UK Health Security Agency

Changing landscape of STEC in the UK

Food and Water Microbiology Proficiency Testing International
Virtual Meeting - Wednesday 12 October 2022

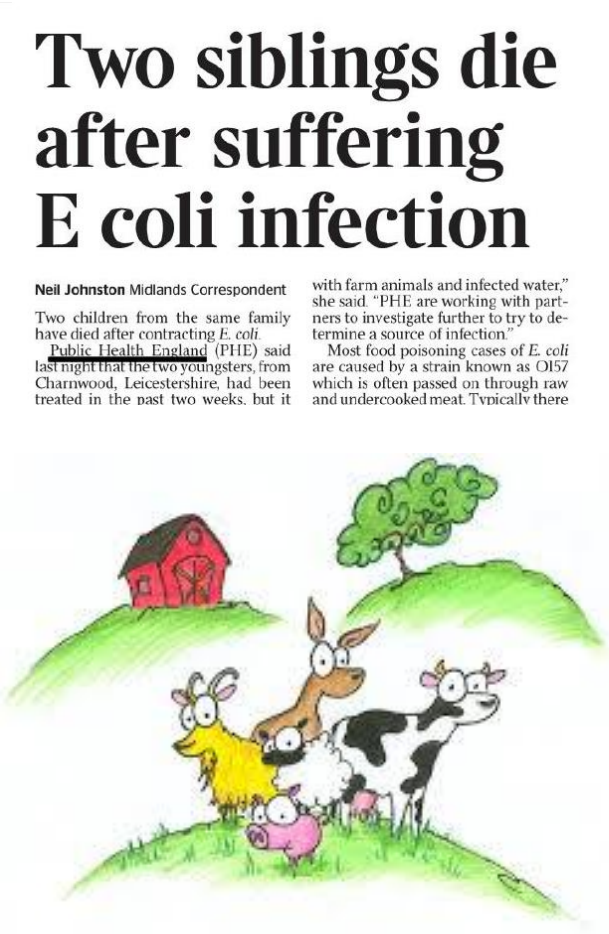
Shiga toxin-producing *E. coli* (STEC)

- Gastrointestinal pathogen that causes severe bloody diarrhoea and Haemolytic Uraemic Syndrome. HUS is associated with long-term renal, cardiac and neurological complications and can be fatal.

- Treatment options are limited as antibiotics contraindicated

- Zoonotic – animal reservoir is mainly cattle, sheep and goats, but almost all animals can be transiently colonised and act as secondary transmission vectors

- Transmission to humans can be food or waterborne or via direct contact with animals or their environment.



Two siblings die after suffering E coli infection

Neil Johnston Midlands Correspondent

Two children from the same family have died after contracting *E. coli*.

Public Health England (PHE) said last night that the two youngsters, from Charnwood, Leicestershire, had been treated in the past two weeks, but it with farm animals and infected water," she said. "PHE are working with partners to investigate further to try to determine a source of infection."

Most food poisoning cases of *E. coli* are caused by a strain known as O157 which is often passed on through raw and undercooked meat. Typically there

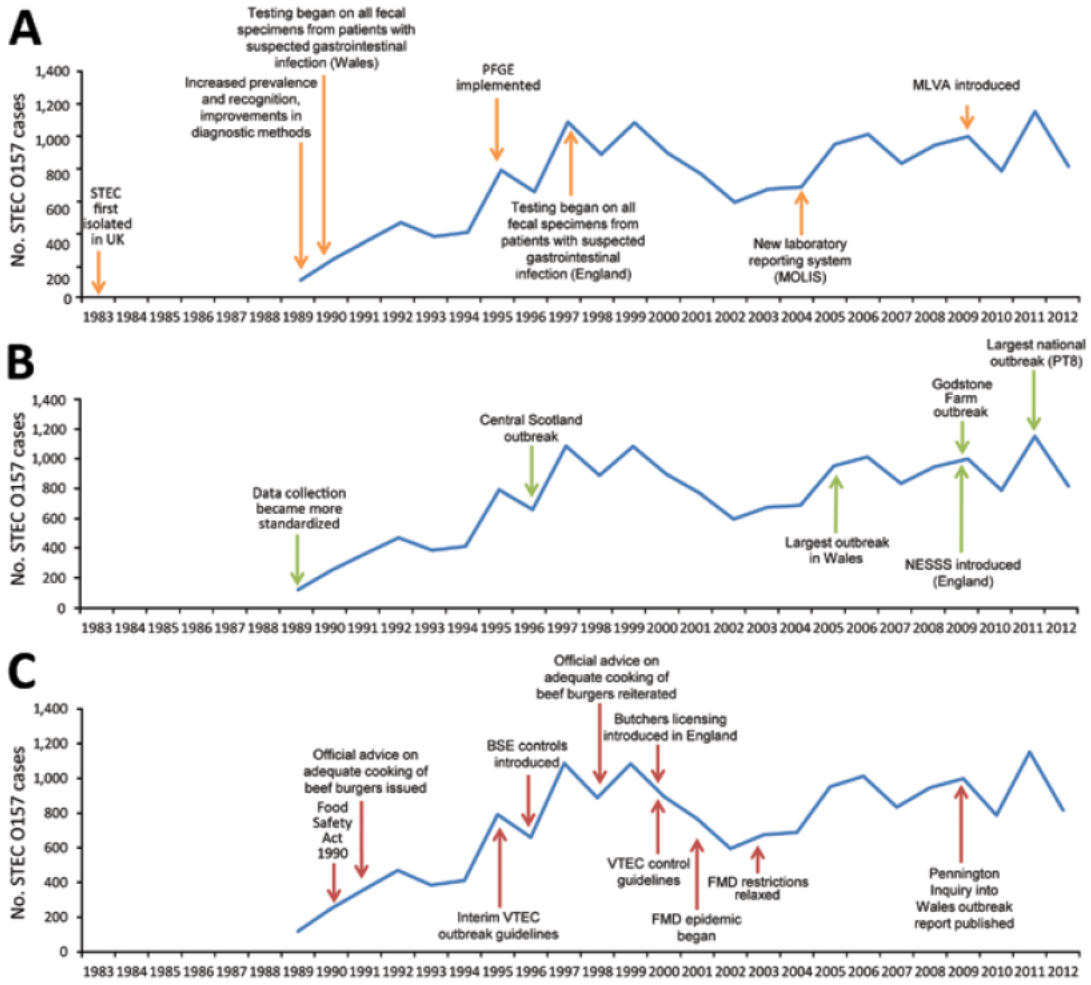
STEC O157:H7 1983-2012

- STEC emerged in the UK in the 1980s as a cause of outbreaks of HUS in children
- The most common type was STEC O157:H7
- Diagnostic algorithms and surveillance strategies were developed to focus on this serotype.

SYNOPSIS

Shiga Toxin–Producing *Escherichia coli* O157, England and Wales, 1983–2012

Natalie L. Adams, Lisa Byrne, Geraldine A. Smith, Richard Elson, John P. Harris, Roland Salmon, Robert Smith, Sarah J. O'Brien, Goutam K. Adak, Claire Jenkins



STEC O157:H7 2009-2022

Epidemiology and Infection

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Original Paper

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Escherichia coli; foodborne zoonoses; gastrointestinal infections; infectious disease epidemiology; zoonotic foodborne diseases

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The epidemiology of Shiga toxin-producing *Escherichia coli* serogroup O157 in England, 2009–2019

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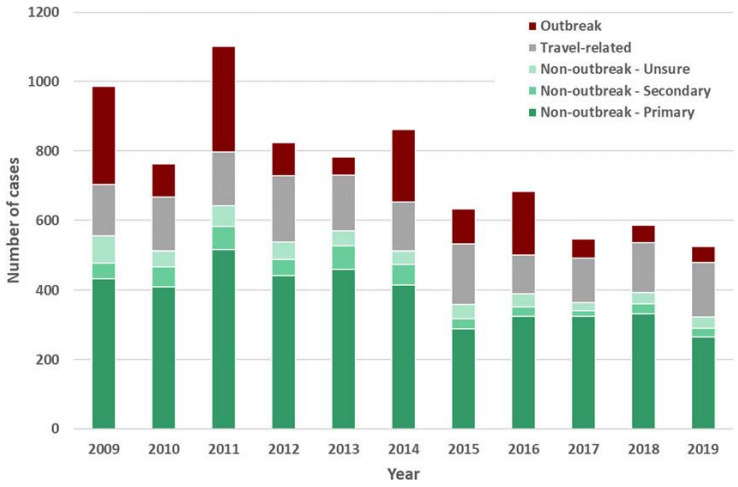
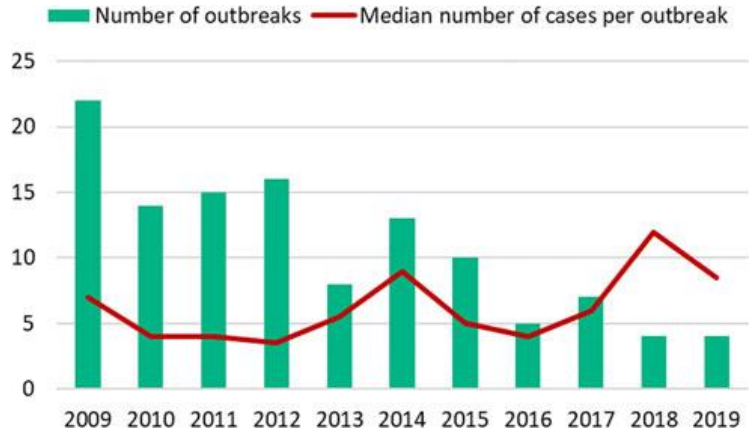
Abstract

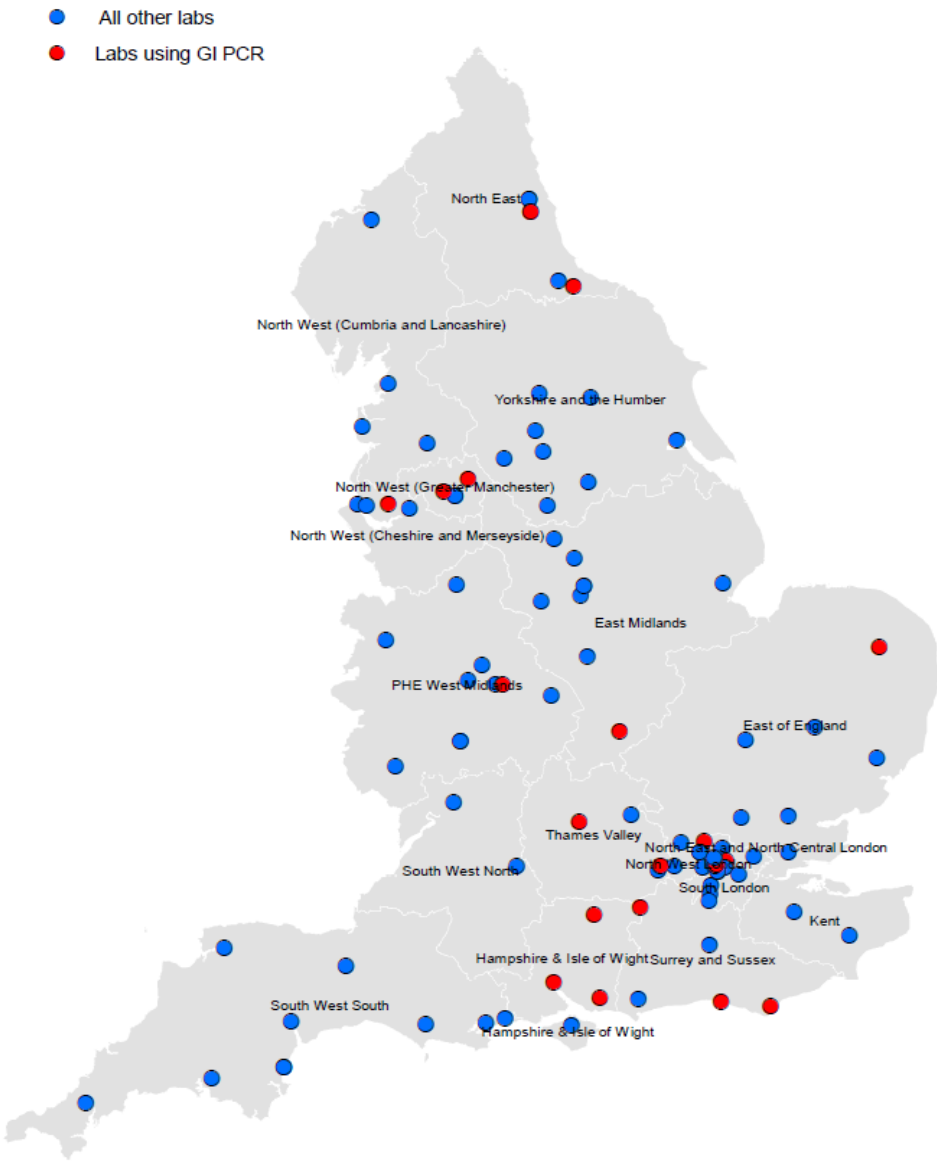
Shiga toxin-producing *Escherichia coli* (STEC) serogroup O157 is a zoonotic, foodborne gastrointestinal pathogen of major public health concern. We describe the epidemiology of STEC O157 infection in England by exploring the microbiological and clinical characteristics, the demographic and geographical distribution of cases, and examining changes in environmental exposures over 11 years of enhanced surveillance. Enhanced surveillance data including microbiological subtyping, clinical presentations and exposures were extracted for all cases resident in England with evidence of STEC O157 infection, either due to faecal culture or serology detection. Incidence rates were calculated based on mid-year population estimates from the Office of National Statistics (ONS). Demographics, geography, severity and environmental exposures were compared across the time periods 2009–2014 and 2015–2019. The number of cases reported to national surveillance decreased, with the mean cases per year dropping from 887 for the period 2009–2014 to 595 for the period 2015–2019. The decline in STEC O157 infections appears to be mirrored by the decrease in cases infected with phage type 21/28. Although the percentage of cases that developed HUS decreased, the percentage of cases reporting bloody diarrhoea and hospitalisation remained stable. The number of outbreaks declined over time, although more refined typing methods linked more cases to each outbreak. Integration of epidemiological data with microbiological typing data is essential to understanding the changes in the burden of STEC infection, assessment of the risks to public health, and the prediction and mitigation of emerging threats.



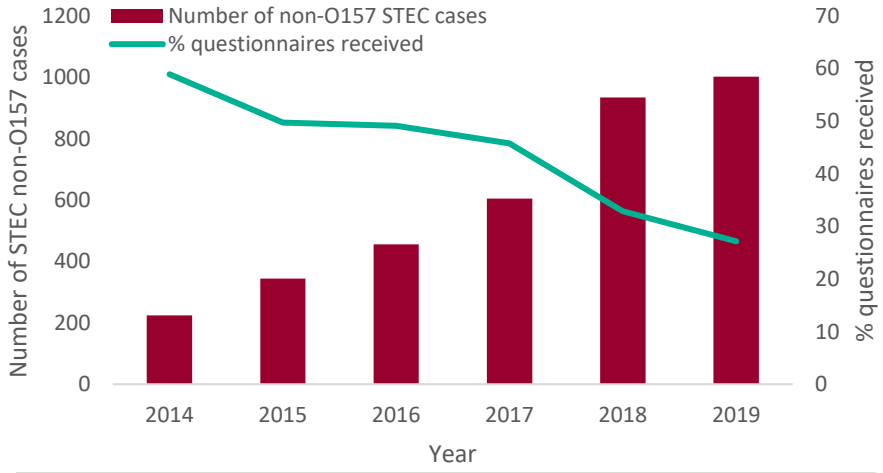


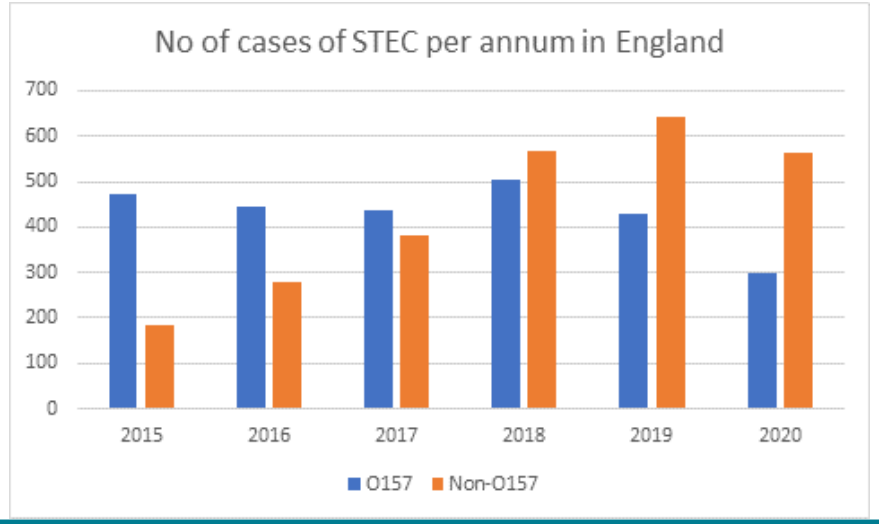
Diagnostic algorithms for STEC

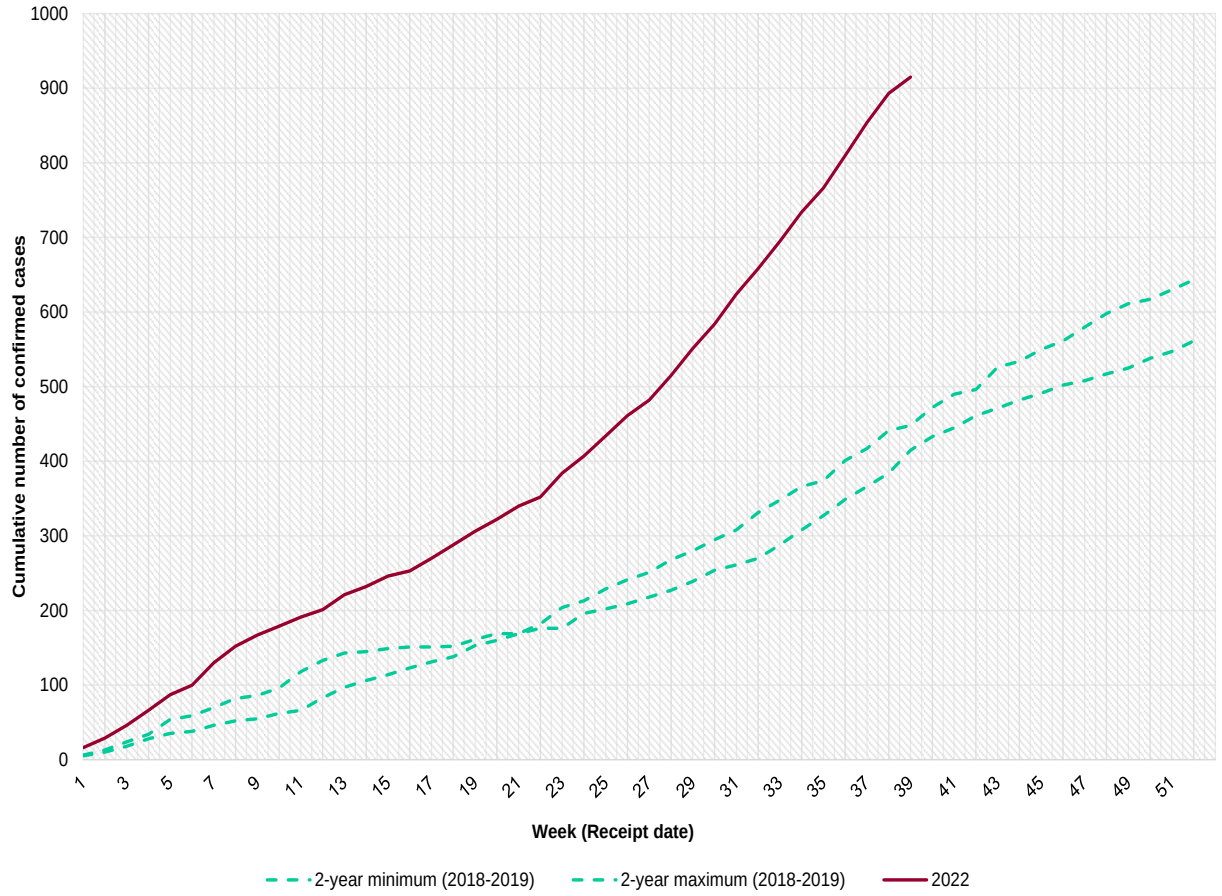
- STEC O157:H7 is inherently resistant to cefixime and tellurite and is unable to ferment sorbitol
- Grows on a selective agar called CT-SMAC (Cefixime Tellurite-Sorbitol MacConkey agar)
- In 2014, NHS laboratories in England began implementing PCR for the detection of all STEC serotypes
- Majority of non-O157 STEC are sorbitol fermenters and therefore, even if they grow on CTSMAC, they cannot be differentiated from commensal gut flora on CT-SMAC
- Faecal specimens testing PCR positive for STEC sent to GBRU for confirmation and culture



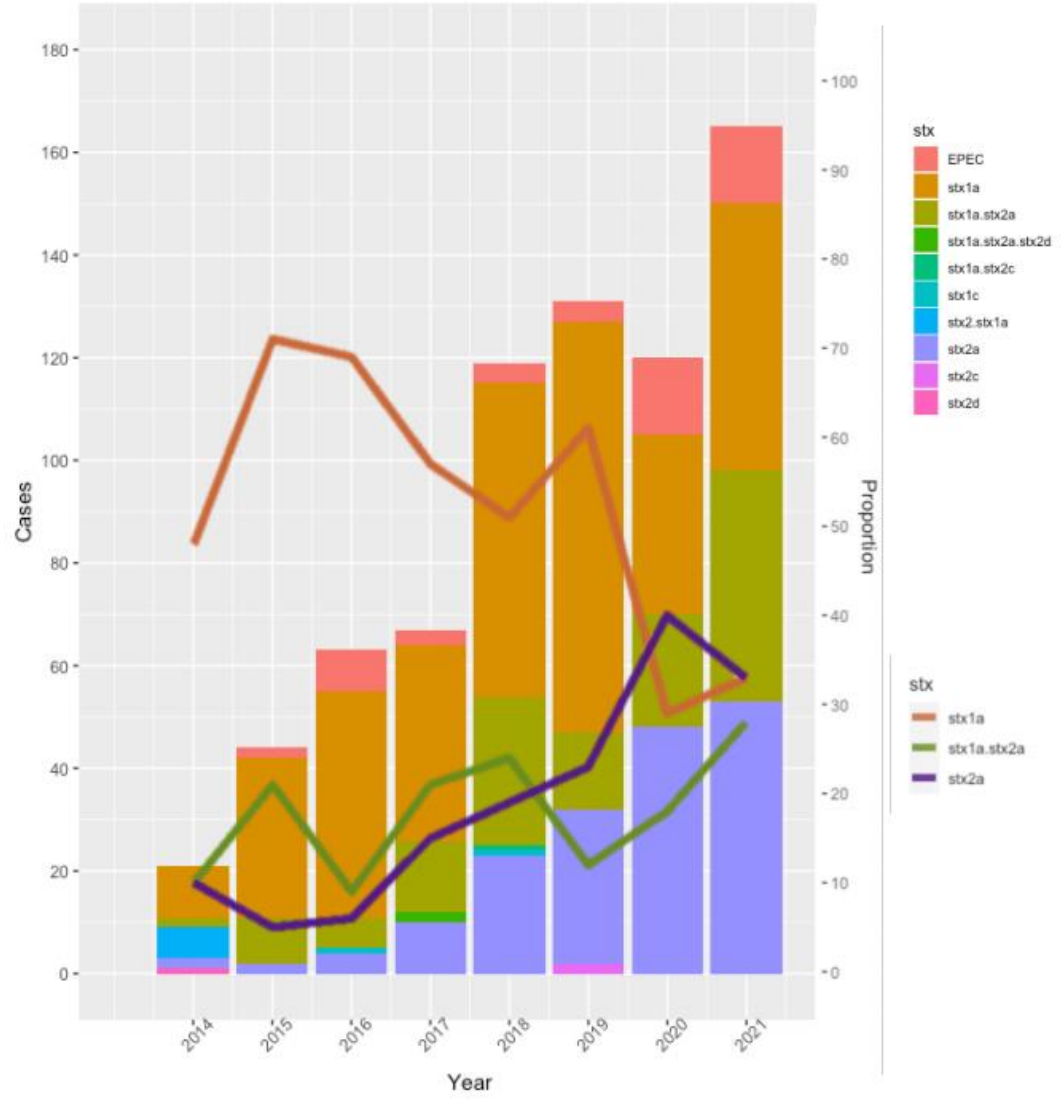
STEC other than serotype O157:H7 (non-O157 STEC)







STEC O26:H11



- STEC O26:H11 is the most frequently detected non-O157 STEC serotype
- Most common non-O157 STEC isolated from patients with STEC-HUS in England
- STEC produces two types of Shiga toxin (stx1 and stx2) that can be divided into at least 10 different subtypes (stx1a-stx1d and stx2a-stx2g)
- STEC harbouring stx2a are significantly associated with causing STEC-HUS
- Proportion of STEC O26:H11 that have stx1a has decreased, whereas the proportion that have stx2a has increased.

STEC O26:H11: clinical outcome

	STEC O26 stx2a	STEC O26 stx1a/stx2a	STEC O26 stx1a	STEC O157
Symptom	%	%	%	%
Diarrhoea	91	99	99	93-95
Abdominal pain	81	93	84	80-83
Blood stool	43	65	56	61-62
Nausea	54	49	50	46-48
Vomiting	46	41	34	35-37
Admitted to hospital	44	32	25	34
Fever	37	42	41	33-34
HUS	24	6	-	3.5
Outcome died	2	-	-	n/a

STEC O26:H11: epidemiology & outbreaks

- Like STEC O157:H7, STEC O26:H11 is endemic in the UK cattle population

- Outbreaks have been associated with:
  - Petting farms
  - Unpasteurised dairy products
  - Ready to eat salad vegetables

- Like STEC O157, STEC O26:H11 has a low infectious dose. Household transmission and outbreaks in nursery school settings are common

Outbreak of STEC O26:H11 linked to mixed salad leaves

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Original Paper

Cite this article: Butt S *et al* (2021). Epidemiological investigations identified an outbreak of Shiga toxin-producing *Escherichia coli* serotype O26:H11 associated with pre-packed sandwiches. *Epidemiology and Infection* **149**, e178, 1–10. https://doi.org/10.1017/S0950268821001576

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Keywords:
Shiga toxin-producing Escherichia coli serotype O26:H11; outbreak; whole genome sequencing; pre-packed sandwiches

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Epidemiological investigations identified an outbreak of Shiga toxin-producing *Escherichia coli* serotype O26:H11 associated with pre-packed sandwiches

Saira Butt[1], Lesley Allison[2], Bhavita Vishram[1], David R. Greig[1], Heather Aird[3], Eisin McDonald[4], Genna Drennan[4], Claire Jenkins[1], Lisa Byrne[1], Kirsty Licence[4], Alison Smith-Palmer[4] and others on behalf of the Incident Management Team

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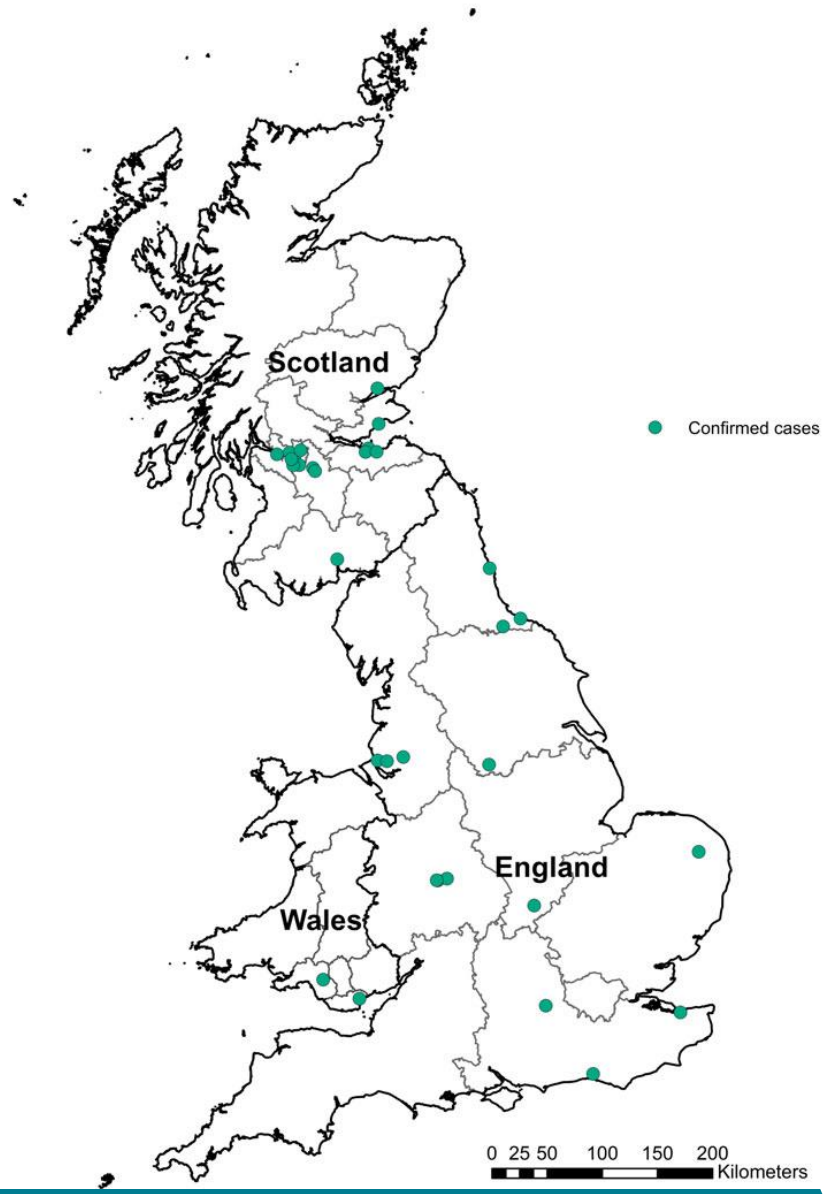
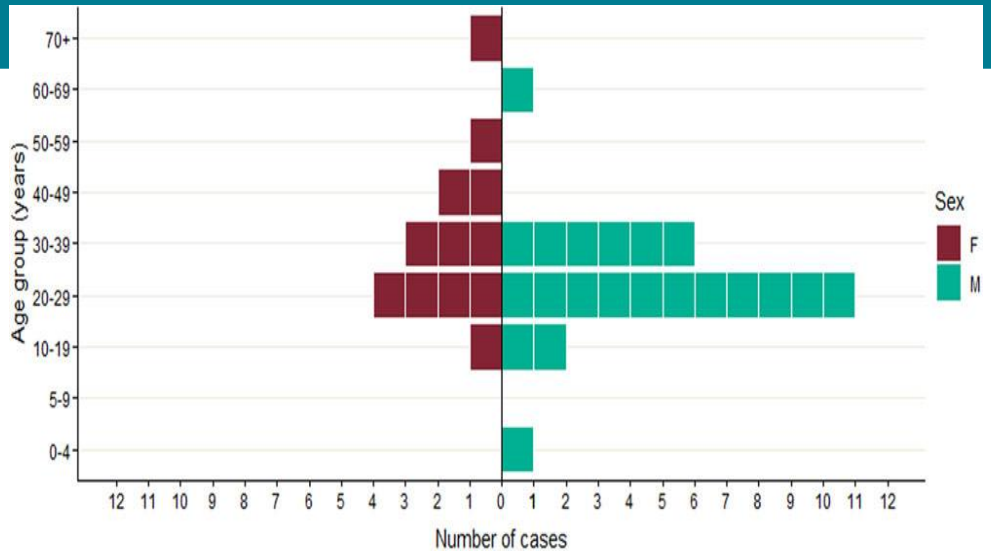
Abstract

In October 2019, public health surveillance systems in Scotland identified an increase in the number of reported infections of Shiga toxin-producing *Escherichia coli* (STEC) O26:H11 involving bloody diarrhoea. Ultimately, across the United Kingdom (UK) 32 cases of STEC O26:H11 *stx1a* were identified, with the median age of 27 years and 64% were male; six cases were hospitalised. Among food exposures there was an association with consuming pre-packed sandwiches purchased at outlets belonging to a national food chain franchise (food outlet A) [odds ratio (OR) = 183.89, $P < 0.001$]. The common ingredient identified as a component of the majority of the sandwiches sold at food outlet A was a mixed salad of Apollo and Iceberg lettuce and spinach leaves. Microbiological testing of food and environmental samples were negative for STEC O26:H11, although STEC O36:H19 was isolated from a mixed salad sample taken from premises owned by food outlet A. Contamination of fresh produce is often due to a transient event and detection of the aetiological agent in food that has a short-shelf life is challenging. Robust, statistically significant epidemiological analysis should be sufficient evidence to direct timely and targeted on-farm investigations. A shift in focus from testing the microbiological quality of the produce to investigating the processes and practices through the supply chain and sampling the farm environment is recommended.



Outbreak of STEC O26:H11 linked to mixed salad leaves



Exposure	OR	95% confidence interval	*P* value	Test
Pre-packaged sandwiches	60.83	4.65–795.21	$P < 0.001$	Wald
Processed meats	18.75	1.60–219.38		
Cooked poultry	7.04	0.45–110.05		
Raw vegetables	5.78	0.83–39.97		
Pasteurised milk	0.22	0.03–1.67		
Fish	0.11	0.13–0.93		
Cooked beef	0.9	0.01–1.18		
Other foods	0.07	0.01–0.58		
Soft fruit/berries	0.03	0.0–0.22		

- Across the UK, 32 cases were identified, median age of 27 years and 64 % were male; six cases were hospitalised.
- Association with consuming pre-packed sandwiches purchased at outlets belonging to a national food chain franchise (OR= 183.89, p<0.001)
- Common ingredient was a mixed salad (Apollo and Iceberg lettuce and spinach leaves)
- Microbiological testing of food and environmental samples were negative for STEC O26:H11, although STEC O36:H19 was isolated from a mixed salad sample taken from premises owned by the implicated food business operator

Detection of non-O157 STEC from clinical specimens and food samples

- Detection of all STEC serotypes from clinical specimens and food samples requires PCR targeting the Shiga toxin (stx) genes
- Clinical specimens and food samples testing positive for stx can be cultured on STEC Chromagar
- Purple colonies on Chromagar can be agglutinated with antisera to the common STEC serotypes associated with the most severe clinical outcomes, specifically O26,O103, O111, O145
- And submitted to GBRU or SERL for confirmation and typing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METHOD

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MICROBIOLOGY SOCIETY

Evaluation of chromogenic selective agar (CHROMagar STEC) for the direct detection of Shiga toxin-producing *Escherichia coli* from faecal specimens

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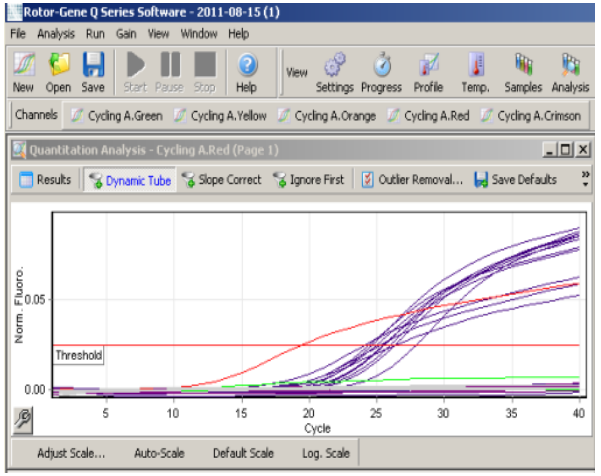

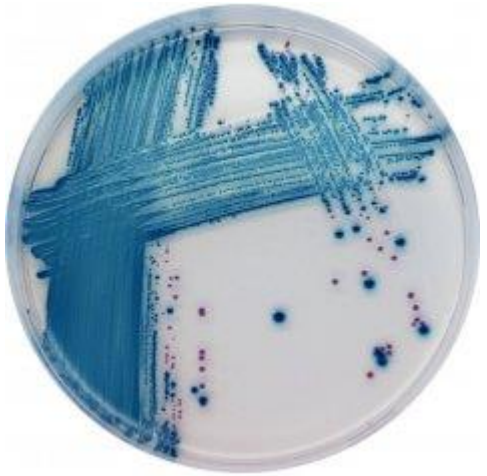

Summary

- Notifications of STEC O157 have declined in the UK over the last 10 years

- Notifications of non-O157 STEC have increased, due in part to the implementation of PCR at a subset of local diagnostic labs

- STEC O26 is the most common non-O157 STEC serotype and has similar characteristics to STEC O157:
  - Ruminant animal reservoir
  - Foodborne
  - Low infectious dose
  - STEC-HUS

- STEC O26 grows as a purple colony of Chromagar and agglutinates with *E. coli* O26 antisera.

STEC O26:H11: who and where?