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STEC in beef prevalence study

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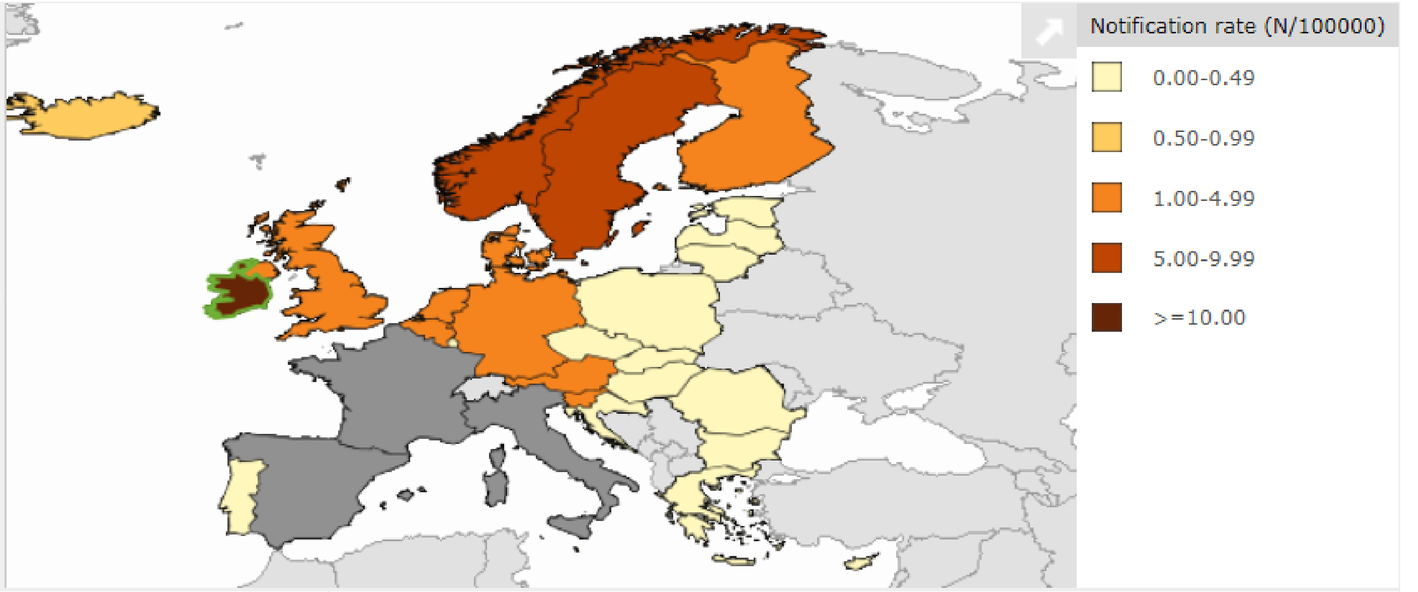
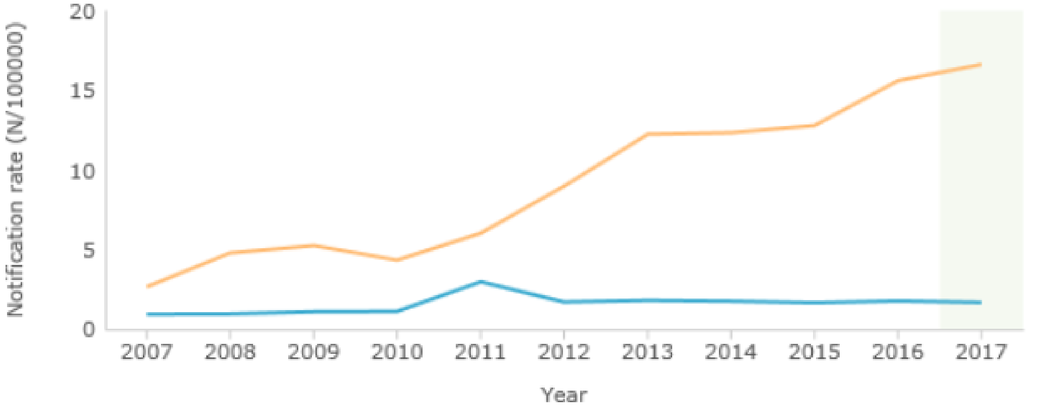
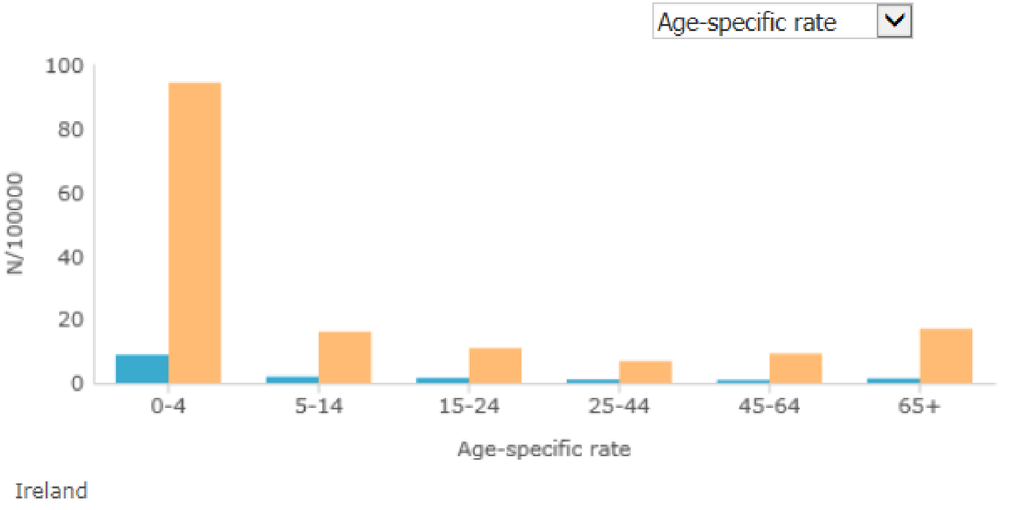
Surveillance Atlas of Infectious Diseases

Verotoxigenic Escherichia coli infection | Confirmed cases | Notification rate | 2017

Region	Notification rate (N/100000)
EU/EEA	1.75
EU	1.67
Ireland	16.62
Norway	7.25
Sweden	5.04
Denmark	4.57
Austria	2.85
Germany	2.50
Netherlands	2.29
Finland	2.24
Malta	1.96







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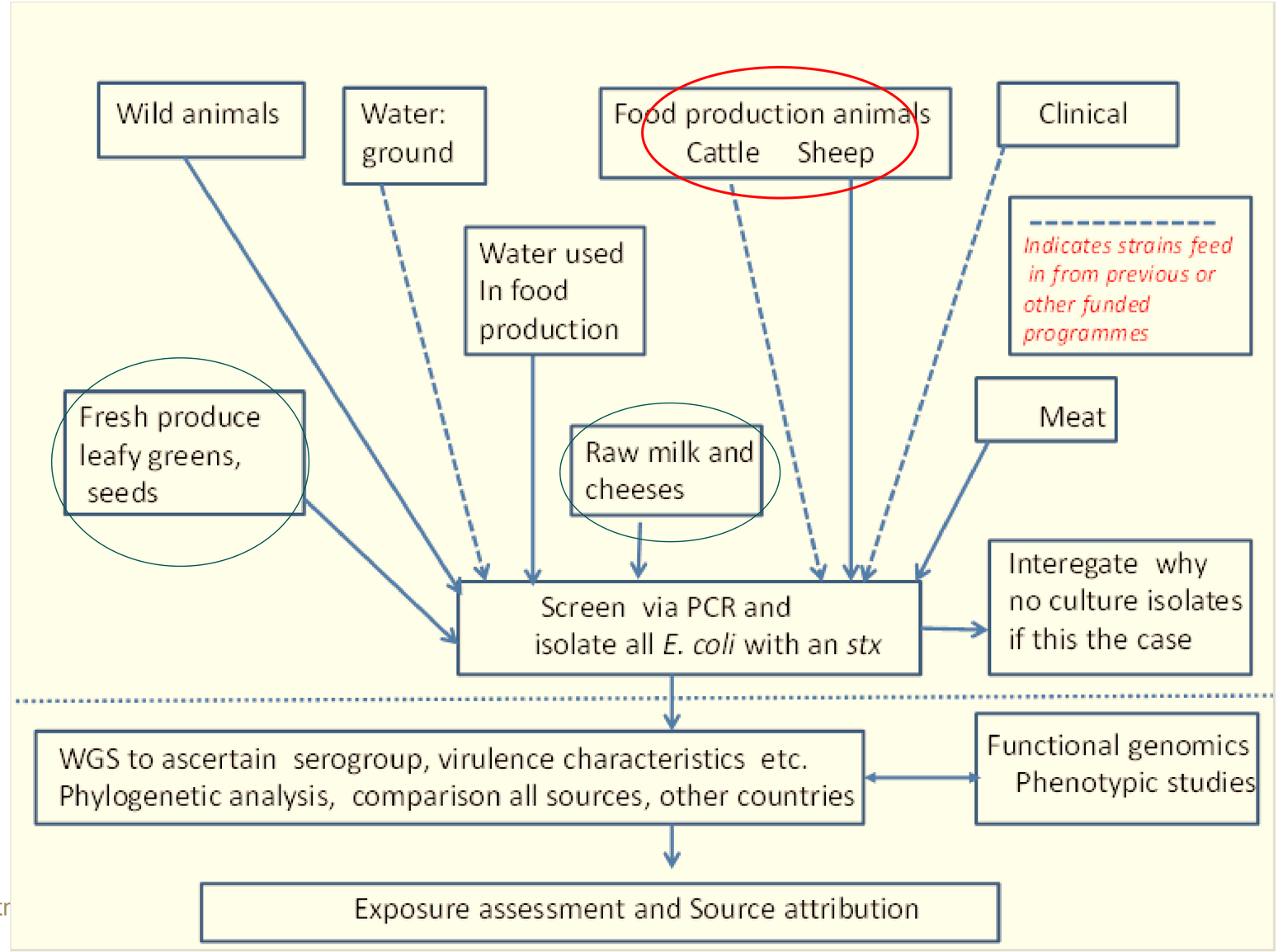


Year of sampling	Matrix	Numbers of Samples	Serogroup examined	STEC/E. coli serogroup culturally recovered (No. of isolates)	Reference
2010	Bovine carcass at slaughter plant	450	Any	STEC (n=5/1.1%) 4 serotypes: O13:H2 (n=1) O26:H11 (n=2) O113:H4 (n=1) O168:H8 (n=1)	Monaghan et al., 2012
2007 - 2008	Beef carcass at slaughter plant	n=301 carcass swabs analysed for O157 & O111 n= 402 carcass swabs analysed for O26, O103 & O145	O157 O26 O111 O103 O145	STEC (n=4; 1.3%) E. coli (n=46; 11.4%) 4 serotypes: O157 (n=7) O26 (n=4) O103 (n=33) O145 (n=2)	Thomas et al., 2012
2012	Beef and Sheep minced meat and minced meat products	Beef samples (n=172) Sheep samples (n= 70)	O156 O26 O111 O103 O145	E. coli O157 (0.58%) beef E. coli O26 (1.16%) beef	Yearsley et al., (2011)
2001 to 2004	Beef carcass at slaughter plant	132	O157	STEC O157 (n=4; 3%)	Carney et al., 2006
1997-1998	Beef carcass at slaughter plant	250	O157	STEC O157 (n=0) E. coli O157:H7 (n=4; 1.6%)	McEvoy et al., 2003
2005 to 2006	Lamb carcasses at slaughter plant	Pre-chill carcass swabs (n=400) Post-chill carcass swabs (n=400)	O157	STEC O157 (n=7; 0.9%) E. coli O157:H7 (n=10; 1.25%) Pre-chill (n=6) Post-chill (n=4)	Lenahan et al., 2007
2004	Pig carcass at slaughter plant	480	O157	STEC O157 (n=1; 0.21%)	Lenahan et al., 2009
2001 to 2004	Beef trimmings at slaughter plant	1351	O157	STEC O157 (n=31; 2.3%) E. coli O157:H7 (n=32; 2.4%)	Carney et al., 2006
2001 to 2004	Head meat at slaughter plant	100	O157	STEC O157 (n=3; 3%)	Carney et al., 2006
2001 to 2002	Retail minced beef and beef burgers	1533	O157	STEC O157 (n=43; 2.8%)	Cagney et al., 2004
2004	Retail minced beef	800	O26 O111	E. coli O26 (n=2; 0.25%)	Murphy et al., 2005

Year of sampling	Matrix	Numbers of Samples	Serogroup examined	STEC/E. coli serogroup culturally recovered (No. of isolates)	Reference
2010	Bovine hide at slaughter plant	450	Strains isolated from stx positive samples serotyped and examined for genes associated with virulence	STEC (n=25; 5.6%)/ E. coli (n=35; 7.8%) 12 serotypes: O5:H- (n=3), O33:H11 (n=1), O55:H11 (n=1), O113:H4 (n=5), O128:H8 (n=14), O136:H12 (n=3), O138:H48 (n=3), O150:H2 (n=1), O168:H8 (n=2), ONT:H11 (n=2)	Monaghan et al., 2012
2007-2008	Bovine hide at slaughter plant	n=301 hide samples analysed for O157 & O111 n= 402 hide samples analysed for O26, O103 & O145	O157 O26 O111 O103 O145	STEC (n=55; 13.7%) /E. coli (n=219; 54.5%) 4 different serotypes: O157 (n=63) O26 (n=27) O103 (n=119) O145 (n=10)	Thomas et al., 2012
2008-2009	Sheep fleece at slaughter plant	500	O157 O26 O111 O103 O145	STEC (n=10; 2%)/ E. coli (n=94; 18.8%) 4 different serotypes: O157 (n=4) O26 (n=5) O103 (n=84) O145 (n=1)	Thomas et al., 2013
2001 to 2004	Bovine hide	1500	O157	STEC O157 (n=98/6.5%) /E. coli O157 (n=109; 7.3%)	O'Brien et al., 2005
2005 to 2006	Lamb fleece samples at slaughter plant	400	O157	STEC (n=22/5.5%) /E. coli O157 (n=23; 5.75%)	Lenahan et al., 2007

Year of sampling	Matrix	Number of Samples	Serogroup examined	STEC/E. coli serogroup culturally recovered (No. of isolates)	Reference
2014-2015	Bovine recto-anal junction at slaughter plant	1317	O157 O26	STEC O157 (n=50; 3.8%) STEC O26 (n=9; 0.68%)	McCabe et al., 2017 Abstract published in ICoMsT congress Proceedings August 13 to 18th 2017
2014	Bovine recto-anal junction of dairy herd (2 x farms) Repeat samples over 1 year	Farm A (n=305) Farm B (n=224)	O157 O26	Farm A STEC (n=18; 5.9%)/E. coli (n=20; 6.6%) representing 2 different serotypes: O157 (n=15) O26 (n=5) Farm B STEC (n=16; 7.1%)/ E. coli (n=17; 7.6%) 2 different serotypes: O157 (n=8) O26 (n=9)	Murphy et al., 2016
2007-2008	Bovine rectal faecal swabs, milk-filters and bulk-tank samples on dairy farms (n=60 farms)	600 rectal faecal samples, 117 milk filters, 120 bulk-tank milk samples	O157 O26 O111 O103 O145	STEC (n=10; 1.2%)/ E. coli (n=57; 6.8%) 4 different serotypes O157 (n=10) O26 (n=12) O103 (n=26) O145 (n=19)	Lynch et al., 2012
2008-2009	Bovine faeces and slurry from beef farms (n=12 farms)	650	Strains isolated from stx positive samples serotyped and examined for genes associated with virulence	STEC (n=84; 12.9%) 33 different serotypes O-:H- (n=3), O-:H10 (n=6), O-:H11(n=2), O-:H12 (n=1), O-:H14 (n=1), O-:H16 (n=1), O-:H18 (n=7), O-:H21 (n=1), O-:H46 (n=1), O-:H48 (n=1), O2:H+ (n=1), O2:H25 (n=1), O2:H27 (n=4), O2:H32 (n=1), O3:H12 (n=1), O26:H11 (n=2), O33:H11 (n=1), O69:H- (n=1), O76:H34 (n=1), O88:H8 (n=1), O113:H4 (n=1), O113:H36 (n=3), O118:H16 (n=1), O136:H12 (n=1), O150:H8 (n=1), O153:H+ (n=1), O153:H40/44 (n=1), O157:H7 (n=26), O157:H16 (n=1), O171:H2 (n=4), OR:H18 (n=1), OX18:H38 (n=2), OX18:H+ (n=3)	Ennis et al., 2012
2007 -2008	Bovine faeces and soil on beef farms (n= 20 farms)	Faeces (n=1200) Soil (n= 600)	Strains isolated from stx positive samples serotyped and examined for the presence of genes associated with virulence	STEC (n=23; 1.9% faecal & n=4; 0.7% soil samples)/ E. coli (n=107; 5.9%) 17 different serotypes: O2:H27 (n=13), O6:H8 (n=1), O13/O150:H2 (n=2), O20:H19 (n=1), O26:H11 (n=14), O86:H21 (n=1), O109:H5 (n=1), O113:H4 (n=31), O116:H28 (n=6) , O119:H5 (n=6), O136:H2 (n=1), O136:H16 (n=2), O145:H28 (n=1), O168:H8 (n=9), O168:H27 (n=1), O171:H2 (n=4), O174:H21 (n=7), ONT:H4 (n=3), ONT:H17 (n=1), ONT:H18 (n=1), ONT:H27 (n=1)	Monaghan et al., 2011

IE: Previous Research prevalence studies

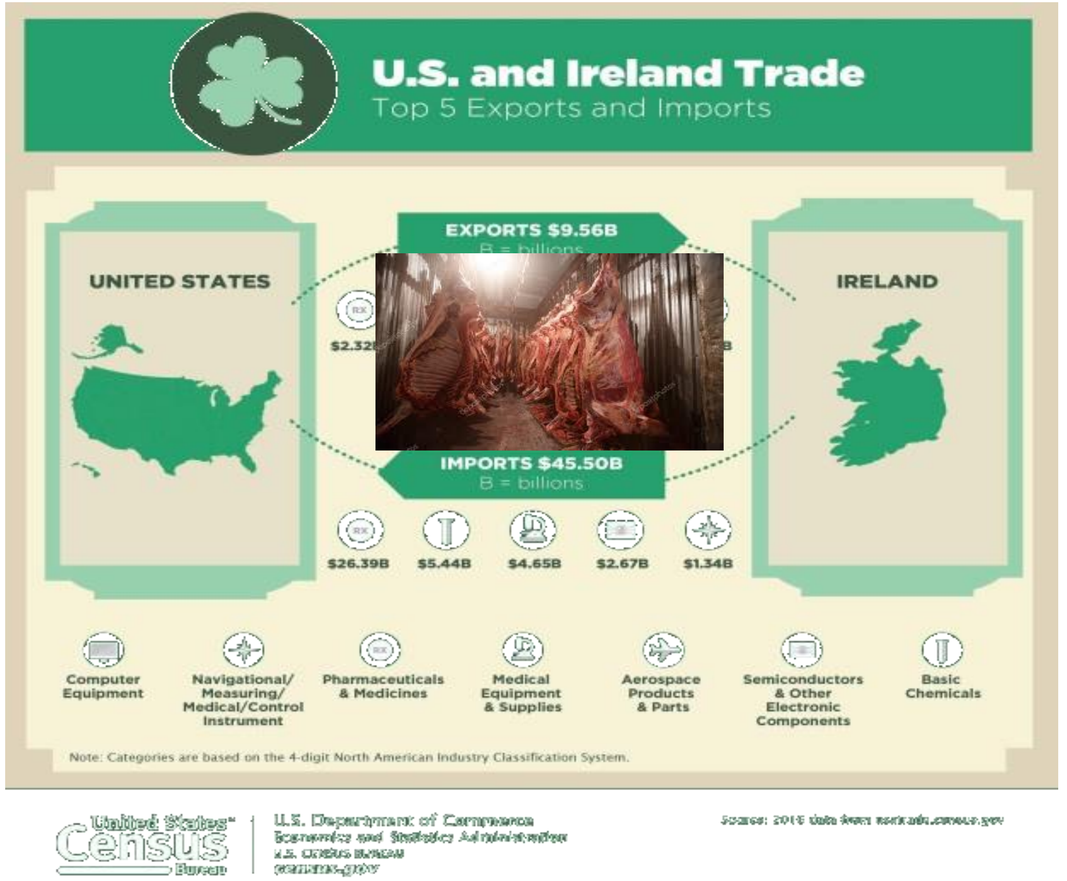
- Beef, meat carcasses and meat cuts
- Hide/Fleece
- Rectum/Faeces

Conclusion:
Carcase level prevalence 0.7 -5.5%
Minced meat/Burger prevalence 0.7 -1.4%

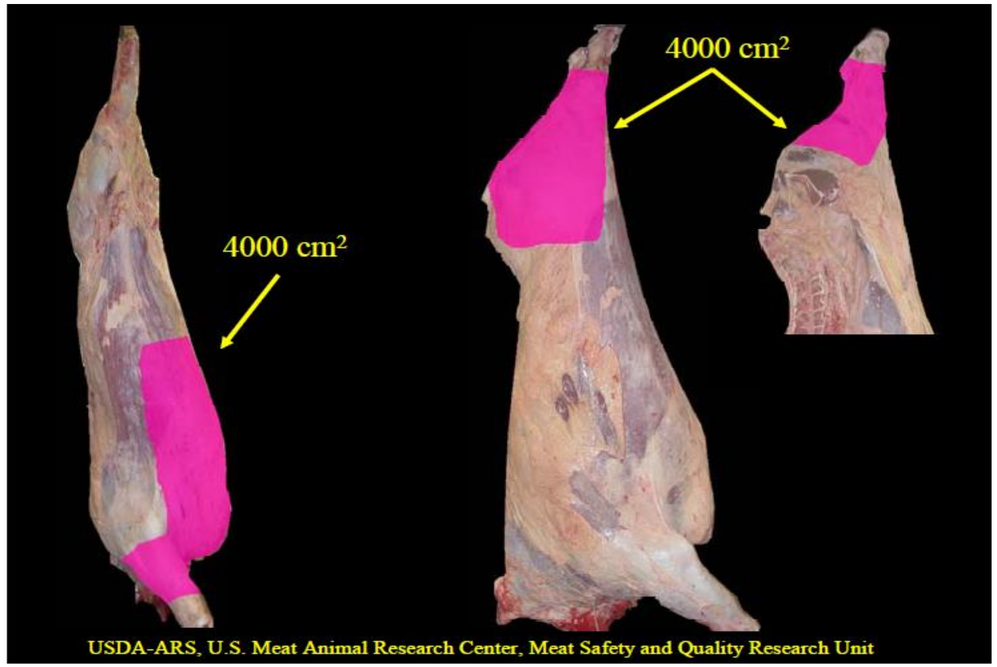
US beef imports trade requirements

Ireland has USDA approval for the exporting of Irish beef both intact cuts and beef intended for grinding. A pre-requisite of USDA for approving the processing plants was that Ireland undertook a comprehensive survey across the food chain to ascertain the prevalence of STEC in the animal population and contamination levels across all food types

- Intact cuts: O157 (MLG 5)
- Beef intended for grinding: O157 plus 6-top serovars -> O26, O45, O103, O111, O121 and O145 (MLG 5B)



Sampling method



28 sampling locations

12 months long, fortnightly sampling

The sampling technique based on the US National survey:

- 2 carcass swabs whole carcass. Swab area 8000cm^2 pre-evisceration (one side) and pre-chill (alternate side)
- 1 Composite meat sample: 12 randomly selected boxes of beef lean trim, 60 pieces of 6.25g => 325-375g

VPHRL

Sampling weeks notified

Sampling materials shipped

Abattoir

Samples taken

Samples delivered

Samples tested

Results issued

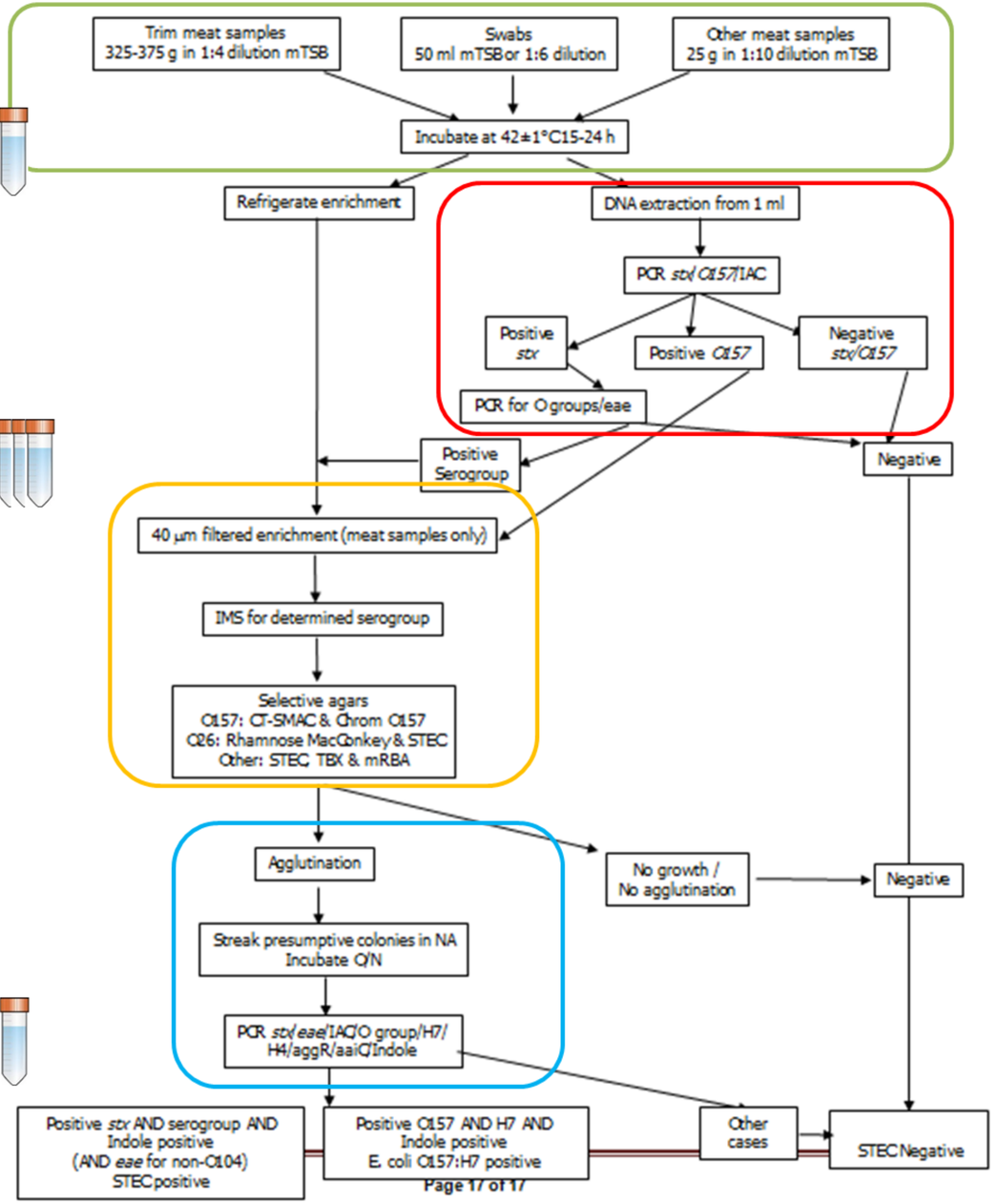
Carcases/Meat released/condemned

Day 1: Resuscitation in enrichment broth
(1 per sample)

Day 2-3: Screening PCR for virulence and serovar genes
(3 to 11 reactions per sample: vtx1, vtx2, eae, O157, O26, O45, O103, O111, O121 and O145)

Day 3-4: Colony isolation
(1 IMS and 2 plates per positive serovar per sample)

Day 5-7: Colony confirmation: indole, latex aglutination, PCR
(4 to endless PCR per sample)



Testing method

Overnight enrichment mTSB

↓

DNA extraction & First PCR (*vtx*1, *vtx*2, *eae*)

↓

Samples positive for *vtx*1 and/or *vtx*2 and *eae* go on for serogroup PCR (QUAD: O26, O45, O103, O157, TRIP: O111, O121, O145)

↓

Positive samples streaked directly onto selective media (STEC, TBX, CT-SMAC, Rhamnose McConkey agar & chromAgar O157)

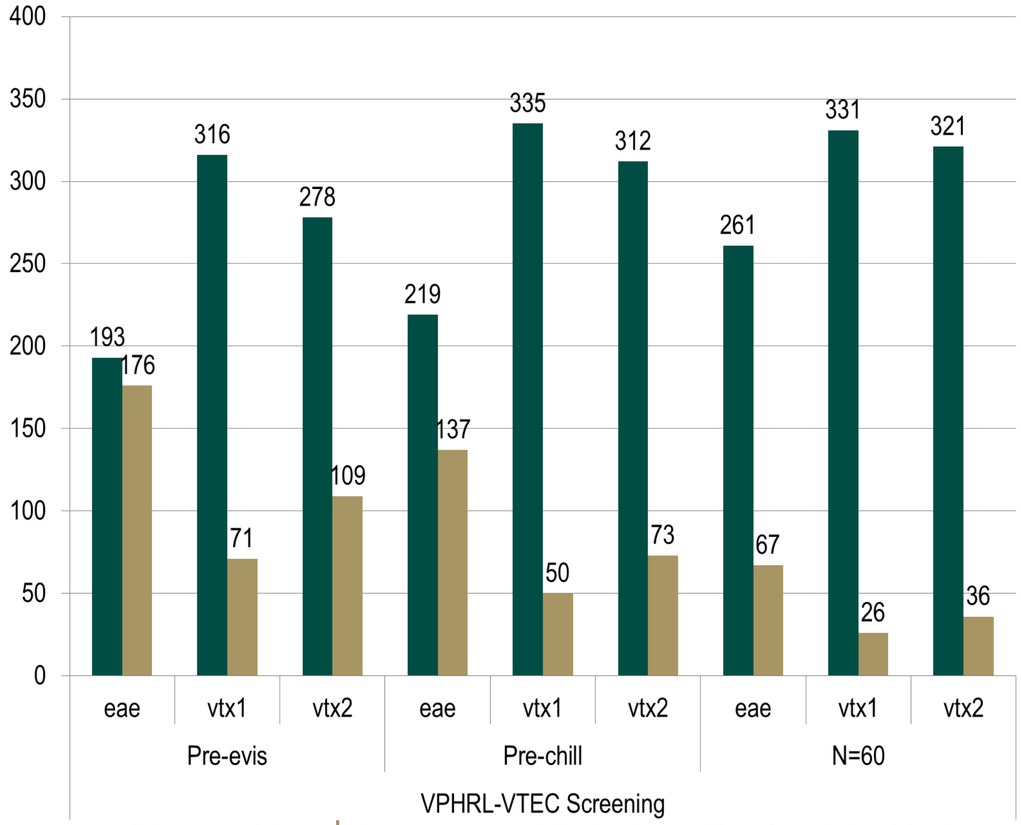
↓

Colonies are and confirmed by PCR as above (1st pooled then isolated)

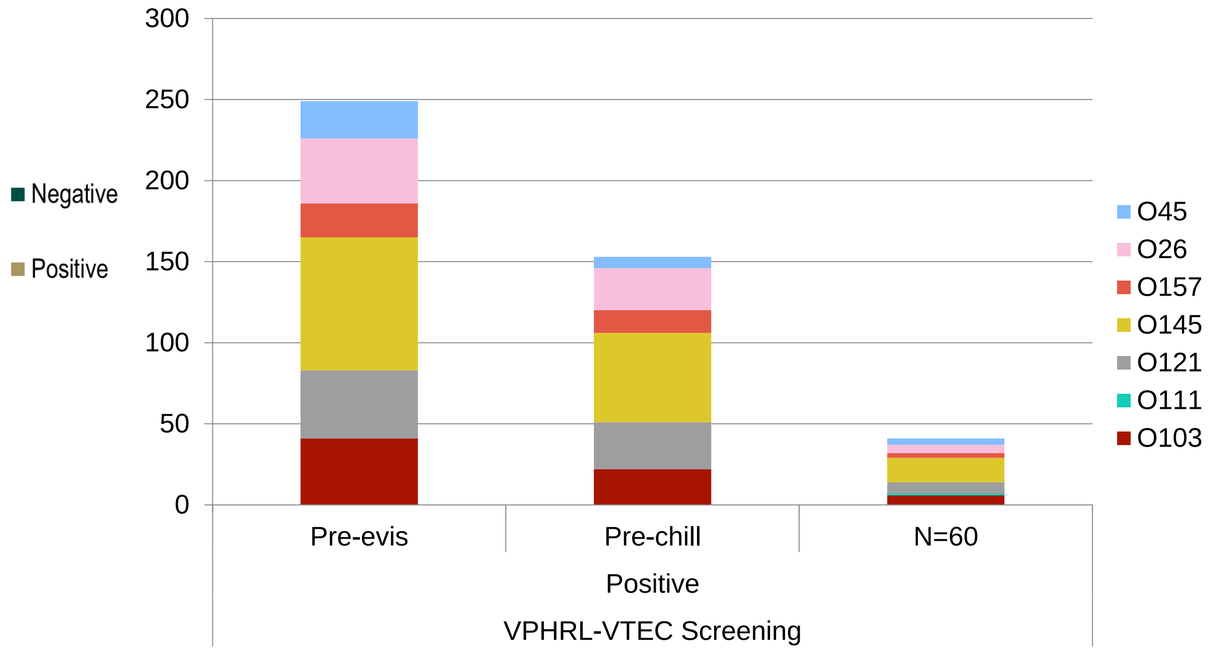
Screening Results

- 786 swabs and 357 N60 samples analysed
- 10,000 PCR screening tests

PCR positive screening results
36% eae
19% vtx2
13% vtx1

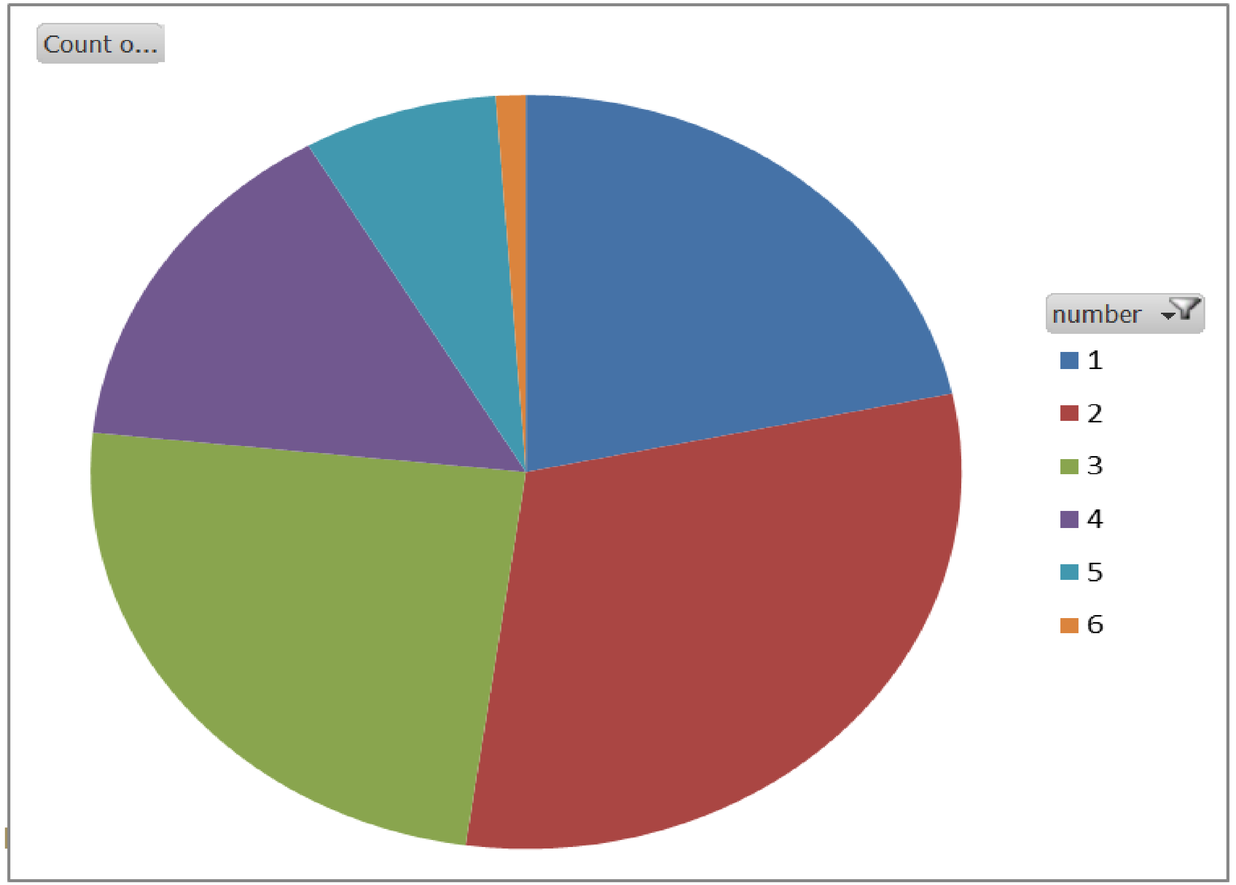


PCR Positive screening results O groups
15.5% O145
8.0% O121
7.4% O26
6.9% O103
3.8% O157
3.4% O45
0.1% O111



Number of serotypes positive in screening

- 140 samples were positive for multiple O-groups



Confirmatory results

- 100 pre-evis, 75 pre-chill and 21 N60 samples underwent confirmatory tests
  - 116 vtx- / eae-
  - 53 vtx- / eae+
  - 15 vtx+ / eae-
  - 12 vtx+ / eae+ ->
    - 6 eae+ STEC non top seven serovars
    - 6 eae + top-7 O-groups + STEC (5 pre-evis and 1 pre-chill swab): O103, O145, O157, O26
    - -> Positive rate: 1.27% pre-evis swabs / 0.25% pre-chill swabs / 0% composite meat

Thanks