



Surveillance report.

STEC in Scotland 2017: Enhanced Surveillance and Reference Laboratory Data

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Introduction

Shiga toxin-producing *Escherichia coli* (STEC), previously referred to as Verotoxigenic *E. coli* (VTEC), are a group of bacteria which can cause gastrointestinal illness in humans. STEC are widespread in the environment and can colonise the gastrointestinal tract of farmed, wild, and domesticated animals and birds and can be shed in their faeces. Ruminants (cattle, sheep and goats) are considered to be the main reservoir of infection although STEC causes no clinical signs of infection in the animal. Transmission to humans can occur as a result of direct contact with STEC-contaminated faecal material, as a result of handling or petting animals or by exposure to faecally contaminated mud or vegetation during recreational activities. Exposure can also occur from consumption of water or food which is contaminated.

Symptoms of STEC infection range from asymptomatic infection, to mild non-bloody diarrhoea, through to bloody diarrhoea, abdominal pain and occasionally fever. Serious outcomes of infection can include haemolytic uraemic syndrome (HUS) which has been shown to be a major cause of acute renal failure in children in Scotland.¹

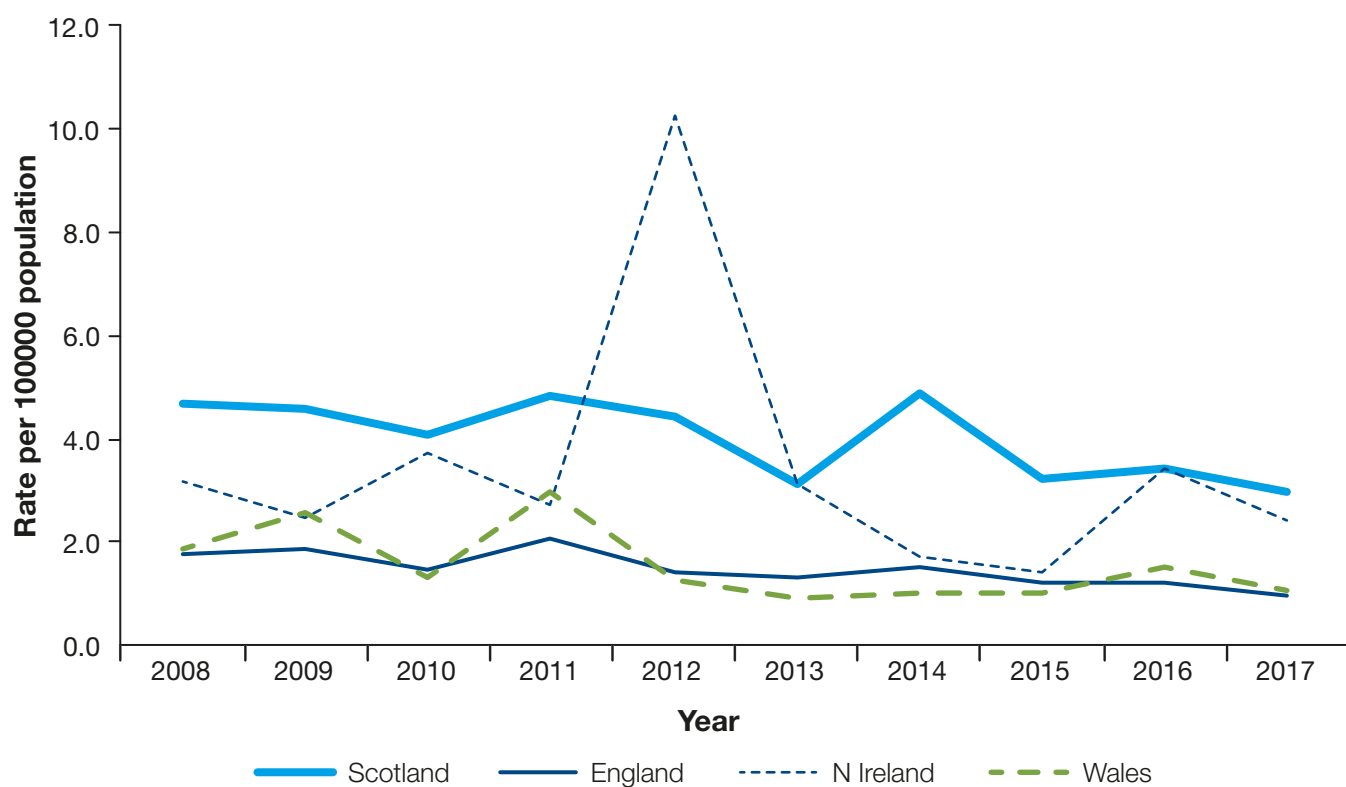
Although large foodborne outbreaks have occurred in Scotland,^{2,3} sporadic infection predominates. In Scotland, *Escherichia coli* O157 (*E. coli* O157) is the most commonly detected STEC serogroup and its potential to cause both secondary spread⁴ and large outbreaks is exacerbated by its low infectious dose.^{2,3} Asymptomatic carriage can also occur.⁵

Diagnostic laboratories investigate all diarrhoeal faeces for the presence of *E. coli* O157 and refer isolates to the Scottish *E. coli* O157/STEC Reference Laboratory (SERL) for confirmation and further typing. STEC of serogroup O157 are the only STEC for which routine standard tests are performed in diagnostic laboratories. Under national guidelines, faeces from high risk patients testing negative at the local laboratory are sent to SERL where more sensitive methods are used for detection and isolation of STEC.⁶

Health Protection Scotland undertakes enhanced surveillance of STEC in close collaboration with SERL and NHS Board health protection teams. Data is also integrated with other surveillance systems, in particular ObSurv, the system for the surveillance of all general outbreaks of infectious intestinal disease.⁷

Reported rates of *E. coli* O157 infection in Scotland rose substantially in the mid-1990s and remain consistently high compared to other countries within the UK and Europe ([Figure 1](#)).

Figure 1: *E. coli* O157: rates per 100,000 population – culture positive cases, UK 2008-2017.*



* Data outwith Scotland courtesy of Public Health Wales, Public Health Agency (NI) and Public Health England. Data for Wales, N Ireland and England include shiga toxin positive cases only. All data for 2017 are provisional.

In addition to *E. coli* O157, laboratory and surveillance data is also captured on non O157 STEC which account for around a third of all STEC in Scotland.

Methods

HPS defines a case as a single person-infection episode with local laboratory or SERL laboratory confirmation of infection by one or more of the following:

- Positive culture (isolates of *E. coli* O157 or other serogroups cultured from faeces)

or

- Positive faecal PCR for Shiga toxin genes, and/or an *E. coli* O157 specific gene, but not confirmed by culture

or

- Serum positive (antibodies to O157 or other serotypes detected in blood serum).

Both symptomatic and asymptomatic cases are included.

HPS surveillance systems collect information about general outbreaks i.e. those affecting members of more than one household, or residents of institutions.⁷ Other cases are therefore either apparently sporadic or occur amongst members of a single household. For ease of comprehension, we refer to cases in general outbreaks as outbreak cases; we refer to cases or clusters restricted to single households as sporadic cases, irrespective of whether they are secondary or primary cases.

Imported infections are defined as those cases from whose onset date, incubation period, and travel and other exposure histories, local investigators judge that the infection was more likely to have been acquired outside the UK than from any other identifiable source.

This report presents analyses of the main variables for STEC infections reported to HPS in 2017.

To allow comparison with previous years, only faecal culture positive cases were included in the following analyses. Cases identified by serodiagnosis or PCR without culture confirmation were excluded. Data for *E. coli* O157 and non-O157 STEC are presented separately.

All data for 2017 will be provisional until 31 December 2018.

Results

E. coli O157

In 2017, a total of 167 cases of *E. coli* O157 reported to HPS. The methods of identification of these are described in [Table 1](#).

Table 1: Laboratory confirmed reports of *E. coli* O157.

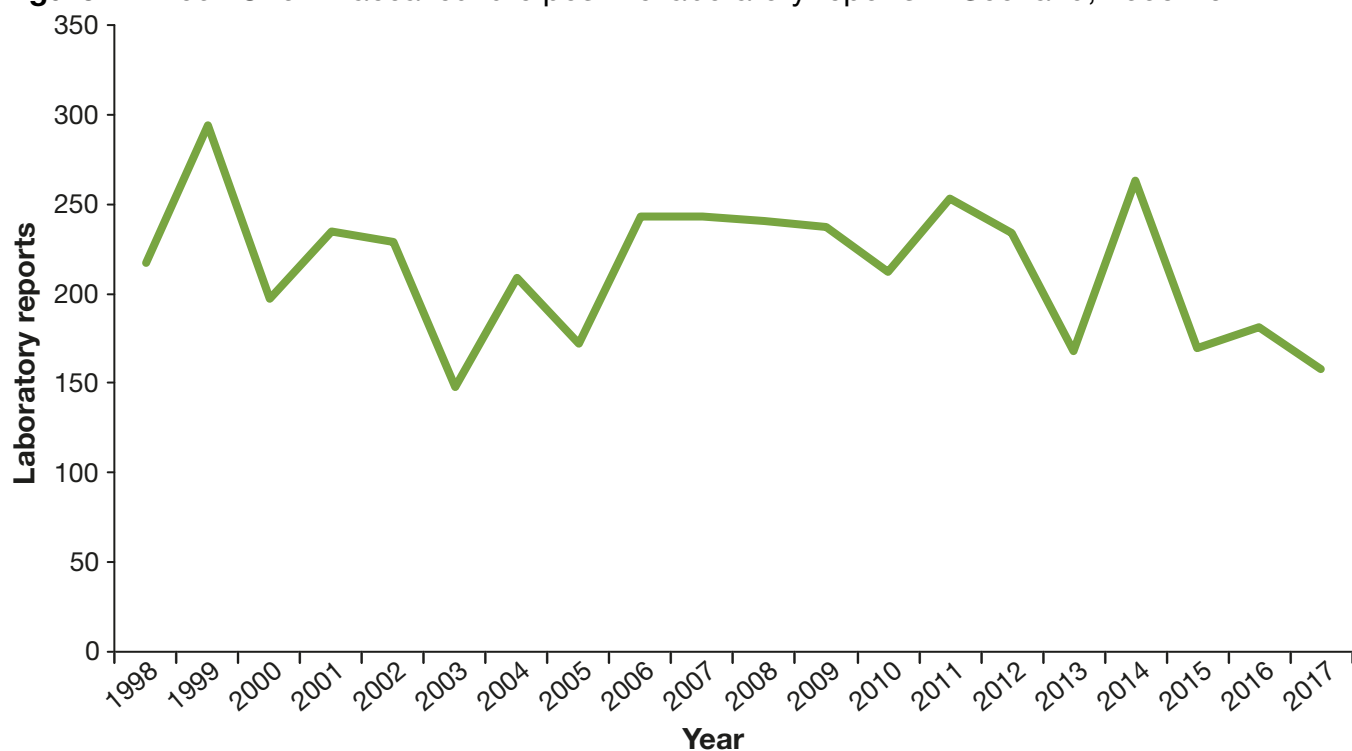
| Method of laboratory confirmation | Total |
|-----------------------------------|-------|
| Culture positive (faeces) | 158* |
| PCR positive, culture negative | 7 |
| Serum positive only | 2 |

*2 cases had two different phage types.

There were 158 faecal culture positive cases of *E. coli* O157 notified to HPS in 2017. Two cases were identified as having a dual infection with two different phage types of *E. coli* O157. This represented a decrease of around 12% on the 181 cases reported in 2016. This decrease was also observed in the rest of the UK.

One case was confirmed at the local diagnostic microbiology laboratory, however the isolate was not received at SERL for further typing. Three culture confirmed cases were also serum positive.

Figure 2: *E. coli* O157: Faecal culture positive laboratory reports in Scotland, 1998-2017.



Geographical distribution and incidence rates

Table 2: *E. coli* O157: NHS board, rates per 100,000 – faecal culture positive cases.

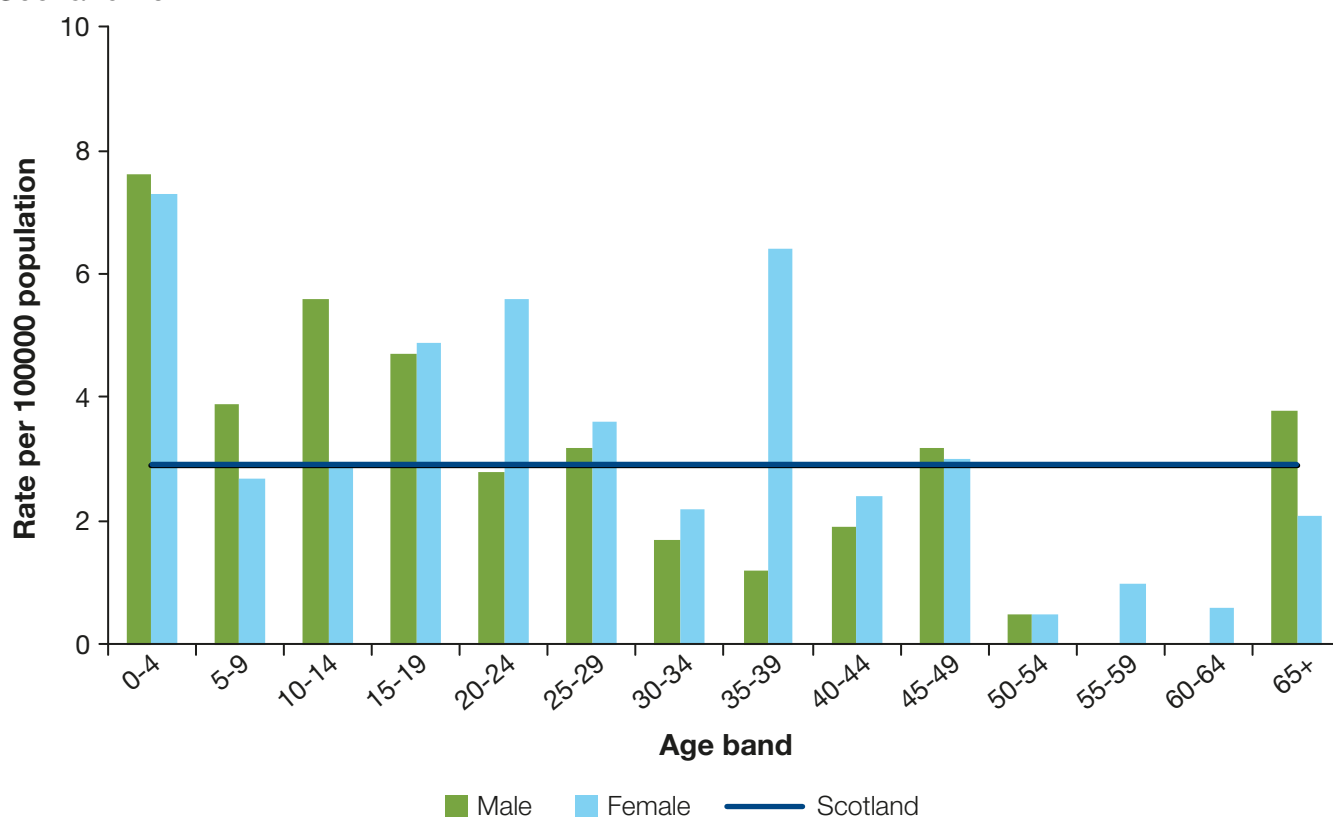
| NHS board | 2017 | 2016 | 2015 |
|-------------------------|------------|------------|------------|
| Ayrshire & Arran | 3.5 | 2.7 | 5.9 |
| Borders | 3.5 | 2.6 | 3.5 |
| Dumfries & Galloway | 3.4 | 10.7 | 10.0 |
| Fife | 1.9 | 2.2 | 2.5 |
| Forth Valley | 2.6 | 2.0 | 2.7 |
| Greater Glasgow & Clyde | 2.2 | 2.5 | 2.2 |
| Grampian | 6.1 | 5.6 | 5.5 |
| Highland | 3.1 | 3.4 | 2.5 |
| Lanarkshire | 1.8 | 3.1 | 2.4 |
| Lothian | 2.0 | 2.0 | 2.0 |
| Orkney | 13.7 | 4.6 | 23.2 |
| Shetland | 4.3 | 0 | 4.3 |
| Tayside | 3.6 | 5.8 | 1.9 |
| Western Isles | 0 | 11.0 | 0.0 |
| All Scotland | 2.9 | 3.4 | 3.2 |

The rate of faecal culture positive cases per 100,000 population for the whole of Scotland in 2017 was 2.9, compared to 3.4 in 2016 and 3.2 in 2015 ([Table 2](#); [Figure 1](#)). Incidence rates varied across Scotland, as they have done historically. The overall rates decreased in 7 of the 14 NHS boards compared with the previous year. The rates for NHS boards with small populations should be interpreted with caution as small numbers can disproportionately affect the incidence rates.

Age and sex

The age distribution of the 158 faecal culture positive cases ranged from less than one to over eighty years of age, with a mean age of 33 years. 47.5% of cases were male and 52.5% were female. Children under 16 years of age accounted for 27% of cases and 18% of cases were aged over 65 years. As seen in previous years, children under 5 years of age had the highest rate of infection, with an overall rate of 7.1 per 100,000 people. The age stratified rates per 100,000 population for males and females are shown in [Figure 3](#).

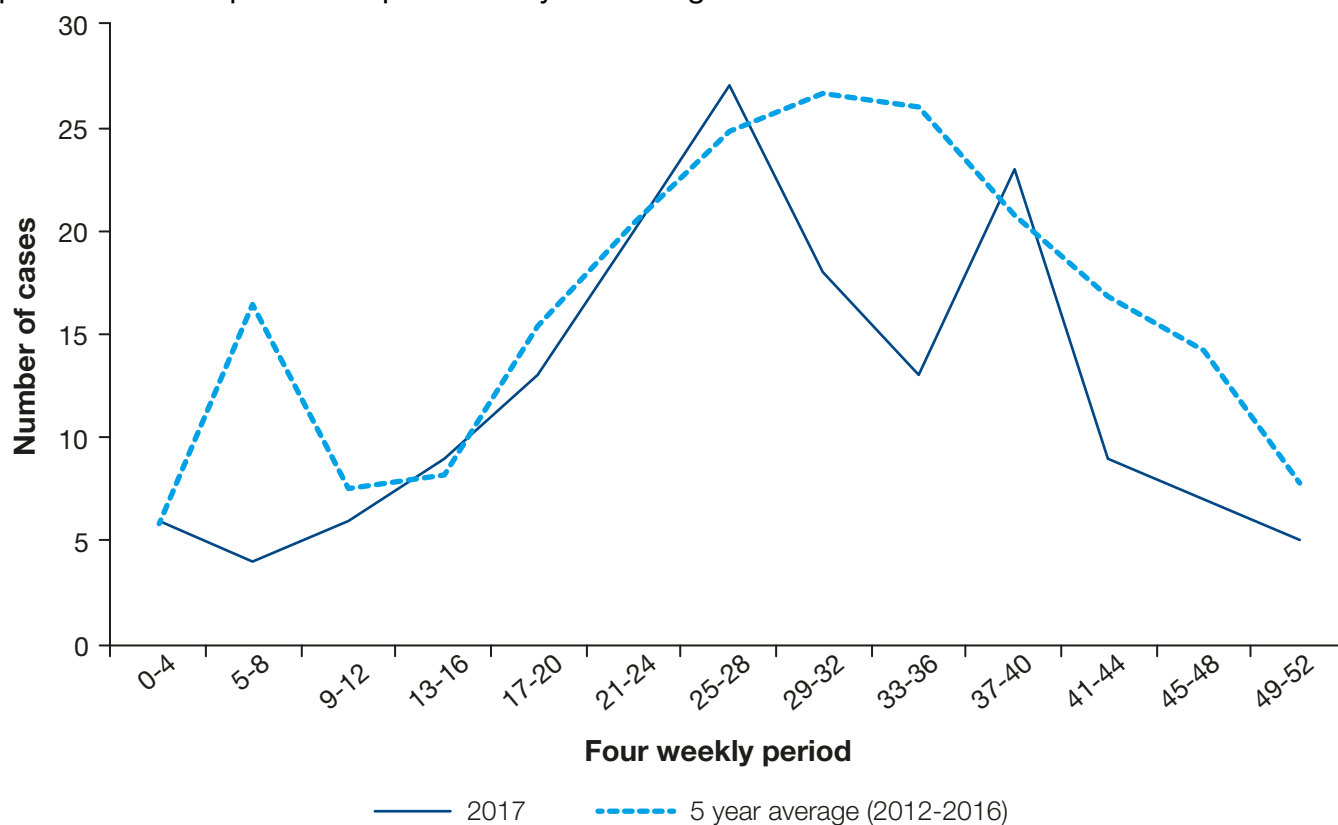
Figure 3: Age stratified rates per 100,000 population, faecal culture positive *E. coli* O157, Scotland 2017.



Seasonality

The number of cases per 4 week period is shown in [Figure 4](#). As in most years, cases tend to peak in the summer months. Most infections occurred in the second and third quarters of the year, with 73% of cases occurring in this time period.

Figure 4: *E. coli* O157: faecal culture positive cases in Scotland, 2017, by 4-week reporting period with comparison to previous 5 year average.



Reference Laboratory data

Isolates of *E. coli* O157 identified by local diagnostic laboratories are routinely sent to SERL for further typing. This includes phenotypic characterisation – phage typing, antimicrobial sensitivity testing as well as genotypic typing – PCR and MLVA analysis. Following an extensive pilot study, whole genome sequencing (WGS) typing was introduced at SERL in August 2017 and is now a UKAS accredited test (ISO 15189). This has replaced MLVA as a more discriminatory method of typing and has also replaced antimicrobial sensitivity testing (using the disk diffusion assay). This additional typing facilitates more accurate identification of outbreaks and in the case of non-O157 STEC, more rapid outbreak detection. For the first time, we are able to compare all Scottish STEC with those from England and Wales on a real time basis to detect UK outbreaks. This has significantly altered surveillance capabilities enabling more timely public health investigation and action.

Phage type (PT) results for culture positive *E. coli* O157 isolates are reported to HPS by SERL. As seen in previous years, PT21/28 and PT8 remain the two most frequently reported phage types. In 2017 however, the proportion of PT21/28 decreased from 44% of reports in 2016 to 27% in 2017 (Table 3). The high number of reports in 2016 of PT21/28 was due mainly to an outbreak of this phage type associated with the consumption of unpasteurised cheese where 26 cases were reported, 21 of whom were resident in Scotland.⁸

Table 3: Phage types of *E. coli* O157 reported in 2017 and 2016.

| Phage type | 2017 | 2017 % of total* | 2016 | 2016 % of total |
|--------------|------|------------------|------|-----------------|
| PT21/28 | 43 | 26.9% | 80 | 44.2% |
| PT 8 | 29 | 18.1% | 34 | 18.8% |
| PT RDNC | 24 | 15% | 8 | 4.4% |
| PT 32 | 20 | 12.5% | 11 | 6.1% |
| PT 4 | 9 | 5.6% | 4 | 2.2% |
| PT Untypable | 8 | 5.0% | 8 | 4.4% |
| PT 31 | 7 | 4.4% | 4 | 2.2% |
| PT 14 | 5 | 3.1% | 4 | 2.2% |
| PT 34 | 5 | 3.1% | 11 | 6.1% |
| PT 1 | 4 | 2.5% | 1 | 0.6% |
| PT 54 | 3 | 1.9% | 9 | 5.0% |
| PT 2 | 1 | 0.6% | 7 | 3.9% |
| PT 67 | 1 | 0.6% | 0 | 0.0% |

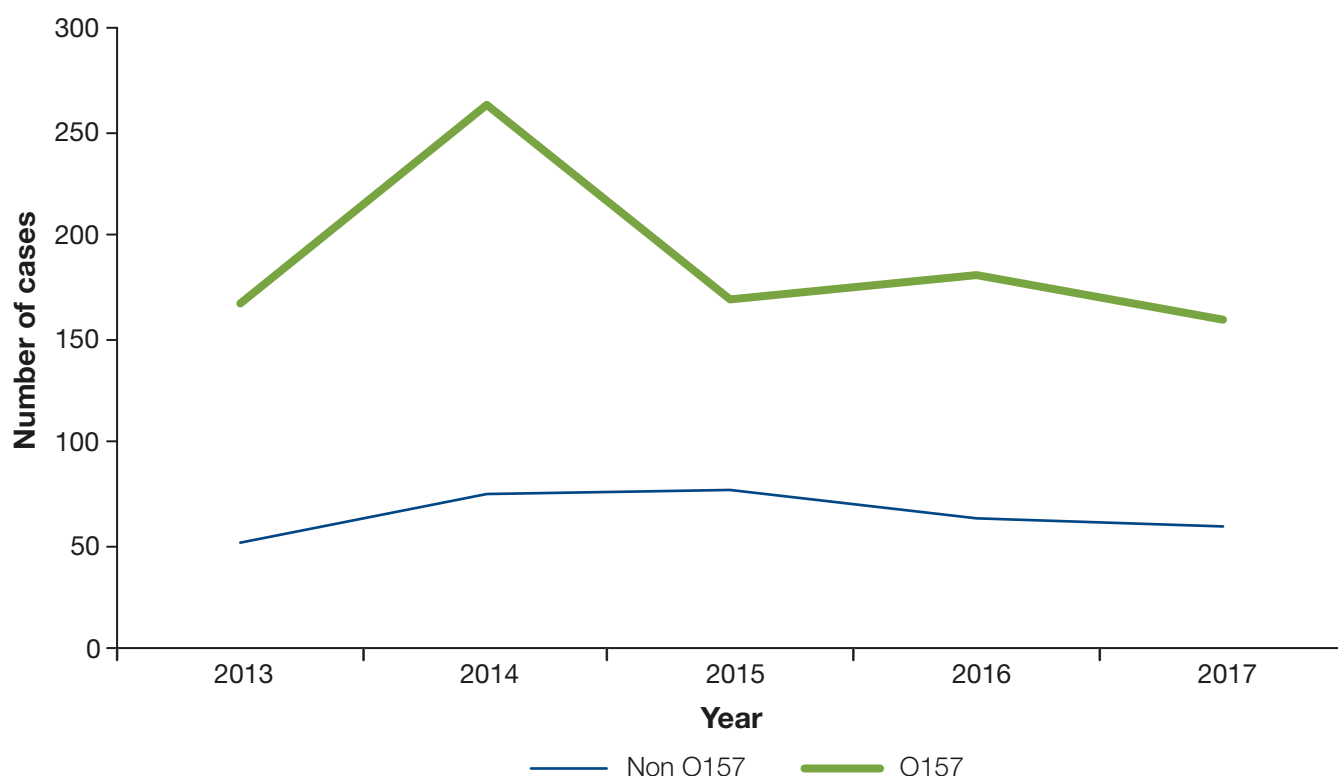
*Two cases had dual infection with PT32/PT34 & PT1/PT8; one case had no phage type result as the isolate was not received at SERL.

Of the 158 *E. coli* O157 culture positive isolates received at SERL in 2017, 31 (19.5%) had no identifiable shiga toxin-producing genes. This was an increase on the 22 (12.2%) shiga toxin negative cases reported in 2016.

Non-O157 STEC

E. coli O157 is the only serogroup of shiga toxin-producing *E. coli* (STEC) routinely detected by diagnostic laboratories in Scotland. Identification of non-O157 STEC therefore requires submission of high risk faecal samples to SERL for further investigation, in line with current Scottish guidance.⁵ In 2017, 59 isolates of non-O157 STEC were cultured and reported by SERL to HPS. This compares to, 63 isolates reported in 2016 and 78 isolates reported in 2015. One person had a dual infection with two different serotypes of non O157. One case of non O157 was also serum positive. In addition, in 2017, there were 25 reports of non-O157 STEC which were not confirmed by culture but were Shiga toxin positive. This was an increase on the 19 reported in 2016. Overall, there were a total of 78 reports of cases with non O157 STEC in 2017.

Figure 5: Faecal culture positive O157 and non-O157 isolates, 2013 - 2017.



In total, nineteen different non-O157 serogroups were identified in 2017, of which 9 were reported on one occasion only. STEC O145 was the most common serogroup and accounted for 13 (22%) of non-O157 faecal culture positive cases. A small cluster of STEC O145 was identified with cases also identified in England. The next most common serogroups were O103 and O26, with 11 and 8 reports respectively. This is the first year O26 was not the most common non-O157 STEC reported. Two isolates were O-Unidentifiable.

Table 4: Non-O157 STEC serogroups reported in Scotland 2017, faecal culture positive reports.

| Serogroup | Total |
|------------------|-------|
| O145 | 13 |
| O103 | 11 |
| O26 | 8 |
| O146 | 3 |
| O166 | 3 |
| O-Unidentifiable | 2 |
| O63 | 2 |
| O91 | 2 |
| O177 | 2 |
| O117 | 2 |
| O113 | 2 |
| Others (9 types) | 9 |

Enhanced surveillance

A standard enhanced surveillance questionnaire is used by health protection teams across Scotland. This collects detailed information on both environmental and food exposures and enables comparison across NHS board areas. In 2017, information on 114 cases (72%) of faecal culture positive *E. coli* O157 and 43 cases (73%) of faecal culture positive non-O157 STEC was provided to HPS following case interviews by the local health protection team.

Information on hospitalisation was available for 157 culture confirmed cases of STEC. Of these, 36% were admitted to hospital for at least one night during their illness. For O157 this figure was 37% and for non-O157 this figure was 33%

Information on clinical presentation was available for 157 culture confirmed cases of STEC. Of these, 71% of cases of STEC reported bloody diarrhoea whilst a further 22% reported diarrhoea with no blood; 6% reported not experiencing any symptoms. Three cases, whilst not reporting diarrhoea of any kind, did report nausea, vomiting or abdominal pain. The clinical presentation of STEC cases are summarised in [Table 5](#) and are also presented for O157 cases and non O157 cases separately.

Table 5: Clinical presentation of culture positive STEC cases in Scotland 2017, for whom enhanced surveillance data is available.

| Clinical Severity | All STEC (N=157) | O157 (N=114) | Non-O157 (N=43) |
|----------------------|------------------|--------------|-----------------|
| Hospitalised | 36% | 37% | 33% |
| Bloody diarrhoea | 71% | 70% | 74% |
| Diarrhoea (no blood) | 22% | 25% | 9% |
| Asymptomatic | 6 % | 4% | 12% |

Sporadic or outbreak cases

During 2017, three general outbreaks of STEC were reported, involving 13 cases. Three different serogroups were involved, O157, O145 and O26. This is slightly less than the number of STEC outbreaks seen in previous years with an average of five outbreaks reported per year over the previous five years (2012-2016).

In two of the outbreaks the main mode of transmission was considered to be foodborne, but in neither was a specific food vehicle identified; in the third, the mode of transmission was considered to be contact with the environment.⁷

As has historically been the case in Scotland,^{2,3} the majority of cases in 2017 were apparently sporadic cases.

Imported infections

Of the 157 cases for which we have information, 15% of all STEC cases were considered to have acquired their infection out-with the UK. For *E. coli* O157 cases, 17% reported travel out with the UK and for non-O157 cases 9% reported travel out with the UK.

Discussion and Conclusions

The number of cases of STEC reported in Scotland decreased slightly in 2017 (both O157 and non-O157 reports). This was in keeping with normal variation expected from year to year.

Despite the variation in the number of cases seen annually, the consistently high rates of STEC infection reported in Scotland as compared to other UK countries, reinforces the need for the continued and comprehensive application of the wide range of existing control measures embedded in food safety and other guidance in Scotland. In addition, it highlights the importance of a comprehensive multi-agency approach to tackling STEC in Scotland as set out in the VTEC Action Plan for Scotland (<http://www.scotland.gov.uk/Publications/2013/11/8897/0>). A multi-agency implementation group was been set up to deliver the recommendations within the Action Plan and is due to report later in 2018.

The NHS Inform web-page has recently been updated, with advice on how to avoid infections, including STEC, whilst enjoying Scotlands outdoors. <https://www.nhsinform.scot/bugs-and-germs>.

In addition, a Public information leaflet has recently been produced to provide specific advice on how to reduce the risk of STEC infection <http://www.hps.scot.nhs.uk/guidelines/detail.aspx?id=793>

Acknowledgements

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NHS board abbreviations

| | | | |
|---------------------|------------------|------------------------|-----------------------------|
| AA Ayrshire & Arran | BR Borders | DG Dumfries & Galloway | GGC Greater Glasgow & Clyde |
| FF Fife | FV Forth Valley | GR Grampian | HG Highland |
| LO Lothian | LN Lanarkshire | OR Orkney | SH Shetland |
| TY Tayside | WI Western Isles | | |

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