ANNUAL SUMMARY OF OUTBREAKS IN NEW ZEALAND 2001

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EXECUTIVE SUMMARY

Introduction: This report summarises the results of outbreak surveillance co-ordinated by ESR during 2001.

Methods: The New Zealand outbreak surveillance system provides a system for local PHS to systematic reporting outbreaks using a form and electronic database included with the national surveillance system EpiSurv. This is an active surveillance system with ESR comparing surveillance data from EpiSurv with laboratory data on outbreak associated specimens held by the national reference laboratories.

Results: The main findings for the year 2001 were:

- A total of 389 outbreaks were reported to ESR during 2001.
- The outbreaks involved a total of 2323 cases, 1049 confirmed (according to the case definition reported for the outbreak) and 1274 probable cases. Combining confirmed and probable cases, the average number of cases per outbreak for 2001 was 6.0.
- A total of 78 cases required hospitalisation and two cases died. Both of the deaths were due to meningococcal disease.
- Of the 389 outbreaks reported during 2001, 227 were common source outbreaks (ie, cases linked to a common source of exposure). Of these, 177 were common event outbreaks (ie, exposures occurred at a common event).
- Outbreaks were identified by recognition that cases were linked to a common source (216 outbreaks), had attended a common event (165), or had person-to-person contact with other case(s) (146).
- Outbreaks were reported from 22 health districts. Auckland Health Districts reported the highest number (213 outbreaks involving 997 cases), followed by Manawatu with 22 outbreaks (106 cases), Hawkes' Bay with 18 outbreaks (182 cases), Wellington with 17 outbreaks (103 cases), and Canterbury with 17 outbreaks (218 cases). No outbreaks were reported from Ruapehu and Southland health districts.
- Health districts with outbreak rates exceeding the national rate (62.2 per 100 000) were West Coast (187.9), Gisborne (147.9), Hawkes Bay (126.8), Wanganui (90.8), Auckland (85.0), Nelson-Marlborough (82.5), Manawatu (72.0) and Hutt (66.0) health districts.
- Enteric pathogens were identified or suspected in 369 (94.9%) outbreaks. The most commonly implicated pathogen or toxin was *Campylobacter* (56 outbreaks) followed by Norwalk-like virus (NLV) (45) and *Salmonella* (37).

- Commercial food operations were implicated in 168 outbreaks, 97 of which were restaurants or cafés. A total of 138 outbreaks were reported as having occurred in the home.

- Foodborne transmission accounted for 192 outbreaks in 2001. Person to person and zoonotic transmission accounted for 132 and 27 outbreaks respectively. Some outbreaks had more than one mode of transmission recorded.

- Time/temperature abuse was the most common factor contributing to foodborne outbreaks (134 outbreaks).

- A specific food type was implicated in 134 of the 192 foodborne outbreaks. The most commonly implicated food type was mixed foods (33 outbreaks) followed by chicken (17 outbreaks). In only a small proportion of these outbreaks were the sources confirmed using epidemiological or laboratory methods.

- Control measures were undertaken for 226 (58.1%) of the 2001 outbreaks. The most commonly reported intervention methods were health and education advice given to people working with the source (169 outbreaks) and modification of procedures (73).

- The majority of outbreaks (304, 85.4%) were reported to or identified by the public health services within one month of onset of illness in the index case.

Discussion: Identified outbreaks contribute a significant proportion of the burden of infectious diseases in New Zealand. This is particularly the case for enteric diseases, where approximately five percent of cases of notifiable enteric diseases are part of identified outbreaks. Much of this burden is preventable, particularly by focusing on food safety, enteric hygiene precautions and hygiene after handling animals.

There are two main types of limitations of this data. These are that the surveillance system does not record information on all outbreaks occurring in New Zealand, and that recording of information on reported outbreaks is often incomplete or inconsistent. Further work is necessary to improve the coverage of the surveillance system and to standardise information collection and application of case definitions.

GLOSSARY OF TERMS USED IN THIS REPORT

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 (*syn.* 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 (ie, 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 (*syn.* 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. In this report, the name for these outbreaks is abbreviated to *dispersed*.

EpiSurv Software package, managed by ESR, that records information about notifiable diseases and disease outbreaks reported to public health services.

ESR Institute of Environmental Science & Research Limited.

Environment All that which is external to the individual human host.

Environmental investigation (of outbreaks) An examination of the surroundings external to human hosts of illness, with the aim of identifying actual or potential vehicles of infection transmission. Part of the environmental investigation is to identify how processes failed to prevent human exposure to disease agents.

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.
F12 database	Database of results of tests performed by the ESR Food laboratories on samples (of food, faeces, etc.) submitted by public health services as part of investigation of foodborne illness episodes and food complaints.
Household outbreak	Outbreak confined to members of a single household.
Index case	The first case in a family or other defined group to come to the attention of the investigator.
Infectious agent	An organism (virus, rickettsia, bacteria, fungus, protozoan or helminth) that is capable of producing infection or infectious disease.
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.
Laboratory investigation (of outbreaks)	Comparison of infectious disease agents in samples taken from different human hosts or vehicles of infection, with the aim of identifying vehicles for infection and delineating groups of individuals exposed to a common outbreak source.
Outbreak investigation	Activities undertaken to establish the existence of an outbreak, describe the outbreak, and to identify the source, transmission mechanism and contributory factors, as a basis for outbreak response.
Outbreak management	All activities undertaken to investigate and respond to outbreaks, and includes outbreak identification and preparation for investigation and response.
Outbreak response	Activities undertaken to prevent further transmission of disease, communicate effectively and to document the outbreak.
Outbreak	An epidemic limited to a localised increase in the incidence of a disease, such as in a village, town, or closed institution.
PHS	Public health service – ie, services that are either part of or contracted with district health boards, and provide public health services. May be subdivided into public health units.
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.

Vehicle of infection transmission	The mode of transmission of an infectious agent from its reservoir to a susceptible host. This can be food, water, a vector, etc.
Zoonosis	An infection or infectious disease transmissible under natural conditions from vertebrate animals to humans

1 INTRODUCTION

Cases of communicable disease occurring as disease outbreaks comprise a large part of the overall burden of communicable disease in New Zealand. Appropriate management of disease outbreaks is important because each outbreak represents a potentially ongoing hazard to health, and investigation of the outbreak is often necessary to identify and control the hazard. Furthermore, outbreak management can help identify new and emerging risk factors for illness, identify new and emerging disease agents, increase understanding about health hazards, mitigate public concern, reduce costs to the health and other sectors, and increase public health service capacity.

Surveillance of outbreaks of enteric disease (infectious intestinal diseases and foodborne and waterborne diseases) is established in several countries, including the United States,[1] England and Wales[2], and Scotland[3] and Ireland.[4] These systems generally don't cover outbreaks of non-enteric disease, nor are they integrated with surveillance of sporadic disease. Recently, the World Health Organisation has established a global outbreak reporting system which aims to collect information on outbreaks which have international significance.[5] Some regions have also developed surveillance of outbreaks of specific diseases, such as Norwalk-like virus, because surveillance of individual cases is very incomplete.[6]

Surveillance of outbreaks adds value to outbreak management by ensuring that information gathered during the process of outbreak investigation is collated and available for analysis. Reasons for systematically collecting data on outbreaks are summarised in Table 1.

Table 1: Reasons for outbreak surveillance

Reasons for oubreak surveillance
• To help control ongoing outbreaks by facilitating recognition of related outbreak events occurring in different places, e.g., identifying discrete outbreaks linked to a common source and hypotheses about this source. • To improve outbreak prevention by identifying factors contributing to outbreaks, e.g., High-risk settings, foods and practices contributing to foodborne outbreaks. • To improve prevention of infectious diseases more generally, e.g., Identifying factors contributing to disease outbreaks can increase understanding about sources and transmission routes for sporadic disease. • To help set priorities e.g. By describing the impact of outbreaks • To improve understanding of disease processes, e.g., describing characteristics of emerging diseases. • To improve public health training, e.g., provide case studies and teaching aids for diseases and outbreak investigation. • To improve outbreak investigation and management practices, e.g., by identifying gaps in the delivery of outbreak investigation services. • To help meet international reporting requirements, e.g. By improved reporting of rare imported diseases and those where eradication is expected.

ESR introduced an outbreak surveillance system in July 1996 and has been improving this system in a series of planned steps since then. The surveillance system has operated electronically since mid 1997.

During 2001, a total of 389 outbreaks were reported to ESR through electronic reporting on EpiSurv and/or from laboratory reports. This surveillance report attempts to summarise and systematically describe these events. This is the fifth year for which a detailed annual analysis of outbreaks has been undertaken.

2 METHODS

Data for this report was extracted from the outbreak surveillance system national database, held at the Institute of Environmental Science & Research Limited (ESR) Kenepuru Science Centre. *Figure 1* describes the principal flows of surveillance information about notifiable diseases and disease outbreaks in New Zealand. Outbreaks identified in the community, by ESR or by district public health services (PHSs) are assessed at the PHS level. Once confirmed as an outbreak, the PHSs record information about the outbreak on a standardised Outbreak Report Form within their district electronic surveillance databases (EpiSurv). PHSs are encouraged to enter preliminary data as an 'interim report' as soon as the outbreak is confirmed, and then complete the remainder of the Outbreak Report Form when final information is available.

On a weekly basis, this information (along with information on individual cases) is downloaded from the district database and sent to ESR. The data is collated within the national database on behalf of the Ministry of Health. The national database is supplemented by information on outbreaks recorded in the F12 food poisoning database (from the ESR Public Health laboratories, Auckland and Christchurch), and by the ESR enteric reference and virology laboratories. PHS staff are asked to complete an Outbreak Report Form for outbreaks reported from these laboratory sources, if appropriate and not already reported.

2.1 Outbreak case definition

The outbreak surveillance system uses the following case definition. Outbreaks should be reported into the system if any one of the following conditions apply:

Two or more cases of illness (whether notifiable or not) are thought to be linked to a common source, in particular where the common source is exposure at a common event, a common site, from food or water dispersed in the community, or in an institutional setting

OR

Cases of disease appear to be occurring as a community-wide outbreak where transmission is occurring from person-to-person (except when this source has become well established as a national epidemic and reporting it as a discrete event no longer serves a useful purpose)

OR

Any other situation where outbreak investigation or control measures are being used or considered.

Outbreak reporting is encouraged in the following situations.
Secondary cases have occurred in an institutional setting
The outbreak has occurred within a household, and there is a reasonable possibility that the outbreak resulted from a common source exposure for that household group. If the outbreak was more likely to have resulted from secondary transmission within a household over a period of time this should not be considered as an outbreak.

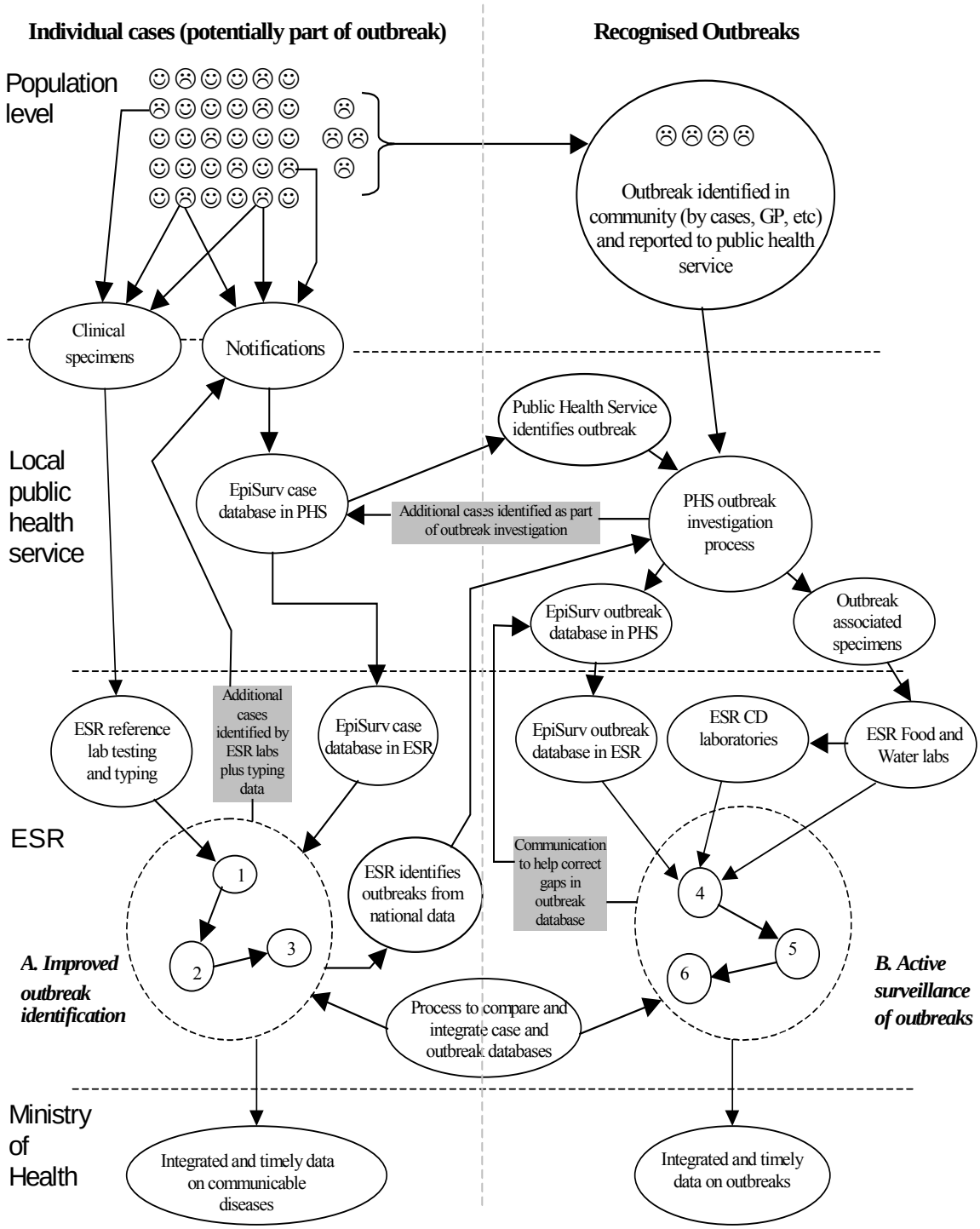
Outbreak reporting is not usually required in the following situations.

Where there is a single secondary case, or small number, who have acquired illness by person-to-person transmission from a primary case. These should be distinguished on the individual case report forms as secondary cases.
Where single cases are linked to a specific contaminated source. For example, a food poisoning case linked to specific food premises. These events should be recorded as a single case on the appropriate individual case report form.

2.2 Data used for this report

The analysis was based on outbreaks reported between 1 January 2001 and 31 December 2001 and received by the national database (EpiSurv) before 26 March 2002. The report therefore includes some outbreaks that commenced in 2000 and excludes some that began in 2001 but were not recognised and reported until 2002. Any changes made to EpiSurv data by PHS staff after 26 March will not be reflected in this report. Following extraction, these data were analysed using Microsoft Access and Excel. Abstracts of outbreaks of particular note during 2001 (see Appendix) were based on information from written outbreak reports sent to ESR by PHSs.

Figure 1 : Surveillance of individual cases and outbreaks f communicable disease : Main processes and information flows



Improved outbreak identification
1 = Data integration
2 = Data review to identify potential outbreaks
3 = Communication of findings toPHS and MoH

Active surveillance of outbreaks
4 = Data integration
5 = Data review to improve quality of data on identified outbreaks
6 = Communication of findings toPHS and MoH

3 RESULTS

A. Characteristics of outbreaks in 2001

3.1 Incidence of outbreaks in New Zealand

A total of 389 outbreaks were reported to ESR in 2001, with a national rate of 10.4 outbreaks per 100 000 population (Table 2). Outbreaks reported during 2001 involved a total of 2323 cases, at a rate of 62.2 per 100 000 population. The average number of cases per outbreak for 2001 was 6.0. The number of outbreaks and number of cases reported during 2001 exceeded those of 2000, when 289 outbreaks were reported that involved 2296 cases. Outbreak and outbreak-case rates were not reported for 2000 outbreaks. Of the 389 outbreaks reported in 2001, 355 (91.3%) were reported as completed as at the date of data extraction (26 March 2002). Analysis was therefore undertaken with 34 outbreaks still reported as interim.

Table 2: Summary of characteristics of outbreaks, January – December 2001

Characteristics	Total	Rate[1]
Total number of outbreaks	389	10.4
Number of cases		
Confirmed[2]	1049	28.1
Probable	1274	34.1
Total	2323	62.2
Number of exposed persons[3]	6258	167.4
Number hospitalised[4]	78	2.1
Number of deaths[5]	2	0.1

1 Crude rate per 100 000 population, based on 2001 census

2 A confirmed case is based on the case definition for the outbreaks defined by the investigating PHS. This includes number of laboratory-confirmed cases for the last 6 months of the year when this information was recorded

3 This information was recorded for 341 (87.7%) of the 389 outbreaks

4 This information was recorded for 335 (86.1%) of the 389 outbreaks

5 This information was recorded for 324 (83.3%) of the 389 outbreaks

The following chart (Figure 2) shows the number of outbreaks reported by year since the outbreak surveillance system was introduced in June 1996. The total for 2001 was more than any previous year.

Figure 2: Number of outbreaks by year, 1996-2001

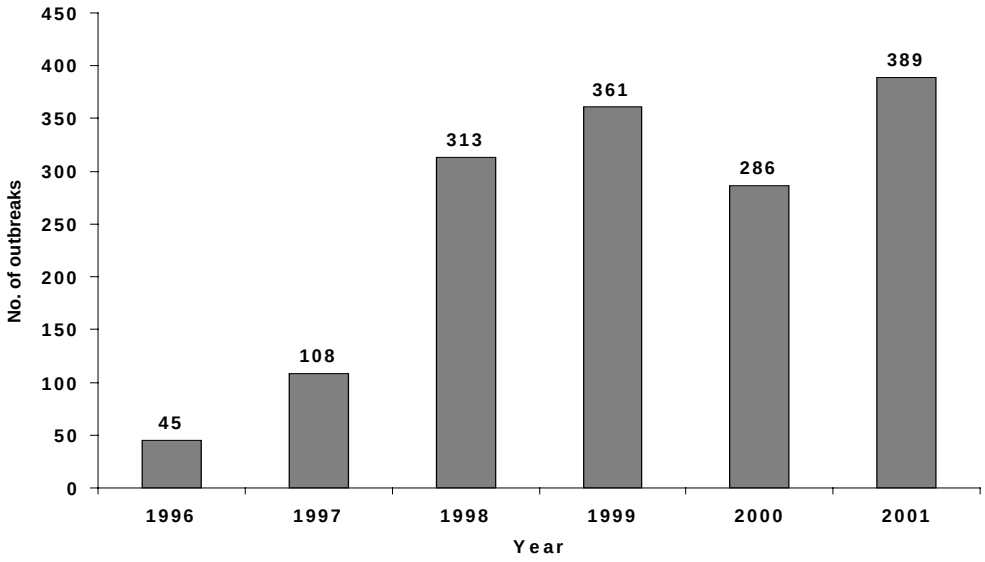
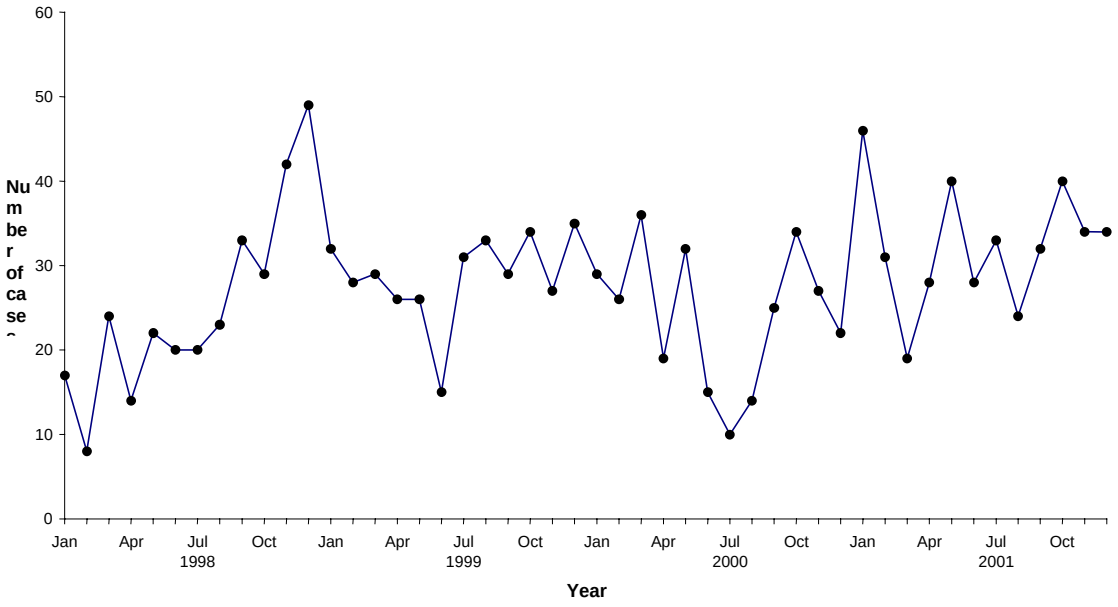


Figure 3 shows the number of outbreaks reported on EpiSurv by month, from January 1998 to December 2001. Combining all outbreaks reported between December 1998 and November 2001, the highest proportion of outbreaks occurred during summer (December to February) months (28.7%) and lowest in winter (June to August) months (19.6%).

Figure 3 : Number of outbreaks by month, January 1998 – December 2001



3.2 Type of outbreak

Common source outbreaks: A total of 227 outbreaks reported in 2001 were recorded as being due to a common source (Table 3). This total is greater than that for outbreaks reported in 2000 (200), although common source outbreaks were a smaller proportion of outbreaks in 2001 (58.4%) than in 2000 (69.2%). Common events, where transmission occurred at a specific time and place (eg, at a wedding reception or at a catered function) accounted for 177 of the common source outbreaks, an increase from the 164 reported in 2000. Common source outbreaks dispersed in the community, where transmission occurred over a wide area (eg, due to a food product contaminated during manufacturing and widely distributed before consumption) accounted for 13 outbreaks, the same number as in 2000. Common source outbreaks at a specific site, where transmission occurred at a specific place but over a protracted period (eg, due to contamination of a public swimming pool) accounted for 37 outbreaks, an increase from the 23 such outbreaks reported in 2000. Common source outbreaks accounted for 1188 cases, an average of 5.2 cases per outbreak.

Community-wide outbreaks: Community-wide outbreaks, where transmission occurred through person-to-person contact, accounted for eight outbreaks, a similar total to that reported in 2000 (nine outbreaks). Community-wide outbreaks accounted for 44 cases, an average of 5.5 cases per outbreak.

Outbreaks in defined settings: A total of 137 outbreaks were recorded as being due to transmission within a defined setting. This total greatly exceeds that reported in 2000 (64), and these outbreaks made up a significantly greater proportion of total outbreaks reported in 2001 (35.2%) than in 2000 (22.1%) [χ^2=13.6, p<0.01]. Of these outbreaks reported in 2001, 104 occurred in household settings, compared with 52 reported in 2000. Household outbreaks accounted for 295 cases, an average of 2.8 cases per outbreak. Transmission within institutional settings (eg, in hospitals or rest homes) accounted for 33 outbreaks, compared with 12 reported in 2000. Institutional outbreaks had 736 associated cases, an average of 22.3 cases per outbreak. One of these outbreaks involved 147 cases.

Table 3: Type of outbreak, January – December 2001

Type of outbreak	No. of outbreaks	Percent (n=389)	No. of cases	Percent (n=2323)
Common source	227	58.4	1188	51.1
Common event	177	45.5	855	36.8
Suspected common source dispersed in community (e.g. food, water)	13	3.3	66	2.8
Suspected common source in specific place (e.g. environmental site)	37	9.5	267	11.5
Community wide person-to-person transmission	8	2.1	44	1.9
Transmission within defined setting	137	35.2	1031	44.4
Household	104	26.7	295	12.7
Institutional (rest home, hospital, childcare, school)	33	8.5	736	31.7
Other outbreak type	4	1.0	26	1.1
Unknown outbreak type	13	3.3	34	1.5
Total	389	100.0	2323	100.0

3.3 Distribution of outbreaks by health district

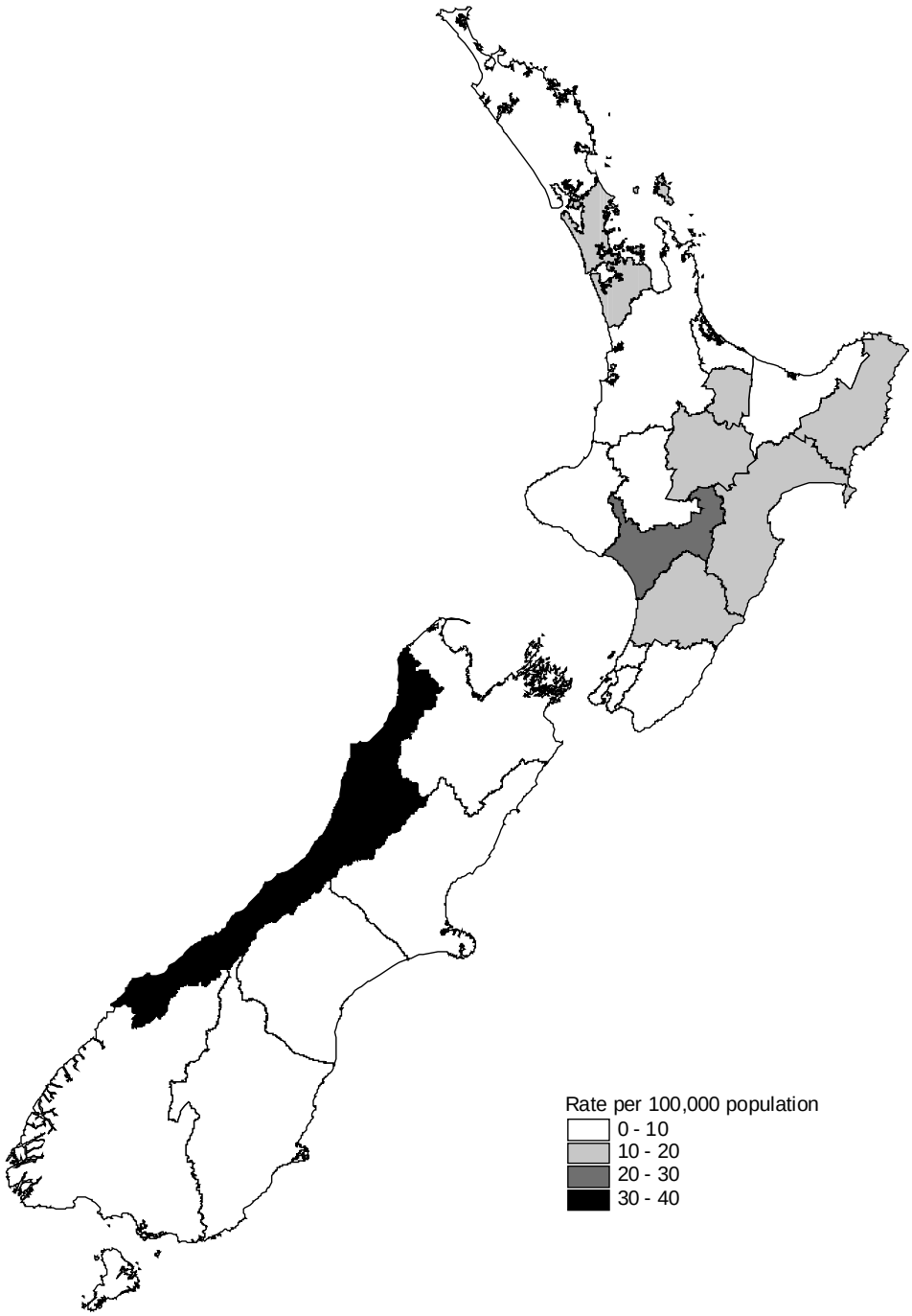
During 2001, outbreaks were reported from 22 of the 24 health districts. The highest number of outbreaks was reported from the Auckland health districts with 213 outbreaks, followed by Manawatu (22), Hawkes Bay (18), Wellington (17) and Canterbury (17) health districts. Remaining health districts reported between zero and twelve outbreaks (Tables 4 and 5). Overall, 54.8% of outbreaks were reported from Auckland health districts. Outbreak rates higher than the national average (10.4 per 100 000) were recorded in West Coast (39.6), Wanganui (20.6), Auckland (18.2), Gisborne (15.9), Manawatu (14.9), Rotorua (14.0), Taupo (12.7) and Hawkes Bay (12.5) health districts. A map of the distribution of outbreaks reported during 2001 is presented in *Figure 4*. Outbreaks have previously been reported from Ruapehu and Southland health districts, although not in 2001.

Table 4: Number of outbreaks by health district, January – December 2001

Health District[1]	No of outbreaks	Percent (n=389)	Outbreak rate (per 100,000 population[2])
Northland	4	1.0	2.9
Auckland[3]	213	54.8	18.2
Waikato	12	3.1	3.9
Eastern Bay of Plenty	2	0.5	4.1
Rotorua	9	2.3	14.0
Taupo	4	1.0	12.7
Tauranga	4	1.0	3.1
Gisborne	7	1.8	15.9
Hawkes Bay	18	4.6	12.5
Taranaki	5	1.3	4.8
Manawatu	22	5.7	14.9
Ruapehu	0	0.0	0.0
Wanganui	12	3.1	20.6
Wairarapa	1	0.3	2.6
Wellington	17	4.4	6.7
Hutt	4	1.0	3.0
Nelson-Marlborough	12	3.1	9.8
Canterbury	17	4.4	4.2
South Canterbury	5	1.3	6.4
West Coast	12	3.1	39.6
Otago	9	2.3	5.4
Southland	0	0.0	0.0
Total	389	100.0	10.4

1 Where no health district was indicated on the reporting form, health district was assigned according to the
2 PHS where the outbreak was entered on to the surveillance system
3 Based on 2001 census
4 Includes North West Auckland, Central Auckland and South Auckland Health Districts

Figure 4: Distribution of outbreaks reported in 2001 (outbreak rates per 100 000 population using 2001 census). n=389



3.4 Distribution of outbreak cases by health district

The highest number of cases of disease associated with outbreaks were reported from Auckland health districts with 997 cases, followed by Canterbury (218), Hawkes Bay (182) and Manawatu (106) health districts. Overall, 42.9% of outbreak cases were reported from Auckland health districts. The outbreak with the greatest number of confirmed cases was reported from Hawkes Bay Health District, and involved 95 confirmed cases of campylobacteriosis. The outbreak with the largest total number of cases (confirmed and probable) was reported from Auckland, and involved 147 cases of infection with a flu-like illness (see Appendix for more detail about this outbreak).

Outbreak case rates exceeding the national average (62.2 per 100 000) were recorded in West Coast (187.9), Gisborne (147.9), Hawkes Bay (126.8), Wanganui (90.8), Auckland (85.0), Nelson-Marlborough (82.5), Manawatu (72.0) and Hutt (66.0) health districts.

Table 5: Number of cases associated with outbreaks by health district, January - December 2001

Health District[1]	No of cases[2]	Percent (n=2323)	Average number of cases per outbreak	Rate per 100,000 population[3]
Northland	24	1.0	6.0	17.1
Auckland[4]	997	42.9	4.7	85.0
Waikato	94	4.0	7.8	30.5
Eastern Bay of Plenty	18	0.8	9.0	36.7
Rotorua	37	1.6	4.1	57.4
Taupo	10	0.4	2.5	31.7
Tauranga	44	1.9	11.0	34.1
Gisborne	65	2.8	9.3	147.9
Hawkes Bay	182	7.8	10.1	126.8
Taranaki	30	1.3	6.0	29.1
Manawatu	106	4.6	4.8	72.0
Ruapehu	0	0.0	-	0.0
Wanganui	53	2.3	4.4	90.8
Wairarapa	9	0.4	9.0	23.5
Wellington	103	4.4	6.1	40.6
Hutt	87	3.7	21.8	66.0
Nelson-Marlborough	101	4.3	8.4	82.5
Canterbury	218	9.4	12.8	54.3
South Canterbury	28	1.2	5.6	35.8
West Coast	57	2.5	4.8	187.9
Otago	60	2.6	6.7	36.1
Southland	0	0.0	-	0.0
Total	2323	100.0	6.0	62.2

1 Where no health district was indicated on the reporting form, health district was assigned according to the PHS where the outbreak was entered on to the surveillance system

2 Number of cases includes laboratory-confirmed, other confirmed and probable cases

3 Based on 2001 census

4 Includes North West Auckland, Central Auckland and South Auckland Health Districts

Among health districts that reported outbreaks in 2001, the average size of outbreaks varied from 2.5 cases per outbreak in Taupo Health District to 21.8 cases per outbreak in Hutt. The national average was 6.0 cases per outbreak.

3.5 Causal pathogens and toxins

The causal pathogen(s) or toxin(s) was identified and recorded for 61.4% (239/389) of the outbreaks in 2001. Remaining outbreaks were recorded as due to gastroenteritis (126) or to flu-like illness (1). Causal agents were identified for a smaller proportion of outbreaks in 2001 than for outbreaks reported in 2000 (74.7%, 216/289). More than one causal agent was recorded for five outbreaks reported in 2001.

The most commonly implicated causal agent among outbreaks in 2001 was *Campylobacter* (14.4%, 56/389) followed by Norwalk-like virus (NLV) (11.6%, 45/389), *Salmonella* (9.5%, 37/389) and *Cryptosporidium* (6.9%, 27/389). Enteric pathogens or toxins were identified or suspected in 94.9% (369/389) of outbreaks, including the 126 outbreaks of gastroenteritis without a specified agent. Non-enteric causal agents were reported for 6.4% (25/389) of outbreaks.

Table 6 shows the number and proportion of outbreaks and cases due to each suspected pathogen or toxin. The highest average number of cases per outbreak were recorded for the single outbreak recorded to be due to a flu-like illness (147 cases), followed by NLV (average of 12.0 cases per outbreak).

Of the 18 pathogens or toxins implicated in both 2001 and 2000 outbreaks, 13 were more frequently implicated in 2001 than in 2000, in parallel with the overall increase in the number of reported outbreaks between the two years. Outbreaks due to pathogens or toxins with the largest absolute increase from 2000 to 2001 were outbreaks due to gastroenteritis (from 73 in 2000 to 126 in 2001), cryptosporidiosis (from 7 to 27), campylobacteriosis (from 37 to 56) and NLV (from 34 to 45). The largest proportional increases between 2000 and 2001 occurred among outbreaks due to *M. tuberculosis*, *N. meningitidis*, vibrio or shigella toxigenic *Escherichia coli* (VTEC/STEC), and cryptosporidiosis, although the absolute increases in outbreaks due to these pathogens were small (with the exception of cryptosporidiosis). Notable pathogens causing outbreaks in 2001 but not in 2000 were *Yersinia*, ciguatera toxin, measles and *Legionella* spp. Overall, the number of outbreaks due to enteric pathogens increased by 35.2% from 2000 to 2001, and the number of outbreaks due to non-enteric pathogens increased by 13.6%.

Table 7 compares, for each illness, the number of cases identified as part of an outbreak with those reported to the national surveillance system as individual cases. The analysis is restricted to illnesses that are notifiable as individual cases and also caused outbreaks reported during 2001. Enteric illnesses where outbreak-associated cases were a higher proportion of total notifications than the average (5.2%) were toxic-shellfish poisoning (100.0%), hepatitis A (18.0%), shigellosis (38.9%), VTEC/STEC (13.2%), cryptosporidiosis (12.2%) and salmonellosis (8.9%). Non-enteric illness where outbreak-associated cases were a higher proportion of total notifications than the average (2.4%) were lead absorption (7.9%) and tuberculosis (3.7%), measles (7.2%), legionellosis (8.7%) and hepatitis C (5.0%).

Table 6: Number of outbreaks and cases by suspected pathogen or toxin, January – December 2001

Suspected pathogen or toxin	No. of outbreaks[1]	Percent (n=389)	No. of cases[2]	Percent (n=2323)	Average no. of cases
Enteric	369	94.9	2095	90.2	5.7
Gastroenteritis (agent not specified)	126	32.4	564	24.3	4.5
Campylobacter	56	14.4	301	13.0	5.4
NLV	45	11.6	541	23.3	12.0
Salmonella	37	9.5	214	9.2	5.8
Cryptosporidium	27	6.9	147	6.3	5.4
Giardia	18	4.6	75	3.2	4.2
Clostridium perfringens	15	3.9	59	2.5	3.9
Staphylococcus aureus	11	2.8	23	1.0	2.1
Shigella	9	2.3	61	2.6	6.8
Bacillus cereus	6	1.5	21	0.9	3.5
Hepatitis A	3	0.8	11	0.5	3.7
VTEC/STEC	4	1.0	10	0.4	2.5
Histamine poisoning	3	0.8	7	0.3	2.3
Yersinia	3	0.8	10	0.4	3.3
Rotavirus	3	0.8	41	1.8	13.7
Ciguatera poisoning	2	0.5	8	0.3	4.0
Toxic shellfish poisoning	1	0.3	2	0.1	2.0
Non Enteric	25	6.4	211	9.1	8.4
Bordetella pertussis	5	1.3	17	0.7	3.4
Mycobacterium tuberculosis	5	1.3	14	0.6	2.8
Neisseria meningitidis	4	1.0	11	0.5	2.8
Lead absorption	3	0.8	8	0.3	2.7
Measles	2	0.5	6	0.3	3.0
Legionella spp.	2	0.5	4	0.2	2.0
Hepatitis C	1	0.3	3	0.1	3.0
MSG poisoning	1	0.3	2	0.1	2.0
Dengue[3]	1	0.3	unknown		
Cannabis oil	1	0.3	16	0.7	16.0
Flu-like illness	1	0.3	147	6.3	147.0

1 More than one pathogen was reported for five outbreaks

2 Number of cases includes laboratory-confirmed, other confirmed and probable cases

3 One Dengue outbreak reported, but no cases were reported.

Table 7: Proportion of total notified to outbreak related cases, 2001

Disease[1]	Total notified cases[2]	Total cases reported from outbreaks	Proportion of total notified cases to cases associated with outbreaks
Enteric			
Campylobacteriosis	10148	301	3.0
Salmonellosis	2417	214	8.9
Giardiasis	1603	75	4.7
Shigellosis	157	61	38.9
Cryptosporidiosis	1207	147	12.2
Hepatitis A	61	11	18.0
VTEC/STEC infection	76	10	13.2
Toxic shellfish poisoning (TSP)	2	2	100
Total Enteric	15671	821	5.2
Non-enteric			
Pertussis	1335	17	1.3
Meningococcal disease	650	11	1.7
Tuberculosis	381	14	3.7
Lead absorption	101	8	7.9
Measles	83	6	7.2
Legionellosis	46	4	8.7
Hepatitis C	60	3	5.0
Total Non Enteric	2656	63	2.4

1 Includes only diseases that are notifiable and were causes of outbreaks reported in 2001
2 Numbers of notified cases obtained from the *Annual Surveillance Summary 2001*

The frequency of pathogens or toxins implicated in specific outbreak types are shown in Table 8. Of outbreaks with a specific implicated enteric pathogen (ie, excluding those without a microbiological diagnosis), *Campylobacter* was the most frequently implicated pathogen in common event (19 outbreaks), common source in specific site (12), and household (19) outbreaks. Giardia was the most frequently implicated enteric pathogen in community-wide outbreaks (3 outbreaks), and NLV was the most frequently implicated pathogen in institutional outbreaks (8). Common event, common source in specific site and household outbreaks accounted for 90.9% (50/55) of the *Campylobacter* outbreaks and 64.4% (29/45) of the NLV outbreaks. Of non-enteric pathogens, *Bordetella pertussis* was the most frequently implicated pathogen in community-wide (2) and household (3) outbreaks, *M. tuberculosis* was the most frequently implicated pathogen in institutional (2) outbreaks, and lead absorption was the most frequently implicated aetiology of common source outbreaks in a specific site (3).

Table 8: Number of outbreaks by outbreak type and suspected pathogen or toxin, January – December 2001

Suspected pathogen or toxin	Outbreak type								
	Event[1]	Disp[2]	Site[3]	Comm[4]	Inst[5]	House[6]	Oth[7]	Unk[8]	Tot[9]
Enteric									
Gastroenteritis	97	5	3		4	15		2	126
Campylobacter	19		12		2	19	1	2	55
NLV	19	2	5	1	8	5	1	4	45
Salmonella spp.	15	1	2		2	14		2	36
Cryptosporidium		1	5	1	4	14	1		26
Giardia		1		3	1	11	1		17
Clostridium perfringens	10		2			1			13
Staphylococcus aureus	7		2			2			11
Shigella	1			1	3	4			9
Bacillus cereus	4		1			1			6
Hepatitis A						3			3
VTEC/STEC		1	1			2			4
Histamine poisoning	3								3
Yersinia						3			3
Rotavirus					3				3
Ciguatera	1					1			2
TSP						1			1
Non-enteric									
Bordetella pertussis				2		3			5
Mycobacterium tuberculosis					2	2		1	5
Neisseria meningitidis					1	2		1	4
Lead absorption			3						3
Measles					1	1			2
Legionella		1	1						2
Hepatitis C					1				1
MSG Poisoning		1							1
Dengue Fever								1	1
Cannabis oil	1								1
Flu-like illness					1				1
Total	177	13	37	8	33	104	4	13	389

1 Common event outbreaks
2 Dispersed common source outbreaks
3 Common source outbreaks in a specific site
4 Community-wide outbreaks
5 Institutional outbreaks
6 Household outbreaks
7 Other outbreak types
8 Outbreak type unknown
9 Total outbreaks

3.6 Outcome of outbreaks

Of the 389 outbreaks reported during 2001, 16 involved cases that were hospitalised, with 78 cases hospitalised in total. This is a reduction from the 150 outbreak-associated cases hospitalised in 2000. There were two recorded deaths among outbreak-associated cases, both due to meningococcal disease, a decrease from the five deaths in 2000. As in 2000, salmonellosis was responsible for the largest number of outbreak-associated hospitalisations. The implicated pathogens or toxins which resulted in the greatest proportion of outbreak cases being hospitalised were due to cannabis oil (87.5%), *Neisseria meningitidis* (81.8%), *Mycobacterium tuberculosis* (57.1%) *Legionella* spp. (50.0%) and measles (33.0%) (Table 9). Note that the proportion of cases of each illlness hospitalised uses the total number of cases of that illness as the denominator, not the total number of cases occurring in outbreaks for which hospitalisation information was recorded (as was done in the *Annual summary of outbreaks in New Zealand 2000*[7]).

Table 9: Number and proportion of hospitalised outbreak-related cases by suspected pathogen or toxin, January – December 2001

Suspected pathogen or toxin	Number of cases	Number of cases hospitalised[1]	Percent of cases hospitalised
Enteric	2095	42	2.0
Salmonella	214	15	7.0
Campylobacter	301	7	2.3
Shigella	61	5	8.2
Gastroenteritis	564	4	0.7
NLV	541	4	0.7
Rotavirus	41	2	4.9
Hepatitis A	11	2	18.2
Cryptosporidium	147	1	0.7
VTEC/STEC	10	1	10.0
Ciguatera	8	1	12.5
Non Enteric	211	36	17.1
Cannabis oil	16	14	87.5
Neisseria meningitidis	11	9	81.8
Mycobacterium tuberculosis	14	8	57.1
Legionella	4	2	50.0
Measles	6	2	33.3
Flu-like illness	147	1	0.7

1 Number of cases includes laboratory-confirmed, other confirmed and probable cases

3.7 Outbreak Setting

The highest number of outbreaks occurred at commercial food operators (168 outbreaks), an increase from 147 outbreaks in these settings in 2000. Outbreaks occurring at home (138) accounted for the next highest number of outbreaks, and the number of outbreaks in this setting had also increased from 2000 (104). The highest proportion of outbreaks implicated a restaurant or café (24.9%, 97/389) followed by takeaway premises (9.8%, 38/389) (Table 10). The setting for the outbreak was unknown for 21 outbreaks, and no information on setting was provided for 22 outbreaks.

Table 10: Outbreaks and cases by setting, January – December 2001

Outbreak setting	No. of outbreaks[1]	Percent (n=389)	No. of cases[2]	Percent (n=2323)
Commercial food operators	168	43.2	752	32.4
Restaurant or café	97	24.9	416	17.9
Takeaway	38	9.8	103	4.4
Special event or catered function	7	1.8	97	4.2
Bakery	7	1.8	14	0.6
Hotel	8	2.1	88	3.8
Supermarket or deli	5	1.3	22	0.9
Other food outlet[3]	5	1.3	12	0.5
Institutions	32	8.2	750	32.3
School/University	1	0.3	116	5.0
Rest home or retirement home	5	1.3	206	8.9
Camp	7	1.8	237	10.2
Childcare centre or pre-school	19	4.9	191	8.2
Community Groups	7	1.8	137	5.9
Clubs	5	1.3	115	5.0
Marae/tangi	2	0.5	22	0.9
Workplace	36	9.3	204	8.8
Workplace	15	3.9	142	6.1
Farm	19	4.9	50	2.2
Abattoir	2	0.5	12	0.5
Household – home	138	35.5	499	21.5
Other	11	2.8	112	4.8
Swimming pool	7	1.8	52	2.2
Playland	3	0.8	35	1.5
Swimming in lake	1	0.3	10	0.4
Bus tour	1	0.3	10	0.4
Shellfish beds	1	0.3	2	0.1
Refugee centre	1	0.3	3	0.1
Information not provided	22	5.7	66	2.8
Setting unknown	21	5.4	69	3.0

1 More than one setting was reported for some outbreaks
2 Number of cases includes laboratory-confirmed, other confirmed and probable cases
3 Other food outlets included dairies, food courts, service stations and food caravans

3.8 Mode of transmission

Table 11 shows the number and proportion of outbreaks and cases by probable mode of transmission. The most commonly implicated mode of transmission was foodborne (192 outbreaks) followed by person to person (132). Foodborne transmission was also responsible for the highest number of cases (1144 cases), followed by person to person spread (919 cases). More than one mode of transmission was recorded for 74 outbreaks, particularly those involving mixed foodborne and person to person transmission. Modes of transmission with the largest increase in number of outbreaks between 2000 and 2001 were person-to-person (from 114 outbreaks in 2000 to 132 in 2001) and zoonotic outbreaks (from 15 in 2000 to 27 in 2001). A larger number of outbreaks had unknown mode of transmission in 2001 (49) than in 2000 (8).

Table 11: Outbreaks and cases by probable mode of transmission, January – December 2001

Probable mode of transmission	No. of outbreaks[1]	Percent (n = 389)	No. of cases[2]	Percent (n=2323)
Foodborne	192	49.4	1144	49.2
Person to person contact	132	33.9	919	39.6
Environmental	24	6.2	105	4.5
Waterborne	22	5.7	370	15.9
Zoonotic	27	6.9	94	4.0
Other mode of transmission	7	1.8	43	1.9
Information not provided	27	6.9	83	3.6
Mode of transmission unknown	49	12.6	232	10.0

1 More than one mode of transmission was recorded for 74 outbreaks
2 Number of cases includes laboratory-confirmed, other confirmed and probable cases

3.9 Specific foods implicated in foodborne outbreaks

A specific food or food type was recorded as being implicated for 134 (69.8%) of the 192 foodborne outbreaks, a decrease from the 76.3% of foodborne outbreaks with an implicated food in 2000. The following table (Table 12) shows the food(s) implicated and the basis by which they were identified.

The most commonly implicated food types were mixed foods (33 outbreaks), followed by chicken (17), seafood (13) and Chinese food (13). More than one basis for identification of the food was recorded for 49 of the 192 outbreaks. The most common method for identifying the food source was from the cases food history (123 outbreaks), followed by environmental investigation (39 outbreaks). Epidemiological methods, using either a retrospective cohort study or a case-control study, were reported as the basis for identifying the source of five outbreaks. Laboratory methods were reported in nine outbreaks.

Outbreak investigations that had used either environmental, epidemiological or laboratory investigation to implicate foods were considered to have confirmatory evidence for the source of the outbreak. Confirmatory evidence that an implicated food was the outbreak source was reported for 62 (32.3%) of the 192 foodborne outbreaks. This represents an increase from the 33 (22.8%) of foodborne outbreaks in 2001 that had a food implicated with confirmatory evidence. The largest fraction of this increase was contributed by increased use

of environmental investigation techniques to implicate foods, from 17 foodborne outbreaks in 2000 to 39 in 2001. In seven (5.2%) of the 134 foodborne outbreaks with an identified source, no basis for identifying the source was recorded.

Table 12: Foods implicated in foodborne outbreaks and the basis for identifying the source, January - December 2001

Food	Number of outbreaks by basis for identifying source						Total[5]
	History[1]	Epi[2]	Lab[3]	Environ[4]	Other	None	
Chicken	17			5	1		17
Seafood (eg, fish, shellfish)	12		3	1		1	13
Sandwich or burger (meat, chicken, seafood)	7		1	2		2	9
Meat (eg, beef, lamb, pork)	8			1			8
Fish & Chips	4				1		5
Meat pie (no chicken)	5			3	1		5
Bakery (eg, cake, cheesecake)	3	1	1				4
Pizza (seafood, Hawaiian, unspecified)	4			2			4
Pate (chicken liver and unspecified)	3			3			3
Water	3	1					3
Dairy (unpasteurised milk, yoghurt)	1					1	2
Rice	1					1	2
Gravy	1						1
Mayonnaise	1		1				1
Mixed foods							
Mixed foods[7]	31	2	1	10	2	1	33
Chinese	11		2	4		1	13
Middle Eastern	5	1		5			5
Indian	5			3	1		5
Italian	1						1
Total	123	5	9	39	6	7	134

1 History – cases had history of exposure to implicated source
2 Epidemiological method – case-control or retrospective cohort investigation
3 Laboratory method – pathogen/toxin/chemical suspected to have caused illness identified in implicated source
5 Environmental method – critical control point failures were identified which were linked to implicated source
6 More than one food item was suspected/confirmed in some outbreaks
7 Mixed food included items in which the main ingredient included chicken (4), beef (1), seafood (1), and lamb (1).
8 Total is number of outbreaks where the basis for identifying source was identified regardless of the number of items identified
9 More than one basis for identification of the food was recorded for 49 (25.5%) of the foodborne outbreaks

3.10 Pathogens causing foodborne outbreaks with implicated foods

Specific pathogens were identified in relation to 108 (56.3%) of the 192 foodborne outbreaks. One or more foods were implicated as the source of 63.9% (69/108) of these outbreaks. The source food(s) were implicated with evidence based on environmental, epidemiological and/or laboratory investigation (ie, confirmatory evidence) for 31 (44.9%) of these 69 outbreaks, and were implicated with evidence from case histories or other forms of evidence (ie, non-confirmatory evidence) for the remaining 38 outbreaks. Pathogens identified in relation to foodborne outbreaks with specific implicated foods, and types of evidence implicating the food(s), are shown in Tables 13a and 13b. For outbreaks with evidence based on epidemiologic, environmental or laboratory investigation, the tables also summarise factors found to have contributed to the outbreak.

Points to note from these tables include the following: five of eight foodborne outbreaks with campylobacteriosis with high level evidence implicated undercooked chicken livers as the source of infection; all of the eight NLV outbreaks with high level evidence identified infected food handlers as the source of infection; and all of the seven *Clostridium perfringens* outbreaks with high level evidence were considered to have resulted from multiple temperature abuse problems.

Table 13a: Pathogens, implicated foods, and levels of evidence for implicated foods for foodborne outbreaks, January to December 2001

Pathogen or toxin[1] and food item(s)	Non-confirmatory evidence[2] for implicated foods	Confirmatory evidence[3] for implicated foods	
	n	n	Factors contributing to outbreak(s)[4]
Campylobacter			
Barbecued chicken	1		
Chicken nuggets	1		
Chicken schnitzel	1		
Chicken livers	2	5	Undercooking
Chicken panini	1		
Butter chicken		1	Inadequate cooling, undercooking, cross contamination
Meat patties	1		
Water	2		
Unpasteurised milk	1		
Mixed	3	1	Inadequate cooling, undercooking, improper storage
Unspecified food(s)	7	1	Preparation too far in advance, improper hot holding
Salmonella			
Satay chicken	1		
Chicken nuggets	1		
Chicken panini	1		
Butter chicken	1		
Saveloys	1		
Egg and salmon sandwiches		1	Cross-contamination, infected food-handler
Raw egg mayonnaise		1	Consumption of raw food
Mixed meals		3	Unsafe ingredients, cross contamination, improper storage or hot holding, infected food handler
Chinese dishes		1	Unsafe ingredients, improper hot holding and storage
Unspecified food(s)	7		
Shigella			
Unspecified food(s)	1	1	Factors not specified
VTEC/STEC			
Unspecified food(s)	2		
Yersinia			
Pork	1		
Unspecified food(s)	1		
Norwalk-like virus			
Oysters	2		
Chicken 'roll up'	1		
Fruit berry cheesecake		1	Infected food handler
Mixed	1	1	Infected food handler
Unspecified	6	6	Infected food handler
Giardia lamblia			
Unspecified	2		

1 Excludes outbreaks without confirmed pathogen
2 Evidence for implicated foods based on case history alone
3 Evidence for implicated foods based on epidemiologic, environmental or laboratory investigation
4 Only includes outbreaks with confirmatory evidence

Table 13b: Pathogens, implicated foods, and levels of evidence for implicated foods for foodborne outbreaks, January to December 2001 (contd.)

Pathogen or toxin[1] and food item(s)	Non-confirmatory evidence[2] for implicated foods	Confirmatory evidence[3] for implicated foods	
	n	n	Factors contributing to outbreak(s)[4]
Clostridium perfringens			
Chicken	1		
Meat balls	1		
Potato fritters	1		
Meat pie		1	Inadequate refrigeration, improper hot holding, inadequate reheating
Gravy	1		
Mixed		2	inadequate refrigeration, improper hot holding
Middle Eastern dish containing chicken		1	Improper hot holding, cross contamination
Tandoori chicken		1	Inadequate refrigeration, undercooking
Indian dishes		1	Inadequate refrigeration, improper hot holding
Unspecified food(s)	3	1	Inadequate refrigeration, undercooking, improper hot holding
Bacillus cereus			
Hawaiian pizza		1	Cross-contamination
Rice	1		
Mixed	2	1	Inadequate refrigeration, improper hot holding, cross-contamination
Unspecified	1		
Staphylococcus aureus			
Chicken kebab		1	Inadequate refrigeration, cross-contamination
Butter chicken	1		
Steak and kidney pie	1		
Meat kebab		1	Inadequate refrigeration, improper hot handling, cross-contamination
Beef and black bean sauce	1		
Mixed	2	2	Inadequate refrigeration, improper hot handling and storage
Unspecified	1		
Histamine			
Smoked fish		3	Unsafe ingredients, inadequate refrigeration, chemical contamination
MSG poisoning			
Fish and chips	1		
Ciguatera			
Fish	1	1	Unknown factors
Toxic shellfish poisoning			
Seafood	1		Unknown factors
Cannabis oil			
Cake		1	Unsafe ingredients, chemical contamination

1 Excludes outbreaks without confirmed pathogen
2 Evidence for implicated foods based on case history alone
3 Evidence for implicated foods based on epidemiologic, environmental or laboratory investigation
4 Only includes outbreaks with confirmatory evidence

3.11 Specific pathogens implicated in waterborne person to person, zoonotic, and environmental outbreaks

The most commonly implicated pathogen in waterborne outbreaks was *Giardia* (8 outbreaks), followed by *Campylobacter* (6) and *Cryptosporidium* (3). The most commonly implicated causal pathogens or toxins among person to person outbreaks were NLV (30 outbreaks), followed by *Cryptosporidium* (19), Giardia (14) and *Salmonella* (14). *Campylobacter* and *Cryptosporidium* each accounted for 10 of the 27 zoonotic outbreaks, and *Cryptosporidium* was implicated in 11 of the 24 (45.8%) environmental outbreaks. More than one causal agent was recorded for some modes of transmission.

3.12 Factors contributing to outbreaks

3.12.1 Foodborne outbreaks

A total of 20 different contributing factors were identified for the 192 foodborne outbreaks reported during 2001. The individual factors most commonly associated with foodborne illness were inadequate cooling and refrigeration of food (44 outbreaks), cross-contamination (29), undercooking food (27), or inadequate hot holding of cooked food (24), as shown in Table 14. Divided into more general categories, time/temperature abuse was recorded as a probable contributing factor in 69.8% (134/192), infected food handlers or inadequate hygiene during food handling was a probable contributing factor in 25.0% (45/192), and use or consumption of unsafe food sources was a probable contributing factor in 8.9% (17/192) of the foodborne outbreaks. No contributing factors were identified in 69 (35.4%) of the foodborne outbreaks.

Table 14: Probable factors contributing to foodborne outbreaks, January – December 2001

Probable factors contributing to outbreak[1]	No. of outbreaks[1]	Percent (n=192)[2]
Time/temperature abuse		
Inadequate cooling or refrigeration	44	22.9
Undercooking	27	14.1
Improper hot holding	24	12.5
Improper storage prior to preparation[3]	15	7.8
Inadequate reheating of previously cooked food	14	7.3
Inadequate thawing	4	2.1
Preparation too far in advance of consumption	3	1.6
No temperature monitoring	3	1.6
Total – time/temperature abuse	134	69.8
Contamination of food		
Cross contamination	29	15.1
Contamination from an infected food handler	9	4.7
Chemical contamination	4	2.1
Inadequate food handling	6	3.1
Total – contamination of food	48	25.0
Unsafe sources		
Consumption of raw food	3	1.6
Use of ingredients from unsafe sources	9	4.7
Consumption of unpasteurised milk	1	0.5
Use of untreated water in food preparation	2	1.0
Consumption contaminated seafood	2	1.0
Total -unsafe sources	17	8.9
Other		
Inadequate food safety knowledge	1	0.5
Inadequate food preparation facilities	3	1.6
Food inadequately preserved	1	0.5
Factors not specified	21	10.9
Factors unknown	69	35.4

1 More than one probable factor was recorded for 58 (30.2%) of the 192 foodborne outbreaks
2 Includes only outbreaks specified as foodborne

Temperature abuse of food was considered to have contributed to a much larger number of outbreaks in 2001 (134) than in 2000 (59). Contamination from infected food handlers was less common in 2001 (9) than in 2000 (24). In general, factors contributing to foodborne outbreaks were identified for a larger proportion of outbreaks in 2001 (123/192, 65.6%) than in 2000 (103/190, 54.2%).

3.12.2 Waterborne outbreaks

Table 15 lists the probable contributing factors identified while investigating the 22 waterborne outbreaks. The most common factor identified was consumption of water from an untreated supply, a contributory factor for 14 outbreaks (63.3%). No contributing factors were identified for one waterborne outbreak. Contributory factors were identified and recorded for a larger proportion of waterborne outbreaks in 2001 than in 2000.

Table 15: Probable factors contributing to waterborne outbreaks, January – December 2001

Probable factors contributing to outbreak	No. of outbreaks[1]	Percent (n=22)
Untreated water supply[2]	14	63.6
Contamination of source water supply	8	36.4
Contamination of reservoir(s) or holding tank(s)	1	4.5
Water treatment process failure	1	4.5
No contributing factors identified	1	4.5

1 More than one factor was recorded for 7 (31.8%) of the 22 waterborne outbreaks
2 Untreated water supply includes: untreated roof, river water supply and unspecified dirty water

3.12.3 Person-to-person outbreaks

Identified contributing factors were recorded for 94 (71.2%) of the 132 outbreaks due to person to person spread (Table 16). More than one contributing factor was recorded for 31 (23.5%) of person-to-person outbreaks. The most commonly identified contributing factor was exposure to infected people (87 outbreaks). Contributory factors were identified and recorded for a larger proportion of person-to-person outbreaks in 2001 than in 2000.

Table 16: Probable factors contributing to person-to-person outbreaks, January – December 2001

Probable factors contributing to outbreak[1]	No. of outbreaks	Percent (n=132)
Exposure to infected people (eg droplet spread)	87	65.9
Poor hygiene of cases	30	22.7
Inadequate vaccination coverage	3	2.3
Inadequate vaccination effectiveness	5	3.8
Excessively crowded living conditions	2	1.5
Poor hygiene in nappy-changing area	1	0.8
No contributing factors identified	41	31.1

1 More than one contributing factor was recorded for 31 (23.5%) of the 132 person-to-person outbreaks

3.12.4 Zoonotic and environmental outbreaks

Identified contributing factors were recorded for 41 (91.1%) of the 45 outbreaks due to zoonotic or environmental transmission (Table 17). More than one contributing factor was recorded for 13 (28.9%) zoonotic or environmental outbreaks. The most commonly identified contributing factor was exposure to infected animals or animal products (27 outbreaks), followed by exposure to one or more contaminated environment(s) (16 outbreaks).

Table 17: Probable factors contributing to environmental and zoonotic outbreaks, January – December 2001

Probable factors contributing to outbreak[1]	No. of outbreaks	Percent (n=45)
Exposure to infected animals or animal products	27	60.0
Exposure to contaminated environment(s)	16	35.6
Exposure to contaminated swimming pool	7	15.6
Exposure to untreated recreational water	3	6.7
Exposure to contaminated play equipment	1	2.2
Exposure to contaminated duck pond	1	2.2
No contributing factors identified	4	8.9

1 More than one contributing factor was recorded for 13 (28.9%) of the 45 zoonotic or environmental outbreaks

B. Outbreak recognition, investigation and control

3.13 Reporting delay

For this section, the date that outbreaks were reported is defined as the first date that the public health service (PHS) was aware of the outbreak, either because it had been reported directly to the PHS or had been identified by the PHS. Of the 356 outbreaks for which a date of onset of illness in the first case was recorded, 304 (85.4%) were reported to a PHS within 30 days of onset, and 32 (9.0%) were reported to a PHS between 31 and 60 days of onset. The majority of outbreaks (54.2%, 193) were reported to a PHS within one week of onset. Eighty five percent of outbreaks (331/389) were entered onto the EpiSurv system within one month of the outbreak being reported to the PHS. Delays to outbreak reporting and recording on EpiSurv were similar to those of 2000.

The delay between date of onset of illness in the first case and the date that the outbreak was reported to the PHS varied by outbreak type. Common event outbreaks were generally reported soon after onset of illness (median of 2 days), while longer delays occurred to reporting of dispersed outbreaks (8 days), outbreaks in a specific place (13 days), community-wide outbreaks (36.5 days), institutional (20 days) and household (14 days) outbreaks (Table 18).

Of the 389 outbreaks reported during 2001, four outbreaks (1.0%) were reported as ongoing at the date the report was last updated. The date of onset of illness onset of illness in the last case was recorded in 348 (90.4%) of the remainder. Of these, 315 outbreaks (90.5%) were over by the time that the outbreak was reported to the PHS (ie, the date of onset of illness in the last case had occurred before the date that the outbreak was reported).

Table 18: Delay from onset of illness in first case to reporting of outbreak to public health service, by outbreak type

Outbreak type	Number	Median delay (days)
Common event	167	2.0
Dispersed	13	8.0
Specific place	33	13.0
Community-wide	8	36.5
Institutional	33	20.0
Household	87	14.0
Other type	4	23.5
Unknown type	11	1.0
All outbreaks	356	6.0

3.14 Recognition of outbreaks and linkage among cases

The means of recognising outbreaks were recorded for 367 (94.3%) of the 389 outbreaks reported during 2001. More than one means of recognition were recorded for 208 (53.5%) outbreaks, and a single set of circumstances was responsible for recognition of the remainder (159, 40.9%). Outbreaks were most often identified due to recognition that cases were linked to a common source (216/389, 55.5%), recognition that cases had attended a common event (165, 42.4%), or recognition that cases had person to person contact with other cases (146, 37.5%). Table 19 shows the number and proportion of outbreaks identified by each means.

Table 19: Recognition of outbreaks, January – December 2001

Means of recognition	No. of outbreaks[1]	Percent (n=389)
Cases linked to common source	216	55.5
Cases attended common event	165	42.4
Cases has person to person contact with other case (s)	146	37.5
Common organism type / strain characteristics between cases	49	12.6
Increase in disease incidence	38	9.8
Other means		
Cases were in the same family	2	0.5
Complaint of outbreak from doctor	1	0.3
Self reported by index	1	0.3
Information not available or unknown	22	5.7

1 More than one means of recognition was recorded for 208 (53.5%) of the 389 outbreaks

3.15 Control measures

Since collection of data on control measures did not commence until mid-2000, this is the first annual report that is able to present information on control measures from a complete year. Specific control measures were undertaken for 226 (58.1%) of the 389 outbreaks reported during 2001, an increase from the 46.2% of outbreaks reported in for the last six months of 2000. Information on whether any specific action was undertaken to control the outbreak was recorded for 334 (85.9%) of the 389 outbreaks. As in 2000, the most common outbreak control measure in 2001 was health education and advice for people working with the source (169 outbreaks), followed by advice on modification of procedures (73) (Table 20).

Table 20: Outbreak control measures undertaken, January – December 2001

Control measures undertaken to control outbreak[1]	No. of outbreaks	Percent (n=389)
Specific action taken	226	58.1
Control of outbreak source		
Health education and advice	169	43.4
Modification of procedures	73	18.8
Exclusion	34	8.7
Cleaning, disinfection	27	6.9
Isolation	12	3.1
Closure	5	1.3
Health warning	21	5.4
Treatment	15	3.9
Removal	8	2.1
Control of outbreak vehicle and vectors		
Removal	7	1.8
Treatment	5	1.3
Contacts and potential contacts		
Health education and advice	58	14.9
Chemoprophylaxis	3	0.8
Vaccination	3	0.8
Other control measures		
Other specified	39	10.0
No control measures	108	27.8
Control measures unknown	55	14.1

1 More than one control method was recorded for 130 (33.4%) of the 389 outbreaks.

4 DISCUSSION

Burden of disease attributed to outbreaks: A total of 389 outbreaks were reported to public health services during 2001 and subsequently received on EpiSurv by ESR, an increase from the 289 outbreaks reported in 2000.[7] This is the largest number of reported outbreaks in any year since outbreak reports began to be collated on EpiSurv, in 1996. The number of outbreak-associated cases also increased, although by a smaller proportion, from 2296 cases (1209 confirmed and 1087 probable) in 2000 to 2323 cases (1049 confirmed and 1274 probable) in 2001. The inconsistency between the increase in outbreaks and the increase in cases suggests that many of the outbreaks reported in 2001 were small, and this is supported by a decrease in the average number of cases per outbreak, from 7.9 in 2000 to 6.0 in 2001.

Cases of notifiable disease occurring as outbreaks comprise approximately 5% of all cases of these diseases notified during 2001. The proportion of cases of notified disease that occur as part of identified outbreaks is much higher for some diseases, notably shigellosis, salmonellosis, , hepatitis A, cryptosporidiosis and VTEC/STEC infection. If national person to person epidemics such as pertussis were included the burden of disease attributed to outbreaks would be very much higher again.

As in 2000, only a small proportion of outbreaks had serious outcomes. There were 78 hospitalised cases from 16 outbreaks, and two deaths. There were fewer of these serious outcomes in 2001 than in 2000. This cannot be explained by a difference in the types of pathogens implicated in 2001 outbreaks, as a larger number of outbreaks were due to severe illnesses (such as tuberculosis and meningococcal disease) in 2001 in comparison with 2000. Fewer outbreak-associated cases of salmonellosis and NLV were hospitalised in 2001 in comparison with 2000, although salmonellosis causes more hospitalisations among outbreak-associated cases than any other pathogen. The potential of individual outbreaks to have a severe impact is emphasised by one outbreak reported in 2001, in which 14 of 16 cases were hospitalised after consuming cake contaminated by cannabis oil.

Outbreak types: Common event outbreaks, in particular those resulting from a common event of exposure, remain the most common outbreak type. The prominence of common event outbreaks within the surveillance system reflects high awareness and identification of these outbreaks by public health services. Other types of common source outbreaks, such as dispersed outbreaks and those occurring in relation to a specific site, may be infrequent because they are more difficult to identify or because they genuinely occur less frequently. While common event outbreaks are often identified and reported by affected individuals in the community, detection of dispersed and specific site outbreaks requires greater scrutiny of routine surveillance data and integration of information sources, in particular between laboratory data and case reports.

While increased numbers of almost all types of outbreaks were reported in 2001 in comparison with 2000, the largest increase was observed among outbreaks within a defined setting. Almost three-quarters of the increase in outbreaks between 2000 and 2001 was comprised of outbreaks of this type. Most of the increase among outbreaks within a defined setting was observed among household outbreaks, which doubled in number between 2000 and 2001. This may have occurred for any or all of the following reasons: outbreaks within a household setting may have been occurring more frequently; they may be more readily

reported to public health services; or public health services may have been more likely to record these outbreaks on EpiSurv.

Geographic distribution of outbreaks: The geographic distribution of outbreaks reported in 2001 is very similar to that of previous years, with the majority of outbreaks reported from Auckland health districts. Health districts with particularly high rates of outbreaks for their population size include West Coast and Wanganui health districts, although interpretation of these rates should be made with caution because the numbers involved are small. No outbreaks were reported from Southland or Ruapehu health districts during 2001, and these health districts also had low numbers of outbreaks reported during 2000. These regional variations deserve more investigation to assess the extent to which they reflect differences in the underlying epidemiology of these diseases or are a function of differences in local surveillance and outbreak investigation practices.

Outbreak aetiology: As in 2000, *Campylobacter*, Norwalk-like virus (NLV) and salmonellae were the three most common causes of enteric disease outbreaks in 2001, and each contributed to more outbreaks than in 2000. Protozoa also accounted for more outbreaks in 2001 than in 2000, with the increase entirely due to outbreaks caused by cryptosporidia. This was reflected in the increase in both person-to-person and zoonotic outbreaks, both of which have cryptosporidia as an important cause. Illnesses due to toxin-producing organisms such as *Clostridium perfringens*, *Staphylococcus aureus*, and *Bacillus cereus* were slightly less common in 2001 than in 2000, but continued to contribute to a large number of outbreaks.

NLV outbreaks typically account for the largest number of cases among outbreaks with an identified pathogen, possibly because outbreaks caused by this organism need to be larger before they are noticed and because of the ability of NLV to infect large numbers of people in institutional settings. The number of outbreaks caused by NLV is likely to be greater than those identified here, as many outbreaks recorded as gastroenteritis (but with no organism detected) will have been caused by this pathogen. Analyses of data on outbreaks of infectious intestinal disease in the United Kingdom has shown that 43.4% of these outbreaks are due to small round structured virus (now termed NLV).[2] If the range of pathogens is similar between New Zealand and the United Kingdom, this suggests that a large proportion of NLV outbreaks are not reported to the New Zealand outbreak surveillance system.

As in previous years, outbreaks caused by non-enteric agents represent less than 10% of outbreaks. The pattern of causal agents tends to be less consistent from year-to-year, though tuberculosis, meningococcal disease, and chemical poisonings (including lead absorption) continued to feature in 2001, along with outbreaks due to agents previously unreported on the outbreak surveillance system, such as cannabis oil and dengue fever virus.

Outbreak setting: Outbreaks occurring in commercial food or household settings were again the most common settings for outbreaks in 2001, and the number of outbreaks in each setting increased between 2000 and 2001. Very few outbreaks were reported from rest homes or retirement homes, and none were reported from hospitals. This is in marked contrast to the distribution of outbreaks in England and Wales, where hospitals and residential homes for elderly people accounted for 63% of outbreaks reported to the Public Health Laboratory Service (PHLS) in 1995 and 1996,[2] and generally involved person-to-person spread of viral agents. This may be because the PHLS system receives information on outbreaks directly from all laboratories, whereas New Zealand system is restricted to including information

collected by public health services, reference laboratories at ESR and the two public health laboratories. The New Zealand outbreak data may be underestimating the burden of disease associated with outbreaks in residential homes and hospitals, if the PHLS data can be applied to New Zealand. Surveillance of hospital-acquired infections and formal linkages between hospital infection control and public health service staff are poorly developed in NZ.

Households continue to be very common settings for outbreaks reported to public health services. The source and mode of transmission of such outbreaks is often difficult to determine when family members regularly eat meals together, food is rarely available for testing, and secondary transmission may be high. The focus of investigating such outbreaks should be on identifying situations where an external common source is implicated or where a particularly serious pathogen is involved. Household outbreaks should only be recorded on EpiSurv if they involve two or more cases linked to a common source, ie, excluding where all except the index case are due to secondary transmission.

Mode of transmission: The most common modes of transmission in 2001 were foodborne and person-to-person contact, as was seen in 2000, 1999 and 1998. As mentioned above, the number of outbreaks with person-to-person and zoonotic modes of transmission increased from 2000 to 2001. These finding emphasises the importance of educating individuals with infectious disease, in particular enteric disease, about the need to maintain scrupulous hygiene to prevent secondary disease transmission. Hygiene after handling animals, in particular before food handling or food consumption, is also very important.

Foods implicated in foodborne outbreaks: As previously recognised, foods such as poultry and seafood dishes were identified as important sources of foodborne outbreaks reported in 2001. This annual summary also provides information about the disease agents identified in association with particular foods implicated in foodborne outbreaks, and describes the level of evidence with which the particular foods were implicated. Strong evidence linked undercooked chicken livers to outbreaks of campylobacteriosis, raw eggs and egg-containing sandwiches to outbreaks of salmonellosis, inadequately cooked or heated meat dishes to *Clostridium perfringens* and *Staphylococcus aureus* outbreaks, and food handling to NLV outbreaks. This type of data underlines the value of the outbreak surveillance system, whereby reports from multiple outbreaks will gradually build up a picture of the common high risk foods and common food handling faults that contribute to outbreaks of enteric disease in New Zealand. Outbreaks are a better means of identifying previously unknown risk foods and other exposures than individual case reports, as individual recollections of the cause of illness may be strongly influenced by the presence of widely-known risk factors. This information needs to be communicated effectively to food safety agencies and the food industry so it can be used to guide future prevention measures.

Factors contributing to outbreaks: Abuse of temperature was again the main contributing factor to foodborne outbreaks, and contributed to a larger number and proportion of foodborne outbreaks in 2001 than in 2000. Education of food handlers about basic food handling and food hygiene, as part of a comprehensive food safety programme, is clearly important. Consumption of water from an untreated supply was the main factor contributing to waterborne outbreaks. The importance of treating or filtering drinking water, in particular roof water supplies, should be emphasised.

Outbreak recognition, investigation and control: The majority of outbreaks were reported to public health services within a week of onset of illness in the first case. Timely recognition of outbreaks is very important, as the probability of identifying a microbiological aetiology in illnesses (and therefore outbreaks) with unknown cause is often dependent on minimising the delay to collection of specimens.[8] Analysis of data collected for this report has shown that it takes significantly longer to identify specific site, community-wide, institutional and household outbreaks than common event outbreaks.

Recognition of outbreaks is largely dependent on recognition of a common link between cases or realisation that cases have attended a common event. Identification of an increase in disease incidence or occurrence of common organism type or strain were less important in outbreak recognition. Recognition of outbreaks from increases in disease incidence and occurrence of common organism type is a marker of the regular examination and integration of surveillance data on laboratory-identified and clinically reported cases, at a national as well as at a district level.

Specific actions were taken to control a greater proportion of outbreaks reported in 2001 than in 2000. Of these actions, health education and advice were the most commonly used measures, followed by advice on modification of procedures. Information on control measures has been collected by the outbreak surveillance system only since July 2000, so conclusions based on the comparison between the 2001 and the limited 2000 data can only be drawn with caution. Modification of procedures has been relatively frequently used, and this may be a result of use of environmental investigations involving hazard analysis critical control points (HACCP) investigation.

The data from 2001 suggest that strong control measures (premises closure, health warnings, isolation) are used in only a minority of outbreaks. Although lack of use of these measures may be entirely appropriate, it is also likely that if strong evidence (ie, from environmental, epidemiological or laboratory investigation) has been collected to implicate a particular outbreak source, this may enable implementation of strong control measures.

Data limitations: There are two main types of limitations in the data recorded on the outbreak surveillance system. Firstly, the outbreak surveillance system does not record information on all outbreaks that would meet the case definition. The system only records outbreaks that have been identified by local public health services (PHSs) and entered onto the database. Certain types of outbreaks are more likely to be identified and reported, for example, those involving unusual organisms or serotypes, that cause large numbers of cases, that occur in well defined settings and groups, and that occur in parts of New Zealand with more vigorous investigation services. Outbreaks caused by notifiable diseases such as *Salmonella* are more easily recognised by local PHSs than those caused by non-notifiable diseases such as gonorrhoea. The PHSs also have a clearer mandate to investigate and report on outbreaks in some settings, such as food premises, than others, such as hospitals. Outbreaks occurring in these other settings may not come to the attention of the PHS, and therefore not be entered on the surveillance system. Some established national epidemics, such as the pertussis epidemic which caused 1335 cases in 2001, have deliberately not been included in the outbreak total, though there is an argument for doing this.

Secondly, the data recorded on reported outbreaks is not always complete or consistent. Fields are not always filled out, and some outbreaks are never fully updated on EpiSurv after first being entered prior to or early in the investigation.

Despite these limitations, outbreaks provide an opportunity to identify the source for many infectious diseases, notably the enteric diseases. Risk factors and potential intervention points can also be identified. Reports on individual outbreaks, and aggregate data of the type contained in this report can be useful sources of information in policy formulation. The Institute of Environmental Science & Research Limited will be exploring ways to progressively improve the quality of data collected by the outbreak surveillance system, and to improve the dissemination and availability of outbreak surveillance information.

APPENDIX

A: Abstracted outbreaks reports 2001

The following is a selection of abstracted outbreak summaries from 2001. These were chosen because of their size, or because they illustrate the use of specific investigation methods.

Outbreak of *Campylobacter* in Hawkes Bay traced to a school water supply

During May 2001 an outbreak of campylobacteriosis occurred at a boarding school in Hawkes Bay. The outbreak came to the attention of the Hawkes Bay Public Health Unit when the school nurse phoned on 24 May 2001 to enquire about appropriate methods for cleaning the hostels after episodes of diarrhoeal illness among students during the preceding two weeks. Students had initially consulted general practitioners and had been clinically diagnosed with viral gastroenteritis, but testing of faecal specimens collected from two students enabled laboratory confirmation of *Campylobacter* infection.

An epidemiological investigation of the outbreak was conducted. During 2001 the school had a roll of 220 pupils (210 boarders and 10 day-pupils) and a staff of 45, approximately 30 of these resided on site with their families. A total of 295 individuals were considered to have been exposed. Outbreak questionnaires were completed by 182 of the 295 people identified at the school, a response rate of 62%. One hundred and thirty seven (75%) of those who responded had had diarrhoea, vomiting, nausea, stomach pains, headache or fever - headache was the most frequently reported symptom (72%). Attack rate (confirmed cases) was 52% (63% including probable). The median age of cases was 14 years and the median duration of illness was 7 days. No significant exposures were identified. The outbreak was not restricted to any particular class or hostel.

Investigation into the school water supply was also undertaken. The school was found to have its own water supply from a spring which drained into a swamp where cattle frequently graze the surrounding area. Ultraviolet treatment of the water supply was on site. *Campylobacter* organisms were isolated from the school water supply both pre and post treatment, from cattle faeces around the water source and from sewage effluent at the inlet to the school's oxidation pond. DNA/PCR assay has confirmed that these organisms were the same strain of *Campylobacter*. Unfortunately, isolates from human faecal specimens were not available for DNA/PCR assay.

The UV treatment system malfunctioned on or about the 18 May and replacement components were not installed until 21 or 22 May. It is likely that the UV treatment system was not working adequately for some time before the UV system malfunctioned.

Temporary manual chlorination of the water supply was advised on initial investigation of this outbreak and is to continue whilst suitable long-term water treatment options are considered. As chlorination is not a long-term option due to a high level of organic material in the water and the potential interaction with trihalomethanes, the Public Health Unit continues to work closely with the Board of Trustees.

Reported by Caroline McElnay (Medical Officer of Health) and Ian Inkson (Health Protection Officer), Public Health Unit, Hawkes Bay.

Outbreak at an outdoor education camp in Auckland

Auckland Public Health Protection Service investigated an outbreak of presumed viral infection among a school group attending an outdoor education camp between 30th April and 4th May, 2001. A total of 147 (60.5%) cases out of the 243 people attending the camp suffered a range of symptoms including abdominal cramps (91.2%), diarrhoea (55.1%), headache (78.9%), nausea (29.9%), lethargy (73.5%), vomiting (29.9%), fever (37.4%), runny nose (27.9) and sore throat (29.3%). Illness onset was a median of 12 days from the first day of the camp and was severe with 23.1% of cases attending a doctor. Illness lasted a median duration of 6 days but in some there was evidence of a 'post-viral syndrome' of lethargy, nausea and abdominal cramps. Bacteria and protozoa were excluded as causes, but a specific virus causing the illness was not identified.

Illness was brought to the camp by members of the school group, as nine cases occurred while there. Campylobacteriosis in two of those who attended the camp was coincidental. The outbreak was point source in nature with a high attack rate suggesting widespread exposure to the infectious agent.

A number of potential risk factors for illness were investigated. Drinking water (RR 2.09, 95% CI 1.12-3.91; p=0.0019) accounted for approximately 50% of illness following the camp and a dose-response relationship between number of occasions of water consumption and illness was found. However, other sources of illness included immersion in the duck pond (RR 1.48, 95% CI 1.23-1.78; p=0.0002), toast (RR 1.52, 95% CI 1.03-2.23; p=0.0116), toast toppings (RR 1.27, 95% CI 0.98-1.64; p=0.0551) bread (RR 1.33, 95% CI 0.94-1.89; p=0.0716) and fruit (RR 1.47, 95% CI 1.00-2.16; p=0.0197). No food handlers were identified as ill during the camp. Direct transfer of the virus from person to person was unlikely to have caused the majority of illness. This is because a large number of cases occurred among groups who used the camp after 4th May and who did not have direct contact with students during the incubation period. Contamination of environmental surfaces in the dining and ablution blocks was likely as there were no towels to dry hands to a level necessary to prevent the transfer of germs in the toilet areas.

The camp was affected by a major flood event on 2nd May, 2001. There was no increased risk of illness for any of the outdoor activities, either before or after the flood and no evidence that there had been a breakdown in the sewerage system during or after the event.

There were also some food hygiene issues identified that may have contributed to the spread of illness. These included structural shortcomings in the kitchen including the absence of a wash hand basin, cross-contamination from a water hose and potential access to vermin. The re-use of condiments and butter and the failure to wash fruit before consumption may also have contributed. The washing up process had the potential to cross-contaminate crockery, plates and cutlery and ideally these items should be communal and washed in a commercial dishwasher.

An investigation into the water supply showed low-level contamination by E. coli, a bacterium associated with faecal contamination. However, this level was not significantly higher than a reading from 18 months earlier and there had not been any illness reported in those using the camp prior to the school group. Nevertheless, the camp water supply can be

defined as a community water supply and should comply with the New Zealand Drinking Water Standards (2000). The measured level of contamination of the water supply represents a health hazard.

Recommendations include:
That the outdoor education camp install a water treatment system in order to provide water of sufficient quality to meet the NZ Drinking Water Standards and that this be monitored regularly.
That the duck pond be sign-posted as being hazardous and that the potential risks of immersion in the pond be communicated to groups using the camp by management.
That soap and towels be provided in the toilets and the towels are changed regularly or single-use towels are installed.
That towels be used on entry to the dining area in future camps when children wash their hands before meals
That a wash hand basin is installed in the kitchen, the flexible hose is removed from the washing up tap and that the holes allowing access to vermin are covered.
That consideration is given to the use of communal plates, utensils and crockery and that the installation of a commercial dishwashing machine be considered.

Reported by Greg Simmons, Auckland District Health Board Public Health Protection.

Outbreak of *Salmonella* Typhimurium 135 infection among food handlers in Taranaki

During January/February 2001 ten cases of *Salmonella* Typhimurium 135 infection occurred among food handlers at a Taranaki supermarket. Cases were reported between 20 January 2001 and 15 February 2001. Nine of the ten cases worked in the delicatessen or bakery areas of the store. No cases of *Salmonella* Typhimurium 135 infection were identified in the surrounding community.

Investigation into the outbreak was undertaken jointly by Taranaki Health health protection officers and the environmental health officer from the territorial authority. The investigation included faecal screen testing, environmental investigation, interviews with staff and food surveys.

The faecal screen testing of staff in the delicatessen and bakery areas identified one asymptomatic carrier of *Salmonella* Typhimurium 135. The environmental investigation identified dirty tea towels in the staff tea-room which were allegedly used by some staff as hand towels. Adequate hand washing facilities were not available in the tea-room, which was in contrast to the new hand washing and drying facilities provided in the shop. Staff were questioned regarding possible contact with each other outside work, but no significant events or contact had occurred. Although there were small social clusters within the group, others who were ill had no contact outside work at all. Staff surveys of foods eaten identified that nearly all staff occasionally ate food from their own department in the supermarket, but no common foods were eaten outside of the supermarket.

It was not determined exactly how the transmission of the infection occurred, however it was clear that faecal oral transmission was facilitated through a lack of hand washing by at least one of the workers. The spread of the disease indicated person to person rather than single

point source transmission, since there were intervals of up to a week between notification dates.

On becoming aware of the incident the supermarket acted decisively to contain the situation; staff were excluded immediately from the delicatessen and bakery areas once onset of symptoms occurred (or a carrier was identified) and were given alternative non-food handling work until clear; ongoing training was to be provided with regard to hand washing and personal hygiene in a food premise; the food safety programme that the supermarket had recently presented to the Ministry of Health for approval was to be amended to include these concerns; and a dishwasher was installed and hand washing facilities provided in the staff tea-room.

This outbreak serves as a reminder of the importance of the basic essentials of personal hygiene such as hand washing and the exclusion of food handlers who have symptoms of gastroenteritis from working with food.

Reported by Murray Lowe, Health Protection Officer, Health Protection Unit, Taranaki

Outbreak of giardiasis in Bay of Plenty and Manawatu

A giardiasis outbreak was identified, consisting of 14 confirmed cases occurring between April and July 2001. The 14 cases were from four households, comprising the following (with report dates in brackets):

Household #1: Galatea – Mother (14 May) and all four children (28 May)
Household #2: Murupara – Mother (14 May) and two of four children (18 May)
Household #3: Murupara – Child (23 May)
Household #4: Palmerston North – Mother (20 June) and four children (18 June, 20 June, 4 July, 4 July).

The suspected source was poor maintenance of a creek drinking water supply treatment at the Galatea farm property, at household #1. The owners had recently removed the course filter at the creek due to ongoing clogging. The under-sink filter cartridge was also replaced with one of unknown specifications (such as Giardia removal) from a door-to-door salesman. It is likely the UV lamp in use required maintenance and was unable to kill all pathogens from the poorer than usual quality of incoming water.

Interviews with the cases and their families identified links between all four households. Members of household #4 had stayed with the Galatea household (#1) between 9 - 20 April, during the school holidays, and therefore had direct access to the creek drinking water supply at household #1. Children from household #1 attended the Murapara kindergarten, which was also attended by members of household #2. The child from household #3 did not attend the kindergarten, but the mother from household #2 acted as a babysitter for this child. Transmission of infection is therefore likely to have been waterborne in the first instance, with subsequent person-to-person transmission.

As a result of this outbreak (and ongoing concerns), local water filter retail/service providers were contacted with a view to reducing the risks for individual rural water supply owners

from poor filter maintenance. One option being considered was a push for maintenance instructions (including replacement specifications) on the side of filter cartridge cases.

Reported by Chris Webber, Health Protection Officer, Toi Te Ora Public Health, Rotorua

An outbreak of *Shigellosis* at a children's health camp

In January and February 2001 an outbreak of *Shigellosis* occurred at a children's camp. The camp was the first under new management and the campers were selected on the basis of social dysfunction. Ninety-six people met the investigative case definition used by the Public Health Unit of the Auckland District Health Board. Thirty of the cases were ill (no data was available for 2 cases). Typically cases presented first with a fever, headache, and upper gastrointestinal discomfort and then progressed to diarrhoea within 24 hours.

The first student became unwell on the 28 January. No staff member was unwell until the 13th February, over two weeks later. On February 18 control measures including isolation of any students and exclusion from work of any staff who became ill and an increased emphasis on hand hygiene were put in place. Those who became ill where treated with antibiotics by the camp doctor. The camp was closed on February 20. Staff and students sent home were followed by health protection officers and public health nurses under active surveillance. Staff who had been unwell were required to have two negative clearance specimens before returning to work.

Epidemiological investigation involved a retrospective cohort study to establish attack rates, cohort demographics, illness onset dates, and risk factors that did not vary over time. A case-control study was undertaken to assess exposures that varied over time. A questionnaire was administered to all camp staff, camp school staff, and children at the camp (see Table 1). Statistical analysis was performed using Epi Info version 6.04b and SAS, and included conditional logistic regression to assess for confounding of risk factors. Microbiological investigation involved asking all cases to submit two faecal specimens, if not already provided, regardless of whether their illness had resolved already. The swimming pool was tested for faecal indicators and *Shigella* species. An environmental investigation of the site, including the swimming pool and an assessment of food safety procedures was undertaken to identify areas where controls were lacking.

Table 21: Characteristics of those interviewed at the Health Camp

Characteristic	Student n=43	Staff/teacher n=53	Total N=96
No data	2	0	2
No. ill (Attack rate)	15 (37%)	15 (28%)	30 (33%)
Age*	9(6-12)	34(14-61)	21(6-61)
Gender (M/F)	28/13	11/42	39/55
Ethnicity			
European	12(29)	39(74)	51(54)
Maori	18(44)	6(11)	24(26)
Pacific Island	7(17)	4(8)	11(12)
Other	4(10)	4(8)	8(9)
Symptoms			
Duration* days	3(1-12)	3(1-12)	3(1-12)
Vomiting n(%)	9(60)	3(20)	12(41)
Diarrhoea n(%)	15(100)	15(100)	30(100)
Other** n(%)	11(75)	10(67)	21(70)

*median(range), **one or more of: fever, headache, nausea, abdominal cramps

The epidemiological investigation showed that the attack rate was higher in the students (37%) than the staff and teachers (28%), but this was not statistically significant (p=0.4). The duration of the illness was essentially the same for students, staff and teachers. Overall a higher percentage of students (60% versus 20%) had vomiting as part of their illness. This difference was also not statistically significant (p=0.06).

Assessment of risk factors that were constant over time show that Maori and Pacific Island staff/teachers were more likely than European or 'other' ethnicities to become ill (Table 2). These findings were statistically significant. However Maori and Pacific Island staff tended to have more hands on (and less administrative) components to their work. Pacific Island students and those of 'other' ethnicity were more likely than European or Maori students to become ill.

Table 22: Assessment of risk factors for illness

Risk factor	Ill n (%)	Not ill n (%)	Relative risk (95%CI*)
Student			
Male gender	11(79)	17(65)	1.3(0.5-3.3)
European	2(13)	10(38)	0.4(0.1-1.4)
Maori	5(33)	13(50)	0.7(0.3-1.7)
Pacific Island	5(33)	2(8)	2.6(1.3-5.4)
Other Ethnicity	3(20)	1(4)	2.5(1.1-5.2)
Staff/teacher			
Female gender	14(93)	28(74)	3.7(0.5-25.0)
European	8(53)	31(82)	0.4(0.2-0.9)
Maori	4(27)	2(5)	2.9(1.3-6.1)
Pacific Island	3(20)	1(3)	3.1(1.5-6.5)
Other Ethnicity	0	4(11)	0.7(0.1-4.2)

*confidence interval

The matched case-control study showed that for students there was a non-statistically significant increased risk for those who swam at the school pool, played in the sandpit, or who had contact with human faeces (Table 3). Using the school toilet appeared to be protective. For staff, there was a non-statistically significant increased risk for those who had contact with human faeces, those who used the kitchen or the clinic toilets, and those who ate camp food while at work.

The microbiological analysis of the swimming pool showed compliance with the microbiological water quality criteria for public pools as outlined on page 13 of the NZ Standard Pool Water Quality 58626:2000. *Shigella* species was not isolated.

Environmental inspection and an assessment of food safety procedures identified several areas where controls were lacking. Corrective actions including documentation of policies/procedures for ill food handlers and faecal accidents were listed as recommendations.

Table 23: Assessment of risk factors for illness by case-control study

Risk factor	Ill n (%)	Not ill n (%)	Odds ratio (95%CI*)	Estimated Relative risk (95%CI*)
Student				
Swim school pool	9(69)	13(50)	2.3(0.5-10.9)	1.6(0.4-7.1)
Play sand pit	8(62)	11(42)	3.5(0.5-27.9)	2.2(0.3-16.9)
School toilet	11(85)	24(92)	0.5(0.4-9.3)	0.6(0.5-11.6)
Contact human faeces	3(23)	2(8)	5.0(0.4-64.0)	2.1(0.2-26.7)
Staff				
Contact human faeces	6(43)	4(14)	3.0(0.8-10.8)	2.1(0.6-7.7)
Kitchen toilet	6(43)	8(29)	1.7(0.4-6.4)	1.4(0.4-4.6)
Clinic toilet	7(50)	12(43)	1.3(0.3-6.6)	1.2(0.2-5.9)
Visitor toilet	6(43)	12(43)	1.0(0.4-3.3)	1.0(0.4-3.3)
Ate camp food	11(79)	11(39)	3.8(1.1-13.9)	2.7(0.8-9.5)
All				
Contact human faeces	9(33)	6(11)	3.4(1.1-10.3)	2.0(0.6-6.1)

*Confidence interval

In conclusion, the inexperience of the new management at the camp, the social background of the children, the long duration of the camp, and the lack of permanent and epidemic hygiene control measures, all conspired to facilitate the development of this outbreak. No one cause was outstanding and it is likely that multiple points of hygiene breakdown lead to the high attack rate among both children and staff.

Reported by Auckland District Health Board Public Health Protection

Campylobacteriosis outbreak linked to Christmas function in Wairarapa

An outbreak of campylobacteriosis was associated with a Christmas work function at a Wairarapa hotel in December 2001. The outbreak investigation was initiated following recognition that two campylobacteriosis notifications were linked to the same function.

Investigation involved an interview using a standard foodborne illness questionnaire. Contact details of all persons attending the function were obtained from the organisers. Details of menu items consumed and whether any illness had occurred (including symptoms) were collated. All persons who attended the function were asked to submit a stool sample. Samples of untreated water used in food preparation were also taken for analysis. As 10 attendees and the three other staff members (two staff members were involved in the food preparation) from the hotel did not appear to have developed symptoms, a retrospective cohort study was carried out. An environmental investigation of the site, including a HACCP analysis was performed. Data was analysed using Excel and standard food and waterborne disease analysis procedures.

Nineteen people had attended the function, eight of whom suffered symptoms of illness (diarrhoea and three to four other symptoms including lethargy, chills, general malaise and dizziness). The incubation period ranged from one to five days. One case was hospitalised and illness persisted in this case and three others for greater than seven days.

All cases reported consuming a variety of food items available at the hotel function, which was a buffet meal. Table 1 shows the findings from analysis of the various foods. Analysis of all meal items indicated that statistically, the sliced roast pork with gravy was the most likely source of illness. The pork meal attack rate for the case group was higher than the control group and the relative risk (6.7) was significantly greater than 1.0. The confidence interval and p value further supported the suspect associated of illness and the pork dish. Confidence intervals and p values for other food items with relative risks greater than 1.5 were also calculated. The results were not statistically significant. The use of potentially contaminated water was not supported by statistical analysis. However the investigators still considered it a likely source. None of the suspected pork meal was available for sampling.

Three of the four specimen samples given were positive for *Campylobacter sp*. A further specimen was negative, however this individual had been asymptomatic for several days by the time the sample was provided. The analysis of the roof water sample showed faecal coliform contamination (59 *E. coli* /100mL).

The HACCP analysis highlighted several food safety practices which may have caused the outbreak including possible time/temperature abuse of the pork roast, inappropriate use of untreated water for food preparation, and unknown temperature of food in hot holding appliance. Several other food safety issues were also observed; storage of food items in beer chiller, separation of raw food and cooked food, and no formal food safety training among all staff. The source of the contamination in this case is unknown (high numbers of *Campylobacter* are likely to be associated with raw meat and food handlers with poor hygiene). Several recommendations were given including the development of a food safety programme.

Table 24: Attack rates and relative risks for 22 individuals attending Wairarapa hotel Christmas function

Item	*People Eating Item*			*People Not Eating Item*			RR	95% Confidence interval
	Ill	Total	Attack Rate (%)	Ill	Total	Attack Rate (%)		
Shrimp	7	18	39	1	4	25	1.6	0.3 – 9.4
Mussel	4	14	29	4	8	50	0.6	0.2 – 1.7
Fish	5	14	29	4	8	50	0.6	0.3 – 1.9
Pork	8	12	67	1*	10	10	6.7	1.0 – 45.0
Chicken	5	15	33	3	7	43	0.8	0.3 – 2.4
Ham	7	14	50	1	8	13	3.8	0.6 - 13.8
Potato	7	17	41	1	5	20	2.1	0.3 – 13.0
Green Salad	8	18	44	1*	4	25	1.8	0.3 – 10.5
Coleslaw	7	20	35	1	2	50	0.7	0.2 – 3.2
Tomato	5	16	31	3	6	50	0.6	0.2 – 1.8
Brandy Snaps	3	9	33	5	13	38	0.9	0.3 – 2.7
Christmas Cake	2	5	40	6	17	35	1.1	0.3 – 4.0
Water	1	5	20	7	17	41	0.5	0.1 – 3.1

* The actual number of ill is 0. One was inserted to enable calculation.

In conclusion, while samples were not available to confirm the link between cases and the suspect meal, the most likely sources of the outbreak was thought to be either the sliced roast pork with gravy dish or untreated roof water supply. Poor storage and handling practices and inadequate time and temperature controls could have contributed to the contamination of the pork dish.

Reported by Health Protection, Choice Health Wairarapa

Dispersed outbreak of *Salmonella* Typhimurium DT160

Background: Forty-five cases of *Salmonella* Typhimurium DT160 (STM160) were identified during May 2001. The increasing incidence due to this *Salmonella* strain, particularly in Auckland, and the high frequency of raw egg consumption suggested a possible dispersed common source of infection.

Methods: A case-control study and environmental investigation were undertaken to identify the source of this outbreak. The environmental investigation involved sampling shell eggs and roof-collected rainwater supplies of exposed cases in Auckland, and an investigation of egg farms (results not available). For the case-control study, cases were identified from *Salmonella* isolates received by the Enteric Reference Laboratory at ESR. All cases with onset of illness after 28 April and notified before 31 August 2001 were eligible for inclusion. Age and suburb matched controls were identified from residential telephone directories. Two controls were matched with each case. Cases and controls were interviewed by telephone by public health service staff using a standardised questionnaire. Matched analyses were done using SAS statistical software.

Results: In the investigation of roof-collected rainwater supplies, eight Auckland residential supplies were tested. STM160 was isolated from four of these supplies. In the investigation of shell eggs, samples were collected of six different egg brands. *Salmonella* species, although not STM160, were isolated from shell surface samples of two brands. Of the individuals identified by the ERL as culture positive for STM160 from participating health districts during the study period, 66.1% (119/180) were included in the study. Contact with wild birds (matched odds ratio [mOR] = 12.3, 95% confidence interval [CI]: 2.8-54.6), contact with another individual with diarrhoea and vomiting in the prior 28 days (mOR = 3.1, CI: 1.7-5.7), and consumption of takeaway food (mOR = 1.7, CI: 1.04-2.8) were all found to have a significant and independent association with infection. Takeaway food consumption alone explained 27% of illness, contact with an ill person explained 13% and contact with a wild birds 11% It was not possible to obtain valid epidemiological estimates of risk associated with roof-collected rainwater supplies.

Conclusion: Wild bird contact, takeaway food consumption, and person-to-person transmission all have important associations with the recent epidemic of STM160. The high proportion of roof-collected rainwater supplies contaminated by STM160 suggests that this is also an important source of illness that could also be plausibly linked to the STM160 outbreak that was occurring in birds at the same time. No single common source was identified, suggesting that the pathogen has come to occupy a range of ecological niches. Recommendations are made for emphasising the importance of personal hygiene, close attention to the investigation of future outbreaks especially when takeaway foods are implicated, and prompt investigation of future emerging *Salmonella* serotypes.

Reported by Craig Thornley, ESR

B: Outbreak report form

[See following pages]

OUTBREAK REPORT FORM

OUTBREAK SUMMARY

Outbreak No.

Reporting Authority

Name of public health officer responsible for investigation _____

Date outbreak reported _____ / _____ / _____ (Day / Month / Year) ☐ **Interim report** ☐ **Final report**

Disease and Implicated Pathogen, Toxin or Chemical

Name of implicated pathogen, toxin or chemical (if known) _____ **subtype** _____

Unknown pathogen ☐ Gastroenteritis

☐ Other illness (specify) _____

CASE DEFINITION(S)

Laboratory-confirmed case _____

_____

Other confirmed case _____

_____

Probable case _____

_____

Outbreak Demographics

Number of cases

Lab-confirmed (as per case defn above) _____ Number hospitalised _____

Other confirmed (as per case defn above) _____ Number died _____

Probable (as per case defn above) _____

Total _____

Outbreak dates

Onset of illness in first case _____ / _____ / _____ (Day / Month / Year)

Onset of illness in last case _____ / _____ / _____ (Day / Month / Year) or ☐ Outbreak ongoing

Age of cases Median age (years) _____ Range (years) _____

Sex of cases Number of males _____ Number of females _____

Incubation period Median _____ ☐ days ☐ hrs Range _____ ☐ days ☐ hrs

Duration of illness Median _____ ☐ days ☐ hrs Range _____ ☐ days ☐ hrs

Circumstances of Exposure/Transmission

How was the outbreak recognised and links among cases established? (tick all that apply)

☐ Increase in disease incidence
☐ Cases attended common event
☐ Cases linked to common source (eg food, water, environmental site)
☐ Cases had person to person contact with other case(s)
☐ Common organism type/strain characteristics between cases
☐ Other means (specify) _____

Type of outbreak (tick one)

☐ Common event
☐ Common source dispersed in community (eg food, water)
☐ Common source in specific place (eg environmental site, farm animals)
☐ Community-wide, person to person transmission
☐ Institutional (transmission within a defined setting)
☐ Household (transmission within a single household)
☐ Other outbreak type (specify) _____
☐ Unknown outbreak type

Were these cases part of a well-defined exposed group?
(eg. Common event, insititutional, environmental, household) ☐ Yes ☐ No ☐ Unknown

If yes, number exposed _____

Date of exposure _____ / _____ / _____ If exposure >1 day, date exposure ended _____ / _____ / _____

Description of exposure event _____

Setting where exposure/transmission occurred or contaminated food/beverage was prepared for consumption
(tick all that apply). *Note – If food was prepared at a different place to where it was consumed, tick each box that applies.*

- ☐ Home
- ☐ Hostel/boarding house
- ☐ Hotel/motel
- ☐ Rest home
- ☐ Hospital (continuing care)
- ☐ Hospital (acute care)
- ☐ Prison
- ☐ Farm
- ☐ Tangi/hui
- ☐ Camp
- ☐ Community/church gathering
- ☐ Childcare centre
- ☐ School
- ☐ Swimming/spa pool
- ☐ Workplace (specify type of workplace) _____
- ☐ Restaurant/café
- ☐ Takeaway
- ☐ Supermarket/delicatessen
- ☐ Caterers
- ☐ Abattoir/meat processing plant
- ☐ Other food outlet
- ☐ Other setting (specify) _____
- ☐ Unknown

Name of setting (if applicable) _____

Address _____
Number Street

_____
Suburb Town/City

Geographic location where exposure/transmission occurred (tick one)

- ☐ Single health district (specify) _____ TLA (specify) _____
- ☐ Multiple health districts (specify) _____
- ☐ Overseas (specify country) _____
- ☐ Unknown

Mode of transmission (tick all that apply)

- ☐ Foodborne, from consumption of contaminated food or drink (excluding water)
- ☐ Waterborne, from consumption of contaminated drinking water
- ☐ Person to person spread, from (non-sexual) contact with an infected person (including droplets)
- ☐ Sexual, from sexual contact with an infected person
- ☐ Parenteral, from needle stick injury or reuse of contaminated injection equipment
- ☐ Environmental, from contact with an environmental source (eg swimming)
- ☐ Zoonotic, from contact with an infected animal
- ☐ Vectorborne, from contact with an insect vector
- ☐ Other mode of transmission (specify) _____
- ☐ Unknown mode of transmission

Vehicle/source of common source outbreak

Was a specific contaminated food, water or environmental vehicle/source identified? ☐ Definite ☐ Suspect ☐ No ☐ Unknown

If suspected or definite, list all vehicles/sources in detail _____

_____

Was the vehicle/source linked to a commercial operator? ☐ Yes ☐ No

If yes, list all operators and record whether each had a Ministry of Health approved food safety plan (FSP) in place.

Name of food operators	MoH approved FSP in place?
_____	☐ Yes ☐ No ☐ Unknown
_____	☐ Yes ☐ No ☐ Unknown
_____	☐ Yes ☐ No ☐ Unknown

Evidence for mode of transmission and vehicle/source (tick all that apply)

- ☐ Epidemiological – cases had history of exposure to implicated source
- ☐ Epidemiological – case control or cohort study showed elevated risk for cases exposed to implicated source
- ☐ Laboratory – pathogen/toxin/chemical suspected to have caused illness identified in implicated source eg. leftover food, water, animal or environmental source
- ☐ Laboratory – pathogen suspected to have caused illness identified in food handler
- ☐ Environmental investigation – identified critical control point failures linked to implicated source
- ☐ Other evidence (specify) _____
- ☐ No evidence obtained

Factors Contributing to Outbreak

Foodborne outbreak (tick all that apply)

Time/temperature abuse
- ☐ Inadequate reheating of previously cooked food
- ☐ Improper storage prior to preparation
- ☐ Inadequate thawing
- ☐ Preparation too far in advance
- ☐ Undercooking
- ☐ Improper hot holding
- ☐ Inadequate cooling or refrigeration

Contamination of food
- ☐ Cross contamination
- ☐ Chemical contamination
- ☐ Contamination from an infected food handler

Unsafe sources
- ☐ Use of ingredients from unsafe sources
- ☐ Consumption of raw food
- ☐ Consumption of unpasteurised milk
- ☐ Use of untreated water in food preparation

- ☐ Other factor (specify) _____
- ☐ Unknown factors

Factors Contributing to Outbreak contd

Outbreak No.

Waterborne outbreak (tick all that apply)

- ☐ Contamination of source water
- ☐ Treatment process failure
- ☐ Post treatment contamination
- ☐ Other factor (specify) _____
- ☐ Unknown factors
- ☐ Untreated water supply
- ☐ Contamination of reservoir(s)/holding tank(s)

Specify the implicated supply distribution zone Zone code _____ ☐ Unknown

Other outbreak (tick all that apply)

Person to person

- ☐ Inadequate vaccination coverage
- ☐ Inadequate vaccination effectiveness
- ☐ Exposure to infected people
- ☐ Poor hygiene of cases
- ☐ Excessively crowded living conditions
- ☐ Unprotected sexual activity
- ☐ Needle/syringe reuse by injecting drug users
- ☐ Other factor (specify) _____
- ☐ Unknown factors

Environmental

- ☐ Exposure to contaminated environment(s)
- ☐ Exposure to infected animals or animal products
- ☐ Exposure to untreated recreational water
- ☐ Exposure to contaminated swimming pool
- ☐ Exposure to inadequately maintained swimming pool

Evidence for implicating a contributing factor

- ☐ Environmental investigation – identified critical control point failure(s)
- ☐ Other evidence for factor contributing to outbreak (specify) _____

Management of the Outbreak

Was any specific action taken to control the outbreak? ☐ Yes ☐ No ☐ Unknown

If yes, list the control measures undertaken (tick all that apply)

Source	**Specify**
☐ Closure	_____
☐ Modification of procedures	_____
☐ Cleaning, disinfection	_____
☐ Removal	_____
☐ Treatment	_____
☐ Exclusion	_____
☐ Isolation	_____
☐ Health education and advice	_____
☐ Health warning	_____

Vehicle and vectors

- ☐ Removal _____
- ☐ Treatment _____

Contacts and potential contacts

- ☐ Chemoprophylaxis _____
- ☐ Vaccination _____
- ☐ Health education and advice _____

Other control measures (specify) _____

Other comments on outbreak _____

Has a written outbreak report been prepared? ☐ Yes ☐ No

If yes, please send a copy to ESR

This form was produced by the Institute of Environmental Science and Research Ltd.

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