OUTBREAK OF VEROTOXIN POSITIVE *Escherichia coli* O157 INFECTION IN SOUTH WALES AUTUMN 2005

Report of the Outbreak Control Team

6th June 2006

CONTENTS

Abbreviations

A+E	Accident and Emergency Department
CI	Confidence Interval
EHO	Environmental Health Officer
FSA	Food Standards Agency
GP	General Practitioner
LA	Local Authority
LHB	Local Health Board
NHS	National Health Service
NPHS	National Public Health Service
NS	Non significant
OCT	Outbreak Control Team
PFGE	Pulse Field Gel Electrophoresis
RCT	Rhondda Cynon Taf
VT	Verotoxin

Glossary

Analytical epidemiological study: Any study in which groups are compared to identify and quantify causes of disease to test a theory as to what the cause may be. Case-control and cohort studies are both examples of analytical studies.

Bacterium: A minute single-celled organism which may be harmless or one that is capable of causing a disease e.g. *E. coli* O157.

Case: Any person who has *E. coli* O157.

Case Control Study: An epidemiological study. It involves comparing people with an illness (cases) to a similar group of people free from that illness (controls) and looking back to see whether they were exposed to a factor of interest e.g. visiting a farm park. Different rates of exposure between cases and controls may point to the cause of the illness.

Case Definition: A list of criteria that must be fulfilled in order to identify a person as a case of a particular disease. It is used in outbreaks of illness to identify who should be included on a list of cases. The criteria can include the symptoms of the illness, laboratory test results, the time and place of illness.

Chi Squared: A statistical test that is used to detect whether two groups differ from one another in a way that is greater than chance alone.

Cohort Study: A study looking at a defined group of people e.g. children attending a particular school and comparing how often illness developed in those with a certain exposure such as eating school meals with how often illness developed in those without the exposure (ie did not eat school meals).

Communicable Disease: Any disease that can be passed from one person to another.

Confidence Interval: A way of expressing, statistically, the certainty about the precision of the findings from a study. The 95% confidence interval represents the range of measurements, calculated from a study, within which we are 95% certain that the true effect lies.

Consultant in Communicable Disease Control (CCDC): A fully trained doctor in a branch of medicine that is responsible for the prevention and control of communicable disease in the community.

Contingency table (2x2): A table (usually 2 rows and 2 columns) that is used in epidemiology to show the relationship between disease and exposure, for example a food source. The table is used to divide people into the categories of diseased and exposed, diseased and not exposed, not diseased and not exposed and not diseased and exposed.

Control: Any person that does not have the illness that can be compared to a case in an analytical epidemiological study.

Descriptive Epidemiology: Describing the characteristics of cases i.e. time, place or person characteristics such as date of onset of illness, place of residence, age or sex.

Environmental Health Officer (EHO): An individual fully trained in environmental health issues such as housing, sanitation, food, clean air, noise and water supplies. Responsibilities include inspecting restaurants and other food premises and following up cases of food and waterborne disease.

Epidemiology: The study of the patterns, causes, and control of disease in groups of people.

Epidemiological link: Cases linked by close social or household contact.

***Escherichia coli* O157:** A type of bacterium that can cause severe illness (See Appendix B for more information on *E. coli* O157).

Fisher's exact test: A statistical test used to determine the association between the exposures and outcomes of interest in an analytical study.

Microbiological Screening/Sampling: Taking a sample e.g. stool/faeces and testing it to see of the infectious agent is present.

Microbiologist: A doctor, mainly laboratory based, who specialises in the diagnosis, treatment and control of infectious agents e.g. bacteria, viruses and fungi.

Odds ratio: A ratio of the probability of an event in an exposed group to the probability in an unexposed group. A measure of 1.0 means that there is no association between the illness and the exposure, a value greater than 1.0 means there is a positive association (ie disease more likely in the exposed) and less than 1.0 means there is a negative association.

Outbreak: An increase in the number of people with an illness or disease that is above what you would normally expect in the population at that particular time, or two or more linked cases with the same illness.

Outbreak Control Team (OCT): A team of people from different, usually public, bodies, brought together, according to official guidance primarily to control the spread of disease during an outbreak. This is done through assessing the range and extent of the outbreak; identifying the source of the problem if possible, implementation of prevention and control measures and communication.

P value: P-values are calculated in statistical tests to estimate how likely it is that the associations observed between an exposure (eg eating a food item) and an outcome (eg becoming a case of *E. coli* O157 disease) could have been due to chance alone. A p-value of 0.05 means, therefore, that there is a 1 in 20 probability that the difference levels of illness between an exposed and an unexposed group occurred by chance alone (and hence a 19 in 20 chance that there is some other "real" explanation)**.** The lower the p-value the more likely the difference between the two groups is real.

Paediatric Senior House officer: A children's doctor.

Phage type A system of sub-classifying certain species of bacteria according to whether they are susceptible to infection by panels of different viruses that infect bacteria ("bacteriophages" literally, "bacteria-eaters").

Primary case: The first individual within a group or family to get the disease. There may be several primary cases in a group if they are exposed to the same source around the same time.

Pulse Field Gel Electrophoresis (PFGE): This is a scientific process based on chopping up with enzymes the genetic material of bacteria such as *E .coli* which enables scientists to determine whether *E. coli* strains taken from different patients and from the environment are related to each other.

Regional Epidemiologist: A doctor specialising in communicable disease epidemiology in a population, working at the all Wales level.

Relative risk: Is used in epidemiological studies to quantify the risk of disease in a group of people exposed to a group of people unexposed. The risk of getting a disease in a group with the risk factor is divided by the risk of getting a disease without the risk factor.

Secondary case: A secondary case is a person that has caught the disease from a primary case.

Verotoxin: this is a toxin produced by the *E. coli* O157 bacteria.

Summary

In September 2005, the largest *E. coli* O157 outbreak ever seen in Wales occurred. There were 157 cases meeting the case definition of which 118 were microbiologically confirmed. 109 of these confirmed cases were of phage type 21/28 and of a strain unique to this outbreak. Primary cases were mostly amongst schoolchildren attending 44 schools in Bridgend, Caerphilly, Merthyr Tydfil and Rhondda Cynon Taf, although there were also three cases in the Vale of Glamorgan.
31 cases were hospitalised, 11 of which were transferred to tertiary hospitals, and one child died.

An Outbreak Control Team (OCT) was convened and a number of investigations were carried out to identify the cause of the outbreak. From the results (which are detailed in this report), the OCT concluded that cooked sliced meats supplied to the school meals service were the source for the transmission of *E. coli O157* to primary cases in the four main Local Authority areas affected.

Control measures were successful in rapidly terminating the presentation of primary cases connected with schools outbreak, but secondary household cases continued to present in October. 50% of all cases excreted the organism for between 5 and 32 days. Some cases continued to excrete *E. coli* O157 for prolonged periods, the longest being 80 days. The outbreak was declared over on December 20th 2005.

During November 2005, 16 cases of *E. coli* O157 infection occurred associated with Abercynon Infants School in Rhondda Cynon Taf. After exhaustive investigation, these were declared a separate outbreak not connected with the main outbreak. However, as the investigative and geographical context was the same in both outbreaks, the Abercynon outbreak report is nested within this document.

Introduction

On the morning of Friday 16th September 2005, the local Health Protection Team of the National Public Health Service for Wales was informed by the Paediatric Senior House Officer at Prince Charles Hospital, Merthyr Tydfil of five admissions of children with watery blood stained diarrhoea. Three had been admitted on the 14th September, and two on the 15th of September. Three other children had been seen with bloody diarrhoea in the assessment unit and discharged home.

The microbiologist rang the same morning to report that two stool specimens in his laboratory had been identified as *E. coli O157*. One had been taken from a child seen in the paediatric assessment unit and the other a specimen from a GP surgery.

An incident meeting was called for that afternoon, involving environmental health officers from Rhondda Cynon Taf and Merthyr Tydfil Local Authorities, the local microbiologist, the Regional Epidemiologist, the Consultant in Communicable Disease Control, clinical staff from Prince Charles Hospital and others. It was noted that all cases were primary school children aged 4-10 years attending different schools in the Cynon Valley or Merthyr Tydfil. Two more cases were added to the list at the meeting, including a child from a school in the Rhondda, where a cluster of ordinary (non-bloody) diarrhoea had been reported the day before. This made 11 cases in total.

After discussion it was agreed to declare an outbreak, and give the meeting the status of an outbreak control meeting. An Outbreak Control Team (OCT) was therefore formed to investigate and control the outbreak of *E. coli* O157.

At the start of the outbreak, the OCT collated information from the first cases to look for common features that might indicate the source of the outbreak. This descriptive epidemiological information was then used to determine the initial environmental investigations and sampling that needed to be undertaken, and the control measures that should be implemented.

As microbiological results became available from cases of *E. coli* O157, this information was used to examine the links between cases and between food samples taken. More detailed information was collected to undertake analytical epidemiological studies to explore the implicated source further. All the information obtained was collated and discussed at OCT meetings to inform the further investigation and control of the outbreak.

This report is a record of these investigations and activities. Members of the OCT (see Appendix A for membership) contributed to writing relevant sections of the report and commented and amended on drafts pulled together by the Editors appointed by the team (Dr Lowe (Chair) and Dr Salmon (Regional Epidemiologist)). The final report was approved by the full OCT.

EPIDEMIOLOGICAL INVESTIGATION - METHODS

Case definition

This was agreed at the inaugural meeting of the outbreak control team on Friday 16th September 2005.

A probable case was any person presenting with bloody diarrhoea within the last fortnight (since 1st September 2005) resident within South Wales.

A confirmed case was a probable case with microbiological confirmation (ie demonstration of Verotoxin positive *E. coli* O157 by recognised microbiological methods).

In practice, as the outbreak evolved and understanding increased certain operational modifications took place.

On 27th September the OCT agreed that any individual with microbiologically confirmed Verotoxin positive *E. coli* O157 even in the absence of symptoms should be considered a case.

Individuals from whom a Verotoxin positive *E. coli O157* was recovered but of a **phage type other than PT21/28** (the outbreak strains) **and** who had an alternative **more likely** source for infection were excluded.

All adults meeting the initial case definition who had a **negative stool result** and **no evidence of a link to the outbreak** or had another explanation for their symptoms were also excluded from the case list, as were children meeting these criteria who did not attend a school in Bridgend, Caerphilly, Merthyr Tydfil or Rhondda Cynon Taf.

Case ascertainment

General Practitioners, General Practitioners Out-of-Hours Services, Hospital Accident and Emergency Departments and Hospital Paediatric Services were contacted by fax or telephone to alert them to the outbreak and to request details of possible cases. The importance of microbiological sampling for cases of diarrhoea was stressed to health services in subsequent communications.

In a series of initially daily press releases commencing Sunday 18th September the general public was urged to seek medical attention if they displayed symptoms of severe or bloody diarrhoea. Letters to schools in the affected areas urged parents and guardians to do the same.

A helpline was set up on Monday 19th September. The number was widely publicised through the media and was used by the public to report suspected cases directly to the NPHS.

Descriptive epidemiology

All cases were contacted by staff of their respective Environmental Health Departments. Semi-structured interviews were conducted using the standard questionnaires developed for the investigation of sporadic cases of positive *E. coli* O157 by the respective councils. These were similar, being based on templates agreed at the South Wales Communicable Disease Technical Panel and enquired as to:-

age, sex, residence, occupation, others living in the household and their ages and occupations, date of onset, symptoms

and exposure to:-

foods over the previous week (including meals taken outside the home), water supply, contact with animals, contact with young children, contact with others with compatible symptoms and recreational settings posing a risk of spread (eg swimming pools). Data was summarised by each department and reported to regular meetings of the Outbreak Control Team.

Household contacts were provided with pots for the submission of faecal samples for microbiological investigation with priority being given to groups that pose an increased risk of spreading infection, as defined in recognised national guidelines. [1,2]

- **Group A:** Any person of doubtful personal hygiene or with unsatisfactory toilet, hand-washing or hand drying facilities at home, work or school.
- **Group B:** Children who attend pre-school groups or nursery.
- **Group C:** People whose work involves preparing or serving unwrapped foods not subjected to further heating.
- **Group D:** Clinical and social care staff who have direct contact with highly susceptible patients or persons in whom a gastrointestinal infection would have particularly serious consequences.

Data was entered onto line lists in MS excel at the Cardiff office of the South and East Health Protection Unit of the National Public Health Service for Wales. It was exported from there into a database held in MS Access and further exported for statistical analyses in EpiInfo versions 5.0 and STATA 9.0.

Analytical Epidemiology

The frequency of cases of school attending age being enrolled for school meals was compared with the overall proportion for the local education authority [council] areas involved.

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[1] Preventing person to person spread following gastrointestinal infections: guidance for public health physicians and environmental health officers. *Commun Dis Public Health* 2004;7:362-84.

[2] Subcommittee of the PHLS Advisory Committee on Gastrointestinal Infections. Guidelines for the control of infection with Verocytotoxin producing Escherichia coli (VTEC). *Commun Dis Public Health 2000; 3: 14-23.*

A *preliminary case control* study was initiated on the afternoon of Sunday 18th September which was completed in the following week. The cases chosen for the study were18 primary school children from the first wave of the epidemic (onsets 10th to 16th September) known to the investigating agencies. Data was abstracted from their initial descriptive interviews (above). Unmatched controls, 3 names for every case, were selected using generated random numbers from the school registers of each of the known cases. Controls were asked about the full range of relevant exposures in the descriptive questionnaires but also about which days they attended school meals during the first week of the school term, consumption of milk and fruit ("fruit tuck shop") at school (procured and served separately) and attendance at certain local fast food outlets and local recreational facilities theoretically representing a risk of spread. Cases and controls responses were compared in 2 by 2 contingency tables, odds ratios and p values were computed (Chi squared or Fisher's Exact test as appropriate) using EpiInfo version 5.

Further to concerns arising out of environmental and food chain investigations a *case control study of the supply of meats to schools in Rhondda Cynon Taf* was undertaken between Thursday 22nd and Saturday 24th September. Twenty two schools were identified in the Rhondda Cynon Taf area where at least one pupil or member of staff was a probable case of *E. coli* O157 infection by 21 September 2005. Twenty five schools without cases were selected at random as controls. The control schools were also randomly selected from the 144 educational units where the food served was prepared in different kitchens from the case schools.

Staff at Rhondda Cynon Taf Council's catering service ("Catering Direct") obtained detailed information on meals provided at each school between Tuesday 6th and Friday 16th by telephoning the cook responsible for each school. Data collected for each meal included: the type of meat(s) served as a main course; whether the meat(s) was served hot or cold; and, the name of the supplier/distributor of the meat(s).

The frequency that meals containing cold cooked meat supplied by the single main supplier were served in case schools was compared with control schools during two time periods. Exposures during the first week of term (Tuesday 6th to Friday 9th) were explored by comparing the products served in schools with cases with an onset before 17th September with control schools. Exposures during the second week of term (Monday 12th to Friday 16th) were investigated by comparing schools with a first case with an onset after 16th September with control schools. Case school and control school's meals served were compared in 2 by 2 contingency tables, odds ratios and p values were computed (Chi squared or Fisher's Exact test as appropriate).

A cohort study of food preferences of children at one of the earliest and worst affected schools was undertaken. A cluster of possible cases of *E. coli* O157 was reported at a single RCT infant school, Penygraig, during the week beginning 19th September. Primary acquisition of illness was likely to have occurred in the week beginning 5th September and school meals commenced from 7th September. Locally restricted choice options on school meal menus resulted in only a limited number of nine main food items being available to children during this time. A cohort study of all children who had attended Penygraig school during the first week of term, 7th – 9th September, was carried out, using pictorial food preference charts as proxies for food histories in the 72% of young children taking school meals. Other children who attended but did not eat school meals were assumed to 'dislike' all nine food items as a proxy for non-exposure.

A *comparison* of the structure and activities in households with and without secondary cases, utilising data obtained from environmental health departments' descriptive interviews (above) is being carried out. This study is also looking at length of faecal excretion of *E. coli* O157 in cases.

MICROBIOLOGICAL INVESTIGATION - METHODS

Humans

Suspected cases and where appropriate, household and close contacts were asked to submit faecal specimens to their respective NHS or NPHS laboratories. These were cultured on selective agar incubated at 37^{o} C for up to 48 hours. Sorbitol non fermenting colonies (NSFs) were tested for latex agglutination with O157 antiserum and their identity was biochemically confirmed. All presumptive O157 isolates were sent to the Laboratory of Enteric Pathogens (LEP) at the Centre for Infections of the Health Protection Agency at Colindale, London. Well separated colonies were transferred onto nylon membranes and tested in DNA hybridization experiments with probes for the genes coding for production of verotoxin (VT) 1 and VT2. Strains were also further differentiated by phagetyping[3] and pulsed-field gel electrophoresis (PFGE) using the method of Willshaw and colleagues.[4]

Foodstuffs

Foodstuffs were obtained by environmental health officers in the four affected boroughs and subsequently by South Wales Police. All foodstuffs were submitted for examination to the NPHS Microbiology Cardiff Food, Water and Environmental Laboratory, situated at Llandough Hospital.

Samples of food were homogenised in modified tryptone soya broth. After incubation at 41^{0}C for 22hrs, immunomagnetic separation (IMS) was carried out using Dynalbeads anti *E. coli O157* (Dynal Biotech ASA, Oslo, Norway) and the deposit was cultured onto cefixime tellurite sorbitol McConkey agar (CT-SMAC). These were incubated at 37^{0}C for 22hrs. Non sorbitol fermenting colonies (NSFs) were tested for latex agglutination with O157 antiserum (Pro-Lab Diagnostics Inc Ontario Canada) and were biochemically confirmed by API (Biomerieux Marcy L'Etoile, France)[5]. All presumptive *E. coli* O157 isolates were sent to the Laboratory of Enteric Pathogens (LEP) at the Centre for Infections of the Health Protection Agency at Colindale, London. Further work was done as for clinical isolates.

The environment

Environmental samples were processed from the meat supplier that prepared cooked meat for the school meals service. Further extensive sampling from premises connected to the meat supplier (such as farms, butchers and abattoirs) was also undertaken.

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[3] Ahmed R, Bopp C, Borczyk A, Kasatiya S. Phage-typing scheme for *Escherichia coli* O157:H7. **J Infect Dis 1989;155:806-9**

[4] Willshaw GA, Smith HR, Cheasty T, Wall PG, Rowe B. Vero cytotoxin-producing *Escherichia coli* O157 outbreaks in England and Wales, 1995: phenotypic methods and genotypic subtyping. **Emerg Infect Dis 1997;3:561-5.**

[5] Health Protection Agency Standard Operating Procedure F17 Issue 2.3 June 2003

Water

No water samples were tested for *E. coli* O157.

ENVIRONMENTAL INVESTIGATIONS- METHODS

Source

Information gathered from interviewing the first reported cases was examined to identify common features that might indicate a source for the outbreak. Some possible sources, such as open farms, some fast food outlets and common social events were able to be ruled out at this early stage. However, some features were shared by several cases, and these were investigated further.

Initial Investigations

Food premises

Fast food outlet A

Initial epidemiological investigations identified different branches of the same fast food outlet where several cases had eaten during the incubation period. All outlets in this fast food chain within the boundary of Rhondda Cynon Taf were identified and the history of legislative compliance of each was checked. On Monday 19th September each of the outlets was inspected and in particular cooking processes and methods of cross contamination were focused on.

Other Premises

Swimming Pool B

Five cases interviewed during 16th/17th September had been to the same swimming pool during the incubation period. The pool was therefore investigated. The chlorination level of the pool water was checked for the relevant time period. Discussions took place with the manager in relation to any incidents that had occurred in the swimming pool and associated facilities. Additionally, extra cleaning and vigilance to hand washing facilities was implemented.

School Investigations

Eating school dinners and being in the school environment were common features shared by all cases presenting in the first few days of the outbreak. The following potential sources for the outbreak were investigated.

School meals

Menus were sought for meals served in the affected schools. Component foods identified and the supply chain investigated. Additionally the method of storage and processing of each food component was investigated.

School milk

Information was obtained on the source and supply of milk to all Rhondda Cynon Taf and Merthyr Tydfil schools by contacting or visiting affected schools and contacting Rhondda Cynon Taf procurement. The supplier was contacted and their production records with associated control measures scrutinised.

Water coolers
Information was obtained on the water cooler situation in the affected schools identified on the 16th and 17th September. This was obtained by contacting education officers and head teachers on 18th and 19th September.

Fruit tuck shops
Information was obtained on the source of the fruit used in these. This was obtained in Rhondda Cynon Taf on the 18th September by contacting head teachers in affected schools. In Merthyr Tydfil, information was sought from affected schools on 19th September.

Further investigations

As soon as cooked sliced meat supplied to school meals in Rhondda Cynon Taf and Merthyr Tydfil was identified as a potential source of the outbreak, the following were investigated.

Cooked sliced meats from school kitchens
Any remaining cooked meats which had been delivered to Merthyr Tydfil and Rhondda Cynon Taf schools and other Rhondda Cynon Taf institutions such as day centres, during the first and second week of term were quarantined and subsequently collected by Environmental Health Officers and submitted to the NPHS Microbiology Food, Water and Environmental Laboratory in Cardiff for analysis.

Meat supplier C
The premise of the supplier of meat to the school meals service was inspected on Monday 19th September by Environmental Health Officers from Bridgend, accompanied by an officer from Rhondda Cynon Taf. The inspection included extensive questioning in relation to policies, procedures and practices. During this time samples of cooked meats, swabs of equipment and the premise and relevant documentation were taken for analysis.

Other environmental investigations

School kitchens
School kitchens of schools in Rhondda Cynon Taf, Merthyr Tydfil, Caerphilly and Bridgend where cases had occurred were visited, and catering staff asked about what foods had been served, where they had been sourced and how they had been prepared at kitchen level during the first two weeks of term. In particular, they were asked to what extent they had deviated from normal menus and practices during this period. Queries were made as to their sickness policies and whether any staff had been ill. Any remaining cooked meat quarantined at the schools was sampled.

School inspections
Schools where cases had occurred were advised in terms of their infectious disease control. The advice concentrated on hand washing facilities, cleaning methods and exclusion policies. In addition, head-teachers of schools in which a case had been identified were asked for daily updates on absentee lists to ensure that any pupil with

possible symptoms of *E. coli* O157 were identified and interviewed. They were also advised in relation to issues of infection control.

Residential Home D

An inspection of a private residential home in Bridgend where a case occurred was undertaken. The manager was interviewed in relation to prevalence of sickness within the home and food safety policies and practices.

Other premises

In Bridgend any other food premise identified in the food history of a case as a potential source of their food poisoning was inspected.

Suppliers of cooked meat to the meat supplier C

Officers from Bridgend County Borough Council and the Food Standards Agency contacted the suppliers of cooked meat to the meat supplier and their relevant home authorities by telephone to establish their compliance history, identify if there were any current issues and request any results of microbiological testing where appropriate.

EPIDEMIOLOGICAL INVESTIGATION – RESULTS

Descriptive epidemiology

Cases

There were **157** cases meeting the case definition described above, of which **118** were confirmed microbiologically to be excreting *Verotoxin positive E. coli* O157. 109 *E. coli* O157 strains were phage type 21/28, three were phage type 32, one phage type RDNC, one phage type 1 and four were untypable. All produced VT (verotoxin) 2.

There were **67** males and **90** females and **127** cases were aged 18 or under. Onsets ranged from 10th September to 8th November (see epidemic curve, Appendix C). All but 8 cases in which dates of onset could be ascertained had onsets before the end of September. There were **44** schools in which exposure to the implicated source resulted in infection. **31** cases were admitted to hospital, of which **2** adults and **9** children were transferred to tertiary centres. There was one death in a 5 year old boy.

Of the two cases with onset dates in November, one was a child meeting the case definition but with a negative stool sample and no known links to other cases. Although the OCT was of the opinion that this case was unconnected to the outbreak, the child was a Rhondda Cynon Taf resident so fulfilled the criteria for remaining on the case list. The other case was a child from the Vale of Glamorgan. (See Appendix C for a full description of the characteristics of the cases).

The schools involved in the outbreak were all in the administrative areas of Bridgend, Caerphilly, Merthyr Tydfil and Rhondda Cynon Taf. (see Appendix C). Most cases resided in these areas, but there was a case in both Neath Port Talbot and Newport. These all had close epidemiological links with primary cases in the four involved Local Authority areas.

Three cases are included from the Colwinston area of the Vale of Glamorgan. These met the case definition and all three were positive for PT21/28 (unique outbreak strain). These cases were investigated to identify any potential source for their infection and to ensure that no acute on-going public health risk was present. The cases were not linked to any transmission within schools. However, further details surrounding the source of infection for these cases is the subject of the current police investigation and will not be discussed in this report.

Patterns of primary cases in the four key Local Authority areas

In Rhondda Cynon Taf, primary cases were spread across 25 primary schools (including nursery and infant schools) and four secondary schools. In Merthyr Tydfil, cases were spread across two primary schools and one secondary school. In Caerphilly, cases were spread across nine primary schools. In Bridgend, only secondary schools were affected, with primary cases in three secondary schools.

Distribution of meat from Meat Supplier C to schools

Cooked sliced meat from Meat Supplier C was distributed to the school meals service in the four key Local Authority areas. In Rhondda Cynon Taf and Merthyr Tydfil the meat was supplied ready to eat to both primary and secondary schools. There was therefore no need to reheat or process them and the slices were either used cold (such

as in sandwiches) or were placed directly on the plate with hot gravy on top. In Caerphilly, where the majority of secondary schools had opted out of the school meals service, the product was mainly supplied to primary schools, most of whom served it cold. In Bridgend, primary schools usually reheated the sliced meat for hot meals. Secondary schools used the cold sliced product.

Analytical epidemiology

Based on the observation that the 8 initial school aged cases all take school dinners and assuming that the likelihood of one child eating dinners is statistically independent of other children's decisions, then, given an overall uptake of school dinners in the area of 60%, the exact binomial probability of observing all 8 children taking school dinners is = 0.017. In addition the first adult case was in a school meal's supervisor.

Table 1: Preliminary case-control study comparing exposure to school meals, milk fruit and fast food for 18 primary school cases reported at the onset of the outbreak where data was available with controls from their schools

	CASES		CONTROLS			
Exposure	**Yes**	**No**	**Yes**	**No**	**OR**	**p**
Tuesday*	**9**	**0**	**5**	**7**	**Undef**	**<0.01**
Wednesday*	**10**	**0**	**8**	**5**	**Undef**	**<0.05**
Thursday*	**9**	**1**	**8**	**5**	**5.6**	**NS**
Friday*	**9**	**1**	**8**	**5**	**5.6**	**NS**
School Milk	**0**	**4**	**8**	**4**	**0**	**<0.1**
Fruit	**1**	**4**	**5**	**6**	**0.3**	**NS**
Fast Food A	**5**	**7**	**4**	**4**	**0.7**	**NS**
Fast Food B	**3**	**9**	**0**	**6**	**Undef**	**NS**

*****Registered for school dinner

Even allowing for the high non response rate, school milk and school fruit (served at break) appeared statistically protective. In other words, those that consumed these were less likely to be a case. Associations were seen with school dinners on specific days.

Case control study of the supply of meats to schools

Data was available from 17 of the 25 (68%) control schools and 16 of the 22 (72%) cases schools. Thirty one individual infections occurred in the 17 case schools. Eleven schools had a case with an onset before 17th September and five schools had a first case with an onset after 16th September.

Figure 1 Cases of *E. coli* O157 in study schools by day of onset

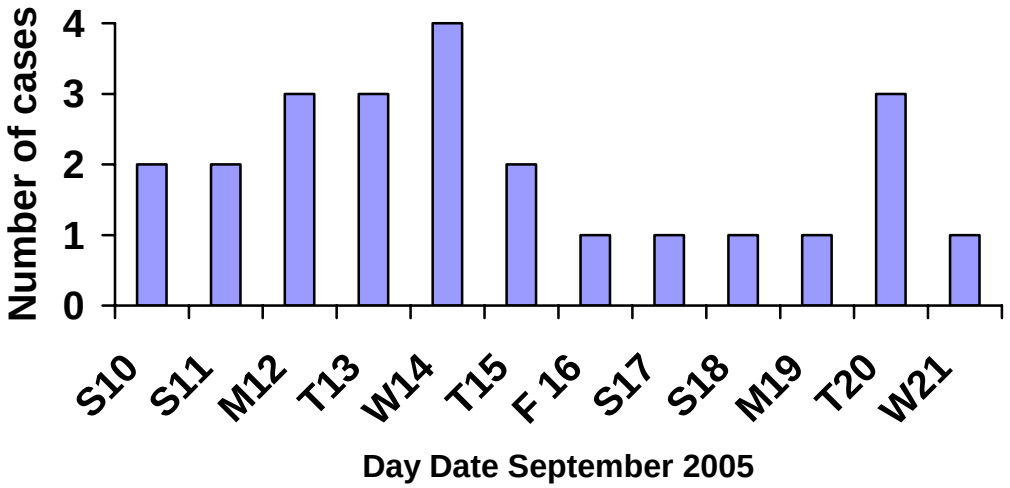
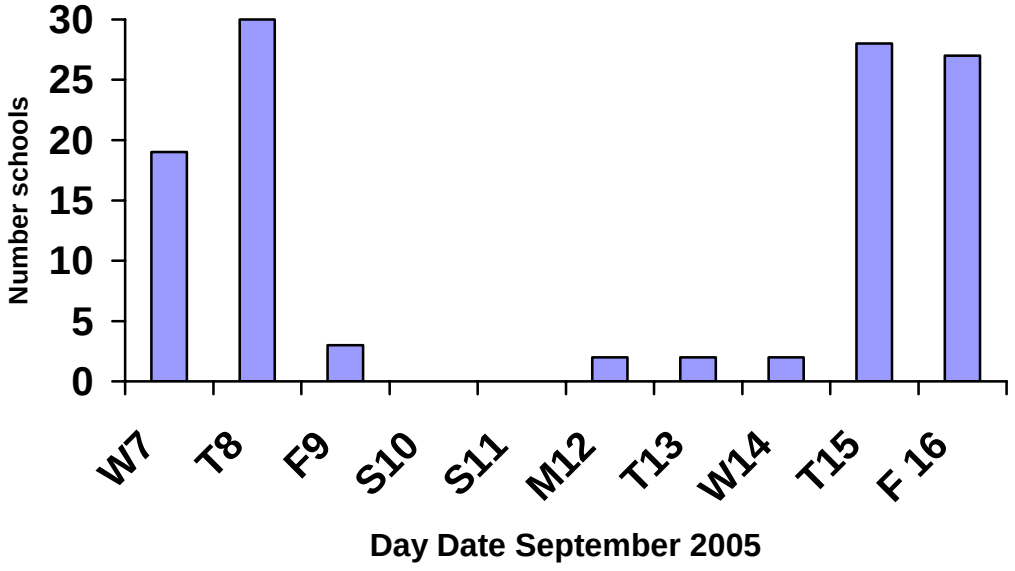


Figure 2 Number of meals containing cold cooked meats from Meat Supplier C served in the 33 study schools by day



A statistically significant association was demonstrated between serving cold cooked turkey supplied by Meat Supplier C on the 8th September and a case occurring in a school with an onset before the 17th (table 2). All schools with a case with an onset

before the 17th were exposed to cold cooked meats supplied by Meat Supplier C during the first week of term.

There were only five schools with a first case occurring with an onset after 16th September. No statistically significant associations were observed for exposures during the second week of term (table 3).

Table 2: Exposure to cold cooked meats supplied by Meat Supplier C during the first week of term in schools with a case whose onset was before 17th September (Compiled 24th September 05).

Exposure	**Cases school (n=11)** [1]		**Control school (n= 17)** [2]		**Odds Ratio**	**95% CI**	**P**
	Exposed		**Exposed**				
	Yes	**No**	**Yes**	**No**			
Wednesday 7th							
Lamb[3]	7	3	7	10	3.3	0.7 – 16.3	0.15
Ham	0	11	1	16	0		0.41
Chicken	0	11	1	16	0		0.41
Thursday 8th							
Turkey	**11**	**0**	**12**	**5**	∞	**1.03 -** ∞	**0.047**
Ham	0	11	1	16	0		0.41
Lamb	2	9	1	16	3.5	0.2 – 223	0.30
Friday 9th							
Ham	0	11	2	15	0		0.24
First Week							
Any	11	0	15	2	∞		0.24

[1]A case school had at least one pupil or member of staff with symptoms compatible with *E.coli O157* infection with an onset before 17th September 2005.
[2] A control had no pupil or member of staff with symptoms compatible with *E.coli O157* infection as of 21st September 2005.
[3] missing data 1 case school

Table 3: Exposure to cold cooked meats supplied by Meat Supplier C during the second week of term in schools with a case whose onset was after 16th September (compiled 24th September).

Exposure	Cases school (n=5) [1]		Control school (n= 17) [2]		Odds Ratio	95% CI	P
	Exposed		Exposed				
	Yes	No	Yes	No			
Monday 12th							
Ham	1	4	1	16	4.0	0-333	0.33
Tuesday 13th							
Ham	1	4	0	17	ND		0.06
Wednesday 14th							
Turkey	0	5	1	16	0		0.58
Chicken	0	5	1	16	0		0.58
Thursday 15th							
Pork	3	2	7	10	2.1	0.2 – 31	0.48
Turkey	2	3	6	11	1.2	0.1 – 14	0.85
Ham	1	4	0	17	ND		0.06
Chicken	0	5	1	16	0		0.58
Friday 16th							
Ham	4	1	13	4	1.2	0.1 – 76	0.87
Second week							
Any	5	0	16	1	∞		0.58

[1]A case school its first pupil or member of staff with symptoms compatible with *E.coli O157* infection with an onset after 16th September 2005.
[2] A control had no pupil or member of staff with symptoms compatible with *E.coli O157* infection as of 21st September 2005.

A cohort study of food preferences

Of 94 pupils on the school register, 84 attended during the first week of term. At initial investigation, 14 confirmed or possible cases[1], had been identified from school attendance registers [school attack rate 16.7%]

Table 4 Relative risk of illness assessed by school register attendance associated with food preferences for main menu items supplied in school meals to Penygraig School, 7th – 9th September

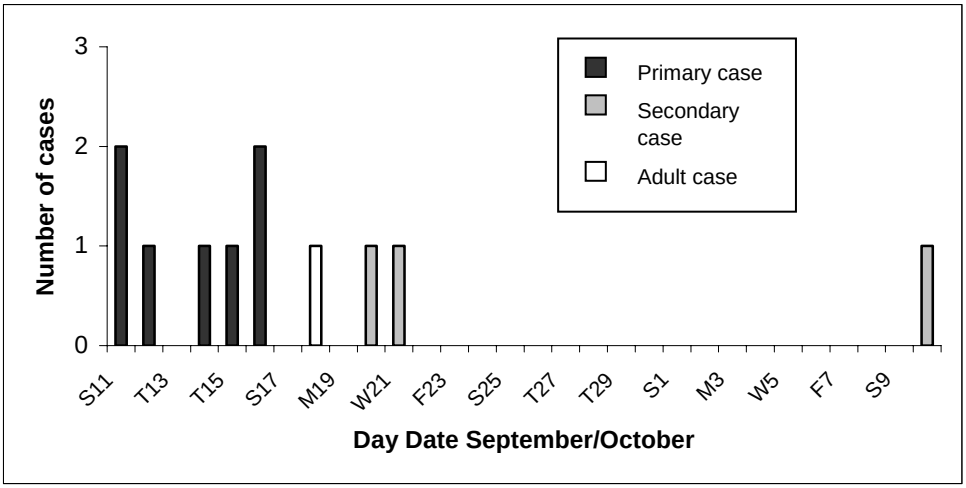
Food Preference	School cohort (n = 55)				Relative Risk	95% CI	P[2]
	Cases[1] (n=4)		Well (n=51)				
	Liked	Disliked	Liked	Disliked			
Sausage (7th)	2	2	49	2	0.08	0.01-0.42	**0.02**
Sliced turkey (8th)	4	0	47	4	Infinite		1.0
Gravy (8th)	2	2	43	8	0.22	0.04-1.39	0.15
Cheese/Tomato Pizza (9th)	4	0	41	10	Infinite		1.0
Dream topping[3] (7th)	1	2	17	24	0.72	0.07-7.38	1.0
Mandarins (7th)	1	3	38	13	0.14	0.02-1.22	0.06
Mousse (8th)	4	0	47	4	Infinite		1.0
Fruit Cup (9th)	1	3	33	18	0.21	0.02-1.85	0.15
Lunch milk (Daily)	4	0	48	3	Infinite		1.0

[1] Children with (i) microbiologically confirmed disease, or (ii) unauthorised school absence of >24 hours recorded on school registers between am 12/09/05 and am 19/09/05 inclusive, or (iii) unauthorised school absence on am 19/09/05 marking the start of a longer period (>24 hours) off school.
[2]Fisher's Exact 2 tailed
[3]Dream Topping not available to reception class

Food preference charts for only 55 pupils (4 cases and 51 well children) were completed on 26th September due to high levels of illness absence. All cases liked cold sliced turkey and pizza and drank milk at lunch. Eating sausages (main meal, 7th September, from Supplier E) appeared statistically protective (Table 4). No other statistically significant associations with illness were observed, including that of food preferences for cold turkey slices served on Thursday 8th September (from Meat Supplier C) or schools meals served on specific days.

Questionnaires from the remainder of the cohort were obtained as children returned to school. By 30th November, 83 of 84 questionnaires were completed and re-analysed for association between food preferences and primary confirmed cases of illness contracted in children attending Penygraig school and included on the Outbreak Control Team register. Eight primary cases were identified in total (Figure 3; school attack rate 9.6%). together with four cases of community acquired infection and one confirmed adult case in a school worker. Due to the differing inclusion criteria used between the September and November analyses, food preferences for school cases (eg those liking sausages) may differ between Tables 4 and 5 (See footnotes in both tables for details of how cases were defined for each analysis).

Figure 3. Epidemic curve of confirmed cases of E coli 0157 with known date of onset, at Penygraig School, September to October.



No statistically significant increase in relative risk of illness was observed between any food preference and defined cases of primary illness in the full school cohort (Table 5), or between any specific day (7^{th} – 9^{th} September). Good eaters (defined as those with average or below average 'fussiness' of their food) appeared more likely to have become ill supporting an exposure dose-response, although statistical significance was not reached. All cases liked cold sliced turkey, pizza and sausages and drank milk at lunch. Almost universal exposure (preference) to main meal items in school dinner eaters may have limited statistical discrimination.

Table 5 Relative risk of confirmed illness associated with food preferences for main menu items supplied in school meals to Penygraig School, 7^{th} – 9^{th} September

Food Preference	School cohort (n = 83)				Relative Risk	95% CI	P[2]
	Cases[5] (n=7)		Well (n=76)				
	Liked	Disliked	Liked	Disliked			
Sausage (7^{th})	7	0	54	22	Infinite		0.18
Sliced turkey (8^{th})	7	0	56	20	Infinite		0.18
Gravy (8^{th})	5	2	48	28	1.42	0.29 – 6.85	1.0
Cheese/Tomato Pizza (9^{th})	7	0	47	29	Infinite		0.09
Dream topping[3] (7^{th})	1	2	20	46	1.14	0.11-11.92	1.0
Mandarins (7^{th})	5	2	44	32	1.73	0.36 – 8.43	0.69
Mousse (8^{th})	6	1	55	21	2.16	0.28 – 16.98	0.67
Fruit Cup (9^{th})	3	4	35	41	0.89	0.21 – 3.72	1.0
Lunch milk (Daily)	7	0	57	19	Infinite		0.34

[5] Microbiologically confirmed or fitting the outbreak definition and on the Outbreak Control Team register at 30.11.05. Total no cases = 8, 1 lost to follow up.

A comparison of the structure and activities in households with and without secondary cases

Results are awaited, however preliminary results on faecal shedding on 92 cases where data is available from the Rhondda Cynon Taf, Merthyr Tydfil and Caerphilly areas show a range of 1-80 days. The average length was 21 days, the median was 16 days. The 25th percentile was 5 days, and the 75th was 32 days, meaning 50% of cases excreted *E. coli* O157 for between 5 and 32 days.

MICROBIOLOGICAL INVESTIGATION – RESULTS

In total, 118 isolates were microbiologically confirmed. The phage type, genotype and PFGE type of the strains are shown in table 6.

Table 6: Typing of isolates from *E. coli O157* positive cases

Phage Type	Genotype	PFGE Type	Number of cases
21/28	VT2	A	33
21/28	VT2	B	6
21/28	VT2	C	43
21/28	VT2	D	1
21/28	VT2	E	9
21/28	VT2	F	1
21/28	VT2	G	1
21/28	VT2	H	1
21/28	VT2	I	1
21/28	VT2	J	1
21/28	VT2	K	1
21/28	VT2	L	1
21/28	VT2	M	2
21/28	VT2	N	1
21/28	VT2	O	1
21/28	VT2	P	1
21/28	VT2	Q	1
21/28	VT2	R	1
21/28	VT2	S	1
21/28	VT2	T	1
21/28	VT2	XX	1
32	VT2		3
1	VT2		1
RDNC*	VT2		1
no isolate			4

* RDNC = reacts but does not conform (to a recognised type)

Ninety three of the 109 phage type 21/28 strains were found to be PFGE types A, B, C, E or M. These types are closely related to each other. Further information on the relatedness of all these strains is awaited from the reference laboratory in Colindale. Examination of the database of the specialist laboratory showed the predominant PFGE types as being unique to the South Wales outbreak. The OCT was informed that these had not been isolated from any other case tested at the laboratory, apart from the three cases in Colwinston in the Vale of Glamorgan (see discussion).

Human Food

A large number of foodstuffs were examined microbiologically. Five samples were positive for *E. coli* O157 phage type 21/28 (See table 7).

Table 7 Source of sample and results for foodstuffs and environmental samples submitted by Local Authorities tested for *E. coli* O157 (up to 6th December 2005)

Sample type	No. of samples	Samples taken from	Samples submitted by	Result
Cooked Meat				
Beef	18	School canteen	Local Authorities	Negative
	5	Others		Negative
	7	Meat Supplier C		Negative
Chicken	80	School canteen		Negative
	1	Other		Negative
	10	Meat Supplier C		Negative
Ham	208	School canteen		Negative
	22	Other		Negative
	13	Meat Supplier C		Negative
Lamb	14	School canteen		**2 positive** [1, 2]
Pork	17	School canteen		Negative
Poultry	1	School canteen		**1 positive** [3]
Turkey	82	School canteen		**2 positive** [4, 5]
	11	Other		Negative
	18	Meat Supplier C		Negative
Miscellaneous				
Yoghurt/desserts	4	School canteen	Local Authorities	Negative
Sandwich fillings	2	School canteen		Negative
Tray of faggots	1	Meat Supplier C		Negative
Fresh mint	1	Meat Supplier C		Negative
Prawn cocktail	1	Meat Supplier C		Negative
Chicken curry	2	Meat Supplier C		Negative
Quiche loraine	1	Meat Supplier C		Negative
Environmental Samples				
Swabs/equipment/overalls etc	44	Meat Supplier C	Local Authority	Negative
	28	Not stated		Negative

1	PT 21/28	VT 2	PFGE (C)	Primary School F
2	PT 21/28	VT 2	PFGE(A)	Primary School G
3	PT 21/28	VT 2	PFGE(C)	Primary School H
4	PT 21/28	VT 2	PFGE(C)	Primary School I
5	PT 21/28	VT 2	PFGE(C)	Primary School J

The five isolates recovered from unused cooked sliced meat samples in schools typed as PT21/28. On PFGE typing four were identical to 41 human isolates from cases (type C), and a fifth isolate (type A) was identical to a further 29 human isolates.

ENVIRONMENTAL INVESTIGATION- RESULTS

Source

Initial Investigations

Food premises

Fast food outlets A
No significant issues were noted during the inspections of these fast food outlets.

Other Premises
Swimming Pool B
The chlorination levels and pool management system were satisfactory. No incident of concern had been noted in the relevant time period.

School Investigations

School milk
All milk supplies to schools in Rhondda Cynon Taf and Merthyr Tydfil were sourced from the same pasteurisation plant. No abnormalities were found in the process and there were no concerns. The plant supplied the Midlands, Yorkshire and the South East as well as Wales (a total of around 1 million units, of which approximately 300,000 went to Wales). There were no reports of any outbreaks of *E. coli* O157 in any of these areas.

Water coolers
In the first four Rhondda Cynon Taf schools investigated, two had mains connected water fountains, one had a mains connected water cooler, and in one school children drank directly from the tap or their own bottled water. Subsequently Merthyr Tydfil education officers and head teachers confirmed that none of the schools affected in Merthyr Tydfil had made use of non mains water coolers immediately prior to the outbreak.

Fruit tuck shops
In the first four schools investigated, the fruit was from three different unconnected sources. Not all affected schools provided fruit tuck shops.

Further investigations

Cooked sliced meats from school kitchens
Of the samples analysed, five samples (from four different schools in Rhondda Cynon Taf and one school in Caerphilly) were positive for *E. coli* O157 VT2 21/28. Details are given under microbiological results.

Meat supplier C
The inspection on the 19th September established that the meat supplier supplied both raw and cooked meats. In addition to the cooking of meat at the premise some meat was supplied for distribution already cooked. A number of contraventions of food

hygiene legislation were identified and in particular poor practices that may result in the cross contamination of cooked meats.

Other environmental investigations

School kitchens

No issues of concern were identified in Rhondda Cynon Taf, Merthyr Tydfil, Caerphilly or Bridgend school kitchens.

School inspections

It was noted that some schools did not have supplies of running hot water, soap, hand drying facilities and toilet roll. Advice was needed in some schools in respect of exclusion of children with diarrhoea and/or vomiting. There were activities in schools which could have exacerbated the spread of any infection such as the sharing of plates of food.

Private Residential home D inspection

This highlighted issues in relation to the training of staff in food hygiene. It also established that the same supplier of meats as the schools was used.

Suppliers of both cooked and raw meats to Meat Supplier C

Enquiries did not identify any concerns in relation to these companies.

CONTROL MEASURES INSTITUTED

Source

Immediate control of suspected cause of outbreak

Quarantine and removal of cold cooked and sliced meats from schools

On Sunday 18th September, the Outbreak Control Team identified cold cooked and sliced meats supplied to Rhondda Cynon Taf and Merthyr Tydfil schools as the likely source of the outbreak. The decision was made that all cold cooked and sliced meats remaining in Rhondda Cynon Taf and Merthyr Tydfil school kitchens should be removed, and no cold meat was to be served in schools unless it had come from a tin. With the routine cleaning and disinfecting of kitchens and these precautions, the OCT was in agreement that school meals could continue to be served. There were no concerns about hygiene standards in individual school kitchens.

Rhondda Cynon Taf and Merthyr Tydfil kitchen supervisory staff were therefore contacted urgently by EHOs and Local Authority Catering Managers on Sunday 18th to advise them to arrange on Monday morning to identify any remaining cooked, sliced meat. They were advised to isolate this in a separate storage area and to label it as not for use. When resources allowed Environmental Health staff then visited each kitchen and removed all of the segregated cooked, sliced meat. In Rhondda Cynon Taf the meat was stored in a freezer trailer hired in by the Authority, prior to it being taken to the laboratory for analysis. In Merthyr Tydfil the meat was stored in two secure freezers away from schools.

A voluntary withdrawal of all cooked products was discussed and agreed with Meat Supplier C after inspection on the evening of 19th September 2005.

Cold cooked and sliced meats from this supplier were withdrawn by the Local Authorities from Bridgend and Caerphilly schools on the 20th September. Samples of meats from schools where available were secured for examination and the remainder was collected and sent for incineration.

On the same day, officers from Bridgend County Borough Council contacted all relevant Local Authorities to advise of customers of Meat Supplier C within their area. Subsequently, all Local Authorities took immediate steps to ensure that customers within their area were contacted to ensure withdrawal of the cooked meats.

Control of likely source of contamination

Enforcement notices on Meat Supplier C

The inspection of Meat Supplier C's premises on the 19th September 2005 resulted in the service of an emergency prohibition notice under section 12 of the Food Safety Act 1990. This Notice stated that the vac packing process posed an imminent risk of injury to health because:

1. the serious risk of cross-contamination from it being used for both raw and cooked foods and
2. its situation underneath the electronic fly killer and
3. its unclean condition

Another visit was made to Meat Supplier C on the 20th September 2005. A further emergency prohibition notice was issued due to an imminent risk of injury to health from, 'the unsanitary condition of the premises due to inadequate disinfection procedures'. This second notice had the effect of closing the business. During the visit a list of customers and a list of suppliers were obtained. That afternoon steps were taken by officers of Bridgend County Borough Council to contact suppliers to Meat Supplier C and their relevant Local Authority to ensure no problems had been identified at such premises.

On 4th October 2005 a child with confirmed *E coli* O157 died. As a result of this sad development, South Wales Police secured the premise belonging to Meat Supplier C and treated the premise as a scene of crime.

On the 26th October 2005, South Wales Police handed back the keys of the premise to the supplier.

On the 24th November 2005 an application was received from the supplier to provide certification under section 12(8) of the Food Safety Act 1990 that there was no longer a risk to health. Fourteen days is the maximum time period given for a Local authority to consider such an application. Having completed further inspections and received further information, a favourable determination was made on 9th December 2005 and the emergency prohibition notices were lifted.

The Food Safety Act 1990 requires that local authorities make an application to the Magistrates Court for emergency prohibition orders to be issued in respect of the emergency prohibition notices. Due to the successful appeal of the supplier on a procedural issue, Bridgend County Borough Council has been instructed for such an application to be remitted back to the Magistrates Court for hearing. At the time of writing this hearing has not been held.

<u>Food Standards Agency and Food Alerts for Action</u>

On Monday 19th September the Food Standards Agency became aware of an outbreak of *E. coli* O157 that the National Public Health Service and several South Wales local authorities were investigating. It also became aware that preliminary investigations by the Outbreak Control Team had considered a number of potential sources of the infection and had determined cold cooked and sliced meats as the likely source.

On the 20th September 2005, Bridgend County Borough Council contacted the Agency in relation to instigating a formal food alert in relation to the cooked meats supplied by Meat Supplier C. The Agency was invited to attend an Outbreak Control Team meeting that afternoon when action necessary with regard to the supply of cooked meat would be amongst the issues discussed.

Information considered at that meeting indicated that Meat Supplier C had supplied cold cooked and sliced meats to schools in a number of local authorities where pupils had been identified as cases. The need for the Agency to issue a "Food Alert for Action" was discussed and it was decided that such a course of action was both necessary and desirable to ensure removal of potentially affected product from the food chain.

The Agency liaised with Bridgend County Borough Council to secure the necessary information. A Food Alert for Action was issued to all Welsh local authorities the following day, Wednesday 21st September in relation to all cooked meat supplied by Meat Supplier C on or before 20th September 2005. A press release was also published.

Meat Supplier C had provided details of its customers to Bridgend County Borough Council and these were appended to the Food Alert in order that local authority officers across Wales could make contact with each to ensure that all cooked meats were removed from the food chain. As a result of information provided to the Agency by the Vale of Glamorgan Council, who had already contacted a number of food businesses in their area, it became apparent that the list of customers supplied by the company might not be complete. An update to the Food Alert was sent to local authorities on 22nd September to notify them of these concerns.

Upon receipt of additional information from local authority sources, it was confirmed that the list was indeed incomplete. Two further updates were issued on requesting local authorities to contact all food businesses that utilised cooked meats to ensure that none from Meat Supplier C remained within the food chain. An extensive operation was undertaken by Welsh local authorities and several thousand businesses were contacted by means of telephone, letter or personal visits. No additional businesses were identified that were in possession of cooked meats supplied by Meat Supplier C.

On 23rd September, a copy of the database of invoices from the computer at Meat Supplier C was taken by Bridgend County Council and given to the Food Standards Agency. A small number of additional customers were identified and details notified to the relevant local authority. The Information from the database was transferred to a spreadsheet format which was shared with members of the OCT as necessary.

Bridgend County Borough Council also provided the Food Standards Agency with details of companies that supplied Meat Supplier C with both raw and cooked meat. These companies and the relevant local authorities were contacted to ascertain whether there had been any incidents of food borne disease associated with them and for information as to food hygiene standards within the food premises.

<u>Removal of cooked meats from premises within the Key Authorities</u>

On 20 September 2005, officers from Bridgend County Borough Council contacted all relevant Local Authorities to advise of customers of Meat Supplier C within their

area. Subsequently, all Local Authorities took immediate steps to ensure that customers within their area were contacted to ensure withdrawal of the cooked meats.

This included contacting residential homes to ensure the withdrawal of all vacuum packed cooked meats supplied by Meat Supplier C. Officers also contacted any other businesses they thought likely to have received meat products from this supplier.

Therefore, at the time of the FSA food alert on 21st September, most relevant premises had already been contacted, based upon Environmental Health Officers' knowledge of individual food businesses locally. Caerphilly, Rhondda Cynon Taf and Merthyr Tydfil Local Authority officers contacted all their butchers to establish whether they had received meat from Meat Supplier C. Between 22nd and 24th September the Local Authority officers either visited or made telephone contact with hundreds of other food businesses, alerting them to the potential hazard. This exercise was fully completed by 26th September, with some Local Authorities sending letters to all registered food businesses.

No further instances of cooked meats from Meat Supplier C were identified as a result of the FSA alert on 21st September. However, one sampling officer did record finding a ham on 22nd September which was delivered by Supplier C but was sourced from Sandwell in the West Midlands. This information was fed back to Bridgend County Borough Council to inform further action. This demonstrates the robust nature of the inspection regime across Local Authorities whereby they had in depth knowledge of high risk food suppliers to their food businesses and were able to identify the likely potential sources of this foodstuff.

Spread

Control of spread within households

Advice given

The advice given to control spread was based on national guidelines.[1,2]

All suspected cases and household contacts received verbal advice from officers as soon as they were identified. This was supported by the issue of advisory leaflets. Particular emphasis was placed upon thorough hand washing, cleaning and disinfection within the home and about children not sharing food etc All cases fitting the case definition were interviewed using an *E. coli* O157 interview questionnaire even when it meant visiting them in hospital. The forms were filled in as far as was practicable.

Various Local Authorities found difficulty in contacting families who had cases transferred to tertiary hospitals outside their local areas, although interviews were sometimes able to be carried out over the phone. However, in some instances, particularly when cases were very ill, relatives declined interview. Transfer often occurred without informing Public or Environmental Health staff, and it was often difficult to get further details. As an example one authority had difficulty in contacting one household because the case had been admitted to Bristol Children's Hospital.

The purpose of the advice given was to minimise the risk of secondary cases occurring from spread from the primary case. Given the low infective dose of *E. coli* O157 needed for illness, secondary spread within households is not uncommon. A number of secondary cases were seen in this outbreak in family members, particularly among young children. This appeared to occur even when all precautions had been taken to try and prevent spread. This led to difficult decisions being made in individual cases to try and minimise further spread. For example, one Authority was forced to persuade a mother of a newborn baby not to return home after delivery because siblings in the household remained positive on screening for a prolonged period.

Control of spread in hospitals

The majority of hospitalised cases were admitted to two hospitals, the Prince Charles Hospital in Merthyr Tydfil and The Royal Glamorgan Hospital in Rhondda Cynon Taf. Standard infection control procedures were in place and no within hospital transmission occurred.

Control of spread in the wider community

Exclusion of cases and contacts from school and work

The exclusion of cases and contacts from work was based on national guidelines as a minimum. [1] A proforma based on these was distributed during the outbreak to ensure consistency of interpretation (see Appendix D- management of cases and controls).

During the initial stages of the outbreak there were children in school who were recovered from diarrhoea but when they were sampled were found to be positive and the families were then treated as being subject to appropriate exclusion policies.

Suspected cases and contacts in risk groups A-D were excluded from work or school until their status was clarified by means of faecal screening. Confirmed cases in risk groups A to D who were otherwise well had to stay away from school and from other children both inside and outside the home until they had produced 2 negative microbiological results.

Many children under 6 years within families affected by the condition were excluded from school, (even if their own samples were negative) until all the family were screened as being negative in order to prevent them carrying the infection into school.

Positive cases continued to provide specimens for screening until two negative stool samples at least 48 hours apart were obtained.

Advice was given to families of cases about not letting their young children and toddlers play or mix with other children outside the family group. Advice was also given about not visiting swimming pools, soft play areas and not attending or organising children's parties (see Appendix E).

The head teachers of affected schools were advised of cases within their school in order to identify potentially affected children and ensure that they were not sent back to school before the family were declared negative.

In Merthyr and Rhondda Cynon Taf, arrangements were made for all families with ongoing cases to receive a support visit from a health visitor known to them to reinforce advice already given by Local Authority officers. Contact was also made with private nurseries.

One Local Authority found it became aware of large numbers of high risk employees as contacts who needed to be excluded from work although their workplaces were outside that authority area. In order to properly monitor the exclusion from high risk activities the responsibility to exclude was transferred to those Local Authorities where the work took place.

In other Local Authorities complex decisions were made about excluding potential carriers, for example a registered childminder who was a contact was required to cease work until the case was negative as contact with that child was continuous and ongoing. Cooperation was achieved as a result of the Local Authority making up the shortfall in income. Similar exclusions occurred in other Local Authorities.

Control measures within schools to prevent secondary transmission

On Sunday 18th September the Outbreak Control Team decided that affected schools could remain open. The following control measures were agreed for primary schools with affected children:

- Withdrawal of cooking activities
- No plasticine, sand or water play
- Advice for head teachers (by letter) on cleaning measures required if children had faecal accidents in school
- Advice with regard to good hand washing

On 23rd September the OCT endorsed the spreading of control measures to all primary schools in the affected four Local Authority areas. It was also clarified that senior schools could continue to deliver their full curriculum, but that vigilance should be taken to make sure that school toilets and hand washing facilities were thoroughly cleaned and adequate. However, depending on local arrangements, food technology lessons were suspended in some senior schools.

At the OCT meeting of 27th September, it was agreed that food should not be brought into schools unless it was for the child's own consumption, with the exception of fruit tuck shops, where the fruit was thoroughly washed. This was agreed subject to the fruit not being served up "buffet style" where individual pieces could be handled by various children.

The school control measures were reviewed at every OCT meeting and left in place. At the OCT meeting of 27th October, it was decided to leave these measures in place until the Christmas break.

All four local Authorities involved put strenuous efforts into carrying out additional precautions as dictated by local circumstances.

All sent out additional letters to head teachers giving information on the various control measures that were relevant for schools on keeping unwell children from school, on reporting suspected cases for investigation and on what they needed to do

to minimise the likelihood of spreading the condition from one person to others. This involved issues around cleaning of toilet accommodation and water fountains etc, cleaning of classroom equipment, and ceasing activities such as plasticine, sand and water play.

Within Local Authorities where primary schools were affected, the need to control access to foodstuffs which might become contaminated was seen as being paramount. Consequently schools were advised that food should not be handled in the classrooms by pupils and hand washing before eating needed to be supervised or organised. The instructions to schools from very early on encouraged a clear separation between classroom activities and eating of foods with the sole exception of fruit tuck which had to be controlled in order to prevent individual portions being handled by more than one child.

Links were set up between individual head teachers of affected schools and Local Authority Environmental Health Departments to identify affected children and ensure that children from families who were positive in risk groups A to D were excluded. Mechanisms were put into operation to ensure there was agreement about their return to classes only once they were confirmed to be negative.

Arrangements were made for letters to be issued to the parents and guardians of all pupils at affected schools in the four key Local Authorities initially and within a few days of the outbreak to all schools in Rhondda Cynon Taf, Merthyr, and Caerphilly explaining what precautions were being taken in schools and what was expected of the parents etc. These letters were delivered home by the children and where people were absent the schools made individual arrangements for delivery. These letters were followed by update letters to reinforce and clarify issues during the outbreak period.

These letters were also sent to parents of nursery children and emphasised the need for increased vigilance over the bowel habits of their children and to keep them home if they were unwell. They were encouraged to improve hand washing by children both after using the toilet and before eating any foods.

In Merthyr Tydfil and Caerphilly detailed advice was given on through the day checks and interim cleaning of toilet facilities as well as how and what to clean to control cross contamination. Advice was given on which parts of toilets needed most attention, for example, door fastenings and handles, taps etc.

Information and guidance was issued on what needed to be provided in toilet facilities ie hot water, toilet paper, hand towels etc. Extra training was organised for caretakers and cleaners on methods of cleaning and the importance of accurately diluting cleaning chemicals to achieve effective disinfection.

Requests were made to schools to undertake deep cleaning of toilets and to audit what quality checks were being made and who was responsible for what. In Merthyr Tydfil, an independent audit of hygiene standards in school toilets was carried out during early October and the results circulated amongst the schools to drive up standards.

Advice where appropriate was given on cleaning certain facilities in schools such as keyboards in computer suites. Requests made to schools to designate those areas

which were intended to be used as eating areas so that they could be cleansed and restrictions put into place about eating in other areas.

Every single school in Caerphilly (approximately 120) was visited by officers from Environmental Health and Health and Safety to assess hygiene standards. All affected schools across RCT were visited by Environmental Health staff to inspect toilet facilities and to ensure that satisfactory arrangements were in place.

Every school in RCT where there was a case was given a 'super' clean. This included cleaning toilets and associated facilities, and schools and nurseries with children under five also had their toys and play equipment cleaned.

Harvest Festivals, Christmas Parties and wider activities in Local Authority areas

As the period extended the issues around not bringing food into school were challenged by traditional seasonal events. Difficult decisions had to be made which affected the school calendar and each Local Authority tackled this activity in slightly differing ways.

Bridgend

Schools were advised of restrictions to Harvest Festivals by letter or e-mail on 13th October 2005. This prevented any fresh fruit and vegetables being brought in from home for redistribution.

On 18th November 2005, advice was given to all schools in relation to precautions to be taken in respect of Christmas fairs and parties. The general advice given was that parties could only continue if schools utilised catering staff to provide the party foods or children brought a plate of food in for their consumption only. No donated food was to be brought in for Christmas fairs.

Caerphilly

An email was sent to Head Teachers on 13th October advising on restrictions to Harvest Festivals. Donations were restricted to monetary contributions only. On 9th November an email was sent to all Head teachers advising on Christmas Parties and Fairs. The general advice was that parties could continue as long as the following precautions were in place: Catering staff only should provide, prepare and serve any party foods with no foods being brought into schools by either children or parents. Christmas Fairs should not include any donated food and prizes must be non-food items. This message was reinforced on 24th November in a letter to schools and parents. Similar advice was issued to all private nurseries and playgroups regarding Christmas festivities.

Merthyr Tydfil

No advice was given on Harvest festivals. Letters were distributed to all schools and parents regarding Christmas parties, in particular advising that no food should be brought in except for their own personal consumption.

This had the effect that many of the schools did not provide food at their Christmas Parties whilst others utilised the services of Merthyr Tydfil Catering who ensured that

the food was not laid out 'buffet style'. Christmas fairs were restricted in relation to the donation of foodstuffs as prizes. It also became evident that some schools were in the habit of preparing foods at school and distributing to the wider community at Christmas time, eg: cawl to Care Homes – this activity was prohibited.

Rhondda Cynon Taf

In respect of Harvest Festivals, schools had in previous years either made soups or parents had brought in food from home which had then been distributed to vulnerable people such as the elderly in the community. This practice was prevented in line with the OCT advice.

Letters were distributed to all schools and parents regarding Christmas parties, in particular advising that no food should be brought in except for their own personal consumption.

In addition, officers gave verbal advice to head teachers and others on how they could enjoy festivities but still comply with OCT advice. For example, external contractors or Catering Direct plating up portions for each child so there was no sharing of food and nothing was brought in from home. Also, with raffles fetes etc., either prizes were altered to non food prizes or they were sourced directly from an outlet so no need to bring onto school premises from home.

Other Precautionary Activities

Merthyr Tydfil

During the outbreak, the level of swimming pool sampling was increased to twice weekly. The majority of water samples were found to be satisfactory. However, a swimming pool at an affected school had been closed prior to the outbreak and was not permitted to re-open for the duration of the outbreak, because of concerns about the maintenance of chlorine levels. Another public pool was found to be operating with a wholly deficient level of chlorine due to the chlorine dosing system being blocked. This pool was taken out of use for a short time (hours) until the problem was resolved.

All of the private nurseries within the Borough were visited by EHOs and hygiene standards assessed. Hygiene advice was given. Restrictions were put into place for private nurseries, mother toddler groups, child care groups, out door activity centres etc which mirrored those restrictions which had been put into place in schools. Toy libraries for nursery groups were suspended.

COMMUNICATIONS

Communication with cases, parents, schools, health professionals, opinion formers and the public was a standard agenda item for the Outbreak Control Team. It was a key priority for the team and was discussed at every meeting.

The Team always sought to contact cases, their families, head teachers and the parents of children in affected schools directly. However, events were fast-moving and people were affected across a wide and dispersed geographical area. So, there were times, such as the announcement of the outbreak at the beginning, where it was judged to be more effective to use the media to communicate information to a wide audience quickly.

Communications with cases, their families and the public

The following means of communication were used by the Outbreak Control Team:

Direct personal contact
Environmental Health Officers sought to contact every case and their immediate family by telephone or in person with advice and information on the *E. coli* O157 infection and how to control its spread. This verbal contact was backed up with information in writing and contact numbers should families want further advice or information.

For many cases, there was repeated contact with Environmental Health Officers taking samples and providing opportunities for families to ask questions and to be given advice.

Before the outbreak was declared over publicly, letters were hand delivered or sent individually to all cases on the case list to inform them of this decision and provide further information about this decision.

Letters to head teachers and schools
The need for schools to put in place control measures and for head teachers to be able to reassure parents, together with the publicly contentious decision to keep the schools open, meant that the Outbreak Control Team recognised the importance of keeping head teachers well briefed. The team also recognised the need to provide information and reassurance for catering staff within schools.

Templates for key letters were drafted by members of the OCT and then adapted by individual Local Authorities as necessary before distribution. The individual circumstances of each area were recognised by the OCT, and additional letters and other communications were sent by separate Local Authorities as the need arose to address local issues (See Appendix F).

Letters to parents
Letters to the thousands of parents and guardians with an interest were the most effective way to explain the outbreak, the actions of the Outbreak Control Team, the

control measures needed and the contacts that could be used for further information. These letters stressed the need for children to remain at home if they had symptoms, and provided the *E. coli* O157 helpline number for queries. The OCT again drafted templates for key letters, which were then adapted by individual Local Authorities as necessary before distribution.

The differing pattern and number of cases between each Authority and local concerns meant that additional letters and other communications were sent by separate Local Authorities as the need arose (See Appendix F).

***E. coli* O157 Helpline**

A helpline (with up to five extensions) was available from 7am on Monday 19th September. It was set up to provide information, collect information and to give advice to the public.

The helpline was staffed by general National Public Health Service staff, supported by a member of the NPHS Health Protection Team who dealt with difficult or clinical queries.

The helpline operated from 9am-9pm (7am-9pm on the first day) in the first five days, then from 9am to 5pm daily until 5pm on Friday 30th September. The line was closed on that date due to falling demand. Parents were informed of this directly by letter and advised to contact their GP or NHS Direct if they had any concerns regarding their health care.

It was decided on Thursday 6th October to reopen the helpline, following the death of a child and the exclusion of pupils from Glenboi School. This remained in operation until Tuesday 20th December, with callers directed to a mobile phone carried by a doctor at weekends.

The helpline number was promoted in every letter to head teachers and parents of pupils in affected schools. It was also promoted in every press release. The printed, electronic and broadcast media all promoted the number on a regular basis. BBC Wales, however, on one occasion broadcast the wrong number following an edition of it's *Week In Week Out* programme on the outbreak.

The helpline was used by parents, the public, head teachers and health professionals. It was very effective at case finding; whenever individuals who had symptoms compatible with *E. coli* O157 presented, details were taken and passed onto the relevant environmental health officers for follow up.

<u>Number of calls received by the helpline</u>

Around 800 calls were logged as being answered by the helpline. This is almost certainly an underestimate of the number of calls handled, as some of those requiring general reassurance would not be logged when lines were extremely busy, particularly if callers refused to give any identifying details. From 13th October, no calls were received on most days, apart from the occasional query, apart from specific days on which significant events would trigger a spate of calls. For example, there were 13 on the 14th November, when a nursery in a separate outbreak and a school in the Vale of

Glamorgan were closed, 16 on 16th November in response to a letter sent to parents about a possible case in a school.

Table 6: Calls to *E. coli* O157 Helpline

Date of calls	Number of calls logged
19/09/2005	137
20/09/2005	131
21/09/2005	102
22/09/2005	65
23/09/2005	70
24/09/2005	8
25/09/2005	21
26/09/2005	64
27/09/2005	30
28/09/2005	14
29/09/2005	9
30/09/2005	7
	Helpline closed - reopened 9am on 7th
06/10/2005	(Calls taken on other lines) 4
07/10/2005	20
08/10/2005	6
09/10/2005	6
10/10/2005	8
11/10/2005	13
12/10/2005	5
13/10 to 19/12/2005	78
Total	**798**

NHS Direct

On Sunday 18th September NHS Direct was informed about the outbreak and an *E. coli O157* helpline opening; on Friday 23rd September about the helpline remaining open over weekend and again on Monday 26th September. The organisation was given a mobile phone number of an NPHS Consultant in Communicable Disease Control as a contact point for any issues at any time.

NHS Direct was briefed on Friday 30th September about the closure of the helpline and given the out of hours ambulance control number as a contact point for any urgent queries. It was informed of the helpline re-opening on 7th October.

School meetings

The Outbreak Control Team discussed the possibility of holding or attending meetings of parents in schools. It was agreed that it was more constructive and productive to contact parents directly through letters and the helpline.

When the decision was taken to exclude children from Glenboi School and take samples from all the pupils there, it was agreed to hold two meetings at the school broken into small groups where parents could ask questions and be given advice.

Members of the Outbreak Control Team also attended a meeting of parents later at Deri School where the child who had died was a pupil. The meeting was an opportunity to answer questions and explain the decisions and actions taken.

Web sites
The web sites of some of the Local Authorities affected by the outbreak posted the regular press releases from the Outbreak Control Team on their sites. The National Public Health Service for Wales also carried background information and occasional updates on its site.

The web site addresses were not actively promoted during the outbreak.

Media
The Outbreak Control Team adopted the strategy of being open and proactive in its approach to the media. Notwithstanding the legitimate public and news interest of the outbreak, it was agreed that the media was a useful vehicle for promoting public health messages.

It was agreed that media communications should be managed so that there was 'one voice' for the Team. This would be more likely to deliver clear and consistent messages.

At the Outbreak Control Team meeting on Saturday 17th September it was agreed that all press enquiries would be channelled through the communication offices of the Rhondda Cynon Taff local authority and the National Public Health Service for Wales. A short, holding press statement was issued.

On Sunday 18th September, Dr Roland Salmon of the National Public Health Service for Wales was nominated as the media spokesperson for the Outbreak Control Team.

From Saturday 17th September until Friday 14th October, a press release giving an update on the outbreak was issued every day to the media. From that date onwards, occasional updates were issued if there were developments to report.

There was daily liaison between members of the Outbreak Control Team in confirming information and messages for the press release. A bar graph was used occasionally to explain the timeline of incubation, onset of illness and notification.

On a few occasions, because of the statutory responsibilities involved, press statements were made separately by member organisations following liaison with the other members e.g. by the Food Standards Authority with a food alert on Wednesday 21st September.

There was also agreement with the South Wales and Gwent Police Services on media strategy when police investigations started on Wednesday 5th October.

Media interest in the outbreak was huge and ongoing for many weeks. The outbreak was frequently the lead item on the Welsh print, electronic and broadcast news. It was covered by current affairs and news programmes and, on a number of occasions, in the UK media.

During the course of the outbreak, the Team received more than 750 separate enquiries from the media. More than 150 broadcast interviews were given. Only a small handful of interview requests were not accepted – usually because of time pressures and unavailability. Other consultants from the National Public Health Service for Wales gave interviews in support of Dr Salmon.

Communications to Health Professionals

Communications to health professionals had two purposes; to provide information and to search for additional cases. This was by phone, fax and/or e-mail.

Summary of communications

16/9/05 (pm)	GP Out of Hours centres covering RCT, Merthyr Tydfil and Cardiff Paediatric on-call teams in Royal Glamorgan Hospital and University Hospital of Wales. Microbiology Royal Glamorgan Hospital NPHS on-call service Centre for Infections, Health Protection Agency, Colindale, London
17/9/05 (am)	GP Out of Hours centres Gwent/Primecare/Cardiff A+E Departments and Medical Teams on call (South East Wales)
(pm)	GP Out of Hours centres Gwent/Primecare/Cardiff A+E Departments (for paediatric and medical on call teams) Welsh Assembly Government Local Health Board representative (South East Wales on call cover)
19/9/05	GPs in South East Wales and Local Health Boards
20/9/05	GPs in South East Wales and Out of Hours services Health Protection Agency teleconference
21/9/05	GPs in South East Wales, Bridgend, Neath Port Talbot, Swansea A+E Departments and Local Health Boards Summary for CDR (Communicable Disease Review) Weekly
23/9/05	GPs, A+E Departments and Local Health Boards and Out of Hours services
26/9/05	GPs, A+E Departments and Local Health Boards and Out of Hours services
28/9/05	GPs, A+E Departments and Local Health Boards and Out of Hours services
4/10/05	GPs, A+E Departments and Local Health Boards and Out of Hours services
5/11/05	GPs in RCT re Abercynon School Update for CDR (Communicable Disease Review) Weekly

11/11/05 GPs, A+E Departments and Local Health Boards and Out of Hours services

Communications to Public Officials and Elected Members to Public Bodies

The Outbreak Control Team anticipated that there would be much government and political interest in the outbreak. The public would get information from their political leaders so the Team considered it important that such public debate should be well informed.

The Office of the Chief Medical Officer for Wales was notified on Friday 16th September of the potential outbreak. The Office was then updated on a near daily basis during the course of the outbreak.

The Health Minister was briefed directly by officers of the National Public Health Service for Wales and the Food Standards Agency on 22nd September. The FSA provided regular updates to the Minister throughout in accordance with their statutory role.

Officers of the National Public Health Service for Wales prepared a briefing on the outbreak which was sent to Assembly Members in the affected areas on Tuesday 27th September. An update was sent on Wednesday 5th October.

A written briefing was sent to the Health Spokespeople of opposition parties and briefings were offered.

Briefings and updates were given to AMs, MPs, the Wales Office and Children's Commissioner in person, by post and by e-mail.

Officers of each of the local authorities involved took responsibility for briefing their cabinet members and other councillors.

Health Protection Teams from the NPHS took responsibility for briefing Local Public Health Directors from Local Health Boards involved. Directors from Merthyr Tydfil and Rhondda Cynon Taf Local Health Boards were part of the main OCT.

DISCUSSION

Introduction

Verotoxin producing (VT+) *E. coli* O157 is a relatively new pathogen. The first case was described in Canada in 1977[6] and the first reported outbreak in England and Wales was in 1983[2]. It is believed to have resulted from the transfer of genetic material from shigella like organisms (long known to have produced verotoxins) to *E. coli* bacteria via bacteriophages (viruses that infect bacteria)[7]. It has been an unusual isolate in Wales, where around 30 sporadic cases a year are diagnosed microbiologically[2]. For just over half of these the source is never identified. Outbreaks are much rarer, the last outbreak in Wales was in 2000 in Swansea with 8 cases, and the largest previous outbreak in Wales was 49 microbiologically confirmed cases in Llandudno in 1995.

This outbreak, with 118 microbiologically confirmed cases therefore represents the largest to have occurred in Wales, and is the second largest to have occurred in the UK. The largest was in Central Scotland in 1996 with 279 microbiologically confirmed cases.[8]

Identification of the source of the bacteria and control of this outbreak depended on two elements. The first was what was already known in the scientific literature about *E. coli* O157 and outbreaks associated with this organism. The second was the epidemiological, microbiological and environmental evidence that was gathered and analysed during the investigation of the outbreak. Both of these elements formed the basis for decisions made by the OCT in the following way.

Identification of the source

Evidence from the literature

The literature identifies cattle as a reservoir of infection. In 1994 and 1995, *E. Coli* O157 was recovered from 0.47% of beef carcasses at slaughter, and from 0.83% of faeces from live cattle.[9,10] One study demonstrated *E. coli* O157 in 15.4% of cattle faecal specimens at one British abattoir and in 2.2% of sheep faecal specimens.[11] It has also been isolated from a number of other farmed animals, and can survive for

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[6] Konowalchuk J, Starvic S, Spiers JI. Vero response to a cytotoxin of Escherichia coli. *Infect Immun* 1977; **18**: 775-9

[7] Cheasty T, Smith HR.*Escherichia.* in Borriello SP, Murray PR, Funke G eds. Topley & Wilson's microbial infections. Vol II (Bacteriology) London 2005 Hodder Arnold p1378.

[8] Cowden JM, Ahmed S, Donaghy M, Riley A. Epidemiological investigation of the Central Scotland outbreak of Escherichia coli O157 infection, November to December 1996. *Epidemiology and Infection* 2001, 126: 335-341

[9] Richards MS, Corkish JD, Sayers AR, McLaren IM, Evans SJ, WrayC. Studies of the presence of verocytotoxic Escherichia coli O157 in bovine faeces submitted for diagnostic purposes in England and Wales and on beef carcasses in abattoirs in the United Kingdom.*Epidemiol Infect* 1998; **120**: 187-92.

[10] Clark A, Morton S, Wright P, Corkish J, Bolton FJ, Russell J. A community outbreak of Vero cytotoxin producing Escherichia coli
O157 infection linked to a small dairy. *Commun Dis Rep CDR Rev*1997; **7**: R206-11.

[11] Chapman PA, Siddons CA, Cerdan Malo AT, Harkin MA. A 1-yearstudy of Escherichia coli O157 in cattle, sheep, pigs and poultry.
Epidemiol Infect 1997; **119**: 245-50.

months in faeces and soil samples.[12] It is no surprise therefore that outbreaks are often associated with farm visits or rural settings.

In terms of food products, consumption of beefburgers has been linked to outbreaks in the UK.[13,14,15] Outbreaks have also been linked to cooked meats, where it is thought to arise from cross-contamination.[16,17,18,19] At the time of this outbreak, there was also a European wide outbreak of *E. coli* O157 linked with salads.[20]

Other food vehicles implicated in the UK associated with outbreaks include unpasteurised milk,[21] cream,[22,23] cheese,[24] yoghurt,[25] contaminated raw vegetables[26] and water.[27,28]

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12 Maule A. Environmental aspects of Escherichia coli O157.*International Food Hygiene* 1999; **9**: 21-3.

13 CDSC. Verotoxin producing Escherichia coli O157: phage type 49.*Commun Dis Rep CDR Wkly* 1991; **1**: 213.

14 48. Willshaw GA, Thirlwell J, Jones AP, Parry S, Salmon RL, Hickey M.Vero cytotoxin producing Escherichia coli O157 in beefburgers linked to an outbreak of diarrhoea, haemorrhagic colitis andhaemolytic uraemic syndrome. *Lett Appl Microbiol* 1994; **19**: 304-7.

15 49. Davis BS, Brogan RT. A widespread community outbreak of Escherichia coli O157 infection in Scotland. *Public Health* 1995; **109**: 381-8.

16 Carter AO, Borczyk AA, Carlson JA, Harvey B, Hockin JC, KarmaliMA, et al. A severe outbreak of Escherichia coli O157:H7-associated hemorrhagic colitis in a nursing home. *N Engl J Med* 1987; **317**: 1496-500.

17 Parry SM, Salmon RL, Willshaw GA, Cheasty T. Risk factors forand prevention of sporadic infections with verocytotoxin (Shiga toxin) producing Escherichia coli O157. *Lancet* 1998; **351**: 1019-22.

18 Stevenson J, Hanson S. Outbreak of Escherichia coli O157 phagetype 2 infection associated with eating precooked meats. *Commun dis Rep CDR Rev* 1996; **6**: R116-8.

19 Gammie AJ, Mortimer PR, Hatch L, Brierly AFM, Chada N, WaltersJB. Outbreak of Verocytotoxin producing Escherichia coli O157 associated with cooked ham from a single source. *PHLS MicrobiologyDigest* 1996; **13**: 142-5.

20 Adak CK, Fisher IS. Personal communication

21 Chapman PA, Wright DJ, Higgins R. Untreated milk as a source of verotoxigenic Escherichia coli O157. *Vet Rec* 1993; **133**: 171-2.

22 CDSC. Cases of Escherichia coli O157 infection associated withunpasteurised cream. *Commun Dis Rep CDR Wkly* 1998; **8**: 377.

23 CDSC. VTEC O157 infection and unpasteurised cream - update. *Commun Dis Rep CDR Wkly* 1998; **8**: 389-92.

24 CDSC. Escherichia coli O157 in Somerset. *Commun Dis Rep CDR Wkly* 1998; **8**: 167.

25 Morgan D, Newman CP, Hutchinson DN, Walker AM, Rowe B, MajidF. Verotoxin producing Escherichia coli O157 infections associated with the consumption of yoghurt. *Epidemiol Infect* 1993; **111**: 181-7.

26 Morgan GM, Newman C, Palmer SR, Allen JB, Shepherd W,Rampling AM, et al. First recognised community outbreak of haemorrhagic colitis due to verotoxin producing Escherichia coli O157:H7 in the UK. *Epidemiol Infect* 1988; **101**: 83-91.

27 61. Jones IG, Roworth M. An outbreak of Escherichia coli O157 andCampylobacteriosis associated with contamination of a drinking water supply. *Public Health* 1996; **110**: 277-82.

28 62. Dev VJ, Main M, Gould I. Waterborne outbreak of Escherichia coliO157. *Lancet* 1991; **337**: 1412.

The literature also identifies outbreaks that occur from person to person spread, particularly in children's day care facilities,[29,30] hospitals, and nursing homes. Outdoor swimming/paddling pools[31] have also been linked to outbreaks.

Evidence for the source from OCT investigations

The initial information available to the OCT was descriptive data collected from interviews with the first few cases. In the first 24 hours, it was striking that all the cases were school aged children attending schools in the Rhondda Cynon Taf and Merthyr Tydfil education authority areas. One child lived outside these areas, but still attended a school within Merthyr Tydfil. It was noted that of the initial 11 cases, every child attended a different school. There was no other common feature between these cases except they all were in a school environment and ate school meals. Five had eaten at different branches of the same fast food outlet, and five had used the same local swimming baths and these were inspected. However, these sources could not account for the other ill children, and subsequently inspection was unremarkable. There were no other common features such as visits to local farms or attendance at the same gatherings outside school.

The OCT therefore focussed on risks within the school environment. The pattern suggested widespread contamination, and not failures at individual school or school kitchen level. Apart from school meals, other risks that the OCT considered included water coolers, school milk and fruit tuck shops.

Enquiries into food sources quickly ruled out water coolers and fruit tuck shops as there were different sources for the fruit, and water sources were generally from the mains. If water had been the source, cases should have presented in the general population. This left a component of school dinners or school milk as being putative sources.

The OCT then used a mixture of descriptive and analytical epidemiology to investigate these links further. Menus were obtained where possible from affected schools and a rapid case control study was undertaken. Unfortunately there were several problems with this study. It was difficult to catch families at home during the Sunday afternoon. The menus supplied did not always reflect the meals actually served in the individual schools, as it was the first week of term, some schools mixed menus, using store cupboard items as necessary. The final problem was that many were young children whose parents did not know what had been given at school, and recall for a period over a week ago was problematic. In many cases no one was able to identify what the child had eaten.

However, enough information was available to confirm that all cases had consumed school meals compared with 60% of controls and school milk was protective

29 64. Allaby MAK, Mayon-White RT. Escherichia coli O157: outbreak in a day nursery. *Commun Dis Rep CDR Review* 1995; **5**: R4-6.

30 65. Swerdlow DL, Griffin PM. Duration of faecal shedding of Escherichia coli O157:H7 among children in day-care centres. *Lancet* 1997; **349**: 745-6.

31 68. Brewster DH, Brown MI, Robertson D, Houghton GL, Bimson J,Sharp JCM. An outbreak of Escherichia coli O157 associated with a children's paddling pool. *Epidemiol Infect* 1994; **112**: 441-7.

(meaning that controls were more likely to have drunk school milk), effectively eliminating it from the investigation.

The menus were scrutinised and each component item considered as a risk factor, using information from the scientific literature. Most items were considered as very low risk for spread of E. *coli* O157. Salad was considered unlikely to be a vehicle because most cases were in primary school rather than secondary school, a group more likely to eat salad.

The remaining items causing concern were cold cooked sliced meats, a well known vehicle from the scientific literature. As these were supplied ready to eat there was no need to reheat or process them within schools. The OCT determined that the slices were either used cold (such as in sandwiches) or were placed directly on the plate with hot gravy on top. This would allow survival of any prior bacterial contamination. Cold cooked meats as the source fitted the pattern of cases seen, particularly in secondary school associated cases, where the food consumed was often a cold meat sandwich rather than a hot meal. There was one supplier (Meat Supplier C) providing the product to the schools meals service.

The decision was therefore made to remove any remaining cold cooked meats from all school kitchens and only serve meat out of tins when school meals resumed the following day (Monday 19th September).

Rhondda Cynon Taf and Merthyr Tydfil were part of a procurement consortium for school meals that also included Bridgend and Caerphilly Local Authorities. However, no case from schools in these areas presented to the OCT until the week of Monday 19th September.

Subsequent investigations have been consistent with the initial hypothesis. Microbiological investigations found that cold cooked meat specimens recovered from five different schools contained the same strain of *E. coli* O157 as many of the cases. Epidemiological analysis suggests a significant association between exposure to cold cooked turkey in the first week of term and a case occurring in the school. Environmental inspection of the premises of Meat Supplier C found significant short comings that led to an emergency prohibition order.

The pattern of cases in each of the four Local Authority areas reflects that of the distribution of this product. In Rhondda Cynon Taf, where the product was served directly, there was a widespread distribution of cases. In Bridgend, where primary schools usually reheated the sliced meat, and secondary schools used the cold sliced product, there were no primary school cases that had acquired infection at school. In Caerphilly, where the majority of secondary schools received supplies from elsewhere, primary cases were only seen in primary schools. Finally, when cold sliced meats were removed from menus, primary cases stopped presenting within a very short time consistent with one incubation period.

There were many schools affected, but in most of these only one or two cases occurred. The OCT considered that this might reflect low level contamination of the product served, for example, only a few slices in the batch supplied to these schools being contaminated.

Control of spread.

Evidence from the literature

Bloody diarrhoea is seen in about half of cases of *E. coli* O157.[32] The incubation period is between one to eight days, with a peak around three to four days. Incubations as long as 14 days have been reported.[2] The organism spreads with ease, requiring few bacteria to cause illness. It is known that prolonged excretion of the bacterium can occur, notably in young children.[33] Certain groups are known to pose a particular risk of spreading infection. These include food handlers, health care and nursery staff, children under 5 years of age in nurseries or playgroups, older children and adults unable to maintain good hygiene (such as those with learning needs, or inadequate access to facilities).[2] There are nationally recognised guidelines that describe in detail how cases and contacts, particularly those in the risk groups should be managed, including what is the minimum microbiological screening required. These guidelines also give advice on hygiene practices recommended in schools. [2]

Comments on the case definition and typing

Using bloody diarrhoea in the case definition was helpful in identifying *E. coli* O157 disease clinically in children, less so in adults, who were likely to have alternative causes for this symptom. It was not specific, as up to 50% of cases may not have had bloody diarrhoea. In practice, the Environmental Health Officers potted most children absent from school with diarrhoea, and the OCT did request that doctors ask for samples from anyone presenting with diarrhoea. However, it was likely that cases were not detected, particularly those with mild symptoms presenting early in the outbreak, and this formed one of the reasons for enforcing control measures within schools.

Reference Laboratory microbiological typing of the confirmed *E. coli* O157 strains revealed that the commonest phage type in the outbreak (21/28) although a common isolate, had identifying characteristics unique to the outbreak which not been seen in any other isolate in the United Kingdom. The 21/28 phage types isolated were of different PFGE types, but the specialist laboratory in Colindale, London indicates that these PFGE types are closely related. This is in contrast to the Abercynon outbreak, where the 21/28 phage type isolated is phylogenetically distinct to that seen in this outbreak.

The cases also included five other phage types, three 32s, one phage type one and a phage type RDNC. These have remained on the case list as they occurred in children attending schools in the affected areas in the same time period as the other cases, and have no other alternative explanation (such as travel within the incubation period). Hence they are linked geographically, epidemiologically and chronologically to the outbreak. It is plausible that cross contamination of cooked meat from raw meat could involve contamination with different phage types at the same time.

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32 Thomas A, Chart H, Cheasty T, Smith HR, Frost JA, Rowe B. Verocytotoxin-producing Escherichia coli, particularly serogroup O157, associated with human infections in the United Kingdom: 1989-1991.*Epidemiol Infect* 1993; **110**: 591-600.

33 .Swerdlow DL, Griffin PM. Duration of faecal shedding of Escherichia coli O157:H7 among children in day-care centres. *Lancet* 1997; **349**: 745-6.

The three cases in the Vale of Glamorgan with the same unique PFGE type appear to be isolated cases within the outbreak. This source is still under investigation as part of an on-going police investigation, but OCT investigations have established that the source is very unlikely to represent any significant on-going public health risk.

Control measures instituted

The main control measure was to remove the suspected food source from the school meals service and other premises supplied by Meat Supplier C. All other measures were designed to prevent secondary transmission of the organism.

The national guidelines were followed during the outbreak as a minimum standard. Due to the large numbers of cases and contacts and particular circumstances, they needed some detailed clarification, and a table clarifying these was drawn up (Appendix D). Later on it was felt that additional advice was needed for cases on social activities, and this was also drawn up and agreed (Appendix E). The need to close schools was considered, but was not done, as the implicated source of infection had been removed and symptomatic children excluded promptly. It was recognised that some children may still be at school with unknown asymptomatic excretion, but with the control measures put in place, these should pose little risk to others. The duration of excretion by cases known to the OCT was used as one of the guides as to how long control measures should be left in place in schools. This was on the basis that unknown excreters (either undetected primary cases or household spread from these) may still be within the school population, but would be expected to be in proportion with the numbers of known excreters. Some children excreted for considerable lengths of time.

Microbiological screening the population of all 46 schools with primary cases was not undertaken. This was for the following reasons:

1. Firstly the risk of spread within the school environment for this outbreak where the source had been removed was judged to be low.
2. Secondly, screening would only identify the status of a child at the moment of screening. It would not prevent a child acquiring infection later from community spread and introducing this into the school environment. The false reassurance to staff from screening might also impact on the fastidious enforcement of control measures in schools to prevent spread.
3. Thirdly, skilled microbiological staff to read samples was a scarce resource, already working at full capacity to screen cases and contacts where the risk of transmission was a more immediate threat. The use of this service was prioritised. It would have taken time to screen children, during which time it was possible that schools would have been closed until screening was completed. If this had happened, informal childcare and extended family groups would provide an environment more conducive to the spread of *E. coli* O157 than a controlled school environment.

There were no known instances where secondary transmission was unequivocally demonstrated within the school environment. Out of the 46 schools involved, in one (Glenboi School) all children were excluded and screened microbiologically before returning, although the school itself remained open for staff. This was because bloody diarrhoea was found in a school toilet, the child could not be identified, and the school was already known to have had 5 primary cases. The child was never found, but 8

asymptomatic positive children were identified. We have no evidence as to whether these were primary cases with ongoing excretion or secondary transmission either within or outside the school environment.

A school in Rhondda Cynon Taf, Abercynon Infants School also had all children excluded and screened microbiologically. Cases here first presented in the week after half-term at the end of October. Exhaustive investigations (detailed in the separate report) have concluded that this was a separate outbreak not connected to the one described here. It is noted however that school closures in the initial stages of the main outbreak would not have prevented the Abercynon outbreak occurring.

The investigations into the circumstances around cases within Abercynon Infant's school, and the prolonged excretion periods of known cases are the reasons that although the outbreak was essentially over by mid October, the OCT did not lift school control measures or declare it publicly officially over until 20th December 2005.

Other issues

The investigation and control of this outbreak was complex, involving individuals from many different agencies. The OCT (see appendix A for a membership list) co-ordinated activity across a large area of South Wales, and have therefore tested in real life the plans and systems already in place for ensuring the control of outbreaks.

There were constraints involved in continuing to manage an outbreak within the context of a police investigation. This did not in any way interfere with the on-going investigation or control of the outbreak itself, but sometimes impacted on the communication of information to other bodies, the public and the media, and has affected the completeness of this report.

Investigating and controlling the outbreak required a considerable number of resources and individuals. There were impacts on Local Authorities not directly involved in the outbreak. Officers were involved in following up cases or contacts in their area, investigating increased numbers of reports of diarrhoea and dealing with enquiries generated by the outbreak. Officers from some of these Authorities were members of the OCT, providing information as required.

The following is a summary of the key issues OCT members encountered or raised whilst undertaking its duties. These and the recommendations that arise from these have already been submitted to the Welsh Assembly Government (on October 13th 2005) for consideration.

<u>Model outbreak plans</u>

The *E. coli* Outbreak provided a major opportunity to test the robustness of these plans within a real life scenario. It would be helpful to review the plans in detail in the light of the recent experience of a serious outbreak covering a wide geographical area.

The Framework for Infectious Disease Emergencies, the Major Outbreak Plan and the Major Food Outbreak plan all now co-exist in Wales. There is a need to ensure that all extant plans are consistent in their approach and fully reflect current organisational

arrangements. Consideration might also be given to bringing all guidance together in a single document.

Statutory responsibilities for health protection within Wales.

It was noted that the NPHS was in an anomalous position with regard to its health protection function. It clearly has a key role in relation to the identification investigation and management of outbreaks in Wales, but unlike Local Health Boards, Local Authorities and the Food Standards Agency, did not have the statutory responsibilities to do this. It is perhaps a historical anomaly that Consultants in Communicable Disease Control retain statutory powers by virtue of their Proper Officer role with Local Authorities.

No specific problems arose in the outbreak in relation to these issues. However, the scale of the response required highlighted the potential difficulties that might arise in different circumstances.

The outbreak did reveal problems in relation to exclusion of family contacts of cases from situations where their presence and activities could put others at potential risk. The small infective dose and the severity of the impact on children made the need for exclusion of potential carriers imperative but the legal position does not always empower officers to carry out this requirement.

Local Authority EHOs had occasional difficulties with some schools during in the outbreak where there were failures to comply with the hygiene advice that was provided. This was often due to inadequate sanitary provision and facilities for hand washing etc. Members of the OCT had no statutory power that could be used to enforce the advice where it was not being complied with. The possibility of an emergency short term improvement order for schools (and other Local Authority institutions) was proposed as being helpful in these situations.

National communications systems in Wales for disseminating important information.

Dissemination of information to a wide geographical area was problematic as there was no one reliable mechanism for distributing information to health agencies, and different routes were tried on different occasions. There were a variety of methods for distributing information to primary care services, but difficulties and delays were common in all these systems.

In particular, getting urgent information to hospital A+E Departments and medical and paediatric teams on call was time consuming and patchy, and relied on individuals within hospitals to ensure information was disseminated

Therefore, although information cascades to health agencies in this outbreak did work overall, but the process was time-consuming and required a variety of methods to be employed, with the need to rely on individuals to pass on information. The current situation is not robust for large complex outbreaks.

From the Local Authority perspective, although informal communication between individual Local Authorities did occur, this was on an ad hoc basis. There was no

central alert system or communication hierarchy to rapidly disseminate information to Authorities who were not members of the OCT. Communication between members of the OCT was good throughout the outbreak. The Food Standards Agency has a system in place for communicating food alerts, there is nothing similar for other alerts.

There was also no method of disseminating information urgently to independent sector nursing and care homes, particularly when it came to the withdrawal of foodstuffs. The databases of contact details existed, what was missing was a mechanism for sending out urgent information rapidly and easily from a central point.

School hygiene standards

Local Authority colleagues found variable hygiene standards during school visits during this outbreak. Some were below what was required to prevent disease transmission. These had to be addressed on an individual basis as there was an absence of nationally agreed standards. A set of minimum standards would be useful to ensure consistency across Local Authority areas and would support all Heads in ensuring schools were safe environments for children to attend during the outbreak, and may prevent future outbreaks occurring.

Infection control advice for hospitalised cases and their families

During OCT discussions, there were concerns that the families of hospitalised cases were not receiving hygiene advice to prevent secondary transmission. The EHOs did not have ready access to these families, and hospital staff did not usually take on the responsibility of advising families on infection control procedures in household settings. This is an important gap in disease control. The OCT proposed that making health professionals aware of these responsibilities would prevent wider disease spread.

Several hospital cases were transferred to English hospitals. It is recognised that this is an issue that extended throughout the UK. In addition, communication with these hospitals was difficult due to issues of patient confidentiality, and OCT members were usually not informed of their transfer.

CONCLUSIONS

1. This was the largest ever *E. coli* O157 outbreak in Wales and the second largest in the United Kingdom.
2. The outbreak was foodborne.
3. From the results of the investigations undertaken, the conclusion of the OCT is that cooked sliced meats supplied to the school meals service were the source for the transmission of *E. coli O157* to primary cases in the four main Local Authority areas affected.
4. The *E. coli* O157 genotype most frequently identified in the cases was unique to this outbreak.
5. When control measures, such as withdrawing and quarantining the implicated source were instituted, primary cases ceased within one incubation period.
6. Secondary spread within schools was contained with the control measures instituted.
7. The severity of disease was comparable to that seen in other outbreaks.

8. A minority of cases continued to excrete for long periods, forcing the OCT to leave control measures in place for some time after cases had ceased to present and the outbreak was effectively over.

RECOMMENDATIONS

During the outbreak, the Welsh Assembly Government asked the OCT to identify any actions that should be undertaken urgently to protect public health. These form the basis for the following recommendations.

1. Local Authority food procurement policy should be reviewed for all schools and other local authority premises such as care homes.

2. Current regulation of the meat industry along the entire food chain ("from farm to fork") should be reviewed.

3. The Major Outbreak Plan and the Major Food Outbreak Plans for Wales should be reviewed.

4. The statutory responsibilities for health protection within Wales should be reviewed. This review should include considering and improving the mechanism for enforcing hygiene standards across schools and other local institutions as well as the delivery of health protection services generally.

5. National communications systems in Wales for disseminating important information should be reviewed.

6. All agencies involved should consider their response to the outbreak and identify areas for improvement or investment.

7. Consideration should be given to whether the Assembly Communicable Disease Control Committee should be re-established.

8. National minimum standards for ensuring good hygiene within the school environment should be developed.

9. An enforceable code of practice should be developed that will ensure that all health professionals (community or hospital based) have a responsibility to ensure that families of individuals with infectious disease receive appropriate infection control advice.

Appendix A

Main members of E Coli O157 Outbreak Control Team

National Public Health Service

Dr Gwen Lowe	(Chair), CCDC, NPHS
Dr Tony Howard	Director, Infection and Communicable Disease Service NPHS
Dr Marion Lyons	Lead CCDC, NPHS
Jackie Murray	Nurse Consultant, NPHS
Chris Lines	Head of Communications, NPHS
Dr Roland Salmon	Regional Epidemiologist, NPHS
Dr Brendan Mason	Regional Epidemiologist, NPHS
Dr Sara Hayes	CCDC, ICDS
Dr Don Ribeiro	Consultant Microbiologist, NPHS
Sue Burge	Technical Head FEW Laboratory, NPHS

Rhondda Cynon Taf County Borough Council

Paul J Mee	Acting Head of Protection, RCT CBC
Alexa Pieris	SEHO, RCT CBC
Heather Lewis	Food / H&S Manager, RCT CBC
Gareth Newton	Divisional Director of Lifelong Learning, RCT CBC
Mike Keating	Education Director, RCT CBC
Ann Williams	Training & Development Officer, Catering Direct, RCT CBC
Anne Bull	Head of Catering Services, Catering Direct, RCT CBC
Rosemary Westlake	Senior Technical Officer, RCT CBC

Merthyr Tydfil County Borough Council

David Dier	Head of Public Health
Susan Gow	Principal Environmental Health Officer
Sarah Nicholls	Environmental Health Officer

Caerphilly County Borough Council

Ceri Edwards	SEHO, Caerphilly CBC
Maria Godfrey	EHO, Caerphilly CBC

Bridgend County Borough Council

Mike Stoddart	Assistant Director, Bridgend CBC
Jane Donagh	Principal EHO, Bridgend CBC

Blaenau Gwent County Borough Council

John Garside	EHO, Blaenau Gwent CBC

Food Standards Agency

Rob Wilkins	EHO, Food Standards Agency
Jane Davies	Assistant Director, Food Standards Agency

Vale of Glamorgan Council

Beverley Warburton	EHO, Vale of Glamorgan CBC
Marie Wakeham	EHO, Vale of Glamorgan CBC

Neath Port Talbot County Borough Council

Rebecca Davies	SEHO, Neath Port Talbot CBC

Rhondda Cynon Taf Local Health Board

Julie Bishop	Associate Acting LPHD, RCT LHB / NPHS

Merthyr Tydfil Local Health Board

Nicola John	Acting LPHD Merthyr Tydfil LHB/ NPHS

Professionals attending one or more E-Coli O157 Outbreak Control Team meetings

National Public Health Service

Dr Lika Nehaul	CCDC, ICDS
Dr Jenny Harries	SpR, NPHS
Christopher Potter	Consultant, NPHS
Kathrin Thomas	SpR, NPHS
Dr Josep Vidal-Alaball	Specialist Registrar, NPHS
Dr Mac Walapu	CCDC, NPHS
Fiona Kinghorn	NPHS
Dr D Carnicer-Port	CCDC, NPHS
Dr Sally Venn	NPHS
Sam Ray	Public Health Nurse, NPHS
Dr Mark Hastings	Director, NPHS Microbiology Cardiff
Alun Paul	Cardiff Laboratory, NPHS
Huw Brunt	SpT, NPHS
Dr Hugo van Woerden	SpR, NPHS
Dr Shantini Parajothy	SpR, NPHS
Sarah Jones	SpT, NPHS
Dr Dirk Werber	EPIET Research Fellow

Rhondda Cynon Taf Local Health Board

Mrs Lynda Williams	Nurse Director, RCT LHB

Rhondda Cynon Taf County Borough Council

Graham Thomas	Head of Governor Support Services, RCT
Mark Sharman	Communications & Marketing, RCT CBC
Andrew Young	Head of Health, RCT CBC
Paul Batcup	Communications Officer, RCT

Caerphilly County Borough Council

Michele Wehden	EHO, Caerphilly CBC

Bridgend County Borough Council

Amy Lewis	SEHO, Bridgend CBC
Jamie Davies	Environmental Health Officer, Bridgend
Chris Goacher	Head of Environmental Health, Bridgend

Bridgend Local Health Board

Dr Edward Coyle	LPHD Bridgend LHB / NPHS
Rod Morris	Head of Health Promotion, Bridgend LPHT

Neath Port Talbot County Borough Council

Steve Richards	EHO, Neath Port Talbot CBC

Swansea County Borough Council

Helen Michael	Technical Officer, Swansea CBC
Cerydd James	EHO, City and Council of Swansea

Powys County Borough Council

Catherine Davies	Environmental Health Officer, Powys CBC
Chris Taylor	Head of Public Protection, Powys CBC

Food Standards Agency

Phil Morgan	Assistant Director, Food Standards Agency
Colin Houston	Deputy Head of Enforcement Division

Prince Charles Hospital

Linda James	Infection Control Nurse
Sian Gore	Infection Control Nurse
Dr A Quoreshi	Microbiologist
Dr Toni Williams	SHO Paediatrics

List of dates of OCT meetings during outbreak

Friday 16th September 2005
Saturday 17th September 2005
Sunday 18th September 2005 (am)
Sunday 18th September 2005 (pm)
Tuesday 20th September 2005
Friday 23rd September 2005
Tuesday 27th September 2005
Thursday 29th September 2005
Monday 3rd October 2005
Friday 7th October 2005
Tuesday 11th October 2005
Tuesday 18th October 2005
Thursday 27th October 2005
Wednesday 16th November 2005
Friday 25th November 2005
Monday 19th December 2005

Appendix B

E coli O157 Fact Sheet

What is e-coli O157?
E-coli O157 is a form of food poisoning caused by a particularly virulent type of Escherichia coli bacteria which typically results in diarrhoea.

How do people get it?
From any of the following sources:

- Handling raw meet, especially beef
- Eating undercooked meat or poultry or other contaminated food product
- Consuming untreated milk or dairy products
- Swimming in or drinking unchlorinated water
- Direct contact with animals particularly on farms or in animal sanctuaries
- Close contact with another infected person

When do people get it?
The illness usually occurs within 3-8 days of infection, but 3-4 days is normal.

What are the signs and symptoms?

- Diarrhoea with bloody stools
- Headaches, nausea and vomiting
- Symptoms normally persist for about a week
- For the very young, old or those already unwell, E-coli O157 may be more severe and complications such as renal failure can occur.

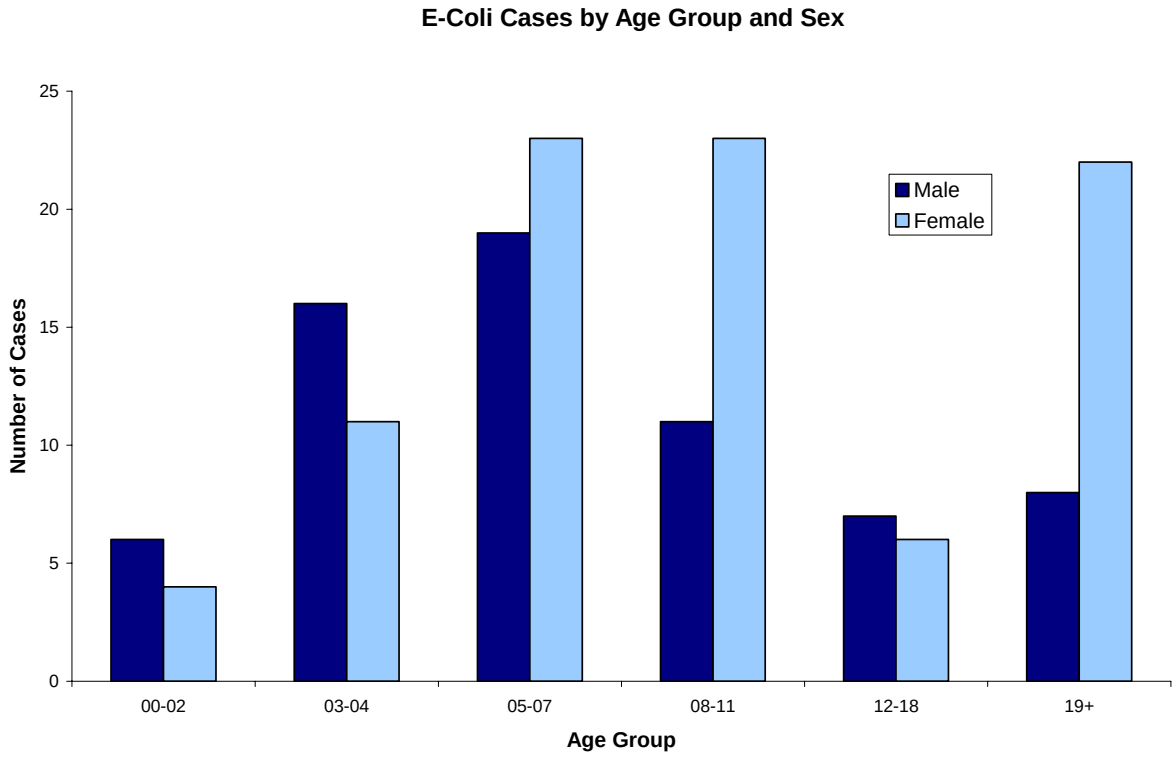
How do people stop it spreading?

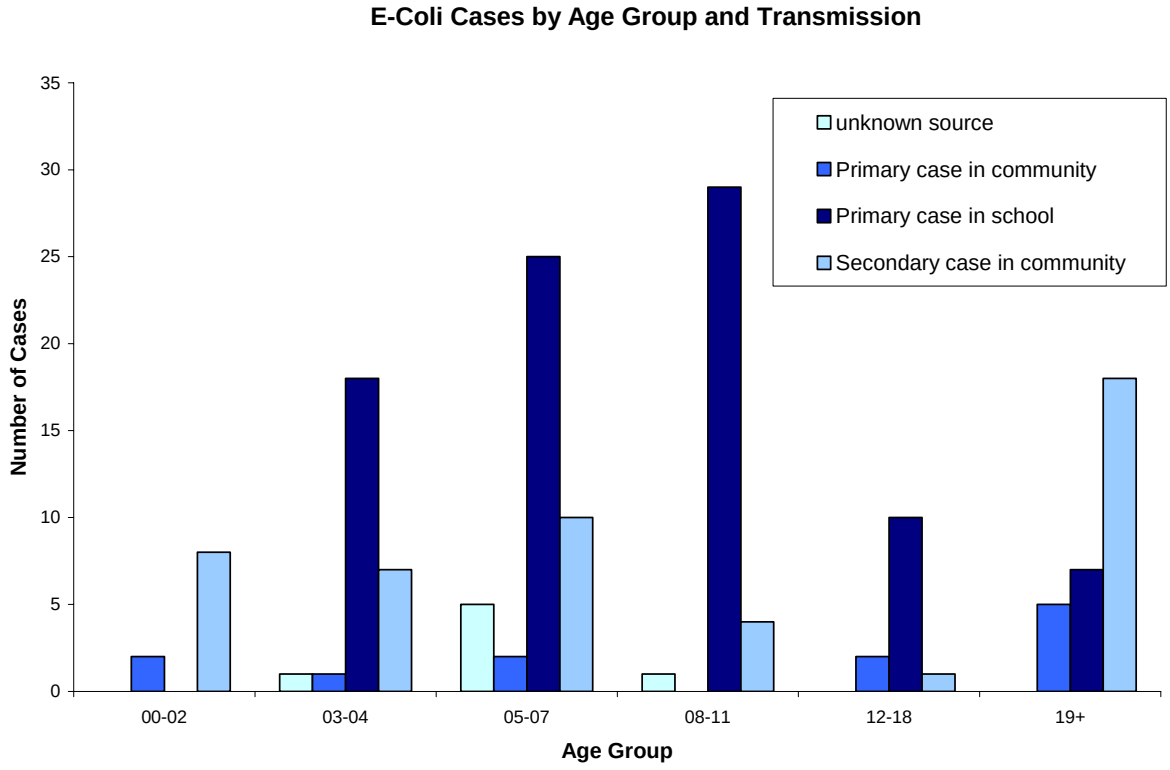
- Wash hands thoroughly after going to the toilet and before preparing meals or eating.
- Young children with the infection should have their hands washed for them or be supervised.
- Disinfect all areas in the toilet daily (including door handles).
- Infected persons should stay away from work until vomiting and diarrhoea have ceased.
- If the infected person is a food handler, works as a health carer/nurse or is a child attending school or a nursery etc, further advice should be obtained.

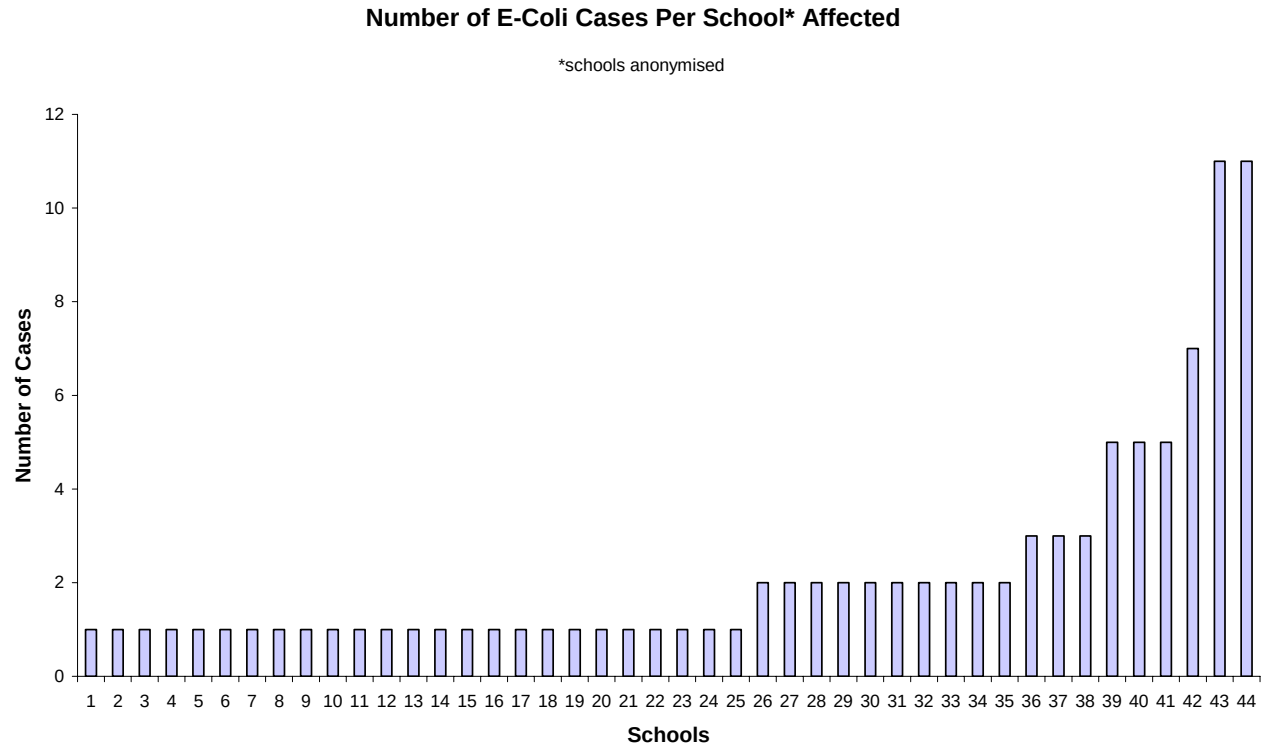
Where is more advice available?

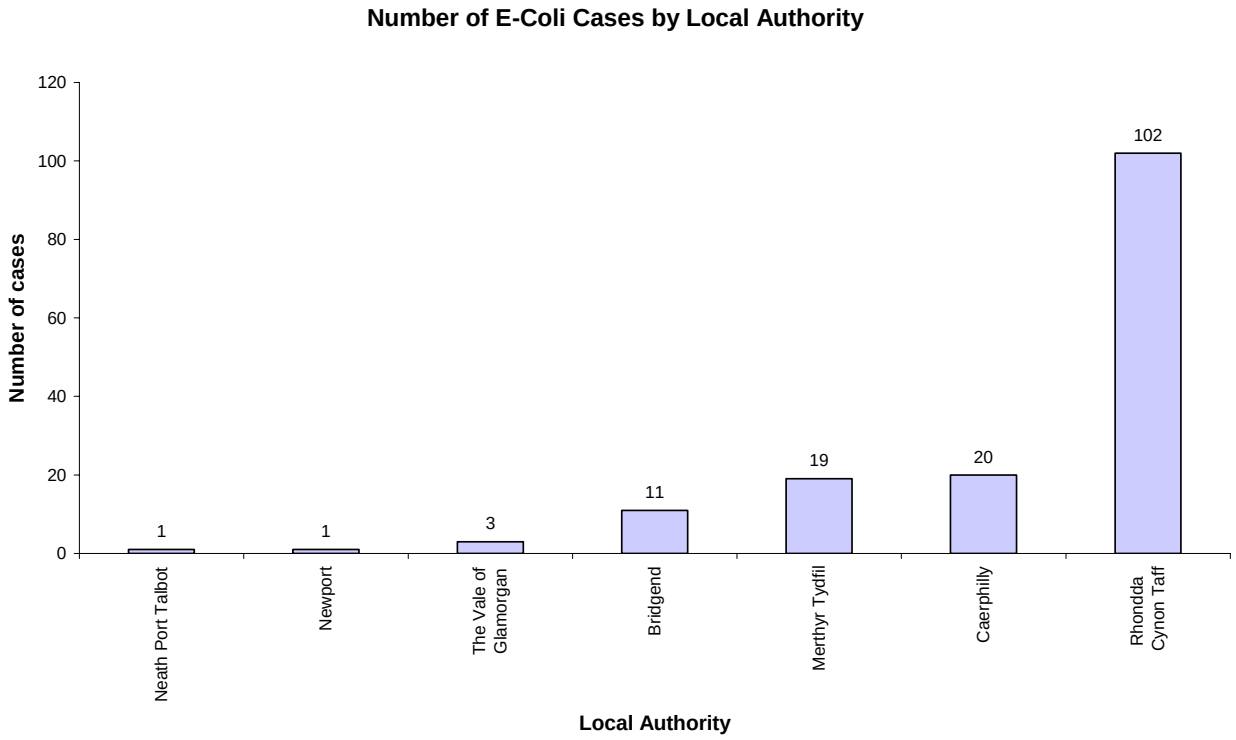
- A GP or health specialist will be able to advise upon individual patient health care.
- The infected person should inform their place of work or, in the case of children, the head teacher of the school to find out if exclusion is necessary and when s/he can return.
- The investigating officer will also provide infected people with a more general leaflet on infection control and may be contacted for further advice.

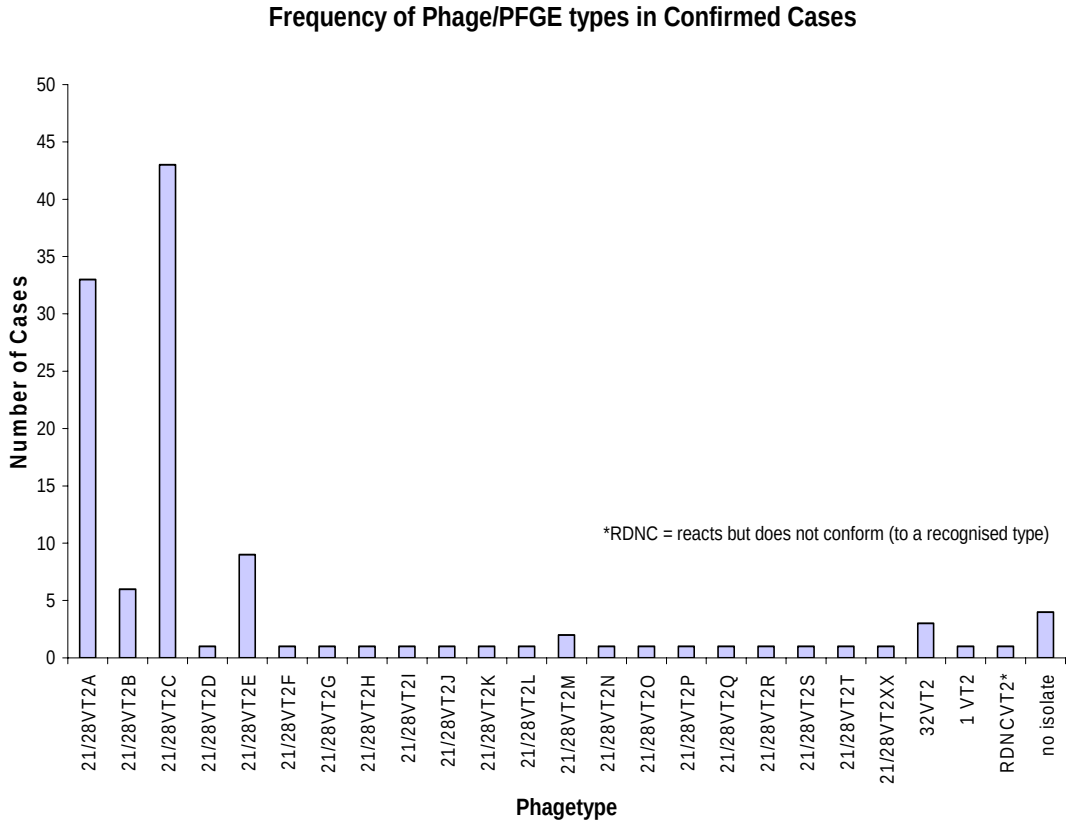
Appendix C – Descriptive Epidemiology

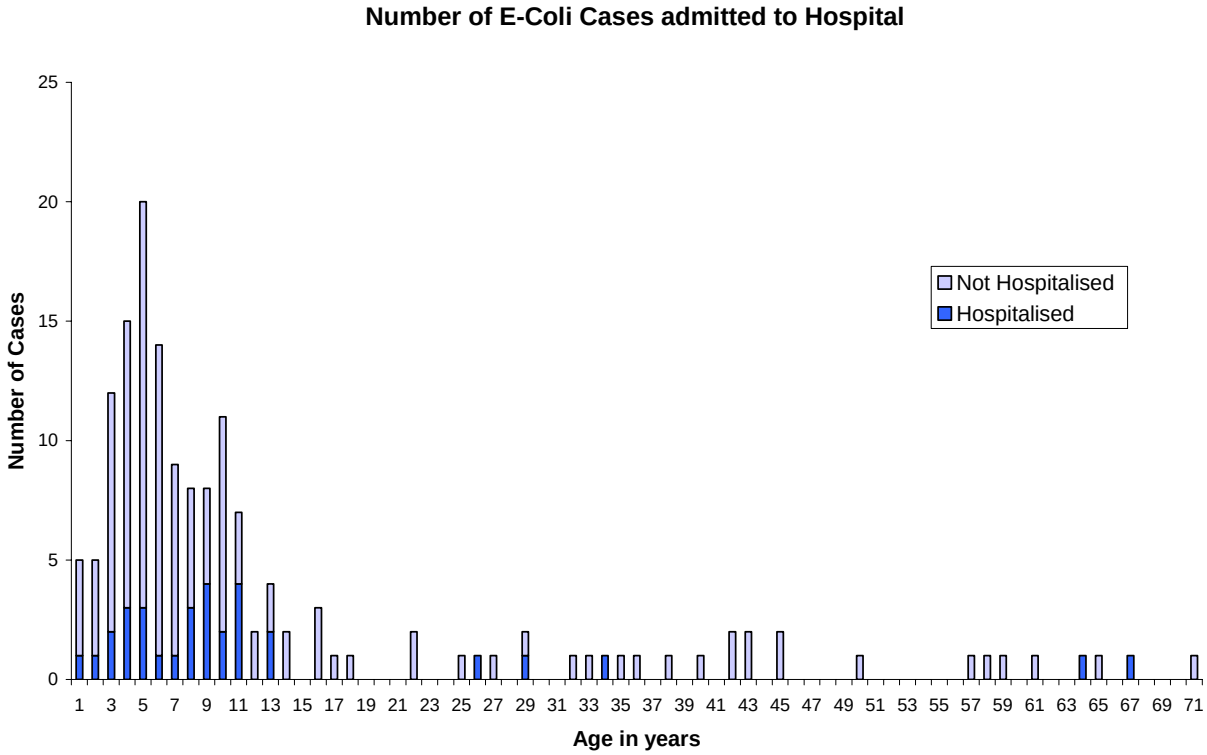


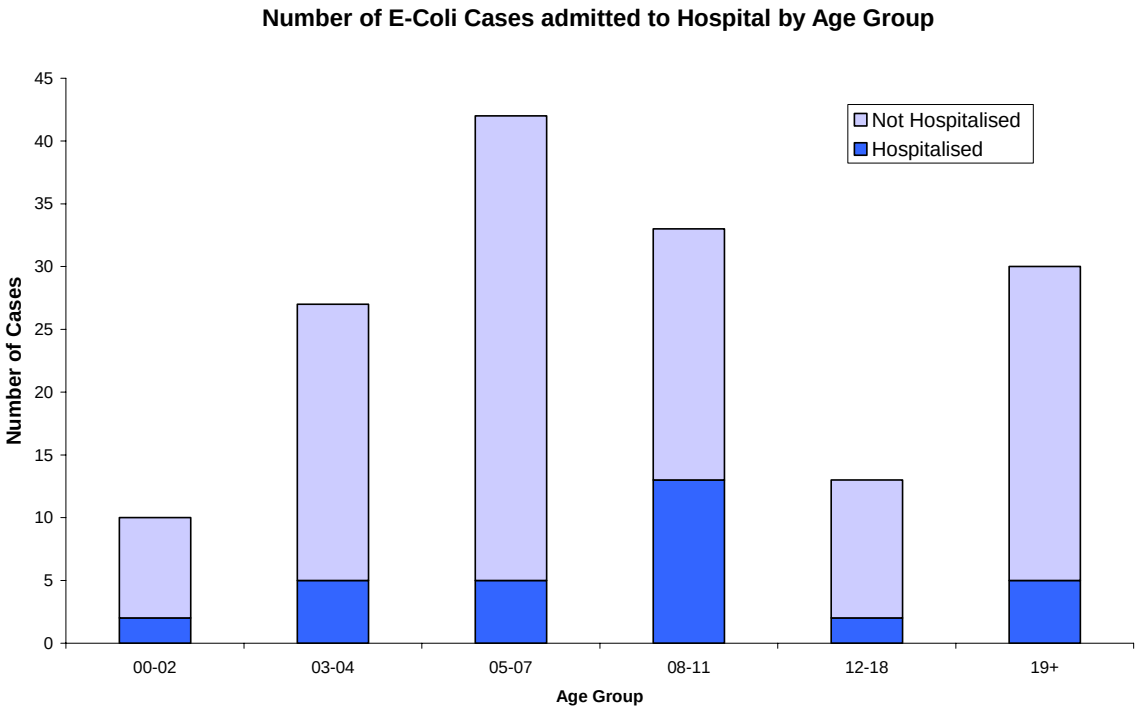

E-Coli Cases by Age Group and Transmission
unknown source
Primary case in community
Primary case in school
Secondary case in community
Number of Cases
0
5
10
15
20
25
30
35
00-02
03-04
05-07
08-11
12-18
19+
Age Group

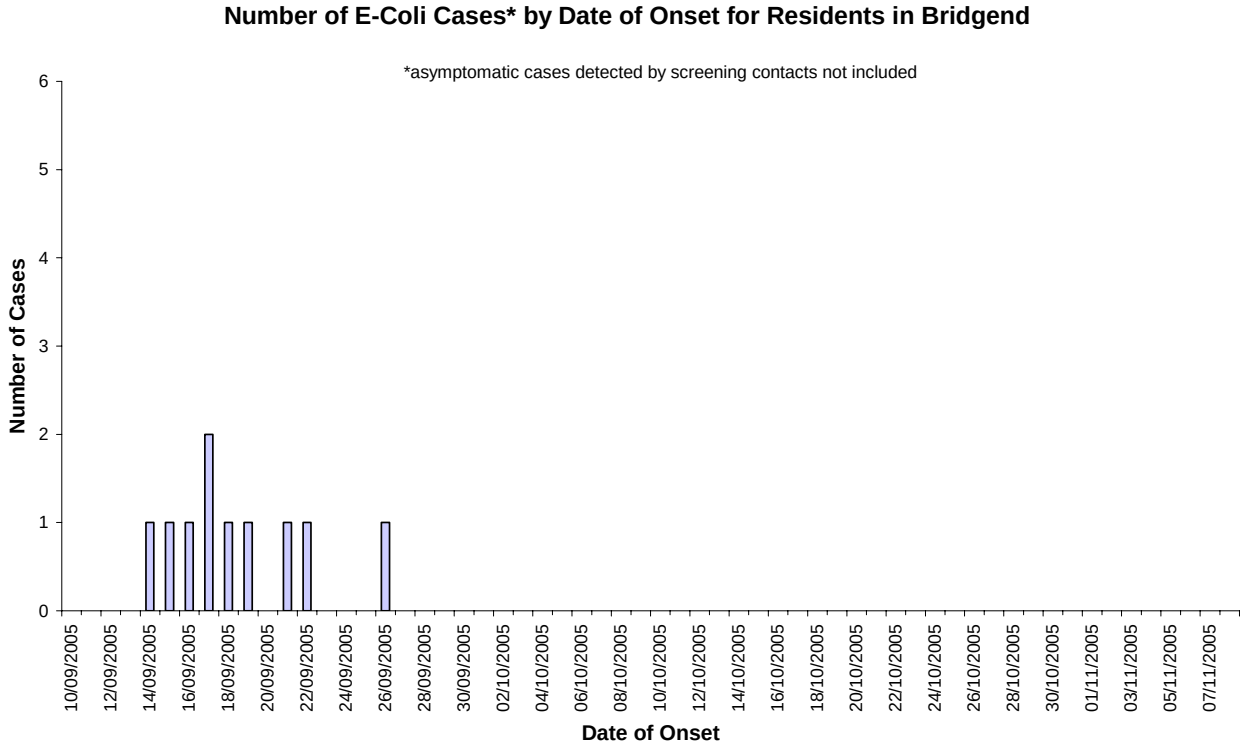

Number of E-Coli Cases Per School* Affected
*schools anonymised
Number of Cases
0
2
4
6
8
10
12
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44
Schools

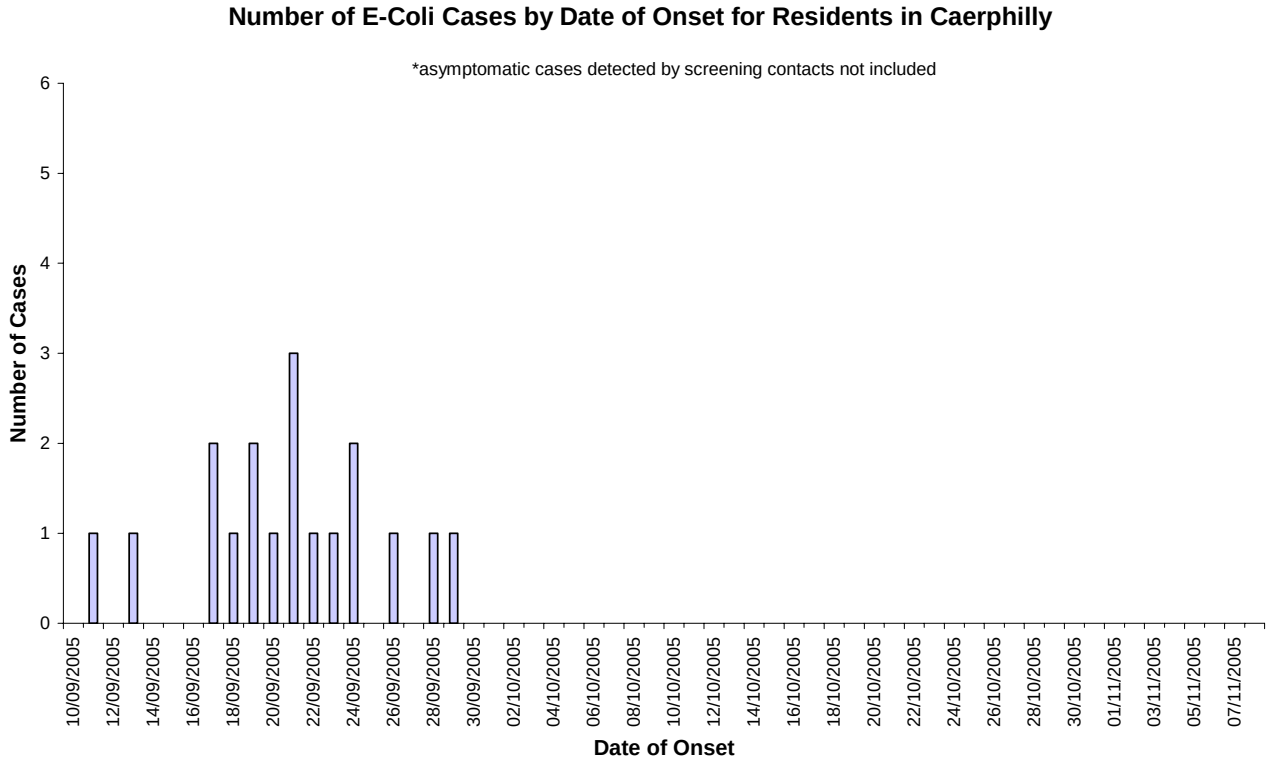

Number of E-Coli Cases by Local Authority
Number of cases
120
100
80
60
40
20
0
1
1
3
11
19
20
102
Neath Port Talbot
Newport
The Vale of Glamorgan
Bridgend
Merthyr Tydfil
Caerphilly
Rhondda Cynon Taff
Local Authority

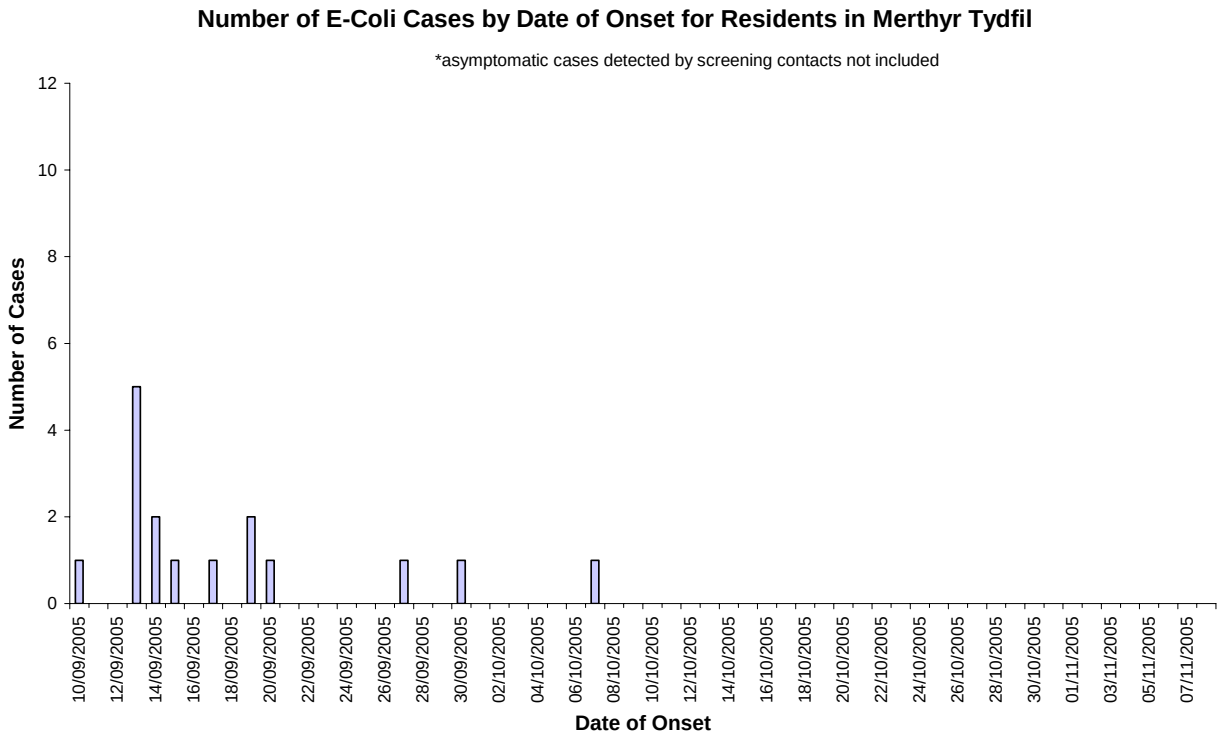

Frequency of Phage/PFGE types in Confirmed Cases
Number of Cases
50
45
40
35
30
25
20
15
10
5
0
*RDNC = reacts but does not conform (to a recognised type)
21/28VT2A
21/28VT2B
21/28VT2C
21/28VT2D
21/28VT2E
21/28VT2F
21/28VT2G
21/28VT2H
21/28VT2I
21/28VT2J
21/28VT2K
21/28VT2L
21/28VT2M
21/28VT2N
21/28VT2O
21/28VT2P
21/28VT2Q
21/28VT2R
21/28VT2S
21/28VT2T
21/28VT2XX
32VT2
1 VT2
RDNCVT2*
no isolate
Phagetype


Number of E-Coli Cases admitted to Hospital
Number of Cases
Age in years
Not Hospitalised
Hospitalised
0
5
10
15
20
25
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 63 65 67 69 71


Number of E-Coli Cases admitted to Hospital by Age Group
Number of Cases
Age Group
Not Hospitalised
Hospitalised
0
5
10
15
20
25
30
35
40
45
00-02
03-04
05-07
08-11
12-18
19+


Number of E-Coli Cases* by Date of Onset for Residents in Bridgend
*asymptomatic cases detected by screening contacts not included
Number of Cases
0
1
2
3
4
5
6
10/09/2005
12/09/2005
14/09/2005
16/09/2005
18/09/2005
20/09/2005
22/09/2005
24/09/2005
26/09/2005
28/09/2005
30/09/2005
02/10/2005
04/10/2005
06/10/2005
08/10/2005
10/10/2005
12/10/2005
14/10/2005
16/10/2005
18/10/2005
20/10/2005
22/10/2005
24/10/2005
26/10/2005
28/10/2005
30/10/2005
01/11/2005
03/11/2005
05/11/2005
07/11/2005
Date of Onset


Number of E-Coli Cases by Date of Onset for Residents in Caerphilly
*asymptomatic cases detected by screening contacts not included
Number of Cases
0
1
2
3
4
5
6
10/09/2005
12/09/2005
14/09/2005
16/09/2005
18/09/2005
20/09/2005
22/09/2005
24/09/2005
26/09/2005
28/09/2005
30/09/2005
02/10/2005
04/10/2005
06/10/2005
08/10/2005
10/10/2005
12/10/2005
14/10/2005
16/10/2005
18/10/2005
20/10/2005
22/10/2005
24/10/2005
26/10/2005
28/10/2005
30/10/2005
01/11/2005
03/11/2005
05/11/2005
07/11/2005
Date of Onset


Number of E-Coli Cases by Date of Onset for Residents in Merthyr Tydfil
*asymptomatic cases detected by screening contacts not included
Number of Cases
0
2
4
6
8
10
12
10/09/2005
12/09/2005
14/09/2005
16/09/2005
18/09/2005
20/09/2005
22/09/2005
24/09/2005
26/09/2005
28/09/2005
30/09/2005
02/10/2005
04/10/2005
06/10/2005
08/10/2005
10/10/2005
12/10/2005
14/10/2005
16/10/2005
18/10/2005
20/10/2005
22/10/2005
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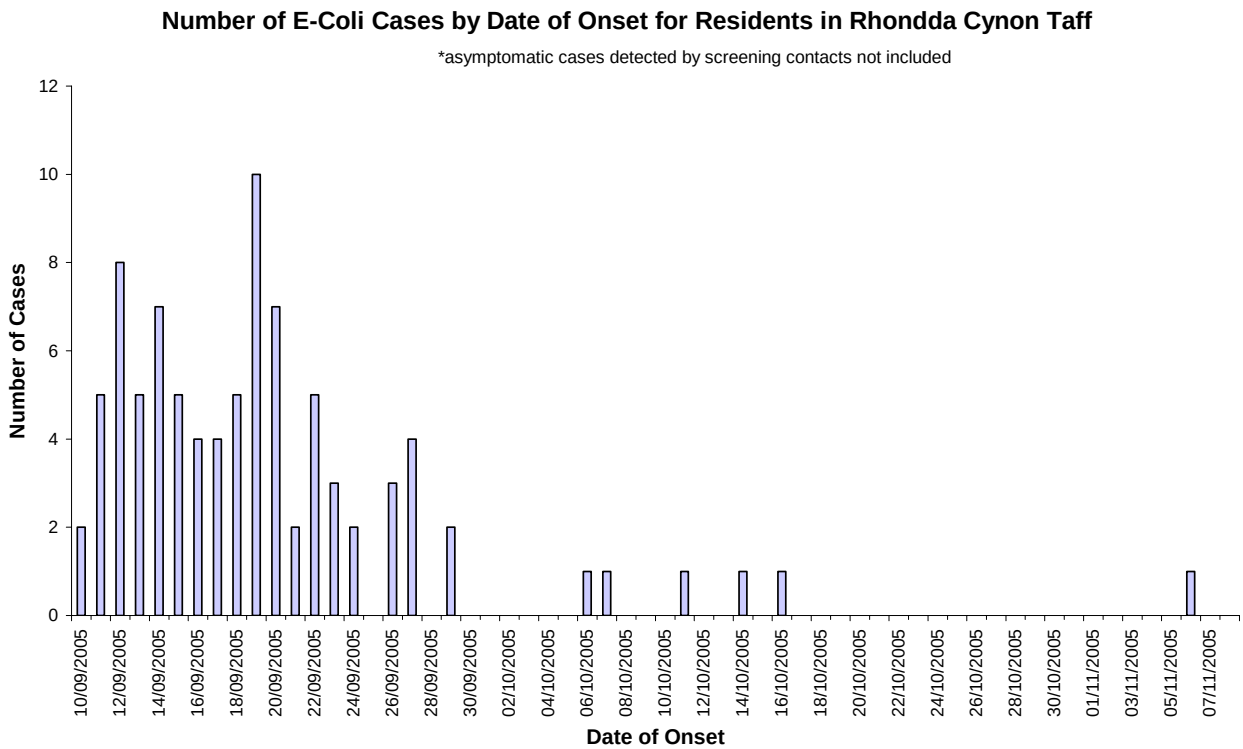
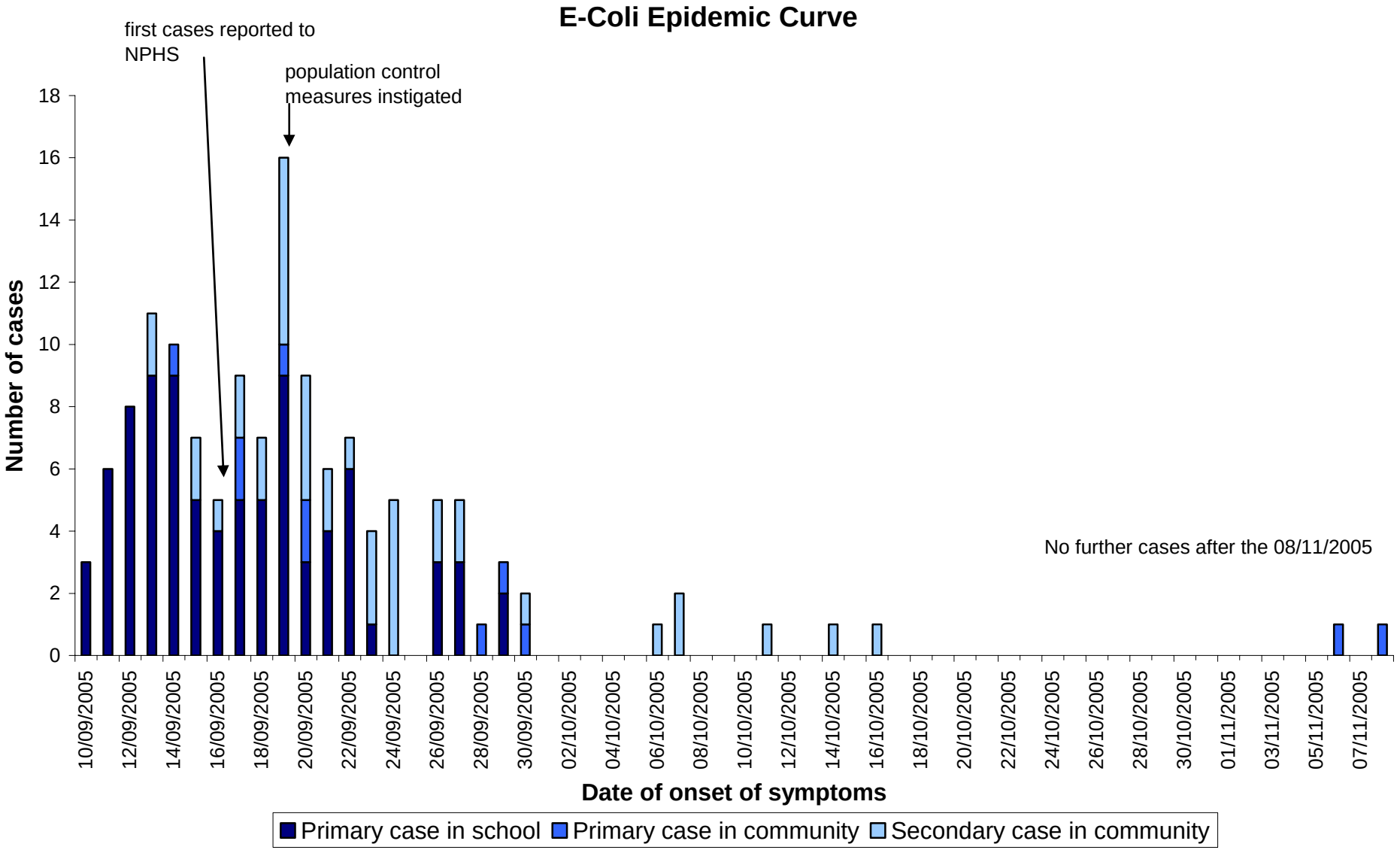
03/11/2005
05/11/2005
07/11/2005
Date of Onset


Number of E-Coli Cases by Date of Onset for Residents in Rhondda Cynon Taff
*asymptomatic cases detected by screening contacts not included
Number of Cases
0
2
4
6
8
10
12
10/09/2005
12/09/2005
14/09/2005
16/09/2005
18/09/2005
20/09/2005
22/09/2005
24/09/2005
26/09/2005
28/09/2005
30/09/2005
02/10/2005
04/10/2005
06/10/2005
08/10/2005
10/10/2005
12/10/2005
14/10/2005
16/10/2005
18/10/2005
20/10/2005
22/10/2005
24/10/2005
26/10/2005
28/10/2005
30/10/2005
01/11/2005
03/11/2005
05/11/2005
07/11/2005
Date of Onset

List of schools with one or more primary cases

Please note that only schools with primary cases (where exposure was considered to have occurred in the school setting to cooked sliced meat) are included. Schools attended by secondary cases (where exposure occurred in the household or other non-school setting) are not included. The schools attended by the two cases in November are not included as exposure was not thought to be in the school setting

School	Local Authority of School
Aberdare Town C.I.W. Primary	RCT
Abertaf Primary school	RCT
Archbishop Mcgrath Catholic School	Bridgend
Bedlinog Primary School	Merthyr Tydfil
Blaengwawr Primary School	RCT
Capcoch Primary School	RCT
Caradog Primary School	RCT
Cwmbach Infants School	RCT
Cwmbach Nursery School	RCT
Cwmdar County Primary School	RCT
Cwmlai Primary School	RCT
Cwrt Rawlin Primary School	Caerphilly
Cynon Infants School	RCT
Deri Primary School	Caerphilly
Glantaf Infants School	RCT
Glenboi Primary School	RCT
Greenhill Primary, Gelligaer	Caerphilly
Hendre Infants School	Caerphilly
Hendre Junior School	Caerphilly
Hirwaun Primary School	RCT
Maesteg Comprehensive Lower School	Bridgend
Maes-y-coed Primary School	RCT
Mountain Ash Comprehensive School	RCT
Pengeulan Primary School	RCT
Pen-Y-Dre High School	Merthyr Tydfil
Penygraig Infants School	RCT
Penyrenglyn Primary School	RCT
Pontyclun Primary School	RCT
Rhigos Primary School	RCT
Rhydri Primary School	Caerphilly
St John Baptist C.I.W. High School	RCT
Ton Pentre Infants School	RCT
Ton Pentre Junior School	RCT
Treorchy Comprehensive School	RCT
Troedyrhiw Infant School	Merthyr Tydfil
Upper Rhymney Junior	Caerphilly
Ynysawdre Comprehensive School	Bridgend
Ynyswen Infant School	RCT
Y.G.G. Llwyncelyn	RCT
Y.G.G. Abercynon	RCT
Ysgol Gymraeg Trelyn	Caerphilly
Ysgol Gynradd Gymraeg Y Castell	Caerphilly
Y.G.G. Bodringallt	RCT
Ysgol yr Eos primary	RCT


E-Coli Epidemic Curve
first cases reported to NPHS
population control measures instigated
No further cases after the 08/11/2005
Number of cases
0
2
4
6
8
10
12
14
16
18
10/09/2005
12/09/2005
14/09/2005
16/09/2005
18/09/2005
20/09/2005
22/09/2005
24/09/2005
26/09/2005
28/09/2005
30/09/2005
02/10/2005
04/10/2005
06/10/2005
08/10/2005
10/10/2005
12/10/2005
14/10/2005
16/10/2005
18/10/2005
20/10/2005
22/10/2005
24/10/2005
26/10/2005
28/10/2005
30/10/2005
01/11/2005
03/11/2005
05/11/2005
07/11/2005
Date of onset of symptoms
Primary case in school
Primary case in community
Secondary case in community

Appendix D

E Coli O157

Management of cases and household contacts in the community

Management of cases

Risk Group	Action
Group I **Food handlers**	Exclude from work 2 negative consecutive faecal samples taken after recovery and at least 48 hours apart
Group II **Care Staff**	Exclude from work 2 negative consecutive faecal samples taken after recovery and at least 48 hours apart
Group III **Children under 5 attending nursery etc**	Exclude from nursery/play group/school 2 negative consecutive faecal samples taken after recovery and at least 48 hours apart
Group IV **Others unable to maintain good personal hygiene**	Exclude from work 2 negative consecutive faecal samples taken after recovery and at least 48 hours apart

All others can return to school/work 48 hours after first normal stool.

Management of Household Contacts

Risk Group	Action
Group I **Food handlers**	Exclude from work 2 negative consecutive faecal samples taken at least 48 hours apart, after case is asymptomatic
Group II **Care Staff**	Exclude from work 2 negative consecutive faecal samples taken at least 48 hours apart, after case is asymptomatic
Group III **Children under 5 attending nursery etc**	Exclude from nursery/play group/school 2 negative consecutive faecal samples taken at least 48 hours apart, after case is asymptomatic
Group IV **Others unable to maintain good personal hygiene**	Exclude 2 negative consecutive faecal samples taken at least 48 hours apart, after case is asymptomatic (this may need to balanced against the level of care required)

All others can attend school or work as normal

Appendix E

Advice on social activities for children

Preventing the spread of E-coli 0157

E-Coli 0157 is a bacteria that spreads easily from person to person. Good personal hygiene, including careful hand washing, is essential to reduce this risk.

However, even with good hygiene, spread to other people may still occur. Children can remain infectious for long periods after the symptoms have gone and can pass on the illness to other people. This leaflet gives some advice on how you can limit the spread of infection.

Advice for children with symptoms

All children with symptoms should not play with other children until they are fully recovered and have been symptom free for **48 hours**.

Avoid swimming until at least two weeks after the symptoms have stopped.

Children under 5 and children who have been told not to go to school

It is recommended that children under 5 and children who have been told by Environmental Health not to attend school should **not** attend parties, after-school clubs and other social activities until they have had two negative stool samples wherever possible.

Parents should think **very** carefully before allowing children that have not been given the all clear to take part in social activities and mix with other children. There is a risk that the infection will be passed onto the other children.

For these children, trips out to the park and walks are generally fine but visits to indoor play areas/centres should be avoided.

Advice when visiting friends or families:

Do

- Ensure hands are washed thoroughly after using the toilet and before eating
- When washing hands it is important to use liquid soap and a separate towel to others
- Young children should be supervised when washing hands or have their hands washed for them

Do not

- Share any food e.g. packets of crisps or sweets, buffet style food
- Touch any food intended for others to eat
- Share toys or play with sand or plasticine etc.

For further advice please contact

APPENDIX F

SUMMARY OF DISTRIBUTION OF INFORMATION BY LOCAL AUTHORITIES

These lists are not comprehensive – informal correspondence with schools and parents are not shown, and not all correspondence captured. The dates on which distribution occurred to individual parents and schools may vary from the main dates shown. Local Authority correspondence was responsive to differing patterns of disease and local circumstances.

RHONDDA CYNON TAF COUNTY BOROUGH COUNCIL

19/09/05	Letter to all head teachers advising of outbreak with attached letter to be distributed to parents. Separate letter for parents of pupils who have had a probable or confirmed case.
21/09/05	Updated letter to all head teachers with attached letter to parents indicating the actions that had been taken to ensure the outbreak is contained.
22/09/05	Updated letter to head teachers and parents.
23/09/05	Letter to head teachers advising them of further restrictions to suspend various activities.
23/9/05	Youth Centres advising them of outbreak and raising hygiene awareness.
26/09/05	Letter to head teachers with regard to after school clubs.
28/09/05	Letter to head teachers offering further guidance and restrictions.
30/09/05	Letter to head teachers with attached update letter to parents.
05/10/05	Letter to head teachers in relation to Harvest Festivals.
07/10/05	Letter to parents of children in Glenboi Primary School advising them of temporary closure.
10/10/05	Letter to head teachers with attached update letter for parents.
12/10/05	Letter to head teachers advising them of importance of electronic communication and ensuring that absent pupils are kept informed.
14/11/05	Letter to head teachers and parents in relation to Christmas festivities.
23/11/05	Letter to headteachers offering advice to organisations providing breakfast clubs.
23/12/05	Letter to head teachers and parents advising them of the end of the outbreak.

12/1/06	Letter to the head teacher and parents of Abercynon Infants.
12/1/06	Letter to the head teacher and parents of Penygrenglyn Primary.
	Nurseries the same time as head teachers.

CAERPHILLY COUNTY BOROUGH COUNCIL

22st September	Letter to all Head Teachers
22st September	Letter and advice leaflet to parents of School children
22st September	Letter to Catering staff
29th September	Update letter to Head Teachers
30th September	Update letter to parents
10th October	Update letter to parents
13TH October	Letter to Head Teachers with info regarding Harvest festivals
18th October	Letter to Head Teachers with info regarding Harvest festivals
28th October	Update letter to Parents
17th November	Letter to private nurseries and Childminders informing them of controls and arrangements for Christmas parties
24th November	Update letter to Head Teachers and arrangements for Christmas parties.
24th November	Update letter to Parents and arrangements for Christmas parties.
22nd December	Letter to Head Teachers lifting controls from the beginning of the new Year.
22nd December	Letter to Parents for distribution in the new year, lifting controls.
22ndDecember	Letter to Childminders and Nurseries lifting controls.

BRIDGEND COUNTY BOROUGH COUNCIL

21/09/05	Letter to all head teachers advising of outbreak and with attached letter to advise parents of outbreak.
22/09/05	Letter to catering staff and school nurses.
05/10/05	Update letter to all head teachers of schools and nurseries requesting actions be taken with attached letter to update parents.
13/10/05	A statement was sent to all schools in relation to Harvest Festivals.
02/11/05	A letter to all nurseries, playgroups and schools reminding of control measures needed.
18/11/05	Letter to head teachers, including primary and nursery schools, advising of precautions to be taken in relation to Christmas fayres and parties.
29/12/06	Letter to head teachers, including nurseries, advising of end of outbreak and lifting of restrictions.
05/01/06	Letter to private playgroups and nurseries advising of end of oubreak.

In addition to the above, a separate correspondence was sent to headteachers and catering staff of schools affected.

MERTHYR TYDFIL COUNTY BOROUGH COUNCIL

19th September	Letter to all parents of schoolchildren
19th September	Letters to Head Teachers of affected schools
20th September	Letters to catering staff and school nurses
21st September	Letter to Head Teachers/Pupil Referral Unit/Integrated Children Centre/Outdoor Education Centre
23rd September	Update letter to parents of affected schools
23rd September	Letter to parents of affected children
23rd September	Letter to catering staff at all schools reinforcing point that they were not a cause of the problem
29th September	Update letter to all Head Teachers emphasising need for provision of all relevant facilities in school toilets
30th September	Update letter to all parents of pupils across Merthyr Tydfil
6th October	E-mail to all Head Teachers about suspending “toy libraries”,

	introducing proformas and concept of independent audits of toilets and offering training for caretakers/cleaners
10th October	Update letter to all parents
20th October	E-mail to all Head Teachers giving them feedback on results of toilet audit – emphasising good practice
31st October	Update letter to parents at affected schools
31st October	Update letter to all Head Teachers requesting vigilance and re-emphasising precautions
10th November	Letter to parents of pupils at Treharris and Trelewis schools following fresh case
23rd November	Letter to all private nurseries re-enforcing information given out to schools about precautions around Christmas parties

The Abercynon Infants School Outbreak – October/November 2005

Introduction

On Saturday 5 November 2005 two families affected by E. Coli O157 were found to be linked to Abercynon Infants School, Ynysmeurig Road, Abercynon, CF45 4SU, a small infants school with a total of 64 pupils aged 3-7 years. Investigations subsequently identified a total of 16 cases, all of whom either attended the school's nursery class or were related to affected children in the nursery class.

This school was located in the same geographical area as the main outbreak and pupils had potentially been exposed to the implicated source described in the main body of the report.

The initial investigation explored the possibility that this was spread from individuals infected in the main outbreak. Detailed microbiological and epidemiological investigations have concluded that this was likely to be an independent outbreak. However, since much of the investigative detail and context are identical to that of the main outbreak, and it occurred within a school which had the main E Coli O157 outbreak control measures in place at the time, the decision has been made to nest this report within the larger report.

Epidemiological methods

Case definition and inclusion/exclusion criteria

Cases were initially included under the original case definition in the main outbreak

Cases belonging to the Abercynon outbreak were retrospectively defined for analysis purposes as "any individual with a positive stool culture for *E. coli 0157* from October 1st 2005 onwards who attended Abercynon Infants School or was a family member, social contact or carer of an affected individual attending the school".

Data collection

Public meetings were held at the school with parents between 11am and 1pm on Sunday 6 November 2005 and between 7pm and 8pm on Monday 7 November 2005. Parents were provided with pots for stool samples and interviews were conducted using a standard structured questionnaire. Visits were made to the school and discussions were undertaken with the Head Teacher who also taught the affected nursery class.

Environmental Health Officers interviewed symptomatic cases using the standard *E. Coli O157* questionnaire. Family members and carers were also potted wherever a positive case was identified.

Discussions were undertaken with staff at the school. Consequently, a line listing was produced and hypotheses were generated regarding the source of the outbreak.

Hypotheses to be tested:

A: The original source could be:

1. The same source as the main outbreak
2. Person to person spread from the main outbreak
3. A community source, for example
    a. An as yet unidentified children's party
    b. the local swimming pool
    c. environmental contamination

B: That spread within the school environment was by person to person transmission:

    d. Linked to the contamination of surfaces in the toilets
    e. Linked to sliced fruit circulated on a plate to children
    f. Linked to toast circulated on a plate to children

Hypotheses under A were tested using information from the competed questionnaires, the main outbreak information and further information from cases and relatives as necessary.

Hypothesis B was tested by the questionnaire outlined in Appendix 1. This was completed by the Head Teacher on a visit to the school on 28th November.

Environmental methods
No environmental sampling was undertaken.

Microbiological methods
The microbiological methods used were identical to those used in the main outbreak, and are described there.

Results

Epidemiology

Cases
Eight symptomatic and seven asymptomatic cases were identified in November. A sibling of a case presented in December 2005 and was therefore not included in any statistical analysis. This made 16 cases in total (4 males). The age range was 2 to 83 years, with 10 cases aged 5 years or less. Eight cases were in the same nursery class. The remaining three child cases were household contacts of affected children in this class. All three adult cases were related to symptomatic cases in the nursery class.

The timeline diagram (Appendix 2) shows the time relationship between onset of illness and diagnosis of the cases. The average time from onset of illness to first negative stool sample for the symptomatic cases was 20.5 days (range 11 – 39 days). The average time from first positive stool specimen to first negative stool specimen for the first 15 cases was 12 days (range 4 – 27 days).

Information about nursery class arrangements

The school was closed for the October half-term school holiday from 24th to 28th October 2005.

Most of the affected children were in the nursery class in Abercynon Infants School. The Head Teacher teaches this class with support from a nursery nurse and a classroom assistant.

Children in the class are divided into four groups by age: red – oldest, blue – next, green – next, yellow – youngest. Children stay in the same group all year. Children stay in their colour groups for some activities, including assembly, but at other times, they are free to mix with the other children in the nursery. For some activities the red and blue groups work together, as do the green and yellow groups.

The school day was mapped out (see Table 1).

Table 1: The Nursery Class school day

Red and Blue Groups	**Green and Yellow Groups**
Register	
Language development (eg. News)	
Story on the carpet	
Activities	
Assembly with infants	Milk
Milk	Toilet and wash hands
Toilet and wash hands	Fruit (Mon + Wed) or toast (Fri)
Fruit (Mon + Wed) or toast (Fri)	Break
Break	
Activities	
Story on the carpet	
Toilet + wash hands	
Lunch	
Toilet and wash hands	
Play	
Story on the carpet	
Activities	
Story on the carpet	
Home time	

Children do not sit at the same tables at all times. They move from area to area depending upon the activity in which they are involved at that time. It was therefore not possible to group children by the tables in the classroom, or by activities where contaminated fomites might have been handled by several children.

For the mid-morning snack, the milk for the children was poured by an adult into disposable cups and the cups were thrown away after use. The fruit served was cut up by the nursery staff, put on a single plate and passed around the children for them to take pieces. The toast was prepared by staff and again cut up and placed on a plate and passed around for the children to help themselves.

All the children in the nursery class have school dinners which are provided by the school.

There are separate toilets for the nursery class. Liquid soap and paper towels are used. There is also a hot air hand dryer. Children are always accompanied to the toilet. They are not observed on the toilet but are supervised individually or as part of a group whilst washing their hands.

In the week beginning 10th October 3 cases had documented absences due to diarrhoea and/or vomiting. One of these was sent home from nursery with diarrhoea.

Epidemiological analysis

Questionnaires were completed on all 27 children who had been on the nursery roll in the week before half-term through an interview with the head teacher.

Attack rates and odds ratios by groups

Attack rates by groups in the class are shown in Table 2 below.

Table 2: Attack rates by groups in the class

Group	Cases/All		Off sick part of week beginning 17/10/05	Revised attack rate (%)
Red	2/6		1	2/5
Blue	3/6		1	3/5
Green	1/6		1	1/5
Yellow	2/9		1	2/8
Red + blue	5/12			5/10
Green + yellow	3/15			3/12

The odds ratio for being in the red or blue group as opposed to the green or yellow group is 2.08 (Exact 95% CI 0.32 – 15.88, Fisher's 2 tailed p value 0.44). This is not statistically significant.

Analysis of the children's activities questionnaire

The analysis of potential risk factors for person-to-person transmission failed to identify any factors that could have facilitated transmission in the nursery class. None of the results were statistically significant. The hand washing abilities of the cases and controls were similar. There were no obvious differences in social mixing between cases and unaffected children. The children tended to interact with other members of their own group or, for the boys, with other boys. Fruit and toast was popular with most of the children.

Family links

There are 4 family clusters where in each cluster the index case was a child in the nursery class.

Community links

No clear community links or potential outside sources of infection were identified. One affected family had social links with a family affected by the main outbreak but this was ruled

out as a potential source on microbiological grounds. Affected children from 2 families went to the local swimming pool the weekend before half-term (14th/15th October 2005) and so this was not thought to account for the outbreak.

Interviews with the parents of 4 symptomatic cases in nursery

There was no history of any parties that the first four symptomatic cases went to in the 2 weeks before onset of symptoms. The children had very little social activity outside the nursery and no high risk activities were identified from the interviews.

Microbiological results

Microbiological analysis identified a total of 16 confirmed cases (9 symptomatic) of *E coli* O157. All the cases were of phage type 21/28, PFGE Abcynobk. This PFGE type was not identified in any cases in the main outbreak and is unique to this outbreak.

Control measures

As the source was unknown and it was considered possible that other children in the school might be at risk of person to person spread, a decision was made to immediately exclude all pupils from the school until they had provided a negative stool sample. Affected children were excluded until they had recovered and provided two negative samples 48 hours apart. The school was not formally closed and teachers continued to attend the school. The school was 'deep cleaned' over the weekend of 5th/6th November and pupils gradually returned as negative stool sample results were obtained.

The school was advised to cease distribution of fruit or toast to the children in the nursery class. Further advice was also provided to reinforce hand washing and that children with gastro-intestinal symptoms should be excluded from the school until well and negative stool samples were obtained.

The outbreak was declared over and control measures lifted on Monday 9th January 2006.

Discussion

Identifying the source and methods of spread

Despite exhaustive investigation, the source of this outbreak has not been identified. It is often the case with *E. coli* O157 that the original source cannot be found. All the cases were of the same PFGE type, supporting a point source with subsequent person to person transmission. The vehicle and mode of spread remains unknown.

Cases submitted stool specimens regularly, approximately every 3 - 4 days, to identify when they stopped excreting the organism (see diagram of dates of symptom onset and laboratory confirmation, Appendix 2). This allowed an estimate of the average period to clearance to be calculated, which for some cases was several weeks. This also supports the hypothesis of person to person transmission starting within the nursery class.

No significant results were identified from investigating the activities, hand hygiene and food preferences of the children. This may be a feature of the small numbers involved. Although the practice of putting food on a plate and handing it around buffet style was suggested as a potential mode of transmission, the analysis did not support this.

There is the question of how the Abercynon outbreak could have occurred, given that control measures were in place at the time. These control measures were designed to prevent spread from asymptomatic carriers after the implicated source for the main outbreak (cooked sliced

meat) and symptomatic children had been removed. All cold cooked meats implicated in the main outbreak had been removed from the school at the time the original control measures were introduced.

Here, the source was unknown, so could not be removed to prevent transmission. This may explain why the outbreak occurred in spite of the measures already in place.

Decision made about Abercynon being an unconnected outbreak

Abercynon was initially thought to be part of the main outbreak, and investigated as such, particularly as it was in the geographical area where the outbreak had occurred and in a school in which control measures were in force.

However, the main OCT considered the evidence and made the decision on 19th December that Abercynon was a separate outbreak that was extremely unlikely to be connected to the main outbreak. This decision was made by considering the microbiological, chronological and epidemiological evidence.

The microbiological typing revealed that although the phage type was 21/28, it was of a very different PFGE type to any of the outbreak strains. The experts typing the outbreak strains in Colindale, London were definite in their opinion that these were not related to the main outbreak. Although epidemiological evidence revealed that some of the cases had social connections with cases in the main outbreak, the two families were affected by different PFGE types.

Chronologically, the Abercynon outbreak took place substantially after the main outbreak had been controlled.

Conclusions

- Abercynon was a separate outbreak unrelated to the main *E. Coli* O157 outbreak occurring in South Wales the previous months.
- The source could not be identified despite exhaustive investigation.
- Rapid investigation and instigation of control measures curtailed the outbreak promptly.
- The final hypothesis of the OCT was that this outbreak may have been due to person to person spread within the nursery following introduction from an unidentified point source.
- Nursery classes continue to be a high risk setting for the spread of *E Coli O157.*

Recommendation

- The distribution and consumption of food and hand washing after using the toilet and before eating should be closely supervised in nursery classes.

Appendix 1 Questionnaire regarding children's activities in nursery

Name of child _____

Name of teacher_____

Date_____

1. How good is their hand hygiene? (please circle)

Good moderate poor

Who are the top three children s/he plays or jointly works with?

A._____

B._____

C._____

2. Do they usually eat the fruit distributed on Mondays and Wednesdays? (please circle)

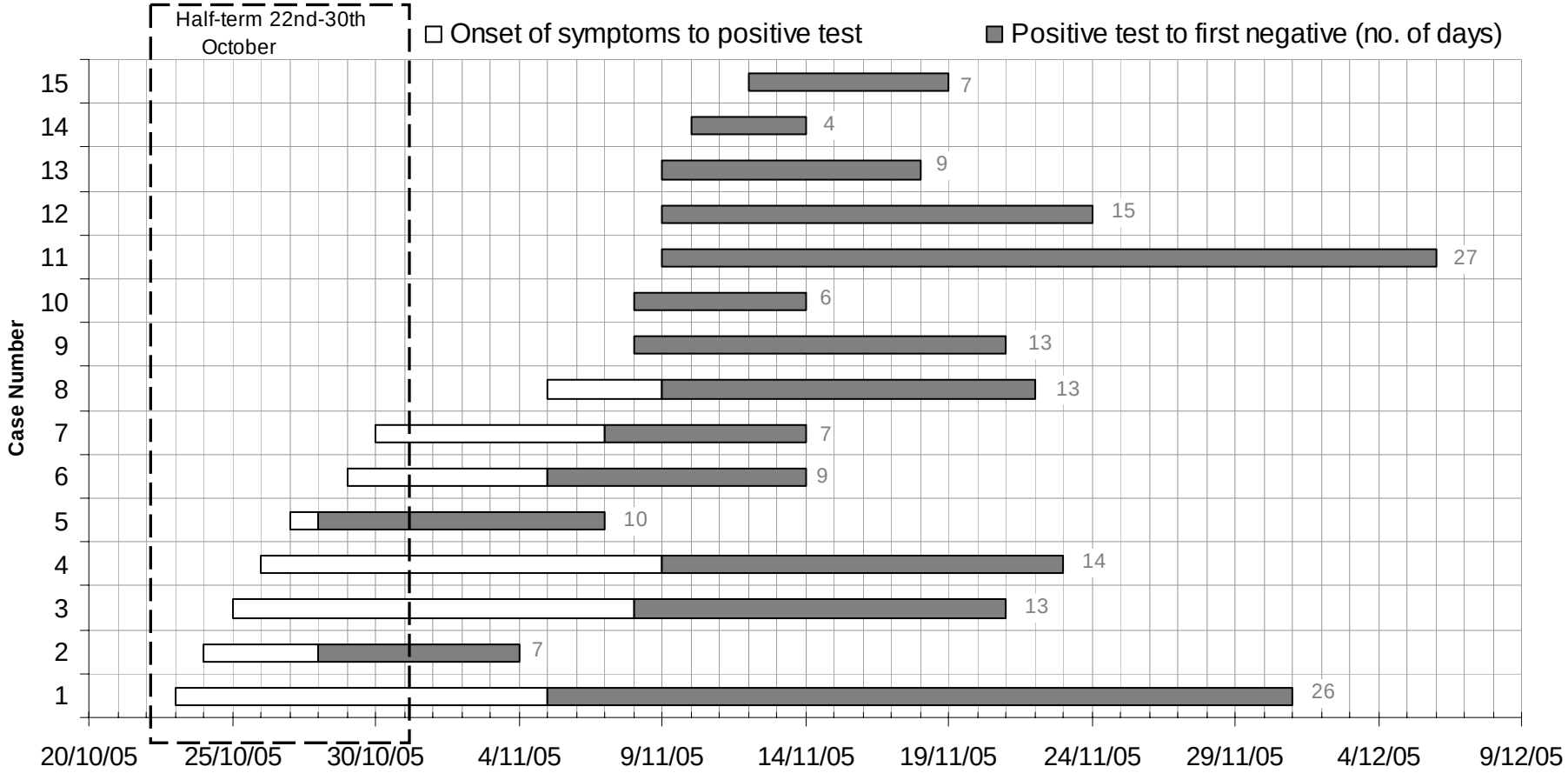
Yes No Don't know

3. Do they usually eat the toast distributed on Fridays? (please circle)

Yes No Don't know

Appendix 2: Graph to show dates of onset, diagnosis and first negative test for the first 15 cases.

Comments: Cases 1 – 4 were all symptomatic nursery class children with no social or family links to each other outside nursery.
Cases 9, 11, 13 and 15 were all asymptomatic nursery class children identified through screening.
The remaining cases (5, 6, 7, 8, 10, 12 and 14) were all household contacts of affected children.



ADDENDUM 1

OUTBREAK OF VEROTOXIN POSITIVE *Escherichia coli* O157 INFECTION IN SOUTH WALES AUTUMN 2005-OUTBREAK REPORT

Page 57 Appendix A
Under the heading: Professionals attending one or more E. coli O157 Outbreak Control Team meetings, the following individuals should be added:

National Public Health Service

Dr Ciaran Humphreys	SpR, NPHS
Dr Arif Mamhood	SpR NPHS
Ceri Harris	Public Health Nurse NPHS

Bridgend County Borough Council

Liam Roman	Press Officer

Prince Charles Hospital

Tracy Morris	Infection Control Nurse

The following amendments should also be made:

Dr D Carnicer-Port should read Dr D Carnicer-Pont
Cerydd James should read Cenydd James