Guidelines for writing outbreak investigation reports

Date: Date of report

To: Supervisor

From: Investigator(s)

Subject:

Location:

Date of departure:

Date of return:

Abstract

Half page or less:

- What was the problem?
- What was done to address the problem?
- What was found?
- What conclusions were drawn?
- What recommendations were made?
- What public health actions were taken?

Background

Nature of the problem and its public health importance:

- Problem description
- Sequence of events leading to the study or investigation
- Why was an investigation undertaken?

Contacts in the field and investigation team

Pertinent background information and situation upon arrival:

- Geographic setting
- Size of community/hospital, etc
- What had been done so far?
- What was known to date?
- Brief statement of the working hypothesis

Objectives of the investigation

Methods

Case definition

Clinical, laboratory, time, place, person

Case finding methods

Source and mode of data gathering (telephone, interviews, record review, etc)

Analytical study-design and rationale

Case-control study

- Control definition
- Control selection
- Definition of exposure(s)
- How was exposure measured and categorised?
- What measure(s) of association were chosen?
- What statistical test(s) were chosen?
- Rationale for stratified and multivariate analysis, if any

Cohort study
- Definition of exposure
- How was exposure measured and categorised?
- What measure(s) of association were chosen?
- What statistical test(s) were chosen?
- Rationale for stratified and multivariate analysis, if any

Cross-sectional, etc
- Idem

Laboratory methods

- Type of samples
- Laboratory examination and methods
- Further typing

Environmental studies

- Type of inspection
- Method for sample collection

Other studies

Results

Descriptive findings

- Response rates
- Number of persons meeting case definition
- Overall attack rate (AR)
- Description by
  time (epidemic curve)
  place (AR by place)
  person (clinical features, AR by demographic characteristics)

Laboratory findings

- Number of samples tested and found positive
- Typing results

Environmental study findings

- Number of samples tested and found positive
- Comparison with human samples

Transition

- What do the descriptive results suggest in terms of risk groups, source, mode of transmission, exposure?
- Hypotheses generated that will be subsequently tested in analytic studies.

Analytical study results

- Proceed from general to particular
- From univariate to bivariable to multivariable (stratification and then regression) analysis.

Further studies performed, if any

Pending results, including lab

Discussion

Main results

Our investigation suggests that ……

Refutation of findings (Validity)

- Limitations of study design
- Possible biases (information, selection, confounding) that may have lead to the observed results.

Inferences from analytic study results

- Whether the findings fit with what is known about the disease
- Which criteria of causality have been met.

Conclusions

- Present a logical, clear interpretation of the results; explain how the working hypothesis is confirmed or disproved by the results.

Recommendations, actions

- Feasible recommendations for prevention/control measures based on public health implications of the findings.
- Rationale for recommendations and actions
- Further or future studies needed

Signatures of investigators and supervisors

Tables

- With a complete legend including time, place, person.

Figures

- With a complete legend including time, place, person.

References

Vancouver style

Annex 5 Example of an outbreak investigation report

Date: 25 September 1996
To: Director of Public Health, Eastern Health Board
From: Thomas Grein, EPIET Fellow, EHB
Subject: Salmonella typhimurium outbreak
Location: Malahide, County Fingal
Date of departure: N/A
Date of return: N/A

Abstract

An outbreak of salmonellosis occurred among 127 persons attending a wedding reception on 21 August 1996. Of 115 interviewed guests, 57 (50%) met the case definition (diarrhoea within three days after having eaten at the reception). Thirty-eight cases visited their GP, seven were admitted to hospital. Forty-six cases submitted stool samples, of which 39 were culture positive for Salmonella typhimurium. Turkey was identified as the most likely vehicle for this outbreak (relative risk ¥). Environmental investigations at the catering facilities showed deficiencies in food hygiene practices. Eight of 17 asymptomatic kitchen workers carried S. typhimurium in their stool.

We recommended: to exclude all symptomatic food handlers from work in the hotel kitchen for 48 hours after their first normal stool; to educate food handlers and other personnel in the hygienic preparation and serving of food; and to immediately address the structural and operational deficiencies in the hotel kitchen. Introduction

Nature of problem

Public health importance

Sequence of events

On 26 August 1996 the Eastern Health Board (EHB) was informed of an outbreak of gastrointestinal illness among guests of a wedding party that was held in a large hotel in Malahide on 21 August 1996.

Many guests had fallen ill since the reception and some had required hospitalisation. Malahide is a popular seaside town approximately twenty kilometres north of Dublin City.

Objectives of investigation

The same day the EHB started an investigation to assess the extent of the outbreak, identify the mode and the vehicle of transmission, and initiate appropriate control measures.

Composition of field investigation team

Dr. Darina O'Flanagan, Specialist in Public Health Medicine at the EHB, led the epidemiological investigations. She was assisted by Dr. Thomas Grein, Fellow of the European Programme for Intervention Epidemiology Training. Mr. Tom McCarthy, Principal Environmental Health Officer for food hygiene North Dublin City with special responsibility for communicable disease, and Mr. Derek Bauer, Principal Environmental Health Officer for County Fingal, led the environmental investigations and supervised the implementation of control measures.

Materials and Methods

Case definition

We defined a case as a person who had consumed food at the wedding reception on 21 August 1996 and developed diarrhoea (three or more loose stools in 24 hours) within the next 72 hours.

Case definition
Note: Only clinical case definition was used. If others would have been used, describe them here.

Case finding

We obtained the addresses and telephone numbers of all 127 attendees of the wedding reception. Hotel management provided a copy of the menu and a list of all food items served during the reception.

Source and mode of data gathering

Starting 27 August 1996, Environmental Health Officers (EHOs) conducted personal interviews at the homes of all wedding guests. Hospitalised cases were interviewed after discharge from hospital. Information was obtained on demographic details, symptoms of gastrointestinal illness three days prior to and after the wedding reception, the time of onset and the duration of symptoms, contact with ill persons not related to the wedding party, secondary spread among family members, foods consumed during the reception, whether the family doctor was contacted because of the illness, whether hospitalisation was required, and length of hospital stay if admitted.

Analytical study design

We conducted a retrospective cohort study to identify the potential vehicle of the outbreak. The retrospective cohort design was chosen because information could be obtained on a clearly identifiable risk group.

Type of analytical study

Rationale

Definition of exposure. The outbreak occurred among 127 guests who attended the wedding reception in the hotel on 21 August 1996. The main meal was served to 108 guests at 1800 hours on 21 August 1996. The meal consisted of honeydew melon, roast turkey, baked Irish gammon (ham steak), a selection of vegetables and potatoes, and chocolate eclairs for dessert. At 2200 hours sandwiches (turkey, ham, chicken, salad, savoury, egg, cheese) were offered to the guests and consumed by 58 individuals. Hotel staff prepared all dishes and sandwiches in a kitchen on the premises except for a home-made birthday cake and a home-made wedding cake. Both cakes were brought into the hotel by guests and consumed throughout the evening. To identify potential risk factors for illness, all guests were asked if they had consumed any of these food items

Definition of exposures

The restaurant of the hotel caters for hotel guests and a large number of visitors. No other functions were held on the day of the wedding reception. The number of persons who attended the restaurant on 21 August 1996 is unknown.

Analysis of the data was performed with Epi Info software, version 6.041. Food specific attack rates (AR), relative risks (RR) and 95% confidence intervals (95% CI) were calculated for the consumption of food items. The c2 test was used to compare proportions between groups.

Chosen measures of associations and statistical tests

Laboratory investigations

All interviewed persons who reported an illness were asked to provide a stool sample. Stool samples were also collected from some individuals who attended the wedding reception but did not become ill. Most specimens from non-cases were obtained from household members of cases. All specimens were submitted to the Public Health Laboratory for culture. Faecal specimens were also obtained from the 17 kitchen workers who were on duty during the week of the wedding reception, regardless of their symptoms.

Environmental investigations

Starting 26 August, EHOs inspected the restaurant and the hotel kitchen on several occasions, investigated food handling practices and interviewed all food handlers for illness one week prior to and after the wedding. They examined transport, storage and preparation processes for the foods served at the wedding reception, and reviewed order and delivery books of the restaurant. The ingredients of incriminated foods were identified and traced to their sources.

Environmental investigations

Type of inspection

Food specimens from the day of the wedding were no longer available when investigations commenced. EHOs sampled the same type of food items which were mentioned on the wedding reception menu and submitted them for culture on 27 August 1996.

Results

Descriptive findings

Of the 127 wedding guests, four individuals had not eaten at the wedding reception and were excluded from the study. None of them reported an illness. Five guests refused to participate in the study and three guests could no longer be contacted. The remaining 115 (93%) individuals were interviewed (table 1). Sixty-two (54%) of them were female, 100 (87%) between 15 and 64 years of age (table 2).

Eligibility

Response rates

Sixty-eight guests reported an illness during the interview. The case definition could be applied to 57 individuals. The overall attack rate among guests was 50%.

Number of persons meeting case definition.
Overall attack rate

Dates and times of onset of illness for the 57 cases are shown in figure 1. There was a steady increase in the number of cases, starting in the night of 21 August, peaking during 22 August and declining over the next 48 hours. Two individuals developed diarrhoea on 25 August 1996 but were not included as cases. The median time (range) between the main meal and onset of illness in cases was 24 (5-72) hours.

Time

Males were 1.3 times (95% CI 0.9 - 1.9) more likely to be a case than females. Guests older than 65 years had the highest attack rate (100%) and were 2.3 times (95% CI 1.7 - 3.2) more likely to become ill than guests 45- 64 years who had the lowest attack rate with 43%.

Person

The main symptoms of cases were diarrhoea (case definition, 100%), feeling feverish (89%), general malaise (88%) and nausea (81%). Vomiting was reported

Clinical features

less frequently (47%). The duration of illness ranged from two hours to 13 days with a median of five days (table 4).

Place

Individuals who ate only during the late meal had a 1.7 times (95% CI 1.0 - 2.6) higher risk of illness than individuals who only ate during the main meal. The attack rates for guests seated at different tables varied between 25% and 80% (c2 = 11.3, p = 0.42). The age and sex distribution of guests seated at tables with higher attack rates (table 5 and 11) was not different from the distribution of guests seated at tables with lower attack rates (table 3).

Laboratory results

Forty-six (81%) cases provided stool samples. Thirty-nine (85%) samples were culture positive for *Salmonella typhimurium.* All isolates showed the same resistance pattern to Ampicillin, Amoxycillin, Chloramphenicol and Sulphonamides. One culture was phage typed at CDSC London (Definitive Type 104). An increase in the number of *S. typhimurium* isolates unrelated to the outbreak was not observed by hospital laboratories in the EHB area during this period.

Summary descriptive findings:

Identifiable risk groups?

The rapid increase and decline in the number of cases, the single peak, the common exposure to food consumed at the wedding reception and the absence of an increase in other laboratory-detected cases of *S typhimurium* suggested a foodborne point source outbreak among the wedding guests (figure).

Analytical study results

Food specific attack rates, relative risks and percentage of cases exposed to the food items consumed at the wedding reception are given in table 5.

Univariate analysis

For seven food items, cases had higher attack rates than non-cases: turkey (RR ¥), savoury sandwich (RR 1.85), birthday cake (RR 1.61), egg sandwich (RR 1.56), chicken sandwich (RR 1.43), ham (RR 1.22) and turkey sandwich (RR 1.12).

There were no cases among guests who had not eaten turkey during the main meal. Of the 57 cases, 52 (91%) had consumed turkey during the main meal

Environmental investigations

Environmental investigations

EHOs noted 23 violations of the food hygiene regulations during the kitchen inspections. Relevant findings with regard to the wedding outbreak were that frozen food was thawed in hot water, cooked meats cooled down at room temperature for indeterminate times and that storage practices in the cold room allowed for possible cross-contamination of raw meat.

Food items from hotel kitchen and bar buffet were sent to the laboratory on 27 August 1996. The only positive microbiological finding was found for a sample of cooked turkey (*Salmonella agona).*

The examination of the kitchen delivery dockets revealed that ten turkeys were delivered to the hotel on 19 August. Six of the ten turkeys were used for the

wedding reception. Each of them weighted 20-24 lb. and were cooked on 20 August at 250oC for thirty minutes and at 180oC for two and a half hours. After cooking they were put into a non-refrigerated holding cabinet, left at room temperature to cool down, and later removed to the cold room. We could not determine how long the turkeys were left in the non-refrigerated holding cabinet. Other turkeys, cooked at midday on 21 August, were left overnight in the holding cabinet before being removed to the cold room.

Seventeen kitchen workers were interviewed and stool samples obtained from them. None reported an illness but eight (47%) stool samples were culture positive for *S. typhimurium*. Antibiotic resistance was determined for some isolates and matched that of the cases (resistant to Ampicillin, Amoxycillin, Chloramphenicol, Sulphonamides).

Discussion

Summary of key findings with regard to objectives

The primary objectives of our study were to identify the mode of transmission, the vehicle of the outbreak and to initiate appropriate control measures. Our data suggest that the vehicle of the outbreak was turkey served during the wedding reception on 21 August, and the infecting agent *S. typhimurium* DT104.

Validity of epidemiological findings

The relative risk for the consumption of turkey was infinite. There were no cases among guests who had not eaten turkey during the main meal. Of the 57 cases, 52 (91%) had consumed turkey during the main meal. Six other food items showed statistically significant relative risk estimates greater than. However, all of these food items were consumed by a small number of cases which makes them implausible vehicles for this outbreak. Thus epidemiologically turkey appears to be the most likely vehicle for this outbreak. Isolation of *S. typhimurium* from the stool of cases supports this finding as the pathogen is frequently found in poultry. Eighty-five percent of the stool cultures available for the cases were positive for this organism.

Limitations of study design

As the epidemiological data were obtained from a non-controlled, observational study some limitations apply to our results. All data were collected by personal interviews and could not be verified. Some information bias is likely to have existed, particularly after interviewees learned through the media about legal proceedings and compensation claims. Although most interviews were conducted within a week following the outbreak recall bias may have led to wrong exposure status. Selection bias is unlikely to have influenced our findings as the participation in the study was high (93%). As most guests ate the same foods stratification for possible confounding could not be performed for most food items. As we did not enquire about the amounts of food consumed we were unable to calculate dose response.

Do results from environmental investigations support findings?

The environmental investigations support our epidemiological findings and revealed severe deficiencies in food handling practices in the hotel kitchen. Stool samples from eight of the 17 kitchen staff on duty during the week of the outbreak were also positive for *S. typhimurium* suggesting that the infective food was prepared and consumed in the hotel kitchen.

Six turkeys were identically prepared on the same day and served at 12 tables. We could not determine if the meat of a whole turkey was served to specific tables or if the meat of all six birds was cut into pieces and then distributed randomly to all 12 tables. Attack rates for the tables vary between 25% and 80% without statistically significant differences. As every table had at least two cases it is more likely that meat of one or more infected birds was served to all tables. The mode of contamination remains unknown. Poor foodhandling practices may have allowed for one infective turkey to cross contaminate others, or contamination may have occurred by an asymptomatic, culture positive food handler.

Causality criteria

Our findings are consistent with other foodborne outbreaks related to the consumption of turkey. It is also a biologically plausible vehicle for the aetiological agent, *S. typhimurium.* The implicated exposure preceded illness. Consumption of turkey was positively associated with illness and this association was stronger than for other food items.

Relevant results from other studies not part of this investigation

More cases, unrelated to the wedding reception, came to our attention. Of five golfers lunching in the same hotel on the day of the wedding reception three fell ill within the next 24 hours. Interviews were conducted with the group. The main symptoms of the three ill individuals were diarrhoea and general malaise lasting between four and ten days. All three had consumed turkey salad sandwiches, the other two unaffected golfers cheese sandwiches. A stool sample was available for one ill individual which was culture positive for *S. typhimurium* (no definite type available). These additional cases strongly support the hypothesis that turkey was the vehicle of the outbreak and *S. typhimurium* the infecting agent.

The Department of Agriculture was informed about the outbreak and subsequently investigated the poultry farm where the turkeys originated. S*. typhimurium* was detected in the dust of one of six turkey houses examined. According to a spokesperson of the Department this is a rare finding on Irish poultry farms. Further investigations are pending.

Recommendations, actions

Recommendations, actions

We recommended excluding all symptomatic food handlers from work in the hotel kitchen for 48 hours after their first normal stool. We also advised to educate food handlers and other personnel in the hygienic preparation and serving of food and to implement the National Standard Authority of Ireland (NSAI) guideline 340:1994 - Hygiene in the Catering Sector4. The structural and operational deficiencies in the hotel kitchen were outlined in a detailed report and hotel management was urged to correct these deficiencies immediately.

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Acknowledgements

The members of the outbreak control team would like to thank the staff of the EHB, in particular the Environmental Health Officers involved in the investigation and the laboratory staff of Cherry Orchard hospital, for their indispensable help. We would also like to thank Dr Alain Moren and Dr Mike Rowland, EPIET/EUPHEM, for reviewing the manuscript of this report.

Table 1 Study characteristics. Wedding reception, Malahide, 21 August 1996

	number (percent)
Wedding cohort	127 (100)
Eligible	123/127 (97)
Refused to participate in study	5/123 (4)
Unable to locate	3/123 (2)
Interviewed (response rate)	115/123 (93)

Table 2 Demographic details of cohort. N = 115. Wedding reception, Malahide, 21 August 1996

	number (percent)
Age class (years)	
5-14	2 (2)
15-44	46 (40)
45-64	54 (47)
> 65	6 (5)
Unknown	7 (6)
Female	62 (54)

Figure Date and time of onset of diarrhoeal illness among cases. n = 57. Wedding reception, Malahide, 21 August 1996

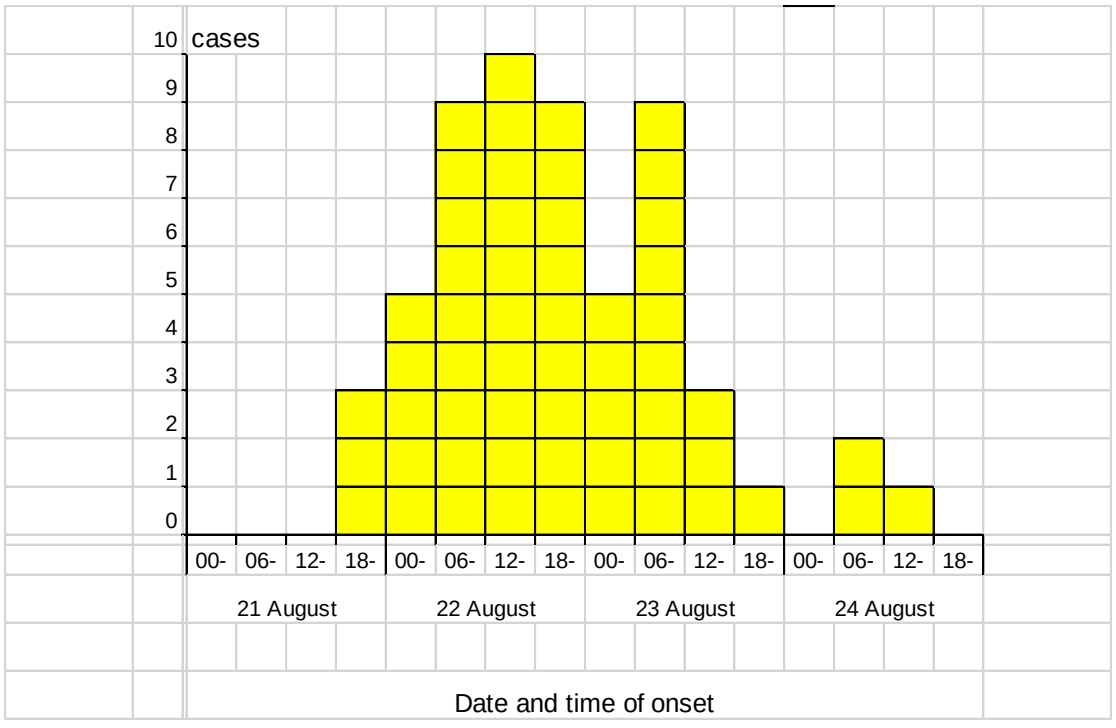

Table 3 Characteristics of cases with attack rates, relative risks (RR) and 95% confidence intervals (95% CI). n = 57. Wedding reception, Malahide, 21 August 1996.

	number	attack rate (%)	RR (95% CI)
All cases	57	57/115 (50)	
Sex			
Female	27	27/62 (44)	
Male	30	30/53 (54)	1.3 (0.90-1.89)
Age class * (years)			
5-14	1	1/2 (50)	1.2 (0.28-4.86)
15-44	25	25/46 (54)	1.3 (0.85-1.92)
45-64	23	23/54 (43)	1.0
65 +	6	6/6 (100)	2.3 (1.72-3.20)
Meals			
Main meal only	57	24/57 (42)	
Late night meal only	7	5/7 (71)	1.7 (0.97 - 2.57)
Seating arrangements #			
Table 1	3	3/10 (30)	1.2 (0.3-5.5)
Table 2	3	3/8 (38)	1.5 (0.3-6.7)
Table 3	5	5/10 (50)	2.0 (0.5-7.7)
Table 4	2	2/5 (40)	1.6 (0.3-8.0)
Table 5	7	7/10 (70)	2.8 (0.8-9.9)
Table 6	4	4/10 (40)	1.6 (0.4-6.6)
Table 7	4	4/8 (50)	2.0 (0.5-8.0)
Table 8	4	4/9 (44)	1.8 (0.4-7.3)
Table 9	2	2/8 (25)	1.0
Table 10	3	3/9 (33)	1.3 (0.3 - 6.1)
Table 11	8	8/10 (80)	3.2 (0.9 - 11.1)
Table 12	5	5/8 (63)	2.5 (0.7 - 9.3)

* $\chi 2 = 7.5$, $p = 0.057$; for seven individuals no information about their age

\# $\chi 2 = 11.3$, $p = 0.42$; seven guests attended only late night meal (no tables assigned), for three guests table number unknown

Table 4 Clinical and laboratory details of cases. n = 57. Wedding reception, Malahide, 21 August 1996

	number (percent)	median (range)
Symptoms		
Diarrhoea	57 (100)	
Feeling feverish	51 (89)	
Aches and pains	50 (88)	
Nausea	46 (81)	
Abdominal cramps	28 (49)	
Vomiting	27 (47)	
Headaches	16 (28)	
Blood seen in / on stool	4 (7)	
GP visit	38 (67)	
Hospitalisation	7 (12)	
Time in hospital (hours)		96 (6 - 312)
Duration of illness (hours)		120 (2 - 312#)
Incubation period (hours)		24 (5 - 72)
Stool samples obtained	46 (81)	
Stool sample +ve for Salmonella typhimurium	39/46 (85)	

\# Sixteen cases were still symptomatic at time of interview, thus upper range > 312 hours

Table 5 Food specific attack rates (AR), relative risks (RR), 95% confidence intervals (95% CI), and percent of cases exposed. Wedding reception, Malahide, 21 August 1996.

	food eaten			***food not eaten***				***95%***	***% cases***
	cases	***total***	***AR %***	***cases***	***total***	***AR %***	***RR***	***C.I.***	***exposed***
Main meal									
Soup	48	102	47	4	6	67	0.71	0.39-1.29	84
Turkey	52	104	50	0	4	0	∞		91
Ham	48	98	49	4	10	40	1.22	0.56 - 2.70	84
Melon	47	100	47	4	7	57	0.82	0.42-1.61	82
Carrots	46	96	48	4	8	50	0.96	0.46-1.98	81
Potatoes	46	98	47	6	10	60	0.78	0.45-1.35	81
Croquettes	43	84	51	7	19	37	1.39	0.74-2.59	75
éclair	41	90	46	11	17	65	0.70	0.46-1.07	72
Stuffing	40	84	48	11	21	52	0.91	0.57-1.45	70
Cauliflower	40	84	48	12	23	52	0.91	0.58-1.43	70
fresh cream	17	44	39	33	62	53	0.73	0.47-1.13	30
coffee cream	8	14	57	44	93	47	1.21	0.73-1.99	14
Scampi	2	4	50	50	104	48	1.04	0.38-2.83	4
wedding cake	25	53	47	27	54	50	0.94	0.64 - 1.39	44
birthday cake	12	17	71	40	91	44	1.61	1.09 - 2.36	21
Sandwiches									
Turkey	3	5	60	23	43	53	1.12	0.52 - 2.42	5
Ham	12	24	50	16	26	62	0.81	0.49 - 1.34	21
Cheese	9	16	56	21	36	58	0.96	0.58 - 1.61	16
Egg	8	10	80	21	41	51	1.56	1.02 - 2.40	14
chicken.	3	4	75	23	44	52	1.43	0.76- 2.70	5
Savoury	3	3	100	26	48	54	1.85	1.42 - 2.39	5
Main meal and/or sandwiches									
Turkey	53	105	50	2	8	25	2.02	0.61 - 6.81	93
Ham	51	104	49	6	10	60	0.82	0.48 - 1.41	89

References

References

Vancouver style

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