

JOINT ECDC-EFSA RAPID OUTBREAK ASSESSMENT

Three clusters of *Salmonella* Enteritidis ST11 infections linked to chicken meat and chicken meat products

26 October 2023

Abstract

From 1 January–24 October 2023, 335 laboratory-confirmed *Salmonella* Enteritidis ST11 cases belonging to three distinct microbiological clusters have been reported in 14 EU/EEA countries, the United Kingdom and the United States, affecting all age groups. Most interviewed cases reported consumption of chicken meat, including chicken kebabs. Nine cases in three countries were hospitalised and one case in Austria died, highlighting the potential for severe and fatal infections from this outbreak.

Following the food exposure information and the national investigations in 2023, the food safety authorities in Austria, Denmark and Italy investigated 10 food products (six contaminated by *Salmonella* Enteritidis ST11 cluster 1 and/or cluster 2), seven final producers in Poland and one in Austria. Traceability information revealed that three *Salmonella*-contaminated kebabs shared a number of Polish food business operators. The trading link of the suspected kebab suggests one or more common source(s)/point(s) of contamination in Austria, Denmark, and Italy.

Following the collection of genomic information, the cluster analysis revealed the presence of the outbreak strains in the food chain in multiple European countries. Most positive foods sampled in 2022–2023 with shared epidemiological data originated from Poland.

Given the information collected, contaminated chicken kebab and chicken meat are the plausible vehicles of the human infections reported in these three clusters. In the absence of conclusive microbiological evidence and comprehensive traceability, the role of the identified final producers, their meat suppliers, and the possible involvement of other food business operators as sources of the infections could not be confirmed or excluded. Further investigations are needed to identify the root cause of the contamination and the source of infections, which is crucial for prompt implementation of targeted effective control and corrective measures. As the source(s) have not been identified, new cases are likely to occur in this prolonged multi-country outbreak.

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Amendment note: Corrections were carried out on 27 October that do not materially affect the outcome of this report. Two human isolates were removed from Figure 9, the number of cases was updated in Table 5, and the spelling of an Austrian national expert was corrected.

Event background

On 1 June 2023, **Denmark** opened an event of a cluster of *Salmonella* Enteritidis sequence type (ST) 11 infections linked to consumption of chicken meat in the European Surveillance portal for Infectious Diseases (EpiPulse, 2023-FWD-00031), hosted by European Centre for Disease Prevention and Control (ECDC). On the same and following days, several countries in the European Union/European Economic Area (EU/EEA) reported cases with isolates matching the Danish representative outbreak isolates through sequencing performed. This pointed to a multi-country outbreak, possibly due to the consumption of contaminated chicken meat.

On 27 July 2023, **Denmark** opened a new event in EpiPulse of a cluster of *S. Enteritidis* sequence ST11 infections, a genetically distinct strain from the previously reported cluster and possibly linked to consumption of contaminated chicken meat (2023-FWD-00045). In the following week, several countries in the EU/EEA reported cases with isolates matching the Danish representative outbreak isolates by sequencing. This pointed to another concurrent multi-country outbreak possibly due to the consumption of contaminated chicken meat.

On 1 August 2023, **Austria** opened an event of a cluster of *S. Enteritidis* sequence ST11 infections, including one fatal case who had probably consumed a chicken kebab in a restaurant before illness (2023-FWD-00048). During the following weeks, cases with isolates matching the Austrian reference strain through sequencing performed were reported in several EU/EEA countries. This indicated a third concurrent multi-country outbreak of *S. Enteritidis* ST11, possibly linked to the consumption of contaminated chicken meat.

On 30 August 2023, ECDC published [a news item](#) summarising the available information on the two *S. Enteritidis* ST11 clusters (2023-FWD-00045 and 2023-FWD-00048) to raise awareness among public health authorities and encourage them to strengthen their foodborne outbreak investigations with food safety and veterinary authorities and report any additional related cases through EpiPulse.

Outbreak strain characterisations

***Salmonella* Enteritidis ST11 Cluster 1 – strain (2023-FWD-00048/Austria)**

S. Enteritidis ST11, HC5_283929 (Enterobase) [1,2], Complex Type (CT)13755 (SeqSphere) [3].

The strain is resistant against nalidixic acid and ciprofloxacin (ResFinder: gyrA pS83Y) [4-6]

***Salmonella* Enteritidis ST11 Cluster 2 – strain (2023-FWD-00045/Denmark)**

S. Enteritidis ST11, HC5_1358 (Enterobase), CT2114 (SeqSphere), SRR25381902 in the European Nucleotide Archive (ENA) [7].

***Salmonella* Enteritidis ST11 Cluster 3 – strain (2023-FWD-00031/Denmark)**

S. Enteritidis ST11, HC5_1358 (Enterobase), CT9791 (SeqSphere), SRR24791065 in ENA.

European outbreak case definitions

The European outbreak case definitions are as follows:

Cluster 1: *Salmonella* Enteritidis ST11 (EpiPulse reference: 2023-FWD-00048/Austria)

A confirmed outbreak case:

- A laboratory-confirmed *Salmonella* Enteritidis ST11 case with disease onset on or after 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).
- AND
- Fulfilling at least one of the following laboratory criteria:
 - within seven cg-allelic differences (AD) from the representative Austrian outbreak reference strain in the national cgMLST pipeline, OR
 - clustering within five cg-allelic differences in a single linkage clustering in a centralised whole genome sequencing (WGS) analysis, OR
 - belonging to the cgMLST HC5_283929 hierarchical cluster by EnteroBase scheme, OR
 - belonging to CT13755 according to SeqSphere scheme, OR
 - clustering according to a national single-nucleotide polymorphism (SNP) pipeline within five SNPs of the Austrian outbreak reference strain, OR
 - belonging to a 5-SNP single linkage cluster with SNP designation 1.1.2.12.4695.7007.% according to the pipeline in the United Kingdom Health Security Agency (UKHSA) [8]

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

A historical clustering case:

- A laboratory-confirmed Cluster 1 case BUT with disease onset prior to 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

Cluster 2: *Salmonella* Enteritidis ST11 (Epipulse reference: 2023-FWD-00045/Denmark)

A confirmed outbreak case:

- A laboratory-confirmed *Salmonella* Enteritidis ST11 case with disease onset on or after 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).

AND

- Fulfilling at least one of the following laboratory criteria:
 - within seven cg-allelic differences (AD) from at least one of the representative Danish outbreak reference strain in the national cgMLST pipeline, OR
 - clustering within six cg-allelic differences in a single linkage analysis in a centralised whole genome sequencing (WGS) analysis, OR
 - belonging to the cgMLST HC5_1358 hierarchical cluster by EnteroBase scheme, OR
 - belonging to CT2114 according to SeqSphere scheme, OR
 - clustering according to a national single-nucleotide polymorphism (SNP) pipeline within five SNPs of the Danish outbreak reference strain, OR
 - belonging to a 5-SNP single linkage cluster with SNP designation 1.1.2.12.12.590.% according to the pipeline in the UK Health Security Agency (UKHSA)

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

A historical clustering case:

- A laboratory-confirmed Cluster 2 case BUT with disease onset prior to 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

Cluster 3: *Salmonella* Enteritidis ST11 (Epipulse reference: 2023-FWD-00031/Denmark)

A confirmed outbreak case:

- A laboratory-confirmed *Salmonella* Enteritidis ST11 case with disease onset on or after 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).

AND

- Fulfilling at least one of the following laboratory criteria:
 - within seven cg-allelic differences (AD) from at least one of the representative Danish outbreak reference strain in the national cgMLST pipeline, OR
 - clustering within six cg-allelic differences in a single linkage analysis in a centralised whole genome sequencing (WGS) analysis, OR
 - belonging to the cgMLST HC5_1358 hierarchical cluster by EnteroBase scheme, OR
 - belonging to CT9791 according to SeqSphere scheme, OR
 - clustering according to a national single-nucleotide polymorphism (SNP) pipeline within five SNPs of the Danish outbreak reference strain, OR
 - belonging to a 5-SNP single linkage cluster with SNP designation 1.1.2.12.12.890.% according to the pipeline in the UKHSA.

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

A historical clustering case:

- A laboratory-confirmed Cluster 3 case BUT with disease onset prior to 1 January 2023 (date of sampling or date of receipt by the laboratory if date of onset is not available).

AND

- No or unknown history of travel outside of the EU/EEA seven days prior to onset of symptoms.

Epidemiological and microbiological investigations of human cases

Since 1 January 2023 and as of 24 October 2023, there have been three *Salmonella* Enteritidis ST11 clusters comprised of 66 (cluster 1), 192 (cluster 2), and 77 (cluster 3) laboratory-confirmed cases in EU/EEA countries, the United Kingdom (UK), and the United States (US) (Tables 2, 3, and 4). Countries use different analytical methods for sequencing data, which leads to variable nomenclature of representative cluster strains, presented in Table 1.

Table 1. Nomenclature of representative *S. Enteritidis* ST11 strains and total number of confirmed cases in the EU/EEA, the UK and the US in 2023 by cluster, as of 24 October 2023

Cluster	No of cases in 2023	Countries involved	Nomenclature of representative <i>S. Enteritidis</i> ST11 strains			
			SeqSphere CT*	HC5**	HC2***	SNP****
Cluster 1	66	9 EU/EEA + UK	CT13755	283929	313217	1.1.2.12.4695.7007%
Cluster 2	192	12 EU/EEA + UK, US	CT2114	1358	352197 61234	1.1.2.12.12.590%
Cluster 3	77	8 EU/EEA + UK	CT9791	1358	252074	1.1.2.12.12.890%

*CT = Cluster type - SeqSphere

**Hierarchical single-linkage cluster with 5 AD cut off by cgLMST - Enterobase

***Hierarchical single-linkage cluster with 2 AD cut off by cgLMST - Enterobase

****SNP = Single nucleotide polymorphism – UKHSA.

Cluster 1: *S. Enteritidis* ST11 Cluster 1 (2023-FWD-00048)

In the cluster 1 of *S. Enteritidis* ST11, 66 cases were identified in nine EU/EEA countries and the UK in 2023 (Table 2). The cases in Poland were historical (before 2023) and detected during a research project (Table 2). Ages ranged from < 1 to 84 years with a significant predominance of males ($p < 0.01$) with the male-to-female ratio 1.8:1 (Table 2). Most cases (19) were reported in France and all these cases belong to the hierarchical cluster HC5_283929 according to the Enterobase scheme. One case in Austria has died and eight cases were hospitalised (three in Poland and five in Germany). Three cases in Norway and two cases each in Sweden and the UK respectively reported travel history to Poland (Table 2). The most recent case was reported in the UK in October 2023.

Table 2. Demographic overview and number of cases in the *S. Enteritidis* ST11 cluster 1 by country in the EU/EEA, as of 24 October 2023

Country	Total number of cases	Number of cases		Gender*		Age range years	Latest case**	Comments
		≤ 2022	2023	Male	Female			
Austria	11	0	9	8	3	<1–63	End-August 2023 ^a	One fatal case linked to a kebab restaurant.
Denmark	1	0	1	0	1	<24	September 2023	Case reported no travel nor consumption of chicken meat.
Finland	2	NA***	2	2	0	1–30	August 2023	No travel history reported for one case, travel history unknown for the other case.
France	19	NA	19	13	6	<1–84	August 2023 ^d	19 cases belong to HC5_283929 and 11 share the same HC2_313217 (Enterobase).
Germany****	12	1	11	8	4	6–81	July 2023 ^a	Five cases hospitalised; two due to salmonellosis, one due to another cause, and cause unknown for two cases.
Netherlands	1	0	1	0	1	15–24	August 2023	
Norway	4	1	3	4	0	10–30	August 2023 ^b	Three cases with travel history to Poland.
Poland*****	6	6	NA	4	2	<1–67	October 2022	Three cases were hospitalised. One case was part of an outbreak of three cases.
Slovenia	2	NA	2	1	1	31–32	April 2023	The vehicle of infection for the first case was probably a sandwich eaten at a party in Slovenia.
Sweden	5	1	4	3	2	19–30	August 2023 ^b	Two cases with travel history to Poland, where one case ate a kebab roll but cannot remember if it was a chicken kebab or not.
Total EU/EEA	63	9	52	43	20			
United Kingdom	21	7	14	11	10	2–53	October 2023	Two cases with travel history to Poland
Total	84	16	66	54	30			

*Male-to-female ratio 1.8:1

**Month of the most recent case: a = disease onset, b = sampling, c = receipt to reference laboratory, d = isolation

***NA = Not applicable

****Includes one case with an epidemiological link to a confirmed case

***** Isolates were tested in the course of a research project.

Cluster 2: *S. Enteritidis* ST11 Cluster 2 (2023-FWD-00045)

Since 1 January 2023 and as of 24 October 2023, 192 laboratory-confirmed *S. Enteritidis* ST11 cases were reported by 12 EU/EEA countries and the UK in cluster 2 (Table 3). In addition, one case was reported in the US with a travel history to Spain, where infection likely occurred. Among cases in the EU/EEA, the age range was < 1 – 98 years and the male-to-female ratio 1.1:1 indicating no difference in case numbers between males and females. One case in Italy was hospitalised. In addition to the US case, six cases reported travel history in Spain before symptom onset: one case in Belgium, two in the Netherlands, and three in Norway (Table 3). Further, one Danish case had travelled to Croatia and one Austrian case to Czechia.

Table 3. Demographic overview and number of cases in the *S. Enteritidis* ST11 cluster 2 by country in the EU/EEA and the United States, as of 24 October 2023

Country	Total number of cases	Number of cases		Gender*		Age range years	Latest case**	Comments
		≤ 2022	2023	Male	Female			
Austria	6	NA***	6	6	0	7–75	July 2023 ^a	One case travelled to Czechia.
Belgium	10	7	3	5	5	3–79	August 2023	One case from 2023 reported travel history to Spain.
Denmark	27	0	24	15	12	9–98	September 2023	22 cases reported no travel, four cases with unknown travel. One case with travel to Croatia. 16/23 reported consumption of kebab/pizzas with chicken as a likely ingredient.
Finland	7	NA	7	6	1	18–83	July 2023 ^b	Three cases are domestic and four with unknown travel.
France	60	NA	60	33	27	<1–86	August 2023 ^d	27 isolates belong to HC2_352197 and 18 to HC2_61234 (Enterobase). All 60 isolates belong to HC5_1358 (Enterobase).
Germany	1	0	1	1	0	5–14	May 2023 ^c	
Ireland	12	11	1	3	8	4–68	July 2023	
Italy	2	NA	2	Unk	Unk	2–20	July 2023 ^b	One case was hospitalised. Both cases reported consumption of chicken meat (one as a kebab).
Netherlands	12	10	2	4	8	19–73	June 2023	Two cases from 2022 reported history of travel to Gran Canaria, Spain.
Norway	9	9	0	Unk	Unk	Unk	2022	One domestic case. Travel history to Spain for three cases and unknown for five cases.
Slovenia	3	3	0	1	2	21–50	2021	
Sweden	2	NA	2	2	0	29–37	July 2023 ^a	One case reported consumption of chicken kebab
Total EU/EEA	151	NA	108	76	63			
United Kingdom	83	NA	83	41	42	< 1-87	October 2023	14 cases reported foreign travel: 11 to EU countries, one on a cruise in the Mediterranean.
United States	1	0	1	0	1	< 25	June 2023 ^a	Travel history to Spain, reported consumption of chicken in Spain.
Total	235	NA	192	117	106			

*Male-to-female ratio = 1.1:1

**NA = Not applicable

**Month of the most recent case: a = disease onset, b = sampling, c = receipt to reference laboratory, d = isolation.

Cluster 3: *S. Enteritidis* ST11 Cluster 3 (2023-FWD-00031)

Since 1 January and as of 24 October 2023, 77 cases have been reported in eight EU/EEA countries and the UK in cluster 3 (Table 4). Cases in Poland were historical (before 2023) and detected during a research project (Table 4). In this cluster, the age ranged from two to 83 years and there is a predominance of males (65%). Travel history was reported for nine cases: one case from Austria had travelled in Hungary, one from Ireland in Spain, four cases from the UK in Poland and three UK cases in Hungary (Table 4).

Table 4. Demographic overview and number of cases in the *S. Enteritidis* ST11 cluster 3 by country in the EU/EEA, as of 24 September 2023

Country	Total number of cases	Number of cases		Gender*		Age range years	Latest case**	Comments
		≤ 2022	2023	Male	Female			
Austria	14	NA***	14	10	4	10–64	April 2023 ^a	One case with travel history to Hungary. 13/14 cases reported consumption of chicken. 5/13 cases reported consumption of chicken kebabs.
Denmark	7	1	7	4	3	9–60	May 2023 ^b	None of the cases reported travel. Six of the seven cases reported consumption of chicken.
France	33	NA	33	19	14	2–83	August 2023 ^d	16 isolates belong to HC2_252074 and all 33 to HC5_1358 (Enterobase).
Germany	8	2	6	7	1	9–58	June 2023 ^a	Five cases with no travel outside Germany.
Ireland	1	0	1	1	0	45–64	July 2023 ^a	Travel history to Spain.
Luxembourg	1	NA	1	1	0	<10	August 2023	No travel history. Case reported consumption of chicken.
Netherlands	2	NA	2	2	0	20–40	April 2023	
Norway	1	1	0	Unk	Unk	<5	2022	
Poland****	4	4	NA	3	1	2–66	2022	All cases were hospitalised.
Total EU/EEA	71	8	64	47	23			
United Kingdom	27	14	13	16	11	3–78		Four cases with travel history to Poland. Three cases with travel history to Hungary (all in 2023). 7/8 cases reported consumption of chicken. 3/8 cases reported consumption of eggs.
Total	98	22	77	63	34			

*Male-to-female ratio = 1.9:1

**Month of the most recent case: a = disease onset, b = sampling, c = receipt to reference laboratory, d = isolation

***NA = Not applicable

****Isolates were tested in the course of a research project.

Information from patient interviews

Cluster 1

In **Austria**, the case who died had eaten a chicken kebab in a restaurant.

In **Denmark**, the case reported consumption of chicken prior to disease onset, but did not travel.

In **Germany**, five out of 12 cases were interviewed.

- Two brothers visited a doner restaurant and ate a chicken kebab before becoming ill. The brothers' parents, who did not visit the doner restaurant, stayed healthy. Most other meals were shared between the brothers and the parents.
- Another patient does not eat any pork. Before symptom onset, he ate egg rice with chicken in an Asian restaurant with his friend, who ate egg rice without chicken and did not become ill.
- One teenage girl ate pancake dough containing raw eggs before the disease onset. She reported also eating chicken but could not remember any details regarding chicken consumption before disease onset.

- Other food items mentioned often were:
 - Meals containing eggs: 5/5
 - Salami (without pork): 4/5
 - Minced meat (beef); cooked: 3/5
 - Minced meat (mixed pork and beef); cooked: 3/5

In **Sweden**, one case reported consumption of a kebab roll in Poland but could not remember if it was chicken kebab or not.

Cluster 2

In **Austria**, two of the five interviewed cases reported eating chicken kebabs shortly before the onset of symptoms. Two cases reported eating other chicken dishes (chicken burrito and chicken schnitzel). One case ate the chicken schnitzel while travelling in the Czechia.

In **Denmark**, sixteen out of the 23 cases reported consumption of kebab/pizzas with chicken as a likely ingredient.

In **Germany**, the patient could not be interviewed.

In **Italy**, two cases reported consumption of chicken meat and one of these cases consumed chicken kebab.

In **Sweden**, one case reported consumption of chicken kebab.

In **the United States**, the case had travelled to Spain and reported consumption of chicken during the travel.

Cluster 3

In **Austria**, thirteen out of the 14 interviewed cases reported consumption of chicken and five out of the 13 cases reported consumption of chicken kebab.

In **Denmark**, six out of the seven cases reported consumption of chicken.

In **Germany**, three of eight cases were interviewed.

- Two out of three visited a doner restaurant before disease onset: one of these did not really remember which doner restaurant and the other was a boy who visited a pizza/doner restaurant, where he shared one chicken kebab with two friends. All three children became ill afterwards. This was the only common meal between the three children (they go to different schools).
- Other food items which were often mentioned were:
 - Meals containing eggs: 3/3
 - Minced meat (beef), cooked: 2/3
 - Raw pork sausage (Zwiebelmettwurst): 2/3
 - Cooked ham: 2/3
 - Salami: 2/3
 - Poultry cold cuts: 2/3
 - Own a dog: 2/3

In **Luxembourg**, the case reported consumption of chicken.

In **the United Kingdom**, seven out of eight interviewed cases reported consumption of chicken and three out of eight reported consumption of eggs.

Microbiological and environmental investigations of food and control measures

Cluster 1

Epi-Pulse event 2023-FWD-00048, RASFF notifications 2023.5055, 2023.6079, 2023.6418, 2023.4360.

Product A

The following section refers to the *Salmonella*-positive kebab product (Product A Batch A) epidemiologically and microbiologically linked to the Epi-Pulse event 2023-FWD-00048 and reported in the RASFF notification 2023.5055 (22 EC validated follow up-*fup*, as of 3 October 2023). A visual representation is provided in Figure 1. This section also briefly describes additional meat producers that were identified in the frame of the outbreak investigations in Austria.

Austria

On 20 July 2023, the food safety authority in Austria reported the detection of two *Salmonella* Enteritidis ST 11 strains matching the representative outbreak strains (cluster 1 and cluster 2) in a frozen chicken kebab product (Product A belonging to Batch A) (RASFF 2023.5055, *fup4*). The official food sample was taken in July in the restaurant (Austrian Restaurant A) visited by the Austrian case who died (2023.5055, *fup7*). An additional official sample from the environment (cleaning cloth) was also collected at the restaurant and revealed the presence of *Salmonella* Enteritidis ST 11 (cluster 2) (2023.5055, *fup7*).

Product A of Batch A was manufactured by the Polish Producer A and was distributed to the Austrian Restaurant A via the Slovenian Wholesaler A (2023.5055, *fup1*) (Figure 1).

Within the national outbreak investigation, the food safety authority in Austria identified additional chicken meat producers other than those traced for Product A and with trading business in Austria (2023.5055, *fup13*). The producers (Table 2) were in Czechia (three producers), Hungary (two), Germany (one), and Poland (two) and were identified for their commercial link in Austria during the period of the investigation. There was no *Salmonella* testing information available in RASFF regarding these additional producers (Table 2).

Slovenia

The Slovenian Wholesaler A received Product A of Batch A on 18 June 2023 (2023.5055, *fup5*) from the Polish Producer A and distributed the goods further to food business operators in Austria (four other recipients), in Croatia (21 recipients), in Hungary (seven recipients), in Italy (one recipient), and within Slovenia (37 recipients) (2023.5055, *fup1*) (Figure 1).

Poland

Following the positive microbiological analytical findings in Austria from Product A Batch A, the food safety authority in Poland reported on traceback information of the contaminated product and the outcome of the controls performed via RASFF (2023.5055, *fup6*).

Product A was produced in June 2023 starting from Meat A (supplied by the Polish Producer B), Meat B (supplied by the Polish Producer C), and Meat C (supplied by the Polish Producer D) (2023.5055, *fup10*). The Polish Producer B sourced meat from Ukraine, the Polish Producer C and the Polish Producer D sourced meat from Poland (2023.5055, *fup10*).

On 4 August 2023, the food authority in Poland reported that the official control performed at the plant of the Polish Producer A did not reveal non-compliance (RASFF 2023.5055, *fup6*). In addition, the Polish Producer A sampled products from other three batches produced in June 2023 and sampled the environment (water/ice samples from June and July) (results of the analysis not available in RASFF 2023.5055, *fup6*).

As part of the control measures taken, the Polish Producer A reported to the Slovenian Wholesaler A about the *Salmonella* detection, reclassified the remaining goods from Batch A as a category 2 by-product, increased the frequency of microbiological testing, and planned additional employee training (RASFF 2023.5055, *fup6*).

To support the investigations in Austria, the food safety authority in Poland shared in RASFF the list of the additional suppliers of the Polish Producer A (2023.5055, *fup10*) other than those traced back from Product A. This list included food business operators from Hungary and Poland (Table 1).

The Polish food safety authority also provided information on the operators mentioned among the additional producers with trading business in Austria. Regarding the Polish Producer M and the Polish Producer N (2023.5055, *fup13*), the food safety authority made the list of their meat suppliers (2023.5055, *fup16*) available in RASFF. Moreover, the outcome of some official controls performed at the Polish Producer M was also shared in RASFF. Samples taken in June 2023 from a batch of poultry kebab (Product L Batch J) did not reveal *Salmonella* detection).

In addition, environmental samples collected in July 2023 at the plant tested *Salmonella*-negative (2023.5055, *fup16*).

Upon request of the food safety authority in France, the food safety authority in Poland also shared in RASFF the list of meat batches (and their origin) used by the Polish Producer A to produce batches of poultry kebabs delivered (July and August 2023) to the French Wholesaler D (2023.5055, *fup10*).

Croatia

The food safety authority in Croatia performed official controls at the food business operators (2023.5055, *fup1*) that received Product A of Batch A from the Slovenian Wholesaler A and shared in RASFF (2023.5055, *fup9*) the outcome of the inspections. Some of the controlled food business operators did not receive such products. For others, the products had already been consumed or returned to the Slovenian Wholesaler A.

Italy

The food safety authority in Italy reported in RASFF (2023.5055, *fup3*) that Product A labelled with a different batch from Batch A was found at the warehouse of the Italian food business operator mentioned among the recipients of the Slovenian Wholesaler A.

Hungary

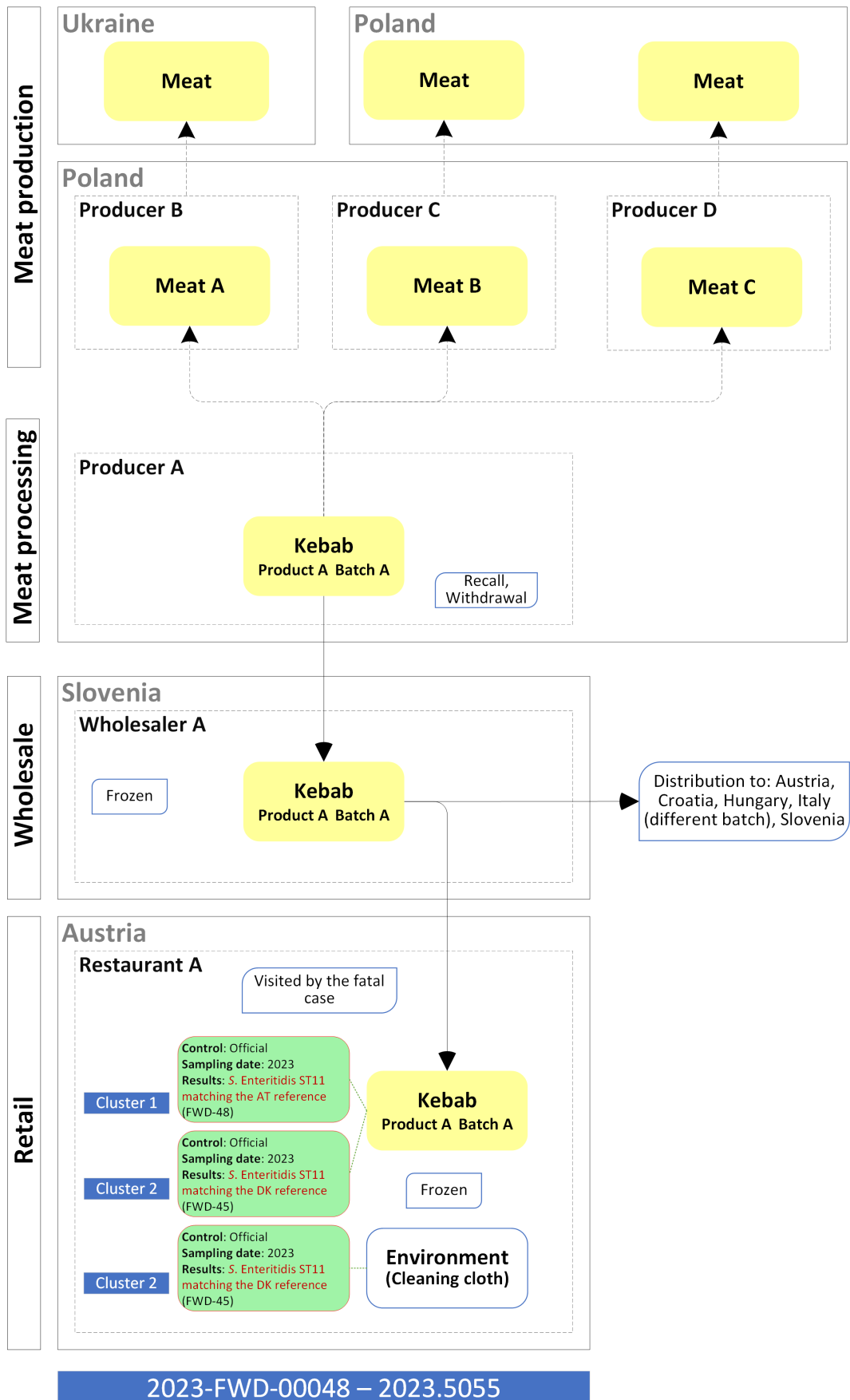
On 26 September 2023, the food safety authority reported in RASFF that Hungarian recipients of Product A (2023.5055, *fup20*) via the Slovenian Wholesaler A had been alerted about the positive microbiological finding. However, according to investigations (2023.5055, *fup20*), the Hungarian recipients had received either batches different from Batch A, or no products at all (June–July 2023).

On 1 September 2023, the food safety authority in Hungary reported information on the operators mentioned among the additional producers with trading business in Austria. In particular, the Hungarian Producer T and the Producer U had not sourced chicken meat from Poland since 1 June (2023.5055, *fup15*).

Czechia

On 25 August 2023, the food authority in Czechia provided information on the operators mentioned among the additional producers with trading business in Austria. It notified in RASFF that the Czech Producer O received chicken meat from the Polish Producer P and the Czech Producer Q received meat from the Polish Producer R in the last 12 months. Conversely, the Czech Producer S had not received poultry meat from Poland in the last 12 months (2023.5055, *fup14*).

Figure 1. Graphical representation of traceability and microbiological analysis of the *Salmonella*-positive food (kebab Product A), as reported by the countries involved under RASFF notification 2023.5055 (as of 3 October 2023, *fup22*)



Product H

The following section refers to the *Salmonella*-positive chicken-turkey kebab product (Product H Batch G) microbiologically linked to the Epi-Pulse event 2023-FWD-00048 and reported in the RASFF notification 2023.6079 (12 EC validated *fup* as of 02 October 2023). A visual representation is provided in Figure 2.

Austria

On 6 September 2023 the food safety authority in Austria notified the detection of *Salmonella* Enteritidis ST 11 strains matching the representative outbreak strains (cluster 1) (2023.6079, *fup9*) in one frozen chicken-turkey kebab product (Product H Batch G). The official food samples were taken in August 2023 as part of an increased sampling performed by the authority at the restaurant level.

Product H Batch G was sampled at the Austrian Restaurant F. The product tested positive for *S. Enteritidis* (i.e., *S. Enteritidis* CT13755 cluster 1 outbreak strain and *S. Enteritidis* CT1483), *S. Virchow*, and *S. Rauform* (2023.6079, *fup12*).

Additional kebab products sampled also tested positive for *Salmonella*. Specifically, Product H Batch H sampled at the Austrian Restaurant H (2023.6079, *fup5*) tested positive for *S. Infantis*. Product H Batch I was sampled at the Austrian Restaurant G in August 2023 and tested positive for *S. Enteritidis* CT1483 and *S. Infantis* (2023.6079, *fup11*).

Product H Batch G, Product H Batch H, and Product H Batch I were manufactured by the Polish Producer C and were distributed in Austria by the German Wholesaler G.

Germany

On 8 September 2023 the food safety authority in Germany reported in RASFF (2023.6079, *fup2*, *fup7*, *fup10*) that the German Wholesaler G purchased the kebab products from the Polish Producer C and that, as part of the preventive measures taken, the German Wholesaler G voluntarily withdrew the products (2023.6079, *fup2*, *fup7*).

Poland

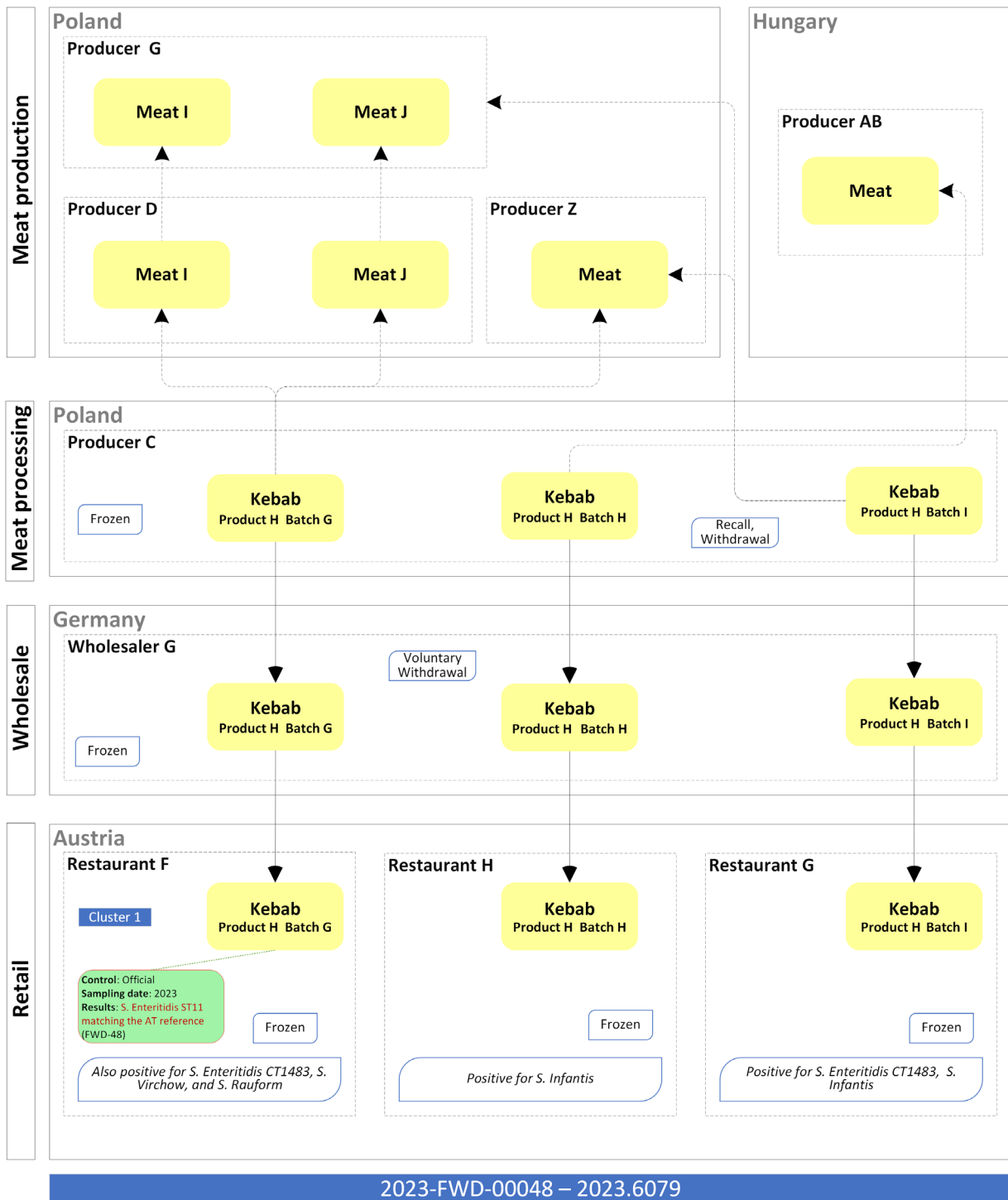
On 11 September 2023, following the positive microbiological findings in Austria from Product H Batch G, the food safety authority reported in RASFF (2023.6079, *fup3*) that the products had been delivered to the German Wholesaler G in August 2023.

Product H Batch G was produced by the Polish Producer C starting from chicken meat (Meat I and Meat J) supplied by the Polish Producer D and sourced by the Polish Producer G (2023.6079, *fup4*). In addition, meat (batch not available in RASFF 2023.6079, *fup6*) from the Polish Producer Z was used to produce Product H Batch G.

Product H Batch H and Product H Batch I were produced by the Polish Producer C starting from chicken meat supplied by the Hungarian Producer AB (2023.6079, *fup14*) and from the Polish Producer Z and the Polish Producer G, respectively.

As part of the control measures taken, the Polish Producer C withdrew the remaining products from the batch (Batch G) not yet sold. The food safety authority in Poland performed an official control at the plant of the Polish Producer C and recommended further investigation to identify the origin of the possible *Salmonella* contamination, including the re-evaluation of the internal food safety procedures. An official sample (poultry meat after cutting Meat L) was collected at the plant (2023.6079, *fup3*) and returned a *Salmonella*-negative result (2023.6079, *fup8*). The food safety authority in Poland also performed an inspection at the Polish Producer Z and reported that (2023.6079, *fup6*) the results of the microbiological tests of skins and meat did not show non-compliant results (checked period 20.06.2023 to 28.07.2023).

Figure 2. Graphical representation of traceability and microbiological analysis of the *Salmonella*-positive food (kebab Product H), as reported by the countries involved under RASFF notification 2023.6079 (as of 2 October 2023, *fup12*)



Product G

The following section refers to the *Salmonella*-positive kebab product (Product G Batch F) that is microbiologically linked to in the Epi-Pulse event 2023-FWD-00048 and reported in the RASFF notification 2023.6418 (4 EC validated *fup* as of 29 September 2023). A visual representation is provided in Figure 3.

Austria

On 21 September 2023 the food safety authority in Austria reported the detection of *Salmonella* Enteritidis ST 11 strains matching the representative outbreak strains (cluster 1) (2023.6418, *fup3*) in a frozen chicken kebab product (Product G Batch F). The official sample was taken in August 2023 at the Austrian Restaurant E as part of increased sampling performed by the authority. The sample was collected in the preparation phase, a few minutes before the skewer, was placed on the grill (2023.6418).

Product G Batch F was manufactured by the Polish Producer AN and further distributed to the Austrian Wholesaler F (2023.6418).

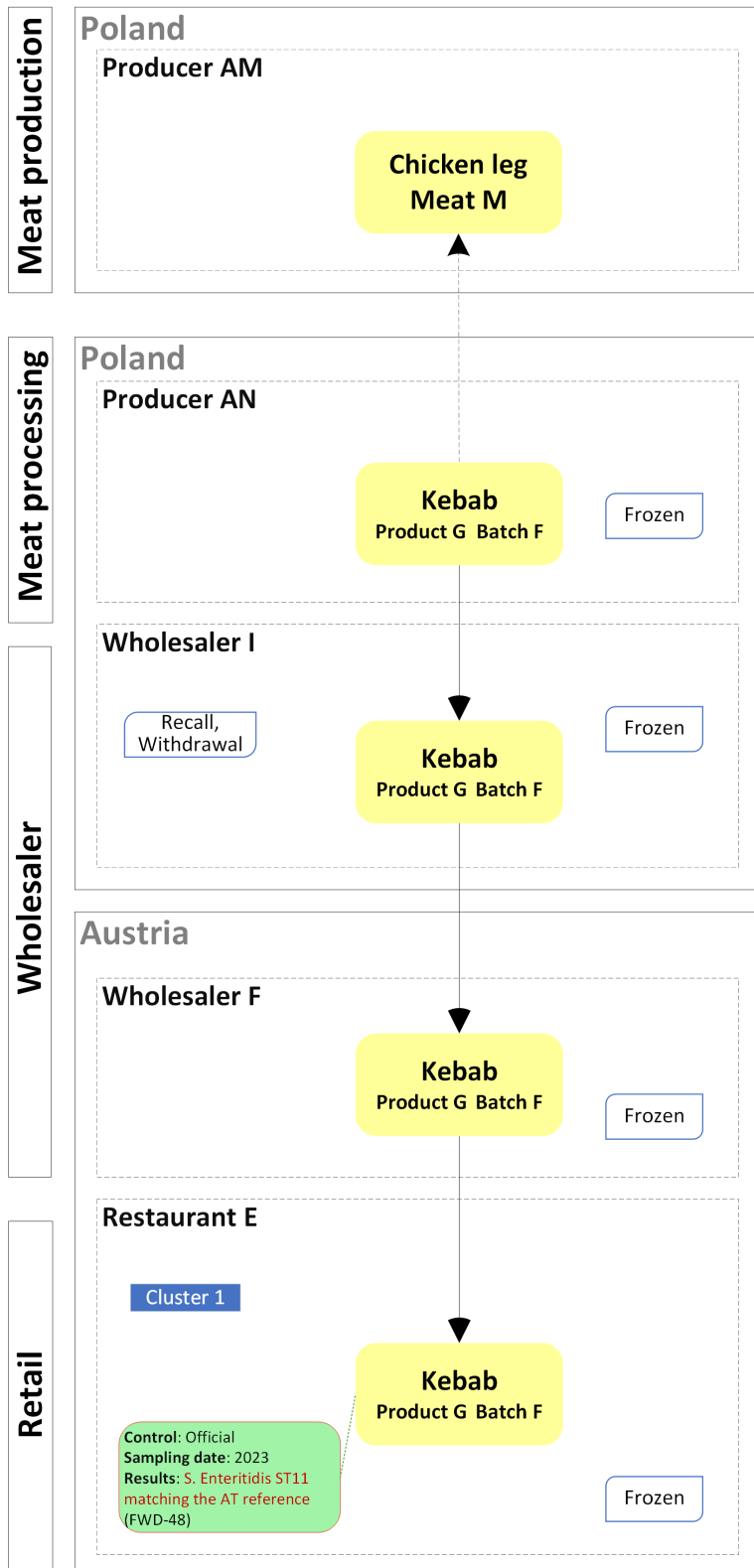
Poland

Following the positive microbiological findings in Austria from Product G Batch F, the food safety authority in Poland reported in RASFF (2023.6418) about the traceback information of the contaminated product and the outcome of the controls performed.

Product G Batch F was produced in July 2023 by the Polish Producer AN starting with chicken leg meat (Meat M) supplied by the Polish Producer AM which sold the entire amount to the Polish Wholesaler I. In July 2023, the Polish Wholesaler I delivered the entire batch to the Austrian Wholesaler F (2023.6418, *fup4*).

As part of the control measures taken, the Polish Wholesaler I recalled the remaining kebab products from Batch F and sent them for destruction.

Figure 3. Graphical representation of traceability and microbiological analysis of the *Salmonella*-positive food (kebab Product G), as reported by the countries involved under RASFF notification 2023.6418 (as of 29 September 2023, *fup4*)



2023-FWD-00048 – 2023.6418

Product I

The following section refers to *Salmonella*-positive chicken wings (Product I Batch K) microbiologically linked to the Epi-Pulse event 2023-FWD-00048 and reported in the RASFF notification 2023.4360 (15 EC validated *fup* as of 9 October 2023). A visual representation is provided in Figure 4.

Bulgaria

On 28 June 2023, the food safety authority in Bulgaria reported the detection of *Salmonella* Enteritidis ST 11 matching the representative outbreak strain (cluster 1) in frozen chicken wings (Product I Batch K). *Salmonella* Enteritidis ST 11 matching the representative outbreak strain (cluster 1) was isolated in Bulgaria but subsequently sequenced in Austria (RASFF 2023.4360, *fup13*, *fup14*).

The sampled product was part of an official control performed by the food safety authority at the Bulgarian Wholesaler H. During the inspection, batches of chicken wings other than Batch K were sampled and reported in RASFF (2023.4360) to be positive for *Salmonella* serovars (*S. Enteritidis* CT1483, *S. Infantis*, and *S. Kottbus*).

The sampled batches, including Product I Batch K were produced by the Polish Producer AJ.

Poland

Following the detection of different *Salmonella* serovars from the batches reported in RASFF 2023.4360, the food safety authority in Poland performed an official control at the Polish Producer AJ and reported to have recommended the producer to implement corrective actions (improving the labelling system, the internal control of the production process, cleaning, and disinfection procedures). The food authority also reported that, according to the own check laboratory results, *Salmonella* was not detected in the reported batches including Batch K (RASFF 2023.4360, *fup5*).

On 18 July 2023, the food safety authority in Poland reported that chicken wings Product I Batch K had been sold in April 2023 to a recipient in Czechia (Retailer A) (RASFF 2023.4360, *fup6*). In addition, the food authority in Poland reported that chicken meat (frozen chicken thigh meat boneless skinless) (different from Product I Batch K) originating from the Polish Producer AJ had been also delivered to other recipients in Czechia and in Estonia (via a Polish trader) (RASFF 2023.4360, *fup8*).

On 20 July 2023, the food safety authority in Poland reported that chicken meat (chicken wings Meat K) testing positive for *S. Infantis* (2023.4360, *fup2*) from the Polish Producer AJ had been used by the Polish Producer AO to produce the frozen chicken kebab Product J Batch L which was subsequently sold in Austria (Austrian Restaurant I) (RASFF 2023.4360, *fup7*, *fup15*).

Czechia

On 24 July 2023, the food safety authority in Czechia reported in RASFF (2023.4360, *fup9*) that the chicken meat from the Polish Producer AJ had been purchased by the Czech Producer Q to produce chicken kebab products intended to be sold in Germany (RASFF 2023.4360, *fup9*). Following the *Salmonella* serovars positive findings, the Czech Producer Q implemented control measures (withdrawal and recalls).

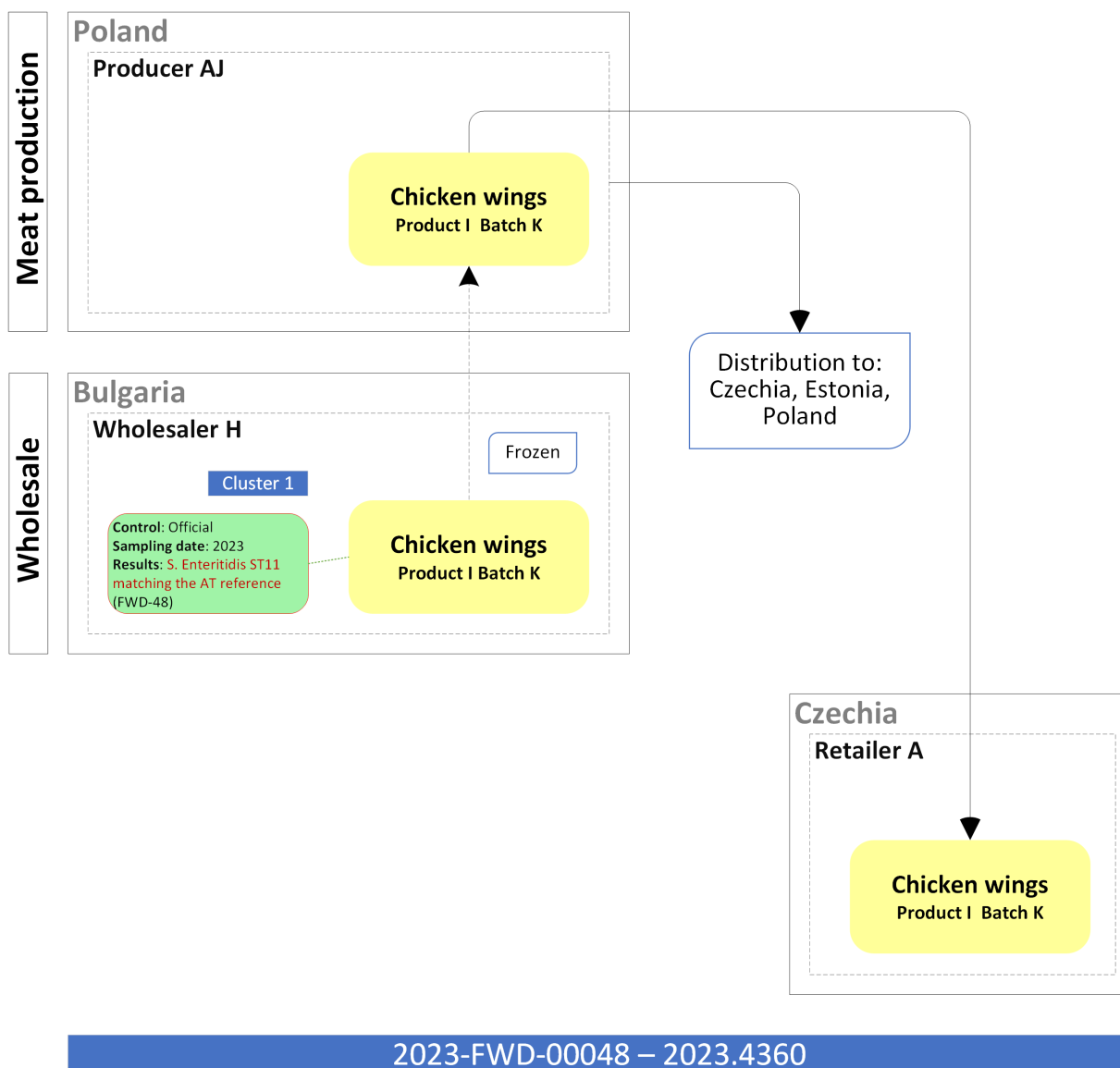
Estonia

On 18 August the food safety authority in Estonia reported that the recipients of the chicken meat from Polish Producer AJ had been alerted and that products were no longer available (RASFF 2023.4360, *fup12*).

Germany

On 27 July 2023, the food safety authority in Germany reported in RASFF to have informed the German recipients about the *Salmonella* serovar positive findings from the chicken kebab products produced by the Czech Producer Q (2023.4360, *fup10*).

Figure 4. Graphical representation of traceability and microbiological analysis of the *Salmonella*-positive chicken meat (chicken wings Product I Batch K), as reported by the countries involved under RASFF notification 2023.4360 (as of 9 October 2023, *fup15*)



Cluster 2

Epi-Pulse event 2023-FWD-00045, RASFF notifications 2023.5788 and 2020.2978.

Product B

The following section refers to the *Salmonella*-positive kebab product (Product B Batch B) microbiologically linked to the Epi-Pulse event 2023-FWD-00045 and reported to the RASFF notification 2023.5788 (10 EC validated follow up, as of 6 October 2023). A visual representation is provided in Figure 5.

Denmark

On 25 August 2023, the food safety authority in Denmark reported the detection of *Salmonella* Enteritidis ST 11 matching the representative outbreak strain (cluster 2) in a frozen pre-roasted kebab product (Product B belonging to Batch B) (RASFF 2023.5788, RASFF 2023.5788, *fup1*). The official food sample was taken in August 2023 at the Wholesaler B that wholesaled Product B from the Danish Wholesaler E. Product B Batch B was produced by the Polish Producer F.

Poland

Following the positive findings in Denmark from Product B Batch B, the food safety authority in Poland reported in RASFF on the traceback information of the contaminated product and the outcome of the controls performed on 29 August 2023 (RASFF 2023.5788, *fup2*).

Product B Batch B was produced in June 2023 by the Polish Producer F from a semi-finished product (Product F) (2023.5788, *fup2*) deriving from Meat D (fresh chicken without giblets) supplied by the Polish Producer G. Meat D was obtained from broilers originating from Farm A in Poland and slaughtered in June 2023 at the Abattoir A that is owned by the Polish Producer G (2023.5788, *fup6*).

Product B Batch B was further sold to the Danish Wholesaler E (2023.5788, *fup2*).

The official control performed at the Polish Producer F did not reveal non-compliance for *Salmonella* (2023.5788, *fup5-fup6*). In addition, on 1 September 2023, an official sample from Product B Batch B (product stored in the warehouse) and from the environment (swabs near the production site) were collected at the plant. *Salmonella* was not detected in the samples (2023.5788, *fup7*).

As part of the control measures implemented, the Polish Producer F suspended the supplies from the Polish Producer G and carried out the cleaning and the disinfection of its own plant (2023.5788, *fup5*).

Italy

On 22 September 2023, following the food exposure information from the Italian cases in 2023 which indicated consumption of chicken meat, hamburger, and kebab, the food safety authority in Italy reported in RASFF (2023.5788, *fup8*) that traceback investigation were initiated to identify the food vehicles.

On 29 September 2023, the food safety authority reported on the traceback investigation of a chicken kebab product consumed by one Italian case (chicken-turkey Kebab Product K Batch M) and about an official control performed at the Italian Producer AP. The official control revealed that the Italian Producer AP had received chicken turkey kebab products including Product K Batch M (2023.5788, *fup9*) from the Polish Producer AQ with raw materials from Polish meat suppliers (including the Polish Producer G, the Polish Producer Y, and the Producer AA). During the official control, a batch of Product K different from Batch M was collected. The sample tested *Salmonella* negative (2023.5788, *fup10*).

Product C

The following section refers to the *Salmonella*-positive chicken breast fillet (Product C Batch C) involved in the Epi-Pulse event 2023-FWD-00045 and linked to the RASFF notification 2020.2978 (6 EC validated follow up, as of 18 September 2020). A visual representation is provided in Figure 5.

Denmark

On 21 July 2020 the food safety authority in Denmark reported the detection of *Salmonella* Enteritidis ST 11 matching the representative outbreak strain (cluster 2) in a frozen chicken breast fillet (Product C Batch C) (RASFF 2020.2978). The official sample was taken in June 2020 at the Danish Producer H. Product C Batch C was produced by the Polish Producer F.

Poland

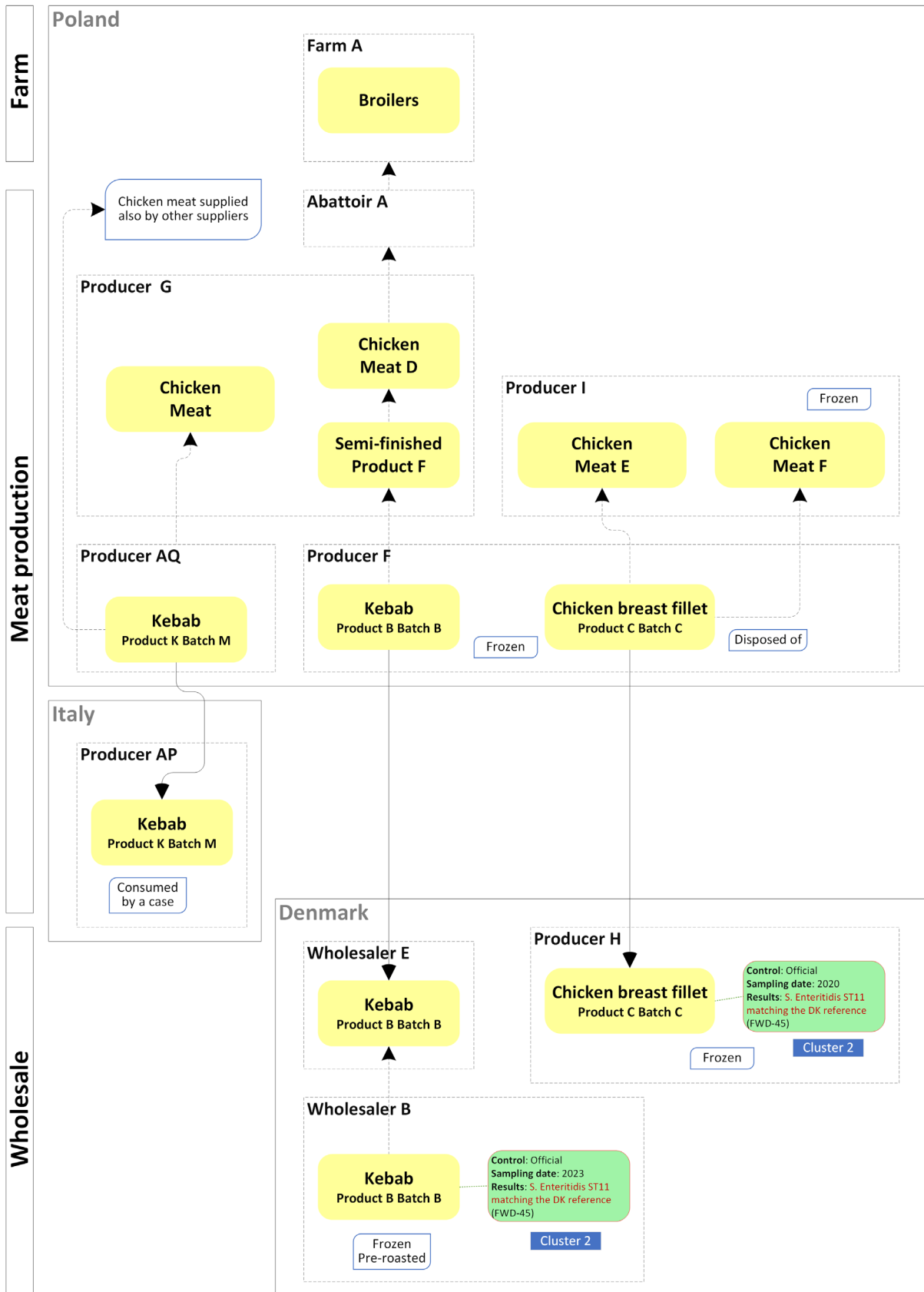
Following the positive findings in Denmark from Product C Batch C, the food safety authority in Poland reported in RASFF about the traceback information of the contaminated product and the outcome of the controls performed (2020.2978, *fup1*).

Product C Batch C was produced in January 2020 by the Polish Producer F from Meat E and Meat F supplied frozen by the Polish Producer I (2020.2978, *fup1-fup3*). Meat E and Meat F were accompanied by certificates showing that *Salmonella* was not found (2020.2978, *fup3*).

Product C Batch C was exclusively sold (frozen) in March 2020 to the Danish Producer H (2020.2978, *fup1*).

As part of the control measures implemented, in July 2020, the Polish Producer F blocked and disposed of the remaining products in stock from Batch C.

Figure 5. Graphical representation of traceability and microbiological analysis of the *Salmonella*-positive food (kebab Product B and chicken breast fillet Product C), as reported by the countries involved under RASFF notifications 2023.5788 and 2020.2978 (as of 6 October 2023 *fup10*, as of 18 September 2020, *fup6*)



2023-FWD-00045 – 2023.5788

2023-FWD-00045 – 2020.2978

Cluster 3

Epi-Pulse event 2023-FWD-00031, RASFF notifications 2023.5104.

Product D, and Product E

The following section refers to suspected chicken kebab products (Product D Batch D, Product D Batch E, and Product E) epidemiologically linked to the Epi-Pulse event 2023-FWD-00031 and reported to the RASFF notification 2023.5104 (10 EC validated follow up, as of 11 September 2023). A visual representation is provided in Figure 6.

Austria

On 27 July 2023 the food safety authority in Austria reported on the outcome of national investigations performed in the frame of an outbreak of infections caused by *Salmonella* Enteritidis ST11 cluster 3 (RASFF 2023.5104).

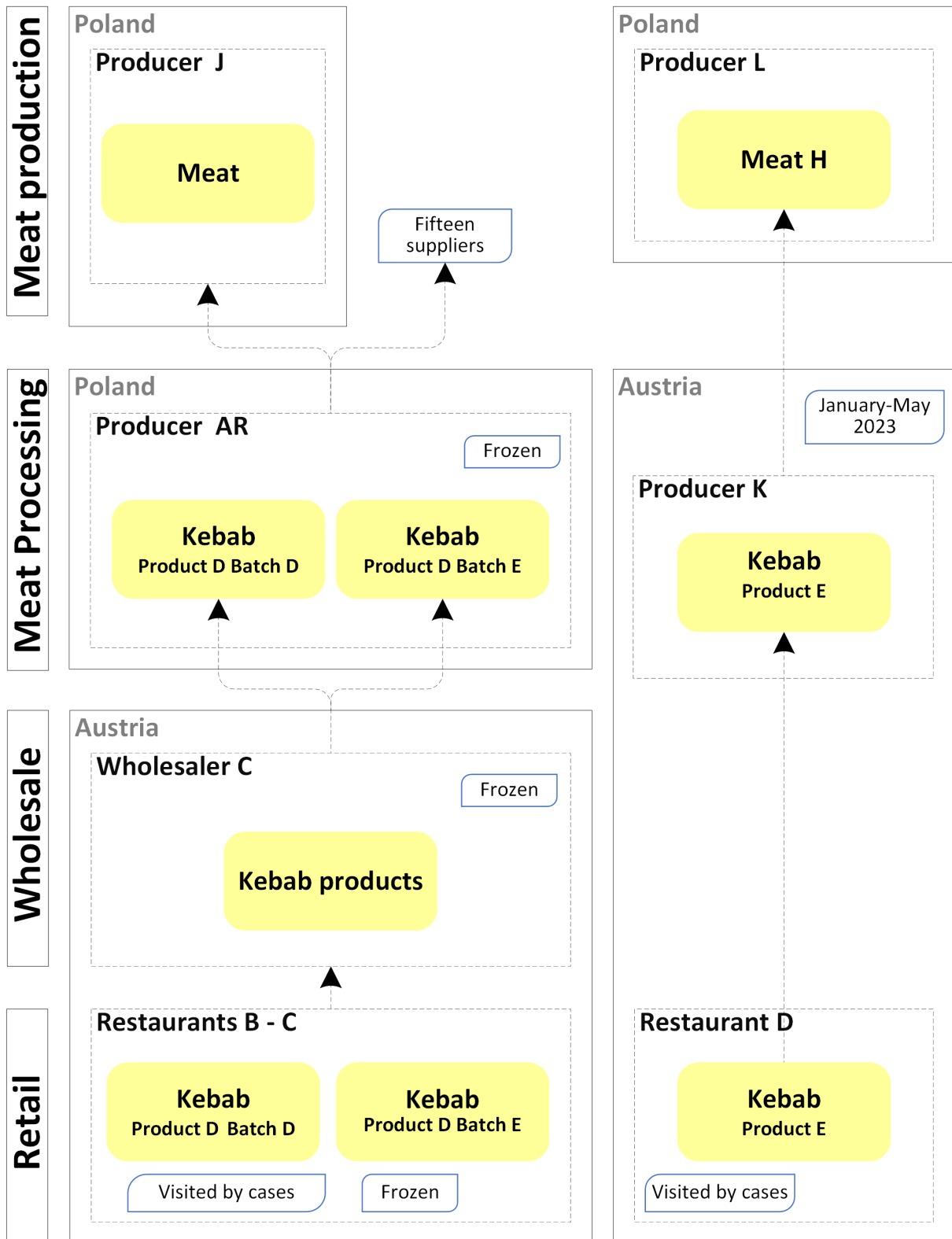
Traceback information on suspected frozen chicken kebab products (Product D Batch D, Product D Batch E, and Product E) available at the restaurants (Restaurants B, C, and D) visited by the cases (in cluster 3) were shared in RASFF. However, microbiological information on the three batches was not available in RASFF (RASFF 2023.5104).

Product D Batch D and Product D Batch E, originated from the Polish Producer AR with meat supplied by sixteen meat suppliers, including the Polish Producer J and were distributed in Austria via the Austrian Wholesaler C. Product E was produced by the Austrian Producer K starting with meat originating from the Polish Producer L (Meat H).

Poland

To support further investigation, the food safety authority in Poland performed some controls at the involved food business operators and reported in RASFF (2023.5104, *fup3*) that the Polish Producer J had no trading business (from January to May 2023) with the supplier of meat involved in the traceability of Product E, namely the Polish Producer L (Figure 3). In addition, the Polish Producer L did not reveal non-compliances with regards to the testing for *Salmonella* (2023.5104, *fup7-fup10*).

Figure 6. Graphical representation of traceability of suspected chicken kebab products (Product D and Product E), as reported by the countries involved under RASFF notifications 2023.5104 (as of 11 September 2023, *fup10*)



2023-FWD-00031 – 2023.5104

European whole genome sequencing analysis of human and non-human isolates

The whole genome sequencing (WGS) data for representative isolates from humans were shared by countries in EpiPulse either as attached FASTA files, uploaded to the ECDC WGS database or as referrals to accession numbers to public repositories. In addition, human isolate sequences within five allelic distances from the representative outbreak sequences identified from public repositories were imported to the ECDC *Salmonella* database. The database also includes sequence data from historical events, where specifically, sequences from events UI-656, UI-584 and UI-421 (according to the event codes in the EPIS platform preceding EpiPulse) cluster within the present event. The largest selection of sequences belongs to the EpiPulse event associated to cluster 2. The human sequences were analysed by ECDC using BioNumerics version 7.6.3 (Applied-Maths, Sint-Martens-Latem, Belgium), which included raw sequence trimming using the default settings; de novo assembly including mismatch correction using SPAdes v.3.7.1. Allele calling was performed on assemblies using the Enterobase core genome scheme and isolates were excluded from further analysis if less than 2702 (90%) of the 3002 core loci were detected.

For cross-sectoral analysis, the cgMLST analysis was performed by both ECDC and EFSA, as previously described [9]. Briefly, genome cgMLST profiles composed of 3255 loci were calculated from assembled genomes using chewBBACA version 2.8.5 (<https://hub.docker.com/layers/ummidock/chewbbaca/tags;https://github.com/B-UMMI/chewBBACA>), according to the schema described by Rossi et al. 2018 [10] for *Salmonella enterica*, made available by the Chewie Nomenclature Server (ChewieNS) [11]. Profiles included in the analysis described below have no more than 5% of missing loci.

EFSA launched calls for data, inviting all EU/EEA Member States to submit genomic information to the EFSA One Health WGS System regarding *S. Enteritidis* ST 11 Cluster 1, Cluster 2, Cluster 3 food isolates collected between 2022 and 2023, focusing on isolates collected from poultry and poultry meat.

By 13 October 2023, a total of 258 profiles of *S. Enteritidis* ST 11 non-human isolates had been successfully shared in the EFSA One Health WGS system by 14 countries: Austria (7), Belgium (16), Czechia (1), Denmark (48), Estonia (1), Finland (1), Germany (83), Italy (37), Latvia (1), the Netherlands (6), Norway (1), Poland (17), Spain (37), and Sweden (2). Additionally, 200 profiles of *S. Enteritidis* ST 11 non-human isolates were generated from sequences retrieved from the European Nucleotide Archive (ENA). Epidemiological data were available for 90% of the 258 shared profiles, corresponding to 229 unique samples, 148 of which were collected in 2022 and 2023.

During the sampling period ranging between 2022 and 2023, 10 samples were collected from 'Composite dishes', 73 from 'Mammals and birds meat and products thereof' (mainly chicken), 63 from 'Non-food matrices' of animal origin (mainly poultry), one from feed and one from the environment. Among the 'Composite dishes' samples, six were related to chicken kebab collected either in Austria (5) or Denmark (1) in 2023.

ECDC queried the EFSA One Health WGS System on 13 October 2023, using one reference genome of *S. Enteritidis* ST 11 isolated from a human for Cluster 1, six reference genomes for Cluster 2 and five reference genomes for Cluster 3. As result of the queries, out of 458 profiles of *S. Enteritidis* ST 11 non-human isolates, nine profiles have been found to belong to Cluster 1 (i.e. AD 5 by single linkage cluster), 30 to Cluster 2 and five to Cluster 3. Below are descriptions for each cluster of the non-human profiles of *S. Enteritidis* ST 11 isolates matching the outbreak strains shared by EU/EEA countries.

Cluster 1 comprises three profiles from samples of chicken kebab originating from Poland and collected in 2023 in Austria (Product A Batch A, RASFF 2023.5055; Product G Batch F, RASFF 2023.6418; Product H Batch G, RASFF 2023.6079), one profile from a sample of poultry meat collected in Germany in 2023, one profile from chicken wings sample collected in Bulgaria in 2023 (RASFF 2023.4360) and an additional two profiles from samples collected in 2022 in Germany comprising boneless chicken drumsticks originating from Poland and chicken breast fillet originating from Germany. In addition, two profiles were shared by Belgium but epidemiological data were not available (Table 5).

Cluster 2 comprises profiles from samples collected in 2023 including: two samples of chicken kebab originating from Poland and collected in Austria (Product A Batch A, RASFF 2023.5055) and Denmark (Product B Batch B, RASFF 2023.5788), one sample of boneless chicken legs collected and originating from Germany, two samples of neck skin from broiler carcasses collected and originating from Spain, and one environment cleaning cloth matrix collected in Austria (RASFF 2023.5055). The cluster includes two samples collected in 2022: one chicken meat sample collected in Germany and one poultry preparation collected in Spain but originating from Germany. The cluster also comprises of four profiles from a chicken breast fillet sample originating from Poland and collected in Denmark in 2020 (Product C Batch C, RASFF 2020.2978), three profiles from poultry meat samples collected in Germany in 2020, one sample of frozen chicken product collected in Czechia (RASFF 2020.3237) and originating from Poland. In addition, the cluster includes eight profiles linked to samples collected in Germany in 2019 including: laying hens farm samples, and samples of chicken meat and sausage. The remaining six profiles originated from ENA without epidemiological data (Table 5).

Finally, Cluster 3 includes one profile from a chicken fresh meat sample collected in 2023 in Germany and one from mechanically separated poultry meat originated from Poland and collected in Italy in 2022 (RASFF 2022.1691). In addition, the cluster includes two profiles from cattle samples collected in Germany in 2020. One profile from a food sample from 2022 was retrieved from ENA without epidemiological data (Table 5).

Table 5. Summary of human and non-human isolates of *S. Enteritidis* ST11 in the centralised cross-sectoral analysis of sequences by cluster, as of 17 October 2023

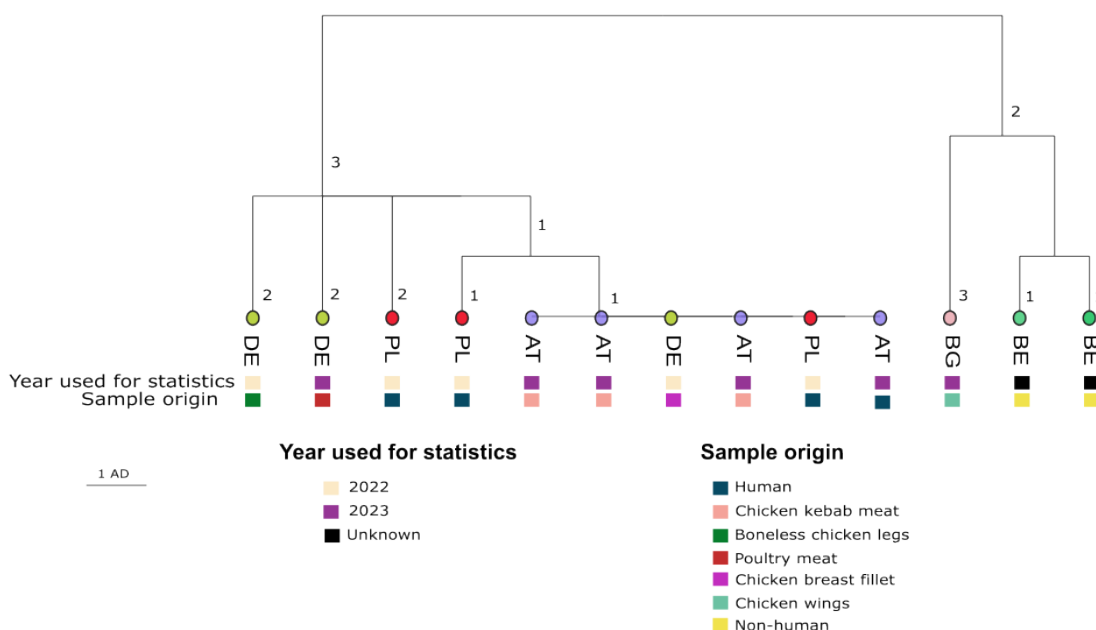
Human isolates in the OH cluster*			Non-human isolates in the OH cluster
Cluster (No of human isolates)	Year range of isolates	Country (No of isolates)	
Cluster 1 (n = 4)	2022 - 2023	AT (1) PL (3)	Nine isolates from: Three isolates from chicken kebab in AT in 2023, originating from PL (Product A, G and H). One isolate from poultry meat in DE in 2023. One isolate from chicken wings in BG in 2023. One isolate from chicken breast fillet in DE in 2022, originating from DE. One isolate from boneless chicken legs in DE in 2022, originating from PL. Two isolates from BE without epidemiological data.
Cluster 2 (n = 266)	2012 - 2023	AT (1) BE (4) DE (2) DK (2) IE (8) IT (2) LU (1) NL (15) NO (5) PL (49) PT (1) SE (1) UK (173) US (2)	30 isolates from: One isolate from a chicken kebab in AT in 2023, originating from PL (Product A). One isolate from a kebab product in DK in 2023, originating from PL (Product B). One isolate from a cleaning cloth in AT in 2023. One isolate from boneless chicken legs in DE in 2023, originating from DE. Two broiler carcass neck skin samples in ES in 2023 One isolate from fresh poultry meat in DE in 2022. One isolate from a poultry preparation in ES in 2022, originating from DE. Three isolates from poultry meat in DE in 2020. One isolate from frozen chicken product in CZ in 2020, originating from PL. Four isolates from chicken breast fillets in DK in 2020, originating from PL. One isolate from chicken meat in DE in 2019. Six isolates from laying hens farms in DE in 2019. One isolate from sausage in DE in 2018. Six isolates from ENA** without epidemiological data.
Cluster 3 (n = 20)	2014 - 2023	DK (3) FR (2) PL (3) UK (12)	Five isolates from: One isolate from fresh chicken meat in DE in 2023. One isolate from mechanically separated poultry meat in IT in 2022, originating from PL. Two isolates from cattle in DE in 2020. One isolate food isolate from ENA without epidemiological data.

*Single-linkage cluster with 5 AD cut off by cgMLST - ECDC and EFSA One Health WGS

**ENA = European nucleotide archive

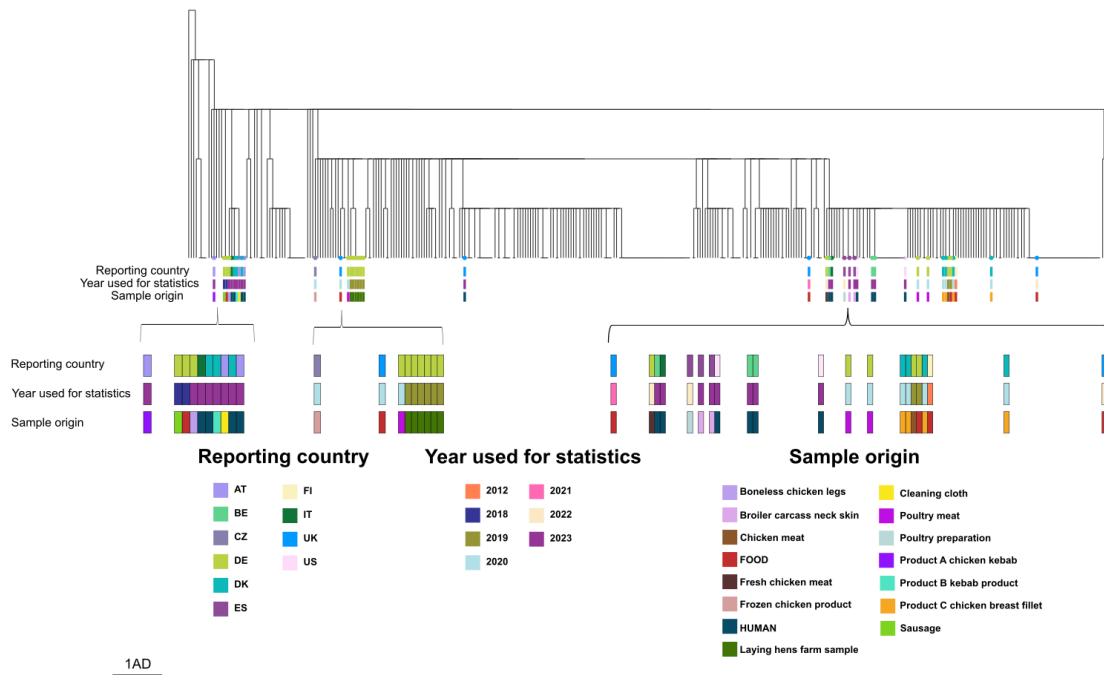
In the centralised single-linkage analysis, six isolates matched with 0 AD by cgMLST in cluster 1. These isolates included one human isolate from Austria in 2023 and one in Poland from 2022. The non-human isolates were sampled from three chicken kebab meats in Austria in 2023 (Product A, G and H) and one chicken breast fillet in Germany in 2022 (originating from Germany, no traceability data).

Figure 7. Single linkage tree with 5 AD cut off of 13 *S. Enteritidis* ST11 sequences in the cluster 1 (2023-FWD-00048), including four human isolates and nine non-human isolates



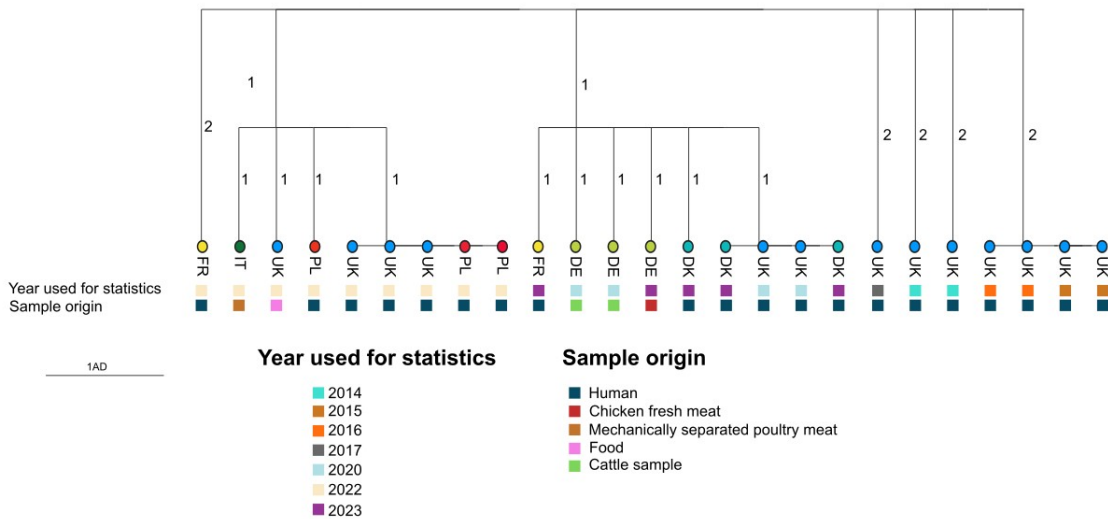
Source: One Health WGS, figure developed by ECDC

Figure 8. Single linkage tree with 5 AD cut off of 363 *S. Enteritidis* ST11 sequences in the cluster 2 (2023-FWD-00045), including detailed information of 11 human isolates from 2023 and 30 non-human isolates



Source: One Health WGS, figure developed by ECDC

Figure 9. Single linkage tree with 5 AD cut off (Enterobase and ChewieNS core genome MLST schemes) of 27 *S. Enteritidis* ST11 sequences in the cluster 3 (2023-FWD-00031), including 20 human isolates and five non-human isolates



Source: One Health WGS, figure developed by ECDC

ECDC and EFSA risk assessment for the EU/EEA

Since 1 January 2023 and as of 24 October 2023, 335 laboratory-confirmed *Salmonella* Enteritidis ST11 cases have been reported in three distinct clusters: 66 for cluster 1, 192 for cluster 2, and 77 for cluster 3, according to the European case definition. These clusters have cases detected in 14 EU/EEA countries, the UK and the US. In all clusters, the age ranges from below five to over 80 years, indicating that the entire population of all age groups are exposed. The most balanced gender difference between males and females was detected for cluster 2 (1.1:1) whereas in clusters 1 and 3, there was predominance of males with male-to-female ratios 1.8:1 and 1.9:1 respectively. One case in Austria died after dining in a kebab restaurant and nine cases were hospitalised, three in Poland and five in Germany, from cluster 1, and one in Italy from cluster 2. The centralised cluster analysis of sequences revealed the presence of human isolates in 2022–2023 for cluster 1, in 2012–2023 for cluster 2, and in 2014–2023 for cluster 3 in multiple European countries, indicating prolonged and endemic circulation of the strains in the EU/EEA.

Patient interviews pointed to chicken meat in various forms (often as chicken kebabs) as likely vehicles of infections in all clusters, highlighting a risk of *S. Enteritidis* infection related to consumption of chicken meat and chicken products.

Following the food exposure information of the interviewed cases and the national outbreak investigations, including the inspections at the kebab restaurants visited or not by the cases, the food safety authorities in Austria, Denmark, and Italy have investigated 10 food products overall and eight final producers.

More specifically, there were four kebab products contaminated by *Salmonella* cluster 1 and/or cluster 2 (kebab Product A Batch A, Product H Batch G, Product G Batch F, Product B Batch B sampled in Austria and in Denmark), and two chicken meat contaminated by *Salmonella* cluster 1 or 2 (wings Product I Batch K sampled in Bulgaria, and breast fillet Product C Batch C sampled in Denmark). The investigation identified three kebab products available at the restaurants visited by the cluster 3 cases but not tested for *Salmonella* (Product D Batch D and Batch E, and Product E sampled in Austria), and one kebab product reported as consumed by an Italian cluster 2 case (Product K Batch M).

Furthermore, there were seven identified final producers located in Poland (Producer A, Producer C, Producer AN, Producer AJ, Producer F, Producer J, Producer AQ) and one final producer (Producer K) located in Austria. The suppliers of the meat (raw materials) were available in RASFF for the four kebab products contaminated by *Salmonella* cluster 1 and/or cluster 2 (Product A, Product B, Product H and Product G) and for the chicken meat contaminated by *Salmonella* cluster 2 (breast fillet Product C). There were seven identified suppliers located in Poland (Producer B, Producer C, Producer D, Producer G, Producer Z, Producer AM, Producer I).

The available traceability information revealed that three kebab products contaminated by *Salmonella* cluster 1 and/or cluster 2 shared some common food business operators, namely the Producer D (Product A and Product H), the Producer C (Product A, and Product H), and the Producer G (Product H and Product B).

In addition, the available traceability information revealed that Producer G was also in common with the Product K (not tested but reported as consumed by the Italian cluster 2 case).

None of the traced-back Polish companies showed *Salmonella* detections from RASFF reporting. This is in accordance with the official controls performed by the food safety authority in Poland in response to the human cases' detection and investigation in Austria, Denmark, and Italy. Microbiological information was not available from RASFF for the traced-back Austrian producer.

In relation to the sampling performed, Kebab Product G contaminated by *Salmonella* Cluster 1 was collected unpacked in the Austrian restaurant, before the skewer had been placed on the grill; therefore, a *Salmonella* cross-contamination event cannot be ruled out. Kebab Product A contaminated by *Salmonella* cluster 1 and cluster 2, and Product H Batch G contaminated by *Salmonella* cluster 1 were sampled from their original package. Product B Batch B contaminated by *Salmonella* cluster 2 was collected at wholesaler level and presumably in its original package.

The sampling in Austria has also revealed a contamination of kebab products with multiple *Salmonella* clusters (Product A contaminated by *Salmonella* cluster 1 and cluster 2) and by multiple *Salmonella* serovars (Product H Batch G contaminated by *Salmonella* cluster 1, *S. Enteritidis*, *S. Virchow*, and *S. Rauform*).

In the absence of the identification of the kebab products consumed by the cases, the competent authority in Austria sampled these kebab products as suspected vehicles of the infections. The epidemiological (trading) link of the suspected kebab products suggests that there might be a common source(s)/point(s) of contamination between the events in Austria, Denmark, and Italy. However, in the absence of microbiological evidence and of comprehensive traceability available from RASFF, the role of the identified final producers of kebab and chicken products, their meat suppliers, and the possible involvement of other food business operators, as point sources of the three clusters of infections could not be confirmed or ruled out.

Regarding the point of contamination of the suspected kebab products, it cannot be ruled out that the contamination might have occurred at the restaurant level (Product G) for the kebab product sampled from an unpacked product. For the other suspected kebab products sampled from packed products, the contamination with multiple *Salmonella* strains happened before the products left their production sites (Product A and Product H Batch G) highlighting the possibility of multiple contamination times (events) along the poultry production chain.

The comparison of the representative outbreak strains with the available genome profiles of the three clusters of *Salmonella* from non-human isolates revealed the presence of the strains in the food chain in multiple European countries. However, the collection of genomic information has revealed that most isolates with shared epidemiological data and from food products collected in 2022–2023, originated from Poland.

Given all the information collected so far, *Salmonella*-contaminated chicken kebab and chicken meat are the plausible vehicle of the human infections reported in these three clusters. The available traceability information for these specific contaminated kebab products and contaminated chicken meat cannot explain cases reported in countries that have not reported being involved by their distribution. Therefore, further investigations are needed.

The contamination with the outbreak strains and with the other *Salmonella* serovars might have occurred at food serving level (at the restaurant level) but more likely higher up in the food production chain and production and processing sites, including the broiler farm level and all the top and downstream stages of the poultry production pyramid.

Identifying the origin of the contamination (root cause) and the source of infections is of utmost importance for the prompt implementation of the adequate control and corrective measures and this requires further food investigations. Only the identification of the source(s) of the infections and the point(s) of contaminations can allow control and corrective measures to be efficient. The reported cases were confirmed by sequencing and thus, represent a very small proportion of all infections in the EU/EEA. New cases are likely to occur in the EU/EEA affecting all age groups and both genders. Infections requiring hospital care were not so frequently reported but one death due to salmonellosis highlights the potential for fatal infections.

Recommendations and options for response

ECDC encourages countries to sequence available *S. Enteritidis* isolates retrieved from samples from children, immunocompromised persons, elderly, and those with severe infections, and interview all cases. Particularly, cases linked to clusters 1 and 3 are recommended to be reported in the ECDC EpiPulse platform under the respective events (2023-FWD-00048 and –00031). Results from case interviews, including consumption setting and form/brand/type of chicken consumed, are recommended to be shared with food safety authorities to enable timely investigations in the food chain. ECDC can offer sequencing support to countries.

EFSA encourages Member States, in particular those involved in this outbreak investigation, to perform sequencing of *S. Enteritidis* ST11 food and environmental isolates related to the RASFF notification mentioned in this assessment (RASFF 2023.5055, 2023.6079, 2023.6418, 2023.4360, 2023.5788, 2020.2978, 2023.5105) and/or linked to the present clusters, either microbiologically (serogroup or ST) or epidemiologically (e.g. consumption of chicken meat and chicken products by human cases or isolates linked to the companies involved in the RASFF notifications listed above). EFSA also recommends the submission of genomic data for *S. Enteritidis* ST11 from any kind of food, feed, animals, and related environment to the EFSA One Health WGS System.

Further food investigation into the possible cause of human infections, including the identification of the source(s) of infections (root cause analysis) is recommended. This will allow appropriate control measures to be implemented.

Source and date of request

The European Commission sent a request to EFSA on 8 September 2023 to produce a Joint EFSA-ECDC Rapid Outbreak Assessment (ROA). EFSA invited ECDC and the request was jointly accepted on 8 September 2023.

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Disclaimer

This rapid outbreak assessment was written jointly by the European Centre for Disease Prevention and Control (ECDC) and the European Food Safety Authority (EFSA). ECDC issued this outbreak assessment document in accordance with Article 20 of Regulation (EU) 2022/2371 on serious cross-border threats to health, Articles 7(1) and 8a of Regulation (EC) No 851/2004 establishing a European Centre for Disease Prevention and Control. EFSA's contribution is based on a mandate from the European Commission requesting EFSA to provide scientific assistance from EFSA in the investigation of multinational food-borne outbreaks (Ares (2013) 2576387, Mandate M-2013-0119, 4 July 2013) in accordance with Article 31 of Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002, laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

The specific purpose of an ECDC-EFSA rapid outbreak assessment is to present an analysis of a cross-border food-borne threat to health and to provide science-based recommendations and options for response. The responsibility for the choice of which options to pursue and which actions to take at national level, following ECDC and EFSA's recommendations, lies with EU Member States and European Economic Area (EEA) countries.

All data published in this rapid outbreak assessment are data collected from EU and/or EEA countries concerned by the outbreak until the date this assessment was produced. Maps and figures published do not represent statements from ECDC or EFSA on the legal or border status of the countries and territories shown but constitute the information on which this rapid outbreak assessment is based.

Annex 1. Disease background

Disease characteristics

Background information about salmonellosis can be found on the websites of ECDC, US CDC, and WHO [12-14].

Disease surveillance for salmonellosis in the EU/EEA

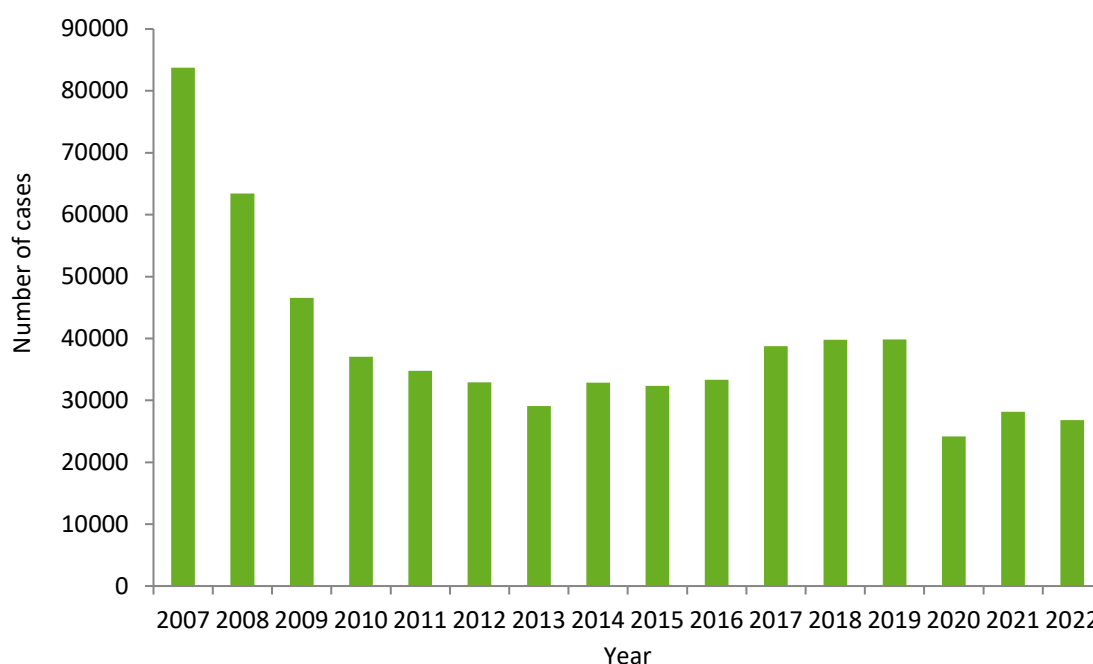
Salmonellosis in humans

Salmonellosis is a notifiable disease in the EU/EEA. Notification of non-typhoidal salmonellosis is mandatory in 27 and voluntary in three of EU/EEA countries. The surveillance systems for salmonellosis have full national coverage in 27 Member States. The EU case definition is used in 26 countries, whereas four (France, Germany, Italy, and Liechtenstein) use other, not specified case definition.

From 2007 to 2022, 623 629 cases of *S. Enteritidis* were reported to The European Surveillance System (TESSy) (mean number of cases per year 38 977, range 24 156 to 83 756) by 29 countries, with Germany and the Czechia accounting for 46% of all cases. The median age for all cases with information available was 22 years (interquartile range IQR=5–52); 52% (n=319 973) were female, and 90% (n=479 960) of infections were acquired in the reporting country. The highest number of cases were reported between June and October.

The COVID-19 pandemic significantly impacted the surveillance data for salmonellosis in 2020–2022. Factors mentioned by countries resulting in lower case numbers were e.g. people avoiding seeking medical care for mild symptoms due to the risk of exposure to COVID-19 in healthcare facilities, limited laboratory capacity due to reallocation of resources to SARS-CoV-2, fewer restaurant visits, increased hand washing, less travel due to travel restriction etc.

Figure A1. Reported *S. Enteritidis* cases in the EU/EEA from 2007 to 2022



Further information can be found in ECDC's Annual epidemiological report [15] and the online *Surveillance atlas of infectious diseases* [16].

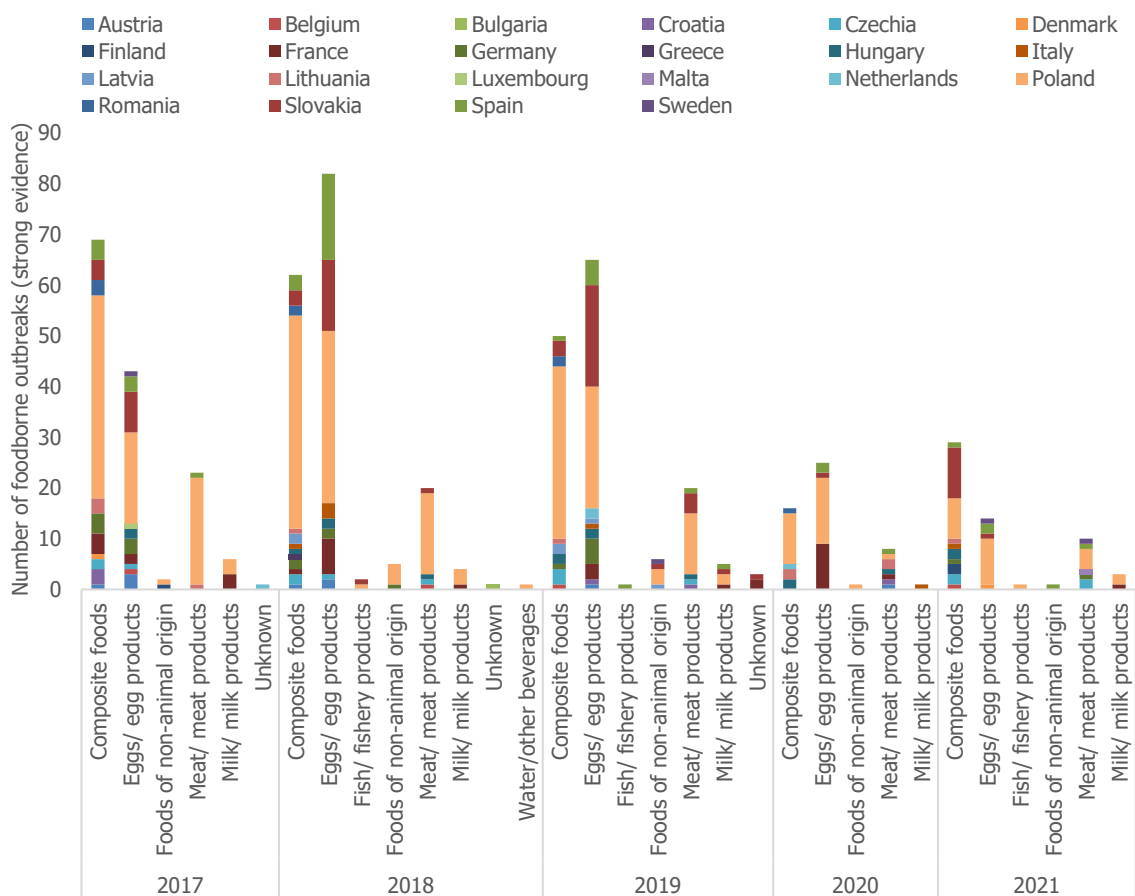
Food-borne outbreaks caused by *S. Enteritidis*

This section summarises country-specific data on food-borne outbreaks associated with *S. Enteritidis* as reported from 2017 to 2021 to EFSA by the Member States in accordance with the Zoonoses Directive 2003/99/EC.

During these five years, 580 strong-evidence foodborne outbreaks caused by *S. Enteritidis* were reported by 22 EU Member States (Austria (n=9), Belgium (n=4), Bulgaria(n=1), Croatia (n=6), Czechia (n=15), Denmark (n=2), Finland (n=3), France (n=35), Germany (n=20), Greece (n=1), Hungary (n=16), Italy (n=7), Latvia (n=6), Lithuania (n=11), Luxembourg (n=1), Malta (n=1), the Netherlands (n=4), Poland (n=308), Romania (n=8), Slovakia (n=73), Spain (n=45), and Sweden (n=4)). There were overall 9 631 human cases reported, 2 151 hospitalisations, and eight deaths.

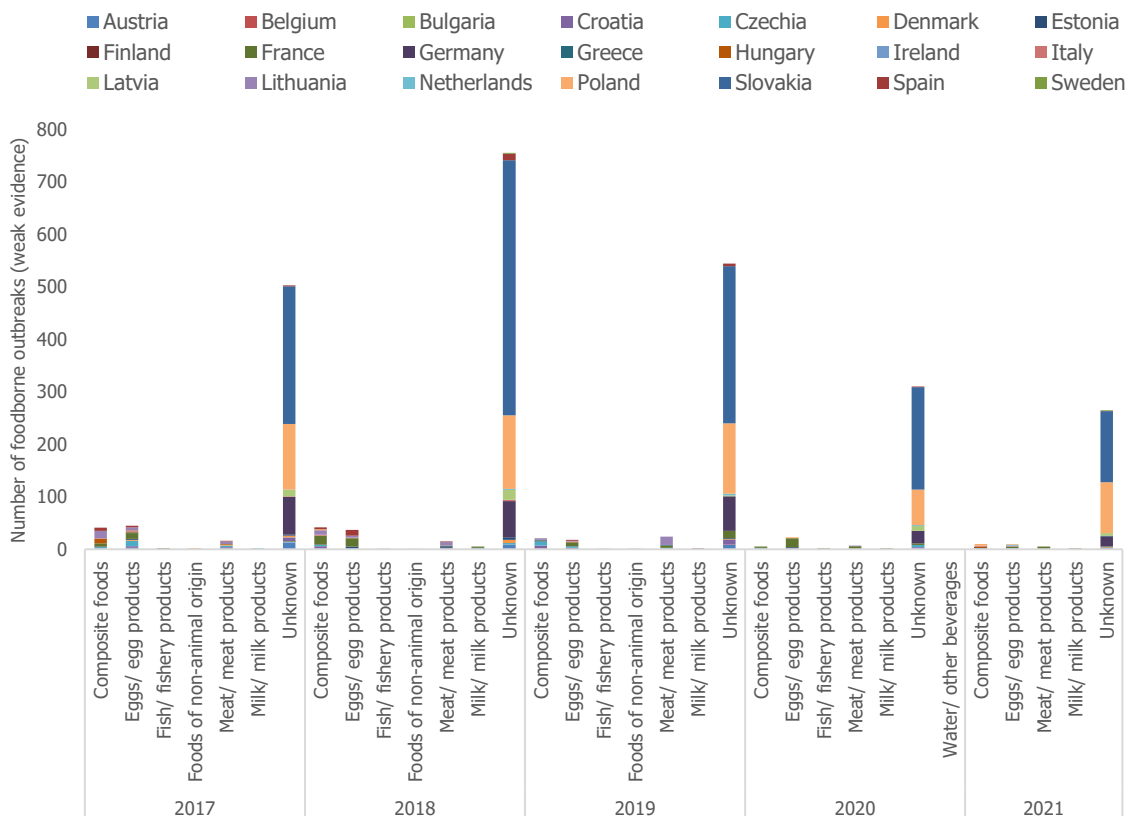
The reported food vehicles included 'Eggs and egg products', 'Composite foods, multi-ingredients foods and other foods', 'Meat and meat products', 'Milk and Milk products', 'Foods of non-animal origin', 'Fish and fishery products', 'Unknown' and 'Water (and other beverages)'.

Figure A2. Number of strong-evidence foodborne outbreaks caused by *S. Enteritidis* and reported by EU Member States between 2017–2021

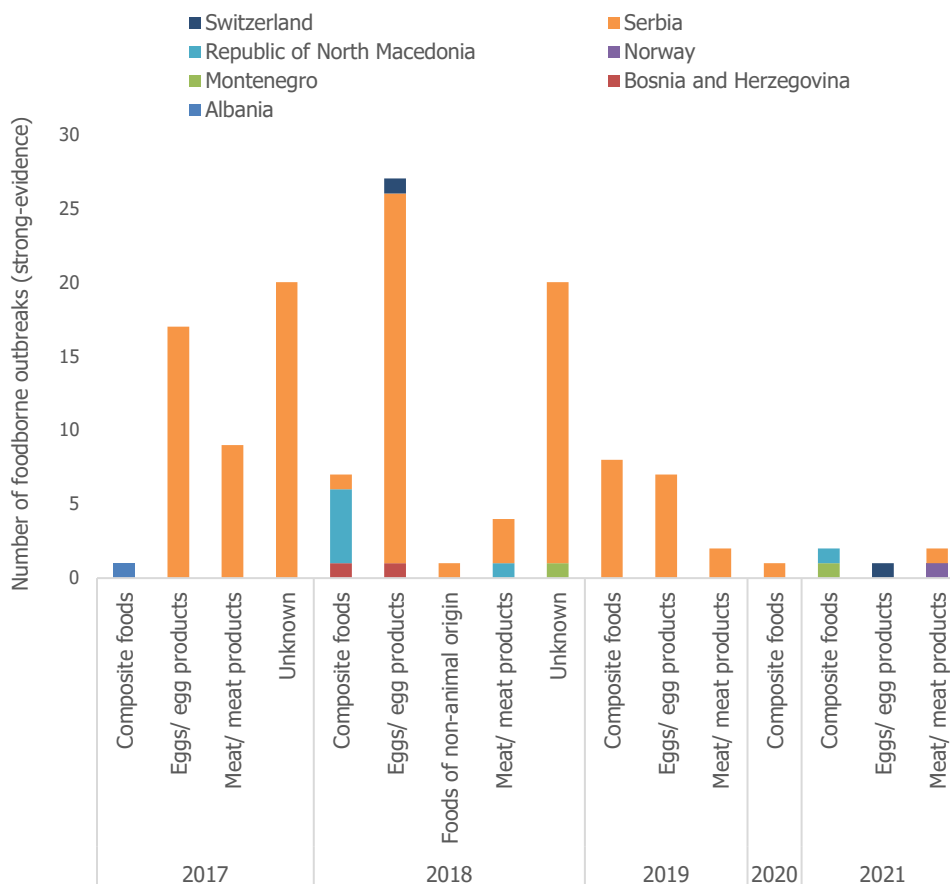


In the same period, 21 EU Member States reported overall 2 721 weak-evidence foodborne outbreaks caused by *S. Enteritidis* (Austria (n=47), Belgium (n=2), Bulgaria (n=2), Croatia (n=46), Czechia (n=47), Denmark (n=16), Estonia (n=29), Finland (n=1), France (n=120), Germany (n=250), Greece (n=3), Hungary (n=15), Ireland (n=1), Italy (n=13), Latvia (n=48), Lithuania (n=66), the Netherlands (n=10), Poland (n=573), Slovakia (n=1377), Spain (n=52), and Sweden (n=3). There were overall 12 655 human cases reported, 3 163 hospitalisations, and eight deaths. The reported food vehicles included 'Unknown', 'Eggs and egg products', 'Composite foods, multi-ingredients foods and other foods', 'Meat and meat products', 'Milk and Milk products', 'Fish and fishery products', 'Foods of non-animal origin', and 'Water (and other beverages)'.

Figure A3. Number of weak-evidence foodborne outbreaks caused by *S. Enteritidis* and reported by EU Member States between 2017–2021



During these five years, seven non-EU Member States reported a total of 129 strong-evidence foodborne outbreaks caused by *S. Enteritidis* (Albania (n=1), Bosnia and Herzegovina (n=2), Montenegro (n=2), Norway (n=1), Republic of North Macedonia (n=7), Serbia (n=114), and Switzerland (n=2)). There were 1 491 human cases reported, 341 hospitalisations, and no deaths. The reported food vehicles included 'Eggs and egg products', 'Meat and meat products', 'Unknown', 'Composite foods, multi-ingredients foods and other foods', and 'Foods of non-animal origin'.

Figure A4. Number of strong-evidence foodborne outbreaks caused by *S. Enteritidis* and reported by non-EU Member States between 2017–2021

In the same period, four non-EU Member States reported a total of 16 weak-evidence foodborne outbreaks caused by *S. Enteritidis* (Montenegro (n=2), Norway (n=2), Serbia (n=10), and Switzerland (n=2)). There were 132 human cases reported, 43 hospitalisations, and no deaths. The reported food vehicles included 'Unknown' and 'Composite foods, multi-ingredients foods and other foods'.

Occurrence of *S. Enteritidis* in ready-to-eat (RTE) and not-RTE food (category poultry and poultry products)

This section summarises country-specific data on the occurrence of *S. Enteritidis* for the matrices 'Food – RTE' and 'Food non-RTE' for the category poultry and poultry products from 2017 to 2021 as reported to EFSA by the EU Member States in accordance with the Zoonoses Directive 2003/99/EC.

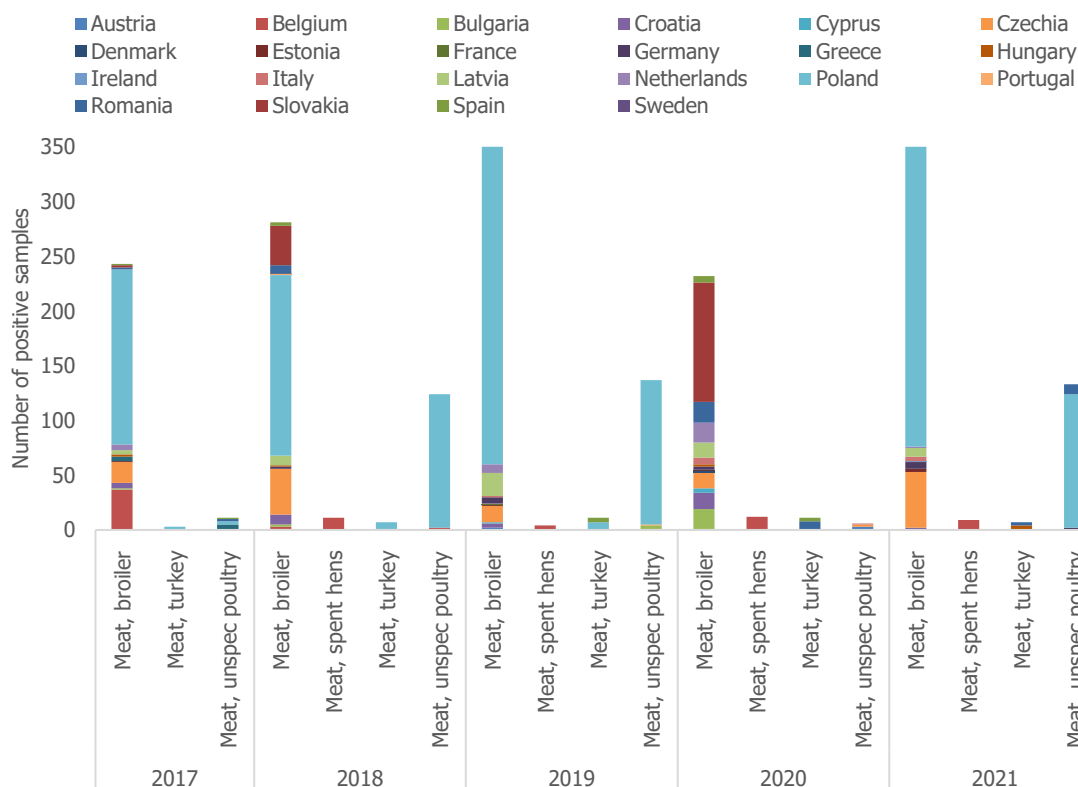
During these five years, 2 424 units positive for *S. Enteritidis* (in poultry and poultry products categories) out of 3 576 130 total units tested for *Salmonella enterica* (for all food categories) (0.0677%) were reported to EFSA for the overall matrices 'Food RTE' and 'Food non-RTE' by 22 EU Member States (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Slovakia, Spain, and Sweden).

The eight units positive for *S. Enteritidis* (in poultry and poultry products categories) out of the 576 099 total units tested for *Salmonella enterica* (for all food categories) (0.0013%) for the matrix 'Food RTE' were reported by two EU Member States (one unit positive in 2018 by Belgium, one unit positive in 2018 and six units in 2021 by Poland, all from 'Meat, unspecified poultry').

The 2 416 units positive for *S. Enteritidis* (in poultry and poultry products categories) out of the 3 000 031 total units tested for *Salmonella enterica* (for all food categories) (0.0805%) for the matrix 'Food non-RTE' belonged to the following matrices: 1930 units positive belonged to 'Meat, broiler' (Austria reported one unit in 2018, two in 2019, one in 2020; Belgium reported 37 units in 2017, two in 2018; Bulgaria reported one unit in 2017, two in 2018, 18 in 2020; Croatia reported five units in 2017, nine in 2018, four in 2019, 15 units in 2020, two units in 2021; Cyprus reported one unit in 2019, four in 2020; Czechia reported 19 units in 2017, 42 in 2018, 15 in 2019, 14 in 2020, 51 units in 2021, Denmark reported two units in 2020; Estonia reported one unit in 2017, one in 2019, one unit in 2020, three in 2021; France reported one unit in 2019; Germany reported two units in 2018, six in 2019, three in 2020, six in 2021; Greece reported four units in 2017; Hungary reported two units in 2017, one in 2018, two in 2020; Ireland reported one unit in 2021; Italy reported one unit in 2019, six in 2020, four in 2021; Latvia reported four units in 2017, nine in 2018, 21 in 2019, 14 in 2020, eight in 2021; the Netherlands reported five units in 2017, eight in 2019, 18 in 2020, one in 2021; Poland reported 160 units in 2017, 165 in 2018, 413 in

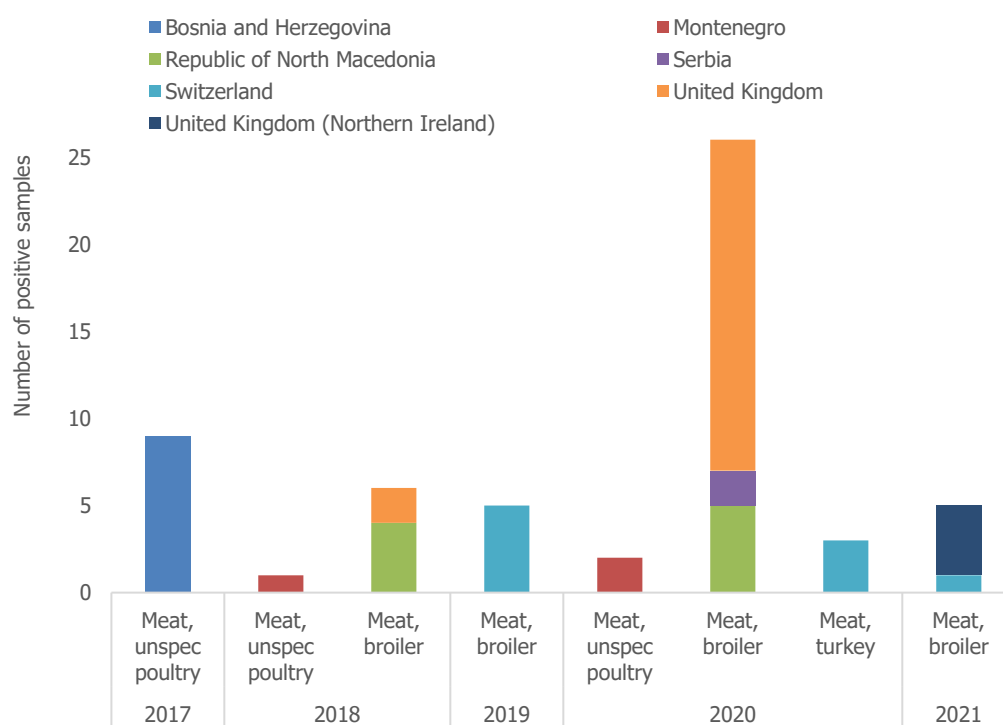
2019, 565 in 2021; Portugal reported one unit in 2018; Romania reported two units in 2017, eight in 2018, two in 2019, 19 in 2020, 19 in 2021; Slovakia reported two units in 2017, 36 in 2018, 11 in 2019, 109 in 2020, 19 in 2021; Spain reported one unit in 2017, three in 2018, five in 2019, six in 2020, three in 2021; Sweden reported one unit in 2021), 411 units positive belonged to 'Meat, unspecified poultry' (Austria reported one unit in 2018, one in 2019, three in 2020; Belgium reported one unit in 2018; Bulgaria reported three units in 2019; Czechia reported one unit in 2019, two in 2020; Germany reported two units in 2021; Greece reported five units in 2017; Italy reported one unit in 2020; Poland reported three units in 2017, 122 in 2018, 132 in 2019, 122 in 2021; Romania reported two units in 2017, nine in 2021), 39 units positive from 'Meat, turkey' (Czechia reported one unit in 2017; Hungary reported four units in 2021; Latvia reported one unit in 2018; Poland reported two units in 2017, six in 2018, seven in 2019; Romania reported eight units in 2020, three in 2021; Spain reported four units in 2019, three in 2020), 36 units positive from 'Meat, spent hens' (Belgium reported 11 units in 2018, four in 2019, 12 in 2020, nine in 2021).

Figure A5. Distribution of the 2416 *S. Enteritidis* positive samples from for the matrix 'Food non-RTE' as reported by EU Member States between 2017–2021



During these five years, no data were reported by the non-EU Member States for *S. Enteritidis* (in poultry and poultry products categories) for the matrix 'Food - RTE'.

In the same period, seven non-EU Member States reported 57 units positive for *S. Enteritidis* (in poultry and poultry products categories) out of 125 710 total units tested for *Salmonella enterica* (for all food categories) (0,0453%) for the matrix 'Food non-RTE'. These 57 units belonged to the matrices: 42 units positive from 'Meat, broiler' (the Republic of North Macedonia reported four units in 2018, five in 2020; Serbia reported two units in 2020; Switzerland reported five units in 2019, one in 2021, the United Kingdom reported two units in 2018, 19 in 2020; the United Kingdom (Northern Ireland) reported four units in 2021), 12 units positive from 'Meat, unspecified poultry' (Bosnia and Herzegovina reported nine units in 2017; Montenegro reported one unit in 2018, two in 2020), and three units positive from 'Meat, turkey' (Switzerland reported three units in 2020).

Figure A6. Distribution of the 57 *S. Enteritidis* positive samples from for the matrix 'Food non-RTE' as reported by non-EU Member States between 2017–2021

Annex 2

Table 1. List of meat suppliers of the Polish Producer A as shared by the food safety authority in Poland to support the food investigations in Austria (Epi-Pulse event 2023-FWD-00048, RASFF notification 2023.5055, *fup10*) (Figure 1)

Suppliers	Country
Producer B	Poland
Producer C	Poland
Producer D	Poland
Producer G	Poland
Producer V	Poland
Producer W	Poland
Producer X	Poland
Producer Y	Poland
Producer Z	Poland
Producer AA	Poland
Producer AB	Hungary
Producer AC	Poland
Producer AD	Poland
Producer AE	Poland
Producer AF	Poland
Producer AG	Poland
Producer AH	Poland

Table 2. Additional kebab producers (other than those traced for Product A) identified for their commercial link in Austria during the period of the investigation in Austria (RASFF 2023.5055)

Producer	Country	Supplier of meat	Country of the supplier	
Producer O	CZ	Producer P	PL	2023.5055, <i>fup14</i>
Producer Q	CZ	Producer R	PL	2023.5055, <i>fup14</i>
Producer S	CZ	No meat from PL	Not available	2023.5055, <i>fup14</i>
Producer T	HU	No meat from PL	Not available	2023.5055, <i>fup15</i>
Producer U	HU	No meat from PL	Not available	2023.5055, <i>fup15</i>
Producer E	DE	Not available	Not available	Not available
Producer M	PL	Producer AI / Producer AC / Producer AJ/ Producer W / Producer AK / Producer AL	PL	2023.5055, <i>fup16</i>
Producer N	PL	47 producers	PL	2023.5055, <i>fup16</i>

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