

***Investigation of a food-related outbreak of
Norovirus gastroenteritis***

EpiSurv Outbreak No: WN 2003 018

Index Case: 03062

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[Please note that this version of the report has been edited to ensure the anonymity the event's participants. This version of the report was placed on www.surv.esr.cri.nz on 1 March 2004 for the benefit of New Zealand's communicable diseases surveillance community - C.S.]

Regional Public Health
Better Health For The Greater Wellington Region



Abstract

An outbreak of gastroenteritis occurred amongst a cohort of 22 individuals who had attended a two-day conference in Wellington. Seven confirmed and a further five suspected cases gave a total of 12 probable cases – an attack rate of 55%. A single faecal specimen was obtained, which was PCR positive for Norovirus. This was assumed to be the causative organism for all cases associated with the outbreak.

Symptom and food questionnaire forms were sent to all 22 conference attendees, and were completed by 13. Cohort analysis showed an increased risk of disease in those individuals who ate fruit salad on the first day of the conference (estimated relative risk > 2.8). The most likely source of infection was thought to be grapes, which had been purchased that morning and used in preparing the fruit salad. The use of appropriate food preparation and storage practices on the part of the conference staff raises the possibility that the grapes had already been contaminated with Norovirus from an outside source prior to purchase.

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Background

Notification of a possible food-related outbreak was received on 1 December 2003. A group of employees from an organisation had attended a two-day conference at a venue in Wellington. Following the conference, a number of individuals had become unwell with vomiting and/or diarrhoea. This organisation's team leader and the conference organiser both contacted Regional Public Health to alert us to the outbreak.

The two-day conference occurred on November 27th and 28th, and was attended by 22 staff from around the country. The conference venue is in Wellington. It had provided all meals throughout the conference, starting with morning tea on the 27th and finishing with lunch on the 28th. The conference had finished after lunch on Friday the 28th, following which the attendees had returned home.

In the week following the conference, the organisation's team leader had learned that several of his staff had been unwell with vomiting and/or diarrhoea. In most cases these symptoms had started late on the Friday night, and had generally resolved after 24-48 hours. Eleven of the 22 conference attendees were thought to have been unwell.

Contact was made with conference venue, which confirmed they had provided all meals for this organisation's conference and supplied us with a copy of the menu. In addition to this organisation, they had also had an out-of-town school group staying at the venue from the 26th to the 28th of November. This school group had eaten breakfast there on the mornings of the 27th and 28th, and had been supplied with packed lunches on Friday the 28th. The conference venue had not received any complaints or reports of illness from this group. Attempts to contact the school principal were unsuccessful, and it was assumed that the school group had not been involved in the outbreak.

The conference venue also reported that several of their staff had eaten their meals at the work during the period of the organisation's conference. None of these staff members had reported being unwell.

In view of the high reported disease rate amongst those attending the conference, this cluster of cases was thought to represent a common source outbreak of gastroenteritis with a probable food-borne source of infection. On this basis an investigation was undertaken to identify the likely source of disease, in terms of both infectious agent and the vehicle of transmission.

Methods

The disease outbreak was described in general terms, and basic information gathered (including the people, place and time involved). This was followed by a three-part inquiry, comprising epidemiological, environmental and microbiological investigations.

Epidemiological Investigation

A retrospective cohort study was undertaken, based on those who had attended the two-day conference. All conference attendees were sent a questionnaire asking about any symptoms they had experienced following the conference, and including a detailed food list from the conference (see Appendix). On the basis of reported symptoms, individuals were classified as cases (with disease) or non-cases (without disease). Cohort analyses were undertaken, using each food item as the exposure of interest and disease cases as the outcome. The disease incidence rate was compared in individuals with and without exposure to a particular food item (using those without exposure as the reference group). Incidence rate ratios were used as an estimate of the relative risk of disease following consumption of each food item.

Figure 1: Calculation of disease incidence rates (attack rates) and rate ratios for food exposures

		Disease		
		+	-	
Exposure to food item	+	a	b	a + b
	-	c	d	c + d
Incidence rate exposed	=	$a / (a + b)$		
Incidence rate unexposed	=	$d / (c + d)$		
Relative risk	=	Incidence rate ratio	=	$\frac{\text{Incidence rate exposed}}{\text{Incidence rate unexposed}}$

Data was entered into EpiData® version 2.1b, and analyses were carried out using EpiInfo® 2002.

Environmental Investigation

A site visit and inspection of food preparation facilities at the conference venue was carried out on 2 December 2003.

The inspection followed the general checklist for investigation of food-related disease outbreaks. This includes inspection of food preparation, cooking and storage facilities (including inspection of refrigerators and measuring of internal temperatures). The staff (two chefs) were also interviewed, including questions on food purchase and storage, food preparation, use of left-overs, cleaning and general hygiene, pest control measures, and staff sickness policies.

The site visit took place four days after the conference. No environmental samples were taken as there was no food remaining from the conference.

Microbiological Investigation

None of the conference goers with symptoms of gastroenteritis had seen a doctor during the course of their illness. One individual submitted a faecal specimen (as requested by Regional Public Health); this was sent to the nearest laboratory for microscopy and culture, and then sent on to Institute of Environmental Science and Research (ESR) for viral studies.

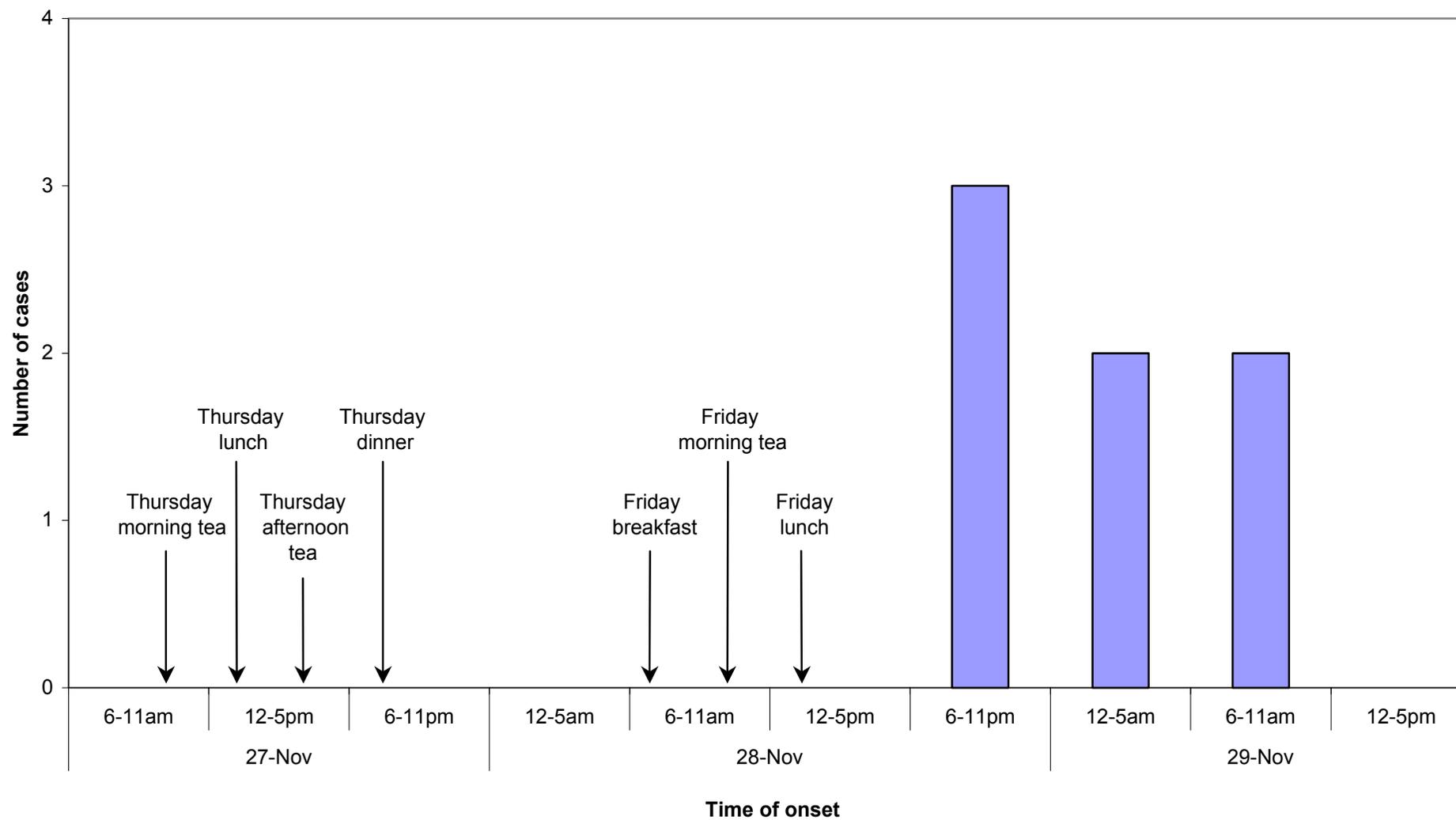
Results

Outbreak description and case definition

The outbreak comprised a cluster of gastroenteritis cases that occurred amongst conference goers who had attended a two-day conference in Wellington on the 27th and 28th of November, 2003. A case was defined as any member of the organisation's team who had attended the conference and subsequently developed symptoms of either vomiting or diarrhoea on the 28th or 29th of November 2003. Amongst the 22 staff who attended the conference there were seven confirmed and a further five suspected cases, giving a total of 12 probable cases. (Suspected cases were those who were reported as unwell by the team leader but who failed to return symptom questionnaires).

An epidemic curve is shown in Figure 2, including the timing of meals served and the onset of symptoms for all confirmed cases.

Figure 2: Onset of symptoms



Epidemiological Investigation

Of the 22 people who attended the conference, 13 completed questionnaires on their symptoms and the foods they consumed. Epidemiological analysis was based on these 13 questionnaires (60% of the total cohort). According to the case definition for this outbreak, there were 7 cases and 6 non-cases amongst the 13 individuals who returned questionnaires.

Disease incidence rates and rate ratios were calculated for each food item on the menu (see Appendix for complete list of food items with incidence rates and rate ratios).

Two of the seven cases arose in individuals who had attended only the first day of the conference, and had eaten only Thursday lunch at the conference venue. It was therefore thought highly likely that the common source of infection was one of the food items included in Thursday's lunch menu. Disease attack rates and rate ratios for each lunch item are shown below.

Table 1: Attack rates and rate ratios for foods served at Thursday lunch

Food Item	People eating item			People not eating item			Rate Ratio
	Cases	Total	Attack rate	Cases	Total	Attack rate	
Bread roll	4	9	44%	3	4	75%	0.6
Fish	7	13	54%	0	0	-	-
Quiche	5	9	56%	2	4	50%	1.1
Mesclun salad	4	8	50%	3	5	60%	0.8
Greek salad	5	9	56%	2	4	50%	1.1
Potato salad	6	9	67%	2	3	67%	1.0
Coleslaw	5	7	71%	2	6	33%	2.1
Fruit salad	7	10	70%	0	3	0%	2.8*
Ice cream	6	9	67%	1	4	25%	2.7

* The rate ratio cannot strictly be calculated, since no-one who had not eaten the fruit salad became sick (so the denominator – the incidence rate for non-exposed - was 0%). An approximate RR has been calculated by adding a 'dummy' case to the non-exposed group; this gives an incidence rate of ¼ or 25% for the non-exposed, resulting in a RR of 2.8. This is probably an underestimate of the true RR.

From the above table it can be seen that three food items from Thursday lunch carried a disease rate ratio greater than 2.0 - ie the coleslaw, the fruit salad and the ice cream.

The estimated RR from the fruit salad is probably underestimated, as there were actually no cases of disease in those individuals who did not eat fruit salad (see footnote to Table 1 above). On the basis of these results, the fruit salad served at Thursday lunch was thought to be the food item most likely to have been responsible for the subsequent outbreak.

It should be noted that cohort numbers were generally small, so attack ratios and rate ratios may well have been affected by random variation. The above figures were considered as a guide to the likely source of infection, rather than as firm evidence of an association between a particular food item and subsequent disease.

Environmental Investigation

Food storage and preparation facilities at the conference venue were inspected on 2 December 2003. The kitchen area was separate from the rest of the conference venue, and was not accessible to conference attendees except through the serving area. The kitchen area was generally clean and well-maintained, with appropriate hand-washing facilities (including a soap dispenser and paper towels). Food preparation surfaces and cooking utensils appeared clean, tidy and well-organised. Prepared food was covered and stored in a refrigerator (the temperature was recorded at just over 6°C). Frozen food was stored separately in a freezer.

All food served at the conference facility was stored, prepared and cooked on site. Two staff were responsible for food purchase, preparation and cooking. Both chefs were interviewed in detail about food preparation, including washing of fruit and vegetables for salads, storage of prepared food prior to serving, checks for adequate cooking (eg for chicken) and treatment of left-over food. In general, all practices described were appropriate and safe. Only one area was identified in which practices could potentially

be improved. This was the use of separate uniforms or aprons for food-related and non-food-related tasks (ie house-keeping duties such as making beds).

Coleslaw and Fruit Salad

In keeping with usual practice, the coleslaw and the fruit salad served at Thursday lunch had been made fresh that morning. The coleslaw consisted of sliced cabbage, grated carrot, raisins and mayonnaise. (The mayonnaise was commercially produced and stored in the refrigerator in its original container.) After preparation (at around 8am) the coleslaw was covered and stored in the fridge until just before serving.

The fruit salad was prepared using a base of tinned tropical fruit salad. A new tin was opened and additional fruits added: passion-fruit pulp (bought in plastic containers and stored in the refrigerator); rock melon and honeydew melon (prepared freshly); and red and green grapes. The grapes were bought from the supermarket and washed under cold running water prior to being added to the salad. The fruit salad was made up at around 10.30am, and covered and stored in the refrigerator until just before serving.

No employees of the conference venue had been unwell in the two weeks prior to the conference, and none reported being unwell at the time of the site visit. All staff are entitled to paid sick leave and are encouraged to take leave when feeling unwell.

Microbiological Investigation

Microscopy and Culture

The sole faecal specimen from the outbreak underwent microscopy and culture at a hospital laboratory. Tests were negative for bacterial pathogens (including Salmonella, Shigella, Yersinia, Campylobacter, Aeromonas and Plesiomonas) and for parasites (Cryptosporidium and Giardia).

PCR

RT-PCR testing at ESR Wellington was positive for Norovirus.

Results: Summary

Epidemiological investigation suggests the food items most likely to be responsible for this outbreak were the coleslaw, fruit salad and ice-cream served at Thursday lunch. The fruit salad carried the highest suspicion, with a relative risk greater than 2.8 for subsequent development of disease.

Environmental investigation showed the conference venue in question had good food preparation and storage practices, with no particular risk factors for a food-related outbreak. However microbial contamination of food may have arisen from an outside source (such as an infected conference attendee, or contamination of ingredients at the supermarket prior to purchase).

Microbial investigations found the cause of the gastroenteritis was Norovirus.

Discussion

This report describes an outbreak of Norovirus gastroenteritis in a group of 22 individuals who attended a two-day conference in Wellington. The high attack rate amongst conference attendees (55%) and the clustering of symptom onset are strong pointers towards a common food-borne source of infection. Epidemiological analysis suggests the fruit salad served at Thursday lunch is the food item most likely to have acted as a vector for this outbreak. Environmental investigation found generally safe food preparation and storage practices at the venue in question; this raises the possibility that one of the fruit salad ingredients had been contaminated with viral particles from an external source.

Although a laboratory diagnosis was made in only one case, Norovirus is very likely to have been the causal agent in all 12 cases within this outbreak. Norovirus (formerly Norwalk-like virus) is one of the most common causes of gastroenteritis in developed countries, responsible for >85% of non-bacterial outbreaks in Europe (Lopman 2003). Norovirus outbreaks are commonly reported on cruise ships (Flemmer 2003, CDC 2003, CDC 2002), in hospitals (Meakins 2003) and in residential facilities (Liu 2003, Miller 2002). Rather than reflecting characteristics specific to these settings, outbreaks are likely to be a potential risk in any situation where people are in close proximity for long periods, and where food is prepared and served *en masse*.

The epidemiology of the above outbreak also fits well with the clinical profile of Norovirus infection. Norovirus has an incubation period of 24-48 hours, followed by a short-lived illness of two to three days' duration (Treanor 1995). Symptoms include abdominal cramps and nausea, followed by vomiting and/or diarrhoea. Myalgia, malaise, headaches and low-grade fever may also occur. Symptoms usually resolve within two to three days.

Norovirus outbreaks are typically associated with a high attack rate, in the order of 40-50% (Flemmer 2003, Carrique-Mas 2003, Miller 2002). In the outbreak described here, the attack rate was 55% (including both confirmed and suspected cases). Amongst

those individuals known to have eaten the fruit salad (the food item of greatest suspicion), 70% subsequently developed gastroenteritis.

Norovirus is known to be transmitted by the faecal-oral route, and airborne transmission is also suspected (Marks 2003). Many outbreaks are associated with a common-source origin, including food-borne and water-borne outbreaks; other outbreaks are thought to be caused by person-to-person transmission.

The outbreak described here was thought to be caused by a common-source food vector. None of the conference staff or attendees reported having been unwell in the two days prior to the conference. The high attack rate amongst conference attendees together with the close clustering of symptom onset is highly suggestive of a common-source exposure. Individuals reported the onset of symptoms late on November 28th or in the early hours of the 29th; since Norovirus has an incubation period of 24-48 hours, exposure to the virus is likely to have occurred some time on Thursday the 27th of November. The development of illness in two conference attendees present only for Thursday lunch provides further evidence for the timing of exposure.

Epidemiological analysis of food survey data points to the fruit salad served at Thursday lunch as the item most likely to have been the source of viral infection. Of the thirteen individuals who returned their food survey forms, 10 had eaten the fruit salad and three had not. The attack rate for subsequent illness was 70% in those who ate fruit salad and 0% in those who did not, giving a rate ratio of > 2.8 (it is not possible to calculate an exact rate ratio since 0 cannot be used as a denominator). The only other food item to produce such a high rate ratio was tea served on Thursday, for which the RR was 3.0 (see Appendix: *Table 2*). The fruit salad was thought to be a more likely source of infection than the tea, firstly because the true RR for the fruit salad is probably higher than 3.0 (given the attack rate of 0% in non-consumers), and secondly because it seems unlikely that the tea could act as a vector for viral transmission when other fluids (such as coffee and water) did not. It should be noted, however, that numbers used in epidemiological calculations were small, so all RR estimates are of limited precision and can be used as a guide only.

According to the two chefs (interviewed during the site visit), the fruit salad (and other salads) were prepared fresh each day. The fruit salad comprised tinned fruit salad as a base, with other ingredients (passionfruit pulp, rock melon and honeydew melon, and red and green grapes) added during preparation. The fruit salad would typically be prepared by around 10.30am, after which it would be covered and chilled in the refrigerator until lunch was served. The grapes were the only fruit to be added to the salad with their skins intact; for this reason they represent the most likely source of viral contamination. Although the chefs reported washing the grapes under cold water prior to adding them to the salad, less-than-vigorous washing may be insufficient to achieve complete viral removal from the surface of multiple small fruit. Since the grapes had been purchased from the supermarket that morning they could well have been contaminated by a customer or staff member prior to purchase. Given the relatively short time delay between purchase and serving (around three hours), viral particles would still have been viable at the time the fruit salad was served.

There were no remnants of food from the conference at the time of the site visit on 2 December, so no environmental samples were able to be taken. In the absence of such samples it is not possible to identify conclusively the source of the Norovirus outbreak. On the basis of the epidemiological evidence, however, it seems likely that one of the food items served at Thursday lunch was the vector for viral transmission, with the greatest suspicion falling on the fruit salad. The accounts obtained from the conference chefs together with the known pathogenesis of viral transmission point to the grapes as the most likely source of viral contamination.

This is the fifth Novovirus outbreak to be investigated by Wellington Regional Public Health in 2003.

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Appendix

- A. Symptom and food item questionnaire**

- B. Table 2: Food exposures, attack rates and rate ratios for the conference**

Regional Public Health Questionnaire
Conference on 27 and 28 November 2003

As you are probably aware, a number of your staff have become unwell following the conference in Wellington on 27 and 28 November. By filling in this form you will help us identify the source of this illness (which is likely to be food-related).

Please complete all sections of the questionnaire, and email directly to Regional Public Health at sarah.hill@huttvalleydhb.org.nz. All information in the questionnaires will be kept confidential to Regional Public Health. If you have any questions, please contact Dr Sarah Hill on (04) 570-9002.

Name: _____
FIRST NAME SURNAME

Phone: _____
WORK HOME

Occupation: _____

Workplace: _____

Did you attend the conference on the following days? (Delete as appropriate)

Thursday 27 November YES / NO
 Friday 28 November YES / NO

Since attending the conference, have you suffered from diarrhoea or vomiting? YES / NO

If YES, complete the following section:
 If NO, go to the food list (next page)

Date of birth: / / Address: _____
DD MM YY

Have you experienced any of the following symptoms? If YES, please note approximate date and time of onset, and how long the symptoms lasted.

Symptoms	Date of Onset	Time of Onset	Duration of Symptoms (hours)
Diarrhoea (3 or more loose bowel motions in 24 hrs) YES / NO	<u> </u> / <u> </u>		Hours
Any blood? YES / NO	<small>DD MM</small>		
Vomiting YES / NO	<u> </u> / <u> </u>		Hours
Nausea (feeling sick) YES / NO	<u> </u> / <u> </u>		
Abdominal/tummy pain YES / NO	<u> </u> / <u> </u>		
Fever or chills YES / NO	<u> </u> / <u> </u>		Hours
Headache YES / NO	<u> </u> / <u> </u>		
Aching muscles/joints YES / NO	<u> </u> / <u> </u>		

Did you see a doctor for these symptoms? YES / NO

If YES Doctor's name: _____

Name and location of practice: _____

Was medicine prescribed? YES / NO Name: _____

Was a faecal specimen sent to the laboratory? YES / NO Date sent: / /

FOOD LIST – Thursday 27 November

The following tables list the foods and drinks provided at the conference on the Thursday of the conference. Please mark with an ‘X’ those meals which you ate, and whether or not you ate each type of food and drink.

	YES	NO	NOT SURE
Morning Tea			
Scone			
Cream			
Lunch			
Bread rolls			
Fish			
Quiche (spinach and feta)			
Salads: Mesclun (green) salad			
Greek salad			
Potato salad			
Coleslaw			
Fruit salad			
Ice cream			
Afternoon Tea			
Carrot cake			
Slice			
Biscuits			
Pre-Dinner Nibbles			
Corn chips			
Potato chips			
Peanuts			
Salsa			
Guacamole			
Dinner			
Bread rolls			
Roast chicken			
Vegetables: Carrots			
Broccoli			
Cauliflower			
Cheese sauce			
Fruit salad			
Ice cream			
Jelly			

Did you drink any of the following on Thursday?

	YES	NO	NOT SURE
Coffee			
Tea			
Iced water			
Beer			
Wine			

Other (please specify):			
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FOOD LIST – Friday 27 November

The following tables list the foods and drinks provided at the conference on the Friday of the conference. Please mark with an 'X' those meals which you ate, and whether or not you ate each type of food and drink.

	YES	NO	NOT SURE
Breakfast			
Cereal			
Toast / spreads			
Fruit			
Morning Tea			
Scone			
Cream			
Lunch			
Bread rolls			
Crumbed chicken			
Quiche (spinach and feta)			
Salads: Mesclun (green) salad			
Greek salad			
Potato salad			
Coleslaw			
Fruit salad			
Ice cream			

Did you drink any of the following on Friday?

	YES	NO	NOT SURE
Coffee			
Tea			
Iced water			
Beer			
Wine			
Other (please specify):			

ANIMAL CONTACT

Did you have any contact with non-domestic animals in the week of the conference? (ie from Monday 24 to Friday 28 November).

YES / NO

If YES, please give details:

OTHER COMMENTS OR SUGGESTIONS:

Thank you for completing this questionnaire. Please email to Regional Public Health at sarah.hill@huttvalleydhb.org.nz. All information in the questionnaires will be kept confidential to Regional Public Health. If you have any questions, please contact Dr Sarah Hill on (04) 570-9002.

Table 2: Food exposures, attack rates and rate ratios for the conference

Day	Meal	Food Item	People eating item			People not eating item			Rate Ratio
			Cases	Total	Attack rate	Cases	Total	Attack rate	
Thursday 27 th	AM tea	Scone	5	10	50%	2	3	67%	0.8
		Cream	2	5	40%	5	8	63%	0.6
	Lunch	Bread roll	4	9	44%	3	4	75%	0.6
		Fish	7	13	54%	0	0	-	-
		Quiche	5	9	56%	2	4	50%	1.1
		Mesclun salad	4	8	50%	3	5	60%	0.8
		Greek salad	5	9	56%	2	4	50%	1.1
		Potato salad	6	9	67%	2	3	67%	1.0
		Coleslaw	5	7	71%	2	6	33%	2.1
		Fruit salad	7	10	70%	0	3	0%	2.8*
		Ice cream	6	9	67%	1	4	25%	2.7
		PM tea	Carrot cake	0	0	-	6	10	60%
	Slice		1	1	100%	4	9	44%	2.3
	Biscuits		1	2	50%	5	10	50%	1.0
	Nibbles	Corn chips	3	7	43%	4	5	80%	0.5
		Potato chips	3	7	43%	3	4	75%	0.6
		Peanuts	2	6	33%	5	7	71%	0.5
		Salsa	2	6	33%	5	6	83%	0.4
		Guacamole	2	4	50%	5	8	63%	0.8
	Dinner	Bread roll	2	6	33%	5	7	71%	0.5
		Roast chicken	5	10	50%	2	3	67%	0.8
		Carrots	4	9	44%	2	3	67%	0.7
		Broccoli	5	10	50%	2	3	67%	0.8
		Cauliflower	5	9	56%	2	3	67%	0.8
		Cheese sauce	4	6	67%	3	5	60%	1.1
		Fruit salad	5	8	63%	2	5	40%	1.6
		Ice cream	4	7	57%	2	5	40%	1.4
		Jelly	2	2	100%	5	9	56%	1.8
	Drinks	Coffee	7	11	64%	0	2	0%	-
		Tea	4	4	100%	3	9	33%	3.0
Water		4	8	50%	3	5	60%	0.8	
Beer		2	5	40%	5	8	63%	0.6	
Wine		3	8	38%	4	5	80%	0.5	

* The rate ratio cannot strictly be calculated, since no-one who had not eaten the fruit salad became sick (so the denominator – the incidence rate for non-exposed - was 0%). An approximate RR has been calculated by adding a ‘dummy’ case to the non-exposed group; this gives an incidence rate of ¼ or 25% for the non-exposed, resulting in a RR of 2.8. This is probably an underestimate of the true RR.

Day	Meal	Food Item	People eating item			People not eating item			Rate Ratio
			Cases	Total	Attack rate	Cases	Total	Attack rate	
Friday 28 th	Breakfast	Cereal	2	4	50%	4	8	50%	1.0
		Toast	2	4	50%	4	7	57%	0.9
		Fruit	3	6	50%	3	6	50%	1.0
	AM tea	Scone	4	9	44%	2	3	67%	0.7
		Cream	2	6	33%	4	6	67%	0.5
	Lunch	Bread roll	2	6	33%	4	6	67%	0.5
		Crumbed chicken	4	9	44%	2	3	67%	0.7
		Quiche	2	5	40%	4	7	57%	0.7
		Mesclun salad	1	4	25%	5	8	63%	0.4
		Greek salad	2	4	50%	3	7	43%	1.2
		Potato salad	4	6	67%	3	6	50%	1.3
		Coleslaw	2	3	67%	4	9	44%	1.5
		Fruit salad	4	6	67%	2	5	40%	1.7
		Ice cream	3	4	75%	3	7	43%	1.8
	Drinks	Coffee	4	8	50%	2	4	50%	1.0
		Tea	2	2	100%	4	10	40%	2.5
		Water	3	6	50%	3	6	50%	1.0