

Outbreak report

LARGE OUTBREAK OF *E. COLI* O157 IN 2005, IRELAND

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In October/November 2005, the largest outbreak of verotoxin-producing *Escherichia coli* (VTEC) ever recorded in Ireland occurred. Eighteen *E. coli* O157 culture-positive cases, phage type 32, verotoxin 2 positive, were identified in a small rural area of mid-west Ireland. Half of these patients were asymptomatic. Two children were admitted to hospital with haemolytic uraemic syndrome, one of whom required peritoneal dialysis, and both recovered. All 18 culture-positive patients had indistinguishable or closely related pulsed field gel electrophoresis (PFGE) patterns. Nine of the VTEC O157 culture-positive individuals were preschool children attending two local crèches. Several culture-positive individuals apparently had exposure to a vulnerable private group water scheme (GWS) in an agricultural area. No microbiological evidence of VTEC was found in food or water. One veterinary sample (an animal rectal swab) was positive for *E. coli* O157 and the PFGE strain was indistinguishable from the outbreak strain. A case control study showed analytical epidemiological evidence of risk related to potential exposure to the GWS but not related to reported consumption of that water. Selection of cases and controls proved challenging. Transmission occurred primarily in childcare and family settings, with significant person-to-person spread. Control measures included voluntary closure of the crèches, exclusion of culture-positive individuals in risk groups until microbiological clearance was achieved and the issuing of a 'boil water' advisory for drinking water pending upgrading of disinfection facilities.

Introduction

Verotoxigenic *Escherichia coli* (VTEC) was first recognised as a cause of serious acute diarrhoeal illness in humans in 1982 [1], and is sometimes complicated by haemorrhagic colitis and haemolytic uraemic syndrome (HUS), the latter particularly in children [2]. Healthy domestic animals, in particular ruminants like cattle, sheep and goats, can harbour and shed VTEC and are regarded as natural reservoirs for these organisms [3]. Close contact with infected calves, goats, and horses has previously been documented as resulting in human infection [4, 5]. The infectious dose is low and transmission to humans is by direct or indirect contact with infected animals or through contaminated food or drinking water in addition to person-to-person spread. In humans, *E. coli* O157:H7 is the most commonly reported serogroup, but others, including O26 and O111, may cause the same spectrum of illness. Illness may be caused by the expression of one or both of two verocytotoxins encoded by the genes VT1 and VT2. VT2 is associated with more severe disease [6]. Most cases are sporadic, but at an international level there have been a number of large serious outbreaks in Scotland [7,8], Canada [9] and Wales [10]

involving food, water and other environmental exposures. Exposure to livestock carrying VTEC O157 is a reported risk factor in Scotland and private water supplies have been implicated as a source [11]. VTEC O157 outbreaks documented in childcare facilities are not unusual [12] and multiple cases in households and families with asymptomatic carriage during outbreaks have also been reported [13]. In Ireland, based on national enhanced surveillance, the number of VTEC O157 cases reported each year is between 60 and 70. The crude incidence was 1.3 per 100,000 population in 2004 [14]. Family outbreaks predominate but there have also been general outbreaks. These tend to be small in size, with five or fewer confirmed cases, although there are occasional exceptions [15]. In October 2005, the notification of a case of HUS-associated VTEC O157 led to the identification of a large outbreak in Ireland [16].

Methods

Samples were transported from the local laboratory in Mid-Western Regional Hospital, Limerick to the Public Health Laboratory (PHL) HSE-Dublin Mid Leinster. Both faecal and drinking water samples were analysed in the Biosafety Level 3 laboratory using the immunomagnetic separation method for the isolation of *E. coli* O157 and polymerase chain reaction for detection of VT1 and VT2 genes. ISO16654 and the culture media cefixime tellurite sorbitol MacConkey agar was used to culture *E. coli* O157. PFGE was used in accordance with the PulseNet protocol [17] to determine strain relatedness. Phage typing was done at the Laboratory for Enteric Pathogens, Health Protection Agency, Colindale, London. Animal/farm samples were collected by Local Authority veterinary personnel and were analysed at the Veterinary Food Safety Laboratory, Cork County Council, using immunomagnetic separation and confirmed by molecular methods. One of the isolates from the animal/farm samples was forwarded to the PHL for comparative analysis. Contacts of cases had stool specimens sent for screening for *E. coli* O157 in accordance with draft guidelines in Ireland [18] and on the basis of risk assessments carried out during the outbreak. All children under 14 years with positive stool samples were reviewed at the local paediatric unit (Mid-Western Regional Hospital) for three weeks to check for HUS. Adults with positive stools were advised to attend their family doctor for appropriate follow-up.

Epidemiological investigations included the use of a trawling questionnaire on all culture-positive individuals. This questionnaire collated data on demography, laboratory and clinical information, crèche / school / occupation, travel history, animal and environmental exposure, drinking water and food history. Drinking water supply (wells, reservoirs and pipes) in the area was charted and residences,

crèches, schools of *E. coli* O157 cases were mapped in relation to the water supply.

Seventy-two water samples were taken throughout the course of the outbreak. Twenty-one water samples and one food sample were tested specifically for *E. coli* O157. Animal/farm samples were taken from five herds in the locality, 38 samples were taken in total (rectal / hide swabs, animal faecal samples, tap water, milk filters and water courses). Rainfall data supplied by Met Éireann (the Irish Meteorological Service) at a nearby station for the period around the outbreak was collated.

Case-control study: a questionnaire was compiled and piloted. It collated details on exposure variables such as crèche/school attended, sources of drinking water, animal and environmental exposures, foods eaten from local food outlets and functions attended. Parents consented to be interviewed by telephone as proxies for children. Case definition: symptomatic cases positive for VTEC O157, VT2+ PT32 who lived in West Limerick. Three controls per case were selected from the geographical area, randomly chosen from child databases. They were group matched by age, but not by sex. Data were analysed using Epi Info 2002 (CDC, US).

Results

Over 200 people, mainly children from two local schools and two childcare facilities (crèches) were tested for VTEC. Investigations yielded 20 VTEC culture-positive individuals. Of these, 18 samples were *E. coli* O157 VT2 +, PT 32 with indistinguishable or closely related PFGE patterns. One other was untypable and the second was serogroup O123. The table shows the characteristics of the culture-positive individuals, half of whom were asymptomatic. One veterinary sample, an animal rectal swab, was positive for *E. coli* O157 VT2 + PT 32. The PFGE pattern was indistinguishable from the outbreak strain. There was no microbiological evidence of VTEC in food or water in this outbreak, but some water samples were positive for coliforms. One food and twenty-one water samples tested negative for *E. coli* O157.

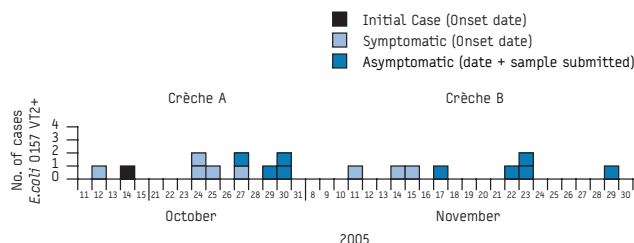
TABLE

Characteristics of VTEC culture-positive individuals and controls, Ireland, 2005

Age group (years)	Result VTEC		
	<i>E. coli</i> O157 VT2 + (symptomatic)	Case	Control
0-4	12 (6)	6	18
5-9	0	0	2
10-14	1 (1)	1	1
35-44	1	0	2
45-54	2 (1)	1	2
55-64	2 (1)	1	0
65+	0	0	2
Males	9	5	14
Females	9	4	13
Crèche A setting	6	3	
Crèche B setting	4	2	
Family setting	8	4	

FIGURE

Temporal distribution of *E. coli* O157 VT2+, West Limerick, Ireland, 2005



The initial case in crèche A was reported to have had onset on 14 October 2005. The last case was detected on 29 November. The outbreak was declared over on 21 December 2005 and microbiological clearance was reported in March 2006. The figure describes the onset of illness in symptomatic cases and dates of submission of the first culture-positive in asymptomatic cases in what appears to be a propagated outbreak. Culture-positive individuals occurred in two distinct clusters involving two crèches and two in the family setting, probably facilitated by person-to-person transmission. There was a link that could not be epidemiologically proven between a family cluster and hospital care of the initial case from crèche A. One member of a family cluster attended crèche B. Investigators were informed that food and drinks were not prepared at crèche A for attending children. Two cases were hospitalised. Both had HUS and one required peritoneal dialysis. All cases recovered.

Drinking water in about 250 households (600 residents) was supplied by a private group water scheme (GWS). This GWS is a private arrangement where trustees manage the supply of drinking water from wells drawing water from the hinterland (a rural/agricultural area in this case where cattle graze and cattle slurry/manure is spread on the land as fertiliser). Rainfall data showed the first two weeks of October to be relatively dry (<5mm rain) with the exception of 10 October when 16mm of rain fell.

Interventions

Primary prevention measures used in this outbreak included:

- ▶ voluntary closure of crèches A and B
- ▶ information on *E. coli* O157 given and hygiene emphasised to all culture-positive individuals and contacts
- ▶ culture-positive individuals in at risk groups, e.g. children under the age of five years, food handlers, those working in a crèche or healthcare setting, were excluded from their work until full microbiological clearance was obtained (two VTEC negative stool specimens at least 48 hours apart)
- ▶ a 'boil water' advisory was issued to users of the GWS pending upgrading of disinfection facilities.

Case-control study: There was analytical epidemiological evidence of risk of VTEC infection from potential exposure to water supplied by the local GWS (OR=11.5; Fisher's exact test P=0.006). Potential exposure was defined as having been in a residence or crèche supplied by the GWS. However, many cases reported 'nil consumption' of the water from GWS. Based on reported consumption the risk from the water did not prove to be statistically significant (OR=4; P=0.15). Other risk exposures examined were not statistically significant. These included contact

with pets, travel, agricultural or food related exposure. Only four of nine cases with symptoms consulted doctors, and two controls did.

Discussion

A point source was initially suspected, possibly from environmental contamination of vulnerable drinking water, but this was not proven. This outbreak was primarily propagated by person-to-person spread in family and crèche settings and the control measures outlined contained further spread. The vulnerable GWS had wells that had no holding tanks, with a risk of insufficient chlorine contact time, and poor engineering flow which made supply less than ideal. A hydrogeological risk assessment subsequently confirmed these weaknesses. The vulnerability of the drinking water supply highlights the need for education and support of trustees who manage private drinking water supply for a population, especially in the rural agricultural setting. Elucidation of the epidemiology of VTEC in animals may identify strategies to reduce the risk of environmental contamination in such circumstances. Irish legislation requires crèches that care for more than three children to be notified to the Health Service Executive. Neither crèche A or B was notified in this instance. Notified crèches are subject to hygiene requirements and are regularly inspected. Parents should be aware of how childcare facilities are regulated so that they can make informed choices when choosing one. Subsequent to the outbreak, an education initiative advising childcare facilities about VTEC was launched in 2006 [19]. The number of asymptomatic culture-positive individuals detected in this outbreak is greater than has been reported elsewhere. For example, in Scottish surveillance data 10% of cases were asymptomatic and most were not linked to outbreaks [20]. However, some recent outbreaks have reported high levels of asymptomatic carriers between 44% and 54% [12, 21]. National guidelines on management of VTEC outbreaks and screening policies may influence the detection of asymptomatic culture-positive individuals. Case and control selection in the case-control study proved challenging. Symptomatic cases with culture confirmed VTEC were chosen and asymptomatic culture-positive individuals were excluded. Using all culture-positive individuals would have implications for selection of controls. In this scenario, without culture results on controls, asymptomatic culture-positive individuals could have been randomly selected as controls. Person-to-person transmission complicated the hypotheses. Apart from recall bias, there may have been some selection bias in the choice of controls, as most interviews were performed during normal working hours. As a result, parents who did not make use of childcare services may have been selected as controls.

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