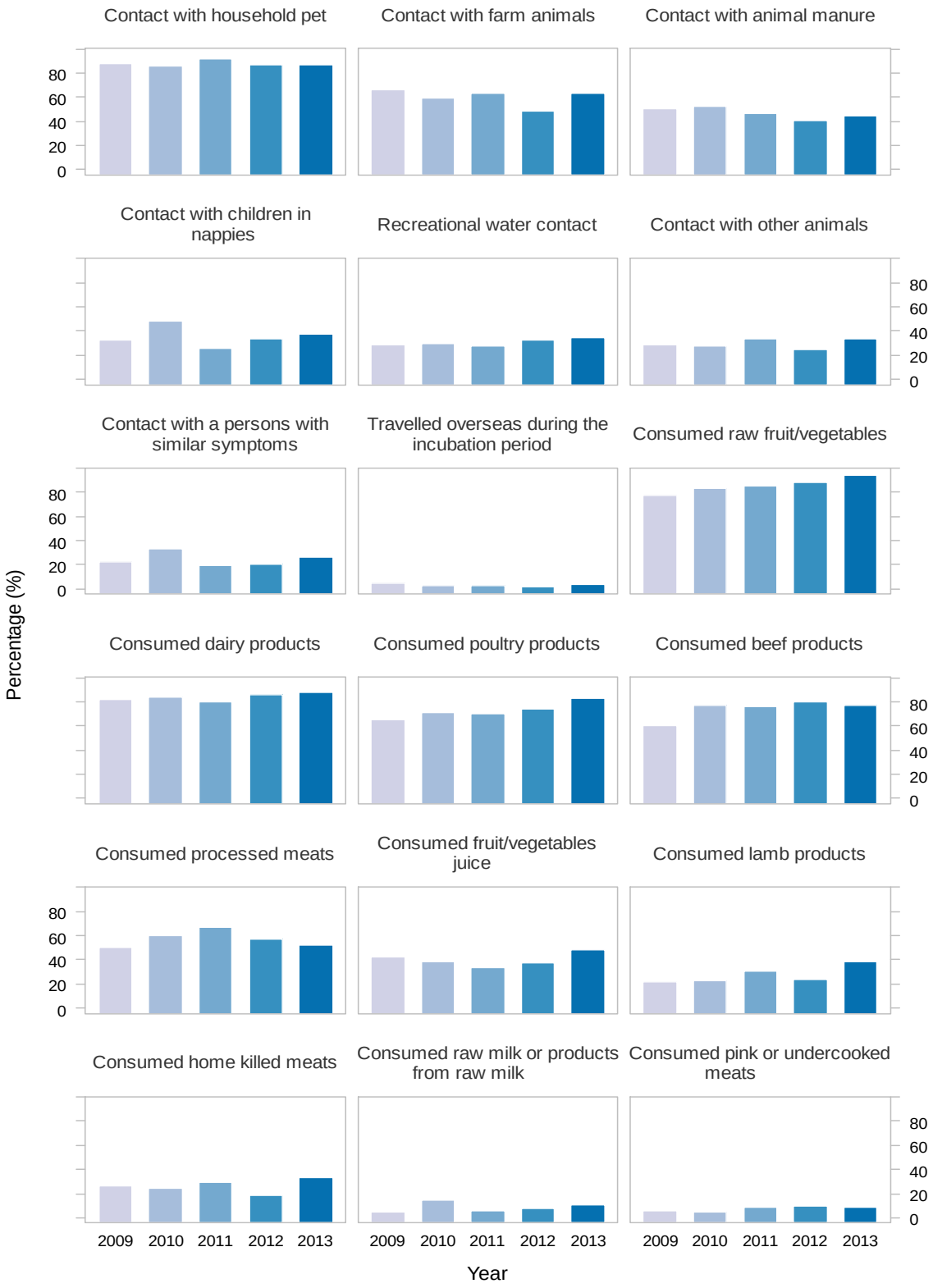
Table 69. Exposure to risk factors reported for notifications of VTEC/STEC infection, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Consumed raw fruit/vegetables	123	8	76	93.9
Consumed dairy products	114	16	77	87.7
Contact with household pets	81	12	114	87.1
Consumed poultry products	104	21	82	83.2
Consumed beef products	96	28	83	77.4
Contact with farm animals	57	33	117	63.3
Consumed processed meats	65	59	83	52.4
Consumed fruit/vegetables juice	56	60	91	48.3
Contact with animal manure	32	39	136	45.1
Consumed lamb products	43	70	94	38.1
Contact with children in nappies	44	76	87	36.7
Recreational water contact	46	89	72	34.1
Contact with other animals	25	50	132	33.3
Consumed home killed meats	40	83	84	32.5
Contact with persons with similar symptoms	37	106	64	25.9
Consumed raw milk or products from raw milk	15	117	75	11.4
Consumed pink or undercooked meats	10	105	92	8.7
Travelled overseas during the incubation period	6	148	53	3.9

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Between 2009 and 2013, the risk factors reported by VTEC/STEC infection cases generally occurred in the same order of importance and to a similar magnitude (Figure 53). The most commonly reported risk factors (excluding consumption of various foods) were contact with household pets and contact with farm animals. The foods with the highest reported consumption by cases were raw fruit and vegetables, and dairy products, followed closely by beef and poultry products, and processed meats.

Figure 53. Percentage of cases with exposure to risk factors reported for VTEC/STEC infection and year, 2009−2013



For cases where information on travel was provided, 3.9% (95% CI 1.6-8.7%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all VTEC/STEC infection cases, a Poisson distribution can be used to estimate the total number of potentially travel-related cases of VTEC/STEC infection in 2013. The resultant distribution has a mean of 8 cases (95% CI 1-18).

If data from the last four years are considered the estimated proportion of cases travelling overseas within the incubation period of the organism is 3.3% (95% CI 1.9-5.4%).

Outbreaks reported as caused by VTEC/STEC

Of the 16 VTEC/STEC outbreaks in 2013, two were reported as foodborne outbreaks with 4 associated cases, including one case that was hospitalised (Table 70). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 70. VTEC/STEC outbreaks reported, 2013

Measure	Foodborne VTEC/STEC outbreaks	All VTEC/STEC outbreaks
Outbreaks	2	16
Cases	4	58
Hospitalised cases	1	7

Over the period from 2004 to 2013 no more than two foodborne outbreaks of VTEC/STEC were reported each year with no outbreaks reported for five of the years (Figure 54). With the exception of an outbreak in 2008 with 14 associated cases, no outbreak in this period had more than four associated cases.

Figure 54. Foodborne VTEC/STEC outbreaks and associated cases reported by year, 2004–2013

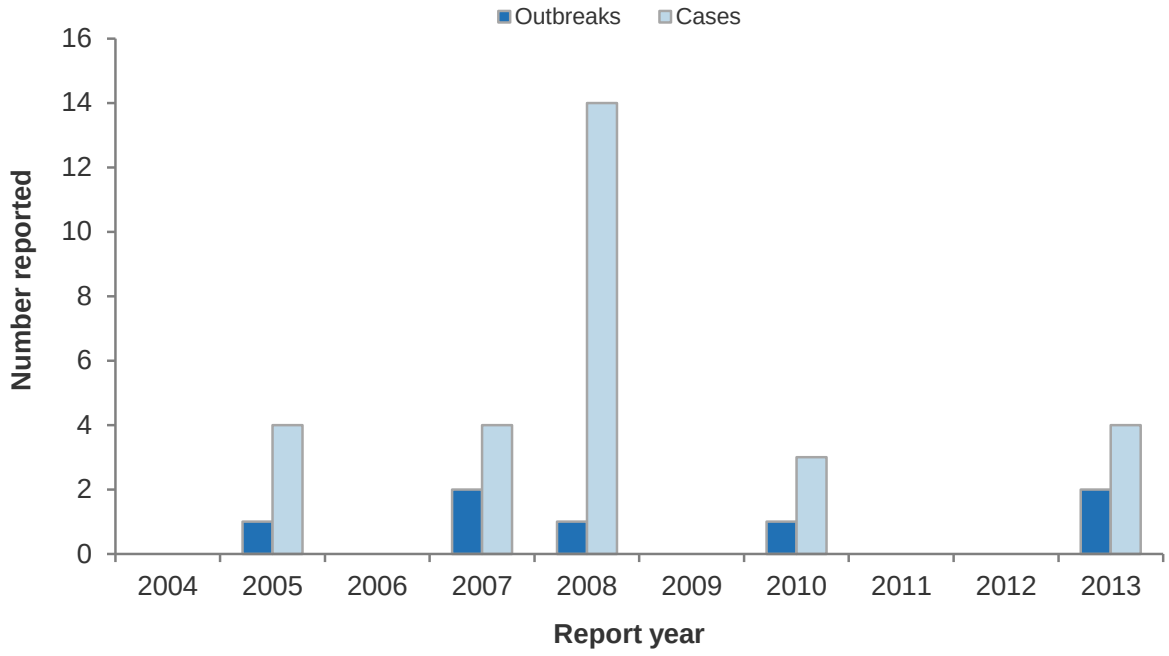


Table 71. Details of foodborne VTEC/STEC outbreaks reported, 2013

PHU	Month	Suspected vehicle	Exposure setting	Preparation setting	No. ill
Waikato	Aug	Unknown	Private Home	Private Home	2C
Waikato	Aug	Raw milk	Private Home	Private Home	2C

PHU: Public Health Unit, C: confirmed, P: probable.

Both STEC/VTEC outbreaks in 2013 were reported by the Waikato PHU (Table 71). No suspected food vehicle was listed for one outbreak, and the evidence was weak for the raw milk as a food vehicle in the second outbreak. The serotypes from both outbreaks were identified as *E.coli* O157:H7.

In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to food-associated VTEC/STEC outbreaks.

VTEC/STEC types commonly reported

A total of 215 cases infected with VTEC/STEC were reported by the ESR Enteric Reference Laboratory in 2013. Of these, 192 (89.3%) isolates were identified as *E. coli* O157:H7, 22 as non-O157:H7 and for one isolate VTEC could not be isolated although verocytotoxin was detected by PCR. Of the 22 non-O157:H7 isolates, two were typed as O121:H19 while the remaining 20 were all unique serotypes (Table 72). The number of non-O157 VTEC/STEC cases in 2013 was similar to 2012 although the percentage of non-O157:H7 cases was lower than previous years due to the large increase in O157:H7 cases in 2013 (Figure 55).

Table 72. VTEC/STEC subtypes identified by the Enteric Reference Laboratory, 2009–2013

Serotype	2009	2010	2011	2012	2013
O157	**137**	**115**	**139**	**119**	**192**
O157:H7	137	115	139	119	192
Non-O157	**8**	**13**	**14**	**23**	**22**
O121:H19					2
O128:H2		1	2		1
O84:H2		1	2		
O176:HNM		2	1	1	
ONT:HNM	3			9	1
ONT:H11				2	1
Other types[a]	5	9	9	11	17
Unable to be typed					**1**
Total	**145**	**128**	**153**	**142**	**215**

[a] Single cases following types were identified

2009: O22:H16, O103:H25, O174:H21, O26:H11, O103:H2

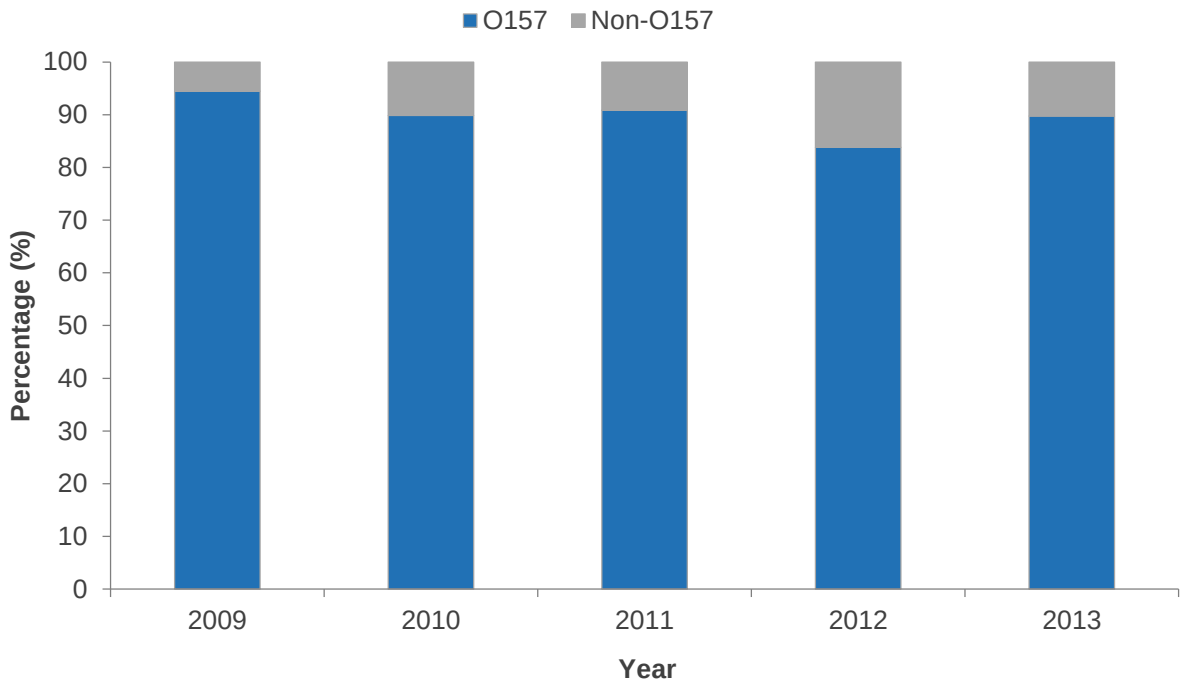
2010: ONT:H21, ONT:H23, ORough:HNT, ORough:H7, O77:HNM, O123:H8, ONT:HRough, O68:HNM, ONT:H2

2011: O103:H2, O123:HNM, O131:HRough, O146:H21, O178:H23, O26:H11, O84:HNM, ONT:H2, ORough:H2

2012: O26:H7, O26:H11, O38:H26, O68:HNM, O84:HNM, O128:HNM, O146:H21, O146:HRough, O176:HRough, O180:HNM, ONT:H7

2013: O26:M11, O38:H26, O84:HNM, O84:HNT, O103:H25, O116:H11, O121:HNT, O123:HMN, O145:H34, O156:H25, O163:H19, O177:HNM, O179:H8, O182:HNM, ONT:H2, ORough:H2, ORough:HNM.

Figure 55. Percentage of *E. coli* O157 and non-O157 laboratory-reported cases by year, 2009–2013



Most human isolates of O157:H7 are further genotyped by pulsed-field gel electrophoresis (PFGE). Table 73 summarises PFGE typing of human O157:H7 isolates each year from 2009 to 2013.

Table 73. PFGE genotypes of human E. coli O157:H7 isolates, 2009-2013

Genotype	Number of isolates				
	2009	2010	2011	2012	2013
Xb0040a1	29	20	17	11	16
Xb0040g	2	3	6	5	14
Xb0040a	8	9	25	23	13
Xb0049	10	25	16	13	10
Xb0040t	2			1	10
Xb0110	1	1		1	4
Xb0168	8	8	11	14	4
Xb0164	4	1			3
Xb0040s					3
Xb0014	3	2	5	5	2
Xb0040g3					2
Xb0168 extra					2
Other types					37
Total	**140**	**115**	**138**	**123**	**120**

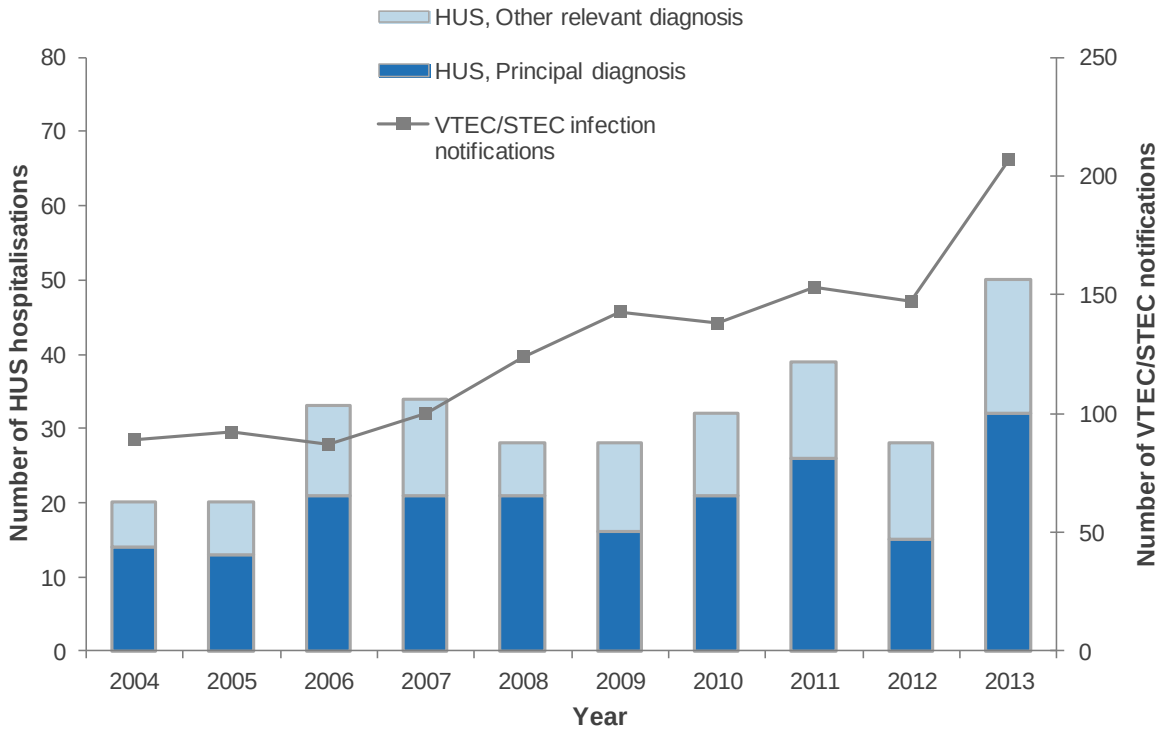
Disease sequelae - haemolytic-uraemic syndrome (HUS)

HUS is a serious sequela that may result from a VTEC/STEC infection.

The ICD-10 code D59.3 was used to extract HUS hospitalisation data from the MoH NMDS database. Of the 50 hospital admissions recorded in 2013 (1.1 per 100 000 population), 32 were reported with HUS as the primary diagnosis and 18 with HUS as another relevant diagnosis.

Between 2004 and 2012, the number of hospitalised cases (any diagnosis code) of HUS each year ranged from 20 to 39 (Figure 56). In 2013, the number of hospitalised cases increased to 50 which corresponds with an increase in the number of VTEC/STEC notifications.

Figure 56. Haemolytic-uraemic syndrome (HUS) hospitalised cases, 2004–2013



In 2013, the number of female hospitalised cases due to HUS was twice the number of male cases (Table 74). This is in contrast to 2012 where the rate of hospitalised cases was the same for females and males (0.6 per 100 000 population).

Table 74. Haemolytic uraemic syndrome hospitalised cases by sex, 2013

Sex	Hospitalised cases[a]	
	No.	Rate[b]
Male	17	0.8
Female	33	1.5
Total	**50**	**1.1**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population

In 2013, the highest age-specific rates of hospitalised cases due to HUS were in the less than 5 years and 5-9 years age groups (Table 75).

Table 75. Haemolytic uraemic syndrome hospitalised cases by age group, 2013

Age group (years)	Hospitalised cases [a]	
	No.	Rate[b]
<5	16	5.2
5 to 9	7	2.3
10 to 14	4	-
15 to 19	1	-
20 to 29	5	0.8
30 to 39	2	-
40 to 49	4	-
50 to 59	5	0.9
60 to 69	3	-
70+	3	-
Total	**50**	**1.1**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

Haemolytic uraemic syndrome cases reported to the New Zealand Paediatric Surveillance Unit (NZPSU)

During 2013, 21 cases of HUS were reported to the NZPSU. The median age at presentation of cases was 3.9 years (range 1.2 to 13 years). Ten cases had *E. coli* O157:H7 isolated from their stools and one had *E. coli* O179:H8 isolated. Eight of those positive for *E. coli* O157:H7 lived on a farm.

Note: the details given above are from an advance excerpt from the NZPSU Annual Report, which had not been published at the time of finalisation of the current report. The source reference provided here is the website where NZPSU Annual Reports are published:
http://dnmeds.otago.ac.nz/departments/womens/paediatrics/research/nzpsu/about/annual-reports.html

Recent surveys

Microbiological survey of pre-packaged fresh leafy salads at retail in New Zealand

A microbiological survey was conducted on pre-packaged fresh leafy salads available at retail in New Zealand [17]. A total of 307 samples were collected from three major cities over a one-year period. Products purchased were those packaged by the producer and not known to be handled or re-packaged by the retailer. Samples were tested at the end of the 'best before' date. The Most Probable Number (MPN) method was used to enumerate *Escherichia coli* in the majority of samples (n = 236) and samples found to contain *E. coli* were subsequently tested for the presence of shiga toxin-producing *E. coli* (STEC). No STEC were detected in any of the samples.

Summary of data from the 2012 nSTEC season

On 4 June 2012, six STEC serotypes (O26, O111, O45, O145, O121, O103), in addition to *E. coli* O157:H7, were declared as adulterants in certain types of raw meat in the USA. These non-O157:H7 types may be referred to as nSTEC serotypes. As a consequence, New Zealand meat exported to the USA has to be tested for the presence of these serotypes. The Enteric Reference Laboratory (ERL) at ESR provides the services for the confirmation of presumptive positive meat enrichment broths [29]. Results from the 2012 season were summarised.

Detection of New Zealand nSTEC from stored meat enrichments

This study aimed to identify stored beef and veal enrichments that contain genes of the nSTECs to facilitate isolation and the building of a library of New Zealand nSTEC isolates for future method validation studies [30]. Meat (beef and veal) samples previously enriched at five New Zealand laboratories were obtained and were tested using Multiplex Ligation-dependent Probe Amplification (MLPA) for 14 genes using probes designed by ESR. The genes targeted were *stx*1A, *stx2A*, *stx*2fA, *eae*, *ehx*A, *rfb*EO157, *fli*CH7, *wzx*O26, *wzx*O45(S88b), *wzy*O45, *wzx*O103, *wzy*O111, *wzy*O121 and *wzy*O145.

PFGE analysis of meat isolates of E. coli O157:H7 in New Zealand

In response to initiatives to further control *E. coli* O157:H7 in the USA beef supply, NZFSA (now incorporated into MPI) and industry agreed in January 2008 to molecular-type by pulsed field gel electrophoresis (PFGE) all *E. coli* O157:H7 isolates detected under the New Zealand *E. coli* O157:H7 monitoring programme, and to provide a summary of the PFGE profiles to the US Food Safety Inspection Service (FSIS) on a regular basis.

The report for 2012 describes the results of PFGE analysis of *E. coli* O157:H7 isolates from meat received by ESR during the period 1 January 2012 to 31 December 2012 [31].

Furthermore, in December 2012 an *E. coli* O157 outbreak and recall in Canada associated with ground beef occurred. The implicated batch supposedly contained Australian and New Zealand beef in addition to Canadian beef. Comparison of the PFGE pattern of the Canadian isolate with those from New Zealand isolates revealed this pattern has never been seen in New Zealand. This helped remove suspicion from New Zealand beef in this investigation.

Relevant New Zealand studies and publications

Journal papers

A study was carried out from July 2011 to July 2012 to investigate risk factors associated with sporadic STEC infections in humans in New Zealand and to provide epidemiological information about the source and exposure pathways [32]. Questionnaire data from 113 eligible cases and 506 controls were analysed using multivariate logistic regression. Statistically significant animal and environmental risk factors for human STEC infections were identified, notably 'Cattle livestock present in meshblock' (the smallest geographical unit) (odds ratio 1.89, 95% CI 1.04-3.42), 'Contact with animal manure' (OR 2.09, 95% CI 1.12-3.90), and 'Contact with recreational waters' (OR 2.95, 95% CI 1.30-6.70). No food-associated risk factors were identified as sources of STEC infection. *E. coli* O157:H7 caused 100/113 (88.5%) of clinical STEC infections in this study.

Relevant regulatory developments

Nil.

Yersiniosis

Summary data for yersiniosis in 2013 are given in Table 76.

Table 76. Summary of surveillance data for yersiniosis, 2013

Parameter	Value in 2013	Source
Number of notified cases	484	EpiSurv
Notification rate (per 100 000)	10.8	EpiSurv
Hospitalisations (% of notifications)[a]	46 (9.5%)	MoH NMDS
Deaths (%)[a]	0 (0%)	EpiSurv
Estimated travel-related cases (%)[a]	28 (5.9%)	EpiSurv
Estimated food-related cases (%)[b]	288 (63.2%)	Expert consultation

[a] Percentage of the number of notified cases. Cases hospitalised may not be notified on EpiSurv.
[b] For estimation of food-related cases the proportions derived from expert consultation exclude travel-related cases.

Case definition

Clinical description: In children under 5 years old, *Y. enterocolitica* infection typically causes diarrhoea, vomiting, fever and occasionally abdominal pain. In contrast, older children and adults are more likely to experience abdominal pain as the prominent symptom. Bacteraemia and sepsis may occur in immunocompromised individuals. *Y. pseudotuberculosis* is more likely to cause mesenteric adenitis and septicaemia than *Y. enterocolitica*.

Laboratory test for diagnosis: Isolation of *Yersinia enterocolitica* or *Y. pseudotuberculosis* from blood or faeces OR detection of circulating antigen by ELISA or agglutination test.

Case classification:

Probable: A clinically compatible illness that is epidemiologically linked to a confirmed case or has had contact with the same common source – that is, is part of a common-source outbreak.

Confirmed: A clinically compatible illness that is laboratory confirmed.

Yersiniosis cases reported in 2013 by data source

During 2013, 484 notifications (10.8 cases per 100 000 population) of yersiniosis and no resulting deaths were reported in EpiSurv.

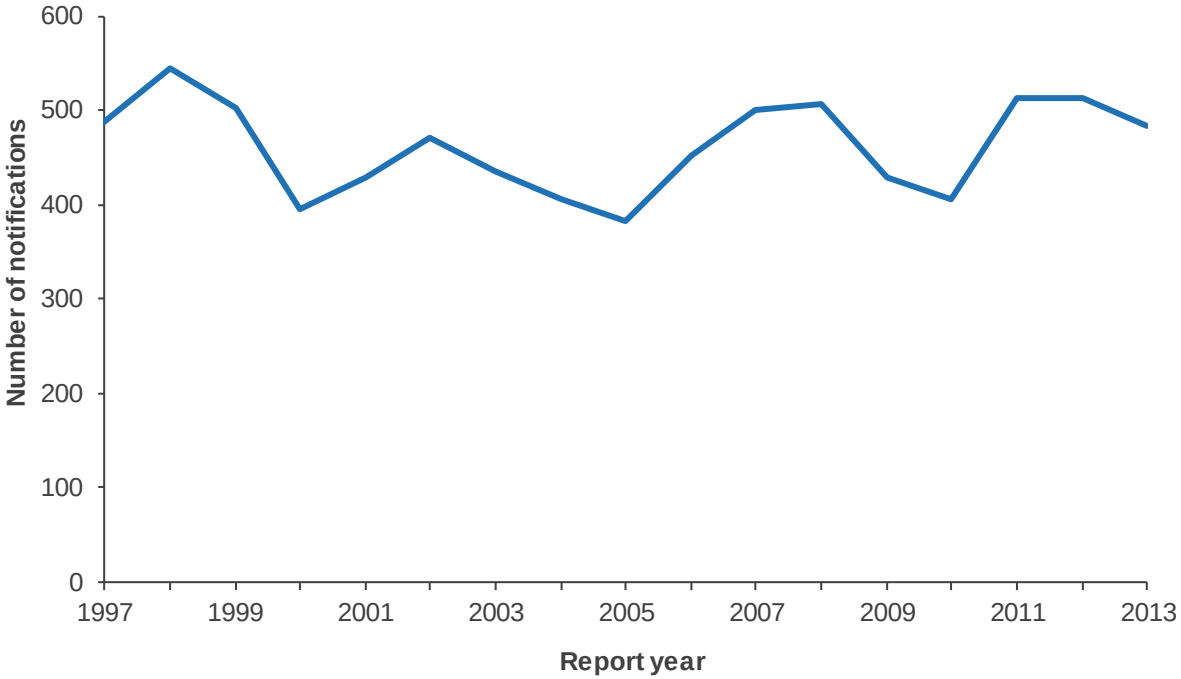
The ICD-10 code A04.6 was used to extract yersiniosis hospitalisation data from the MoH NMDS database. Of the 46 hospital admissions (1.0 admissions per 100 000 population) recorded in 2013, 29 were reported with yersiniosis as the primary diagnosis and 17 with yersiniosis as another relevant diagnosis.

It has been estimated by expert consultation that 63.2% (95th percentile credible interval: 29.0% to 91.5%) of yersiniosis incidence is due to foodborne transmission. Approximately 70% of foodborne transmission was estimated to be due to consumption of pork.

Notifiable disease data

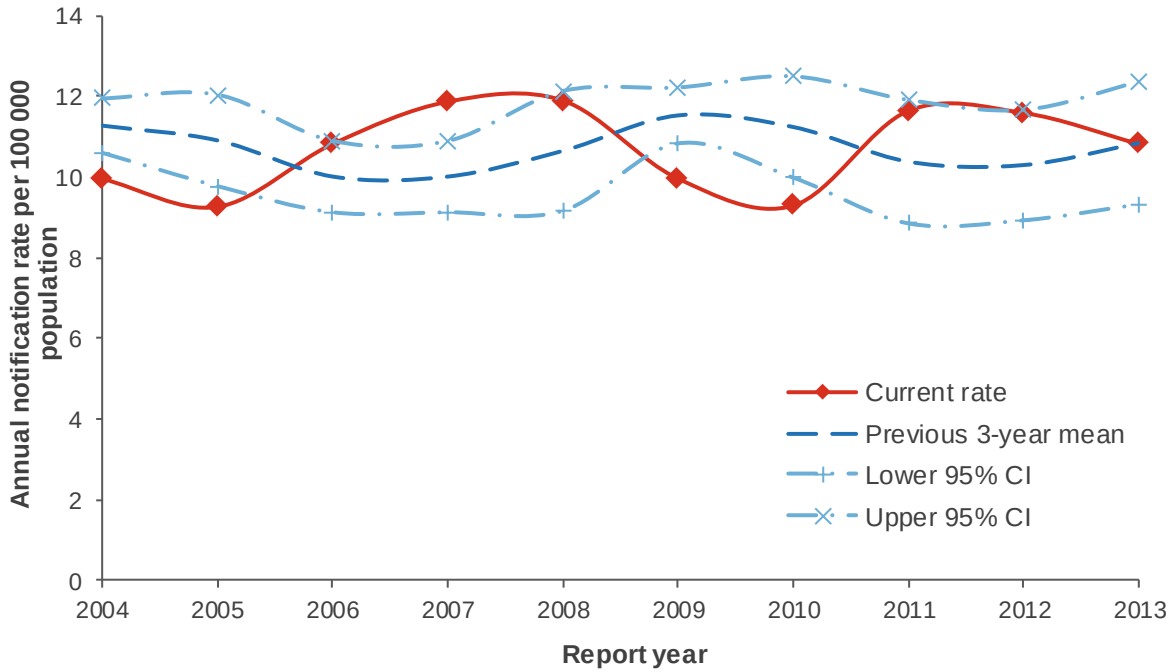
Yersiniosis became notifiable in 1996, with the highest number of notifications reported in 1998 (546 cases). Since 1998, the annual number of notifications reported has been between 383 notifications (2005) and 517 notifications (2012) (Figure 57).

Figure 57. Yersiniosis notifications by year, 1997–2013



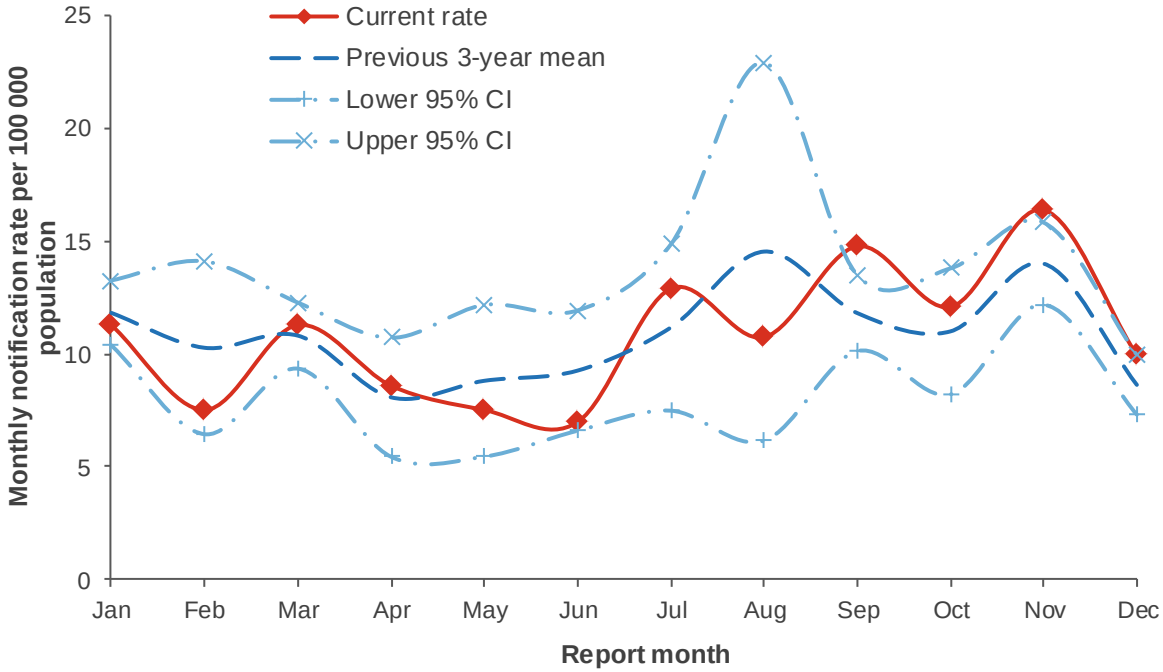
The yersiniosis annual notification rate has remained stable (ranging from 9.3 to 11.9 per 100 000) between 2004 and 2013 (Figure 58).

Figure 58. Yersiniosis notification rate by year, 2004–2013



The number of notified cases of yersiniosis per 100 000 population by month for 2013 is shown in Figure 59. The 2013 monthly notification rate trend was similar to the mean monthly rate in previous years.

Figure 59. Yersiniosis monthly rate (annualised), 2013



Yersiniosis notification rates varied spatially and temporally throughout New Zealand over the last four years as illustrated in Figure 60. In 2013, the highest rates were for the Lakes (24.3 per 100 000 population, 25 cases) and Canterbury (19.9 per 100 000, 101 cases) DHBs.

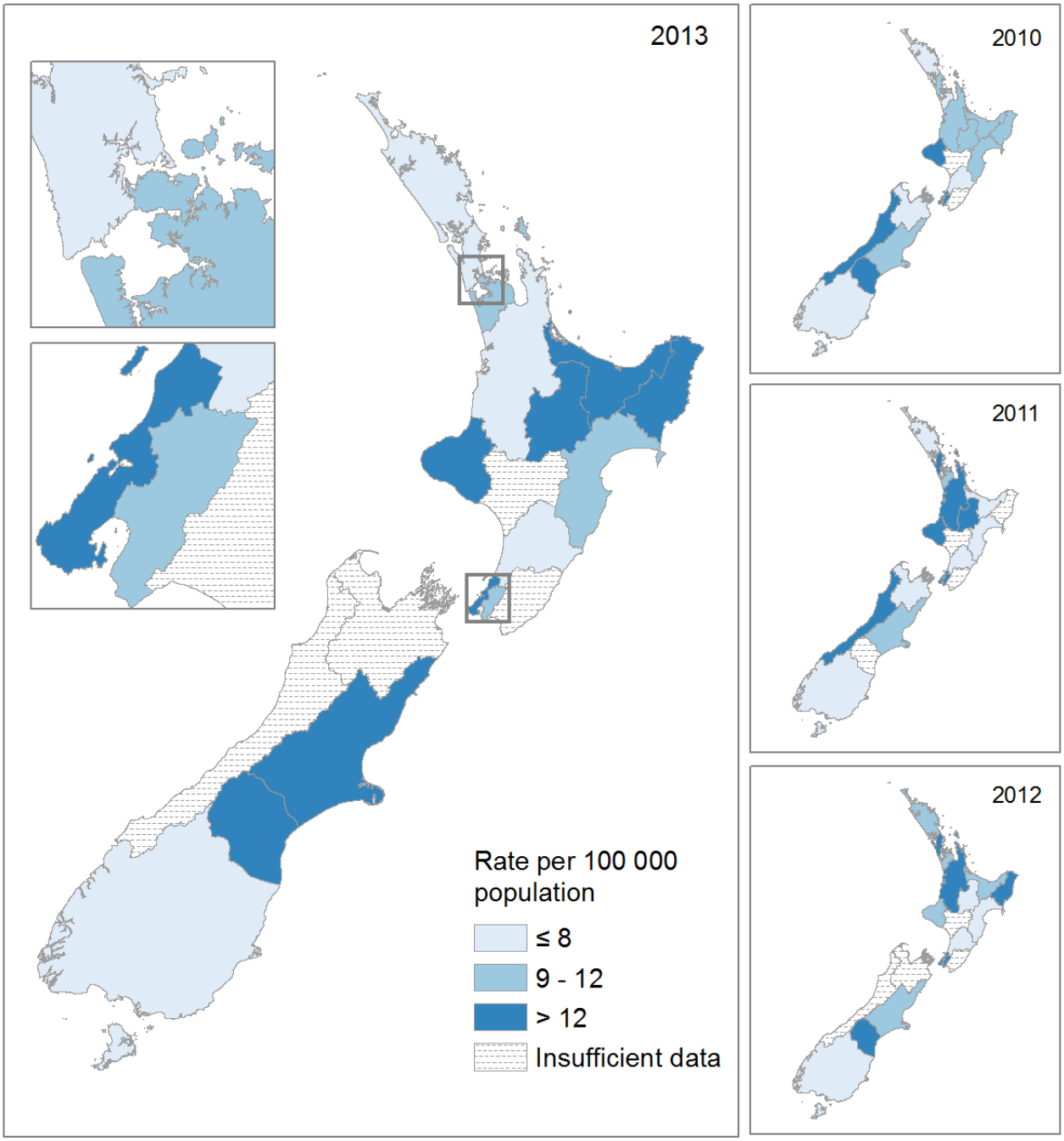
The yersiniosis notification rate was slightly higher for males (11.6 per 100 000 population, 256 cases) than for females (10.0 per 100 000, 228 cases) in 2013. In contrast the hospitalisation rate was slightly higher for females compared to males (Table 77).

Table 77. Yersiniosis cases by sex, 2013

Sex	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
Male	256	11.6	19	0.9
Female	228	10.0	27	1.2
Total	**484**	**10.8**	**46**	**1.0**

[a] MoH NMDS data for hospital admissions
[b] per 100 000 of population

Figure 60. Geographic distribution of yersiniosis notifications, 2010–2013



In 2013, the highest yersiniosis notification rates were for the less than 1 year (68.5 per 100 000 population, 41 cases) and 1 to 4 years (39.2 per 100 000, 97 cases) age groups. Notification rates were more than four times higher for the under five year olds than for any other age group (Table 78). Half of the hospitalised cases were aged over 50 years.

Table 78. Yersiniosis cases by age group, 2013

Age group (years)	EpiSurv notifications		Hospitalisations[a]	
	No.	Rate[b]	No.	Rate[b]
<1	41	68.5	4	-
1 to 4	97	39.2	3	-
5 to 9	22	7.4	0	-
10 to 14	25	8.8	2	-
15 to 19	16	5.2	0	-
20 to 29	60	9.4	8	-
30 to 39	43	7.7	6	-
40 to 49	46	7.4	0	-
50 to 59	54	9.3	5	-
60 to 69	32	7.2	4	-
70+	47	10.9	14	4.5
Unknown	1	-	-	-
Total	**484**	**10.7**	**46**	**1.0**

[a] MoH NMDS data for hospital admissions

[b] per 100 000 of population (rate not calculated when fewer than five cases reported)

In 2013, the most commonly reported risk factors for yersiniosis notifications were consumption of food from retail premises (39.4%) followed by contact with farm animals (25.5%), contact with faecal matter (25.0%) and consumption of untreated water (23.2%) (Table 79).

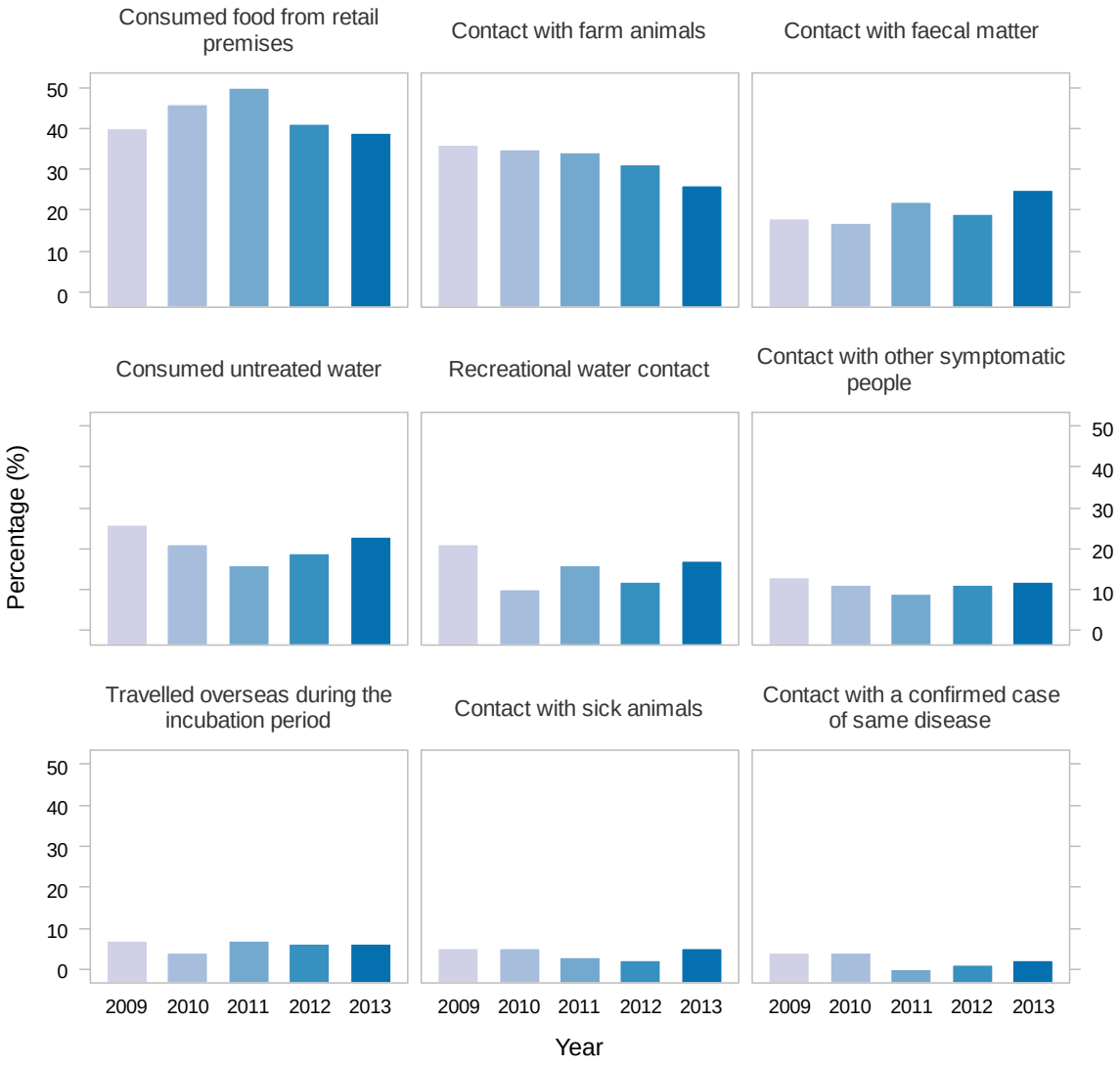
Table 79. Exposure to risk factors reported for yersiniosis notifications, 2013

Risk factor	Notifications			
	Yes	No	Unknown	%[a]
Consumed food from retail premises	82	126	276	39.4
Contact with farm animals	59	172	253	25.5
Contact with faecal matter	52	156	276	25.0
Consumed untreated water	48	159	277	23.2
Recreational water contact	38	184	262	17.1
Contact with other symptomatic people	26	188	270	12.1
Travelled overseas during the incubation period	14	224	246	5.9
Contact with sick animals	11	205	268	5.1

[a] Percentage refers to the cases that answered "yes" out of the total number of cases for which this information was supplied. Cases may have more than one risk factor recorded.

Between 2009 and 2013, the most commonly reported risk factor for yersiniosis cases was consumption of food from retail premises, followed by contact with farm animals (Figure 61). In the earlier years there was an increasing trend in the percentage of cases reporting consumption of food from retail premises but this decreased in 2012 and 2013. There has been a decrease in cases reporting contact with farm animals between 2009 and 2013.

Figure 61. Percentage of cases with exposure to risk factors reported for yersiniosis and year, 2009−2013



For cases where information on travel was provided, 5.9% (95% CI 3.4-9.9%) had travelled overseas during the incubation period. Assuming that the cases for which travel information was provided were representative of all yersiniosis cases, a Poisson distribution can be used to estimate the total number of potentially travel related cases of yersiniosis in 2013. The resultant distribution has a mean of 28 cases (95% CI 13-49).

If data from the last four years are considered, the estimated proportion of cases travelling overseas within the incubation period of the organism was 5.7% (95% CI 4.3-7.4%).

Outbreaks reported as caused by *Yersinia* spp.

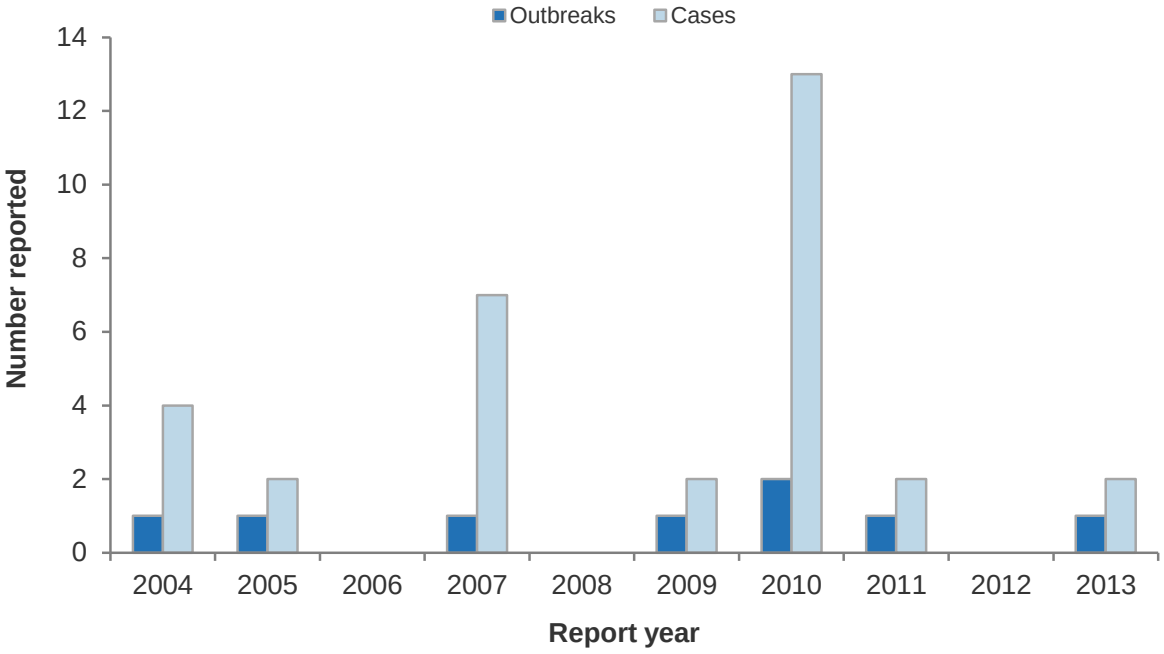
During 2013, there were three *Yersinia* spp. outbreaks, with a total of 13 cases, reported in EpiSurv. There was one *Yersinia* spp. outbreak associated with a suspected foodborne source in 2013 (Table 80). This suspected foodborne outbreak related to a food service setting with no listed suspected food vehicle. An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

Table 80. *Yersinia* spp. outbreaks reported, 2013

Measure	Foodborne Yersinia spp. outbreaks	All *Yersinia* spp. outbreaks
Outbreaks	1	3
Cases	2	13
Hospitalised cases	1	1

Between 2004 and 2013 very few foodborne *Yersinia* spp. outbreaks were reported in EpiSurv (two or less each year, with a total number of associated cases ranging from 2 to 13) (Figure 62).

Figure 62. Foodborne *Yersinia* spp. outbreaks and associated cases reported by year, 2004–2013



In 2013, no food or clinical samples were submitted to ESR's Public Health Laboratory relating to food-associated *Yersinia* spp. outbreaks.

Yersinia types commonly reported

In 2013, clinical laboratories submitted 479 isolates for *Yersinia* spp. confirmation and typing to the Enteric Reference Laboratory at ESR. Notifiable *Yersinia* spp. (i.e. *Yersinia enterocolitica* (YE) and *Y. pseudotuberculosis* (YTB)) were identified in 87% of these isolates. Note that the case status in EpiSurv is changed to "not a case" for *Yersinia* isolates that are identified by ERL as non notifiable (i.e. not YE or YTB) and these cases no longer appear in the reported notification data.

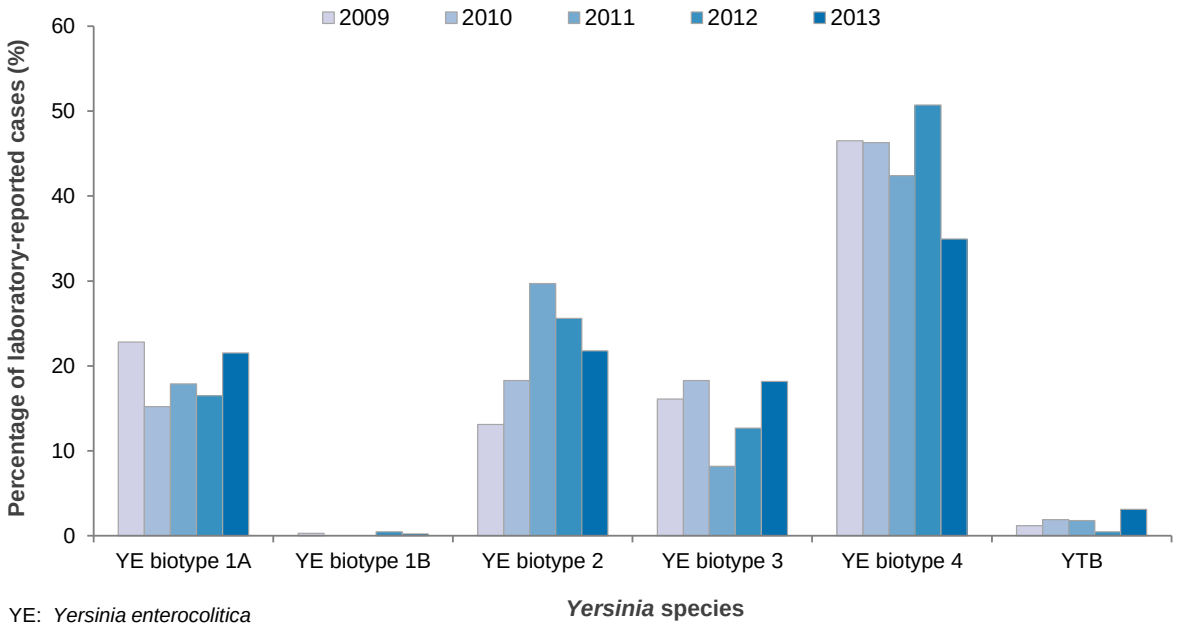
The number of notifiable *Yersinia* spp. cases identified by the Enteric Reference Laboratory at ESR each year is shown in Table 81. Between 2009 and 2013, the largest proportion of cases was due to YE biotype 4. An increase in the proportion of cases being reported with YE biotype 1A, YE biotype 3 and YTB were seen in 2013 compared to the previous year (Figure 63).

These numbers need to be interpreted with some caution as a) not all clinical laboratories forward isolates to ERL for confirmation and biotyping and b) the number of isolates forwarded for confirmation and typing, as a percentage of all notifications, has changed during this period and c) the isolation and identification of *Yersinia* spp. are highly sensitive to the methods used by laboratories.

Table 81. Notifiable *Yersinia* spp. identified by the Enteric Reference Laboratory, 2009–2013

Species	2009	2010	2011	2012	2013
Yersinia enterocolitica	**325**	**252**	**433**	**443**	**405**
biotype 1A	75	39	79	69	90
biotype 1B	1	0	0	2	1
biotype 2	43	47	131	107	91
biotype 3	53	47	36	53	76
biotype 4	153	119	187	212	146
biotype not identified	-	-	-	-	1
Yersinia pseudotuberculosis	**4**	**5**	**8**	**2**	**13**
Total	**329**	**257**	**441**	**445**	**418**

Figure 63. Percentage of laboratory-reported cases of notifiable *Yersinia* spp. by species and year, 2009–2013



YE: *Yersinia enterocolitica*
YTB: *Yersinia pseudotuberculosis*

Note: percentage was calculated using the number of cases for each species out of all notifiable *Yersinia* isolates (i.e. excludes *Y. frederiksenii*, etc)

Recent surveys

Nil.

Relevant New Zealand studies and publications

Nil.

Relevant regulatory developments

Nil.

SUMMARY TABLES

SUMMARY TABLES

This appendix brings together data from different sources as summary tables to facilitate comparisons between conditions.

Table 82. Number of cases and rate per 100 000 population of selected notifiable diseases in New Zealand, 2012–2013

Disease	2012		2013		Change [b,c]
	Cases	Rates	Cases	Rates	
Campylobacteriosis	7031	158.6	6837	152.9	↞
Cryptosporidiosis	877	19.8	1348	30.1	↠
Gastroenteritis[a]	735	16.6	558	12.5	↞
Giardiasis	1719	38.8	1729	38.7	→
Hepatitis A	82	1.8	91	2.0	→
Listeriosis	25	0.6	19	0.4	←
Salmonellosis	1085	24.5	1143	25.6	→
Shigellosis	132	3.0	137	3.1	→
VTEC/STEC infection	147	3.3	207	4.6	↠
Yersiniosis	517	11.7	484	10.8	←

[a] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

[b] ↞= Significant decrease, ↠ = Significant increase, ▫ = No change, ← = Not significant decrease, → = not significant increase, NA = not applicable

[c] Fisher's exact tests were used to determine statistical significance. Results are considered statistically significant when the *P* value is less than or equal to 0.05.

Table 83. Deaths due to selected notifiable diseases recorded in EpiSurv, 1997-2013

Disease	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Campylobacteriosis	2	2	1	3	1	1	0	0	1	1	1	0	0	0	0	0	1
Gastroenteritis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Giardiasis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Listeriosis - non perinatal	2	0	1	2	1	0	2	3	1	0	2	3	2	3	1	4	2
Listeriosis - perinatal	6	0	2	4	1	3	2	2	0	1	2	2	2	4	0	2	3
Salmonellosis	2	2	1	7	2	1	0	0	1	1	1	1	1	0	0	0	0
Shigellosis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VTEC/STEC infection	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Yersiniosis	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Note: The numbers in this table are those recorded in EpiSurv where the notifiable disease was the primary cause of death. Information on deaths is most likely to be reported by Public Health Services when it occurs close to the time of notification and investigation.

Table 84. MoH mortality data for selected notifiable diseases, 2009-2011

Disease	ICD 10 Codes	2009		2010		2011 [a]	
		Und[b]	Cont[c]	Und[b]	Cont[c]	Und[b]	Cont[c]
Campylobacteriosis	A04.5	1	0	0	4	0	2
Hepatitis A	B15	0	0	0	2	0	0
Listeriosis	A32	3	3	3	0	0	1
Salmonellosis	A02	1	4	0	1	0	0
Shigellosis	A03	0	0	0	0	0	0
Yersiniosis	A04.6	1	0	0	0	0	0

[a] Latest year that data are available.
[b] Underlying – main cause of death.
[c] Contributory – selected contributory cause of death (not main cause of death).

Table 85. MoH Hospitalisations data for selected notifiable diseases, 2011-2013

Disease	ICD 10 Codes	2011		2012		2013	
		Principal diagnosis	Other relevant diagnosis	Principal diagnosis	Other relevant diagnosis	Principal diagnosis	Other relevant diagnosis
Campylobacteriosis	A04.5	445	132	544	116	585	124
Cryptosporidiosis	A07.2	16	2	42	12	38	21
Giardiasis	A07.1	35	25	27	23	24	23
Hepatitis A	B15	8	11	35	4	29	10
Listeriosis	A32	11	19	14	13	13	11
Salmonellosis	A02	107	29	128	46	126	40
Shigellosis	A03	22	6	12	8	26	3
Toxic shellfish poisoning	T61.2	14	1	19	1	-	-
VTEC/STEC infection	A04.3	12	6	13	0	46	50
Yersiniosis	A04.6	16	23	18	23	29	17

Note: hospital admission data may include multiple admissions (to the same or different hospitals) for the same case and admissions may relate to cases first diagnosed in previous years.

Table 86. Number of cases and rate per 100 000 population of selected notifiable diseases by ethnic group, 2013

Disease	Ethnic group											
	Maori		Pacific Peoples		Asian		MELAA[a]		European or Other		Total[b]	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
Campylobacteriosis	536	80.2	147	53.2	320	62.2	36	71.9	5348	180.5	6837	152.9
Cryptosporidiosis	157	23.5	35	12.7	42	8.2	14	28.0	1050	35.4	1348	30.1
Gastroenteritis[c]	48	7.2	12	4.3	32	6.2	3	NC	399	13.5	558	12.5
Giardiasis	97	14.5	16	5.8	77	15.0	30	59.9	1391	47.0	1729	38.7
Hepatitis A	16	2.4	21	7.6	11	2.1	2	NC	40	1.4	91	2.0
Listeriosis	4	NC	0	NC	2	NC	0	NC	13	0.4	19	0.4
Salmonellosis	77	11.5	56	20.3	84	16.3	13	26.0	846	28.6	1143	25.6
Shigellosis	4	NC	52	18.8	13	2.5	3	NC	50	1.7	137	3.1
VTEC/STEC infection	21	3.1	4	NC	7	1.4	0	NC	172	5.8	207	4.6
Yersiniosis	43	6.4	20	7.2	88	17.1	5	10.0	301	10.2	484	10.8

[a] Middle Eastern/Latin American/African.

[b] Total includes cases where ethnicity was unknown.

[c] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

Note: Denominator data used to determine disease rates for ethnic groups is based on the proportion of people in each ethnic group from the estimated resident 2013 census population applied to the 2013 mid year population estimates from Statistics New Zealand. Ethnicity is prioritised in the following order: Māori, Pacific Peoples, Asian, MELAA and European or Other Ethnicity (including New Zealander). Where fewer than five cases have been notified, a rate has not been calculated and the cell marked NC.

Table 87. Number of cases and rates of selected notifiable diseases per 100 000 population by sex, 2013

Disease	Sex					
	Male		Female		Total[a]	
	Cases	Rate	Cases	Rate	Cases	Rate
Campylobacteriosis	3833	174.1	3004	132.3	6837	152.9
Cryptosporidiosis	618	28.1	729	32.1	1348	30.1
Gastroenteritis[b]	247	11.2	311	13.7	558	12.5
Giardiasis	858	39	871	38.4	1729	38.7
Hepatitis A	41	1.9	50	2.2	91	2
Listeriosis – non perinatal	7	0.3	7	0.3	14	0.3
Salmonellosis	582	26.4	561	24.7	1143	25.6
Shigellosis	58	2.6	79	3.5	137	3.1
VTEC/STEC infection	86	3.9	121	5.3	207	4.6
Yersiniosis	256	11.6	228	10	484	10.8

[a] Total includes cases where sex was unknown.

[b] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

Table 88. Number of cases and rates of selected notifiable diseases per 100 000 population by age group, 2013

	<1		1 to 4		5 to 9		10 to 14		15 to 19		20 to 29		30 to 39		40 to 49		50 to 59		60 to 69		70+		Total	
Disease	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**	**Cases**	**Rate**
Campylobacteriosis	138	230.5	698	281.7	253	84.9	221	77.4	464	151.7	1,091	170.7	754	134.7	862	139.2	877	150.7	744	167.7	735	170.8	6,837	152.9
Cryptosporidiosis	39	65.1	418	168.7	185	62.1	81	28.4	61	19.9	163	25.5	210	37.5	86	13.9	48	8.3	38	8.6	19	4.4	1348	30.1
Gastroenteritis	23	38.4	71	28.7	19	6.4	12	4.2	20	6.5	63	9.9	66	11.8	73	11.8	47	8.1	47	10.6	89	20.7	558	12.5
Giardiasis	30	50.1	374	151.0	140	47.0	38	13.3	30	9.8	168	26.3	375	67.0	242	39.1	140	24.1	140	31.5	51	11.9	1729	38.7
Hepatitis A	0		13	5.2	20	6.7	14	4.9	4		15	2.3	10	1.8	5	0.8	6	1.0	3		1		91	2
Listeriosis	0		0		1		0		0		2		4		1		2		3		6	1.4	19	0.4
Salmonellosis	64	106.9	202	81.5	66	22.1	40	14.0	65	21.2	166	26.0	117	20.9	142	22.9	112	19.3	94	21.2	75	17.4	1143	25.6
Shigellosis	3		12	4.8	17	5.7	3		8	2.6	28	4.4	22	3.9	14	2.3	16	2.8	7	1.6	7	1.6	137	3.1
VTEC/STEC infection	12	20.0	66	26.6	21	7.0	16	5.6	13	4.2	20	3.1	10	1.8	8	1.3	12	2.1	14	3.2	15	3.5	207	4.6
Yersiniosis	41	68.5	97	39.2	22	7.4	25	8.8	16	5.2	60	9.4	43	7.7	46	7.4	54	9.3	32	7.2	47	10.9	484	10.8

[a] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

Note: Where fewer than five cases have been notified a rate has not been calculated and the cell has been left blank.
Rates for each disease have been divided into three bands and shaded to indicate the age groups with highest, medium and lowest rates of disease. Shadings used are:

Fewer than 5 cases in a cell or less than a national total of 50 cases for the year

First (lowest) band

Second (middle) band

Third (highest) band

Table 89. Number of cases of selected notifiable diseases by District Health Board, 2013

Disease	District Health Board																				
	Northland	Waitemata	Auckland	Counties Manukau	Waikato	Lakes	Bay of Plenty	Tairawhiti	Taranaki	Hawke's Bay	Whanganui	MidCentral	Hutt Valley	Capital & Coast	Wairarapa	Nelson Marlborough	West Coast	Canterbury	South Canterbury	Southern	Total
Campylobacteriosis	221	772	598	536	774	180	262	83	236	336	108	285	151	440	68	188	69	801	167	562	6837
Cryptosporidiosis	28	121	86	57	215	62	36	4	37	136	20	46	40	104	13	21	8	191	38	85	1384
Gastroenteritis[a]	5	70	59	37	33	9	19	0	7	1	23	69	75	95	9	4	8	19	0	16	558
Giardiasis	47	171	189	189	179	57	99	14	49	63	11	38	38	164	20	71	11	181	13	125	1729
Hepatitis A	4	5	7	9	1	0	2	1	0	7	1	1	0	2	0	1	0	46	1	3	91
Listeriosis	0	3	3	2	0	0	3	0	2	0	0	1	1	1	1	1	0	1	0	0	19
Salmonellosis	51	116	134	83	94	19	54	17	20	31	7	35	24	58	11	52	7	142	21	167	1143
Shigellosis	5	18	37	36	4	1	1	0	2	1	0	0	3	7	0	1	0	7	2	12	137
VTEC/STEC infection	11	27	20	23	44	3	10	1	9	2	1	3	1	4	1	3	2	27	5	10	207
Yersiniosis	10	42	52	49	26	25	36	6	14	14	4	13	14	52	0	1	0	101	8	17	484

[a] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

Table 90. Rate per 100 000 population of selected notifiable diseases by District Health Board, 2013

Disease	Northland	Waitemata	Auckland	Counties Manukau	Waikato	Lakes	Bay of Plenty	Tairawhiti	Taranaki	Hawke's Bay	Whanganui	MidCentral	Hutt Valley	Capital & Coast	Wairarapa	Nelson Marlborough	West Coast	Canterbury	South Canterbury	Southern	Total
Campylobacteriosis	139.2	137.3	127.8	104.0	207.6	174.8	123.1	177.7	213.2	216.1	173.1	168.0	104.9	146.7	137.2	133.1	211.3	157.9	292.9	181.4	152.9
Cryptosporidiosis	17.6	21.5	18.4	11.1	57.7	60.2	16.9		33.4	87.5	32.1	27.1	27.8	34.7	32.0	14.9	24.5	37.6	66.7	27.4	30.1
Gastroenteritis	3.1	12.5	12.6	7.2	8.9	8.7	8.9		6.3		36.9	40.7	52.1	31.7	22.1		24.5	3.7		5.2	12.5
Giardiasis	29.6	30.4	40.4	36.7	48.0	55.3	46.5	30.0	44.3	40.5	17.6	22.4	26.4	54.7	49.2	50.2	33.7	35.7	22.8	40.3	38.7
Hepatitis A		0.9	1.5	1.7						4.5								9.1			2
Listeriosis																					0.4
Salmonellosis	32.1	20.6	28.6	16.1	25.2	18.4	25.4	36.4	18.1	19.9	11.2	20.6	16.7	19.3	27.1	36.8	21.4	28.0	36.8	53.9	25.6
Shigellosis	3.1	3.2	7.9	7.0										2.3				1.4		3.9	3.1
VTEC/STEC infection	6.9	4.8	4.3	4.5	11.8		4.7		8.1									5.3	8.8	3.2	4.6
Yersiniosis	6.3	7.5	11.1	9.5	7.0	24.3	16.9	12.8	12.6	9.0		7.7	9.7	17.3				19.9	14.0	5.6	10.8

[a] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.

Rates for each disease have been divided into three bands and shaded to indicate DHBs with the highest, middle and lowest rates of disease. Shadings used are:

- Fewer than 5 cases in a cell or less than a national total of 50 cases for the year
- First (lowest) band
- Second (middle) band
- Third (highest) band

Table 91. Number of cases of selected notifiable diseases by year, 1987–1999

Disease	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Campylobacteriosis	2921	2796	4187	3850	4148	5144	8101	7714	7442	7635	8924	11 572	8161
Cryptosporidiosis[a]										119	357	866	977
Gastroenteritis[a b]										555	310	492	601
Giardiasis[a]										1235	2127	2183	1793
Hepatitis A	158	176	134	150	224	288	257	179	338	311	347	145	119
Listeriosis	12	7	10	16	26	16	11	8	13	10	35	17	19
Salmonellosis	1140	1128	1860	1619	1244	1239	1340	1522	1334	1141	1177	2069	2077
Shigellosis	143	145	137	197	152	124	128	185	191	167	117	122	147
VTEC/STEC infection[c]							3	3	6	7	13	48	64
Yersiniosis[a]										330	488	546	503

[a] Acute gastroenteritis, cryptosporidiosis, giardiasis, VTEC/STEC infection and yersiniosis were added to the Health Act 1956 notification schedule in June 1996.
[b] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.
[c] The first case of VTEC/STEC infection confirmed in New Zealand was reported in October 1993 [33].

Table 92. Number of cases of selected notifiable diseases by year, 2000–2013

Disease	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Campylobacteriosis	8418	10 146	12 494	14 788	12 215	13 836	15 873	12 778	6694	7177	7346	6689	7016	6837
Cryptosporidiosis	775	1208	975	817	611	888	737	924	764	854	954	610	877	1348
Gastroenteritis[a]	727	940	1087	1026	1363	557	937	622	686	712	493	630	735	558
Giardiasis	1688	1604	1547	1570	1514	1231	1214	1402	1660	1639	1985	1934	1714	1729
Hepatitis A	107	61	106	70	49	51	123	42	89	44	46	26	82	91
Listeriosis	22	18	19	24	26	20	19	26	27	28	23	26	25	19
Salmonellosis	1795	2417	1880	1401	1081	1382	1335	1275	1339	1128	1146	1056	1081	1143
Shigellosis	115	157	112	87	140	183	102	129	113	119	104	101	132	137
VTEC/STEC infection	67	76	73	104	89	92	87	100	124	143	138	153	147	207
Yersiniosis	396	429	472	436	407	383	453	502	508	430	406	514	514	484

[a] Cases of acute gastroenteritis from a common source or foodborne intoxication e.g. staphylococcal intoxication.
Note: cell is blank where data are unavailable.

Table 93. Rate per 100 000 population of selected notifiable diseases in New Zealand and other selected countries

Disease	Country/Region (publication year of report)						
	New Zealand (2013)	Australia[a] (2013)	USA[b] (2013)	Canada[d] (2011)	UK[e] (2012)	EU Total[e] (2012)	Other high
Campylobacteriosis	152.9	64.6	13.8	5.6	117.4	55.5	174 (Czech Republic)[e] 110 (Luxembourg)[e]
Cryptosporidiosis	30.1	17.0	3.0[c]	NN	5.8[f]	2.0[f]	9.0 (Ireland)[f] 4.0 (Sweden)[f]
Giardiasis	38.7	NN	6.4[c]	NN	6.3[f]	5.5[f]	26.1 (Bulgaria)[f] 18.3 (Estonia)[f]
Hepatitis A	2.0	0.8	0.5[c]	NN	0.4[f]	2.5[f]	74.5 (Bulgaria)[f] 12.1 (Romania)[f]
Listeriosis	0.4	0.3	0.3	0.4	0.3	0.4	1.3 (Iceland)[e] 1.1 (Finland)[e]
Salmonellosis	25.6	56.5	15.2	19.7	14.3	22.2	98 (Czech Republic)[e] 86 (Slovakia)[e]
Shigellosis	3.1	2.4	4.8	2.5	3.3[f]	1.6[f]	10.6 (Bulgaria)[f] 9.9 (Slovakia)[f]
VTEC/STEC infection	4.6	0.8	2.3[g]	1.4[h]	2.2	1.2	9.0 (Ireland)[e] 6.3 (Netherlands)[e]
Yersiniosis	10.8	NN	0.4	1.1	0.1[f]	2.2[f]	11.4 (Lithuania)[f] 10.3 (Finland)[f]

NN: Not notifiable

[a] National Notifiable Diseases Surveillance System (NNDSS) http://www9.health.gov.au/cda/source/CDA-index.cfm

[b] FoodNet – Foodborne Diseases Active Surveillance Network http://www.cdc.gov/foodnet/

[c] Centers for Disease Control and Prevention. Summary of notifiable disease http://www.cdc.gov/mmwr/mmwr_nd/index.html (CDC data presented here relate to the 2011 year).

[d] National Enteric Surveillance Program (NESP) http://www.nml-lnm.gc.ca/NESP-PNSME/index-eng.htm

[e] European Food Safety Authority and European Centre for Disease Prevention and Control (ECDC). The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2012 http://www.efsa.europa.eu/en/efsajournal/doc/3547.pdf

[f] European Centre for Disease Prevention and Control (ECDC). Annual epidemiological report on communicable diseases in Europe http://ecdc.europa.eu/en/Pages/home.aspx (ECDC data presented here relate to the 2011 year).

[g] Includes both *Escherichia coli* O157 and non-O157.

[h] *Escherichia coli* O157 only.

Table 94. Foodborne outbreaks and associated cases by pathogen/condition, 2013

Pathogen/Condition	Outbreaks		Cases	
	No.	%[a]	No.	%[b]
Norovirus	16	13.3	172	22.1
Campylobacter spp.	16	13.3	77	9.9
Giardia spp.	10	8.3	36	4.6
Clostridium perfringens	9	7.5	208	26.7
Salmonella spp.	9	7.5	45	5.8
Shigella spp.	4	3.3	21	2.7
Histamine (Scombroid) fish poisoning	3	2.5	21	2.7
Cryptosporidium spp.	3	2.5	11	1.4
VTEC/STEC infection	2	1.7	4	0.5
Rotavirus	1	0.8	41	5.3
Salmonella Paratyphi	1	0.8	14	1.8
Clostridium septicum	1	0.8	7	0.9
Bacillus cereus	1	0.8	3	0.4
Sapovirus	1	0.8	2	0.3
Sulphur dioxide poisoning	1	0.8	2	0.3
Staphylococcus aureus	1	0.8	2	0.3
Yersinia spp.	1	0.8	2	0.3
Pathogen not identified[c]	44	36.7	140	18.0
Total[d]	**120**	**100**	**778**	**100**

[a] Percentage of outbreaks for each pathogen/condition, calculated using the total number of foodborne outbreaks (120). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

[b] Percentage of cases for each pathogen/condition, calculated using the total number of associated cases (778).

[c] All outbreaks with no pathogen identified in 2013 were recorded as gastroenteritis.

[d] Two agents were reported in five foodborne outbreaks with 33 associated cases, therefore totals add to more than 100%.

Table 95. Foodborne outbreaks and associated cases by exposure setting, 2013

Exposure setting	Outbreaks		Cases	
	No.	%[a]	No.	%[b]
Commercial food operators	**72**	**60.0**	**465**	**59.8**
Restaurant/café/bakery	48	40.0	280	36.0
Takeaway	13	10.8	42	5.4
Caterers	3	2.5	111	14.3
Fast food restaurant	1	0.8	2	0.3
Other food outlet	5	4.2	17	2.2
Supermarket/delicatessen	2	1.7	8	1.0
Temporary or mobile food premise	1	0.8	7	0.9
Institutions	**10**	**8.3**	**108**	**13.9**
Childcare	3	2.5	47	6.0
Camp site	1	0.8	12	1.5
Hospital (acute care)	1	0.8	4	0.5
Hotel/motel	1	0.8	3	0.4
Long-term care facility	1	0.8	22	2.8
School	1	0.8	4	0.5
Other institution	2	1.7	16	2.1
Other	**50**	**41.7**	**342**	**44.0**
Private home	38	31.7	145	18.6
Farm	1	0.8	4	0.5
Community/church gathering	2	1.7	121	15.6
Workplace	2	1.7	17	2.2
Other setting[c]	7	5.8	55	7.1
Unknown exposure setting	**4**	**3.3**	**10**	**1.3**

[a] Percentage of outbreaks for each exposure setting, calculated using the total number of foodborne outbreaks (120). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

[b] Percentage of cases for each exposure setting, calculated using the total number of associated cases (778).

[c] Includes three outbreaks (21 cases) where transmission occurred overseas.

Table 96. Foodborne outbreaks and associated cases by preparation setting, 2013

Preparation setting	Outbreaks		Cases	
	No.	%[a]	No.	%[b]
Commercial food operators	**70**	**58.3**	**467**	**60**
Restaurant/café/bakery	46	38.3	256	32.9
Takeaway	13	10.8	48	6.2
Caterers	5	4.2	125	16.1
Fast food restaurant	1	0.8	2	0.3
Other food outlet	6	5	42	5.4
Institutions	**5**	**4.2**	**53**	**6.8**
Long-term care facility	2	1.7	35	4.5
Camp	1	0.8	12	1.5
School	1	0.8	4	0.5
Other institution	1	0.8	2	0.3
Other	**31**	**25.8**	**243**	**31.2**
Private home	19	15.8	72	9.3
Overseas manufacturer	5	4.2	27	3.5
Farm	4	3.3	17	2.2
Community/church gathering	2	1.7	121	15.6
Commercial food manufacturer	2	1.7	8	1
Unknown preparation setting	**17**	**14.2**	**98**	**12.6**
Total[c]	**120**		**778**	

[a] Percentage of outbreaks for each preparation setting, calculated using the total number of foodborne outbreaks (120). An outbreak has been classed as foodborne in this report if food was recorded as one of the likely modes of transmission applicable to the outbreak. It is important to note that a single outbreak may have multiple pathogens, modes of transmission, settings where exposure occurred, or settings where preparation of food was conducted.

[b] Percentage of cases for each implicated vehicle/source, calculated using the total number of associated cases (778).

[c] More than one preparation setting was implicated for some outbreaks therefore sum of individual preparation setting numbers exceed total number of outbreaks/cases reported.

REFERENCES

REFERENCES

1. Lake R, Whyte R, Kliem C. 2005. *Evaluation of foodborne disease outbreaks/human health surveillance interface.* Christchurch: ESR.
2. Cressey P, Lake R. 2013. *Expert elicitation: Foodborne transmission of enteric pathogens in New Zealand.* Christchurch: ESR.
3. Scallan E, Hoekstra RM, Angulo FJ, et al. 2011. Foodborne illness acquired in the United States--major pathogens. *Emerging Infectious Diseases* 17(1): 7-15.
4. Hall G, Kirk M. 2005. *Foodborne illness in Australia. Annual incidence circa 2000.* Canberra: Australian Government Department of Health and Aging.
5. Adak GK, Long SM, O'Brien SJ. 2002. Trends in indigenous foodborne disease and deaths, England and Wales: 1992 to 2000. *Gut* 51(6): 832-841.
6. Havelaar AH, Galindo AV, Kurowicka D, et al. 2008. Attribution of foodborne pathogens using structured expert elicitation. *Foodborne Pathogens and Disease* 5(5): 649-59.
7. World Health Organization. 2010. *International statistical classification of disease and related health problems 10th revision 2010.* Available from: https://apps.who.int/classifications/icd10/browse/2010/en. Accessed 28 March 2012.
8. ESR. 2014. *Notifiable and Other Diseases in New Zealand: Annual Report 2013.* Porirua: ESR.
9. ESR. 2014. *Annual summary of outbreaks in New Zealand 2013.* Wallaceville: ESR.
10. Cressey P, Lake R. 2005. *Ranking food safety risks. Development of NZFSA policy 2004-2005.* Christchurch: ESR.
11. Adlam SB, Perera S, Lake RJ, et al. 2011. Acute gastrointestinal illness in New Zealand: A community study. *Epidemiology and Infection* 139(2): 302-308.
12. Perera S, Adlam B. 2007. *Acute gastrointestinal illness (AGI) study: General Practice survey.* Wellington: ESR.
13. Lake R, King N, Sexton K, et al. 2009. Acute gastrointestinal illness in New Zealand: Information from a survey of community and hospital laboratories. *New Zealand Medical Journal* 122(1307): 48-54.
14. Lake RJ, Adlam SB, Perera S, et al. 2010. The disease pyramid for acute gastrointestinal illness in New Zealand. *Epidemiology and Infection* 138(10): 1468-1471.
15. Cressey P, Lake R. 2007. *Risk ranking: Estimates of the burden of foodborne disease for New Zealand.* Christchurch: ESR.
16. ESR. 2013. *Notifiable and Other Diseases in New Zealand: Annual Report 2012.* Porirua: ESR.
17. Hewitt J, Rivas L. 2013. *Microbiological survey of pre-packaged fresh leafy salads at retail in New Zealand.* Christchurch: ESR.
18. Muellner P, Pleydell E, Pirie R, et al. 2013. Molecular-based surveillance of campylobacteriosis in New Zealand - From source attribution to genomic epidemiology. *Eurosurveillance* 18(3): 37-43.
19. Gilpin BJ, Walsh G, On SL, et al. 2013. Application of molecular epidemiology to understanding campylobacteriosis in the Canterbury region of New Zealand. *Epidemiology and Infection* 141(6): 1253-1266.
20. Rivas L, Paulin S, Horn B. 2013. *A microbiological survey of New Zealand produced packaged ready-to-eat poultry meat – a pilot study.* Christchurch: ESR.
21. Rivas L, Horn B. 2013. *Microbiological survey of ready-to-eat red meats at retail in New Zealand.* Christchurch: ESR.
22. Hudson A, Gilpin B. 2013. *Typing of Listeria monocytogenes isolates from food and construction of a PFGE database.* Christchurch: ESR.
23. Ministry for Primary Industries. 2013. *Guidance for the control of Listeria monocytogenes in ready-to-eat foods. Part 2: Good Operating Practices.* Available from: http://www.foodsafety.govt.nz/elibrary/industry/good-operating-practices.pdf. Accessed 1 May 2014.
24. Thornley CN, Hewitt J, Perumal L, et al. 2013. Multiple outbreaks of a novel norovirus GII.4 linked to an infected post-symptomatic food handler. *Epidemiology and Infection* 141(8): 1585-1597.

25. Wilson M, Lindsay J, Grounds P. 2013. *Survey of dried and edible nuts, seeds and nut and seed products available in New Zealand.* Christchurch: ESR.
26. McCallum L, Paine S, Sexton K, et al. 2013. An outbreak of *Salmonella T*yphimurium phage type 42 associated with the consumption of raw flour. *Foodborne Pathogens and Disease* 10(2): 159-164.
27. Ministry for Primary Industries. 2013. *Salmonella Risk Management Strategy 2013-2014.* Available from: http://www.foodsafety.govt.nz/elibrary/industry/salmonella-strategy_2010-14.pdf. Accessed 1 May 2014.
28. Rhodes L, Jiang W, Knight B, et al. 2013. The genus *Pseudo-nitzschia* (Bacillariophyceae) in New Zealand: Analysis of the last decade's monitoring data. *New Zealand Journal of Marine and Freshwater Research* 47(4): 490-503.
29. Dufour M. 2013. *Summary of the data from the 2012 Super 6 season.* Kenepuru: ESR.
30. Cornelius A. 2013. *Summary of ESR MLPA screening (o, eae, stx) of stored meat enrichments.* Christchurch: ESR.
31. Gilpin B. 2013. *PFGE analysis of meat isolates of E. coli O157:H7 in New Zealand.* Christchurch: ESR.
32. Jaros P, Cookson AL, Campbell DM, et al. 2013. A prospective case-control and molecular epidemiological study of human cases of Shiga toxin-producing *Escherichia coli* in New Zealand. *BMC Infectious Diseases* 13(1).
33. Anonymous. 1996. Another three cases of *Escherichia coli* O157 infection. *New Zealand Public Health Report* 3(2): 12.