STEC – recent developments including trends in outbreaks and use of whole genome sequencing.

Richard Elson
Gastrointestinal Infections Department,
Public Health England, National Infections Service

ACMSF 20th October 2016
Background

• STEC Surveillance
• History – 1983-2012
• Whole genome sequencing
• Outbreaks – trends and notable examples
• Novel uses of data
• Using WGS in outbreak investigations
Surveillance of STEC in England

- Routine laboratory based surveillance since 1983
- Enhanced surveillance introduced in 2009
- Routine MLVA and WGS introduced in 2012 and 2015 respectively as a complement to phenotypic methods)
Recent emergence of predominant UK lineages

- **Lineage I** – contains PT21/28 and PT32

- **Lineage II** – ancestral lineage, contains PT8

- **Lineage I/II** – contains PT2

- Common ancestor of current circulating diversity ~ 175 years ago.
- Most recent common ancestor of Lineage I and I/II ~ 150 years ago.

*Dallman* TJ, et al. Applying phylogenomics to understand the emergence of Shiga-toxin-producing *Escherichia coli* O157:H7 strains causing severe human disease in the UK.
Strain replacement

![Line graph showing the percentage of total cases over years. The graph indicates a decline in strain replacement cases from 1989 to 2012, with a peak around 1997.](image-url)
Strain replacement

- PT2 restricted to Lineage I/II and PT21/28 to Lineage I
- Evidence of strain replacement of one genotype by another rather than PT switching within single genotype
Risk profile - England

Rates of infection are higher in:

• People living in rural areas compared to urban areas

• Rural cases report higher levels of exposure to private water supplies, open fresh water, livestock or their faeces

• Urban cases more likely to report visiting a farm, rural cases more likely to report living on or working at a farm or having access via family members.

• Non-O157 STEC strains were associated with higher hospitalization and HUS rates than O157 STEC strains (but are under ascertained).

  • (Byrne et al. The Epidemiology, Microbiology and clinical impact of Shiga toxin-producing *Escherichia coli* in England, 2009-2012.)

• VTEC incidence associated with higher cattle density, higher ratio of cattle to people and higher minimum temperature.

Spatial distribution

Incidence rate/100,000 person years

Animal density (Animals/Km2)
Spatial clustering

Statistically significant spatial clustering occurs outside urban areas and maps closely to areas of high cattle and sheep density.
Severity

Risk factors for progression to tHUS

• Being aged 1-4 years of age
• Being female
• Being infected with PT21/28 or PT2
• Receiving β-lactam antibiotics
• Presenting with vomiting or bloody diarrhoea

Foodborne outbreaks - trends

Outbreaks of STEC O157 reported to PHE eFOSS. Includes foodborne followed by person to person transmission.
Foodborne outbreaks

Outbreaks of STEC O157 reported to PHE eFOSS. * Includes foodborne followed by person to person transmission.
Foodborne vs. non foodborne transmission

Outbreaks of STEC O157 reported to PHE eFOSS. Includes foodborne followed by person to person transmission.
Notable outbreaks

- 2011 – STEC O157 PT8 associated with handling raw leeks and potatoes.
- 2013 – STEC O157 PT2 associated with watercress.
- 2014 – STEC O157 PT21/28 associated with unpasteurised drinking milk.
- 2016 – STEC O157 PT34 associated with mixed salad leaves.
Exposure assessment
Exposure assessment

Calculated in terms of exposure frequencies reported by cases versus non-cases
Exposure exceedance alerts

In development with FSA

- Using enhanced surveillance data to identify unusual increases in the reporting of an exposure, particularly food which may provide an early indication of a contaminated food or ingredient in circulation.

- We propose to use exposures reported by all STEC cases reported to NESSy from 2009 to date and apply the Farrington flexible method (observed vs. expected) currently used for the national exceedance system at PHE (all pathogens).

- This will be run on a weekly basis and the underlying statistical methodology takes into account seasonal variations based on previous years data.

- Will run on responses to closed and open questions – closed questions have consistent denominator.
Using WGS in outbreaks