



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

**Are we looking in the right
places?**

**Insights from One Health STEC
surveillance in The
Netherlands**

**FOOD
POISONING**



Eelco Franz
RIVM

Head of Department
Epidemiology Enteric, vectorborne and Zoonotic Infections

Eelco.franz@rivm.nl



STEC surveillance in NL

Mandatory by law



Report cases



Regional health authority

Pseudonymized report

Enteric disease
<21 days
AND
stx1+eae
stx2
Culture Stx-producing E. coli

HUS+Stx

Centralized surveillance
RIVM



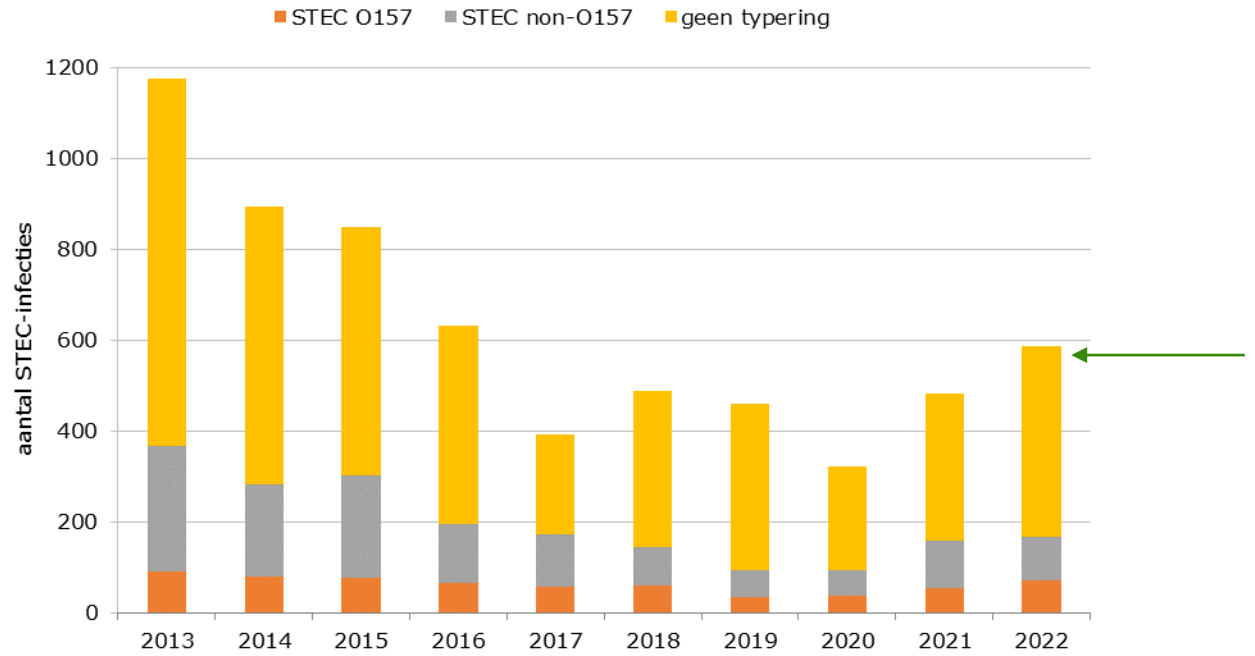
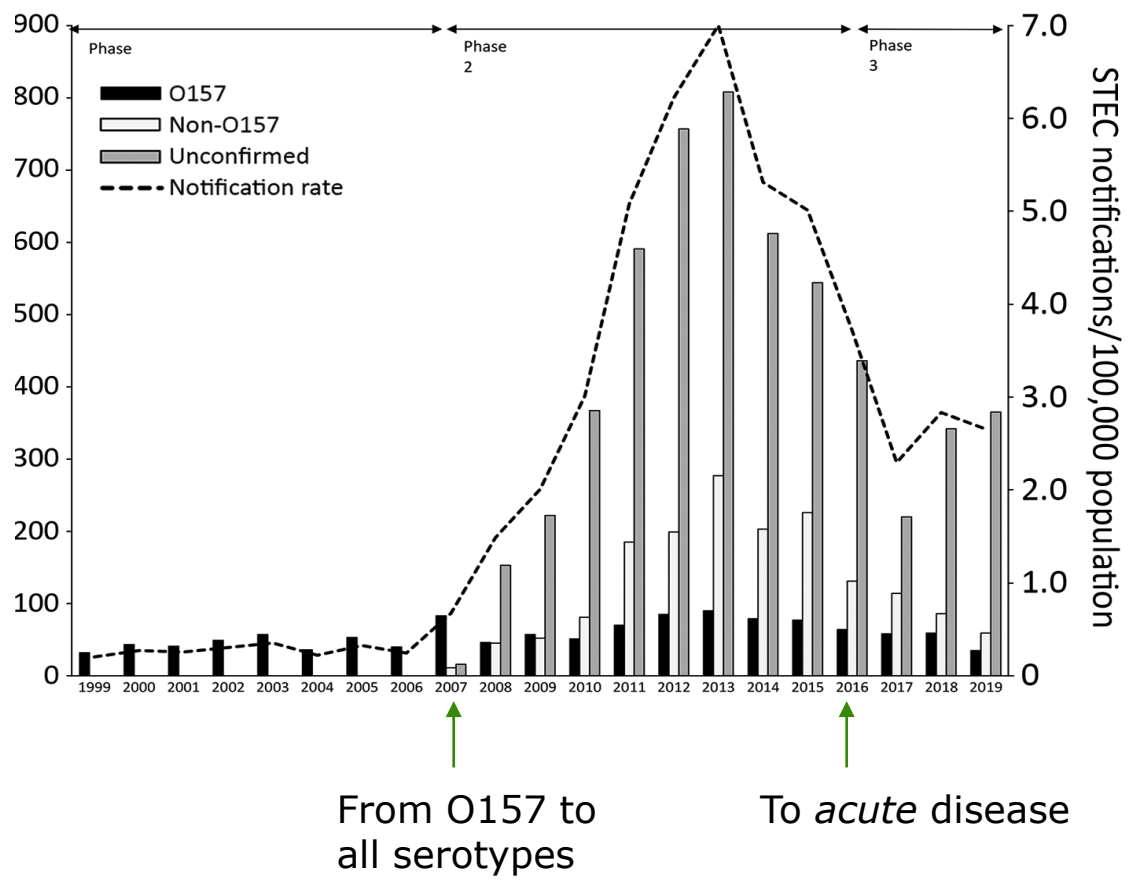
Medical labs and physicians



STEC isolates

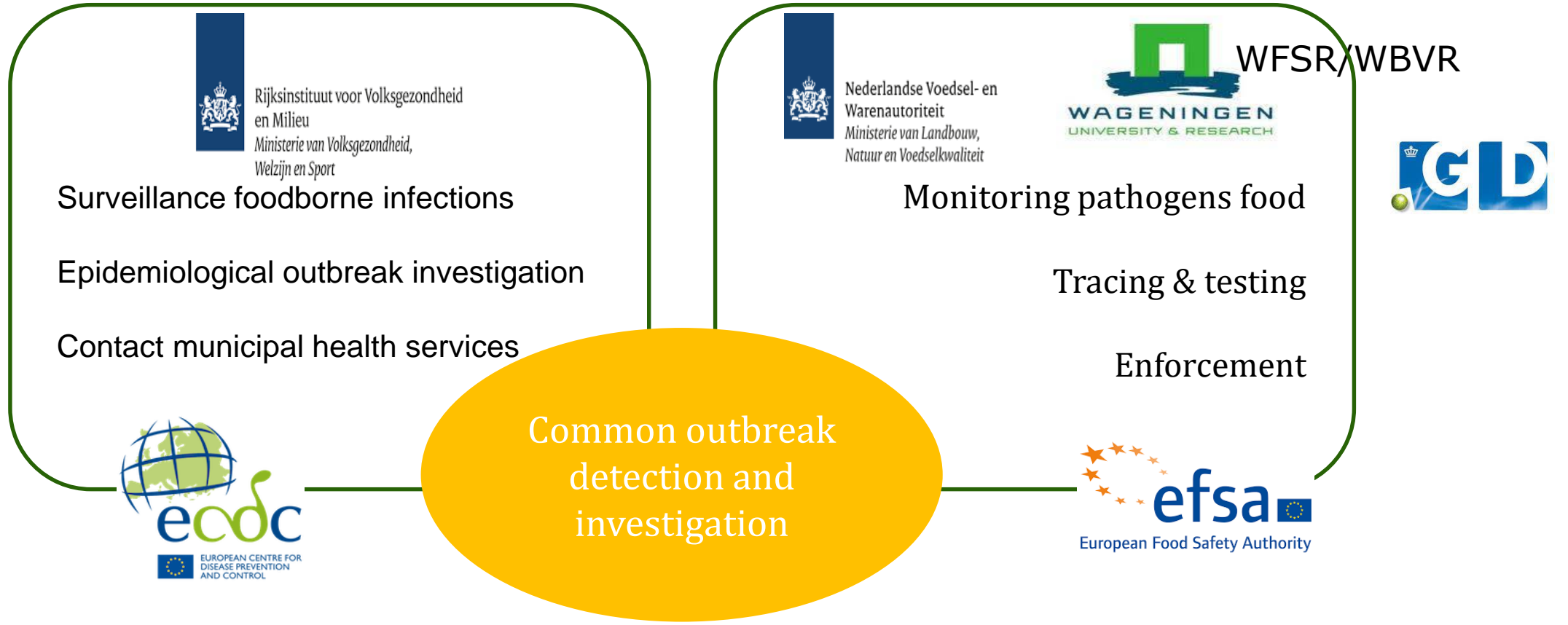


STEC in The Netherlands





Organization 'public health food safety' in NL





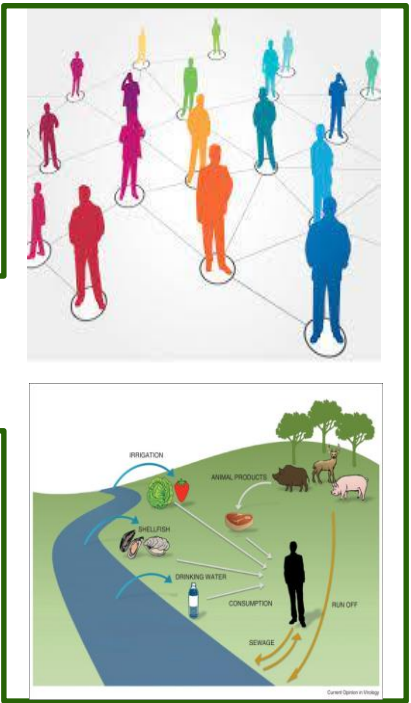
Noodzaak kiemsurveillance

WGS-data pathogens

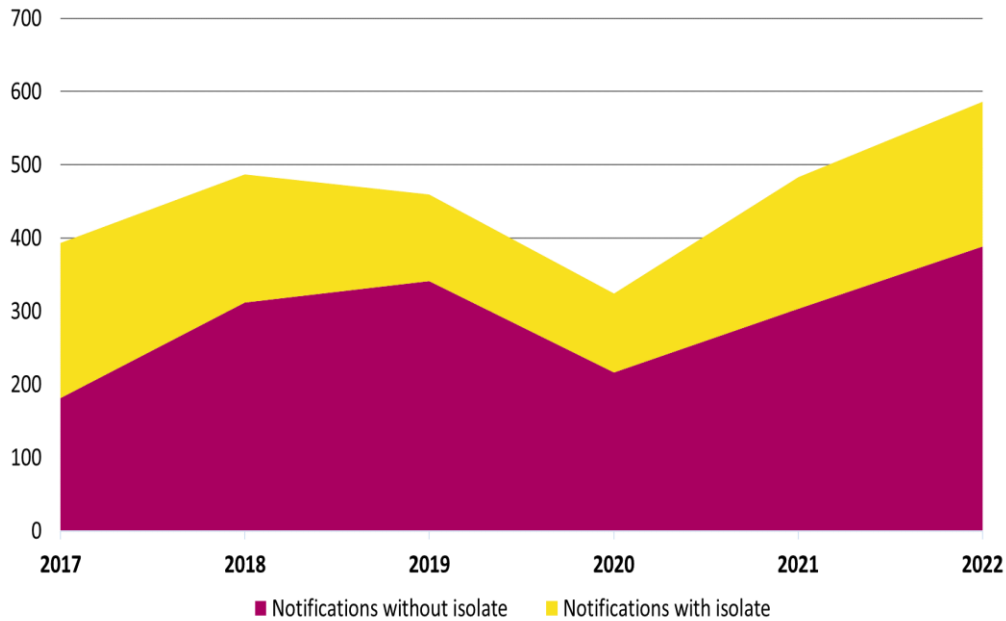


Outbreak detection

Mandatory notification

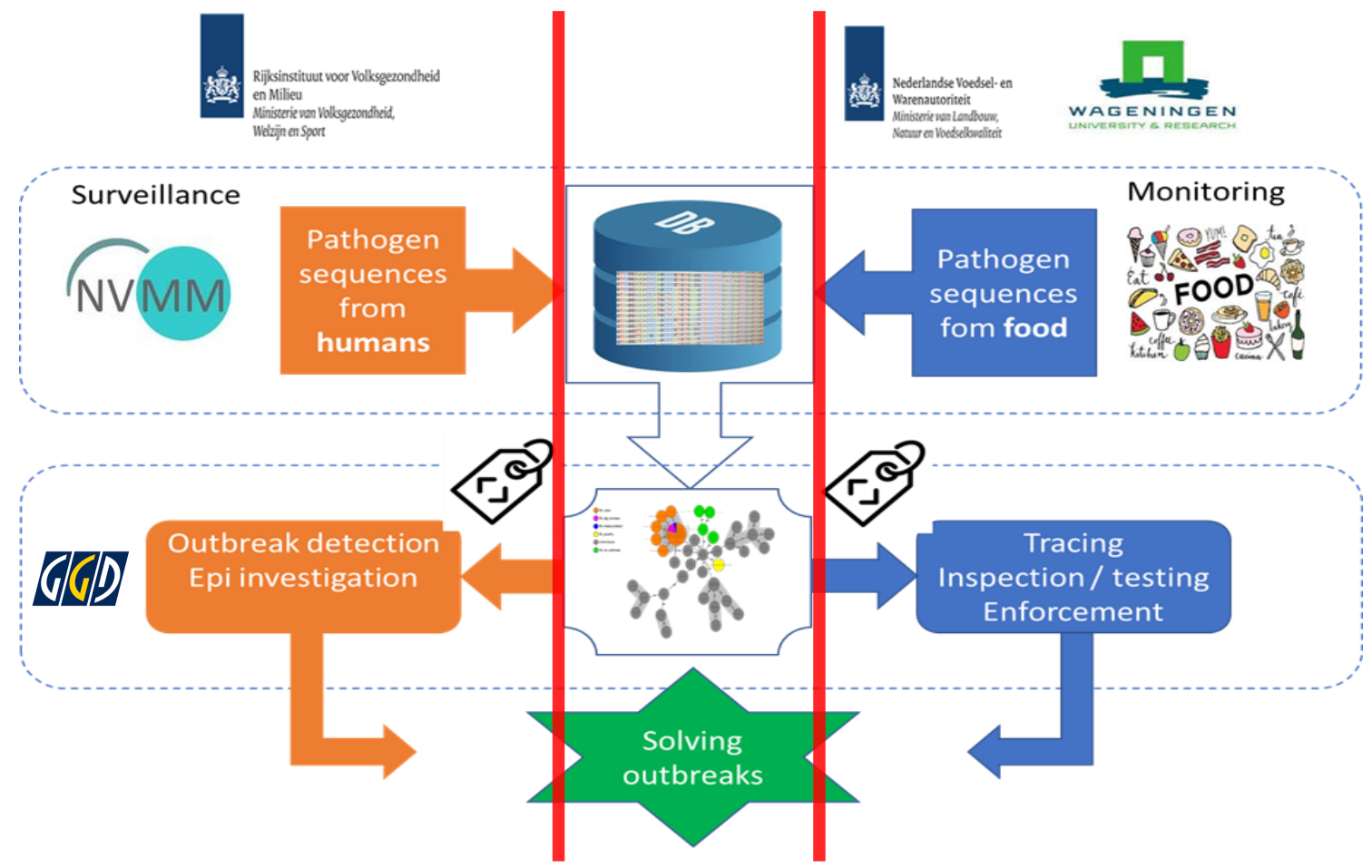


Need for isolates!





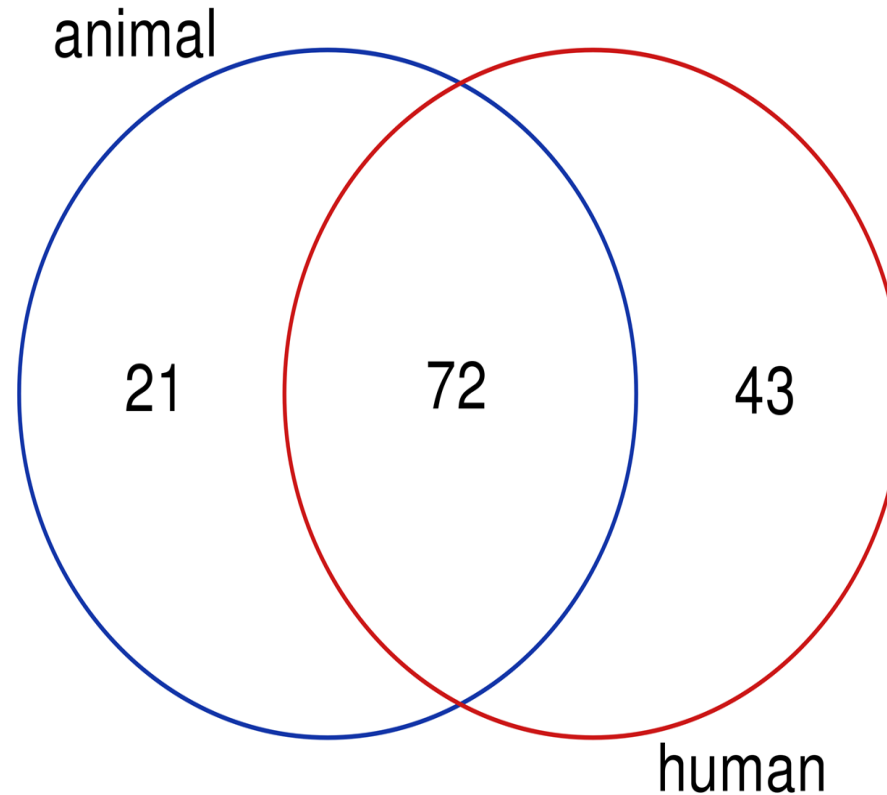
WGS data-sharing human-food





Serotype distribution

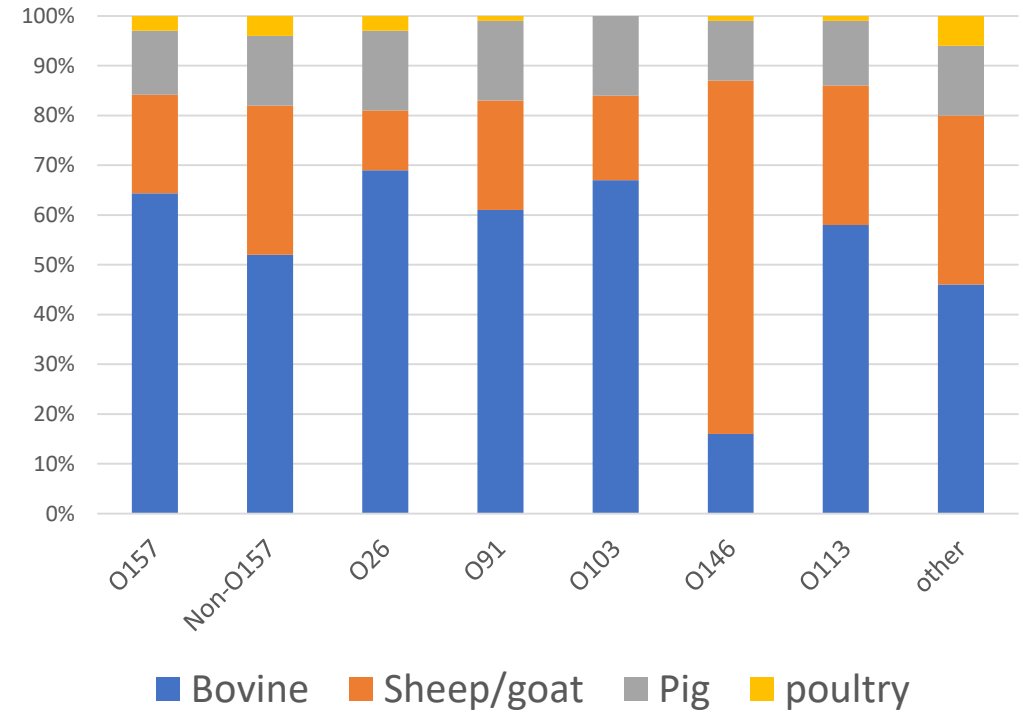
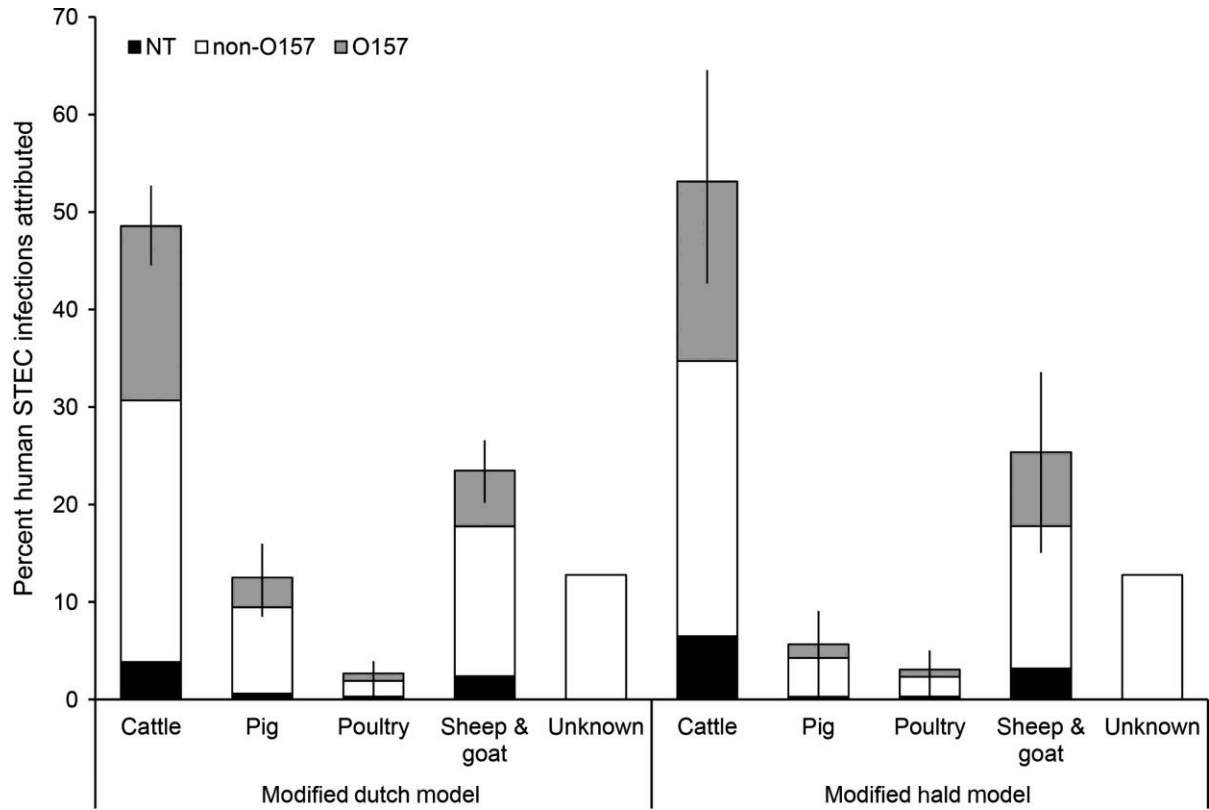
- Data:
- 1761 from patients
 - 1301 from animal/food
 - 136 O-types



Names	total	elements
animal human	72	O146 O187 O182 O176 O8 O76 O2/O50 O104 O125 O157 O49 O109 O4 O153/O178 O174 O11 O155 O102 O93 O166 O108 O98 O113 O63 O36 O127 O55 O84 O78 O100 O150 O130 O121 O111 O51 O23 O NT O117 O115 O5 O168 O163 O136 O9 O177 O103 O18 O154 O128 O88 O145 O22 O38 O112 O153 O91 O15 O89 O54 O183 O123 O45 O85 O156 O2 O26 O116 O43 O171 O27 O6
animal	21	O90 O21 O17/O77 O110 O159 O3 O149 O160 O175 O126 O81 O138 O179 O185 O59 O29 O48 O24 O133 O17 O165
human ?	43	O28 O96 O137 O167 O70 O74 O178 O16 O101/O162 O169 O80 O71 O1 O82 O20 O37 O25 O39 O152 O181 O132 O172 O119 O186 O38 O151 O105 O40 O118 O134 O100/O154 O170 O101 O141 O75 O107 O131 O92 O69 O118/O151 O147 O79 O180



Source attribution NL





Relations patient and non-human

STEC clusters

	Isolates		Human clusters			Mixed clusters		
	human	non-human	n	isolates	range	n	isolates	range
O26	200	35	23	59	2-6	1	2	2
O157	411	22	55	194	2-18	2	8	4
other	1150	1244	81	211	2-8	10	27	2-5

Mixed clusters very rare





- Little outbreaks / clusters
- Little overlap human – food isolates
- (other) Sources / transmission routes leading to sporadic cases?

Non-zoonotic?

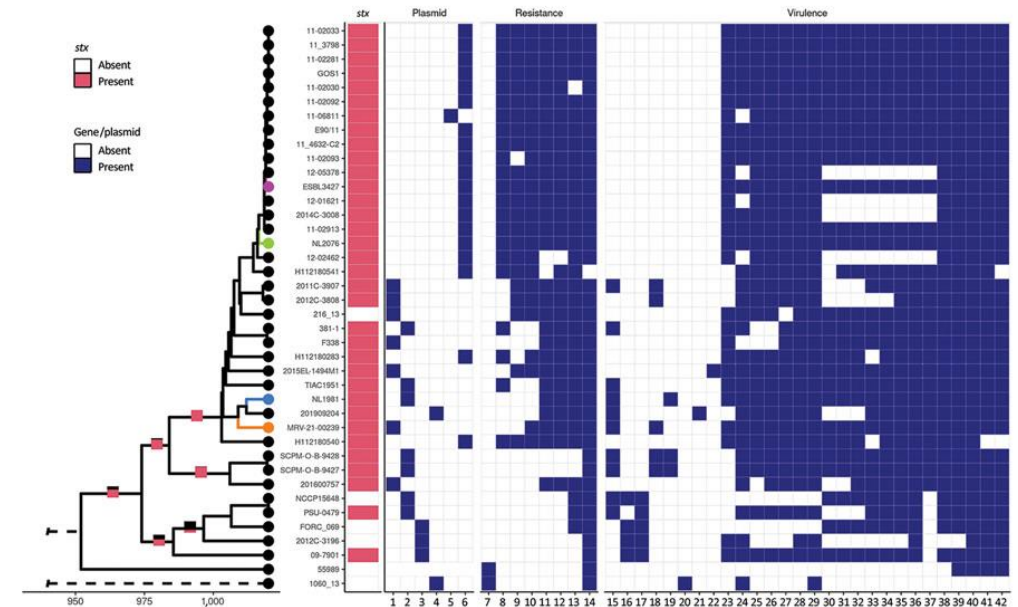


[Kintz 2023: Animal and environmental risk factors for sporadic Shiga toxin-producing Escherichia coli \(STEC\) infection in England: a case control study for O157, O26 and other STEC serotypes - PubMed \(nih.gov\)](#): **childcare occupations** raised the risk of infection for all serotypes.

[An outbreak of a rare Shiga-toxin-producing Escherichia coli serotype \(O117:H7\) among men who have sex with men - PubMed \(nih.gov\)](#): **MSM transmission**

[Identification of verocytotoxin-producing Escherichia coli O117:H7 in men who have sex with men, England, November 2013 to August 2014 - PubMed \(nih.gov\)](#). **MSM transmission**

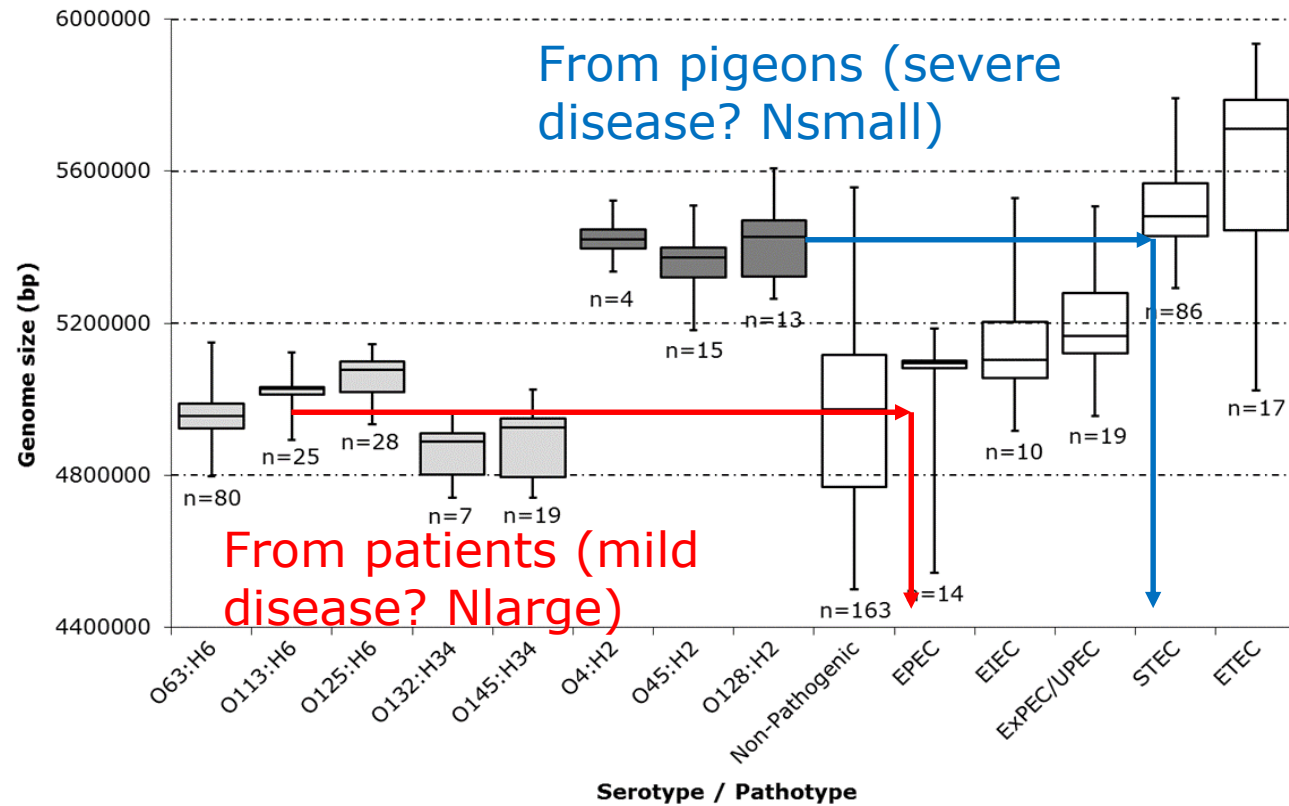
[Sporadic Occurrence of Enteroaggregative Shiga Toxin-Producing Escherichia coli O104:H4 Similar to 2011 Outbreak Strain - PubMed \(nih.gov\)](#). **Human reservoir**





Non-zoonotic?

t-EPEC/STEC (2f) hybrids



- Phylogenetically separated
- Different genome sizes
- Different virulent profiles
- Many t-EPEC/STEC but patient-pigeon different operons

t-EPEC/STEC hybrids with human reservoir?

Idem dito EAEC-/ETEC-STEC

-> quantify incidence



Environmental transmission

UK Strachan 2006:
Risk was 100 times greater when **visiting a pasture** than eating a burger in Grampian.

[UK Elson 2019:](#)

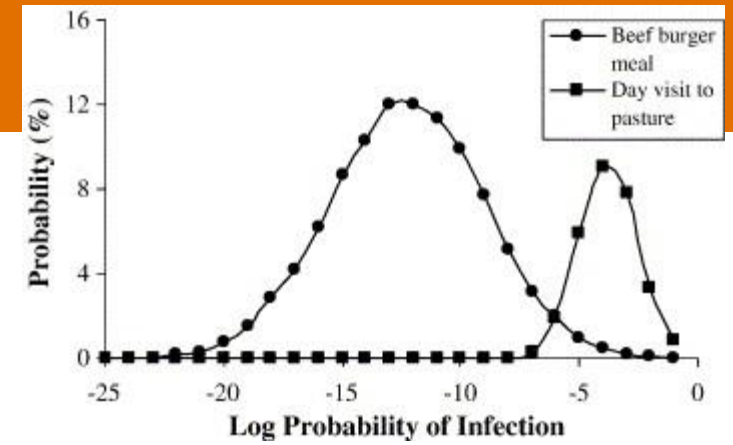
Living in rural areas with high densities of cattle, sheep or pigs and those served by private water supplies were associated with increased risk

[NL Friesmea 2011:](#)

Livestock density showed an increased risk of STEC cases in summer for **living in areas with cattle**, probably due to direct or indirect contact with cattle, resulting in symptomatic infections, especially in young children

[NL Mulder 2020:](#)

Consistent significant association between the population-weighted number of **small ruminants, but not cattle**, and the incidence of reported human STEC O157 infections in summer with a PAF of 49%.



Exact transmission routes?



Environmental transmission

Air?

Soil/water?

Direct contact animals

Agricultural products



Direct contact animals

NL Friesema 2012:

Risk factors for STEC infections in the Dutch population differed between age groups and serogroup categories, and were related to eating meat and **contact with farm animals**.

[CH: Animal petting zoos as sources of Shiga toxin-producing Escherichia coli, Salmonella and extended-spectrum \$\beta\$ -lactamase \(ESBL\)-producing Enterobacteriaceae - PubMed \(nih.gov\)](#)

Of 163 faecal samples, 75 contained stx1, stx2 or stx1/stx2 genes

[AU: Petting zoos as sources of Shiga toxin-producing Escherichia coli \(STEC\) infections - ScienceDirect.](#)





Fresh produce

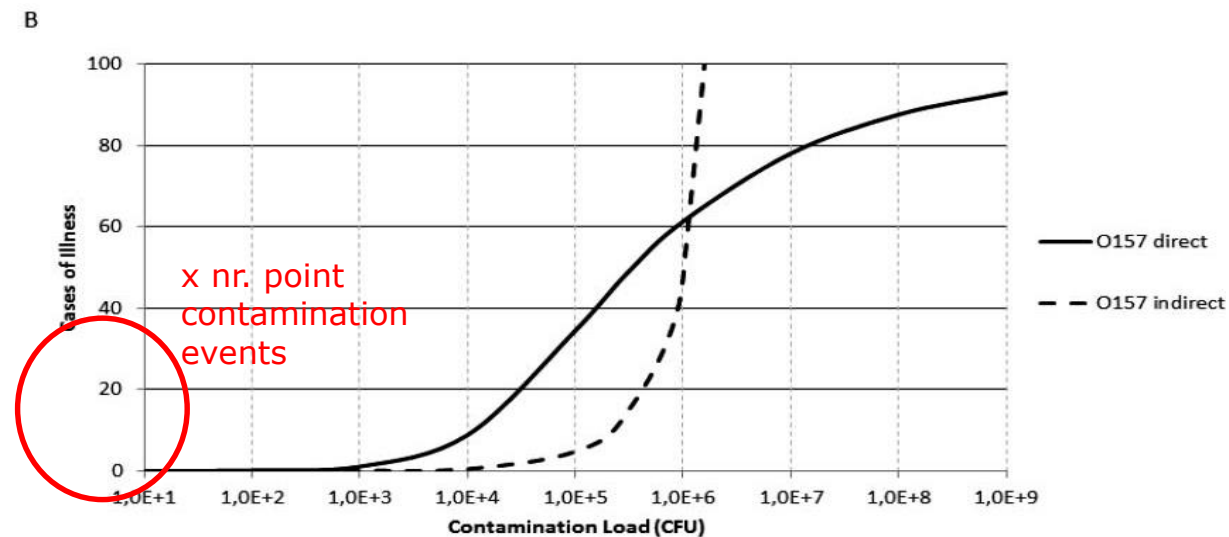
US: Marder 2023: attribution non-O157 STEC disease burden
1 - Lettuce (PAF 39%), 2 - fastfood (PAF 23%), 3 - tomatoes (PAF 21%)

NL:

Wijnands 2014: 0,11% O157 raw prepacked
NVWA monitoring 201: 4/887 (0,45%) STEC
NVWA monitoring 2022: 2/965 (0,21%) STEC
Franz 2010 / Pielaat 2014 : ≈ 100 cases/yr

Number of cases mainly driven by point contamination events (birds, other wildlife, manure)

Source finding hampered by high throughput



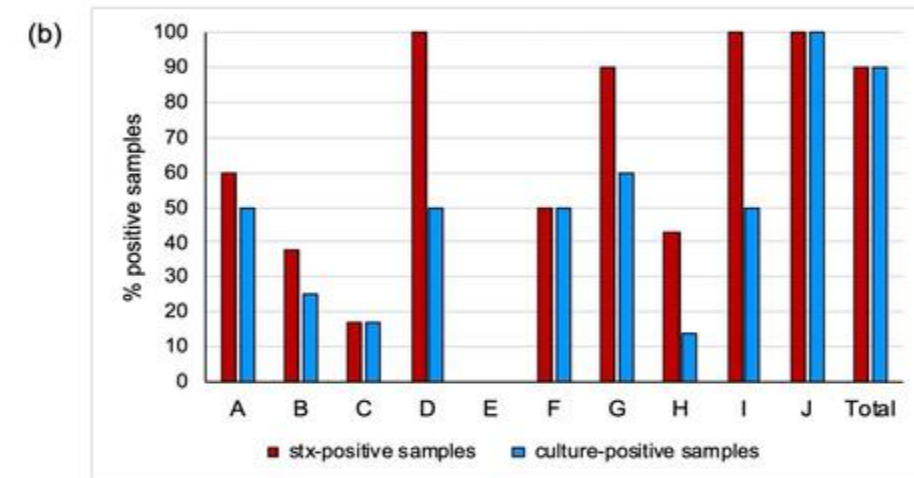
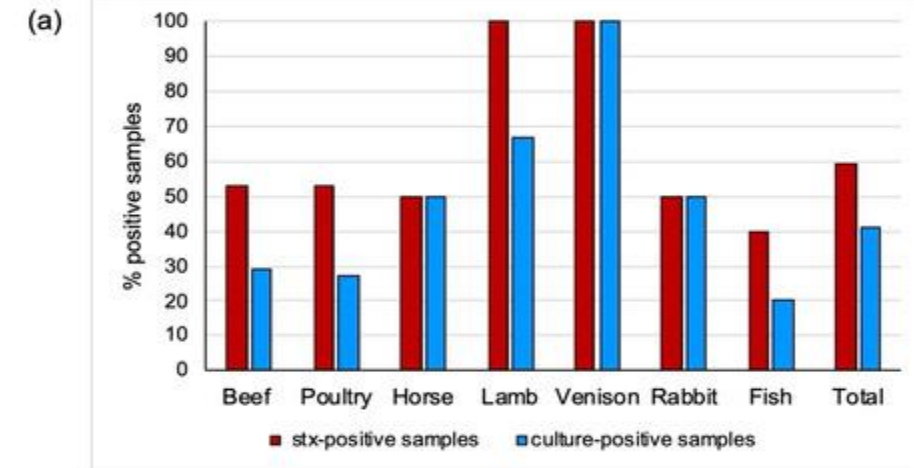


Other animal / food sources: pet food

Outbreak related to raw pet food (Kaindama 2021, UK)

Surprisingly high prevalence STEC

- van Bree 2017 (NL): 8/35 (23%) samples STEC O157
- Treier 2021 (CH): 41% of 59 samples culture positive STEC O91:H14, O145:H28, O146:H21, and O146:H28





Other animal / food sources: flour

[An outbreak of Shiga toxin-producing Escherichia coli O121 infections associated with flour-Canada, 2016-2017†](#)
(Morton 2017)

[Shiga Toxin-Producing E. coli Infections Associated with Flour - PubMed \(nih.gov\)](#)
(Crowe 2017)

[Bacteriological analysis of wheat flour associated with an outbreak of Shiga toxin-producing Escherichia coli O121](#)
(Gill 2019)

[Salmonella Outbreak Linked to Raw Cookie Dough | CDC](#)



Low moisture product
Low contamination rate



1. Environmental transmission

Living in rural area with high density of livestock (sheep!)

Direct contact animals

2. Humans

Especially stx-tEPEC, stx-EAEC, stx-ETEC etc.

Quantify incidence humans, picked-up by food testing?

3. Pet food

More samples/WGS

4. Other food products then red meat (flour/dough, produce)

More samples/WGS

Sporadic cases

Clusters/outbreaks





Thank you

Ingrid Friesema

And colleagues from:

