



## **FOOD STANDARDS AGENCY: RESEARCH PROJECT E03004**

- PROJECT DELIVERABLE 03/02: Final report on management related risk factors for foodborne disease outbreaks
- PROJECT DELIVERABLE 03/03: Final report on catering practices and management Related risk factors for foodborne disease outbreaks attributed to Salmonella Enteritidis

# **MANAGEMENT RISK FACTORS ASSOCIATED WITH FOODBORNE DISEASE OUTBREAKS WITHIN THE CATERING INDUSTRY IN ENGLAND AND WALES**

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## **EXECUTIVE SUMMARY**

### **Introduction**

Most foodborne disease outbreaks in England and Wales occur in catering businesses, and the most commonly reported contributing factors are failures of food safety controls resulting in inadequate cooking or reheating, cross contamination from raw to cooked foods and inadequate refrigeration of cooked foods. In this study we have looked behind the food safety control failures to compare underlying management, operational and commercial factors in businesses where there have and have not been outbreaks. The purpose is to help explain why outbreaks occur and to identify factors that may be targeted to reduce the risk of outbreaks in the future. We should emphasise, however, that in a case control study a risk factor indicates a statistical association between the factor and the occurrence of an outbreak of foodborne disease. It does not itself necessarily imply a causal role in the outbreak nor does its presence mean that an outbreak will occur. Several of the factors that were statistically associated with outbreak premises were included in the study on an exploratory basis, and further work is required to understand the explanation for the statistical associations.

### **Background**

Several major reports on foodborne disease, such as the Richmond Report, the Stanley Royd Report and the Pennington Group Report have pointed to failures in management, inadequate procedures and staffing issues as contributory causes to outbreaks. However, to our knowledge few epidemiological studies have addressed these areas to try to quantify risk factors. In this study we have examined five groups of factors related to:

- Business characteristics
- Staff employed and structure
- Systems of management of staff
- Operational practices
- Unusual events and circumstances

### **Methods**

Outbreaks of foodborne disease occurring in England and Wales in catering businesses between 1 December 2002 and 31 December 2003 were considered to be cases. These outbreaks were identified through the Health Protection Agency (HPA) surveillance system at the Communicable Disease Surveillance Centre, Colindale, and through an informal network of caterers and environmental health officers. For each outbreak case, a control business, matched for local authority of occurrence and small medium sized enterprise (SME) status was selected from the local authority food registers. Case and control businesses were contacted by letter and telephone, and face to face interviews of the owner or manager or senior chef at the business were carried out by trained interviewers following a standard protocol.

## Results

88 case businesses (90%) and 91 control businesses (93%) agreed to participate in the study.

Of the 88 outbreaks, 58 (66%) were bacterial and 44 (50%) were due to *S. Enteritidis*. In the 88 outbreaks there were 1,851 reported human cases.

Case businesses were more likely to be hotels, to serve Chinese cuisine and to be small or small/medium sized SMEs as opposed to micro SMEs. They were also more likely to serve dinner, snacks, offer room service and be open for 10 or more hours. They were statistically significantly less likely to offer cheaper meals. When the inter-relation between these factors was considered it appeared that serving dinner and offering cheaper meals were independently significant.

Case businesses were more likely than controls to have multiple levels of management, employ full time kitchen staff, employ casual staff and pay head chefs and porters above the national average. They were less likely to have the owner or manager working in the kitchen. These factors tend to be closely related to one another and to the complexity of the menus offered. When this was taken into account none of these factors were independently significant.

Case businesses were more likely to provide staff accommodation and to report staff sicknesses before or at the time of the outbreak. These two factors could not be explained by association with other factors in this group.

We found associations between case businesses and several training variables. In multivariate analysis these training variables were not independently significant risk factors except for kitchen manager who received intermediate food hygiene training which was independent of the other training variables. This training variable was associated with larger SMEs and businesses employing more than 250 staff and also businesses offering more expensive meals. Importantly, there was no indication of any protection from the training variables collected

Case businesses were more likely to use hot display cabinets for a variety of foods, and to prepare foods such as poultry from raw. They also were more likely to be supplied with fresh produce from regional level suppliers, rather than national or local sources. When these factors were examined together, two factors tended to stand out as factors of importance, the regional supply of eggs, and poultry on hot display buffets.

We considered whether the presence of food safety management systems based on the principles of Hazard Analysis Critical Control Points (HACCP) principles was a protective factor. However, it is important to acknowledge when considering the findings that the implementation of such systems was not assessed as part of the study and that at the time of the study the participating businesses were not legally required to have HACCP systems in place. There was no difference between case and control businesses in the maintenance of HACCP records or in verbal approaches based on HACCP principles, nor in maintaining temperature records, cleaning schedules or staff training records.

Unusual events were much more likely to be reported by case businesses, as was the use of a relief manager at the time of the outbreak, or a change in menu preparation but the change of menu preparation was only of marginal significance when the association with the other two variables was taken into account

### **Salmonella Enteritidis Outbreaks**

Similar findings to the above were found for the subset of outbreaks caused by *S. Enteritidis*, although smaller numbers reduced the statistical power. In particular we found an association with Chinese cuisine and with the regional supply of eggs. We also found an association with higher wages. There was some evidence that eggs served in a hot display buffet was a risk factor, as was the use of cooling water in cooking ranges.

### **All bacterial outbreaks**

Similar findings were seen in this dataset.

### **Discussion**

The study, with a very high participation rate and high quality data, has produced unique insights into management risk factors.

The inter-connection between variables is highly complex. Furthermore, since multiple statistical tests were carried out in this study we would expect several false positive associations, the study findings should therefore be interpreted cautiously.

The association between outbreaks and hotels seems to be explained by the fact that hotels are more likely to serve dinner. Factors associated with more complex dinner menus such as offering more expensive meals, preparation of foods from raw and use of hot buffet displays were more common in hotels and Chinese restaurants. The presence of the owner or manager working in the kitchen did not itself appear to be a protection once cheaper meals and business size were taken into account. We were unable to explain why full time kitchen staff were associated with case businesses. Consideration should be given to whether fulltime staff were more likely to be expected to perform tasks for which they are not skilled.

The finding that staff sickness was a risk factor could be because staff sickness leads to foodborne outbreaks, or perhaps more probably, that staff who were cases of illness as part of the outbreak were misclassified by interviewees as ill before the outbreak. The link with providing staff accommodation cannot be explained and could be a chance finding.

An important finding was that neither formal training nor the presence of food safety management systems based on HACCP principles, although implementation of these systems was not assessed during the study, were linked to reduced risk. The lack of protection raises questions about both the appropriateness of training courses and the potential danger of businesses relying on paper proof of due diligence rather than ensuring application of sound catering principles.

The subset of *S. Enteritidis* outbreaks associated with Chinese restaurants can be explained in large measure by the use of regional egg supplies. Our study suggests that the quality of eggs supplied through this route should be examined.

## **Conclusion**

Outbreaks of foodborne disease were more common in catering businesses that are larger SMEs and that cater for the higher price range, offering more services. Outbreak businesses tended to have more tiers of management, have fulltime kitchen staff, use casual staff and offer staff accommodation. They were more likely to have supplies of eggs, poultry and meat from regional suppliers; regional supply of eggs was associated with *S. Enteritidis* outbreaks. They were less likely to collect food directly from the supplier. Outbreak businesses were more likely to use hot display cabinets and to reheat certain foods. They were also more likely to have a recent change of menu, or a new process or procedure or practice, or have a relief manager on at the time. Reported formal training and the presence of food safety management systems based on HACCP principles, were not related to reduced risk, although we cannot say how well these systems were followed since the study could not assess this aspect of management.

## **Recommendations**

1. Further research is needed to explore the possible relationship between occurrence of outbreaks and the employment of full-time kitchen staff and the provision of staff accommodation.
2. Further investigation is needed into the content and delivery of food hygiene training programmes to reinforce the ways in which training is linked to subsequent responsibilities in catering.
3. Further work is required to understand how approaches to HACCP control procedures are related to the actual implementation of HACCP principles in the catering business.
4. The catering industry should be alerted to the findings of this study. Regional workshops should be held for local authorities and other interested public health agencies in order to develop the application of the protocol for the identification of management risk factors during routine and outbreak investigations.
5. A working group should be established to consider the integration of key risk factors into the guidance on assessing the 'Confidence in Management' section of the inspection rating schemes, Food Safety Act 1990 Code of Practice. This group should include representatives from LACORS, FSA, environmental health practitioners and the project team.

## 1.0 INTRODUCTION

- 1.1 Most foodborne disease outbreaks that occur in England and Wales are reported in catering premises (Djuretic et al, 1996). The Food Standards Agency aims to reduce food poisoning by 20% by the year 2006. The most commonly reported contributing factors are food safety control failures (e.g. cross contamination, inappropriate storage and inadequate cooking and reheating). Government has produced legislation and guidance which primarily focuses on food safety control systems such as temperature control (Food Safety Act 1990, Code of Practice No.10). However, failures in temperature control continue to feature in foodborne outbreaks (Djuretic et al, 1996) which in turn continue to be a public health challenge and undermine public confidence in the food industry. Management related and operational issues in the catering sector will have an effect on the food safety control system of a food business and are likely to be related to the underlying causes of these outbreaks. These include issues relating to the employment and management of staff, the catering practices adopted by a business and breakdown in business operations. Management issues are rarely reported in outbreak investigations and little is known about their role in contributing to outbreaks.
- 1.2 The following report describes an epidemiological study that compares management and operational practices in catering businesses where outbreaks of foodborne disease occurred, with practices in non-outbreak catering businesses.
- 1.3 The study was conducted by Cardiff University, Checkmate International and the Health Protection Agency, and was commissioned and funded by the Food Standards Agency (research project E03004).
- 1.4 A pilot study collected data from 60 outbreaks (Appendix 1) between November 2001 and October 2002, and 63 control businesses (Report, Jan 2003). Results were used to refine methods for the main study and establish professional networks for efficient data collection.
- 1.5 The main case control study collected data from 88 outbreaks that occurred between 1<sup>st</sup> December 2002 and 31<sup>st</sup> December 2003, and from 91 control businesses. Data collection methods and some variables were identical in the pilot and main study and so for these variables, the pilot and main study data have been pooled in order to increase the sample size and hence the power of the study (see Methods).
- 1.6 This final report presents analyses of three sets of data; all foodborne disease outbreaks, outbreaks caused by *Salmonella enterica* serovar Enteritidis, and all bacterial foodborne disease outbreaks.

## 2.0 BACKGROUND

- 2.1 Management, operational and commercial business factors in the catering sector such as financial and personnel policies and practices will have an effect on the food safety control system of a food business. The Richmond Report recognised that failures in equipment, procedures, changes in policy and practice as well as human error were all important causes of food poisoning (Richmond et al, 1989). In a recently published study on the microbiological quality of cold ready-to-eat sliced meats from catering establishments, researchers showed significant relationships between microbiological quality and consumer at-risk scores, confidence in management scores, management food hygiene training and the presence of a food safety management system based on HACCP principles assessed by an environmental health practitioner during a site inspection (Gillespie et al, 2000). Furthermore, significant relationships between management food hygiene training and the implementation of food safety procedures were found. It is highly likely that such factors play a pivotal role in determining whether or not an outbreak could take place in a particular premises (Gillespie et al, 2000).
- 2.2 To our knowledge, there has not yet been a published systematic review of the underlying management causes of food safety control failures in food poisoning outbreaks. Nevertheless, reports into high profile outbreaks have highlighted such issues. The committee of enquiry into the outbreak of food poisoning at Stanley Royd hospital in 1984 found that employment arrangements amongst staff contributed to food safety control failures. These included understaffing and a bonus scheme of payment, which resulted in long working hours and in supervisors having to work as cooks rather than supervising the food preparation practices. Furthermore, there was a history of abnormally high sickness rates, particularly long-term sickness. Lack of communication between senior and middle catering management was also evident. The management structure had in fact been altered less than 12 months prior to the outbreak, leaving the catering advisor with 'responsibility without power'. Significantly, 'an apparent gulf' existed between management and kitchen workers (Committee of Inquiry, 1986).
- 2.3 More recently, The Pennington Group investigated the major outbreak of VTEC O157 in Scotland in 1996. The Group's subsequent report referred to the need for a full commitment of management and workforce for the successful application of HACCP (Pennington et al 1997). This recommendation is also reflected in the Industry Guide to Good Hygiene Practice: Catering Guide (1997) which emphasises the need for staff involvement in setting up a HACCP system and the need for that system to be dynamic in character.
- 2.4 Published reports of several smaller outbreaks refer to management related issues that affected the food safety control system in the implicated food businesses (Roels et al, 1998), (Roels et al, 1997). Clearly, a study is needed

to look at outbreaks across the board in order to provide results that are relevant to all catering operations.

2.5 The most suitable approach to achieve this is to compare business practices in catering premises where an outbreak has occurred with such practices in other similar types of premises. The case control method is therefore particularly suitable. Furthermore, this method is efficient because it requires few premises (outbreaks are a relatively uncommon occurrence) and allows multiple exposures to be examined in one study. Hence, costs are reduced and timely information can be gathered to inform future policy decisions. A matched case control study was undertaken to test the hypotheses that outbreaks of foodborne disease are associated with:

- i. Specific business characteristics.
- ii. Patterns of staff employment and structure.
- iii. Patterns and systems of management of staff.
- iv. Specific operational practices.
- v. Occurrence of unusual events/circumstances.

## 3.0 METHODS

### Case Definition

3.1 A case was defined as a catering business located in England and Wales that was confirmed as the place of a general outbreak of bacterial or viral food poisoning between 1st December 2002 and 31st December 2003.

- 'Catering business' was defined as a commercial or voluntary organisation that prepares, serves and sells food to the final consumer. It included restaurants, public houses, cafes, takeaways, hotels, guesthouses, and caterers. It did not include private houses, mobile retailers, armed services camps, retailers, manufacturers and suppliers. Hospitals, residential institutions, schools, universities, colleges and places of work were included when the outbreak was 'point source' and confirmed to be the result of foodborne transmission only.
- An 'outbreak of bacterial or viral food poisoning' was defined as 'three or more persons from more than one household who were thought to have a common exposure to a proven infection'. This was slightly more stringent than the more commonly used PHLS definition of a general outbreak which is two or more people from more than one household.
- 'Confirmed as the place' was defined as 'environmental, epidemiological or microbiological evidence collected during the local authority outbreak investigation'.

3.2 Reported viral foodborne disease outbreaks were reviewed to ensure that only those viral outbreaks where transmission was predominantly foodborne were included. The criteria used were:

- The outbreak was a point source outbreak.
- There was a common food exposure – meal/buffet lunch/wedding breakfast.
- Foodborne transmission was the only or predominant transmission pathway identified by investigators.
- The cases did not have any other common exposure that could explain the outbreak apart from the consumption of food.
- The outbreak was not known to be the result of a guest or member of staff vomiting in a public area.

### Case Finding

3.3 Outbreaks (cases) were identified from the foodborne disease surveillance system managed nationally at the Health Protection Agency. In addition, reports were reviewed from the network of national catering and hotel chains, trade contacts and environmental health officers (EHOs), developed and maintained for the duration of this research. Information collected from these two sources was used to identify the outbreak location and relevant local

authority. When local authorities had completed all formal investigations into the outbreak, case and control business details were released to the project team. When case businesses were being considered for prosecution, control business details were released to the project earlier to avoid unnecessary detail in interviewing and reduce recall bias.

### **Estimation of Study Population Size**

3.4 Estimated numbers of outbreaks available to study were based on the number of foodborne disease outbreaks officially reported to the Health Protection Agency. The most recently available published data at the time of project preparation was for the period 1995 - 1998 when 2,698 general outbreaks of infectious intestinal disease were reported in England and Wales. Outbreaks not associated with catering operations were not eligible for inclusion in this study and so removed from this total, giving 707 outbreaks, an average of 176 per year. A participation rate of 50% was assumed and a target of 88 outbreaks over one year was set for the main study.

### **Control Definition**

3.5 A control was defined as 'a catering business located in England and Wales which had not been reported as a source of a general outbreak of bacterial or viral food poisoning between 1st December 2002 and 31st December 2003'.

### **Control Selection**

3.6 Control businesses were drawn from the same source population as cases, that is, the catering industry in England and Wales. Matching was only considered appropriate for two variables; SME status (categorised as either employing less than or greater than or equal to 250 staff) and local authority. This enabled other fixed variables relating to the characteristics of the business, namely type of cuisine and type of catering business, to be investigated for their risk potential. In addition, it was likely that if these two variables (SME status and region) were not held constant there would be marked imbalance between the groups. Control businesses were selected from the public food premises register of the local authority area where the outbreak occurred. The local authority environmental health department selected the control by a standard protocol that could be applied to either a computer or paper register:

- 'Go to the case business on the food register'.
- 'Count five businesses down from the case business'.
- 'If the fifth business is a catering business and has the same SME status, select this one'.
- 'If the fifth business is not a catering business or not the same SME status, go to the business below, and so on until a match is found'.

## Recruitment

- 3.7 On receipt of business details, letters were sent to both case and control businesses requesting their participation. A standard template was used for both case and control businesses, but in order to maximise participation rates, letters were tailored to the particular circumstances of the business.
- 3.8 The letter was followed by a telephone call a week later. We sought to arrange an appointment with the person most familiar with the daily routine of the business and operational practices to the owner, an appropriate manager or head chef. Telephone calls were also used to build up a rapport with the business to discuss details of the study and to reiterate the value of their participation. In some circumstances a visit was made to the business to encourage participation. In general, the recruitment process took approximately 3 weeks, varying between 10 days and 8 weeks, with interviews usually taking place within 14 days. It was rare for these appointments to be rearranged. Appointment times ranged from 9.00am to 10.30pm and in general occurred before or just after serving hours.

## Development of interview protocol

- 3.9 All interviews were undertaken to a standard protocol (Appendix 2). The pilot study was used to generate hypotheses and to test the application and design of the interview protocol. The questions (variables) included in this original protocol were based on:
- Limited published literature available on management issues associated with foodborne disease outbreaks, including Government reports and articles published in peer review journals.
  - Industry and local authority investigations into food safety incidents and foodborne disease outbreaks.
  - The project team's knowledge of the catering industry.
- 3.10 The following *a priori* hypotheses groups were generated:
- Specific business characteristics
  - The employment of staff
  - The management of staff
  - Specific operational practices
  - The occurrence of unusual events/circumstances
- 3.11 Whilst the focus of the interview protocol was to establish how the business was operated and managed, we also wanted to explore how the business managed food safety. The following questions were asked:
- Do you have a cleaning schedule?
  - Do you have temperature control records?

- Do you have staff training records?
- Do you have a HACCP system?

The 'HACCP' question related to the presence of a food safety management system incorporating the 5 principles of HACCP. The study design did not allow us to consider how the systems were operated, so we cannot say whether HACCP principles were followed in practice. The term 'HACCP' can be misunderstood so where caterers were unaware of the term 'HACCP' other terms used within the industry were referred to, namely hazard analysis, safe assured catering and risk assessment and if necessary the general principle of HACCP was explained to the business. This approach enabled the interviewer to establish whether or not a food safety management system incorporating the principles of HACCP was present in a business at the time of the outbreak.

It should be noted however that at the time of data collection between 2002 and 2003, the presence of a formal HACCP system was not a legal requirement within the catering industry.

3.12 With the exception of a minimal number of exploratory variables (see Table 12); all questions related to pre-specified hypotheses groups. Table 1 defines the variables analysed in the study. All questions outlined in the protocol related to the time of the outbreak and to the 14 days before this occurrence. 'Trigger events' were used in all interviews to help businesses recall practices and operations over the specified time period. This was particularly relevant to control businesses that we did not expect would be able to immediately recall the period of time in question. Trigger events included:

- Extremes in weather.
- School and national holidays.
- Calendar events and religious festivals.
- Significant local and national news events, including sporting events.

## Data Collection

3.13 The appointment involved a face-to-face interview at the business address using one of three regional field investigators. These investigators had backgrounds in catering and food safety and were selected specifically for their interpersonal and communication skills within the catering sector. All investigators received regular project training to ensure consistency in approach. Whilst the interview was conducted to the standard protocol, the process was very informal, usually involving a discussion over a cup of coffee. This approach was used to develop trust between the business and interviewer, with the view to encouraging openness and the receipt of data that truly reflected how the business was operated. Inspection of the business was not considered appropriate as this would (a) not provide any useful information regarding events that occurred sometime in the past and (b) suggest an enforcement visit. The duration of interviews ranged from forty five minutes to two and a half hours; the average time was approximately 75 minutes. In cases where the head chef or manager was absent from work at

the time of the outbreak, additional discussions were held with staff members present at the time of the outbreak. This approach ensured that the data collected reflected the management and operation of the business in different circumstances. Completed interview protocols were carbonised. The original was sent by first class post to the University where the data was securely stored. The interviewer retained the copy until confirmation of receipt was received, and then the copy was either destroyed or returned to the centre.

### **Data Entry and Validation**

- 3.14 A password protected database was created using Microsoft ACCESS 2003 into which all information recorded on the paper study protocols were entered. All data entry was carried out by one of the report's authors to ensure consistency and accuracy of data coding and entry.
- 3.15 On completion, data base entries were visually checked independently against the paper questionnaires by two other members of staff and, where necessary, corrected accordingly.

### **Data Analyses**

- 3.16 Analyses were undertaken on 3 datasets:
- All foodborne disease outbreaks.
  - Foodborne disease outbreaks attributed to S. Enteritidis.
  - Bacterial foodborne disease outbreaks.
- 3.17 Foodborne disease outbreaks attributed to S. Enteritidis (n=60) were analysed separately to address the sudden increase in the number of S. Enteritidis foodborne disease outbreaks in 2003. Of the 60 outbreaks, 44 came from the main study and 16 from the pilot. An additional set of questions relating to the use and the handling of eggs were asked of the 39 outbreaks and their controls that occurred between May and December 2003 (See Appendix 4).
- 3.18 Foodborne disease outbreaks attributed to bacterial contamination comprised 90 (61%) outbreaks, 58 outbreaks from the main study and 32 outbreaks from the pilot.
- 3.19 The interval between date of outbreak and interview with case and control businesses was calculated. Non-participating businesses were compared to study businesses to determine the representativeness of the data.
- 3.20 The epidemiological characteristics of the main study outbreaks were described in terms of temporality, causative pathogen, number of reported and confirmed cases, geographical distribution, type of catering business and SME category. Characteristics of control businesses were described and business ownership, SME category and type of catering business were compared to case businesses.

- 3.21 The time the site had been in operation and the time the interviewee had been in post (in years) was compared for cases and controls by categorising into <1 year, 1- years, 2- years, 5- years and 10 or more years. The data was displayed as box plots and histograms.
- 3.22 Catering methods were considered in relation to the entire menu offered by the business. The amount of bulk preparation, cook to order, prepared from raw on site and regenerated on site was compared between case and controls by categorising the percentage of the menu by: 10% and less, 11 - 30%, 31 – 50%, 51% - 70%, 71 – 90% and >90%. The data was display as histograms. This analysis was only undertaken for all foodborne disease outbreaks.

### **Data Pooling**

- 3.23 Review of pilot and main study populations outlined in Appendix 3 indicated that where questions from the pilot and main study were identical pooling of data was appropriate in order to increase the sample size and hence the power of the study. Data were pooled for the following questions:
- Business characteristics
    - Type of catering business
    - Type of cuisine
    - Business ownership (family business etc)
  - Staff employment and structure
    - Management structure
    - Recruitment of agency staff
    - Recruitment of staff with food hygiene and/or professional qualifications
  - Staff management
    - Maintaining hygienic standards
    - Communication
    - Staff incentives
  - Operational practices
    - Menu specifications
    - HACCP
  - Unusual events
    - All questions within this hypothesis group

### **Univariate Analysis**

- 3.24 The frequency of exposure in case businesses was compared to that of control businesses firstly by unmatched analyses using SPSS for Windows. SPSS (Statistical Package for the Social Sciences) is a data management and analysis package that performs a range of statistical analyses required by the methods used in epidemiological case control studies. Dichotomous categorical variables (yes/no answers) relating to the five prior hypotheses groups were compared in 2x2 tables by calculating odds ratios with 95% confidence limits. Pearson chi square was used to test the null hypothesis (p value) unless a cell had an expected count of less than five, in which case

Fisher's Exact Test was used. The data were then analysed in matched case control sets by calculation of Mantel Haenszel matched odds ratios using STATA (Stata Corporation, 1997). With the exception of bacterial foodborne disease outbreaks, variables identified as significant at the 10% level are highlighted in bold in the univariate tables. In the case of bacterial outbreaks, the univariate tables only include variables significant at the 10% level.

## Multivariate Analysis

3.25 Data were stratified by suspected confounding variables in order to decide on the most appropriate methods for multivariate analysis. Business size was a confounding variable and even though case and control businesses were matched for SME status (and thus controlled for the difference between businesses employing less than or greater than 250 employees) there was still the possibility of variation of business size within the SMEs. Case and control businesses were matched for SME status (that is whether they employed more than or less than 250 staff) but could not be matched for SME size since these data were not available from the public food premises register. It was considered likely that an SME catering business employing 5 staff might have different management issues to an SME catering business employing 89 staff. The number of staff employed by each business was collected in the main study. This enabled additional ordinal variables to be created to represent SME size. This was based on the categories identified in the Commission Recommendation of 06/05/03 concerning the definition of micro, small and small medium enterprises (2003/361/EC):

- i) Non SME: a business employing more than 250 employees which operates either from one sites or multiple sites throughout the country
- ii) Medium SME: small medium enterprise employing between 50 and 249 employees.
- iii) Small medium SME: small medium enterprise employing between 10 and 49 employees.
- iv) Micro SME: small medium enterprise employing less than 10 employees.

3.26 Using STATA, conditional logistic regression was undertaken on the main study dataset (88 outbreaks) to identify those variables independently associated with an outbreak of foodborne disease (Parry et al, 1998), (Rothman, 1986). Variables identified as significant at the 10% level in univariate analysis were selected for multivariate analysis. For some variables there were insufficient numbers of cases to be included in the models and some variables were excluded because of duplication. For example,

- 'room service' was not taken forward as it was exclusively linked to 'hotel'
- 'Head chef paid below national average wage' was not taken forward as it relates to 'head chef paid above the national average wage'

- Poultry served at small functions was the only variable for this type of practice identified in the multivariate table 18. It was adjusted for other significant foods types served at a small function.

3.37 These selected variables were first adjusted for potential confounders within their hypothesis groups and then for potential selected confounders drawn from other hypothesis groups. For example, the use of casual staff may relate to other staff employment variables as well as some business characteristic variables. First a model was specified that included staff employment and management variables ('manager/owner working in the kitchen', 'chefs salaried', 'kitchen team employed fulltime', 'head chef' and 'kitchen porter paid above the national average') and then models were tested that in turn included potential business characteristic confounders ('hotel', 'business size', 'dinner and meal for 2 <£21').

3.28 Multivariate analysis was carried out initially to investigate the relationship between the following business characteristic variables (Table 13):

- i) If a business was a 'hotel', it was also considered more likely to stay 'open for more than 10 hours continuously' but not more likely to serve 'Chinese cuisine', serve 'dinner', serve 'snacks' or serve 'meal for 2 <£21'. Therefore 'hotel' was adjusted for 'open for more than 10 hours continuously'.
- ii) If a business was a 'pub/bar', it was also considered more likely to serve cheaper food i.e. 'meal for 2 <£21', but was not more likely to 'open for more than 10 hours continuously', serve Chinese cuisine, serve dinner or serve snacks. Therefore 'pub/bar' was adjusted for 'meals less than £21'.
- iii) If a business served 'Chinese cuisine', it was also considered more likely to serve 'dinner' and to serve buffet style meals that were 'meal for 2 <£21', but was not more likely to 'open for more than 10 hours continuously', be a hotel, be a pub/bar, or serve snacks. Therefore 'Chinese cuisine' was adjusted for 'dinner' and 'meal for 2 <£21'.
- iv) If a business served 'dinner', it was also considered more likely to serve 'Chinese cuisine' but not more likely to 'open for more than 10 hours continuously', be a hotel, be a pub/bar, or serve snacks or 'meal for 2 <£21'. Therefore 'dinner' was adjusted for 'Chinese cuisine'.
- v) If a business served 'snacks', it was also considered more likely to be 'open for more than 10 hours continuously' and serve 'meal for 2 <£21', but not more likely to be a hotel, be a pub/bar or serve 'Chinese cuisine' or 'dinner'. Therefore 'snacks' was adjusted for 'open for more than 10 hours continuously' and 'meal for 2 <£21'.
- vi) If a business was 'open for more than 10 hours continuously', it was also considered more likely to be a 'hotel' and to serve 'snacks' but not more likely to serve Chinese cuisine, serve dinner, serve meal for 2 <£21. Therefore 'open for more than 10 hours continuously' was adjusted for 'hotel' and 'snacks'.
- vii) If a business served 'meal for 2 <£21' it was also considered more likely to be a 'pub/bar', more likely to serve 'Chinese cuisine', and 'snacks' but

not to 'open for more than 10 hours continuously', be a 'hotel' or serve 'dinner'. Therefore "meal for 2 <£21" was adjusted for 'pub/bar' and 'Chinese cuisine' and 'snacks'.

- 3.29 Within the staff employment and structure hypothesis group (Table 14) the tiers of management between the kitchen manager and site manager or owner were considered mutually exclusive. However, there were potential relationships between staff employment and staff structures (tiers of management). Therefore, each structure variable was adjusted for all of the individual kitchen staff employment variables. Similarly, each of the individual staff employment variables were adjusted for the only staff structure variable (owner/manager working in a kitchen) which had remained independently associated with outcome. Finally, adjustment was made for variables in the food and beverage hypothesis group and for the potential business characteristics confounders (hotel, dinner, meal for 2 <£21 and business size).
- 3.30 Within the staff management hypothesis group (Table 16) the two staff facilities variables were adjusted for each other (i.e. staff using guest toilets and staff accommodation). In order to investigate a relationship between staff sickness and provision of staff facilities, the staff sickness variable (member of kitchen or food and beverage staff sick at time of outbreak or 14 days before) was adjusted for the staff facilities variables. Staff incentives were adjusted for staff facilities (i.e. staff toilets and staff accommodation). Finally, communication via day to day verbal contact was adjusted for staff facilities and incentives variables and then for the management structures.
- 3.31 Within the operational practices hypothesis group two models were developed, type of food (Table 18) and suppliers (Table 19). In the type of food model all the variables relating to hot display buffets were adjusted for each other since it was considered likely that if one food was served on a hot display buffet others would be as well e.g. a Chinese hot display buffet would include shellfish, rice, eggs, red meat and poultry. Similarly, where poultry was cooked from raw it was considered likely that other ingredients i.e. vegetables and red meat, would be cooked from raw. A similar approach was used for functions.
- 3.32 The only three variables identified within the unusual events model (Table 20) with sufficient numbers to conduct a multivariate analysis were 'relief manager at time of outbreak', 'unusual incident at time of outbreak' and 'change in menu preparation', and these were adjusted for each other.

## 4.0 RESULTS

### DATA VALIDITY

#### **Main Study Population**

4.1 From 1<sup>st</sup> December 2002 to 31<sup>st</sup> December 2003, 180 suspected outbreaks were identified. Of these, 98 (54%) came within the case definition (see paragraph 3.1). 88 (90%) of the 98 case businesses eligible for inclusion participated in this study. Sixty two (71%) of the outbreaks were identified by the Health Protection Agency (Table 2). Ninety one (93%) control businesses that were approached agreed to participate.

#### **Non participant population**

4.2 There were 10 non-participant case businesses (Table 3) and 7 non-participant control businesses (Table 4). Six businesses with *S. Enteritidis* outbreaks, one with *S. Typhimurium*, one with VTEC O157, one with *Shigella sonnei* and one with Norovirus declined to participate. Nine of the 10 case businesses were SMEs, six were restaurants, two were commercial caterers and one was a nursing home. Two of the non-participant case businesses (restaurants) were still being considered for prosecution at the time of analysis. Of the seven control businesses that declined four were SMEs.

#### **Outbreak Details**

4.3 Outbreaks occurred throughout the year but there was a definite seasonal pattern. Forty five (51%) occurred between July and October (Figure 1) and 17 (19%) occurred in August. The lowest number of outbreaks occurred in January (3, 3%) and November 2003 (2, 2%).

4.4 There were 58 (66%) bacterial outbreaks, of which 44 were due to *S. Enteritidis* and 4 to *Campylobacter*. Of the *S. Enteritidis* outbreaks, PT4 accounted for 10 (23%) outbreaks (Table 5). There were 20 presumptive norovirus outbreaks, of which 13 (43%) were microbiologically confirmed. (Figure 2).

4.5 In the 88 outbreaks that took part in the main study there were 1,851 reported cases (Figure 3). Of the 70 microbiologically confirmed outbreaks 706 cases (38%) were laboratory confirmed. Outbreaks ranged in size from 3 to 142 reported cases (Figure 3).

#### **Geographical Distribution**

4.6 Outbreaks occurred throughout England and Wales (Figure 4), with a concentration in the South East (14, 16%), East (16, 16%), South West (12, 14%) and Yorkshire and Humber areas (11, 13%) (Table 6). The fewest number of outbreaks were recorded in the East Midlands (3, 3%) and Wales (5, 7%).

## **Case Businesses**

4.7 Restaurants were the commonest type of case business with 36 cases (41%), followed by hotels with 19 (22%) (Figure 5). Other catering businesses included residential care homes (8%), educational establishments (2%) and shop caterers (3%) whose secondary income was catering (that is they made and sold food products/meals on site e.g. bakers and butchers). Sixty (68%) case businesses were SMEs of which 25 (42%) were micro businesses, 28 (47%) were small businesses and 7 (11%) were small-medium businesses (Figure 6). Thirty out of 88 (34%) case businesses were family businesses all of which were also SMEs (Figure 7). Twenty four (27%) large case businesses were part of a national chain. Only one case business operated as a voluntary organisation.

## **Control Businesses**

4.8 Thirty seven (41%) control businesses were family owned and 26 (29%) were part of a national chain (Figure 8). Compared to case businesses there was a higher proportion of micro SMEs (48, 53%) and a lower proportion of small (14, 15%) and small medium (1, 1%) SMEs (Figure 9). Thirty five (39%) control businesses were restaurants (Figure 10). There were proportionally more pub bars (18, 20%) and cafes (11, 12%) and less hotels (11, 12%) than case businesses. The proportion of other catering establishments, namely shop caterers, educational establishments and residential care homes were similar.

## **MANAGEMENT RISK FACTORS – ALL OUTBREAKS**

### **Time site had been in operation – all outbreaks**

4.9 Case businesses had been in operation on the current site for longer than control businesses (mean 30 years vs. 21 years) but this was not statistically significant (independent sample t test  $p = 0.33$ ; 95% CI difference between means = -9.11 – 26.64) (Figure 11). Case businesses were not more likely to be in their first year of business than controls (18/88 vs. 12/81, OR = 0.86: 95%CI = 0.42 – 1.75,  $p = 0.67$ ).

### **Time interviewee in post - all outbreaks**

4.10 Interviewees in case and control businesses had been in post a similar time (mean 7 years vs. 7 years) (independent sample t test  $p = 0.80$ ; 95%CI difference between means = -2.77 – 2.13) (Figure 12). The people interviewed were the owner of the business (73, 41%), general managers (59, 33%), deputy managers (23, 13%), and others (59, 33%). Case business interviewees were not more likely to be in the first year of their post than controls (10/88 vs. 8/88, OR = 0.1.33: 95%CI = 0.50 – 3.54,  $p = 0.57$ ).

## **Menu preparation – all outbreaks**

4.11 The percentage of the menu that was reported to be bulk prepared in case and control businesses was similar (Fisher's exact test = 0.15) (Figure 13) as was the percentage of food cooked to order (Fisher's exact test = 0.12) (Figure 14), the amount of menu that was prepared from raw on site (Fisher's exact test = 0.13) (Figure 15) and the amount of menu that was regenerated on site (Fisher's exact test = 0.12) (Figure 16).

## **UNIVARIATE ANALYSIS**

### **Sample Size – all outbreaks**

4.12 In the following analyses, pilot study data have been combined with data from the main study for the variables previously discussed in section 3.22. Thus the total number of cases and controls used varies depending on which population has been used:

- 148 cases and 148 controls: pooled data from the pilot and main study.
- 88 cases and 88 controls: data from the main study.
- 100 cases and 100 controls: SME cases from pooled data.
- 48 cases and 48 controls: Non SME cases from pooled data.

### **Business characteristics – all outbreaks: Table 7**

4.13 Thirty six (24%) case businesses and 20 (14%) control businesses were hotels (OR = 3.29, 1.41 – 7.66). Eighteen (12%) case businesses and 28 (19%) control businesses operated as pub/bars (OR = 0.41, 0.17 – 0.99). Case businesses were more likely to serve Chinese cuisine (OR = 5.00, 1.71 – 14.63), to be small (OR 3.80, 1.41 – 10.18) or small medium SMEs (OR 7.00, 0.86 – 56.89) and were less likely to be micro SMEs (OR = 0.09, 0.02 – 0.39). Seventy nine (90%) cases served dinner compared with 67 (76%) controls (OR 3.00, 1.19 – 7.56), and cases were also more likely to serve snacks and offer room service (OR = 1.55 – 18.30). Fifty (57%) cases and 37(42%) controls were open for 10 hours or more continuously (OR = 2.18, 1.07 – 4.45).

### **Staff employment and structure – all outbreaks: Table 8**

4.14 Case businesses (29, 20%) were more likely than control businesses (17, 11%) (OR = 2.10, 1.02 – 4.29) to have multiple levels of management between the business owner or general manager and the kitchen manager. Also, twenty one (14%) case businesses were more likely than control businesses (13, 9%) to report having an area manager and multiple levels of management between the general manager and the kitchen manager (OR = 2.14, 0.89 – 5.26). Only 28 (19%) case businesses but 52 (35%) control businesses had the owner or general manager working in the kitchen (OR = 0.33, 0.17 – 0.64). Case businesses (33, 38%) were twice as likely to use casual staff as control businesses (20, 23%) (OR = 2.08, 1.05 – 1.15). Sixty

six (75%) case businesses and 50 (57%) control businesses employed fulltime kitchen staff (OR = 2.78, 1.30 – 5.95) (this excluded the kitchen manager and deputy) and case businesses were also more likely to employ fulltime food and beverage (F&B) staff than control businesses (OR = 2.60, 1.25 – 5.39). Fulltime F&B managers were more likely to be employed by case businesses (63, 72%) than control businesses (46, 52%) (OR = 2.55, 1.27 – 5.11). Thirteen (15%) case businesses reported paying salaries to F&B staff compared to 8 (9%) control businesses (OR = 3.00, 0.81 – 11.08). Case businesses (48, 55%) were more likely to report paying their head chef (OR = 2.38, 1.25 – 4.56) and kitchen porters (OR = 2.50, 1.10 – 5.68) above the national average wage and case businesses (11, 13%) were less likely to report paying their head chefs below the national average wage (OR = 0.50, 0.22 – 1.11).

### **Staff management – all outbreaks: Table 9**

- 4.15 Case businesses (27, 31%) were more likely to report that they provided staff accommodation (OR = 4.00, 1.50 – 10.66), than control businesses (12, 14%) and were also more likely to report kitchen managers (OR = 3.00, 0.97 – 9.30) absent from work at the time of the outbreak or up to 14 days prior to the outbreak. In addition, case businesses (23, 26%) were much more likely to report a staff member sick at the time of the outbreak or 14 days before compared to control businesses (2, 2%) (OR = 15.75, 3.59 – 69.16).
- 4.16 A higher proportion of case businesses reported that they either provided or had kitchen and food and beverage staff with training (these included induction, basic and intermediate food hygiene training and professional training). Twenty two (25%) case businesses but only 8 (9%) control businesses reported employing kitchen managers who had received intermediate food hygiene training (OR = 3.80, 0.43 – 10.18) and 30 (34%) case businesses but only 18 (20%) control businesses reported food and beverage staff with basic food hygiene training (OR = 2.50, 1.10 – 5.68). Case businesses (14, 16%) were also more likely to report that kitchen staff had received professional training than control businesses (5, 6%) (OR = 5.50, 1.01 – 24.81).
- 4.17 Fifty two (39%) case businesses and 70 (47%) control businesses reported that they communicated business issues verbally on a daily basis (OR = 0.58, 0.36 – 0.95). Case businesses were also more likely to offer staff incentives than control businesses (OR = 1.81, 1.08 – 3.03).

### **Operational practices: Table 10**

- 4.18 A higher proportion of case businesses reported catering for small functions (<20 people) but this was only of marginal statistical significance. Foods included: bread/cakes (OR = 2.60, 0.93 – 7.29), poultry (OR = 2.00, 0.94 – 4.27), red meat (OR = 1.91, 0.92 – 3.96), desserts (OR = 2.29, 0.94 – 5.56) and sauce (OR = 2.14, 0.87 – 5.25). A similar pattern was found in catering for large functions, bread/cakes (OR = 2.13, 0.92 – 4.92), vegetables (OR = 1.79, 0.93 – 3.44), fish (OR = 2.18, 1.07 – 4.45) and poultry (OR = 1.93, 1.01

– 3.68). However, case businesses (23, 26%) were less likely than control businesses (38, 43%) to report serving egg dishes at large functions (OR = 2.25, 1.14 – 4.44). Case businesses were more likely to offer food from a hot display buffet such as dishes containing poultry (OR = 3.50, 1.41 – 8.67) and eggs (OR = 3.75, 1.24 – 11.30). A similar pattern was found for shellfish (OR = 7.50, 1.72 – 32.80), red meat (OR = 3.50, 1.41 – 8.67), rice/pasta (OR = 2.86, 1.21 – 6.76) and vegetables (OR = 2.11, 0.95 – 4.67). Case businesses were more likely to prepare and cook some high-risk foods from raw ingredients. Fifty eight (66%) case businesses and 41 (47%) control businesses prepared poultry dishes from raw (OR = 3.13, 1.41 – 6.93) and 58 (66%) cases and 48 (55%) controls prepared dishes containing red meat from raw (OR 2.25, 0.98 – 5.17). A similar pattern was found for vegetables (OR = 2.50, 0.97 – 6.44). Case businesses were more likely to report serving poultry (OR = 5.00, 1.10 – 22.82) and case businesses were also more likely to report serving ice cream (OR = 4.50, 1.52 – 13.30). Twenty eight (32%) case businesses compared to 16 (18%) control businesses reported reheating rice/pasta dishes to order (OR = 2.71, 1.14 – 6.46).

- 4.19 A higher proportion of case businesses reported using regional suppliers to supply certain foods directly to their premises. Nineteen (23%) case businesses compared to 7 (9%) control businesses used regional suppliers for red meat (OR = 6.00, 1.34 – 26.81) and 25 (30%) cases and 7 (9%) controls used regional suppliers for eggs (OR = 4.00, 1.50 – 10.66). Case businesses were more likely to use regional suppliers for poultry, with 21 (36%) case businesses compared to 6 (8%) control businesses (OR = 4.67, 1.34 – 16.23). Twenty (23%) case businesses but 35 (40%) control businesses collected food directly from their supplier (OR = 0.38, 0.17 – 0.80).
- 4.20 We considered whether the presence of a food safety management system that incorporated the principles of HACCP made a difference to being a case or control business, although the implementation of such systems was not assessed during the study. No significant differences were observed for either a documented HACCP or a verbally communicated HACCP approach. There were also no significant differences reported in maintaining temperature control records, keeping a cleaning schedule or keeping staff training records.

#### **Unusual events – all outbreaks: Table 11**

- 4.21 Nineteen (13%) case businesses had a relief manager on duty compared to 2 (1%) control businesses (OR = 18.00, 2.40 – 134.83). Case businesses (36, 24%) were also more likely to report an unusual incident than control businesses (14, 9%) (OR = 3.44, 1.64 – 7.23). Thirteen (9%) case businesses compared to 2 (1%) control businesses reported a change in menu preparation (OR = 12.00, 1.56 – 92.29). The use of temporary or alternative equipment (cases: 8, 2%, controls: 2, 1%) and the use of new procedures (cases: 8, 5%, controls: 0, 0%) also occurred more frequently in case businesses (OR could not be calculated).

## **Other factors – all outbreaks: Table 12**

- 4.22 Thirty five (47%) case businesses reported that the average cost of a meal for 2 people was <£21, compared to 65 (82%) control businesses (OR = 0.15, 0.05 – 0.42).

## **MULTIVARIATE ANALYSIS**

### **Selection of variables - multivariate analysis**

- 4.23 All management factors with a p value of <0.1 and fulfilling the criteria outlined in paragraph 3.26 were grouped in the pre-defined categories (see section 3.10).

### **Business characteristics – multivariate analysis: Table 13**

- 4.24 Being a hotel was of marginal significance (adjusted OR, 2.44, 0.86 – 6.94) when controlling for hours of opening. Serving cheaper meals (meal for 2 <£21) remained a significant protective factor independent of the effect of pub/bar, Chinese cuisine and snacks (adjusted OR = 0.16, 0.06 – 0.48).

### **Staff employment and structure (kitchen) – multivariate analysis: Table 14**

- 4.25 This model included variables relating to the number of tiers of management before the kitchen manager, the use of casual staff, employment of fulltime kitchen staff, providing salaries to chefs and the provision of wages above the national average for head chefs and kitchen porters.
- 4.26 The use of casual staff (OR = 3.06, 1.22 – 7.72) and employing fulltime kitchen staff (OR = 3.12, 1.23 – 7.87) were significant risk factors independent of the effect of other group variables. Both these risk factors remained significant when adjusted for food and beverage variables: casual staff (OR = 2.41, 1.11 – 5.24) and fulltime kitchen staff (OR = 2.25, 1.02 – 5.01). Employing kitchen staff fulltime remained an independent risk factor when adjusted for hotel (OR = 2.45, 1.12 – 5.35), business size (OR = 2.29, 1.01-5.20), serving dinner (OR = 2.38, 1.08 - 5.23) and cheaper meals (OR = 2.13, 0.83 – 5.47). Use of casual staff was not independent of cheaper meals (OR = 0.179, 0.070 – 4.54).
- 4.27 The owner/manager working in the kitchen was independently protective (OR = 0.33, 0.12 – 0.93) when adjusted for other variables in the group and was also independent of hotel (OR = 0.36, 0.18 – 0.70) and serving dinner (OR = 0.37, 0.16 – 0.90) but not independent of cheaper meals (OR = 0.71, 0.24 – 2.08) and business size (OR = 0.66, 0.24 – 1.92).

### **Staff employment and structure (Food and Beverage) – multivariate analysis: Table 15**

- 4.28 The food and beverage model included the following variables: employing food and beverage fulltime managers, employing food and beverage staff

fulltime and providing all food and beverage staff with salaries. Each of these three variables was adjusted for the other but no independent effects were observed.

#### **Staff Management – multivariate analysis: Table 16**

- 4.29 In a model that included the following variables: staff use of customer toilets, provision of staff accommodation, member of staff sick at the time of outbreak, provision of staff incentives and daily verbal communication, provision of staff accommodation remained a significant independent factor, with an adjusted odds ratio of 3.81 (1.42 – 10.27). It was independent of hotel (OR = 3.53, 1.30 – 9.60), business size (OR = 3.71, 1.20 – 11.41), dinner (OR = 4.25, 1.56 – 11.58) and cheaper meals (OR = 8.95, 1.83 – 43.69). Staff reporting to be sick at the time of the outbreak or 14 days before remained independently significant when adjusted for other staff management variables (OR = 20.01, 2.60 – 154.11), hotel (OR = 22.04, 2.91 – 166.93), business size (OR = 48.64, 3.53 – 664.58), dinner (OR = 25.30, 3.31 – 193.52) and cheaper meals (OR = 35.42, 3.40 - 369.32). No other significant independent effects were observed.

#### **Staff management – training – multivariate analysis: Table 17**

- 4.30 The following variables were included in this model: kitchen managers trained to intermediate food hygiene, kitchen staff who had received induction training, kitchen staff trained to basic food hygiene, food and beverage staff who had received professional training and food and beverage staff trained to basic food hygiene. Kitchen managers trained to intermediate food hygiene remained a significant risk factor independent of the effect of other variables (OR = 3.31, 1.12 – 9.72). Kitchen managers trained to intermediate food hygiene was also independent of hotel (OR = 3.36, 1.23 – 9.16), business size (OR = 2.47, 0.88 – 6.97) and dinner (OR = 3.62, 1.32 – 9.93) but not independent of cheaper meals (OR = 2.04, 0.62 – 6.68). No other significant independent effects were observed

#### **Type of food served – multivariate analysis: Table 18**

- 4.31 This model included the following variables: shellfish dishes served from hot display buffets, poultry dishes served from hot display buffets, poultry dishes made from raw, ice cream served, poultry dishes served at small functions and dishes containing eggs served at large functions. Shellfish (adjusted OR = 4.69, 0.87 – 25.33) and poultry (adjusted OR = 9.12, 0.86 – 96.60) served from a hot display buffet were independent of the effects of other operational practice variables. Shellfish was marginally independent of hotel (OR = 7.22, 1.62 – 32.06), business size (OR = 4.52, 0.98 – 20.77) and dinner (OR = 6.91, 1.55 – 30.85) but numbers were too small to conduct conditional logistic regression on cheaper meals. Poultry served from a hot display buffet also remained independent of hotel (OR = 3.44, 1.37 – 8.66), dinner (OR = 3.10, 1.23 – 7.81) and cheaper meals (OR = 3.70, 1.04 – 13.17) but was not independent of business size (OR = 2.03, 0.98 – 20.77). Poultry dishes prepared and cooked from raw remained a significant risk factor when

adjusted for the effect of all operational practice variables (OR = 12.27, 1.38 – 109.05) and hotel (OR = 3.35, 1.45 – 7.78), business size (OR = 3.13, 1.29 – 7.62), dinner (OR = 2.73, 1.21 – 6.19), but only marginally so for cheaper meals (OR = 2.48, 0.91 – 6.78). The service of ice cream was marginally independent of the effects of other variables (OR = 3.03, 0.94 – 9.82) and also independent of hotel (OR = 4.82, 1.56 – 14.93), business size (OR = 2.93, 0.95 – 9.08) and dinner (OR = 3.52, 1.14 – 10.86) but not independent of cheaper meals (OR = 2.29, 0.60 – 8.75). Dishes containing egg served at large functions remained of marginal significance when adjusted for the effects of other operational practice variables (OR = 3.10, 0.69 – 13.92), hotel (OR = 1.91, 0.93 – 3.92) and dinner (OR 1.94, 0.96 – 3.92) and business size (OR = 2.10, 1.00 – 4.41).

### **Suppliers – multivariate analysis: Table 19**

4.32 The following variables were included in this model: regional poultry supplier, regional egg supplier, regional red meat supplier, national poultry supplier, national egg supplier and food collected directly from the supplier. Variables were adjusted in turn for supplier variables and then the business characteristics variables. The only variable which remained a significant risk factor independent of the effect of all supplier and business characteristic variables was regional egg supplier: other variables (OR = 3.07, 1.03 – 9.09), hotel (OR = 3.75, 1.39 – 10.09), business size (OR = 2.96, 1.04 – 8.43), dinner (OR = 3.47, 1.28 - 9.36) and cheaper meals (OR = 4.57, 1.33 – 15.71). Food collected directly from the supplier remained marginally independent of other supplier variables (OR = 0.47, 0.19 – 1.09), hotel (OR = 0.36, 0.16 – 0.78), dinner (OR = 0.40, 0.18 – 0.88) and cheaper meals (OR = 0.36, 0.13 – 1.03) but not independently protective of business size (OR = 0.57, 0.24 – 1.39). National poultry supplier was only marginally independent of other group variables (OR = 0.39, 0.13 – 1.14), but not independent of other business variables.

### **Unusual events – multivariate analysis: Table 20**

4.33 All variables within this model relate to the time of the outbreak or 14 days before this event. The model included relief manager on duty, unusual incident, change in menu preparation, temporary or alternative equipment used, new procedure or practice used and a power cut. Calculations could not be conducted on the latter 3 variables as numbers were too small for conditional logistic regression. Reporting of an unusual incident was a significant risk factor, independent of all other group variables (OR = 2.61, 1.17 – 5.81) and business characteristics; hotel (OR = 3.35, 1.59 – 7.10), business size (OR = 3.67, 1.16 – 11.63), dinner (OR = 3.39, 1.21 – 9.53) and cheaper meals marginally (OR = 3.24, 0.95 – 11.08). Employment of a relief manager was independently significant when adjusted for the effects of other unusual event variables (OR = 16.03, 2.11 – 121.91), hotel (OR = 2.63, 1.11 – 6.28), and marginally independent of dinner (OR = 5.80, 0.70 – 48.01), but it was not independent of business size (OR = 5.18, 0.61 – 43.91).

## **SALMONELLA ENTERITIDIS OUTBREAKS**

### **Time site has been in operation – S. Enteritidis outbreaks**

4.34 Case businesses had been in operation for slightly longer on the current site than control businesses (mean 21 years vs. 16 years) but this was not statistically significantly different (independent sample t test  $p = 0.28$ ; 95%CI difference between means = 4.89 – 16.50) (Figure 17). Case businesses were no more likely to be in their first year of business than controls (OR = 2.32; 95%CI = 0.54 – 9.90).

### **Time interviewee in post – S. Enteritidis outbreaks**

4.35 Interviewees in case and control businesses had been in post a similar time (mean 7 years vs. 9 years) (independent sample t test  $p = 0.33$ ; 95%CI difference between means = 5.08-1.72) (Figure 18). Fifty (55%) interviewees were the owners of the businesses and 24 (26%) were general managers. Second tier managers comprised 9 (10%) of the interviewees. Interviewees in case businesses were not more likely to be in their first year at the business than control interviewees (OR = 1.08; 95%CI = 0.35 – 3.38,  $p = 0.90$ ).

## **UNIVARIATE ANALYSIS – SALMONELLA ENTERITIDIS OUTBREAKS**

### **Sample Size – S. Enteritidis outbreaks**

4.36 This analysis was carried out to address the causes of the surge in S. Enteritidis outbreaks during 2003. Pilot study data has been combined with data from the main study for the variables previously discussed in section 3.22. The total number of cases and controls used for this analysis varies depending on which population has been used.

- 60 cases and 60 controls: pooled data from the pilot and main study.
- 44 cases and 44 controls: data from the main study.
- 52 cases and 52 controls: SME businesses from the pooled data.
- 8 cases and 8 controls: Non SME businesses from the pooled data.
- 39 cases and 39 controls: data from outbreaks that were reported to HPA between 1<sup>st</sup> June and 31<sup>st</sup> December 2003.

### **Business characteristics – S. Enteritidis outbreaks: Table 21**

4.37 Twenty two (37%) case businesses and 6 (10%) control businesses served Chinese cuisine (OR = 6.33, 1.87 – 21.40). Case businesses (11, 18%) were more likely to operate as a small independent business from more than one premises than control businesses (2, 3%) (OR = 5.50, 1.22 – 24.81). Case businesses were more likely to operate as small SMEs (OR = 4.00, 1.13 – 14.17) or small medium sized business (OR = N/A) and less likely to operate as micro SMEs (OR = 0.07, 0.01 – 0.50). Twenty two (50%) case businesses compared to 12 (27%) control businesses reported being open continuously for 10 hours or more (OR = 4.67, 1.34 – 16.24).

### **Staff employment and structure – S. Enteritidis outbreaks: Table 22**

- 4.38 Case businesses (13, 22%) were more likely to have multiple levels of management between the business owner or general manager and the kitchen manager than control businesses (4, 7%) (OR = 5.50, 1.22 – 24.81). Only 13 (22%) case businesses as opposed to 30 (50%) control businesses had the owner or general manager working in the kitchen (OR = 0.19, 0.07 – 0.55). Case businesses (16, 36%) were more likely to report paying a salary to their kitchen staff than control businesses (8, 17%) (OR = 3.67, 1.02 – 13.14). Case businesses (12, 27%) were more likely to pay their kitchen porters a wage above the national average than control businesses (3, 7%) (OR = 5.50, 1.22 – 24.81). Thirty two (73%) case businesses and 18 (41%) control businesses employed fulltime F&B managers (OR = 5.67, 1.66 – 19.34) and 17 (39%) case businesses and 9 (20%) control businesses employed fulltime F&B staff.

### **Staff Management – S. Enteritidis outbreaks: Table 23**

- 4.39 Case businesses (22, 50%) were more likely to report that staff used customer toilets than control businesses (11, 25%) (OR = 3.20, 1.17 – 8.73) and were more likely to provide staff accommodation (13, 30%) than control businesses (5, 11%) (OR = 3.67, 1.02 – 13.14). Four (9%) case businesses compared with no control businesses reported kitchen staff being sick at the time of the outbreak or up to 14 days before. Case businesses were also more likely to pay staff for the first 3 days of sick leave (OR = 2.33, 0.90 – 6.07). A greater proportion of case businesses (14, 32%) reported having food and beverage managers who had received induction food hygiene training than control businesses (6, 14%) (OR = 3.00, 0.97 – 9.30).

### **Operational practices – S. Enteritidis outbreaks: Table 24**

- 4.40 Case businesses were more likely to report serving a range of foods in a hot display buffet. This applied to poultry dishes (OR = 7.50, 1.72 – 32.80), red meat (OR = 7.00, 1.59 – 30.80), egg dishes (OR = 6.00, 1.34 – 26.81), shellfish dishes (OR = 5.00, 1.10 – 22.82), rice/pasta (OR = 4.33, 1.23 – 15.21), sauce (OR = 5.50, 1.22 – 24.81) and vegetables (OR = 3.25, 1.06 – 9.97). Case businesses were more likely to offer dishes at small functions than control businesses. This applied to poultry (OR = 3.00, 0.97 – 9.30), red meat (OR = 3.25, 1.06 – 9.97), shellfish (OR = 4.33, 1.23 – 15.21), rice/pasta (OR = 3.25, 1.06 – 9.97), sauce (OR = 3.33, 0.92 – 12.11), vegetables (OR = 4.33, 1.23 – 15.21), fish (OR = 3.67, 1.02 – 13.14) and fruit (OR = 4.00, 0.85 – 18.34).
- 4.41 Thirty two (73%) case businesses and 23 (52%) control businesses prepared and cooked poultry dishes from raw (OR = 3.00, 0.97 – 9.30). Case businesses (40, 91%) were also more likely to report serving ice cream than control businesses (33, 75%) (OR = 4.50, 0.97 – 20.83). Fourteen (32%) case businesses and 8 (18%) control businesses reported partially preparing sauces (OR = 3.00, 0.81 – 11.08).

- 4.42 A greater proportion of case businesses used a regional supplier for the delivery of some high-risk foods. Nineteen (45%) case businesses and 4 (10%) control businesses reported using a regional supplier for the delivery of eggs (OR = 7.00, 1.59 – 30.80) and 15 (37%) case businesses compared with 2 (5%) control businesses used a regional supplier for poultry deliveries (OR = 11.00, 1.42 – 85.20). A similar pattern was found for red meats (OR = 9.00, 1.14 – 71.04) and dairy products (OR = 7.00, 0.86 – 56.89). Case businesses (6, 14%) were less likely to report the use of a national supplier for delivery of eggs than control businesses (15, 38%) (OR = 0.18, 0.04 – 0.82) and 11 (27%) cases but 17 (46%) controls reported using a national poultry supplier (OR = 0.30, 0.82 – 1.09). Ten (23%) case businesses and 22 (50%) control businesses reported collecting food directly from the supplier (OR = 0.13, 0.03 – 0.58).
- 4.43 We considered whether the presence of a food safety management system that incorporated the principles of HACCP made a difference to being a case or control business, although the implementation of such systems was not assessed during the study. No significant differences were observed between case and control businesses for either a documented HACCP or a verbally communicated HACCP approach. There were also no significant differences between the proportion of case businesses and control businesses reported to be maintaining temperature control records, keeping a cleaning schedule or keeping staff training records.

#### **Unusual events – S. Enteritidis outbreaks: Table 25**

- 4.44 Nine (15%) case businesses and 1 (2%) control business reported employing a relief manager at the time of the outbreak (OR = 9.00, 1.14 – 71.04) and 15 (25%) case businesses and 6 (10%) control businesses reported experiencing an unusual incident at the time of the outbreak (OR = 5.50, 1.22 – 24.81). Case businesses were more likely to report that there had been a change in menu preparation and offering promotions at the time of the outbreak than control businesses, both odds ratios could not be calculated..

#### **Other factors – S. Enteritidis outbreaks: Table 26**

- 4.45 Fourteen (40%) case businesses and 29 (81%) control businesses reported offering a meal for 2 <£21 (OR = 0.08, 0.01 – 0.64). No other variables within this group were identified as significant.

#### **Catering practices – S. Enteritidis outbreaks: Table 27**

- 4.46 Thirty eight (97%) case businesses and 33 (85%) control businesses reported using raw shell eggs. Sixteen (41%) case businesses compared to 3 (8%) control businesses served Chinese cuisine (OR = 7.50, 1.72 – 32.80). Thirty four (87%) case businesses and 25 (69%) control businesses reported batch cooking foods that contained egg (OR = 3.00, 0.81 – 11.08). Cooked egg dishes were less likely to be refrigerated by case businesses (OR = 0.38, 0.14 – 1.08). Case businesses were less likely than control businesses (7, 32%) to

prepare function and buffet food differently from the regular menu. Separate cleaning equipment for raw and ready to eat food areas were reported to be used in 24 (62%) case businesses but 32 (82%) control businesses (OR = 0.33, 0.11 – 1.03). Sixteen (41%) case businesses but only 5 (13%) control businesses reported using cooling water around their cooking range (OR = 4.67, 1.34 – 16.24).

## **MULTIVARIATE ANALYSIS**

### **Selection of Variables – S. Enteritidis outbreaks**

4.47 All management factors with a p value of <0.1 and fulfilling the criteria outlined in paragraph 3.26 were grouped according to the pre-defined hypotheses (see section 3.10). This analysis used the same approach that was applied to all foodborne disease outbreaks. As this is a sub set of the main data and thus a smaller sample size used for analysis, numbers were frequently too small to conduct conditional logistic regression.

### **Business Characteristics – S. Enteritidis outbreaks: Table 28**

4.48 Chinese cuisine remained a significant risk factor independent of hours of opening, and SME on more than one site, with an adjusted odds ratio of 3.83 (1.06 – 13.84). Open for 10 hours or more continuously was of marginal significance (adjusted OR = 3.17, 0.98 – 10.23) when adjusted for type of cuisine. Serving cheaper meals remained a significant protective factor independent of the effect of Chinese cuisine (adjusted OR = 0.06, 0.006 – 0.69).

### **Staff employment and structure (food and beverage and kitchen) – S. Enteritidis outbreaks: Table 29**

4.49 This model included variables relating to the number of tiers of management before the kitchen manager, recruitment of agency kitchen staff, provision of salaries to all kitchen staff, paying wages above the national average for kitchen porters, employing fulltime food and beverage managers and food and beverage staff and recruiting agency food and beverage staff. Paying a wage above the national average to kitchen porters was marginally independently significant (OR = 8.09, 0.73 – 72.81) when adjusted for other variables within the group. It was also independent of Chinese cuisine (OR = 5.78, 1.20 – 27.81) and of open continuously for 10 hours or more (OR = 12.64 (1.87 – 85.26) but was not independent of cheaper meals (OR = 7.10, 0.63 – 80.02). Numbers were too small to conduct conditional logistic regression on business size. Recruiting agency kitchen staff was not independent of Chinese cuisine (OR = 5.31, 1.02 – 27.50). The owner/manager working in the kitchen was not independent of other group variables but was protective independent of Chinese cuisine (OR = 0.25, 0.08 – 0.77) and open continuously for 10 hours (OR = 0.22, 0.06 – 0.81).

### **Staff management – S. Enteritidis outbreaks: Table 30**

4.50 In a model that included the following variables: staff use of customer toilets, provision of staff accommodation, member of kitchen staff sick at the time of outbreak and paying staff for the first 3 days of sick leave, provision of staff accommodation was the only variable that remained a borderline significant risk factor, independent of the effect of the other group variables, with an adjusted odds ratio of 4.52 (0.93 – 22.02). Provision of staff accommodation was also marginally independent of business size (OR = 5.44, 0.95 – 31.27) and open for 10 hours or more continuously (OR = 3.41, 0.91 – 12.71) but was not independent of Chinese cuisine (OR = 2.49, 0.62 – 9.88). Numbers were too small to conduct a conditional logistic regression on cheaper meals. No other significant effects were observed.

### **Staff management training – S. Enteritidis outbreaks: Table 31**

4.51 Two training variables were included in this model: food and beverage managers that had received induction food hygiene training, and food and beverage staff that had received professional training. When adjusted for each other, food and beverage managers that had received induction food hygiene training remained marginally significant (OR = 4.00, 0.97 – 9.30). It was also marginally independent of open for 10 hours continuously (OR = 2.93, 0.93 – 9.22) but not independent of Chinese cuisine (OR = 2.61, 0.79 – 8.52), business size (OR = 1.90, 0.57 – 6.34) or cheaper meals (OR = 2.52, 0.49 – 13.10)

### **Operational practices - hot display buffets – S. Enteritidis outbreaks: Table 32**

4.52 In a model that included the following foods served from a hot display buffet: vegetables, shellfish, poultry, red meat, eggs, rice/pasta and sauce, none remained independent when adjusted for the effect of each other. However, red meat dishes served within a hot display buffet was independent of Chinese cuisine (OR = 9.20, 1.57 – 54.02) and open for 10 hours or more continuously (OR = 5.24, 1.13 – 24.32) but was not independent of business size (OR = 3.45, 0.71 – 16.70). Dishes containing egg remained marginally independent of Chinese cuisine (OR = 4.35, 0.90 – 20.95) and open for 10 hours or more continuously (OR = 4.38, 0.93 – 20.58). Egg dishes served in a hot display buffet was not an independent risk factor when adjusted for business size (OR = 2.80, 0.56 – 14.00)

### **Operational practices – functions – S. Enteritidis outbreaks: Table 33**

4.53 This model included the following foods served as part of a small function (<20 people): vegetables, fish, shellfish, red meat, rice/pasta and sauce. None of these variables remained independently significant when adjusted for the effect of other function variables. Numbers were too small to conduct conditional logistic regression on both vegetables and shellfish served at a small function.

#### **Operational practices - regional suppliers – S. Enteritidis outbreaks: Table 34**

4.54 Regional red meat supplier, regional milk supplier, regional dairy products supplier and regional salad supplier were not independent of regional egg supplier but regional egg supplier was independent of regional red meat supplier (OR = 4.55, 0.94 – 22.13). It was also independent of Chinese cuisine (OR = 5.33, 1.16 – 24.49), business size (OR = 5.49, 0.99 – 30.43), open for 10 or more hours continuously (OR = 5.74, 1.24 – 26.40) and cheaper meals (OR = 1.44 – 108.63).

#### **Unusual events – S. Enteritidis outbreaks: Table 35**

4.55 This model included the variables: relief manager on duty, unusual incident, food preparation not working properly, change in menu, change in menu preparation and promotions on offer. Experiencing an unusual incident at the time of the outbreak was independent of the effect of other variables, with an adjusted odds ratio of 4.66 (1.01 – 21.41). Unusual incident was also independent of Chinese cuisine (OR = 9.43, 1.34 – 66.36), marginally independent of business size (OR = 8.43, 0.83 – 85.66) but not independent of open for 10 hours or more continuously (OR = 3.30, 0.65 – 16.74) and cheaper meals (OR = 3.49, 0.38 – 31.81). A relief manager on duty at the time of the outbreak was of borderline significance when adjusted for the effect of other variables with an adjusted odds ratio of 7.47 (0.93 – 60.01). Relief manager was also independent of Chinese cuisine (OR = 7.44, 2.02 – 27.31) but not independent of business size (OR = 2.00, 0.18 – 22.07) and open for 10 hours or more continuously (OR = 2.37, 0.23 – 23.88).

#### **Catering practices – egg handling – S. Enteritidis outbreaks: Table 36**

4.56 A model was specified that related to egg handling: regional egg supplier, batch cooking eggs, refrigerating egg dishes and egg dishes served from a hot display buffet. Eggs served from a hot display buffet was marginally independent of the effect of other variables with an adjusted odds ratio of 7.01 (0.84 – 58.31). Eggs served from a hot display buffet was marginally independent of Chinese cuisine (OR = 4.35, 0.90 – 20.95), marginally independent of open for 10 hours or more continuously (OR = 4.38, 0.93 – 20.58) but not independent of business size (OR = 2.80, 0.56 – 14.01).

#### **Catering practices – hygiene variables – S. Enteritidis outbreaks: Table 37**

4.57 We considered the following hygiene variables: food prepared differently from the regular menu, buffet containers topped up, separate cleaning equipment for raw and ready to eat foods, cooling water in a cooking range and a business which has extended its back of house accommodation. Numbers were too small to conduct conditional logistic regression on food prepared differently from the regular menu and buffet containers topped up, but the remaining 3 variables were adjusted in turn for eggs served in a hot display buffet. Only cooling water in a cooking range was of marginal independence

with an adjusted odds ratio of 3.39 (0.84 – 13.55). Cooling water in a cooking range was independent of Chinese cuisine (OR = 4.67, 1.34 – 16.23) and open for 10 hours or more continuously (OR = 4.46, 1.24 – 15.92) and of marginal independence when adjusted for business size (OR = 4.14, 0.85 – 20.34) and cheaper meals (OR = 6.51, 0.70 – 61.11).

## **MANAGEMENT RISK FACTORS – ALL BACTERIAL OUTBREAKS**

### **Time site has been in operation – all bacterial outbreaks**

4.58 Case businesses had been in operation on the current site slightly longer than control businesses (mean 20 years vs. 15 years) but this was not statistically significant (independent sample t test  $p = 0.24$ ; 95%CI difference between means = -3.58 – 14.24) (Figure 19). Case businesses were not more likely to be in their first year of business than controls (6/58, 4/61), (OR = 1.64: 95%CI = 0.44 – 6.15).

### **Time interviewee in post – all bacterial outbreaks**

4.59 Interviewees in case and control businesses had been in post a similar time (mean 8 years vs. 8 years) (independent sample t test  $p = 0.99$ ; 95%CI difference between means = -2.84 – 2.89) (Figure 20). Interviewees in case businesses were not more likely to be in their first year at the business than interviewees of control businesses (10/58 vs. 11/61, OR = 0.95: 95%CI = 0.37 – 2.43,  $p = 0.91$ ).

## **UNIVARIATE ANALYSIS**

### **Sample size – all bacterial outbreaks**

4.60 Pilot study data has been combined with data from the main study for the variables previously discussed in section 3.22. Thus the total number of cases and controls used for this analysis varies depending on which population has been used:

- 90 cases and 90 controls: pooled data from the pilot and main study
- 58 cases and 58 controls: data from the main study

4.61 The tables only present the proportion of case and control businesses exposed to variables where the differences are statistically significant at  $p < 0.10$  levels.

### **Business characteristics – all bacterial outbreaks: Table 38**

4.62 Twenty three (26%) case businesses but only 7 (8%) control businesses served Chinese cuisine (OR = 5.00, 1.71 – 14.63). Fifty one (88%) case businesses compared to 41(71%) control businesses reported serving dinner (OR = 3.50, 1.15 – 10.63). Case businesses (29, 50%) were more likely to report being open for 10 hours or more continuously (OR = 2.67, 1.04 – 6.81).

Four (4%) case businesses but 11 (12%) control businesses operated as a pub bar (OR = 0.13, 0.02 – 1.00).

#### **Staff employment and structure – all bacterial outbreaks: Table 39**

4.63 Case businesses were more likely to have multiple levels of management between the business owner or general manager and the kitchen manager than control businesses (OR = 2.80, 1.01 – 7.77) and less likely to have the general manager working in the kitchen (OR = 0.35, 0.16 – 0.74) more likely to have employed full time food and beverage staff (OR = 2.43, 1.01 – 5.86), and food and beverage managers (OR = 2.63, 1.16 – 5.93) and to recruit agency staff (OR = 3.75, 1.24 – 11.30). Case businesses were more likely to pay their head chefs (OR = 2.33, 1.07 – 5.09) and their kitchen porters (OR = 1.45 – 17.27) above the national average.

#### **Staff management – all bacterial outbreaks: Table 40**

4.64 Thirty two (55%) case businesses and 18 (31%) control businesses reported that their staff used the guest WC (OR = 3.33, 1.34 – 8.30) and 15 (26%) case businesses and 6 (10%) control businesses reported providing staff accommodation (OR = 3.25, 1.06 – 9.97). Case businesses (10, 17%) were more likely to report a member of staff sick at the time of the outbreak than control businesses (OR = 4.75, 1.62 – 13.96). Four (7%) case businesses reported kitchen staff either sick at work, on sick leave or with a family member suffering from vomiting and diarrhoea compared to no control businesses.

#### **Operational practices: – all bacterial outbreaks: Table 41**

4.65 Case businesses were more likely to use hot displays for buffets. This applied to poultry dishes (OR = 9.00, 2.09 – 38.79), red meat dishes (OR = 8.50, 1.96 – 36.79), shellfish (OR = 6.00, 1.34 – 26.81), vegetable dishes (OR = 3.75, 1.24 – 11.30), egg dishes (OR = 4.00, 1.13 – 14.17), rice/pasta dishes (OR = 3.75, 1.24 – 11.30) and sauces (OR = 4.67, 1.34 – 16.24).

4.66 Case businesses also reported catering for small functions (less than 20 people) than control businesses. This applied to vegetables (OR = 4.00, 1.34 – 11.96), fish (OR = 3.25, 1.06 – 9.97), shellfish (OR = 3.00, 1.09 – 8.25), poultry (OR = 3.75, 1.25 – 11.30), red meat (OR = 4.25, 1.43 – 12.63), rice/pasta dishes (OR = 2.67, 1.04 – 6.81), ice cream (OR = 3.50, 0.72 – 16.85), sauces (OR = 4.00, 1.13 – 14.17), fruit (OR = 3.33, 0.92 – 12.11) and desserts (OR = 2.75, 0.88 – 8.64).

4.67 Case businesses were more likely than control businesses to prepare and cook poultry and red meat dishes from raw. Forty one (71%) case businesses and 28 (48%) control businesses prepared and cooked poultry dishes from raw (OR = 3.60, 1.34 – 9.70) and 41 (71%) case businesses and 31 (53%) control businesses prepared and cooked red meat dishes from raw (OR = 3.50, 1.15 – 10.63). Fifty six (97%) case businesses and 48 (83%) control businesses reported serving poultry (OR = 5.00, 1.10 – 22.82). Fifty three

(91%) case businesses and 41 (71%) control businesses served ice cream (OR = 5.00, 1.45 – 17.27). Twenty five (43%) case businesses and 14 (24%) control businesses reheated rice/pasta (OR = 2.83, 1.12 – 7.19). Case businesses (18, 31%) were also more likely to only partially prepare sauce compared to control businesses (9, 16%) (OR = 4.00, 1.13 – 14.17). Ten (17%) case businesses and 3 (5%) control businesses served fruit from a cold display buffet (OR = 8.00, 1.00 – 63.96).

- 4.68 A higher proportion of case businesses reported using regional suppliers. Seventeen (31%) case businesses and 6 (12%) control businesses used regional suppliers for the supply of red meat (OR = 10.00, 1.28 – 78.12) and 21 (38%) case businesses and 4 (8%) control businesses used regional egg suppliers (OR = 8.00, 1.84 – 34.79). The same trend applied to regional poultry suppliers (OR = 5.50, 1.22 – 24.81), regional dairy suppliers (OR = 4.50, 0.97 – 20.83). National egg suppliers were less likely to be used by case businesses (12, 21%) compared to control businesses (20, 38%) (OR = 0.33, 0.11 – 1.03). Seven (78%) cases and 3 (33%) controls employed a national sandwich supplier (insufficient data to conduct matched odds ratio) and case businesses were less likely to use national poultry suppliers (OR = 0.36, 0.12 – 1.14). Case businesses also reported that they were less likely to collect food directly from the suppliers (OR = 0.26, 0.10 – 0.70).

#### **Unusual events – all bacterial outbreaks: Table 42**

- 4.69 Thirteen (14%) case businesses and 1 (1%) control business reported employing a relief manager at the time of the outbreak (OR = 13.00, 1.70 – 99.37). Case businesses were more likely to report an unusual incident than control businesses (OR = 6.33, 1.87 – 21.40). Seven case businesses and one control business reported using food preparation equipment that was not working properly (OR = 7.00, 0.86 – 56.90), and 10 (11%) case businesses compared to no controls business reported a change in menu preparation at the time of the outbreak. Case businesses (10, 11%) were also more likely to offer promotions at the time of the outbreak than control businesses (2, 2%) (OR = 5.00, 1.10 – 22.82).

#### **Other factors – all bacterial outbreaks: Table 43**

- 4.70 Twenty one (45%) case businesses and 41(84%) control businesses offered meals for 2 people for less than £21 (OR = 0.12, 0.03 – 0.51).

### **BACTERIAL FOODBORNE DISEASE OUTBREAKS – MULTIVARIATE ANALYSIS**

#### **Selection of variables – all bacterial outbreaks**

- 4.71 All management factors with a p value of <0.1 and fulfilling the criteria outlined in paragraph 3.26 were grouped according to the pre-defined hypotheses (see section 3.10 and multivariate analysis). This analysis used the same approach that was applied to all foodborne disease outbreaks (paragraphs 3.25 – 3.30). As this is a sub set of the main data and thus a smaller sample

size, numbers were frequently too small to conduct conditional logistic regression.

#### **Business characteristics – all bacterial outbreaks: Table 44**

- 4.72 Only cheaper meals (meal for 2 <£21) remained a significant management protective factor, with an adjusted odds ratio of 0.13 (0.02 – 0.68).

#### **Staff structure and employment – all bacterial outbreaks: Tables 45, 46, 47**

- 4.73 The staff structure model (Table 45) included the two variables: owner/manager working in the kitchen and two tiers of management before the kitchen manager. Both variables were adjusted for kitchen and food and beverage staff employment and salary variables. The owner/manager working in the kitchen remained independently protective when adjusted for food and beverage employment variables (OR = 0.29, 0.09 – 0.91) and the kitchen employment variables (OR = 0.30, 0.10 – 0.96) but was not independent of cheaper meals (OR = 0.59, 0.19 – 1.91) or business size (OR = 0.52, 0.15 – 1.63).
- 4.74 Two further models were constructed that considered the relationship between food and beverage staff employment variables and kitchen staff employment variables. The food and beverage model (Table 46) included the following variables: recruitment of agency food and beverage staff, food and beverage staff recruited with professional qualifications, employment of fulltime food and beverage managers and fulltime food and beverage staff. None of these variables remained statistically significantly independent when adjusted for each other or for cheaper meals. However, recruitment of agency food and beverage staff was of marginal significance with an increased odds ratio, and it did remain an independent risk factor when adjusted for business size (OR = 24.15, 1.36 – 428.05).
- 4.75 The kitchen employment model (Table 47) included the following variables: recruitment of agency kitchen staff, head chefs and kitchen porters paid above the national average wage and all kitchen staff salaried. Kitchen porters paid above the national average wage remained independent (OR = 4.20, 1.08 – 16.32).

#### **Staff management – all bacterial outbreaks: Table 48**

- 4.76 This model included the following variables: staff used the guest WC, provision of staff accommodation and member of staff sick at the time of the outbreak. Staff use of guest WC was an independent risk factor (OR = 3.31, 1.05 – 10.48) and was independent of cheaper meals (OR = 9.07, 1.58 – 51.98) and business size (OR = 2.96, 1.09 – 8.03). Any member of staff sick at the time of the outbreak was also an independent management risk factor when adjusted for the effect of other group variables (OR = 17.65, 2.13 – 146.22), cheaper meals (OR = 8.65, 1.10 – 68.28) and business size (OR = 10.26, 1.32 – 79.85).

## **Operational practices – all bacterial outbreaks: Tables 49 - 69**

4.77 Thirty eight variables were identified as significant at the 10% level within this hypothesis group. It was therefore decided to use models that included the same food type.

### **Vegetables – all bacterial outbreaks: Table 49**

4.78 Vegetables served at small functions was independent of vegetables served on a hot display buffet (OR 4.03, 1.28 – 12.63), cheaper meals (OR = 8.45, 1.06 – 66.96) and business size (OR = 6.03, 1.47 – 24.81). Vegetables served on a hot display were independent of small functions (OR = 3.77, 1.18 – 12.04), marginally independent of cheaper meals (OR = 1.11, 0.88 – 57.49) but not independent of business size (OR = 2.25, 0.65 – 7.78).

### **Fish – all bacterial outbreaks: Table 50**

4.79 Fish served at large and small functions was not independently associated with outbreaks.

### **Shellfish – all bacterial outbreaks: Table 51**

4.80 Shellfish served at small and large functions were not independent of one another, but shellfish at small functions was independent of cheaper meals (OR = 5.77, 1.12 – 29.58) and business size (OR = 3.83, 1.10 – 13.27).

### **Poultry – all bacterial outbreaks: Table 52**

4.81 Poultry served at small functions was independently significant when adjusted for the effects of other group variables (OR = 4.32, 1.07 – 17.49), cheaper meals (OR = 4.24, 0.91 – 19.71) and business size (OR = 5.58, 1.33 – 23.29). Poultry served from a hot display buffet was also independent of the effect of other variables (OR 9.89, 1.94 – 50.25), and independent of business size (OR = 4.50, 0.97 – 20.83).

### **Red Meat – all bacterial outbreaks: Table 53**

4.82 Red meat served at small functions was independently significant when adjusted for the effect of other group variables, (OR = 5.82, 1.30 – 24.94), cheaper meals (OR = 4.34, 0.94 – 20.08) and business size (OR = 6.02, 1.48 – 24.46). Red meat served from a hot display buffet was also independent of other group variables (OR = 15.71, 1.90 – 130.00) and business size (OR = 4.81, 1.04 – 22.09).

### **Rice / Pasta – all bacterial outbreaks: Table 54**

4.83 Only rice/pasta served from a hot display buffet was independent of other group variables (OR = 3.64, 1.12 – 11.85) and of cheaper meals (OR = 4.72, 0.91 – 24.63). Whilst rice served at small functions was not independent of

other food type variables, it was independent of cheaper meals (OR = 3.27, 0.82 – 12.03) or business size (OR = 3.51, 1.07 – 11.53).

#### **Egg – all bacterial outbreaks: Table 55**

4.84 As there was only one egg variable significant at the 10% level, eggs served from a hot display buffet, this was adjusted in turn for cheaper meals and businesses size. It was not independent of either of these variables.

#### **Ice Cream – all bacterial outbreaks: Table 56**

4.85 Serving ice cream was independently significant of serving ice cream at small functions (OR = 4.79, 1.38 – 16.59) and marginally independent of business size (OR = 3.10, 0.85 – 11.35). Serving ice cream at small functions was independent of business size (OR = 15.94, 1.37 – 185.21), marginally independent of cheaper meals (OR = 9.58, 0.85 – 108.50) but not independent of serving ice cream.

#### **Sauce – all bacterial outbreaks: Table 57**

4.86 Whilst sauce served from a hot display buffet was independent of other group variables (OR = 6.24, 1.45 – 26.83) and cheaper meals (OR = 7.65, 0.96 – 61.21), it was not independent of business size. Sauce served at small functions was of borderline significance (OR = 3.72, 0.80 – 17.45) but independent of cheaper meals (OR = 6.47, 0.79 – 52.81) and business size (OR = 8.49, 1.37 – 52.70). Using sauce that was partially prepared was independently significant of business size (OR = 5.02, 0.98 – 25.60) but not independent of other variables.

### **Dessert – all bacterial outbreaks: Table 58**

4.87 Dessert served at small functions was independent when adjusted for business size (OR = 8.44, 1.55 – 45.89) but was not independent of cheaper meals (OR = 3.18, 0.65 – 22.18).

### **Fruit – all bacterial outbreaks: Table 59**

4.88 Fruit served at a small function was independent of the effect of fruit served from a cold display buffet (OR = 3.85, 0.92 – 15.44), and of business size (OR = 4.23, 0.92 – 19.48) but not of cheaper meals (OR = 5.14, 0.61 – 43.64). Fruit served from a cold display buffet was independently significant of small functions (OR = 9.30, 1.08 – 79.79) but was not independent of business size.

### **Regional Suppliers – all bacterial outbreaks: Table 60**

4.89 When egg regional supplier was adjusted for the effect of poultry and red meat it was independently significant (OR = 5.32, 1.11 – 24.63). Egg regional supplier was also independent of food collected directly from the supplier (OR = 7.95, 1.67 – 37.88), cheaper meals (OR = 9.91, 1.68 – 58.39) and business size (OR = 6.40, 1.29 – 31.55)

### **National Suppliers – all bacterial outbreaks: Table 61**

4.90 National suppliers of eggs, poultry, herbs and sandwiches were included in this model. There was insufficient data to conduct conditional logistic regression on these variables and none of these variables remained independently significant of cheaper meals, food collected directly from the supplier or business size, with the exception of national herb supplier when adjusted for business size (OR = 4.38, 0.92 – 20.76) which was of marginal significance.

### **Unusual events – all bacterial outbreaks: Tables 62 - 63**

4.91 Reporting an unusual event was independently significant when adjusted for the effect of other group variables (OR = 5.74, 1.62 – 20.28) and independent of the use of a relief manager (OR = 5.15, 1.50 – 17.74) but not independent of cheaper meals (OR = 5.12, 0.61 - 43.36). Offering promotions was marginally independent of other group variables (OR = 4.89, 0.97 – 24.71) and relief manager (OR = 4.11, 0.88 – 19.21). Food preparation equipment not working properly was not independent of other variables but was independently significant when adjusted for relief manager (OR = 15.62, 1.15 – 211.83) (Table 62). Relief manager was adjusted in turn for the effects of food preparation equipment not working properly, promotions on offer, unusual events, cheaper meals and business size. With the exception of business size, the use of a relief manager remained independently significant when adjusted for the effect of each of these variables: food preparation equipment (OR = 21.46, 2.07 – 221.93), promotions (OR = 11.52, 1.49 – 88.72) and unusual event (OR = 9.84, 1.26 – 76.66) (Table 63).

## **FURTHER EXPLORATORY ANALYSES**

4.92 A large number of variables have been collected and the foregoing analyses demonstrate the complexity of their interaction (Table 64). In order to explore these relationships further we have carried out a further set of analyses. We have set out a hierarchy of management factors in Figure 21. The two 'unusual event' variables that were statistically significant have been put in other appropriate prior hypotheses groups; relief manager was included in staff structure and employment, and change in menu preparation was put in operational practices. Within each of the four prior hypotheses groups we have fitted models to a reduced set of variables, namely, those that were independently statistically significant when adjusted for other group variables. For example, we considered that owners or managers of businesses selling cheaper meals would be more likely to work in the kitchen because these businesses are smaller concerns.

### **Business Characteristics – all outbreaks: Table 65**

4.93 In a model including only serving dinner (OR = 1.38, 0.39 – 4.89) and cheaper meals (OR = 0.16, 0.05 – 0.49) only cheaper meals remained independently associated with outbreaks.

### **Staff Structure and Employment – all outbreaks: Tables 66 and 67**

4.94 In a model including use of casual staff (OR = 3.22, 1.39 – 7.46) employing fulltime kitchen staff (OR = 3.68, 1.54 – 8.79) and owner/manager working in the kitchen (OR = 0.29, 0.11 – 0.75), all remained independent. In a further model adding relief manager, use of casual staff and employing full time staff remained independently associated with outbreaks with virtually identical estimates of the odds ratio, but relief manager was only marginally independent (OR = 8.44, 0.89 – 79.80).

### **Staff Management – all outbreaks: Tables 68, 69 and 70**

4.95 Staff accommodation (OR = 3.12, 0.96 - 10.09) and manager trained to intermediate food hygiene (OR = 2.69, 0.90 – 8.03) were marginally independent, and staff sickness (OR = 21.32, 2.58 – 176.30) was independent, within this group. When owner/manager working in the kitchen was added to this model odds ratios were virtually unchanged and the new variable was also independently significant. However, when cheaper meals was added to staff accommodation, staff sickness and manager in kitchen, the latter was not independent (OR = 0.86, 0.24 – 3.03).

### **Operational Practices – all outbreaks: Table 71**

4.95 When the six operational practices variables were introduced in a model, only regional egg supply was independently significant (OR = 3.33, 1.07 – 10.40).

### **Between Group Comparisons – all outbreaks: Tables 72 and 73**

- 4.96 The use of casual staff, fulltime kitchen staff and owner/manager working in the kitchen were independently significant (Model 2, Table 66). However, when cheaper meals was added to the three, owner/manager working in the kitchen (OR = 0.60, 0.19 – 1.88) was not independent and casual staff (OR = 2.44, 0.89 – 6.69) and full time kitchen staff (OR = 2.70, 0.99 – 7.38) were of marginal independence. When only staff sickness (OR = 38.7, 2.42 – 621.18), staff accommodation (OR = 6.18, 1.11 – 34.48) and cheaper meals (OR = 0.11, 0.02 – 0.50) were included in a model each was strongly independently significant.

## 5.0 DISCUSSION

- 5.1 This study was set up to address the business related factors that may predispose to foodborne disease outbreaks in the UK catering industry. We took a case-control approach, comparing catering businesses where there was an outbreak with control catering businesses where no outbreak had occurred. At the outset we were uncertain what the response rate was likely to be, since it was thought that businesses that had experienced an outbreak would be reluctant to admit to faults in management. Recruitment methods were critical to attaining high participation rates and whilst the methods adopted by this study were extremely labour intensive, they proved successful in encouraging business participation. The support of the business community from the study has been remarkably good, and the response rates for case businesses of 90%, and for control businesses of 93%, has substantially exceeded our expectations. The outbreaks included in the study were all those identified by CDSC that met the study criteria, as well as other outbreaks identified informally through professional networks. This coverage, the high response rate, and the general features of the outbreaks including expected seasonal trends, gave us confidence that the data are representative of outbreaks that occur in England and Wales.
- 5.2 The accuracy of the data obtained is of critical importance. Our priority during data collection was to establish exactly how businesses operated and not just to receive answers that the interviewees thought we wanted to hear. This involved building up a degree of trust with the business, talking informally to them about the issues that affected their business and their opinions on general matters relating to catering and food safety. The only way to achieve this was to undertake face to face interviews at the catering business address with an interviewee most familiar with the business operation (owner or a manager). Whilst this approach was time consuming we are confident that the answers we received reflected business operations. This can be illustrated by the fact that many businesses offered us different answers to those given to the EHOs who initially investigated the outbreak, including admission of faults in processes. For example, one business assured the EHO that chicken parfait was cooked to a core temperature of 63°C, but during our discussions, the head chef admitted that chicken parfait was only ever cooked to 40°C and should be pink in the middle.

### All foodborne disease outbreaks

- 5.3 The size of outbreaks included in this study ranges from 3 to 142 reported cases with 45% between 3 and 10 cases. Although it is usually the larger outbreaks of foodborne disease that receive media coverage and independent investigations, e.g. The Pennington Report (1997) and The Committee of Enquiry into the Stanley Royd outbreak (1986), it is the smaller foodborne disease outbreaks that are much more common and account for most outbreak cases (P.O.S.T., 1997).

- 5.4 The geographical distribution of outbreaks can be explained in part by the distribution and concentration of catering businesses. According to the Office of National Statistics (ONS, 2003) 42% of catering businesses are located in the south east of England and 42% of our outbreaks occurred in this area. Seven percent of catering businesses are located in Wales, where 7% of outbreaks also occurred. The south west of England accounts for 12% of catering businesses and 14% of outbreaks. However, a disproportionate number of outbreaks were observed in Cornwall and Devon where 5 outbreaks occurred in late July and August 2003. These outbreaks were all attributed to *S. Enteritidis*, 3 with phage type 14b and 2 with phage type 4. Three of the catering businesses associated with these outbreaks were known to use the same regional supplier for eggs and 2 of the 3 businesses were associated with phage type 14b. Similarly, there was a disproportionately low number of outbreaks in the London area, where 16% of the catering population are located but only 8% of the outbreaks occurred. We cannot exclude the possibility that some regional differences observed in this study could reflect regional differences in laboratory diagnosis, local authority and public health investigation policies and available resources (FSA, 2000).
- 5.5 We collected hundreds of variables, and by chance in such a large dataset we would expect many statistically significant associations. The approach we have taken to this problem was to rigorously spell out the possible causal pathways before undertaking the analyses. Variables were grouped into sets according to prior hypotheses.
- Business characteristics
  - Staff employment and structure
  - Staff management
  - Operational practices
  - Unusual events (breakdown in usual business operation)
- 5.6 Clearly, these 5 hypotheses groups are not independent of one another. They reflect the operation and management within the catering industry: the type of business, how the business is set up, how staff are managed, how the business delivers the product and service and what happens when something goes wrong.

#### Business Characteristics

- 5.7 Restaurants were the most common type of catering business associated with foodborne outbreaks (36%). They were also the most common type of control business (39%). Within the hospitality industry, restaurants made up the greatest proportion of establishments in 2003 (32.2%) (People 1<sup>st</sup>, 2004). However, hotels made up 6.9% of businesses within the hospitality industry but accounted for 24% of the outbreaks. Hotels are distinct from the other catering business groups because, in addition to catering, other services such as accommodation and leisure facilities are available to the customer. Further, in the larger hotels, the catering service offered is usually more diverse and more customers are catered for, which will determine the volume of food and

number of staff employed. We also considered what would make a hotel more likely to be associated with a foodborne disease outbreak. When we adjusted for the interrelation between business characteristic variables we found that the adjusted odds ratio (OR) for being a hotel reduced, and failed to retain statistical significance. Serving dinner remained a significant risk factor, and serving cheaper meals was statistically significantly protective. This suggests that hotels are more at risk of outbreaks because of the factors to do with the complexity of the menu. Cheaper meals tend to be simpler and less risky foods. In general, a dinner (evening meal) menu will be a more complex menu, involving a more intricate and longer preparation time than that of a breakfast, lunch or snack menu, presenting a greater chance of bacterial or viral contamination of food. Fifty three (67%) case businesses that reported serving dinner prepared and cooked poultry dishes from raw, and 54 (68%) case businesses who served dinner prepared and cooked red meat dishes from raw.

- 5.8 Small SMEs and small medium SMEs were more likely to be associated with foodborne disease outbreaks. Conversely, outbreaks were less likely to be associated with micro SMEs. Micro businesses were statistically significantly more likely to serve cheaper meals and were also more likely to have the owner/manager working in the kitchen. Both of these factors were also less likely to be associated with foodborne disease outbreaks (although owner/manager working in the kitchen was not independent of cheaper meals and did not remain independent when adjusted for independent staff management risk factors) and this explains the apparent protective effect of micro businesses.
- 5.9 In univariate analysis catering businesses serving Chinese cuisine were many times more likely to be associated with a foodborne disease outbreak but when cheaper meals and dinner were taken into account it no longer remained significant. We considered whether an operation or catering practice occurred more frequently in Chinese cuisine that would explain its significance in univariate analysis. Chinese cuisine involves a complex preparation. In general, food is prepared from raw and this practice provides a greater opportunity for food safety control failures to occur, particularly cross contamination and poor temperature control. In the main study, of the 22 businesses serving Chinese cuisine, 18 (82%) prepared and cooked poultry dishes from raw compared to 81 (53%) in other cuisine types. Seventeen (77%) prepared and cooked red meat dishes from raw compared to 89 (58%) businesses serving other types of cuisine.

### **Staff Employment and Structure**

- 5.10 Eight staff employment and structure variables were found to be significant at the 5% level. In conditional logistical regression, only three variables remained independently significant: owner/manager working in the kitchen, kitchen staff employing fulltime staff, and the use of casual staff. Case businesses were statistically significantly less likely to have the owner/manager working in the kitchen allowing for other kitchen employment and structure variables, but this was not independent of business size.

Businesses where the owner/manager worked in the kitchen were either micro or small SMEs. However, the owner/manager working in the kitchen was not independent of serving cheaper meals. In smaller businesses serving cheaper meals the owner/manager is more likely to work in the kitchen. The risk would appear to do with the complexity of the menu rather than the absence of the owner/manager from the kitchen.

- 5.11 The finding that kitchen staff (excluding the kitchen manager and deputy) were more likely to be fulltime employees in case businesses than control businesses needs explanation. This finding was independent of hotel status, even though hotels have already been identified as more likely to employ a fulltime staff (People 1<sup>st</sup>, 2005). Fulltime kitchen managers were not identified as a management risk factor. We did not have data to explore whether businesses were more likely to expect full time kitchen staff to undertake work outside their ability areas.
- 5.12 We also were unable to say whether fulltime kitchen staff were less likely to be rigorously supervised in comparison to part time staff. On the other hand use of casual staff was also more likely to be associated with an outbreak business, even though businesses with full time kitchen staff were less likely to have casual staff.

### **Staff Management**

- 5.13 Case businesses were twenty times more likely to have any member of kitchen and/or food and beverage staff sick at the time of the outbreak or up to 14 days before. This management risk factor included staff sick at work or on leave, and staff with a close family member suffering from vomiting and diarrhoea, and it related to both viral and bacterial foodborne disease outbreaks. Staff sickness is a known risk factor for viral outbreaks but is not well documented for bacterial outbreaks. We sought to exclude staff illness that was part of the outbreak rather than preceding it, but it is possible that the former staff may have been misclassified by interviewees. The provision of staff accommodation also was an independent management risk factor. The provision of staff accommodation is not exclusively related to hotels. Restaurants will provide staff accommodation, including restaurants serving ethnic cuisine such as Chinese and Indian restaurants. Pubs and restaurants that form part of a national chain frequently require 'live in' managers and catering businesses in a relatively remote location will offer staff accommodation. We have no explanation for this association in our dataset.

### **Training**

- 5.14 Since the introduction of the Food Safety Act 1990, subsequent regulations and industry advice, food hygiene training has become an integral part of most catering businesses. We expected to observe that some of the training variables would offer protection against foodborne disease outbreaks. However, it was case businesses that we found to be statistically significantly more likely to have kitchen and food and beverage staff who had received food hygiene training at varying levels of the operation. This related to the

range of food hygiene training offered, namely induction, basic, intermediate, advanced and professional training. Kitchen managers trained to intermediate food hygiene level remained an independent management risk factor when adjusted for other staff management variables but did not remain independent of business size and cheaper meals. This level of training is associated with larger SMEs and businesses employing more than 250 staff and was also found to be associated with businesses offering more expensive meals. Kitchen managers trained to intermediate food hygiene level did not remain independent when adjusted for provision of staff accommodation, staff sick at the time of outbreak and owner manager working in the kitchen. None of the 30 businesses who reported having a kitchen manager trained to intermediate food hygiene had the owner/manager working in the kitchen. Thus intermediate food hygiene training is not a risk factor in itself..

- 5.15 The attitude of those catering businesses that have invested in this level of training should also be considered. The provision of adequate supervision and instruction is a legal requirement and thus in fulfilling this legal requirement food hygiene training has been the focus of enforcing authorities and food safety consultants for a number of years. Training may also form part of a 'due diligence' defence, along with other documented food safety systems. It is possible that some businesses will focus on establishing a good documented due diligence rather than ensuring that trained staff apply the knowledge attained in food hygiene training and understand the importance of its application. Is it possible that these businesses view training kitchen managers as an alternative to close supervision?

### **Operational Practices**

- 5.16 The operational practices category contained the greatest number of variables; both catering practices, food products and documented food safety control systems came within this category. We considered a number of variables that related directly to the management of food safety. These included; the presence of a food safety management system incorporating the first 5 principles of HACCP, the maintenance of temperature control records, maintenance of a cleaning schedule and the maintenance of staff training. There was no significant risk or protective factor. It was particularly disappointing to observe that food safety management systems using the 5 main principles of HACCP had not had any significant positive impact on catering businesses that participated in this study, irrespective of business size. A number of businesses that were interviewed had no documented approach to HACCP but still applied its principles by running a tight control over the kitchen operation. These observations endorse the opinion that the application of HACCP within the catering industry, particularly but not exclusively within SMEs, requires careful consideration in relation to the needs, barriers and drivers of catering businesses (People 1<sup>st</sup>, 2005). We did find that 11% of case businesses with a written HACCP experienced a change in menu preparation at the time of the outbreak compared to 1% of control businesses. Also, 14% of case businesses with written HACCP reported employing a relief manager at the time of the outbreak compared to only 1% of control business. It is possible that the presence of an unusual

event within a business may affect the routine implementation of written food safety management systems. Also, a higher proportion of businesses with written HACCP reported having multiple tiers of management between the kitchen manager and owner/site manager. This could also have an effect on the ability of a business with several lines of management and communication to adapt appropriately to changes to their operation. Similar results were not observed in catering businesses that applied a verbal food safety management system. These explanations provide further evidence that the application of HACCP with the catering industry requires specific attention to the inherent nature of this industry and the operational practices that may affect its effectiveness.

- 5.17 The receipt and use of raw ingredients introduces additional bacterial contaminants into the kitchen, particularly in the case of raw chicken. If these products are not effectively managed the chances of cross contamination during preparation and storage are increased. Poultry dishes prepared and cooked from raw were found to be independently associated with outbreaks. There was also a suggestion that serving poultry in a hot display buffet was a risk factor.
- 5.18 Use of regional suppliers for eggs, red meat and poultry was linked to case businesses. Regional egg suppliers were independently associated with outbreaks. The product that they supply to the catering businesses can be sourced from any county or country. There are two likely reasons why they have been identified as a management risk factor. Regional suppliers are likely to have evolved from a small local business serving the local community. These suppliers in general deliver to SMEs. If this expansion from a local supplier to a regional supplier occurs over a relatively short period of time, operating practices and systems, equipment and facilities may be inadequate to cope. This is particularly relevant to the application of food safety systems and the provision of appropriate equipment to assure the delivery of safe food. This can be compared to national suppliers, driven by the high food safety standards and accredited and assured safe systems of work required by their customers who will include national retail and catering businesses. On the other hand, local suppliers may have a relatively small but stable customer base, will work within their capacity and are driven by maintaining local reputation. Eggs supplied to the catering industry may present additional risks particularly imported eggs. In a press release in October 2004, the FSA reported that since 2002 the Health Protection Agency continued to investigate foodborne disease outbreaks associated with *S. Enteritidis* and many of these had been linked to Spanish eggs. The statement also commented that the use by the catering trade of Spanish eggs was a major source of this infection. At the time of the study, Spain was the largest single non-UK source of eggs in England and Wales. Interviews with a number of catering businesses associated with *S. Enteritidis* outbreaks confirmed the use of regional egg suppliers.
- 5.19 Case businesses were statistically significantly less likely to collect food directly from their suppliers. This practice tends to occur more frequently in smaller businesses. 77% of micro businesses collect food from the supplier

compared to only 2% of small medium business. This would account for the variable not being independent of business size. These suppliers are locally situated businesses and include cash and carry stores that form part of a national company and national retail supermarkets.

- 5.20 As well as considering specific food types in relation to catering methods, we examined whether the entire menu was cooked to one of the following catering methods: cook to order, cook from raw ingredients, bulk preparation and regeneration of prepared food on site. Each catering method presented different opportunities for food safety control failures to occur. Bulk preparation of food is more liable to food safety control failures because of the high volume of food prepared at any one time and the need to attain adequate core temperatures. Food that is cooked to order presents less opportunity to food safety control failures. Food cooked from raw ingredients could either be cooked to order or bulk prepared. Food regenerated on site provides the least opportunity for food safety control failures as within the catering industry these tend to be individual meals which are regenerated to order. Typical foods would include pasta dishes, pies, some vegetarian meals, frozen foods intended for the fryer to be served with chips. Thus in general, these products simply require reheating to a specified temperature and are usually reheated and served as individual portions. Examination of these categorical variables showed no significant differences between case and controls and it is possible that the selected categories were inappropriate. We therefore decided that further examination of these variables within a smaller dataset would be of no value.

### **Unusual Events**

- 5.21 It is reasonable to expect that a breakdown in the normal business operation will have an impact on the occurrence of outbreaks. Businesses employing a relief manager at the time of the outbreak were 18 times more likely to be associated with an outbreak in univariate analysis. A relief manager will be employed in the position for a relatively short and temporary period of time. This person is unlikely to be familiar with all operational practices within the business and may not know all members of the team and the dynamics of that team. It would not be surprising if, during the daily demands of managing an unfamiliar catering business, mistakes occur and in some circumstances these errors would involve food safety control failures. The impact of a relief manager can be illustrated by experiences of one case business. This business operated as a high class catering business. The head chef was on leave and one of the chefs took over the role of kitchen manager. Normally, the head chef was the only person to prepare chicken liver parfait. The kitchen had a written HACCP. While the relief manager was in post he prepared chicken liver parfait to his own recipe. This was then served to customers resulting in an outbreak of *Campylobacter*. This example illustrates how, in some circumstances, deviation from established well-controlled practices can result in outbreaks. Case businesses were also statistically significantly more likely to have introduced a change in menu preparation.

## **Other factors**

- 5.22 Within this exploratory category, we found that offering an average meal price for 2 <£21 was a strong protective factor. Cheaper meals frequently involve a simple catering practice with little opportunity to deviate from the standard operating procedure and usually requiring less catering skill. Such meals would include fish and chips, pizza and pub meals regenerated on site, and lunchtime meals offered by businesses that are only open during the day. In addition, in the case of businesses that handle raw ingredients such as fish and chip shops, the actual limited preparation and cooking process i.e. freezer to fryer or fridge to fryer, may account for these businesses generally not being associated with outbreaks. Only 30% of catering businesses offering cheaper meals reported serving dinner. Catering methods likely to present more opportunity for failures in food safety control tend to occur less frequently in businesses offering cheaper meals. These facts appear to explain many of other associations within the dataset.

## **Foodborne disease outbreaks attributed to S. Enteritidis**

- 5.23 As this study progressed it was decided to undertake a separate analysis of foodborne disease outbreaks attributed to S. Enteritidis.

## **Business Characteristics**

- 5.24 S. Enteritidis outbreaks were associated with serving Chinese cuisine and not serving cheaper meals. Whilst it is known that Chinese cuisine uses a large number of raw eggs compared to other cuisine types there may be other related explanations. Chinese cuisine involves a long complex preparation, foods are frequently prepared from raw and these may be partially cooked and then placed under cold storage until required for cooking within a final dish. This type of process provides a greater opportunity for food safety control failures to occur, particularly cross contamination and inadequate temperature control. 81% of businesses serving Chinese cuisine reported preparing and cooking poultry dishes from raw compared to 57% of businesses serving other types of cuisine. 48% of businesses that reported serving Chinese cuisine served egg dishes from hot display buffets compared to 24% of businesses serving other types of cuisine.

## **Staff Employment and Structure**

- 5.25 Following adjustment for other variables and potential business characteristic confounders, the only variable identified as marginally independent was kitchen porters whose wages were above the national average, although this factor was not independent of cheaper meals. There is no apparent reason for this association. Only 25% of case businesses that reported paying kitchen porters above the national average wages served Chinese cuisine, and only 17% reported having a relief manager on duty at the time of the outbreak. However 83% of these businesses also reported being open for 10 hours or

more. It is possible that these two unexpected management risk factors are linked although this observation should be viewed with caution given the small sample size and the marginal significance shown in some of the adjustments.

- 5.26 In the analysis of all foodborne disease outbreaks the owner/ manager working in the kitchen was independently protective within the staff employment group. However, in the Salmonella outbreak dataset it was not.

### **Staff management**

- 5.27 Only one variable remained independently associated with S. Enteritidis outbreaks when adjusted for other variables in this group; provision of staff accommodation. The provision of staff accommodation is not exclusively related to hotels; restaurants will provide staff accommodation, including those serving ethnic cuisine. Forty three percent of businesses serving Chinese cuisine reported providing staff accommodation and 89% of these were case businesses. This can be compared with 13% businesses serving other types of cuisine who also reported providing staff accommodation.

### **Training**

- 5.28 Induction training of food and beverage managers was found to be of marginal significance and was not independent of Chinese cuisine, business size or of serving cheaper meals.

### **Operational Practices**

- 5.29 Following adjustment very few variables remained independent management risk factors. S. Enteritidis is more commonly associated with eggs and poultry. However inadvertent cross contamination means that potentially any food product under the right conditions can be associated with a foodborne disease outbreak. The service of egg dishes using a hot display buffet did not remain independent when adjusted for other hot display buffet variables and business size. However, it remained marginally independent of Chinese cuisine and being open for 10 hours or more. Egg dishes that are commonly served on a hot display buffets would include fried eggs, scrambled eggs, hard boiled eggs, composite dishes such as a hot rice dish and eggs that are whisked and added as an ingredient to rice, pasta and noodle dishes and protein dishes where the egg is used as a binding agent. All 26 businesses that served egg dishes on a hot display buffet also reported serving rice/ pasta, poultry and red meat dishes on a hot display buffet. Chinese cuisine uses a high proportion of eggs, particularly within composite dishes and as a binding agent.

### **Regional Suppliers**

- 5.30 Sourcing from a regional egg supplier was identified as a marginally independent management risk factor. These results were also observed in the analysis of all foodborne disease outbreaks. Also during data collection, it was apparent that the same regional supplier was linked to more than one

foodborne disease outbreak attributed to *S. Enteritidis*. One regional egg supplier supplied a case business in Cornwall and also supplied two cases businesses situated in Devon. Another regional supplier based in London was known to have supplied a case business in Berkshire and Hampshire. Regional egg supply was independent of Chinese cuisine, even though Chinese restaurants were more often supplied with eggs regionally, and it was independent of other business confounders. Regionally supplied eggs may be more likely to be contaminated with *Salmonellas*.

- 5.31 Food safety controls were not found to be independently protective. It was particularly disappointing to observe that the presence of food safety management systems based on the 5 main principles of HACCP had not had any significant positive impact, although the implementation of such systems was not assessed during the study.
- 5.32 We did note however that food safety management systems were not a common feature of catering businesses serving Chinese cuisine. This may be compounded by a language barrier where all staff within the business do not speak or read fluently in the language used to present the food safety management system. Three of the four businesses serving Chinese cuisine with a written HACCP were associated with a *S. Enteritidis* outbreak. We considered whether the presence of an unusual event within a business might affect the routine implementation of written food safety management systems. Only one case business with a written HACCP also reported a change in menu preparation at the time of the outbreak and 5 case businesses with a written HACCP reported having a relief manager on duty at the time of the outbreak.

### **Unusual or Unexpected Events**

- 5.33 On examination of the nature of the unusual events that were reported by businesses it became apparent most should have been anticipated and planned for. Most either related to more specific events already recorded e.g. change in menu preparation or they related to unplanned or unpredicted events like 'extremely hot weather'. Given that controls were matched for each area, weather conditions would be similar for both. However, what this variable may show is that some businesses are either better managed or equipped to deal with unusual weather conditions. For example, during an interview with a business associated with a *S. Enteritidis* outbreak during August 2003, it was found that eggs were stored in the garage, normally a cool dry environment. However during the hot summer, this environment came to resemble a greenhouse and as a result any contaminated eggs were being stored in conditions that were suitable for bacterial growth. This business was unable to adapt their operation to these changes in temperature.

### **Other Factors**

- 5.34 Case businesses were statistically significantly less likely to offer a meal for 2 people (excluding drinks) <£21. It is apparent that cheaper meals are

commonly associated with simple catering methods that provide less opportunity for food safety control failures to occur.

### **Handling and Use of Eggs**

5.35 This hypothesis was generated from a case control study coordinated by the Health Protection Agency in 2003, following a national increase in *S. Enteritidis* PT14b in that same year that suggested that food consumed outside the home and from specific types of catering establishments was the most likely source of infection. In particular, there was a clear association between eating food from Chinese restaurants and sporadic cases of *S. Enteritidis* PT14b infection. Thirty nine *S. Enteritidis* outbreaks were included within this hypothesis group. A sub set of the total dataset was used because the case definition only included outbreaks that were reported to the HPA between 1<sup>st</sup> June 2003 and 31<sup>st</sup> December 2003. However, though case businesses were statistically significantly more likely to use raw eggs, were more likely to serve Chinese cuisine and were less likely to store cooked dishes containing egg in the refrigerator, none remained independently associated with *S. Enteritidis* outbreaks. This may be due to small numbers. Odds ratio remained virtually unchanged. However, the use of cooling water in the cooking range remained independently associated with *S. Enteritidis* outbreaks. This practice commonly associated with Chinese cuisine, was reported in all 16 case businesses and 3 control businesses reported to serve Chinese cuisine but also in 2 control businesses who reported serving other cuisine types. This practice is not therefore exclusive to Chinese cuisine.

### **Bacterial outbreaks**

5.36 We undertook a separate analysis of bacterial foodborne disease outbreaks. This analysis was undertaken on all laboratory confirmed foodborne disease outbreaks.

### **Business Characteristics**

5.37 Only cheaper meals were independently associated with bacterial outbreaks when adjusted for other variables in this hypothesis group providing a protective effect. This management factor was also identified as protective for all foodborne disease outbreaks and those attributed to *S. Enteritidis*.

### **Staff Structure and Employment**

5.38 Case businesses were less likely to have the owner/manager working in the kitchen; this was identified in all foodborne disease outbreaks as well as those attributed to *S. Enteritidis*. Use of agency staff was of marginal independent significance but the odds ratio increased from 3.8 on univariate analysis to 8.9 on multivariate analysis. Agency staff were associated with bacterial outbreaks as was having a relief manager on duty at the time of the outbreak.

## **Kitchen Staff Employment Variables**

5.39 Payment of kitchen porter staff above the national average remained a significant independent risk factor. There is no obvious reason for this.

## **Staff Management**

5.40 Businesses that reported a staff member sick, included staff sick at work, on leave and staff with a close family member suffering from vomiting and diarrhoea. This management risk factor was also identified as independently associated with all foodborne disease outbreaks. Staff using the guest WC was independently associated with bacterial outbreaks. This variable has not been previously identified as a management risk factor. Whilst only 18% of businesses that reported staff using the guest WC also reported a staff member sick at the time of the outbreak, 89% were associated with a bacterial outbreak.

## **Training**

5.41 In common with the analyses of all foodborne disease outbreaks and *S. Enteritidis* outbreaks, we observed that training staff to any level of food hygiene did not offer any protection against association with bacterial foodborne disease outbreaks.

## **Operation Practices**

5.42 Poultry and red meat dishes were also independent management risk factors when adjusted for other variables. Hot display buffets usually provide a range of dishes for the customer and so it is likely that the display of red meat and poultry dishes are linked. Nearly all businesses who reported serving red meat dishes from hot display buffet also served poultry dishes.

## **Unusual Events**

5.43 In line with outbreaks of *S. Enteritidis*, examination of the nature of the unusual events that were reported by businesses indicated only a few would constitute an unexpected event.

## 6.0 CONCLUSIONS

- 6.1 The outbreaks included in the study are representative of outbreaks that occurred in the catering industry in England and Wales as suggested by:
- Temporal and geographical trends reflect official laboratory surveillance over the same data collection time period.
  - Foodborne disease is under-reported, but we succeeded in identifying outbreaks from informal sources as well as the HPA.
  - The study included a wide range of outbreak size (3 – 142 reported cases) and comprised a higher proportion of smaller foodborne disease outbreaks (45% with fewer than 10 reported cases).
  - We achieved very high participation rates, 90% for case businesses and 93% for control businesses.
- 6.2 We are confident that the data collected was of high quality because we used field investigators with a background in catering and food safety but who were not employed by local authorities to undertake informal face to face interviews. This approach prevented any perception on the part of the interviewees of being judged, and thus encouraged trust and openness with the receipt of data that truly reflected how the business operated. It is our opinion that an inspection or visit by an enforcing officer would not have achieved this.
- 6.3 Outbreaks of foodborne disease are more common in catering businesses that are larger SMEs and where they cater for the higher price range and offer more services.
- 6.4 Reported formal training and the presence of food safety management systems based on HACCP principles were not related to reduced risk, although the implementation of such systems was not assessed during the study.
- 6.5. Outbreak businesses tended to have more tiers of management, have fulltime kitchen staff, use casual staff and offer staff accommodation.
- 6.6. Outbreak businesses were more likely to have supplies of eggs, poultry and meat from regional suppliers; regional supply of eggs was particularly associated with *S. Enteritidis* outbreaks. They were less likely to collect food directly from the supplier.
- 6.7. Outbreak businesses were more likely to use hot display cabinets and to reheat certain foods.
- 6.8. Outbreak businesses were more likely to have a recent change of menu, or a new process or procedure or practice, or have a relief manager on at the time.

## **7.0 Recommendations**

- 7.1 Further research is needed to explore the possible relationship between occurrence of outbreaks and the employment of full-time kitchen staff and the provision of staff accommodation.
- 7.2 Further investigation is needed into the content and delivery of food hygiene training programmes and the ways in which training is linked to subsequent responsibilities in catering.
- 7.3 Further work is required to understand how approaches to HACCP control procedures are related to the actual implementation of HACCP principles in the catering business.
- 7.4 The catering industry should be alerted to the findings of this study. Regional workshops should be held for local authorities and other interested public health agencies in order to develop the application of the protocol for the identification of management risk factors during routine and outbreak investigations.
- 7.5 A working group should be established to consider the integration of key risk factors into the guidance on assessing the 'Confidence in Management' section of the inspection rating schemes, Food Safety Act 1990 Code of Practice. This group should include representatives from LACORS, FSA, environmental health practitioners and the project team.

## **8.0 Glossary of technical terms**

### **Confounding**

Confounding occurs when an estimate of the relation between an exposure and a disease or event is distorted by the influence of another factor. This will occur when a variable is related to both exposure and the disease under study. This can lead to false associations or to the masking of a real association.

### **Matching**

The process of selecting controls so that they are similar to cases with respect to confounding factors. In the case of this study, businesses were matched by region and SME status.

### **Univariate analysis**

This refers to the examination of individual factors in relation to their occurrence in cases and controls. The resulting 2 X 2 table allows odds ratios to be calculated. However, this analysis does not consider the relationships between variables.

### **Multivariate analysis**

Multivariate analysis considers multiple variables at the same time using complex statistical techniques such as logistic regression. These analyses allow the specific effects of variables to be estimated after taking into account their relationships with other variables.

### **Odds ratio**

The ratio of odds (chance) of exposure among cases to the odds in favour of exposure among the controls. It is a summary measure of association between a variable and the condition under study.

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# TABLES

**Table 1 List of Variables Analysed in The Study**

<b>HYPOTHESIS: The business characteristics of catering businesses associated with food poisoning outbreaks was different to those of non outbreak businesses.</b>	
<b>Variable</b>	<b>Definition</b>
Hotel	Includes bed and breakfast establishments and residential pubs
Restaurant	Includes takeaways
Other catering businesses	Includes canteens in workplaces, universities and colleges, residential care homes, caterers, schools, clubs, shop caterers and cafes.
Family business	A business which is owned and operated by members of the same family, applicable to any size of business
Small independent	A business employing less than 250 employees which operates from one site.
Small independent > 1	A business employing less than 250 employees which operates from more than one site.
Large independent	A business employing greater than 250 employees which operates from one site.
National chain	A business employing greater than 250 employees which operates from multiple sites throughout the country.
Voluntary organisation	An organisation whose members are not paid for their work and that does not make a profit. Includes registered charities, church groups, luncheon clubs and community groups.
SME	Small medium sized enterprise employing less than 250 staff, includes micro, small and small medium SMEs
Micro SME	Small medium sized enterprise employing less than 10 staff
Small SME	Small medium sized enterprise employing between 11 – 49 staff
Small medium SME	Small medium sized enterprise employing between 50 and 249 staff
Lunch	Meal served at midday
Dinner	Meal served in the evening/night
<b>HYPOTHESIS: Staff employment in catering businesses associated with food poisoning outbreaks is different to those of non outbreak businesses.</b>	
<b>Variable</b>	<b>Definition</b>
Casual staff	Staff employed by a business on an infrequent and irregular basis
Salaried	Staff receive a weekly or monthly wage and are not paid by the hour.
Food and Beverage	Food and beverage, which includes front of house/customer areas
Tier 1	Manager and deputy, applies to either kitchen or F&B
Tier 2	Tier below Manager and Deputy can comprise of chefs, bar supervisors, team leaders, restaurant supervisors
Tier 3	Tier below tier 2 comprising of kitchen assistants, kitchen porters, bar staff, waiters
Team	Staff other than the manager or deputy of the kitchen or F&B
Kitchen manager	The person in charge of the kitchen usually known as the head chef, executive chef, kitchen manager, catering manager
Food and Beverage manager	The person in charge of those areas where customers are served usually the dining area and bar usually know as F&B manager, Restaurant manager, head waiter, beverages manager

**Table 1 List of Variables Analysed in the Study**

<b>HYPOTHESIS: Management of staff in catering businesses associated with food poisoning outbreaks is different to those of non outbreak businesses.</b>	
<b>Variable</b>	<b>Definition</b>
Induction training	Formal or informal training undertaken by the employer at the start of employment
Basic training	Level 1 training, nationally recognised, accredited qualification of generally one day duration
Intermediate training	Level 2 training, nationally recognised accredited qualification usually of three days duration
Advanced training	Level 3 training, nationally recognised accredited qualification for manager usually of five days duration.
Professional training	Training in the profession in which the person works with Institute, Association, trade, graduate qualifications
Tier 1	Manager and Deputy of either kitchen or F&B
Tier 2	Generally chefs/head waiters or head bar man
Tier 3	Generally kitchen assistant, kitchen porters, waiters, bar staff
Leave	Authorised absence from work
Sick leave	Absence from work due to sickness and/or diarrhoea, symptoms of gastroenteritis
Sick at work	Vomited or experienced diarrhoea while working at the catering business
Family with Diarrhoea and vomiting	A close member of the family i.e. a person living in the same household whose has sickness and/or diarrhoea, symptoms of gastroenteritis
Staff incentives	Includes bonus schemes, meals paid for, accommodation provided, tips, staff discounts
Internal pressures	Includes wage percentage, GP, undertaking of additional roles, cutting corners
External pressures	Includes increased utility costs, high or change in rent/lease agreement, contractual issues
d-verb	Informal verbal communication
Meeting	Any formal meeting, including shift briefs
Notices	Includes notice board, signs, booklets, written procedures
Training	Includes formal certified training and on the job training
Diary	Includes function sheets
Checks/audits	Includes inspections, monitoring undertaken either internally or externally

**Table 1 List of Variables Analysed in the Study**

<b>HYPOTHESIS: Operational practices in catering businesses associated with food poisoning outbreaks are different to those of non outbreak businesses.</b>	
<b>Variable</b>	<b>Definition</b>
Menu specifications	Written documents outlining the preparation, cooking and presentation of food, includes recipes
Bulk preparation	The preparation of menu items for more than two people in advance of ordering. These items can be either hot or cold. Preparation can include cooking.
Food regenerated on site	Food products that simply require reheating to be ready for human consumption can either be frozen or fresh products. Branded ready made meals come within this category.
Totally made	Food items which come into the kitchen in a raw state and require full preparation and cooking before service e.g. a raw whole chicken.
Partially prepared	Food items which come into the kitchen partially prepared but still require preparation or cooking e.g. precooked lasagne, frozen chips.
Served only	Food items which come into the kitchen ready to eat with no further preparation required, apart from wrapper removal e.g. fresh cakes, fruit, cooked sliced ham
Cook to order	Menu item which is ordered by a customer and then cooked from raw for immediate service.
Reheat to order	Menu item which is ordered by a customer and only requires reheating before service as the product has been cooked sometime in advance.
Freezer to Fryer	Frozen food put directly from the freezer into the fryer before serve to the customer e.g. scampi, chips, battered fish.
Small Function 1 (SMALL FUNCTION)	A party/function of less than 20 persons
Large Function 2 (LARGE FUNCTION)	A party/function of more than 20 persons
Hot display buffet	Hot food displayed on hot plates, hot trolley, heated display unit for service either directly by the customer or by staff.
Cold display buffet	Cold food displayed on a refrigerated display unit for service either directly by the customer or by staff.
Ambient display buffet	Food displayed at room temperature for service either directly by the customer or by staff.
Poultry	Includes chicken and duck
Red meat	Includes beef, lamb and pork
Local supplier	A food supplier who operates within the local community extending to no greater than one county,
Regional supplier	A food supplier who operates within one to seven counties.
National supplier	A food supplier who operates throughout the country of England and Wales or both.
HACCP	Hazard Analysis Critical Control Point
Written HACCP	A documented system of HACCP either developed by the business or bought as a product.
Verbal HACCP	Business follows the key principles of HACCP but do not have any system recorded. Business has shown some understanding of HACCP.

**Table 1 List of Variables Analysed in the Study**

<b>HYPOTHESIS:</b> Occurrence of unusual events/circumstances in catering businesses associated with food poisoning outbreaks is different to those non outbreak businesses.	
<b>Variable</b>	<b>Definition</b>
Food preparation equipment	Any equipment involved in the receipt, storage, handling, preparing, cooking, holding, reheating, serving of food.
Change in menu preparation	The method in which a menu item is prepared for service. This may not necessarily mean that there has been a change in menu.
Temporary or alternative equipment	Equipment not routinely used by the catering business, used either to replace a piece of equipment or as an addition.
Disturbance to water supply	Provision or quality of the water supply is abnormal, intermittent, ceases
Relief manager	A manager employed on a temporary basis to fill in for an absent manager of either the whole business or part thereof.
Other incident/unusual occurrence	Includes increased water rates, rent, and tax, additional expenditure that may have affected business, extreme weather and incidents outside the normal business routine which affected the operation in some way.
<b>Exploratory variables</b>	
Meal for 2 <£21	Also referred to in the text as cheaper meals
Opening hours	Hours the business is open to the public for the service of food and/or drink
Covers	Number of meals or servings made and sold to customers

**Table 2      Outbreak Notification Source – Main Study**

<b>Notification source</b>	<b>Number of outbreaks (%)</b>
Industry network	16 (18%)
EHO network	10 (11%)
CDSC surveillance programme	62 (71%)
Total	88 (100%)

**Table 3 Comparison of participating and non-participating Case businesses**

<b>Business characteristic</b>	<b>Study businesses</b>	<b>Non participating businesses</b>
Commercial caterer	5/88 (6%)	3/10 (30%)
Restaurant	36/88 (41%)	6/10 (60%)
Nursing Home	7/88 (8%)	1/10 (10%)
Large business	28/88 (32%)	1/10 (10%)
SME	60/88 (68%)	9/10 (90%)
<b>Causative pathogen</b>	<b>Study businesses</b>	<b>Non participating businesses</b>
S. Enteritidis	44/88 (50%)	6/10 (60%)
S. typhimurium	3/88 (3%)	1/10 (10%)
Shigella sonnei	0/88 (0%)	1/10 (10%)
VTEC 0157	0/88 (0%)	1/10 (10%)
Norovirus	30/88 (34%)	1/10 (10%)

**Table 4 Comparison of participating and non participating Control businesses**

<b>Business characteristic</b>	<b>Study businesses</b>	<b>Non participating businesses</b>
Restaurant	35/91 (39%)	3/7 (43%)
Cafes	11/91 (12%)	2/7 (29%)
Pub/bar	18/91 (20%)	1/7 (14%)
Bingo Hall	1/91 (1%)	1/7 (14%)
Large businesses	28/91 (31%)	3/7 (43%)
SME	63/91 (69%)	4/7 (57%)

**Table 5 Serotypes of Salmonella Enteritidis**

<b>Salmonella</b>		<b>Salmonella</b>	
Enteritidis PT4	10	Enteritidis PT1c	1
Enteritidis PT14b	8	Enteritidis PT24	1
Enteritidis PT1	7	Enteritidis PT56	1
Enteritidis PT6a	3	Enteritidis PT12	1
Enteritidis PT6	3	Enteritidis PT not confirmed	2
Enteritidis PT6d	1	Branderup	2
Enteritidis PT8	2	London	1
Enteritidis PT1e	2	Thompson PT1a	1
Enteritidis PT2	1	Typhimurium DT49	1
Enteritidis PT21b	1	Typhimurium U104	1
Enteritidis PT21	1	Typhimurium U277	1
Enteritidis PT O9G	1	Total	53

**Table 6      Region of Outbreaks**

<b>Region</b>	<b>Number of Outbreaks</b>
North East	9 (10%)
North West	4 (5%)
Yorkshire and the Humber	11 (13%)
East Midlands	3 (3%)
West Midlands	7 (8%)
South West	12 (14%)
London	7 (8%)
South East	14 (16%)
East	16 (18%)
Wales	5 (7%)
<b>TOTAL</b>	<b>88 (100%)</b>

**Table 7 Business Characteristics**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>Is your business a hotel?</b>	<b>36/148 (24%)</b>	<b>20/148 (14%)</b>	<b>3.29 (1.41 – 7.66)</b>	<b>0.004</b>
Is your business a restaurant?	53/148 (36%)	58/148 (39%)	0.83 (0.49 – 1.42)	0.50
<b>Is your business a pub/bar?</b>	<b>18/148 (12%)</b>	<b>28/148 (19%)</b>	<b>0.41 (0.17 – 0.99)</b>	<b>0.04</b>
Is your business another type of catering business?	41/148 (28%)	42/148 (28%)	0.96 (0.53 – 1.72)	0.88
<b>Do you serve Chinese cuisine?</b>	<b>23/148 (16%)</b>	<b>7/148 (5%)</b>	<b>5.00 (1.71 – 14.63)</b>	<b>0.001</b>
Do you serve British cuisine?	107/148 (72%)	113/148 (76%)	0.75 (0.41 – 1.38)	0.35
Do you serve Indian cuisine?	7/148 (5%)	11/148 (7%)	0.56 (0.19 – 1.66)	0.29
Do you serve other cuisine?	11/148 (7%)	17/148 (11%)	0.63 (0.28 – 1.38)	0.24
Are you a family business?	40/148 (27%)	49/148 (33%)	0.61 (0.31 – 1.18)	0.14
Are you a small independent?	40/148 (27%)	41/148 (28%)	0.95 (0.52 – 1.74)	0.88
Are you a small independent business >1 site?	17/148 (11%)	9/148 (6%)	1.89 (0.84 – 4.24)	0.12
<b>Are you a large independent?</b>	<b>6/148 (4%)</b>	<b>3/148 (2%)</b>	-	<b>0.08</b>
Are you part of a national chain?	42/148 (28%)	44/148 (30%)	0.33 (0.03 – 3.20)	0.32
Are you a voluntary organisation?	3/148 (2%)	2/148 (1%)	2.00 (0.18 – 22.06)	0.56
<b>Are you a micro SME?</b>	<b>25/88 (28%)</b>	<b>45/88 (51%)</b>	<b>0.09 (0.02 – 0.39)</b>	<b>&lt;0.001</b>
<b>Are you a small SME?</b>	<b>28/88 (32%)</b>	<b>14/88 (16%)</b>	<b>3.80 (1.41 – 10.18)</b>	<b>0.004</b>
<b>Are you a small medium SME?</b>	<b>7/88 (11%)</b>	<b>1/88 (1%)</b>	<b>7.00 (0.86 – 56.89)</b>	<b>0.03</b>
SMEs				
Is your business a hotel?	17/100 (17%)	13/100 (13%)	1.80 (0.60 – 5.37)	0.29
Is your business a restaurant?	47/100 (47%)	46/100 (46%)	1.05 (0.56 – 1.97)	0.87
<b>Is your business a pub/bar?</b>	<b>4/100 (4%)</b>	<b>13/100 (13%)</b>	<b>0.10 (0.01 – 1.78)</b>	<b>0.007</b>
Is your business another type of catering business?	31/99 (31%)	28/100 (28%)	1.21 (0.60 – 2.46)	0.59
Non SMEs				
Is your business a hotel?	<b>19/48 (40%)</b>	<b>7/48 (15%)</b>	<b>7.00 (1.59 – 30.80)</b>	<b>0.003</b>
Is your business a restaurant?	6/48 (13%)	12/48 (25%)	0.45 (0.16 – 1.31)	0.13
Is your business a pub/bar	14/48 (29%)	15/48 (31%)	0.86 (0.29 – 2.55)	0.78
Is your business another type of catering business	9/48 (19%)	14/48 (29%)	0.44 (0.14 – 1.44)	0.17
SMEs				
<b>Do you serve Chinese cuisine?</b>	<b>23/100 (23%)</b>	<b>7/100 (7%)</b>	<b>5.00 (1.71 – 14.63)</b>	<b>0.001</b>
Do you serve British cuisine?	63/100 (63%)	71/100 (71%)	0.60 (0.29 – 1.23)	0.60
Do you serve Indian cuisine?	7/100 (7%)	11/100 (11%)	0.56 (0.19 – 1.66)	0.29
Do you serve other cuisine?	7/100 (7%)	11/100 (11%)	0.60 (0.22 – 1.65)	0.32
Non SMEs				
Do you serve Chinese cuisine?	0/48 (0%)	0/48 (0%)	-	-
Do you serve British cuisine?	44/88 (50%)	42/88 (88%)	1.50 (0.42 – 5.32)	0.53
Do you serve Indian cuisine?	0/88 (0%)	0/88 (0%)	-	-
Do you serve other cuisine?	4/88 (8%)	6/88 (7%)	0.67 (0.19 – 2.36)	0.53
Do you serve breakfast?	37/88 (42%)	31/148 (35%)	1.46 (0.72 – 2.96)	0.29
Do you serve lunch	79/88 (90%)	72/88 (82%)	2.16 (0.82 – 5.70)	0.11
<b>Do you serve dinner</b>	<b>79/88 (90%)</b>	<b>67/88 (76%)</b>	<b>3.00 (1.19 – 7.56)</b>	<b>0.01</b>
<b>Do you serve snacks</b>	<b>51/88 (58%)</b>	<b>39/88 (44%)</b>	<b>2.33 (1.07 – 5.09)</b>	<b>0.03</b>
<b>Do you offer room service</b>	<b>18/88 (20%)</b>	<b>5/88 (6%)</b>	<b>5.33 (1.55 – 18.30)</b>	<b>0.003</b>
Do you offer functions for <20 people	32/88 (36%)	31/88 (35%)	1.06 (0.54 – 2.10)	0.86
Do you offer functions for >20 people	39/88 (44%)	30/88 (34%)	1.56 (0.83 – 2.93)	0.16
<b>Do you serve lunch and dinner</b>	<b>87/88 (99%)</b>	<b>84/88 (95%)</b>	-	<b>0.08</b>
<b>Are you open for 10 or more hours continuously</b>	<b>50/88 (57%)</b>	<b>37/88 (42%)</b>	<b>2.18 (1.07 – 4.45)</b>	<b>0.03</b>

**Table 8 Staff Employment and Structure**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>Does the owner/manager work in the kitchen</b>	<b>28/148 (19%)</b>	<b>52/148 (35%)</b>	<b>0.33 (0.17 – 0.64)</b>	<b>0.0005</b>
<b>2 tiers of management before the kitchen manager/chef</b>	<b>29/148 (20%)</b>	<b>17/148 (11%)</b>	<b>2.10 (1.02 – 4.29)</b>	<b>0.04</b>
1 tier of management before the kitchen manager/head chef	51/148 (14%)	46/148 (31%)	1.19 (0.70 – 2.02)	0.51
3 tiers of management before the kitchen manager/head chef	2/148 (1%)	0/148 (0%)	-	0.16
<b>Area manager and 2 tiers of in house management before the kitchen manager</b>	<b>21/148 (14%)</b>	<b>13/148 (9%)</b>	<b>2.14 (0.89 – 5.26)</b>	<b>0.09</b>
*Area manager and no tiers of management before the kitchen manager	1/148 (1%)	4/148 (4%)	0.25 (0.03 – 2.23)	0.18
Problem recruiting staff	29/88 (33%)	33/88 (38%)	0.80 (0.41 – 1.54)	0.50
Problem retaining staff	15/88 (17%)	16/88 (18%)	0.93 (0.44 – 1.98)	0.85
Recruit agency staff (kitchen)	29/148 (20%)	26/148 (18%)	1.19 (0.61 – 2.31)	0.61
Recruit staff with professional qualifications (kitchen)	38/148 (26%)	29/148 (20%)	1.56 (0.83 – 2.93)	0.16
Recruit staff with food hygiene qualifications (kitchen)	48/148 (32%)	41/148 (28%)	1.33 (0.76 – 2.35)	0.32
Recruit agency staff (F&B)	29/148 (20%)	20/148 (14%)	1.82 (0.87 – 3.79)	0.11
<b>Recruit staff with professional qualifications (F&amp;B)</b>	<b>12/148 (8%)</b>	<b>4/148 (3%)</b>	<b>3.00 (0.97 – 9.30)</b>	<b>0.05</b>
Recruit staff with food hygiene qualifications (F&B)	14/148 (9%)	16/148 (11%)	0.8 (0.38 – 1.89)	0.68
<b>Use casual staff</b>	<b>33/88 (38%)</b>	<b>20/88 (23%)</b>	<b>2.08 (1.05 – 4.15)</b>	<b>0.03</b>
Kitchen manager fulltime	82/88 (93%)	84/88 (95%)	0.60 (0.14 – 2.51)	0.48
<b>Kitchen staff fulltime</b>	<b>66/88 (75%)</b>	<b>50/88 (57%)</b>	<b>2.78 (1.30 – 5.95)</b>	<b>0.006</b>
All kitchen staff salaried	20/88 (23%)	14/87 (16%)	1.75 (0.73 – 4.17)	0.20
<b>Only chefs salaried</b>	<b>17/88 (19%)</b>	<b>9/87 (10%)</b>	<b>2.33 (0.90 – 6.07)</b>	<b>0.07</b>
Only managers of kitchen salaried	12/88 (14%)	16/87 (18%)	0.71 (0.32 – 1.61)	0.41
None of kitchen staff salaried	33/88 (38%)	33/87 (38%)	0.94 (0.48 – 1.86)	0.86
<b>Head chef wages above national average</b>	<b>48/88 (55%)</b>	<b>30/88 (34%)</b>	<b>2.38 (1.25 – 4.56)</b>	<b>0.006</b>
<b>Head chef wages below national average</b>	<b>11/88 (13%)</b>	<b>20/88 (23%)</b>	<b>0.50 (0.22 – 1.11)</b>	<b>0.08</b>
Head chef wages same as the national average	12/88 (14%)	11/88 (13%)	0.91 (0.38 – 2.14)	0.83
Head chef wages vary	2/88 (2%)	0/88 (0%)	-	0.16
<b>Kitchen porter wages above national average</b>	<b>24/88 (27%)</b>	<b>12/88 (14%)</b>	<b>2.50 (1.10 – 5.68)</b>	<b>0.02</b>
Kitchen porter wages below national average	29/88 (33%)	25/88 (28%)	1.33 (0.63 – 2.82)	0.45
Agency pays kitchen porter wages	0/88 (0%)	1/88 (1%)	-	0.32
Kitchen porter wages same as national average	12/88 (14%)	14/88 (16%)	0.83 (0.36 – 1.93)	0.67
<b>F&amp;B manager fulltime</b>	<b>63/88 (72%)</b>	<b>46/88 (52%)</b>	<b>2.55 (1.27 – 5.11)</b>	<b>0.007</b>
<b>F&amp;B staff fulltime</b>	<b>36/88 (41%)</b>	<b>20/88 (23%)</b>	<b>2.60 (1.25 – 5.39)</b>	<b>0.008</b>
<b>All F&amp;B staff salaried</b>	<b>13/87 (15%)</b>	<b>8/87 (9%)</b>	<b>3.00 (0.81 – 11.08)</b>	<b>0.08</b>
<b>All fulltime F&amp;B staff salaried</b>	<b>4/87 (5%)</b>	<b>0/87 (0%)</b>	-	<b>0.05</b>
All non casual F&B staff salaried	1/87 (1%)	1/87 (1%)	1.00 (0.06 – 15.99)	1.00
Only F&B manager salaried	13/87 (15%)	21/87 (24%)	1.89 (0.84 – 4.23)	0.12
No F&B staff are salaried	37/87 (43%)	39/87 (45%)	0.91 (0.50 – 1.67)	0.76

\* Fishers exact test used

**Table 9 Staff Management**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Pay staff for the first 3 days of sick leave	41/88 (47%)	33/88 (38%)	1.53 (0.80 – 2.94)	0.19
Designated staff toilets	66/88 (75%)	61/88 (69%)	1.36 (0.68 – 2.71)	0.38
<b>Staff use customer toilets</b>	<b>47/88 (53%)</b>	<b>35/88 (40%)</b>	<b>1.75 (0.95 – 3.23)</b>	<b>0.07</b>
<b>Provide staff accommodation</b>	<b>27/88 (31%)</b>	<b>12/88 (14%)</b>	<b>4.00 (1.50 – 10.66)</b>	<b>0.003</b>
<b>Kitchen manager absent from work at the time and/or 14 days before outbreak</b>	<b>15/88 (17%)</b>	<b>7/88 (8%)</b>	<b>3.00 (0.97 – 9.30)</b>	<b>0.05</b>
Member/s kitchen team absent from work at the time and/or 14 days before outbreak	12/88 (14%)	6/88 (7%)	2.20 (0.76 – 6.33)	0.13
F&B manager absent from work at the time and/or 14 days before outbreak	5/88 (6%)	3/88 (3%)	1.67 (0.40 – 6.97)	0.48
Member/s of F&B team absent from work at the time and/or 14 days before outbreak	4/88 (5%)	1/88 (1%)	4.00 (0.45 – 35.79)	0.18
<b>Kitchen manager sick at time and/or 14 days before outbreak</b>	<b>10/88 (11%)</b>	<b>2/88 (2%)</b>	<b>9.00 (1.14 – 71.04)</b>	<b>0.01</b>
<b>Members/s of kitchen team sick at time and/or 14 days before outbreak</b>	<b>9/88 (10%)</b>	<b>0/88 (0%)</b>	-	<b>0.003</b>
<b>F&amp;B manager sick at time and/or 14 days before outbreak</b>	<b>4/88 (5%)</b>	<b>0/88 (0%)</b>	-	<b>0.05</b>
<b>Member/s of F&amp;B team sick at time and/or 14 days before outbreak</b>	<b>5/88 (6%)</b>	<b>0/88 (0%)</b>	-	<b>0.03</b>
<b>Any staff member sick at time of outbreak and/or 14 days before</b>	<b>23/88 (26%)</b>	<b>2/88 (2%)</b>	<b>15.75 (3.59 – 69.16)</b>	<b>&lt;0.001</b>
ALL:				
Are there incentives to maintain hygiene standards	48/148 (32%)	48/148 (32%)	1.00 (0.59 – 1.69)	1.00
Are there disincentives to maintain hygiene standards	14/148 (9%)	14/148 (9%)	1.00 (0.45 – 2.23)	1.00
Is there support to maintain hygiene standards	135/148 (91%)	140/148 (95%)	0.62 (0.26 – 1.48)	0.28
Is there good communication between front and back of house	133/148 (90%)	128/148 (86%)	1.42 (0.68 – 2.97)	0.35
<b>Is there staff incentives</b>	<b>62/148 (42%)</b>	<b>43/148 (29%)</b>	<b>1.81 (1.08 – 3.03)</b>	<b>0.02</b>
EMPLOYEES				
Are there unrealistic demands on you	19/71 (27%)	25/71 (35%)	0.68 (0.34 – 1.39)	0.29
Do internal pressures affect the way the business is run	26/71 (37%)	25/71 (35%)	1.08 (0.51 – 2.29)	0.85
Is there good communication between you and your line manager? (main study)	34/39 (87%)	38/39 (97%)	-	-
Is there good communication between you and your team? (main study)	38/39 (97%)	39/39 (100%)	-	-
BUSINESS OWNERS:				
Do internal pressures affect the way the business is run	16/35 (46%)	13/35 (37%)	2.00 (0.50 – 8.00)	0.32
Do external pressures affect the way the business is run	13/35 (37%)	17/35 (49%)	0.56 (0.19 – 1.66)	0.29
KITCHEN				
Tier 1 induction FH training	46/88 (52%)	37/88 (42%)	1.75 (0.86 – 3.56)	0.12
Tier 1 basic FH training	78/88 (89%)	77/88 (88%)	1.13 (0.43 – 2.92)	0.81
<b>Tier 1 intermediate FH training (kitchen manager)</b>	<b>22/88 (25%)</b>	<b>8/88 (9%)</b>	<b>3.80 (1.42 – 10.18)</b>	<b>0.004</b>

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Tier 1 advanced FH training	8/88 (9%)	4/88 (5%)	2.33 (0.60 – 9.02)	0.21
Tier 1 professional training	38/88 (43%)	29/88 (33%)	1.82 (0.87 – 3.79)	0.11
<b>Tier 2 induction FH training</b>	<b>46/88 (52%)</b>	<b>33/88 (38%)</b>	<b>2.18 (1.07 – 4.45)</b>	<b>0.03</b>
<b>Tier 2 basic FH training</b>	<b>59/88 (67%)</b>	<b>49/88 (56%)</b>	<b>1.91 (0.92 – 3.96)</b>	<b>0.08</b>
Tier 2 intermediate FH training	12/88 (14%)	9/88 (10%)	1.50 (0.53 – 4.21)	0.44
Tier 2 advanced FH training	0/88 (0%)	2/88 (21%)	-	0.16
Tier 2 professional training	22/88 (25%)	19/88 (22%)	1.25 (0.59 – 2.67)	0.56
<b>Tier 3 induction FH training</b>	<b>36/88 (41%)</b>	<b>19/88 (22%)</b>	<b>2.70 (1.31 – 5.58)</b>	<b>0.005</b>
<b>Tier 3 basic FH training</b>	<b>39/88 (44%)</b>	<b>21/88 (24%)</b>	<b>3.00 (1.41 – 6.38)</b>	<b>0.003</b>
Tier 3 intermediate FH training	2/88 (2%)	2/88 (2%)	1.00 (0.14 – 7.10)	1.00
Tier 3 advanced FH training	0/88 (0%)	0/88 (0%)	-	-
<b>Tier 3 professional training</b>	<b>14/88 (16%)</b>	<b>5/88 (6%)</b>	<b>5.50 (1.01 – 24.81)</b>	<b>0.01</b>
F&B				
Tier 1 induction FH training	30/88 (34%)	26/88 (30%)	1.27 (0.64 – 2.49)	0.49
Tier 1 basic FH training	44/88 (50%)	38/88 (43%)	1.38 (0.72 – 2.62)	0.33
Tier 1 intermediate FH training	8/88 (9%)	6/88 (7%)	1.40 (0.44 – 4.41)	0.56
Tier 1 advanced FH training	2/88 (2%)	4/88 (5%)	0.50 (0.09 – 2.73)	0.41
Tier 1 professional training	14/88 (16%)	12/88 (14%)	1.22 (0.51 – 2.95)	0.65
Tier 2 induction FH training	25/88 (28%)	23/88 (26%)	1.14 (0.56 – 2.34)	0.72
<b>Tier 2 basic FH training</b>	<b>30/88 (34%)</b>	<b>18/88 (20%)</b>	<b>2.50 (1.10 – 5.68)</b>	<b>0.02</b>
Tier 2 intermediate FH training	1/88 (1%)	1/88 (1%)	1.00 (0.06 – 15.99)	1.00
Tier 2 advanced FH training	0/88 (0%)	0/88 (0%)	-	-
<b>Tier 2 professional training</b>	<b>8/88 (9%)</b>	<b>3/88 (3%)</b>	<b>6.00 (0.72 – 49.84)</b>	<b>0.05</b>
Tier 3 induction FH training	16/88 (18%)	15/88 (17%)	1.10 (0.47 – 2.59)	0.83
<b>Tier 3 basic FH training</b>	<b>17/88 (19%)</b>	<b>7/88 (8%)</b>	<b>2.43 (1.01 – 5.86)</b>	<b>0.04</b>
Tier 3 intermediate FH training	0/88 (0%)	0/88 (0%)	-	-
Tier 3 advanced FH training	0/88 (0%)	0/88 (0%)	-	-
Tier 3 professional training	4/88 (5%)	1/88 (1%)	4.00 (0.45 – 35.79)	0.18
Business issues communicated:				
<b>d-verb</b>	<b>52/148 (39%)</b>	<b>70/148 (47%)</b>	<b>0.58 (0.36 – 0.95)</b>	<b>0.03</b>
meetings	59/148 (40%)	47/148 (32%)	1.56 (0.90 – 2.64)	0.11
notices	22/148 (15%)	21/148 (14%)	1.09 (0.48 – 2.47)	0.83
training	0/148 (0%)	1/148 (1%)	-	0.32
diary	29/148 (20%)	27/148 (18%)	1.10 (0.59 – 2.06)	0.75
not given	24/148 (16%)	22/148 (15%)	1.13 (0.57 – 2.21)	0.73
Food hygiene issues communicated:				
<b>d-verb</b>	<b>75/141 (53%)</b>	<b>77/147 (53%)</b>	<b>1.13 (0.65 – 1.95)</b>	<b>0.67</b>
meetings	26/141 (18%)	26/147 (18%)	1.00 (0.48 – 2.10)	1.00
notices	36/141 (26%)	41/147 (28%)	0.84 (0.47 – 1.50)	0.74
training	22/141 (16%)	25/147 (17%)	0.89 (0.47 – 1.72)	0.74
diary	3/141 (2%)	3/147 (2%)	1.00 (0.20 – 4.95)	1.00
checks/audits	22/141 (16%)	18/147 (12%)	1.33 (0.63 – 2.82)	0.45
not done	9/141 (6%)	11/147 (7%)	0.89 (0.34 – 2.30)	0.81

**Table 10 Operational Practices**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Menu specifications used	71/148 (48%)	64/148 (43%)	1.27 (0.76 – 2.12)	0.36
<b>BREAD/CAKES:</b>				
Made from raw	20/88 (23%)	15/88 (17%)	1.56 (0.67 – 3.59)	0.30
Partially prepared	22/88 (25%)	28/88 (32%)	0.63 (0.28 – 1.38)	0.24
Served only	72/88 (82%)	78/88 (89%)	0.57 (0.24 – 1.36)	0.20
Cook to order	13/88 (15%)	13/88 (15%)	1.00 (0.43 – 2.31)	1.00
Cold display buffet	4/88 (5%)	1/88 (1%)	4.00 (0.45 – 35.79)	0.18
Hot display buffet	2/88 (2%)	4/88 (5%)	0.50 (0.09 – 2.73)	0.41
Ambient display buffet	36/88 (35%)	31/88 (35%)	1.36 (0.68 – 2.71)	0.38
Function for less than 20 people	28/88 (32%)	26/88 (30%)	1.17 (0.54 – 2.52)	0.69
Function for more than 20 people	31/88 (35%)	25/88 (28%)	1.38 (0.72 – 2.62)	0.33
<b>Fruit:</b>				
Made from raw	9/88 (10%)	8/88 (9%)	1.13 (0.43 – 2.92)	0.81
Partially prepared	39/88 (44%)	40/88 (45%)	0.95 (0.52 – 1.74)	0.88
Served only	75/88 (85%)	69/88 (78%)	1.75 (0.73 – 4.17)	0.20
Cook to order	8/88 (9%)	8/88(9%)	1.00 (0.32 – 3.10)	1.00
Freezer to fryer	1/88 (1%)	1/88 (1%)	1.00 (0.06 – 15.99)	1.00
Cold display buffet	10/88 (11%)	6/88 (7%)	2.00 (0.60 – 6.64)	0.24
Ambient display buffet	25/88 (28%)	21/88 (24%)	1.40 (0.62 – 3.15)	0.41
<b>Function for less than 20 people</b>	<b>17/88 (19%)</b>	<b>9/88 (10%)</b>	<b>2.60 (0.93 – 7.29)</b>	<b>0.06</b>
<b>Function for more than 20 people</b>	<b>22/88 (25%)</b>	<b>13/88 (15%)</b>	<b>2.13 (0.92 – 4.92)</b>	<b>0.07</b>
<b>VEGETABLES:</b>				
<b>Made from raw</b>	<b>27/88 (31%)</b>	<b>18/88 (20%)</b>	<b>2.50 (0.97 – 6.44)</b>	<b>0.05</b>
Partially prepared	61/88 (69%)	68/88 (77%)	0.53 (0.23 – 1.26)	0.14
Served only	84/88 (95%)	85/88 (97%)	0.75 (0.17 – 3.35)	0.71
Cook to order	54/88 (61%)	49/88 (56%)	1.26 (0.69 – 2.31)	0.45
Reheat to order	18/88 (20%)	21/88 (24%)	0.81 (0.39 – 1.69)	0.58
Freezer to fryer	62/88 (70%)	57/88 (65%)	1.38 (0.68 – 2.83)	0.37
Cold display buffet	1/88 (1%)	3/88 (3%)	0.33 (0.03 – 3.20)	0.32
<b>Hot display buffet</b>	<b>36/88 (41%)</b>	<b>26/88 (30%)</b>	<b>2.11 (0.95 – 4.67)</b>	<b>0.06</b>
Ambient display buffet	9/88 (10%)	7/88 (8%)	1.40 (0.44 – 4.41)	0.56
<b>Function for less than 20 people</b>	<b>33/88 (38%)</b>	<b>24/88 (27%)</b>	<b>1.90 (0.88 – 4.09)</b>	<b>0.09</b>
<b>Function for more than 20 people</b>	<b>37/88 (42%)</b>	<b>26/88 (30%)</b>	<b>1.79 (0.93 – 3.44)</b>	<b>0.09</b>
<b>FRESH HERBS:</b>				
Made from raw	9/88 (10%)	12/88 (14%)	0.73 (0.29 – 1.80)	0.49
Partially prepared	52/88 (59%)	49/88 (56%)	1.16 (0.63 – 2.14)	0.64
Served	62/88 (70%)	56/88 (64%)	1.35 (0.72 – 2.53)	0.34
<b>FISH:</b>				
Made from raw	40/88 (45%)	38/88 (43%)	1.15 (0.55 – 2.42)	0.71
Partially prepared	54/88 (61%)	53/88 (60%)	1.07 (0.53 – 2.16)	0.86
Served only	75/88 (85%)	77/88 (88%)	0.78 (0.29 – 2.08)	0.61
Cook to order	60/88 (68%)	59/88 (67%)	1.06 (0.55 – 2.05)	0.87
Reheat to order	3/88 (3%)	6/88 (7%)	0.50 (0.13 – 2.00)	0.32
Freezer to fryer	33/88 (38%)	34/88 (39%)	0.94 (0.46 – 1.89)	0.86
<b>Cold display buffet</b>	<b>3/88 (3%)</b>	<b>8/88 (9%)</b>	<b>0.29 (0.06 – 1.38)</b>	<b>0.10</b>
Hot display buffet	30/88 (34%)	23/88 (26%)	2.00 (0.81 – 4.96)	0.13
Ambient display buffet	7/88 (8%)	5/88 (6%)	1.40 (0.44 – 4.41)	0.56
<b>Function for less than 20 people</b>	<b>29/88 (33%)</b>	<b>21/88 (24%)</b>	<b>2.00 (0.86 – 4.67)</b>	<b>0.10</b>
<b>Function for more than 20 people</b>	<b>35/88 (40%)</b>	<b>22/88 (25%)</b>	<b>2.18 (1.07 – 4.45)</b>	<b>0.03</b>

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>SHELLFISH:</b>				
Made from raw	26/88 (30%)	20/88 (23%)	1.60 (0.73 – 3.53)	0.24
Partially prepared	48/88 (55%)	50/88 (57%)	0.89 (0.47 – 1.72)	0.73
Served only	69/88 (78%)	50/88 (57%)	1.42 (0.68 – 2.97)	0.35
<b>Cook to order</b>	<b>54/88 (61%)</b>	<b>43/88 (49%)</b>	<b>1.85 (0.94 – 3.63)</b>	<b>0.07</b>
Reheat to order	12/88 (14%)	10/88 (11%)	1.25 (0.49 – 3.17)	0.64
Freezer to fryer	26/88 (30%)	22/88 (25%)	1.36 (0.63 – 2.97)	0.43
Cold display buffet	4/88 (5%)	5/88 (6%)	0.75 (0.17 – 3.35)	0.71
<b>Hot display buffet</b>	<b>21/88 (24%)</b>	<b>8/88 (9%)</b>	<b>7.50 (1.72 – 32.80)</b>	<b>0.002</b>
Ambient display buffet	7/88 (8%)	7/88 (8%)	1.00 (0.32 – 3.10)	1.00
Function for less than 20 people	28/88 (32%)	20/88 (23%)	1.73 (0.82 – 3.63)	0.14
Function for more than 20 people	30/88 (34%)	21/88 (24%)	1.69 (0.85 – 3.36)	0.13
<b>POULTRY:</b>				
<b>Made from raw</b>	<b>58/88 (66%)</b>	<b>41/88 (47%)</b>	<b>3.13 (1.41 – 6.93)</b>	<b>0.003</b>
Partially prepared	54/88 (61%)	55/88 (63%)	0.93 (0.44 – 1.98)	0.85
<b>Served</b>	<b>86/88 (98%)</b>	<b>78/88 (89%)</b>	<b>5.00 (1.10 – 22.82)</b>	<b>0.02</b>
Cook to order	54/88 (61%)	46/88 (52%)	1.50 (0.80 – 2.82)	0.21
Reheat to order	36/88 (41%)	33/88 (38%)	1.21 (0.60 – 2.46)	0.59
Freezer to fryer	12/88 (14%)	10/88 (11%)	1.29 (0.48 – 3.45)	0.62
Cold display buffet	3/88 (3%)	4/88 (5%)	0.67 (0.11 – 3.99)	0.65
<b>Hot display buffet</b>	<b>39/88 (44%)</b>	<b>24/88 (27%)</b>	<b>3.50 (1.41 – 8.67)</b>	<b>0.004</b>
Ambient display buffet	12/88 (14%)	11/88 (13%)	1.11 (0.45 – 2.73)	0.82
<b>Function for less than 20 people</b>	<b>36/88 (41%)</b>	<b>26/88 (30%)</b>	<b>2.00 (0.94 – 4.27)</b>	<b>0.07</b>
<b>Function for more than 20 people</b>	<b>40/88 (45%)</b>	<b>28/88 (32%)</b>	<b>1.86 (0.97 – 3.55)</b>	<b>0.06</b>
<b>RED MEAT:</b>				
<b>Made from raw</b>	<b>58/88 (66%)</b>	<b>48/88 (55%)</b>	<b>2.25 (0.98 – 5.17)</b>	<b>0.05</b>
Partially prepared	55/88 (63%)	47/88 (53%)	1.73 (0.82 – 3.63)	0.14
Served only	83/88 (94%)	80/88 (91%)	1.75 (0.51 – 5.98)	0.37
Cook to order	62/88 (70%)	60/88 (68%)	1.14 (0.56 – 2.34)	0.72
Reheat to order	33/88 (38%)	35/88 (40%)	0.89 (0.45 – 1.74)	0.73
Cold display buffet	3/88 (3%)	2/88 (2%)	1.50 (0.25 – 8.98)	0.65
<b>Hot display buffet</b>	<b>39/88 (44%)</b>	<b>24/88 (27%)</b>	<b>3.50 (1.41 – 8.67)</b>	<b>0.004</b>
Ambient display buffet	7/88 (8%)	7/88 (8%)	1.00 (0.35 – 2.85)	1.00
<b>Function for less than 20 people</b>	<b>34/88 (39%)</b>	<b>24/88 (27%)</b>	<b>1.91 (0.92 – 3.96)</b>	<b>0.08</b>
<b>Function for more than 20 people</b>	<b>39/88 (44%)</b>	<b>26/88 (30%)</b>	<b>1.93 (1.01 – 3.68)</b>	<b>0.04</b>
<b>GAME:</b>				
Made from raw	10/88 (11%)	9/88 (10%)	1.17 (0.39 – 3.47)	0.78
Partially prepared	12/88 (14%)	11/88 (13%)	1.12 (0.43 – 2.91)	0.81
Served only	20/88 (23%)	18/88 (20%)	1.18 (0.53 – 2.64)	0.68
Cook to order	15/88 (17%)	10/88 (11%)	1.71 (0.67 – 4.35)	0.25
Reheat to order	0/88 (0%)	2/88 (3%)	-	0.16
Cold display buffet	0/88 (0%)	2/88 (2%)	-	0.16
Hot display buffet	12/88 (14%)	10/88 (11%)	1.50 (0.42 – 5.31)	0.53
Ambient display buffet	0/88 (0%)	1/88 (1%)	-	0.32
Function for less than 20 people	12/88 (14%)	7/88 (8%)	2.25 (0.69 – 7.30)	0.17
Function for more than 20 people	12/88 (14%)	8/88 (9%)	2.00 (0.60 – 6.64)	0.25
<b>COOKED MEAT:</b>				
Made from raw	14/88 (16%)	9/88 (10%)	1.56 (0.67 – 3.59)	0.30
Partially prepared	27/88 (31%)	28/88 (32%)	0.95 (0.50 – 1.81)	0.87
Served only	61/88 (69%)	61/88 (69%)	1.00 (0.45 – 2.23)	1.00
Prepare to order	11/88 (13%)	12/88 (14%)	0.83 (0.25 – 2.73)	0.76
Reheat to order	3/88 (3%)	3/88 (3%)	1.00 (0.20 – 4.95)	1.00
Cold display buffet	10/88 (11%)	12/88 (14%)	0.80 (0.32 – 2.03)	0.64

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Hot display buffet	0/88 (0%)	1/88 (1%)	-	0.32
Ambient display buffet	25/88 (28%)	27/88 (31%)	0.87 (0.41 – 1.82)	0.70
Function for less than 20 people	25/88 (28%)	24/88 (27%)	1.07 (0.52 – 2.22)	0.85
Function for more than 20 people	30/88 (34%)	27/88 (31%)	1.18 (0.62 – 2.24)	0.62
<b>PATE:</b>				
Made from raw	14/88 (16%)	12/88 (14%)	1.18 (0.53 – 2.64)	0.68
Partially prepared	8/88 (9%)	7/88 (8%)	1.14 (0.41 – 3.15)	0.80
Served only	35/88 (40%)	32/88 (32%)	1.15 (0.63 – 2.09)	0.65
Prepare to order	3/88 (3%)	2/88 (2%)	1.50 (0.25 – 8.97)	0.65
Cold display buffet	5/88 (6%)	6/88 (7%)	0.80 (0.21 – 2.98)	0.74
Ambient display buffet	14/88 (16%)	10/88 (11%)	1.67 (0.61 – 4.59)	0.32
Function for less than 20 people	16/88 (18%)	9/88 (10%)	2.17 (0.82 – 5.70)	0.65
Function for more than 20 people	20/88 (23%)	15/88 (17%)	1.45 (0.68 – 3.13)	0.34
<b>SANDWICHES:</b>				
Made from raw	58/88 (66%)	57/88 (65%)	1.07 (0.52 – 2.22)	0.85
Partially prepared	5/88 (6%)	4/88 (5%)	1.25 (0.33 – 4.65)	0.74
Served only	59/88 (67%)	60/88 (68%)	0.93 (0.44 – 1.98)	0.85
Prepare to order	43/88 (49%)	39/88 (44%)	1.25 (0.65 – 2.41)	0.50
Cold display buffet	6/88 (7%)	10/88 (11%)	0.56 (0.19 – 1.96)	0.28
Ambient display buffet	26/88 (30%)	25/88 (28%)	1.06 (0.54 – 2.10)	0.86
Function for less than 20 people	22/88 (25%)	24/88 (27%)	0.86 (0.40 – 1.85)	0.69
Function for more than 20 people	28/88 (32%)	23/88 (26%)	1.31 (0.68 – 2.52)	0.41
<b>SALADS:</b>				
Made from raw	50/88 (57%)	53/88 (60%)	0.86 (0.46 – 1.61)	0.63
Partially prepared	28/88 (32%)	26/88 (30%)	1.13 (0.57 – 2.27)	0.72
Served only	75/88 (85%)	76/88 (86%)	0.91 (0.39 – 2.14)	0.83
Prepare to order	23/88 (26%)	22/88 (25%)	1.07 (0.53 – 2.16)	0.86
Cold display buffet	15/88 (17%)	14/88 (16%)	1.11 (0.45 – 2.73)	0.82
Ambient display buffet	28/88 (32%)	28/88 (32%)	1.00 (0.53 – 1.89)	1.00
Function for less than 20 people	30/88 (34%)	26/88 (30%)	1.33 (0.63 – 2.82)	0.45
Function for more than 20 people	34/88 (39%)	27/88 (31%)	1.44 (0.76 – 2.72)	0.26
<b>EGGS:</b>				
Made from raw	59/88 (67%)	53/88 (60%)	1.55 (0.72 – 3.30)	0.26
Partially prepared	38/88 (43%)	39/88 (44%)	0.94 (0.48 – 1.86)	0.86
Served only	85/88 (96%)	82/88 (93%)	2.00 (0.50 – 8.00)	0.32
Cook to order	52/88 (59%)	50/88 (57%)	1.11 (0.59 – 2.10)	0.75
Reheat to order	5/88 (6%)	2/88 (2%)	2.50 (0.49 – 12.89)	0.26
Freezer to fryer	4/88 (5%)	7/88 (8%)	0.50 (0.13 – 2.00)	0.32
Cold display buffet	7/88 (8%)	10/88 (11%)	0.63 (0.20 – 1.91)	0.41
Hot display buffet	<b>14/88 (16%)</b>	<b>25/88 (28%)</b>	<b>3.75 (1.24 – 11.30)</b>	<b>0.02</b>
Ambient display buffet	20/88 (23%)	18/88 (20%)	1.20 (0.52 – 2.78)	0.67
Function for less than 20 people	34/88 (39%)	26/88 (30%)	1.73 (0.82 – 3.63)	0.14
Function for more than 20 people	<b>38/88 (43%)</b>	<b>23/88 (26%)</b>	<b>2.25 (1.14 – 4.44)</b>	<b>0.02</b>
<b>people</b>				
<b>RICE/PASTA:</b>				
Made from raw	44/88 (50%)	42/88 (48%)	1.13 (0.57 – 2.27)	0.72
Partially prepared	48/88 (55%)	42/88 (48%)	1.40 (0.72 – 2.72)	0.32
Served only	80/88 (91%)	77/88 (88%)	1.50 (0.53 – 4.21)	0.44
Cook to order	41/88 (47%)	39/88 (44%)	1.11 (0.59 – 2.06)	0.75
Reheat to order	<b>28/88 (32%)</b>	<b>16/88 (18%)</b>	<b>2.71 (1.14 – 6.46)</b>	<b>0.02</b>
Freezer to fryer	2/88 (2%)	0/88 (0%)	-	0.16
Cold display buffet	3/88 (3%)	5/88 (6%)	0.60 (0.14 – 2.51)	0.48
Hot display buffet	<b>35/88 (40%)</b>	<b>22/88 (50%)</b>	<b>2.86 (1.21 – 6.76)</b>	<b>0.01</b>
Ambient display buffet	9/88 (10%)	7/88 (8%)	0.71 (0.23 – 2.25)	0.56

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Function for less than 20 people	29/88 (33%)	22/88 (25%)	1.64 (0.77 – 3.46)	0.19
Function for more than 20 people	35/88 (40%)	25/88 (28%)	1.67 (0.88 – 3.16)	0.11
<b>DESSERTS:</b>				
Made from raw	37/88 (42%)	33/88 (38%)	1.21 (0.66 – 2.22)	0.54
Partially prepared	33/88 (38%)	23/88 (26%)	1.63 (0.87 – 3.03)	0.12
Served only	80/88 (91%)	75/88 (85%)	1.71 (0.67 – 4.35)	0.25
Cook to order	21/88 (24%)	16/88 (18%)	1.42 (0.68 – 2.97)	0.35
Reheat to order	2/88 (2%)	3/88 (3%)	0.50 (0.05 – 5.51)	0.56
Cold display buffet	13/88 (15%)	12/88 (14%)	1.11 (0.45 – 2.73)	0.82
Hot display buffet	11/88 (13%)	11/88 (13%)	1.00 (0.35 – 2.85)	1.00
Ambient display buffet	25/88 (28%)	21/88 (24%)	1.33 (0.63 – 2.82)	0.45
<b>Function for less than 20 people</b>	<b>28/88 (32%)</b>	<b>19/88 (22%)</b>	<b>2.29 (0.94 – 5.56)</b>	<b>0.06</b>
Function for more than 20 people	31/88 (35%)	24/88 (27%)	1.54 (0.77 – 3.09)	0.22
<b>ICE CREAM:</b>				
<b>Made from raw</b>	<b>5/88 (6%)</b>	<b>1/88 (1%)</b>	<b>5.00 (58 – 42.80)</b>	<b>0.10</b>
Partially prepared	8/88 (9%)	10/88 (11%)	0.71 (0.23 – 2.25)	0.56
<b>Served only</b>	<b>80/88 (91%)</b>	<b>66/88 (75%)</b>	<b>4.50 (1.52 – 13.30)</b>	<b>0.003</b>
Prepare to order	4/88 (5%)	6/88 (7%)	0.67 (0.19 – 2.36)	0.53
Function for less than 20 people	12/88 (14%)	6/88 (7%)	2.20 (0.76 – 6.33)	0.13
Function for more than 20 people	13/88 (15%)	7/88 (8%)	2.00 (0.75 – 5.33)	0.16
<b>SAUCE:</b>				
Made from raw	38/88 (43%)	31/88 (35%)	1.41 (0.76 – 2.63)	0.27
Partially prepared	24/88 (27%)	19/88 (22%)	1.56 (0.67 – 3.59)	0.30
Served only	74/88 (84%)	70/88 (80%)	1.36 (0.63 – 2.97)	0.43
Cook to order	21/88 (24%)	14/88 (16%)	1.78 (0.79 – 4.02)	0.16
Reheat to order	9/88 (10%)	9/88 (10%)	1.00 (0.35 – 2.85)	1.00
Cold display buffet	4/88 (5%)	2/88 (2%)	2.00 (0.37 – 10.92)	0.41
<b>Hot display buffet</b>	<b>23/88 (26%)</b>	<b>12/88 (14%)</b>	<b>2.83 (1.12 – 7.19)</b>	<b>0.02</b>
Ambient display buffet	4/88 (5%)	8/88 (9%)	0.50 (0.15 – 1.66)	0.25
<b>Function for less than 20 people</b>	<b>23/88 (26%)</b>	<b>15/88 (17%)</b>	<b>2.14 (0.87 – 5.25)</b>	<b>0.09</b>
Function for more than 20 people	21/88 (24%)	18/88 (20%)	1.25 (0.59 – 2.67)	0.56
<b>BRANDED/READY MADE MEALS:</b>				
Partially prepared	21/88 (24%)	24/88 (27%)	0.75 (0.32 – 1.78)	0.51
Served only	25/88 (28%)	28/88 (32%)	0.75 (0.32 – 1.78)	0.51
Cook to order	14/88 (16%)	12/88 (14%)	1.29 (0.48 – 3.45)	0.62
Reheat to order	9/88 (10%)	10/88 (11%)	0.75 (0.17 – 3.35)	0.71
Freezer to fryer	1/88 (1%)	1/88 (1%)	1.00 (0.06 – 15.99)	1.00
Cold display buffet	0/88 (0%)	0/88 (0%)	-	-
<b>Hot display buffet</b>	<b>1/88 (1%)</b>	<b>5/88 (6%)</b>	<b>0.20 (0.02 – 1.71)</b>	<b>0.10</b>
Ambient display buffet	1/88 (1%)	3/88 (3%)	0.33 (0.03 – 3.20)	0.32
Function for less than 20 people	1/88 (1%)	0/88 (0%)	-	0.32
Function for more than 20 people	2/88 (2%)	2/88 (2%)	1.00 (0.14 – 7.10)	1.00
<b>MILK:</b>				
<b>Serve</b>	<b>84/88 (95%)</b>	<b>77/88 (88%)</b>	<b>3.33 (0.92 – 12.11)</b>	<b>0.05</b>
Cook to order	4/88 (5%)	5/88 (6%)	0.80 (0.21 – 2.97)	0.74
Cold display buffet	3/88 (3%)	6/88 (7%)	0.50 (0.13 – 2.00)	0.32
Ambient display buffet	8/88 (9%)	9/88 (10%)	0.89 (0.34 – 2.30)	0.81
Function for less than 20 people	9/88 (10%)	11/88 (13%)	0.75 (0.26 – 2.16)	0.59
Function for more than 20 people	15/88 (17%)	17/88 (19%)	0.85 (0.38 – 1.89)	0.68
<b>DAIRY PRODUCTS:</b>				
Made from raw	3/88 (3%)	1/88 (1%)	3.00 (0.31 – 28.84)	0.32
Partially prepared	21/88 (24%)	18/88 (20%)	1.27 (0.58 – 2.80)	0.55
Serve	80/88 (91%)	76/88 (86%)	1.57 (0.61 – 4.05)	0.35
Prepare to order	5/88 (6%)	5/88 (6%)	1.00 (0.29 – 3.45)	1.00

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Cold display buffet	8/88 (9%)	11/88 (13%)	0.67 (0.24 – 1.87)	0.44
Ambient display buffet	20/88 (23%)	14/88 (16%)	1.55 (0.72 – 3.30)	0.26
Function for less than 20 people	11/88 (13%)	15/88 (17%)	0.56 (0.19 – 1.66)	0.29
Function for more than 20 people	19/88 (22%)	20/88 (23%)	0.93 (0.45 – 1.93)	0.85
Highest no. of covers served per week is twice as many as or greater than the average no. of covers served.	10/78 (13%)	12/79 (15%)	0.88 (0.32 – 2.41)	0.80
<b>Collect foods directly from supplier</b>	<b>20/88 (23%)</b>	<b>35/88 (40%)</b>	<b>0.38 (0.17 – 0.80)</b>	<b>0.009</b>
<b>NATIONAL SUPPLIERS:</b>				
Vegetable	30/83 (36%)	36/86 (42%)	0.67 (0.32 – 1.38)	0.27
Red meat	33/83 (40%)	35/80 (44%)	0.67 (0.27 – 1.63)	0.37
<b>Poultry</b>	<b>35/85 (41%)</b>	<b>41/79 (52%)</b>	<b>0.43 (0.16 – 1.12)</b>	<b>0.07</b>
Sandwiches	16/19 (84%)	11/20 (55%)	-	0.32
<b>Eggs</b>	<b>29/84 (35%)</b>	<b>37/82 (45%)</b>	<b>0.43 (0.16 – 1.12)</b>	<b>0.07</b>
Desserts	40/62 (65%)	41/69 (59%)	0.67 (0.24 – 1.87)	0.44
Game	9/22 (41%)	5/19 (26%)	-	0.32
Milk	45/84 (54%)	46/77 (60%)	0.62 (0.26 – 1.48)	0.27
Dairy products	49/81 (60%)	55/75 (73%)	0.64 (0.28 – 1.48)	0.64
Shellfish	40/69 (58%)	30/64 (47%)	2.17 (0.82 – 5.70)	0.11
Pate	21/27 (78%)	14/25 (56%)	2.00 (0.18 – 22.06)	0.56
Bread/cakes	43/69 (62%)	43/77 (56%)	1.50 (0.61 – 3.67)	0.37
Fruit	33/75 (44%)	29/70 (41%)	0.92 (0.42 – 2.02)	0.84
Fresh herbs	28/65 (43%)	17/57 (30%)	1.33 (0.56 – 3.16)	0.51
Fish	42/77 (55%)	39/77 (51%)	1.18 (0.53 – 2.64)	0.68
Cooked meat	32/55 (58%)	35/58 (60%)	0.83 (0.25 – 2.73)	0.76
Salads	29/57 (51%)	24/51 (47%)	1.00 (0.25 – 3.99)	1.00
Ice cream	49/76 (64%)	44/64 (69%)	0.77 (0.34 – 1.75)	0.53
Branded ready made meals	22/25 (88%)	23/28 (82%)	-	0.32
Sauce	39/56 (70%)	33/48 (69%)	0.83 (0.25 – 2.73)	0.76
<b>REGIONAL SUPPLIERS:</b>				
Vegetable	17/83 (20 %)	13/86 (15%)	1.56 (0.67 – 3.59)	0.30
<b>Red meat</b>	<b>19/83 (23%)</b>	<b>7/80 (9%)</b>	<b>6.00 (1.34 – 26.81)</b>	<b>0.007</b>
<b>Poultry</b>	<b>21/85 (36%)</b>	<b>6/79 (8%)</b>	<b>4.67 (1.34 – 16.23)</b>	<b>0.008</b>
Sandwiches	1/19 (5%)	1/20 (5%)	-	-
<b>Eggs</b>	<b>25/84 (30%)</b>	<b>7/82 (9%)</b>	<b>4.00 (1.50 – 10.66)</b>	<b>0.003</b>
Desserts	15/69 (22%)	9/62 (15%)	1.67 (0.61 – 4.59)	0.32
Game	5/22 (23%)	0/19 (0%)	-	0.32
Milk	5/77 (6%)	5/77 (6%)	2.00 (0.68 – 5.85)	0.20
<b>Dairy products</b>	<b>13/81 (16%)</b>	<b>3/75 (4%)</b>	<b>3.67 (1.02 – 13.14)</b>	<b>0.03</b>
Shellfish	16/69 (23%)	16/64 (47%)	1.00 (0.32 – 3.10)	1.00
Pate	2/27 (7%)	1/25 (4%)	-	1.00
Bread/cakes	8/69 (12%)	11/77 (14%)	0.86 (0.29 – 2.55)	0.32
Fruit	9/75 (12%)	9/70 (13%)	1.00 (0.35 – 2.85)	0.78
Fresh herbs	11/65 (17%)	11/57 (19%)	0.86 (0.29 – 2.55)	1.00
Fish	14/77 (18%)	14/77 (18%)	1.00 (0.32 – 3.10)	0.78
Cooked meat	4/58 (7%)	6/55 (11%)	2.00 (0.37 – 10.91)	1.00
Salads	8/57 (14%)	6/51 (12%)	2.00 (0.50 – 8.00)	0.41
Ice cream	12/64 (19%)	12/64 (19%)	1.80 (0.60 – 5.37)	0.32
Branded ready made meals	2/25 (8%)	1/28 (4%)	-	0.29
Sauce	9/56 (16%)	8/48 (17%)	1.34 (0.30 – 5.96)	0.32
<b>LOCAL SUPPLIERS:</b>				
Vegetable	37/83 (45%)	40/86 (47%)	0.94 (0.49 – 1.83)	0.87
Red meat	34/83 (41%)	41/80 (51%)	0.53 (0.23 – 1.26)	0.14

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Poultry	31/85 (36%)	37/79 (47%)	0.60 (0.26 – 1.37)	0.22
Sandwiches	4/19 (21%)	9/20 (45%)	-	0.32
Eggs	30/84 (36%)	38/82 (46%)	0.56 (0.25 – 1.27)	0.16
Desserts	15/69 (22%)	16/62 (26%)	0.75 (0.26 – 2.16)	0.59
Game	9/22 (41%)	14/19 (74%)	-	0.32
Milk	30/84 (36%)	27/77 (35%)	1.00 (0.38 – 2.66)	1.00
Dairy products	23/81 (28%)	19/75 (25%)	0.86 (0.29 – 2.55)	0.78
Shellfish	17/69 (25%)	20/64 (31%)	0.58 (0.23 – 1.48)	0.25
Pate	5/27 (19%)	10/25 (40%)	0.33 (0.03 – 3.20)	0.32
Bread/cakes	23/69 (35%)	28/77 (36%)	0.86 (0.40 – 1.85)	0.70
Fruit	33/75 (47%)	33/70 (47%)	1.00 (0.43 – 2.31)	1.00
Fresh herbs	27/65 (42%)	29/57 (51%)	0.88 (0.32 – 2.41)	0.80
Fish	25/77 (32%)	26/77 (34%)	0.87 (0.41 – 1.82)	0.71
Cooked meat	19/55 (35%)	21/58 (36%)	1.00 (0.32 – 3.10)	1.00
Salads	23/57 (40%)	22/51 (43%)	0.86 (0.29 – 2.55)	0.78
Ice cream	12/76 (16%)	9/64 (14%)	0.86 (0.29 – 2.55)	0.78
Branded ready made meals	2/25 (8%)	4/28 (14%)	-	0.32
Sauce	9/56 (16%)	10/48 (21%)	-	0.32
Verbal HACCP (at time of outbreak)	21/148 (14%)	25/148 (17%)	1.39 (0.82 – 2.36)	0.22
Written HACCP (at time of outbreak)	83/148 (56%)	73/148 (49%)	0.81 (0.43 – 1.53)	0.51
No HACCP (at time of outbreak)	43/148 (29%)	46/148 (31%)	0.90 (0.52 – 1.54)	0.90
Temperature control records kept (at time of outbreak)	68/88 (77%)	65/88 (74%)	1.38 (0.55 – 3.42)	0.49
Cleaning schedule kept (at time of outbreak)	57/88 (65%)	54/88 (61%)	1.21 (0.60 – 2.46)	0.59
Staff training records kept (at time of outbreak)	55/88 (63%)	59/88 (67%)	0.75 (0.35 – 1.59)	0.45

**Table 11 Unusual Events**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Short staffed at time of outbreak	17/148 (11%)	12/148 (8%)	1.50 (0.67 – 3.34)	0.32
<b>Relief manager at time of outbreak</b>	<b>19/148 (13%)</b>	<b>2/148 (1%)</b>	<b>18.00 (2.40 – 134.83)</b>	<b>0.0001</b>
<b>Unusual incident at time of outbreak</b>	<b>36/148 (24%)</b>	<b>14/148 (9%)</b>	<b>3.44 (1.64 – 7.23)</b>	<b>0.0005</b>
<b>Temp/alternative FPE used at time of outbreak</b>	<b>8/148 (5%)</b>	<b>2/148 (1%)</b>	-	<b>0.01</b>
Recently installed FPE used at time of outbreak	4/148 (3%)	3/148 (2%)	1.33 (0.30 – 5.96)	0.71
FPE due service at time of outbreak	3/148 (2%)	4/148 (3%)	0.75 (0.17 – 3.35)	0.71
FPE not working properly at time of outbreak	9/148 (6%)	4/148 (3%)	2.25 (0.69 – 7.3)	0.17
FPE breakdown at time of outbreak	9/148 (6%)	5/148 (3%)	2.00 (0.60 – 6.64)	0.25
<b>New procedure or practice at time of outbreak</b>	<b>8/148 (5%)</b>	<b>0/148 (0%)</b>	-	<b>0.005</b>
Change/new menu at time of outbreak	12/148 (8%)	12/148 (8%)	1.00 (0.42 – 2.40)	1.00
<b>Change in menu prep at time of outbreak</b>	<b>13/148 (9%)</b>	<b>2/148 (1%)</b>	<b>12.00 (1.56 – 92.29)</b>	<b>0.002</b>
Promotions on offer at time of outbreak	11/148 (7%)	7/148 (5%)	1.57 (0.61 – 4.05)	0.35
<b>Power cut at time of outbreak</b>	<b>0/148 (0%)</b>	<b>4/148 (3%)</b>	-	<b>0.05</b>
Water disturbance at time of outbreak	2/148 (1%)	2/148 (1%)	1.00 (0.14 – 7.10)	1.00

**Table 12 Other factors**

Exploratory Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Do you take bookings	69/88 (74%)	64/88 (73%)	1.38 (0.68 – 2.83)	0.37
Is catering your main business	66/88 (75%)	68/88 (77%)	0.83 (0.36 – 1.93)	0.67
Do you use independent food hygiene consultants	23/88 (26%)	21/88 (24%)	1.22 (0.51 – 2.95)	0.65
Is your premises on mains water supply	88/88 (100%)	86/88 (98%)	-	0.16
Do you feel that water is a food hygiene issue	51/88 (58%)	56/88 (64%)	0.58 (0.23 – 1.48)	0.25
<b>Do you have a good working relationship with the local EHO</b>	<b>77/88 (88%)</b>	<b>84/88 (95%)</b>	<b>0.36 (0.12 – 1.14)</b>	<b>0.07</b>
Have any staff been sacked or resigned (Tier 1&2 kitchen)	-	-	-	-
Have any staff been sacked or resigned (Tier 1&2 F&B)	-	-	-	-
<b>Were your opening hours different at the time of the outbreak</b>	<b>2/88 (2%)</b>	<b>7/88 (8%)</b>	<b>0.29 (0.06 – 1.38)</b>	<b>0.10</b>
<b>Meal for 2 (excluding drinks) for &lt; £21<sup>0</sup></b>	<b>35/75 (47%)</b>	<b>65/79 (82%)</b>	<b>0.15 (0.05 – 0.42)</b>	<b>&lt;0.001</b>
<b>Meal for 2 (excluding drinks) for &gt;£41<sup>0</sup></b>	<b>9/75 (12%)</b>	<b>2/79 (3%)</b>	<b>5.25 (1.10 – 25.16)</b>	<b>0.02</b>
< 25% of guests are regulars*	8/88 (18%)	10/88 (11%)	0.80 (0.32 – 2.03)	0.64
<b>25 – 50% of guests are regulars*</b>	<b>35/88 (40%)</b>	<b>23/88 (26%)</b>	<b>1.86 (0.97 – 3.56)</b>	<b>0.06</b>
<b>50 – 75% of guests are regulars*</b>	<b>24/88 (27%)</b>	<b>35/88 (40%)</b>	<b>0.56 (0.29 – 1.07)</b>	<b>0.08</b>
>75% of guests are regulars*	21/88 (24%)	20/88 (23%)	1.08 (0.51 – 2.29)	0.85

<sup>0</sup> Price categories were based on industry experience.

\* Regular customers are those customers considered to be regulars by the interviewed business

**Table 13 Multivariate Business Characteristics**

Variable	Unadjusted OR	Adjusted OR	P value
Hotel	3.29 (1.41 – 7.66) p = 0.004	2.44 (0.86 – 6.94) <sup>1</sup>	0.09
Pub / Bar	0.41 (0.17 – 0.99) p = 0.04	0.54 (0.12 – 2.39) <sup>2</sup>	0.42
Chinese cuisine	5.00 (1.71 – 14.63) p = 0.001	2.80 (0.63 – 12.54) <sup>3</sup>	0.18
Dinner	3.00 (1.19 – 7.56) p = 0.01	2.70 (1.06 – 6.87) <sup>4</sup>	0.04
Snacks	2.33 (1.07 – 5.09) p = 0.03	1.91 (0.66 – 5.56) <sup>5</sup>	0.23
Open more than 10 hours continuously	2.18 (1.07 – 4.45) p = 0.03	1.78 (0.84 – 3.76) <sup>6</sup>	0.13
Meal for 2 <£21	0.15 (0.05 – 0.42) p = <0.001	0.16 (0.06 – 0.48) <sup>7</sup>	0.001

- <sup>1</sup> adjusted for open more than 10 hours continuously
- <sup>2</sup> adjusted for meal for 2 <£21
- <sup>3</sup> adjusted for dinner, meal for 2 <£21
- <sup>4</sup> adjusted for Chinese cuisine
- <sup>5</sup> adjusted for open more than 10 hours continuously, meal for 2 <£21
- <sup>6</sup> adjusted for snacks, hotel
- <sup>7</sup> adjusted for pub / bar, Chinese cuisine, snacks

**Table 14 Multivariate Staff Employment and Structure (kitchen)**

		Adjusted for potential confounders within this hypothesis group		Adjusted in turn for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for potential confounders in staff employment and structure table	Adjusted for F & B salary variables ⊗	Hotel	Business size	Dinner	Meal for 2 <£21
Area manager and 2 tiers of management before the kitchen manager	2.14 (0.89 – 5.26) p = 0.09	⊙ 2.59 (0.69 – 9.78) p = 0.16					
2 tiers of management before the kitchen manager	2.10 (1.02 – 4.29) p = 0.04	⊙ 1.58 (0.39 – 6.44) p = 0.52					
Owner/manager working in the kitchen	0.33 (0.17 – 0.64) p = 0.0005	⊙ 0.33 (0.12 – 0.93 ) p = 0.04	0.42 (0.17 – 1.07) p = 0.07	0.36 (0.18 – 0.70) p = 0.003	0.68 (0.24 – 1.92) p = 0.47	0.37 (0.16 – 0.90) p = 0.03	0.71 (0.24 – 2.08) p = 0.53
Use casual staff	2.08 (1.05 – 1.15) p = 0.03	● 3.06 (1.22 – 7.72) p = 0.02	2.41 (1.11 – 5.24) p = 0.03	1.97 (0.97 – 4.00) p = 0.06	1.91 (0.91 – 4.03) p = 0.09	1.86 (0.92 – 3.80) p = 0.09	1.79 (0.70 – 4.54) p = 0.22
Kitchen Staff team full time	2.78 (1.30 – 5.95) p = 0.006	● 3.12 (1.23 – 7.87) p = 0.02	2.25 (1.02 – 5.01) p = 0.05	2.45 (1.12 – 5.35) p = 0.03	2.29 (1.01 – 5.20) p = 0.05	2.38 (1.08 – 5.23) 0.03	2.13 (0.83 – 5.47) p = 0.12
Only chefs salaried	2.33 (0.90 – 6.07) p = 0.07	● 1.58 (0.49 – 5.12) p = 0.44					
Head Chef wages above national average	2.38 (1.25 - 4.56) p = 0.006	● 1.36 (0.62 – 3.01) p = 0.44					

		Adjusted for potential confounders within this hypothesis group		Adjusted in turn for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for potential confounders in staff employment and structure table	Adjusted for F & B salary variables ⊗	Hotel	Business size	Dinner	Meal for 2 <£21
Kitchen Porter wages above national average	2.50 (1.10 – 5.68) p = 0.02	● 1.62 (0.62 – 4.18 ) p = 0.32					

⊙ Use of casual staff, only chefs salaried, kitchen team fulltime, and kitchen porter paid above national average, head chef paid above national average.

●MS4, use of casual staff, only chefs salaried, kitchen team fulltime, kitchen porter paid above national average, head chef paid above national average

⊗ F&B managers' fulltime, F&B team fulltime, all F&B staff salaried

**Table 15      Multivariate Staff Employment and Structure (F&B)**

		Adjusted for potential confounders within this hypothesis group	Adjusted in turn for potential business characteristics confounders			
Risk Factor	Unadjusted		Hotel	Business size	Dinner	Meal for 2 <£21
F&B managers employed fulltime	2.55 (1.27 – 5.11) p = 0.007	<sup>^</sup> 1.73 (0.76 – 3.93) p = 0.19				
F&B team employed fulltime	2.60 (1.25 – 5.39) p = 0.008	<sup>^</sup> 1.79 (0.76 – 4.24) p = 0.18				
All F&B staff salaried	3.00 (0.81 – 11.08) P = 0.08	<sup>^</sup> 1.81 (0.45 – 7.28) p = 0.41				

<sup>^</sup> adjusted for other variables in this table

**Table 16 Multivariate Staff Management**

Risk Factor	Unadjusted	Adjusted for potential confounders within this hypothesis group	Adjusted for potential confounders from other hypothesis groups	Adjusted in turn for potential business characteristics confounders			
				Hotel	Business size	Dinner	Meal for 2 <£21
Staff use customer toilets	1.75 (0.95 – 3.23) p = 0.07	*1.64 (0.86 – 3.12) p = 0.13		1.69 (0.90 – 3.17) p = 0.10	1.82 (0.93 – 3.56) p = 0.08	1.67 (0.89 – 3.12) p = 0.11	1.82 (0.79 - 4.19) p = 0.16
Provide staff accommodation	4.00 (1.50 – 10.66) p = 0.003	**3.81 (1.42 – 10.27) p = 0.008		3.53 (1.30 – 9.60) p = 0.01	3.71 (1.20 – 11.41) p = 0.02	4.25 (1.56 – 11.58) p = 0.005	8.95 (1.83 – 43.69) p = 0.007
Member of kitchen or F&B staff sick at time of outbreak or 14 days before	22.00 (2.97 – 163.21) p = <0.0001	^ 20.01 (2.60 – 154.11) p = 0.004		22.04 (2.91 – 166.93) p = 0.003	48.46 (3.53 - 664.58) p = 0.004	25.30 (3.31 – 193.52) p = 0.002	35.42 (3.40 – 369.32) p = 0.003
Staff incentives	1.81 (1.08 – 3.03) p = 0.02	@ 1.80 (0.84 – 3.84) p = 0.13		2.02 (1.12-3.65) p = 0.02	1.25 (0.60 – 2.63) p = 0.55	1.65 (0.81 – 3.35) p = 0.17	1.50 (0.65 – 3.49) p = 0.95
Communication via day-to-day verbal	0.58 (0.36 – 0.95)	##0.89 (0.42 – 1.85) p = 0.75	#0.58 (0.34 – 0.98) p = 0.04	0.58 (0.35 – 0.96) p = 0.03	1.26 (0.60 – 2.63) p = 0.55	0.32 (0.40 – 1.35) p = 0.32	0.80 (0.36 – 1.76) p = 0.58

\* adjusted for staff accommodation

\*\* adjusted for staff use customer WC

^ adjusted for staff use customer toilets and staff accommodation

@ adjusted for staff use customer toilets and provide staff accommodation

# adjusted for MS1, MS2, and MS4

## adjusted for staff use customers WC, staff accommodation, staff incentives.

**Table 17 Multivariate Staff Management – training**

Risk Factor	Unadjusted	Adjusted for potential confounders in the table	Adjusted in turn for potential business characteristics confounders			
			Hotel	Business size	Dinner	Meal for 2 <£21
Kitchen staff training – Tier 1 intermediate	3.80 (1.42 – 10.18) p = 0.004	<sup>^</sup> 3.31 (1.12 – 9.72) p = 0.03	3.36 (1.23 – 9.16) p = 0.02	2.47 (0.88 – 6.94) p = 0.09	3.62 (1.32 – 9.93) p = 0.01	2.04 (0.62 – 6.68) p = 0.24
Kitchen staff training – Tier 2 induction	2.18 (1.07 – 4.45) p = 0.03	<sup>^</sup> 1.31 (0.49 – 3.51) p = 0.60				
Kitchen staff training – Tier 2 basic	1.91 (0.92 – 3.96) p = 0.08	<sup>^</sup> 1.30 (0.56 – 3.04) p = 0.54				
Kitchen staff training – Tier 3 induction	2.70 (1.31 – 5.58) p = 0.005	<sup>^</sup> 1.31 (0.45 – 3.84) p = 0.61				
Kitchen staff training – Tier 3 basic	3.00 (1.41 – 6.38) p = 0.003	<sup>^</sup> 1.60 (0.58 – 4.42) p = 0.37				
Kitchen staff training Tier 3 professional	5.50 (1.01 - 24.81) p = 0.01	<sup>^</sup> 2.10 (0.35 – 12.51) p = 0.41				
F&B training – tier 2 basic	2.50 (1.10 – 5.68) p = 0.02	<sup>^^</sup> 1.47 (0.50 – 4.33) p = 0.48				
F&B training – tier 2 professional	6.00 (0.72 – 49.84) p = 0.05	<sup>^^</sup> 5.99 (0.63 – 57.01) p = 0.12				
F&B training – tier 3 basic	2.43 (1.01 – 5.86) p = 0.04	<sup>^^</sup> 2.03 (0.61 – 6.78) p = 0.25				

<sup>^</sup> adjusted for all kitchen staff training variables

<sup>^^</sup> adjusted for all F&B staff training variables

**Table 18 Multivariate type of food served**

Risk Factor	Unadjusted	Adjusted for potential business characteristics confounders				
		Adjusted for potential confounders in operational practices	Hotel	Business size	Dinner	Meal for 2 <£21
Shellfish hot display buffet	7.50 (1.72 – 32.80) p = 0.002	*4.69 (0.87 – 25.33) p = 0.07	7.22 (1.62 – 32.06) p = 0.009	4.52 (0.98 – 20.77) 0.05	6.91 (1.55 – 30.85) p = 0.01	- NB
Poultry hot display buffet	3.50 (1.41 – 8.67) p = 0.004	**9.12 (0.86 – 96.60) p = 0.06	3.44 (1.37 – 8.66) p = 0.009	2.03 (0.76 – 5.38) p = 0.16	3.10 (1.23 – 7.81) p = 0.02	3.70 (1.04 – 13.17) p = 0.04
Red meat hot display buffet	3.50 (1.41 – 8.67) p = 0.004	***3.48 (0.09 – 131.92) p = 0.50				
Eggs hot display buffet	3.75 (1.24 – 11.30) p = 0.02	****1.82 (0.45 – 7.32) p = 0.40				
Rice/pasta hot display buffet	2.71 (1.21 – 6.76) 0.01	*****0.90 (0.19 – 4.18) p = 0.89				
Poultry prepared and cooked from raw	3.13 (1.41 – 6.93) p = 0.003	#12.27 (1.38 – 109.05) p = 0.02	3.35 (1.45 – 7.78) p = 0.005	3.13 (1.29 – 7.62) p = 0.01	2.73 (1.21 – 6.19) p = 0.02	2.48 (0.91 – 6.78) p = 0.08
Ice cream served	4.50 (1.52 – 13.30) p = 0.003	##3.03 (0.94 – 9.82) p = 0.06	4.82 (1.56 – 14.93) p = 0.006	2.93 (0.95 – 9.08) p = 0.06	3.52 (1.14 – 10.86) p = 0.03	2.29 (0.60 – 8.75) p = 0.23
Poultry (small function)	2.00 (0.94 – 4.27) p = 0.07	~1.65 (0.16 – 16.89) p = 0.67	1.89 (0.86 – 4.13) p = 0.11	1.85 (0.79 – 4.32) p = 0.16	1.70 (0.78 – 3.73) p = 0.18	1.70 (0.68 – 4.29) p = 0.26
Eggs (large function)	2.25 (1.14 – 4.44) p = 0.02	~~ 3.10 (0.69 – 13.92) p = 0.14	1.91 (0.93 – 3.92) p = 0.08	2.10 (1.00 – 4.41) p = 0.05	1.94 (0.96 – 3.92) p = 0.06	1.71 (0.69 – 4.27) p = 0.25

NB. Numbers were too small to conduct conditional logistic regression

\*Poultry HOT DISPLAY BUFFET, eggs HOT DISPLAY BUFFET, red meat HOT DISPLAY BUFFET, rice HOT DISPLAY BUFFET

\*\* Vegetables HOT DISPLAY BUFFET, Sauce HOT DISPLAY BUFFET, branded ready made meals HOT DISPLAY BUFFET

\*\*\* Poultry HOT DISPLAY BUFFET, eggs HOT DISPLAY BUFFET, shellfish HOT DISPLAY BUFFET, rice HOT DISPLAY BUFFET

\*\*\*\* Poultry HOT DISPLAY BUFFET, shellfish HOT DISPLAY BUFFET, red meat HOT DISPLAY BUFFET, rice HOT DISPLAY BUFFET

\*\*\*\*\* Poultry HOT DISPLAY BUFFET, eggs HOT DISPLAY BUFFET, red meat HOT DISPLAY BUFFET, shellfish HOT DISPLAY BUFFET

# Vegetables PREPARED AND COOKED FROM RAW, red meat PREPARED AND COOKED FROM RAW

## Milk served, poultry served

~ red meat SMALL FUNCTION, fruit SMALL FUNCTION, vegetables SMALL FUNCTION, dessert SMALL FUNCTION, fish SMALL FUNCTION

~~ poultry LARGE FUNCTION, vegetables LARGE FUNCTION, red meat LARGE FUNCTION, fruit LARGE FUNCTION

**Table 19 Multivariate suppliers**

		Adjusted for potential confounders within this hypothesis group	Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for potential confounders in the table	Hotel	Business size	Dinner	Meal for 2 <£21
Regional poultry supplier	4.67 (1.34 – 16.23) p = 0.008	*4.61 (0.47 – 45.63) p = 0.19	4.36 (1.24 – 15.29) p = 0.02	2.86 (0.77 – 10.57) p = 0.12	4.14 (1.18 – 14.56) p = 0.03	1.76 (0.44 – 7.11) p = 0.42
Regional eggs supplier	4.00 (1.50 – 10.66) p = 0.003	*3.07 (1.03 – 9.09) p = 0.04	3.75 (1.39 – 10.09) p = 0.009	2.96 (1.04 – 8.43) p = 0.04	3.47 (1.28 – 9.36) p = 0.01	4.57 (1.33 – 15.71) p = 0.02
Regional red meat supplier	6.00 (1.34 – 26.81) p = 0.007	*0.56 (0.03 – 9.96) p = 0.70	8.78 (1.69 – 45.75) p = 0.01	2.99 (0.61 – 14.65) p = 0.18	4.36 (0.94 – 20.17) p = 0.06	2.07 (0.39 – 10.83) p = 0.39
National poultry supplier	0.43 (0.16 – 1.12) p = 0.07	^ 0.39 (0.13 – 1.14) p = 0.08	0.62 (0.23 – 1.72) p = 0.36	0.76 (0.26 – 2.27) p = 0.62	0.49 (0.18 – 1.32) p = 0.16	0.79 (0.22 – 2.88) p = 0.72
National eggs supplier	0.43 (0.16 – 1.12) p = 0.07	^ 0.73 (0.26 – 2.12) p = 0.57	0.43 (0.16 – 1.14) p = 0.09	0.56 (0.19 – 1.64) p = 0.29	0.59 (0.21 – 1.65) p = 0.32	0.80 (0.25 – 2.52) p = 0.70
Collect food directly from the supplier	0.38 (0.17 – 0.80) p = 0.009	^ 0.47 (0.19 – 1.09) p = 0.08	0.36 (0.16 – 0.78) p = 0.01	0.57 (0.24 – 1.39) p = 0.22	0.40 (0.18 – 0.88) p = 0.02	0.36 (0.13 – 1.03) p = 0.06

\*Adjusted for other regional supplier variables in table

^ Adjusted for other national supplier variables in table

**Table 20 Multivariate unusual events**

			Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for potential confounders within this hypothesis group	Hotel	Business size	Dinner	Meal for 2 <£21
Relief manager at time of outbreak	18.00 (2.40 – 134.83) p = 0.0001	16.03 (2.11 – 121.91) P = 0.007	2.63 (1.11 – 6.28) p = 0.03	5.18 (0.61 – 43.91) p = 0.13	5.80 (0.70 – 48.01) p = 0.10	NB
Unusual incident at time of outbreak	3.44 (1.64 – 7.23) p = 0.0005	2.61 (1.17 – 5.81) P = 0.02	3.35 (1.59 – 7.10) p = 0.002	3.67 (1.16 – 11.63) p = 0.03	3.39 (1.21 – 9.53) p = 0.02	3.24 (0.95 – 11.08) p = 0.06
Change in menu preparation at time of outbreak	12.00 (1.56 – 92.29) p = 0.002	7.50 (0.94 – 59.92) p = 0.06	11.73 (1.47 – 93.24) p = 0.02	NB	NB	NB
Temporary/alternative food equipment used at time of outbreak	*	NB	NB	NB	NB	NB
New procedure or practice at time of outbreak	*	NB	NB	NB	NB	NB
Power cut at time of outbreak	*	NB	NB	NB	NB	NB

NB Numbers were too small to conduct conditional logistic regression

\* Odds ratios unavailable where no cases or controls were exposed.

**Table 21 Salmonella Enteritidis: Business characteristics**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Is your business a hotel?	3/60 (5%)	4/60 (7%)	0.67 (0.11 – 3.99)	0.65
Is your business a restaurant?	34/60 (57%)	27/60 (45%)	1.88 (0.79 – 4.42)	0.14
*Is your business a pub/bar?	3/60 (5%)	6/60 (10%)	0.25 (0.03 – 2.24)	0.18
Is your business another type of catering business?	20/60 (33%)	23/60 (38%)	0.75 (0.32 – 1.78)	0.51
<b>Do you serve Chinese cuisine?</b>	<b>22/60 (37%)</b>	<b>6/60 (10%)</b>	<b>6.33 (1.87 – 21.40)</b>	<b>0.0006</b>
Do you serve British cuisine?	32/60 (53%)	38/60 (63%)	0.54 (0.21 – 1.35)	0.18
<b>*Do you serve Indian cuisine?</b>	<b>2/60 (3%)</b>	<b>7/60 (12%)</b>	<b>0.17 (0.02 – 1.38)</b>	<b>0.06</b>
Do you serve other cuisine?	4/60 (7%)	9/60 (15%)	0.38 (0.10 – 1.41)	0.13
Are you a family business?	27/60 (45%)	31/60 (52%)	0.60 (0.22 – 1.65)	0.32
Are you a small independent?	13/60 (22%)	18/60 (30%)	0.62 (0.26 – 1.48)	0.28
<b>Are you a small independent business &gt;1 site?</b>	<b>11/60 (18%)</b>	<b>2/60 (3%)</b>	<b>5.50 (1.22 – 24.81)</b>	<b>0.01</b>
*Are you a large independent?	4/60 (7%)	2/60 (3%)	-	0.16
Are you part of a national chain?	5/60 (8%)	6/60 (10%)	0.50 (0.05 – 5.51)	0.56
*Are you a voluntary organisation?	0/60 (0%)	1/60 (2%)	-	0.32
<b>Are you a micro SME?</b>	<b>15/44 (34%)</b>	<b>29/44 (66%)</b>	<b>0.07 (0.01 – 0.50)</b>	<b>0.0005</b>
<b>Are you a small SME?</b>	<b>17/44 (39%)</b>	<b>8/44 (18%)</b>	<b>4.00 (1.13 – 14.17)</b>	<b>0.02</b>
<b>*Are you a small medium SME?</b>	<b>5/44 (11%)</b>	<b>0/44 (0%)</b>		<b>0.03</b>
<b>SMEs</b>				
*Is your business a hotel?	2/52 (4%)	4/52 (8%)	0.33 (0.03 – 3.20)	0.32
Is your business a restaurant?	32/52 (62%)	25/52 (48%)	2.17 (0.82 – 5.70)	0.11
*Is your business a pub/bar?	2/52 (4%)	5/52 (10%)	0.25 (0.03 – 2.24)	0.18
Is your business another type of catering business?	16/52 (31%)	18/52 (35%)	0.78 (0.29 – 2.09)	0.62
<b>Non SMEs</b>				
*Is your business a hotel?	1/8 (13%)	0/8 (0%)	-	0.32
*Is your business a restaurant?	2/8 (25%)	2/8 (25%)	1.00 (0.14 – 7.10)	1.00
*Is your business a pub/bar	1/8 (13%)	1/8 (13%)	-	-
*Is your business another type of catering business	4/8 (50%)	5/8 (63%)	0.67 (0.11 – 3.99)	0.65
<b>SMEs</b>				
<b>Do you serve Chinese cuisine?</b>	<b>22/52 (42%)</b>	<b>6/52 (12%)</b>	<b>6.33 (1.87 – 21.40)</b>	<b>0.0006</b>
Do you serve British cuisine?	25/52 (48%)	31/52 (60%)	0.50 (0.19 – 1.33)	0.16
<b>*Do you serve Indian cuisine?</b>	<b>2/52 (4%)</b>	<b>8/52 (15%)</b>	<b>0.17 (0.02 – 1.38)</b>	<b>0.06</b>
*Do you serve other cuisine?	3/52 (6%)	7/52 (13%)	0.29 (0.06 – 1.38)	0.10
<b>Non SMEs</b>				
*Do you serve Chinese cuisine?	0/8 (0%)	0/8 (0%)	-	-
*Do you serve British cuisine?	7/8 (88%)	7/8 (88%)	1.00 (0.06 – 15.99)	1.00
*Do you serve Indian cuisine?	0/8 (0%)	0/8 (0%)	-	-

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Do you serve other cuisine?	1/8 (13%)	1/8 (13%)	1.00 (0.06 – 15.99)	1.00
Do you serve breakfast?	14/44 (32%)	14/44 (32%)	1.00 (0.38 – 2.66)	1.00
Do you serve lunch	38/44 (86%)	33/44 (75%)	2.25 (0.69 – 7.31)	0.17
Do you serve dinner	39/44 (89%)	34/44 (72%)	2.67 (0.71 – 10.05)	0.13
Do you serve snacks	17/44 (39%)	16/44 (36%)	1.40 (0.44 – 4.41)	0.56
Do you offer room service	4/44 (9%)	3/44 (7%)	1.33 (0.30 – 5.96)	0.71
Do you offer functions for <20 people	16/44 (36%)	13/44 (30%)	1.50 (0.53 – 4.21)	0.44
Do you offer functions for >20 people	17/44 (39%)	14/44 (32%)	1.33 (0.56 – 3.160)	0.51
Do you serve lunch and dinner	43/44 (98%)	41/44 (93%)	-	0.16
<b>Are you open for 10 or more hours continuously</b>	<b>22/44 (50%)</b>	<b>12/44 (27%)</b>	<b>4.67 (1.34 – 16.24)</b>	<b>0.008</b>

\* Fishers exact test used.

**Table 22 Salmonella Enteritidis: Staff employment and structure**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>Does the owner/manager work in the kitchen</b>	<b>13/59 (22%)</b>	<b>30/60 (50%)</b>	<b>0.19 (0.07 – 0.55)</b>	<b>0.0007</b>
<b>2 tiers of management before the kitchen manager/chef</b>	<b>13/59 (22%)</b>	<b>4/60 (7%)</b>	<b>5.50 (1.22 – 24.81)</b>	<b>0.01</b>
1 tier of management before the kitchen manager/head chef	24/59 (41%)	18/60 (30%)	2.17 (0.82 – 5.70)	0.11
*3 tiers of management before the kitchen manager/head chef	2/59 (3%)	0/60 (0%)	-	0.16
*Area manager and 2 tiers of in house management before the kitchen manager MS1	3/59 (5%)	1/60 (2%)	-	0.16
*Area manager and no tiers of management before the kitchen manager	0/59 (0%)	2/60 (3%)	-	0.16
Problem recruiting staff	13/44 (30%)	18/47 (39%)	0.60 (0.22 – 1.65)	0.32
*Problem retaining staff	4/44 (9%)	6/44 (14%)	0.50 (0.13 – 2.00)	0.32
<b>Recruit agency staff (kitchen)</b>	<b>9/60 (15%)</b>	<b>3/60 (5%)</b>	<b>4.00 (0.85 – 18.84)</b>	<b>0.06</b>
Recruit staff with professional qualifications (kitchen)	12/60 (20%)	9/60 (15%)	1.60 (0.52 – 4.89)	0.41
Recruit staff with food hygiene qualifications (kitchen)	19/60 (32%)	16/60 (27%)	1.43 (0.54 – 3.75)	0.47
<b>Recruit agency staff (F&amp;B)</b>	<b>10/60 (17%)</b>	<b>4/60 (7%)</b>	<b>4.00 (0.85 – 18.84)</b>	<b>0.06</b>
*Recruit staff with professional qualifications (F&B)	3/60 (5%)	1/60 (2%)	3.00 (0.31 – 28.84)	0.32
*Recruit staff with food hygiene qualifications (F&B)	5/60 (8%)	4/60 (7%)	1.50 (0.25 – 8.98)	0.65
Use casual staff	13/44 (30%)	8/44 (18%)	1.71 (0.67 – 4.35)	0.25
*Kitchen Tier 1 fulltime	40/44 (91%)	42/44 (95%)	0.50 (0.05 – 5.51)	0.56
Kitchen staff team fulltime	29/44 (66%)	28/44 (64%)	1.40 (0.44 – 4.41)	0.56
<b>All kitchen staff salaried</b>	<b>16/44 (36%)</b>	<b>8/43 (17%)</b>	<b>3.67 (1.02 – 13.14)</b>	<b>0.03</b>
*Only chefs salaried	4/44 (9%)	4/43 (9%)	1.33 (0.30 – 5.96)	0.71
Only managers of kitchen salaried	3/44 (7%)	8/43 (17%)	0.38 (0.10 – 1.41)	0.13
None of kitchen staff salaried	18/44 (41%)	15/43 (35%)	1.14 (0.41 – 3.15)	0.80
*Head chef wages above national average	18/44 (41%)	11/44 (25%)	1.88 (0.79 – 4.42)	0.14
Head chef wages below national average	9/44 (20%)	10/44 (23%)	1.00 (0.35 – 2.85)	1.00
Head chef wages same as the national average	7/44 (16%)	8/44 (18%)	0.86 (0.29 – 2.55)	0.78
*Head chef wages vary	2/44 (5%)	0/44 (0%)	-	0.32
<b>Kitchen porter wages above national average</b>	<b>12/44 (27%)</b>	<b>3/44 (7%)</b>	<b>5.50 (1.22 – 24.81)</b>	<b>0.01</b>
Kitchen porter wages below national average	12/44 (32%)	12/44 (27%)	1.33 (0.46 – 3.84)	0.59
Agency pays kitchen porter wages	0/44 (0%)	0/44 (0%)	-	-
<b>Kitchen porter wages same as national average</b>	<b>3/44 (7%)</b>	<b>8/44 (18%)</b>	<b>0.29 (0.06 – 1.38)</b>	<b>0.10</b>
<b>F&amp;B tier 1 fulltime</b>	<b>32/44 (73%)</b>	<b>18/44 (41%)</b>	<b>5.67 (1.66 – 19.34)</b>	<b>0.002</b>

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>F&amp;B staff team fulltime</b>	<b>17/44 (39%)</b>	<b>9/44 (20%)</b>	<b>2.60 (0.93 – 7.29)</b>	<b>0.06</b>
<b>All F&amp;B staff salaried</b>	<b>12/44 (27%)</b>	<b>7/43 (16%)</b>	<b>3.50 (0.73 – 16.85)</b>	<b>0.10</b>
*All fulltime F&B staff salaried	1/44 (2%)	0/43 (0%)	-	0.32
*All non casual F&B staff salaried	1/44 (2%)	0/43 (0%)	-	0.32
Only F&B manager salaried	6/44 (14%)	4/43 (9%)	2.00 (0.37 - 10.92)	0.41
No F&B staff are salaried	19/44 (43%)	18/43 (42%)	0.90 (0.37 – 2.21)	0.82

\*Fishers exact test used

**Table 23 Salmonella Enteritidis: Staff management**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>Pay staff for the first 3 days of sick leave</b>	<b>26/44 (59%)</b>	<b>18/44 (42%)</b>	<b>2.33 (0.90 – 6.07)</b>	<b>0.07</b>
Designated staff toilets	34/44 (77%)	35/44 (80%)	0.88 (0.32 – 2.41)	0.80
<b>Staff use customer toilets</b>	<b>22/44 (50%)</b>	<b>11/44 (25%)</b>	<b>3.20 (1.17 – 8.73)</b>	<b>0.02</b>
<b>Provide staff accommodation</b>	<b>13/44 (30%)</b>	<b>5/44 (11%)</b>	<b>3.67 (1.02 – 13.14)</b>	<b>0.03</b>
*Tier 1 kitchen staff absent from work at the time and/or 14 days before outbreak	3/44 (7%)	3/44 (7%)	1.00 (0.20 – 4.95)	1.00
*Member/s kitchen team absent from work at the time and/or 14 days before outbreak	6/44 (14%)	3/44 (7%)	2.00 (0.50 – 8.00)	0.32
*Tier 1 F&B staff absent from work at the time and/or 14 days before outbreak	2/44 (5%)	1/44 (2%)	2.00 (0.18 – 22.06)	0.56
*Member/s of F&B team absent from work at the time and/or 14 days before outbreak	1/44 (2%)	0/44 (0%)	-	0.32
*Tier 1 kitchen staff sick at time and/or 14 days before outbreak	1/44 (2%)	1/44 (2%)	1.00 (0.06 – 15.99)	1.00
<b>*Members/s of kitchen team sick at time and/or 14 days before outbreak</b>	<b>4/44 (9%)</b>	<b>0/44 (0%)</b>	<b>-</b>	<b>0.05</b>
*Tier 1 F&B staff sick at time and/or 14 days before outbreak	1/44 (2%)	0/44 (0%)	-	0.32
*Member/s of F&B team sick at time and/or 14 days before outbreak	2/44 (5%)	0/44 (0%)	-	0.16
<b>ALL:</b> Are there incentives to maintain hygiene standards	8/44(18%)	9/44 (20%)	-	-
*Are there disincentives to maintain hygiene standards	5/44 (11%)	5/44 (11%)	-	-
*Is there support to maintain hygiene standards	41/44 (93%)	43/44 (98%)	-	-
Is there good communication between front and back of house	37/44 (84%)	36/44 (82%)	-	-
Is there staff incentives	12/44 (27%)	8/44 (18%)	-	-
<b>EMPLOYEES:</b> *Are there unrealistic demands on you	4/12 (33%)	3/12 (25%)	1.50(0.25 – 8.98)	0.65
Do internal pressures affect the way the business is run	4/12 (33%)	5/12 (42%)	0.67 (0.11 – 3.99)	0.65
<b>*Is there good communication between you and your line manager?</b>	<b>9/12 (75%)</b>	<b>12/12 (100%)</b>	<b>-</b>	<b>0.08</b>
*Is there good communication between you and your team?	11/12 (92%)	12/12 (100%)	-	0.32
<b>BUSINESS OWNERS:</b> Do internal pressures affect the way the business is run	9/14 (64%)	7/14 (50%)	-	-
Do external pressures affect the way the business is run	6/14 (43%)	8/14 (57%)	-	-
<b>KITCHEN</b> Tier 1 induction FH training	17/44 (39%)	13/44 (39%)	1.67 (0.61 – 4.59)	0.32
Tier 1 basic FH training	38/44 (83%)	39/44 (89%)	1.00 (0.25 – 4.00)	1.00
Tier 1 intermediate FH training	6/44 (14%)	4/44 (9%)	2.00 (0.37 – 10.92)	0.41

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Tier 1 advanced FH training	2/44 (5%)	2/44 (5%)	1.00 (0.06 – 15.99)	1.00
Tier 1 professional training	15/44 (34%)	12/44 (27%)	1.60 (0.52 – 4.89)	0.41
Tier 2 induction FH training	18/44 (41%)	12/44 (27%)	2.00 (0.75 – 5.33)	0.16
Tier 2 basic FH training	24/44 (55%)	27/44 (61%)	0.75 (0.26 – 2.16)	0.59
*Tier 2 intermediate FH training	5/44 (11%)	4/44 (9%)	1.50 (0.25 – 8.98)	0.65
*Tier 2 advanced FH training	0/44 (0%)	2/44 (5%)	-	0.16
Tier 2 professional training	10/44 (23%)	10/44 (23%)	1.00 (0.35 – 2.85)	1.00
Tier 3 induction FH training	13/44 (30%)	9/44 (20%)	1.67 (0.61 – 4.59)	0.32
Tier 3 basic FH training	15/44 (34%)	12/44 (27%)	1.60 (0.52 – 4.89)	0.41
*Tier 3 intermediate FH training	1/44 (2%)	1/44 (1%)	1.00 (0.06 – 15.99)	1.00
Tier 3 advanced FH training	0/44 (0%)	0/44 (0%)	-	-
*Tier 3 professional FH training	4/44 (9%)	2/44 (5%)	3.00 (0.31 – 28.84)	0.32
<b>F&amp;B</b>				
<b>Tier 1 induction FH training</b>	<b>14/44 (32%)</b>	<b>6/44 (14%)</b>	<b>3.00 (0.97 – 9.30)</b>	<b>0.05</b>
Tier 1 basic FH training	24/44 (55%)	17/44 (39%)	2.00 (0.81 – 4.96)	0.13
*Tier 1 intermediate FH training	2/44 (5%)	2/44 (5%)	1.00 (0.14 – 7.10)	1.00
*Tier 1 advanced FH training	0/44 (0%)	1/44 (2%)	-	0.32
*Tier 1 professional training	4/44 (9%)	1/44 (2%)	4.00 (0.45 – 35.79)	0.18
Tier 2 induction FH training	11/44 (25%)	6/44 (17%)	2.25 (0.70 – 7.31)	0.17
Tier 2 basic FH training	14/44 (32%)	10/44 (23%)	2.00 (0.60 – 6.64)	0.25
Tier 2 intermediate FH training	0/44 (0%)	0/44 (0%)	-	-
Tier 2 advanced FH training	0/44 (0%)	0/44 (0%)	-	-
<b>*Tier 2 professional training</b>	<b>3/44 (7%)</b>	<b>0/44 (0%)</b>	<b>-</b>	<b>0.08</b>
*Tier 3 induction FH training	6/44 (14%)		2.00 (0.37 – 10.92)	0.41
*Tier 3 basic FH training	4/44 (9%)	5/44 (11%)	0.80 (0.21 – 2.98)	0.74
Tier 3 intermediate FH training	0/44 (0%)	0/44 (0%)	-	-
Tier 3 advanced FH training	0/44 (0%)	0/44 (0%)	-	-
Tier 3 professional training	0/44 (0%)	0/44 (0%)	-	-
Business issues communicated:				
d-d verbal meetings	20/57 (35%)	27/60 (45%)	0.64 (0.28 – 1.49)	0.30
notices	18/57 (32%)	14/60 (23%)	1.44 (0.62 – 3.38)	0.39
diary training	2/57 (3%)	4/60 (7%)	-	0.16
not done	7/57 (12%)	8/60 (13%)	0.86 (0.29 – 2.55)	0.78
	14/57 (25%)	13/60 (22%)	1.29 (0.48 – 3.45)	0.62
Food hygiene issues communicated:				
d-d verbal meetings	33/57 (58%)	36/60 (60%)	0.90 (0.37 – 2.21)	0.82
notices	9/57 (16%)	7/60 (12%)	1.40 (0.44 – 4.41)	0.56
training	11/57 (19%)	11/60 (18%)	1.00 (0.35 – 2.85)	2.85
diary	9/57 (16%)	5/60 (8%)	2.00 (0.60 – 6.64)	0.25
checks/audits	1/57 (2%)	0/60 (0%)	-	0.32
not done	3/57 (5%)	5/60 (8%)	0.60 (0.14 – 2.51)	0.48
	3/57 (5%)	5/60 (8%)	0.67 (0.11 – 3.99)	0.65

\*Fishers exact test used

**Table 24 Salmonella Enteritidis: Operational practices**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Menu specifications used	21/60 (35%)	17/60 (28%)	0.90 (0.37 – 2.21)	0.82
<b>BREAD/CAKES:</b>				
Made from raw	10/44 (23%)	12/44 (27%)	0.57 (0.17 – 1.95)	0.37
Partially prepared	7/44 (16%)	11/44 (25%)	0.57 (0.17 – 1.95)	0.37
<b>Served only</b>	<b>30/44 (68%)</b>	<b>37/44 (84%)</b>	<b>0.42 (.015 – 1.18)</b>	<b>0.09</b>
Cook to order	6/44 (14%)	1/44 (2%)	0.50 (0.15 – 1.66)	0.25
*Cold display buffet	4/44 (9%)	11/44 (25%)	4.00 (0.45 – 35.79)	0.18
*Hot display buffet	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
Ambient display buffet	10/44 (23%)	9/44 (20%)	0.86 (0.29 – 2.55)	0.78
Function for less than 20 people	10/44 (23%)	12/44 (27%)	1.20 (0.37 – 3.93)	0.76
Function for more than 20 people	10/44 (23%)	11/44 (25%)	0.80 (0.32 – 2.03)	0.64
<b>Fruit:</b>				
*Made from raw	4/44 (9%)	5/44 (11%)	0.80 (0.21 – 2.98)	0.74
Partially prepared	19/44 (43%)	21/44 (48%)	0.83 (0.36 – 1.93)	0.67
Served only	36/44 (82%)	33/44 (75%)	1.75 (0.51 – 5.98)	0.37
*Cook to order	2/44 (5%)	3/44 (7%)	0.50 (0.05 – 5.51)	0.56
*Freezer to fryer	1/44 (2%)	1/44 (2%)	1.00 (0.06 – 15.99)	1.00
<b>Cold display buffet</b>	<b>8/44 (18%)</b>	<b>3/44 (7%)</b>	<b>6.00 (0.72 – 49.84)</b>	<b>0.06</b>
Ambient display buffet	5/44 (11%)	8/44 (18%)	0.40 (0.08 – 2.06)	0.26
<b>Function for less than 20 people</b>	<b>10/44 (23%)</b>	<b>4/44 (9%)</b>	<b>4.00 (0.85 – 18.34)</b>	<b>0.06</b>
Function for more than 20 people	9/44 (20%)	8/44 (18%)	1.17 (0.39 – 3.47)	0.78
<b>VEGETABLES:</b>				
Made from raw	15/44 (34%)	12/44 (27%)	1.67 (0.40 – 6.97)	0.48
Partially prepared	28/44 (64%)	32/44 (73%)	0.50 (0.15 – 1.66)	0.25
*Served only	42/44 (95%)	41/44 (93%)	1.50 (0.25 – 8.98)	0.65
Cook to order	27/44 (61%)	25/44 (57%)	1.10 (0.47 – 2.59)	0.83
<b>Reheat to order</b>	<b>6/44 (14%)</b>	<b>14/44 (32%)</b>	<b>0.27 (0.08 – 0.98)</b>	<b>0.03</b>
Freezer to fryer	31/44 (70%)	24/44 (55%)	2.00 (0.75 – 5.33)	0.16
*Cold display buffet	<b>0/44 (0%)</b>	<b>3/44 (7%)</b>	-	<b>0.08</b>
<b>Hot display buffet</b>	<b>23/44 (52%)</b>	<b>14/44 (32%)</b>	<b>3.25 (1.06 – 9.97)</b>	<b>0.03</b>
*Ambient display buffet	2/44 (5%)	4/44 (9%)	0.33 (0.03 – 3.20)	0.32
<b>Function for less than 20 people</b>	<b>18/44 (41%)</b>	<b>8/44 (18%)</b>	<b>4.33 (1.23 – 15.21)</b>	<b>0.01</b>
Function for more than 20 people	16/44 (36%)	12/44 (27%)	1.57 (0.61 – 4.05)	0.35
<b>FRESH HERBS:</b>				
Made from raw	4/44 (9%)	10/44 (23%)	0.38 (0.10 – 1.41)	0.13
Partially prepared	25/44 (57%)	26/44 (59%)	0.89 (0.34 – 2.30)	0.81
Served	27/44 (61%)	30/44 (68%)	0.67 (0.27 – 1.63)	0.37
<b>FISH:</b>				
Made from raw	23/44 (52%)	22/44 (50%)	1.13 (0.43 – 2.92)	0.81
Partially prepared	22/44 (50%)	23/44 (52%)	1.00 (0.35 – 2.85)	1.00
Served only	34/44 (77%)	35/44 (80%)	1.00 (0.29 – 3.45)	1.00
Cook to order	25/44 (57%)	26/44 (59%)	0.90 (0.37 – 2.21)	0.82
*Reheat to order	1/44 (2%)	4/44 (9%)	0.33 (0.03 – 3.20)	0.32
Freezer to fryer	14/44 (32%)	14/44 (32%)	1.00 (0.32 – 3.10)	1.00
*Cold display buffet	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
Hot display buffet	18/44 (41%)	13/44 (30%)	2.25 (0.69 – 7.31)	0.17
*Ambient display buffet	1/44 (2%)	2/44 (5%)	0.50 (0.05 – 5.51)	0.56
<b>Function for less than 20 people</b>	<b>15/44 (34%)</b>	<b>7/44 (16%)</b>	<b>3.67 (1.02 – 13.14)</b>	<b>0.03</b>
Function for more than 20 people	14/44 (32%)	8/44 (18%)	2.20 (0.76 – 6.33)	0.13

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>SHELLFISH:</b>				
Made from raw	15/44 (34%)	14/44 (32%)	1.00 (0.29 – 3.45)	1.00
Partially prepared	23/44 (52%)	25/44 (57%)	0.89 (0.34 – 2.30)	0.81
Served only	33/44 (75%)	33/44 (75%)	1.00 (0.35 – 2.85)	1.00
Cook to order	25/44 (57%)	20/44 (45%)	2.00 (0.68 – 5.85)	0.20
Reheat to order	9/44 (20%)	7/44 (16%)	1.40 (0.44 – 4.41)	0.56
Freezer to fryer	10/44 (23%)	11/44 (25%)	0.83 (0.25 – 2.73)	0.76
*Cold display buffet	3/44 (7%)	2/44 (5%)	2.00 (0.18 – 22.06)	0.56
<b>Hot display buffet</b>	<b>13/44 (30%)</b>	<b>5/44 (11%)</b>	<b>5.00 (1.10 – 22.82)</b>	<b>0.02</b>
*Ambient display buffet	2/44 (5%)	4/44 (9%)	0.33 (0.03 – 3.20)	0.32
<b>Function for less than 20 people</b>	<b>18/44 (41%)</b>	<b>8/44 (18%)</b>	<b>4.33 (1.23 – 15.21)</b>	<b>0.01</b>
Function for more than 20 people	14/44 (32%)	11/44 (25%)	1.43 (0.54 – 3.75)	0.47
<b>POULTRY</b>				
<b>Made from raw</b>	<b>32/44 (73%)</b>	<b>23/44 (52%)</b>	<b>3.00 (0.97 – 9.30)</b>	<b>0.05</b>
Partially prepared	24/44 (55%)	26/44 (59%)	0.75 (0.26 – 2.16)	0.59
<b>*Served</b>	<b>42/44 (95%)</b>	<b>37/44 (84%)</b>	<b>3.50 (0.73 – 16.85)</b>	<b>0.10</b>
Cook to order	25/44 (57%)	20/44 (45%)	1.50 (0.61 – 3.67)	0.37
Reheat to order	21/44 (48%)	20/44 (45%)	1.14 (0.41 – 3.15)	0.80
Freezer to fryer	9/44 (20%)	7/44 (16%)	1.50 (0.42 – 5.32)	0.53
*Cold display buffet	2/44 (5%)	2/44 (5%)	1.00 (0.14 – 7.10)	1.00
<b>Hot display buffet</b>	<b>24/44 (55%)</b>	<b>11/44 (25%)</b>	<b>7.50 (1.72 – 32.80)</b>	<b>0.002</b>
*Ambient display buffet	4/44 (9%)	4/44 (9%)	1.00 (0.20 – 4.95)	1.00
<b>Function for less than 20 people</b>	<b>18/44 (41%)</b>	<b>10/44 (23%)</b>	<b>3.00 (0.97 – 9.30)</b>	<b>0.05</b>
Function for more than 20 people	17/44 (39%)	12/44 (27%)	1.71 (0.67 – 4.35)	0.25
<b>RED MEAT:</b>				
Made from raw	32/44 (73%)	26/44 (59%)	2.67 (0.71 – 10.05)	0.13
Partially prepared	24/44 (55%)	21/44 (48%)	1.33 (0.46 – 3.84)	0.59
*Served only	41/44 (93%)	38/44 (86%)	2.00 (0.37 – 10.92)	0.41
Cook to order	27/44 (61%)	27/44 (61%)	1.00 (0.38 – 2.66)	1.00
Reheat to order	20/44 (45%)	22/44 (50%)	0.67 (0.24 – 1.87)	0.44
*Cold display buffet	2/44 (5%)	1/44 (2%)	2.00 (0.18 – 22.06)	0.56
<b>Hot display buffet</b>	<b>24/44 (55%)</b>	<b>12/44 (27%)</b>	<b>7.00 (1.59 – 30.80)</b>	<b>0.003</b>
*Ambient display buffet	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
<b>Function for less than 20 people</b>	<b>18/44 (41%)</b>	<b>9/88 (20%)</b>	<b>3.25 (1.06 – 9.97)</b>	<b>0.03</b>
Function for more than 20 people	18/44 (41%)	11/44 (25%)	2.00 (0.81 – 4.96)	0.13
<b>GAME:</b>				
*Made from raw	4/44 (9%)	6/44 (14%)	0.60 (0.14 – 2.51)	0.48
*Partially prepared	2/44 (5%)	5/44 (11%)	0.25 (0.03 – 2.24)	0.18
Served only	6/44 (14%)	9/44 (20%)	0.57 (0.17 – 1.95)	0.37
*Cook to order	3/44 (7%)	4/44 (9%)	0.75 (0.17 – 3.35)	0.71
*Reheat to order	0/44 (0%)	0/44 (0%)	-	0.32
Cold display buffet	0/44 (0%)	0/44 (0%)	-	-
*Hot display buffet	4/44 (9%)	6/44 (14%)	0.50 (0.09 – 2.73)	0.41
Ambient display buffet	0/44 (0%)	0/44 (0%)	-	-
*Function for less than 20 people	4/44 (9%)	2/44 (5%)	3.00 (0.31 – 28.84)	0.32
*Function for more than 20 people	2/44 (5%)	3/44 (7%)	0.50 (0.05 – 5.51)	0.56
<b>COOKED MEAT:</b>				
<b>*Made from raw</b>	<b>7/44 (16%)</b>	<b>1/44 (2%)</b>	<b>7.00 (0.86 – 56.89)</b>	<b>0.03</b>
Partially prepared	11/44 (25%)	14/44 (32%)	0.75 (0.26 – 2.16)	0.59
Served only	25/44 (57%)	25/44 (57%)	1.17 (0.39 – 3.47)	0.78
*Prepare to order	3/44 (7%)	4/44 (9%)	0.50 (0.05 – 5.51)	0.56

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Reheat to order	1/44 (2%)	3/44 (7%)	0.50 (0.05 – 5.51)	0.56
Freezer to Fryer	0/44 (0%)	0/44 (0%)	-	-
Cold display buffet	7/44 (16%)	5/44 (11%)	1.40 (0.44 – 4.41)	0.56
*Hot display buffet	0/44 (0%)	1/44 (2%)	-	0.32
Ambient display buffet	6/44 (14%)	10/44 (23%)	0.43 (0.11 – 1.66)	0.21
Function for less than 20 people	8/44 (18%)	7/44 (16%)	1.20 (0.37 – 3.93)	0.76
Function for more than 20 people	10/44 (23%)	12/44 (27%)	0.78 (0.29 – 2.09)	0.62
<b>PATE:</b>				
Made from raw	4/44 (9%)	8/44 (18%)	0.50 (0.15 – 1.67)	0.25
*Partially prepared	2/44 (5%)	1/44 (2%)	2.00 (0.18 – 22.06)	0.56
Served only	9/44 (20%)	16/44 (36%)	0.50 (0.20 – 1.24)	0.13
*Prepare to order	1/44 (2%)	1/44 (2%)	1.00 (0.06 – 15.99)	1.00
*Cold display buffet	3/44 (7%)	2/44 (5%)	1.50 (0.25 – 8.98)	0.65
*Ambient display buffet	4/44 (9%)	3/44 (7%)	1.33 (0.30 – 5.96)	0.71
Function for less than 20 people	6/44 (14%)	3/44 (7%)	2.00 (0.50 – 8.00)	0.32
Function for more than 20 people	5/44 (11%)	7/44 (16%)	0.71 (0.23 – 2.25)	0.56
<b>SANDWICHES:</b>				
Made from raw	22/44 (50%)	24/44 (55%)	0.78 (0.29 – 2.09)	0.62
*Partially prepared	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
Served only	23/44 (52%)	25/44 (57%)	0.78 (0.29 – 2.09)	0.62
Prepare to order	13/44 (30%)	13/44 (30%)	1.00 (0.40 – 2.52)	1.00
*Cold display buffet	5/44 (11%)	4/44 (9%)	1.33 (0.30 – 5.96)	0.71
Ambient display buffet	7/44 (16%)	11/44 (25%)	0.50 (0.15 – 1.66)	0.25
Function for less than 20 people	6/44 (14%)	8/44 (18%)	0.60 (0.14 – 2.51)	0.48
Function for more than 20 people	8/44 (18%)	11/44 (25%)	0.70 (0.27 – 1.84)	0.47
<b>SALADS:</b>				
Made from raw	21/44 (48%)	28/44 (64%)	0.53 (0.23 – 1.26)	0.14
Partially prepared	10/44 (23%)	10/44 (23%)	1.00 (0.38 – 2.66)	1.00
Served only	32/44 (73%)	34/44 (77%)	0.80 (0.32 – 2.03)	0.64
Prepare to order	7/44 (16%)	13/44 (30%)	0.50 (0.19 – 1.33)	0.16
Cold display buffet	9/44 (20%)	7/44 (16%)	1.50 (0.42 – 5.32)	0.53
Ambient display buffet	8/44 (18%)	13/44 (30%)	0.50 (0.17 – 1.46)	0.20
Function for less than 20 people	12/44 (27%)	10/44 (23%)	1.40 (0.44 – 4.41)	0.56
Function for more than 20 people	13/44 (30%)	13/44 (30%)	1.00 (0.42 – 2.40)	1.00
<b>EGGS:</b>				
Made from raw	34/44 (77%)	30/44 (44%)	1.75 (0.51 – 5.98)	0.37
Partially prepared	17/44 (39%)	16/44 (36%)	1.14 (0.41 – 3.15)	0.80
*Served only	43/44 (98%)	39/44 (89%)	4.00 (0.45 – 35.79)	0.18
Cook to order	28/44 (64%)	23/44 (52%)	2.00 (0.68 – 5.85)	0.20
*Reheat to order	3/44 (7%)	2/44 (5%)	1.00 (0.14 – 7.10)	1.00
*Freezer to fryer	0/44 (0%)	1/44 (2%)	-	0.32
Cold display buffet	6/44 (14%)	5/44 (11%)	1.25 (0.34 – 4.65)	0.74
<b>Hot display buffet</b>	<b>18/44 (41%)</b>	<b>8/44 (18%)</b>	<b>6.00 (1.34 – 26.81)</b>	<b>0.01</b>
Ambient display buffet	5/44 (11%)	6/44 (14%)	0.75 (0.17 – 3.35)	0.71
Function for less than 20 people	16/44 (36%)	11/44 (25%)	2.00 (0.68 – 5.85)	0.20
Function for more than 20 people	16/44 (36%)	11/44 (25%)	1.71 (0.67 – 4.35)	0.25
<b>RICE/PASTA:</b>				
Made from raw	26/44 (59%)	24/44 (55%)	1.33 (0.46 – 3.84)	0.59
Partially prepared	21/44 (48%)	20/44 (45%)	1.00 (0.40 – 2.52)	1.00
Served only	39/44 (89%)	37/44 (84%)	1.33 (0.30 – 5.96)	0.71
Cook to order	16/44 (36%)	20/44 (45%)	0.50 (0.17 – 1.46)	0.20
Reheat to order	20/44 (45%)	13/44 (30%)	2.00 (0.75 – 5.33)	0.16
*Freezer to fryer	2/44 (5%)	0/44 (0%)	-	0.16
*Cold display buffet	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
<b>Hot display buffet</b>	<b>23/44 (52%)</b>	<b>13/44 (30%)</b>	<b>4.33 (1.23 – 15.21)</b>	<b>0.01</b>

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Ambient display buffet	2/44 (5%)	5/44 (11%)	0.40 (0.08 – 2.06)	0.26
<b>Function for less than 20 people</b>	<b>17/44 (39%)</b>	<b>8/44 (18%)</b>	<b>3.25 (1.06 – 9.97)</b>	<b>0.03</b>
Function for more than 20 people	16/44 (36%)	12/44 (27%)	1.57 (0.61 – 4.05)	0.35
<b>DESSERTS:</b>				
Made from raw	20/44 (45%)	19/44 (43%)	1.10 (0.47 – 2.59)	0.83
Partially prepared	15/44 (34%)	11/44 (25%)	1.57 (0.61 – 4.05)	0.35
Served only	38/44 (86%)	35/44 (80%)	1.40 (0.44 – 4.41)	0.56
Cook to order	9/44 (20%)	10/44 (23%)	0.89 (0.34 – 2.30)	0.81
*Reheat to order	0/44 (0%)	1/44 (2%)	-	0.32
Cold display buffet	9/44 (20%)	5/44 (11%)	2.33 (0.60 – 9.02)	0.21
Hot display buffet	7/44 (16%)	7/44 (16%)	1.00 (0.20 – 4.95)	1.00
Ambient display buffet	7/44 (16%)	11/44 (25%)	0.50 (0.15 – 1.66)	0.25
Function for less than 20 people	10/44 (23%)	6/44 (14%)	2.00 (0.60 – 6.64)	0.25
Function for more than 20 people	10/44 (23%)	11/44 (25%)	0.88 (0.32 – 2.41)	0.80
<b>ICE CREAM:</b>				
*Made from raw	0/44 (0%)	1/44 (2%)	-	0.32
*Partially prepared	2/44 (5%)	5/44 (11%)	0.33 (0.03 – 3.20)	0.32
<b>Served only</b>	<b>40/44 (91%)</b>	<b>33/44 (75%)</b>	<b>4.50 (0.97 – 20.83)</b>	<b>0.03</b>
*Prepare to order	1/44 (2%)	4/44 (9%)	0.25 (0.03 – 2.24)	0.18
*Function for less than 20 people	5/44 (11%)	2/44 (5%)	2.50 (0.49 – 12.89)	0.26
*Function for more than 20 people	5/44 (11%)	4/44 (9%)	1.33 (0.30 – 5.96)	0.71
<b>SAUCE:</b>				
Made from raw	20/44 (45%)	17/44 (39%)	1.22 (0.51 – 2.95)	0.65
<b>Partially prepared</b>	<b>14/44 (32%)</b>	<b>8/44 (18%)</b>	<b>3.00 (0.81 – 11.08)</b>	<b>0.08</b>
Served only	35/44 (80%)	35/44 (80%)	0.88 (0.32 – 2.41)	0.80
Cook to order	8/44 (18%)	8/44 (18%)	1.00 (0.32 – 3.10)	1.00
Reheat to order	5/44 (11%)	6/44 (14%)	0.50 (0.09 – 2.73)	0.41
*Freezer to fryer	0/44 (0%)	2/44 (5%)	-	0.16
*Cold display buffet	3/44 (7%)	1/44 (2%)	3.00 (0.31 – 28.84)	0.32
<b>Hot display buffet</b>	<b>16/44 (36%)</b>	<b>7/44 (16%)</b>	<b>5.50 (1.22 – 24.81)</b>	<b>0.01</b>
*Ambient display buffet	2/44 (5%)	5/44 (11%)	0.40 (0.08 – 2.06)	0.26
<b>Function for less than 20 people</b>	<b>14/44 (32%)</b>	<b>7/44 (16%)</b>	<b>3.33 (0.92 – 12.11)</b>	<b>0.05</b>
Function for more than 20 people	10/44 (23%)	9/44 (20%)	1.17 (0.39 – 3.47)	0.78
<b>BRANDED/READY MADE MEALS:</b>				
*Partially prepared	3/44 (7%)	6/44 (14%)	0.40 (0.08 – 2.06)	0.26
Served only	5/44 (11%)	6/44 (14%)	0.80 (0.21 – 2.98)	0.74
*Cook to order	3/44 (7%)	3/44 (7%)	1.00 (0.14 – 7.10)	1.00
Reheat to order	2/44 (5%)	0/44 (0%)	-	0.16
Freezer to fryer	0/44 (0%)	0/44 (0%)	-	-
Cold display buffet	0/44 (0%)	0/44 (0%)	-	-
*Hot display buffet	1/44 (2%)	3/44 (7%)	0.33 (0.03 – 3.20)	0.32
*Ambient display buffet	0/44 (0%)	2/44 (5%)	-	0.16
Function for less than 20 people	0/44 (0%)	0/44 (0%)	-	-
Function for more than 20 people	0/44 (0%)	0/44 (0%)	-	-
<b>MILK:</b>				
Serve	41/44 (93%)	38/44 (86%)	2.00 (0.37 – 10.92)	0.41
*Cook to order	2/44 (5%)	3/44 (7%)	0.67 (0.11 – 3.99)	0.65
*Cold display buffet	1/44 (2%)	2/44 (5%)	0.50 (0.05 – 5.51)	0.56
<b>*Ambient display buffet</b>	<b>1/44 (2%)</b>	<b>5/44 (11%)</b>	<b>0.20 (0.02 – 1.71)</b>	<b>0.10</b>
*Function for less than 20 people	4/44 (9%)	3/44 (7%)	1.50 (0.25 – 8.98)	0.65
Function for more than 20 people	6/44 (14%)	7/44 (16%)	0.80 (0.21 – 2.98)	0.74

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>DAIRY PRODUCTS:</b>				
*Made from raw	1/44 (2%)	1/44 (2%)	1.00 (0.06 – 15.99)	1.00
Partially prepared	7/44 (16%)	9/44 (20%)	0.71 (0.23 – 2.25)	0.56
Serve	37/44 (84%)	37/44 (84%)	0.83 (0.25 – 2.73)	0.76
*Prepare to order	1/44 (2%)	3/44 (7%)	0.33 (0.03 – 3.20)	0.32
*Cold display buffet	3/44 (7%)	5/44 (11%)	0.60 (0.14 – 2.51)	0.48
Ambient display buffet	4/44 (9%)	7/44 (16%)	0.50 (0.13 – 1.20)	0.32
*Function for less than 20 people	5/44 (11%)	5/44 (11%)	1.00 (0.20 – 4.95)	1.00
Function for more than 20 people	8/44 (18%)	9/44 (20%)	0.86 (0.29 – 2.55)	0.78
*Highest no. of covers served per week is twice as many as or greater than the average no. of covers served.	4/37 (11%)	4/36 (11%)	1.50 (0.25 – 8.98)	0.65
<b>Collect foods directly from supplier</b>	<b>10/44 (23%)</b>	<b>22/44 (50%)</b>	<b>0.13 (0.03 – 0.58)</b>	<b>0.002</b>
<b>NATIONAL SUPPLIERS:</b>				
Vegetable	9/41 (22%)	13/42 (31%)	0.60 (0.22 – 1.65)	0.32
Red meat	12/41 (29%)	14/38 (37%)	0.63 (0.20 – 1.91)	0.41
<b>Poultry</b>	<b>11/41 (27%)</b>	<b>17/37 (46%)</b>	<b>0.30 (0.82 – 1.09)</b>	<b>0.05</b>
*Sandwiches	5/6 (83%)	3/7 (43%)	-	-
<b>Eggs</b>	<b>6/42 (14%)</b>	<b>15/39 (38%)</b>	<b>0.18 (0.04 – 0.82)</b>	<b>0.01</b>
Desserts	14/32 (44%)	15/28 (54%)	0.57 (0.17 – 1.95)	0.37
*Game	2/7 (29%)	2/10 (20%)	-	-
Milk	19/41 (46%)	21/37 (57%)	0.44 (0.14 – 1.44)	0.17
Dairy products	19/37 (51%)	26/36 (72%)	0.44 (0.14 – 1.44)	0.17
Shellfish	13/33 (39%)	15/33 (45%)	1.67 (0.40 – 6.97)	0.48
*Pate	5/8 (63%)	7/12 (58%)	-	0.32
Bread/cakes	16/30 (53%)	19/37 (51%)	1.50 (0.42 – 5.32)	0.53
Fruit	12/36 (33%)	12/34 (35%)	1.00 (0.32 – 3.10)	1.00
Fresh herbs	7/27 (26%)	6/31 (10%)	1.00 (0.25 – 4.00)	1.00
Fish	13/35 (37%)	14/35 (40%)	0.75 (0.26 – 2.16)	0.59
Cooked meat	9/21 (43%)	16/25 (64%)	0.50 (0.09 – 2.73)	0.42
<b>Salads</b>	<b>6/21 (29%)</b>	<b>7/20 (35%)</b>	<b>-</b>	<b>0.08</b>
Ice cream	18/39 (46%)	20/31 (65%)	0.45 (0.16 – 1.31)	0.13
*Branded ready made meals	2/4 (50%)	6/6 (100%)	-	-
Sauce	12/26 (46%)	11/17 (65%)	0.25 (0.03 – 2.24)	0.18
<b>REGIONAL SUPPLIERS:</b>				
Vegetable	12/41 (29%)	8/42 (19%)	2.25 (0.69 – 7.31)	0.17
<b>Red meat</b>	<b>13/41 (32%)</b>	<b>3/38 (8%)</b>	<b>9.00 (1.14 – 71.04)</b>	<b>0.01</b>
<b>Poultry</b>	<b>15/41 (37%)</b>	<b>2/37 (5%)</b>	<b>11.00 (1.42 – 85.20)</b>	<b>0.004</b>
*Sandwiches	0/6 (0%)	1/7 (14%)	-	-
<b>Eggs</b>	<b>19/42 (45%)</b>	<b>4/39 (10%)</b>	<b>7.00 (1.59 – 30.80)</b>	<b>0.003</b>
Desserts	10/32 (31%)	6/28 (21%)	1.50 (0.42 – 5.32)	0.53
*Game	2/7 (29%)	0/10 (0%)	-	-
<b>Milk</b>	<b>6/41 (15%)</b>	<b>1/37 (3%)</b>	<b>6.00 (0.72 – 49.84)</b>	<b>0.06</b>
<b>*Dairy products</b>	<b>8/37 (22%)</b>	<b>1/36 (3%)</b>	<b>7.00 (0.86 – 56.89)</b>	<b>0.03</b>
Shellfish	10/33 (30%)	8/33 (24%)	2.00 (0.18 – 22.06)	0.56
Pate	0/8 (0%)	0/12 (0%)	-	-
*Bread/cakes	3/30 (10%)	4/37 (11%)	1.00 (0.20 – 4.95)	1.00
Fruit	5/36 (14%)	5/34 (15%)	1.00 (0.20 – 4.95)	1.00
Fresh herbs	6/27 (22%)	7/31 (23%)	1.33 (0.30 – 5.96)	0.71
Fish	8/35 (23%)	5/35 (14%)	4.00 (0.45 – 35.79)	0.18
*Cooked meat	3/21 (14%)	1/25 (4%)	-	0.16
<b>Salads</b>	<b>6/21 (29%)</b>	<b>4/20 (20%)</b>	<b>5.00 (0.58 – 42.80)</b>	<b>0.10</b>

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Ice cream	12/39 (31%)	9/31 (29%)	1.75 (0.51 – 5.98)	0.37
Branded ready made meals	0/4 (0%)	0/6 (0%)	-	-
*Sauce	8/26 (31%)	3/17 (18%)	4.00 (0.45 – 35.79)	0.18
<b>LOCAL SUPPLIERS:</b>				
Vegetable	21/41 (51%)	22/42 (52%)	0.91 (0.39 – 2.14)	0.83
Red meat	19/41 (46%)	23/38 (61%)	0.55 (0.20 – 1.47)	0.23
Poultry	17/41 (41%)	22/37 (59%)	0.50 (0.19 – 1.33)	0.16
Sandwiches	2/6 (33%)	4/7 (57%)	-	-
Eggs	17/42 (40%)	20/39 (51%)	0.67 (0.24 – 1.87)	0.44
Desserts	8/32 (25%)	9/28 (32%)	0.83 (0.25 – 2.73)	0.76
*Game	3/7 (43%)	8/10 (80%)	-	-
Milk	16/41 (39%)	15/37 (41%)	1.00 (0.29 – 3.45)	1.00
Dairy products	10/37 (27%)	10/36 (28%)	0.50 (0.09 – 2.73)	0.41
Shellfish	12/33 (36%)	11/33 (33%)	0.60 (0.14 – 2.51)	0.48
*Pate	3/8 (38%)	5/12 (42%)	-	0.32
Bread/cakes	12/30 (40%)	1/37 (43%)	0.57 (0.17 – 1.95)	0.37
Fruit	19/36 (53%)	17/34 (50%)	1.00 (0.35 – 2.85)	1.00
Fresh herbs	14/27 (52%)	18/31 (58%)	0.75 (0.17 – 3.35)	0.71
Fish	16/35 (46%)	17/35 (49%)	0.78 (0.29 – 2.09)	0.62
Cooked meat	10/21 (48%)	10/25 (40%)	1.33 (0.30 – 5.96)	0.71
Salads	10/21 (48%)	10/20 (50%)	1.00 (0.25 – 4.00)	1.00
Ice cream	10/39 (26%)	3/31 (10%)	2.00 (0.50 – 8.00)	0.32
*Branded ready made meals	2/4 (50%)	0/6 (0%)	-	-
*Sauce	7/26 (27%)	4/17 (24%)	1.00 (0.20 – 4.95)	1.00
Written HACCP AT TIME OF OUTBREAK	22/60 (37%)	19/60 (32%)	1.30 (0.57 – 2.96)	0.53
Verbal HACCP AT TIME OF OUTBREAK	10/60 (17%)	13/60 (22%)	0.70 (0.27 – 1.84)	0.47
No HACCP AT TIME OF OUTBREAK	27/60 (45%)	26/60 (43%)	1.08 (0.49 – 2.37)	0.84
Temperature control record kept AT TIME OF OUTBREAK	30/44 (68%)	27/44 (61%)	1.50 (0.53 – 4.21)	0.44
Cleaning schedule kept AT TIME OF OUTBREAK	22/44 (50%)	22/44 (50%)	1.10 (0.47 – 2.59)	0.83
Staff training records kept AT TIME OF OUTBREAK	23/44 (52%)	29/44 (66%)	0.55 (0.21 – 1.47)	0.23

\*Fishers exact test used

**Table 25 Salmonella Enteritidis: Unusual events**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
*Short staffed at time of outbreak	6/60 (10%)	5/60 (8%)	1.25 (0.34 – 4.65)	0.74
<b>*Relief manager at time of outbreak</b>	<b>9/60 (15%)</b>	<b>1/60 (2%)</b>	<b>9.00 (1.14 – 71.04)</b>	<b>0.01</b>
<b>Unusual incident at time of outbreak</b>	<b>15/60 (25%)</b>	<b>6/60 (10%)</b>	<b>5.50 (1.22 – 24.81)</b>	<b>0.01</b>
*Temp/alternative FPE used at time of outbreak	2/60 (3%)	1/60 (2%)	-	0.32
*Recently installed FPE used at time of outbreak	2/60 (3%)	1/60 (2%)	2.00 (0.18 – 22.06)	0.56
*FPE due service at time of outbreak	0/60 (0%)	0/60 (0%)	-	-
<b>*FPE not working properly at time of outbreak</b>	<b>5/60 (8%)</b>	<b>1/60 (2%)</b>	<b>5.00 (0.58 – 42.80)</b>	<b>0.10</b>
*FPE breakdown at time of outbreak	4/60 (7%)	2/60 (3%)	3.00 (0.31 – 28.84)	0.32
*New procedure or practice at time of outbreak	2/60 (3%)	0/60 (0%)	-	0.16
<b>*Change/new menu at time of outbreak</b>	<b>1/60 (2%)</b>	<b>5/60 (8%)</b>	<b>0.20 (0.02 – 1.71)</b>	<b>0.10</b>
<b>*Change in menu prep at time of outbreak</b>	<b>4/60 (7%)</b>	<b>0/60 (0%)</b>	-	<b>0.05</b>
<b>*Promotions on offer at time of outbreak</b>	<b>4/60 (7%)</b>	<b>0/60 (0%)</b>	-	<b>0.05</b>
*Power cut at time of outbreak	0/60 (0%)	1/60 (2%)	-	0.32
*Water disturbance at time of outbreak	0/60 (0%)	1/60 (2%)	-	0.32

\*Fishers exact test used

**Table 26 Salmonella Enteritidis: Other factors**

Exploratory Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Do you take bookings	32/44 (73%)	29/44 (66%)	1.33 (0.56 – 3.16)	0.51
Is catering your main business	32/44 (73%)	33/44 (75%)	0.83 (0.25 – 2.73)	0.76
Do you use independent food hygiene consultants	5/44 (11%)	6/44 (14%)	0.50 (0.05 – 5.51)	0.56
*Is your premises on mains water supply	44/44 (100%)	42/44 (95%)	-	0.16
Do you feel that water is a food hygiene issue	24/44 (55%)	27/44 (61%)	0.57 (0.17 – 1.95)	0.37
<b>Do you have a good working relationship with the local EHO</b>	<b>38/44 (86%)</b>	<b>43/44 (98%)</b>	<b>0.17 – (0.02 – 1.38)</b>	<b>0.06</b>
<b>Meal for 2 (excluding drinks) for &lt; £21<sup>0</sup></b>	<b>14/35 (40%)</b>	<b>29/36 (81%)</b>	<b>0.08 (0.01 – 0.64)</b>	<b>0.002</b>
Meal for 2 (excluding drinks) for >£41 <sup>0</sup>	3/35 (9%)	1/36 (3%)	2.00 (0.18 – 22.06)	0.56
* < 25% of guests are regulars*	3/44 (7%)	4/44 (9%)	0.75 (0.17 – 3.35)	0.71
25 – 50% of guests are regulars*	16/44 (36%)	11/44 (25%)	1.67 (0.61 – 4.59)	0.32
50 – 75% of guests are regulars*	11/44 (25%)	18/44 (42%)	0.45 (0.16 – 1.31)	0.13
>75% of guests are regulars*	14/44 (32%)	11/44 (25%)	1.43 (0.54 – 3.75)	0.47

\* Regular customers are those customers considered to be regulars by the business

<sup>0</sup> Price category was based on industry experience.

**Table 27 Salmonella Enteritidis: Catering practices**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
<b>Are raw shell eggs used</b>	<b>38/39 (97%)</b>	<b>33/39 (85%)</b>	-	<b>0.03</b>
Do you use suppliers because they are cheap	7/39 (18%)	10/37 (27%)	0.67 (0.24 – 1.87)	0.44
<b>Do you use suppliers because they are good quality</b>	<b>23/38 (61%)</b>	<b>30/37 (81%)</b>	<b>0.36 (0.12 – 1.14)</b>	<b>0.07</b>
Do you use suppliers because of loyalty	11/38 (29%)	11/37 (30%)	0.86 (0.29 – 2.55)	0.78
Do you use suppliers for another reason	18/38 (18%)	6/37 (16%)	1.20 (0.37 – 3.93)	0.76
Is raw food cooked at the table	1/39 (3%)	0/39 (0%)	-	0.32
Do you offer a sit down buffet	8/39 (21%)	4/39 (10%)	2.33 (0.60 – 9.02)	0.21
Do you offer a self service buffet	15/39 (38%)	11/39 (28%)	1.67 (0.61 – 4.59)	0.32
Do you offer functions	14/39 (36%)	14/39 (36%)	1.00 (0.35 – 2.85)	1.00
<b>Is this food prepared differently to regular menu</b>	<b>1/25 (4%)</b>	<b>7/22 (32%)</b>	-	<b>0.03</b>
Hot buffet food not served at premises where prep.	2/25 (8%)	4/21 (19%)	0.33 (0.35 – 3.20)	0.32
Hot buffet food/function food prep. Advance and reheated	22/39 (56%)	16/39 (41%)	1.50 (0.25 – 8.98)	0.65
Do you serve/prepare hot buffet food	11/25 (44%)	10/21 (48%)	1.75 (0.73 – 4.17)	0.20
Do you use bain marie	7/22 (32%)	6/17 (35%)	0.67 (0.11 – 3.99)	0.65
Do you use a plate warmer	5/22 (23%)	2/17 (12%)	-	0.16
Do you use a hot plate	10/22 (45%)	9/17 (53%)	1.50 (0.25 – 8.98)	0.65
Do you use other equipment to keep food warm	5/22 (23%)	6/17 (35%)	0.67 (0.11 – 3.99)	0.65
Do you serve/prepare cold buffets	15/39 (38%)	16/39 (41%)	0.88 (0.32 – 2.41)	0.80
Do you use a refrigerated unit to keep buffet food cold	7/15 (47%)	6/16 (38%)	1.00 (0.06 – 15.99)	1.00
Do you use ice to keep buffet food cold	0/15 (0%)	0/16 (0%)	-	-
Do you keep cold buffet food at room temperature	5/15 (33%)	9/16 (56%)	0.50 (0.05 – 5.51)	0.56
Do you use another method to keep buffet food cold	3/14 (21%)	3/16 (19%)	-	0.32
<b>Are buffet food containers topped up</b>	<b>7/19 (37%)</b>	<b>1/19 (5%)</b>	-	<b>0.08</b>
Can you tell what temp hot/cold food is kept	27/39 (69%)	29/39 (74%)	0.71 (0.23 – 2.25)	0.56
Are raw eggs stored in fridge	19/37 (51%)	19/33 (58%)	0.67 (0.24 – 1.87)	0.44
Are eggs whisked	36/36 (100%)	29/31 (94%)	-	0.16
<b>Are eggs whisked using a fork/chop sticks</b>	<b>11/36 (31%)</b>	<b>14/29 (48%)</b>	<b>0.29 (0.06 – 1.38)</b>	<b>0.10</b>
Are eggs whisked using a hand whisk	19/36 (53%)	11/29 (38%)	2.00 (0.60 – 6.64)	0.25
Are eggs whisked using an electric whisk	5/36 (14%)	3/29 (10%)	1.14 (0.42 – 3.14)	0.80
Are eggs whisked using another method	7/36 (19%)	3/29 (10%)	2.33 (0.60 – 9.02)	0.21
Is whisking utensil used for other purposes	12/36 (33%)	8/28 (29%)	1.67 (0.40 – 6.97)	0.48
Raw eggs used in batter , soups, rice, noodles	20/38 (53%)	16/33 (48%)	1.40 (0.44 – 4.41)	0.56
<b>Is pasteurised egg used</b>	<b>3/39 (8%)</b>	<b>0/39 (0%)</b>	-	<b>0.08</b>
Dishes heated thoroughly before consumption	38/38 (100%)	31/33 (94%)	-	0.16
Do you use a thermometer	23/38 (61%)	19/33 (56%)	1.67 (0.61 – 4.59)	0.32
Check visually	23/38 (61%)	29/33 (56%)	2.00 (0.50 – 8.00)	0.32
<b>Is food containing eggs batch cooked</b>	<b>34/39 (87%)</b>	<b>25/36 (69%)</b>	<b>3.00 (0.81 – 11.08)</b>	<b>0.08</b>
Are egg fried rice/noodles/soups/batter	16/38 (42%)	9/35 (26%)	2.00 (0.68 – 5.85)	0.20

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
prepared in batches				
Are other egg dishes prepared in batches	19/39 (48%)	19/35 (54%)	0.75 (0.26 – 2.16)	0.59
<b>Cooked dishes with egg refrigerated</b>	<b>12/39 (31%)</b>	<b>20/36 (56%)</b>	<b>0.38 (0.14 – 1.08)</b>	<b>0.06</b>
Dishes containing egg kept hot	20/39 (51%)	12/35 (34%)	2.50 (0.78 – 7.97)	0.11
<b>Separate cleaning equipment</b>	<b>24/39 (62%)</b>	<b>32/39 (82%)</b>	<b>0.33 (0.11 – 1.03)</b>	<b>0.05</b>
<b>Cooling water used in cooking range</b>	<b>16/39 (41%)</b>	<b>5/39 (13%)</b>	<b>4.67 (1.34 – 16.24)</b>	<b>0.008</b>
Cooling water topped up	12/16 (75%)	4/5 (80%)	-	-
Cooling water added to dishes while cooking	4/16 (25%)	1/5 (20%)	-	0.32
Cooling water used to clean chopsticks	4/16 (25%)	2/5 (40%)	-	-
Cooling water used to wet dishcloths	4/16 (25%)	2/5 (40%)	-	-
Has your business grown since you first opened	22/39 (56%)	21/39 (54%)	1.09 (0.48 – 2.47)	0.83
<b>Has your business extended it's accommodation</b>	<b>3/39 (8%)</b>	<b>10/39 (26%)</b>	<b>0.30 (0.08 – 1.09)</b>	<b>0.05</b>
<b>Do you serve Chinese cuisine</b>	<b>16/39 (41%)</b>	<b>3/39 (8%)</b>	<b>7.50 (1.72 – 32.80)</b>	<b>0.002</b>

**Table 28 Salmonella Enteritidis: Multivariate business characteristics**

Variable	Unadjusted OR	Adjusted OR	P value
Chinese cuisine	6.33 (1.87 – 21.40) p = 0.0006	3.83 (1.06 – 13.84) <sup>1</sup> p = 0.04	0.04
Indian cuisine	0.17 (0.02 – 1.38) p = 0.06	0.32 (0.03 – 3.01) <sup>1</sup> p = 0.32	0.32
Small independent business > 1 site	5.50 (1.22 – 24.81) p = 0.01	4.04 (0.87 – 18.85) <sup>2</sup> p = 0.08	0.08
Open more than 10 hours continuously	4.67 (1.34 – 16.24) p = 0.008	3.17 (0.98 – 10.23) <sup>3</sup> p = 0.05	0.05
Meal for 2 < £21	0.08 (0.01 – 0.64) p = 0.002	0.06 (0.006 – 0.69) <sup>4</sup> p = 0.02	0.02

<sup>1</sup> adjusted for open more than 10 hours continuously, small independent business > 1 site

<sup>2</sup> adjusted for Chinese cuisine, Indian cuisine

<sup>3</sup> adjusted for Chinese cuisine, Indian cuisine

<sup>4</sup> adjusted for Chinese cuisine

**Table 29 Salmonella Enteritidis: Multivariate staff employment and structure (Food and Beverage and kitchen)**

		Adjusted for potential business characteristics confounders				
Risk Factor	Unadjusted	Adjusted for all other variables in the table	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
2 tiers of management before the kitchen manager	5.50 (1.22 – 24.81) p = 0.01	2.15 (0.25 – 18.83) p = 0.49	5.00 (1.00 – 24.99) p = 0.05	1.24 (0.20 – 7.75) p = 0.81	2.10 (0.40 – 11.09) p = 0.38	1.28 (0.21 – 7.89) p = 0.79
Owner/manager working in the kitchen	0.19 (0.07 – 0.55) p = 0.0007	0.28 (0.06 – 1.27) p = 0.10	0.25 (0.08 – 0.77) p = 0.02	0.37 (0.07 – 1.98) p = 0.24	0.22 (0.06 – 0.81) p = 0.02	0.64 (0.15 – 2.70) p = 0.54
Recruit agency kitchen staff	4.00 (0.85 – 18.84) p = 0.06	7.44 (0.73 – 754.95) p = 0.40	5.31 (1.02 – 27.50) p = 0.05	NB	4.73 (0.50 – 44.52) p = 0.17	3.34 (0.36 – 30.80) p = 0.29
All Kitchen Staff salaried	3.67 (1.02 – 13.14) p = 0.03	2.58 (0.42 – 15.85) p = 0.31				
KP wages above nat ave	5.50 (1.22 – 24.81) p = 0.01	8.09 (0.90 – 72.81) p = 0.06	5.78 (1.20 – 27.81) p = 0.02	NB	12.64 (1.87 – 85.26) p = 0.009	7.10 (0.63 – 80.02) p = 0.11
Recruit agency F&B staff	4.00 (0.85 – 18.84) p = 0.06	0.80 (0.01 – 78.40) p = 0.93				
F&B manager fulltime	5.67 (1.66 – 19.34) p = 0.002	2.24 (0.32 – 15.76) p = 0.42				
F&B staff fulltime	2.60 (0.93 – 7.29) p = 0.06	1.79 (0.27 – 11.93) p = 0.54				

NB: Numbers were too small to conduct conditional logistic regression

**Table 30 Salmonella Enteritidis: Multivariate staff management**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for potential business characteristics confounders			
			Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Pay staff for 1 <sup>st</sup> three days of sick leave	2.33 (0.90 – 6.07) p = 0.07	1.89 (0.66 – 5.40) p = 0.24				
Staff use customer toilets	3.20 (1.17 – 8.73) p = 0.02	2.39 (0.80 – 7.14) p = 0.12				
Provide staff accommodation	3.67 (1.02 – 13.14) p = 0.03	4.52 (0.93 – 22.02) p = 0.06	2.49 (0.62 – 9.88) p = 0.19	5.44 (0.95 – 31.27) p = 0.06	3.41 (0.91 – 12.71) p = 0.07	NB
Member of kitchen staff sick at time of outbreak or 14 days before	*	0.79 (0.06 – 10.90) p = 0.86	1.34 (0.11 – 16.62) p = 0.82	0.37 (0.01 – 9.16) p = 0.54	2.33 (0.16 – 33.14) p = 0.53	NB

\* Odds ratios unavailable where no cases or controls were exposed

NB Numbers were too small to conduct conditional logistic regression

**Table 31 Salmonella EEnteritidis: Multivariate Staff management - training**

			Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for other variables in the table	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
F&B training – tier 1 induction	3.00 (0.97 – 9.30) p = 0.05	4.00 (0.97 – 9.30) p = 0.06	2.61 (0.79 – 8.52) p = 0.11	1.90 (0.57 – 6.34) p = 0.30	2.93 (0.93 – 9.22) p = 0.07	2.52 (0.49 – 13.10) p = 0.27
F&B training – professional	*					

\* Odds ratios unavailable where no cases or controls were exposed

**Table 32 Salmonella Enteritidis: Multivariate operational practices – hot display Buffets**

Risk Factor	Unadjusted	Adjusted for potential business characteristics confounders				
		Adjusted for all hot display buffet variables	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Vegetables	3.25 (1.06 – 9.97) p = 0.03	0.19 (0.008 – 4.81) p = 0.32				
Shellfish	5.00 (1.10 – 22.82) p = 0.02	0.93 (0.06 – 13.15) p = 0.96				
Poultry	7.50 (1.72 – 32.80) p = 0.002	NB				
Red meat	7.00 (1.59 – 30.80) p = 0.003	9.70 (0.54 – 171.94) p = 0.12	9.20 (1.57 – 54.02) p = 0.01	3.45 (0.71 – 16.70) p = 0.12	5.24 (1.13 – 24.32) p = 0.03	NB
Eggs	6.00 (1.34 – 26.81) p = 0.01	3.23 (0.26 – 39.29) p = 0.36	4.35 (0.90 – 20.95) p = 0.07	2.80 (0.56 – 14.00) p = 0.21	4.38 (0.93 – 20.58) p = 0.06	NB
Rice/pasta	4.33 (1.23 – 15.21) p = 0.01	1.19 (0.03 – 44.59) p = 0.92				
Sauce	5.50 (1.22 – 24.81) p = 0.01	2.14 (0.28 – 16.18) p = 0.46	-	-		

NB Numbers were too small to conduct conditional logistic regression

**Table 33 Salmonella Enteritidis: Multivariate operational practices – Small functions < 20 people**

		Adjusted for potential business characteristics confounders				
Risk Factor	Unadjusted	Adjusted for all function variables	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Vegetables	4.33 (1.23 – 15.21) p = 0.01	NB				
Fish	3.67 (1.02 – 13.14) p = 0.03	# 0.90 (0.07 – 11.20) p = 0.94				
Shellfish	4.33 (1.23 – 15.21) p = 0.01	NB				
Red meat	3.25 (1.06 – 9.97) p = 0.03	# 1.60 (0.07 – 37.95) p = 0.77				
Rice/pasta	3.25 (1.06 – 9.97) p = 0.03	#1.60 (0.60 – 37.95) p = 0.77				
Sauce	5.50 (1.22 – 24.81) p = 0.01	#0.76 (0.04 – 14.40) p = 0.85				

# adjusted for rice, red meat, sauce and fish served in function 1

**Table 34 Salmonella Enteritidis: Multivariate operational practices – Regional suppliers**

		Adjusted for potential business characteristics confounders				
Risk Factor	Unadjusted	Adjusted for regional supplier eggs	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Eggs	7.00 (1.59 – 30.80) p = 0.003	#4.55 (0.94 – 22.13) p = 0.06	5.33 (1.16 – 24.49) p = 0.03	5.49 (0.99 – 30.43) p = 0.05	5.74 (1.24 – 26.40) p = 0.03	12.50 (1.44 – 108.63) p = 0.02
Red meat	9.00 (1.14 – 71.04) p = 0.01	3.83 (0.41 – 35.53) p = 0.24				
Milk	6.00 (0.72 – 49.84) p = 0.06	0.34 (0.07 – 1.73) p = 0.20				
Dairy products	7.00 (0.86 – 56.89) p = 0.03	2.17 (0.17 – 27.50) p = 0.54				
Salads	5.00 (0.58 – 42.80) p = 0.10	NB				

# adjusted for regional supplier of red meat

NB: Numbers were too small to conduct conditional logistic regression

**Table 35 Salmonella Enteritidis: Multivariate unusual events**

			Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for other variables in the table	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Relief manager at time of outbreak	9.00 (1.14 – 71.04) p = 0.01	7.47 (0.93 – 60.01) p = 0.06	7.44 (2.02 – 27.31) p = 0.002	2.00 (0.18 – 22.07) p = 0.57	2.37 (0.23 – 23.88) p = 0.46	NB
Unusual incident at time of outbreak	5.50 (1.22 – 24.81) p = 0.01	4.66 (1.01 – 21.41) p = 0.05	9.43 (1.34 – 66.36) p = 0.02	8.43 (0.83 – 85.66) p = 0.07	3.30 (0.65 – 16.74) p = 0.15	3.49 (0.38 – 31.81) p = 0.27
Food equipment not working at time of outbreak	5.00 (0.58 – 42.80) p = 0.10	NB	NB	NB	NB	NB
Change in menu at time of outbreak	0.20 (0.02 – 1.71)	NB	NB	NB	NB	NB
Change in menu preparation at time of outbreak	P = 0.05	NB	NB	NB	NB	NB
Promotions on offer at time of outbreak	P = 0.05	NB	NB	NB	NB	NB

NB: Numbers were too small to conduct conditional logistic regression

**Table 36 Salmonella EEnteritidis: Multivariate egg handling**

			Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for other egg variables	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Regional supplier of eggs	7.00 (1.59 – 30.80) p = 0.003	2.67 (0.49 – 14.64) p = 0.26	5.33 (1.16 – 24.49) p = 0.03	5.49 (0.99 – 30.43) p = 0.05	5.74 (1.24 – 26.40) p = 0.03	12.50 (1.44 – 108.63) p = 0.02
Batch cooking eggs	3.00 (0.81 – 11.08) p = 0.08	2.63 (0.45 – 15.48) p = 0.28	2.03 (0.49 – 8.46) p = 0.33	1.31 (0.24 – 7.11) p = 0.75	2.47 (0.61 – 9.910) p = 0.20	9.60 (0.67 – 137.35) p = 0.10
Refrigerating egg dishes	0.38 (0.14 – 1.08) p = 0.06	0.43 (0.12 – 1.51) p = 0.19	0.49 (0.17 – 1.47) p = 0.20	0.56 (0.16 – 1.96) p = 0.37	0.45 (0.15 – 1.37) p = 0.16	0.69 (0.19 – 2.48) p = 0.58
Eggs Hot Display Buffet	6.00 (1.34 – 26.81) p = 0.01	7.01 (0.84 – 58.31) p = 0.07	4.35 (0.90 – 20.95) p = 0.07	2.80 (0.56 – 14.01) p = 0.21	4.38 (0.93 – 20.58) p = 0.06	NB

NB: Numbers were too small to conduct conditional logistic regression

**Table 37 Salmonella Enteritidis: Multivariate hygiene variables**

			Adjusted for potential business characteristics confounders			
Risk Factor	Unadjusted	Adjusted for eggs in a hot display buffet	Chinese cuisine	Business size	Open for more than 10 hours continuously	Meal for 2 <£21
Food prepared differently from regular menu	Unmatched: 0.10 (0.01 – 0.90) p = 0.02	NB	NB	NB	NB	NB
Buffet containers topped up	Unmatched: 11.67 (1.28 – 106.79) p = 0.02	NB	NB	NB	NB	NB
Separate cleaning equipment	0.33 (0.11 – 1.03) p = 0.05	0.43 (0.12 – 1.50) p = 0.18	0.31 (0.09 – 1.05) p = 0.06	0.17 (0.03 – 0.91) p = 0.04	0.39 (0.12 – 1.28) p = 0.12	0.36 (0.08 – 1.55) p = 0.17
Cooling water used in cooking range	4.67 (1.34 – 16.24) p = 0.008	3.39 (0.84 – 13.55) p = 0.09	4.67 (1.34 – 16.23) p = 0.02	4.14 (0.85 – 20.34) p = 0.08	4.46 (1.24 – 15.92) p = 0.02	6.51 (0.70 – 61.11) p = 0.10
Business extended its accommodation	0.30 (0.08 – 1.09) p = 0.05	0.83 (0.31 – 2.20) p = 0.70	1.19 (0.48 – 3.01) p = 0.70	0.72 (0.25 – 2.02) p = 0.52	1.16 (0.49 – 2.80) p = 0.73	1.89 (0.48 – 7.40) p = 0.36

NB Numbers were too small to conduct conditional logistic regression

**Table 38 Bacterial outbreaks: Business characteristics**

<b>Variable</b>	<b>Proportion of matched cases exposed</b>	<b>Proportion of matched controls exposed</b>	<b>Matched odds ratio (95% C.I.)</b>	<b>P value</b>
Pub/bar	4/90 (4%)	11/90 (12%)	0.13 (0.02 – 1.00)	0.02
Chinese cuisine	23/90 (26%)	7/90 (8%)	5.00 (1.71 – 14.63)	0.001
Serve dinner	51/58 (88%)	41/58 (71%)	3.50 (1.15 – 10.63)	0.02
Open 10hrs continuously	29/58 (50%)	19/58 (33%)	2.67 (1.04 – 6.81)	0.03

N.B. Tables 38 – 43 only identify management risk factors for bacterial outbreaks significant at the 10% level.

**Table 39 Bacterial outbreaks: Staff employment and structure**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Owner/kitchen manager working in the kitchen	22/90 (24%)	39/90 (43%)	0.35 (0.16 – 0.74)	0.004
2 tiers of management before the kitchen manager	17/90 (19%)	8/90 (9%)	2.80 (1.01 – 7.77)	0.04
Food and Beverage Tier 2 professional	4/58 (7%)	0/58 (0%)	NB	0.06
Food and Beverage Tier 1 fulltime	39/58 (67%)	26/48 (45%)	2.63 (1.16 – 5.93)	0.02
Food and Beverage team full time	22/58 (38%)	12/58 (21%)	2.43 (1.01 – 5.86)	0.04
All staff salaried	17/58 (29%)	9/57 (16%)	3.00 (0.97 – 9.30)	0.05
Food and beverage recruit agency staff	18/90 (20%)	8/90 (9%)	3.50 (1.15 – 10.63)	0.02
Food and beverage recruit agency staff	17/90 (19%)	6/90 (7%)	3.75 (1.24 – 11.30)	0.01
Food and beverage require professional qualifications	6/90 (7%)	1/90 (1%)	6.00 (0.72 – 49.84)	0.06
Head chef wages above national average	26/58 (45%)	14/58 (24%)	2.33 (1.07 – 5.09)	0.03
Kitchen porter paid above national average	17/58 (29%)	5/58 (9%)	5.00 (1.45 – 17.27)	0.005

NB. Insufficient data to conduct matched analysis

**Table 40 Bacterial outbreaks: Staff management**

<b>Variable</b>	<b>Proportion of matched cases exposed</b>	<b>Proportion of matched controls exposed</b>	<b>Matched odds ratio (95% C.I.)</b>	<b>P value</b>
Staff use guest WC	32/58 (55%)	18/58 (31%)	3.33 (1.34 – 8.30)	0.006
Provide staff accommodation	15/58 (26%)	6/58 (10%)	3.25 (1.06 – 9.97)	0.03
Kitchen staff sick at work, sick leave or family with D&V	4/58 (7%)	0/58 (0%)	NB	0.06
Any member of staff sick	10/58 (17%)	2/58 (3%)	4.75 (1.62 – 13.96)	0.002

NB. Insufficient data to conduct matched analysis

**Table 41 Bacterial outbreaks: Operational practices**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Veg small function	25/58 (43%)	13/58 (22%)	4.00 (1.34 – 11.96)	0.007
Veg hot display buffet	27/58 (47%)	16/58 (28%)	3.75 (1.24 – 11.30)	0.01
Fish small function	20/58 (34%)	11/58 (19%)	3.25 (1.06 – 9.97)	0.03
Fish large function	20/58 (34%)	12/58 (21%)	2.14 (0.87 – 5.26)	0.09
Shellfish small function	15/58 (26%)	10/58 (17%)	3.00 (1.09 – 8.25)	0.03
Shellfish hot display buffet	15/58 (26%)	5/58 (9%)	6.00 (1.34 – 26.81)	0.008
Poultry prepared and cooked from raw	41/58 (71%)	28/58 (48%)	3.60 (1.34 – 9.70)	0.007
Poultry served	56/58 (97%)	48/58 (83%)	5.00 (1.10 – 22.82)	0.02
Poultry small function	25/58 (43%)	14/58 (24%)	3.75 (1.25 – 11.30)	0.01
Poultry hot display buffet	29/58 (50%)	13/58 (22%)	9.00 (2.09 – 38.79)	0.003
Red meat hot display buffet	29/58 (50%)	14/58 (24%)	8.50 (1.96 – 36.79)	<0.001
Red meat small function	25/58 (43%)	12/58 (21%)	4.25 (1.43 – 12.63)	0.005
Red meat large function	25/58 (43%)	15/58 (26%)	2.11 (0.96 – 4.67)	0.06
Red meat prepared and cooked from raw	41/58 (71%)	31/58 (53%)	3.50 (1.15 – 10.63)	0.02
Eggs hot display buffet	18/58 (31%)	9/58 (16%)	4.00 (1.13 – 14.17)	0.02
Rice pasta Reheat to order	25/58 (43%)	14/58 (24%)	2.83 (1.12 – 7.19)	0.02
Rice pasta small function	22/58 (38%)	12/58 (21%)	2.67 (1.04 – 6.81)	0.03
Rice pasta hot display buffet	26/58 (45%)	15/58 (26%)	3.75 (1.24 – 11.30)	0.01
Ice cream served	53/58 (91%)	41/58 (71%)	5.00 (1.45 – 17.27)	0.005
Ice cream small function	7/58 (12%)	2/58 (3%)	3.50 (0.72 – 16.85)	0.10
Sauce small function	19/58 (33%)	10/58 (17%)	4.00 (1.13 – 14.17)	0.02
Sauce hot display buffet	19/58 (33%)	8/58 (14%)	4.67 (1.34 – 16.24)	0.008
Sauce partially prepared	18/58 (31%)	9/58 (16%)	4.00 (1.13 – 14.17)	0.02
Bread/cakes served	42/58 (72%)	50/58 (86%)	0.43 (0.16 – 1.12)	0.07
Fruit small function	13/58 (22%)	6/58 (10%)	3.33 (0.92 – 12.11)	0.05
Fruit cold display buffet	10/58 (17%)	3/58 (5%)	8.00 (1.00 – 63.96)	0.02
Deserts small function	17/58 (29%)	10/58 (17%)	2.75 (0.88 – 8.64)	0.07
Branded ready made meals reheat to order	3/58 (5%)	1/58 (1%)	NB	0.16
Regional red meat supplier	17/55 (31%)	6/51 (12%)	10.00 (1.28 – 78.12)	0.007
Regional poultry supplier	18/55 (33%)	5/49 (10%)	5.50 (1.22 – 24.81)	0.01
National poultry supplier	15/55 (27%)	20/49 (41%)	0.36 (0.12 – 1.14)	0.07
National eggs	12/56 (21%)	20/53 (38%)	0.33 (0.11 – 1.03)	0.05

supplier				
Regional eggs supplier	21/56 (38%)	4/53 (8%)	8.00 (1.84 – 34.79)	0.001
Regional dairy product supplier	11/51 (22%)	2/48 (4%)	4.50 (0.97 – 20.83)	0.04
Local game supplier	5/12 (42%)	11/13 (85%)	NB	0.32
National sandwich supplier	7/9 (78%)	3/9 (33%)	NB	NB
Food collected from supplier	14/58 (24%)	28/58 (48%)	0.26 (0.10 – 0.70)	0.004

NB. Insufficient data to conduct matched analysis

**Table 42 Bacterial outbreaks: Unusual events**

<b>Variable</b>	<b>Proportion of matched cases exposed</b>	<b>Proportion of matched controls exposed</b>	<b>Matched odds ratio (95% C.I.)</b>	<b>P value</b>
Relief manager	13/90 (14%)	1/90 (1%)	13.00 (1.70 – 99.37)	0.001
Unusual incident	23/90 (26%)	7/90 (8%)	6.33 (1.87 – 21.40)	0.001
Food Preparation Equipment not working	7/90 (8%)	1/90 (1%)	7.00 (0.86 – 56.90)	0.03
Change in menu preparation	10/90 (11%)	0/90 (0%)	NB	0.002
Promotions offer	10/90 (11%)	2/90 (2%)	5.00 (1.10 – 22.82)	0.02

NB. Insufficient data to conduct matched analysis

**Table 43 Bacterial outbreaks: Other factors**

Variable	Proportion of matched cases exposed	Proportion of matched controls exposed	Matched odds ratio (95% C.I.)	P value
Meal for 2 for <£21	21/47 (45%)	41/49 (84%)	0.12 (0.03 – 0.51)	0.001
Good relationship with EHO	51/58 (88%)	57/58 (98%)	0.14 (0.02 – 1.16)	0.03

**Table 44 Bacterial outbreaks: Multivariate business characteristics**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>
Pub/bar	0.13 (0.02 – 1.00) p = 0.02	0.29 (0.006 – 14.03) P = 0.53
Chinese cuisine	5.00 (1.71 – 14.63) p = 0.001	2.28 (0.46 – 11.22) P = 0.31
Serve dinner	3.50 (1.15 – 10.63) p = 0.02	1.08 (0.19 – 6.31) P = 0.93
Open over 10 hours continuously	2.67 (1.04 – 6.81) p = 0.03	1.85 (0.38 – 9.04) P = 0.45
Meal for 2 <£21	0.12 (0.03 – 0.51) p < 0.01	0.13 (0.02 – 0.68) P = 0.02

**Table 45 Bacterial outbreaks: Multivariate staff structure (Kitchen and F&B)**

Risk Factor	Unadjusted	Adjusted for F&B variables	Adjusted for kitchen variables	Adjusted for meal for 2 <£21	Adjusted for business size
Owner/manager working in the kitchen	0.35 (0.16 – 0.74) p = 0.004	0.29 (0.09 – 0.91) <sup>1</sup> p = 0.03	0.30 (0.10 – 0.96) p = 0.04 <sup>2</sup>	0.59 (0.19 – 1.91) p = 0.40	0.52 (0.15 – 1.63) p = 0.25
2 tiers of management before the kitchen	2.80 (1.01 – 7.77) p = 0.004	0.76 (0.18 – 3.26) <sup>1</sup> p = 0.71	0.86 (0.16 – 4.43) p = 0.86 <sup>2</sup>	0.73 (0.15 – 3.61) p = 0.70	0.58 (0.12 – 2.73) p = 0.49

<sup>1</sup> Adjusted for use of food and beverage agency staff, require food and beverage professional qualifications, food and beverage manager full time, food and beverage team full time

<sup>2</sup> Adjusted for use of kitchen agency staff, head chef wages above national average, kitchen porter wages above national average, all staff salaried.

**Table 46 Bacterial outbreaks: Multivariate Staff employment (F&B)**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for all other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
F&B agency staff recruited	3.75 (1.24 – 11.30) p = 0.01	8.96 (0.88 – 90.79) p = 0.06	3.50 (0.39 – 31.65) p = 0.27	24.15 (1.36 – 428.05) p = 0.03
F&B require professional qualifications	6.00 (0.72 – 49.84) p = 0.06	1.71 (0.14 – 20.45) p = 0.67	1.00 (0.01 – 91.46) p = 1.00	2.02 (0.18 – 22.10) p = 0.57
F&B manager full time	2.63 (1.16 – 5.93) p = 0.02	2.06 (0.74 – 5.77) p = 0.17	1.38 (0.43 – 4.40) p = 0.58	1.94 (0.79 – 4.81) p = 0.15
F&B team full time	2.43 (1.01 – 5.86) p = 0.04	1.87 (0.57 – 6.13) p = 0.30	1.91 (0.53 – 6.93) p = 0.32	1.81 (0.64 – 5.12) p = 0.26

**Table 47 Bacterial outbreaks: Multivariate staff employment (Kitchen)**

Risk Factor	Unadjusted	Adjusted for all other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Kitchen agency staff recruited	3.50 (1.15 – 10.63) p = 0.02	2.47 (0.44 – 13.83) p = 0.30	1.60 (0.28 – 9.12) p = 0.60	7.12 (1.04 – 48.62) p = 0.05
Head chef wages above national average	2.33 (1.07 – 5.09) p = 0.03	1.93 (0.76 – 4.92) p = 0.16	1.65 (0.51 – 5.37) p = 0.41	1.60 (0.66 – 3.84) p = 0.30
Kitchen porter wages above national average	5.00 (1.45 – 17.27) p = 0.005	4.20 (1.08 – 16.32) p = 0.04	3.68 (0.77 – 17.72) p = 0.10	8.19 (1.58 – 42.41) p = 0.01
All kitchen staff salaried	3.00 (0.97 – 9.30) p = 0.05	3.31 (0.97 – 11.30) p = 0.06	0.66 (0.12 – 3.78) p = 0.64	2.57 (0.68 – 9.73) p = 0.16

**Table 48 Bacterial outbreaks: Multivariate staff management**

Risk Factor	Unadjusted	Adjusted for all other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Staff use guest WC	3.33 (1.34 – 8.30) p = 0.006	3.31 (1.05 – 10.48) p = 0.04	9.07 (1.58 – 51.98) p = 0.01	2.96 (1.09 – 8.03) p = 0.03
Provide staff accommodation	3.25 (1.06 – 9.97) p = 0.03	3.11 (0.78 – 12.37) p = 0.11	6.72 (0.82 – 55.25) p = 0.08	3.20 (0.82 – 12.61) p = 0.10
Any member of staff sick	4.75 (1.62 – 13.96) p = 0.002	17.65 (2.13 – 146.22) p = 0.008	8.65 (1.10 – 68.28) p = 0.04	10.26 (1.32 – 79.85) p = 0.03

NB Insufficient data to include Kitchen staff sick at work, sick leave or family with D&V

**Table 49 Bacterial outbreaks: Multivariate Operational practices – Vegetables**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Vegetables small function	4.00 (1.34 – 11.96) p = 0.007	4.03 (1.28 – 12.63) p = 0.02	8.45 (1.06 – 66.96) p = 0.04	6.03 (1.47 – 24.81) p = 0.01
Vegetables hot display buffet	3.75 (1.24 – 11.30) p = 0.01	3.77 (1.18 – 12.04) p = 0.03	1.11 (0.88 – 57.49) P = 0.07	2.25 (0.65 – 7.78) p = 0.20

NB Food types have been grouped together

**Table 50 Bacterial outbreaks: Multivariate Operational practices - Fish**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Fish small function	3.25 (1.06 – 9.97) p = 0.03	2.65 (0.79 – 8.93) p = 0.12	5.12 (0.96 – 27.25) p = 0.06	3.52 (0.98 – 12.61) p = 0.05
Fish large function	2.14 (0.87 – 5.26) p = 0.09	1.51 (0.56 – 4.12) p = 0.41	2.47 (0.73 – 8.36) p = 0.73	1.81 (0.67 – 4.91) p = 0.24

**Table 51 Bacterial outbreaks: Multivariate Operational practices – shellfish**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Shellfish small function	3.00 (1.09 – 8.25) p = 0.03	2.02 (0.69 – 5.99) p = 0.20	5.77 (1.12 – 29.58) p = 0.04	3.83 (1.10 – 13.27) p = 0.03
Shellfish hot display buffet	6.00 (1.34 – 26.81) p = 0.008	4.41 (0.92 – 21.00) p = 0.06	NB	3.45 (0.72 – 16.50) p = 0.12

**Table 52 Bacterial outbreaks: Multivariate Operational practices - Poultry**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Poultry prepared and cooked from raw	3.60 (1.34 – 9.70) p = 0.007	1.28 (0.31 – 5.35) p = 0.74	2.96 (0.73 – 11.95) p = 0.13	3.01 (1.00 – 9.09) p = 0.05
Poultry served	5.00 (1.10 – 22.82) p = 0.02	2.67 (0.36 – 19.86) p = 0.34	3.16 (0.34 – 29.61) p = 0.32	3.33 (0.69 – 16.02) p = 0.13
Poultry small function	3.75 (1.25 – 11.30) p = 0.01	4.32 (1.07 – 17.49) p = 0.04	4.24 (0.91 – 19.71) p = 0.07	5.58 (1.33 – 23.29) p = 0.02
Poultry hot display buffet	9.00 (2.09 – 38.79) p = 0.003	9.89 (1.94 – 50.25) p = 0.006	NB	4.50 (0.97 – 20.83) P = 0.03

**Table 53 Bacterial outbreaks: Multivariate Operational practices – red meat**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Red meat prepared and cooked from raw	3.50 (1.15 – 10.63) p = 0.02	2.04 (0.60 – 6.95) p = 0.25	4.04 (0.73 – 22.17) p = 0.11	3.20 (0.91 – 11.32) p = 0.07
Red meat small function	4.25 (1.43 – 12.63) p = 0.005	5.82 (1.36 – 24.94) p = 0.02	4.34 (0.94 – 20.08) p = 0.06	6.02 (1.48 – 24.46) p = 0.01
Red meat large function	2.11 (0.96 – 4.67) p = 0.06	0.53 (0.15 – 1.86) p = 0.32	3.02 (0.93 – 9.84) p = 0.07	1.87 (0.76 – 4.66) p = 0.17
Red meat hot display buffet	8.50 (1.96 – 36.79) p < 0.001	15.71 (1.90 – 130.00) p = 0.01	NB	4.81 (1.04 – 22.09) p = 0.04

**Table 54 Bacterial outbreaks: Multivariate Operational practices  
– Rice/pasta**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Rice/pasta reheated to order	2.83 (1.12 – 7.19) p = 0.02	2.40 (0.83 – 6.95) p = 0.11	1.32 (0.39 – 4.50) p = 0.65	3.18 (1.09 – 9.28) p = 0.03
Rice/pasta hot display buffet	3.75 (1.24 – 11.30) p = 0.01	3.64 (1.12 – 11.85) p = 0.03	4.72 (0.91 – 24.63) p = 0.07	2.25 (0.65 – 7.78) p = 0.20
Rice small function	2.67 (1.04 – 6.81) p = 0.03	1.97 (0.71 – 5.47) p = 0.19	3.27 (0.82 – 13.03) p = 0.09	3.51 (1.07 – 11.53) p = 0.04

**Table 55 - Bacterial outbreaks: Multivariate Operational practices Eggs**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Eggs hot display buffet	4.00 (1.13 – 14.17) p = 0.02	n/a	5.67 (0.68 – 47.06) p = 0.11	1.99 (0.50 – 7.88 ) p = 0.32

**Table 56 Bacterial outbreaks: Multivariate Operational practices – Ice cream**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Ice cream served	5.00 (1.45 – 17.27) p = 0.005	4.79 (1.38 – 16.59) p = 0.01	2.96 (0.60 – 14.55) p = 0.18	3.10 (0.85 – 11.35) p = 0.09
Ice cream small function	3.50 (0.72 – 16.85) p = 0.10	3.12 (0.64 – 15.30) p = 0.16	9.58 (0.85 – 108.50) p = 0.07	15.94 (1.37 – 185.21) p = 0.03

**Table 57 Bacterial outbreaks: Multivariate Operational practices – Sauce**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for business size
Sauce small function	4.00 (1.13 – 14.17) p = 0.02	3.72 (0.80 – 17.45) p = 0.10	6.47 (0.79 – 52.81) p = 0.08	8.49 (1.37 – 52.70) p = 0.02
Sauce hot display buffet	4.67 (1.34 – 16.24) p = 0.008	6.24 (1.45 – 26.83) p = 0.01	7.65 (0.96 – 61.21) p = 0.06	2.71 (0.73 – 10.12) p = 0.14
Sauce partially prepared	4.00 (1.13 – 14.17) P = 0.02	3.16 (0.75 – 13.28) p = 0.12	NB	5.02 (0.98 – 25.60) p = 0.05

**Table 58 - Bacterial outbreaks: Multivariate Operational practices  
- Dessert**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Dessert small function	2.75 (0.88 – 8.64) p = 0.07	n/a	3.18 (0.65 – 22.18) p = 0.14	8.44 (1.55 – 45.89) p = 0.01

**Table 59 Bacterial outbreaks: Multivariate Operational practices – Fruit**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for other variables in the table</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Fruit small function	3.33 (0.92 – 12.11) p = 0.05	3.85 (0.92 – 15.44) p = 0.06	5.14 (0.61 – 43.64) p = 0.13	4.23 (0.92 – 19.48) p = 0.06
Fruit cold display buffet	8.00 (1.00 – 63.96) p = 0.02	9.30 (1.08 – 79.79) p = 0.04	NB	6.96 (0.58 – 83.42) p = 0.13

**Table 60 Bacterial outbreaks: Multivariate Operational practices  
– Regional suppliers**

Risk Factor	Unadjusted	Adjusted for other variables in the table <sup>1</sup>	Adjusted for meal for 2 <£21	Adjusted for collecting food from the supplier	Adjusted for business size
Red meat regional supplier	10.00 (1.28 – 78.12) p = 0.007	1.27 (0.04 – 38.69) p = 0.88	3.79 (0.42 – 33.74) p = 0.23	10.05 (1.19 – 84.69) p = 0.03	5.00 (0.59 – 42.41) p = 0.14
Poultry regional supplier	5.50 (1.22 – 24.81) P = 0.01	1.80 (0.15 – 21.54) p = 0.64	2.26 (0.42 – 11.92) p = 0.34	4.88 (1.04 – 22.73) p = 0.04	3.10 (0.63 – 15.17) p = 0.16
Egg regional supplier	8.00 (1.84 – 34.79) p = 0.001	3.42 (0.55 – 21.44) p = 0.19	9.91 (1.68 – 58.39) p = 0.01	7.95 (1.67 – 37.88) p = 0.009	6.40 (1.29 – 31.55) p = 0.02
Dairy regional supplier	4.50 (0.97 – 20.83) P = 0.04	1.37 (0.20 – 9.45) p = 0.75	4.71 (0.55 – 40.38) p = 0.16	3.38 (0.70 – 16.35) p = 0.11	2.16 (0.41 – 11.44) p = 0.37

<sup>1</sup> Egg regional supplier adjusted for chicken regional supplier and red meat regional supplier only, adjusted odds ratio = 5.32 (1.11 – 24.63) p = 0.04.

**Table 61 Bacterial outbreaks: Multivariate Operational practices – national suppliers**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for meal for 2 <£21	Adjusted for collecting food from the supplier	Adjusted for business size
Egg national supplier	0.33 (0.11 – 1.03) P = 0.05	NB	0.46 (0.11 – 1.81) p = 0.27	0.38 (0.12 – 1.25) p = 0.11	0.43 (0.11 – 1.67) p = 0.23
Poultry national supplier	0.36 (0.12 – 1.14)	NB	0.38 (0.07 – 2.01) p = 0.26	0.44 (0.13 – 1.44) p = 0.18	0.54 (0.15 – 1.94) p = 0.35
Fresh Herbs national supplier	1.80 (0.60 – 5.37) P = 0.29	NB	0.70 (0.16 – 3.01) p = 0.63	1.87 (0.60 – 5.80) p = 0.28	4.38 (0.92 – 20.76) p = 0.06
Sandwiches national supplier	NB	NB	NB	NB	NB

**Table 62 Bacterial outbreaks: Multivariate – unusual events**

Risk Factor	Unadjusted	Adjusted for other variables in the table	Adjusted for relief manager	Adjusted for meal for 2 <£21
Food production equipment not working at the time of outbreak <sup>1</sup>	7.00 (0.86 – 56.90) p = 0.03	5.40 (0.65 – 45.25) p = 0.12	15.62 (1.15 – 211.83) p = 0.04	NB
Promotions on offer at the time of outbreak <sup>1</sup>	5.00 (1.10 – 22.82) p = 0.02	4.89 (0.97 – 24.71) p = 0.06	4.11 (0.88 – 19.21) p = 0.07	NB
Unusual incident at the time of outbreak <sup>1</sup>	6.33 (1.87 – 21.40) P = 0.001	5.74 (1.62 – 20.28) p = 0.007	5.15 (1.50 – 17.74) p = 0.009	5.12 (0.61 – 43.36) p = 0.13

<sup>1</sup> Could not adjust for business size due to insufficient data

**Table 63 Bacterial outbreaks: Multivariate - unusual events**

<b>Risk Factor</b>	<b>Unadjusted</b>	<b>Adjusted for food production equipment not working</b>	<b>Adjusted for promotion</b>	<b>Adjusted for unusual event</b>	<b>Adjusted for owner/manager working in the kitchen</b>	<b>Adjusted for meal for 2 &lt;£21</b>	<b>Adjusted for business size</b>
Relief manager at the time of outbreak	13.00 (1.70 - 99.37) p = 0.001	21.46 (2.07 – 221.93) p = 0.01	11.52 (1.49 – 88.72) p = 0.02	9.84 (1.26 – 76.66) p = 0.03	18.16 (2.20 – 149.49) p = 0.007	NB	2.18 (0.21 – 22.74) p = 0.51

**Table 64 Summary of management risk factors and management protective factors identified in the logistic regression analyses**

<b>MANAGEMENT RISK FACTORS</b>					
	<b>Business characteristics</b>	<b>Staff structure &amp; employment</b>	<b>Staff management</b>	<b>Operational practices</b>	<b>Unusual events</b>
<b>All foodborne disease outbreaks</b>	Hotel Serving dinner	Use of casual staff Fulltime kitchen staff	Provision of staff accommodation Member of staff sick Kitchen Mgr with intermediate food hygiene training	Poultry dishes cooked and prepared from raw Shellfish and poultry dishes served from a hot display buffet Regional egg suppliers	Use of a relief manager Change in menu preparation
<b>Foodborne disease outbreaks attributed to S. Enteritidis</b>	Serving Chinese cuisine Open for 10 hrs continuously	Kitchen porter's wages above national average.		Egg dishes served on a hot display buffet Regional egg supplier Cooling water used in the cooking range	
<b>Bacterial foodborne disease outbreaks</b>		Kitchen porter's wages above national average.	Provision of staff accommodation Member of staff sick	Poultry and red meat dishes served at small functions Poultry and red meat dishes served from a hot display buffet Regional egg supplier	Use of a relief manager
<b>MANAGEMENT PROTECTIVE FACTORS</b>					
	<b>Business characteristics</b>	<b>Staff structure &amp; employment</b>	<b>Staff management</b>	<b>Operational practices</b>	<b>Unusual events</b>
<b>All foodborne disease outbreaks</b>	Meal for 2 <£21	Owner/manager working in the kitchen		Food collected directly from the supplier	
<b>Foodborne disease outbreaks attributed to S. Enteritidis</b>	Meal for 2 <£21				
<b>Bacterial foodborne disease outbreaks</b>	Meal for 2 <£21				

**Table 65 Business Characteristics: Model 1**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Dinner	1.38 (0.39 – 4.89)	0.62
Meal for 2 for <£21	0.16 (0.05 – 0.49)	0.001

**Table 66 Staff Structure and Employment: Model 2**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Use of casual staff	3.22 (1.39 – 7.46)	0.006
Kitchen staff employed fulltime	3.68 (1.54 – 8.79)	0.003
Owner/manager working in kitchen	0.29 (0.11 – 0.75)	0.01

**Table 67 Staff Structure and Employment: Model 3**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Use of casual staff	3.37 (1.40 – 8.11)	0.007
Kitchen staff employed fulltime	3.93 (1.56 – 9.96)	0.004
Owner/manager working in kitchen	0.28 (0.11 – 0.74)	0.01
Relief manager at the time of outbreak	8.44 (0.89 – 79.80)	0.06

**Table 68 Staff Management: Model 4**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Provision of staff accommodation	3.12 (0.96 – 10.09)	0.06
Kitchen manager trained to intermediate food hygiene	2.69 (0.90 – 8.03)	0.08
Staff sick at the time of outbreak	21.32 (2.58 – 176.30)	0.005

**Table 69 Staff Management: Model 5**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Provision of staff accommodation	3.44 (0.99 – 11.90)	0.05
Kitchen manager trained to intermediate food hygiene	2.33 (0.76 – 7.14)	0.14
Staff sick at the time of outbreak	21.87 (2.63 – 181.57)	0.004
Owner/manager working in kitchen	0.32 (0.12 – 0.88)	0.03

**Table 70 Staff Management: Model 6**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Provision of staff accommodation	6.11 (1.09 – 34.25)	0.04
Staff sick at the time of outbreak	39.09 (2.46 – 620.35)	0.009
Owner/manager working in kitchen	0.86 (0.24 – 3.03)	0.81
Meal for 2 <£21	0.11 (0.02 – 0.54)	0.006

**Table 71      Operational Practices: Model 7**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Poultry prepared and cooked from raw	1.99 (0.77 – 5.16)	0.56
Poultry hot display buffet	1.95 (0.55 – 6.88)	0.30
Shellfish hot display buffet	4.88 (0.55 – 43.57)	0.16
Regional egg supplier	3.33 (1.07 – 10.40)	0.04
Food collected from supplier	0.58 (0.23 – 1.44)	0.24
Change in menu preparation	3.68e+15 (not calculated)	1.00

**Table 72 Inter Group Comparisons: Model 8**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Use of casual staff	2.44 (0.89 – 6.69)	0.08
Kitchen staff employed fulltime	2.70 (0.99 – 7.38)	0.05
Owner/manager working in kitchen	0.60 (0.19 – 1.88)	0.38
Meal for 2 <£21	0.23 (0.07 – 0.72)	0.01

**Table 73 Inter Group Comparisons: Model 9**

<b>Variable</b>	<b>Adjusted for other variables in model</b>	<b>P value</b>
Staff sick at the time of outbreak	38.77 (2.42 – 621.18)	0.01
Provision of staff accommodation	6.18 (1.11 – 34.48)	0.04
Meal for 2 <£21	0.11 (0.02 – 0.50)	0.004



# FIGURES

Figure 1 Temporal Distribution

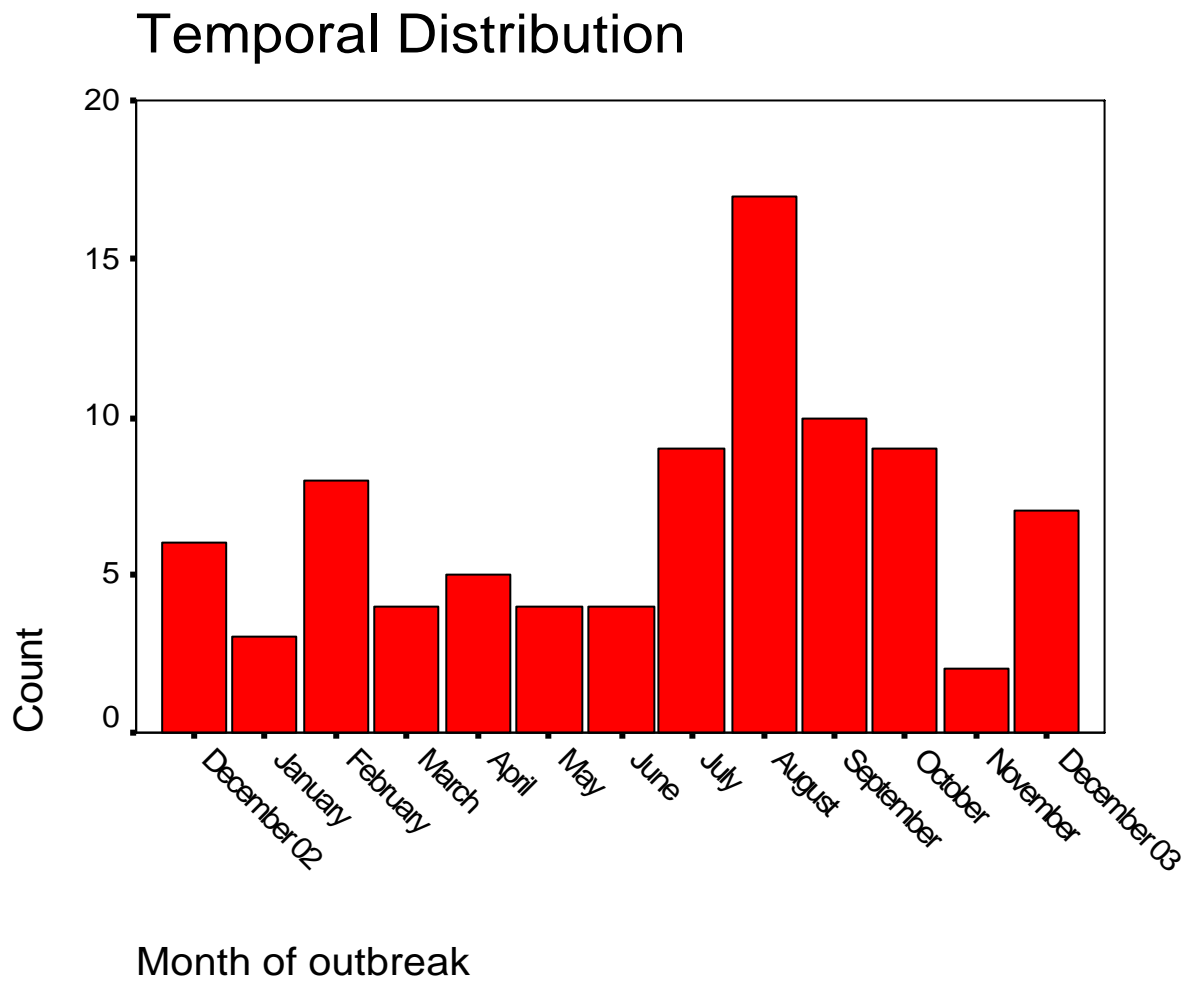


Figure 2 Causative Pathogen

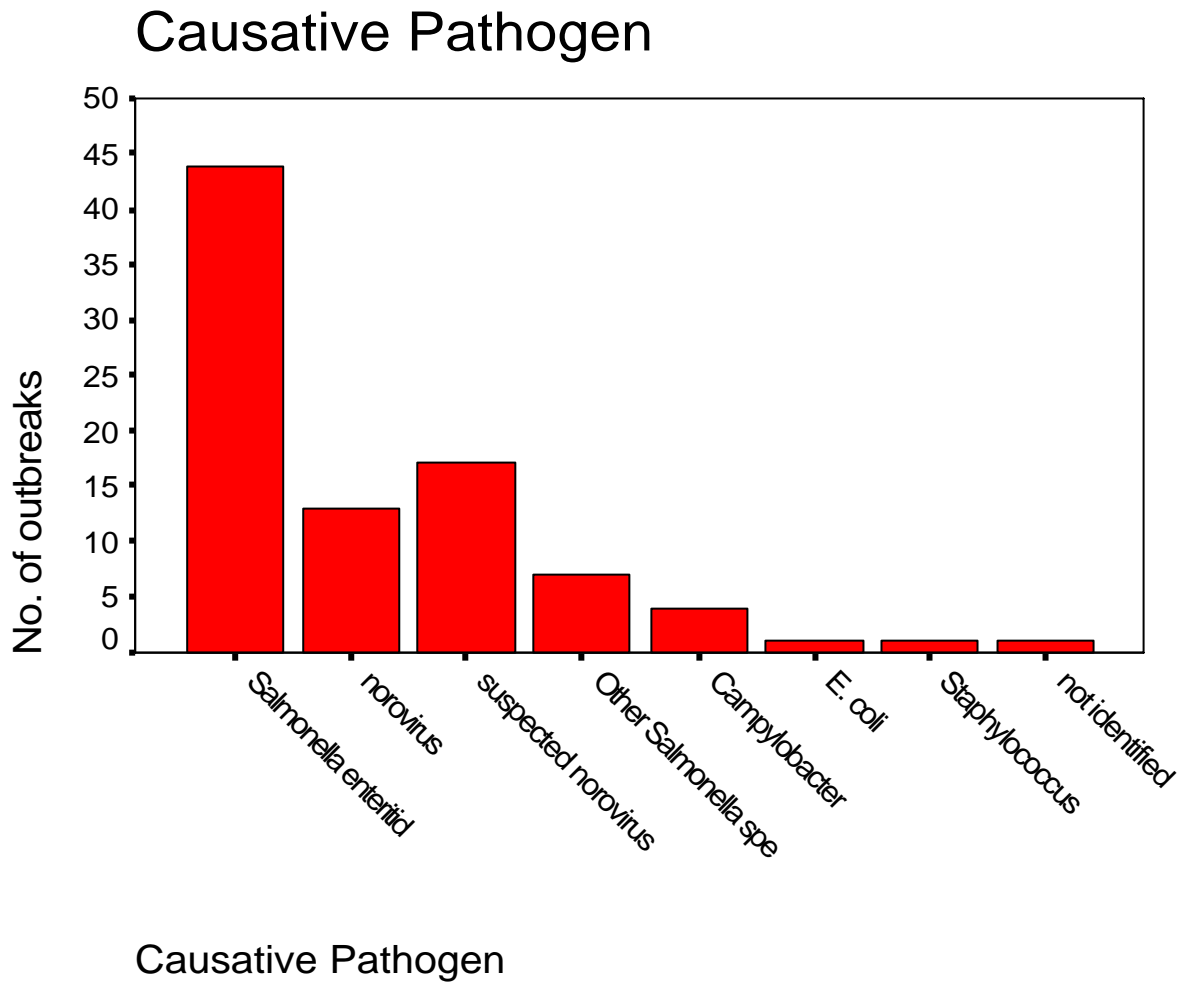
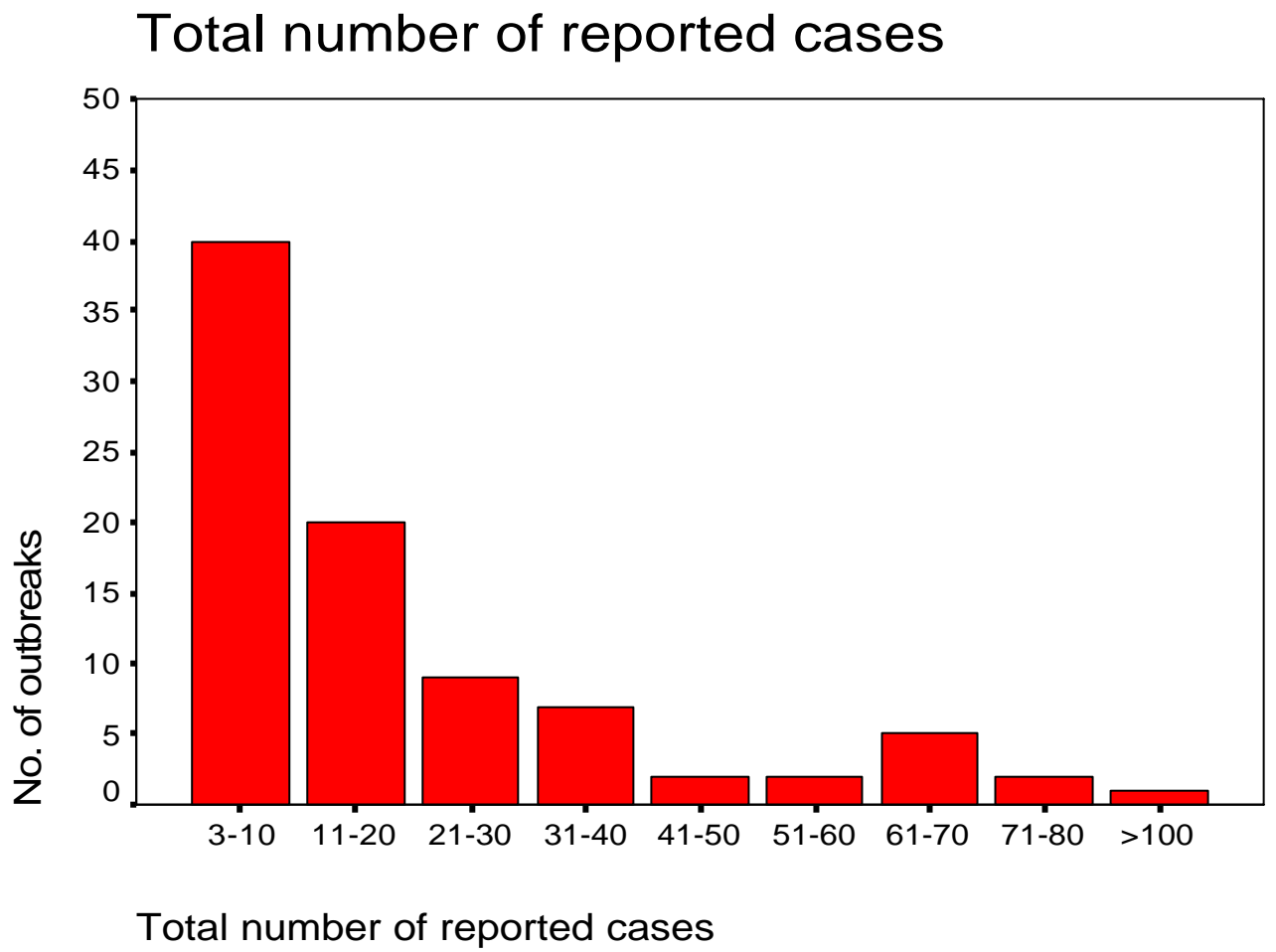


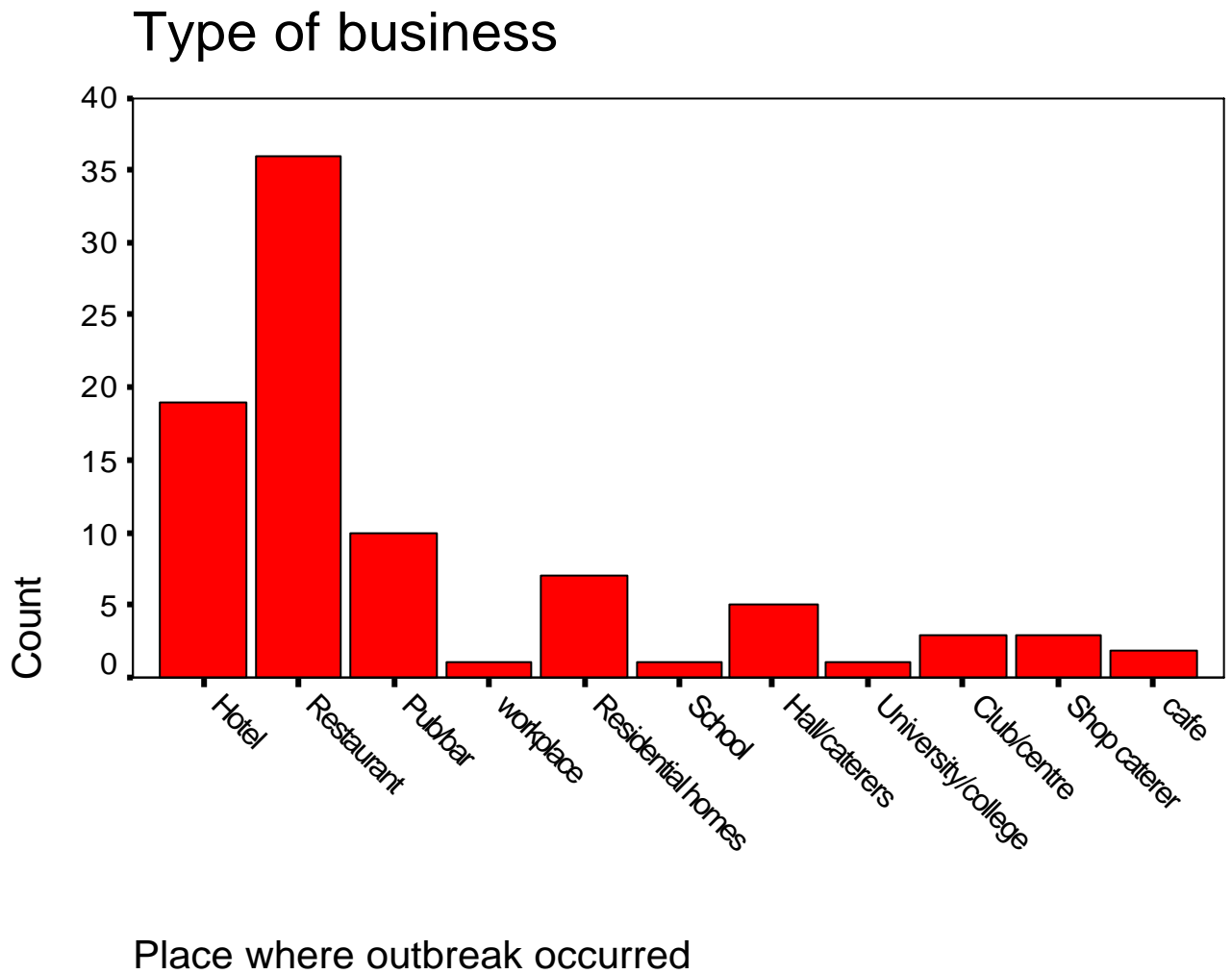
Figure 3 Total Number of Reported Cases



**Figure 4** Geographical distribution of main study outbreaks

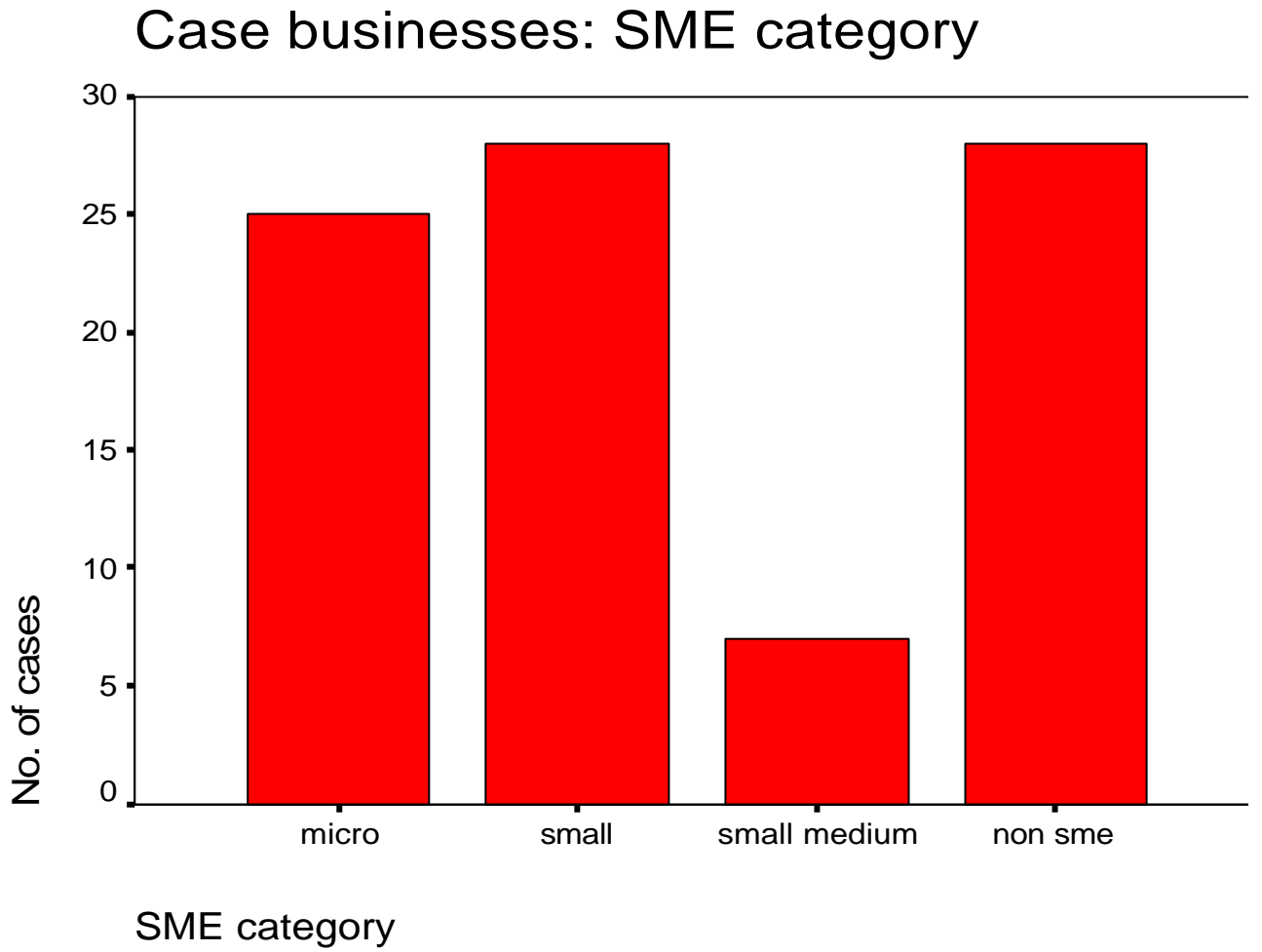


Figure 5 Case Businesses: Type of Business

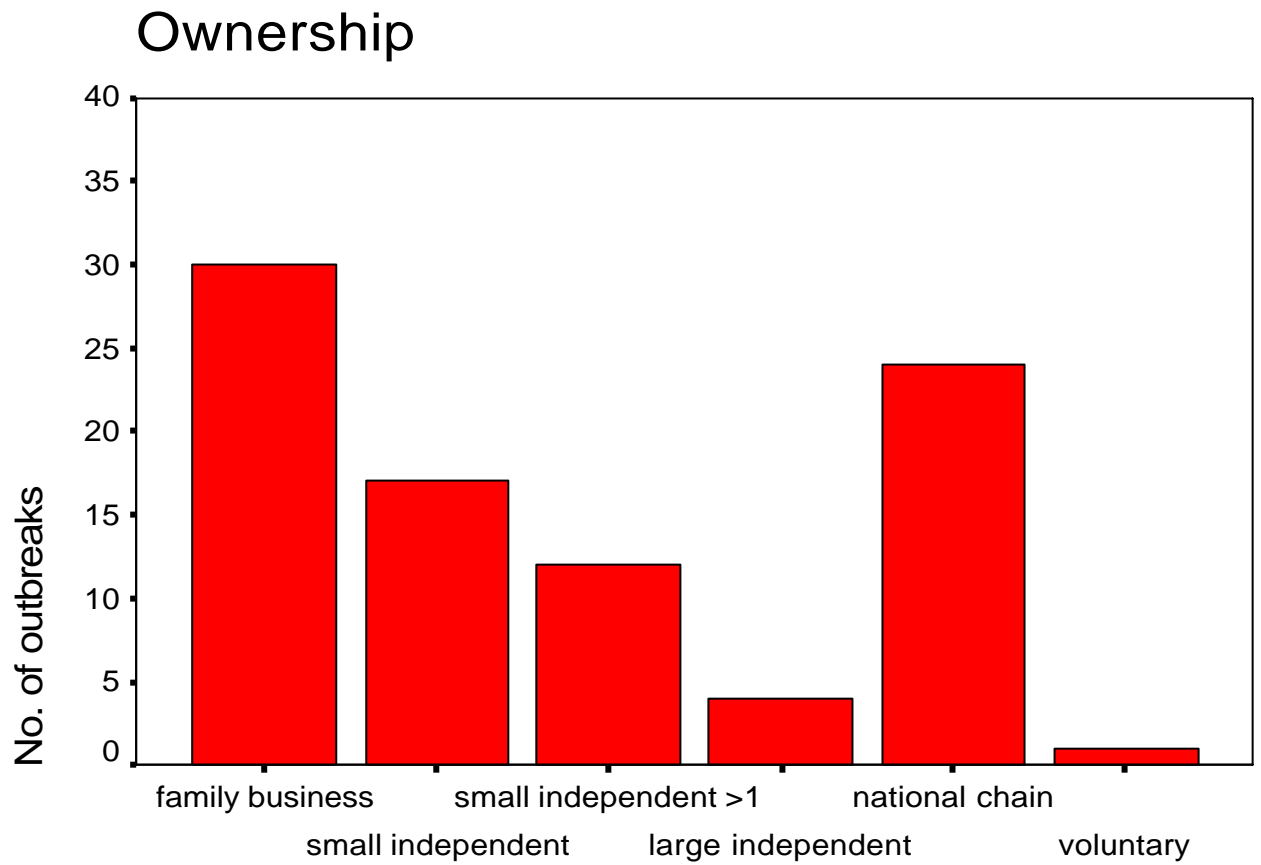


\* 'Shop caterer' refers to a retail food business which provides a catering service e.g. a bakery shop that makes sandwiches on site to sell to customers.

Figure 6 Case Businesses: SME Category



**Figure 7 Case Businesses: Ownership**



Ownership

Figure 8 Case and Control Businesses: Ownership

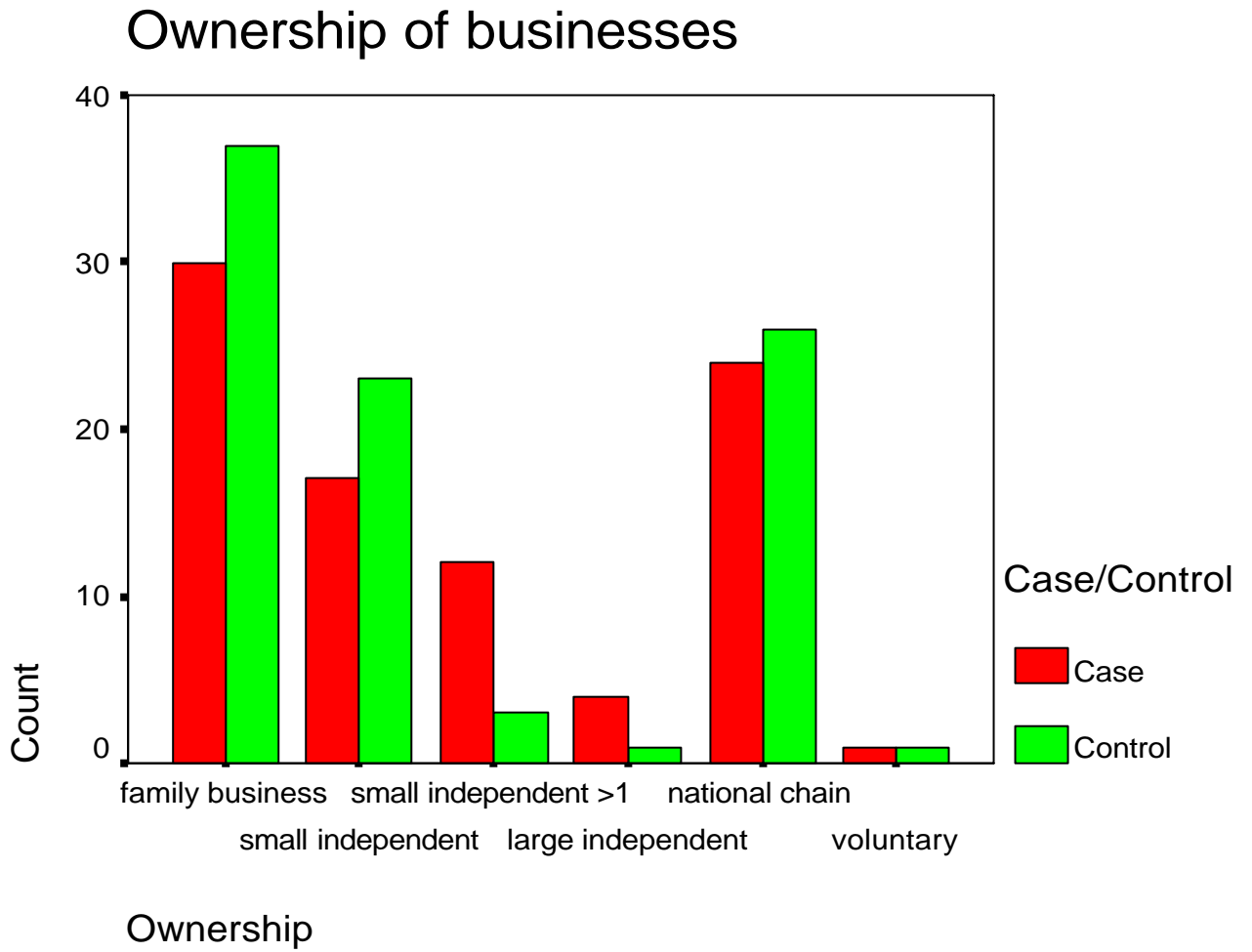


Figure 9 Case and Control Businesses: SME Category

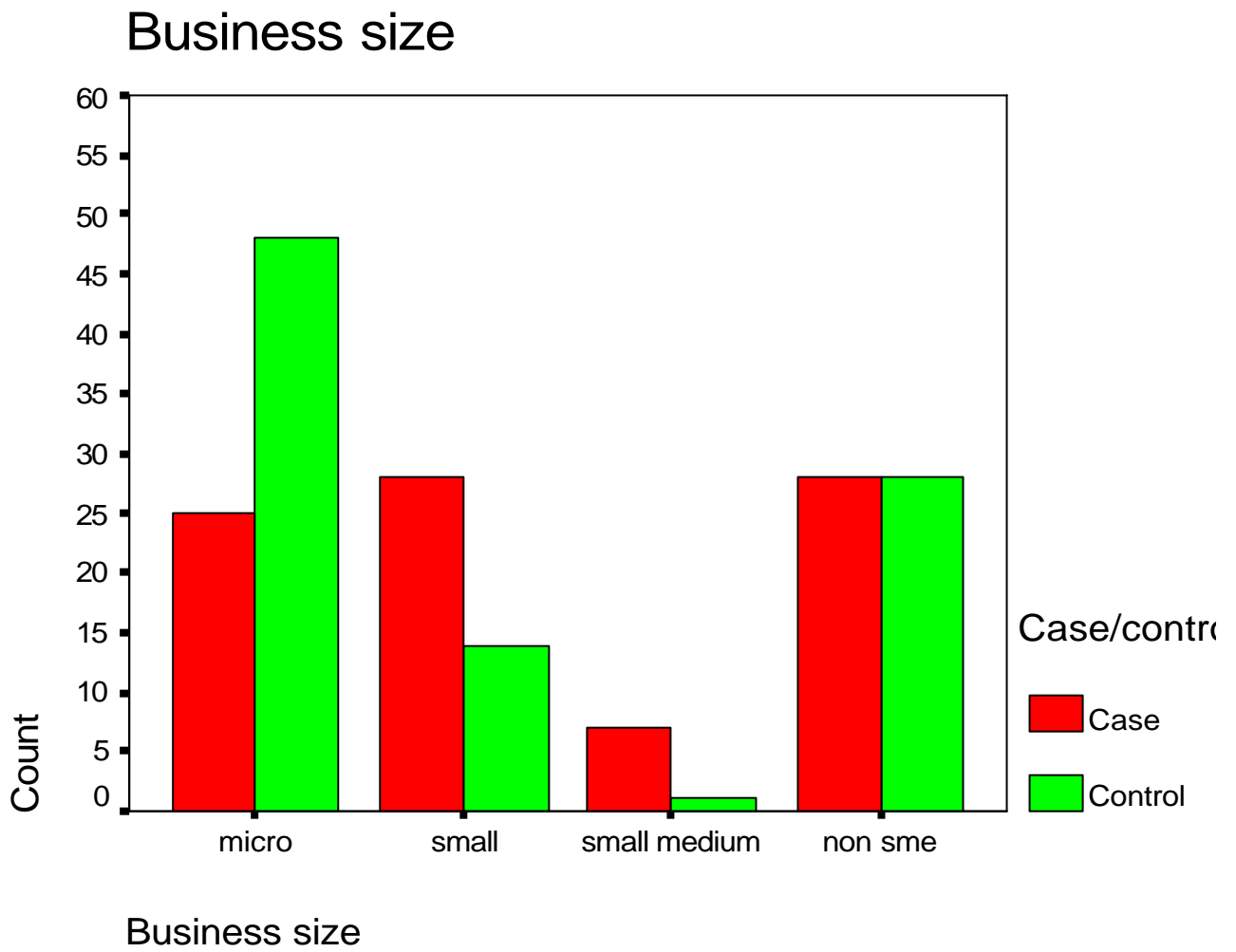
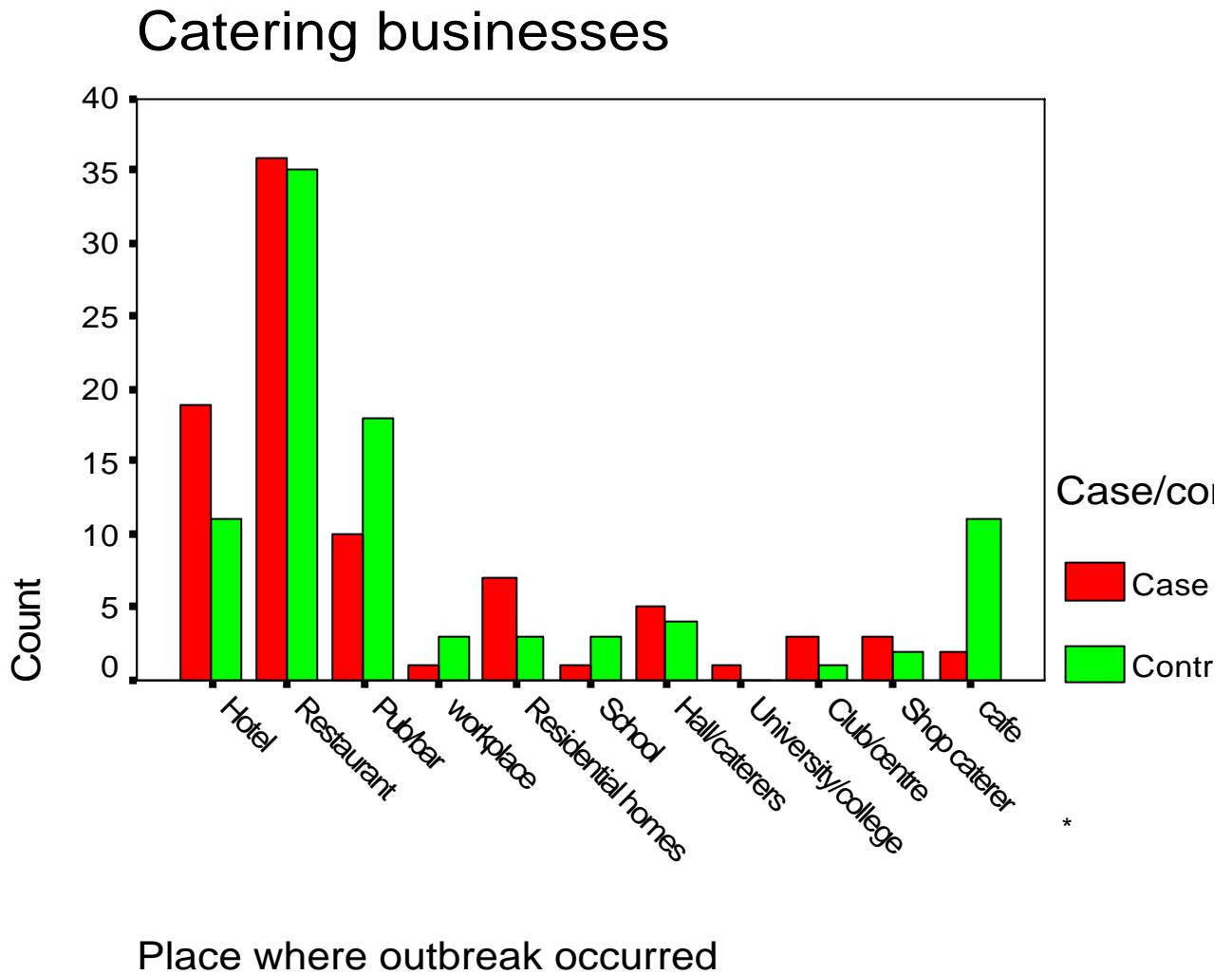


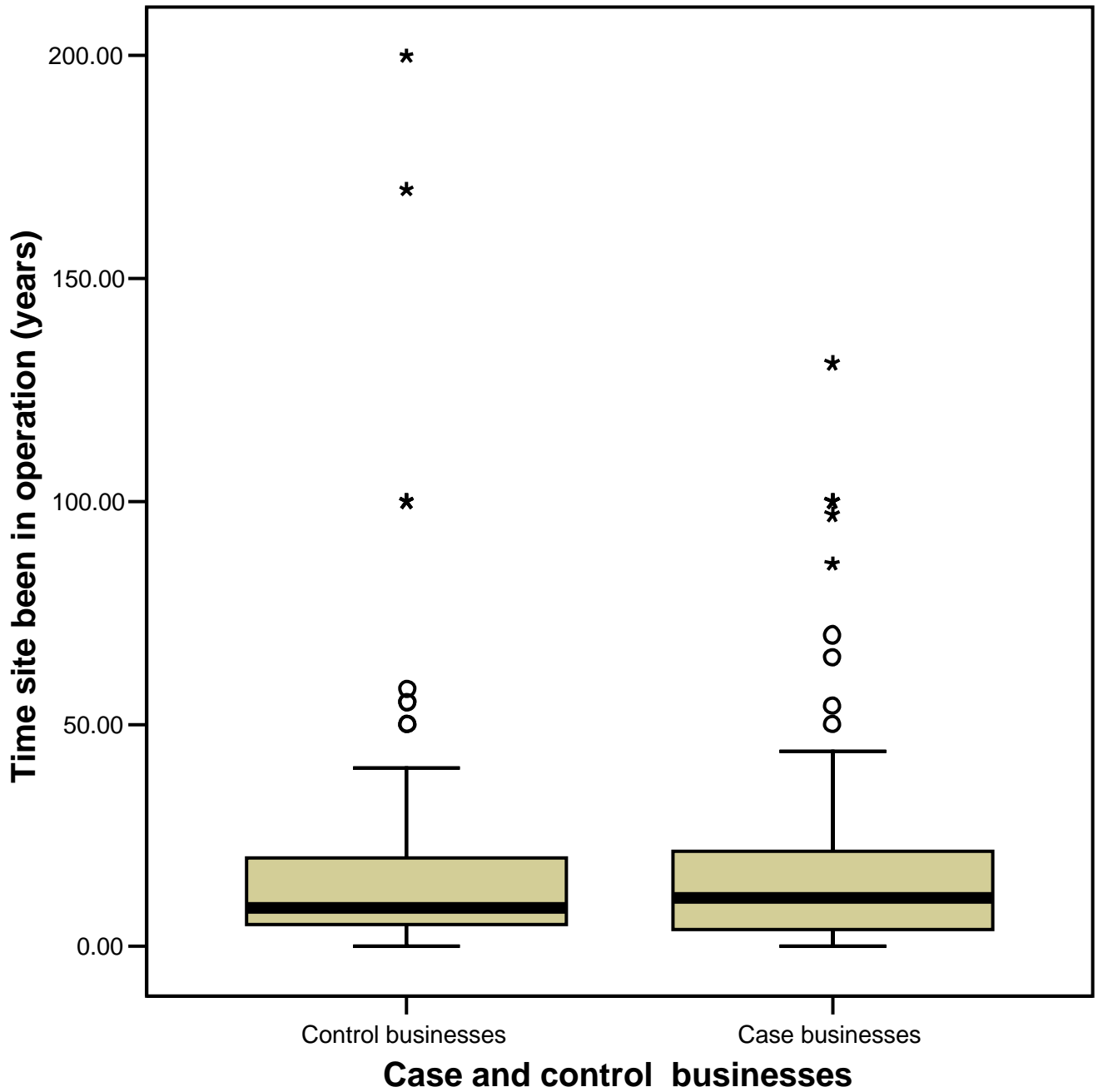
Figure 10 Case and Control Businesses: Type of Business



\* 'Shop caterer' refers to a retail food business which provides a catering service e.g. bakery shop that makes sandwiches on site to sell to customers.

**Figure 11 Time site in operation for all foodborne disease outbreaks**

Two case businesses in operation 600 years and 400 years recoded to 100 years for production of box plots

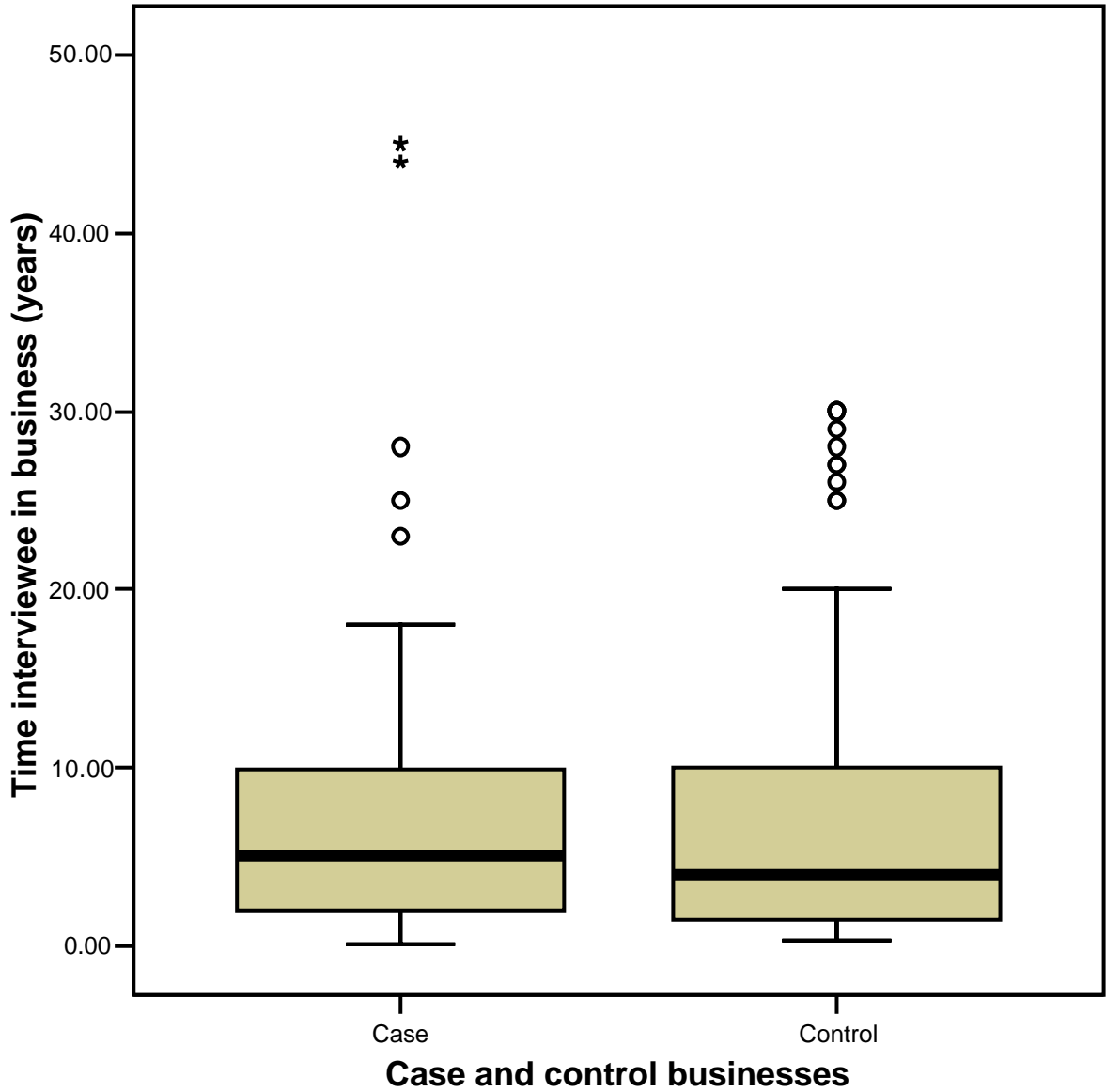


'\*' and 'o' are outliers, each one represents one business (cases or controls)

'\*' are records (cases or controls) that are more than 3 box lengths

'o' are records (cases or controls) that are more than 1.5 box lengths

**Figure 12 Interviewee in business for all foodborne disease outbreaks**



'\*' and 'o' are outliers, each one represents one business (cases or controls)  
'\*' are records (cases or controls) that are more than 3 box lengths  
'o' are records (cases or controls) that are more than 1.5 box lengths

Figure 13 Percentage of menu bulk prepared

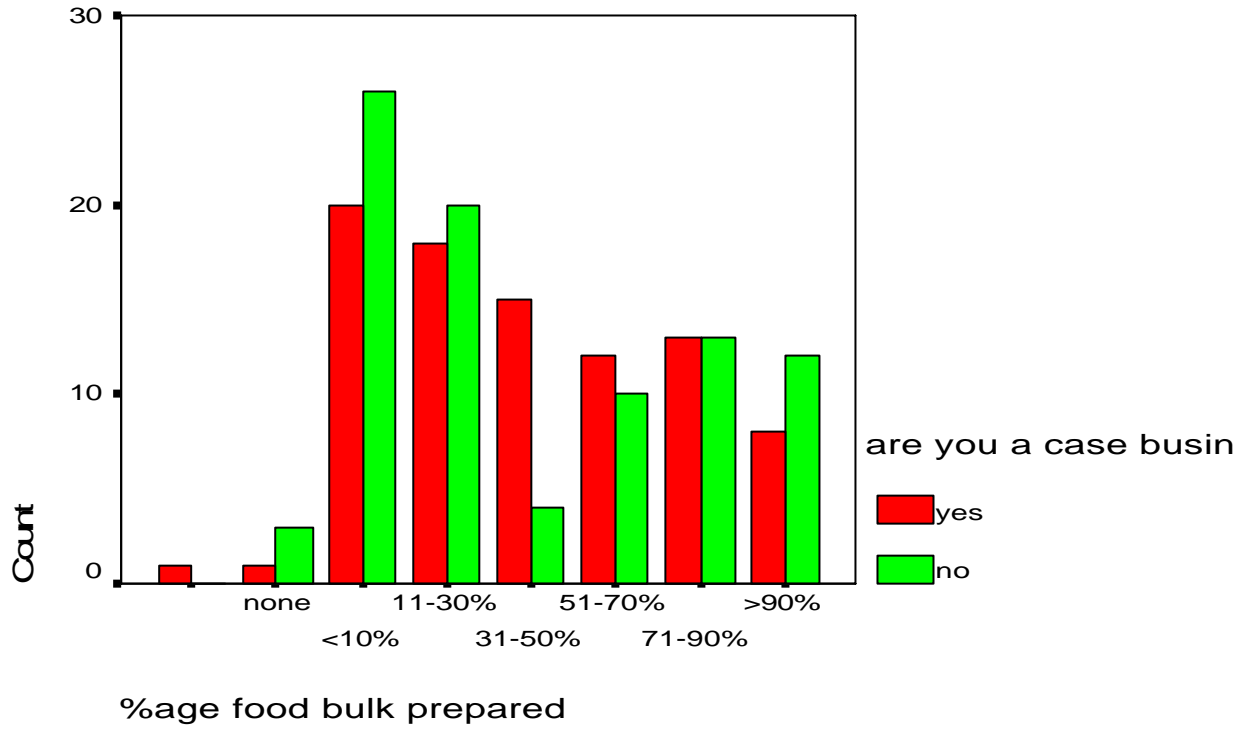


Figure 14 Percentage of menu cooked to order



Figure 15 Percentage of menu cooked from raw on site

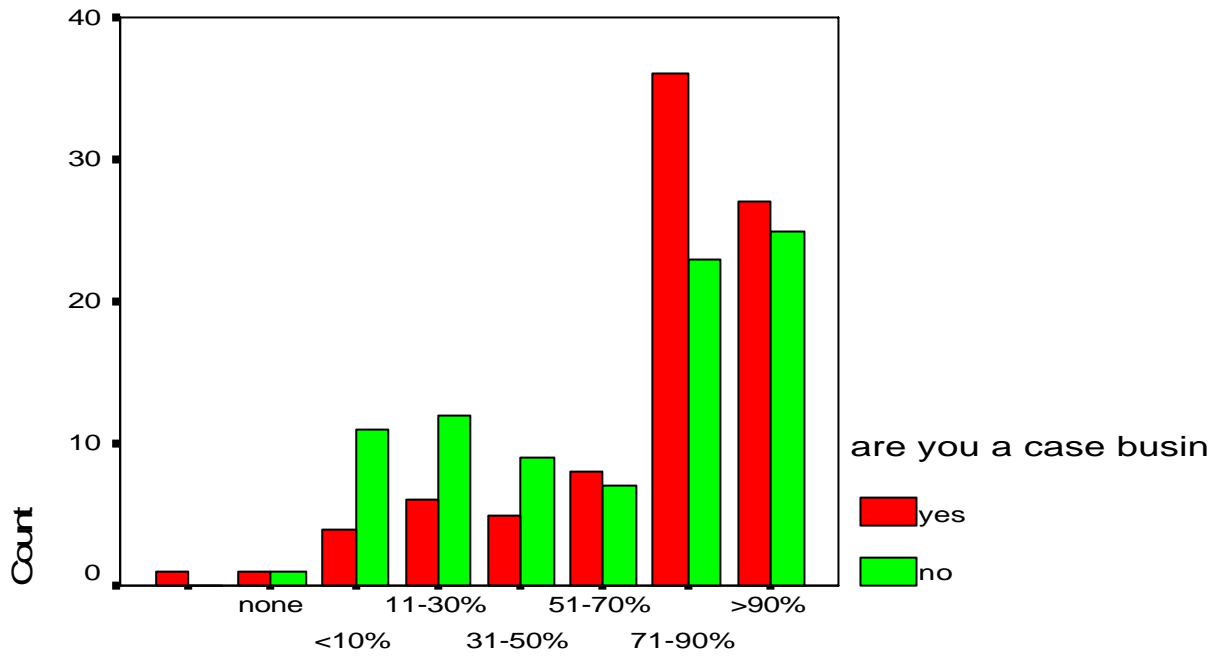


Figure 16 Percentage of menu regenerated on site

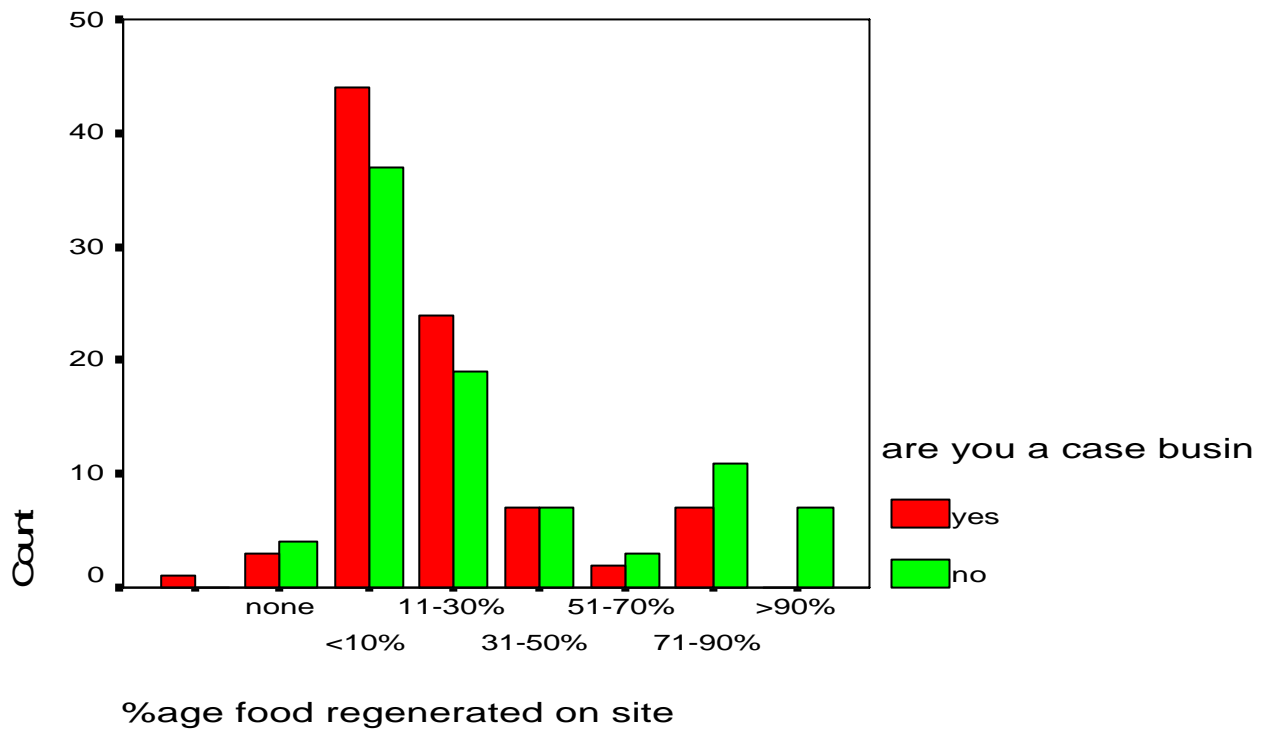
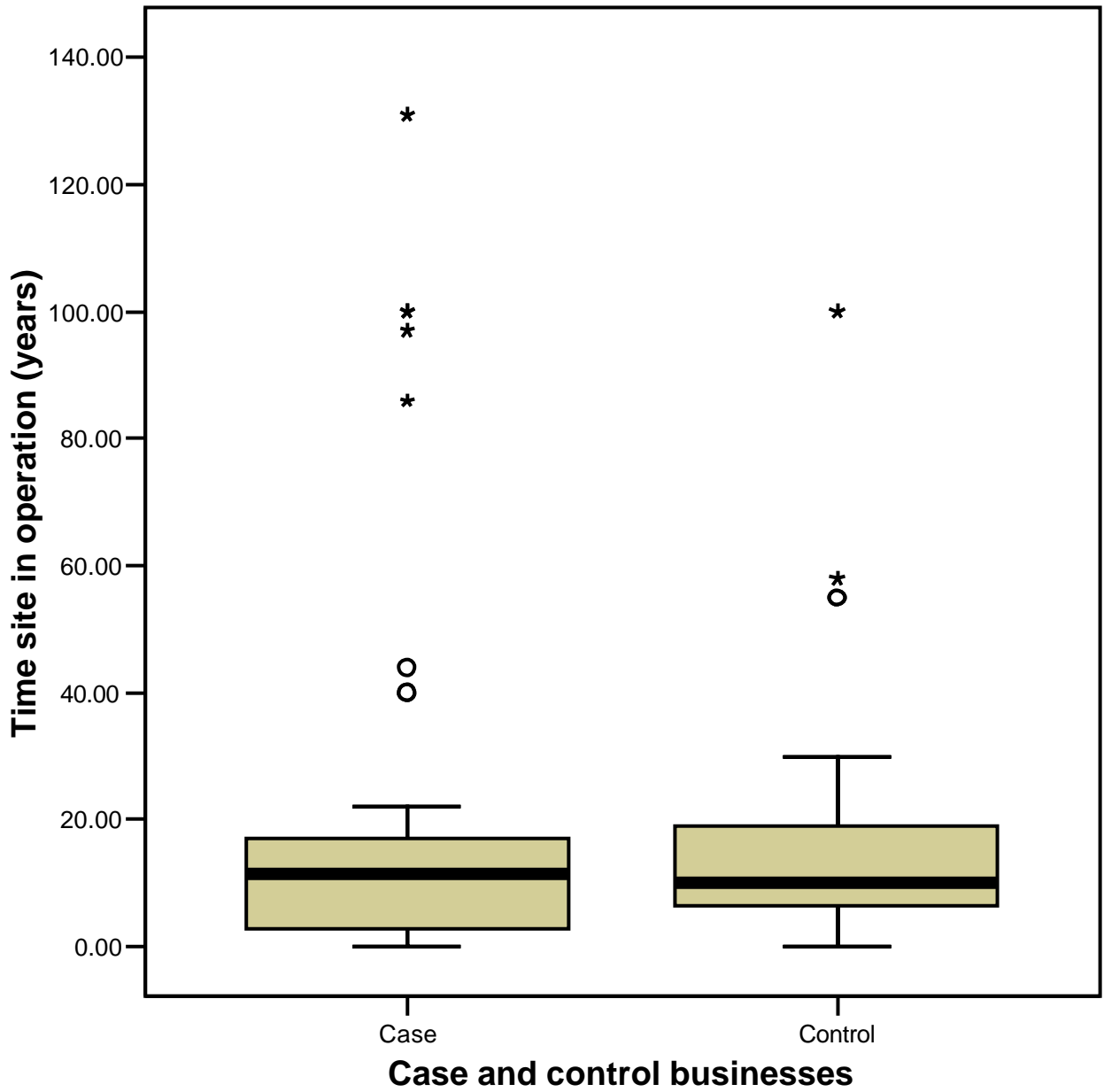


Figure 17 S. Enteritidis: Time site in operation

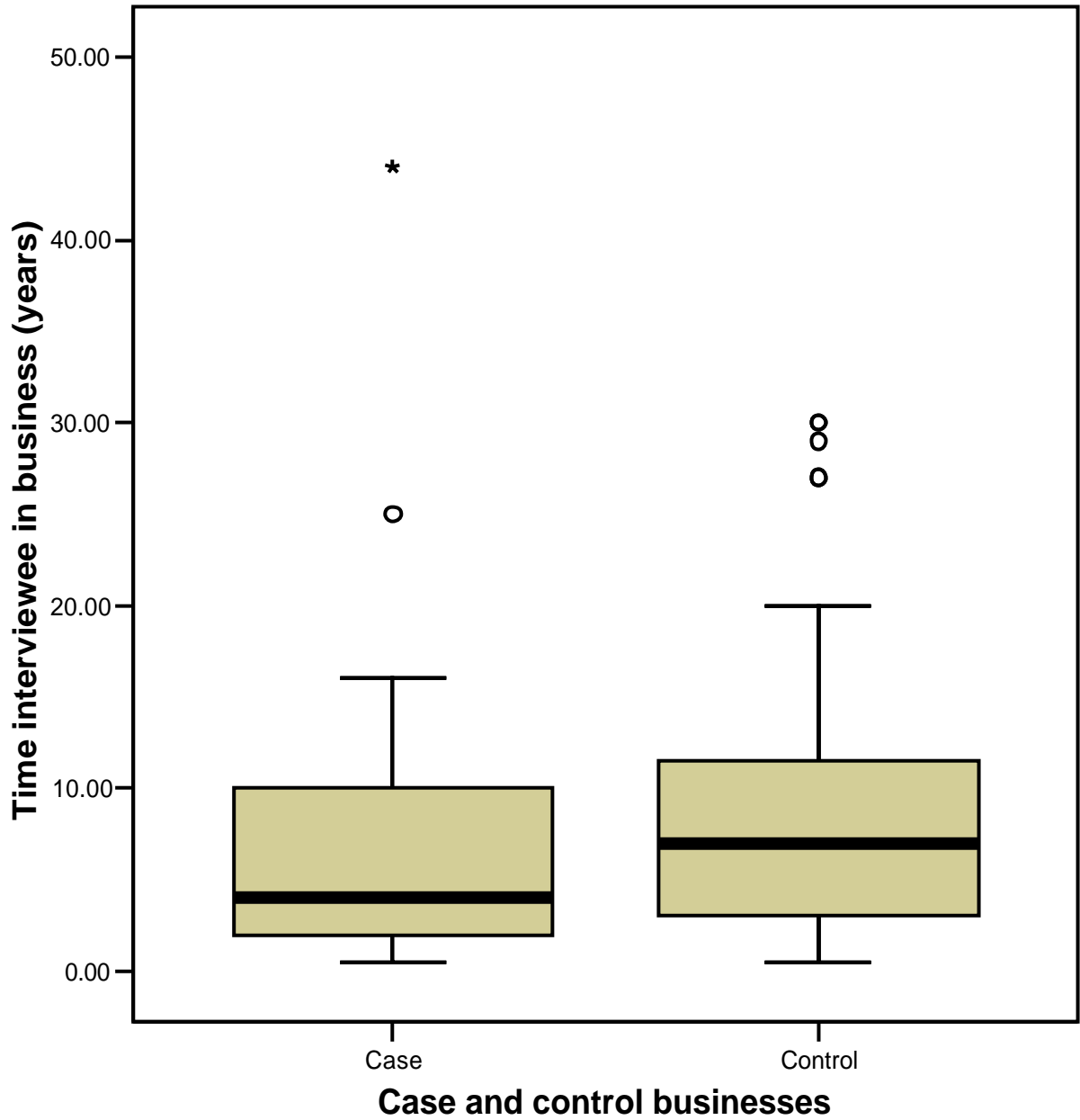


'\*' and 'o' are outliers, each one represents one business (cases or controls)

'\*' are records (cases or controls) that are more than 3 box lengths

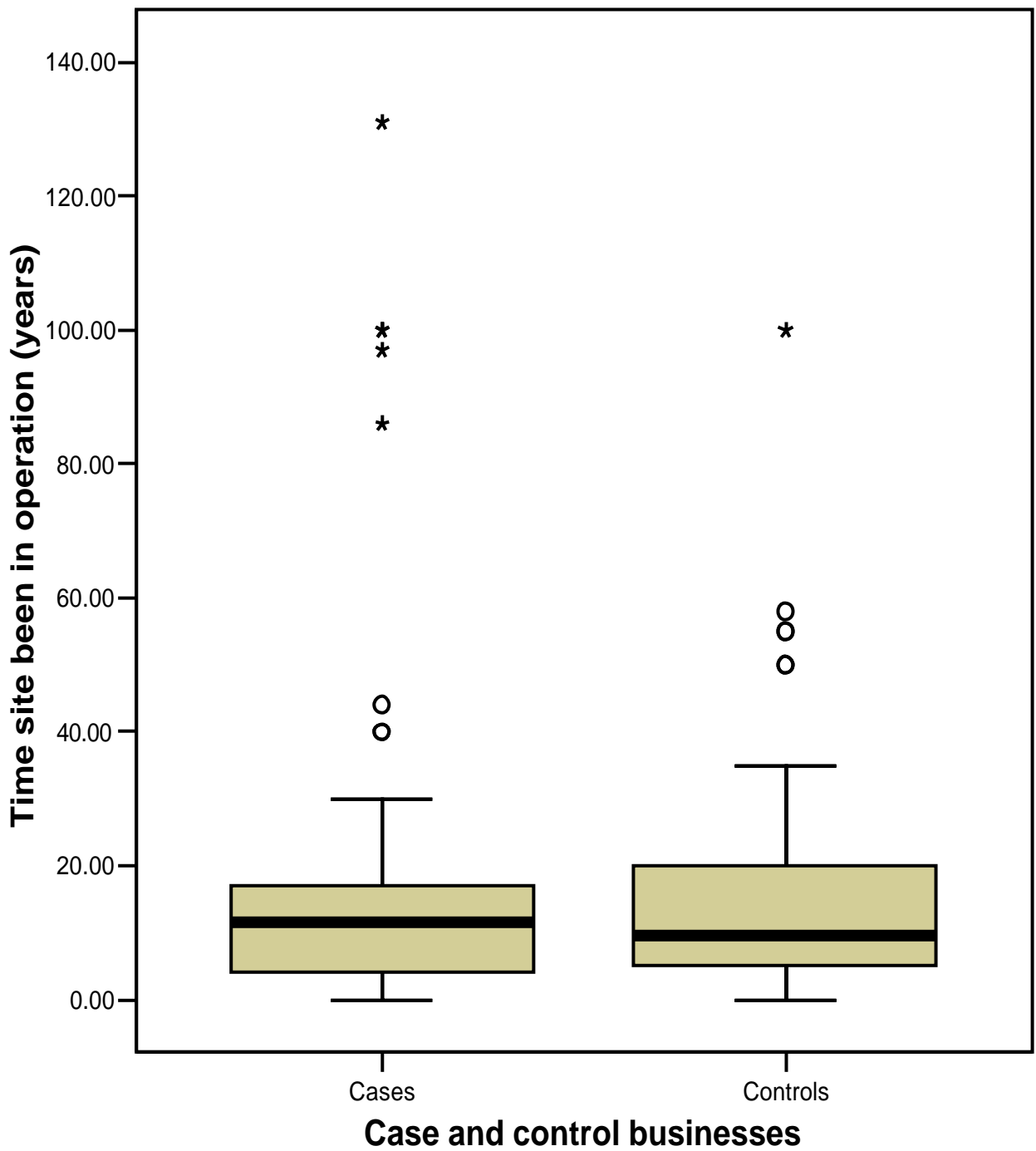
'o' are records (cases or controls) that are more than 1.5 box lengths

Figure 18 S. Enteritidis: Time interviewee in post



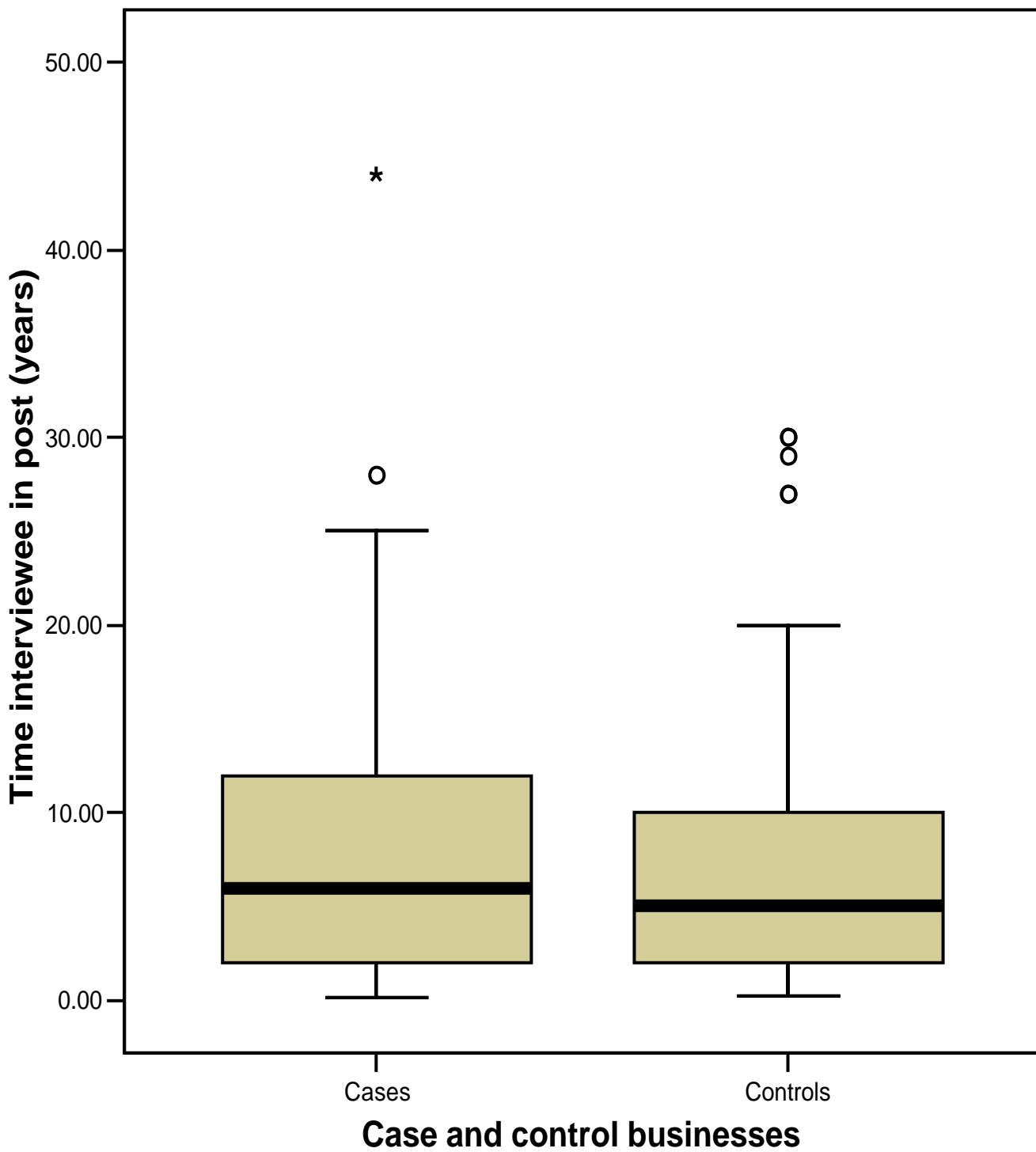
'\*' and 'o' are outliers, each one represents one business (cases or controls)  
'\*' are records (cases or controls) that are more than 3 box lengths  
'o' are records (cases or controls) that are more than 1.5 box lengths

**Figure 19 Bacterial Outbreaks: Time site in Operation**

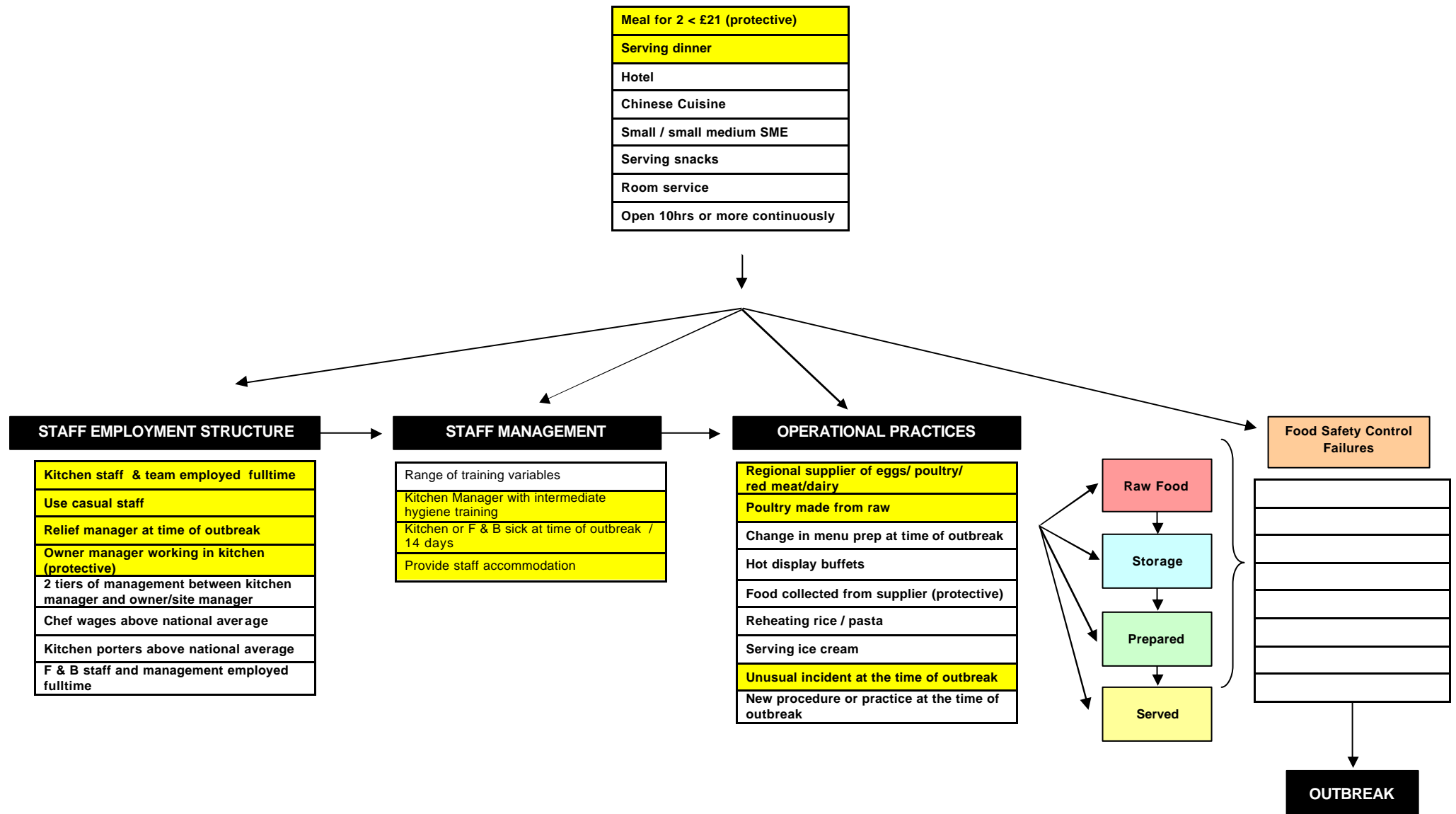


'\*' and 'o' are outliers, each one represents one business (cases or controls)  
'\*' are records (cases or controls) that are more than 3 box lengths  
'o' are records (cases or controls) that are more than 1.5 box lengths

**Figure 20 Bacterial Outbreaks: Time interviewee in post**



**Figure 21** Schematic diagram of Management Risk Factors associated with all foodborne disease outbreaks. Shaded variables were independently significant in their prior hypotheses groups. Other variables were significant at the 5% level in the univariate analyses.





# APPENDICES

## APPENDIX 1 PILOT STUDY: OUTBREAKS

(1<sup>st</sup> November 2001 – 31<sup>st</sup> October 2002)

STUDY NO.	PHLS NO.	LOCATION	INTERVIEWS COMPLETED
1. 002	124/01	Lake District	v
2. 003	004/02	Leeds	v
3. 004	004/02	Leeds	v
4. 005	120/01	Oxford	v
5. 006	538/01	Hexham	v
6. 007	598/01	Knowsley	v
7. 008	122/01	Southport	v
8. 009	012/02	London	v
9. 010	-	Tunbridge Wells	v
10. 011	120/02	Bracknell	v
11. 012	017/02	Anlaby	v
12. 013	244/02	Darlington	v
13. 014	228/02	Swindon	v
14. 015	020/02	Horsham	v
15. 016	-	Birmingham	v
16. 017	255/02	Gloucester	v
17. 018	252/02	Harlow	v
18. 019	323/02	Barnet, London	v
19. 020	030/02	Andover	v
20. 021	253/02	North Bovey	v
21. 022	662/02	Lewisham	v
22. 023	027/02	Saffron Walden	v
23. 024	035/02	Kidderminster	v
24. 027	350/02	Hackney, London	v
25. 028	305/02	Evesham	v
26. 029		Plymouth	v
27. 030	050/02	Wickham Market	v (fine £9,700 3mth sen)
28. 031	WalesCDSC	Wrexham	v
29. 032	056/02	Higham Ferrers	v
30. 033	062/02	Milton Keynes	v
31. 034	295/02	Hoylake	v
32. 035	-	Middlesbrough	v
33. 036	-	Salisbury	v
34. 037	Whit	Horsham	v
35. 038	ECO2	Bristol	v
36. 039	ECO4	Slough	v
37. 040	558/02	Norwich	v
38. 041	512/02	Keynsham	v
39. 042	258/02	Birmingham centre	v
40. 043	076/02	Liverpool	v (fine £16,000 + claims)
41. 044	064/02	Thetford	v
42. 045	WalesCDSC	Chepstow	v
43. 046	063/02	Lincoln	v
44. 047	369/02	Southport	v
45. 049	ECO15	Brentwood	v
46. 050		Plymouth	v
47. 051	ECO17	St. Albans	v
48. 052	Whit	Wrotham	v
49. 053	077/02	Donnington	v
50. 054	622/02	March	v
51. 055	079/02	Titchwell	v
52. 056	061/02	Hull	v
53. 057	737/02	Oundle	v

54. 058	086/02	Maidstone	v
55. 059	077/02	St. Aldry GC	v
56. 060	1295/02	Mildenhall	v
57. 061	-	Newmarket	v
58. 062	068/02	Felixstowe	v
59. 063	083/02	Brantham	v
60. 064		Bracknell	v

025con, 026con and 048con interviewed and included

60 outbreaks participated (60 case businesses and 63 control businesses)

**Case Response Rate – 86%**

**Control Response Rate – 93%**

**MAIN STUDY OUTBREAKS: 1<sup>st</sup> December 2002 – 31<sup>st</sup> December 2003**

<b>STUDY NO.</b>	<b>PHLS NO.</b>	<b>LOCATION</b>	<b>INTERVIEWS COMPLETED</b>
1. 001m	EHO not.	SALISBURY	v
2. 002m	Industry	RAYLEIGH	v
3. 003m	102/03	CARDIFF	v
4. 004m	88/03	PERSHORE	v
5. 005m	1611/03	HORSHAM	v
6. 006m	Industry	DUNSTABLE	v
7. 007m	9/03	POOLE	v
8. 008m	EHO not.	TUN. WELLS	v
9. 009m	EHO not.	YORK	v
10. 010m	EHO not.	BIRMINGHAM	v
11. 011m	13/03	LONDON	v
12. 012m	EHO not.	BIRMINGHAM	v
13. 013m	EHO not.	BIRMINGHAM	v
14. 014m	79/03	COVENTRY	v
15. 015m	Industry	LONGSTOWE	v
16. 016m	Industry	Stoke on Trent	v
17. 017m	190/03	MANCHESTER	v
18. 018m	252/03	BIRMINGHAM	v
19. 019m	16/03	LEEDS	v
20. 020m	253/03	MERSEYSIDE	v
21. 021m	221/03	East Rudham	v
22. 022m	Industry	Basingstoke	v
23. 023m	Industry	Crewe	v
24. 024m	251/03	West Herts	v
25. 025m	18/03	Nottingham	v (fined £1600 +£3100 costs)
26. 026m	22/03	Durham	v
27. 027m	-	I.O.W	v
28. 028m	-	Wenvoe	v
29. 029m	48/03	Plymouth	v
30. 030m	32/03	Maidenhead	v
31. 031m	42/03	Callington	v
32. 032m	62/03	Kingsbridge	v
33. 033m	47/03	Torpoint	v
34. 034m	37/03	Sudbury	v
35. 035m	65/03	Penzance	v
36. 036m	60/03	Romsey	v
37. 037m	Industry	Exeter	v
38. 038m	46/03	Cinderford	v
39. 039m	58/03	Westminster	v
40. 040m	57/03	Sheffield	v
41. 041m	Industry	Dartford	v
42. 042m	64/03	Wellington	v
43. 043m	ECO14	Epping	v
44. 044m	34/03	Slough	v
45. 045m	59/03	Basildon	v
46. 046m	33/03	Stockton on Tees	v
47. 047m	39/03	North Lincs	v
48. 048m	55/03	Bedford	v
49. 049m	24/03	Swansea	v
50. 051m	26/03	Ellesmere Port	v
51. 052m	302/03	Stowmarket	v
52. 053m		Cardiff	v
53. 054m	100/03	Greenwich	v
54. 055m	SP1571	Leeds	v
55. 056m	SP1577	Leeds	v

56. 057m	ECO16	Cheltenham	v
57. 058m	ECO17	Hinkley	v
58. 059m	ECO19	High Wycombe	v
59. 061m	EHO	Reigate	v
60. 062m	83/03	Enfield	v (fined £16,000 & claims)
61. 065m	77/03	Tonbridge	v
62. 066m	74/03	Great Yarmouth	v
63. 067m	78/03	Southend	v
64. 068m	82/03	Hastings	v
65. 069m	80/03	Sunderland	v
66. 070m	87/03	Darlington	v
67. 071m	-	Darlington	v
68. 072m	94/03	South Woodford	v
69. 073m	81/03	Wickham Bishops	v
70. 074m	76/03	Bishop Stortford	v
71. 075m	67/03	Staines	v
72. 077m	73/03	Derwentside	v
73. 078m	75/03	Cleveland	v
74. 079m	98/03	Llandudno	v
75. 080m	66/03	Eastbourne	v
76. 081m	89/03	Leeds	v
77. 082m	ECO	Bradford	v
78. 083m	70/03	Swindon	v
79. 084m	88/03	Warrington	v
80. 085m	101/03	Kensington	v
81. 086m	91/03	Durham	v
82. 087m	ECO23	Southampton	v
83. 088m	ECO24	Wakefield	v
84. 089m	524/03	Leeds	v
85. 092m	532/03	Leeds	v
86. 093m	104/03	Leeds	v
87. 094m	102/03	Dagenham	v
88. 095m	97/03	London	v

063mcon, 064mcon and 076mcon all interviewed and included

88 outbreaks (88 case businesses and 91 control businesses)

- Response rate: 90% cases, 96% controls
- Refusals:

## APPENDIX 2      FIELD INVESTIGATORS - INTERVIEW PROTOCOL

**NB:** All questions must relate to the period of time in question, that is 14 days before and at the time of the outbreak (ATO).

**Relevant Investigation Dates:**

**REMINDER TRIGGERS** (*during the 14 days in question check news, holiday/calendar events extremes in weather*):

# CASE BUSINESS PROTOCOL

Please note: in the event of limited time/cooperation sections 1,2,3 are the priority. However every attempt must be made to fully complete the protocol.

## CONTENTS

<b>SECTION 1: BUSINESS DETAILS .....</b>	<b>2</b>
<b>SECTION 2: STAFFING.....</b>	<b>5</b>
<b>SECTION 3: CATERING OPERATIONS.....</b>	<b>12</b>
<b>SECTION 4: PUBLIC HEALTH AND INCIDENT DETAILS OF OUTBREAK .....</b>	<b>14</b>
<b>SECTION 5: STAFF INTERVIEWS .....</b>	<b>18</b>
<b>SECTION 6: INTERVIEWERS PERCEPTIONS AT THE TIME OF THE INVESTIGATION</b>	<b>22</b>

NB.

The following persons from the business should be questioned:

Section 1	Key contact (Manager/Owner)
Section 2	Key contact and Head Chef
Section 3	Key contact and Head Chef – ‘Operational’ and ‘Hygiene procedure’ questions only.
Section 4	As identified above

Case Business

CODE:

**SECTION 1:**

**BUSINESS DETAILS**

INTERVIEW - Key contact (Manager/Owner)

---

**GENERAL CHARACTERISTICS**

1.1 Name of interviewee:

Position of interviewee:

Time in business:

1.2 Business Name:

Business Address:

Business Tel:

Owner:

1.3 Description of business:

1.4 How long has the business (outlet) been in operation?

1.5 Does that mean you do?

Breakfast  Lunches  Dinner  Snacks  Room service

Functions 1 (<20)  Functions 2 (>20)

1.6 What percentage of your income comes from functions?

1.7 What's the average cost of a meal for 2 (excluding wine?)

1.8 What are your opening hours?

1.9 Do you take bookings? YES  NO

1.10 Is catering your main business? YES  NO

1.11 What is your busiest time of year? (Month/s)

1.12 Covers means servings/meals/customers

Average number of covers per week?

Lowest number of covers per week?

Highest number of covers per week?

1.13 Do you use menu specifications?  
*(Must be written and includes recipes)*

YES  NO

1.14 What proportion of meals have menu specs?

1.15 What proportion of your customers are:

- Senior Citizens
- Young families
- Other adults

1.16 What proportions of your customers are regulars?

< 25%  25 – 50%  50–75%  >75%

1.17 Do you collect foods directly from the supplier?

YES  NO

1.18 Is your business a S.M.E.?  
*(Small medium-sized business, < 250 employees)*

YES  NO

1.19 Do you use independent Food Hygiene Consultants?

YES  NO

1.20 Are the premises on mains water supply?

YES  NO

1.21 Do you feel that water is a food hygiene issue?

YES

NO

1.22 Do you feel you have a good working relationship with the local EHO?

YES

NO

## **SECTION 2: STAFFING**

---

2.1 Outline the staff structure (*flow diagram*):









2.6 Do you have a problem recruiting staff? YES  NO   
If 'Yes', what staff and why

2.7 Do you have a problem retaining staff? YES  NO   
If 'Yes', what staff and 'why'

BACK OF HOUSE STAFF

FRONT OF HOUSE

2.8 Do you recruit agency staff?  
YES  NO  YES  NO

2.9 Do you have a recruitment policy that requires people with professional qualifications?  
YES  NO  YES  NO

2.10 Do you have a recruitment policy that requires people with food hygiene qualifications?  
YES  NO  YES  NO

2.11 Which kitchen staff are salaried?

2.12 Which F&B staff are salaried?

2.13 Is your Head Chef paid above, same, below the national average wage?

2.14 Are your kitchen porters or equivalent above, same, or below the national average wage?

2.15 Do you use casual staff?

YES

NO

If 'Yes' discuss issues (same staff used/bank/high turnover, reliable? Are records kept of these staff)

2.16 Do you pay your staff for the first 3 days of sick leave?

YES

NO

2.17 Do you have designated staff toilets?

YES

NO

2.18 Do staff use customer toilets?

YES

NO

2.19 Do you provide staff accommodation/staff house?

YES

NO

**Comments:**



Please circle appropriate answer.

3.2 What percentage of food is bulk prepared?

=10%      11-30%      31-50%      51-70%      71-90%      >90%

3.3 What percentage of food is cook to order?

=10%      11-30%      31-50%      51-70%      71-90%      >90%

3.4 What percentage of food is made from raw ingredients on site?

=10%      11-30%      31-50%      51-70%      71-90%      >90%

3.5 What percentage of food is bought in for regeneration on site?

=10%      11-30%      31-50%      51-70%      71-90%      >90%

**Comments:**

**SECTION 4:**  
**PUBLIC HEALTH AND INCIDENT DETAILS OF OUTBREAK:** [INTERVIEW - Key contact and Head Chef](#)

---

4.1 Date of onset of outbreak: (exposure)

4.2 Causative organism:

4.3 Microbiologically Confirmed: YES  NO

4.4 Total number of cases (i.e. confirmed and unconfirmed):

4.5 Number of laboratory confirmed cases:

4.6 Food vehicles identified and evidence supporting identification:

4.7 Additional evidence:

Epidemiological:

Microbiological:

Environmental:

4.8 Last risk rating number: Date:

Last 'confidence in management score': Date:

**Food Safety Control Failures – Specific enquiries**

**Incident details of outbreak (at the time of outbreak and 14 days before).**

INTERVIEW - Key contact AND also ask 'operation Issue' and 'hygiene procedure' questions to the Head Chef or in his absence a member of the kitchen staff who was there during the specified times KEEP REFERING BACK TO THE TIME PERIOD IN QUESTION.

**At time of Outbreak (ATO):**

**14 days before:**

4.9 What were your hours of opening different during this time period?

4.10 How many covers did you serve (was it a busy/average/quiet time – relate to months):

- 2 weeks before
- 1 week before
- ATO

**Operational Issues**

Operational Issues	ATO		14 Days Before	
	Y	N	Y	N
1. Did any food preparation equipment breakdown?				
2. Was any food preparation equipment not working properly?				
3. Was any food preparation equipment due for a service/maintenance check?				
4. Was any food preparation equipment recently installed?				
5. Did you use any temporary/alternative equipment?				
6. Was a new procedure or working practice put in place/alterd?				
7. Was there a change in menu or new menu on offer?				
8. Was there a change in menu preparation?				
9. Were there any promotions on offer?				

Operational Issues	ATO		7 Days Before	
	Y	N	Y	N
10. Was there a power cut (gas, electric)				
11. Was there a disturbance to your water supply?				
12. Were you short staffed?				
13. Was a relief manager in position? (Owner, GM, HC, RM)				
14. Did you collect any food directly from the supplier?				
15. Was there any other incident/unusual occurrence that happened?				

**Comments:**

4.11 Did any of the above issues occur or any other unusual circumstances happen within the last 4 months? *(If food vehicle identified – focus on that operation.)*

**Food Safety Documentation (written)**

Hygiene Procedures/documentation		ATO		14 Days Before	
		Y	N	Y	N
1. A H.A.C.C.P System <i>(refer hazard analysis, assured safe catering, risk assessment)</i>	Written				
	Verbal				
	Nothing				
2. Temperature control records	Exist				
3. Cleaning schedule	Exist				
4. Staff training records	Exist				

4.12 Do you have any food safety records?

YES

NO

If 'Yes' , please identify

If 'No' why?

**Comments:**

## SECTION 5: STAFF INTERVIEWS

INTERVIEW – Head Chef, Manager and Area Manager (National) OR Food Handler, Head Chef and Owner (SME)

**Only tick either Yes or No NOT BOTH BOXES. If in doubt take the general/norm situation.**

---

5.1 Job title:

Length of time in current job:

Length of time in this employment:

Length of time in the catering industry:

5.2 Are there any disincentives to maintain hygienic standards? *(Not paid for cleaning at end of shift, come in early without pay to prepare.)* YES  NO

5.3 Are there any incentives to maintain hygienic standards? *(Bonus for clean kitchen, paid when training.)* YES  NO

5.4 Are you provided with enough support to maintain hygienic standards? *(Enough sanitiser, new equipment.)* YES  NO

5.5 Is there good communication between you and your line Manager/boss? YES  NO

5.6 Is there good communication between you and your team? YES  NO

5.7 Is there good communication between front and back of house? *(Work well with each other, is there any friction.)* YES  NO

5.8 Do you feel unrealistic demands are made on you? *(Over booking, large functions, poor equipment.)* YES  NO

5.9 Are there any internal pressures, which may have affected the way the business was run? YES  NO

*(Wage percentage and GP down, undertake additional roles.)*  
5.10 Are there any external pressures, which may have affected the way the business is run? YES  NO   
*(Increased water rates, high rent, contractual issues.)*

5.11 Are there any staff incentives? YES  NO

Please identify:

5.12 Average number of hours worked in a day:

On average, how many hours did you work on those specified days?

5.13 What do you think is the greatest risk to food hygiene in your business?  
*(What do you think would cause an outbreak of food poisoning in this business.)*

5.14 How are business issues communicated to staff?  
*(e.g. bookings, last week's turnover, promotions)*

5.15 How are food hygiene issues communicated to staff?  
*(e.g. cleaning, washing hands, wearing protective clothing, EHO visit)*

5.16 What do you think caused the outbreak of food poisoning?

5.17 Job title:

Length of time in current job:

Length of time in this employment:

Length of time in the catering industry:

5.18 Are there any disincentives to maintain hygienic standards? *(Not paid for cleaning at end of shift, come in early without pay to prepare.)* YES  NO

5.19 Are there any incentives to maintain hygienic standards? *(Bonus for clean kitchen, paid when training.)* YES  NO

5.20 Are you provided with enough support to maintain hygienic standards? *(Enough sanitiser, new equipment.)* YES  NO

5.21 Is there good communication between decision makers and risk takers? *(Use relevant language.)* YES  NO

5.22 Is there good communication between front and back of house? *(Work well with each other, is there any friction.)* YES  NO

5.23 Do you feel unrealistic demands are made on you? *(Over booking, large functions, poor equipment.)* YES  NO

5.24 Are there any internal pressures, which may have affected the way the business was run? *(Wage percentage and GP down, undertake additional roles.)* YES  NO

5.25 Are there any external pressures, which may have affected the way the business is run? *(Increased water rates, high rent, contractual issues.)* YES  NO

5.26 Are there any staff incentives? YES  NO

Please identify:

5.27 Average number of hours worked in a day:

On average, how many hours did you work on those specified days?

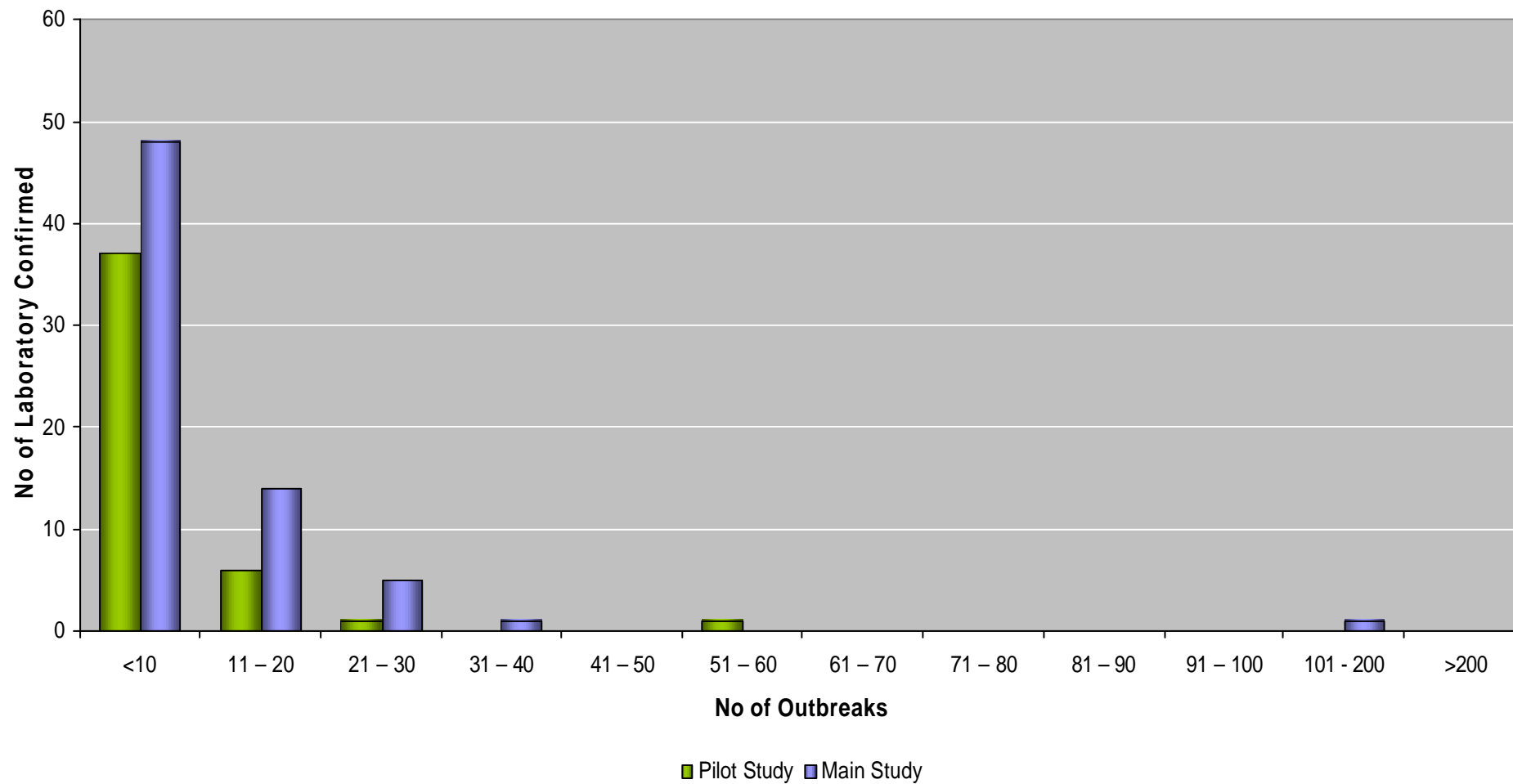
- 5.28 What do you think is the greatest risk to food hygiene in your business?  
*(What do you think would cause an outbreak of food poisoning in this business.)*
- 5.29 How are business issues communicated to staff?  
*(e.g. bookings, last week's turnover, promotions)*
- 5.30 How are food hygiene issues communicated to staff?  
*(e.g. cleaning, washing hands, wearing protective clothing, EHO visit)*
- 5.31 What do you think caused the outbreak of food poisoning?



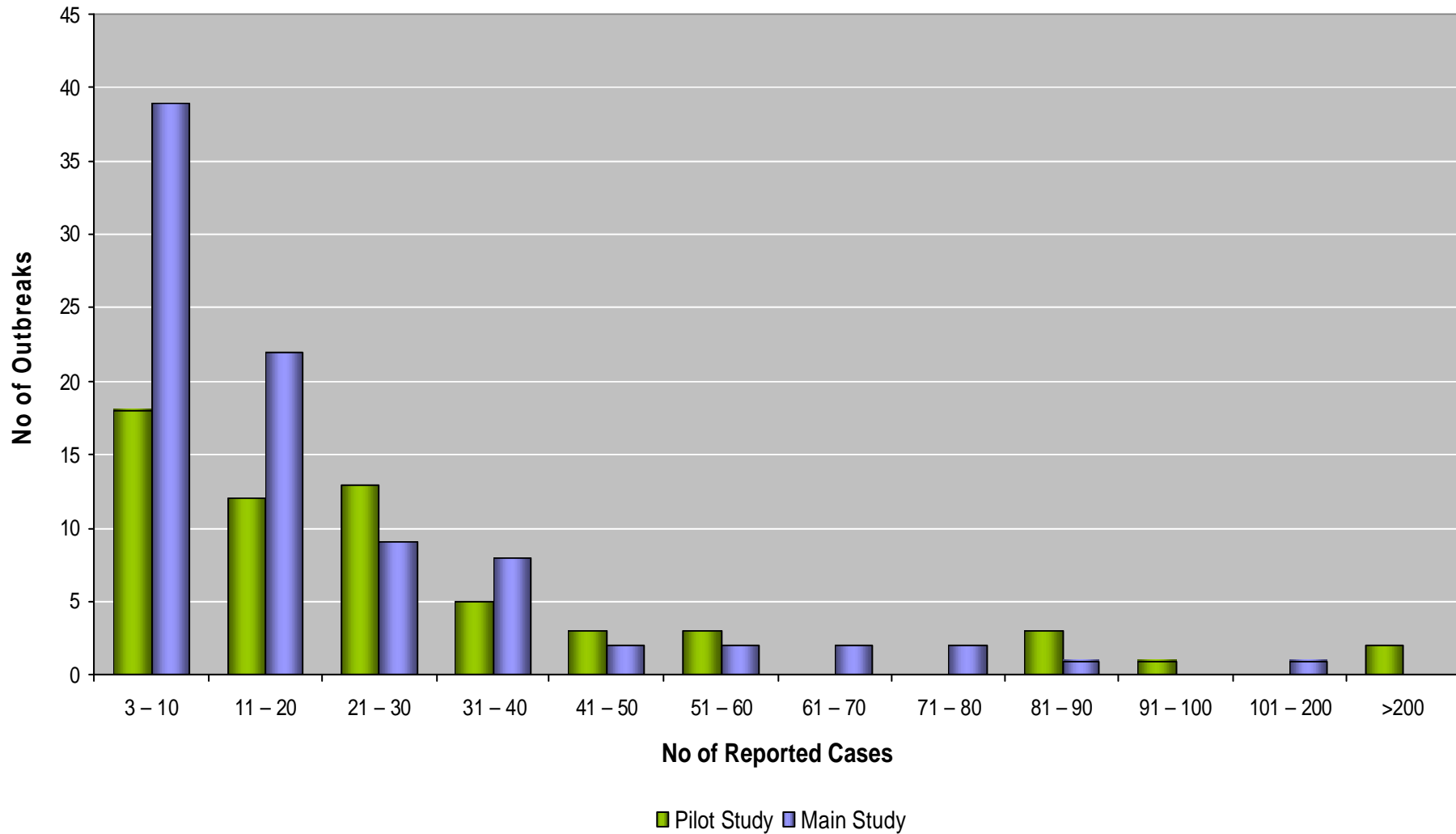
### APPENDIX 3      REVIEW OF PILOT AND MAIN STUDY POPULATION

In advance of pooling data from the main and pilot study, information was reviewed for comparability.

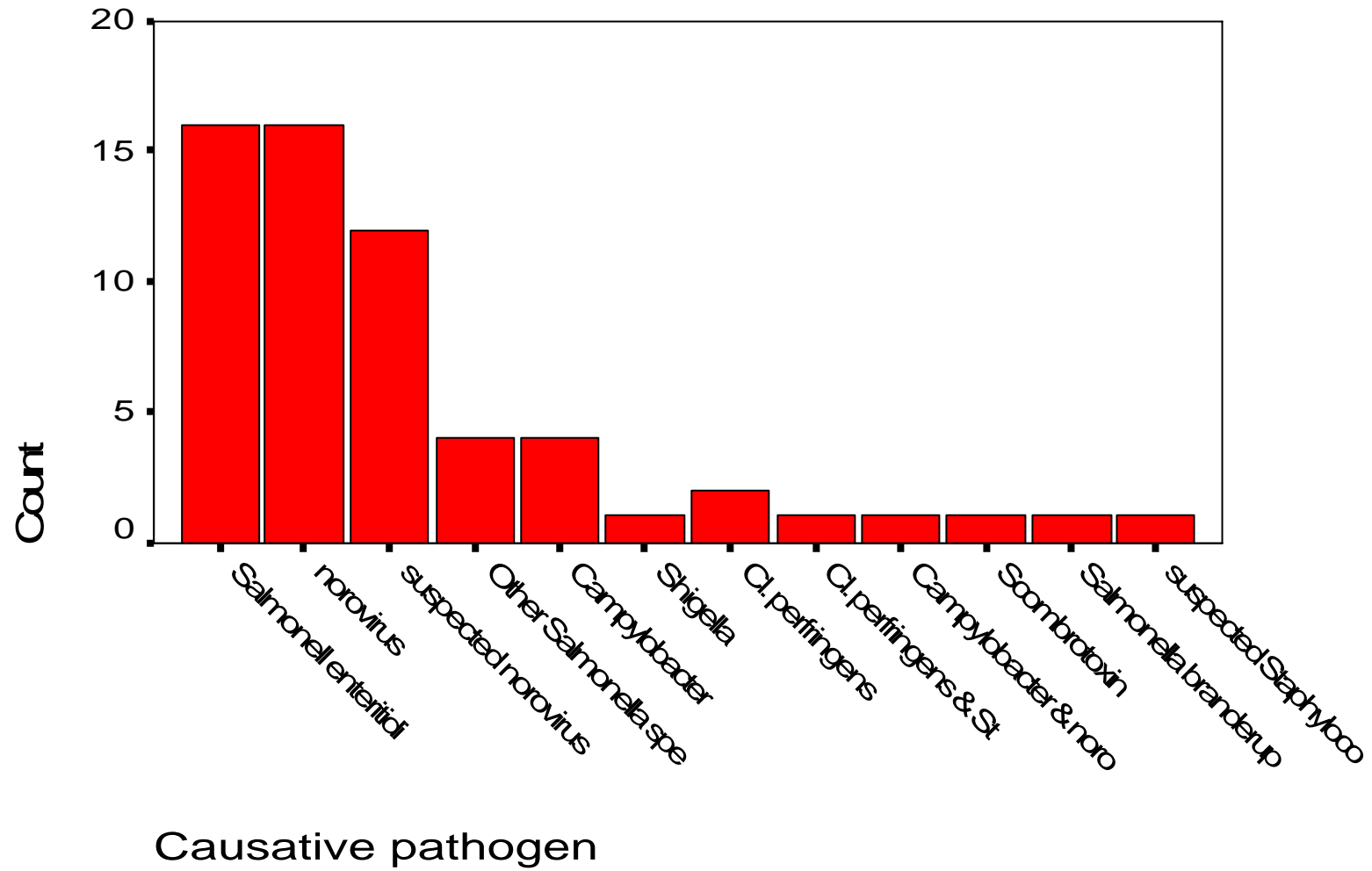
#### Size of Outbreaks (Laboratory Confirmed Cases)



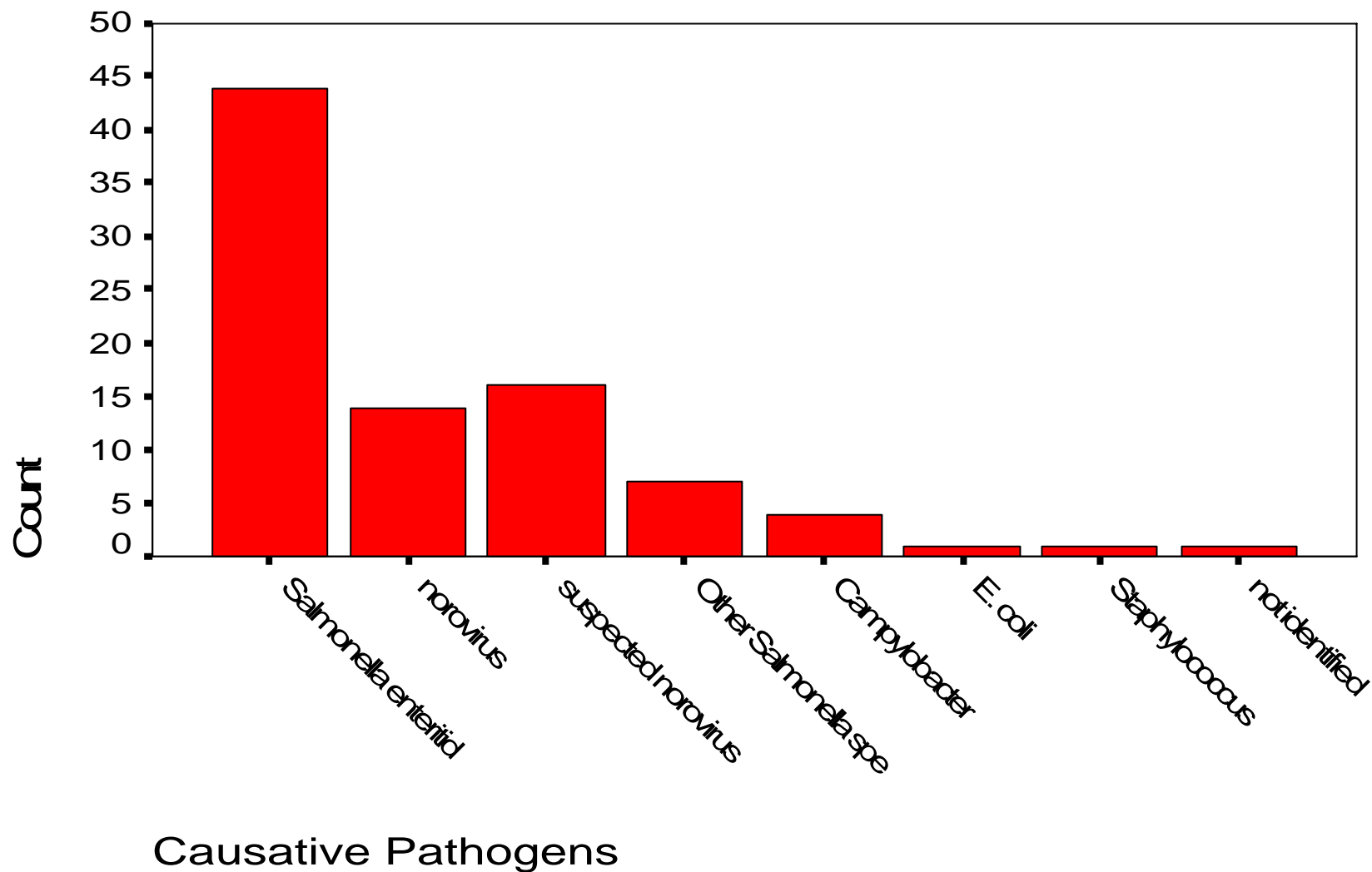
### Size of Outbreaks (Total Reported Cases)



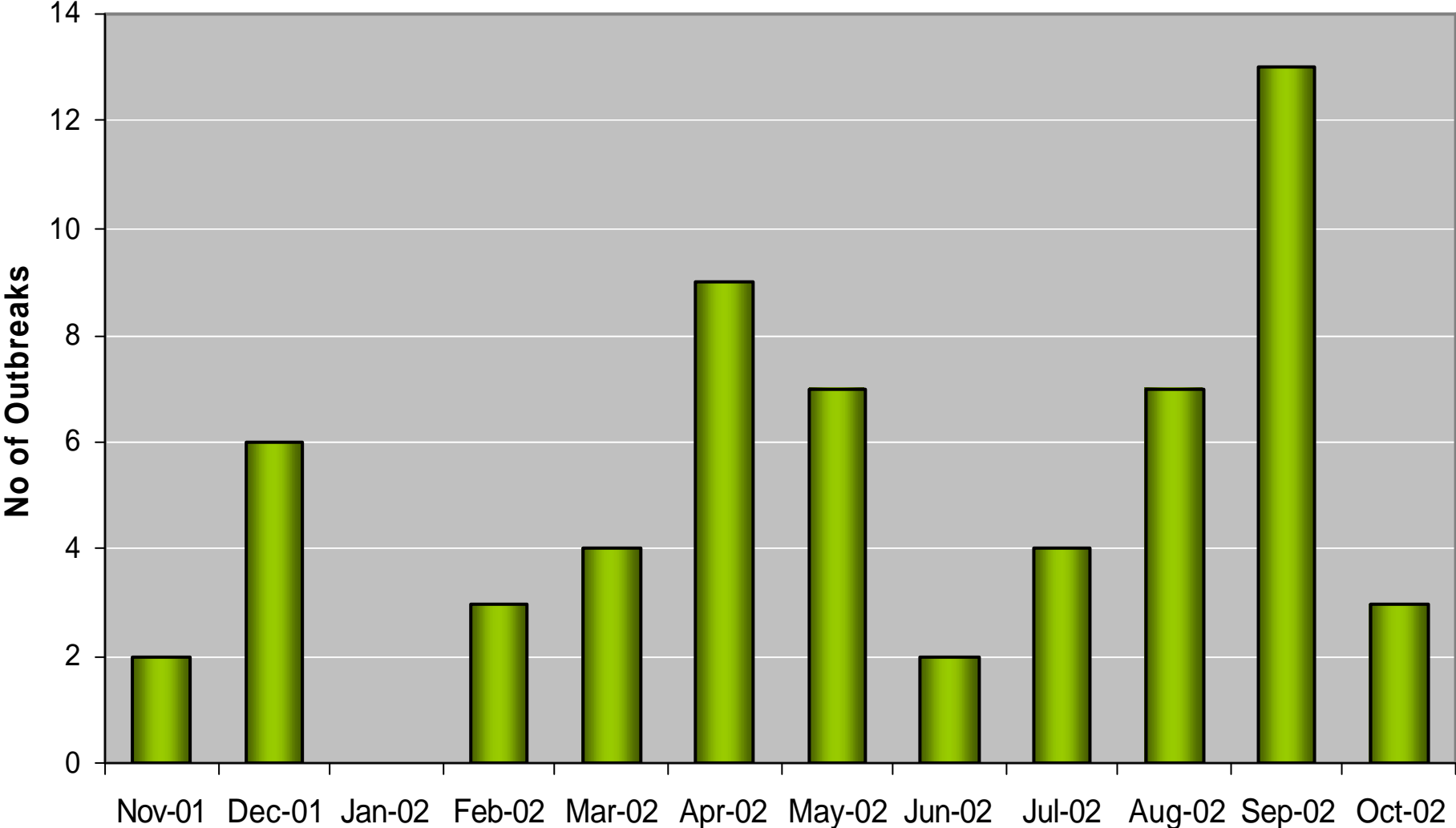
# Pilot Study: Causative Pathogen



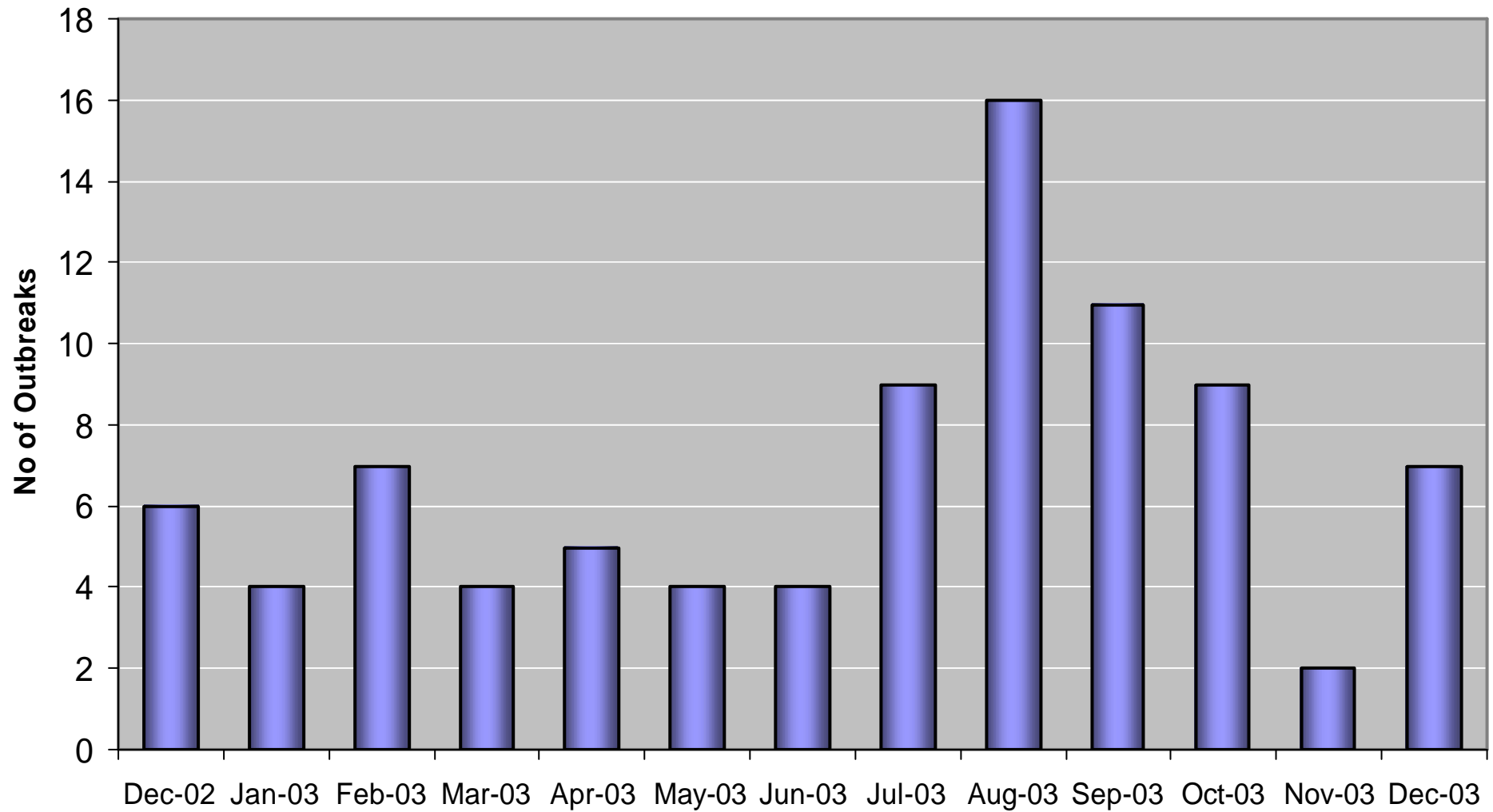
# Main Study:Causative Pathogens



# Pilot Study - Temporal Distribution of Outbreaks

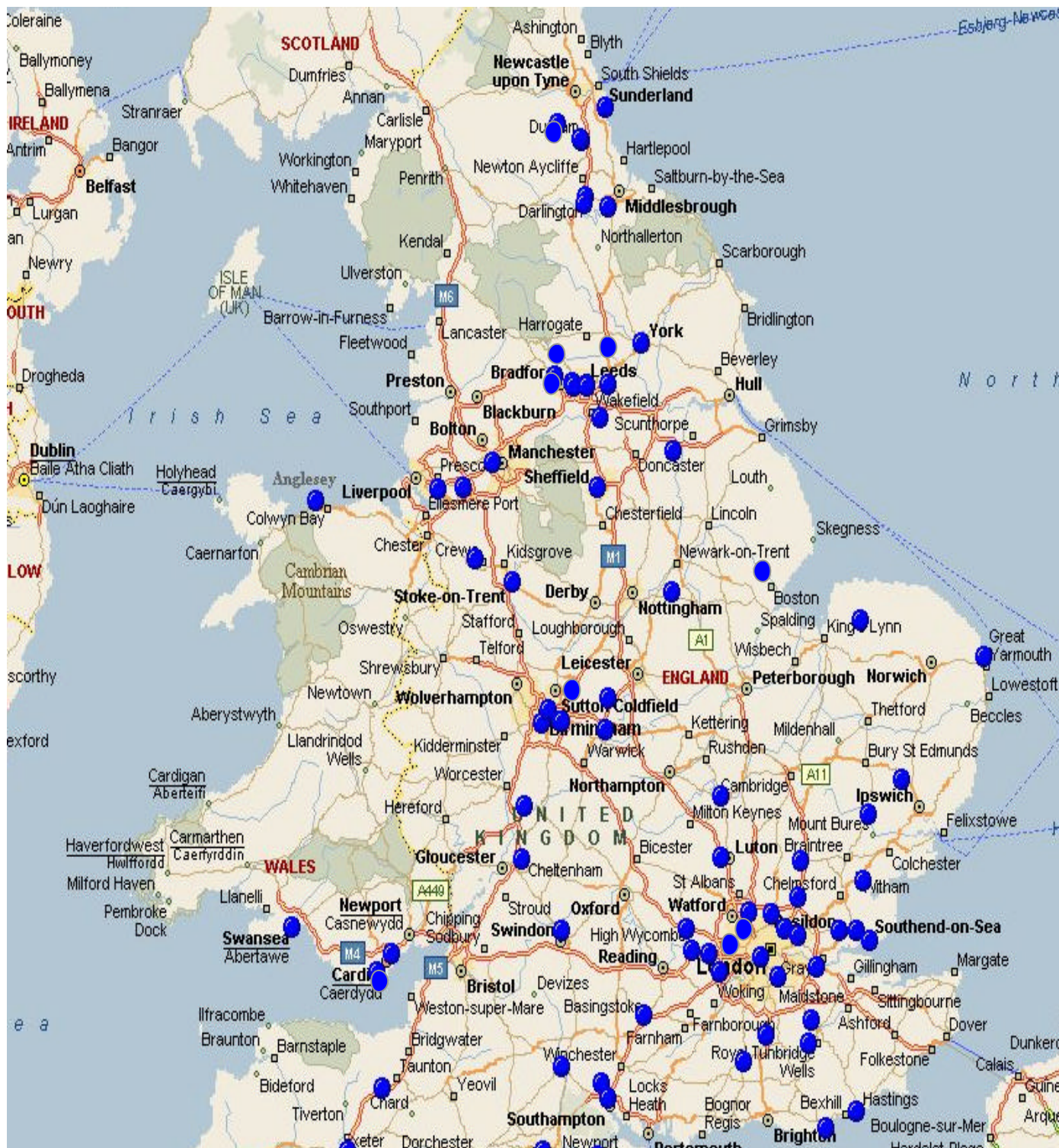


## Main Study - Temporal Distribution of Outbreaks





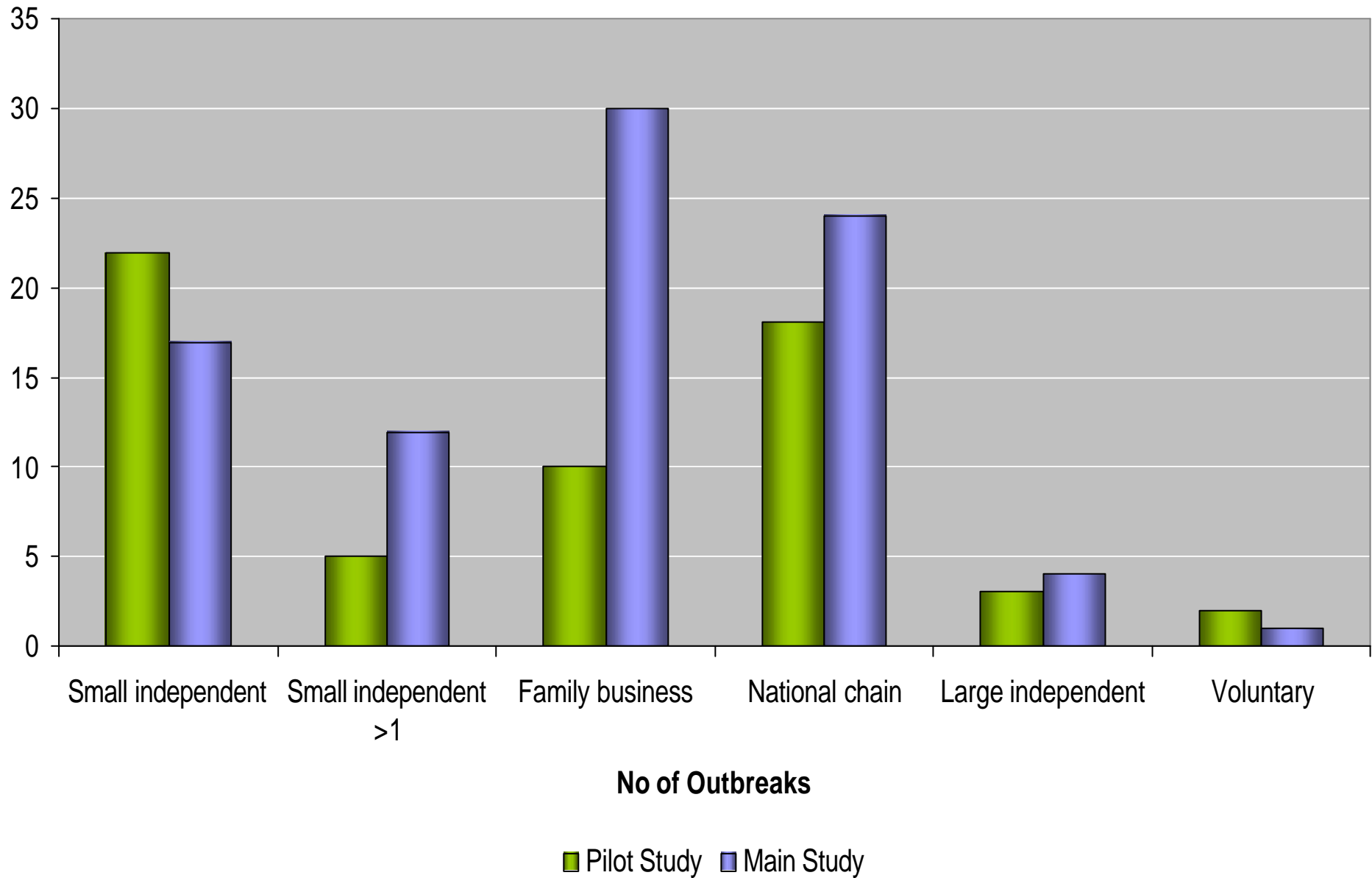
## PILOT STUDY: Geographical distribution



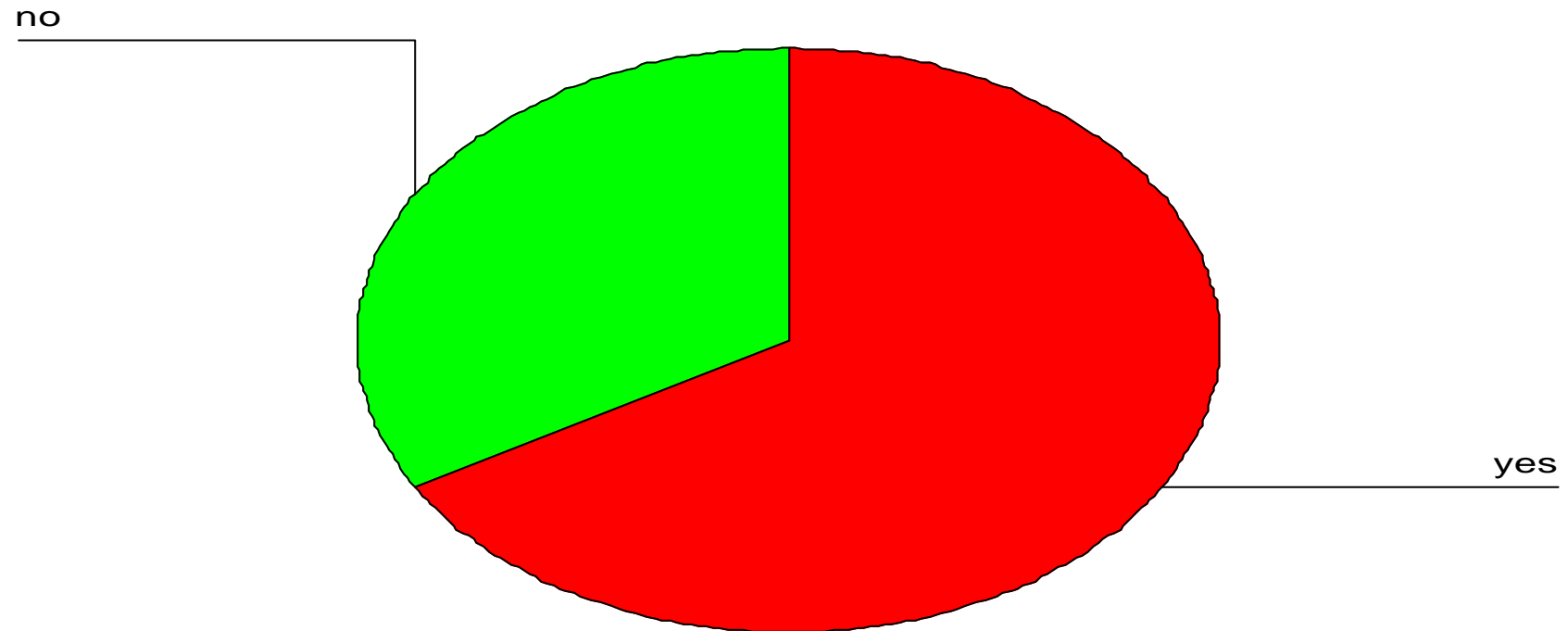
**MAIN STUDY:  
Geographical  
distribution**

PILOT STUDY		MAIN STUDY		TOTAL
REGION	NUMBER OF OUTBREAKS	REGION	NUMBER OF OUTBREAKS	
North East	3	North East	9	12
North West	6	North West	4	10
Yorkshire and the Humber	4	Yorkshire and the Humber	11	15
East Midlands	4	East Midlands	3	7
West Midlands	3	West Midlands	7	10
South West	9	South West	12	21
East	13	East	16	29
London	5	London	7	12
South East	11	South East	14	25
Wales	2	Wales	5	7
Total	60	Total	88	148

# Ownership



## Pilot Study: Are you a SME?



In the pilot study 67% of outbreaks were associated with SME catering businesses compared with 68% in the main study.

## **APPENDIX 4**

Additional questions for catering businesses associated with  
Salmonella enteritidis outbreaks in England and Wales during  
2003.

**All questions must relate to before and at the time of the outbreak, as many  
businesses have since changed their practices.**

**Business Code:**

**Date of interview:**

Q1 Why do you use your suppliers?

- Cheap ?
- Good Quality ?
- Commitment/loyalty ?
- Other ? Please specify \_\_\_\_\_

Q2 Do you have contingency suppliers for eggs, poultry and meat. Y/N. If Yes, please provide details?

- Eggs \_\_\_\_\_
- Poultry \_\_\_\_\_
- Meat \_\_\_\_\_

Q3 Is food cooked from raw at customer's tables or in front of customers, for example, at a central griddle (Mongolian Barbeque or similar style)?

Yes/No

Q4 Do you serve food at a:

- Sit down buffet (*food/buffet bought to table following order*) Yes/No
- Self serve buffet (*food on display for all customers*) Yes/No
- Functions (e.g. birthday, religious or other celebrations) Yes/No

Q5 Is this food prepared differently (for example at a different time, in different premises) to regular menu food?

Yes/No

Q6 Is hot buffet/function food served away from the premises where it was cooked e.g. at community centres, halls, musical events?

Yes/No

Q7 Is hot buffet/function food prepared in advance and reheated?

Yes/No

Q8 How do you keep buffet food hot?

- Bain Marie ?
- Plate Warmer (with candles) ?
- Hot Plate ?
- Other ? Please specify\_\_\_\_\_

Q9 How do you keep cold buffet food cold (e.g. salad, preserved vegetables, noodles salads etc)?

- Refrigerated Unit ?
- Ice ?
- Room temperature ?
- Other ? Please specify\_\_\_\_\_

Q10 Are buffet food containers replaced or topped up when empty/almost empty?

- Contents and containers completely replaced ?
- Contents topped up ?

Q11 How do you know food is hot/cooked when it is served?

- Visual (steaming, looks cooked) ?
- Touch (plate is hot) ?
- Thermometer ?
- Other ? Please specify\_\_\_\_\_

Q12 Can you tell me what temperature hot and cold food is *actually* kept at?

Yes/No If Yes, please specify temperature:

Q13 Are raw shell eggs stored under refrigeration?

Yes/No

Q14 If eggs are whisked, are they whisked by hand (including chopsticks), by electric hand mixer or by another means?

- Hand Fork /Chopsticks ?
- Hand Whisk ?
- Electric Hand Whisk ?
- Other (e.g. food processor) ? Please specify\_\_\_\_\_

Q15 After whisking egg, are these utensils used for any other purpose?

Yes/No

Q16 Do they come into contact with (tick all that apply)

- Raw food only ?
- Ready to eat food only ?
- Both raw and ready to eat food ?
- Food being cooked or reheated ?

Q17 Is raw shell egg used in batter, soups or other dishes such as fried rice or noodles?

Yes/No

Q18 Is pasteurised egg used in batter, soups or other dishes such as fried rice or noodles?

Yes/No

Q19 Of the dishes on your regular menus, what proportion of dishes contain egg or have raw shell egg as an ingredient? (Please consult menu)

- Lunch Menu \_\_\_\_\_%
- Evening Menu \_\_\_\_\_%
- Buffet Menu \_\_\_\_\_%
- Function Menu \_\_\_\_\_%

Q20 Are these dishes heated through thoroughly before consumption?

Yes/No (Examples are that they are boiled, piping hot, steaming or above 63 Deg C when served)

Q21 How do you tell that the dishes are thoroughly cooked?

- Visual ?
- Touch/feel ?
- Thermometer ?
- Other ? Please specify \_\_\_\_\_

Q22 When preparing egg fried rice, noodles or similar dishes are these prepared in large batches (i.e. > 2 servings at a time)?

Yes/No

Q23 Is this food cooked in large batches (>2 servings at a time)?

- Always (regular menu, buffet *and* function food) ?
- Only for Buffets ?
- Only for functions ?
- For both buffets and functions ?

Q24 Are cooked dishes containing egg refrigerated?

Yes/No

Q25 Are dishes containing egg kept hot?

Yes/No

Q26 Do you have separate cleaning equipment (cloths, mops etc.) for ready to eat and non-ready to eat food areas?

Yes/No  
Q27 Is cooling water used around your wok/cooking range?

Yes/No

Q28 Is this water completely replaced or topped up?

Yes/No

Q29 Do you use this water for any of the following purposes?

- Adding this water to dishes while cooking? Yes/No
- Cleaning/rinsing chopsticks? Yes/No
- To wet/dampen dishcloths? Yes/No

Q30 What temperature is the water? (*Exact temperatures not necessary*)

Q31 Has your business grown since you first opened? (Doubled, tripled, remained static?) Yes/No

Q32 If yes, have you carried out any extending your business/carried out renovations to accommodate this? (*e.g. expanded the kitchen, increased storage area, increased customer/dining area etc.*) Yes/No

