Part 1: *Salmonella* Strathcona outbreak investigation, Austria, 2023

Part 2: Antimicrobial resistance profiles of *Salmonella* spp. Isolates from 2000-2023 in Austria

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Salmonella Strathcona: International Context

EpiPulse Event 2023-FWD-00090

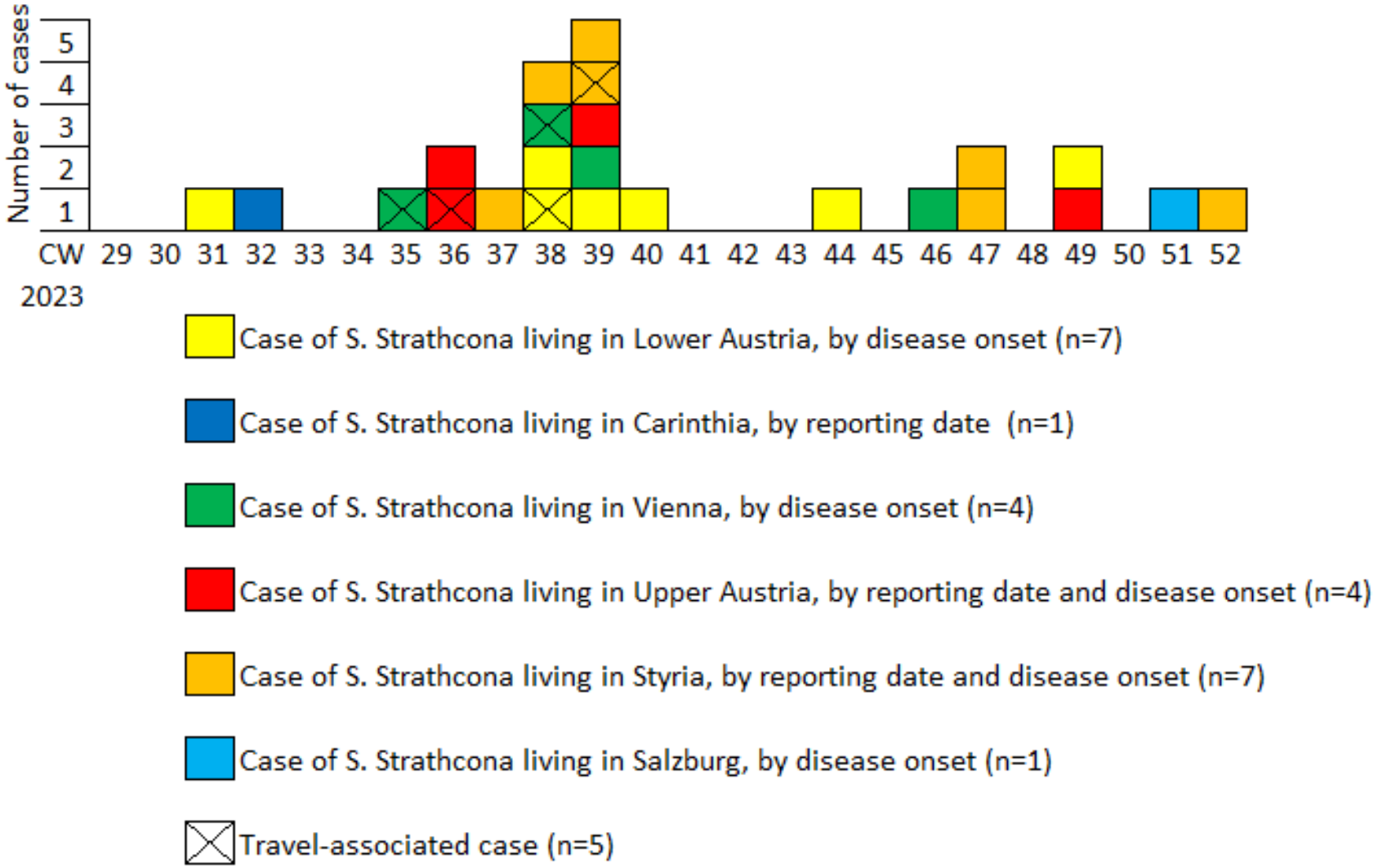
- **27.10.2023:** EpiPulse Event published by Germany
- Additional cases were found in the following countries: N=201
  - Italy N=62
  - Germany N=47
  - Austria N=24
  - Czechia N=13
  - UK N=13
  - France N=9
  - USA N=8
  - Switzerland N=8
  - Croatia N=6
  - Denmark N=5
  - Sweden N=2
  - Finland N=2
  - Norway N=1
  - Luxembourg N=1

Descriptive Epidemiology in Austria

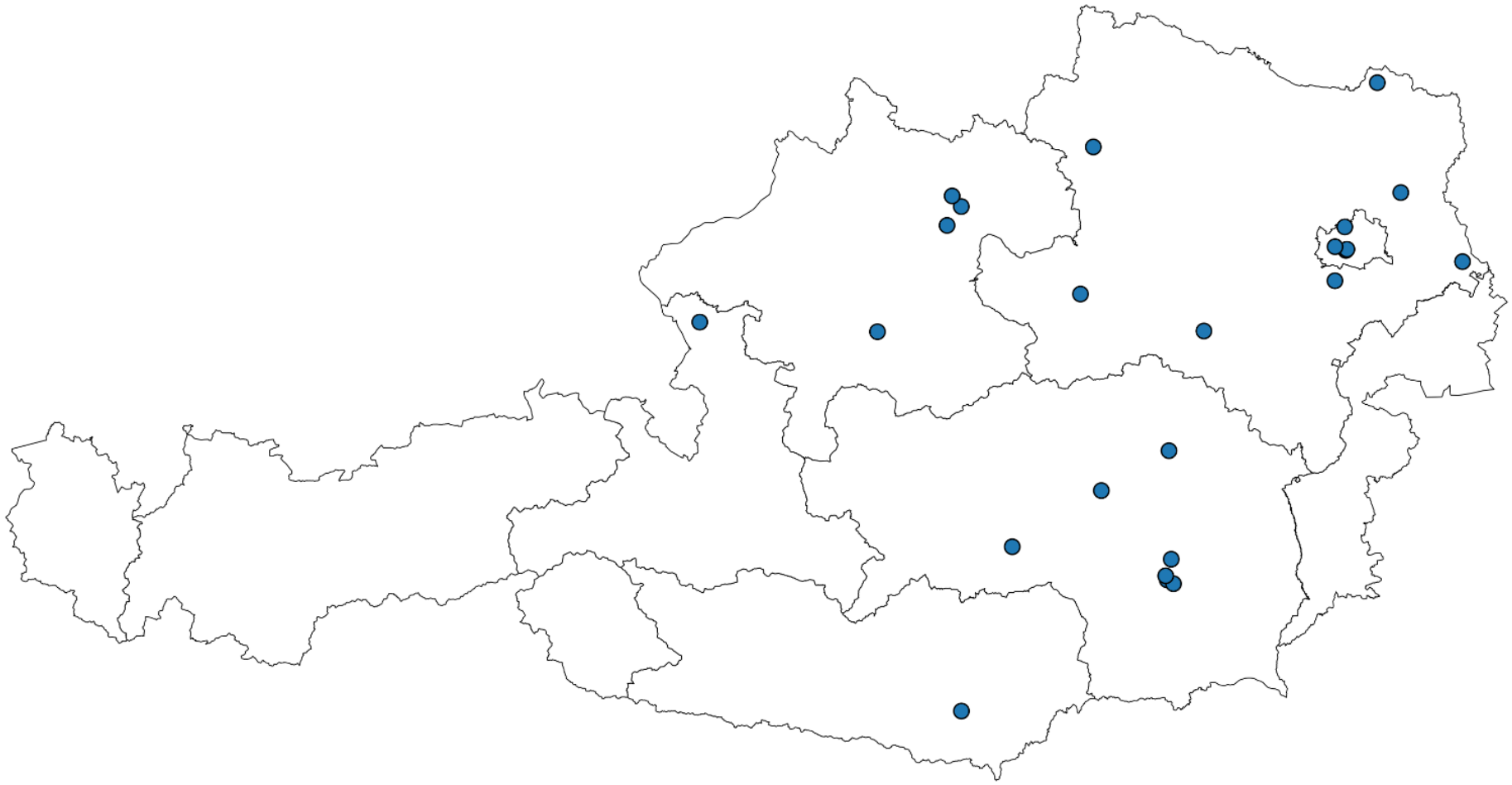
Salmonella Strathcona– META AUSBRUCH 64

- **20.10.2023:** AGES reported a potential foodborne outbreak to the MoH caused by *Salmonella* Strathcona ST2559 CT3910
- N=24 confirmed cases occurred in 6/9 provinces (K, NÖ, OÖ, S, ST, W) between August and December 2023
  - Median age 44 (min 14 - max 77 years)
  - 8 cases male (33%)
- N=4 hospitalisations
- N=0 deaths
- 19/24 interviews completed
- 5/24 cases travel-assoicated: Montenegro (n=2), Italy (n=1), Croatia (n=1) and unknown country of travel (n=1)

Outbreak cases with *S.* Strathcona infection by calender week of date of onset and by province of residence, Austria, 2023, n=24

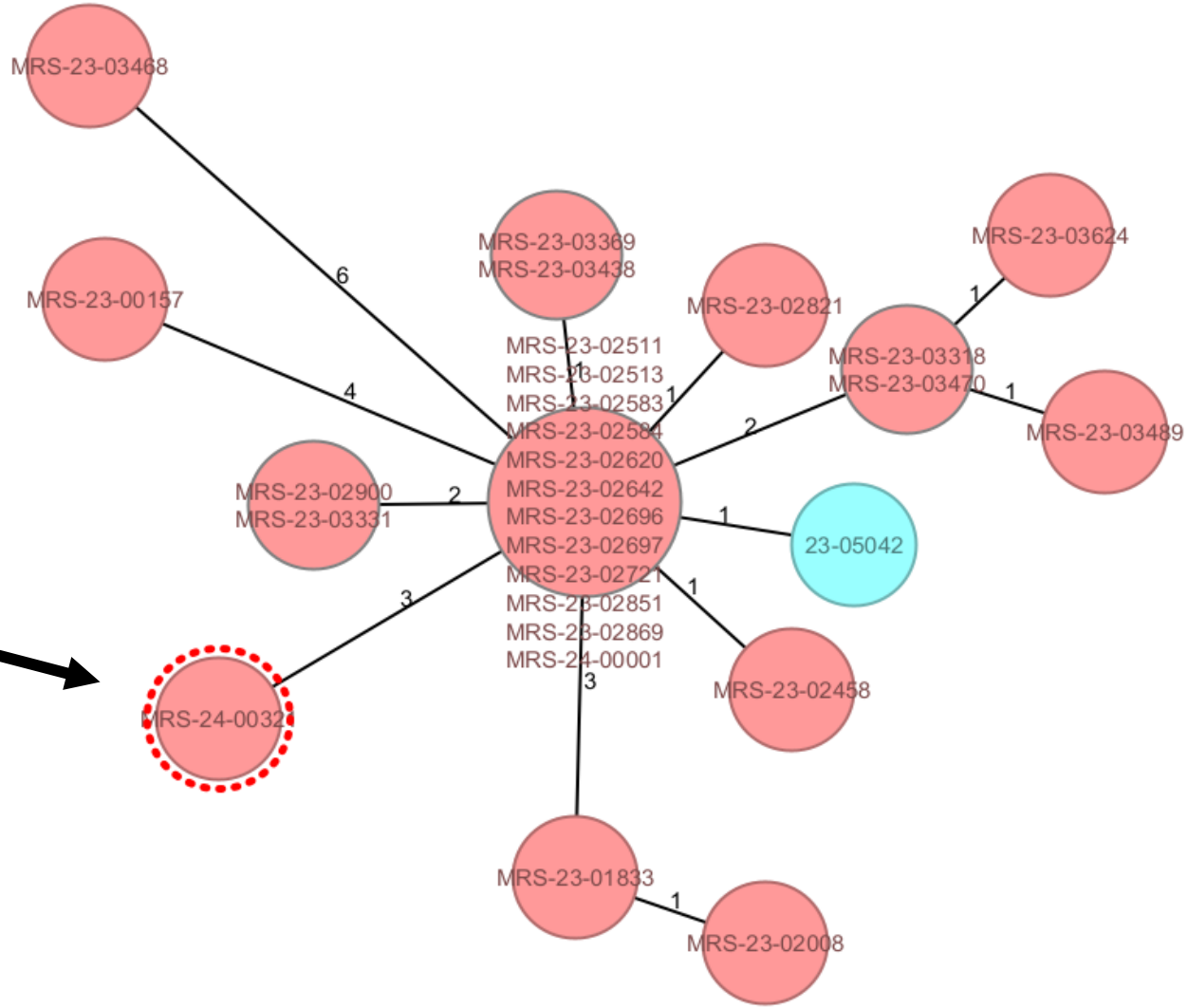


Regional distribution of *S.* Strathcona outbreak cases by postal code, Austria, 2023, N=24



Microbiology: Minimum Spanning Tree

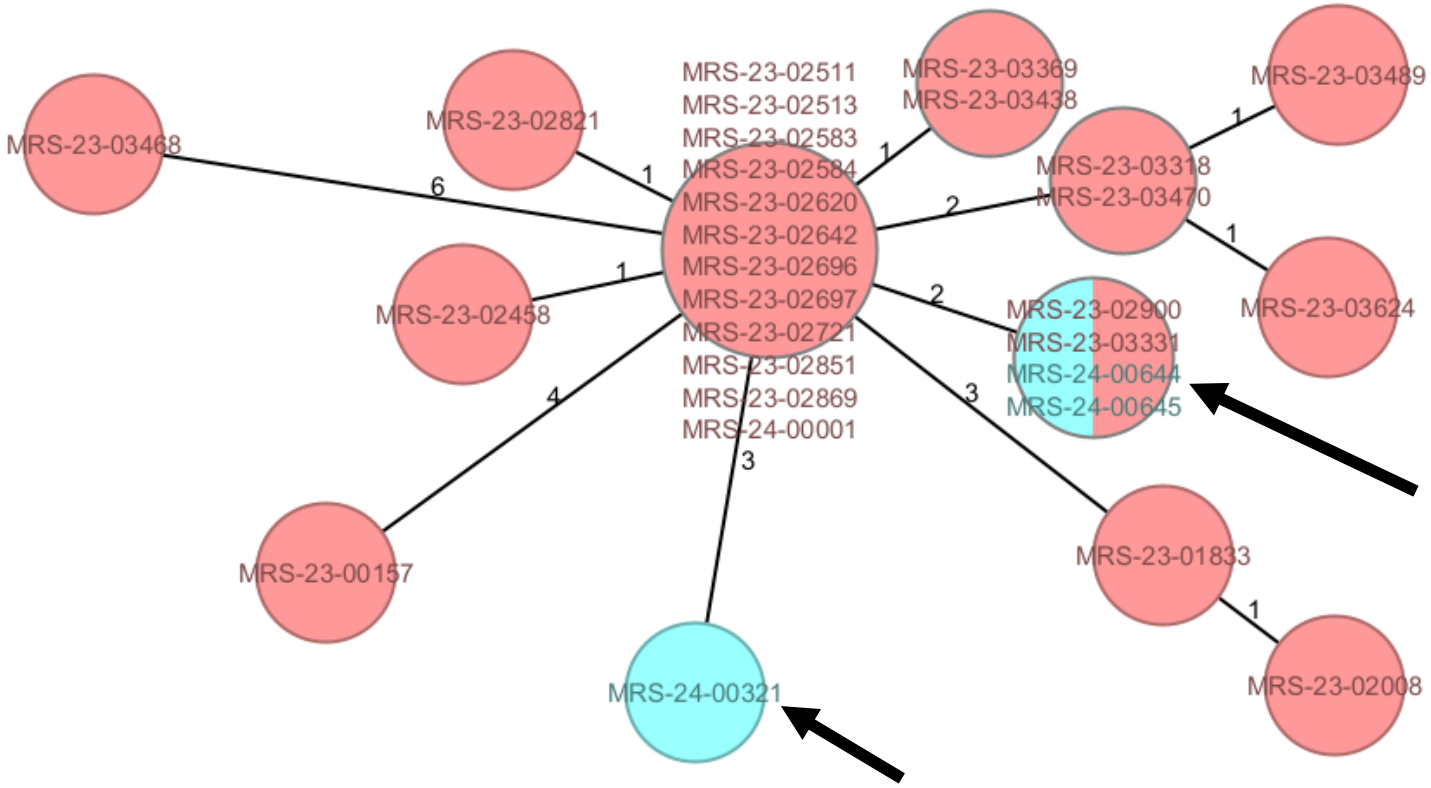
- Human isolates in red (N=26)
  - Two cases were excluded:
  - MRS-23-00157 – consistent carrier state
  - MRS-23/03468 – >5 AD
- Sewage sludge isolate from waste water treatment plant from January 2024 in red dotted circle
- Reference strain in blue from Germany (N=1)



Microbiology: Minimum Spanning Tree

S. Strathcona positive isolates from one laying hen flock in Lower Austria

- New: Non-human isolates in blue (n=3)
- New: Laying hen flock associated with Case 18: positive for outbreak strain on 18.03.2024
  - Dust specimen
  - Boot swab
- 0 AD difference to outbreak case in red: MRS-23/03331
- „Case 18“ Date of onset: 04.11.2023



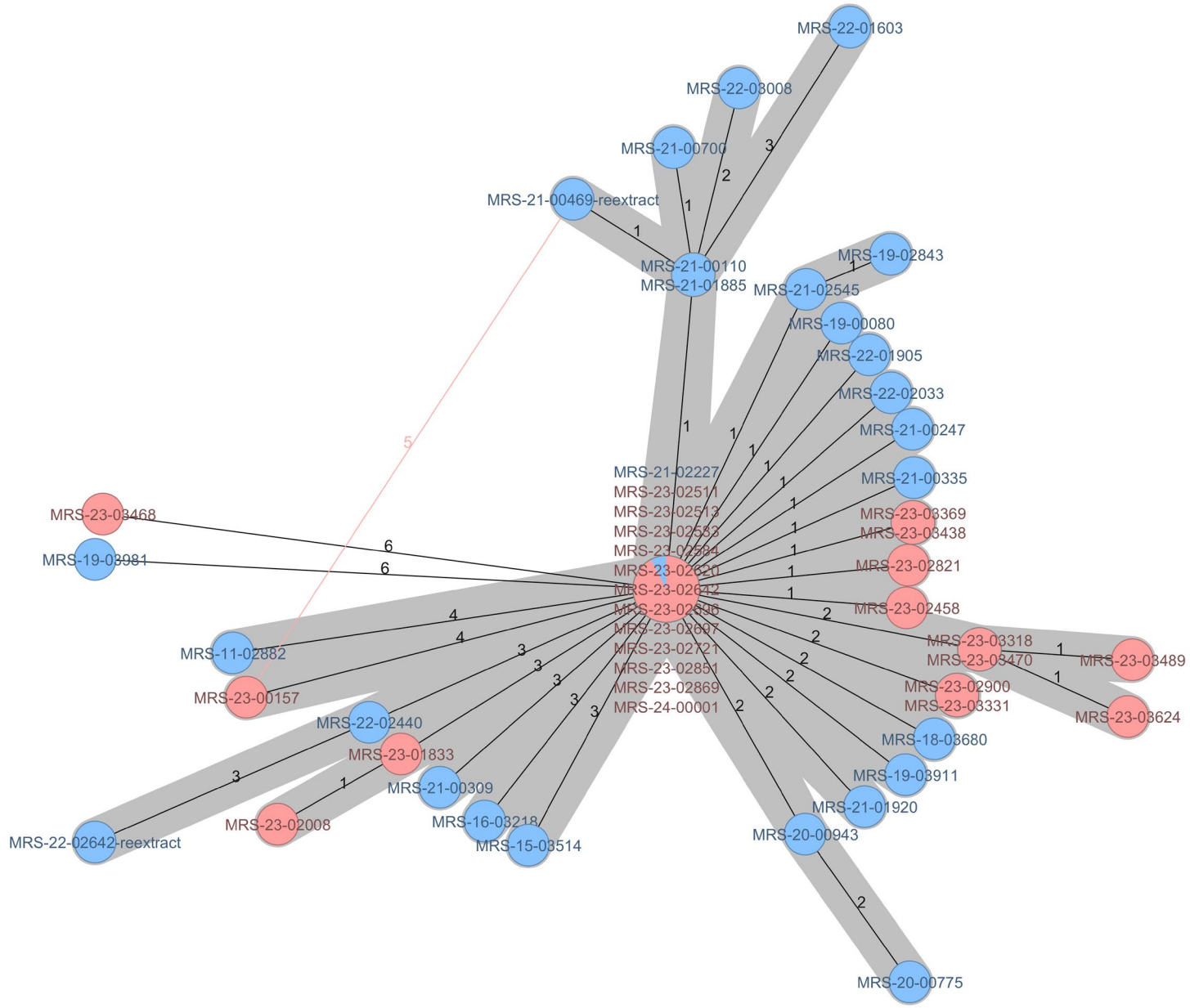
03.2024: Laying hen isolates

01.2024: Sewage sludge isolate

Microbiology: Minimum Spanning Tree

Historical cases 2011-2022

- Human isolates from 2023 in red (N=26)
- Human isolates from 2011-2022 in blue (N=24)
  - 2011: n=1
  - 2015: n=1
  - 2016: n=1
  - 2018: n=1
  - 2019: n=4
  - 2020: n=2
  - 2021: n=9
  - 2022: n=5



Results from case interviews in Austria

- Interviews on eating habits, purchasing behaviour and potential exposures were conducted using a standardised questionnaire (interviews performed by one person)
- Out of the 14 cases interviewed without travel association, 13 reported shopping at **Spar/Eurospar/Interspar and one received food basket with products from Spar**

- 13/14 cases reported eating **small tomatoes with vine** prior to their illness
- A second round of interviews revealed the following preferences:
  - **Packaging preference:** 12/12 cases purchased their tomatoes in cardboard trays that were wrapped in plastic
  - **Cultivation method preference**: 12/12 cases purchase organic tomato products
  - **Country of origin preference:** 9/12 cases reported purchasing small tomatoes from outside of Austria
  - **Product preference:** 9/12 cases reported purchasing organic cherry tomatoes

Food traceback investigation for „food basket“

- „Case 23“ (71a, m, Lower Austria)
  - 29.11.2023: 18 crates of **organic cherry tomatoes** were „deleted“ from the central SPAR warehouse register
  - 01.12.2023: A donation of food was collected from the central SPAR warehouse
  - 02.12.2023: A „food basket“ was distributed by a humanitarian aid organisation to family of case
  - 05.12.2023: Date of disease onset of case 23
  - 15.01.2024: Information became available that the tomato product has been delivered by a supplier from Country X on 22.11.2023
  - **19.01.2024: Austria wrote an inquiry for Country X via RASFF**
  - 23.01.2024: Primary producer identified
  - 30.01.2024: Further investigation regarding distribution supply chains of product from this primary producer as well as potential microbiological testing of water source

Could the supplier from Country X have supplied the organic cherry tomatoes to the other outbreak cases? (Delivery info available for 11/14 cases)

Case - EMS ID	Date of onset	Supermarket address	Time period of interest (2 weeks prior to onset)
Fall 3 - 12675545	18.09.2023	Spar: Petrifelderstraße 25, 8042 Graz Interspar: Ostbahnstraße 3, 8041 Graz	05.09.2023 - 18.09.2023
Fall 4 - 12676693	01.10.2023	Spar: Rotmoosweg 40, 8045 Graz	17.09.2023 - 01.10.2023
Fall 7 - 12672048	03.08.2023	Spar: Laaer Straße 14-16, 2170 Poysdorf Spar: Neudorf b. Staatz 161, 2135 Neudorf im Weinviertel	20.07.2023 - 03.08.2023
Fall 8 - 12676773	28.09.2023	Spar: Friedrich-Schiller-Straße 74/76, 2340 Mödling	14.09.2023 - 28.09.2023
Fall 11 - 12674115	07.09.2023	Eurospar: Linzberg 19, 4209 Engerwitzdorf	26.08.2023 - 07.09.2023
Fall 12 - 12676788	29.09.2023	Eurospar: Linzberg 19, 4209 Engerwitzdorf Spar: Reichenauer Str. 9, 4203 Altenberg bei Linz	15.09.2023 - 29.09.2023
Fall 15 - 12675897	28.09.2023	Interspar: Grinzinger Straße 112, 1190 Wien	14.09.2023 - 28.09.2023
Fall 16 - 12675163	20.09.2023	Spar Gourmet: Porzellangasse 43, 1090 Wien	06.09.2023 - 20.09.2023
Fall 17 - 12679720	13.11.2023	Spar: Hütteldorfer Straße 180, 1140 Wien Spar: Meiselmarkt, 1150 Wien	30.10.2023 – 13.11.2023
Fall 18 - 12679929	04.11.2023	Spar: Hauptstraße 79, 2214 Auersthal	20.10.2023 – 04.11.2023
Fall 19 - 12680317	24.11.2023	Eurospar: Auweg 2, 8650 Kindberg	10.11.2023 – 24.11.2023

RASFF - Reply from Country X

Fup4 on 15.03.2024

Austria's questions:

1. Who are recipients countries of this product?
2. Was the water source tested for *Salmonella* spp.?
3. Valid „Organic-Certificate"?
4. Who is currently receiving product or has season ended?

Country X reply:

1. Slovakia, Austria, Germany, Poland, Italy
2. Yes, in January 2024, *Salmonella* spp. not detected
3. Yes, since 30.12.2022
4. Germany, Poland, Italy

RASFF - Reply from Austria

Fup5 on 08.05.2024 and Fup 8 on 21.05.2024

Austria's questions:

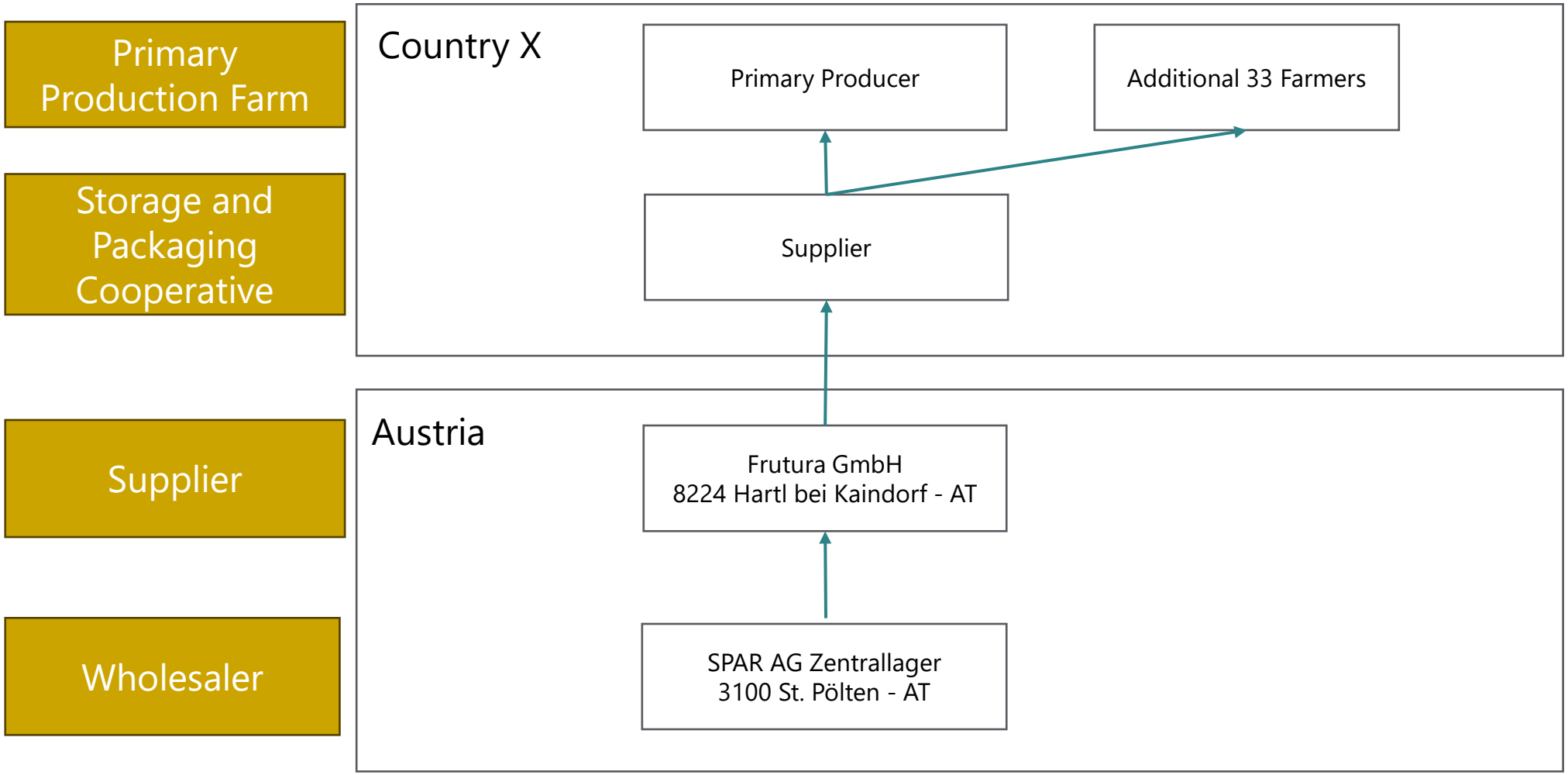
1. Potential link to the primary producer mentioned in RASFF 2011.5383?
2. More information regarding the supply chain who receive organic cherry tomatoes?
3. Information from primary producer about the production process: hydroponics, type of irrigation system, other products are grown at this site and whether they are watered using the same irrigation system?

Country X reply:

1. No link to between primary producers in 2011 and 2023
2. Additional information and delivery invoices provided
3. Irrigation method – automatic drip system and other products produced at this site include: cucumbers, cabbage, pepper, green beans, mango, papaya

Tracing investigation

Organic cherry tomatoes: Batch number 0000690532, Packaged by 20.11.2023, Delivered on 22.11.2023



Control measures in Austria

- **Since January 2024**, no new outbreak cases have been registered in Austria
- The hypothesis that „**small tomatoes with vine**“ could be the potential food vehicle is based on interviews with Austrian cases as well as case interviews from other EU countries
- Trace back of the supply chain of the organic cherry tomatoes, linked to „Case 23“ was investigated
- Food investigation performed : n=9 food specimens were taken by federal food inspectors for *Salmonella* spp. testing
  - Organic cherry tomatoes, organic San Marzano tomatoes and organic oval tomatoes
  - The results: *Salmonella* spp. not detected in 25g

Food investigation in Austria

Only organic tomato products produced outside of Austria were tested for *Salmonella* spp.

Nr.	Description	Place of sampling	Date of sampling	Specimen number	Microbiological Results for *Salmonella* spp.
1	Bio-Cherry Tomaten Mix	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167721	3/3 portions of sample Not detected in 25 g
2	Bio-Cherrytomaten Mix KL. I	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167722	3/3 portions of sample Not detected in 25 g
3	Bio-Cherrytomaten Mix KL. I	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167723	3/3 portions of sample Not detected in 25 g
4	Bio-Ovaltomaten , Kl. I	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167724	3/3 portions of sample Not detected in 25 g
5	Bio-Ovaltomaten , Kl. I	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167725	3/3 portions of sample Not detected in 25 g
6	Sizilianische Bio-Cherry-Tomaten, Kl. I an der Rispe	Frutura Obst & Gemüse Kompetenzzentrum GmbH 8224 Hartl Fruturastraße 1	21.12.2023	23167726	3/3 portions of sample Not detected in 25 g
7	Cherry Tomate MIX Bio	SPAR 8230 Hartberg, Bahnhofstraße 16	21.12.2023	23167729	3/3 portions of sample Not detected in 25 g
8	Bio Mini San Marzano	SPAR 8230 Hartberg, Bahnhofstraße 16	21.12.2023	23167730	3/3 portions of sample Not detected in 25 g
9	Bio-Cherry-Tomaten aus biologischer Landwirtschaft	SPAR 8230 Hartberg, Bahnhofstraße 16	21.12.2023	23167731	3/3 portions of sample Not detected in 25 g

Veterinary inspections at laying hen farm in Austria

- 01.2024 New herd arrived (1.500 laying hens)
- New herd tested: Negative for *Salmonella* spp. on 05.01.2024
- Veterinary inspection 03.2024: 1 out of 3 flocks positive for outbreak strain
- Results from human stool specimens confirms continuous carriage
- Official veterinarian believes that two other herds may be at risk due to insufficient hygiene control measures in place at farm
- Farm owner reported direct contact of hands with chicken feed, kitchen scraps are also given to laying hens
- Recommendations for stricter hygiene measures and monthly veterinary inspections, case will receive antibiotic therapy and stool will be retested
- Farm sells fresh eggs, various types of pasta
- No legal basis to cull flock (poultry hygiene act)

A summary of evidence for organic cherry tomatoes

- The evidence from epidemiological investigations from other countries indicates that there is a common food vehicle (aligned questionnaire)
- In Austria, other potential common food vehicles were eliminated (chicken, eggs, apples, raspberries, parmesan cheese) (EU-collaboration meetings)
- In Austria, the second round of interviews provided convincing evidence for the packaging preference for the type of tomatoes purchased
- In Austria, the case interviews indicated one common supermarket chain where purchases were made by all cases (case 23 via food basket)
- In Austria, the ONLY tomato product that went into the „food basket“ was organic cherry tomatoes

Next steps in the outbreak investigation

- In Austria: May 2, 2024: Confirmation that Spar will continue to receive tomatoes via supplier from Country X in the 2024 season
- In Austria: Intensified laboratory investigation and food sampling of cherry tomatoes planned
- Calculate packaging contamination level – number of cases/units received, units collected per location?
- Not looking to place blame – our common goal is to stop the outbreak

Part 2: Antimicrobial resistance profiles of *Salmonella* spp. Isolates from 2000-2023 in Austria

Antibiotic Resistance Testing for Salmonella Isolates in Austria

- The National Reference Center for *Salmonella* conducts resistance testing and evaluation for all isolates following EUCAST guidelines or CLSI (Clinical and Laboratory Standards Institute) guidelines.
- NRL-S receives all human and non-human isolates in Austria
- Testing methods include disk diffusion and minimum inhibitory concentration (MIC) testing using the ε-test for specific scenarios.
- Antibiotic selection aligns with current ECDC (European Centre for Disease Prevention and Control) recommendations.
- To detect low-level ciprofloxacin resistance, Pefloxacin is used instead of Ciprofloxacin, following EUCAST guidelines.

Antimicrobial susceptibility testing in Austria since 2000

N=16

- Ampicillin
- Chloramphenicol
- Streptomycin
- Sulfonamide
- Tetracycline
- Tigecycline
- Trimethoprim
- Gentamicin
- Kanamycin
- Nalidixic acid
- Ciprofloxacin/Pefloxacin
- Cefotaxime
- Ceftrazidime
- Meropenem
- Azithromycin

AMR in human Salmonella spp. isolates in Austria, 2023

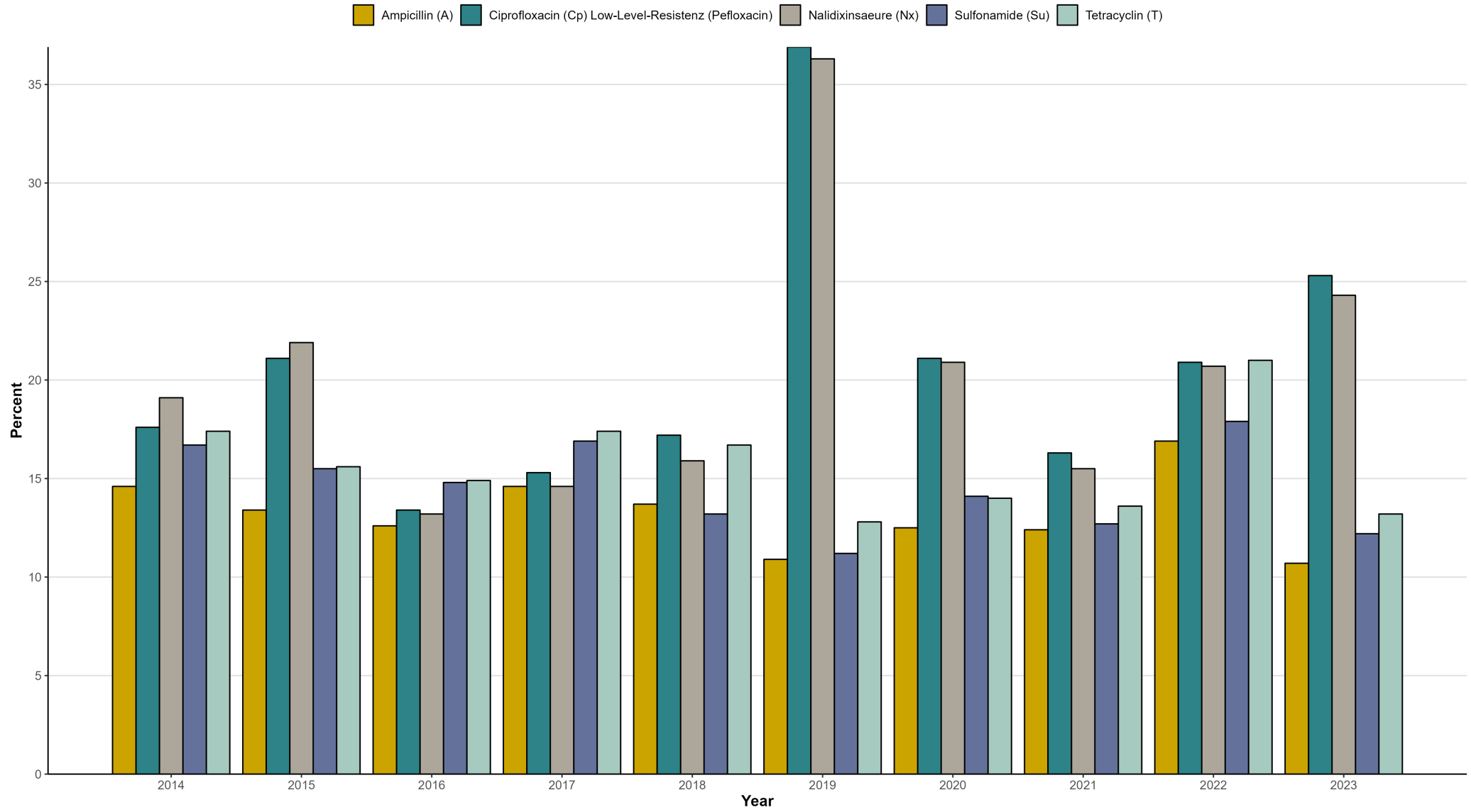
Total tested Salmonella spp isolates from human cases N=1218

- As in previous years, in 2023, the resistance rates against several antibiotics (ampicillin, sulfonamides, tetracyclines) were over 10%.
- The main cause for this is the increased occurrence of multidrug-resistant S. Typhimurium strains.
- Due to the frequent presence of nalidixic acid/low-level ciprofloxacin-resistant S. Enteritidis and S. Infantis isolates, the low-level ciprofloxacin resistance rate was 20.9%.
- The proportion of multidrug-resistant isolates (defined as resistance to three or more classes of antibiotics) was 17.2%

Proportion of resistance among human Salmonella isolates, comparison 2000 – 2023, Austria

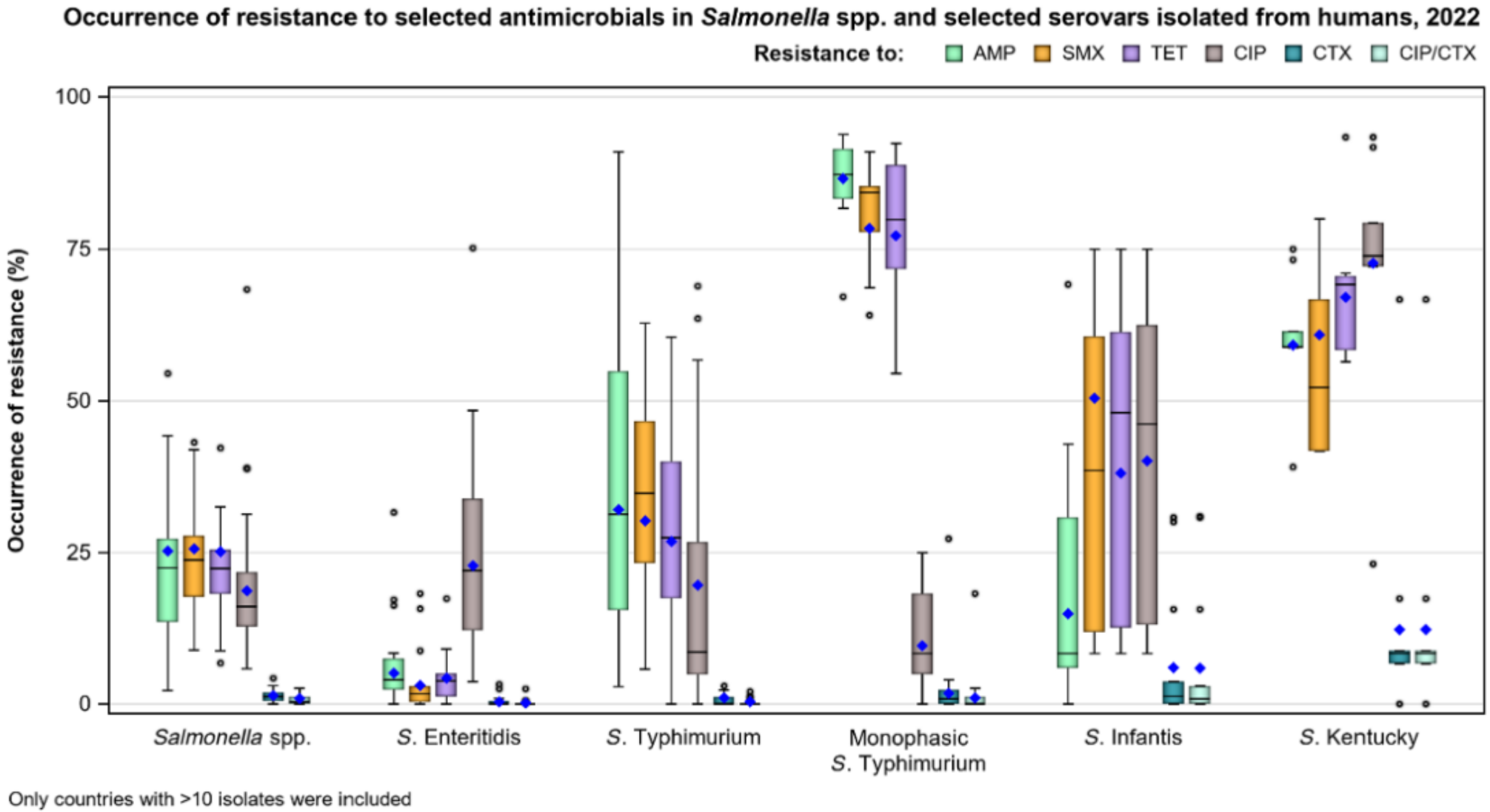
Antibiotic	2000-2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Ampicillin (A)	6,6	14,6	13,4	12,6	14,6	13,7	10,9	12,5	12,4	16,9	10,7
Chloramphenicol (C)	2,2	2,8	2,1	2,4	3,2	2,6	2,0	2,6	1,3	4,5	3,5
Streptomycin (S)	6,1	-	-	-	-	-	-	-	-	-	-
Sulfonamide (Su)	6,0	16,7	15,5	14,8	16,9	13,2	11,2	14,1	12,7	17,9	12,2
Tetracycline (T)	6,8	17,4	15,6	14,9	17,4	16,7	12,8	14,0	13,6	21,0	13,2
Tigecycline (Tig)	--	0,5 (8)	0,3 (5)	0	0	0,1 (2)	0,2 (4)	0	0,1 (1)	0,7 (8)	1,1 (13)
Trimethoprim (Tm)	1,6	3,5	2,1	2,6	2,5	2,0	2,3	2,9	2,1	2,9	3,3
Gentamicin (G)	0,5	1,9	1,2	1,2	0,9	1,2	1,2	0,4	0,5	1,5	1,1
Kanamycin (K)	0,7	-	-	-	-	-	-	-	-	-	-
Nalidixic acid (Nx)	6,9	19,1	21,9	13,2	14,6	15,9	36,3	20,9	15,5	20,7	24,3
Ciprofloxacin (Cp) High-Level-Resistence	< 0,1 (10)	2,3 (39)	1,2 (20)	0,9 (13)	0,9 (16)	1,2 (19)	0,9 (16)	0,7 (6)	0,4 (4)	0,7 (8)	0,8 (10)
Low-Level-Resistence (Pefloxacin)	-	17,6	21,1	13,4	15,3	17,2	36,9	21,1	16,3	20,9	25,3
Cefotaxime (Ctx)	0,2 (103)	0,9 (16)	0,4 (7)	0,5 (8)	0,5 (9)	0,8 (12)	0,5 (9)	0,4 (4)	0,4 (4)	0,5 (6)	1,1 (14)
Ceftazidime (Caz)	-	0,9 (15)	0,4 (6)	0,5 (7)	0,5 (8)	0,4 (6)	0,5 (9)	0,4 (4)	0,2 (2)	0,3 (4)	1,1 (13)
Meropenem (M)	-	0	0	0	0	0	0	0	0	0	0
Azithromycin (Azm)	-	-	-	-	0,6 (11)	0,6 (10)	0,3 (6)	0,3 (3)	0,1 (1)	0,3 (3)	0,3 (4)
Multiresistant	6,5	16,1	14,5	14,3	16,3	12,9	10,2	12,6	11,8	17,2	12
Total	**67937**	**1716**	**1630**	**1480**	**1706**	**1543**	**1882**	**906**	**1048**	**1166**	**1218**

Percentage of AMR in Salmonella Isolates, 2013-2014, Austria



Trends in resistance: EU Comparisons for 2022

Note: AMP, ampicillin; SMX, sulfamethoxazole; TET, tetracycline; CIP, ciprofloxacin; CTX, cefotaxime; CIP/CTX, combined 'microbiological' resistance to ciprofloxacin and cefotaxime; Blue diamond, resistance at the reporting MS group level; Horizontal lines represent median, boundaries are 25th and 75th percentiles



Source: The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2021–2022 (wiley.com)

joint EU Summary report on AMR is from EFSA AND ECDC and the figure showed is data from the FWD-Net.

Trends in resistance: EU Comparisons for 2022

Austria in Comparison to EU AMR Data

Occurrence of resistance to commonly used antimicrobials in human and/or veterinary medicine:

- For monophasic *S*. Typhimurium 1,4,[5],12:i:-
  - Austria reported a lower proportion of ampicillin resistance (67.2%) compared to other countries
  - Austria and Spain reported a lower proportion of sulfonamide resistance (64.1% and 68.7%, respectively)

Source: The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2021–2022 (wiley.com)

AMR in human Salmonella spp Isolates from 2000-2022, Austria

- Overall, the level of resistance is dependent on the number of travel-associated cases and the type of Salmonella outbreak that occur in a year
- Percentage of resistance genes are typically higher in a year when there is less *S.* Enteritidis – Inverse relationship
- Isolates of *S.* Concorde, *S.* Typhimurium, *S.* Kentucky and *S.* Infantis generally have higher levels of AMR

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