An Outbreak of *E. coli* O157/VTEC at the SSE Hydro, Glasgow, January 2014

A report on behalf of the Incident Management Team

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Executive Summary

Twenty-two cases of laboratory confirmed *E. coli* O157/Verotoxin-producing *E. coli* (VTEC) were reported to NHS Greater Glasgow and Clyde Public Health Protection Unit (PHPU) between 29 January and 13 February 2014. All of these individuals had epidemiological links to the SSE Hydro, Glasgow.

Investigation of the outbreak required epidemiological, environmental and microbiological analysis. NHS Greater Glasgow and Clyde PHPU was successfully supported in the investigation, management and control of this outbreak by seven Scottish health boards, Public Health England, Environmental Health colleagues in Glasgow City Council and North Lanarkshire Council, the Scottish *E. coli* O157 Reference Laboratory, Health Protection Scotland and the Food Standards Agency.

Nineteen of the cases attended and ate beef burgers at the SSE Hydro between Friday 17 and Sunday 19 January 2014. The remaining three individuals were household contacts of these primary cases. The majority of those affected were not severely unwell, however three individuals required hospital treatment. Nine individuals, including one case, required a formal exclusion from work or education. For one individual this resulted in a prolonged absence from the workplace.

Microbiological analysis identified three strains of VTEC from human samples, the predominant strain being *E. coli* O157 phage type 31. Only minor variation was identified between isolates in keeping with a single source of exposure.

Environmental investigation found descriptive evidence strongly suggesting the possibility of processing errors leading to undercooking as well as the potential for cross contamination in the preparation and serving of the beef burger products. These processing errors would provide plausible mechanisms for exposure to VTEC.

Although this was a sizeable outbreak of *E. coli* O157/VTEC, it is fortunate that the number of individuals affected was not larger given the nature of the venue. The relatively low proportion of severe cases is likely to be due to the virulence of the phage type involved and the age range of cases. The outbreak provides a reminder of the potential for *E. coli* O157 contamination of beef products and the need for adequate cooking and cross-contamination measures in the preparation of these products.
1. Introduction

On the morning of Wednesday 29 January 2014 the NHS Greater Glasgow and Clyde Public Health Protection Unit (PHPU) was contacted by its counterparts at NHS Lanarkshire to report two cases of *E. coli* O157 infection. Both persons had attended the SSE Hydro, Glasgow on Saturday 18 January and had consumed beef burgers within the premises. The first individual (case 1) was a 32 year old male who had developed symptoms of bloody diarrhoea on Wednesday 22 January. *E. coli* O157 infection had been confirmed on 27 January when isolated from a faecal sample. The second individual (case 2) was a 35 year old male and a close relation of case 1. His diarrhoeal symptoms had commenced on Tuesday 21 January and the result of testing was awaited. Further household contacts of case 1 were undergoing investigation of symptoms suggestive of *E. coli* O157 infection.

Later, on Wednesday 29 January, two additional cases of *E. coli* O157 were reported to the NHS Greater Glasgow and Clyde PHPU. Case 3 was a 12 year old male from the NHS Greater Glasgow and Clyde Health Board area. He had attended the SSE Hydro on Sunday 19 January and developed bloody diarrhoea on 22 January. Case 4 was a 16 year old male resident in NHS Lothian. He had attended the SSE Hydro on 18 January and developed symptoms on 21 January. Both cases had also consumed beef burgers sold within the SSE Hydro during their visit.

All four cases and contacts were managed by their local health protection teams following recommended Health Protection Network *E. coli* O157/VTEC guidelines. A Problem Assessment Group (PAG) met on Wednesday 29 January chaired by Dr Eleanor Anderson, Consultant in Public Health Medicine at NHS Greater Glasgow and Clyde Health Board. The PAG reviewed the available information and actions taken to date and agreed on additional investigations, control measures and communications. An outbreak was declared. The group met as an Incident Management Team (IMT) the next day and over the following days and weeks with a final meeting conducted on 13 February 2014. The IMT included representatives from health board public health protection units, local authorities, Health Protection Scotland, the Food Standards Agency and local and national laboratories. This report is an account of the investigation and management of the outbreak by the IMT.
2. Background

2.1 Verotoxin-producing E. coli (VTEC) and E. coli O157

*Escherichia coli* (E. coli) bacteria live in the intestines of most humans and animals. There are hundreds of different strains of *E. coli* and usually these bacteria are harmless constituents of normal gut flora. Verotoxin-producing *E. coli* (VTEC) are strains of *E. coli* which produce toxins with the ability to cause disease in humans. The VTEC strain, or serogroup, most identified in humans with gastrointestinal illness in the UK is *E. coli* O157, however the number of reported cases of non-O157 VTEC in Scotland has increased in recent years.¹

The principal reservoir of VTEC is in the gut of cattle. The estimated carriage rate of *E. coli* O157 in cattle is between 8-16%.² Sheep may also act as a reservoir with estimated carriage rates averaging 2%.³ The immediate land environment and water sources surrounding animals carrying VTEC can therefore become contaminated by the shedding of contaminated faeces.

VTEC can be transmitted to humans in the following ways:

- Ingestion of contaminated food
- Drinking contaminated water (e.g. untreated private water supplies in rural settings).
- Direct or indirect contact with the faeces or environments of contaminated livestock (e.g. farm premises or grazing land, or animal visitor attractions).
- Direct transmission from an infected human to another (e.g. where hand washing practice has not been able to prevent cross-contamination).

The infectious dose of VTEC is low compared to other gastrointestinal pathogens, with only a small number of bacteria (probably less than 1,000) required to cause infection.¹ This means that VTEC can spread easily in families or in settings such as day nurseries.

The incubation period for VTEC ranges from 1-14 days but is usually 3-4 days. Gut invasion by these organisms can cause stomach cramps and diarrhoea which ranges from mild gastroenteritis to severe bloody diarrhoea. Approximately 60% of cases in Scotland report bloody stools.⁴ Asymptomatic carriage can also occur. Around 9% of cases in Scotland, mostly children under 16 years of age, will develop a serious complication known as Haemolytic Uraemic Syndrome (HUS) which is associated with acute renal failure, anaemia and thrombocytopenia (TTP).⁴ A small number of adults may also develop a thrombocytopenic complication. Treatment options for VTEC are limited to supportive interventions such as rehydration. Antibiotic therapy and anti-diarrhoeal preparations are contraindicated and have been associated with increased risk of HUS.
2.2 VTEC in ground beef products

The carcass of the animal may become contaminated with VTEC in the abattoir due to exposure to organisms on the hide or in the animal’s gut. This contamination by micro-organisms such as *E. coli* O157 can therefore occur on the surface of whole cuts of meat. The inside of a cut of meat will rarely contain *E. coli* O157 as the organism will not penetrate the meat significantly. This explains why serving steaks or joints of beef “pink” or rare is generally not discouraged; the cooking process, correctly adhered to, will kill any bacteria present on the surface of the beef.

Where beef is ground, as used in the preparation of beef burgers, the potentially contaminated surface of the meat is normally mixed throughout the product mass. This is why it is advised that minced beef products should be fully cooked and not served “pink”.

More than one VTEC serogroup is occasionally identified in samples submitted by infected individuals. Where this transmission is due to contaminated ground beef products, there are two possible explanations: individual cattle can be a reservoir for more than one serogroup of VTEC resulting in co-infection, or, meat products may have been produced by mixing meat from multiple cattle carcasses.

2.3 Description of the setting

The SSE Hydro is an arena located in Finnieston, Glasgow on the same site as the Scottish Exhibition and Conference Centre (SECC) and hosts shows consisting of high profile musical artists, global entertainment and sports events. The SSE Hydro was officially opened on September 2013 and is believed to be the fifth busiest entertainment venue in the world, aiming to attract one million visitors every year. The facility has a capacity of 13,000 seats. There are five main food outlets within the Hydro, four on the ground floor and one on the 2nd floor.
3. Epidemiological investigation and results

3.1 Data collection

The NHS Board in which each suspected case was resident took responsibility for data collection from that case and the follow up of contacts as per the usual practice of their health protection unit. All cases were interviewed either face to face or by telephone by Environmental Health Officers (EHOs) or health protection staff. The information obtained from interviews with the cases was recorded on the enteric investigation forms in use at each Board. These forms assess exposure to a range of risk factors for the acquisition of VTEC.

Health Protection Teams at other Boards notified NHS Greater Glasgow and Clyde PHPU of confirmed or probable cases of VTEC in their board area, who had exposures in Glasgow during their incubation period. Given the potential risk to public health from the incident, boards agreed to share data. All those with access to these data dealt with it in accordance with data protection legislation. Enteric investigation forms were therefore shared with the NHS Greater Glasgow PHPU and close communication was maintained.

3.2 Case definition

The following case definitions were used by the incident management team.

**Confirmed case:** An individual with gastrointestinal symptoms and an epidemiological link to the SSE Hydro and either *E. coli* O157/VTEC identified from a faecal sample or serum IgM antibodies to *E. coli* O157.

Confirmed cases are further classed as;
- Primary cases: confirmed cases who have a direct epidemiological link to the SSE Hydro.
- Secondary cases: confirmed cases who did not attend an event at the SSE Hydro but had biologically plausible exposure to another confirmed or probable case.

**Probable case:** An individual with gastrointestinal symptoms strongly suggestive of *E. coli* O157/non-O157 VTEC infection and an epidemiological link to the event at the SSE Hydro between 17 and 19 January 2014.

**Suspected case:** An individual with an epidemiological link to the SSE Hydro and gastrointestinal symptoms that provide sufficient reason for action to be taken to exclude VTEC infection.
3.3 Descriptive epidemiology

In total, 22 individuals were confirmed to have *E. coli* O157 infection. A number of other probable or possible cases were investigated by local public health protection units.

Nineteen of the 22 cases were male, and three were female. The confirmed cases ranged in age from 9-61 years with a mean age of 27 years. Cases were identified across seven NHS Scotland board areas with one further case from Cumbria, England.

![Figure 1: Confirmed cases by Health Board Area](image)

Twenty-one of the confirmed cases were symptomatic. One secondary case was asymptomatic and detected through screening as they were in a high risk group*. Symptoms included diarrhoea, bloody diarrhoea, abdominal pain, nausea, vomiting and fever. Twelve individuals reported bloody diarrhoea. Three cases were hospitalised for between three and six days. No cases were recorded to have serious complications.

The fact that none of the cases were children under five years of age was fortunate as this group is known to be at high risk of Haemolytic Uraemic Syndrome (HUS) and other serious complications with VTEC infection. Specialist assessment is required for this group during the course of their illness.

All 19 of the confirmed primary cases had attended the SSE Hydro between Friday 17 January and Sunday 19 January 2014. The three secondary cases had not attended the venue but were household contacts of confirmed cases who had attended. All primary cases were male whilst all

* A description of risk groups is given in a table on page 16
secondary cases were female. The dates of symptom onset for primary and secondary confirmed cases are described in the epidemic curve (a graph plotting the number of cases by the date of onset of symptoms for each case) below (Figure 2). The dates of onset are consistent with exposure to VTEC while attending the SSE Hydro between 17 and 19 January or, for secondary cases, with secondary transmission from a confirmed primary case.

Figure 2: Confirmed cases by date of symptom onset

Food exposures of the confirmed primary cases
All of the 19 confirmed primary cases had eaten a six ounce burger served on a bread bun from the “Big Grill”, a burger outlet within the SSE Hydro. Ten of the 19 confirmed cases had cheese on their burger. No other additions to the burger such as salad or condiments were consistently consumed by the confirmed cases.

4. Environmental investigations and results
4.1 Environmental Investigation
The PHPU reported the suspected outbreak to Land and Environmental Services (Environmental Health) at Glasgow City Council on 29 January 2014. The first visit by Glasgow City Council Environmental Health Officers (EHOs) to the SSE Hydro was made on the afternoon of that day. There was no food preparation or handling taking place at either the Big Grill or the Wee Grill – another burger outlet in the SSE Hydro - at the time of this visit. The only food handling taking
place at the time was at the SSE Hydro central production kitchen where food was being prepared for an event the following day (30 January 2014). The potential for, and mechanism by which, cases could have been exposed to VTEC whilst at the venue was assessed to inform the investigation and to identify any ongoing risk to public health which required remedial action. In keeping with the epidemiological information that cases had consumed beef burgers at the venue, attention was paid to locating the outlets that sold these particular products and to the methods used in their preparation.

EHOs gathered information on the food outlets available and the products sold at each. Enquiries were made about staff illness and staff training. Food preparation practices were observed where possible; otherwise a description of the processes used was sought from the food business staff. This included a detailed discussion with the Executive Chef at the SSE Hydro on the preparation of beef burgers. Food Safety Management System documents and monitoring records were reviewed.

The Food Standards Agency (FSA) assisted in tracing supplies and distribution of beef burgers.

4.2 Findings of the Environmental Health Investigation
There were two main food outlets that sold beef burgers within the SSE Hydro. Both outlets were operated by Levy Restaurants, a member of the Compass Group. “The Big Grill” is situated in the main foyer on the ground floor, and “The Wee Grill” is situated on the 2nd floor. Both outlets are supported by a central production kitchen situated on the first floor of the SSE Hydro. Other commercial food outlets within the SSE Hydro offer fish and chips, pizza, pasta, hotdogs and beverages.

Two burger sizes were being sold, 6oz and 3oz (referred to as children’s burger). During the weekend in question there were five events, over the course of which there were an estimated 1,800 6oz beef burgers sold.

First impressions of the catering facilities were good. Staff were well presented and the premises were in a visibly clean condition. The company demonstrated a comprehensive training programme which included an induction process for new staff. The chefs present during the investigation had been on duty throughout the weekend of 17 to 19 January. There was no history of relevant staff illness in the period before or during the event in question.
4.2.1 Assessment of food preparation processes

Temperature Control

Beef burgers served at both outlets were initially prepared in the central production kitchen. Subsequent to defrosting, burgers were seared in the central production kitchen, cooled and then kept in chilled storage. When required, these partially cooked beef burgers were then transferred to the outlets and cooked to order on the outlet grill (See Appendix 1). The manner in which the beef burgers were seared (partially cooked) was not detailed within the Compass Food Safety Management System (FSMS) / Hazard Analysis and Critical Control Points (HACCP). Indeed, the process step was not referred to at all (Appendix 2).

Examination of trays of 6 oz seared burgers within chilled storage identified a lack of uniformity in the appearance of the burgers at this stage. Some burgers appeared well seared, while others were barely seared with pink raw meat visible on the surface of the burger. The practice of searing raw beef burgers was viewed as potentially problematic; though EHOs believed that the process should not, in principle, present a risk of food poisoning provided that each burger was thoroughly cooked at a later point prior to sale. A trained, experienced chef should be capable of assessing the adequacy of the cooking of a beef burger using a combination of cooking time, appearance and firmness. This may be undermined by the cooking of a series of beef burgers which were not consistent in nature at the start of the cooking process and exacerbated by high demand for this cooked-to-order item. Temperature monitoring using a digital probe thermometer is highly effective; however, it would not be expected that this would be undertaken with every beef burger. Officers were advised that the core temperature of beef burgers were indeed periodically monitored using probe thermometers, however temperature monitoring records for the unit had not been adequately completed. In addition, when the use of a probe thermometer was discussed with staff, officers were advised that the probe was inserted into the item while still on the griddle. This practice could potentially lead to an over-estimation of the actual core temperature. During a subsequent visit to the Big Grill while the outlet was operational, the chef was observed inserting the probe into the thinnest part of a cooked chicken breast. This practice could also lead to an over-estimation of the core temperature as the core temperature should always be measured at the thickest part of the food item.

In conclusion, it appeared that there had been an inadequate hazard analysis of the beef burger preparation process as it was described. The operation described did not match that specified
within the company FSMS / HACCP, and a step had been introduced (i.e. searing) which may have increased the risk of a lack of control at a subsequent cooking stage. Paper copies of monitoring records appeared to be poorly collated and organised. Such records are required by legislation and would, if complete, offer some assurance as to the adequacy of the cooking process.

Cross contamination
The potential for cross contamination of ready-to-eat food from raw or undercooked meat was also assessed in line with the guidance. The following facts were established during the interview with food handling staff at the Big Grill:

- Tongs were not designated specifically for use with either ready-to-eat foods or raw meat.
- Separate washing of utensils was not being undertaken in that ready-to-eat food utensils were being cleaned and disinfected in the same double sink unit and at the same time as raw food utensils and equipment.
- The same cloths were being used to clean utensils that were in contact with both ready-to-eat and raw foods.
- Adequate cleaning and disinfection of the double sink unit was not being properly carried out after it was used for the cleaning and disinfection of raw utensils and equipment.

4.2.2 Food sampling at SSE Hydro
No burgers were available at the SSE Hydro from the same batch as had been used during the weekend of 17 to 19 January 2014 as a consequence of the time that had elapsed before cases were first notified to public health. Samples of the available raw and cooked beef burgers, cheese, rocket and tomato were submitted for microbiological examination. Evidence of VTEC was not isolated from these samples.

Adenosine Triphosphate (ATP) swabbing and testing, an indicator of the efficacy of cleaning and disinfection, were conducted at the Big Grill. Results indicated that the cleaning processes conducted prior to swabbing had been effective.

4.2.3 Distribution chain of raw beef burgers
Frozen raw 3oz and 6oz beef burgers were supplied to the SSE Hydro by an established manufacturer within central Scotland. The establishment is approved under Regulation (EC) 853 / 2004 for the production of meat preparations. EHOs from the relevant Local Authority visited the factory. All blast freezer and main freezer temperatures and hygiene check list records were
satisfactory. All knife sterilizers and related temperature monitoring were also recorded as being satisfactory.

No beef burgers of the batch used at the SSE Hydro during the weekend 17 to 19 January remained for testing. Tests conducted on other batches of meat were negative for E. coli O157.

Tracing of the beef burgers in the batch supplied to the SSE Hydro on the weekend of 17 to 19 January 2014 identified that these were also sent to another food establishment in Edinburgh. There have been no known complaints or instances of illness associated with eating beef burgers of the same batch when prepared in this particular establishment.

5. Microbiological investigation and results

5.1 Microbiological investigation

Faecal samples from symptomatic individuals were submitted to the local diagnostic laboratory for culture. Presumptive positive isolates of E. coli O157 were forwarded from the local laboratory to the Scottish E. coli O157/VTEC Reference Laboratory (SERL) for confirmation and typing. Faeces testing negative at the local diagnostic laboratory, but from individuals with symptoms suggestive of a verotoxin-producing E. coli (VTEC) infection or from symptomatic contacts of known cases, were also forwarded to SERL for more sensitive testing in line with current Scottish guidance.¹

SERL use real-time PCR to screen all submitted isolates and faeces for the presence of verotoxin genes (vtx1 and vtx2), which could indicate the presence of VTEC, and the rfbO157 gene, specific for E. coli O157. For faeces testing positive for one or more of these genes, the organism is cultured for diagnostic confirmation, typing and epidemiological purposes. Faecal samples submitted to SERL from contacts of cases with an E. coli O157 infection or patients with HUS, which have tested negative at the local diagnostic laboratory, also undergo Immunomagnetic Separation (IMS) testing for E. coli O157.

E. coli O157 isolates are subtyped using phage typing and multi-locus VNTR analysis (MLVA) and VTEC other than serogroup O157 are subtyped using pulsed-field gel electrophoresis (PFGE).

Typing results are analysed in conjunction with all relevant epidemiological information.
5.2 Microbiological results

Evidence of VTEC infection was identified in 22 individuals. All had laboratory-confirmed evidence of infection with *E. coli* O157. Two subtypes of *E. coli* O157 were detected: phage type 31 and phage type 4. Of the 19 primary cases, 16 demonstrated the presence of *E. coli* O157 phage type 31. The presence of the same organism and phage type was also confirmed on all three of the confirmed secondary cases. Two further primary cases, the initial Lanarkshire cases, were found to have *E. coli* O157 phage type 4. The remaining case had only serological evidence of *E. coli* O157 infection so no subtyping is available.

One probable case was culture negative at the local diagnostic laboratory, but a sample was not sent to SERL for further testing.

Dual infection (i.e. the presence of more than one VTEC serogroup) was detected in four of the 22 cases. As shown in the table 1, *E. coli* O182 was confirmed in three cases and *E. coli* O113 was confirmed in one case.

The MLVA profiles confirmed that the 19 Scottish phage type 31 *E. coli* O157 isolates were genetically identical by this method and the isolate from the English case had only a small variation (a single locus variant) which is sometimes observed during outbreaks. Similarly, there was also a small difference in the MLVA profiles of the two phage type 4 isolates. The PFGE profiles of the three *E. coli* O182 isolates were indistinguishable.

No other cases of *E. coli* O157 phage type 31 were notified in Scotland in the first quarter of 2014. This is a relatively uncommon phage type in Scotland, accounting for less than 5% of all cases historically, and with only one case in 2013 and four in 2012. The O182 serogroup which was identified in the outbreak has never been recorded previously in Scotland; these are the first three cases.
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6. Risk Management

6.1 Hand and environmental hygiene advice

All cases were given verbal advice by their local health protection unit on hand hygiene and environmental hygiene in the home. Symptomatic individuals were advised not to return to work or school until 48 hours after symptoms had settled or, if an individual was excluded (see below), until this exclusion was lifted by the health protection unit.

6.2 Exclusion

Official exclusion is used for groups of people who pose a special risk of spreading infection. These individuals may be either cases or close contacts of cases. Those individuals identified as belonging to special risk groups require microbiological clearance prior to return to pre-school or work. This usually consists of two negative faecal samples submitted 24 hours apart.

These special risk groups (cases or contacts) fall into four categories as specified in the table below:

<table>
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<th>Any person of doubtful personal hygiene or with unsatisfactory toilet, hand washing or hand drying facilities at home, work or school</th>
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<tr>
<td>Group B</td>
<td>Children under 5 years old who attend pre-school groups or nursery or other similar groups</td>
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<td>Group C</td>
<td>People whose work involves preparing or serving unwrapped foods not subjected to further cooking</td>
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<tr>
<td>Group D</td>
<td>Clinical and social care staff in high risk care facilities who have direct contact with highly susceptible patients or persons in whom a gastrointestinal infection would have particularly serious consequences</td>
</tr>
</tbody>
</table>

Three children attending pre-school (Group B) who were contacts of cases were officially excluded. Six individuals (one case and five contacts) whose occupational circumstances placed them in either Group C or Group D were also excluded. These individuals consisted of two food handlers, two nursery workers and two health care workers. One of the nursery workers who was never symptomatic but tested positive for VTEC, was excluded from work for a total of three months.
6.3 Active case finding
The IMT communicated actively with the public, through media releases and interviews on TV and radio, to raise awareness of the outbreak. The primary aim of this was to identify symptomatic cases who had not presented to health services. Professional communications also raised awareness amongst health professionals to aid reporting of symptomatic individuals.

6.4 Improvements to food safety management at the SSE Hydro
On the first visit by EHO’s, the central production kitchen was operational; however, the Wee Grill and Big Grill outlets were not trading as there were no events taking place that day.

Levy Restaurants / Compass management representatives at the SSE Hydro were made aware of EHO concerns and agreed to make changes to existing procedures. The two-part cooking process used for the beef burgers, i.e. searing followed by cooking, was highlighted as presenting risks. Whilst the two-step cooking process is not an inherently dangerous practice, it does require the control measures and monitoring procedures at the cooking step to be conducted with a reduced margin for error. In order to reduce the potential for undercooking or cross contamination Levy Restaurants/Compass elected to change the process so that no raw meat would be present at the outlets.

A revised cleaning programme was instituted using the appropriate cleaning and disinfecting agents. As described, the outcome of the follow-up ATP swabbing process was suggestive of a successful cleaning and disinfection process of surfaces.

Following the implementation of control measures and given no recent reports of staff illness, the SSE Hydro was allowed to continue serving food from the outlets.

7. Risk communication
7.1 Cases and household contacts
Cases and household contacts were contacted by their local health protection unit and/or EHO as and when they were notified. Further communications to clarify details of their case, provide advice and communicate test results were from the local teams as per usual practice.
7.2 Professionals
On 31 January a letter (Appendix 3) was sent out from the PHPU to all NHS Greater Glasgow and Clyde General Practitioners, Directors of Acute and Community Health Care Partnerships (CHCPs), Out of Hours services, NHS 24 and Accident and Emergency departments. This letter was circulated to other Boards for adaptation and similar circulation.

Local diagnostic laboratories in NHS Greater Glasgow and Clyde were also alerted to the details of the outbreak.

7.3 Health board areas
Health Protection Scotland alerted Health Protection Teams in all NHS Boards in Scotland of the outbreak. It was advised that any other Boards who had cases associated with the Hydro should contact the IMT at NHS Greater Glasgow and Clyde. Health Protection Scotland also circulated information to colleagues in Public Health England.

7.4 Scottish Government Health Department
On 29 January 2014 the Chief Medical Officer’s office was advised of the outbreak.

7.5 Public and the media
A press release was issued on 31 January 2014, with an update statement on 3 February 2014. Direct interviews were conducted with the BBC, STV, Radio Clyde, Real Radio and the Daily Mail on 31 January. Updates on the number of affected cases were given on request after each IMT.
8. Conclusion

Twenty-two confirmed cases with laboratory evidence of *E. coli* O157 infection were identified during this outbreak. Most cases were not severely unwell, however, three cases were hospitalised (compared to a national average of over 40% of all VTEC cases in Scotland\(^1\)). This relatively low proportion of severe cases compared with previous outbreaks is likely to be due to the virulence properties of the strain of *E. coli* O157 involved and the age range of cases.

There is strong epidemiological evidence pointing to the exposure being the consumption of beef burgers purchased from the Big Grill at the SSE Hydro between 17 January and 19 January. The predominant strain was *E. coli* O157 phage type 31 and microbiological typing (MLVA) demonstrated only a minor variation, in only one isolate, in keeping with a single source of exposure. There were no other notified cases of *E. coli* O157 phage type 31 in Scotland around the time of this outbreak.

In addition, the clear epidemiological link of the two *E. coli* O157 phage type 4 to the larger outbreak, and the dual infection of one case with a rare VTEC strain, *E. coli* O182, indistinguishable from that seen in other confirmed cases in this outbreak, makes the likely source of exposure the beef burgers at the SSE Hydro.

VTEC strains matching the human isolates were not isolated from any food item. Despite identification of the batch of beef burgers served at the Big Grill between 17 and 19 January and tracing of this product batch, all beef burgers had been consumed or discarded. Food samples tested were from different batches and all were negative for *E. coli* O157.

Descriptive evidence gathered by environmental health officers strongly suggests the possibility of processing errors leading to undercooking as well as the potential for cross contamination in the preparation and serving of the beef burger products. These processing errors would provide plausible mechanisms for exposure to VTEC. They include a lack of consistency in the searing and cooking process of the burger, inadequacy of temperature monitoring records, apparent weaknesses in temperature monitoring techniques, an inappropriate cleaning and disinfection regime, and an absence of documented evidence of a hazard analysis having been conducted in relation to the two-step cooking process. The epidemiological evidence suggesting exposure to *E. coli* O157 over three days of serving supports the likelihood of a processing error leading to the undercooking of beef burgers.
9. Lessons Learned

This outbreak provides a reminder of the potential for \textit{E. coli} O157 contamination of ground beef products and of the need for adequate cooking and cross-contamination measures in the preparation of these products.

It is a legal requirement for food safety hazards at critical points in the food handling or production process to be analysed by the food business operator and for such hazards to be subsequently controlled and the controls monitored. Effective hazard analysis and mitigation is essential in helping to prevent foodborne outbreaks of disease.

The findings of the outbreak also highlight that high risk food preparation processes are particularly dependent on effective control measures. These control measures must be validated and implemented rigorously, particularly in a pressurised environment. The two-stage process used by Levy Restaurants/Compass in the preparation of the beef burgers is not inherently dangerous if undertaken meticulously; however, it is a process which increased the potential for inadequate cooking and hence exposure to \textit{E. coli} O157/VTEC.

10. Recommendations

10.1 This outbreak should be used to highlight the risks associated with undercooked ground beef products.

\textbf{Action} : NHS Greater Glasgow and Clyde, Glasgow City Council, the Food Standards Agency

10.2 An assessment should be made of the wider use of the two part process of cooking beef burgers and the outbreak should be used to highlight the associated risks of this process.

\textbf{Action} : Glasgow City Council, the Food Standards Agency
11. References


Appendix 1: Levy Restaurants /Compass Catering – Hydro
Beef Burger Production Process as described by Levi Restaurant /Compass Staff on 29 January 2014

Notes
1. The searing process involved the cooking of the outer surface of each burger. There was no intention to cook the burgers throughout.
2. The cooking process is carried out on a griddle. Burgers were described as generally being cooked to order.
Appendix 2: Levy Restaurants/Compass Catering / Hydro
Beef Burger Production Process as described by Compass Document Managing Food Safety – Hazard analysis and Critical Control Points (HACCP)

Document as provided to Glasgow City Council during February 2014

The document refers to the production of beef burgers and is not site-specific (other than any additions which are “Site Specific or Client Specific Requirements”)

The flow diagram below represents Glasgow City Council’s interpretation of the information provided within the aforementioned document - specifically Page 4 - Hazard Analysis and Critical Control Points Flow Chart for Cooking Burgers

Notes
1. The Compass HACCP document refers to frozen, chilled and ambient/dry goods storage;
2. The cooking stage is carried out in a steam oven. There is no reference to searing burgers as all are described as being precooked at a central location prior to distribution to individual outlets.
3. The Compass HACCP document refers to a designated reheating temperature of 82°C.
Dear Colleague,

Re: Cases of E. coli O157 associated with visiting the SSE Hydro in Glasgow

The Public Health Protection Unit (PHPU), NHS Greater Glasgow and Clyde has been made aware of a number of cases of E. coli O157 who attended the SSE Hydro in the last three weeks. There is an association with eating burgers in diagnosed cases, but other food items have not been excluded as a cause. The PHPU wishes to identify whether there are any other cases in the NHS GGC area associated with this venue.

As per your usual practice, please would you make the PHPU aware of any patient that you suspect has symptoms of E. coli O157. We would request that you also arrange for a faecal sample to be submitted to aide diagnosis.

Yours sincerely,

Dr Eleanor Anderson
Consultant Public Health
NHS Greater Glasgow and Clyde