

JOINT ECDC-EFSA RAPID OUTBREAK ASSESSMENT

Multi-country outbreak of *Salmonella* Mbandaka ST413, possibly linked to consumption of chicken meat in the EU/EEA, Israel and the UK

30 November 2022

Abstract

A cross-border outbreak of *Salmonella* Mbandaka ST413 has been ongoing in the EU/EEA, Israel, and the UK since September 2021. By 8 November 2022, 196 cases had been reported in Czechia (n=5), Estonia (n=3), Finland (n=89), France (n=10), Germany (n=2), Ireland (n=1), the Netherlands (n=1), the United Kingdom (n=81), and Israel (n=4), according to the European case definition. Nineteen cases were hospitalised and five cases had septicaemia. One case in the UK died.

Based on case interviews from Finland and the UK, ready-to-eat (RTE) chicken products and/or fresh chicken meat are the likely vehicles of infection. Fifteen cases in Finland reported consumption of six RTE products from three brands. All 15 cases had consumed at least one RTE chicken product. Two products were marketed under the same brand name, which is adopted by the Estonian Company A and the Finnish Company B. Based on additional information, such as purchase data, and consultation of the grocery chains selling the products and of the Finnish Company B, the food authority in Finland linked the products to the Estonian Company A. However, this link could not be verified by the identification of the batches nor by microbiological evidence. The Estonian Company A received processed chicken meat from different suppliers, but there is no further information in RASFF. Therefore, the role of the Estonian Company A as a source of infection could not be established.

Epidemiological data and microbiological evidence from whole genome sequencing of human isolates indicate there are several active sources through different food distribution chains, with a likely common source higher up in the chicken supply chain. New cases are likely to occur in the EU/EEA until the source has been identified and controlled.

Further investigations are needed by public health and food safety authorities to identify the source(s)/origin of contamination.

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Event background

On 20 May 2022, the United Kingdom (UK) reported a cluster of 31 *Salmonella* Mbandaka ST413 cases from England (25 cases), Scotland (3 cases) and Wales (3 cases) with sample dates between 24 September 2021 and 23 April 2022 (EpiPulse ID 2022-FWD-00033). Of the 13 cases where information was available, four (31%) were admitted to hospital and one case has died. The UK shared the sequence data of two representative outbreak strains with countries for comparison with the sequence data in the national databases.

On 16 June 2022, Finland reported a cluster of nine *S. Mbandaka* cases from different regions between 19 April and 24 May 2022 (EpiPulse ID 2022-FWD-00042). Subsequent analysis on 20 June confirmed that the cluster of nine Finnish cases was genetically close to the representative isolates of the UK outbreak strains.

As new cases continued to be reported in Finland and the UK in September, indicating that the outbreak was ongoing, ECDC and EFSA decided to further investigate and to produce a Rapid Outbreak Assessment.

Outbreak strain characterisation

The two representative outbreak strains from the UK are characterised as follows:

- *Salmonella* Mbandaka, sequence type (ST) 413, EBG (e-BURST group) 62, UKHSA (United Kingdom Health Security Agency) 5-SNP (single nucleotide polymorphism) single linkage cluster address designation: 1.148.273.438.602.665.% [1].
- Predicted antimicrobial resistance determinants were detected against the following classes of antibiotics: aminoglycosides (*aac(6′)-Iaa*) and fluoroquinolones (single mutation of the gene *parC*[57:T-S], which does not necessarily confer resistance). Phenotypic testing has not been performed.

The Enterobase cgMLST hierarchical cluster designation for the outbreak isolates is HC5_286156 [2,3].

There are **four representative strains** available in the European Nucleotide Archive (ENA):

- The United Kingdom: two outbreak strains' sequence accession codes are SRR16920742 (October 2021) and SRR19087024 (April 2022)
- Finland: two outbreak strains' sequence accession codes are ERR10225555 and ERR10225556.

EU/EEA outbreak case definition

A confirmed outbreak case:

- A laboratory-confirmed *Salmonella* Mbandaka ST413 case with or without symptom onset on or after 1 September 2021 (date of sampling or date of receipt by the reference laboratory if date of onset is not available).

AND

- Fulfilling at least one of the following laboratory criteria: an *S. Mbandaka* ST413 isolate by:
 - the national cgMLST pipeline within five cg-allelic differences (AD) from the representative UK or Finnish outbreak strains, OR
 - clustering in a centralised whole genome sequencing (WGS) analysis within five cg-allelic differences in a single linkage analysis, OR
 - belonging to the same cgMLST HC5_286156 cluster (Enterobase scheme), OR
 - belonging to a 5-SNP single linkage cluster with SNP designation 1.148.273.438.602.665.% (t5:665) according to the UKHSA pipeline in the UK.

A possible outbreak case:

- A laboratory-confirmed *S. Mbandaka* case with or without symptom onset on or after 1 September 2021 (date of sampling or date of receipt by the reference laboratory if date of onset is not available) without molecular typing/sequencing data.

Exclusion criterion for a possible outbreak case:

- Travel history outside the EU/EEA within seven days prior to infection.

Epidemiological and microbiological investigations of human cases

By 8 November 2022, **196** cases (140 confirmed and 56 possible) have been reported in seven EU/EEA countries (Czechia, Estonia, Finland, France, Germany, Ireland, and the Netherlands), the UK, and Israel (Table 1). The first case was identified in the UK with a sample date on 24 September 2021 (a confirmed case) and the most recent case was reported in Estonia on 17 October 2022 (a confirmed case) (Table 1).

Of 40 cases with information available in the UK, nine (22.5%) were admitted to hospital and one case died. In Finland, 10 of 73 interviewed cases (13.6%) were hospitalised and five cases (6.8%) had septicaemia. Overall, the cases are reported across all age groups and there is no difference by gender.

One confirmed case in the Netherlands reported travel to Ukraine and two confirmed cases in the UK reported travel to Nigeria and United Arab Emirates during the incubation period. One confirmed case in Estonia worked in Finland and had travelled on a passenger ferry to Estonia via Sweden.

Table 1. Demographic and background information of 196 human *S. Mbandaka* cases in seven EU/EEA countries, the UK, and Israel, as of 8 November 2022

Country	Total	Confirmed cases	Possible cases	Time range	Age range (median)	Gender		Comments
						M	F	
Czechia	5	0	5	March - May 2022	< 1 - 86 years (68)	1	4	Two cases were hospitalised
Estonia	3	3	0	1 January - 17 October 2022	16 - 58 years (47)	1	2	One case worked in Finland and travelled to Estonia on a ferry via Sweden.
Finland	89	42	47	19 April - 17 October 2022	<1 - 75 years (27)	34	55	10 cases were hospitalised and five cases had septicaemia. Cases are reported nationwide.
France	10	10	0	February - September 2022	13 - 95 years (79)	4	6	Two cases from different regions were interviewed: both were hospitalised and reported no travel
Germany	2	2	0	November 2021, May 2022	24 and 65 years	1	1	
Ireland	1	1	0	July 2022	Between 30-40 years	0	F	No travel history
The Netherlands	1	1	0	March 2022	> 50 years	1	0	Travel history to Ukraine
Total EU/EEA	111	59	52			40	64	
Israel	4	0	4	13 January - 12 July 2022	1 - 44 years (1)	3	1	
United Kingdom	81	81	0	24 September 2021 - 13 October 2022	<1 - 87 years (37)	44	37	Nine cases were hospitalised and one case has died. Two cases with travel histories to Nigeria and United Arab Emirates.
Total	196	140	56			87	102	

Information from patient interviews

In the UK, 18/26 (69.2%) cases reported consumption of ready-to-eat (RTE) chicken products within the week prior to the onset of symptoms. Most notably, chicken products such as slices/pieces used in sandwiches and wraps were reported at a higher than expected rate compared to national dietary survey data. 10/26 cases (38.5%) indicated purchase of chicken products from local cafés and restaurants, including wraps, sandwiches/baguettes and kebabs. It is possible that the chicken products of interest were being distributed through retail as well as the catering sector, however no clear food chain links have been identified in the UK to date. Additionally, the majority of cases (17/26, 65.4%) indicated consumption of chicken bought fresh, including chicken breast, thighs, and the whole chicken.

In Finland, 64 of 67 interviewed cases (95.5%) had eaten or possibly eaten various chicken products before becoming ill. Based on detailed patient interviews and purchase information available, 15 cases had consumed or purchased certain ready-to-eat products of three brands. The products are sold in at least two of the largest grocery chains in Finland, whose grocery market shares are 36% and 46%. One possible case, an asymptomatic staff member of a food company in Finland, who tested positive for *S. Mbandaka* in September, handled raw material of salad products in buggies without hand contact at the company's plant. The case had regularly consumed RTE wraps, like those reported by the 15 Finnish cases. Several cases had eaten out in restaurants.

Microbiological and environmental investigations of food and control measures

On 29 July 2022, EFSA opened a Rapid Alert System for Food and Feed (RASFF) notification (News 2022.4440) to inform the food safety authorities of an ongoing multi-country outbreak.

As of 28 November 2022, 10 EC validated follow-ups – *fup* were shared by countries through the platform.

Finland

On 26 August 2022, the food safety authority in Finland informed in RASFF that a traceability analysis was performed on the chicken products reported to have been consumed by the Finnish cases (based on food exposure information from the interviews). Some of the mentioned chicken products were traced to 11 restaurant servings and one product sold at a grocery store. The chicken products used were pre-cooked in all serving/product except one. The chicken products originated from several manufacturers located in different countries (EU countries, including Finland, and non-EU countries). The list of countries was not available in RASFF (*fup2*).

On 11 October 2022, the outcome of further investigations based on food exposure and purchase information from 15 interviewed Finnish cases was shared in RASFF.

Fifteen Finnish cases reported consumption of five RTE products containing chicken meat and one containing salmon, from three brands. The six RTE products were sold by at least either one or the other of the two largest grocery chains in Finland (*fup8*). The six RTE products were Product A ('chicken wrap') of Brand A, Product B ('chicken baguette') of Brand A, Product C ('chicken wrap') of Brand B, Product D ('chicken sandwich') of Brand B, Product E ('chicken ciabatta') of Brand C, and Product F ('smoked salmon sandwich') of Brand C (*fup4*).

The batch numbers and/or the expiring dates of the six RTE products reported to have been consumed by the cases were not available (*fup4*, *fup8*).

Based on purchase data, four out of the six products were identified based on their EAN-codes. At least one of four RTE products is connected to six Finnish cases out of 15. The four products were Product A ('chicken wrap') of Brand A, Product B ('chicken baguette') of Brand A, Product E ('chicken ciabatta') of Brand C, and Product F ('smoked salmon sandwich') of Brand C.

Based on cases interviews (food exposure) and traceback analysis performed by consulting the grocery chains selling the products (selling period from March 2022) and the Finnish Company B, the food safety authority in Finland linked Product A ('chicken wrap') of Brand A, Product C ('chicken wrap') of Brand B, Product D ('chicken sandwich') of Brand B, Product E ('chicken ciabatta') of Brand C, and Product F ('smoked salmon sandwich') of Brand C to the Estonian Company A.

Brand A is used by at least two food companies such as the Estonian Company A and the Finnish Company B. The two companies belong to the same food group. The food authority in Finland stated that none of the six RTE products is manufactured at the premises of the Finnish Company B (*fup8*).

Estonia

On 30 September 2022 the food safety authority in Estonia performed an official control at the Estonian Company A after being informed by the authorities in Finland about the food exposure and purchase information from the Finnish cases (*fup7*). During the inspection, 15 environmental samples were collected of which eight samples were taken from non-food contact surfaces (two samples from drains, floor scraper, vacuum device, transport trolley wheels, oven trolley in the dishwashing room, pallet, and blue brush samples) and seven samples were taken from food contact surfaces such as a mixer, employee's hands during work, wrap line tape during work, chicken slicer cutter, cutting board, sandwich line tape, and sandwich line control scale (*fup7*). Furthermore, samples were collected from RTE food products such as 'chicken wrap', 'chicken ciabatta' of Brand B, 'chicken burrito' of Brand D, 'chicken baguette'. Samples were also collected from the processed chicken meat used as an ingredient at the Estonian Company A and intended for the production of 'chicken wrap' and 'chicken ciabatta' of Brand B such as the frozen heat-treated chicken cubes and the frozen heat-treated steam cooked chicken breast fillets. This processed chicken meat originated from the Dutch Company C (*fup9*).

The food authority stated that *Salmonella* was not detected in any sample (*fup6*).

On 10 October 2022, additional official samples of raw materials and ingredients used at the Estonian Company A for the preparation of RTE food products ('chicken wrap' and 'chicken baguette') were collected (*fup7*). The sampled raw materials and ingredients consisted of two samples of leaf vegetable (Frillice salad, Estonian origin), two samples of leaf vegetable washed and vacuum packed (Frillice salad, Estonian origin), mayonnaise (Finnish origin, supplier Finnish Company B), and BBQ sausage smoky hickory (Swedish origin). *Salmonella* was not detected (*fup7*). The food authority in Estonia also informed in RASFF that a total of 129 own check analyses had been performed for *Salmonella* in 2022 by the Estonian Company A yielding negative results.

Samples of the Estonian Company A's products are also analysed (own check) for *Salmonella* by the retailers that sell them (*fup7*). *Salmonella* was not detected in any above-mentioned sample (*fup6*).

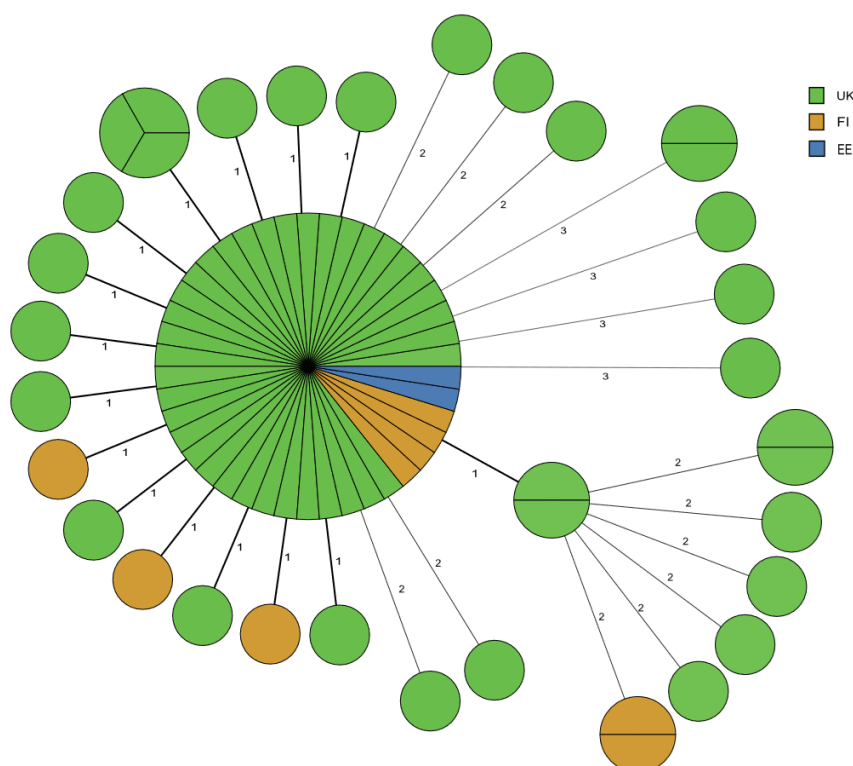
The food authority also reported that the Estonian Company A is not the only food company producing products with the trademark of Brand A (*fup6*). Furthermore, Estonian Company A's products are widely sold in the Estonian market (*fup7*). The food safety authority stated that with exception of Finland, the Estonian Company A does not sell its products in the countries that have reported the number of human cases to ECDC, including UK.

According to the information shared in RASFF by the food safety authority, three non-human isolates of *Salmonella* Mbandaka ST413 were available in Estonia and originated from samples of pig carcass and pig organs, and from an environmental sample. The cluster analysis performed at the national level on the three non-human sequences revealed no matches with the four available human sequences of *Salmonella* Mbandaka ST413 (*fup6*).

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

The representative sequences from countries 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 Enterobase core genome scheme and isolates were excluded from further analysis if less than 2 702 (90%) of the 3 002 core loci were detected. A minimum spanning tree was generated to visualise the results (Figure 1).

Figure 1. Minimum spanning tree based on number of differing alleles (cgMLST, Enterobase scheme) including *S. Mbandaka* sequences from 78 representative human isolates from Estonia (n=2), Finland (n=9) and the UK (n=67), 2021-2022, as of 22 November 2022



On 14 July 2022, EFSA launched a call for data, inviting Member States to submit to the EFSA One Health WGS System genomic information regarding food isolates of *S. Mbandaka* collected between January 2021 and July 2022, focusing on those isolates collected in the poultry production line including feed. By 21 July 2022, six countries had replied: Austria, Belgium, France, Germany, Ireland, and Lithuania. There have been three genomic data submissions (one sequence from Austria and two sequences from Germany).

On 6 October 2022, in the context of this ROA, EFSA launched a second call for data regarding *S. Mbandaka* food isolates collected in 2022 from chicken products. By 8 November 2022, five countries replied: France, Germany, Ireland, Luxembourg, and Spain. There have been 11 additional genomic information submissions (six sequences from Germany, one sequence from Luxembourg, one sequence from Ireland, and three sequences from Spain).

For cross-sectorial analysis, the cgMLST analysis was performed in both ECDC and EFSA as previously described [4]. Briefly, genome profiles were calculated from assembled genomes using chewBBACA version 2.8.5

(<https://github.com/B-UMMI/chewBBACA>) using the schema as described by Rossi et al. 2018 [5] for *Salmonella enterica* made available by chewie Nomenclature Server [6] at <https://chewbbaca.online/species/4>. Isolates with more than 10% of missing loci (325 over a total of 3 255 loci) were excluded from the analysis.

At the time of the analysis, the EFSA One Health WGS System contained 251 cgMLST genomic profiles of *S. Mbandaka* ST413 isolates collected from food, feed, animals and related environment. Out of 251 profiles, 229 were generated from sequences retrieved from the public repository European Nucleotide Archive (ENA) and 22 profiles were submitted to EFSA by Member States as a response to the two data calls launched in July and October 2022 and in the context of 'Multi-country outbreak of multiple *Salmonella enterica* serotypes linked to imported sesame-based products' [7]. ECDC queried EFSA One Health WGS System on 28 October 2022 using the entire cluster of 76 *S. Mbandaka* as reference genomes and 30 ADs as threshold. This comparison did not reveal any allelic profiles of *S. Mbandaka* ST 413 isolates in the EFSA One Health WGS System with AD lower or equal to five against any profiles of human isolates in the query. The closest four non-human isolates detected in the query submitted by ECDC are 15 AD from the outbreak cluster in a single-linkage cluster analysis.

ECDC and EFSA risk assessment for the EU/EEA

A cross-border outbreak of *S. Mbandaka* ST413 has been ongoing in the EU/EEA, Israel, and the UK since September 2021. By 8 November 2022, 196 cases have been reported (140 confirmed and 56 possible) according to the European case definition in seven EU/EEA countries (Czechia, Estonia, Finland, France, Germany, Ireland, and the Netherlands), the United Kingdom, and Israel. Nineteen cases have been hospitalised, five cases had septicaemia, and one case in the UK died. Cases have occurred across all age groups and there is no overall difference by gender.

Case interviews in Finland and the UK showed that consumption of various types of ready-to-eat (RTE) chicken products was commonly reported among cases. The products mentioned are e.g., chicken wrap, chicken tortilla, RTE chicken salad, prepacked chicken products including chicken breast/drumsticks, chicken sandwiches, and chicken pasta. Many cases have consumed these products at cafés and restaurants but some cases in the UK also report consumption of chicken bought fresh (chicken breast, thighs, and whole chicken), suggesting that various chicken products and meat may have been distributed through retail and catering. Chicken meat appears to be a common ingredient of the RTE products reported by cases in Finland and the UK. This suggests that contaminated chicken meat used as an ingredient in RTE chicken products can be the origin of infections.

Based on food exposure information, six RTE products (Products A, B, C, D, E, and F) from three brands (Brands A, B, and C) seemed to have been consumed by 15 cases in Finland before the symptom onset. Five out of six products (Products A, B, C, D, and E) had chicken meat as a common ingredient and all 15 cases had consumed or purchased at least one RTE chicken product.

Products A and B were traded with the same Brand A, which is adopted, according to the available information, by at least two food business operators such as the Estonian Company A and the Finnish Company B. The involvement of other food operators producing products with the same brands cannot be ruled out. The food safety authority in Finland consulted the Finnish Company B, trading products of the same brand (Brand A), that declared not having produced the mentioned six RTE products. A staff member in the Finnish Company B, who tested positive for *S. Mbandaka* (asymptomatic case), reported regular consumption of chicken wraps like those reported to have been consumed by the 15 Finnish cases.

Based on cases interviews, purchase data, and after having consulted the grocery chains selling the products and the Finnish Company B, the food safety authority in Finland linked the six RTE products to the Estonian Company A. However, the link to the Estonian Company A is not followed by the identification of batch numbers and/or expiry dates of the six RTE products and by any microbiological evidence. There is no available information in RASFF on any sampling of the products for *Salmonella* testing in Finland. Furthermore, official control performed at the Estonian Company A by the food safety authority in Estonia did not reveal any *Salmonella* detection from the sampled environment and food products. In addition, according to the information shared by the food safety authority in Estonia, the Estonian Company A received processed chicken meat by some suppliers, including the Dutch Company C, for which no further information was available in RASFF. With exception of Finland, the Estonian Company A does not sell its products in the countries that have reported the number of human cases to ECDC, including UK that reported the second largest number of cases. Therefore, the role of the Estonian Company A as a source of infection could not be established.

Based on available information from case interviews and trace back investigations, the working hypothesis is RTE chicken products containing contaminated chicken meat as likely vehicles of infections, with freshly sold chicken as another possible vehicle. This hypothesis is plausible since *S. Mbandaka* has been isolated in poultry, feeds, and foods in several Member States (based on the prevalence data reported by EU/EFTA countries to EFSA annually) and shown to circulate for many years in poultry production posing therefore a continuous risk for human infections [8].

The comparison of the representative outbreak strains with the available genomic profiles of *S. Mbandaka* ST413 from non-human isolates did not reveal any match. This indicates that the *S. Mbandaka* ST413 strain in this event is different from the one detected in the recently reported cross-border outbreak linked to sesame-based products [7].

Epidemiological data and microbiological evidence from whole genome sequencing of human isolates indicate there are several active sources through different food distribution chains, including RTE chicken products via retails and catering, with a likely common source higher up in the chicken supply chain. New cases are likely to occur in the EU/EEA until the source has been identified and controlled.

Further investigations are needed by public health authorities to test this working hypothesis and by food safety authorities to identify and confirm the vehicles of infection, to trace back food products, and to identify possible points of contamination and/or microbial growth along the chicken meat production chain, including important control points such as transportation of RTE products.

Options for response

ECDC encourages Member States to sequence *S. Mbandaka* isolates from human cases and interview cases with *S. Mbandaka* ST413 infection, focusing on the consumption of various chicken/poultry meat and related products. Further investigations are recommended in cooperation with food safety authorities. ECDC encourages countries to update their country's case information in EpiPulse event [2022-FWD-00033](#) or [2022-FWD-00042](#).

EFSA encourages Member States to perform sequencing of *S. Mbandaka* ST 413 food isolates linked to the present cluster either microbiologically (serotype or ST) or epidemiologically (e.g., reported consumption of RTE chicken products by human cases) and to submit genomic data of *S. Mbandaka* ST 413 isolates from any kind of food, feed, animal and related environment to the EFSA One Health WGS System.

Source and date of request

ECDC sent a request to EFSA on 4 October 2022 to produce a Joint Rapid Outbreak Assessment (ROA). EFSA accepted the request on 5 October 2022.

Consulted experts and national contact points

ECDC experts (in alphabetical order): Áine Collins, Cecilia Jernberg, Johanna Takkinen.

Public health experts consulted for data and facts validation:

Czechia: Ondřej Daniel and Michaela Špačková (National Institute of Public Health);

Estonia: Jelena Rjabinina (Health Board);

Finland: Ruska Rimhanen-Finne, Saara Salmenlinna, and Anni Vainio (Finnish Institute for Health and Welfare);

France: Maria Pardos de la Gandara (Institut Pasteur, Centre National de Référence des *E. coli*, *Shigella* et *Salmonella*) and Nathalie Jourdan-Da Silva (Santé publique France);

Germany: Michael Pietsch and Sandra Simon (National Reference Centre for *Salmonella* and other bacterial enteric pathogens, Robert Koch Institute);

Ireland: Niall De Lappe (National *Salmonella*, *Shigella* and *Listeria* Reference Laboratory, University Hospital Galway);

Israel: Maya Davidovich-Cohen (Public Health Laboratories, Jerusalem, Ministry of Health);

The Netherlands: Roan Pijnacker (National Institute for Public Health and the Environment);

The United Kingdom: Amy Douglas, Lesley Larkin, Thomas Thackray, Anaïs Painset (United Kingdom Health Security Agency), Lynda Browning (Public Health Scotland), Derek Brown (Scottish Microbiology Reference Laboratories).

EFSA staff (in alphabetical order): Lorena Corredor Barrera, Valentina Rizzi, Mirko Rossi, Eleonora Sarno, Frank Verdonck

RASFF contact points: Estonia, Finland, the Netherlands.

National experts consulted by the RASFF contact points:

Estonia: Jelena Sögel, Elle Männisalu, Kairi Sisask (Food Department, Agriculture and Food Board);

Finland: Mika Varjonen, Elina Leinonen, Annika Pihlajasaari (Finnish Food Authority).

Disclaimer

ECDC issued this outbreak assessment document in accordance with Article 10 of Decision No 1082/13/EC and Article 7(1) of Regulation (EC) No 853/2004 establishing a European Centre for Disease Prevention and Control (ECDC), and with the contribution of EFSA 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 (EFSA) and laying down procedures in matters of food safety.

In the framework of ECDC's mandate, the specific purpose of an ECDC-EFSA outbreak assessment is to present different options on a certain matter. The responsibility on the choice of which option to pursue and which actions to take, including the adoption of mandatory rules or guidelines, lies exclusively with EU/EEA Member States. In its activities, ECDC strives to ensure its independence, high scientific quality, transparency and efficiency.

This report was written under the coordination of an internal response team at ECDC, with contributions from EFSA, at the behest of the European Commission based on a mandate requesting scientific assistance from EFSA in the investigation of multinational food-borne outbreaks (Ares (2013) 2576387, Mandate M-2013-0119, 7 July 2013).

All data published in this rapid outbreak assessment are correct to the best of ECDC's and EFSA's knowledge. Maps and figures published do not represent a statement on the part of ECDC, EFSA or its partners on the legal or border status of the countries and territories shown.

Annex 1. Disease background

Disease characteristics

Background information about salmonellosis can be found on the websites of ECDC, US CDC, and WHO [9-11].

Disease surveillance for *Salmonella* Mbandaka infections in the EU/EEA and the United Kingdom

Salmonella Mbandaka isolation in humans

This section summarises country-specific data on human *S. Mbandaka* cases as reported to the European Surveillance System (TESSy) by EU Member States in accordance with the ECDC founding regulation (Regulation (EC) 851/2004) and Decision No 1082/2013/EU on serious cross-border threats to health.

Salmonella Mbandaka is reported as part of salmonellosis surveillance in the EU/EEA. Notification of non-typhoidal salmonellosis is mandatory in most EU Member States, as well as in Iceland and Norway. In four Member States, reporting is voluntary (Belgium, France, Luxembourg, and the Netherlands). Food poisoning is a notifiable disease under national legislation in all countries of the UK except for Scotland. Under this legislation, reporting of *Salmonella* spp. isolated from human samples in public health laboratories is also mandatory throughout the UK. The surveillance systems for salmonellosis have full national coverage in all Member States except three (Belgium, the Netherlands and Spain). The population coverage in 2021 was estimated to be 85% in Belgium and 64% in the Netherlands. The coverage is not reported for Spain.

Between 2007 and 2021, a total of 2 978 cases of *S. Mbandaka* were reported to the European Surveillance System (TESSy) by 27 EU/EEA countries and the UK (data as of 15 July 2022). The average number of cases per year was 199 (range 70-480). The UK accounted for 26.4% of all cases, followed by Germany with 16.2% and France with 14.3%. Among cases with known importation status (n=1 884), 58.6% are reported as domestically-acquired infections. Among imported cases with known probable country of infection (n= 679), 19.2% reported travel to India, 17.6% reported travel to Thailand and 10.5% reported travel to Egypt.

The number of reported cases has been relatively stable between 2007 and 2021, except for a notable peak in cases in 2010 (Figure 2). This is principally due to an increase of cases in Austria due to a foodborne outbreak linked to table eggs; outbreak investigations revealed that *S. Mbandaka* was introduced into the implicated laying hen flocks via contaminated commercial feed [4]. In 2020 and 2021, 70 and 97 cases respectively were reported to TESSy. This was considerably lower than the number of cases reported in previous years (average 182 cases reported annually between 2015 and 2019) and is likely due to the COVID-19 pandemic. During all years of surveillance, *S. Mbandaka* ranked 36th among reported serotypes.

Among cases with known information (n=2 925), 51.2% were female. There is a predominance of females in most years except in 2011, 2017, 2020 and 2021, when the number of males slightly exceeded that of females (Figure 3). Among domestically-acquired infections, the annual predominance of females is less common, and between 2015 and 2020, cases were more often reported in males than in females (Figure 4). There is strong evidence that the proportion of females in the age group 45-65 years was significantly higher than that of males ($p<0.001$) (Figure 5). In the period between 2007 and 2021, 32.1% of cases were reported during the summer/early autumn (August to October).

Further information can be found in ECDC's annual epidemiological report for 2020 [12] and the online 'Surveillance atlas of infectious diseases' [13].

Figure 2. *S. Mbandaka* cases by year, EU/EEA and the UK (up to 2019), 2007–2021, (n=2 978)

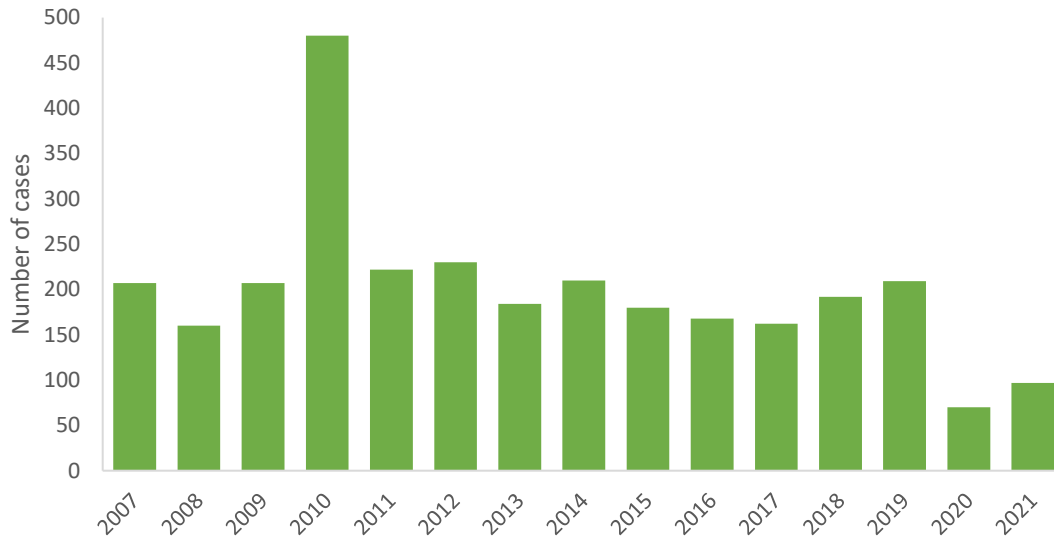


Figure 3. *S. Mbandaka* cases by gender and year in the EU/EEA countries and the UK (up to 2019), 2007–2021 (n=2 925)

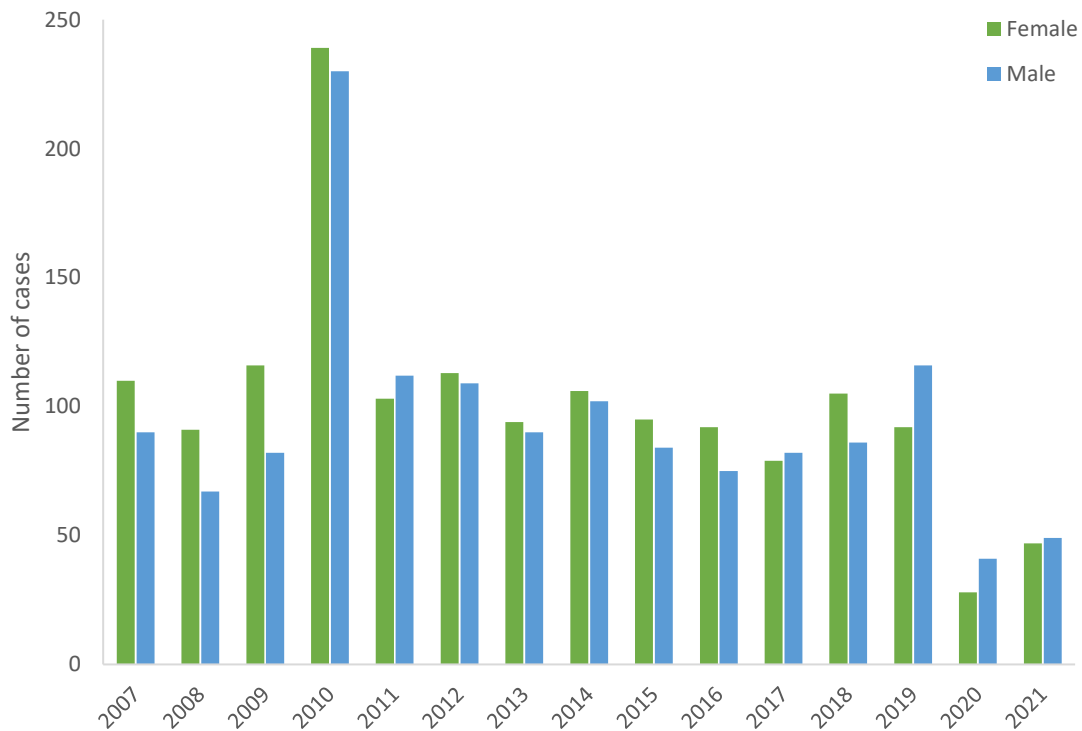


Figure 4. Domestically acquired *S. Mbandaka* infections by sex and year in the EU/EEA and the UK (up to 2019), 2007–2021 (n=1 315)

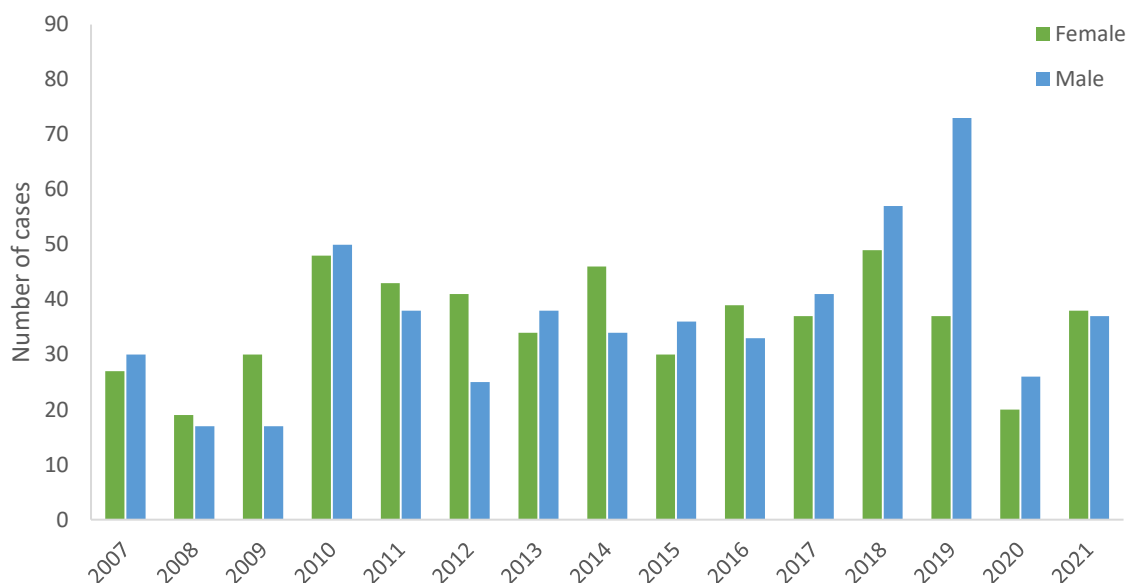
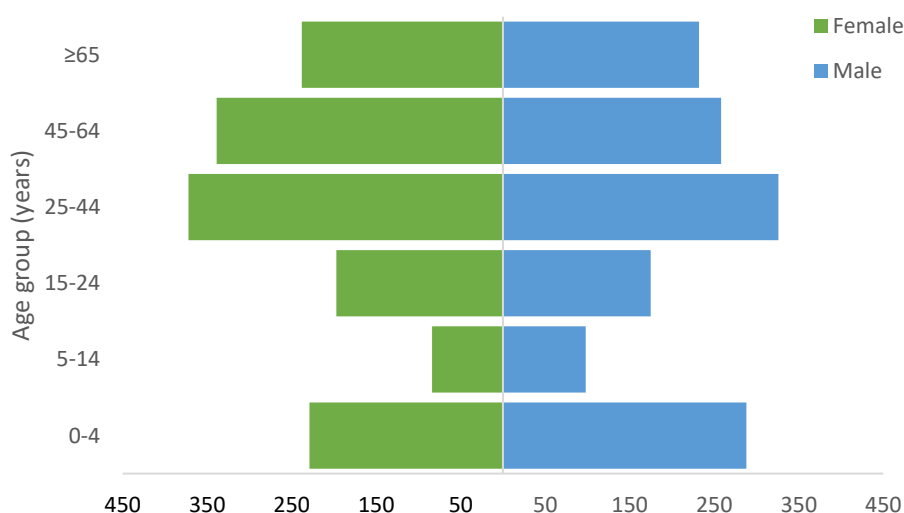


Figure 5. *S. Mbandaka* cases by age group and sex in the EU/EEA and the UK (up to 2019), 2007–2021 (n=2 836)



Food-borne outbreaks caused by *S. Mbandaka*

This section summarises country-specific data on foodborne outbreaks associated with *S. Mbandaka* as reported from 2016 to 2020 to EFSA by EU Member States in accordance with the Zoonoses Directive 2003/99/EC.

During these five years, two weak-evidence foodborne outbreaks caused by *S. Mbandaka* were reported by Spain in 2016 and Slovakia in 2018. The reported food vehicles were ‘Unknown’. In total, 13 human cases were reported (11 cases in Spain and two in Slovakia). One non-EU country (Serbia) reported one strong evidence foodborne outbreak in 2018. The reported food vehicle was ‘eggs and egg products’. There were eight reported cases. Among the reported outbreaks, there were no hospitalised patients and no deaths.

Occurrence of *S. Mbandaka* in food

This section summarises country-specific data on the occurrence of *S. Mbandaka* for the matrices ‘Food – RTE’ and ‘Food non-RTE’ from 2016 to 2020 as reported to EFSA by the EU Member States in accordance with the Zoonoses Directive 2003/99/EC.

During this five-year period, 74 units positive for *S. Mbandaka* out of 62 846 total units tested (0.11%) were reported to EFSA for the matrices 'Food RTE' and 'Food non-RTE' by 14 EU Member States (Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, France, Hungary, Italy, Latvia, the Netherlands, Poland, and Slovakia).

The two units positive for *S. Mbandaka* out of the 392 total units tested (0.51%) for the matrix 'Food RTE' were reported by one EU Member State (Hungary) and belonged to 'Other processed food products and prepared dishes' (reported in 2017 and 2020).

The 72 units positive for *S. Mbandaka* out of the 62 454 total units tested (0.11%) for the matrix 'Food non-RTE' belonged to the following matrices: 49 units positive from 'Meat from broilers (*Gallus gallus*)' (two units from Austria in 2018 and 2019, 14 units from Belgium from 2016 to 2019, four units from Croatia in 2018 and 2019, one unit from Czechia in 2018, two units from Italy in 2020, one unit from Latvia in 2019, 17 units from the Netherlands from 2017 to 2020, seven units from Poland in 2018, and one unit from Slovakia in 2017); six units positive from 'Meat from pig' (one unit reported by Bulgaria in 2018, one unit by Denmark in 2019, one unit by Estonia in 2016, two units by France in 2019, one unit by Italy in 2018); five units positive from 'Meat from bovine animals' (one unit from Estonia in 2018, two units from France in 2019, one unit from Hungary in 2020, and one unit from Italy in 2020); four units positive from 'Meat from other animal species or not specified' (one unit reported by Croatia in 2018 and three by Italy in 2017, 2018, and 2019); three units positive from 'Meat from spent hens' (three units reported by Belgium in 2018); two units positive from 'Meat from duck' (two units reported by Denmark and Hungary in 2019 and 2017, respectively); two units positive from 'Other processed food products and prepared dishes' (two units reported by the Netherlands in 2017); one unit positive from 'Meat from poultry, unspecified' (one unit reported by Poland in 2019).

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