

UPDATE ON STEC IN THE EU AND ON EFSA MOLECULAR TYPING DATA COLLECTION

Mirko Rossi BIOHAW unit



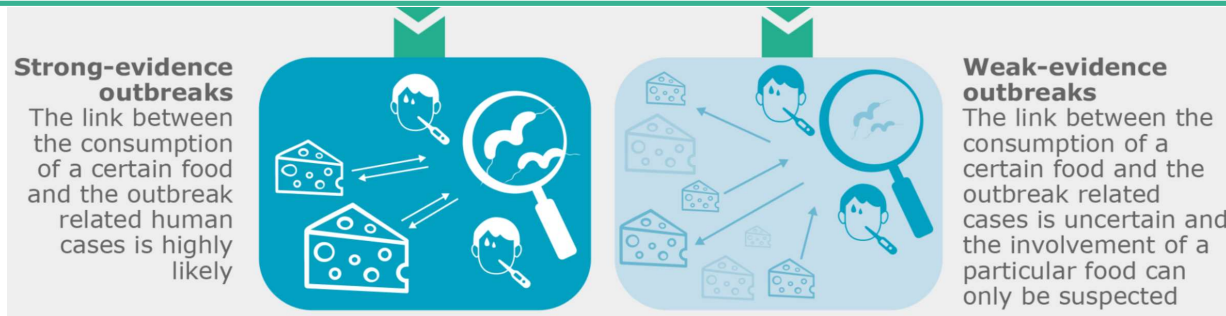
MONITORING OF ZONOSSES AND FOODBORNE OUTBREAKS IN EU

- **Mandatory monitoring** of zoonoses and foodborne outbreak in accordance with **Directive 2003/99/EC**
- Data collected
 - in the context of **Regulation (EC) No 2073/2005** => not detectable STEC O157, O26, O111, O103, O145 and O104:H4 in 25 g of product
 - All the other food and animal testing data originate from the reporting obligations of MSs under **Directive 2003/99/EC**
- **STEC monitoring data are non-harmonized** and not comparable between MS; no possible assessing temporal and spatial trends at EU level.

MONITORING OF ZOOSES AND FOODBORNE OUTBREAKS IN EU

- **EU-FORS***: current system for monitoring FBOs in the EU, implemented since 2010 and updated in 2014

Classification of foodborne outbreaks: '**strong**'-/'**weak**'-evidence outbreaks based on the strength of evidence implicating a suspected food vehicle as the cause of the outbreak



Strength of evidence: qualitative measure of the level of uncertainty which affects the likelihood that a food item is the vehicle of the outbreak. It is based on a carefully assessment of all available categories of evidence

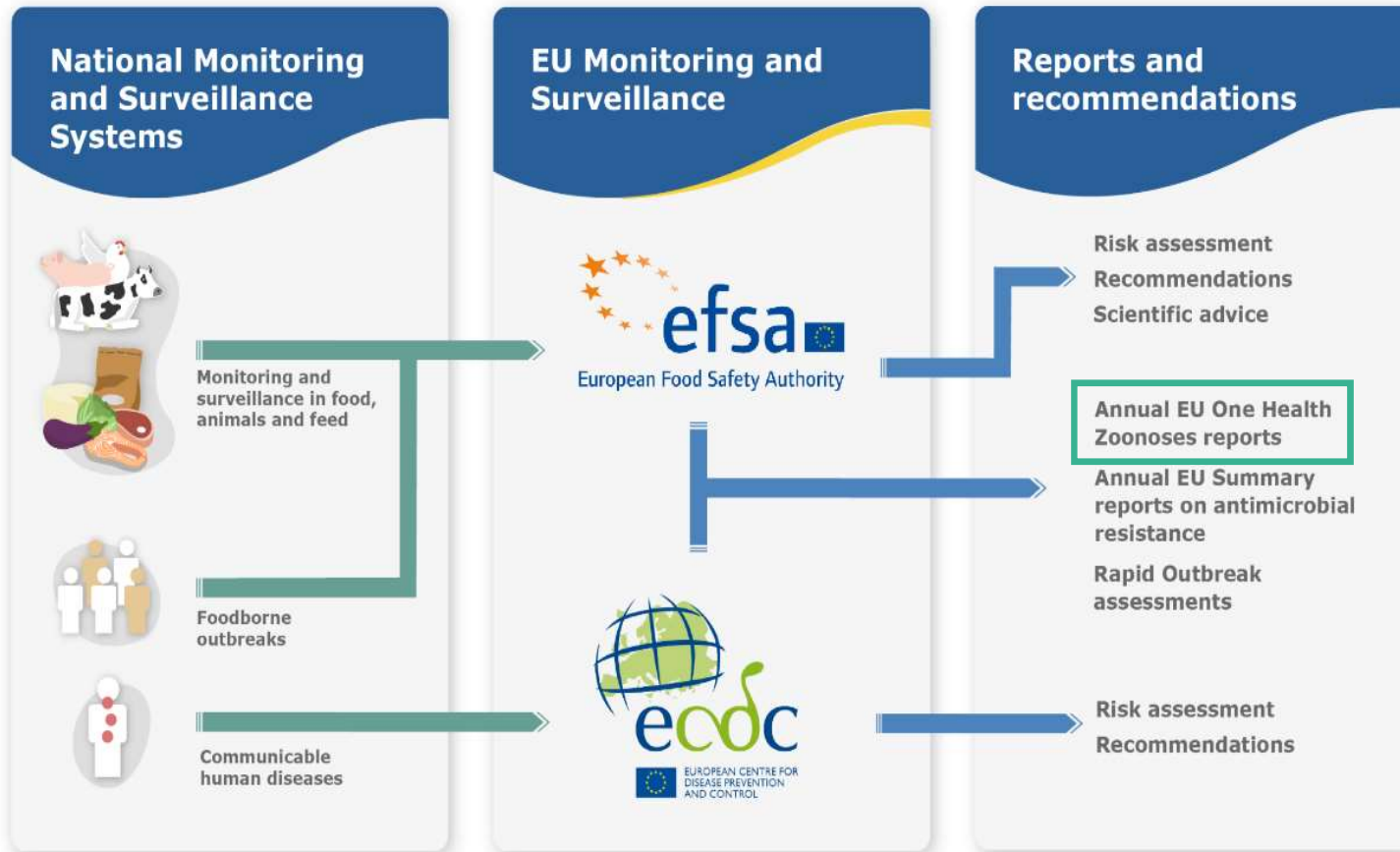
Although the data reporting rules follow the same standard EFSA harmonized specifications*, **foodborne outbreak surveillance activities are not fully harmonized across the EU**

Differences in sensitivity and type of outbreaks under surveillance may exist. Therefore, difference in the numbers and types of reported outbreaks, as well as in the causative agents, may not necessarily reflect the level of food safety among MS.

Aggregated findings at EU level and direct comparison between reporting countries should be interpreted with caution

*EFSA, 2014 available online: <https://efsa.onlinelibrary.wiley.com/doi/abs/10.2903/j.efsa.2014.3598>

EU ONE HEALTH ZOOSES REPORT (EUOHZ) & ONLINE TOOLS



SCIENTIFIC REPORT

APPROVED: 11 November 2022
doi: 10.2903/efsa.2022.7666

The European Union One Health 2021 Zoonoses Report
European Food Safety Authority
European Centre for Disease Prevention and Control

Abstract
This report of the European Food Safety Authority and the European Centre for Disease Prevention and Control presents the results of zoonoses monitoring and surveillance activities carried out in 2021 in 27 MS: the United Kingdom (Northern Ireland) and also non-MS: Kyrgyzstan, Singapore and...

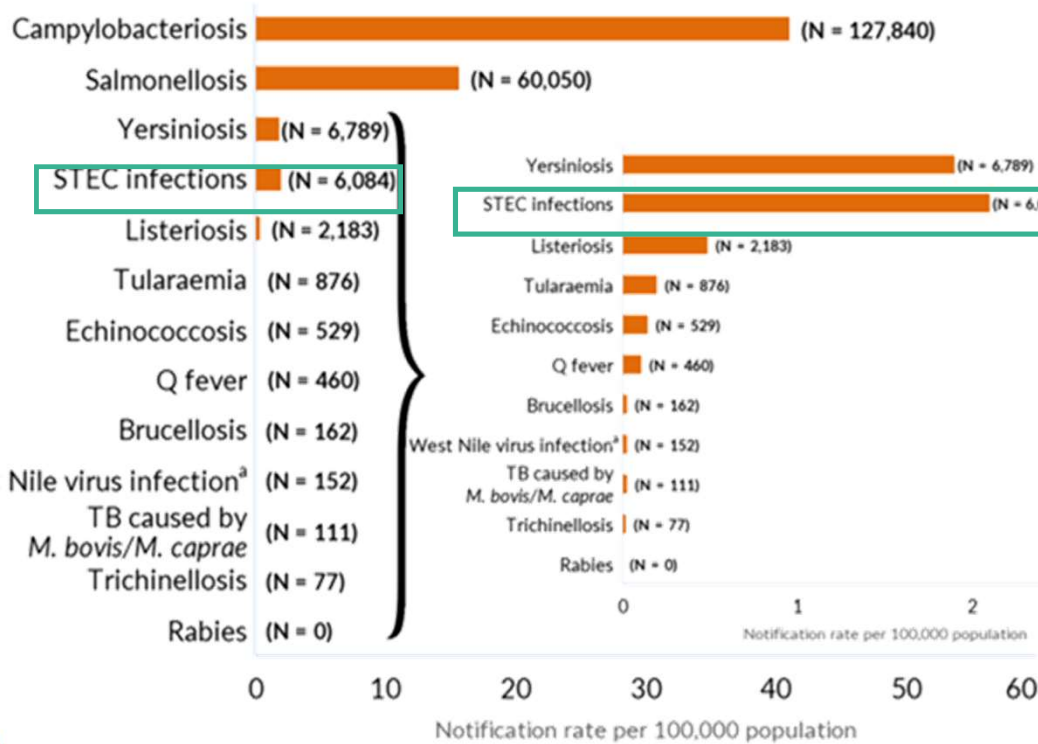
Foodborne outbreaks
STORY MAP

Foodborne outbreaks
DASHBOARD

For *E. coli* will be available for 2022 report



STEC, 2021 HUMAN DATA



Notification rate (per 100,000 population) **2.1**

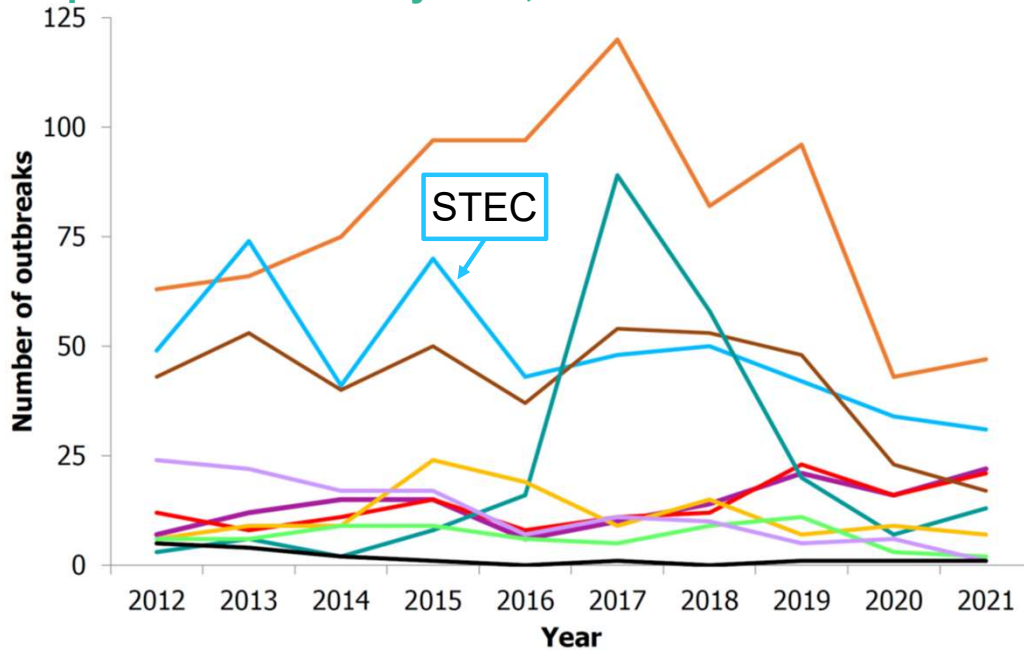
Trend (2017-2021) Increasing

6,084 Cases of illness

- 4,355 Infections acquired in the EU
- 117 Infections acquired outside the EU
- 1,612 Unknown travel status or unknown country of infection
- 901 Hospitalisations
- 18 Deaths

STEC, MONITORING OF **FOODBORNE OUTBREAKS** IN EU, 2021

Number of foodborne outbreaks by causative agent, reported to the EU by MSs, 2012–2021



Human cases in foodborne outbreaks

31 Foodborne outbreaks
 5 Strong-evidence outbreaks
 26 Weak-evidence outbreaks



275 Cases of illness

47 Hospitalisations

0 Deaths

Food vehicles causing strong-evidence outbreaks



Bovine meat and products thereof
2 Outbreaks



Milk
1 Outbreak



Vegetables and juices and other products thereof
1 Outbreak

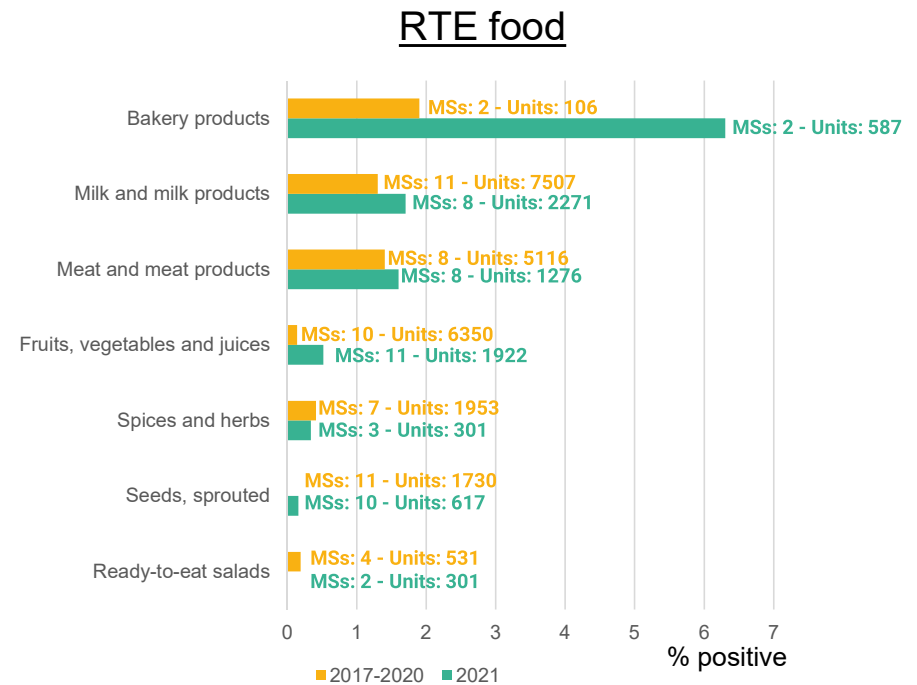


Meat and meat products, unspecified
1 Outbreak



STEC - MAIN FINDINGS IN FOOD AND ANIMALS

- 22 MSs reported the presence of STEC in **3.6% of 17,516 food samples** taken according to an '**objective sampling**' strategy
- Overall, STEC was most commonly found in '**fresh meat derived from different animal species**' (7% STEC-positive),
- 16 MSs tested 7,444 RTE food samples for STEC
- In RTE food the most commonly found positive was **bakery products (6.3%)**
- Testing of animal samples increased with 3,746 animal samples reported by 7 MSs (6.1%+), mostly cattle



SEROGROUPS AND VIRULENCE GENE TYPING

- Of the food isolates, 27.4% were provided with information, many belonging to the top 20 STEC serogroups reported in human
- Only 32.5% (N = 284) of the STEC isolated from food in 2021 were reported with information on virulence gene typing (stx1 or stx2 and eae)

Virulence genes profile	N of animal isolates in 2021 ^(a)	N of food isolates in 2021 ^(a)	N of human isolates in 2021 (%)	Relative frequency of the virulotype in ^(b)		
				HUS	Hospitalisation	Bloody diarrhoea
<i>stx2; eae+</i>	53	23	164 (34.1)	17.7	42.0	40.2
<i>stx1; stx2; eae+</i>	17	10	126 (26.2)	5.9	35.7	64.8
<i>stx1; eae+</i>	43	34	58 (12.1)	1.2	27.4	27.3
<i>stx2; eae-</i>	–	139	74 (15.4)	2.7	24.3	14.8
<i>stx1; eae-</i>	–	61	34 (7.1)	0.3	20.3	14.1
<i>stx1; stx2, eae-</i>	–	17	25 (5.2)	1.4	15.3	19.4
Total	77	284	481 (100)	–	–	–



ACKNOWLEDGEMENTS



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Raquel Garcia Fierro, Pierre-Alexandre Beloeil



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



Consortium ZOE: Consortium ZOE: Istituto Superiore di Sanità staff; Istituto Zooprofilattico delle Venezie staff; the French Agency for Food, Environmental and Occupational Health & Safety staff; Istituto Zooprofilattico Sperimentale dell'Abruzzo e del Molise "G. Caporale" staff; Istituto Zooprofilattico Sperimentale della Lombardia ed Emilia Romagna B. Ubertini – IZSLER staff

Data Providers

EFSA: Scientific Networks for Zoonoses Monitoring Data and AMR

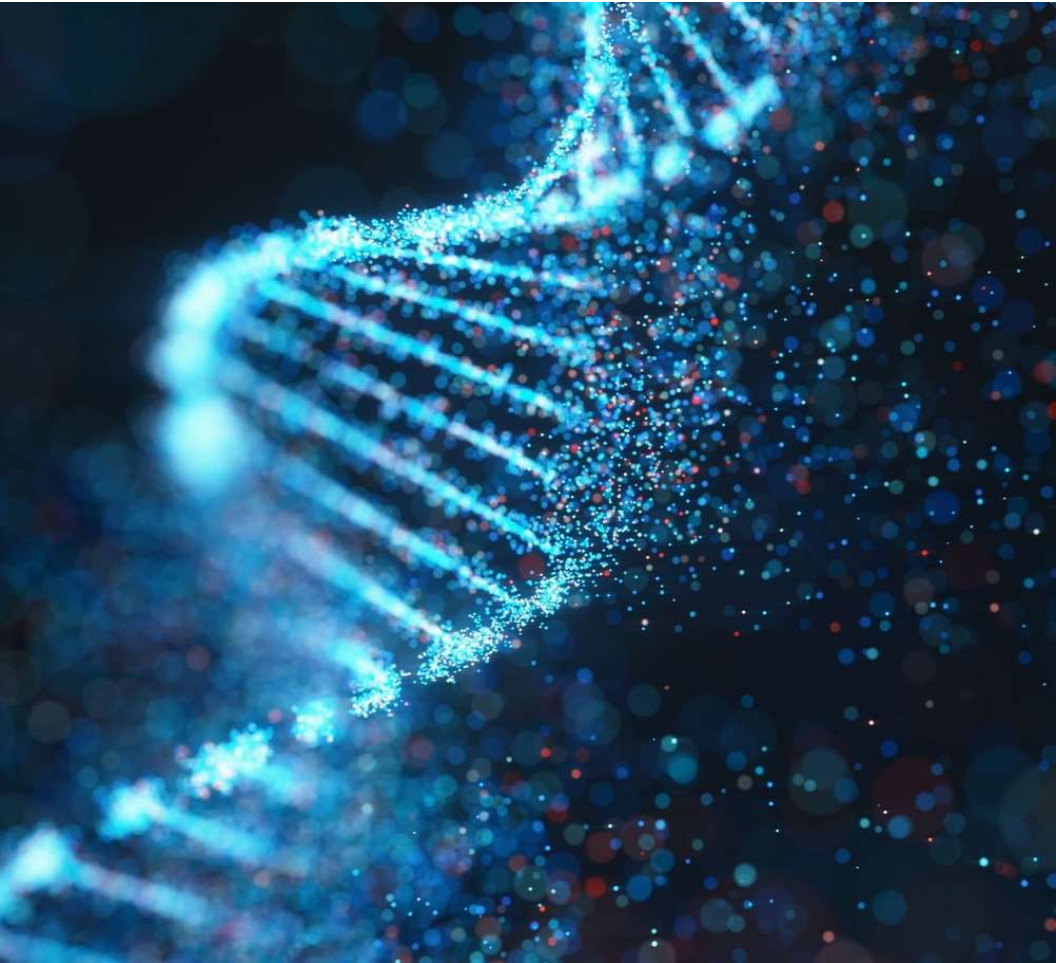
ECDC: Food and Waterborne Diseases and Zoonoses Network, Emerging and Vector-borne Diseases Network and the Tuberculosis Network

Contact in EFSA

✉ zoonoses@efsa.europa.eu

www.efsa.europa.eu



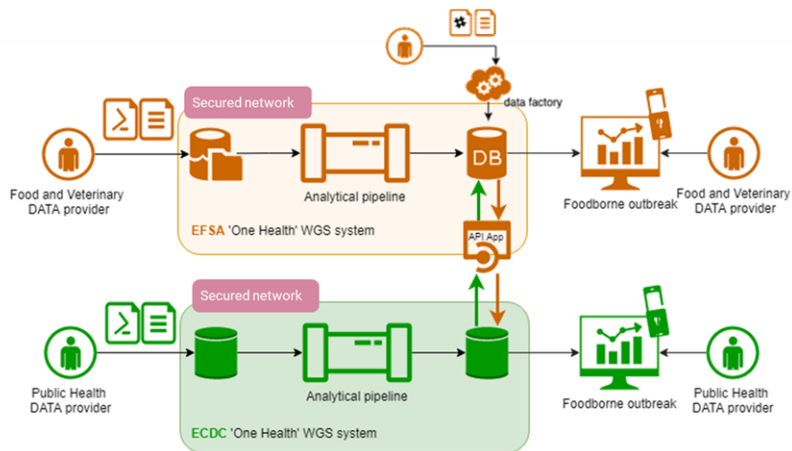


EFSA ONE HEALTH WGS SYSTEM



EU ONE HEALTH WGS DATA SHARING MODEL

- **Controlled-Centralized Data Sharing at sector level:** EFSA and ECDC collects data centrally based on their remit;
- **Cross-Sectoral Collaboration**



Requirement from the requestor



Interoperability



Cross-sector matches



Machine-to-machine

1. **Two platforms** collecting data from each sector
2. Detection of **joint microbiological clusters** of human and non-human food-borne pathogens isolates
3. Data **exchange on demand** when matches have been found
4. Automatic **exchange of WGS-based typing data** and epidemiological data between the two systems

The **One Health WGS system** is in operation since July 2022



WHO CAN ACCESS THE EFSA PLATFORM

EFSA system user type

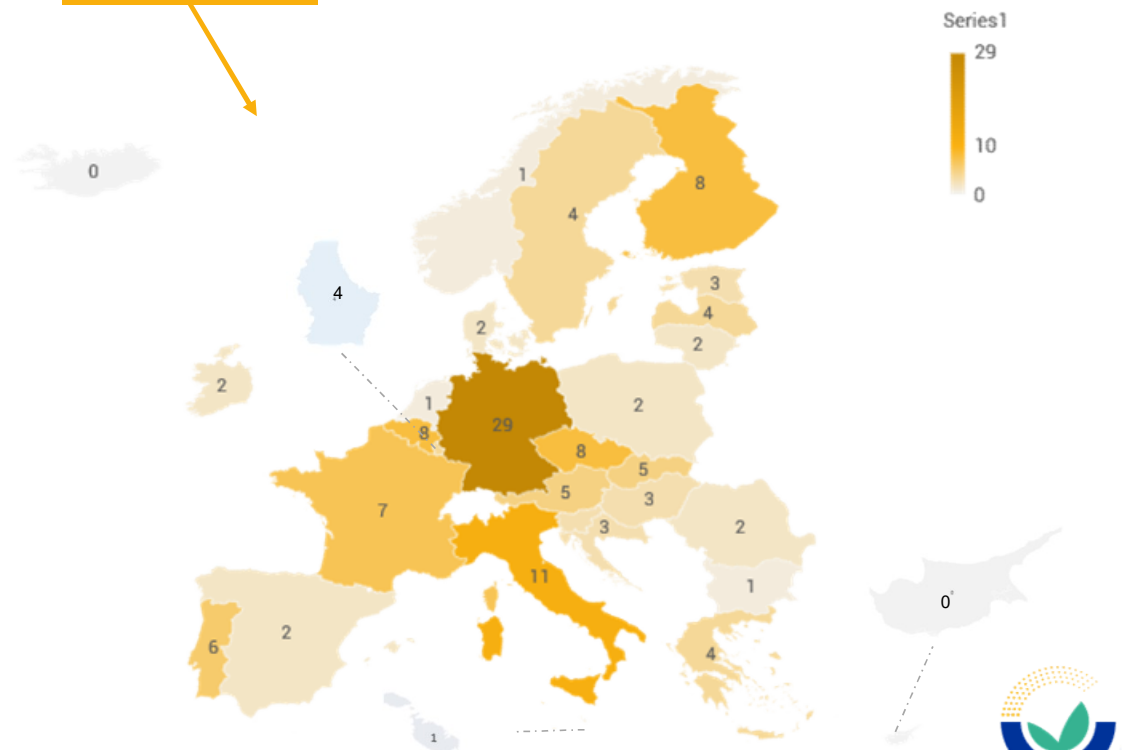
Country Officer

- Coordinate data provider organisations
- Contact point for EFSA
- Overview data submissions and results at country level
- Review annually list of data provider organisations

Data Provider

- Share typing data to EFSA Database
- Manage shared information (e.g. edit, delete)
- Perform analysis (search for matches, build trees, etc.) and compare the data
- Validate data

All EU/EEA countries appointed a Country Officer.
Data Providers are in total 132 from 27 EU/EEA



as of 15 August 2023



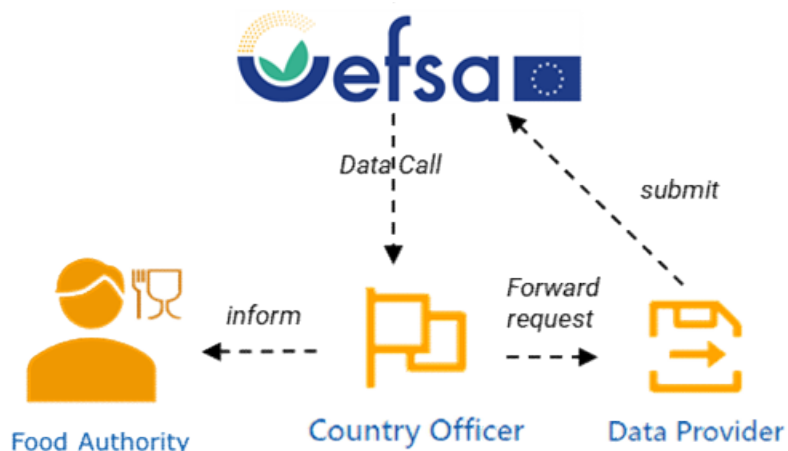
WHEN DATA ARE SHARED IN THE EFSA PLATFORM

REACTIVE

- Data calls for all countries when a outbreak assessment has been requested
- Data calls for specific countries on *ad hoc* basis
- Country officer is dispatcher of EFSA requests
- Country officer ensures coordination at MS level

PROACTIVE

- Data provider can share data at any time
- Each country has own strategy on sharing
 - All own checks data
 - Data collected for annual monitoring
 - Only in response to EFSA calls
 - ...
- EFSA network suggested to prioritize for sharing data prospectively data related to:
 - IRASFF notifications
 - outbreak national investigation
 - cross-sectorial national cluster
- MS are always invited to share data as response during outbreak investigation and monitoring



WHAT DATA ARE SHARED THROUGH THE EFSA PLATFORM

For each entry we collect experimental data and typing data and (optional) epidemiological data



Experimental data: information related to the experiment (*raw sequencing reads*)



Typing data: genomic profile and other typing data extracted from the raw sequencing reads

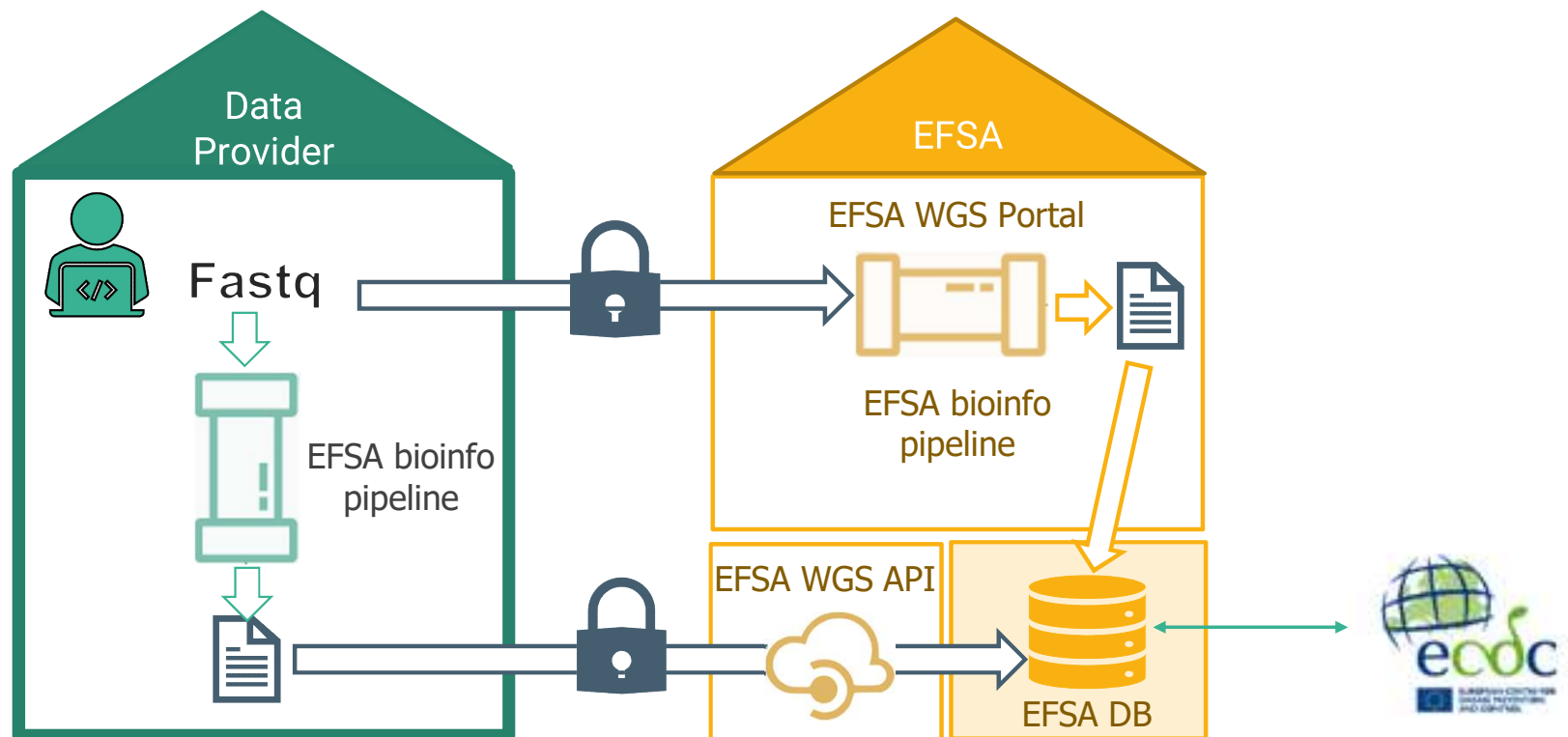


Epidemiological data: information related to the food, feed and animal samples from which the pathogen isolates linked to genomic profiles originated



HOW DATA ARE SHARED THROUGH THE EFSA PLATFORM

1. Share data using the WGS portal uploading *fastq* → take advantage of EFSA computing resources
2. Share data programmatically releasing directly profiles and typing data → control the entire process



HOW DATA ARE VISUALIZED: DATA OVERVIEW GRID

The screenshot displays the EFSA data overview grid interface. The top navigation bar includes 'Reports', 'Queries', and 'GrapeTree'. A user profile for 'ROSSI Mirko' is visible in the top right. The main area is a data table with columns for 'Status', 'Local raw reads ID', 'Status', 'Last modified on', 'Species', 'EpiData upload status', 'Pipeline run status', and 'Pipeline version'. A 'toolbar' is located above the table, containing buttons for 'Edit', 'Delete', 'Hide country info', 'Re-upload', 'Stop', 'Un-release', 'Generate GrapeTree', 'Query', and 'References'. A 'row actions' menu is open on the left, showing options like 'View', 'Edit', 'Delete FastQ', 'Download Fastq file', 'Execute', 'Release', 'Un-release', and 'Pipeline results'. A 'Details overview pop-up' is shown on the right, displaying a detailed view of a pipeline run with various metrics and status indicators. At the bottom, a 'filters' section allows users to refine the data view with checkboxes for 'Show only released', 'Show only uploaded not executed', 'Show only executed not released', 'Show public', and 'Show priv'. An 'Audit trail' label is also present on the left side of the interface.

row actions

toolbar

tables

Details overview pop-up

Audit trail

filters

HOW ECDC/EFSA INTERACT: THE QUERY WORKFLOWS

Recurring weekly querying

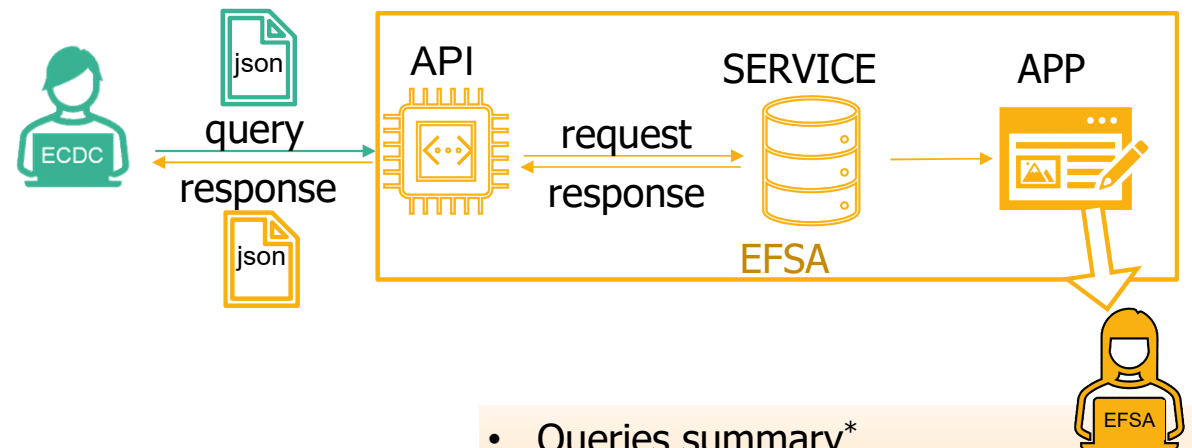
- **Indicator-based surveillance**
- Automatic weekly querying
- Cluster definition at ECDC
- Fixed threshold

Ad hoc querying

- **Event-based surveillance**
- Querying on demand
- Linked to events in EpiPulse
- Multiple thresholds

For any ECDC query finding matches

- A tree based on ECDC query only
- A query sent to ECDC
- A tree based on the query sent to ECDC



- Queries summary*
- MSTs including human and food data

*>30k queries since 1st of July 2022
Average 2500 queries each month



HOW MATCH FINDING IS VISUALIZED

The screenshot displays the EFSA WGS Portal interface. The top navigation bar includes 'Monitor', 'Data Overview', 'Reports', 'Queries', and 'GrapeTree'. The user is logged in as 'Remi Mestdagh (Admin)'. The main content area is titled 'Sent queries' and features a table of matches and a GrapeTree visualization.

Sent queries	Received query	Entries	ECDC ent
<input type="checkbox"/> test			
<input type="checkbox"/> SIM_2016-01.LJST.01.CC155.Ascl.0062.Apel.0528		MIG-2021-000267	
		MIG-2021-000262	
		MIG-2021-000216	
		MIG-2021-000026	
		MIG-2021-000035	
		MIG-2021-000240	
		MIG-2021-000043	
		MIG-2021-000212	
		MIG-2021-000254	
		MIG-2021-000204	
		MIG-2021-000251	
		MIG-2021-000215	
		MIG-2021-000033	
		MIG-2021-000049	
		MIG-2021-000027	
		MIG-2021-000231	
		MIG-2021-000214	

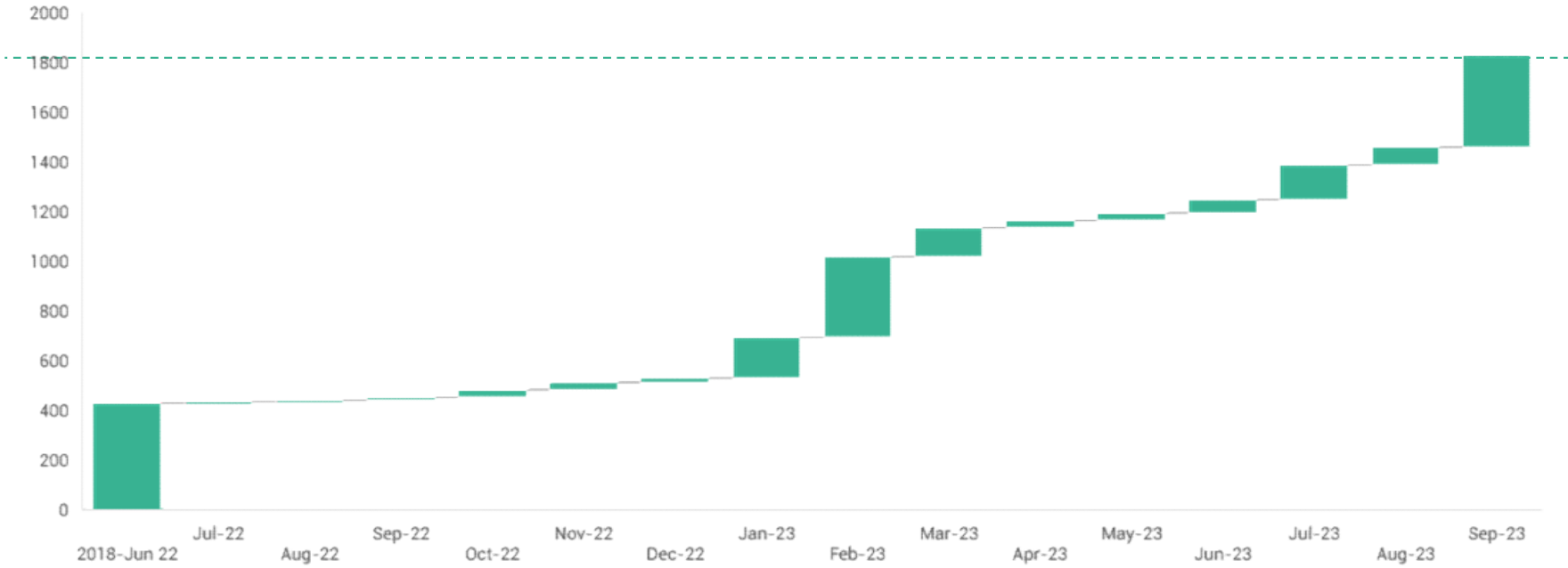
The GrapeTree visualization shows a star-like phylogenetic tree with a central node and several peripheral nodes. The nodes are color-coded by sampling year:

- 2016 (8) - Blue
- 2018 (5) - Light Blue
- 2016 (3) - Orange
- 2013 (2) - Yellow
- 2010 (1) - Green
- 2017 (1) - Dark Green

The interface includes a sidebar with 'Inputs/Outputs' (Load Files), 'Tree Layout' (Original tree, Static Redraw, Centre Tree, Show Tooltips), 'Node Style', 'Branch Style', 'Rendering' (Dynamic, Selected Only, Static, Real Branch Length), and 'Context Menu'.

At the bottom of the page, the text reads: 'WGS Portal v1.16.0 (Master-94) - WGS API v1.17.1 (Master-134)'.

MEMBER STATES CONTRIBUTION TO EFSA DATABASE



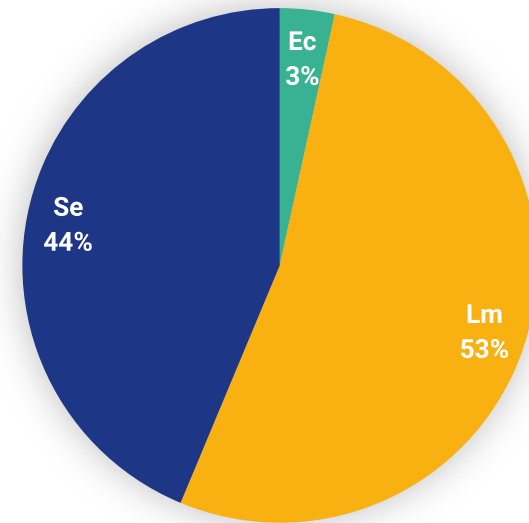
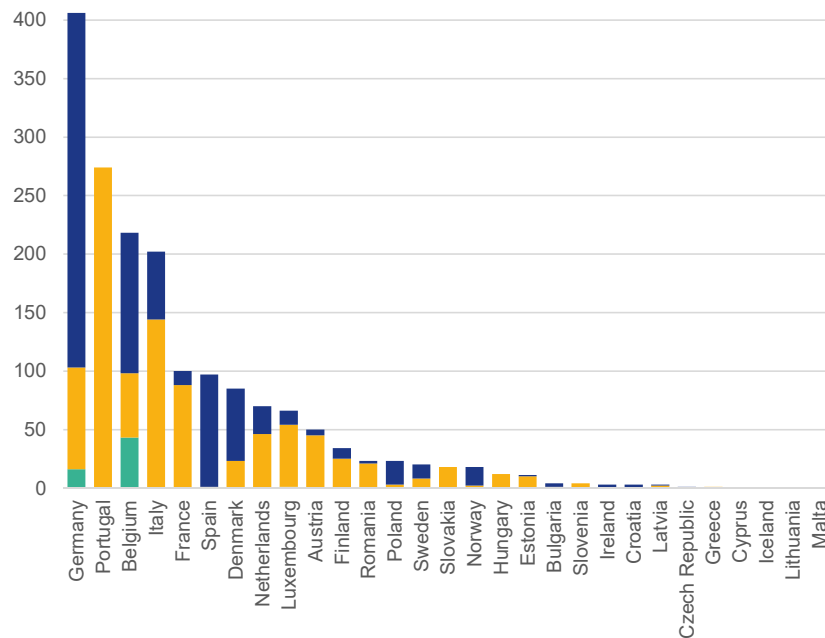
Legacy dataset
Info session
Info session
Info session
Open Data calls
Open Data calls
Open Data calls
Open Data calls
Open Data calls

as of 26 Sep 2023



MEMBER STATES CONTRIBUTION TO EFSA DATABASE

Uneven contribution from MS



Data shared by MS

In addition **imported from public repositories**

1000 *Salmonella*

4000 *Listeria*

as of 26 Sep 2023



E. COLI DASHBOARD - SEROGROUPS VS SAMPLING MATRIXES

Dashboards E. coli

Public All Epi Data All Sampling Date All Isolation Date All Country All Owner Organisation All Dashboards E. coli

Go to page: Dashboards E. coli

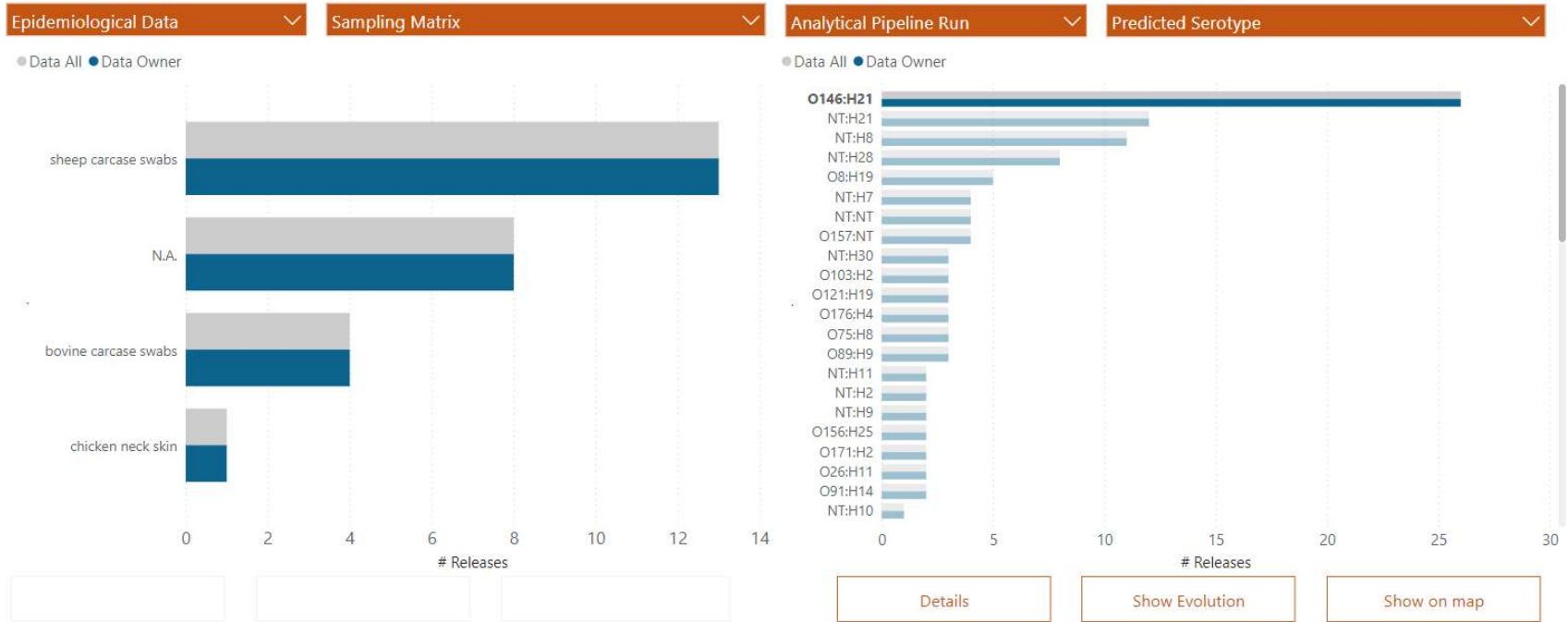
3 75%
Reporting countries

18 12%
Released profiles with EpiData

3 27%
Sampling matrixes reported

26 18%
Released profiles

1 1%
Public profiles



ENHANCEMENT OF THE BIOINFORMATIC ANALYSIS

- The bioinformatic analysis in the WGS system was designed to perform analyses in a standardized manner with minimal human supervision
- It serves its purpose well, but there is definitely room for improvement
 - Improve QC
 - Improve E. coli STX typing
 - ...
- How we would like to work:
 - Collect issues and complains from network and data provider
 - Discuss on regular basis with EURLs on the detected issues
 - EURLs will analyse the issue and propose solutions (also based on consultation on their NRL network)
 - EFSA will implement the solutions

