

ISSN: 1176-3485

**ANNUAL SUMMARY OF OUTBREAKS  
IN NEW ZEALAND 2007**

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 2008

Client Report  
FW 08035

**ANNUAL SUMMARY OF OUTBREAKS  
IN NEW ZEALAND 2007**

Population and Environmental Health Group

April 2008

## **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, Jonathan Williman has 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 author would also like to thank Catherine Tisch and Dr Shanika Perera at ESR and Dr Alison Roberts at the Ministry of Health for their peer review of the draft report and helpful feedback provided.

This report is available on the Internet at [www.surv.esr.cri.nz](http://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

|   |           |
|---|-----------|
| <b>EXECUTIVE SUMMARY .....</b>                              | <b>I</b>  |
| <b>1. INTRODUCTION .....</b>                                | <b>1</b>  |
| <b>2. METHODS .....</b>                                     | <b>1</b>  |
| 2.1. Outbreak definition .....                              | 1         |
| 2.2. Data source .....                                      | 2         |
| 2.3. Data analysis .....                                    | 2         |
| 2.4. Data limitations .....                                 | 3         |
| <b>3. RESULTS .....</b>                                     | <b>4</b>  |
| 3.1. Characteristics of outbreaks .....                     | 4         |
| 3.2. Distribution of outbreaks by PHU .....                 | 4         |
| 3.3. Type of outbreak .....                                 | 5         |
| 3.4. Causal agent .....                                     | 6         |
| 3.5. Morbidity and mortality .....                          | 9         |
| 3.6. Outbreak setting .....                                 | 9         |
| 3.7. Mode of transmission .....                             | 11        |
| 3.8. Foodborne outbreaks .....                              | 13        |
| 3.9. Person-to-person outbreaks .....                       | 16        |
| 3.10. Waterborne outbreaks .....                            | 17        |
| 3.11. Environmental outbreaks .....                         | 18        |
| 3.12. Zoonotic outbreaks .....                              | 20        |
| 3.13. Outbreaks with overseas transmission .....            | 21        |
| 3.14. Outbreak recognition, investigation and control ..... | 21        |
| 3.15. Summary of trends .....                               | 24        |
| <b>GLOSSARY .....</b>                                       | <b>27</b> |

## LIST OF TABLES

|   |    |
|---|----|
| Table 1: Outbreaks and associated cases by PHU, 2007.....   | 5  |
| Table 2: Outbreaks and associated cases by type of outbreak, 2007 .....                                 | 6  |
| Table 3: Outbreaks and associated cases by agent type, 2007 .....                                       | 7  |
| Table 4: Outbreak type by agent type, 2007 .....  | 8  |
| Table 5: Hospitalised outbreak cases and total outbreak cases by agent type, 2007 .....                 | 10 |
| Table 6: Outbreaks and associated cases by setting of exposure/transmission, 2007.....                  | 11 |
| Table 7: Outbreaks and associated cases by mode of transmission, 2007 .....                             | 12 |
| Table 8: Foodborne outbreaks and associated cases by agent type, 2007.....                              | 13 |
| Table 9: Foodborne outbreaks <sup>1</sup> and associated cases by implicated vehicle / source, 2007.... | 14 |
| Table 10: Foodborne outbreaks <sup>1</sup> by casual agent and implicated vehicle / source, 2007 .....  | 15 |
| Table 11: Foodborne outbreaks by contributing factor, 2007 .....  | 16 |
| Table 12: Person-to-person outbreaks and associated cases by agent type, 2007.....                      | 17 |
| Table 13: Waterborne outbreaks and associated cases by agent type, 2007 .....                           | 18 |
| Table 14: Waterborne outbreaks by contributing factor, 2007 .....                                       | 18 |
| Table 15: Environmental outbreaks and associated cases by agent type, 2007 .....                        | 19 |
| Table 16: Zoonotic outbreaks and associated cases by agent type, 2007 .....                             | 20 |
| Table 17: Outbreaks with overseas transmission by country, 2007 .....                                   | 21 |
| Table 18: Median reporting delay by outbreak type, 2007 .....   | 22 |
| Table 19: Outbreaks by means of recognition, 2007 .....   | 22 |
| Table 20: Outbreaks by control measures undertaken, 2007 .....  | 23 |

## LIST OF FIGURES

|  |    |
|--|----|
| Figure 1: Outbreak rates by PHU, 2007 .....  | 4  |
| Figure 2: Percentage of outbreaks by agent type and mode of transmission, 2007 ..... | 12 |
| Figure 3: Number of outbreaks and associated cases by month, 2007 .....              | 24 |
| Figure 4: Number of outbreaks by year, 2001-2007 .....                               | 24 |
| Figure 5: Percentage of outbreaks by agent type and year, 2001-2007 .....            | 25 |

## **EXECUTIVE SUMMARY**

### **Characteristics**

- There were 492 outbreaks reported in 2007 involving 7988 cases.
- The national reported outbreak rate was 11.6 outbreaks per 100 000 population.
- There were 193 hospitalisations and 11 deaths associated with outbreaks notified in 2007.

### **Distribution by Public Health Unit (PHU)**

- The highest number of outbreaks was reported by Auckland, which represented 47.6% (234/492) of all outbreaks in 2007.
- The highest reported outbreak rate (31.0 outbreaks per 100 000 population) was observed in the West Coast.
- Auckland, Tauranga, Canterbury, West Coast, and Otago reported outbreak rates higher than the national rate.
- No outbreaks were reported by the Eastern Bay of Plenty and only one outbreak was reported by Gisborne, Wanganui, and South Canterbury.

### **Type of outbreak**

- Over forty percent (42.5%, 209/492) of all outbreaks and 75.0% (5990/7988) of all associated cases were reported as linked to institutional outbreaks.
- Common source outbreaks represented 29.3% (144/492) of all outbreaks and 16.8% (1339/7988) of all associated cases, the majority of which resulted from a common event.
- Household outbreaks represented 20.5% (101/492) of all outbreaks and 3.6% (284/7988) of all associated cases.

### **Causal agents**

- The causal agent (pathogen, toxin or chemical) was identified in 70.1% (345/492) of outbreaks involving 84.9% (6782/7988) of outbreak related cases.
- The remaining outbreaks where no organism was isolated were all recorded as gastroenteritis.
- Enteric agents were implicated in 97.0% (477/492) of outbreaks and 97.9% (7821/7988) of outbreak related cases.
- The most common implicated pathogen was norovirus (41.9% of outbreaks), followed by *Cryptosporidium* (5.9%), *Giardia* (4.3%) and *Campylobacter* (4.1%).

### **Outbreak setting**

- The most common settings where exposure or transmission occurred were rest homes (26.4% of outbreaks) and the home environment (19.5%).
- The highest number of outbreak related cases was recorded as rest homes (46.3%), continuing care hospitals (26.6%) and acute care hospitals (11.9%).

## **Mode of transmission**

- Person-to-person outbreaks were the most common mode of transmission, accounting for 66.3% (326/492) of outbreaks and 87.9% (7018/7988) of cases.
- Environmental transmission was recorded in 18.5% (91/492) of outbreaks involving 32.3% (2582/7988) of cases.
- Foodborne transmission was recorded in 15.0% (74/492) of outbreaks involving 7.6% (611/7988) of cases.
- Multiple modes of transmission were identified in 25.2% (124/492) of outbreaks associated with 42.9% (3425/7988) of cases.

## **Recognition, investigation and control**

- The majority of outbreaks (56.6%, 267/472) were reported within one week of the onset of illness in the first case.
- The overall median reporting delay for outbreaks was five days.
- Outbreaks were most frequently identified when cases had person-to-person contact with other cases (57.7% of outbreaks), there was an increase in disease incidence (42.3%), cases attended a common event (28.3%) and cases were linked to a common source (22.4%).
- Outbreak control measures were undertaken in 95.8% (452/472) of outbreaks reported in 2007. The most common measures were health education and advice (71.8%, 386/472 outbreaks) and cleaning and disinfection (44.3%, 209/472).

## 1. INTRODUCTION

Outbreak surveillance in New Zealand has been conducted by ESR since 1996. The outbreak surveillance system was incorporated as a module within EpiSurv, the national notifiable disease surveillance system, in 1997.

Outbreak surveillance is undertaken for the following reasons<sup>1</sup>:

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

## 2. METHODS

### 2.1. Outbreak definition

The Manual for Public Health Surveillance in New Zealand<sup>2</sup> 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.

---

<sup>1</sup> Lopez L, Baker M, Kieft C. *Annual Summary of Outbreaks in New Zealand 2000*. 2001, Institute of Environmental Science & Research Ltd (ESR).

<sup>2</sup> *Manual for Public Health Surveillance*, 2005, Institute of Environmental Science & Research Ltd (ESR).

## **2.2. Data source**

Outbreaks are reported to or identified by the local PHU. Data on each outbreak is recorded by the PHU on a standardised Outbreak Report Form within EpiSurv. PHUs are encouraged to enter early data as an interim report that can be finalised when further data is available. This data is sent daily to be collated within the national EpiSurv database by ESR on behalf of the Ministry of Health. The national database is supplemented by data from the ESR enteric reference, virology and public health laboratories. If an outbreak is first identified by these laboratory sources, the responsible PHU is requested to complete an Outbreak Report Form.

The Outbreak Report Form consists of the following sections:

- Reporting authority (outbreak report date, interim/final report)
- Disease and implicated pathogen, toxin or chemical (name of implicated agent, case definitions)
- Outbreak demographics (number of cases, outbreak dates, age/sex of cases, incubation period, duration of illness)
- Circumstances of exposure/transmission (means of outbreak recognition, type of outbreak, setting, geographic location, mode of transmission, vehicle/source, evidence)
- Factors contributing to 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 2007 and 31 December 2007 and recorded on EpiSurv as at 26 February 2008. Amendments made to outbreak data on EpiSurv after 26 February 2008 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 NZ population estimates for 2007. Data on trends was based on data previously published in annual outbreak summary reports for 2001 to 2006.

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 using the outbreak report date and the date of onset of illness in the first case.

## **2.4. Data limitations**

The available outbreak data is 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 between 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, resulting in measurement bias. For example, the date of onset of illness in the first case was not reported for 31 outbreaks.

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 are mostly restricted to 2005 and 2006.

### 3. RESULTS

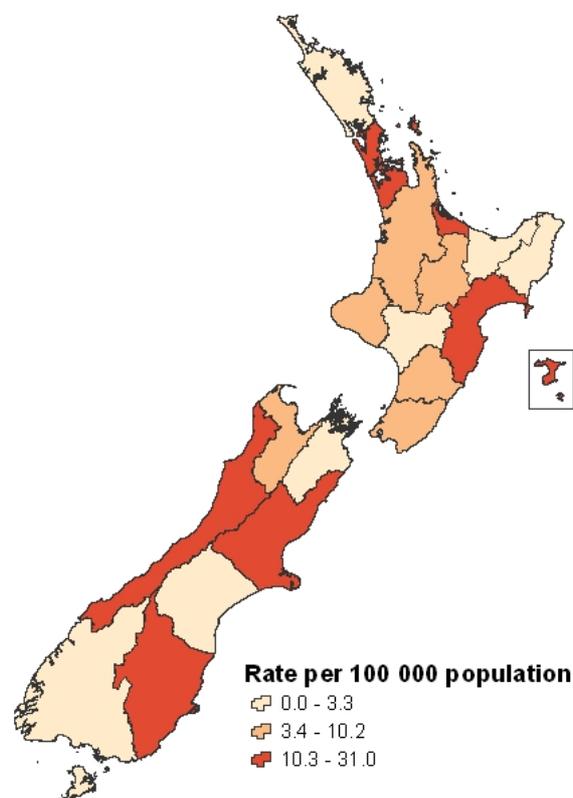
#### 3.1. Characteristics of outbreaks

There were 492 outbreaks reported in 2007 compared to 495 outbreaks reported in 2006. The national rate of 11.6 outbreaks per 100 000 population in 2007 was similar to 2006 when there were 12.0 outbreaks per 100 000 population. All of the outbreaks reported in 2007 were classified as final. A total of 7988 cases were associated with outbreaks at a national rate of 188.9 cases per 100 000 population. Of the total cases, 2521 (31.6%) were confirmed and 5467 (68.4%) were probable.

#### 3.2. Distribution of outbreaks by PHU

The highest number of outbreaks (234) was reported by the Auckland PHU, which represented 47.6% (234/492) of all outbreaks in 2007 (see Table 1). Canterbury had the second highest number of outbreaks (63) and the highest number of outbreak associated cases (2252). The highest outbreak rate (31.0 per 100,000) was observed in the West Coast (see Figure 1), although the West Coast only accounted for 2.0% (10/492) of all outbreaks reported. Other PHU with an outbreak rate higher than the national rate (11.6 outbreaks per 100 000 population) included Otago (17.2), Auckland (16.6), Tauranga (13.8) and Canterbury (13.6). Only one outbreak was reported by each of Gisborne, Wanganui and South Canterbury PHUs and no outbreaks were reported by the Eastern Bay of Plenty.

**Figure 1: Outbreak rates by PHU, 2007**



**Table 1: Outbreaks and associated cases by PHU, 2007**

| PHU                     | No. of outbreaks | % of outbreaks<br>(n=492) | No. of cases | % of cases   | Outbreak rate <sup>1</sup><br>(n=7988) |
|-------------------------|------------------|---------------------------|--------------|--------------|--|
| Northland               | 5                | 1.0                       | 96           | 1.2          | 3.2                                    |
| Auckland <sup>2</sup>   | 234              | 47.6                      | 2146         | 26.9         | 16.6                                   |
| Waikato                 | 31               | 6.3                       | 495          | 6.2          | 8.8                                    |
| Tauranga                | 21               | 4.3                       | 389          | 4.9          | 13.8                                   |
| East. Bay of Plenty     | 0                | 0.0                       | 0            | 0.0          | 0.0                                    |
| Gisborne                | 1                | 0.2                       | 9            | 0.1          | 2.2                                    |
| Rotorua                 | 4                | 0.8                       | 69           | 0.9          | 3.9                                    |
| Taranaki                | 5                | 1.0                       | 95           | 1.2          | 4.7                                    |
| Hawke's Bay             | 16               | 3.3                       | 270          | 3.4          | 10.5                                   |
| Wanganui                | 1                | 0.2                       | 37           | 0.5          | 1.6                                    |
| Manawatu                | 14               | 2.8                       | 307          | 3.8          | 8.5                                    |
| Wellington <sup>3</sup> | 47               | 9.6                       | 1187         | 14.9         | 10.2                                   |
| Nelson                  | 2                | 0.4                       | 29           | 0.4          | 4.5                                    |
| Marlborough             | 3                | 0.6                       | 8            | 0.1          | 3.3                                    |
| West Coast              | 10               | 2.0                       | 42           | 0.5          | 31.0                                   |
| Canterbury              | 63               | 12.8                      | 2252         | 28.2         | 13.6                                   |
| South Canterbury        | 1                | 0.2                       | 60           | 0.8          | 1.2                                    |
| Otago                   | 32               | 6.5                       | 471          | 5.9          | 17.2                                   |
| Southland               | 2                | 0.4                       | 26           | 0.3          | 1.8                                    |
| <b>National</b>         | <b>492</b>       | <b>100.0</b>              | <b>7988</b>  | <b>100.0</b> | <b>11.6</b>                            |

1 Crude rate of outbreaks per 100 000 population calculated using Statistics NZ population estimates for 2007

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

3 Includes Wellington, Hutt and Wairarapa health districts

### 3.3. Type of outbreak

In 2007 over a quarter (29.3%, 144/492 outbreaks) of all outbreaks and 16.8% (1339/7988) of associated cases were reported as a common source outbreak. Of these outbreaks, 114 (23.2%) reportedly resulted from a common event, 20 (4.1%) from a common source in a specific site and 10 (2.0%) from a common source dispersed in the community (see Table 2). Institutional outbreaks had the highest number of cases per outbreak (28.7), accounting for 42.5% (209/492) of all outbreaks and 75.0% (5990/7988) of outbreak associated cases. Household outbreaks accounted for 20.5% (101/492) of outbreaks but just 3.6% (284/7988) of outbreak cases. Community wide outbreaks, where transmission always occurred through person-to-person contact, represented 2.8% (13/492) of reported outbreaks.

**Table 2: Outbreaks and associated cases by type of outbreak, 2007**

| <b>Outbreak type</b>    | <b>No. of outbreaks</b> | <b>% of outbreaks (n=492)</b> | <b>No. of cases</b> | <b>% of cases (n=7988)</b> | <b>Cases per outbreak</b> |
|-------------------------|-------------------------|-------------------------------|---------------------|----------------------------|---------------------------|
| Common event            | 114                     | 23.2                          | 1016                | 12.7                       | 8.9                       |
| Dispersed common source | 10                      | 2.0                           | 128                 | 1.6                        | 12.8                      |
| Common site             | 20                      | 4.1                           | 195                 | 2.4                        | 9.8                       |
| Community wide          | 13                      | 2.6                           | 181                 | 2.3                        | 13.9                      |
| Institutional           | 209                     | 42.5                          | 5990                | 75.0                       | 28.7                      |
| Household               | 101                     | 20.5                          | 284                 | 3.6                        | 2.8                       |
| Other outbreak type     | 7                       | 1.4                           | 117                 | 1.5                        | 16.7                      |
| Unknown outbreak type   | 18                      | 3.7                           | 77                  | 1.0                        | 4.3                       |
| <b>Total</b>            | <b>492</b>              | <b>100.0</b>                  | <b>7988</b>         | <b>100.0</b>               | <b>16.2</b>               |

### 3.4. Causal agent

The causal agent was identified in 345 (70.1%) outbreaks that were associated with 6782 (84.9%) cases. For each of these outbreaks only one causal agent was recorded. No specific pathogen was reported in the remaining 147 (29.9%) outbreaks, all of which were recorded as gastroenteritis outbreaks.

Enteric agents were implicated in the vast majority of outbreaks (97.0%, 477/492) and cases (97.9%, 7821/7988) (see Table 3). The most common causal agent implicated in outbreaks in 2007 was norovirus, which resulted in 206 (41.9%) outbreaks and 5902 (73.9%) associated cases. The average number of cases associated with each norovirus outbreak (28.7) was the highest of any enteric agent in 2007 (after *Bacillus cereus* which was only implicated in one outbreak). The next most common causal agent associated with outbreaks was *Cryptosporidium* (5.9%) followed by *Giardia* (4.3%), *Campylobacter* (4.1%), and *Clostridium perfringens* (2.6%). Outbreaks due to *Salmonella* species had the second highest number of associated cases (1.8%).

Non-enteric agents accounted for only 15 (3.0%) outbreaks associated with 167 (2.1%) cases in 2007. The three agents involved in more than one outbreak were: *Mycobacterium tuberculosis* (3), *Influenza* (2), and measles (2). The average number of cases associated with the two influenza outbreaks (47.5) was the highest of any non-enteric agent

The specific causal agents implicated in the various outbreak types are shown in Table 4. Common event outbreaks were mostly associated with norovirus (23 outbreaks), *Campylobacter* (12) and *C. perfringens* (11). Outbreaks due to a common source dispersed in the community were most frequently linked to *Salmonella* (3 outbreaks), while outbreaks due to a common source in a specific site were mostly commonly due to *Cryptosporidium* (4). The majority of institutional outbreaks were due to norovirus (69.4%, 145/209). Norovirus was also frequently associated with household outbreaks (24) as were *Cryptosporidium* (17 outbreaks), and *Giardia* (14).

**Table 3: Outbreaks and associated cases by agent type, 2007**

| <b>Agent type</b>                  | <b>No. of outbreaks</b> | <b>% of outbreaks (n=492)</b> | <b>No. of cases</b> | <b>% of cases (n=7988)</b> |
|------------------------------------|-------------------------|-------------------------------|---------------------|----------------------------|
| <b><i>Enteric</i></b>              |                         |                               |                     |                            |
| Norovirus                          | 206                     | 41.9                          | 5902                | 73.9                       |
| <i>Cryptosporidium</i> spp.        | 29                      | 5.9                           | 102                 | 1.3                        |
| <i>Giardia</i> spp.                | 21                      | 4.3                           | 111                 | 1.4                        |
| <i>Campylobacter</i> spp.          | 20                      | 4.1                           | 54                  | 0.7                        |
| <i>Clostridium perfringens</i>     | 13                      | 2.6                           | 87                  | 1.1                        |
| <i>Salmonella</i> spp.             | 8                       | 1.6                           | 141                 | 1.8                        |
| VTEC/STEC                          | 6                       | 1.2                           | 13                  | 0.2                        |
| <i>Shigella</i> spp.               | 6                       | 1.2                           | 24                  | 0.3                        |
| Rotavirus                          | 5                       | 1.0                           | 69                  | 0.9                        |
| <i>Salmonella typhi</i>            | 5                       | 1.0                           | 17                  | 0.2                        |
| <i>Yersinia</i> spp.               | 3                       | 0.6                           | 15                  | 0.2                        |
| Histamine (scombroid)              | 2                       | 0.4                           | 8                   | 0.1                        |
| <i>Staphylococcus aureus</i>       | 2                       | 0.4                           | 6                   | 0.1                        |
| <i>Bacillus cereus</i>             | 1                       | 0.2                           | 51                  | 0.6                        |
| Ciguatera fish poisoning           | 1                       | 0.2                           | 2                   | 0.0                        |
| Toxic shellfish poisoning          | 1                       | 0.2                           | 2                   | 0.0                        |
| <i>Vibrio parahaemolyticus</i>     | 1                       | 0.2                           | 11                  | 0.1                        |
| Unidentified pathogen <sup>1</sup> | 147                     | 29.9                          | 1206                | 15.1                       |
| <b>Total enteric</b>               | <b>477</b>              | <b>97.0</b>                   | <b>7821</b>         | <b>97.9</b>                |
| <b><i>Non-enteric</i></b>          |                         |                               |                     |                            |
| <i>Mycobacterium tuberculosis</i>  | 3                       | 0.6                           | 29                  | 0.4                        |
| <i>Influenza</i> spp.              | 2                       | 0.4                           | 95                  | 1.2                        |
| Measles                            | 2                       | 0.4                           | 7                   | 0.1                        |
| Carbon monoxide                    | 1                       | 0.2                           | 4                   | 0.1                        |
| Chlorine                           | 1                       | 0.2                           | 2                   | 0.0                        |
| Group A <i>Streptococcus</i>       | 1                       | 0.2                           | 8                   | 0.1                        |
| Hepatitis B                        | 1                       | 0.2                           | 3                   | 0.0                        |
| <i>Legionella longbeachae</i>      | 1                       | 0.2                           | 9                   | 0.1                        |
| Methyl bromide                     | 1                       | 0.2                           | 4                   | 0.1                        |
| Mumps                              | 1                       | 0.2                           | 4                   | 0.1                        |
| <i>Mycobacterium bovis</i>         | 1                       | 0.2                           | 2                   | 0.0                        |
| <b>Total non-enteric</b>           | <b>15</b>               | <b>3.0</b>                    | <b>167</b>          | <b>2.1</b>                 |

<sup>1</sup> All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

**Table 4: Outbreak type by agent type, 2007**

| Agent type                        | Outbreak Type     |                   |                    |                  |                   |                  |                  |                  | Total      |
|-----------------------------------|-------------------|-------------------|--------------------|------------------|-------------------|------------------|------------------|------------------|------------|
|                                   | CEvt <sup>1</sup> | CDsp <sup>2</sup> | CSite <sup>3</sup> | Com <sup>4</sup> | Inst <sup>5</sup> | Hse <sup>6</sup> | Oth <sup>7</sup> | Unk <sup>8</sup> |            |
| <b>Enteric</b>                    |                   |                   |                    |                  |                   |                  |                  |                  |            |
| Norovirus                         | 23                | 1                 | 2                  | 5                | 145               | 24               | 2                | 4                | 206        |
| <i>Cryptosporidium</i> spp.       | 6                 | 0                 | 4                  | 0                | 2                 | 17               | 0                | 0                | 29         |
| <i>Giardia</i> spp.               | 1                 | 0                 | 1                  | 3                | 2                 | 14               | 0                | 0                | 21         |
| <i>Campylobacter</i> spp.         | 12                | 0                 | 0                  | 0                | 1                 | 5                | 0                | 2                | 20         |
| <i>Clostridium perfringens</i>    | 11                | 0                 | 1                  | 0                | 0                 | 1                | 0                | 0                | 13         |
| <i>Salmonella</i> spp.            | 3                 | 3                 | 0                  | 0                | 0                 | 0                | 2                | 0                | 8          |
| VTEC/STEC                         | 2                 | 1                 | 0                  | 0                | 0                 | 3                | 0                | 0                | 6          |
| <i>Shigella</i> spp.              | 1                 | 0                 | 0                  | 0                | 0                 | 5                | 0                | 0                | 6          |
| Rotavirus                         | 1                 | 0                 | 0                  | 0                | 4                 | 0                | 0                | 0                | 5          |
| <i>Salmonella typhi</i>           | 3                 | 1                 | 0                  | 0                | 0                 | 0                | 1                | 0                | 5          |
| <i>Yersinia</i> spp.              | 0                 | 1                 | 1                  | 0                | 1                 | 0                | 0                | 0                | 3          |
| Histamine (scombroid)             | 1                 | 0                 | 1                  | 0                | 0                 | 0                | 0                | 0                | 2          |
| <i>Staphylococcus aureus</i>      | 2                 | 0                 | 0                  | 0                | 0                 | 0                | 0                | 0                | 2          |
| <i>Bacillus cereus</i>            | 1                 | 0                 | 0                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Ciguatera fish poisoning          | 0                 | 0                 | 0                  | 0                | 0                 | 1                | 0                | 0                | 1          |
| Toxic shellfish poisoning         | 0                 | 0                 | 1                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| <i>Vibrio parahaemolyticus</i>    | 0                 | 0                 | 1                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Unidentified pathogen             | 45                | 3                 | 6                  | 2                | 51                | 29               | 0                | 11               | 147        |
| <b>Total enteric</b>              | <b>112</b>        | <b>10</b>         | <b>18</b>          | <b>10</b>        | <b>206</b>        | <b>99</b>        | <b>5</b>         | <b>17</b>        | <b>477</b> |
| <b>Non-enteric</b>                |                   |                   |                    |                  |                   |                  |                  |                  |            |
| <i>Mycobacterium tuberculosis</i> | 0                 | 0                 | 0                  | 2                | 0                 | 0                | 1                | 0                | 3          |
| Influenza spp.                    | 0                 | 0                 | 0                  | 0                | 1                 | 0                | 0                | 1                | 2          |
| Measles                           | 0                 | 0                 | 0                  | 0                | 0                 | 2                | 0                | 0                | 2          |
| Carbon monoxide                   | 0                 | 0                 | 1                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Chlorine                          | 1                 | 0                 | 0                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Group A <i>Streptococcus</i>      | 0                 | 0                 | 0                  | 0                | 1                 | 0                | 0                | 0                | 1          |
| Hepatitis B                       | 0                 | 0                 | 0                  | 0                | 0                 | 0                | 1                | 0                | 1          |
| <i>Legionella longbeachae</i>     | 0                 | 0                 | 1                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Methyl bromide                    | 1                 | 0                 | 0                  | 0                | 0                 | 0                | 0                | 0                | 1          |
| Mumps                             | 0                 | 0                 | 0                  | 0                | 1                 | 0                | 0                | 0                | 1          |
| <i>Mycobacterium bovis</i>        | 0                 | 0                 | 0                  | 1                | 0                 | 0                | 0                | 0                | 1          |
| <b>Total non-enteric</b>          | <b>2</b>          | <b>0</b>          | <b>2</b>           | <b>3</b>         | <b>3</b>          | <b>2</b>         | <b>2</b>         | <b>1</b>         | <b>15</b>  |
| <b>Total outbreaks</b>            | <b>114</b>        | <b>10</b>         | <b>20</b>          | <b>13</b>        | <b>209</b>        | <b>101</b>       | <b>7</b>         | <b>18</b>        | <b>492</b> |

- 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. Morbidity and mortality

There were 57 (11.6%) outbreaks reported in 2007 that involved the hospitalisation of cases. A total of 193 outbreak associated cases were hospitalised. There were ten times more hospitalised cases for outbreaks due to enteric agents (176) compared to non-enteric agents (17). However, a higher percentage of cases associated with non-enteric outbreaks were hospitalised compared to enteric outbreaks (10.2% versus 2.3%) (see Table 5). The enteric agent with the highest proportion of hospitalised cases was *Salmonella typhi* (82.4%), followed by verotoxin producing *Escherichia coli* (VTEC) (30.8%), *Vibrio parahaemolyticus* (27.3%) and *Shigella* (20.8%).

There were eleven deaths associated with outbreaks in 2007; all but one of these were due to norovirus (10 deaths). The remaining death was linked to an outbreak of *Influenza* in Wellington. All of the fatalities related to outbreaks in residents of rest homes or hospitals with continuing care.

### 3.6. Outbreak setting

The most common outbreak setting was a rest or retirement home, which was recorded in 130 (26.4%) outbreaks with 3695 (46.3%) associated cases (see Table 6). Other common institutional settings were continuing care hospitals (63 outbreaks), childcare centres (25) and acute care hospitals (23). Commercial food operators were a common outbreak setting, which included restaurants/cafés (41 outbreaks), takeaway outlets (26), caterers (6), other food outlet (2) and supermarkets/delicatessens (1). Approximately one-fifth of all outbreaks occurred in the home (96 outbreaks). The setting was unknown in 83 (16.9%) outbreaks.

**Table 5: Hospitalised outbreak cases and total outbreak cases by agent type, 2007**

| Agent type                         | No. of hospitalised cases <sup>1</sup> | No. of total cases | % of cases hospitalised (n=7988) |
|------------------------------------|--|--------------------|----------------------------------|
| <b><i>Enteric</i></b>              |  |                    |                                  |
| Norovirus                          | 129                                    | 5902               | 2.2                              |
| <i>Salmonella typhi</i>            | 14                                     | 17                 | 82.4                             |
| <i>Salmonella</i> spp.             | 9                                      | 141                | 6.4                              |
| <i>Shigella</i> spp.               | 5                                      | 24                 | 20.8                             |
| VTEC/STEC                          | 4                                      | 13                 | 30.8                             |
| <i>Vibrio parahaemolyticus</i>     | 3                                      | 11                 | 27.3                             |
| <i>Campylobacter</i> spp.          | 1                                      | 54                 | 1.9                              |
| Rotavirus                          | 1                                      | 69                 | 1.4                              |
| <i>Cryptosporidium</i> spp.        | 0                                      | 102                | 0.0                              |
| <i>Bacillus cereus</i>             | 0                                      | 51                 | 0.0                              |
| Ciguatera fish poisoning           | 0                                      | 2                  | 0.0                              |
| <i>Clostridium perfringens</i>     | 0                                      | 87                 | 0.0                              |
| <i>Giardia</i>                     | 0                                      | 111                | 0.0                              |
| Histamine (scombroid)              | 0                                      | 8                  | 0.0                              |
| <i>Staphylococcus aureus</i>       | 0                                      | 6                  | 0.0                              |
| Toxic shellfish poisoning          | 0                                      | 2                  | 0.0                              |
| <i>Yersinia</i> spp.               | 0                                      | 15                 | 0.0                              |
| Unidentified pathogen <sup>2</sup> | 10                                     | 1206               | 0.8                              |
| <b>Total enteric</b>               | <b>176</b>                             | <b>7821</b>        | <b>2.3</b>                       |
| <b><i>Non-enteric</i></b>          |  |                    |                                  |
| <i>Mycobacterium tuberculosis</i>  | 7                                      | 29                 | 24.1                             |
| Measles                            | 3                                      | 7                  | 42.9                             |
| <i>Legionella longbeachae</i>      | 3                                      | 9                  | 33.3                             |
| Chlorine                           | 2                                      | 2                  | 100.0                            |
| <i>Mycobacterium bovis</i>         | 1                                      | 2                  | 50.0                             |
| <i>Influenza</i> spp.              | 1                                      | 95                 | 1.1                              |
| Carbon monoxide                    | 0                                      | 4                  | 0.0                              |
| Group A <i>Streptococcus</i>       | 0                                      | 8                  | 0.0                              |
| Hepatitis B                        | 0                                      | 3                  | 0.0                              |
| Methyl bromide                     | 0                                      | 4                  | 0.0                              |
| Mumps                              | 0                                      | 4                  | 0.0                              |
| <b>Total non-enteric</b>           | <b>17</b>                              | <b>167</b>         | <b>10.2</b>                      |
| <b>Total hospitalisations</b>      | <b>193</b>                             | <b>7988</b>        | <b>2.4</b>                       |

1 This information was recorded for 77.2% (380/492) of outbreaks, relating to 70.0% (5429/7988) of cases

2 All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

**Table 6: Outbreaks and associated cases by setting of exposure/transmission, 2007**

| <b>Outbreak setting</b>                 | <b>No. of outbreaks<sup>1</sup></b> | <b>% of total outbreaks (n=492)</b> | <b>No. of cases<sup>1</sup></b> | <b>% of total cases (n=7988)</b> |
|---|-------------------------------------|-------------------------------------|---------------------------------|----------------------------------|
| <b><i>Commercial food operators</i></b> |                                     |                                     |                                 |                                  |
| Restaurant/Café                         | 41                                  | 8.3                                 | 406                             | 5.1                              |
| Takeaway                                | 26                                  | 5.3                                 | 164                             | 2.1                              |
| Caterer                                 | 6                                   | 1.2                                 | 217                             | 2.7                              |
| Other food outlet                       | 2                                   | 0.4                                 | 12                              | 0.2                              |
| Supermarket/Deli                        | 1                                   | 0.2                                 | 4                               | 0.1                              |
| <b><i>Institutions</i></b>              |                                     |                                     |                                 |                                  |
| Rest/Retirement Home                    | 130                                 | 26.4                                | 3695                            | 46.3                             |
| Hospital (continuing care)              | 63                                  | 12.8                                | 2122                            | 26.6                             |
| Hospital (acute care)                   | 23                                  | 4.7                                 | 954                             | 11.9                             |
| Childcare centre                        | 25                                  | 5.1                                 | 387                             | 4.8                              |
| Camp                                    | 9                                   | 1.8                                 | 458                             | 5.7                              |
| School                                  | 3                                   | 0.6                                 | 139                             | 1.7                              |
| Hotel/Motel                             | 2                                   | 0.4                                 | 12                              | 0.2                              |
| Prison                                  | 1                                   | 0.2                                 | 55                              | 0.7                              |
| Hostel/Boarding house                   | 1                                   | 0.2                                 | 4                               | 0.1                              |
| <b><i>Community</i></b>                 |                                     |                                     |                                 |                                  |
| Community/Church gathering              | 5                                   | 1.0                                 | 80                              | 1.0                              |
| Swimming/Spa pool                       | 4                                   | 0.8                                 | 10                              | 0.1                              |
| Tangi                                   | 1                                   | 0.2                                 | 2                               | 0.0                              |
| <b><i>Workplace</i></b>                 |                                     |                                     |                                 |                                  |
| Workplace                               | 6                                   | 1.2                                 | 32                              | 0.4                              |
| Farm                                    | 7                                   | 1.4                                 | 32                              | 0.4                              |
| <b><i>Home</i></b>                      | <b>96</b>                           | <b>19.5</b>                         | <b>541</b>                      | <b>6.8</b>                       |
| <b><i>Other setting</i></b>             | <b>24</b>                           | <b>4.9</b>                          | <b>330</b>                      | <b>4.1</b>                       |
| <b><i>Unknown setting</i></b>           | <b>83</b>                           | <b>16.9</b>                         | <b>235</b>                      | <b>2.9</b>                       |

1 More than one setting was recorded for some outbreaks

### 3.7. Mode of transmission

In 2007, the most common reported mode of transmission was person-to-person (66.3%, 326/492 outbreaks), followed by environmental (18.5%, 91/492) and foodborne (15.0%, 74/492) (see Table 7). Person-to-person transmission also accounted for the highest percentage of cases (87.9%, 7018/7988). Environmental mode of transmission had the second highest percentage of cases (32.3%, 2582/7988). The mode of transmission was unknown in 97 (19.7%) outbreaks.

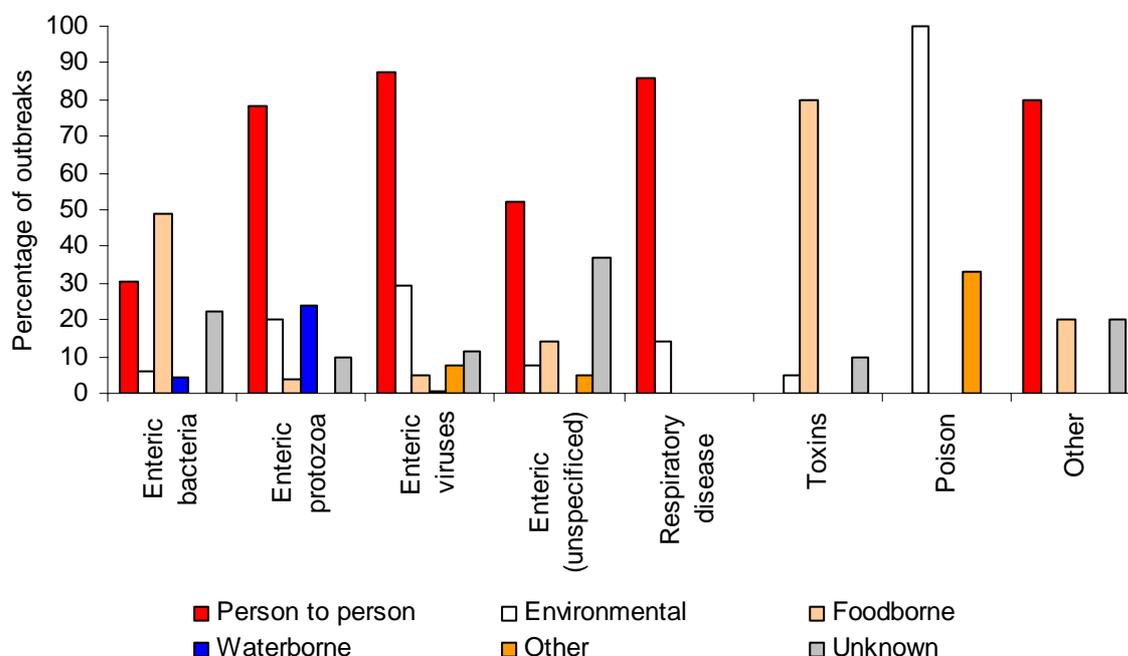
**Table 7: Outbreaks and associated cases by mode of transmission, 2007**

| Transmission mode | No. of outbreaks <sup>1</sup> | % of total outbreaks (n=492) | No. of cases <sup>1</sup> | % of total cases (n=7988) |
|-------------------|-------------------------------|------------------------------|---------------------------|---------------------------|
| Person-to-person  | 326                           | 66.3                         | 7018                      | 87.9                      |
| Environmental     | 91                            | 18.5                         | 2582                      | 32.3                      |
| Foodborne         | 74                            | 15.0                         | 611                       | 7.6                       |
| Waterborne        | 15                            | 3.0                          | 205                       | 2.6                       |
| Zoonotic          | 7                             | 1.4                          | 35                        | 0.4                       |
| Sexual contact    | 2                             | 0.4                          | 6                         | 0.1                       |
| Other             | 24                            | 4.9                          | 709                       | 8.9                       |
| Unknown           | 97                            | 19.7                         | 397                       | 5.0                       |

<sup>1</sup> More than one mode of transmission was recorded for 124 outbreaks with 3425 associated cases.

Person-to-person transmission was the most common mode of transmission for enteric protozoa (78.0%, 39/50), enteric viruses (87.7%, 185/211 outbreaks), unspecified enteric pathogens (52.4%, 77/147) and respiratory diseases (85.7%, 6/7) (see figure 2). Person-to-person transmission also contributed substantially to enteric bacteria outbreaks (30.6%, 15/49). Environmental transmission was an important contributing factor in 29.4% (62/211) of outbreaks due to enteric viruses and was also involved in one respiratory outbreak due to *Legionella longbeachae*. Foodborne transmission was the principal mode of transmission for enteric bacteria (49.0%, 24/49) and toxins (85.0%, 17/20).

**Figure 2: Percentage of outbreaks by agent type and mode of transmission<sup>1</sup>, 2007**



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

### 3.8. Foodborne outbreaks

#### *Causal agent*

There were 74 foodborne outbreaks reported in 2007, 21 (28.4%) of which were not linked to a specific pathogen (see Table 8). Specific pathogens most commonly associated with foodborne outbreaks included *Campylobacter* (12 outbreaks), *C. perfringens* (12), norovirus (10) and *Salmonella* (7). Enteric bacteria (*Campylobacter*, *Salmonella*, *Escherichia*, *Vibrio* and *Yersinia*) were implicated in 31.1% (23/74) of foodborne outbreaks, enteric toxins (*Clostridium*, histamine, *Bacillus cereus*, *Staphylococcus* and toxic shellfish poisoning) in 23.0% (17/74), enteric viruses (norovirus) in 13.5% (10/74), and enteric protozoa (*Cryptosporidium* and *Giardia*) in 2.7% (2/74).

**Table 8: Foodborne outbreaks and associated cases by agent type, 2007**

| Agent type                         | No. of outbreaks | % of outbreaks (n=74) | No. of cases | % of cases (n=611) |
|------------------------------------|------------------|-----------------------|--------------|--------------------|
| <i>Campylobacter</i> spp.          | 12               | 16.2                  | 35           | 5.7                |
| <i>Clostridium perfringens</i>     | 12               | 16.2                  | 83           | 13.6               |
| Norovirus                          | 10               | 13.5                  | 240          | 39.3               |
| <i>Salmonella</i> spp.             | 7                | 9.5                   | 56           | 9.2                |
| VTEC/STEC                          | 2                | 2.7                   | 4            | 0.7                |
| Histamine (scombroid)              | 2                | 2.7                   | 8            | 1.3                |
| <i>Cryptosporidium</i> spp.        | 1                | 1.4                   | 6            | 1.0                |
| <i>Giardia</i>                     | 1                | 1.4                   | 6            | 1.0                |
| <i>Salmonella typhi</i>            | 1                | 1.4                   | 3            | 0.5                |
| <i>Staphylococcus aureus</i>       | 1                | 1.4                   | 2            | 0.3                |
| <i>Bacillus cereus</i>             | 1                | 1.4                   | 51           | 8.3                |
| Toxic shellfish poisoning          | 1                | 1.4                   | 2            | 0.3                |
| <i>Vibrio parahaemolyticus</i>     | 1                | 1.4                   | 11           | 1.8                |
| <i>Yersinia</i> spp.               | 1                | 1.4                   | 7            | 1.1                |
| Unidentified pathogen <sup>1</sup> | 21               | 28.4                  | 97           | 15.9               |
| <b>Total</b>                       | <b>74</b>        | <b>100.0</b>          | <b>611</b>   | <b>100.0</b>       |

1 All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

#### *Vehicle / source implicated*

Of the 74 foodborne outbreaks in 2007, 4 (5.4%) outbreaks had a definite source identified and 55 (74.3%) had a suspected source identified. The actual definite or suspected sources were listed in 96.7% (57/59) of these outbreaks. No source was identified for 14 outbreaks, and for one outbreak the source was recorded as unknown. The main foods implicated in these outbreaks were poultry (19 outbreaks), other meat (17) and fresh produce (12) (see Table 9). The highest number of cases was associated with outbreaks linked to fresh produce (241 cases) and rice, noodles or pasta (132).

Of the four outbreaks where a definite source was identified, one outbreak due to histamine fish poisoning occurred after cases purchased contaminated fish cakes from a general store and one outbreak due to *Salmonella* Montevideo was linked to a premise where all 10 of the reported cases had eaten a chicken, lamb or falafel kebab. The remaining two outbreaks were both linked to a sandwich premise where a food handler was infected with the same genotype of norovirus as the cases, although no specific food item was recorded for these outbreaks.

The largest reported foodborne outbreak occurred at a school sports tournament where 88 cases were infected by norovirus. The likely source of the outbreak was a rice/couscous salad that had been contaminated by a pre-symptomatic food handler. The initial infection was followed by secondary person-to-person spread of the virus.

**Table 9: Foodborne outbreaks and associated cases by implicated vehicle / source, 2007**

| Implicated vehicle / source          | No. of outbreaks <sup>1</sup> | % of outbreaks (n=74) | No. of cases | % of cases (n=611) |
|--------------------------------------|-------------------------------|-----------------------|--------------|--------------------|
| Poultry                              | 19                            | 25.7                  | 97           | 15.9               |
| Meat (lamb, beef, pork)              | 16                            | 21.6                  | 111          | 18.2               |
| Fresh produce                        | 12                            | 16.2                  | 241          | 39.4               |
| Rice/noodles/pasta                   | 6                             | 8.1                   | 132          | 21.6               |
| Roast meal                           | 6                             | 8.1                   | 65           | 10.6               |
| Kebab                                | 6                             | 8.1                   | 25           | 4.1                |
| Shellfish                            | 4                             | 5.4                   | 51           | 8.3                |
| Processed meat <sup>2</sup>          | 4                             | 5.4                   | 14           | 2.3                |
| Fish                                 | 3                             | 4.1                   | 19           | 3.1                |
| Eggs                                 | 2                             | 2.7                   | 22           | 3.6                |
| Pies                                 | 2                             | 2.7                   | 6            | 1.0                |
| Pulses/Lentils                       | 1                             | 1.4                   | 51           | 8.3                |
| Dairy                                | 1                             | 1.4                   | 6            | 1.0                |
| Sandwich/burger                      | 1                             | 1.4                   | 2            | 0.3                |
| Infected food handler                | 9                             | 12.2                  | 144          | 23.6               |
| Unspecified food source <sup>3</sup> | 6                             | 8.1                   | 50           | 8.2                |
| No vehicle / source identified       | 15                            | 20.3                  | 74           | 12.1               |

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

2 Processed meats included savalloys, cheerios, hot dogs and bacon

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

Foodborne outbreaks with poultry as a possible vehicle or source (19 outbreaks) were often associated with *Campylobacter* (5 outbreaks) followed by *Clostridium perfringens* (3) and *Salmonella* (3) (see Table 10). Foodborne outbreaks with meat (other than poultry) as a possible vehicle or source (17 outbreaks) were most commonly associated with *Clostridium perfringens* (7). There were six outbreaks in which fish or shellfish were implicated, these were linked to histamine poisoning (2), norovirus (1), toxic shellfish poisoning (1) and *Vibrio parahaemolyticus* (1) (one was linked to an unidentified pathogen). An infected food handler was implicated in the nine foodborne outbreaks of which four were associated with norovirus.

**Table 10: Foodborne outbreaks by causal agent and implicated vehicle / source, 2007**

| <b>Implicated vehicle / source<sup>1</sup></b> | <i>Campylobacter</i> spp. | <i>Clostridium perfringens</i> | Norovirus | <i>Salmonella</i> spp. | Other causal agent <sup>2</sup> | Unidentified pathogen <sup>3</sup> | Total number of outbreaks |
|--|---------------------------|--------------------------------|-----------|------------------------|---------------------------------|------------------------------------|---------------------------|
| Poultry  | 5                         | 3                              | 2         | 3                      | 1                               | 5                                  | 19                        |
| Meat (lamb, beef, pork)                        | 1                         | 7                              | 0         | 1                      | 1                               | 6                                  | 16                        |
| Fresh produce                                  | 1                         | 2                              | 2         | 2                      | 2                               | 3                                  | 12                        |
| Rice/noodles/pasta                             | 0                         | 1                              | 1         | 1                      | 1                               | 2                                  | 6                         |
| Kebab  | 1                         | 3                              | 0         | 1                      | 0                               | 1                                  | 6                         |
| Shellfish                                      | 0                         | 0                              | 1         | 0                      | 2                               | 1                                  | 4                         |
| Processed meat <sup>4</sup>                    | 0                         | 0                              | 0         | 1                      | 1                               | 2                                  | 4                         |
| Fish   | 0                         | 0                              | 0         | 0                      | 3                               | 0                                  | 3                         |
| Eggs   | 0                         | 0                              | 0         | 1                      | 0                               | 1                                  | 2                         |
| Pies   | 0                         | 0                              | 0         | 0                      | 0                               | 2                                  | 2                         |
| Pulses/Lentils                                 | 0                         | 0                              | 0         | 0                      | 1                               | 0                                  | 1                         |
| Dairy  | 0                         | 0                              | 0         | 0                      | 1                               | 0                                  | 1                         |
| Sandwich/burger                                | 0                         | 0                              | 0         | 0                      | 0                               | 1                                  | 1                         |
| Infected food handler                          | 1                         | 0                              | 4         | 1                      | 1                               | 1                                  | 9                         |
| Unspecified food source <sup>5</sup>           | 1                         | 0                              | 2         | 0                      | 1                               | 2                                  | 6                         |
| No vehicle / source identified                 | 3                         | 1                              | 0         | 4                      | 1                               | 6                                  | 15                        |
| <b>Total</b>                                   | <b>12</b>                 | <b>12</b>                      | <b>10</b> | <b>7</b>               | <b>12</b>                       | <b>21</b>                          | <b>74</b>                 |

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

2 Includes all causal agents listed in table 8 that were implicated in less than three foodborne outbreaks

3 All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

4 Processed meats included savalloys, cheerios, hot dogs and bacon

5 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 time and temperature abuses (47.3%, 35/74) such as inadequate cooling or refrigeration, improper hot holding and inadequate reheating of previously cooked food (see Table 10). Contamination of food either via cross-contamination with other food or via an infected food handler, were also common contributing factors (32.4%, 24/74). Factors contributing to foodborne outbreaks were unknown in 24 outbreaks (32.4%).

**Table 11: Foodborne outbreaks by contributing factor, 2007**

| <b>Contributing factor</b>                     | <b>No. of outbreaks<sup>1</sup></b> | <b>% of foodborne outbreaks (n=74)</b> |
|--|-------------------------------------|--|
| <b><i>Time/temperature abuse</i></b>           | <b>35</b>                           | <b>47.3</b>                            |
| Inadequate cooling or refrigeration            | 19                                  | 25.7                                   |
| Improper hot holding                           | 18                                  | 24.3                                   |
| Inadequate reheating of previously cooked food | 11                                  | 14.9                                   |
| Improper storage prior to preparation          | 9                                   | 12.2                                   |
| Undercooking                                   | 7                                   | 9.5                                    |
| Preparation too far in advance                 | 5                                   | 6.8                                    |
| Inadequate thawing                             | 2                                   | 2.7                                    |
| <b><i>Contamination of food</i></b>            | <b>24</b>                           | <b>32.4</b>                            |
| Cross contamination                            | 17                                  | 23.0                                   |
| Contamination from an infected food handler    | 9                                   | 12.2                                   |
| Chemical contamination                         | 0                                   | 0.0                                    |
| <b><i>Unsafe sources</i></b>                   | <b>4</b>                            | <b>5.4</b>                             |
| Use of ingredients from unsafe sources         | 3                                   | 4.1                                    |
| Consumption of raw food                        | 1                                   | 1.4                                    |
| Use of unpasteurised milk in food preparation  | 1                                   | 1.4                                    |
| Use of untreated water in food preparation     | 0                                   | 0.0                                    |
| <b><i>Other factors</i></b>                    | <b>8</b>                            | <b>10.8</b>                            |
| <b><i>Unknown factors</i></b>                  | <b>24</b>                           | <b>32.4</b>                            |

1 More than one contributing factor was recorded for some outbreaks

### 3.9. Person-to-person outbreaks

#### *Causal agents*

There were 326 person-to-person outbreaks with 7018 associated cases in 2007, 77 (23.6%) of which were not linked to a specific pathogen (see Table 22). The most common causal agent was norovirus, which was recorded in 55.2% (180/326) of person-to-person outbreaks involving 80.4% (5643/7018) of cases. Other common pathogens included *Cryptosporidium* (6.7%) and *Giardia* (5.2%). Enteric viruses (norovirus, and rotavirus) were implicated in 56.7% (185/326) of person-to-person outbreaks, enteric protozoa (*Cryptosporidium* and *Giardia*) in 12.0% (39/326), enteric bacteria (*Campylobacter*, *Shigella*, VTEC/STEC and *Yersinia*) in 4.6% (15/326), respiratory pathogens (*Mycobacterium* and *Influenza*) in 0.9% (3/326) and other casual agents (Group A *Streptococcus*, mumps and measles) in 1.8% (6/326).

The two largest person-to-person outbreaks were attributed to norovirus and occurred at Princess Margaret Hospital (205 cases) and Christchurch Public Hospital (191) in Canterbury. Both outbreaks occurred near the beginning of October. The largest non-enteric outbreak was attributed to influenza A and involved 88 cases. The outbreak occurred at an adventure school near Wellington among students aged between 5 and 11 years.

**Table 12: Person-to-person outbreaks and associated cases by agent type, 2007**

| Agent type                         | No. of outbreaks | % of outbreaks (n=326) | No. of cases | % of cases (n=7018) |
|------------------------------------|------------------|------------------------|--------------|---------------------|
| Norovirus                          | 180              | 55.2                   | 5643         | 80.4                |
| <i>Cryptosporidium</i> spp.        | 22               | 6.7                    | 85           | 13.3                |
| <i>Giardia</i>                     | 17               | 5.2                    | 91           | 1.2                 |
| <i>Campylobacter</i> spp.          | 5                | 1.5                    | 15           | 1.3                 |
| <i>Shigella</i> spp.               | 5                | 1.5                    | 20           | 0.2                 |
| Rotavirus                          | 5                | 1.5                    | 69           | 0.3                 |
| VTEC/STEC                          | 3                | 0.9                    | 7            | 1.0                 |
| <i>Mycobacterium tuberculosis</i>  | 3                | 0.9                    | 29           | 0.1                 |
| <i>Yersinia</i> spp.               | 2                | 0.6                    | 8            | 0.4                 |
| <i>Influenza</i> spp.              | 2                | 0.6                    | 95           | 0.1                 |
| Measles                            | 2                | 0.6                    | 7            | 1.4                 |
| <i>Mycobacterium bovis</i>         | 1                | 0.3                    | 2            | 0.1                 |
| Group A <i>Streptococcus</i>       | 1                | 0.3                    | 8            | 0.0                 |
| Mumps                              | 1                | 0.3                    | 4            | 0.1                 |
| Unidentified pathogen <sup>1</sup> | 77               | 23.6                   | 935          | 0.1                 |
| <b>Total</b>                       | <b>326</b>       | <b>100.0</b>           | <b>7018</b>  | <b>100.0</b>        |

1 All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

### *Contributing factors*

Exposure to infected people was the primary contributing factor reported for 93.6% (305/326) of person-to-person outbreaks reported in 2007. Other contributing factors reported included poor hygiene of cases (9.5%, 31/326), excessively crowded living conditions (2.1%, 7/326) and inadequate vaccination coverage (0.9%, 3/326).

### **3.10. Waterborne outbreaks**

#### *Causal agents*

There were 15 waterborne outbreaks with 205 associated cases reported in 2007. The most commonly reported pathogen was *Giardia* (7 outbreaks) followed by *Cryptosporidium* (5) (see Table 12). Enteric protozoa (*Giardia* and *Cryptosporidium*) were implicated in 80.0% (12/15) of waterborne outbreaks and enteric bacteria (*Campylobacter*) in 13.3% (2/15). An enteric virus, norovirus, was reported for one (6.7%) waterborne outbreak in which there were several suspected sources including, polluted drinking water, inadequate maintenance of a swimming pool and temperature abuse of food, although the pathogen was not isolated from any suspected source.

**Table 13: Waterborne outbreaks and associated cases by agent type, 2007**

| Agent type           | No. of outbreaks | % of outbreaks (n=15) | No. of cases | % of cases (n=205) |
|----------------------|------------------|-----------------------|--------------|--------------------|
| Giardia              | 7                | 46.7                  | 32           | 15.6               |
| Cryptosporidium spp. | 5                | 33.3                  | 16           | 7.8                |
| Campylobacter spp.   | 2                | 13.3                  | 5            | 2.4                |
| Norovirus            | 1                | 6.7                   | 152          | 74.1               |
| <b>Total</b>         | <b>15</b>        | <b>100.0</b>          | <b>205</b>   | <b>100.0</b>       |

*Contributing factors*

The most common contributing factor linked to waterborne outbreaks was an untreated water supply (12 outbreaks) followed by contamination of a water source (3) (see Table 13).

**Table 14: Waterborne outbreaks by contributing factor, 2007**

| Contributing factor                           | No. of outbreaks <sup>1</sup> | % of total outbreaks (n=15) |
|---|-------------------------------|-----------------------------|
| Untreated water supply                        | 12                            | 80.0                        |
| Contamination of water source                 | 3                             | 20.0                        |
| Treatment process failure                     | 1                             | 6.7                         |
| Contamination of reservoir(s)/holding tank(s) | 1                             | 6.7                         |
| Post treatment contamination                  | 1                             | 6.7                         |
| Other factors                                 | 1                             | 6.7                         |
| Unknown factors                               | 2                             | 13.3                        |

<sup>1</sup> More than one contributing factor was recorded for some outbreaks

**3.11. Environmental outbreaks***Causal agents*

There were 91 environmental outbreaks with 2582 associated cases in 2007, 11 (12.1%) of which were not linked to a specific pathogen (see Table 14). The most common causal agent identified in environmental outbreaks was norovirus, which was recorded in 67.0% (61/91) of environmental outbreaks and associated with 90.1% (2327/2582) cases. Enteric viruses (norovirus and rotavirus) were implicated in 68.1% (62/91) of environmental outbreaks, enteric protozoa (*Cryptosporidium*, *Campylobacter*, *Giardia* and *Yersinia*) in 14.3% (13/91), and respiratory pathogens (*L. longbeachae*) in 1.1% (1/91). Carbon monoxide, chlorine and methyl bromide poisoning were each associated with one environmental outbreak.

A definite link through environmental sampling was confirmed for two of the outbreaks. In one outbreak *Legionella longbeachae* was isolated from potting mix that was genetically indistinguishable from that isolated from cases.

**Table 15: Environmental outbreaks and associated cases by agent type, 2007**

| <b>Agent type</b>                  | <b>No. of outbreaks</b> | <b>% of outbreaks (n=91)</b> | <b>No. of cases</b> | <b>% of cases (n=2582)</b> |
|------------------------------------|-------------------------|------------------------------|---------------------|----------------------------|
| Norovirus                          | 61                      | 67.0                         | 2327                | 90.1                       |
| <i>Cryptosporidium</i> spp.        | 8                       | 8.8                          | 38                  | 1.5                        |
| <i>Campylobacter</i> spp.          | 2                       | 2.2                          | 6                   | 0.2                        |
| <i>Giardia</i>                     | 2                       | 2.2                          | 7                   | 0.3                        |
| Carbon monoxide                    | 1                       | 1.1                          | 4                   | 0.2                        |
| Chlorine                           | 1                       | 1.1                          | 2                   | 0.1                        |
| <i>Legionella longbeachae</i>      | 1                       | 1.1                          | 9                   | 0.3                        |
| Methyl bromide                     | 1                       | 1.1                          | 4                   | 0.2                        |
| Rotavirus                          | 1                       | 1.1                          | 21                  | 0.8                        |
| Toxic shellfish poisoning          | 1                       | 1.1                          | 2                   | 0.1                        |
| <i>Yersinia</i> spp.               | 1                       | 1.1                          | 2                   | 0.1                        |
| Unidentified pathogen <sup>1</sup> | 11                      | 12.1                         | 160                 | 6.2                        |
| <b>Total</b>                       | <b>91</b>               | <b>100.0</b>                 | <b>2582</b>         | <b>100.0</b>               |

1 All outbreaks with no pathogen identified in 2007 were classified as gastroenteritis

#### *Contributing factors*

The major contributing factor associated with environmental outbreaks was exposure to a contaminated environment, which was recorded in 92.3% (84/91) of environmental outbreaks. The other contributing factors were exposure to infected animals or animal products (8.8%, 8/91), contaminated or inadequately maintained swimming pools (5.5%, 5/91), and untreated recreational water (3.3%, 3/91).

### 3.12. Zoonotic outbreaks

#### *Causal agents*

There were seven zoonotic outbreaks with 35 associated cases reported in 2007. The most common casual agent identified in zoonotic outbreaks was *Cryptosporidium* which was linked to almost 60% (4/7) of the zoonotic outbreaks and 80% (27/35) of associated cases (see Table 15). Enteric protozoa (*Cryptosporidium* and *Giardia*) were implicated in 71.4% (5/7) of zoonotic outbreaks and enteric bacteria (*Campylobacter* and *Yersinia*) in 28.6% (2/7).

**Table 16: Zoonotic outbreaks and associated cases by agent type, 2007**

| <b>Agent type</b>           | <b>No. of outbreaks</b> | <b>% of outbreaks (n=7)</b> | <b>No. of cases</b> | <b>% of cases (n=35)</b> |
|-----------------------------|-------------------------|-----------------------------|---------------------|--------------------------|
| <i>Cryptosporidium</i> spp. | 4                       | 57.1                        | 27                  | 77.1                     |
| <i>Campylobacter</i>        | 1                       | 14.3                        | 2                   | 5.7                      |
| <i>Giardia</i>              | 1                       | 14.3                        | 4                   | 11.4                     |
| <i>Yersinia</i> spp.        | 1                       | 14.3                        | 2                   | 5.7                      |
| <b>Total</b>                | <b>7</b>                | <b>100.0</b>                | <b>35</b>           | <b>100.0</b>             |

#### *Contributing factors*

Exposure to infected animals or animal products and to infected people was reported as a contributing factor for all zoonotic outbreaks in 2007. Other contributing factors included exposure to contaminated environment (57.1%, 4/7) and untreated water supplies (57.1%, 4/7). The most common settings for zoonotic outbreaks were the home (6 outbreaks) and on a farm (5 outbreaks). For three of the seven zoonotic outbreaks specific animals were implicated as potential source vehicles, these were cows, calves and ducks.

### 3.13. Outbreaks with overseas transmission

There were 7 outbreaks in 2007 with overseas transmission involving 25 cases. Three outbreaks were linked to *Salmonella typhi*, two to *Cryptosporidium* and one each to *Shigella* and *Vibrio parahaemolyticus* (see Table 16). The country most commonly associated with the outbreaks was Samoa (2).

**Table 17: Outbreaks with overseas transmission by country, 2007**

| Agent type                     | Brazil   | China    | Samoa    | Sri Lanka | Thailand | Tonga    | No. of outbreaks |
|--------------------------------|----------|----------|----------|-----------|----------|----------|------------------|
| <i>Cryptosporidium</i> spp.    | 1        | 1        | 0        | 0         | 0        | 0        | 2                |
| <i>Shigella</i> spp.           | 0        | 0        | 0        | 0         | 0        | 1        | 1                |
| <i>Salmonella typhi</i>        | 0        | 0        | 2        | 1         | 0        | 0        | 3                |
| <i>Vibrio parahaemolyticus</i> | 0        | 0        | 0        | 0         | 1        | 0        | 1                |
| <b>Total</b>                   | <b>1</b> | <b>1</b> | <b>2</b> | <b>1</b>  | <b>1</b> | <b>1</b> | <b>7</b>         |

### 3.14. Outbreak recognition, investigation and control

#### *Timeliness of reporting*

For the 472 outbreaks where timeliness data was available, the majority were reported to the PHU within one week of the first onset of illness (56.6%, 267/472), while 33.5% (158/472) of outbreaks were reported between 7 and 30 days (inclusive) after the onset and 4.9% (23/472) of outbreaks were reported between 31 and 60 days after the onset. Twenty-four (5.1%) outbreaks were reported more than 60 days after the first onset of illness.

Reporting delay (time between date of onset of illness in the first case and the report date) varied between different outbreak types (see Table 17). With the exception of unknown outbreak types, the shortest median reporting delay (3.5 days) was associated with a common event, followed by those from institutional outbreaks (5.0) and community-wide outbreaks (6.0). The longest median reporting delay (17.5 days) was observed for outbreaks with a common source dispersed in the community.

**Table 18: Median reporting delay by outbreak type, 2007**

| <b>Outbreak type</b>    | <b>No. of outbreaks<sup>1</sup></b> | <b>Median reporting delay (days)</b> |
|-------------------------|-------------------------------------|--------------------------------------|
| Common event            | 112                                 | 3.5                                  |
| Dispersed common source | 10                                  | 17.5                                 |
| Common site             | 18                                  | 6.5                                  |
| Community wide          | 10                                  | 6.0                                  |
| Institutional           | 201                                 | 5.0                                  |
| Household               | 97                                  | 7.0                                  |
| Other outbreak type     | 7                                   | 14.0                                 |
| Unknown outbreak type   | 17                                  | 1.0                                  |
| <b>Total</b>            | <b>472</b>                          | <b>5.0</b>                           |

1 Outbreaks were excluded if the date of onset of illness in the first case was either missing or incorrectly entered

### *Recognition of outbreaks*

Almost 60% (284/492) of outbreaks were identified when cases had person-to-person contact with other cases. Other frequent means of outbreak recognition included: when there was an increase in disease incidence (42.3%); when cases attended a common event (28.3%) and when cases were linked to a common source (22.4%) (see Table 18). There was more than one means of recognition for 46.3% (228/492) of outbreaks.

**Table 19: Outbreaks by means of recognition, 2007**

| <b>Means of recognition</b>                          | <b>No. of outbreaks<sup>1</sup></b> | <b>% of total outbreaks (n=492)</b> |
|--|-------------------------------------|-------------------------------------|
| Cases had person-to-person contact with other cases  | 284                                 | 57.7                                |
| Increase in disease incidence                        | 208                                 | 42.3                                |
| Cases attended common event                          | 139                                 | 28.3                                |
| Cases linked to common source                        | 110                                 | 22.4                                |
| Common organism type/strain characteristics in cases | 28                                  | 5.7                                 |
| Other means  | 19                                  | 3.9                                 |
| Unknown means  | 4                                   | 0.8                                 |

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

### *Control measures*

Outbreak control measures were known to have been undertaken in 95.8% (452/472) of outbreaks reported in 2007, it was unknown whether control measures were taken in 20 outbreaks. The most common measures undertaken were health education and advice for those working with the source (386 outbreaks), followed by cleaning and disinfection (209) (see Table 19).

**Table 20: Outbreaks by control measures undertaken, 2007**

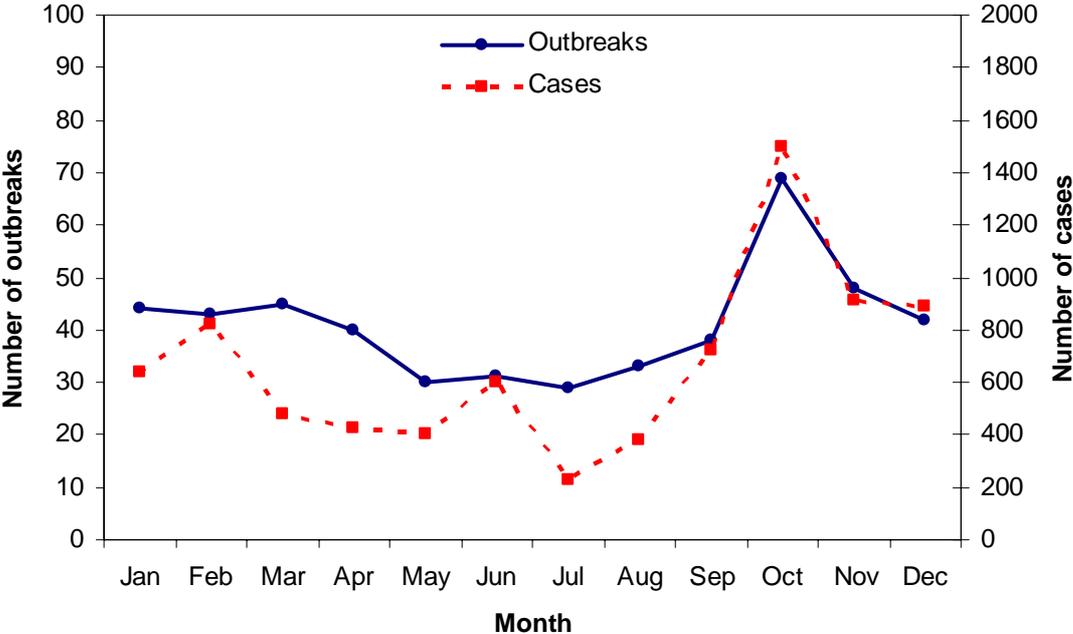
| <b>Outbreak control measure</b>               | <b>No. of outbreaks<sup>1</sup></b> | <b>% of total outbreaks (n=492)</b> |
|---|-------------------------------------|-------------------------------------|
| <b><i>Source</i></b>                          |                                     |                                     |
| Health education and advice                   | 386                                 | 78.5                                |
| Cleaning, disinfection                        | 209                                 | 42.5                                |
| Modification of procedures                    | 182                                 | 37.0                                |
| Isolation                                     | 175                                 | 35.6                                |
| Exclusion                                     | 172                                 | 35.0                                |
| Closure                                       | 112                                 | 22.8                                |
| Health warning                                | 37                                  | 7.5                                 |
| Treatment                                     | 18                                  | 3.7                                 |
| Removal                                       | 6                                   | 1.2                                 |
| <b><i>Vehicle and vector</i></b>              |                                     |                                     |
| Treatment                                     | 3                                   | 0.6                                 |
| Removal                                       | 1                                   | 0.2                                 |
| <b><i>Contacts and potential contacts</i></b> |                                     |                                     |
| Health education and advice                   | 46                                  | 9.3                                 |
| Chemoprophylaxis                              | 6                                   | 1.2                                 |
| Vaccination                                   | 3                                   | 0.6                                 |
| <b><i>Other control measures</i></b>          | <b>54</b>                           | <b>11.0</b>                         |
| <b><i>No control measures</i></b>             | <b>20</b>                           | <b>4.1</b>                          |
| <b><i>Unknown control measures</i></b>        | <b>20</b>                           | <b>4.1</b>                          |

1 More than one control measure was recorded for some outbreaks

**3.15. Summary of trends**

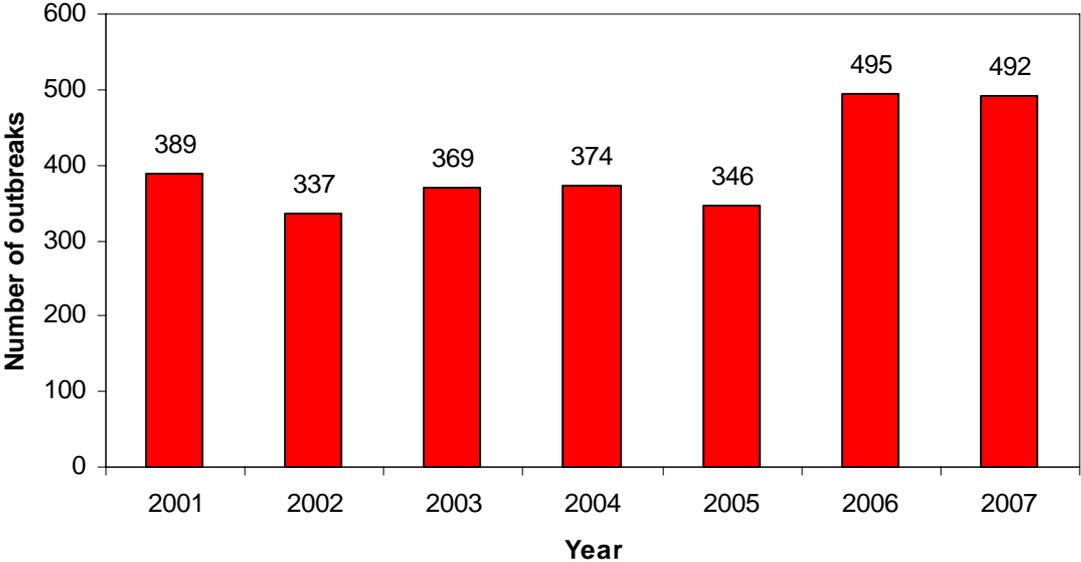
In 2007, the highest number of outbreaks was reported in October (69 outbreaks) followed by November (48) and March (45). The highest number of outbreak related cases also occurred in October (1495 cases) and November (909) (see Figure 3).

**Figure 3: Number of outbreaks and associated cases by month, 2007**



The annual number of outbreaks in 2007 (492) was similar to 2006 (495) and higher than all other years since 2001 (see Figure 4).

**Figure 4: Number of outbreaks by year, 2001-2007**



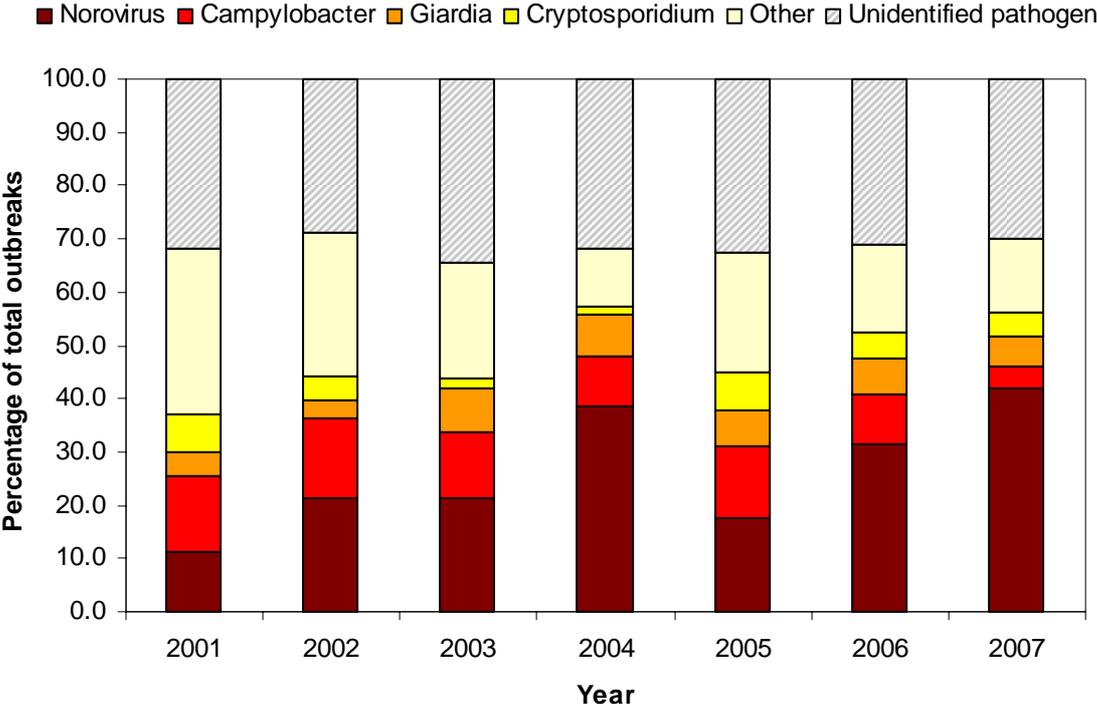
The national annual outbreak rate for 2007 (11.6 outbreaks per 100 000 population) was similar to the rate for 2006 (12.0 per 100 000 population) and greater than the rates for 2001 to 2005. Similarly, the national outbreak case rate of 188.9 cases per 100 000 population in 2007 was significantly higher ( $p < 0.001$ ) compared with the rate of 152.2 in 2006 or 65.2 in 2005.

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 40 (11.6%) in 2005 to 209 (42.5%) in 2007. In 2006 and 2007, 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 casual agent has remained close to 70% (range 65.6% to 71.2%). In 2007, 70.1% (345/492) of outbreaks were linked with an identified agent, the highest level since 2002 (71.2%, 239/336).

From 2002 to 2006 the most common reported casual agent linked to outbreaks was norovirus followed by *Campylobacter* (see Figure 5). The number of norovirus linked outbreaks and associated cases increased markedly between 2005 (61 outbreaks and 1159 cases) and 2006 (156 outbreaks and 3945 cases), this increase continued in 2007 with 206 outbreaks and 5902 cases. In contrast, between 2006 and 2007 the number of outbreaks linked to *Campylobacter* decreased by more than 50% and the number of associated cases by more than 75% (2006: 47 outbreaks and 223 cases; 2007: 20 outbreaks and 54 cases). In 2007 the number of outbreaks linked to *Campylobacter* was overtaken by the number linked to either *Cryptosporidium* (29) or *Giardia* (21).

**Figure 5: Percentage of outbreaks by agent type and year, 2001-2007**



In 2007, the most common outbreak setting was in a rest or retirement home. The home was the second most common setting, although hospitals (both continuing care and acute) had a higher proportion of associated cases. This is similar to 2006, when homes followed by rest homes were the most common settings, and 2004 when rest homes were the most common setting. In 2005, and prior to 2004, restaurants/cafés and the home had been 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 170 to 74, whilst the number of outbreaks linked to environmental transmission increased from 22 to 91. In 2007, person-to-person remained the most common mode of transmission with environmental transmission the second most common mode.

In 2007, seven outbreaks involving 25 cases had overseas transmission. In comparison, 13 outbreaks involving 30 cases had overseas transmission in 2006. Samoa was the country most commonly associated with outbreaks that had overseas transmission (2 outbreaks) in 2007. This differs from 2005 and 2006, when Fiji and India had been the most commonly associated countries.

The median delay between date of onset of illness in the first case and the outbreak report date was calculated as 5.0 days for 2007, this delay has remained constant since 2002.

Health education and advice related to the outbreak source has been the most common control measure from 2001 to 2006, followed by modification of procedures pertaining to the source. In 2007 health education and advice remained the most common control measure however cleaning and disinfection was more commonly reported than modification of procedures. The proportion of outbreaks where it was report that no control measures were undertaken decreased from 27.8% of outbreaks in 2001 to 3.5% in 2005, but has since increased to 4.1% in 2007.

## **GLOSSARY**<sup>3</sup>

### **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**

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**

Outbreak of individuals in the 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 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 that which is external to the individual human host.

---

<sup>3</sup> 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**

Outbreak confined to members of a single household.

**Institutional outbreak**

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.