3.3 Verotoxigenic *E. coli*

Summary

Number of VTEC cases, 2011: 283
Crude incidence rate, 2011: 6.2/100,000
Number of VTEC-associated HUS 2011: 19
Number of VTEC cases, 2010: 199

Introduction

One of the most serious outbreaks of foodborne disease ever reported in the European Union was a verotoxigenic *E. coli* O104 outbreak identified in Germany in May 2011. Cases related to this outbreak were detected in several European countries, including a cluster of cases which were exposed in the Bordeaux region of France. As of 27/07/2011, a total of 782 HUS cases, including 29 deaths, and 3,128 non-HUS cases, including 17 deaths, were reported to the European Centre for Disease Prevention and Control (ECDC).[1] A Task Force of the European Food Safety Authority (EFSA) reported on 5/7/2011 that fenugreek seeds imported from Egypt were the most likely source of the outbreaks in Germany and France.[2] This outbreak is a reminder of the potential severity of disease associated with VTEC infections, and the magnitude of outbreaks that can result from contamination of food produced and distributed on a large scale.

Table 1. Number and crude incidence rates confirmed and probable VTEC, Ireland 2004-2011

Year	Confirmed cases	Probable cases	Total VTEC	CIR VTEC[a] (95% CI)
2004	61	0	61	1.4 (1.1-1.8)
2005	125	0	125	3.0 (2.4-3.5)
2006	153	5	158	3.7 (3.2-4.3)
2007	115	52	167	3.9 (3.3-4.5)
2008	213	13	226	5.3 (4.6-6.0)
2009	238	3	241	5.7 (5.0-6.4)
2010	197	2	199	4.7 (4.0-5.4)
2011[b]	272	11	283	6.2 (5.5-6.9)

[a] Data from the 2011 census were used to calculate rates in 2011, and 2006 to calculate incidence rates for 2004-2010
[b] Confirmed cases include 194 VTEC O157 cases, 48 VTEC O26 cases, 25 VTEC strains of other serogroups, and five mixed infections. Nine probable cases were reported on the basis of being epidemiologically linked to laboratory confirmed cases of VTEC O157, and one VTEC O26 and one VTEC O145 probable case were reported on the basis of detection of vt genes only.

Fortunately, there were no cases related to this outbreak identified in Ireland, however, the reported verotoxigenic *E. coli* (VTEC) incidence rate in Ireland is generally high relative to other European countries. In 2010 (the latest year for which data are published), the overall VTEC incidence rate in the European Union was 0.83 per 100,000. For several years, Ireland has reported the highest VTEC incidence rate of any Member State in the EU, although Denmark and Sweden also reported relatively high incidence rates of >3.0 per 100,000 in 2010.[3]

The dominant transmission routes reported for VTEC infection in Ireland have been person-to-person spread, especially in childcare facilities and among families with young children, and waterborne transmission associated with exposure to water from untreated or poorly treated private water sources.[4-7] Other important transmission routes identified internationally include food (often minced beef products or fresh produce such as lettuce and spinach), and contact with infected animals or contaminated environments.[3, 8-10]

Materials and Methods

Infection due to Enterohaemorrhagic *E. coli* (EHEC) is a notifiable disease (S.I. 707 of 2003) since 2004 by clinicians and laboratory directors. This report focuses

on cases that conform to the case definition used for VTEC enhanced surveillance (http://www.ndsc.ie/hpsc/A-Z/Gastroenteric/VTEC/SurveillanceForms/). Enhanced epidemiological information was supplied as in previous years by HSE personnel, and VTEC confirmation and typing data were provided by the HSE Dublin Mid Leinster Public Health Laboratory at Cherry Orchard Hospital (DML-PHL). Data from all sources are maintained in the Computerised Infectious Disease Reporting (CIDR) system. Outbreaks of VTEC are notifiable since 2004 and data are provided to CIDR by regional public health departments.

Data from the CSO 2011 census were used to provide denominators for the calculation of national, regional and age-specific incidence rates in 2011.

Results

Incidence

In 2011, there were 283 confirmed and probable cases of VTEC notified, equating to a crude incidence rate (CIR) of 6.17 per 100,000 (Table 1). If only confirmed VTEC cases are considered, the 272 cases (CIR=5.93 [5.22-6.63]) notified this year represent a 38% increase overall on the number of confirmed cases notified in 2010, and a 14% increase on the number reported in 2009, the year with the highest number of confirmed cases prior to this (Table 1 and Figure 1). One additional suspected case of VTEC was reported. An elderly female in HSE-E developed HUS, but was not confirmed as VTEC.

For comparison, in England and Wales there was a 49% increase in *E. coli* O157 numbers in 2011 compared to 2010, however, the reported incidence rate for 2010 was lower than usual, and the increase in *E. coli* case numbers in 2011 was only 14% on 2009 case numbers[11]. *E. coli* O157 case numbers were reported to be 19% higher in Scotland in 2011 relative to 2010, but it was stated that 2011 incidence was closer to the historical average than to 2010, again because case number in 2010 were relatively low[12].

Of 268 cases where information was available on symptoms, 192 (72%) were symptomatic, 78 (41%) of which developed bloody diarrhoea. Nineteen individuals (6.7%) developed HUS, the same number as last year. One elderly HUS case with VTEC O157 VT2 infection died but death was not due to VTEC infection. The elderly patient reported as a suspected VTEC case also died; the cause of death in this case was reported as unknown. Where reported (n=250), 76 (30%) of notified cases required hospitalisation (38% of symptomatic cases).

Seasonal distribution

Typically, VTEC cases are most commonly associated with late summer, however in 2011, the highest

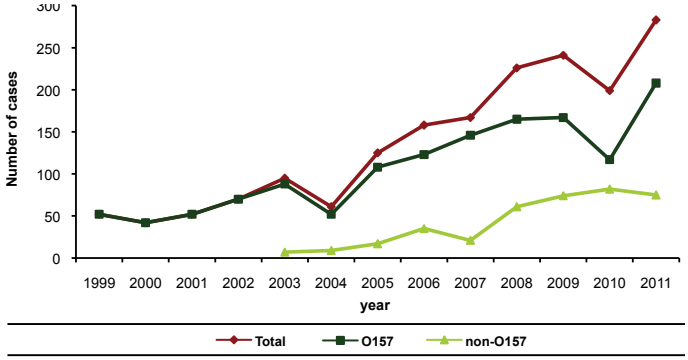

Figure 1. Annual number of confirmed and probable VTEC cases by serogroup, Ireland 1999-2011
Note: For simplicity in this figure, cases with mixed VTEC O157/other serogroup infections are included in the data for O157.

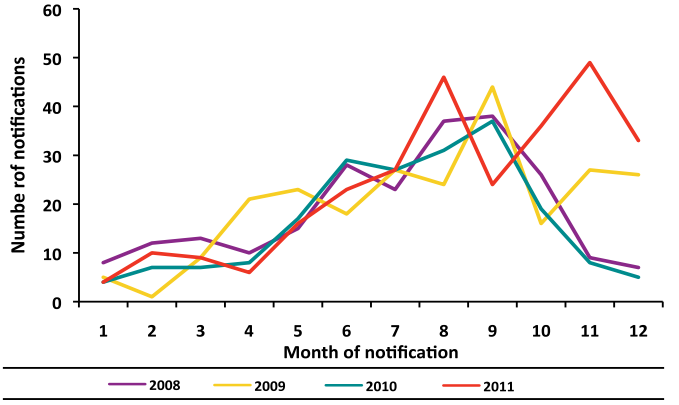

Figure 2. Seasonal distribution of VTEC cases, Ireland 2008-2011

Table 2. Number and crude incidence rate confirmed and probable VTEC by serogroup and HSE area, and number and crude incidence rate VTEC-associated HUS by HSE area, Ireland 2011

HSE-area	Number [CIR (95% CI)] VTEC O157	Number [CIR (95% CI)] non-O157 VTEC	Number [CIR (95% CI)] all VTEC	Number [CIR (95% CI)] VTEC-associated HUS
East	18 [1.1 (0.6-1.6)]	11 [0.7 (0.3-1.1)]	**29 [1.8 (1.1-2.4)]**	4 [0.3 (0.0-0.5]
Midlands	57 [20.2 (14.9-25.4)]	7 [2.5 (0.6-4.3)]	**64 [22.7 (17.1-28.2)]**	4 [1.4 (0.0-2.8)]
Mid-West	17 [4.5 (2.4-6.6)]	39 [10.3 (7.1-13.5)]	**56 [14.8 (10.9-18.6)]**	1 [0.3 (-0.3-0.8)]
North-East	21 [4.8 (2.7-6.8)]	2 [0.5 (-0.2-1.1)]	**23 [5.2 (3.1-7.4)]**	2 [0.5 (-0.2-1.1)]
North-West	17 [6.6 (3.5-9.7)]	7 [2.7 (0.7-4.7)]	**24 [9.3 (5.6-13.0)]**	0 [0.0 (0.0-0.0)]
South-East	22 [4.4 (2.6-6.3)]	1 [0.2 (-.0.2-0.6)]	**23 [4.6 (2.7-6.5)]**	5 [1.0 (0.1-1.9)]
South	37 [5.6 (3.8-7.4)]	4 [0.6 (0.0-1.2)]	**41 [6.2 (4.3-8.1)]**	2 [0.3 (-0.1-0.7)]
West	19 [4.3 (2.4-6.2)]	4 [0.9 (0.0-1.8)]	**23 [5.2 (3.0-7.3)]**	1 [0.2 (-0.2-0.7)]
Ireland	208 [4.5 (3.9-5.2)]	75 [1.6(1.3-2.0)]	**283 [6.2 (5.5-6.9)]**	19 {0.4 (0.2-0.6)]

*Rates per 100,000 calculated using CSO census 2011 for denominator data

proportion of cases was in quarter 4; overall this year, 42% of cases were reported in quarter 4 with 34% of cases in quarter 3. Figure 2 shows the seasonal distribution in 2011 relative to previous years.

Regional distribution

The highest VTEC incidence rates were reported in the HSE-M followed by the HSE-MW, where the rates were over three times and twice the national crude rate respectively (Table 2). The HSE-M rate was significant higher than the rates for all other areas except the HSE-MW, while the HSE-MW rate was significantly higher than five other HSE-areas. As in previous years, the HSE-E reported the lowest overall crude incidence rate (Table 2), around 30% of the national rate this year.

The particularly high rate for VTEC incidence in the HSE-M was largely due to one community waterborne VTEC O157 outbreak described in detail later in this chapter (Table 2 and Figure 3). The elevated overall incidence rate in the HSE-MW was strongly influenced by a high reported incidence rate for non-O157 infections (Figure 3). Historically, the HSE-MW have reported relatively high numbers of non-O157 VTEC infections; it is likely that much of the regional variation in non-O157 VTEC incidence reflects regional differences in laboratory diagnostic practice for non-O157 infections.

Reviewing the VTEC-associated HUS incidence rates by region, the HSE-M reported the highest rate, however, the numbers of HUS cases in all regions were too low to establish if there was any statistically significant difference in rates (Table 2).

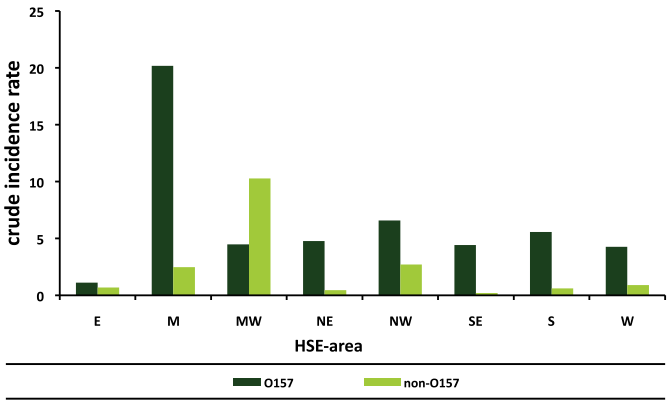

Figure 3: Crude incidence rate VTEC O157 and non-O157, Ireland 2011

Table 3. Serotype and verotoxin (VT) profiles for VTEC isolates as determined at the PHL HSE Dublin Mid Leinster, Cherry Orchard Hospital in 2011

Serogroup	VT1	VT1+VT2	VT2	Total
O157[a]	0	60	138	198
O26	29	19	1	49
O5	5	2	0	7
Ungroupable	1	1	4	6
O128	0	3	0	3
O146	0	3	0	3
O145	0	0	2	2
O111	0	1	0	1
O150	0	1	0	1
O185	0	0	1	1
O44	0	0	1	1
O76	1	0	0	1
Total	**36**	**90**	**147**	**273**[b]

[a]For one confirmed *E. coli* O157 case diagnosed in another jurisdiction, no vt typing data were available.
[b] Nine notifications were reported on the basis of being epidemiologically linked to laboratory confirmed cases, and thus no isolates were available for inclusion in this table.

Table 4. Number of cases (and percentage where known) for selected risk factors, Ireland 2011

Risk factor	Number 'Yes' and % where reported	Number 'No' and % where reported	Number where risk factor was unknown or not reported
Food suspected	23 (17.8%)	106 (82.2%)	155
Exposure to farm animals or their faeces	74 (43.3%)	97 (56.7%)	113
Exposure to private well water[a]	69 (36.9%)	118 (63.1%)	96
Travel-associated[b]	4 (1.8%)	215 (98.2%)	64
Attendance at a CCF	51 (32.3%)	107 (67.7%)	125
Attendance at a CCF (among <5 yrs)	49 (67.1%)	24 (32.9%)	57

[a]Composite variable recoded from two different water supply exposure enhanced variables in CIDR
[b]Based on CIDR core variable *Country of Infection*
[c] *Childcare Facility*

Laboratory typing

In 2011, the serogroup and verotoxin profiles of VTEC isolates referred to the HSE PHL Dublin Mid Leinster, Cherry Orchard Hospital are displayed in Table 3. As usual among VTEC O157 in Ireland, isolates containing the genes for verotoxin 2 (*vt2*) were more common (70%) than strains containing both *vt1* and *vt2*. VTEC O26 strains containing only *vt1* made up 59% of all VTEC O26 reported, with 39% of VTEC O26 containing the genes for both *vt1* and *vt2*.

Risk factors

Under enhanced surveillance for VTEC, risk factor information is routinely collected on VTEC notifications (Table 4).

Exposure to farm animals or their faeces and exposure to private well water were relatively common among cases; 43.3% and 36.9% reported these exposures respectively. This is consistent with the low incidence of VTEC infection among residents in the largely urban HSE-E population and the higher incidence recorded in more rural parts of the country. According to CSO data, in the general population, around 10.1% of households are served by private wells, indicating that, on a national basis, exposure to private wells is likely to be more common among VTEC cases than among the general population.

Unlike salmonellosis, foreign travel plays only a minor role in VTEC infection in Ireland, with the majority of infections acquired indigenously. The countries where the four travel-associated Irish VTEC cases had travelled to during their incubation periods were Portugal (n=2), Spain (n=1) and Hungary (n=1).

Where the information was available, around a third of VTEC cases in 2011 were reported to attend a Childcare Facility (CCF). When these analyses were restricted to notified VTEC under five years of age, around two-thirds reported attendance at a childcare facility. In the absence of knowing the proportion of the general population less than 5 years of age who attend a CCF, it is not possible to estimate if attendance at a CCF increases a child's risk of VTEC infection.

Outbreak and environmental investigations

The outbreak surveillance system plays a key role in our understanding of VTEC transmission in Ireland. Fifty-one VTEC outbreaks were notified in 2011, which included 198 of the 283 VTEC notifications. Thirty-eight outbreaks were due to VTEC O157, seven to VTEC O26, two were mixed VTEC strain outbreaks, and four were caused by other VTEC strains. The suspected modes of transmission are listed in Table 5.

Person-to-person spread is an important mode of VTEC transmission particularly between young children, and was suspected to have played a role in 24 (47%) VTEC outbreaks in 2011 in which 85 persons were reported ill (Table 5 and Figure 4). Seventeen of these outbreaks were reported as being solely due to person-to-person transmission. The second most common transmission route reported was waterborne transmission, which was reported to have contributed to six outbreaks (12%) with 31 persons ill. Microbiological evidence was obtained implicating private water sources in three of these outbreaks (further details below on a general waterborne outbreak). Two family outbreaks were reported as being suspected to be foodborne, but no suspected foods were reported and animal/environmental contact was reported as the suspected mode of transmission in three family outbreaks. For 43% (n=22) of VTEC outbreaks in 2011, the transmission route was reported as unknown or not specified (Table 5 and Figure 4).

Table 5. VTEC outbreaks by suspected mode of transmission, Ireland 2011

Suspected mode of transmission	Number of outbreaks	Number ill	Number confirmed cases
Animal contact	1	4	3
Environmental / Fomite	1	2	2
Person-to-person	17	65	59
Person-to-person and possibly Waterborne	1	3	3
P-P and Animal contact	1	1	4
P-P and Foodborne	2	9	3
P-P and Waterborne	2	5	3
Unknown/P-P	1	2	3
Waterborne	3	23	37
Not Specified	1	1	2
Unknown	21	63	61
Total	51	178	180

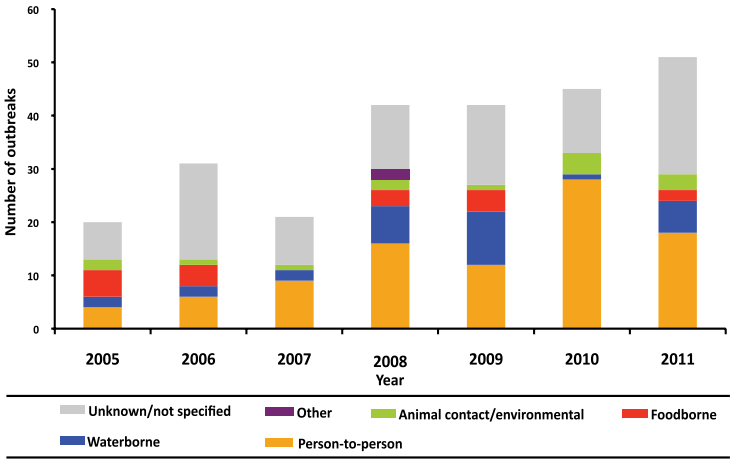

Figure 4. Number of VTEC outbreaks by suspected transmission route and year, Ireland 2004-2011

Note: In this figure, reported transmission routes were grouped for simplicity. Any outbreak where food contributed was reported as foodborne, any outbreak where water contributed was reported as waterborne, any outbreak where animal contact contributed was reported as Animal contact. Person-to-person outbreaks include only those outbreaks reported as being due only to person-to-person transmission.

The majority of outbreaks (76%) were family outbreaks, with twelve general outbreaks notified. The 39 family outbreaks resulted in 82 persons becoming ill, an average of 2.1 persons per outbreak, while the twelve general outbreaks resulted in 96 persons becoming ill, an average of 8 persons per outbreak.

Nine general outbreaks were associated with childcare facilities/arrangements (CCFs), two were reported as community outbreaks and one small general outbreak was linked to a hotel. This is the highest number of general VTEC outbreaks reported in a single year since surveillance for VTEC infection commenced in 1999.

Four of the outbreaks associated with CCFs were reported as being due to person-to-person spread. The mode of transmission for a fifth outbreak was waterborne transmission within a private house followed by person-to-person transmission to a CCF contact, while the transmission routes for the remaining four CCF outbreaks were unknown. The number of persons ill within these outbreaks ranged from 1 to 29 (median 5).

Among the community VTEC outbreaks, a large waterborne outbreak was reported in the HSE-M associated with two VTEC O157 strains (one VT2 and one VT1+2). There were 38 cases in total, 23 of whom were symptomatic. Seven cases required hospitalisation and one developed HUS. Epidemiological and microbiological evidence pointed towards drinking water from a private group water scheme serving around 300 homes as being the most likely source of illness. Both outbreak strains were detected in a water sample from the group water scheme, and 89% of cases had a definite epidemiological link to this supply[13]. Two days in advance of the first outbreak cases coming to the attention of health authorities, a boil water notice had been already been put on the supply following detection of *E. coli* and coliforms in a water sample.

In the second community outbreak, two geographically and temporally linked adult HUS cases were notified, however, no definite epidemiological link was established between the cases. In the hotel related outbreak, two visitors to a hotel developed illness; the mode of transmission was not established.

Summary

There was an increase in the reported incidence of VTEC infection in Ireland in 2011 reversing the downward trend observed in 2010. Notably the incidence rates in the United Kingdom reported by the Health Protection Agency and Health Protection Scotland were also higher in 2011 following reporting of low VTEC incidence rates in 2010. It is possible that the low rates reported in 2010 reflected a reduction in some common risk factor between the three jurisdictions that year.

In 2010, HPSC had noted a decrease in the number of waterborne VTEC outbreaks reported, and this would be consistent with the reported low rainfall in Ireland in 2010[14]. A common effect such as a change in climate could explain an international change in the trend such as was observed in 2010.

In 2011, person-to person spread and drinking water were significant transmission routes for VTEC outbreaks in Ireland. Person-to person spread was important both in CCFs and private households, and exclusion of children with infectious gastrointestinal disease symptoms from CCFs remains an important control measure in the prevention of outbreaks in these settings[15].

The large waterborne outbreak in the HSE-M associated with a private group scheme was particularly significant. Private wells serve around 10% of households in Ireland, with private group water schemes serving a further 3% of homes [16]. According to the latest EPA drinking water report[17], there were improving levels of compliance with the drinking water quality standards in the group water scheme sector during 2010 but it was also reported that the microbiological water quality in a significant proportion of group water schemes continued to be inferior to that in public water supplies, in particular in privately-sourced group water schemes. Exposure to untreated or poorly treated private supplies have long been recognised as a risk factor for VTEC infection in Ireland, however, outbreaks to date have generally been smaller and mostly confined to household settings. This outbreak highlights the vulnerability of some larger private water supplies in Ireland, and the potential for a high impact on human health when a vulnerable supply serves a large population.

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