3.3 Verotoxigenic *E. coli*

Summary

Number of VTEC cases, 2015: 730
Crude incidence rate, 2015: 15.9/100,000
Number of VTEC-associated HUS, 2015: 22
Number of VTEC cases, 2014: 707

Introduction

For many years, Ireland has the highest verotoxigenic *Escherichia coli* (VTEC) notification rate in Europe, with the exception of 2011 when Germany reported the highest rate due to a large VTEC O104 outbreak linked with fenugreek seeds.[1-2] In 2015, the notification rate for confirmed VTEC cases in the European Union/European Economic Area was 1.52 per 100,000 (similar to 2014; 1.56/100,000) and the highest country-specific rates were in Ireland, Sweden and the Netherlands (12.92, 5.65 and 5.08 per 100,000 population, respectively).[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.[4-8] 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.[2, 9-10]

Materials and Methods

Infection with verotoxigenic *E. coli* became a notifiable disease in 2012; prior to that VTEC were notifiable under the category Enterohaemorrhagic *E. coli* (EHEC) since 2004. Enhanced epidemiological information was supplied as in previous years by HSE personnel, and the VTEC National Reference Laboratory at the Public Health Laboratory, Cherry Orchard Hospital Dublin (VTEC-NRL at PHL) provided VTEC confirmation and typing data. Data from all sources are maintained in the Computerised Infectious Disease Reporting (CIDR) system. Outbreaks of VTEC are notifiable since 2004 and these data are reported to CIDR by the eight regional Departments of Public Health. The data presented in this report were extracted from CIDR on 23rd November 2016.

Data from the Central Statistics Office (CSO) 2011 census were used to provide denominators for the calculation of national, regional and age-specific incidence rates in 2015.

Results

Incidence

In 2015, 730 cases of VTEC were notified in Ireland, equating to a crude incidence rate (CIR) of 15.9 per 100,000 (95% CI 14.8-17.1). Compared with 2014 there was a 3% increase in the incidence of VTEC (15.4 per 100,000); p=0.54). Of the 730 VTEC notifications in 2015, 600 (82%) were classified as confirmed cases (CIR 13.1 per 100,000; 95% CI 12.0-14.1), 126 as probable cases and four as possible cases. The criteria under which notified cases were reported in 2015 is outlined in Table 1.

As the classification of VTEC cases changed significantly upon the amendment of the Irish VTEC case definition in 2012, it is not valid to directly compare the number of notifications by case classification before 2012.

Table 1. Number of VTEC notifications by criteria for notification, Ireland, 2015

Notification criteria	Confirmed	Probable	Possible	Total
Laboratory confirmation by culture[a]	483	88	-	**571**
Laboratory confirmation by PCR only[b]	117	15	-	**132**
Serodiagnosis (valid for HUS only)	-	-	-	**0**
Reported solely on the basis of epidemiological link	-	23	-	**23**
Clinical HUS not meeting lab or epi criteria	-	-	4	**4**
Total	**600**	**126**	**4**	**730**

[a] Symptomatic culture confirmed cases are classified as confirmed cases, while asymptomatic culture confirmed cases are classified as probable cases

[b] Symptomatic PCR-confirmed cases are classified as confirmed cases, while asymptomatic PCR-confirmed cases are classified as probable cases

Of the 703 cases with laboratory evidence of infection, 241 cases (34%) were reported as being infected with *E. coli* O26 (5.3 per 100,000; 95% CI 4.6-5.9), 150 cases (21%) with *E. coli* O157 (3.3 per 100,000; 95% CI 2.7-3.8), 308 cases (44%) with other VTEC strains, and 4 cases had mixed VTEC infections and were infected with more than one VTEC strain. Of the 23 probable cases reported on the basis of an epidemiological link to a confirmed case, one was linked to an *E. coli* O157 case, one was linked to an *E. coli* O26 case and 21 were linked to an outbreak due to mixed VTEC infection. Figure 1 illustrates the distribution of VTEC cases in Ireland by serogroup since 1999. The downward trend in VTEC infections due to *E. coli* O157 and the upward trend in *E. coli* O26 observed in recent years continued in 2015. Compared with 2014, there was a 16% decrease in O157 infections, a 3% increase O26 infections and a 7% increase in other non-O157/non-O26 infections.

Severity of illness

Of the 730 notified cases in 2015, 622 (85%) were symptomatic and 197 (32%) of the symptomatic cases developed bloody diarrhoea (36% of symptomatic cases when limited to where the bloody diarrhoea variable is completed). Twenty-two individuals (3%) developed HUS, a decrease of 19% on 2014 (n=27) and of 29% on 2013 (n=31). In 2015, five deaths occurred among VTEC cases, however only one of these five deaths was attributed to VTEC infection. Where hospitalisation status was reported (n=714), 237 (33%) of these cases were hospitalised (36% of symptomatic cases).

Of the 22 HUS cases, seven were infected with *E. coli* O26, four with *E. coli* O157, two ungroupable and one each with *E. coli* O103, O145 and O177 (Table 2). Of the remaining six HUS cases, two were reported as confirmed cases (verotoxin genes detected in stool samples but no isolate was cultured) and four were possible cases (i.e. clinical HUS, without laboratory or epidemiological criteria). Although, numbers are small, 27% (i.e. 3 of 8) *E. coli* O26 vertotoxin 2 (*vt2*) developed HUS.

HUS cases ranged in age from 6 months to 74 years and 73% (n=16) of the cases were in children under 10 years of age. Fifteen of the HUS cases were considered sporadic,

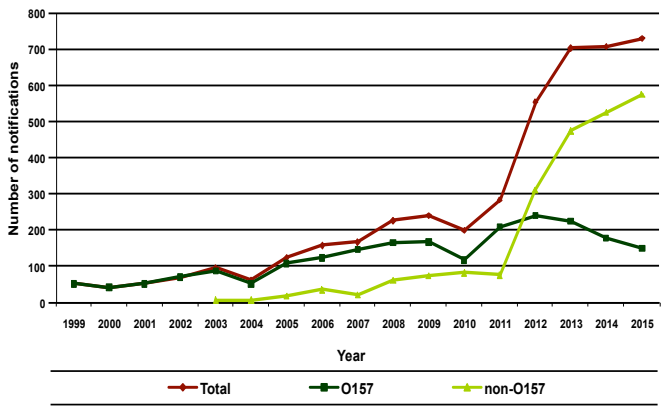

Figure 1. Annual number of confirmed and probable VTEC cases by serogroup, Ireland 1999-2015

Note: For simplicity in this figure, cases with mixed VTEC O157/other serogroup infections are included in the data for O157, as are probable cases linked to known *E. coli* O157 outbreaks. Non-O157 data includes cases with mixed non-O157 infections and probable cases linked to known O26 outbreaks

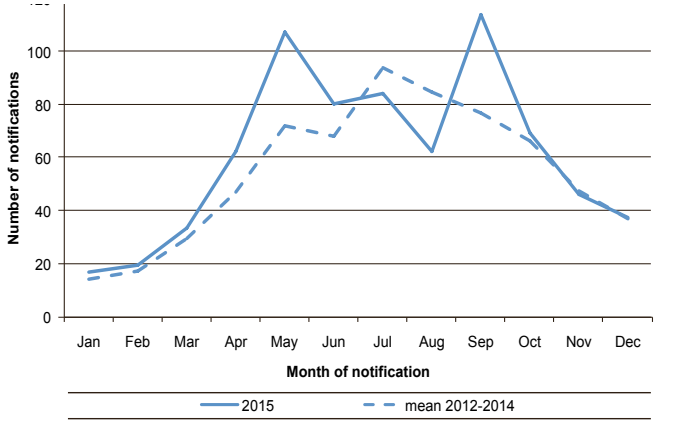

Figure 2. Seasonal distribution of the number of VTEC notifications in Ireland, 2015 and the mean of 2012-2014

Table 2. Number of VTEC notifications by serogroup, verotoxin and HUS status, Ireland, 2015

Serogroup[a]	Verotoxin	HUS	non-HUS	Total	% with HUS
O26	*vt1*	0	77	**77**	0.0%
	vt2	3	8	**11**	27%
	vt1+vt2	4	150	**154**	2.6%
	Not reported	0	1	**1**	0.0%
O157	*vt1*	0	0	**0**	0.0%
	vt2	4	115	**119**	3.4%
	vt1+vt2	0	32	**32**	0.0%
	Not reported	0	1	**1**	0.0%
Other	*vt1*	0	117	**117**	0.0%
	vt2	6	125	**131**	4.6%
	vt1+vt2	1	57	**58**	1.6%
	Not reported	0	3	**3**	0.0%
No organism	Unknown	4	22	**26**	15.4%
Total		**22**	**708**	**730**	3.0%

[a]For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

four were part of family outbreaks and three were part of general outbreaks (including two cases linked to the same community outbreak).

Seasonal distribution

Figure 2 shows the seasonal distribution of notifications in 2015 relative to the mean monthly number of cases in the years 2012-2014. The typical summer peak normally seen in July was not observed in 2015; two distinct peaks were seen of almost similar magnitude, one in April and the other in September. However, examining the seasonal distribution by serogroup variations were observed; O26 and non-O157/non-O26 (others) had a bimodal distribution (Figure 3). *E. coli* O26 peaked in July and September and non-O157/non-O26 (others) peaked in May and September. Although, the numbers of *E. coli* O157 notifications peaked in September, this peak was not as pronounced as previous years and was preceded with smaller peaks in May and July (Figure 3).

Regional distribution

In 2015, the highest VTEC incidence rates were reported in the HSE-W followed by the HSE-M, HSE-MW and HSE-SE, where the rates were significantly higher than the national crude incidence rate (Table 3). The incidence of VTEC in HSE-E and HSE-NW were significantly lower than the national crude incidence rate. The highest incidence of HUS amongst VTEC cases was in HSE-M and HSE-MW (Table 3). In the eight HSE areas, the incidence of *E. coli* O26 in 2015 exceeded or equaled that of *E. coli* O157 (Figure 3). Other serogroups (i.e. non-O157/non-O26) accounted for the highest rates of VTEC infections in five of the eight HSE areas (Figure 3)

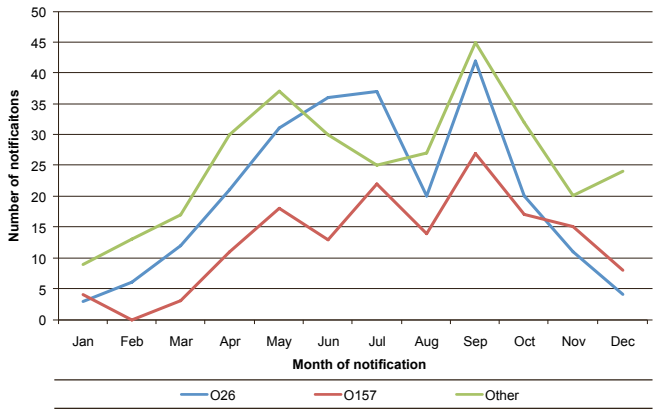

Figure 3: Seasonal distribution of VTEC notifications by serogroup, Ireland, 2015

For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

Age-sex distribution

As in previous years, the highest reported age-specific incidence rate in 2015 was in the 0-4 year age group (81.4 per 100,000). Incidence rates were higher among females in all age groups 20 years of age and older but were slightly higher in males in those <15 years of age (Figure 5).

Laboratory typing

In 2015, the serogroup and verotoxin profiles of VTEC isolates/samples referred to the VTEC-NRL at PHL, Cherry Orchard Hospital are presented in Table 4. The most common serogroup reported was *E. coli* O26 (n=241), followed by *E. coli* O26 (n=150). Among the other serogroups listed by the World Health Organisation as having the highest association with HUS internationally, there were 41 *E. coli* O145, 15 *E. coli* O103 cases and 6 *E. coli* O111. Although numbers are relatively small, infections due to O145 continued to increase from 17 cases in 2013, to 31 cases in 2014 and 41 cases in 2015.

As usual among *E. coli* O157 cases in Ireland, isolates containing the genes for *vt2* were more common (78%) than strains containing genes for both *vt1* and *vt2*. Among the VTEC O26 strains those containing the genes for both *vt1* and *vt2* accounted for the majority (64%), followed by *vt1* only (32%) and those containing *vt2* making up the remaining 4% of *E. coli* O26 cases. In contrast, the majority (85%) of O145 strains were *vt2*-postive. Furthermore, *vt1*-containing strains made up the majority of O103 strains (87%), while VTEC O111 comprised of *vt1* (50%) and *vt1+vt2* (50%) containing strains (Table 4).

Risk factors

Under the enhanced surveillance system for VTEC, risk factor information is routinely collected on all notifications (Table 5).

Exposure to farm animals or their faeces and exposure to private well water were relatively common among cases in

Table 3. Number and crude incidence rates of by serogroup and HSE area, and number and crude incidence rate of VTEC-associated HUS by HSE area, Ireland, 2015

HSE-area	Number of VTEC cases	Crude incidence rate /100,000 (95% CI)	Number HUS cases	Incidence of HUS /100,000 (95% CI)
E	84	5.2 (4.1-6.3)	3	0.2 (0.0-0.4)
M	85	30.1 (23.7-36.5)	3	1.1 (0.0-2.3)
MW	109	28.7 (23.3-34.1)	4	1.1 (0.0-2.1)
NE	67	15.2 (11.6-18.8)	1	0.2 (0.0-0.7)
NW	25	1.9 (5.9-13.5)	0	0.0 (0.0-0.0)
S	112	16.9 (13.7-20.0)	4	0.6 (0.0-1.2)
SE	112	22.5 (18.3-26.7)	3	0.6 (0.0-1.3)
W	136	30.5 (25.4-35.7)	4	0.9 (0.0-1.8)
IE	**730**	**15.9 (14.8-17.1)**	**22**	**0.5 (0.3-0.7)**

2015; 37.9% and 33% reported these exposures, respectively. 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 appears 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 (>97%).

Where the information was available, just under a fifth of VTEC cases in 2015 were attending a childcare facility (CCF). When these analyses were restricted to notified VTEC under five years of age, 43.2% reported attendance at a childcare facility. This is similar to the proportion of children in the general population who use non-parental childcare (42%) as reported by the Central Statistics Office.[11]

Outbreak and environmental investigations

The outbreak surveillance system plays a key role in our understanding of the transmission of VTEC infection in Ireland. Ninety-one VTEC outbreaks were notified in 2015, which included 280 of the 730 VTEC notifications. Forty-one outbreaks were due to *E. coli* O26, 18 to *E. coli* O157, 16 were mixed *E. coli* strain outbreaks, and 16 were caused by other VTEC strains.

The majority of outbreaks (n=78, 86%) were family outbreaks, with 13 general outbreaks also notified. The 73 family outbreaks resulted in 148 persons becoming ill, an average of 1.95 (range 1-7) persons ill per outbreak. The 13 general outbreaks resulted in 84 persons becoming ill, an average of 7 (range 1-44) persons ill per outbreak.

Seventy-four outbreaks occurred in private homes, eight involved extended families, five involved childcare facilities, three were community outbreaks and one was in a residential institution.

The suspected modes of transmission are listed in Table 6.

Person-to-person spread is consistently the most common mode of VTEC transmission reported in Ireland, particularly between young children, and was suspected to have played a role in 51 (56%) VTEC outbreaks in 2015 in which 114 persons were reported ill (Table 6 and Figure 5). Thirty-four of these outbreaks were reported as being solely due to person-to-person transmission, including two outbreaks which occurred in CCFs.

Waterborne transmission was reported to have contributed to 19 outbreaks (21%) with 82 persons ill.

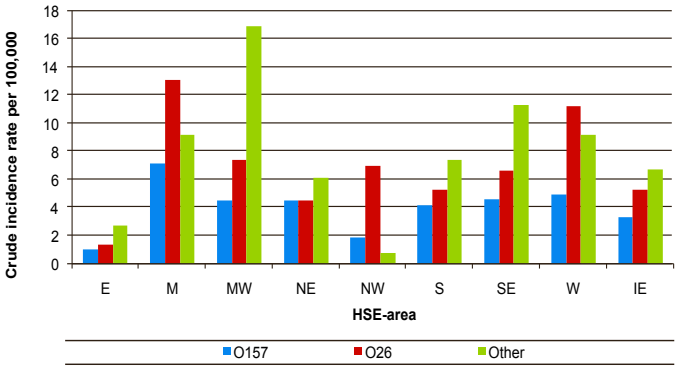

Figure 4: Crude incidence rate VTEC O157, O26 and other serogroups by HSE area, Ireland, 2015
For simplicity mixed infections were recorded as O157 if at least one strain was O157, as O26 if at least one strain was O26 but not O157, and as Other if only non-O157 or non-O26 strains were detected.

Table 4. Serotype and verotoxin (vt) profiles for strains associated with laboratory confirmed VTEC cases, as determined at the VTEC-NRL at PHL, Cherry Orchard Hospital, 2015

Serogroup	vt1	vt2	vt1 + vt2	Not reported	Total
O26	77	11	152	1	**241**
O157	-	117	32	1	**150**
O145	1	35	5	-	**41**
O103	13	2	-	-	**15**
O146	10	-	1	-	**11**
O5	6	-	3	-	**9**
O78	6	1	-	-	**7**
O111	3	-	3	-	**6**
O128ab	-	2	4	-	**6**
O177	2	4	-	-	**6**
O182	6	-	-	-	**6**
O84	6	-	-	-	**6**
O91	1	2	2	-	**5**
O76	2	-	2	-	**4**
O8	-	3	-	-	**3**
O108	2	-	-	-	**2**
O113	-	1	1		**2**
O117	2	-	-	-	**2**
O128ad	-	2	-	-	**2**
O98	2	-	-	-	**2**
O101	-	1	-	-	**1**
O105	-	1	-	-	**1**
O105ac	-	1	-	-	**1**
O117:H17	-	1	-	-	**1**
O126	-	1	-	-	**1**
O130	-	1	-	-	**1**
O136	1	-	-	-	**1**
O136:H12	-	1	-	-	**1**
O141	-	1	-	-	**1**
O149	1	-	-	-	**1**
O150	-	-	1	-	**1**
O156	-	1	-	-	**1**
O174	1	-	-	-	**1**
O178	1	-	-	-	**1**
O185	1	-	-	-	**1**
O186	-	-	1	-	**1**
O2	-	1	-	-	**1**
O22	1	-	-	-	**1**
O71	-	-	1	-	**1**
O74	-	-	1	-	**1**
O87	1	-	-	-	**1**
OE11362-78	-	1	-	-	**1**
OE7477-77	1	-	-	-	**1**
Ungroupable/ unidentifiable	47	33	67	3	**150**
Mixed	-	2	2	-	**4**
Total	**194**	**226**	**278**	**5**	**703**

This is higher than the number of waterborne VTEC outbreaks reported in 2014 (n=9) and 2013 (n=8) but similar to the number reported in 2012 (n=21) (Figure 6). Of the 19 outbreaks with links to waterborne transmission, 16 were family outbreaks with exposure to private wells reported in 13 of these and three were general outbreaks. One of the three general outbreaks occurred in the community resulting in 44 people ill and was linked to a private group water scheme.

Similar to 2014, in 2015 animal/environmental contact was reported to have contributed to nine outbreaks (9.9%) with 20 persons ill. All occurred in private houses (Figure 6).

One outbreak (family outbreak, 2 persons ill) was reported as foodborne and linked to unpasteurised cheese while another family outbreak with three persons ill was reported as food/waterborne, where the individuals had been exposure to unpasteurised milk and water from a private well.

For 31% (n=28) of VTEC outbreaks in 2015, the transmission route was reported as unknown (Table 6 and Figure 6).

Summary

The number of VTEC notifications in Ireland continued to rise (but not significantly) in 2015. Within the European Union, Ireland continues to have the highest incidence rate for VTEC, reporting over seven times the European average in 2015.[3]

The upward trend observed in Ireland in recent years of non-O157 notifications continued in 2015 and reflects the more widespread use by the primary hospital laboratories, of diagnostic methods that detect a broader range of *E. coli* serogroups and the use of more sensitive molecular methods that detect verotoxin genes directly in stool samples[12] Furthermore, national guidance developed for the laboratory diagnosis of human VTEC in Ireland provides a co-ordinated approach to VTEC diagnosis in Ireland.[13]

Foodborne transmission was the first recognised transmission route for VTEC infection historically, with minced beef, unpasteurised dairy products, and fresh produce consumed raw all having been implicated in outbreaks across the world. Foodborne outbreaks typically comprise a small percentage of the total number of VTEC outbreaks in Ireland and 2015 was not an exception with foodborne outbreaks comprising 2.2 % of the VTEC outbreaks notified.

Transmission by person-to-person spread, however, remained the most common transmission route reported in VTEC outbreaks and was involved in 56% of outbreaks. As usual, person-to-person spread was most frequently associated with private house and childcare facility outbreaks. Hand-washing and exclusion of cases in risk groups from high risk settings remains a key prevention measures for VTEC.[14]

In 2015, after person-to person spread, contaminated drinking water was the second most commonly suspected mode of transmission. As in previous years, the majority of the drinking-water associated outbreaks reported were linked with private water supplies and one outbreak was

Table 5. Number of cases of VTEC (and percentage where information available) for selected risk factors, Ireland, 2015 (n=730)

Risk factor	Yes (% of known)	No	Unknown or not reported
Food suspected	27 (5.4)	473	230
Exposure to farm animals or their faeces	245 (37.9)	402	83
Exposure to private well water[a]	215 (33.0)	437	78
Travel-associated[b]	18 (2.7)	645	67
Attendance at a CCF[c]	112 (18.8)	485	133
Attendance at a CCF[c] (among <5 yrs)	104 (43.2)	137	49

[a]Composite variable recoded from two different water supply exposure enhanced variables in CIDR
[b]Inferred from CIDR core variable *Country of Infection*
[c] *CCF=childcare facility*

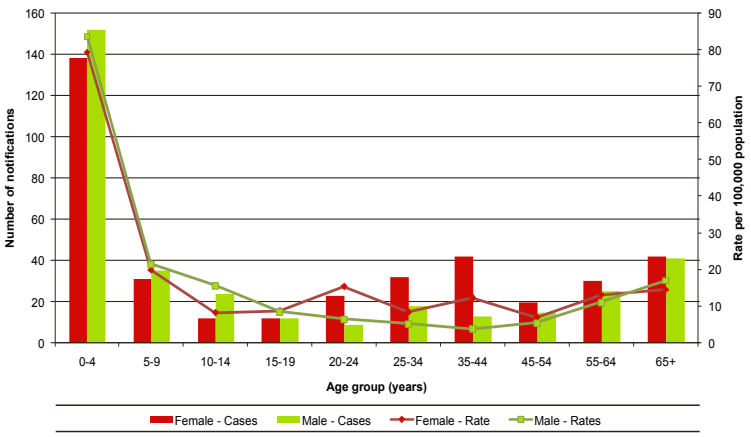

Figure 5. Age-sex distribution VTEC notifications, Ireland, 2015

linked to contaminated water from a private group water scheme. Exposure to water from contaminated untreated or poorly treated private water supplies has historically been recognised as a strong risk factor for VTEC infection in Ireland.[6-8, 15]This has been particularly pronounced following periods of heavy rainfall.

Animal/environmental contact was reported as the third most common route of transmission for VTEC outbreaks in 2015. This has long been recognised as a risk factor for VTEC infection [9-10] and cases due to this transmission route are not unexpected in Ireland given the large cattle population, the high proportion of rural dwellers, and the large number of farming families.[8] Fortunately, none of these animal contact outbreaks were associated with public venues such as open farms, and so the numbers of people affected were small. Advice is available on the HPSC website on how to minimise the risk of gastrointestinal infections following exposure to farm animals and environments, and for the safe recreational use of farmland.[16]

The focus for reducing the incidence of VTEC should be on reducing person-to-person and waterborne transmission. Efforts should focus initially on publicizing materials already developed in Ireland, including national guidance for crèche owners on the management of infectious-disease spread in CCFs[17], guidance for public health professionals on the management of VTEC cases and outbreaks in CCFs[14] and a leaflet developed for well owners outlining the infectious disease risks associated with drinking water from private wells, providing advice on actions that can be taken and what to do in the event the well water is contaminated.[18]

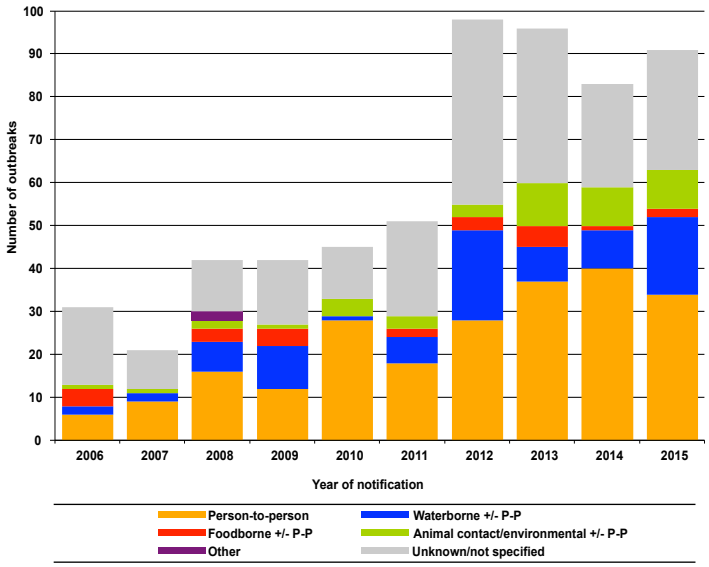

Figure 6. Number of VTEC outbreaks by suspected transmission route and year, Ireland, 2006-2015

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 other 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

Table 6. VTEC outbreaks by suspected mode of transmission, Ireland, 2015

Transmission route	Number of outbreaks	Number ill	Number of associated CIDR events[a]
Person-to-person	34	73	83
Foodborne	1	2	2
Waterborne	8	55	57
Person-to-person and waterborne	10	24	29
Foodborne and waterborne	1	3	3
Animal contact	2	3	4
Person-to-person and animal contact	7	17	17
Unknown	28	55	85
Total	**91**	**232**	**280**

[a] These figures may differ from the number ill, as asymptomatic cases identified as a result of screening will also be reported in CIDR

References

1. ECDC. 2011. Epidemiological updates on the VTEC O104 outbreak. http://ecdc.europa.eu/en/healthtopics/escherichia_coli/whats_new/Pages/epidemiological_updates.aspx
2. EFSA Tracing seeds, in particular fenugreek (*Trigonella foenum-graecum*) seeds, in relation to the Shiga toxin-producing *E. coli* (STEC) O104:H4 2011 Outbreaks in Germany and France. 2011. http://ecdc.europa.eu/en/press/news/Lists/News/ECDC_DispForm.aspx?List=32e43ee8%2De230%2D4424%2Da783%2D85742124029a&ID=455&RootFolder=%2Fen%2Fpress%2Fnews%2FLists%2FNews
3. ECDC. Surveillance Atlas of Infectious Diseases. Available at http://atlas.ecdc.europa.eu/public/index.aspx?Instance=GeneralAtlas
4. Garvey, P. et al. 2010. Epidemiology of verotoxigenic *E. coli* in Ireland, 2007. Epi-Insight: 11(9)
5. Locking et al. 2010. *Escherichia coli* O157 Infection and Secondary Spread, Scotland, 1999–2008 EID 17(3): 524 http://www.cdc.gov/eid/content/17/3/pdfs/524.pdf
6. O'Sullivan et al. 2008. Increase in VTEC cases in the south of Ireland: link to private wells? Eurosurveillance 13(39) http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=18991
7. HPSC. 2008. Press release. Householders must properly maintain private water supplies following increase in contamination – HPSC. http://www.hpsc.ie/hpsc/PressReleases/2008PressReleases/MainBody,3127,en.html
8. Óhaiseadha C, Hynds PD, Fallon UB, O›Dwyer J. 2017. A geostatistical investigation of agricultural and infrastructural risk factors associated with primary verotoxigenic E. coli (VTEC) infection in the Republic of Ireland, 2008-2013. Epidemiol Infect. 145(1):95-105.
9. Locking et al. 2001. Risk factors for sporadic cases of *Escherichia coli* O157 infection: the importance of contact with animal excreta. Epidemiol Infect. 127(2):215-20. http://journals.cambridge.org/download.php?file=%2FHYG%2FHYG127_02%2FS095026880100604 5a.pdf&code=6ed8f62e070b25379a01ec5fab104dcd
10. Griffin. 2010. Review of the major outbreak of *E. coli* O157 in Surrey, 2009 http://www.griffininvestigation.org.uk/
11. Central Statistics Office. 2009. Quarterly National Household Survey. Childcare. Quarter 4 2007. Accessed at http://www.cso.ie/en/media/csoie/releasespublications/documents/labourmarket/2007/childcareq42007.pdf
12. Rice T, Quinn N, Sleator RD, Lucey B. 2016. Changing diagnostic methods and decreased detection of verotoxigenic *Escherichia coli*, Ireland. Emerg Infect Dis. 22(9); 1656-1657.
13. HPSC. 2014. Guidance for Laboratory Diagnosis of Human Verotoxigenic *E. coli* Infection produced by The Laboratory Sub-Group of the VTEC Sub-Committee of the Health Protection Surveillance Centre Scientific Advisory Committee, Ireland. Available at http://www.hpsc.ie/A-Z/Gastroenteric/VTEC/Guidance/ReportoftheHPSCSub-CommitteeonVerotoxigenicEcoli/File,4544,en.pdf
14. HPSC. 2013. VTEC (Verocytoxigenic *E. coli*) in Childcare Facilities: Decision Support Tool for Public Health. Accessed on October 7th at http://www.hpsc.ie/hpsc/A-Z/Gastroenteric/VTEC/Guidance/ReportoftheHPSCSub-CommitteeonVerotoxigenicEcoli/File,4559,en.pdf
15. Garvey P, Carroll A, McNamara E, McKeown P. 2016. Verotoxigenic Escherichia coli transmission in Ireland, a review of notified outbreaks, 2004-2012. Epidemiol Infect. 144; 917-926.
16. HPSC. VTEC Guidance. http://www.hpsc.ie/A-Z/Gastroenteric/VTEC/Guidance/
17. HPSC Preschool and Childcare Facility Subcommittee. 2012. Management of Infectious Disease in Childcare Facilities and Other Childcare Settings. Accessible at http://www.hpsc.ie/hpsc/A-Z/LifeStages/Childcare/
18. Health Service Executive. 2013. Leaflet on the Risk of illness from well water http://www.lenus.ie/hse/bitstream/10147/294332/1/Leaflet_Precautions%20and%20advice%20for%20reducing%20risk%20of%20illness%20from%20well%20water.pdf