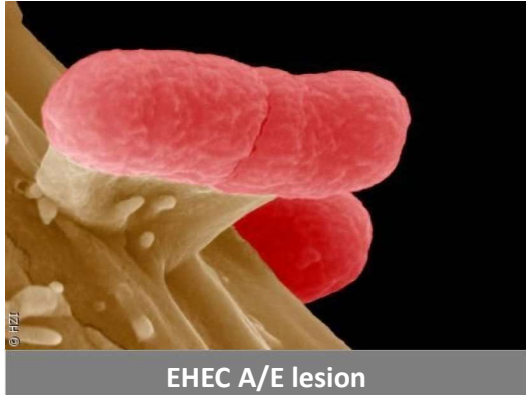




Stephen Fitzgerald| Science of Artisan Cheese | 19.08.26

The STEC Landscape: Current Insights and Future Directions

Moredun Research Institute

Animal health research institute

Moredun Scientific limited
- Contract research

Experimental farm onsite





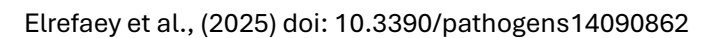
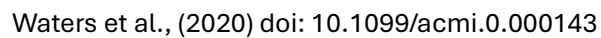
Overview



Changing landscape What we're learning Looking ahead

- Classification
- Disease
- Genomics
- Healthy Carriers
- STEC Diversity
- Cheesemaking
- Research Bias
- Farming practices
- Data modelling

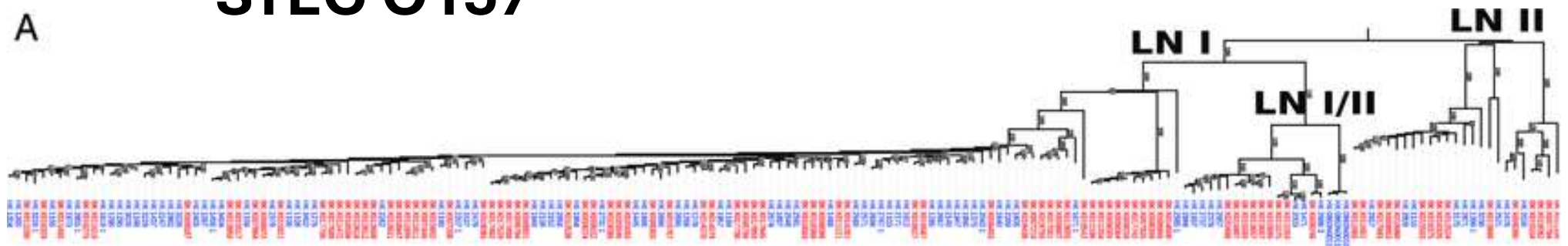
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STEC: More than one organism

STEC O157

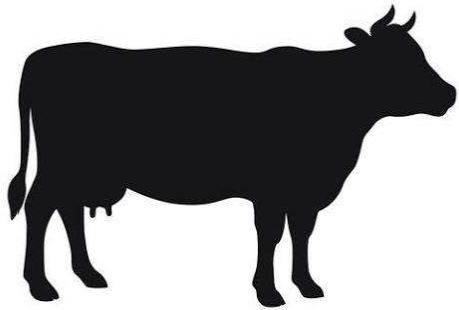
A



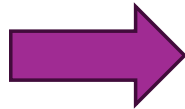
Why STEC Matters

STEC infections has been estimated to range from 0.6 to 136 cases per 100 000 patient years

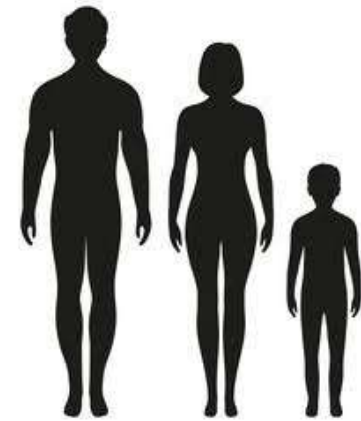
Low infectious dose



< 1000 CFU



10,000,000 CFU/g



10 – 50 CFU

Why STEC Matters



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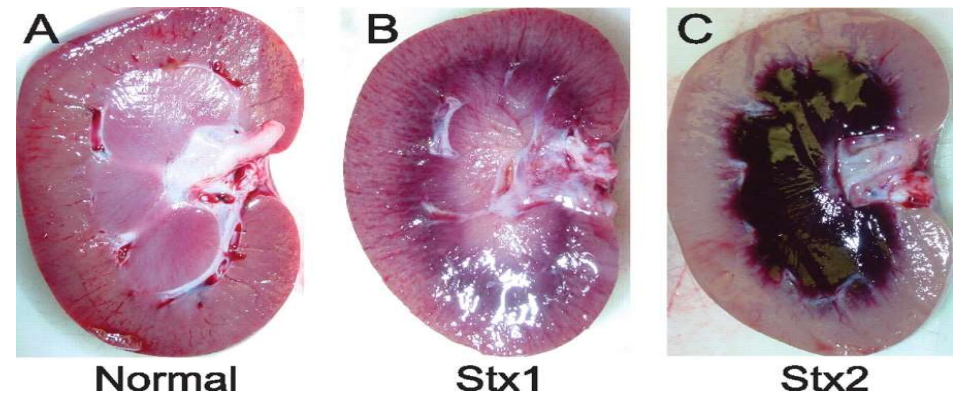
STEC infections has been estimated to range from 0.6 to 136 cases per 100 000 patient years

Severe illness

- STEC O157
 - Gastroenteritis
 - Colitis
 - Bloody diarrhea
 - Haemolytic Uraemic syndrome (HUS)
- Non – O157 STEC
 - Big six (O26, O45, O103, O111, O12, O145)
 - Acute diarrhea, dysentery, HUS
 - Significant morbidity



Tanquilut *et al.* (2019) DOI:10.1016/j.idcr.2019.e00629



D. J. Stearns-Kurosawa *et al.* Infect. Immun. 2010;78:2497-2504

Why STEC Matters

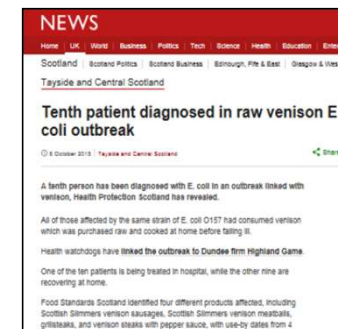
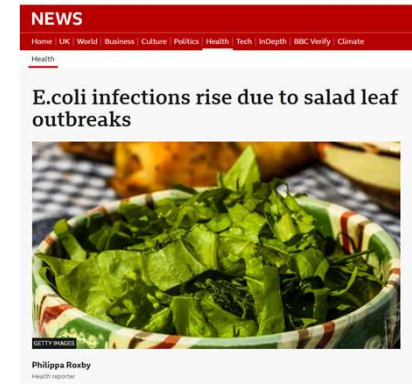
STEC infections has been estimated to range from 0.6 to 136 cases per 100 000 patient years

Disproportionate affects



10 – 15% of children under 5 progress to HUS

Public concern

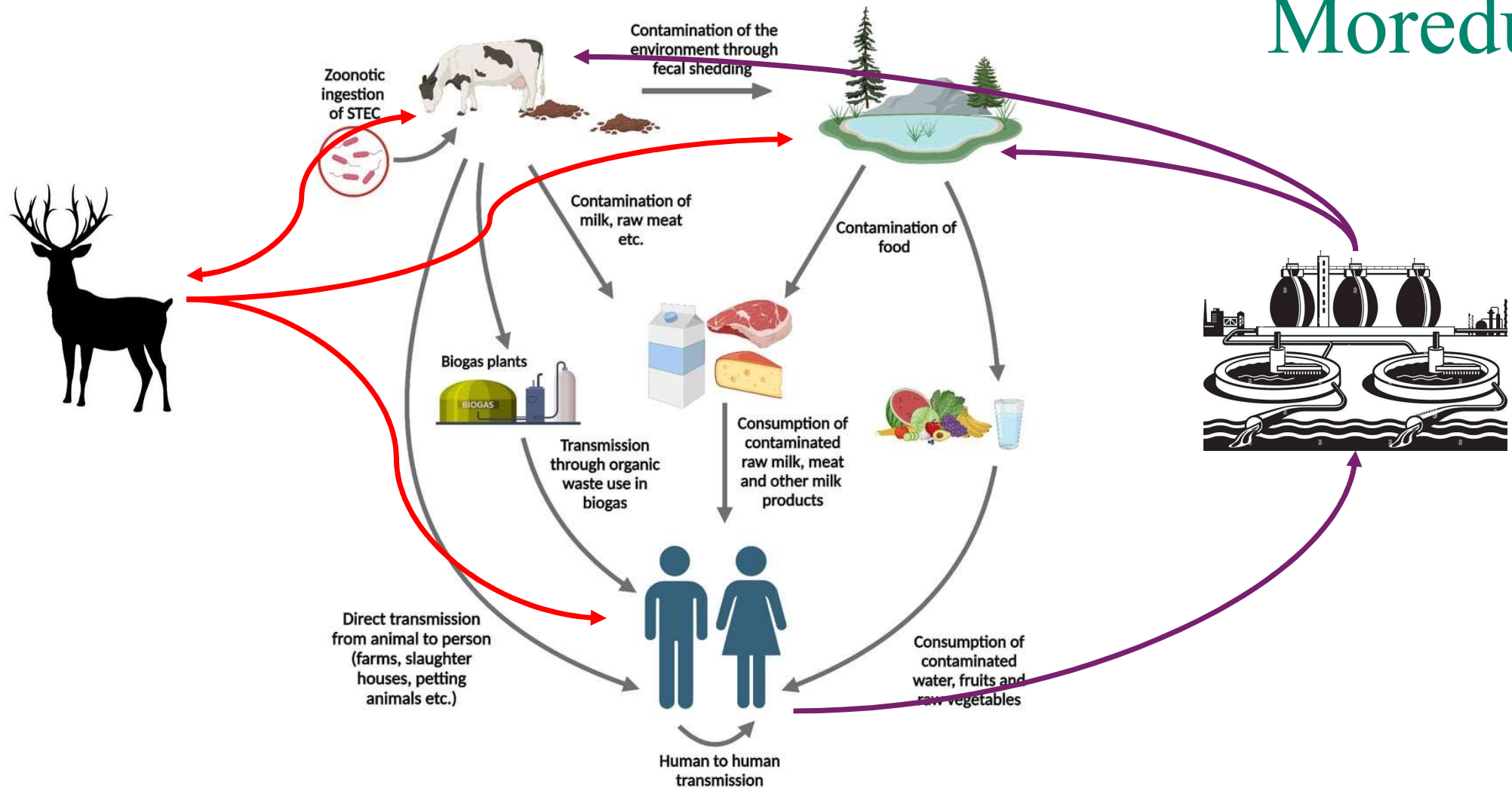


Revolution in Outbreak detection



- 1. Finding "Invisible" Outbreaks**
- 2. Nailing Down the Exact Food Source**
- 3. Predicting Severe Illness (The Toxin Genes)**
- 4. Solving "Cold Cases" Years Later**

Following STEC through the foodchain



Animals: Healthy Carriers



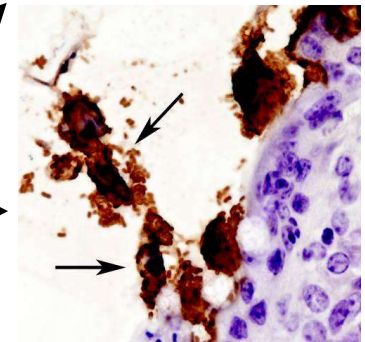
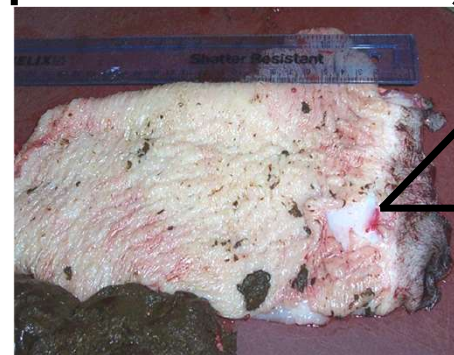
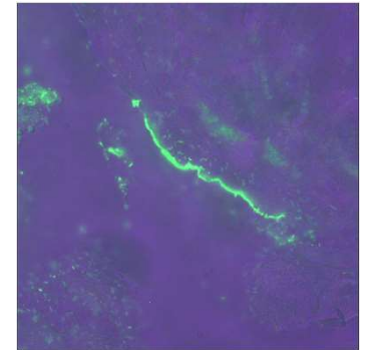
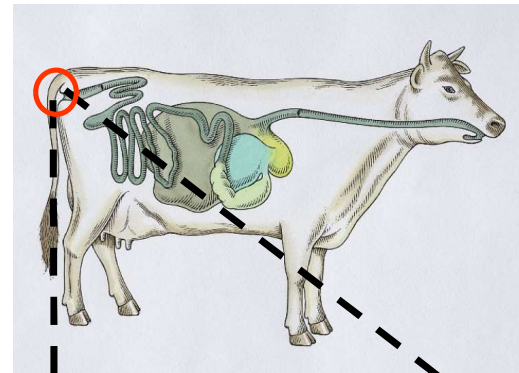
Asymptomatic carriers



Elimination difficult

Economic and commercial barriers

Host-pathogen interactions



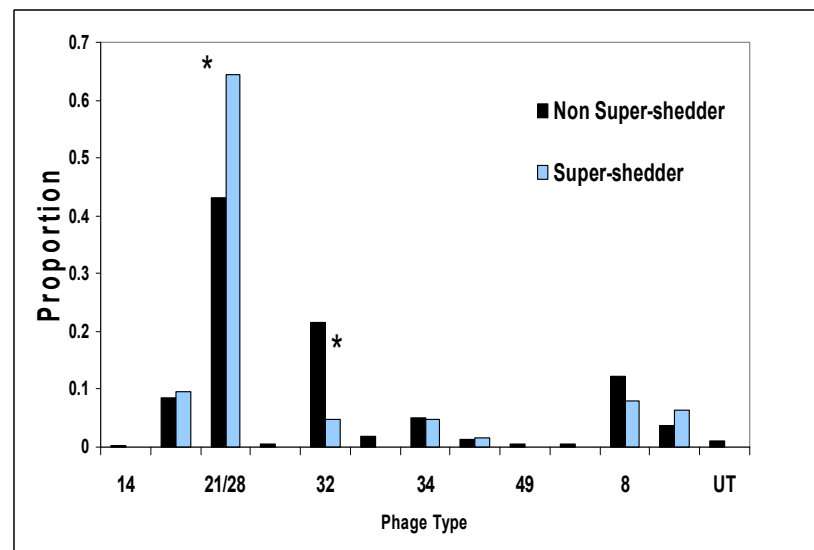


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Animals: Healthy Carriers

Why shedding varies?

Super-shedding: > 10,000 CFU/g

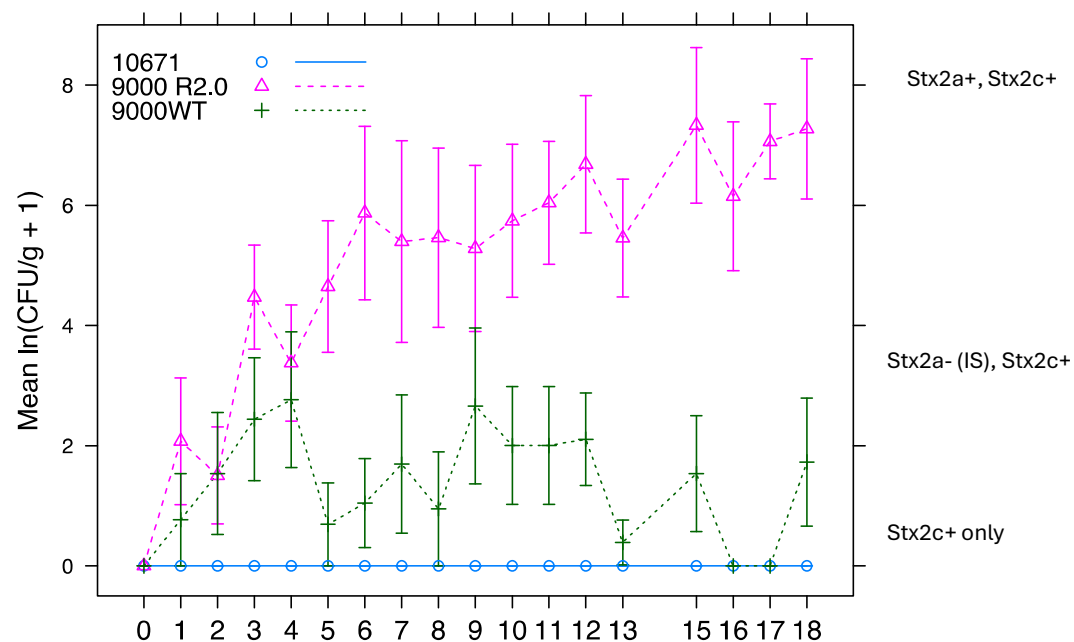


Super-shedding and the link between human infection and livestock carriage of *Escherichia coli* O157

Margo Chase-Topping*, David Gally*, Chris Low*, Louise Matthews¹ and Mark Woolhouse*

Chase-Topping et al. 2007. *J Clin Microbiol.* 2007. 45:1594-603

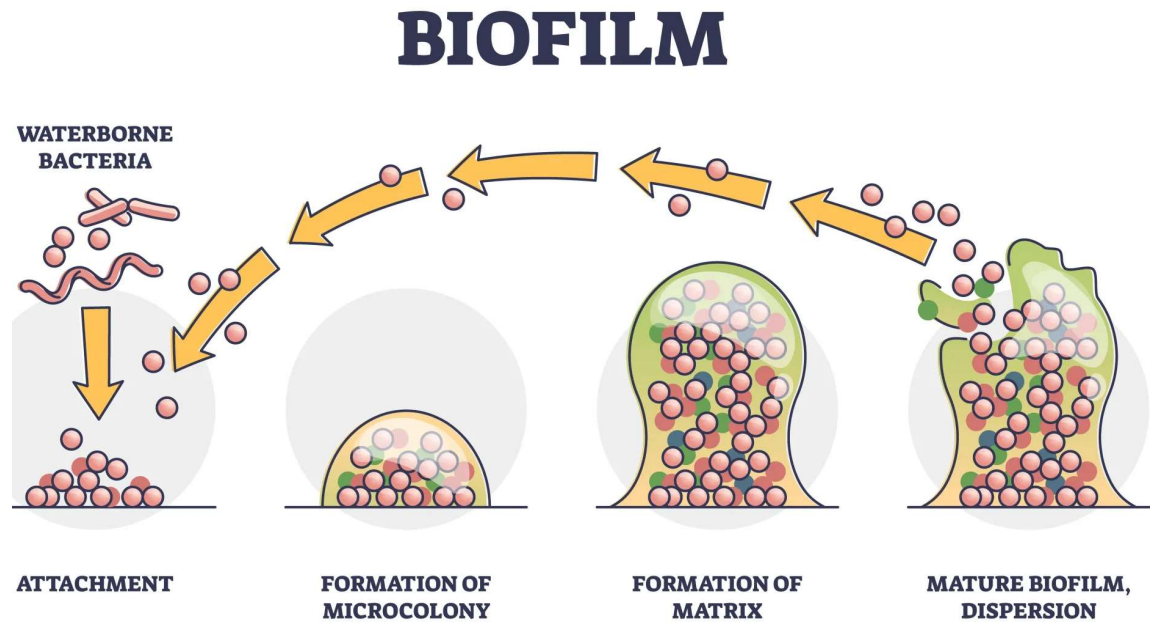
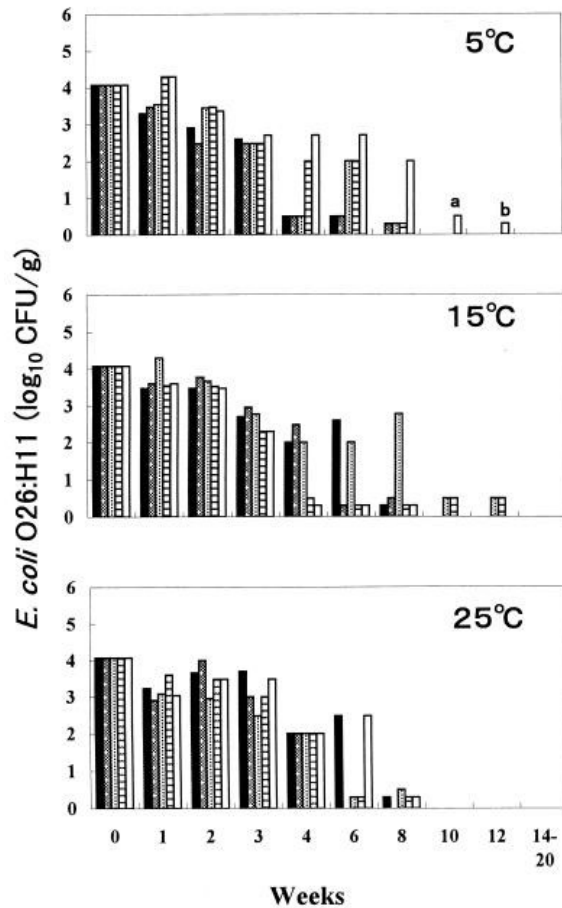
Transmission dynamics



Fitzgerald et al. (2019). doi.org/10.1371/journal.ppat.1008003

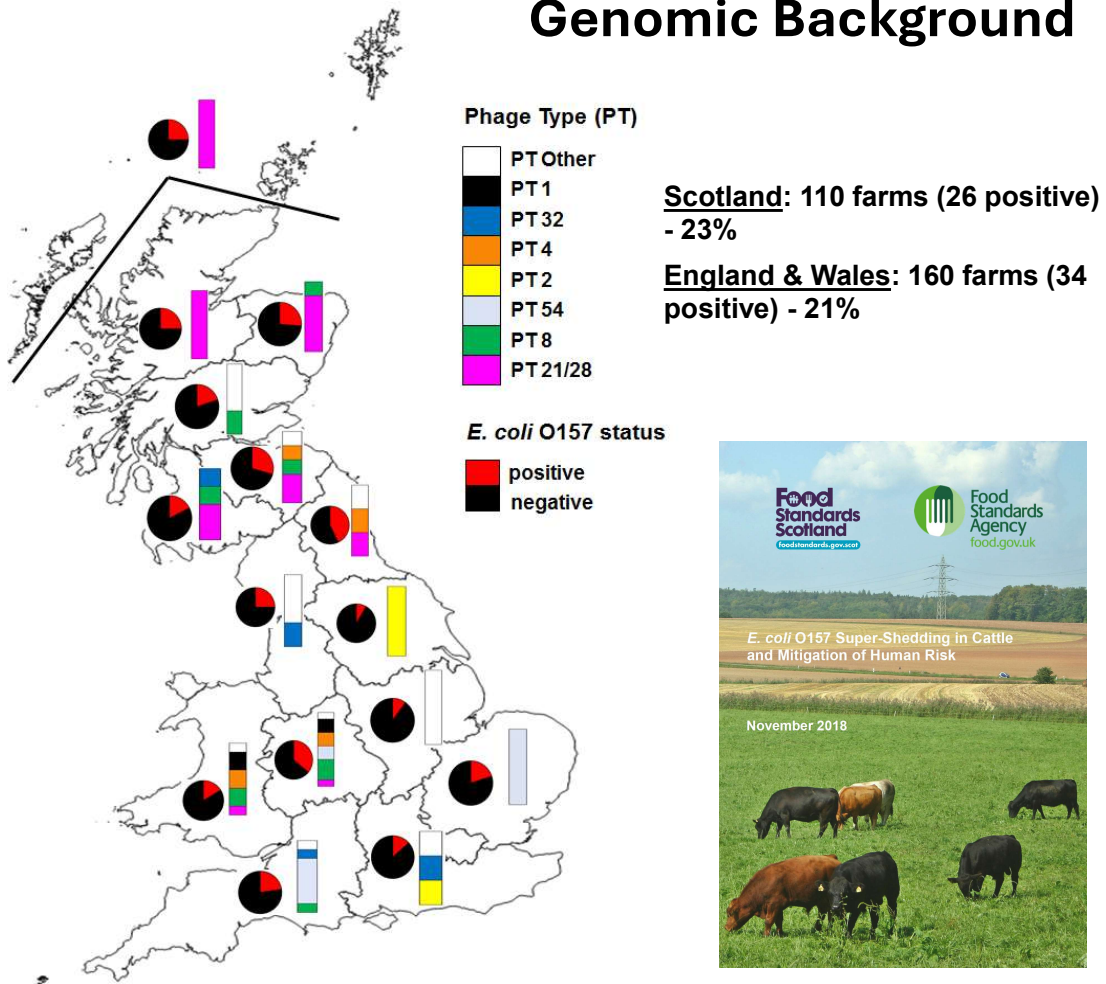
Animals: Healthy Carriers

Environmental survival



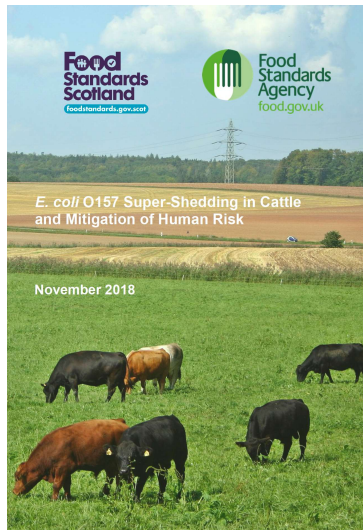
Not All STEC Are Equal

Genomic Background



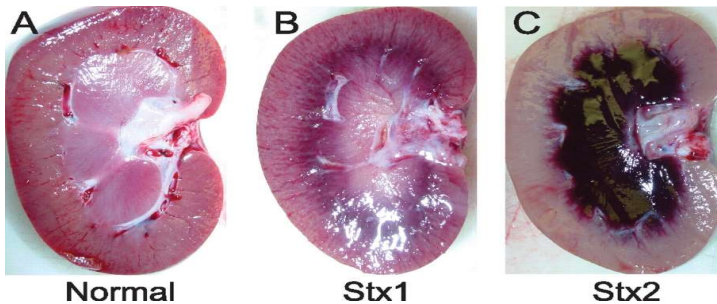
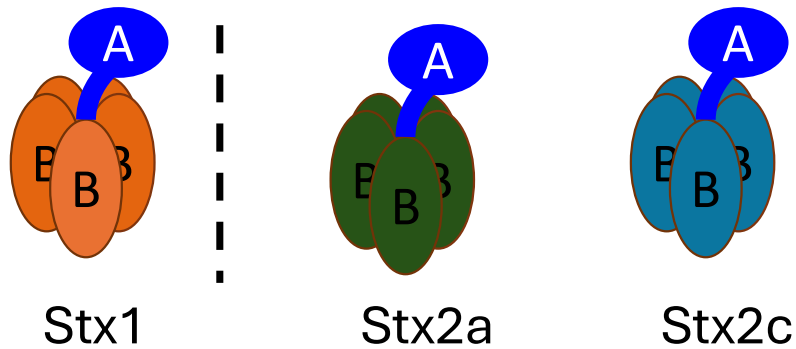
Same, Same

.....but different

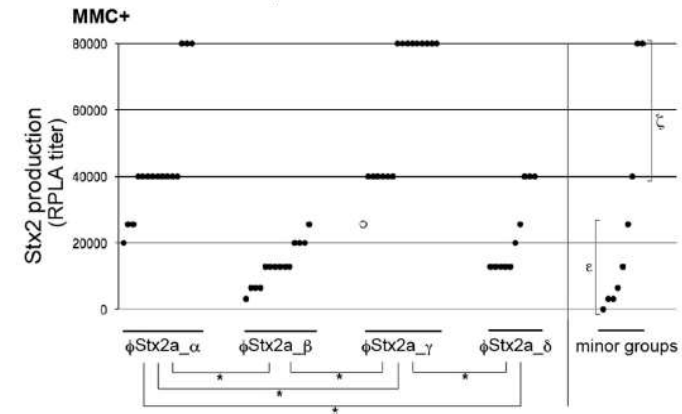
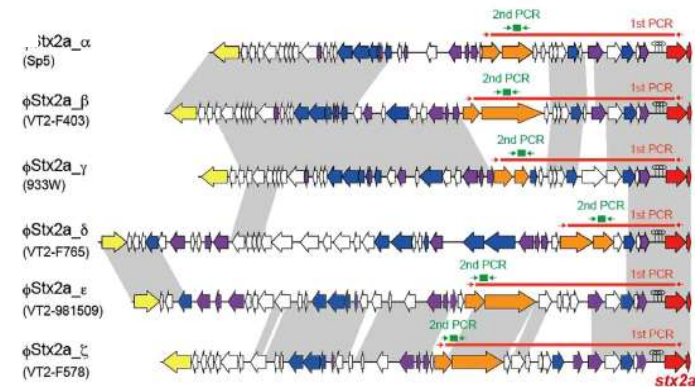


Not All STEC Are Equal

Shiga toxin (Stx)



D. J. Stearns-Kurosawa et al. Infect. Immun. 2010;78:2497-2504

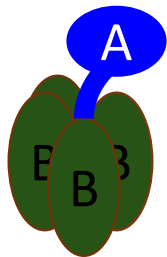
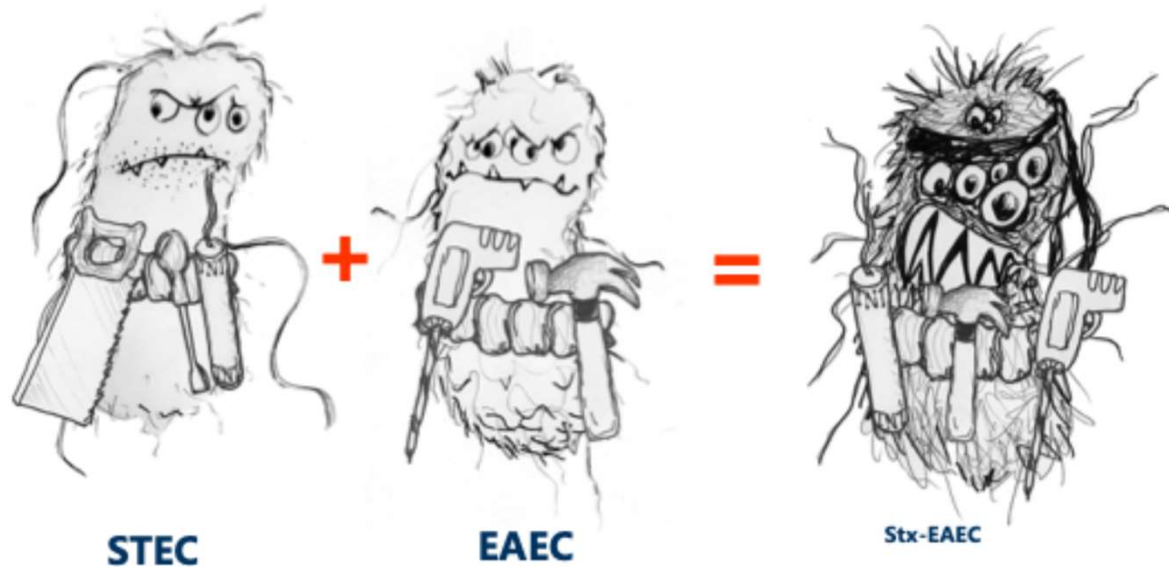


Ogura et al 2015. Scientific Reports

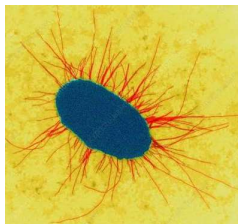
Not All STEC Are Equal



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+



FOOD SAFETY INFOSHEET JUNE 9, 2011

AT LEAST 30 DEATHS LINKED TO RARE E. COLI STRAIN, O104:H4

Over 2400 illnesses including 720 cases of kidney failure in one of largest outbreaks in history



The cause of this outbreak remains unknown, but the majority of those sickened ate fresh raw sprouts, lettuce, tomatoes, and/or cucumbers

Authorities in Germany recommend to avoid eating sprouts, raw lettuce, tomatoes, and cucumbers in that country.

However, the specific contaminated item remains unknown- the above foods are often eaten together, making the investigation difficult.

As fresh produce is not usually cooked, contamination may have occurred at the farm, at the restaurant or anywhere in between.

Raw produce has been linked to over 400 outbreaks of foodborne illness since 1990.

The largest foodborne illness outbreak Germany has ever experienced began in early May, and sick people particularly those suffering from hemolytic uremic syndrome (which leads to kidney failure) are still being reported. *E. coli* O104:H4, causes disease similar to the more common O157:H7 serotype. This strain appears to be especially dangerous and has led to more deaths and hospitalizations than usually seen with a pathogenic *E. coli* outbreak.

The majority of cases are reported in Northern Germany, but there have been illnesses reported in the U.S., Canada, Austria, Denmark, Norway, Switzerland, Sweden, Spain, France, and the Netherlands. With the exception of only 2 cases, all those affected had recently visited Germany.

The source of the outbreak has been difficult to determine as indicators and pathogens have been found on many of the foods that have been investigated, but the outbreak strain has not been found.



K-STATE NC COOPERATIVE EXTENSION

FOR MORE INFO, CONTACT BEN CHAPMAN AT BENJAMIN.CHAPMAN@NCSSU.EDU OR DOUG POWELL AT DPOWELL@NCSSU.EDU

Not All STEC Are Equal



	HUS				Hospitalisation				BD			
	with <i>eae</i>	n	without <i>eae</i>	n	with <i>eae</i>	n	without <i>eae</i>	n	with <i>eae</i>	n	without <i>eae</i>	n
stx1 (all)	1.2	517	0.3	316	27.4	318	20.3	207	27.3	436	14.1	255
stx1a	1.2	512	0.0	139	27.6	312	20.7	82	27.3	432	8.0	112
stx1c	-	5	0.6	159	-	6	18.9	122	-	4	19.5	128
stx2 (all)	17.7	904	2.7	365	42.0	748	24.3	173	40.2	910	14.8	325
stx2a	27.4	446	10.4	48	56.4	404	32.0	25	58.4	476	26.3	38
stx2b	-	5	0.5	206	-	1	21.3	94	-	5	10.5	190
stx2c	4.3	161	5.0	20	19.8	172	-	8	23.9	188	-	18
stx2d	-	11	10.3	29	-	9	33.3	21	-	9	16.0	25
stx2e	-	0	0.0	29	-	0	-	16	-	0	31.8	22
stx2f	3.8	208	-	10	21.0	119	-	1	8.7	196	-	10
stx2g	-	1	0.0	21	-	0	-	6	-	1	10.0	20
stx2a+stx2c	29.0	62	-	0	57.1	42	-	0	65.5	29	-	0
stx1; stx2 (all)	5.9	679	1.4	357	35.7	569	15.3	248	64.8	676	19.4	283
stx1a; stx2a	20.8	159	4.5	22	59.3	81	-	15	56.6	136	-	18
stx1a; stx2b	-	2	0.0	108	-	2	6.4	78	-	2	16.7	90
stx1a; stx2c	0.8	485	-	2	31.9	470	-	0	67.5	510	-	2
stx1c; stx2b	-	4	1.0	202	-	5	14.6	144	-	4	18.1	160



Pathogenicity assessment of STEC strains

Stx2a > Stx2d > Other Stx > eae

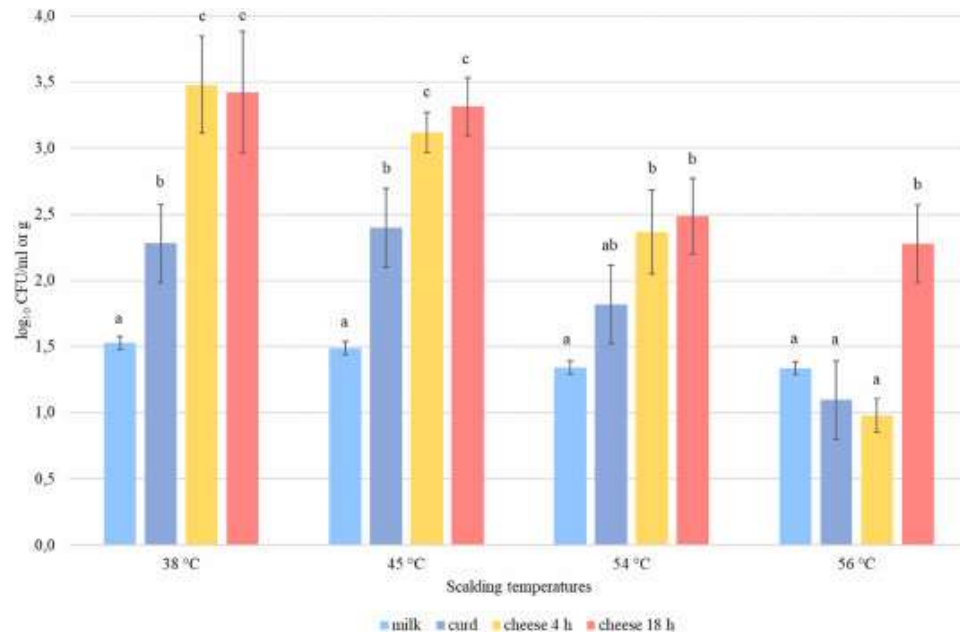
EFSA BIOHAZ Panel et al (2020) <https://doi.org/10.2903/j.efsa.2020.5967>

What research is asking today

How long can STEC survive during cheesemaking?

Curd formation -> Aging and Ripening

Which environmental conditions favour persistence?

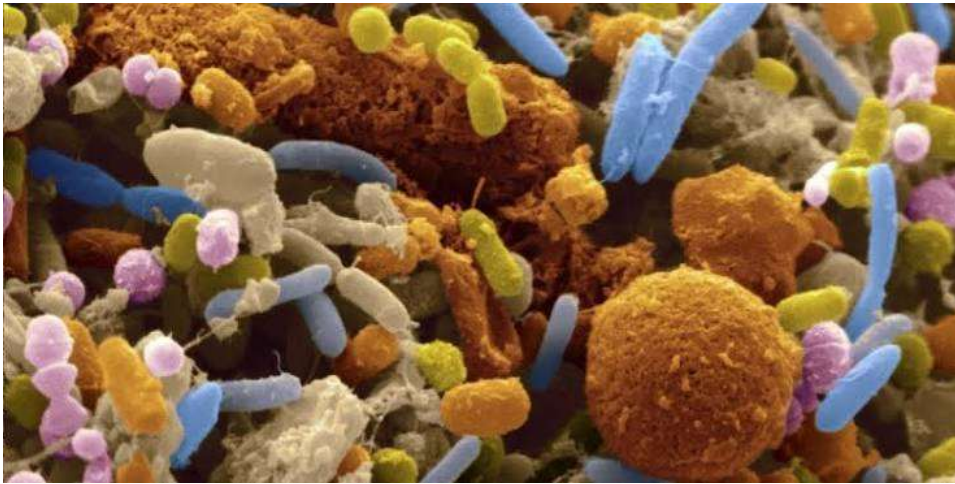


Growth kinetics - Stress adaptation - Strain Variation - Biofilms

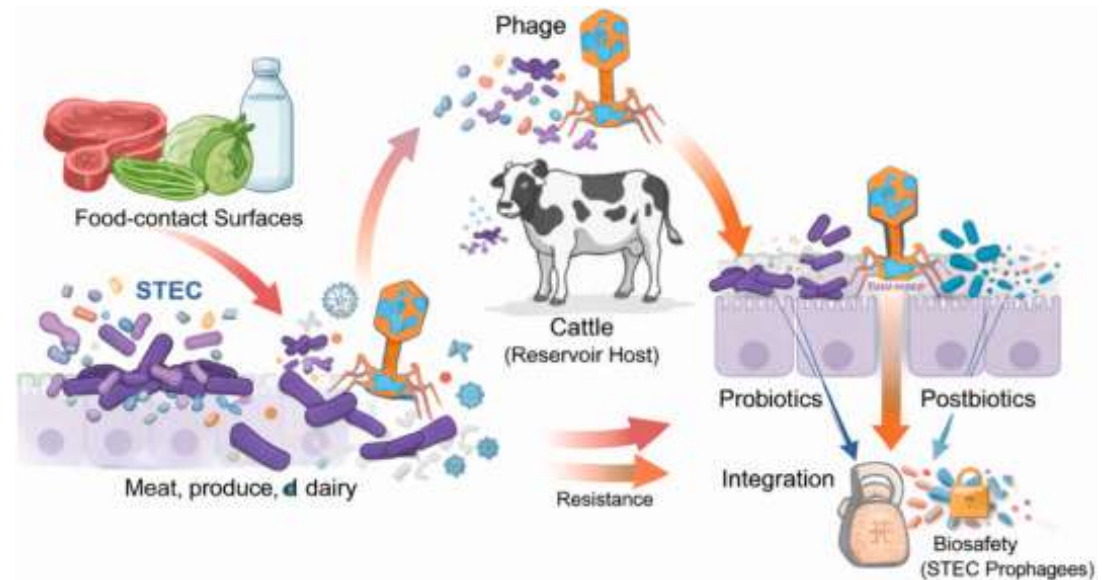
What research is asking today

Probiotic and postbiotic control strategies?

Microbial communities

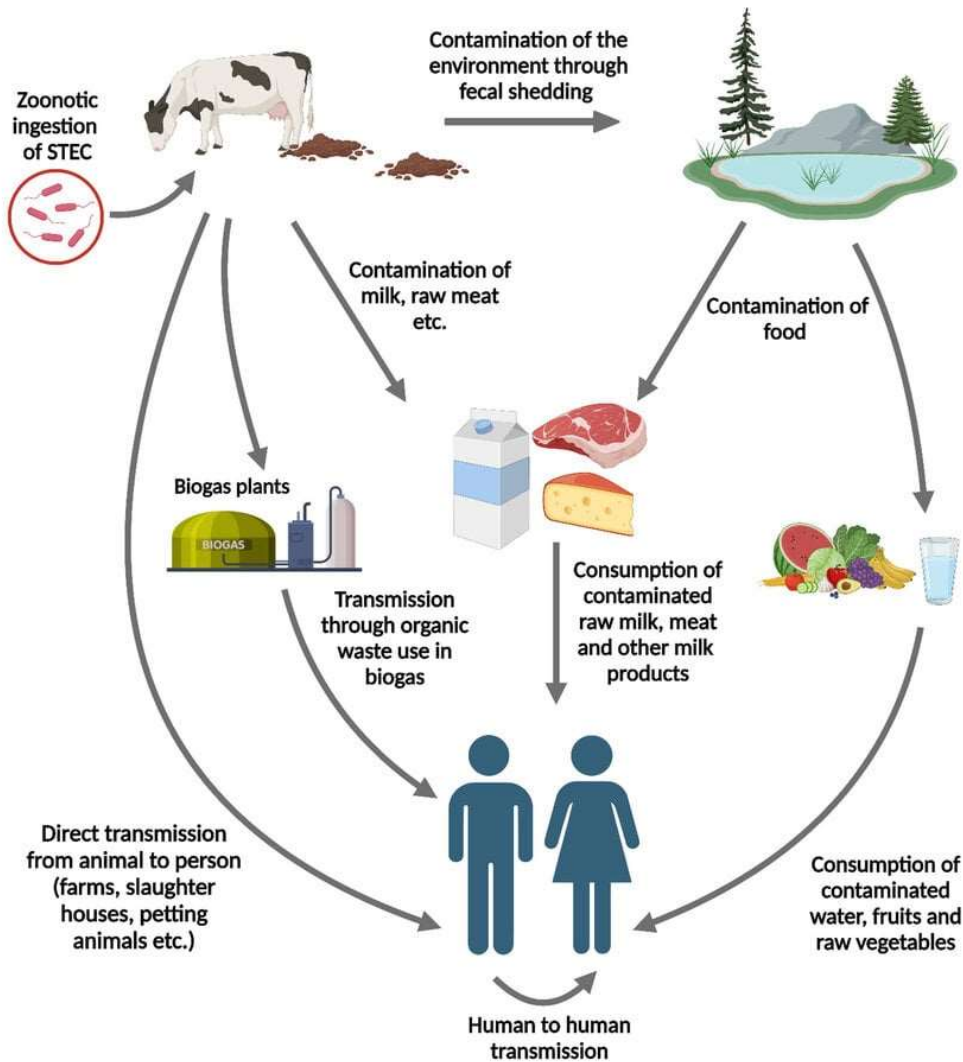


Phage therapy



Chelliah et al., (2026) <https://doi.org/10.1016/j.fbio.2026.108607>

Lessons from outbreaks



**Rarely a
single point
of failure**

Where Artisan Cheesemakers Fit



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Assured Code of Practice

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Herd Health

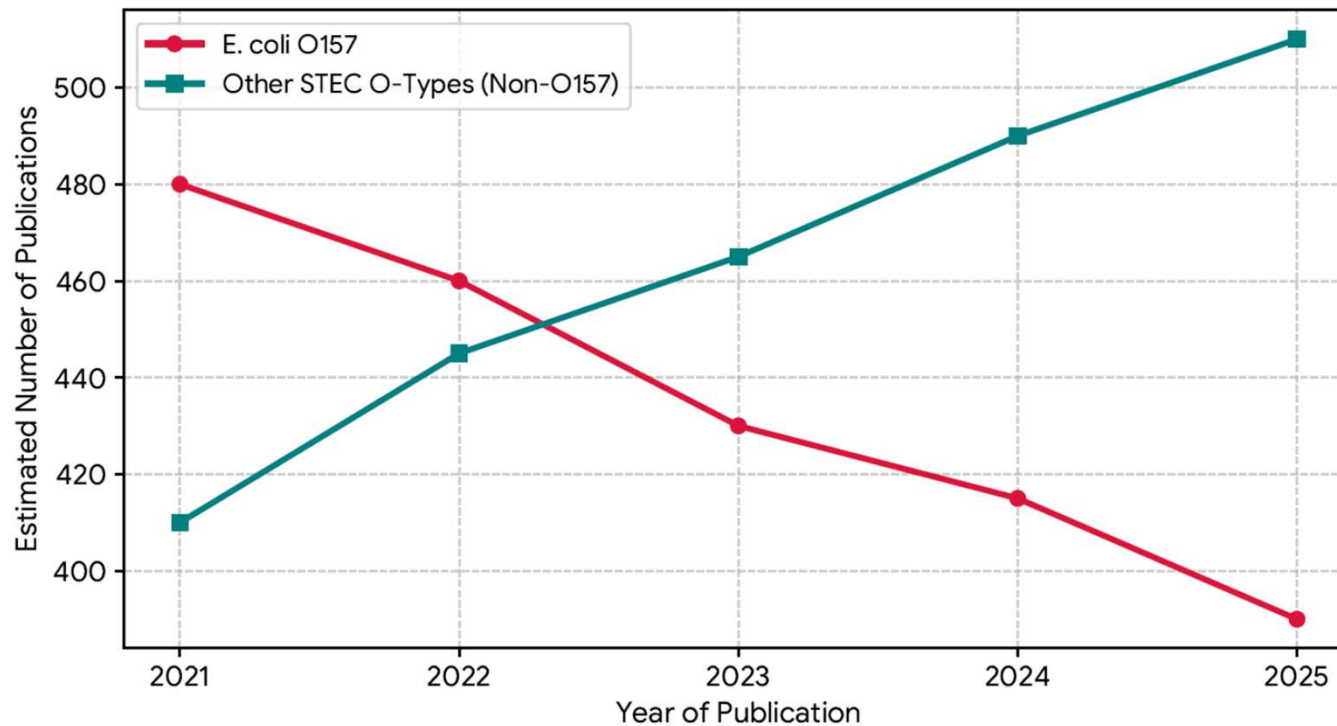
Monitoring and testing

HACCP

Training

Next Generation of STEC Research

Scientific Publication Trends (Last 5 Years):
E. coli O157 vs. Other STEC O-Types



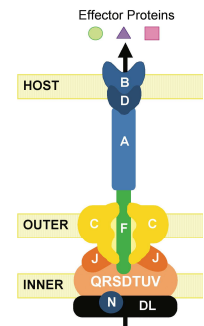
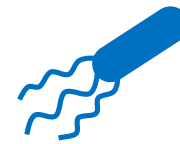
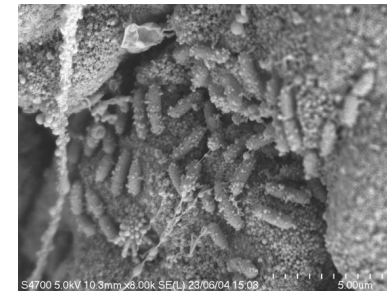
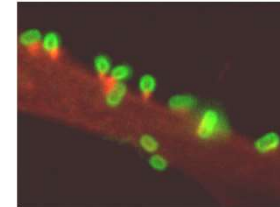
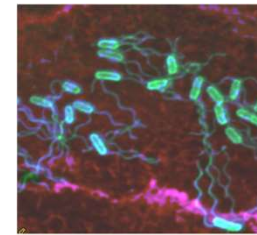
**Addressing the
research bias?**

Next Generation of STEC Research



Novel intervention strategies

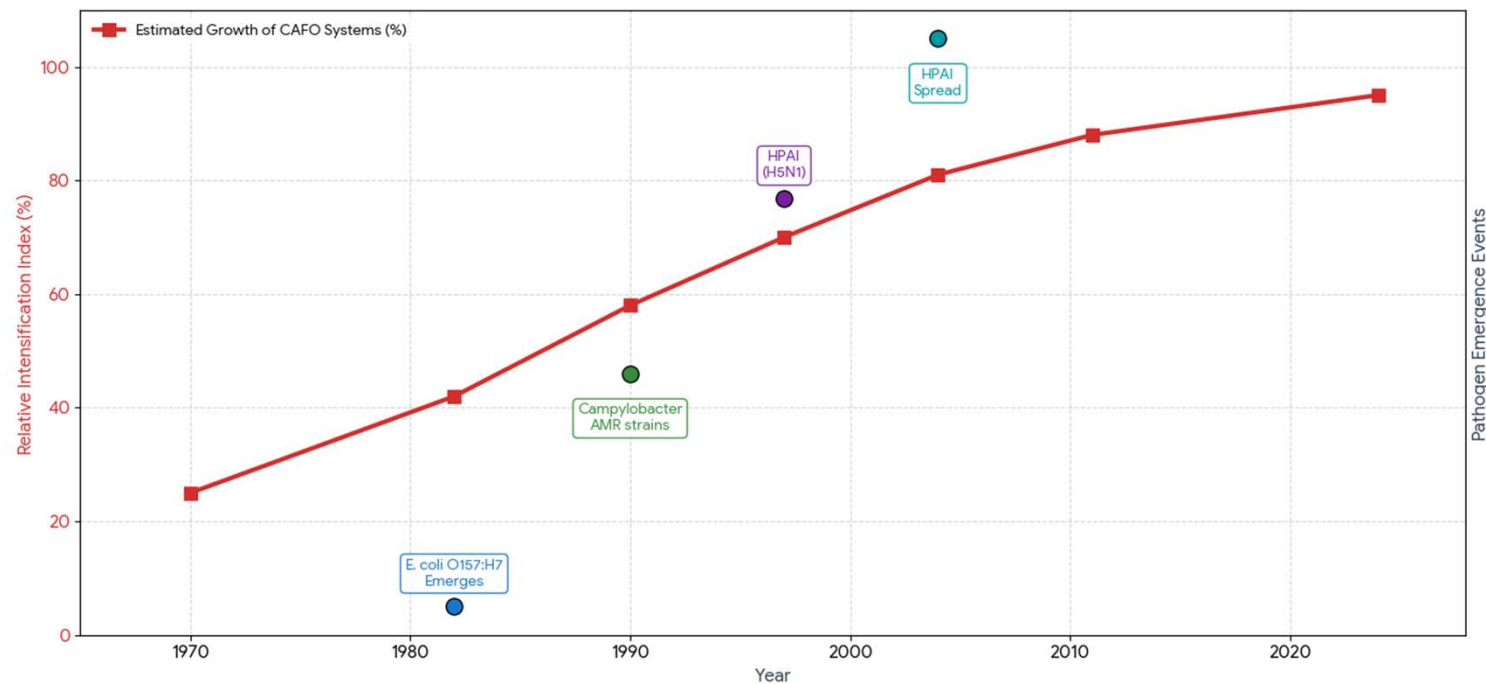
- Phage therapies
- New targets for vaccine development
- Competitor microbial communities



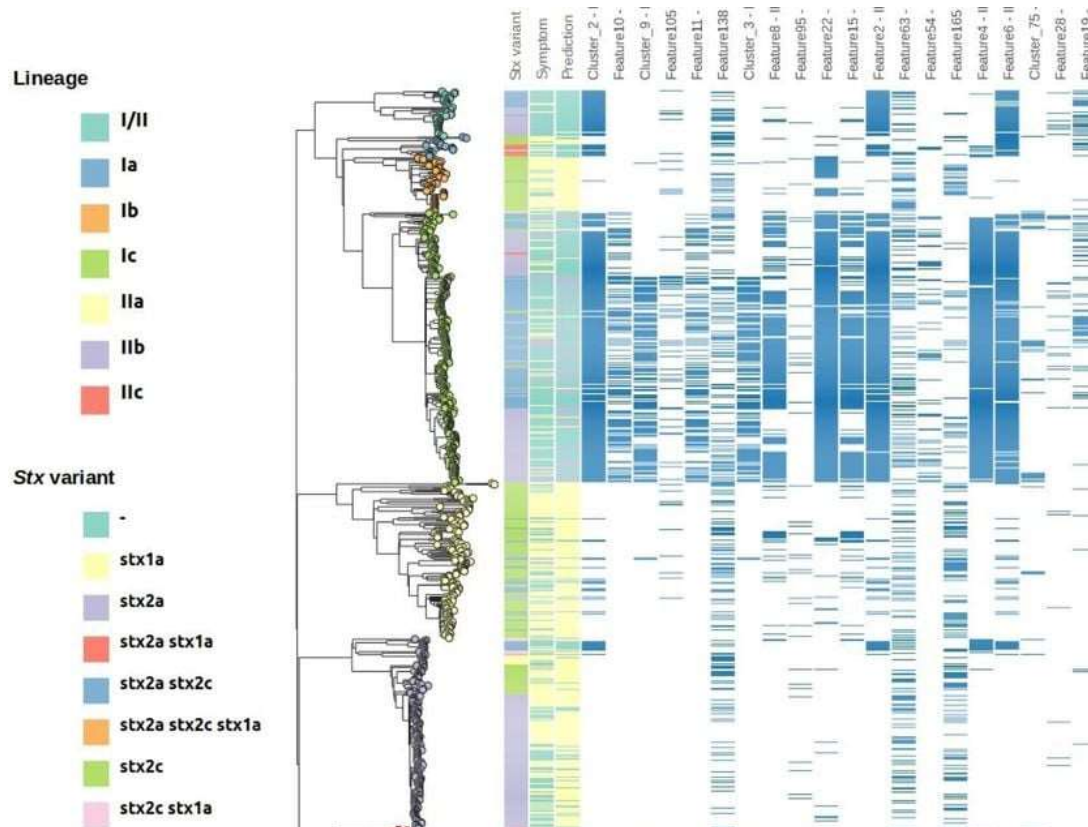
Next Generation of STEC Research

Farming practices

Timeline of CAFO Intensification and Emergence of Adapted Livestock Pathogens



Next Generation of STEC Research



**Predictive AI
and
mathematical
models**

Paganini et al (2025) <https://doi.org/10.1099/mgen.0.001591>

Opportunities for Partnerships



Developing a research partnership -
challenges, knowledge, collaboration



Summer studentships

Small Research Grants

Thank you for your attention!

