



ANNUAL SUMMARY OF OUTBREAKS IN NEW ZEALAND 2009

Prepared as part of a Ministry of Health contract for scientific services



by
Population and Environmental Health Group
Institute of Environmental Science and Research Limited

April 2010

Client Report FW 10048

ACKNOWLEDGMENTS

This report has been prepared by the Population and Environmental Health (PEH) Group of the Institute of Environmental Science and Research Ltd. In particular, Liza Lopez and Catherine Tisch have contributed to the analysis and reporting of outbreak data for this report.

This report could not have been produced without the continued support of staff in the Public Health Services who provide us with data from their regions. The authors would like to thank Gail Greening for the norovirus section, Carol Kliem for data integration, David Slaney at ESR and Grant Storey at the Ministry of Health for their review of the draft report and helpful feedback provided.

This report is available on the Internet at www.surv.esr.cri.nz

DISCLAIMER

This report or document (“the Report”) is given by the Institute of Environmental Science and Research Limited (“ESR”) solely for the benefit of the Ministry of Health, Public Health Services Providers and other Third Party Beneficiaries as defined in the Contract between ESR and the Ministry of Health, and is strictly subject to the conditions laid out in that Contract.

Neither ESR nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for use of the Report or its contents by any other person or organisation.

CONTENTS

EXECUTIVE SUMMARY	I
Incidence and outcomes	i
Outbreak types.....	i
Causal agents	i
Outbreak settings	i
Modes of transmission.....	i
Sources	i
Recognition, reporting, investigation and control	ii
1. INTRODUCTION	1
2. METHODS	1
2.1. Outbreak definition	1
2.2. Data sources	2
2.3. Data analysis	2
2.4. Data limitations	3
3. RESULTS	3
3.1. Characteristics of outbreaks.....	3
3.2. Distribution of outbreaks by PHU	3
3.3. Types of outbreak	6
3.4. Causal agents	6
3.5. Norovirus outbreaks – strains and setting.....	10
3.5.1. Gastroenteritis outbreaks caused by other enteric viruses	12
3.6. Morbidity and mortality.....	12
3.7. Outbreak settings	12
3.8. Modes of transmission	14
3.9. Foodborne outbreaks.....	16
3.10. Person-to-person outbreaks.....	20
3.11. Waterborne outbreaks	22
3.12. Environmental outbreaks	23
3.13. Zoonotic outbreaks	24
3.14. Outbreaks with overseas transmission.....	24
3.15. Outbreak recognition, investigation and control.....	25
3.16. Summary of trends.....	28
GLOSSARY	31
REFERENCES	33

LIST OF TABLES

Table 1: Outbreaks and associated cases by PHU, 2009.....	4
Table 2: Outbreaks and associated cases by type of outbreak, 2009	6
Table 3: Outbreaks and associated cases by agent type, 2009.....	8
Table 4: Outbreak type by agent type, 2009	9
Table 5: Hospitalised outbreak cases and total outbreak cases by agent type, 2009	13
Table 6: Outbreaks and associated cases by setting of exposure/transmission, 2009.....	14
Table 7: Outbreaks and associated cases by mode of transmission, 2009	15
Table 8: Foodborne outbreaks and associated cases by agent type, 2009.....	17
Table 9: Foodborne outbreaks and associated cases by implicated vehicle/source, 2009	18
Table 10: Foodborne outbreaks by causal agent and implicated vehicle/source, 2009	19
Table 11: Foodborne outbreaks by contributing factor, 2009	20
Table 12: Person-to-person outbreaks and associated cases by agent type, 2009.....	21
Table 13: Waterborne outbreaks and associated cases by agent type, 2009	22
Table 14: Waterborne outbreaks by contributing factor, 2009	22
Table 15: Environmental outbreaks and associated cases by agent type, 2009	23
Table 16: Zoonotic outbreaks and associated cases by agent type, 2009	24
Table 17: Outbreaks with overseas transmission by destination, 2009.....	25
Table 18: Median reporting delay by outbreak type, 2009	25
Table 19: Outbreaks by means of recognition, 2009	26
Table 20: Outbreaks by control measures undertaken, 2009	27

LIST OF FIGURES

Figure 1: Number of outbreaks per 100 000 population by PHU, 2009	5
Figure 2: Laboratory-confirmed norovirus outbreak typing by month, 2009	10
Figure 3: Laboratory-confirmed norovirus outbreak strains by setting, 2009	11
Figure 4: Percentage of outbreaks by agent type and mode of transmission, 2009.....	16
Figure 5: Number of outbreaks and associated cases by month, 2009	28
Figure 6: Outbreak rates and associated cases by year, 2001–2009	28
Figure 7: Percentage of outbreaks by agent type and year, 2001–2009.....	29

EXECUTIVE SUMMARY

The following is a summary of the main findings in this report:

Incidence and outcomes

There were 638 outbreaks reported during 2009 involving 10 734 cases (2582 confirmed and 8152 probable cases). A total of 337 cases required hospitalisation and 21 cases died.

The highest number of outbreaks was reported by Auckland Public Health Unit, which represented 37.1% (237/638) of all outbreaks in 2009.

Public health units with outbreak rates exceeding the national rate (14.8 per 100 000 population) were West Coast (49.2 per 100 000 population), Manawatu (31.7 per 100 000 population), Otago (20.0 per 100 000 population), Taranaki (17.5 per 100 000 population), Southland (17.4 per 100 000 population), Wellington (17.0 per 100 000 population), Bay of Plenty (16.8 per 100 000 population) and Auckland (16.3 per 100 000 population).

Outbreak types

Institutional outbreaks were the most common outbreak type comprising 58.2% (371/638) of outbreaks reported and 82.1% (8815/10734) of associated cases. Household outbreaks accounted for 19.0% (121/638) of outbreaks and 3.5% (371/10734) of associated cases.

Causal agents

The causal agent (pathogen, toxin or chemical) was identified in 72.1% (460/638) of outbreaks involving 80.3% (8619/10734) of outbreak-associated cases.

Enteric agents were implicated in 91.8% (586/638) of outbreaks. The most commonly identified pathogen was norovirus 42.3% (270/638), followed by *Giardia* 6.4% (41/638) and rotavirus 5.0% (32/638). The most commonly implicated non-enteric agent was *Bordetella pertussis* 4.2% (27/638).

Outbreak settings

The most common settings where exposure or transmission occurred were rest or retirement homes (36.2%, 231/638) and the home environment (21.9%, 140/638).

The highest percentage of outbreak-related cases occurred in rest or retirement homes (59.2%, 6354/10734), followed by continuing care hospitals (28.3%, 3043/10734) and acute care hospitals (11.1%, 1189/10734).

Modes of transmission

Person-to-person transmission accounted for 84.6% (540/638) of outbreaks in 2009. Environmental and foodborne transmission accounted for 21.5% (137/638) and 13.2% (84/638) outbreaks, respectively. Multiple modes of transmission were implicated in 30.6% (195/638) of outbreaks.

Sources

Of the 84 outbreaks associated with a foodborne mode of transmission, 4.8% (4/84) had a definite source identified and 75.0% (63/84) had a suspected source identified. The actual, definite or suspected sources were listed in 97.0% (65/67) of these outbreaks.

The most commonly implicated food type was poultry (15 outbreaks), followed by vegetables (root) (13 outbreaks), shellfish (11 outbreaks), grains/beans (11 outbreaks) and fish (10 outbreaks). The highest percentage of cases was associated with outbreaks linked to poultry (18.9%, 123/651 cases), followed by rice (16.0%, 104/651), grains/beans (11.4%, 74/651) and vegetables (root) (10.3%, 67/651).

Recognition, reporting, investigation and control

Most outbreaks were recognised by person-to-person contact with other cases (67.9%, 433/638), by increases in disease incidences (58.2%, 371/638) and when cases were linked to a common source (30.6%, 195/638).

Time/temperature abuse was the most common factor contributing to foodborne outbreaks (28.6%, 24/84), followed by contamination of food (26.2%, 22/84).

Control measures were reported for 90.8% (579/638) of the 2009 outbreaks. The most commonly reported intervention methods were health and education advice given to people working with the source 70.5% (450/638) and cleaning and disinfection 60.8% (388/638).

Over half of all outbreaks (61.1%, 356/583 where information was available) were reported within one week of the onset of illness in the first case. The overall median reporting delay for outbreaks was four days.

1. INTRODUCTION

Outbreak surveillance in New Zealand has been conducted by the Institute of Environmental Science and Research Ltd (ESR) on behalf of the Ministry of Health since 1996. This system collects data on disease outbreaks reported by public health units. Since 1997, the outbreak surveillance system has been incorporated as a module within EpiSurv, the national notifiable disease surveillance system.

Outbreak surveillance is undertaken to [1]:

- identify and control widely dispersed outbreaks
- improve outbreak prevention
- assess impact of outbreaks and set priorities
- evaluate prevention strategies
- improve investigation methods
- improve public health training
- improve understanding of emerging diseases
- meet international reporting requirements.

2. METHODS

2.1. Outbreak definition

The Manual for Public Health Surveillance in New Zealand [2] states that the following types of outbreaks should be reported:

- two or more cases linked to a common source, in particular where the common source is exposure at a common event, food or water dispersed in the community, an environmental source, or a source in an institutional setting
- a community-wide or person-to-person outbreak (except when the source has become well established as a national epidemic and reporting it as a discrete event no longer serves a useful purpose)
- any other situation where outbreak investigation or control measures are being used or considered.

Outbreak reporting is encouraged for:

- a secondary case in an institution
- household outbreaks – if there is a reasonable possibility that the outbreak resulted from a common source exposure for that household group.

Outbreak reporting is not usually required for:

- most secondary cases
- single cases where a specific contaminated source is identified.

2.2. Data sources

Outbreaks are reported to, or identified by, local public health units (PHU). Data on each outbreak are recorded by the PHU on a standardised Outbreak Report Form within EpiSurv. PHUs are encouraged to enter data early as an interim report that can be finalised when further data are available. These data are entered at each PHU via a secure web-based portal onto the EpiSurv database. The real-time data are collated and analysed by ESR on behalf of the Ministry of Health. The national database is supplemented by data from the ESR Enteric Reference Laboratory, and virology and public health laboratories. If an outbreak is first identified by these laboratory sources, the appropriate PHU is asked to complete an Outbreak Report Form.

The Outbreak Report Form consists of the following sections:

- reporting authority (outbreak report date and interim/final report)
- disease and implicated pathogen, toxin or chemical (name of implicated agent and case definitions)
- outbreak demographics (number of cases, outbreak dates, age/sex of cases, incubation period and duration of illness)
- circumstances of exposure/transmission (means of outbreak recognition, type of outbreak, setting, geographic location, mode of transmission and vehicle/source evidence)
- factors contributing to the outbreak (specific factors relating to foodborne, waterborne, person-to-person and environmental outbreaks)
- management of the outbreak (control measures undertaken)

The terms used in the Outbreak Report Form that relate to this report are defined in the glossary at the end of this report.

2.3. Data analysis

This report contains an analysis of data on outbreaks reported between 1 January 2009 and 31 December 2009, and recorded on EpiSurv as at 12 February 2010. Amendments made to outbreak data on EpiSurv after 12 February 2010 will not be reflected in this report.

The number and percentage of outbreaks and/or associated cases were ascertained. Rates were calculated using national and PHU population figures based on Statistics New Zealand population estimates for 2009.

The categories and subcategories analysed in this report were directly based on fields in the Outbreak Report Form with two exceptions: implicated food sources were grouped into one or more food categories and reporting delay was calculated as the difference between the outbreak report date and the date of onset of illness for the first case.

2.4. Data limitations

The available outbreak data are restricted to the outbreaks recorded in EpiSurv by PHUs. Outbreaks are more likely to be reported if they involve unusual pathogens, notifiable diseases, a large number of cases or a well-defined setting. The differing availability of resources among PHUs may also impact on outbreak reporting at a regional level. For these reasons caution is advised when interpreting the data contained in this report.

Measurement bias occurs when fields in an Outbreak Report Form are incomplete or incorrectly entered. For example, the date of onset of illness for the first case was not reported for 55 outbreaks in 2009.

Different methods of data analysis have been used in the Annual Summary of Outbreaks in New Zealand prior to 2005. In 2003 and 2004, interim outbreak reports were excluded from analysis. In 2002, causal agents were categorised as laboratory confirmed versus suspected. As a result of these different analytical methods, comparisons of outbreak trends in published past reports should be restricted to the period since 2005.

3. RESULTS

3.1. Characteristics of outbreaks

There were 638 outbreaks reported in 2009 compared with 451 outbreaks reported in 2008. The national rate of 14.8 outbreaks per 100 000 population in 2009 was higher than 2008 when there were 10.6 outbreaks per 100 000 population. Of the outbreak reports in 2009, 99.7% (636/638) were classified as final, while the remaining two outbreaks were classified as interim. A total of 10 734 cases was associated with outbreaks, giving a national rate of 248.8 outbreak cases per 100 000 population. Of the 10 734 cases, 2582 (24.1%) cases were confirmed and 8152 (75.9%) cases were probable.

3.2. Distribution of outbreaks by PHU

The highest number of outbreaks (237) and associated cases (2215) was reported by the Auckland PHU, which represented 37.1% (237/638) of all outbreaks in 2009 (Table 1). Wellington PHU reported the second highest number of outbreaks (81), followed by Manawatu (50) and Waikato (49) PHUs. The highest outbreak rate (49.2 per 100 000 population) was reported by the West Coast PHU (Figure 1), although the West Coast only accounted for 2.5% (16/638) of all outbreaks reported. Other PHUs with an outbreak rate higher than the national rate (14.8 outbreaks per 100 000 population) were Manawatu (31.7 outbreaks per 100 000 population), Otago (20.0 outbreaks per 100 000 population), Taranaki (17.5 outbreaks per 100 000 population), Southland (17.4 outbreaks per 100 000 population), Wellington (17.0 outbreaks per 100 000 population), Bay of Plenty (16.8 outbreaks per 100 000 population) and Auckland (16.3 outbreaks per 100 000 population).

Table 1: Outbreaks and associated cases by PHU, 2009

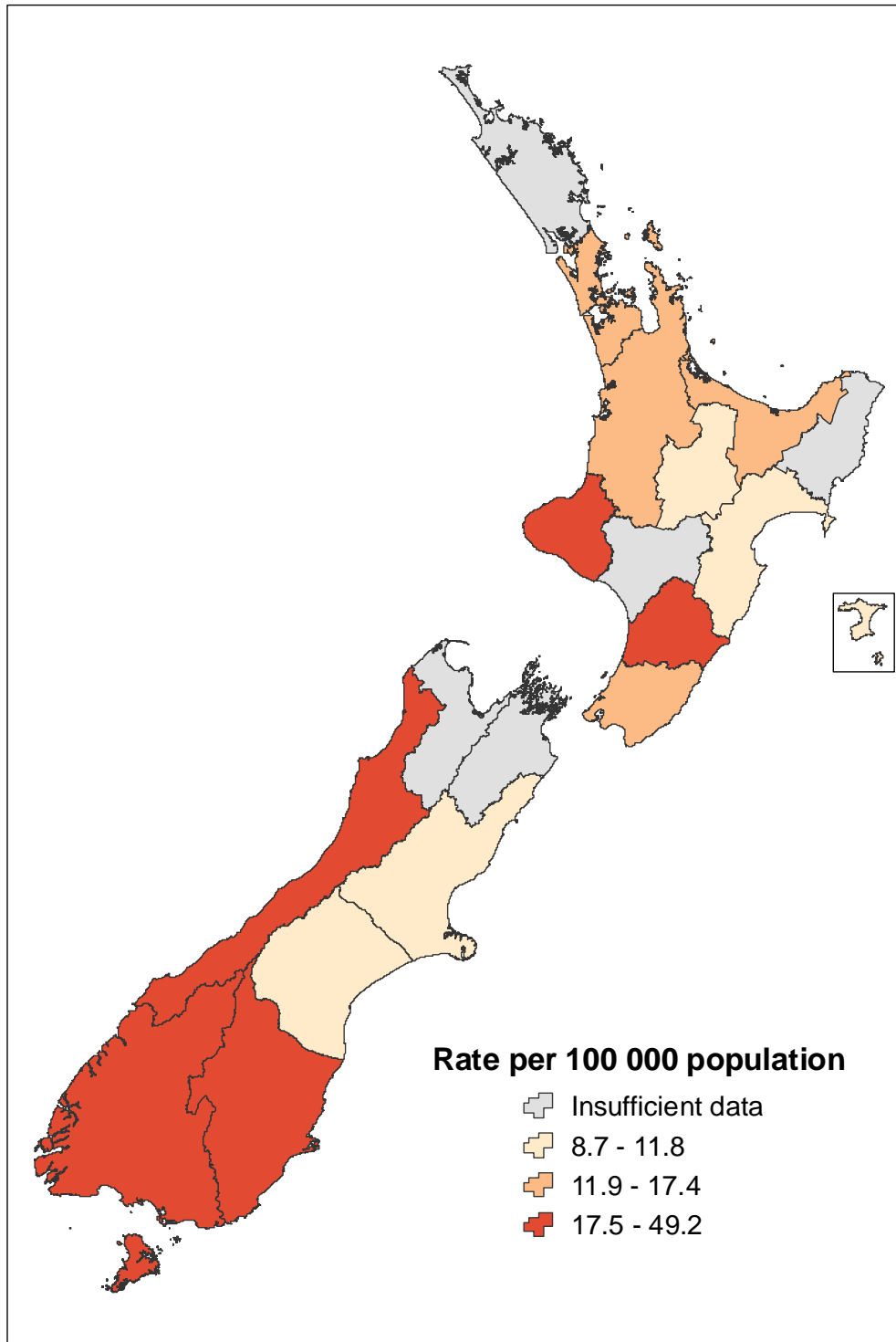
PHU	No. of outbreaks	% of outbreaks (N = 638)	No. of cases	% of cases (N = 10 734)	Outbreak rate¹
Northland	3	0.5	42	0.4	1.9
Auckland ²	237	37.1	2215	20.6	16.3
Waikato	49	7.7	777	7.2	13.6
Bay of Plenty	35	5.5	521	4.9	16.8
Rotorua	9	1.4	187	1.7	8.7
Taranaki	19	3.0	340	3.2	17.5
Hawke's Bay	16	2.5	385	3.6	10.4
Gisborne	4	0.6	59	0.5	8.7
Wanganui	4	0.6	140	1.3	6.5
Manawatu	50	7.8	1547	14.4	31.7
Wellington ³	81	12.7	1441	13.4	17.0
Nelson	4	0.6	148	1.4	2.9
West Coast	16	2.5	175	1.6	49.2
Canterbury	44	6.9	1412	13.2	9.3
South Canterbury	10	1.6	362	3.4	11.8
Otago	36	5.6	662	6.2	20.0
Southland	21	3.3	321	3.0	17.4
Total	638	100	10 734	100	14.8

¹ Crude rate of outbreaks per 100 000 population calculated using Statistics New Zealand population estimates for 2009

² Includes Northwest Auckland, Central Auckland and South Auckland health districts

³ Includes Wellington, Hutt and Wairarapa health districts

Figure 1: Number of outbreaks per 100 000 population by PHU, 2009



Note : Where less than five outbreaks were reported a population rate has not been calculated

3.3. Types of outbreak

In 2009, institutional outbreaks had the highest median number of cases per outbreak (18.0 cases), accounting for 58.2% (371/638) of all outbreaks and 82.1% (8815/10734) of outbreak-associated cases. Household outbreaks accounted for 19.0% (121/638) of outbreaks, but just 3.5% (371/10734) of outbreak-associated cases. Common event outbreaks accounted for 9.6% (61/638) of outbreaks and 3.8% (406/10734) of associated cases, while community-wide outbreaks accounted for 4.2% (27/638) of outbreaks and 4.1% (439/10734) of associated cases (Table 2). Community-wide outbreaks, where transmission only occurred through person-to-person contact, represented 3.6% (23/638) of reported outbreaks.

Table 2: Outbreaks and associated cases by type of outbreak, 2009

Outbreak type	No. of outbreaks	% of outbreaks (N = 638)	No. of cases	% of cases (N = 10 734)	Median no. of cases per outbreak
Institutional	371	58.2	8815	82.1	18.0
Household	121	19.0	371	3.5	2.0
Common event	61	9.6	406	3.8	3.0
Community wide	27	4.2	439	4.1	6.0
Dispersed common source	20	3.1	177	1.6	3.0
Common site	19	3.0	310	2.9	7.0
Other outbreak type	16	2.5	198	1.8	7.5
Unknown outbreak type	3	0.4	18	0.2	3.0
Total	638	100	10 734	100	4.5

3.4. Causal agents

The causal agent was identified in 72.1% (460/638) of outbreaks involving 80.3% (8619/10734) of associated cases. For each of these outbreaks only one causal agent was recorded. No specific pathogen was identified in the remaining 27.9% (178/638) of outbreaks and 19.7% (2115/10734) of the associated cases, all of which were recorded as gastroenteritis outbreaks.

Enteric agents were implicated in the vast majority of outbreaks (91.8%, 586/638) and associated cases (94.8%, 10176/10734) (Table 3). The most common causal agent implicated in outbreaks in 2009 was norovirus, which resulted in 42.3% (270/638) of outbreaks and 66.3% (7116/10734) of the associated cases. The median number of cases associated with each norovirus outbreak (20.0) was the highest of any enteric agent (after sapovirus which was only implicated in one outbreak involving 29 cases). The next most common enteric causal agents associated with outbreaks were *Giardia* (6.4%, 41/638), rotavirus (5.0%, 32/638) and *Cryptosporidium* (3.1%, 20/638). Outbreaks due to rotavirus had the second highest number of associated cases (4.0%, 424/10734).

Non-enteric agents accounted for 8.2% (52/638) of outbreaks associated with 5.2% (558/10734) of cases in 2009 (Table 3). The five agents involved in more than one outbreak were: *Bordetella pertussis* (4.2%, 27/638), respiratory illness (unidentified pathogen) (1.3%, 8/638), Influenza A H1N1 virus (1.1%, 7/638), measles virus (0.5%, 3/638) and *Mycobacterium tuberculosis* (0.5%, 3/638). The median number of cases associated with measles virus (31.0) was the highest of any non-enteric agent and of all outbreaks in 2009.

The specific causal agents implicated in the various outbreak types are shown in Table 4. Common event outbreaks were mostly associated with norovirus (17 outbreaks). Outbreaks due to a common source dispersed in the community were most frequently linked to *Salmonella* (4 outbreaks), while outbreaks due to a common source in a specific site were most commonly due to norovirus (4). The majority of institutional outbreaks were caused by norovirus (221 outbreaks) or by rotavirus (28). For household outbreaks, the most common agent was *Giardia* (33 outbreaks), followed by norovirus (17) and *Cryptosporidium* (16).

Table 3: Outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 638)	No. of cases	% of cases (N = 10 734)	Median cases per outbreak
<i>Enteric</i>					
Norovirus	270	42.3	7116	66.3	20.0
<i>Giardia</i> spp.	41	6.4	131	1.2	3.0
Rotavirus	32	5.0	424	4.0	10.5
<i>Cryptosporidium</i> spp.	20	3.1	68	0.6	3.0
<i>Campylobacter</i> spp.	12	1.9	65	0.6	3.0
<i>Salmonella</i> spp.	12	1.9	76	0.7	4.0
VTEC/STEC (<i>Escherichia coli</i> O157)	4	0.6	15	0.1	2.5
<i>Clostridium</i> spp.	3	0.5	88	0.8	8.0
<i>Shigella</i> spp.	3	0.5	8	0.1	2.0
<i>Salmonella</i> Typhi (typhoid fever)	2	0.3	6	0.1	3.0
<i>Vibrio parahaemolyticus</i>	2	0.3	7	0.1	3.5
<i>Yersinia</i> spp.	2	0.3	15	0.1	7.5
Ciguatera fish poisoning	1	0.2	6	0.1	6.0
Hepatitis A	1	0.2	2	0.0	2.0
Histamine (scombroid) fish poisoning	1	0.2	3	0.0	3.0
<i>Salmonella</i> Paratyphi B (paratyphoid fever)	1	0.2	2	0.0	2.0
Sapovirus	1	0.2	29	0.3	29.0
Unidentified pathogen ¹	178	27.9	2115	19.7	5.5
Total enteric	586	91.8	10176	94.8	9.0
<i>Non-enteric</i>					
<i>Bordetella pertussis</i>	27	4.2	104	1.0	3.0
Respiratory illness (unidentified pathogen)	8	1.3	134	1.2	11.0
Influenza A H1N1 virus	7	1.1	76	0.7	13.0
Measles virus	3	0.5	205	1.9	31.0
<i>Mycobacterium tuberculosis</i>	3	0.5	20	0.2	4.0
Conjunctivitis	1	0.2	12	0.1	12.0
Mumps	1	0.2	3	0.0	3.0
Carbon monoxide	1	0.2	2	0.0	2.0
<i>Neisseria meningitidis</i>	1	0.2	2	0.0	2.0
Total non-enteric	52	8.2	558	5.2	4.0

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Table 4: Outbreak type by agent type, 2009

Agent type	Outbreak Type								Total
	CEvt ¹	CDsp ²	CSite ³	Com ⁴	Inst ⁵	Hse ⁶	Oth ⁷	Unk ⁸	
Enteric									
Norovirus	17	2	4	4	221	17	5	0	270
<i>Giardia</i> spp.	0	0	1	3	2	33	2	0	41
Rotavirus	0	0	1	1	28	2	0	0	32
<i>Cryptosporidium</i> spp.	2	0	1	0	1	16	0	0	20
<i>Campylobacter</i> spp.	4	2	2	0	2	1	1	0	12
<i>Salmonella</i> spp.	0	4	2	0	1	5	0	0	12
VTEC/STEC (<i>Escherichia coli</i> O157)	0	0	1	0	0	2	1	0	4
<i>Clostridium</i> spp.	1	2	0	0	0	0	0	0	3
<i>Shigella</i> spp.	0	0	0	0	0	3	0	0	3
<i>Salmonella</i> Typhi	1	0	0	0	0	1	0	0	2
<i>Vibrio parahaemolyticus</i>	0	0	0	0	0	2	0	0	2
<i>Yersinia</i> spp.	0	0	0	0	0	1	0	1	2
Ciguatera fish poisoning	0	1	0	0	0	0	0	0	1
Hepatitis A	0	0	0	0	0	0	1	0	1
Histamine (scombroid) fish poisoning	0	1	0	0	0	0	0	0	1
<i>Salmonella</i> Paratyphi B	0	0	0	0	0	1	0	0	1
Sapovirus	0	0	0	0	1	0	0	0	1
Unidentified pathogen	35	8	6	5	95	26	1	2	178
Total enteric	60	20	18	13	351	110	11	3	586
Non-enteric									
<i>Bordetella pertussis</i>	0	0	1	7	9	9	1	0	27
Respiratory illness (unidentified pathogen)	0	0	0	0	7	0	1	0	8
Influenza A H1N1 virus	0	0	0	2	4	0	1	0	7
Measles virus	0	0	0	2	0	1	0	0	3
<i>Mycobacterium tuberculosis</i>	0	0	0	2	0	1	0	0	3
Carbon monoxide	1	0	0	0	0	0	0	0	1
Conjunctivitis	0	0	0	1	0	0	0	0	1
Mumps	0	0	0	0	0	0	1	0	1
<i>Neisseria meningitidis</i>	0	0	0	0	0	0	1	0	1
Total non-enteric	1	0	1	14	20	11	5	0	52
Total outbreaks	61	20	19	27	371	121	16	3	638

- ¹ Common event
- ² Common source dispersed in community
- ³ Common site
- ⁴ Community wide

- ⁵ Institutional
- ⁶ Household
- ⁷ Other
- ⁸ Unknown

3.5. Norovirus outbreaks – strains and setting

The most common causal agent implicated in outbreaks in 2009 was norovirus, which resulted in 42.3% (270/638) of outbreaks and 66.3% (7116/10734) of the associated cases. Norovirus was confirmed by laboratory testing for 73.7% (199/270) of the outbreaks. No testing was carried out for 71 outbreaks. In contrast to international data, no seasonal winter peak was observed. For laboratory-confirmed outbreaks, the highest number was reported in October (27) and the lowest number in February (3) (Figure 2). This is consistent with data for the previous eight years where the number of reported outbreaks has peaked in October.

Healthcare institutions (rest/retirement homes and acute or continuing care hospitals) were the most common setting for norovirus outbreaks at 60.3% (120/199) (Figure 3). It should be noted, however, that some outbreaks can have multiple settings. Outbreaks were also commonly associated with food-related settings 15.1% (30/199). The norovirus genotype was identified by DNA sequencing in 98.5% (196/199) of the outbreaks. The majority of strains identified belonged to GII.4 (78.4%, 156/199). GII.4 has been the predominant genotype responsible for outbreaks both in New Zealand and overseas over the last 10 years, especially in healthcare and institutional settings. A range of both GI and GII genotypes were associated with food-related and childcare and school-related outbreaks.

Figure 2: Laboratory-confirmed norovirus outbreak typing by month, 2009

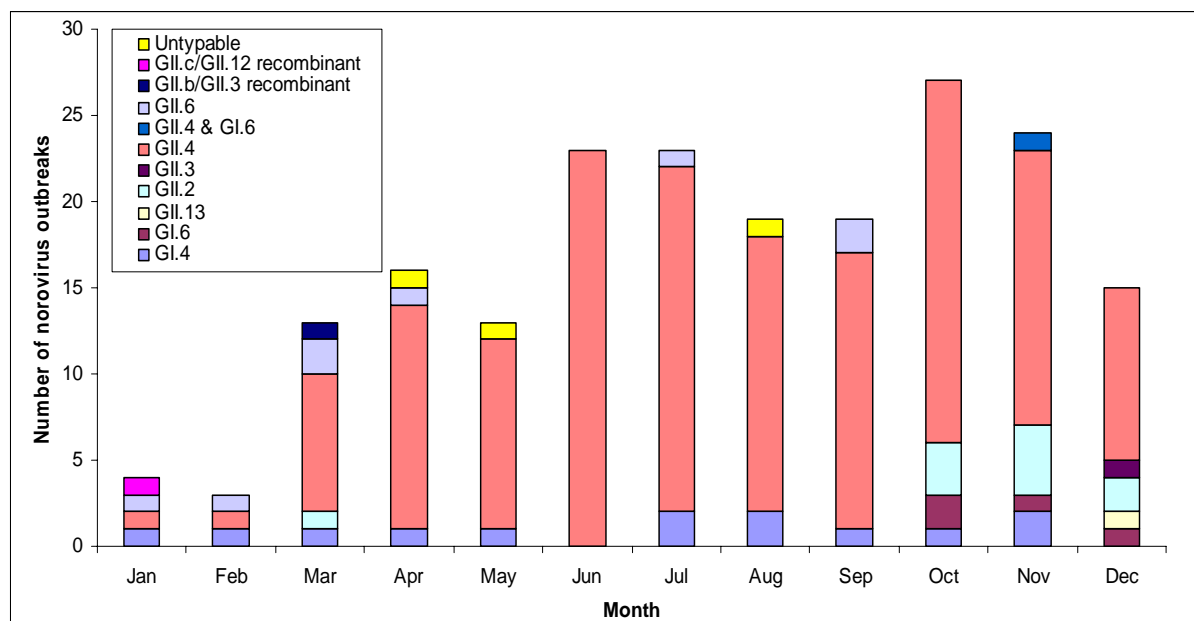
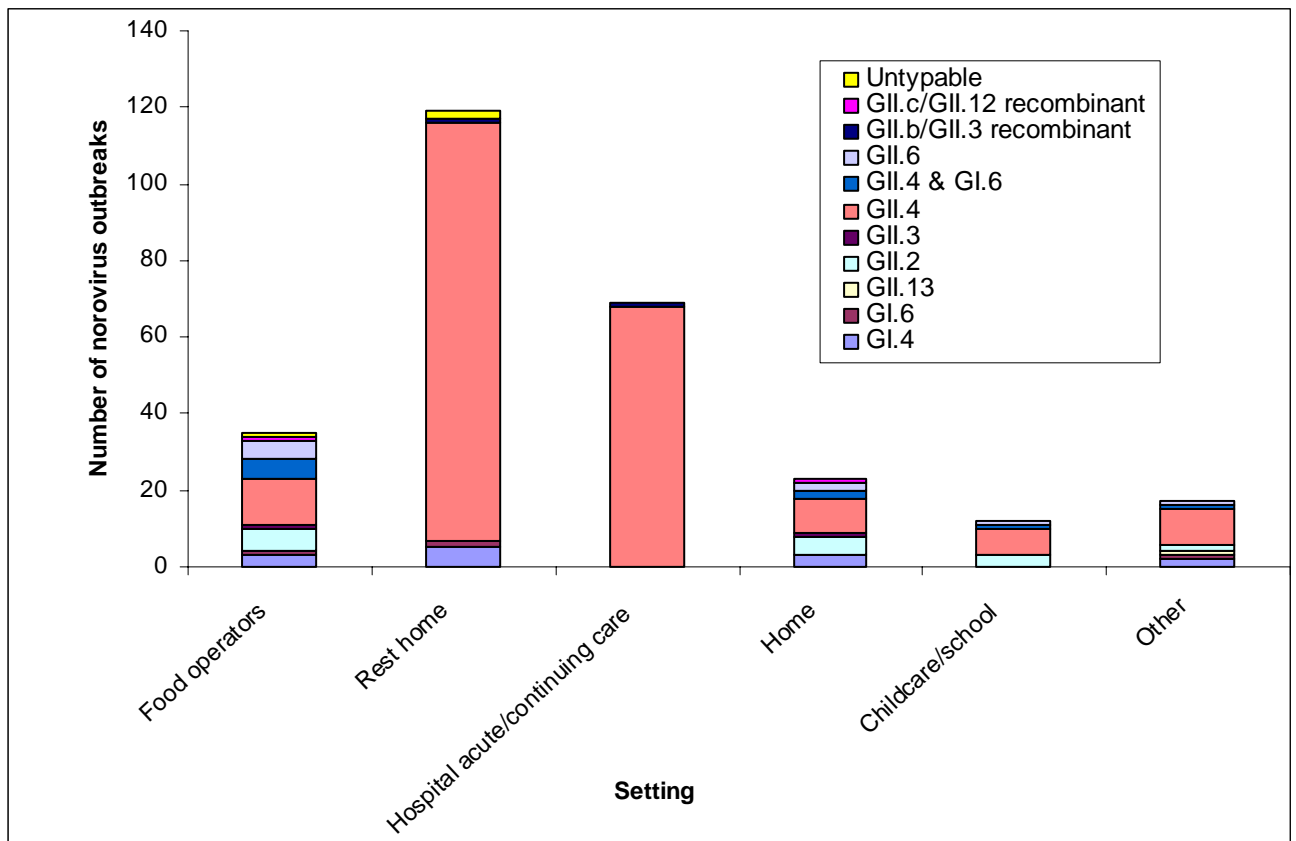


Figure 3: Laboratory-confirmed norovirus outbreak strains by setting, 2009



Note that more than one setting was recorded for 65/199 outbreaks

3.5.1. Gastroenteritis outbreaks caused by other enteric viruses

Specimens from outbreaks found to be negative for norovirus were tested for the presence of sapovirus and astrovirus. These viruses are frequently associated with outbreaks of paediatric gastroenteritis overseas. Of 53 outbreaks analysed, astroviruses were associated with four outbreaks in rest homes and sapoviruses in two outbreaks.

3.6. Morbidity and mortality

Hospitalisation information was recorded for 54.4% (347/638) of outbreaks. A total of 337 outbreak-associated cases were hospitalised. There were almost eight-times more cases hospitalised for outbreaks due to enteric agents (299) compared with non-enteric agents (38) (Table 5). However, a higher percentage of cases associated with non-enteric outbreaks was hospitalised compared with enteric outbreaks (8.6% versus 5.6%). The non-enteric agent with the highest proportion of hospitalised cases was *Neisseria meningitidis* (100%, 2/2 cases), followed *M. tuberculosis* (65.0%, 13/20) and measles virus (8.3%, 17/205). The enteric agent with the highest proportion of hospitalised cases was *S. Typhi* (83.3%, 5/6), followed by *Salmonella* species (44.7%, 17/38) and *Campylobacter* (8.6%, 5/58).

There were 21 deaths associated with outbreaks in 2009, most of which were due to norovirus (17) and resulted from outbreaks in rest homes (16) and/or hospitals (1). Five of these outbreaks had rest homes and hospitals (acute care) as settings. Two of the other deaths were due to Influenza A H1N1 virus (2), for which the outbreak settings were home for one case and both home and tangi for the other case. The remaining two deaths were due to carbon monoxide poisoning which occurred in the home.

3.7. Outbreak settings

The most common outbreak setting was a rest or retirement home, which was recorded in 36.2% (231/638) of all outbreaks and 59.2% (6354/10734) of cases. The home environment was recorded in 21.9% (140/638) of all outbreaks and in 7.4% (797/10734) of associated cases (Table 6). Other common institutional settings were continuing care hospitals (16.6%, 106/638), childcare centres (9.7%, 62/638) and acute care hospitals (6.7%, 43/638). Commercial food operators were a common outbreak setting, which included restaurants/cafes (10.7%, 68/638), takeaway outlets (2.4%, 15/638), other food outlets (0.3%, 2/638), supermarkets/delicatessens (0.3%, 2/638) and caterers (0.2%, 1/638). The outbreak setting was unknown in eight (1.3%) outbreaks.

Table 5: Hospitalised outbreak cases and total outbreak cases by agent type, 2009

Agent type	No. of outbreaks ¹	No. of associated cases ¹	No. of hospitalised cases	No. of cases hospitalised (%)
Enteric				
Norovirus	148	3729	243	6.5
<i>Salmonella</i> spp.	6	38	17	44.7
Rotavirus	21	322	14	4.3
<i>Campylobacter</i> spp.	9	58	5	8.6
<i>Salmonella</i> Typhi	2	6	5	83.3
Ciguatera fish poisoning	1	6	0	0.0
<i>Clostridium</i> spp.	3	88	0	0.0
<i>Cryptosporidium</i> spp.	16	54	0	0.0
<i>Giardia</i> spp.	19	58	0	0.0
Hepatitis A	1	2	0	0.0
<i>Salmonella</i> Paratyphi B	1	2	0	0.0
<i>Shigella</i> spp.	2	4	0	0.0
<i>Vibrio parahaemolyticus</i>	2	7	0	0.0
VTEC/STEC (<i>Escherichia coli</i> O157)	1	8	0	0.0
<i>Yersinia</i> spp.	2	15	0	0.0
Unidentified pathogen ²	76	908	15	1.7
Total enteric	310	5305	299	5.6
Non-enteric				
Measles virus	3	205	17	8.3
<i>Mycobacterium tuberculosis</i>	3	20	13	65.0
<i>Bordetella pertussis</i>	19	68	4	5.9
Influenza A H1N1 virus	4	44	2	4.5
<i>Neisseria meningitidis</i>	1	2	2	100
Respiratory illness (unidentified pathogen)	5	98	0	0.0
Carbon monoxide	1	2	0	0.0
Mumps virus	1	3	0	0.0
Total non-enteric	34	442	38	8.6
Total hospitalisations	347	5747	337	5.9

¹ Hospitalisation information was recorded for 54.4% (347/638) of outbreaks, relating to 53.5% (5747/10734) of cases

² All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Table 6: Outbreaks and associated cases by setting of exposure/transmission, 2009

Outbreak setting	No. of outbreaks¹	% of total outbreaks (N = 638)	No. of cases¹	% of total cases (N = 10 734)
<i>Commercial food operators</i>				
Restaurant/cafe	68	10.7	284	2.6
Takeaway	15	2.4	45	0.4
Other Food outlet	2	0.3	32	0.3
Supermarket/deli	2	0.3	19	0.2
Caterers	1	0.2	17	0.2
<i>Institutions</i>				
Rest/Retirement Home	231	36.2	6354	59.2
Hospital (Continuing care)	106	16.6	3043	28.3
Childcare centre	62	9.7	954	8.9
Hospital (Acute care)	43	6.7	1189	11.1
School	16	2.5	442	4.1
Hotel/Motel	7	1.1	60	0.6
Camp	6	0.9	54	0.5
Hostel/Boarding house	6	0.9	69	0.6
Prison	2	0.3	14	0.1
<i>Community</i>				
Community/Church gathering	5	0.8	200	1.9
Swimming/Spa pool	5	0.8	98	0.9
Tangi	1	0.2	13	0.1
<i>Workplace</i>				
WorkPlace	10	1.6	277	2.6
Farm	10	1.6	45	0.4
Abattoir	0	0.0	0	0.0
<i>Home</i>	140	21.9	797	7.4
<i>Other setting</i>	40	6.3	714	6.7
<i>Unknown setting</i>	8	1.3	58	0.5

1 More than one setting was recorded for 137 outbreaks with 3266 associated cases

3.8. Modes of transmission

In 2009, the most common reported mode of transmission was person-to-person (84.6%, 540/6438 outbreaks), followed by environmental (21.5%, 137/638) and foodborne (13.2% 84/638) (Table 7). Person-to-person transmission also accounted for the highest percentage of cases (93.3%, 10020/10734), followed by the environmental mode of transmission (34.8%, 3731/10734). The mode of transmission was unknown in 38 (6.0%) outbreaks.

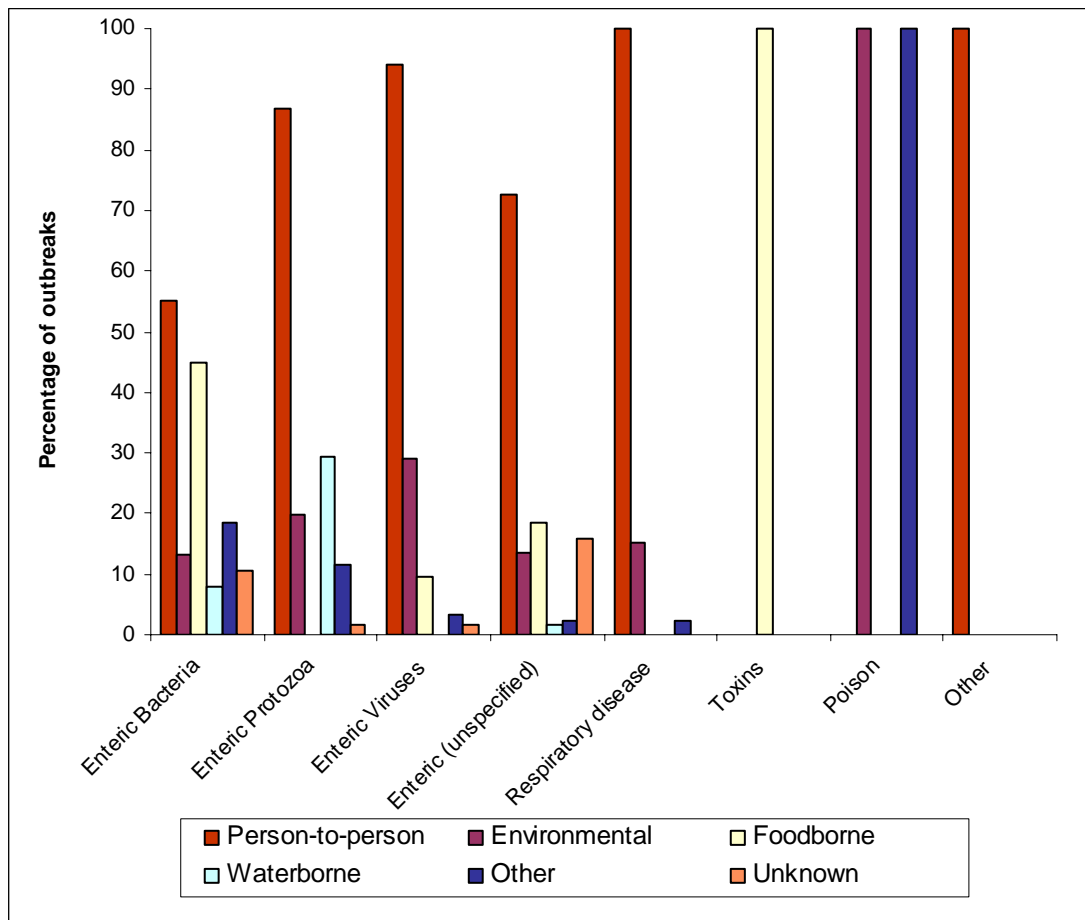
Table 7: Outbreaks and associated cases by mode of transmission, 2009

Transmission mode	No. of outbreaks¹	% of total outbreaks (N = 638)	No. of cases¹	% of total cases (N = 10 734)
Person-to-person	540	84.6	10020	93.3
Environmental	137	21.5	3731	34.8
Foodborne	84	13.2	651	6.1
Waterborne	24	3.8	87	0.8
Zoonotic	14	2.2	67	0.6
Other	16	2.5	287	2.7
Unknown	38	6.0	328	3.1

¹ More than one mode of transmission was recorded for 195 outbreaks with 4256 associated cases

Person-to-person transmission was the most common mode of transmission for enteric bacteria (55.3%, 21/38), enteric protozoa (86.9%, 53/61), enteric viruses (94.1%, 286/304), unspecified enteric pathogens (72.5%, 129/178), respiratory disease (100%, 46/46) and other viruses (100%, 5/5) (Figure 4). Foodborne transmission was the principal mode of transmission for toxins (100%, 5/5), but it also contributed substantially to outbreaks due to enteric bacteria (44.7%, 17/38) and unspecified enteric pathogens (18.5%, 33/178). Waterborne transmission was the second highest mode of transmission for enteric protozoa (29.5%, 18/61), while environmental was the principal mode of transmission for poison (100%, 1/1). Environmental transmission also contributed to outbreaks of enteric viruses (28.9%, 88/304).

Figure 4: Percentage of outbreaks by agent type and mode of transmission¹, 2009



¹ More than one mode of transmission was recorded for some outbreaks therefore totals may add to greater than 100%

3.9. Foodborne outbreaks

Causal agent

There were 84 foodborne outbreaks with 651 associated cases reported in 2009, 60.7% (51/84) of which were linked to a specific pathogen (Table 8). Specific pathogens most commonly associated with foodborne outbreaks included norovirus (34.5%, 29/84), *Campylobacter* (8.3%, 7/84) and *Salmonella* (7.1%, 6/84). Enteric viruses (norovirus) were implicated in 34.5% (29/84) of foodborne outbreaks, enteric bacteria (*Campylobacter*, *Salmonella*, *S. Paratyphi B*, *Vibrio parahaemolyticus* and *Yersinia*) in 20.2% (17/84), and enteric toxins (*Clostridium*, ciguatera fish poisoning and histamine (scombroid) fish poisoning) in 6.0% (5/84) of foodborne outbreaks.

Table 8: Foodborne outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 84)	No. of cases	% of cases (N = 651)
Norovirus	29	34.5	349	53.6
<i>Campylobacter</i> spp.	7	8.3	39	6.0
<i>Salmonella</i> spp.	6	7.1	47	7.2
<i>Clostridium</i> spp.	3	3.6	88	13.5
<i>Vibrio parahaemolyticus</i>	2	2.4	7	1.1
Ciguatera fish poisoning	1	1.2	6	0.9
Histamine (scombroid) fish poisoning	1	1.2	3	0.5
<i>Salmonella</i> Paratyphi B	1	1.2	2	0.3
<i>Yersinia</i> spp.	1	1.2	2	0.3
Unidentified pathogen ¹	33	39.3	108	16.6
Total	84	100	651	100

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Vehicle/source implicated

Of the 84 foodborne outbreaks in 2009, four (4.8%) outbreaks had a definite source identified and 63 (75.0%) had a suspected source identified. The actual, definite or suspected sources were listed in 97.0% (65/67) of these outbreaks. The main foods implicated in these 65 outbreaks were poultry (15 outbreaks), vegetables (root) (13), shellfish (11), grains/beans (11) and fish (10) (Table 9). The highest number of cases was associated with outbreaks linked to poultry (123 cases), rice (104), grains/beans (74) and vegetables (root) (67). No source was identified for 15.5% (13/84 outbreaks) and the source was unknown for 4.8% (4/84) of the outbreaks.

Of the four outbreaks where a definite source was identified, the largest outbreak involved 78 cases from Nelson-Marlborough that became ill after consuming a butter chicken and rice meal contaminated with *Clostridium* spp. An outbreak occurred in Auckland after 17 cases had consumed raw oysters contaminated with norovirus GI. Sixteen cases suffered from *Campylobacter* infection after having consumed unpasteurised milk from a farm in Northland. A further three cases became ill with norovirus after consuming undercooked oysters at a restaurant/café in Waikato.

Table 9: Foodborne outbreaks and associated cases by implicated vehicle/source, 2009

Implicated vehicle/source	No. of outbreaks¹	% of outbreaks (N = 84)	No. of cases	% of cases (N = 651)
Poultry	15	17.9	123	18.9
Vegetables (root)	13	15.5	67	10.3
Shellfish ²	11	13.1	52	8.0
Grains/beans	11	13.1	74	11.4
Fish	10	11.9	51	7.8
Dairy	9	10.7	59	9.1
Rice	6	7.1	104	16.0
Meat (pork)	6	7.1	29	4.5
Vegetables (leafy)	5	6.0	48	7.4
Meat (beef)	4	4.8	21	3.2
Fruits/nuts	4	4.8	24	3.7
Oils/sugars	3	3.6	24	3.7
Vegetables (vine/stalk)	3	3.6	41	6.3
Eggs	2	2.4	29	4.5
Meat (game)	1	1.2	27	4.1
Meat (lamb)	1	1.2	3	0.5
Water	1	1.2	2	0.3
Unspecified food source ³	18	21.4	153	23.5
No vehicle/source identified	17	20.2	129	19.8

¹ More than one vehicle / source was implicated in some outbreaks

² Nine of the 11 shellfish outbreaks were due to oysters only

³ A common meal, premises or setting may have been implicated but no specific food items were recorded
Note: Mixed foods were assigned to multiple categories based on the groupings published by Painter et al 2009. Only explicit ingredients were assigned into a category. All foods within a mixed item were given equal priority.

Foodborne outbreaks with shellfish or fish as a possible vehicle or source (21 outbreaks) were frequently linked to norovirus (11) (Table 10). Foodborne outbreaks with poultry as a possible vehicle or source (15 outbreaks) were most commonly associated with *Campylobacter* (4).

Table 10: Foodborne outbreaks by causal agent and implicated vehicle/source, 2009

Implicated vehicle/source¹	Norovirus	<i>Campylobacter</i> spp.	<i>Salmonella</i> spp.	<i>Clostridium</i> spp.	<i>Vibrio parahaemolyticus</i>	Other²	Unidentified Pathogen³	Total number of outbreaks
Poultry	3	4	0	1	0	1	6	15
Vegetables (root)	6	1	0	1	0	0	5	13
Shellfish	7	0	0	0	1	0	3	11
Grains/beans	4	0	0	0	0	0	7	11
Fish	4	0	0	1	1	2	2	10
Dairy	3	2	0	0	0	0	4	9
Rice	1	0	0	1	0	0	4	6
Meat (pork)	2	1	0	0	0	1	2	6
Vegetables (leafy)	2	0	0	0	0	0	3	5
Meat (beef)	2	2	0	0	0	0	0	4
Fruits/nuts	0	0	1	0	2	0	1	4
Oils/sugars	1	0	0	0	0	0	2	3
Vegetables (vine/stalk)	2	0	0	0	0	0	1	3
Eggs	1	0	0	0	0	0	1	2
Meat (game)	1	0	0	0	0	0	0	1
Meat (lamb)	0	1	0	0	0	0	0	1
Water	0	0	0	0	0	1	0	1
Unspecified food source ⁴	6	0	4	0	0	0	8	18
No vehicle/source identified	4	0	1	1	0	0	11	17
Total	29	7	6	3	2	4	33	84

¹ More than one vehicle / source was implicated in some outbreaks

² Includes all causal agents listed in Table 9 that were implicated in less than three foodborne outbreaks

³ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

⁴ A common meal, premises or setting may have been implicated but no specific food items were recorded

Contributing factors

The factors contributing to foodborne outbreaks most commonly involved either time and temperature abuses (28.6%, 24/84) or contamination of food (26.2%, 22/84). Time and temperature abuses include factors such as undercooking, inadequate reheating of previously cooked food, inadequate cooling or refrigeration of food and improper storage prior to preparation (Table 11). Contamination of food may occur via cross-contamination with other food, via an infected food handler or from chemical contamination. Unsafe sources accounted

for 13.1% (11/84) of the outbreaks. Factors contributing to foodborne outbreaks were unknown in 54.8% (46/84) of the outbreaks.

Table 11: Foodborne outbreaks by contributing factor, 2009

Contributing factor	No. of outbreaks¹	% of foodborne outbreaks (N = 84)
<i>Time/temperature abuse</i>	24	28.6
Undercooking	7	8.3
Inadequate cooling or refrigeration	4	4.8
Improper storage prior to preparation	4	4.8
Inadequate reheating of previously cooked food	3	3.6
Improper hot holding	3	3.6
Preparation too far in advance	2	2.4
Inadequate thawing	1	1.2
<i>Contamination of food</i>	22	26.2
Cross contamination	15	17.9
Contamination from an infected food handler	7	8.3
Chemical contamination	0	0.0
<i>Unsafe sources</i>	11	13.1
Consumption of raw food	6	7.1
Use of unpasteurised milk in food preparation	3	3.6
Use of ingredients from unsafe sources	2	2.4
Use of untreated water in food preparation	0	0.0
<i>Other factors</i>	7	8.3
<i>Unknown factors</i>	46	54.8

¹ More than one contributing factor was recorded for some outbreaks

3.10. Person-to-person outbreaks

Causal agents

There were 540 person-to-person outbreaks with 10 020 associated cases in 2009, 76.1% (411/540) of which were linked to a specific pathogen (Table 12). The most common causal agent was norovirus, which was recorded in 46.7% (252/540) of person-to-person outbreaks involving 69.4% (6950/10020) of cases. Other common pathogens included *Giardia* (7.0%, 38/540) and rotavirus (5.9%, 32/540). Of the person-to-person outbreaks, enteric viruses (norovirus, rotavirus, hepatitis A and sapovirus) were implicated in 53.0% (286/540) of the outbreaks, and enteric protozoa (*Giardia* and *Cryptosporidium*) in 9.8% (53/540), respiratory bacteria (*B. pertussis*, *M. tuberculosis* and *N. meningitidis*) in 5.7% (31/540), enteric bacteria (*Salmonella*, *Campylobacter*, *E. coli* O157, *Shigella*, *S. Paratyphi B*, *S. Typhi* and *V. parahaemolyticus*) in 3.9% (21/540), respiratory virus (Influenza A H1N1 virus) in 1.3% (7/540) and other causal agents (respiratory illness (unidentified pathogen), measles virus, conjunctivitis and mumps virus) in 2.4% (13/540) of the outbreaks.

Norovirus was identified as the causal agent in 75.7% (137/181) of the person-to-person outbreaks where the causal agent was identified and there were 20 or more associated cases. The two largest person-to-person outbreaks were attributed to norovirus, both of these occurred at Palmerston North Hospital with 320 cases and 231 cases. The third largest person-to-person outbreak was attributed to measles virus, it occurred at a community, childcare, school and home setting in multiple health districts (Canterbury, West Coast and South Canterbury) and was associated with 170 cases.

Table 12: Person-to-person outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 540)	No. of cases	% of cases (N = 10 020)
Norovirus	252	46.7	6950	69.4
<i>Giardia</i> spp.	38	7.0	122	1.2
Rotavirus	32	5.9	424	4.2
<i>Bordetella pertussis</i>	27	5.0	104	1.0
<i>Cryptosporidium</i> spp.	15	2.8	55	0.5
Respiratory illness (unidentified pathogen)	8	1.5	134	1.3
Influenza A H1N1 virus	7	1.3	76	0.8
<i>Salmonella</i> spp.	7	1.3	20	0.2
<i>Campylobacter</i> spp.	4	0.7	17	0.2
VTEC/STEC (<i>Escherichia coli</i> O157)	4	0.7	15	0.1
Measles virus	3	0.6	205	2.0
<i>Mycobacterium tuberculosis</i>	3	0.6	20	0.2
<i>Shigella</i> spp.	3	0.6	8	0.1
Conjunctivitis	1	0.2	12	0.1
Hepatitis A	1	0.2	2	0.0
Mumps	1	0.2	3	0.0
<i>Neisseria meningitidis</i>	1	0.2	2	0.0
<i>Salmonella</i> Paratyphi B	1	0.2	2	0.0
<i>Salmonella</i> Typhi	1	0.2	2	0.0
Sapovirus	1	0.2	29	0.3
<i>Vibrio parahaemolyticus</i>	1	0.2	3	0.0
Unidentified pathogen ¹	129	23.9	1815	18.1
Total	540	100	10 020	100

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Contributing factors

Exposure to infected people was the primary contributing factor reported for 91.5% (494/540) of person-to-person outbreaks reported. Other contributing factors reported included poor hygiene of cases (30.2%, 163/540), excessively crowded living conditions (2.2%, 12/540) and inadequate vaccination coverage (1.9%, 10/540).

3.11. Waterborne outbreaks

Causal agents

There were 24 waterborne outbreaks with 87 associated cases reported in 2009, 87.5% (21/24) of which were linked to a specific pathogen (Table 13). The most commonly reported waterborne pathogen was *Giardia* (54.2%, 13/24), followed by *Cryptosporidium* (20.8%, 5/24). Enteric protozoa (*Giardia* and *Cryptosporidium*) were implicated in 75.0% (18/24) of waterborne outbreaks and enteric bacteria (*Salmonella* and *S. Paratyphi B*) in 12.5% (3/24).

Table 13: Waterborne outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 24)	No. of cases	% of cases (N = 87)
<i>Giardia</i> spp.	13	54.2	44	50.6
<i>Cryptosporidium</i> spp.	5	20.8	13	14.9
<i>Salmonella</i> spp.	2	8.3	6	6.9
<i>Salmonella</i> Paratyphi B	1	4.2	2	2.3
Unidentified pathogen ¹	3	12.5	22	25.3
Total	24	100	87	100

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Contributing factors

The most common contributing factor linked to waterborne outbreaks was an untreated drinking-water supply (66.7%, 16/24), followed by contamination of reservoir(s)/holding tank(s) (20.8%, 5/24) (Table 14).

Table 14: Waterborne outbreaks by contributing factor, 2009

Contributing factor	No. of outbreaks ¹	% of total outbreaks (N = 24)
Untreated drinking-water supply	16	66.7
Contamination of reservoir(s)/holding tank(s)	5	20.8
Contamination of water source	4	16.7
Other factors	1	4.2
Unknown factors	5	20.8

¹ More than one contributing factor was recorded for some outbreaks

3.12. Environmental outbreaks

Causal agents

There were 137 environmental outbreaks with 3731 associated cases reported in 2009, 82.5% (113/137) of which were linked to a specific pathogen (Table 15). The most common causal agent identified in environmental outbreaks was norovirus, which was recorded in 61.3% (84/137) of environmental outbreaks and associated with 80.2% (2994/3731) of cases. Enteric viruses (norovirus, rotavirus and sapovirus) were implicated in 64.2% (88/137) of environmental outbreaks, enteric protozoa (*Giardia* and *Cryptosporidium*) in 8.8% (12/137), enteric bacteria (*Salmonella*, *Campylobacter*, and *S. Paratyphi B*) in 3.6% (5/137) and respiratory pathogens (respiratory illness (unidentified pathogen), *B. pertussis* and Influenza A H1N1 virus) in 5.1% (7/137) of environmental outbreaks. Carbon monoxide was associated with one environmental outbreak.

Table 15: Environmental outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 137)	No. of cases	% of cases (N = 3731)
Norovirus	84	61.3	2994	80.2
<i>Giardia</i> spp.	9	6.6	34	0.9
Respiratory illness (unidentified pathogen)	5	3.6	98	2.6
<i>Cryptosporidium</i> spp.	3	2.2	10	0.3
Rotavirus	3	2.2	75	2.0
<i>Salmonella</i> spp.	3	2.2	21	0.6
<i>Bordetella pertussis</i>	1	0.7	2	0.1
<i>Campylobacter</i> spp.	1	0.7	3	0.1
Carbon monoxide	1	0.7	2	0.1
Influenza A H1N1 virus	1	0.7	2	0.1
<i>Salmonella</i> Paratyphi B	1	0.7	2	0.1
Sapovirus	1	0.7	29	0.8
Unidentified pathogen ¹	24	17.5	459	12.3
Total	137	100	3731	100

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Contributing factors

The major contributing factor associated with environmental outbreaks was exposure to a contaminated environment, which was recorded in 96.4% (132/137) of environmental outbreaks. The other contributing factors were exposure to contaminated swimming pools (2.9%, 4/137), infected animals or animal products (2.2%, 3/137), untreated recreational water (2.2%, 3/137) and inadequately maintained swimming pools (0.7%, 1/137).

3.13. Zoonotic outbreaks

Causal agents

There were 14 zoonotic outbreaks with 67 associated cases reported in 2009, 92.9% (13/14) of which were linked to a specific pathogen (Table 16). The most common causal agent identified in zoonotic outbreaks was *Cryptosporidium* which was linked to 42.9% (6/14) of the zoonotic outbreaks and 25.4% (17/67) of associated cases. Enteric protozoa (*Cryptosporidium* and *Giardia*) were implicated in 50.0% (7/14) of zoonotic outbreaks and enteric bacteria (*Campylobacter*, *Salmonella*, *Escherichia coli* O157, and *Yersinia*) in 42.9% (6/14).

Table 16: Zoonotic outbreaks and associated cases by agent type, 2009

Agent type	No. of outbreaks	% of outbreaks (N = 14)	No. of cases	% of cases (N = 67)
<i>Cryptosporidium</i> spp.	6	42.9	17	25.4
<i>Campylobacter</i> spp.	3	21.4	21	31.3
<i>Giardia</i> spp.	1	7.1	6	9.0
<i>Salmonella</i> spp.	1	7.1	15	22.4
VTEC/STEC (<i>Escherichia coli</i> O157)	1	7.1	2	3.0
<i>Yersinia</i> spp.	1	7.1	2	3.0
Unidentified pathogen ¹	1	7.1	4	6.0
Total	14	100	67	100

¹ All outbreaks with no pathogen identified in 2009 were classified as gastroenteritis

Contributing factors

Exposure to infected animals or animal products and to infected people was reported as a contributing factor for all zoonotic outbreaks in 2009. Other contributing factors included exposure to other infected people (50.0%, 7/14 outbreaks) and poor hygiene (35.7%, 5/14). The most common settings for zoonotic outbreaks were the home (8 outbreaks) and farms (7 outbreaks). For seven of the 14 zoonotic outbreaks, specific animals were implicated as potential sources, these included cows, calves and a wild pig.

3.14. Outbreaks with overseas transmission

There were five outbreaks in 2009 with overseas transmission involving 54 cases; each outbreak was associated with a different overseas destination (Table 17). The majority of cases associated with overseas transmission contracted measles virus (57.4%, 31/54 cases).

Table 17: Outbreaks with overseas transmission by destination, 2009

Agent type	Australia	Fiji	Indonesia	Samoa	Vietnam	No. of outbreaks	No. of cases
<i>Cryptosporidium</i> spp.	0	1	0	0	0	1	4
Measles virus	0	0	0	0	1	1	31
<i>Salmonella</i> spp.	1	0	0	0	0	1	13
<i>Salmonella</i> Paratyphi B	0	0	1	0	0	1	2
<i>Salmonella</i> Typhi	0	0	0	1	0	1	4
Total	1	1	1	1	1	5	54

3.15. Outbreak recognition, investigation and control

Timeliness of reporting

For the 583 outbreaks where timeliness of reporting data were available, the majority were reported to the PHU within one week of onset of illness in the first case (61.1%, 356/583), while 28.8% (168/583) of outbreaks were reported between 7 and 30 days (inclusive) after the onset of illness in the first case, and 5.8% (34/583) of outbreaks were reported between 31 and 60 days after the onset of illness in the first case. Twenty-five (4.3%) outbreaks were reported more than 60 days after the onset of illness in the first case.

Reporting delay (time between date of onset of illness in the first case and the report date) varied between different outbreak types (Table 18). The shortest median reporting delay (2.0 days) was associated with dispersed common source outbreaks, followed by common event (3.0) and institutional outbreaks (4.0). The longest median reporting delay (14.0 days) was observed for community-wide outbreaks, with the overall median reporting delay for outbreaks being four days.

Table 18: Median reporting delay by outbreak type, 2009

Outbreak type	No. of outbreaks ¹	Median reporting delay (days)
Common event	56	3.0
Dispersed common source	20	2.0
Common site	19	8.0
Community wide	21	14.0
Institutional	349	4.0
Household	103	12.0
Other outbreak type	12	5.5
Unknown outbreak type	3	1.0
Total	583	4.0

¹ Outbreaks were excluded if the date of onset of illness in the first case was missing

Recognition of outbreaks

Almost 70% (433/638) of outbreaks were identified when cases had person-to-person contact with other cases and when there was an increase in disease incidence (58.2%, 371/638) (Table 19). Other frequent means of outbreak recognition included when cases were linked to a common source (30.6%, 195/638) and when cases attended a common event (21.9%, 140/638). There was more than one means of recognition for 61.1% (390/638) of outbreaks.

Table 19: Outbreaks by means of recognition, 2009

Means of recognition	No. of outbreaks¹	% of total outbreaks (N = 638)
Cases had person-to-person contact with other cases	433	67.9
Increase in disease incidence	371	58.2
Cases linked to common source	195	30.6
Cases attended common event	140	21.9
Common organism type/strain characteristics in cases	46	7.2
Other means	25	3.9
Unknown means	15	2.4

¹ More than one means of recognition was recorded for some outbreaks

Control measures

Outbreak control measures were known to have been undertaken in 90.8% (579/638) of outbreaks reported in 2009, it was unknown whether control measures were taken in 9.2% (59/638) of outbreaks. The most common measures undertaken were health education and advice regarding the source (70.5%, 450/638), followed by cleaning and disinfection (60.8%, 388/638) (Table 20).

Table 20: Outbreaks by control measures undertaken, 2009

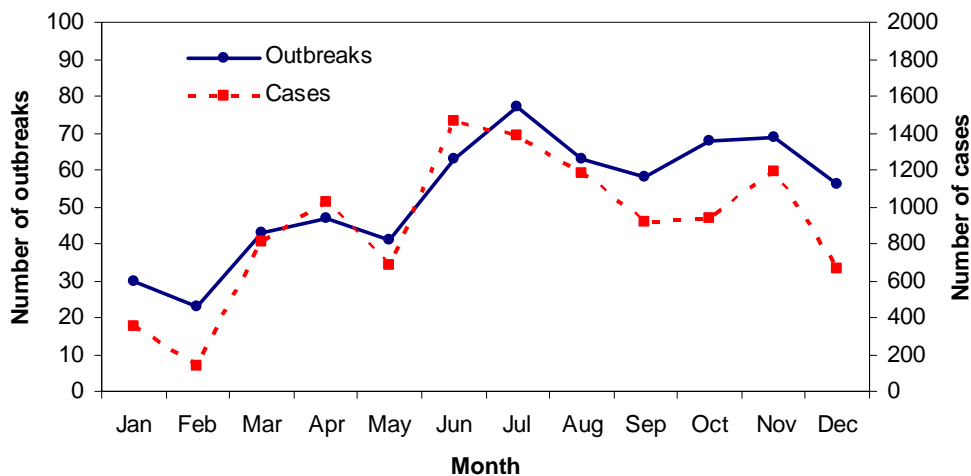
Outbreak control measure	No. of outbreaks¹	% of total outbreaks (N = 638)
<i>Source</i>		
Health education and advice	450	70.5
Cleaning, disinfection	388	60.8
Exclusion	338	53.0
Isolation	321	50.3
Modification of procedures	201	31.5
Closure	180	28.2
Health warning	121	19.0
Treatment	48	7.5
Removal	13	2.0
<i>Vehicle and vector</i>		
Removal	6	0.9
Treatment	6	0.9
<i>Contacts and potential contacts</i>		
Health education and advice	107	16.8
Chemoprophylaxis	17	2.7
Vaccination	4	0.6
<i>Other control measures</i>	63	9.9
<i>No control measures</i>	44	6.9
<i>Unknown control measures</i>	59	9.2

¹ More than one control measure was recorded for some outbreaks

3.16. Summary of trends

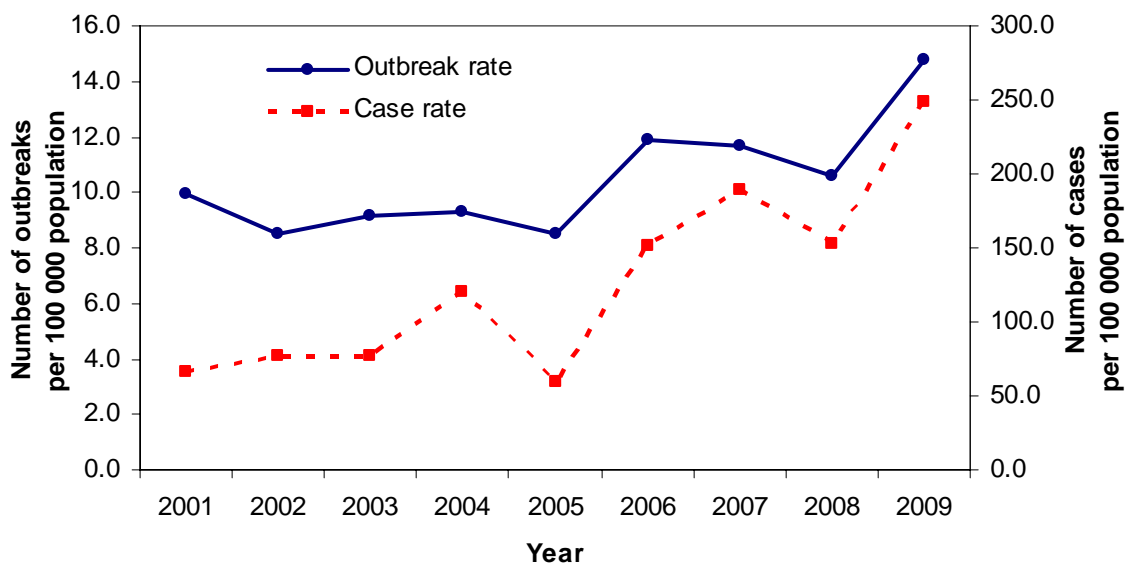
In 2009, the highest number of outbreaks was reported in July (77 outbreaks), followed by November (69) and October (68). The highest number of outbreak-related cases occurred in June (1468 cases) and July (1386 cases) (Figure 5).

Figure 5: Number of outbreaks and associated cases by month, 2009



The national annual outbreak rate for 2009 (14.8 outbreaks per 100 000 population) was higher than the rates for 2008 and 2007 (10.6 and 11.7 per 100 000, respectively) and greater than the rates for 2001 to 2006 (Figure 6). Similarly, the national outbreak case rate of 248.7 cases per 100 000 population in 2009 was higher than the 2008 case rate (152.8 cases per 100 000) and all other years since 2001.

Figure 6: Outbreak rates and associated cases by year, 2001–2009

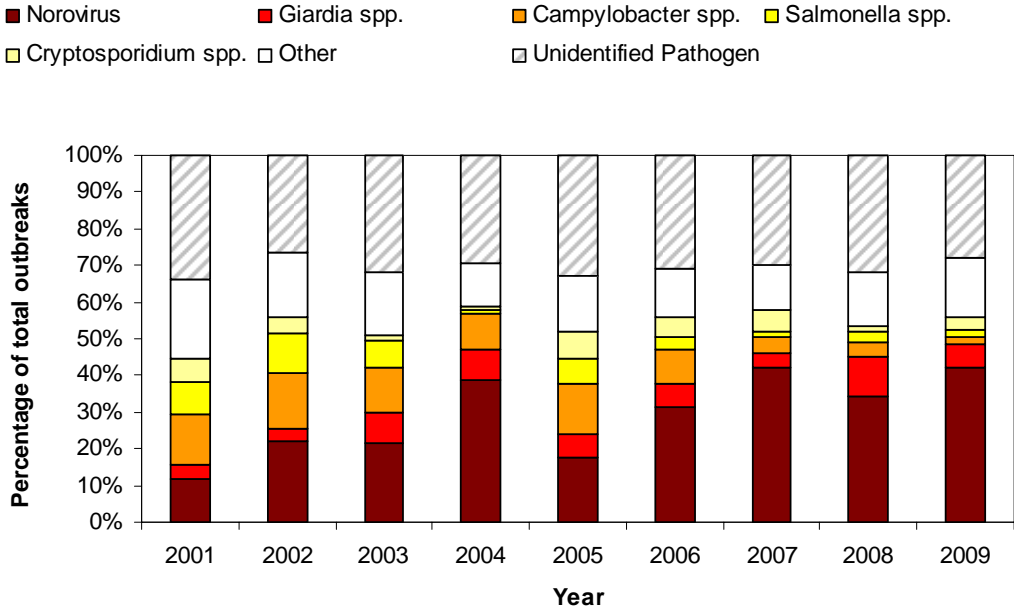


Common event outbreaks were consistently the most frequent outbreak type between 2001 and 2005. Since 2005, the number (and proportion) of institutional outbreaks has increased from 41 (11.7%) in 2005 to 184 (40.8%) in 2008 and 371 (58.2%) in 2009. From 2006 to 2009, institutional outbreaks were therefore the most common outbreak type. Household outbreaks were also an important outbreak type accounting for over 20% of all outbreaks since 2005.

Since 2001, the number of outbreaks linked with an identified causal agent has remained close to 70% (range 66.3% to 73.4%). In 2009, 72.1% (460/638) of outbreaks were linked to an identified agent. From 2001 to 2006, the most commonly reported causal agent linked to outbreaks was norovirus, followed by *Campylobacter* (Figure 7). The number of norovirus-linked outbreaks and associated cases increased markedly between 2005 (62 outbreaks and 1167 cases) and 2007 (207 outbreaks and 5932 cases), although there were fewer norovirus outbreaks in 2008 (154 outbreaks and 3935 cases). In 2009, this increased to 270 outbreaks with 7116 cases, the highest observed since reporting began in 2001. The number of *Giardia* outbreaks more than doubled between 2007 (21 outbreaks and 111 cases) and 2008 (50 outbreaks and 184 cases), but decreased again in 2009 (41 outbreaks and 131 cases).

In contrast, since 2006 the number of outbreaks linked to *Campylobacter* has decreased by 66% and the number of associated cases has decreased by more than 50% (2006: 47 outbreaks and 221 cases; 2008: 16 outbreaks and 109 cases). This decreasing trend continued in 2009 (12 outbreaks and 65 cases). This is the lowest number of *Campylobacter* outbreaks reported since 2001. In 2008 there were far fewer outbreaks linked to *Cryptosporidium* (7 outbreaks and 29 cases) compared with the previous three years when there were 25 or more outbreaks and greater than 100 cases annually. However, the number of outbreaks increased in 2009 to levels similar in previous years (20 outbreaks and 68 cases).

Figure 7: Percentage of outbreaks by agent type and year, 2001–2009



In 2009, the most common outbreak settings were rest or retirement homes and the home. This is similar to 2007, 2006 and 2004 when rest or retirement homes and the home were the

two most common settings. In 2005, and prior to 2004, restaurants/cafés and the home were the most common outbreak settings.

The principal modes of transmission from 2001 to 2006 were foodborne and person-to-person transmission. Between 2005 and 2007, the number of outbreaks linked to foodborne transmission fell from 185 to 74, whilst the number of outbreaks linked to environmental transmission increased from 22 to 91. In 2008, person-to-person remained the most common mode of transmission, and foodborne closely followed by environmental were the next two most common modes of transmission. In 2009, person-to-person, environmental and foodborne were the also the most common modes of transmission.

In 2009, five outbreaks involving 54 cases had overseas transmission. This is similar to 2008, when there were seven outbreaks involving 54 cases that had overseas transmission. No country was associated with more than two outbreaks a year between 2007 and 2009.

The median delay between date of onset of illness in the first case and the outbreak report date was calculated as 4.0 days for 2009 and in 2008. This delay was one day less than the median delay for the previous five years.

Health education and advice related to the outbreak source has been the most common control measure since 2001. Between 2001 and 2006, modification of procedures pertaining to the source had been the second most common control measure undertaken. In 2007 and 2008 cleaning and disinfection was more commonly reported than modification of procedures. The proportion of outbreaks where it was reported that no control measures were undertaken decreased from 27.8% of outbreaks in 2001 to 3.5% in 2005, but has since increased to 6.0 in 2008 and 6.9% in 2009.

GLOSSARY¹

Common event outbreak

An outbreak due to exposure of a group of persons to a noxious influence that is common to the individuals in the group, where the exposure is brief and essentially simultaneous and all resultant cases develop within one incubation period of the disease. Cases therefore have exposures that are grouped in place and time (synonymous with point source outbreak).

Common site outbreak

An outbreak due to exposure of a group of persons to a noxious influence that is common to the individuals in the group, where exposures have occurred at the same place (or site) but over a longer time period than those of common event outbreaks (i.e. grouped in place but not in time). In the Outbreak Report Form, these outbreaks are called *common source in a specific place*.

Common source outbreak

An outbreak due to exposure of a group of persons in the community to a noxious influence that is common to the individuals in the group. These outbreaks are subcategorised into common event (where exposures are grouped in time and place), dispersed common source (grouped in time but not in place) and common site (grouped in place but not in time).

Community-wide outbreak

An outbreak that occurs among individuals in a community where transmission predominantly occurs by direct exposure of susceptible people to infectious people (synonymous with person-to-person outbreak).

Contamination

The presence of a disease-causing agent on a body surface, in clothes, bedding, toys or other inanimate articles or substances, including water and food.

Dispersed common source outbreak

Outbreak due to exposure of a group of persons in the community to a noxious influence that is common to the individuals in the group, where the exposures are not grouped in place (and may or may not be grouped in time). These outbreaks are often due to a distributed vehicle of infection transmission, such as a commercially prepared food item or a water supply.

EpiSurv

The national notifiable disease surveillance system managed by ESR to record data on notifiable diseases and outbreaks reported by public health units.

ESR

Institute of Environmental Science & Research Limited.

Environment

All factors which are external to the individual human host.

¹ Adapted from *Disease Outbreak Manual*. 2002, Institute of Environmental Science & Research Ltd (ESR).

Exposure

Proximity and/or contact with a potential source of a disease agent in such a manner that effective transmission of the agent and harmful or protective effects of the agent may occur.

Household outbreak

An outbreak confined to members of a single household.

Institutional outbreak

An outbreak confined to the population of a specific residential or other institutional setting, such as a hospital, rest home, prison or boarding school.

Outbreak

An epidemic limited to a localised increase in the incidence of a disease, such as in a town or closed institution.

Source (of illness)

The person, animal, object or substance from which a disease agent passes to a host.

Transmission of illness

Any mechanism by which a disease agent is spread through the environment or to another person. Mechanisms are defined as either direct or indirect.

REFERENCES

1. Lopez L, Baker M, Kieft C. *Annual Summary of Outbreaks in New Zealand 2000. 2001*, Wellington, New Zealand. Institute of Environmental Science & Research Ltd (ESR).
2. *Manual for Public Health Surveillance*, 2005, Wellington, New Zealand. Institute of Environmental Science & Research Ltd (ESR).
3. Painter J, et al., *Recipes for Foodborne Outbreaks: A Scheme for Categorizing and Grouping Implicated Foods*. *Foodborne Pathogens and Disease*, 2009. 6(10):p.1259-1264. DOI.10.1089/fpd.2009.0350.