16th Annual Workshop of the National Reference Laboratories for E. coli in the EU

18-19 October, 2021

Update on STEC in the EU, based on the EU One Health Zoonoses 2019 report

Frank Boelaert

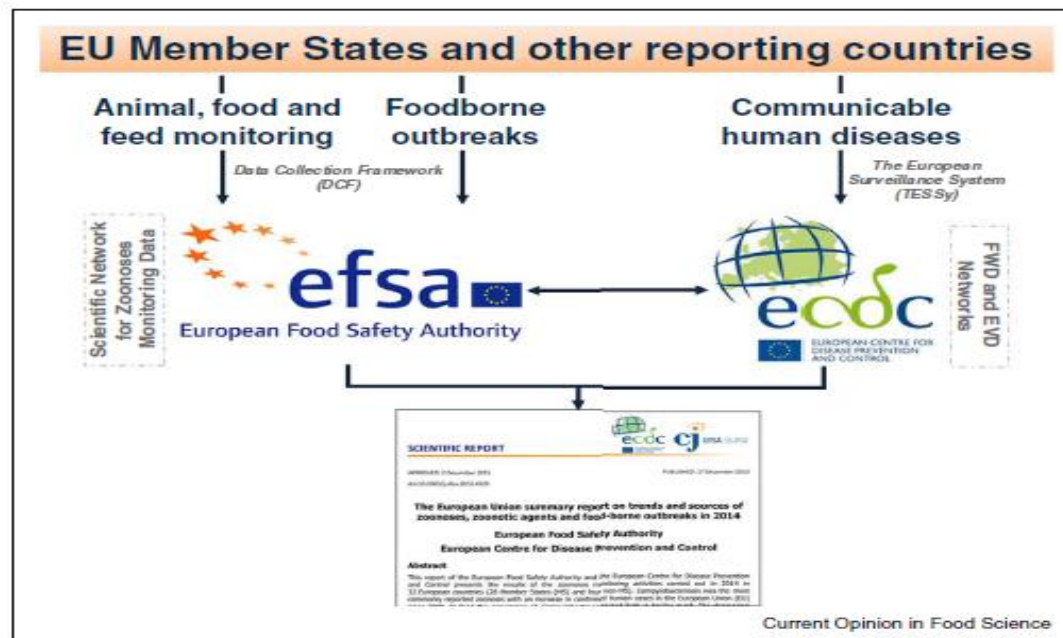Senior scientific officer

Trusted science for safe food

efsa
European Food Safety Authority

https://www.efsa.europa.eu/en/efsajournal/pub/6406

The European Union One Health 2019 Zoonoses Report

Published: 27 February 2021   Approved: 19 January 2021

EFSA Journal on the Wiley Online Library

Read the article

Access the PDF

DOI: 10.2903/j.efsa.2021.6406

Data flow and EFSA's integrated approach for the production of the joint EFSA-ECDC EU Summary Report on zoonoses and food-borne outbreaks in the EU. Note: FWD Network: European Food and Waterborne Diseases and Zoonoses Network; EVD Network: European Emerging and Vector-borne Diseases Network.
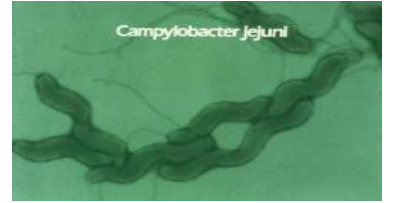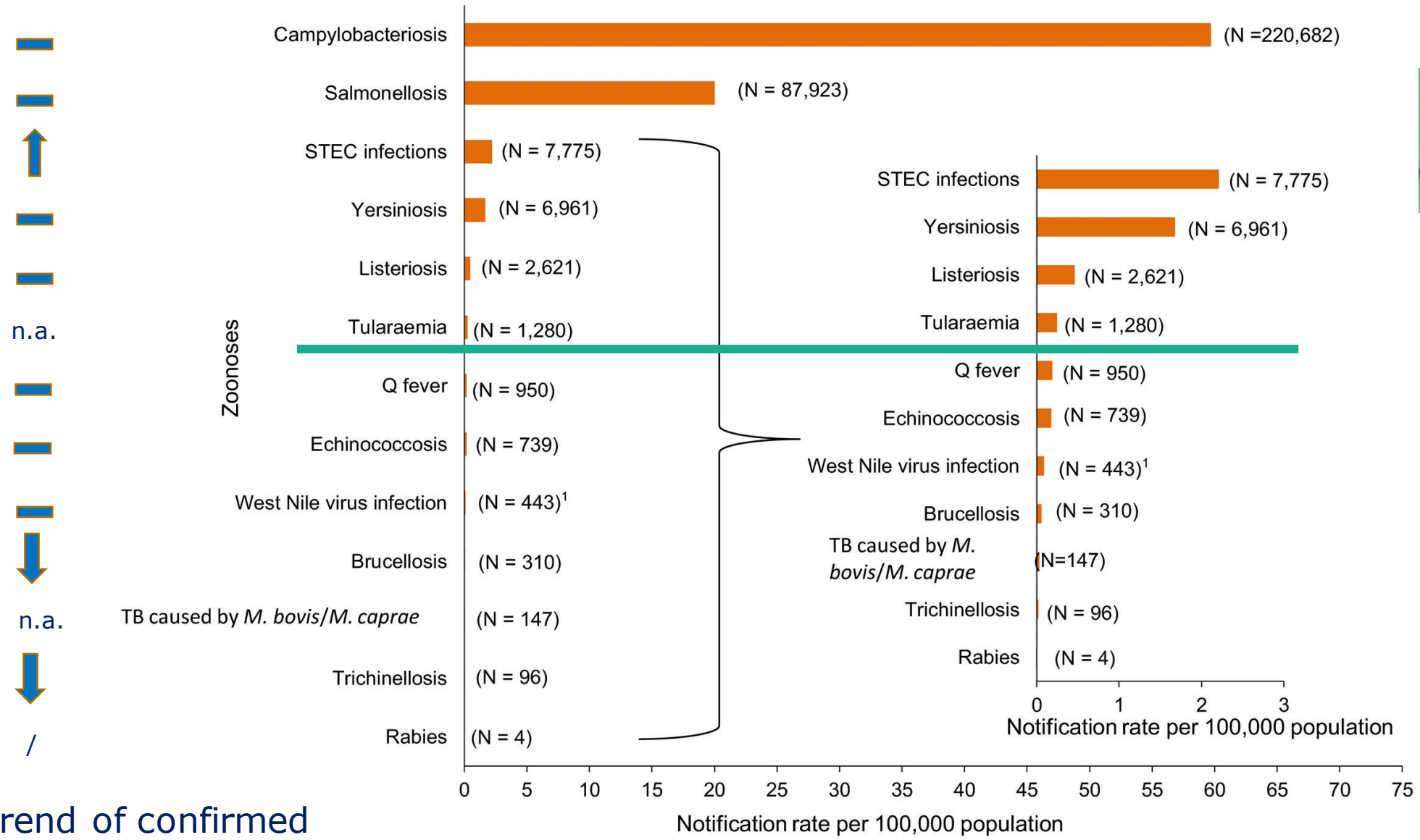
The EUOHZ:
- a joint scientific report by EFSA and ECDC, and
- the product of intensive collaboration with MS and EC DG SANTE (D4, G2 and G4)

EU trend of confirmed cases in 2015–2019

Reported hospitalisations and case fatalities due to zoonoses in confirmed human cases in the EU, 2019

| Disease	Number of confirmed human cases	Hospitalisation					Deaths		
		Status available (%)	Number of reporting MS[b]	Reported hospitalised cases	Proportion hospitalised (%)	Outcome available (%)	Number of reporting MS[b]	Reported deaths	Case fatality (%)
Campylobacteriosis	220,682	29.1	16	20,432	31.8	78.0	17	47	0.03
Salmonellosis	87,923	44.5	15	16,628	42.5	71.8	17	140	0.22
STEC infections	7,775	37.3	18	1,100	37.9	61.0	20	10	0.21
Yersiniosis	6,961	27.4	15	648	33.9	57.0	14	2	0.05
Listeriosis	2,621	51.1	19	1,234	92.1	65.1	20	300	17.6
Tularaemia	1,280	22.8	12	149	51.0	21.6	13	1	0.36
Echinococcosis	739	33.3	14	109	44.3	31.4	14	2	0.86
Q fever	950	NA[c]	NA	NA	NA	67.3	13	4	0.63
West Nile virus infection[a]	443	83.7	9	347	93.5	99.3	11	52	11.8
Brucellosis	310	44.5	11	98	71.0	36.8	12	2	1.75
Trichinellosis	96	16.7	5	6	37.5	25.0	7	1	4.20
Rabies	4	NA[c]	NA	NA	NA	75.0	3	3	100.0

Severity of the diseases was analysed based on hospitalisation and outcome of the reported cases. Based on data on severity, **listeriosis** and **West Nile virus infection** were the two most severe diseases with the highest case fatality (listeriosis, 17.6%) and the highest hospitalisation (West Nile virus infection, 93.5%). Almost all confirmed cases with data available on hospitalisation for these two diseases were hospitalised. About one out of every fifth and one out of 10 confirmed listeriosis and WNV cases, respectively, with known data were fatal.

There was a significantly increasing
trend (p < 0.01) for STEC in the
EU/EEA in 2015–2019.

Five MS (Austria, Denmark,
Finland, Malta and Poland)
reported significantly increasing
trends (p < 0.01). One MS (the
Netherlands) had a significantly
decreasing (p < 0.01) trend over
the same time period.
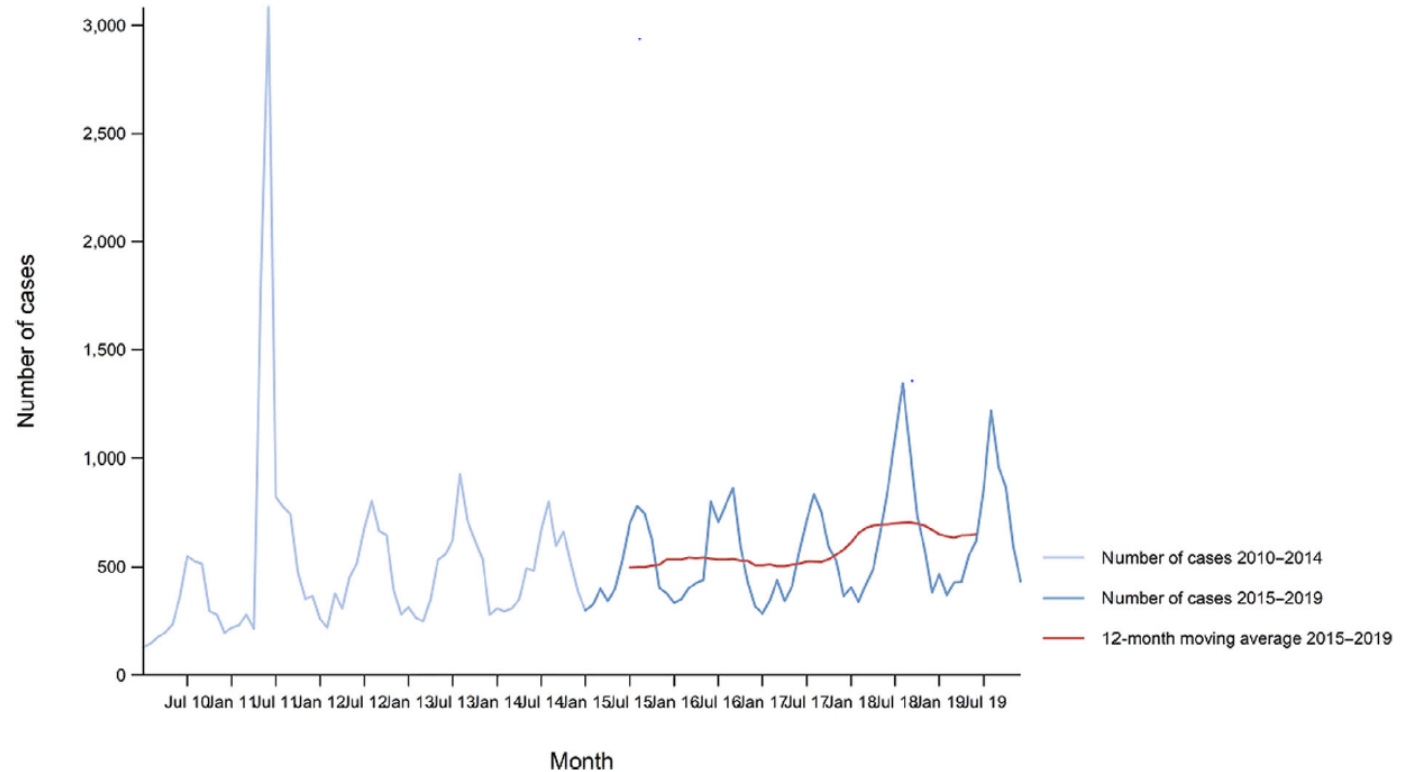
Source: Austria, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Romania, Slovakia, Slovenia, Sweden and the United Kingdom. Belgium, Bulgaria, Czechia, Croatia, Portugal and Spain did not report data to the level of detail required for the analysis.

- In 2019, 7,775 confirmed cases of Shiga toxin-producing *E. coli* (STEC) infections in humans were reported at the EU level by 27 EU countries.
- The EU notification rate was 2.2 cases per 100,000 population, which was similar to 2018.
- The highest notification rates were reported in Ireland, Malta, Denmark and Sweden.
- The EU/EEA **trend has been increasing** from 2015 to 2019.
- STEC was the third most frequent bacterial agent detected in food-borne outbreaks in the EU, with 42 outbreaks, 273 cases, 50 hospitalisations and 1 death reported in 2019.
- The sources in the four strong-evidence STEC food-borne outbreaks during 2019 were 'bovine meat and products thereof' (two outbreaks), 'milk' and 'tap water, including well water' (one outbreak each). During 2010–2018, strong-evidence STEC outbreaks were mostly caused by 'bovine meat and products thereof' (18), 'tap water, including well water' (16), 'vegetables and juices and other products thereof' (10) and milk (8) and cheese (8).
- In 2019, 21 MS reported the presence of STEC in **2.8% of 20,395 food samples**, compared with 2.4% in 2018.

- Sprouted seeds were tested by six MS with no positive STEC results from 331 official samples. An EU regulation with a microbiological criterion for the presence of STEC in this food commodity has been in force since 2013.

- Overall, STEC was most commonly found in meat of different types derived from different animal species (4.1% STEC-positive), followed by 'milk and dairy products' (2.1%) while 'fruits and vegetables' was the least contaminated category (0.1%). Sixteen MS tested **6,297 'ready-to-eat' food samples for STEC of which 37 (0.6%) were found to be STEC-positive,** including 17 meat and meat product samples, 16 milk and milk product samples with 10 from cheese, two samples from spices and herbs, and one STEC-positive sample from salads and 'fruits, vegetables and juices' each.

Distribution of the 20 most frequent serogroups reported in confirmed cases of human STEC infections in EU/EEA, 2017–2019

Confirmed cases in humans: data on STEC serogroups (based on the O antigen) were reported in 2019 by 24 MS. Serogroup data were available for 57.9% of the human confirmed cases, which was a slight decrease compared with in 2018 (61.6%).

Serogroup	2019			2018			2017		
	Cases	MS	%	Cases	MS	%	Cases	MS	%
O157	1,195	22	26.6	1,735	21	34.5	1,299	22	31.9
O26	722	16	16.0	833	18	16.6	577	17	14.2
NT[1]	572	11	12.7	497	9	9.9	493	10	12.1
O146	220	11	4.9	179	9	3.6	139	8	3.4
O103	213	13	4.7	233	14	4.6	245	13	6.0
O91	181	12	4.0	192	10	3.8	178	12	4.4
O145	162	11	3.6	158	12	3.1	147	12	3.6
O128[2]	113	12	2.5	107	10	2.1	79	11	1.9
O80	80	9	1.8	64	8	1.3	42	7	1.0
O111	63	12	1.4	79	15	1.6	92	17	2.3
O63	62	8	1.4	24	6	0.5	30	6	0.7
O113	60	10	1.3	63	7	1.3	56	7	1.4
O117	52	6	1.2	52	7	1.0	29	3	0.7
O76	48	9	1.1	52	9	1.0	31	6	0.8
O27	44	6	1.0	23	5	0.5	15	5	0.4
O55	36	10	0.8	35	9	0.7	30	8	0.7
O8	36	7	0.8	48	8	1.0	28	6	0.7
O78	30	8	0.7	21	7	0.4	23	5	0.6
O121	29	8	0.6	45	6	0.9	30	6	0.7
O182	28	7	0.6	20	6	0.4	16	4	0.4
Other	554	–	12.3	573	–	11.4	488	–	12.0
Total	**4,500**	**22**	**100.0**	**5,033**	**23**	**100.0**	**4,067**	**23**	**100.0**

(1): Non-typable STEC include those strains in which the laboratory tried but was not able to define the O-serogroup. This depends on how many sera/molecular tools are included in the typing panel.
(2): Including O128ab.
Source: 24 MS and two non-MS: Austria, Belgium, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, the United Kingdom and Iceland and Norway.

- Food : 25,238 sample units tested of which 2.5% (641) were STEC-positives.

- Animals : 2,588 animal sample units tested of which 14.1% (366) were STEC-positive.

Serogroup	Human			Food			Animals		
	STEC cases	MS	%	STEC-positive	MS	%	STEC-positive	MS	%
O157	1,195	22	26.6	43	7	6.7	45	5	12.3
O26	722	16	16.0	14	6	2.2	1	1	0.3
NT[1]	572	11	12.7	316	10	49.1	253	4	69.1
O146	220	11	4.9	13	2	2.0	2	1	0.5
O103	213	13	4.7	8	6	1.2	1	1	0.3
O91	181	12	4.0	10	4	1.6	ND		0.0
O145	162	11	3.6	4	1	0.6	1	1	0.3
O128[2]	113	12	2.5	2	1	0.3	ND		0.0
O80	80	9	1.8	ND		0.0	ND		0.0
O111	63	12	1.4	1	1	0.2	1	1	0.3
O63	62	8	1.4	ND		0.0	ND		0.0
O113	60	10	1.3	17	5	2.7	2	1	0.5
O117	52	6	1.2	2	1	0.3	ND		0.0
O76	48	9	1.1	ND		0.0	ND		0.0
O27	44	6	1.0	ND		0.0	ND		0.0
O55	36	10	0.8	10	1	1.6	ND		0.0
O8	36	7	0.8	7	2	1.1	14	1	3.8
O78	30	8	0.7	ND		0.0	ND		0.0
O121	29	8	0.6	1	1	0.2	1	1	0.3
O174	ND		0.0	8	2	1.2	1	1	0.3
O182	28	7	0.6	ND	ND	ND	ND	ND	ND
Other	554	–	12.3	97	6	15.1	43	3	11.7
Total	4,500	22	100.0	641	20	100.0	366	8	100.0

ND: not detected.
(1): Non-typable STEC include those strains in which the laboratory tried but was not able to define the O-serogroup. This depends on how many sera/molecular tools are included in the typing panel.
(2): Including O128ab.

Food : of 212 isolates 45 (21.2%) belonged to the top five serogroups (O157, O26, O103, O111 and O145) while the remaining 167 isolates (78.8%) belonged to 53 different O-groups. All the top 20 STEC serogroups isolated from human infections were also found in the STEC isolated from food in 2019, except for serogroups O80, O5 and O76 only found in food.

Food category[a]	Samples positive for					
	Any STEC	O157	O26	O145	O103	O111
	N	N	N	N	N	N
Bovine meat	315	14	7	4	4	1
Ovine and goat meat	102	3	3	0	2	0
Other ruminants meat[b]	10	0	0	0	0	0
Pig meat	54	0	0	0	0	0
Other meat[c]	21	0	0	0	1	0
Mixed meat	16	0	0	0	1	0
Milk and dairy products[d]	39	0	3	0	0	0
Raw milk[e]	52	1	1	0	0	0
Fruit and vegetable	2	0	0	0	0	0
seeds[f]	0	0	0	0	0	0
Other food	5	0	0	0	0	0
Total	**616**	**18**	**14**	**4**	**8**	**1**

MS: Member State; N: number of samples; STEC: Shiga toxin-producing *Escherichia coli*.

Note: Only results from samples tested by the ISO TS 13136:2012 method were included.

(a): The different meat categories presented in this table include all types of meat (not only fresh).

(b): Includes meat from deer.

(c): Includes meat from other animals (other than ruminants).

(d): Includes any type of dairy product, cheese and milk other than raw milk.

(e): Includes raw milk from different species, but most tested and all the positive samples were from cows.

(f): Includes only sprouted seeds.

Virulotypes of the food, animal and human isolates causing severe infection (HUS, hospitalisation and bloody diarrhoea) in 2019 and comparison with those associated with severe disease in humans in 2012–2017, in EU

Virulence genes profile	No of animal isolates in 2019^	No of food isolates in 2019^	No of human isolates in 2019 (%)	Relative frequency of the virulotype in*		
				HUS	Hospitalisation	Bloody diarrhoea
stx2; eae+	8	13	399 (42.1)	17.7	42.0	40.2
stx2; stx1; eae+	26	3	285 (30.1)	5.9	35.7	64.8
stx2; eae-	ND	42	90 (9.5)	2.7	24.3	14.8
stx1; eae+	1	25	88 (9.3)	1.2	27.4	27.3
stx1; eae-	ND	25	44 (4.6)	0.3	20.3	14.1
stx2; stx1; eae-	1	30	42 (4.4)	1.4	15.3	19.4
Total	**36**	**138**	**948**			

ND: Not detected.

*: Relative frequencies (%) of the different combinations of *stx* gene subtypes with or without the eae gene in STEC isolated from severe disease (TESSy data, 2012–2017). Data from: EFSA Journal 2020;18(1):5967.

^: Due to the low number of isolates virulotyped for food and animals only the number of isolates is displayed.

The most commonly reported virulence gene combination was *stx*1-/*stx*2+/*eae*+, accounting for 42.1% (399/948) of the severe human cases with known virulotypes. The proportion of the second most common virulotype *stx*1+/*stx*2+/*eae*+ accounted for 30.1% (285/948) of the cases. Together these two virulotypes represented 72.2% of the total number of severe human cases with known virulotypes in 2019.

The most common *stx* gene subtypes (human isolates) were *stx*1a (261/865; 30.2%), *stx*2a (222/865; 25.7%), *stx*2c (182/865; 21.0%) and *stx*2a;*stx*2c (100/865; 11.6%), representing 88.5% of the total number of subtypes in severe human cases.

Stx genes subtypes combinations	No of food isolates in 2019^	No of human isolates in 2019 (%)	Relative frequency of the *stx* genes subtypes combinations in*					
			HUS		Hospitalization		Bloody Diarrhea	
			eae+	eae-	eae+	eae-	eae+	eae-
Stx1a	10	261 (30.2)	1.2	0.0	27.6	20.7	27.3	8.0
Stx2a	3	222 (25.7)	27.4	10.4	56.4	32	58.4	26.3
Stx2c	2	182 (21.0)	4.3	5.0	19.8	NR	23.9	NR
Stx2c;Stx2a	1	100 (11.6)	29.0	NR	57.1	NR	65.5	NR
Stx2d;Stx2a	1	ND	–	–	–	–	–	–
Stx2g;Stx2a	2	ND	–	–	–	–	–	–
Stx2b	1	39 (4.5)	NR	0.5	NR	21.3	NR	10.5
stx1c	ND	30 (3.5)	NR	0.6	NR	18.9	NR	19.5
Stx2d	4	16 (1.8)	NR	10.3	NR	33.3	NR	16.0
Stx2f	ND	8 (0.9)	3.8	NR	21.0	NR	8.7	NR
Stx1d	1	3 (0.3)	–	–	–	–	–	–
Stx2c;Stx2a;Stx1a§	1	ND	20.8	4.5	59.3	NR	56.6	NR
Stx2a;Stx1a	8	ND	20.8	4.5	59.3	NR	56.6	NR
Stx1a;Stx1c	ND	1 (0.1)	–	–	–	–	–	–
Stx2e	ND	1 (0.1)		NR	NR	NR	NR	31.8
Stx2a;Stx2e	ND	1 (0.1)	–	–	–	–	–	–
Stx2c;Stx2d	ND	1 (0.1)	–	–	–	–	–	–
Stx2d;Stx2b	2	ND	–	–	–	–	–	–
Stx2d;Stx1a	1	ND	–	–	–	–	–	–
Stx2d;Stx2a;Stx1a	2	ND	–	–	–	–	–	–
Total	**39**	**865**						

NR: data present in the TESSy data set used, with less than 20 isolates.
ND: Not detected.
– : not present in the TESSy database in the 2012–2017 period.
*: Relative frequencies (%) of the different combinations of *stx* gene subtypes in STEC isolated from severe disease (TESSy data, 2012–2017). Human data from: EFSA Journal 2020;18(1):5967.
^: Due to the low number of isolates virulotyped for food only the number of isolates is displayed. Only six animal isolates were provided with the information on the *stx* gene subtypes and have not been included in this table.

- Of the isolates from **food** with the reported information on the serogroup **21.2% belonged to the 'top-five' serogroups (O157, O26, O103, O111 and O145)** in 2019 and more than half of all the remaining STEC belonged to the top-20 STEC serogroups reported in human infections to ECDC in 2015–2018.

- Most of the virulotypes of STEC isolates from food and animal were also identified in severe STEC infections in humans. This identification, however, was only carried out on 52.9% of the food isolates for the stx gene typing (stx1 and stx2) and stx gene subtyping was only done for 6.1% of the food isolates, and even less for animal isolates.

- Testing of animal samples was still not widely carried out in the EU with 2,588 animal samples tested for STEC by nine MS in 2019.

Thank you for your attention

Acknowledgements

Giusi Amore, Winy Messens, Michaela Hempen, Valentina Rizzi, Sotiria-Eleni Antoniou, Francesca Baldinelli, Elisabeth Dorbek-Kolin, Yves Van der Stede, Anca Stoicescu and Luca Pasinato

contractors: the Istituto Zooprofilattico Sperimentale delle Venezie, Italy; **the Istituto Superiore di Sanita, Italy**; the EURL for Parasites (ISS, Italy), and the EURL for *Listeria monocytogenes* (ANSES)

Taina Niskanen, Joana Haussig, Marlena Kaczmarek and Joana Gomes Dias

Data Providers

EFSA   Scientific Network for Zoonoses Monitoring Data

ECDC   Food and Waterborne Diseases and Zoonoses Network, Emerging and Vector-borne Diseases Network and the Tuberculosis Network

AHAW Panel   **BIOHAZ Panel**   **DG SANTE D4, G2 and G4**

European Union Reference Laboratories

Animal Health

Food and Feed

Stay connected

efsa — European Food Safety Authority

Subscribe to
efsa.europa.eu/en/news/newsletters
efsa.europa.eu/en/rss

Receive job alerts
careers.efsa.europa.eu – job alerts

Follow us on Twitter
@efsa_eu
@plants_efsa
@methods_efsa
@animals_efsa

Follow us Linked in
Linkedin.com/company/efsa

Contact us
efsa.europa.eu/en/contact/askefsa