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EPIDEMIOLOGY OF VEROTOXIGENIC *E. COLI* IN IRELAND

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http://www.hpa.org.uk/hpa/inter/enter-net_menu.htm

Summary

- In 2006, 158 confirmed and probable cases of VTEC were notified to HPSC, a crude incidence rate (CIR) of 3.7 per 100,000. This is the highest annual total of VTEC infections reported since surveillance began in 1999, and represents a 26% increase on the number of cases reported in 2005
- The rise in notifications in Ireland this year was strongly influenced by the increased number of non-O157 infections reported compared to 2005 (35 vs. 17 cases), in particular VTEC O26
- For the second year running, cases of VTEC infection due to atypical sorbitol-fermenting VTEC O157 were reported. There were two confirmed cases and a third epidemiologically-linked HUS case from whom no VTEC was isolated
- As in previous years, evidence was again obtained showing that untreated drinking water plays an important role in VTEC transmission in Ireland

Introduction

Verotoxigenic *E. coli* (VTEC), and in particular serogroup O157, are an important cause of gastroenteric illness in Ireland. Unlike more common forms of gastroenteritis such as norovirus, illness can be very severe with up to 10% of patients developing haemolytic uraemic syndrome (HUS), a life-threatening complication. The reported incidence in Ireland has risen from 2.4 per 100,000 in 2003 to 3.0 per 100,000 in 2005, with children most commonly affected and at higher risk of complications.[1] A small infective dose facilitates person-to-person transmission, both within households and in child-care facilities. Other important transmission routes include food (often minced beef products and most recently fresh produce such as lettuce and spinach), drinking water and contact with infected animals or contaminated environments.[2,3]

Case Definition for VTEC Enhanced Surveillance

Clinical description
Clinical picture compatible with VTEC infection, e.g. diarrhoea (often bloody) and abdominal cramps. Illness may be complicated by haemolytic uraemic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP). Cases may also be asymptomatic.

Laboratory criteria for diagnosis
One of the following:

- Isolation of verocytotoxin-producing *E. coli*
- Serological confirmation in patients with HUS or TTP
- For probable cases: detection of genes coding for VT1/VT2 production

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Case classification

Suspected:	A case of HUS or TTP of possible infective aetiology
Probable:	A laboratory confirmed isolate without clinical information or a case where the genes coding for VT1/VT2 production have been detected or a case with clinical symptoms that has an epidemiological link*
Confirmed:	A clinically compatible case that is laboratory confirmed

Materials and Methods

In 2004, disease due to Enterohaemorrhagic *E. coli* (EHEC) became notifiable (S.I. 707 of 2003). This report focuses only on those notified EHEC cases that are regarded as VTEC, i.e. those that conform to the case definition used for VTEC enhanced surveillance.

Enhanced information was supplied as in previous years by HSE personnel, and typing data were provided by the HSE Dublin Mid Leinster Public Health Laboratory at Cherry Orchard Hospital which offers specialist diagnostic and typing services for VTEC.

Clinicians were also requested to report suspected cases of VTEC, i.e. cases of HUS or TTP of possible infective aetiology, for which there was no laboratory or epidemiological evidence of VTEC infection.

Results

Incidence

In 2006, 153 confirmed and five probable cases of VTEC were notified to HPSC, a crude incidence rate (CIR) of 3.7 per 100,000 (table 1). This is the highest annual total of VTEC infections reported since surveillance began in 1999, and represents a 26% increase on the number of cases reported in 2005.

Table 1. Number and crude incidence rates confirmed and probable VTEC O157 and non-O157 VTEC, Ireland 1999-2006

Year	VTEC O157	CIR VTEC O157* (95% CI)	Non-O157 VTEC	CIR non-VTEC * (95% CI)	Total	CIR Total* (95% CI)
2001	52	1.3 (0.9-1.6)	N/A	N/A	N/A	N/A
2002	70	1.7 (1.3-2.2)	N/A	N/A	N/A	N/A
2003	88	2.2 (1.8-2.7)	7	0.2 (0.0-0.3)	95	2.4 (1.9-2.9)
2004	52	1.2 (0.9-1.6)	9	0.2 (0.1-0.4)	61	1.4 (1.1-1.8)
2005	108	2.6 (2.1-3.0)	17	0.4 (0.2-0.6)	125	3.0 (2.4-3.5)
2006	123[$]	2.9 (2.4-3.4)	35[‖]	0.8 (0.6-1.1)	158	3.7 (3.2-4.3)

[*] Data from the 2002 census were used to calculate rates in 2001-2003, and from 2006 census for rates in 2004-2006, thus, rates quoted for 2004 and 2005 may differ from previously published rates.
[$] For simplicity, the 3 mixed infections are included in the rates calculated for VTEC O157 infections. Includes 119 confirmed and four probable cases
[‖] Includes one probable VTEC O26 case

As in previous years, the most common serogroup reported was VTEC O157 (n=123) [table 1], followed by VTEC O26 (n=31), VTEC O103 (n=2), VTEC O113 (n=1) and VTEC O115 (n=1). Three of the VTEC O157 cases were co-infected with non-O157 VTEC strains. One was a mixed O157/O8 infection, one a mixed O157 with two different ungroupable *E. coli* strains, and the third was a mixed O157/O26 infection. Two confirmed VTEC O157 infections were due to sorbitol-fermenting *E. coli* O157. One probable case was epidemiologically linked with these two cases.

Although not notifiable, an additional four (HUS) cases without laboratory or epidemiological evidence of VTEC infection were reported as suspected VTEC cases.

Regional and seasonal distribution

Regional variation was noted in the numbers of cases notified (table 2), with the highest incidence rates for VTEC overall in the HSE-W, HSE M, HSE-MW and HSE-NE. Notably, the serogroup distribution in the NW was strikingly different from other areas. In the NW, VTEC O26 was the most common serogroup reported –in fact, the NW reported no cases of VTEC O157 this year- whereas VTEC O157 was consistently the most common VTEC reported in all other areas.

The highest number of confirmed and probable cases was reported in Q3, although relatively high numbers of cases were also reported in Q4, in particular in October.

Table 2. Number of confirmed VTEC cases by quarter and HSE area, crude incidence rate and age-standardised incidence rate by HSE area, Ireland 2006

	E	M	MW	NE	NW	SE	S	W	Total
Quarter									
Q1	2	0	0	0	1	1	0	2	**6**
Q2	8	9	4	2	3	0	2	11	**39**
Q3	11	8	10	15	5	2	5	10	**66**
Q4	9	1	7	4	0	6	8	12	**47**
Serogroup									
VTEC O157	22	17	18	17	0	9	12	25	**120**
Non-O157 VTEC	7	1	3	3	9	0	2	10	**35**
Mixed O157/non-O157 infection	1	0	0	1	0	0	1	0	**3**
Total	**30**	**18**	**21**	**21**	**9**	**9**	**15**	**35**	**158**
CIR VTEC* (95% CI)	**2.0 (1.3-2.7)**	**7.2 (3.9-10.5)**	**5.8 (3.3-8.3)**	**5.3 (3.1-7.6)**	**3.8 (1.3-6.3)**	**2.0 (0.7-3.2)**	**2.4 (1.2-3.6)**	**8.5 (5.7-11.3)**	**3.7 (3.2-4.3)**

*Rates calculated using denominator data from CSO census 2006

Age-sex distribution

Disease incidence was highest among young children which is consistent with previous years (table 3: mean age=19 years, median age =7.5 years), and there were similar numbers of male (n=81) and female (n=76) cases; for one case sex was unknown. In contrast to previous years, the age distribution of non-O157 cases more closely matched that for VTEC O157 cases, possibly reflecting improved awareness and diagnosis of non-O157 infections among adult patients.

Table 3. Age distribution notified VTEC cases and age-specific incidence rate, Ireland 2006

Age group	VTEC O157	Non-O157 VTEC	Total	Age-specific incidence rate
<5 yrs	44	15	**59**	**19.5**
5-14 yrs	27	9	**36**	**6.4**
>=15 yrs	52	11	**63**	**1.9**
Total	**123**	**35**	**158**	**3.7**

Clinical features

Information on symptoms was available for 151 notified cases, of whom 109 (72%) were reported as symptomatic. Reported symptoms included bloody diarrhoea in 58 cases, and haemolytic ureamic syndrome (HUS) in 17 cases. HUS cases ranged in age from 1 to 76 years, and as expected, a higher proportion of paediatric (14/95) than adult (3/63) cases developed HUS. Notably, three HUS cases were associated with non-O157 VTEC (one

For the four suspected VTEC cases (i.e. HUS of possible infective aetiology) where no evidence of VTEC was uncovered), the age range was 10 months to 7 years.

Criteria for diagnosis

One reported case in 2006 was diagnosed by serodiagnosis, five cases were notified as probable cases on the basis of epidemiological linkage to confirmed cases (these included two HUS cases), and the remaining cases were all culture confirmed.

Phage and verotoxin typing

In 2006, 118 VTEC O157 isolates were referred to the HSE PHL Dublin Mid Leinster, Cherry Orchard Hospital (table 4). As in previous years, PT32 was the commonest phage type reported (n=56), accounting for 47% of the VTEC O157 reported. The second most common phage type this year was PT21/28.

The verotoxin profiles of VTEC strains were typical (table 4). Eighty-seven per cent of VTEC O157 strains carried the genes for VT2 only while 13% carried the genes for both VT1 and VT2 (table 3). In contrast, 66% of non-O157 VTEC isolates carried the genes for VT1 only, 18% for VT2 only, and 16% VT1 and VT2.

Table 4. Verotoxin and phage typing results for VTEC isolates referred to the PHL HSE Dublin Mid Leinster, Cherry Orchard Hospital in 2006

Serogroup	PT	VT1 only	VT2 only	VT1 & VT2	Total
O157	**2**	0	1	0	**1**
	8	0	2	11	**13**
	14	0	3	0	**3**
	31	0	7	0	**7**
	32	0	52	4	**56**
	34	0	2	0	**2**
	51	0	3	0	**3**
	21/28	0	29	0	**29**
	RDNC	0	3	0	**3**
	N/K	0	1	0	**1**
O26	**-**	19	6	6	**31**
O ungroupable	**-**	1	1	0	**2**
O103	**-**	2	0	0	**2**
O113	**-**	1	0	0	**1**
O115	**-**	1	0	0	**1**
O8	**-**	1	0	0	**1**
Total	**-**	**25**	**110**	**21**	**156**

Note that for one case diagnosed by serodiagnosis, and five probable cases reported on the basis of epidemiological linkage, isolates were not available for typing. Table 4 includes all strains isolated from mixed VTEC infections.

eaeA gene, 113 (97.4%) were positive, compared to 32 (86.5%) of 37 non-O157 isolates typed. All 116 VTEC O157 examined were positive for the *ehylA* gene, with 97.3% (36/37) of non-O157 isolates positive for this gene.

Environmental investigations

Thirty VTEC outbreaks were reported this year, comprising 90 of the 158 confirmed and probable cases notified (table 5). Three outbreaks were described as general outbreaks and 27 as family outbreaks. Twenty-five were due to VTEC O157 and five due to VTEC O26. The suspected modes of transmission reported are listed in table 5.

For one family outbreak and for one sporadic case in 2006, examination of water from the private wells of the affected households confirmed the presence of the *E. coli* O157 indistinguishable from the associated human isolates.

Table 5. VTEC outbreaks in Ireland 2006 by suspected mode of transmission

Suspected mode of transmission*	Number of outbreaks	Number confirmed cases	Number ill
Animal contact	1	3	3
Person-to-person	5	21	8
Waterborne	1	2	2
P-P and foodborne	3	9	7
Foodborne	1	2	1
P-P and waterborne	1	3	2
Unknown/Not specified	18	50	43
Total	**30**	**92**	**68**

*P-P denotes person-to-person transmission

Discussion

In 2006, 158 confirmed and probable cases of VTEC were notified to HPSC, a crude incidence rate (CIR) of 3.7 per 100,000. This is the highest annual total of VTEC infections reported since surveillance began in 1999, and represents a 26% increase on the number of cases reported in 2005. Ireland, along with the United Kingdom, has some of the highest reported incidence rates of VTEC infection in Europe.[5] The incidence rate for VTEC O157 of 2.9 per 100,000 in Ireland in 2006 compares with 4.8 per 100,000 in Scotland, 2.6 per 100,000 in Northern Ireland, and 1.9 per 100,000 in England and Wales. [6,7,8]

The rise in notifications in Ireland in 2006 was strongly influenced by the increased number of non-O157 infections reported compared to 2005 (35 vs. 17 cases). Since surveillance for non-O157 cases began in 2003, there has been a sharp increase in the reported incidence of non-O157 infection, which almost certainly reflects increased awareness and improved diagnosis nationally of non-O157 infections. Non-O157 VTEC were associated with four HUS cases this year, including one HUS case with a mixed VTEC O157/VTEC O26 infection, demonstrating their capacity to cause severe disease. Interestingly, almost three-quarters of all non-O157 VTEC in 2006 were reported by three HSE-areas (HSE-W, HSE-NE and HSE-E), however, it should be noted that this regional variation could reflect either a true difference in the risk of infection or regional variation in laboratory diagnostic policy for non-O157.

For the second year running, cases of VTEC infection due to atypical sorbitol-fermenting VTEC O157 were reported. There were two confirmed cases and a third epidemiologically-linked HUS case from whom no VTEC was isolated. A number of human infections due to these atypical sorbitol-fermenting VTEC O157 strains were also reported in the United Kingdom in 2006, and they are an emerging concern in Europe, in particular as they require different laboratory isolation techniques than typical non-sorbitol fermenting *E. coli* O157 strains. [9,10]

For three VTEC cases this year, more than one VTEC strain was isolated. In all three cases, VTEC O157 were isolated in combination with non-O157 strain(s). It will of interest to monitor these occurrences in the future to see if there is a difference in clinical presentation or outcome between cases of infection due to a single VTEC strain versus mixed VTEC infections.

Person-to-person spread is an important mode of VTEC transmission in households, child-care facilities and institutions, and was suspected to have played a role in nine VTEC outbreaks in 2006. Hand hygiene advice and exclusion guidance are crucial measures in managing outbreaks in settings where vulnerable individuals are congregated.[11] During 2006, the Food Safety Authority of Ireland produced a leaflet for childcare facilities entitled *E. coli* O157: protecting children in your care [12]

The second most common suspected mode of transmission reported in 2006 was food (four outbreaks), although no foods were found positive for VTEC during investigations. Confirmation of the role of food in small family outbreaks is difficult, as leftovers are rarely available for testing due to the potentially long interval between exposure and symptom onset. A growing number of foodborne VTEC outbreaks in the United States and Europe have been linked with fresh produce, in particular lettuce and spinach.[2,13] Non-meat food items should not be overlooked as potential vehicles of infection in VTEC cases.

As in previous years, evidence was again obtained showing that untreated drinking water plays an important role in VTEC transmission in Ireland.[1,14] There were two incidents where examination of water from the private wells of affected households confirmed the presence of *E. coli* O157 indistinguishable from the associated human isolates. Drinking water from untreated private water supplies remains an important risk factor for VTEC infection in Ireland.

Given the relatively high incidence of human VTEC infection in Ireland, a designated VTEC Reference laboratory which is adequately resourced is essential. Sophisticated molecular typing tools employed by the DML-PHL at Cherry Orchard Hospital (such as pulsed field gel electrophoresis) are increasingly demonstrating their value in the investigation of outbreaks and clusters. Safeguarded resourcing of these essential elements of the service will ensure that the necessary surge capacity and responsiveness exists to effectively inform public health action during VTEC incidents.

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