Cohort study of a dual-pathogen point source outbreak associated with the consumption of chicken liver pâté, UK, October 2009

A. Wensley, L. Coole
Yorkshire and the Humber Regional Epidemiology Unit, Health Protection Agency, Leeds, UK
Address correspondence to A Wensley, L Coole, E-mail: adrian.wensley@hpa.org.uk

ABSTRACT

Background In October 2009, a dual-pathogen outbreak of Campylobacter and Salmonella occurred in which 59 cases were identified among guests attending a regional conference in the North of England. The mean symptomatic period was 5.4 days (confidence intervals: 4.4–6.4), and over 84% of the cases had abdominal pain and diarrhoea.

Methods A retrospective cohort study was used to investigate the outbreak, and active case-finding was performed through the conference organizers and environmental health officers. A focused questionnaire was distributed to all guests via the event organizers 10 days after the conference.

Results Response rate among guests was 61% (107/175). A cohort study was undertaken, and a strong association was found between illness and consumption of chicken liver pâté, supporting the hypothesis that chicken liver pâté was the most likely cause of the outbreak.

Conclusion This is the first mixed pathogen outbreak documented associated with the consumption of chicken liver pâté and adds to the evidence of potential hazards associated with the undercooking of poultry livers. A rapid outbreak investigation with collaboration between several organizations and the venue led to identification of the most probable source.

Keywords cohort, chicken liver, food poisoning, outbreak, pate

Introduction

On 13 October 2009, the Health Protection Agency (HPA) was notified by the local Environmental Health team of a potential outbreak of illness among attendees at a regional conference hosted in the North West of England. The event had taken place over the weekend of 10 October 2009. Several delegates had reported symptoms of diarrhoea and vomiting with onset dates from Sunday 11th October.

This was a large conference with 1000 delegates from across the Yorkshire region. Activities included a formal dinner on Saturday 10th October with 175 guests. Delegates stayed in a number of different hotels and attended a range of activities and functions over the weekend.

Methods

The study design

A retrospective cohort study was used to investigate this outbreak. A cohort study was feasible because a complete guest list was accessible for the formal dinner, which was suspected as the source. Several symptomatic people notified themselves, but active case-finding was performed through the conference organizers and environmental health officers.

On 14th October, an initial hypothesis-generating questionnaire was used by nursing staff within the West Yorkshire Health Protection Unit for self-presenting cases. A further focused questionnaire was then distributed to all guests who attended the formal dinner on 10th October; these questionnaires were distributed via the event organizers. This questionnaire included questions on symptoms, medication, foods and drink consumed. These questionnaires were distributed 10 days after the conference, and the response rate among guests was 61% (107/175).
Case definition
Probable cases were defined as attendees at the Conference on the weekend of the 10th October, with symptoms of diarrhoea and one of either abdominal pain, fever or vomiting, together with onset of symptoms between the 10th and 16th of October. Confirmed cases were defined as having the same time, person and place attributes with a microbiological confirmation of Salmonella or Campylobacter.

Statistical analysis
The data were entered into an Epidata database, cleaned and checked for inconsistencies. Data analysis was performed with Epidata Analysis v3.1 (EpiData Association) and STATA 11.2 (StataCorp). Risk ratios (RR) and confidence intervals (CI) and Fisher’s exact tests were calculated individually for all food items. Multivariable analysis was performed using logistic regression. The multivariable model was constructed using all food items that were significantly associated with illness in the single-variable analysis ($P < 0.05$).

Microbiology
Stool specimens were requested from cases still found to be symptomatic during initial telephone interviews with Health Protection Unit nurses. Specimens were processed for gastrointestinal pathogens according to standard protocols.

Environmental risk assessment
Environmental health officers collected detailed information on the preparation, storage and transportation processes for the food catered at the event. In the total four food handlers identified themselves as unwell, all reported eating chicken liver pâté on 10th October, but nothing else from the menu. All observed appropriate workplace exclusion periods. The chicken pâté consumed on Saturday 10th October was prepared in two batches at the venue on 8th and the 9th October. A bain-marie was used, which had 1.5 times more capacity than the usual cooking pan for the pâté. Investigating Local Authority Environmental Health Officers were informed that the cooking times were not adjusted and that the two different sizes of cooking container were used in the same oven, at the same temperature and for the same length of time.

Results
Descriptive epidemiology
The median age of cases was 67 years (mean: 66.9 years; range: 50–86 years). Men and women were reasonably equally distributed (58 and 42%, respectively). The dates of onset of symptoms were between the 10th and 16th October, and the median incubation period was 2 days (mean: 2.08 days; range: 0–6 days). The median duration of illness was 5 days (mean: 5.4 days; range: 1–14 days). Fig. 1 shows the epidemic curve of the cases, comprising 11 culture positive confirmed cases and 48 probable cases.

Initial information indicated onset dates peaking on 11th October with an epicurve consistent with a point source exposure.

The most common symptoms reported by the cases were diarrhoea (100%), abdominal pain (85%), nausea (51%) and fever (36%). Vomiting was only reported in 12% of the cases. Duration of symptoms had a mean of 5.4 days (CI: 4.4–6.4) with symptoms lasting longer than one week for nine people. The majority of affected individuals reported a symptom duration of 5/6 days that would be consistent with bacterial rather than viral gastroenteritis. The absence of reported secondary cases also suggested that a viral aetiology was less likely and was consistent with bacterial pathogens associated with low levels of person to person transmission.

Analytical epidemiology
The single-variable analysis of all food items is shown in Table 1. Confounding of the single-variable analysis was evident when adjusted after stratification by chicken liver pâté, as shown in Table 2. In order to adjust for potential confounding, a logistic regression analysis was performed. Table 3 shows the final logistic regression model; all candidate variables that did not add to the explanatory power of the model were excluded.

For the meal held on 10th October, the strongest associations with univariate analysis were chicken liver pâté, roast beef and chocolate dessert. After adjusting for all other food items, only the chicken pâté (OR: 14.7; 95% CI: 2.587–0.6) was significantly associated with illness in the final model.

Fig. 1 Cases identified by onset of symptoms, mixed pathogen outbreak, UK, October 2009.
Sixty-eight per cent \( (n = 56) \) of persons who ate the chicken liver pâté became ill. Chocolate dessert has a notable risk effect but is not statistically significant. This may suggest an association, particularly given the dual microbiology that the cases of illness could have arisen from more than one source.

**Microbiology**

A relatively small number of cases submitted samples with results on 14 guests available. However, bacterial infectious intestinal disease was confirmed in 11 of these, with both single and mixed *Campylobacter* and *Salmonella* infections. Five cases were confirmed as *Campylobacter*, three as *Salmonella* and three were infected with both pathogens. Typing of the *Salmonella* isolates from guests revealed the organism to be *S. typhimurium DT8*. In addition, one member of staff who reported eating the pâté was confirmed as having a dual infection.

One food sample was available from the meal, and environmental samples were taken six days later. When submitted for microbiological investigation, all were negative.

**Discussion**

**Main findings of this study**

The outbreak investigation was conducted rapidly, to initiate an appropriate public health response. This enabled quick implementation of control measures and attempted to minimize recall bias in the cohort. As a result of early feedback, the catering venue reviewed their compliance with hazard analysis and critical control points (HACCP) procedures and introduced additional checks to ensure cooking temperatures reached a minimum of 76 degrees and that cooking times were adjusted to account for larger size vessels to ensure this.

The results show a strong association between the consumption of chicken liver pâté at the meal on the 10th October and illness caused by *Campylobacter* and *Salmonella*. The multivariable model shows that even after adjusting for other significant risk factors, the odds of becoming ill after consumption of the pâté increased by over 14 times. The epidemiological analyses as well as the biological plausibility (e.g. incubation time, clinical picture and duration of illness) suggest that *Salmonella* and *Campylobacter* were the most likely causative agents responsible for the outbreak of gastroenteritis. The environmental investigation supports the hypothesis that undercooking of the chicken liver pâté resulting from a failure to adjust cooking times for the larger volume prepared may have been instrumental. Chicken liver pâté dishes have been previously associated with outbreaks due to a range of pathogens including *Campylobacter* and *Salmonella*.

**What is already known on this topic**

*Campylobacter* is the most commonly reported cause of bacterial food poisoning in England and Wales. Almost 62,700

---

**Table 1** Exposures associated with case definition of illness with a risk ratio greater than 1.5, mixed pathogen outbreak, UK, October 2009

<table>
<thead>
<tr>
<th>Case</th>
<th>Exposed</th>
<th>Unexposed</th>
<th>Risk ratio</th>
<th>95% CI</th>
<th>P exact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Cases</td>
<td>AR (%)</td>
<td>Total</td>
<td>Cases</td>
</tr>
<tr>
<td>Chicken liver pâté</td>
<td>82</td>
<td>56</td>
<td>68.3</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>Roast beef</td>
<td>91</td>
<td>57</td>
<td>62.6</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>Gravy</td>
<td>85</td>
<td>52</td>
<td>61.2</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>Chocolate dessert</td>
<td>70</td>
<td>46</td>
<td>65.7</td>
<td>37</td>
<td>13</td>
</tr>
</tbody>
</table>

**Table 2** Adjusted risk ratio after stratification by chicken liver pâté exposure, with percentage change, mixed pathogen outbreak, UK, October 2009

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Crude</th>
<th>95% CI</th>
<th>Exposed stratum</th>
<th>Unexposed stratum</th>
<th>M–H adjusted</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>95% CI</td>
<td>RR</td>
<td>RR</td>
<td>RR</td>
<td></td>
</tr>
<tr>
<td>Roast beef</td>
<td>5.01</td>
<td>1.36–18.50</td>
<td>0.68</td>
<td>3</td>
<td>1.35</td>
<td>0.51–3.58 –73.1%</td>
</tr>
<tr>
<td>Gravy</td>
<td>1.92</td>
<td>1.02–3.63</td>
<td>0.66</td>
<td>3.56</td>
<td>0.83</td>
<td>0.61–1.14 –56.8%</td>
</tr>
<tr>
<td>Chocolate</td>
<td>1.87</td>
<td>1.17–2.99</td>
<td>1.34</td>
<td>3</td>
<td>1.42</td>
<td>0.94–2.13 –24.1%</td>
</tr>
</tbody>
</table>
cases were reported by laboratories for England and Wales during 2010, with an increase of 16% from 2009. \(^3\) \textit{Campylobacter} reporting has increased almost yearly for England and Wales from 44,544 cases in 2004. The infection is usually self-limiting with an incubation period between 2 and 5 days. Common clinical features are abdominal pain, diarrhoea, malaise and fever, which may persist for a week or longer. \(^4\) The infective dose required for illness can be as low as 500 organisms,\(^5\) but the organisms do not readily replicate in food.

Despite the frequency of \textit{Campylobacter} infection, outbreaks attributed to the pathogen are rare. Twenty-two per cent of all \textit{Campylobacter} outbreaks between 1992 and 2009 were attributed to the consumption of poultry livers, which constitutes the largest potential source of human infection.\(^6\) Undercooking of meat, unpasteurized milk and untreated water are also commonly identified risk factors. Studies of the contamination of poultry have reported chicken liver contamination rates of up to 90% in internal tissue.\(^7\) A Food Standards Agency (FSA) survey of chicken samples during 2008 identified that 65.2% were contaminated with \textit{Campylobacter},\(^8\) and this has continued to be a focus for the FSA in their 2010–2015 strategic plan.\(^9\) Outbreaks of \textit{Campylobacter} occurring as a result of consumption of undercooked chicken livers and chicken liver pâté are well documented.\(^1,5,10\) Mixed pathogen outbreaks are uncommon;\(^11\) no literature is currently available linking mixed pathogen outbreaks to chicken liver pâté consumption. \textit{Salmonella} organisms account for almost half of all foodborne outbreaks reported to the HPA, and 50% of these \textit{Salmonella} outbreaks were attributed to poultry.\(^2\) An FSA survey identified that 6.6% of chicken samples were contaminated with \textit{Salmonella}.\(^8\) Whilst there are numerous serotypes of \textit{Salmonella} responsible for human disease, \textit{S. typhimurium} is the second most common after \textit{S. enteritidis}. Common clinical features of \textit{Salmonella} include diarrhoea, stomach cramps and less frequently fever and vomiting. The incubation period is usually 12–72 h.\(^12\) Red meat and poultry have been associated with illness, as well as raw eggs, milk and dairy products.\(^13\) There are \(\sim\)10,000 \textit{Salmonella} infections reported per year and \textit{S. typhimurium} generally accounts for between 1500 and 2000 cases a year.\(^14\)

### What this study adds

Given the high number of foodborne outbreaks, the fact that multi-pathogen outbreaks are reported infrequently is surprising.\(^15\) Some papers suggest that mixed outbreaks may be more common than is generally suspected, but laboratory investigations often stop after identification of a single pathogen.\(^11\) Consideration of the possibility of mixed pathogen outbreaks may be helpful to teams investigating and managing outbreaks and contribute to establishing the true prevalence of multi-pathogen outbreaks in the UK.

### Limitations of this study

It is possible that this study was affected by ascertainment bias as the suggestion that the pâté was responsible for the outbreak may have spread among delegates. This has been highlighted in other similar small cohort outbreak studies.\(^5\) The broad and inclusive case definition used permits that some guests may have been misclassified as outbreaks cases that would only reduce the strength of any observed associations.

The epidemiological findings taken together with the Environmental Health Officer report supports the conclusion that the chicken liver pâté was a source of \textit{Campylobacter} and \textit{Salmonella} infection among delegates at the conference. Although this may not account for every case of gastrointestinal upset experienced, it does explain all of the microbiologically confirmed cases.

One of the challenges in this investigation was the small number of appropriate food samples for testing and the scarcity of other microbiological samples, including stool and environmental samples. Further microbiological confirmations may have allowed examination of the exposures to specific pathogens; however, with the microbiological evidence available, this was not possible. A number of cases had microbiological evidence of either \textit{Campylobacter} or \textit{Salmonella}, or both. A symptomatic food handler also had confirmed dual infection in a time frame consistent with exposure to the same source as the conference guests.

In conclusion, this study highlights important risk factors that might arise due to changes in cooking practices. Significant public health issues from pâté preparation from chicken livers have been identified in a number of publications.\(^1,5,10\) Food safety procedures need to be regularly monitored and reviewed to ensure effective procedures are

### Table 3

<table>
<thead>
<tr>
<th>Exposure</th>
<th>OR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken liver pâté</td>
<td>14.669</td>
<td>2.457 – 87.562</td>
<td>0.003</td>
</tr>
<tr>
<td>Roast beef</td>
<td>2.675</td>
<td>0.249 – 28.698</td>
<td>0.416</td>
</tr>
<tr>
<td>Gravy</td>
<td>0.311</td>
<td>0.044 – 2.215</td>
<td>0.244</td>
</tr>
<tr>
<td>Chocolate dessert</td>
<td>2.532</td>
<td>0.968 – 6.621</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Downloaded from https://academic.oup.com/jpubhealth/article-abstract/35/4/585/1686091 by guest on 06 October 2018
followed. Contributory factors in most outbreaks are cross-contamination, inadequate heat treatment and inappropriate food storage. Review of temperature and duration of cooking are especially important if any changes to standard cooking practices are made. Identification of occasional unsafe cooking practices in establishments with generally high standards of hygiene can be very difficult, and emphasis on prevention through clear food preparation guidance may help prevent future outbreaks.

Acknowledgements
The authors wish to acknowledge the contribution of members of the outbreak control team, environmental health officers and colleagues within the Health Protection Agency.

References
8 Food Standards Agency. FSA report for the UK survey of Campylobacter and Salmonella contamination of fresh chicken at retail sale, 2009.