Public Health England

Protecting and improving the nation's health

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

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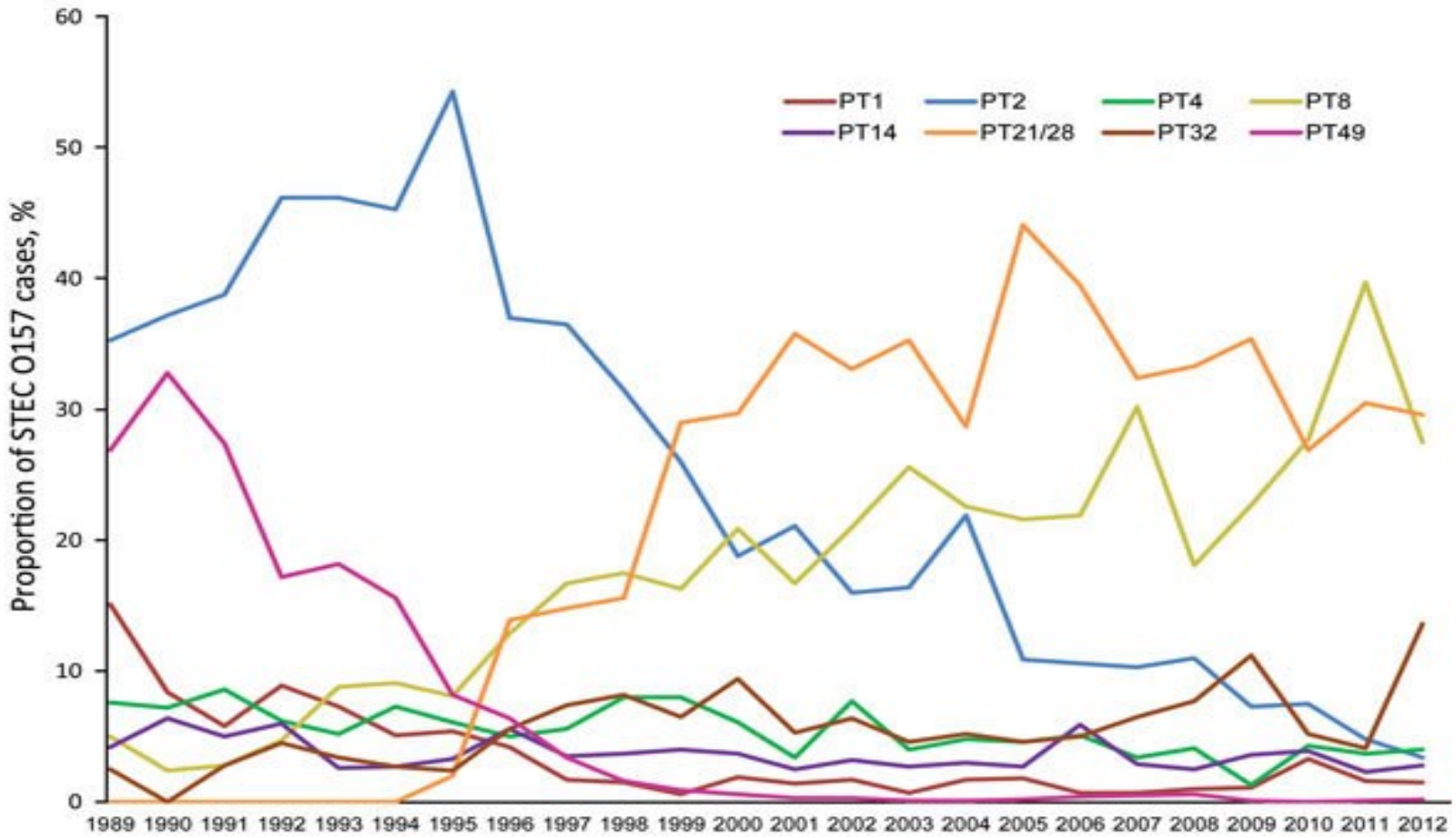
Background

- 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)

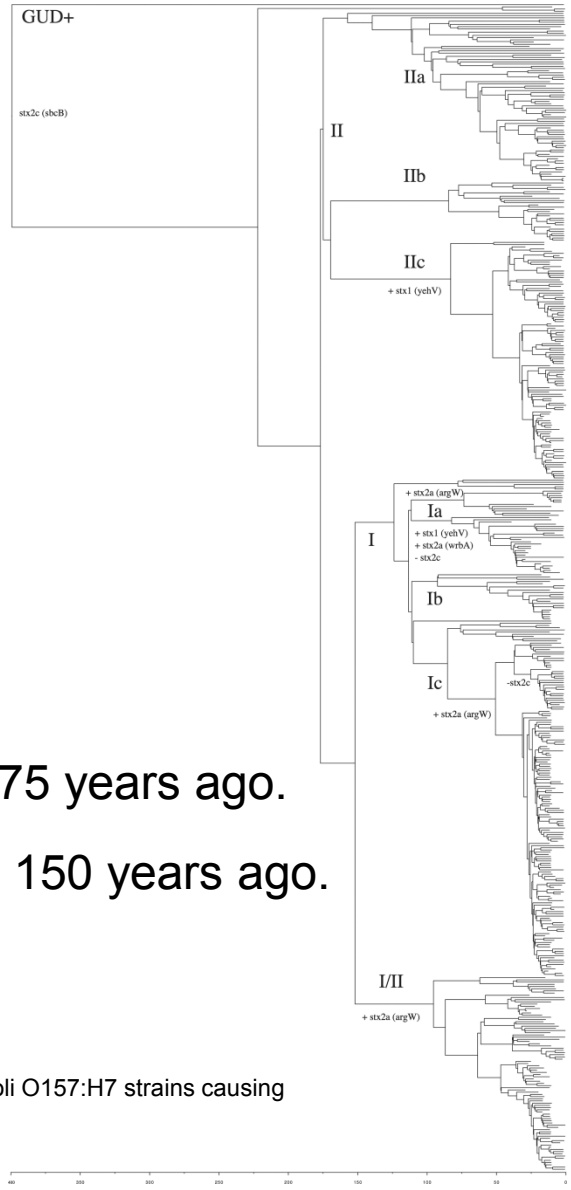
History



Adams NL, Byrne L, Smith GA, Elson R, Harris JP, Salmon R, Smith R, O'Brien SJ, Adak GK, Jenkins C. Shiga Toxin-Producing Escherichia coli O157, England and Wales, 1983-2012. Emerg Infect Dis. 2016 Apr;22(4):590-7.

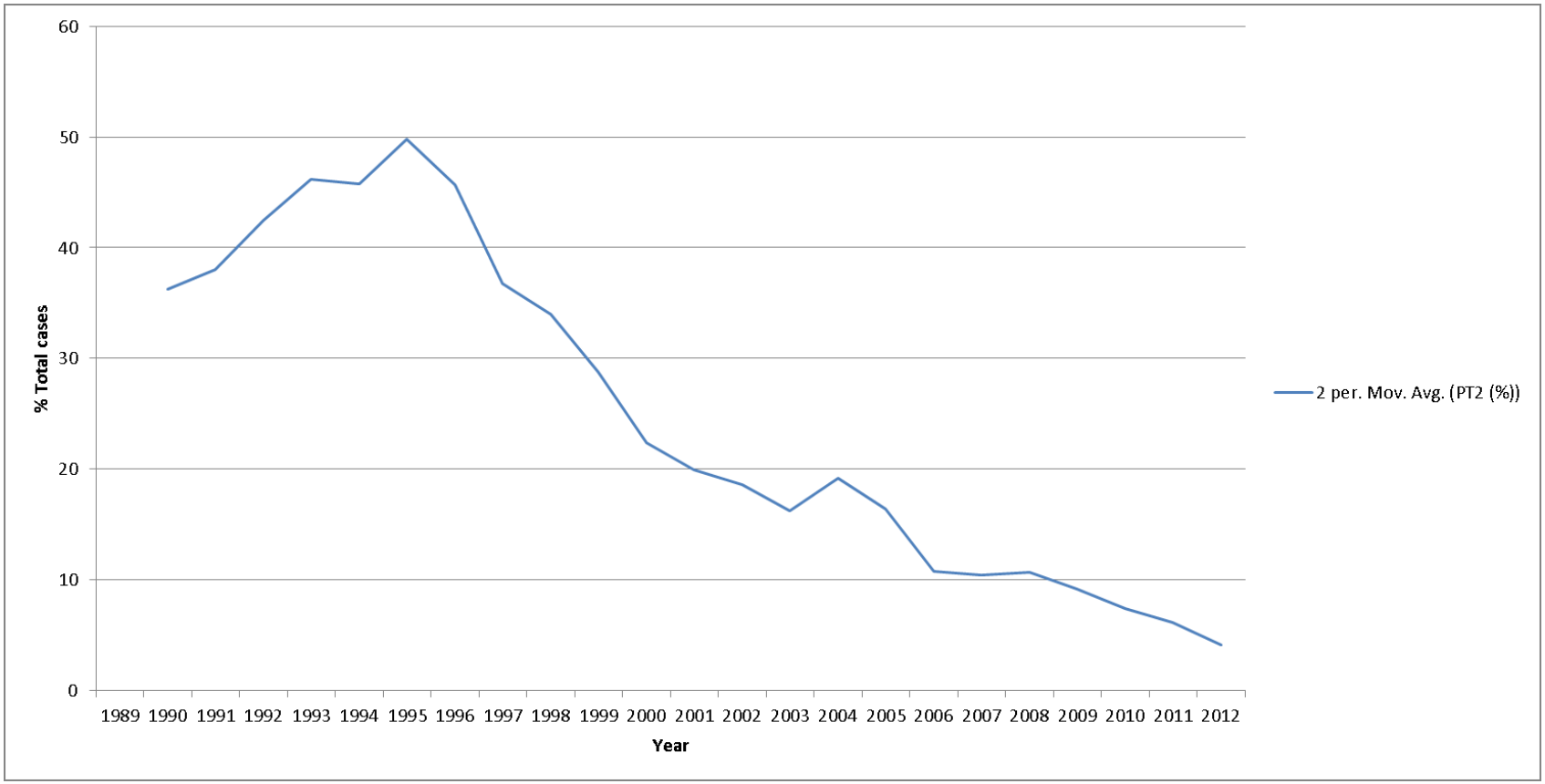
Recent emergence of predominant UK lineages

- **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.

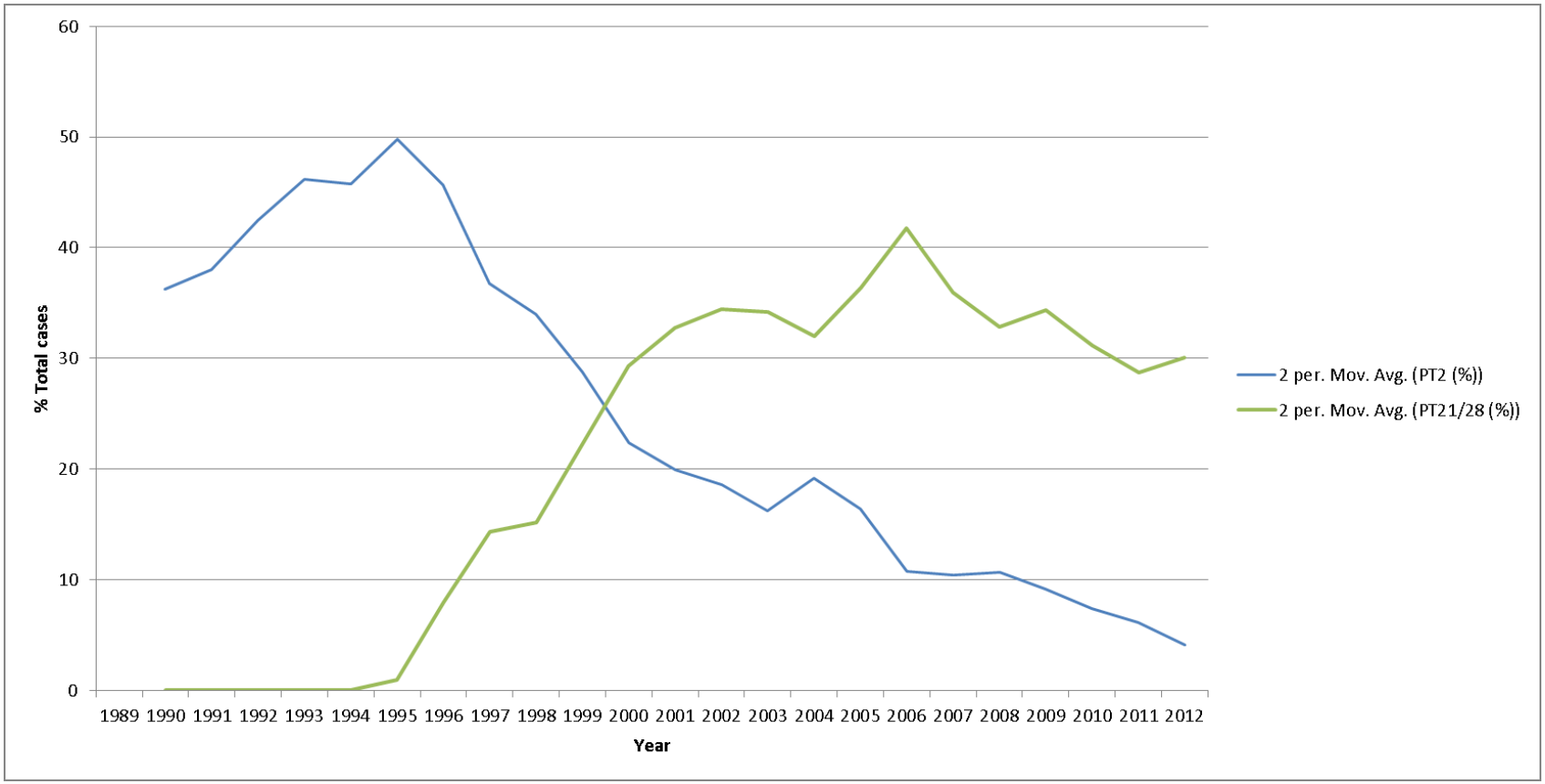


Dallman TJ, et al. Applying phylogenomics to understand the emergence of Shiga-toxin-producing Escherichia coli O157:H7 strains causing severe human disease in the UK.

Strain replacement

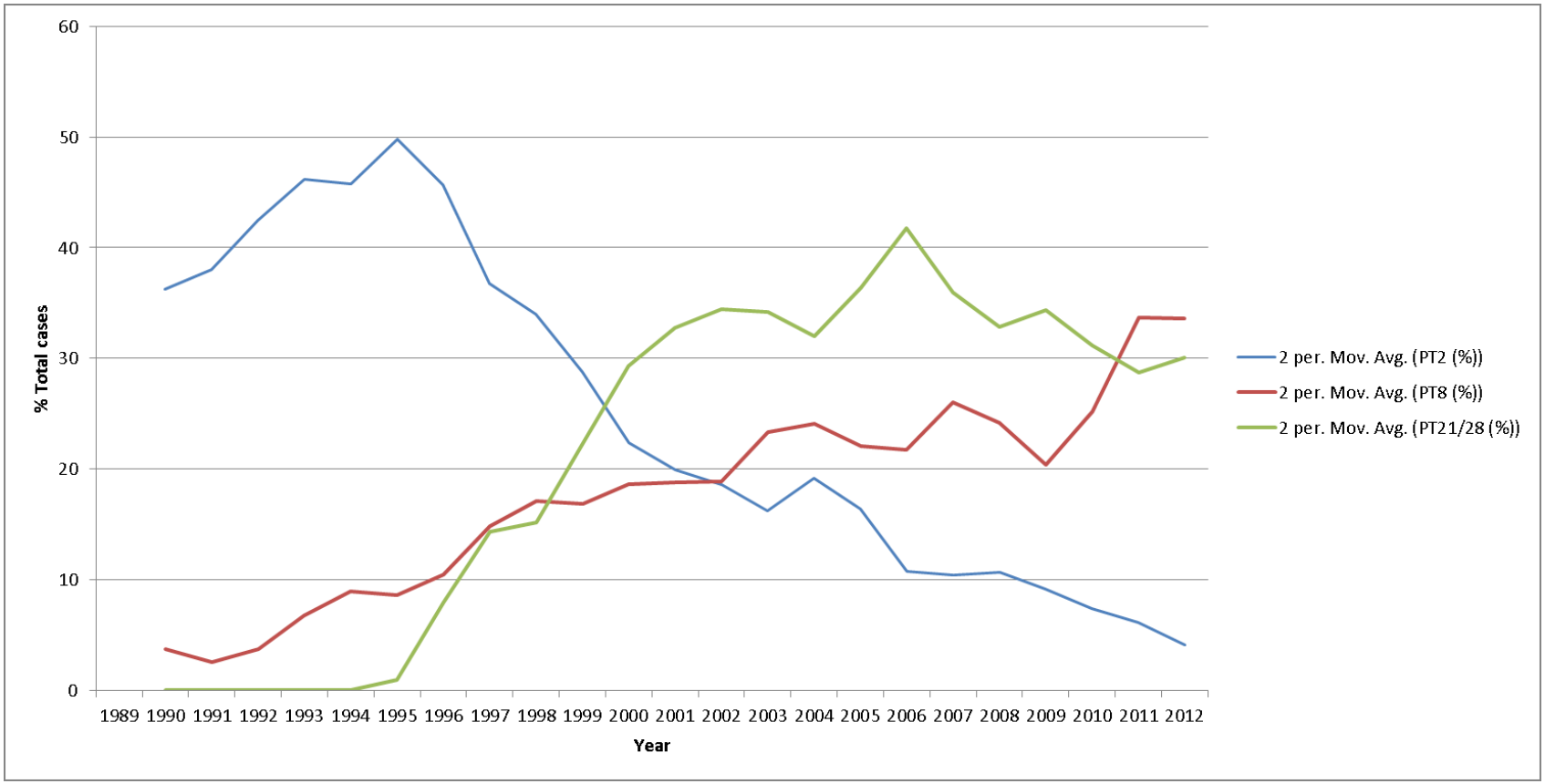


Strain replacement

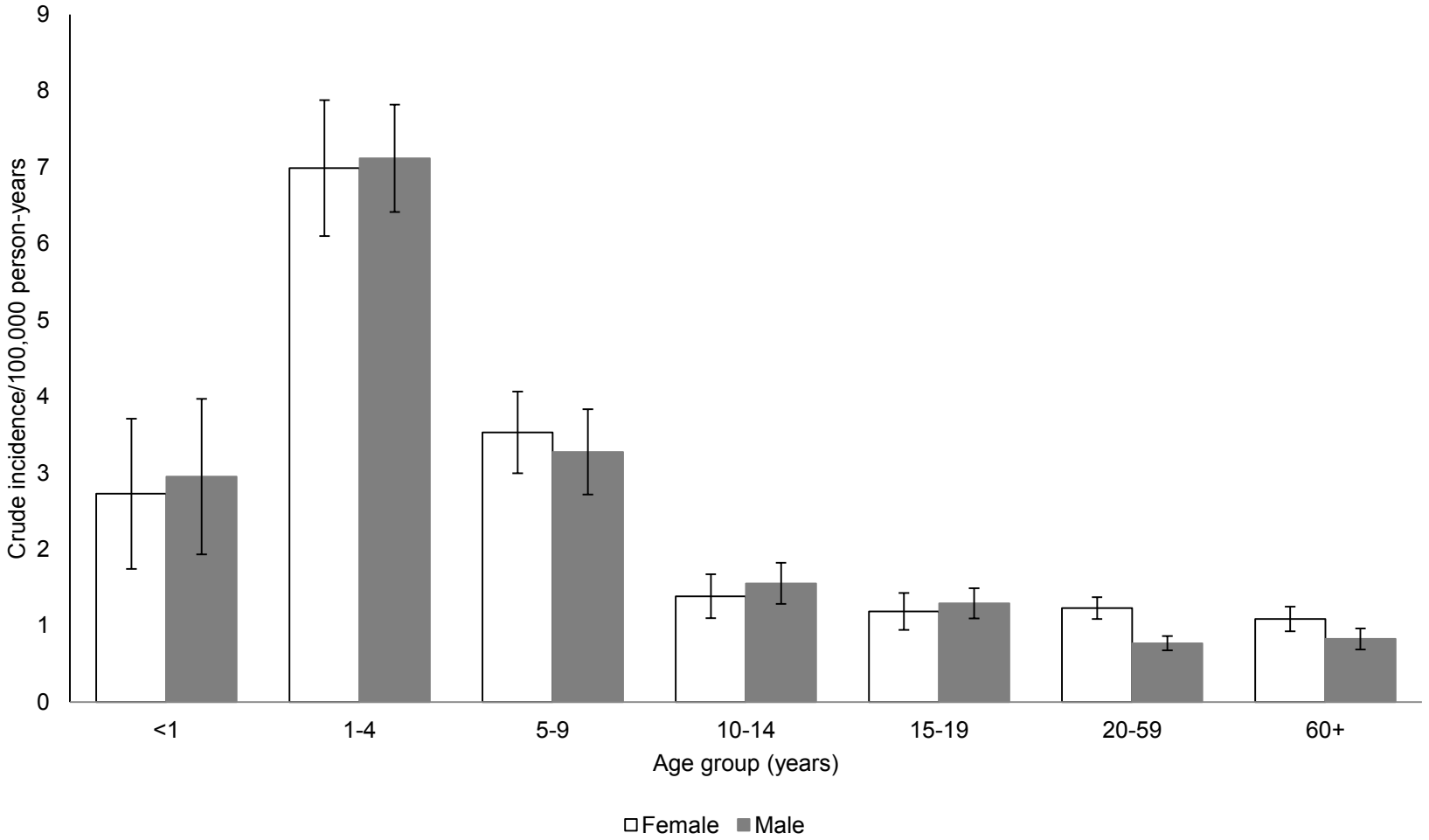


- PT2 restricted to Lineage I/II and PT21/28 to Lineage I
- Evidence of strain replacement of on one genotype by another rather than PT switching within single genotype

Strain replacement



Burden of morbidity



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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).

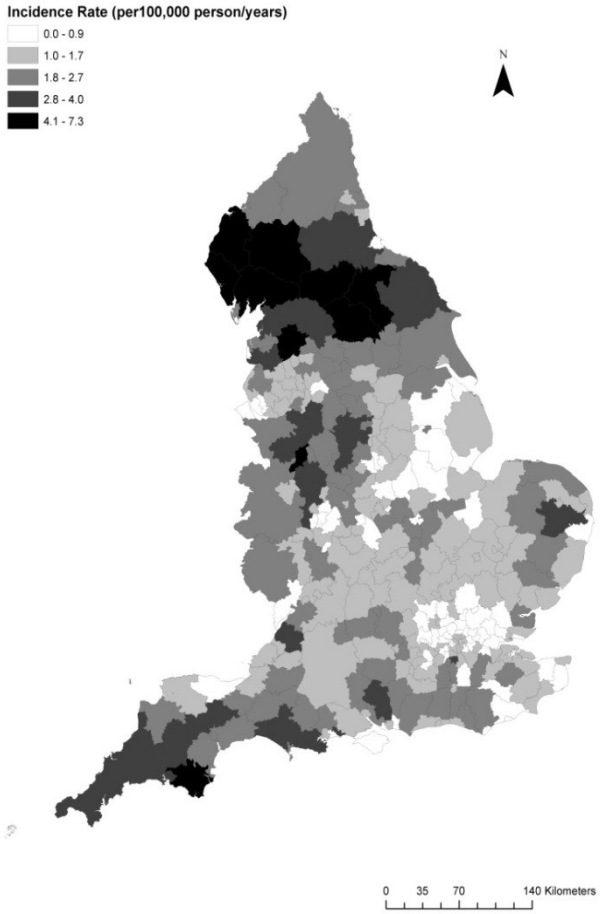
•(Byrne et al. The Epidemiology, Microbiology and clinical impact of Shiga toxin-producing *Escherichia coli* in England, 2009-2012.)

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

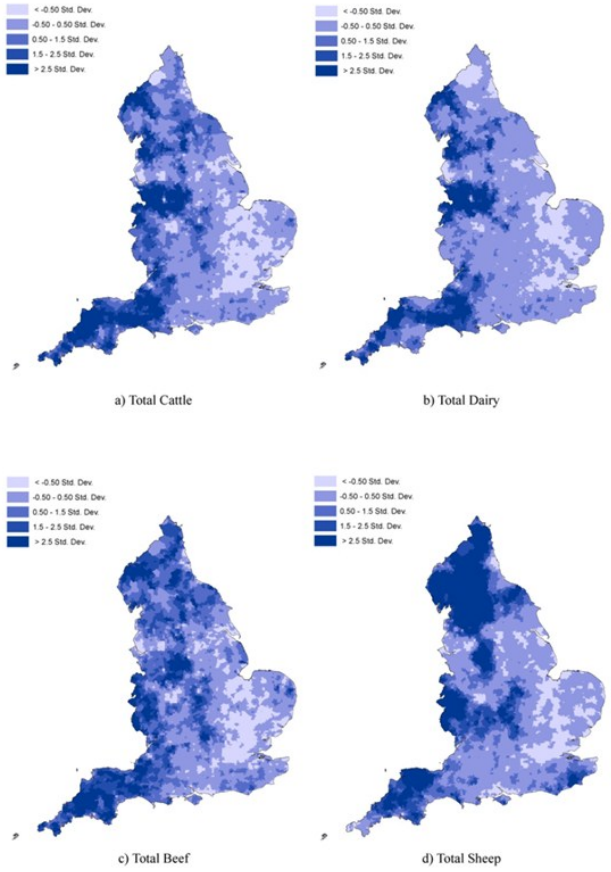
(Grace, K. Investigation into the spatial and temporal patterns of sporadic cases of VTEC O157 in England 2009-2011. Unpublished MSc thesis 2013)

Spatial distribution

Incidence rate/100,000 person years

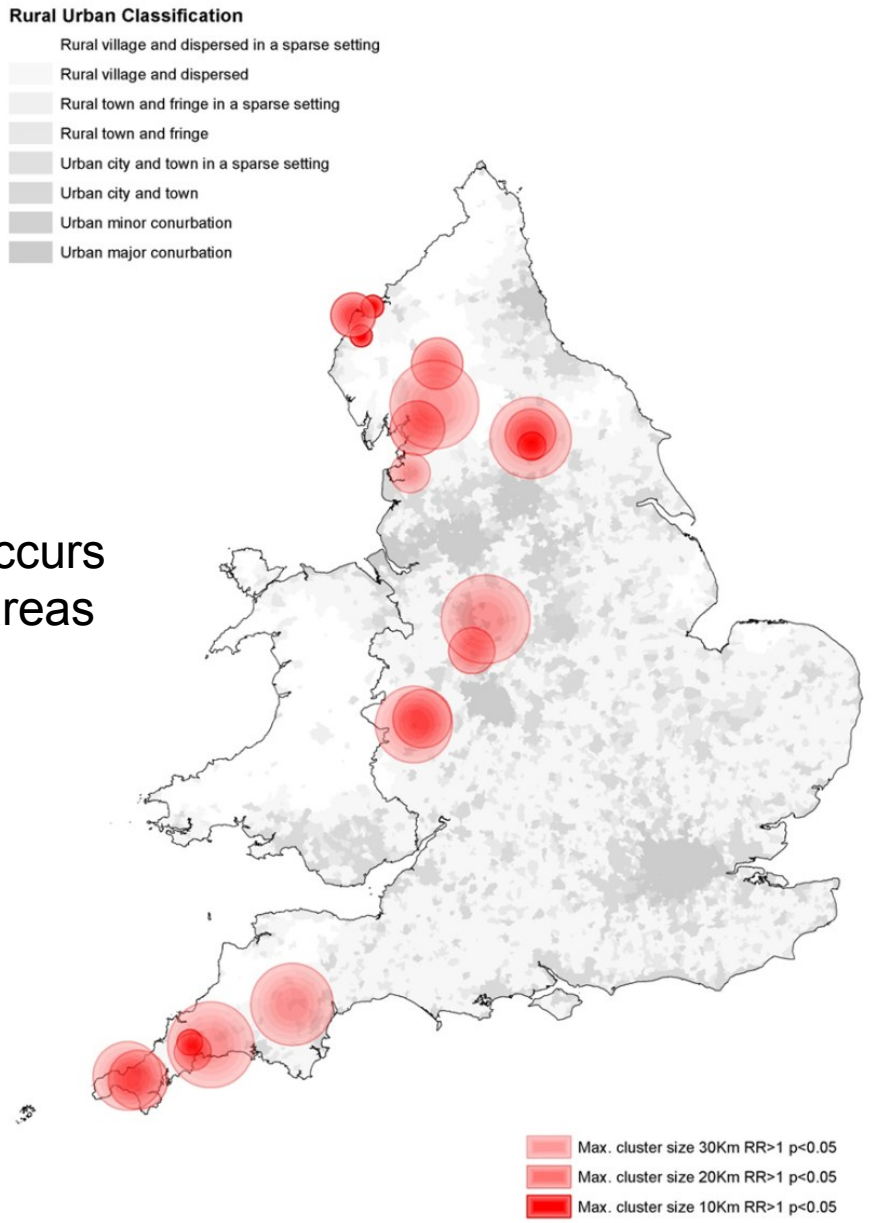


Animal density (Animals/Km2)



Spatial clustering

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



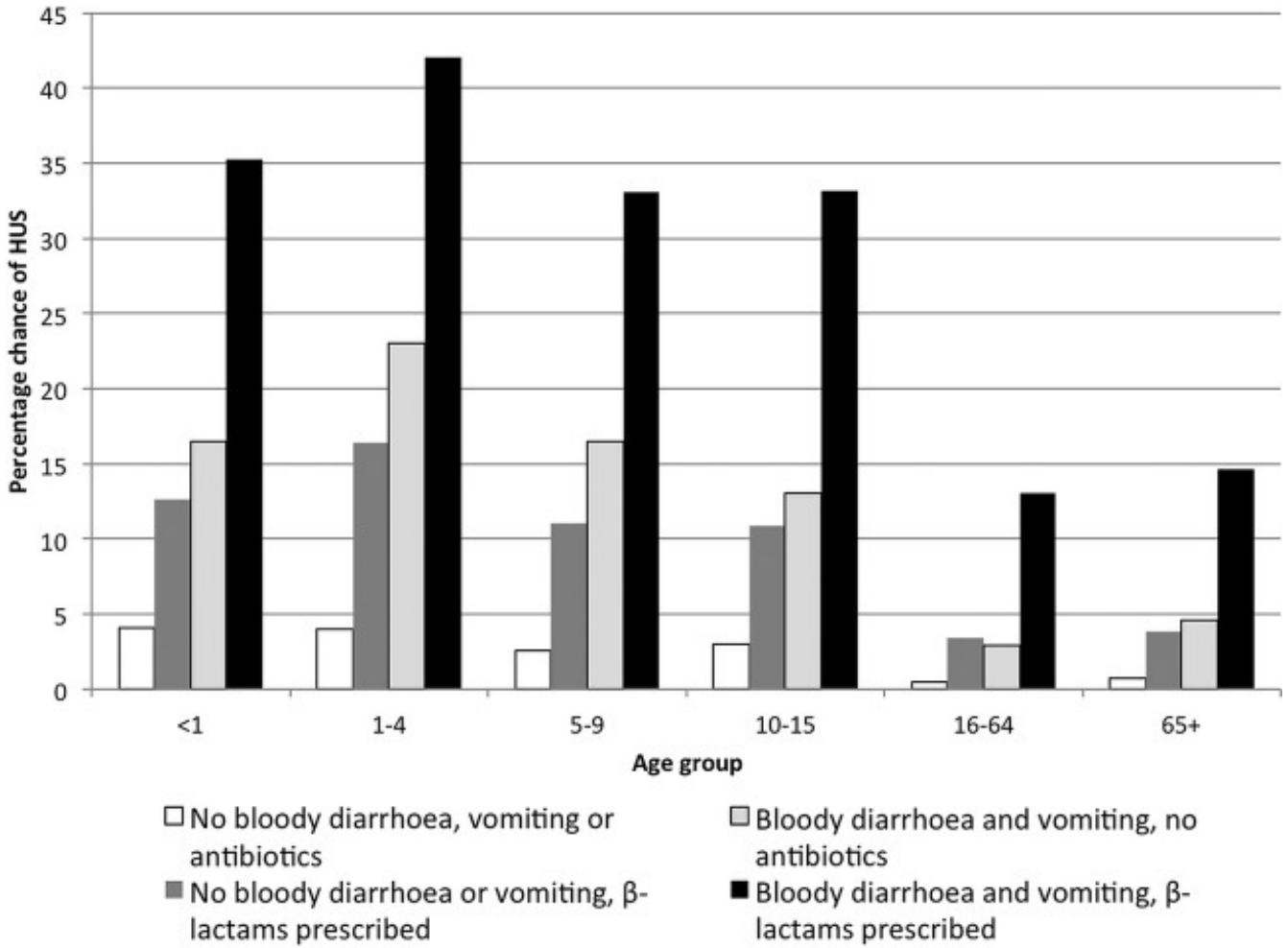
Severity

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

Launders N, Byrne L, Jenkins C, Harker K, Charlett A, Adak GK. Disease severity of Shiga toxin-producing E. coli O157 and factors influencing the development of typical haemolytic uraemic syndrome: a retrospective cohort study, 2009-2012. BMJ Open. 2016 Jan 29;6(1).

Disease severity



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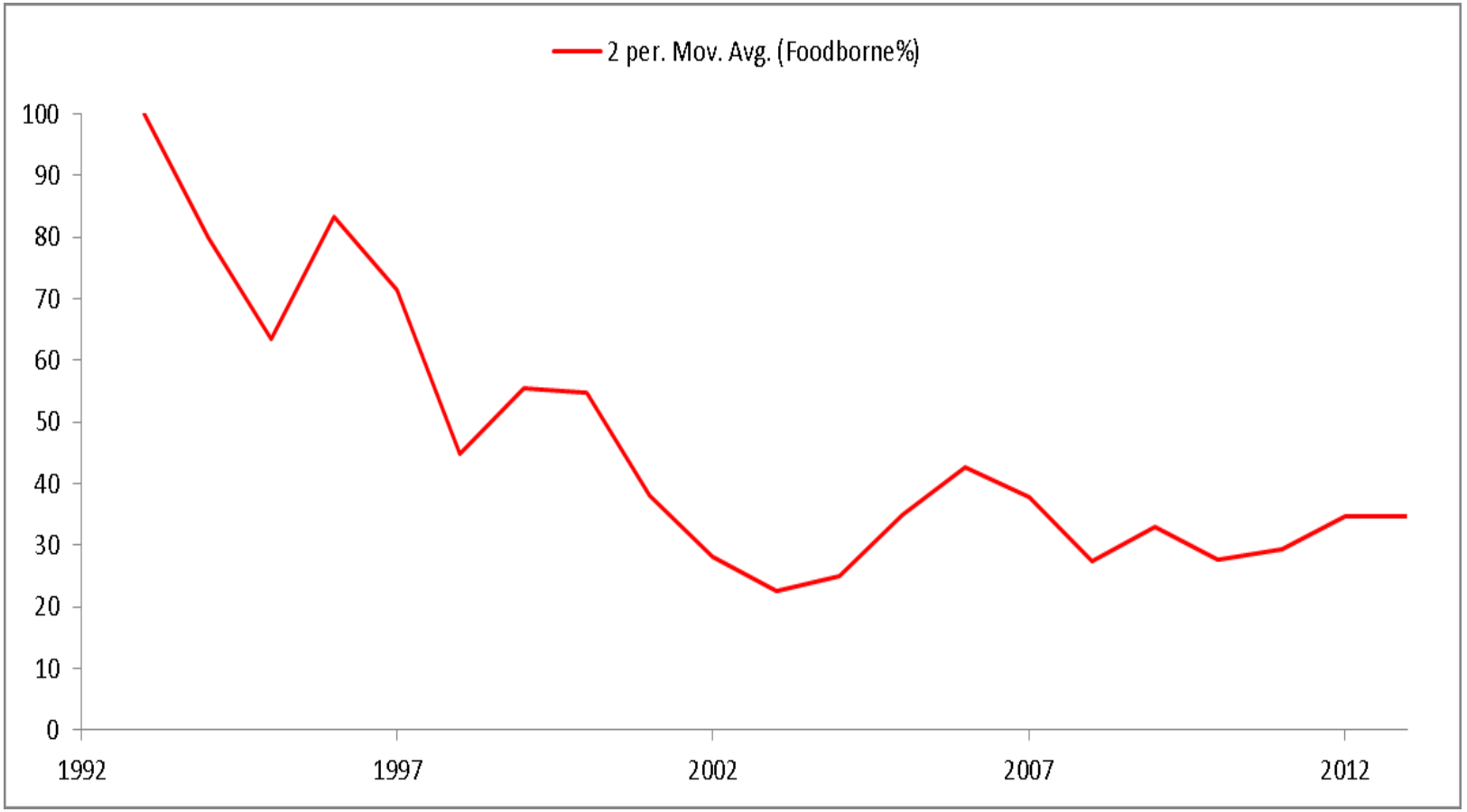
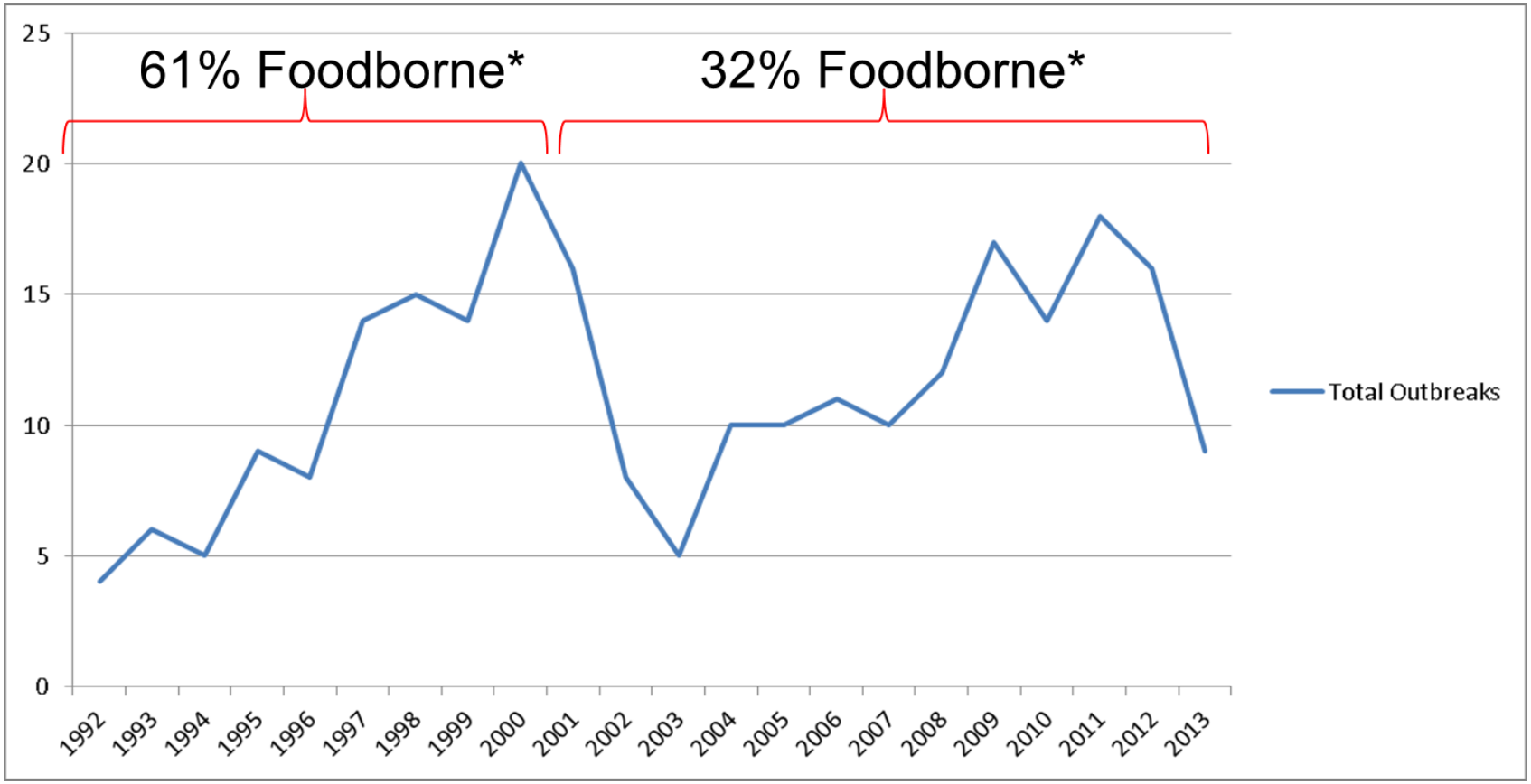
Foodborne outbreaks - trends



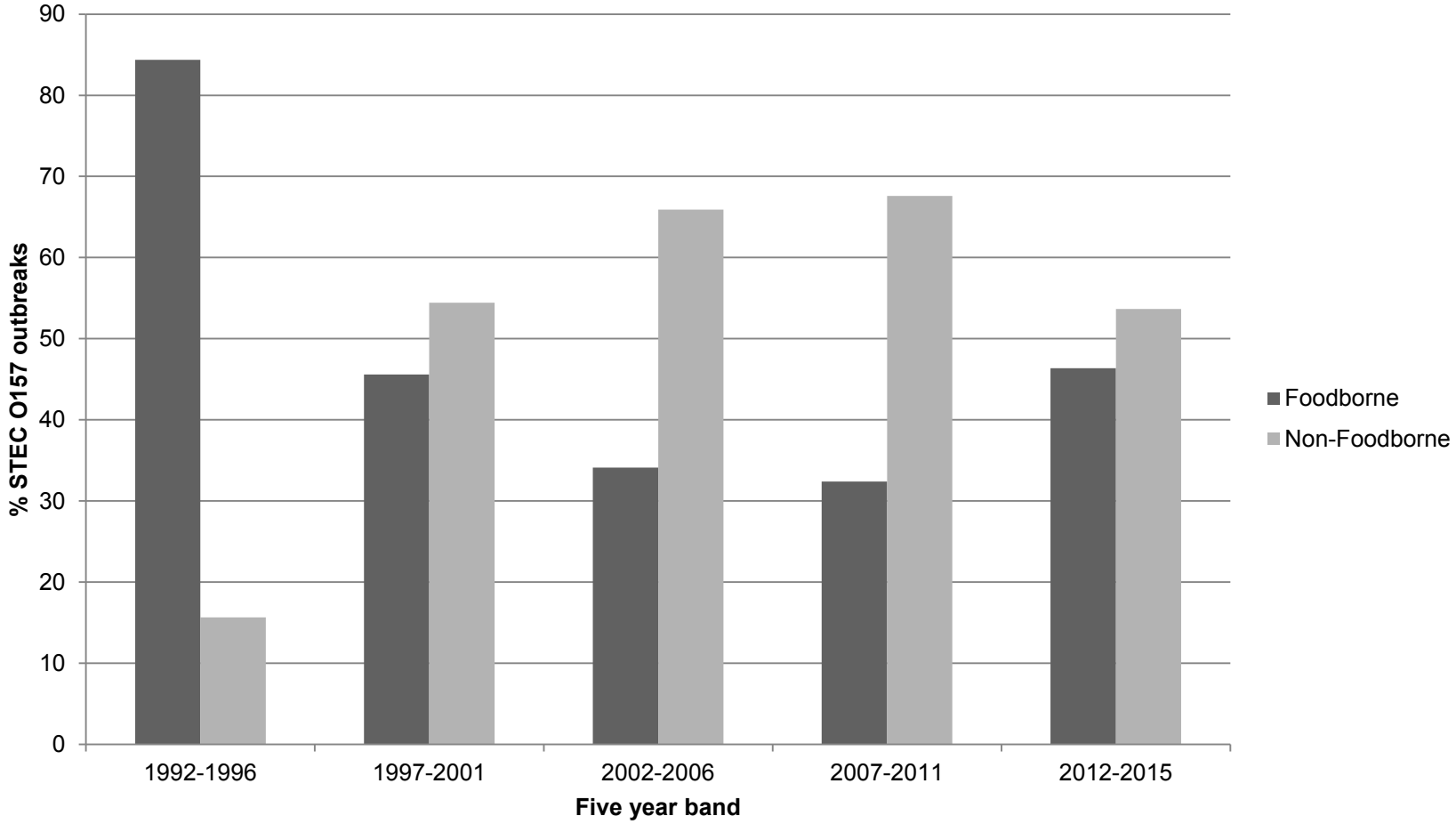
Outbreaks of STEC O157 reported to PHE eFOSS. Includes foodborne followed by person to person transmission.

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

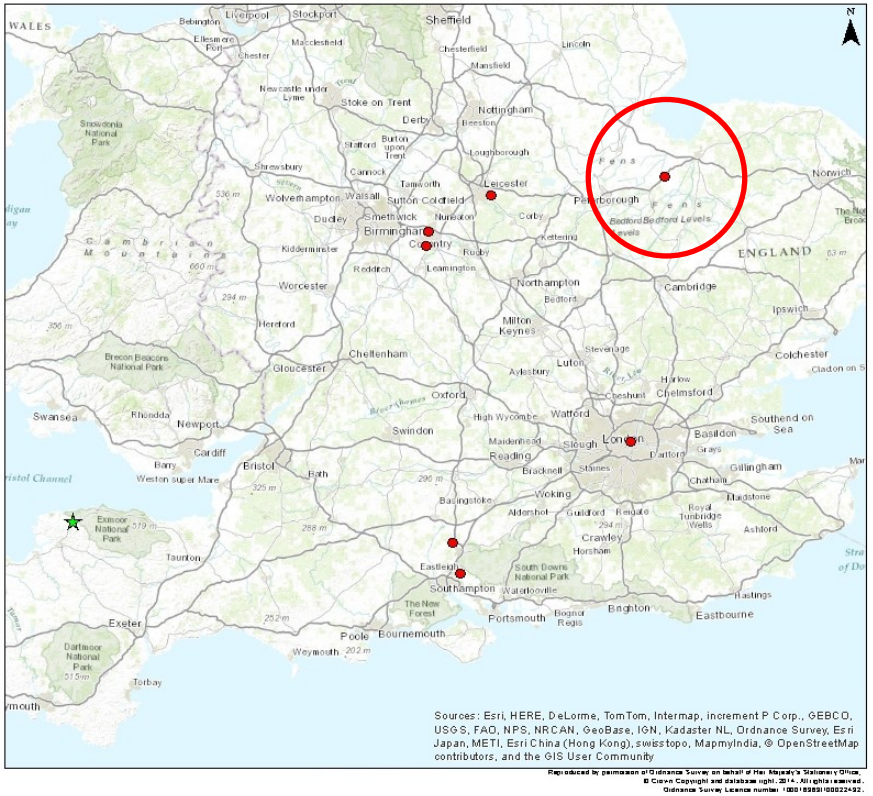
Exposure exceedance alerts

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



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