Scottish surveillance of enteric pathogens

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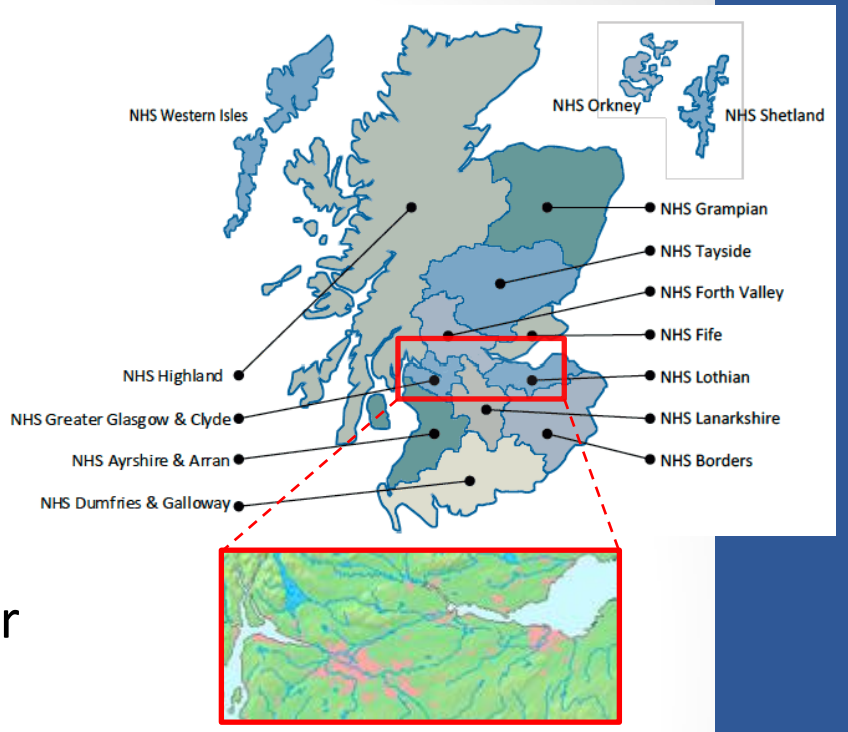
Overview

- Background
  - Health service in Scotland
  - Organisation of national surveillance of infections and health problems associated with environmental hazards
- Surveillance of enteric infections
  - General information
  - Surveillance of specific pathogens
- Summary and Conclusions

Background

NHS Scotland

- 5,4 millioner indbyggere (2015)
  - ”Central belt” 3,5 millioner (65%)
- 14 health boards (”amter”).
- Sundhed i befolkningen er af højeste politiske prioritet.
- Højt niveau af koordinering af indsatser
  - Politikker (oftest nationalt dækkende)
  - Indsatser (oftest koordinerede centralt)
- Kort ”afstand” mellem det skotske sundhedsministerium og primær & sekundær sektorer.
- Demografiske udfordringer:
  - en voksende ældre population
  - stor ulighed i folkesundhed, levealder, kroniske lidelser



“Central Belt” area with urban areas (pink), including Glasgow to the west and Edinburgh to the east

National surveillance of infections

Health Protection Scotland

Functions

- Surveillance & monitoring hazards & exposures affecting people & impact they have on their health
- Co-ordination of national health protection programmes, for example, immunisation & antimicrobial resistance
- Expert advice & horizon scanning
- Preparation & response to outbreaks and incidents
- Enabling good professional practice
- Supporting the ongoing development of a confident & competent health protection workforce
- Support commissioning specialist/reference lab services
- Research & innovation to provide evidence for action

Priority topics:

- Antimicrobial resistance (AMR)
- Healthcare associated infection (HAI)
- Blood borne viruses (BBVs)
- Environmental public health (EPH)
- Gastrointestinal & zoonotic infections
- Immunisations
- Public health microbiology
- Respiratory infections
- Sexually transmitted infections (STIs)
- Travel health
- Emerging infections

https://www.hps.scot.nhs.uk/about-us/

Surveillance of enteric infections

General Information

- Surveillance of gastrointestinal infection in Scotland is mainly based on laboratory reporting by frontline diagnostic labs
  - Electronic Communication of Surveillance in Scotland (ECOSS)
- Supplemented by an extensive surveillance network which includes:
  - NHS boards
  - hospitals
  - general practitioners
  - local authorities
- ObSurv is the surveillance system established in 1996 for all general outbreaks of Infectious Intestinal Disease (IID) in Scotland.

DISEASES TO BE NOTIFIED BY REGISTERED MEDICAL PRACTITIONERS WITH EFFECT FROM 1 JANUARY 2010: NOTIFICATIONS ARE BASED ON REASONABLE SUSPICION AND SHOULD NOT AWAIT LAB. CONFIRMATION

* Anthrax
* Botulism
Brucellosis
* Cholera
* Clinical syndrome due to E.coli O157 infection **(see Note 1)**
* Diphtheria
* Haemolytic Uraemic Syndrome (HUS)
* Haemophilus influenzae type b (Hib)
* Measles
* Meningococcal disease
Mumps
* Necrotizing fasciitis
* Paratyphoid
* Pertussis
* Plague
* Poliomyelitis
* Rabies
Rubella
* Severe Acute Respiratory Syndrome (SARS)
* Smallpox
Tetanus
Tuberculosis (respiratory or non-respiratory) **(see Note 2)**
* Tularemia
* Typhoid
* Viral haemorrhagic fevers
* West Nile fever
Yellow Fever

*It is recommended that those diseases above marked with an * require urgent notification, i.e. within the same working day. Follow up written / electronic notification within 3 days is still required.

Note 1: **E.coli O157**

Clinical suspicion should be aroused by (i) likely infectious bloody diarrhoea or (ii) acute onset non-bloody diarrhoea with a biologically plausible exposure and no alternative explanation. Examples of biologically plausible exposures include:

- contact with farm animals, their faeces or environment;
- drinking privately supplied or raw water;
- eating foods such as undercooked burgers or unpasteurised dairy products;
- contact with a confirmed or suspected case of VTEC infection.

Laboratory diagnostic methods 1

- Since surveillance is predominantly laboratory-based, there are a number of ascertainment biases: -
  - Which patients are tested?
  - What pathogens are looked for?
  - How sensitive are the techniques?

Laboratory diagnostic methods 2

- Chromogenic culture plates (XLD) for *Salmonella* and *Shigella* usually combined with selenite enrichment.
- Selective *Campylobacter* plate (microaerophilic).
- Sorbitol MacConkey plate for O157 STEC.
- All liquid stools in patients >2 (hospital & community) tested for *C.difficile* (ESCMID ESGCD 2-step algorithm including toxin EIA).
- Auramine phenol stain and microscopy for *Cryptosporidium spp.*
- Ova, cyst and parasite microscopy on 10-15% stools according to travel history (also culture for *Vibrio spp.).*
- Testing for viruses mainly in suspected outbreaks.
- *E.coli* other than O157 STEC not routinely tested for in frontline diagnostic labs.
- *Yersinia spp.* not routinely tested for in frontline diagnostic labs.
- Enteric molecular diagnostics not generally used in frontline diagnostic labs*.

Laboratory surveillance data is an underestimate

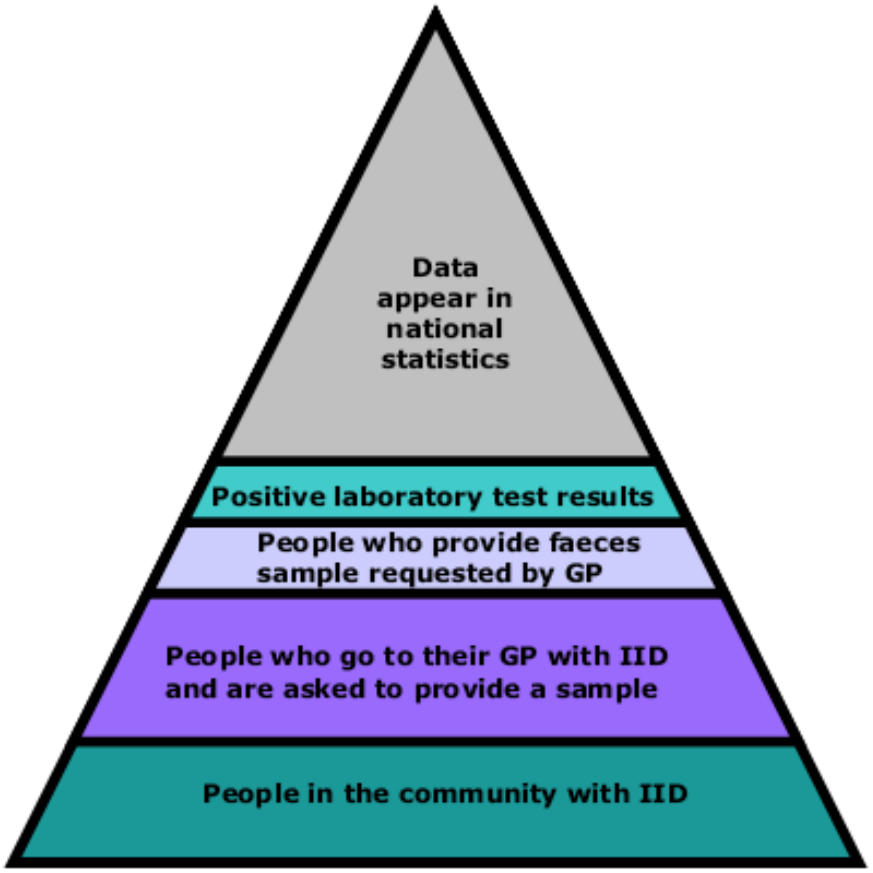


Figure 1 The surveillance pyramid illustrating attrition of data at each level.

GI infections in the UK – IID2 study

https://www.food.gov.uk/research/research-projects/the-second-study-of-infectious-intestinal-disease-in-the-community-iid2-study

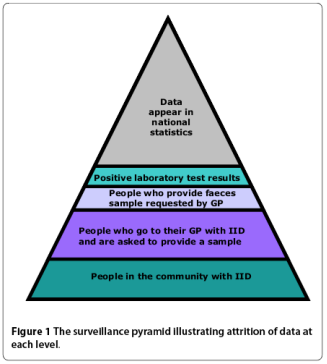


Figure 1 The surveillance pyramid illustrating attrition of data at each level.

7,735

Official statistics (lab reports)

14,452

49,404

6,530

128,022

GP consultations

83,850

78,973

11,291

Norovirus 2,905,278

Rotavirus 783,737

Campylobacter 571,949

Salmonella 38,606

Other bacterial pathogens are an order of magnitude less common than salmonella

Surveillance of specific pathogens

Campylobacter

https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2708/documents/1_annual-summary-campylobacter-2018-12022019.pdf

- During 2018 there were 6096 reports of *Campylobacter*, making this the commonest bacterial enteric infection in Scotland.
- This was an increase of 301 (5.2%) compared to 2017.
- This is the second consecutive year reports have increased following a decline in 2015 and 2016.
- The overall rate in 2018 was 112.8 per 100,000 population, compared to 107.2 per 100,000 population in 2017.
- Amongst children and young adults, rates are higher in children under 5 years of age and amongst adults rates are highest in those over 50.
- Overall rates are higher in males, with 126.1 per 100,000 population compared to 101.4 per 100,000 population for females.
- Most cases are apparently sporadic. In 2018, no general outbreaks (affecting more than one household) were reported to ObSurv.
- Currently an active area of research with FSS and UK FSA, especially regarding WGS based typing and ascertainment.

Figure 1: Laboratory isolates of *Campylobacter* reported to HPS, 2009-2018.

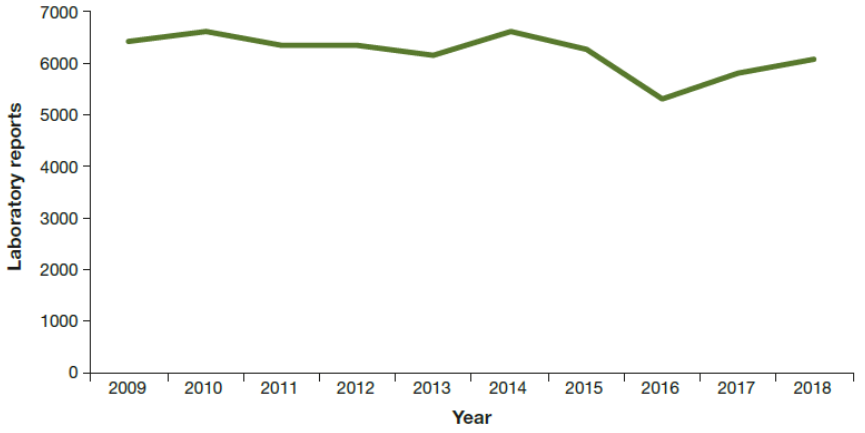
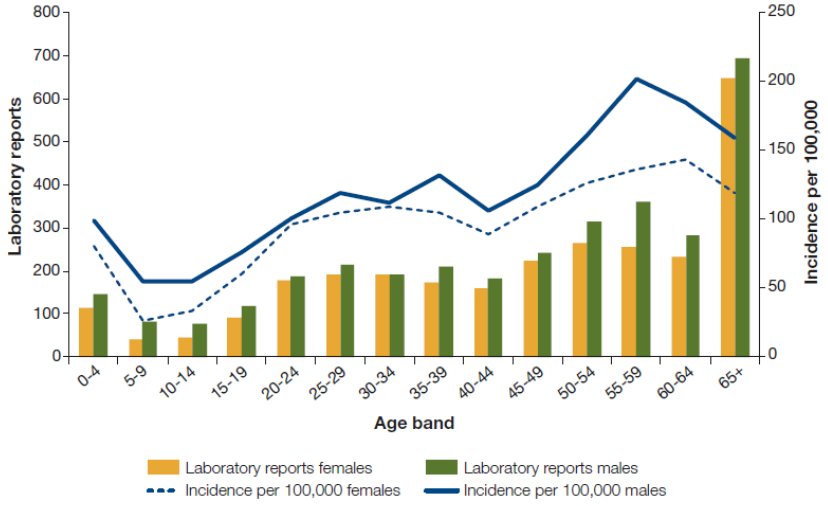


Figure 2: Laboratory reports and incidence per 100,000 of *Campylobacter* by sex and age band in 2018.



Salmonella

- All human isolates of *Salmonella* are sent to the Reference laboratory in Glasgow for serotyping and molecular subtyping.
- This was previously by conventional serotyping, PFGE and antibiogram, but for the last 2 years has used WGS (now also for AMR monitoring).
- During 2018, the Reference Laboratory reported 751 cases of human non-typhoidal *Salmonella* to Health Protection Scotland (13.9 per 100,000).
- This represented a 10% decrease on the 840 cases reported in 2017, and the 839 cases reported in 2016.
- The two most common serotypes were *Salmonella* Enteritidis and *Salmonella* Typhimurium which accounted for 55% of all isolates.
- Overall higher rates were observed in children under 5 years of age compared with older children.
- In 2018, there were six general outbreaks reported to ObSurv. This compares with eight in 2017. Four of the outbreaks reported in 2018 were part of UK outbreaks.

Figure 1: Laboratory isolates of *Salmonella* reported to HPS, 2009-2018.

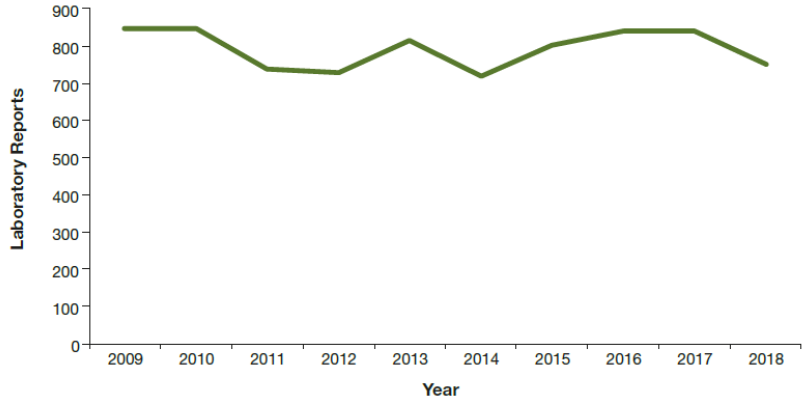
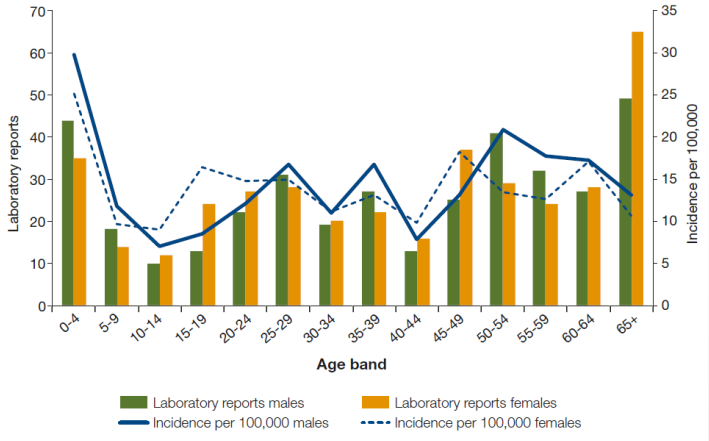


Table 1: The ten most commonly reported serotypes in Scotland, 2018

Serotype	Number of cases
S. Enteritidis	275
S. Typhimurium	139
S. Newport	28
S. Infantis	23
S. Agona	21
S. Stanley	16
S. Java	13
S. SaintPaul	13
S. Kentucky	11
S. Virchow	10
Others (75 serotypes)	202

Figure 2: *Salmonella* in Scotland 2018, Age and sex -stratified rates per 100,000 population



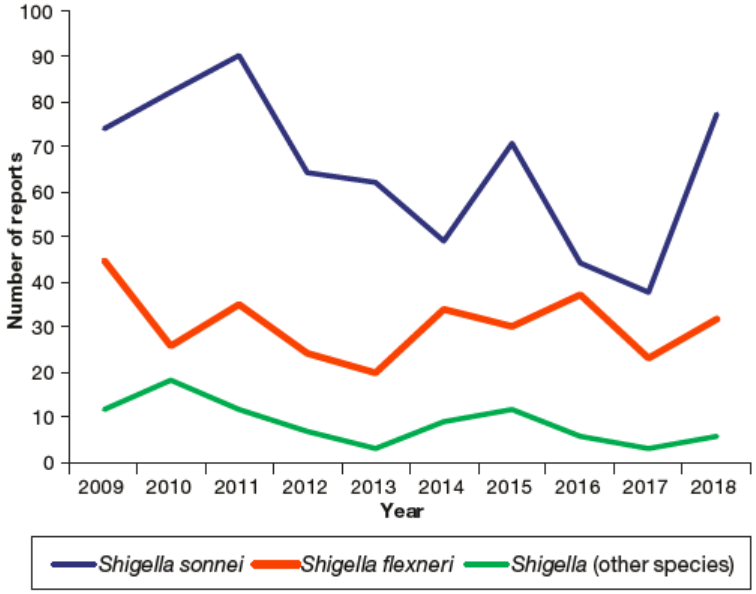
https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2709/documents/1_annual-summary-salmonella-2018-12022019.pdf

Shigella

https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2784/documents/1_annual-surveillance-shigella-2018.pdf

- All human isolates of *Shigella* are sent to the Reference laboratory in Glasgow for speciation and molecular subtyping.
- Since October 2017, the Glasgow Reference Laboratory has routinely undertaken WGS on all *Shigella* isolates in Scotland, replacing traditional typing techniques.
- In 2018, there were 115 reports of *Shigella* in Scotland.
- The most common species identified was *Shigella sonnei* with 77 cases (67.0%). This is an increase when compared with the 38 reports (59.4%) in 2017 and 44 reports (50.6%) in 2016.
- In recent years many countries have observed an increase in *Shigella sonnei* and *Shigella flexneri* infections associated with MSM, and the spread of drug-resistant strains is of concern.

Figure 1: Reports of *Shigella* in Scotland by species, 2009-2018



E.coli O157/STEC

https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2847/documents/1_stec-scotland-2018.pdf

- Particular interest in Scotland
  - Rates per 100,000 higher than rest of UK
  - High profile outbreaks
  - This has resulted in: -
    - Research focus
    - Enhanced surveillance
- Ruminants (cattle, sheep and goats) are main reservoir of infection.
- Particular focus in Scotland on direct/indirect contamination with animal faeces.
- Although large foodborne outbreaks have occurred in Scotland, sporadic infection predominates.
- VTEC/STEC action plan.
- All *E. coli* O157 isolates sent to the Reference Laboratory for confirmation and further typing (previously phage typing/PFGE – now WGS).
- Faeces from "high risk patients" testing negative at the local laboratory are sent to Reference Laboratory, where molecular methods are used for detection of *E. coli* O157 and other STEC.
- Non-O157 STEC account for over a third of all STEC in Scotland (30 serogroups identified).
- Enhanced surveillance demonstrated that a third of patients required admission to hospital.
- Three outbreaks of *E. coli* O157, two outbreaks of *E. coli* O145 and one of *E. coli* O26 occurred.

Figure 5: Laboratory confirmed cases of *E. coli* O157 and non-O157 STEC in Scotland 2014-2018.

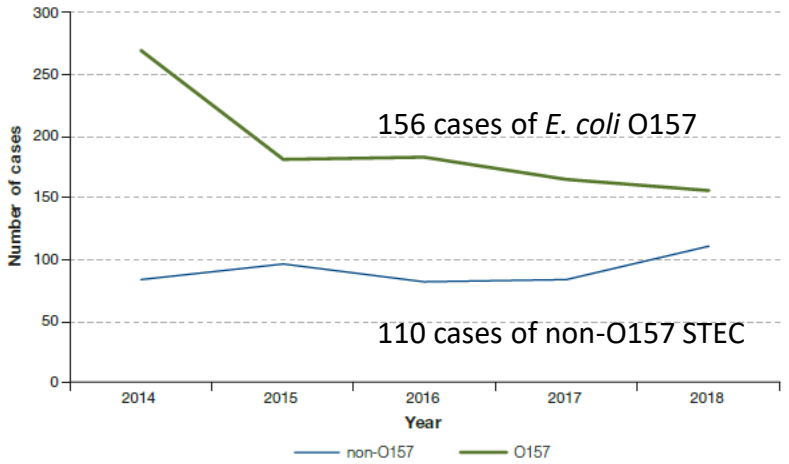
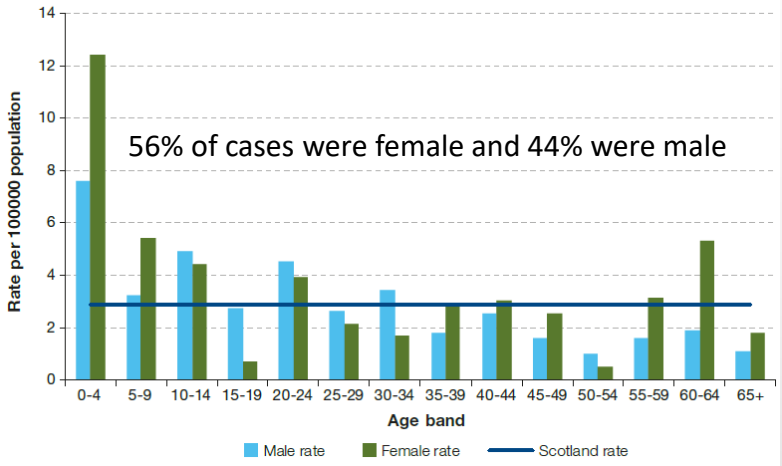


Table 6: Serogroups of culture confirmed cases on non O157 STEC in Scotland, 2018.

Serogroup	Total
O26	34
O145	12
O103	6
O146	3
O112	2
O113	2
O128	2
O153 – O178	2
O182	2
O63	2
O8	2
Others (19 types)	19

Phage type	2018	2018 % of total
PT 8	52	33.3%
PT21/28	27	17.3%
PT RDNC	21	14.1%
PT 32	14	9.0%
PT Untypable	11	6.4%
PT 14	6	3.8%
PT 31	4	2.6%
PT 2	4	2.6%
PT 54	2	1.3%
PT 51	1	0.6%
PT 4	1	0.6%

Figure 3: *E. coli* O157, age stratified rates per 100,000 population (n=156), 2018.



Clostridioides difficile

https://hpspubsrepo.blob.core.windows.net/hps-website/nss/2776/documents/1_HAI-Annual-Report-2018-final-v1%201.pdf

- Mandatory surveillance in patients aged ≥65 years since October 2006. Extended to include those aged 15-64 years in April 2009.
- Between 2008 and 2018 incidence rate has been reduced by more than 80% from around 160 per 100,000 to 24.2 per 100,000 population.
- Between 2014 and 2018, there was a year on year decrease of 4.7% in the rate og HA-CDI (p<0.001).
- Between 2014 and 2018, there was a year on year decrease of 7.1% in the rate of CA-CDI (p<0.001).
- Since 2008 the Reference laboratories in Glasgow have carried out PCR ribotyping under a snapshot, and severe cases and/or outbreaks typing schemes.
- Scottish study from last year showed that CDI is associated with a 3-fold increase in 30-day all-cause mortality compared to those without CDI and increased mean length of stay by 22.3%.
- Reduction in CDI achieved by national multidisciplinary initiative : -
  - Antimicrobial stewardship
  - Infection Prevention & Control measures
  - Cleaning/disinfection
- Details can be found in: -
  - Guidance on Prevention and Control of Clostridium difficile Infection (CDI) in Health and Social Care Settings in Scotland
  - Recommended protocol for testing for Clostridium difficile and subsequent culture

FIGURE 11: Overall quarterly CDI incidence rates for Scotland (per 100 000 total bed days) in patients ≥65 years for the period October 2006 to June 2012

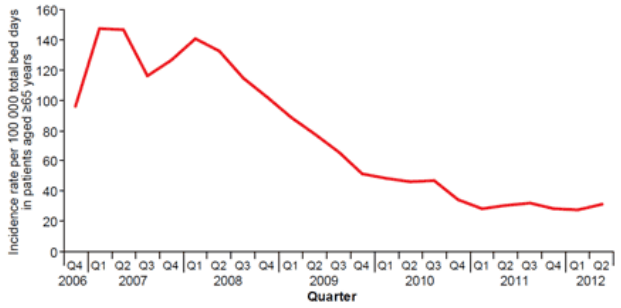
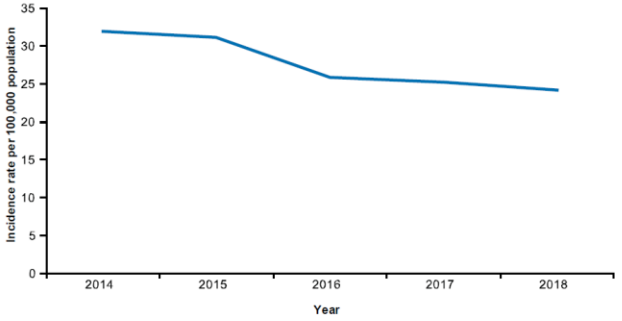
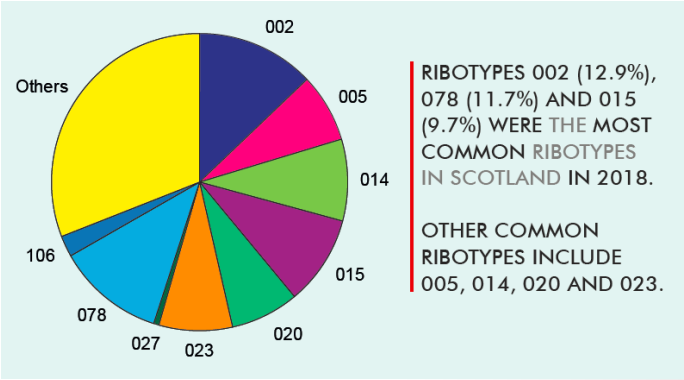


FIGURE 9: CDI incidence rate in patients aged ≥15 years per 100,000 population for Scotland, 2014 to 2018.





General outbreaks of infectious intestinal disease in 2018

NHS board	Organism	Confirmed, Suspected, Nil return	Location	Main mode/s of spread	Cases ill	Cases positive	Suspect vehicle	Evidence for suspicion
VV	*E. coli* O157	C	Community	FB	5	5	N/K	N/A
VV	*E. coli* O26	C	Community	Multi+FB	5	5	N/K	N/A
VV	*E. coli* O145	C	Community	FB	2	2	N/K	N/A
VV	*E. coli* O157	C	Community	FB	5	5	N/K	N/A
VV	*E. coli* O145	C	Community	FB	3	3	N/K	N/A
VV	*E. coli* O157	C	Community	FB	2	2	N/K	N/A
VV	*Salmonella Enteritidis*	C	Community	Other	7	7	Feeder mice	D
VV	*Salmonella Enteritidis*	C	Community	FB	2	2	Eggs (Poland)	D
VV	*Salmonella Typhimurium*	C	Community	FB	2	2	Multiple	D
VV	*Salmonella Agona*	C	Community	FB	8	8	N/K	N/A
VV	*Salmonella Newport*	C	Community	FB	6	6	Unpasteurised goats milk cheese (France)	D, M
VV	*Salmonella Bovismorbificans*	C	Restaurants	FB	5	5	N/K	N/A
TY	*Cryptosporidium*	C	School	P to P	2	2	N/A	N/A
LN	*Cryptosporidium*	C	Swimming pool	Water	3	3	N/A	N/A
FV	NV	C	Event	Multi+FB	60	4	N/K	N/A

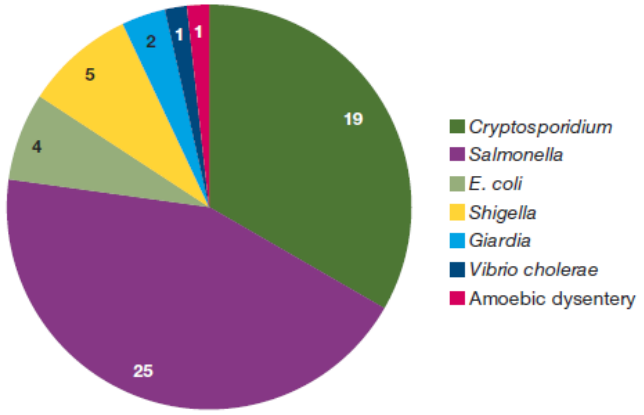
Overseas outbreaks of infectious intestinal disease

- In 2018, information was circulated concerning 57 outbreaks of infectious intestinal disease in persons returning to Scotland from abroad.
- Although this was an increase when compared to the 35 overseas outbreaks reported in 2017, the average number of overseas outbreaks between 2003 and 2018 was 57.
- Parasitic infections of interest in this context, and in recent years have had cases of *Cyclospora spp* infection associated with travel to Mexico.
- *Cryptosporidium spp* are of interest because they see two seasonal peaks; one in spring (coincides with lambing /calving) and visits to petting farms during the easter holidays); another peak in autumn (travel cases and person-person) rather than animal-person transmission.

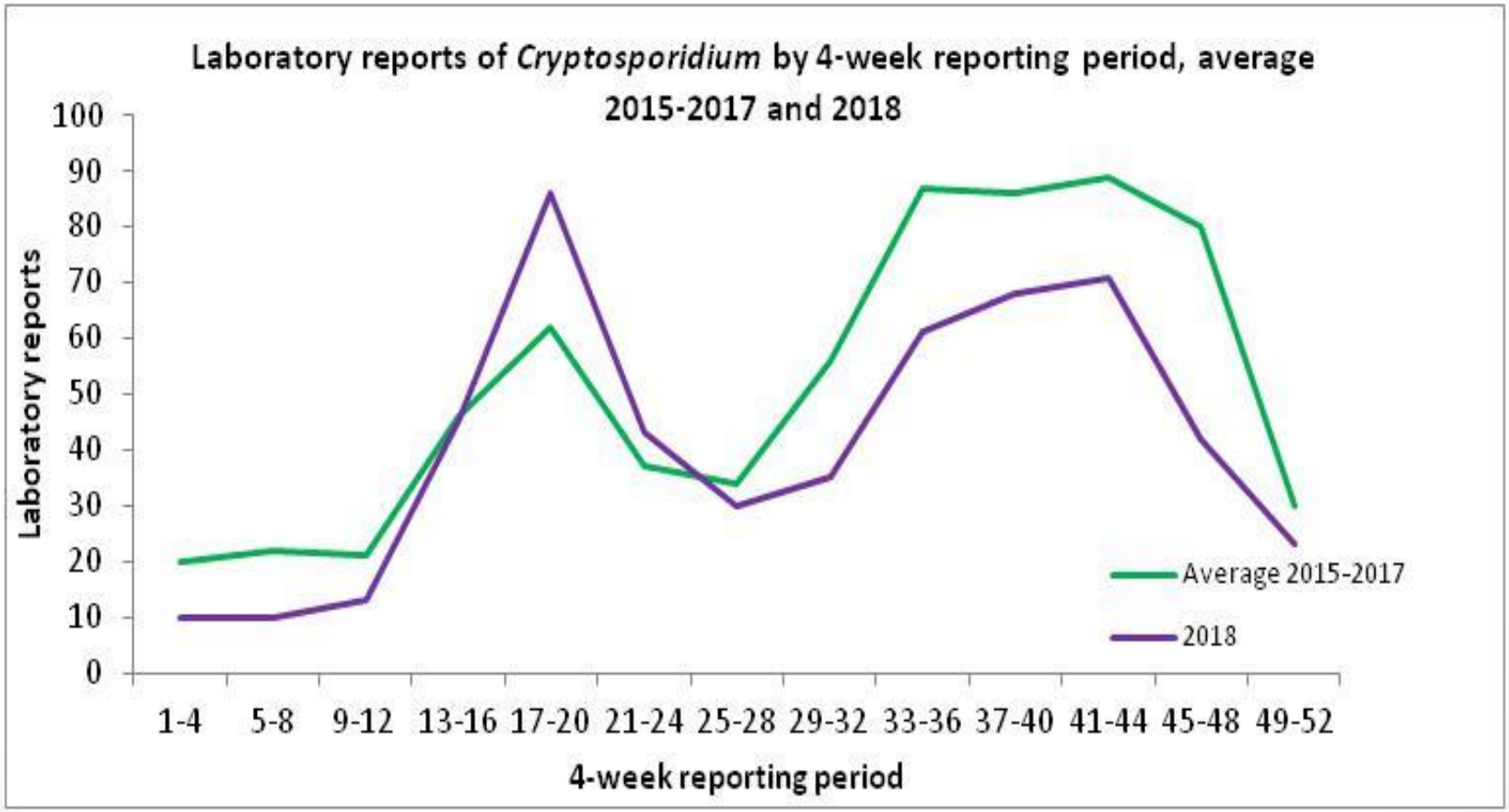
Table 1: Countries reported as associated with potential overseas outbreaks of infectious intestinal disease in 2018.

Country	Number of Outbreaks
Spain	17
Turkey	16
Mexico	6
Egypt	4
Cuba	3
Cyprus	2
Tunisia	2
Countries reported on one occasion	7
Total	**57**

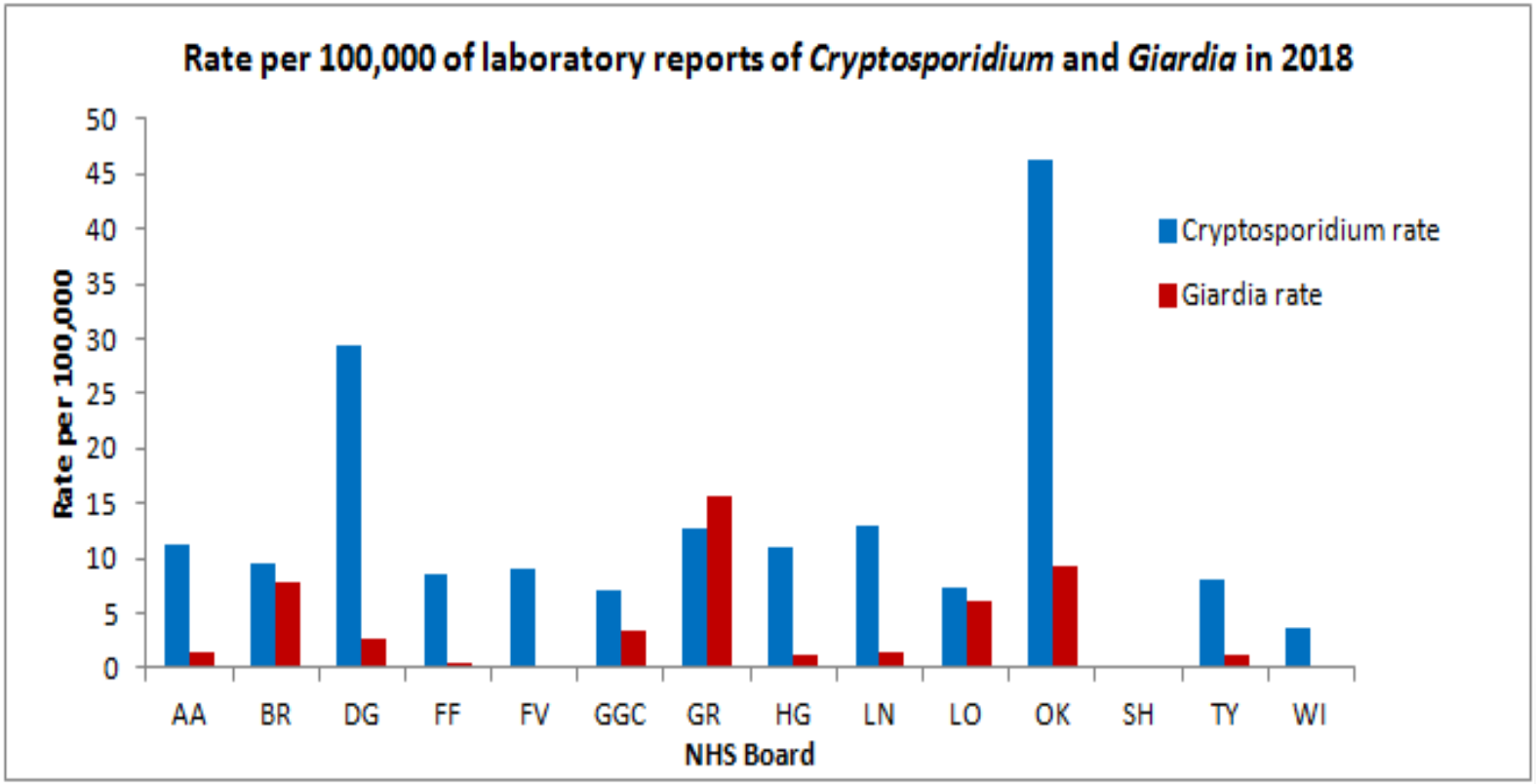
Figure 2: Pathogens associated with potential overseas outbreaks of infectious intestinal disease reported to HPS in 2018 (n=57).



Laboratory reports of *Cryptosporidium* by 4-week reporting period, average 2015-2017 and 2018



Comparison of rates per 100,000 of laboratory reports of *Cryptosporidium* and *Giardia*



Summary & Conclusions

Summary & Conclusions 1

- Surveillance of enteric pathogens in Scotland is predominantly based on laboratory-confirmed infections
- This is inevitably influenced by
  - who is tested
  - the pathogens looked for
  - the methods chosen
- The impact of particular infections in Scotland has resulted in important national initiatives e.g. VTEC/STEC task force and the control of CDI
- The adoption of molecular testing panels is likely in the near future
  - Increase the range of pathogens detected
  - Increased sensitivity (at least for some pathogens)
  - Address lack of skilled/experienced staff
  - BUT concern at lack of isolates for typing

Summary & Conclusions 2

- WGS is replacing typing and AMR surveillance in the reference setting, and is revolutionising our understanding of the epidemiology of enteric infection
- WGS has revolutionised detection and investigation of clusters of infection
  - Time frame and temporal clustering of cases
  - Number of cases
  - Geographical spread – single or multi NHS board
  - Household clusters
  - Travel related clusters
  - Animal isolates (type (domestic or farm), time in relation to human cases)
  - Part of national or international outbreaks
  - “Not all clusters are equal”
- For O157 STEC now starting to use the WGS data on virulence genes etc. and linking that to the enhanced surveillance and clinical data to get a better understanding of the pathogenicity and epidemiology of STEC