

# Susceptibility testing for AMR surveillance – problems and possibilities

Hanna Merk, Antimicrobial Resistance and Healthcare-Associated Infections (ARHAI) Section  
Antimicrobial Susceptibility Testing with EUCAST Criteria and Methods - Postgraduate course  
Programme, Tallinn, Estonia, 5 September 2024

# European Centre for Disease Prevention and Control (ECDC)



- An EU agency aimed at strengthening Europe's defences against infectious diseases.
- ECDC's mission is to identify, assess and communicate current and emerging threats to human health posed by infectious diseases.
- In order to achieve this mission, ECDC works in partnership with national health protection bodies across Europe to strengthen and develop continent-wide disease surveillance and early warning systems.



# Outline

- EARS-Net
- Problems and possibilities using the example of EARS-Net
  - Coverage
  - Continuity
    - Aim
    - Clinical data
  - Inconsistent reporting
  - Comparability
  - Timeliness
  - Resistance genes
  - Analysis
- Conclusion

# European Antimicrobial Resistance Surveillance Network (EARS-Net) - a short overview



- Routine antimicrobial susceptibility test (AST) results are collected from clinical laboratories by the national network representative in each participating country.
- If it is not possible to include data from all the relevant laboratories, countries can report data from sentinel laboratories.
- Only data from invasive (blood and cerebrospinal fluid) isolates are included.
- Phenotypic
- Qualitative SIR required
- Quantitative results possible
- 8 bacterial pathogens of public health importance:
  - *Escherichia coli*
  - *Klebsiella pneumoniae*
  - *Pseudomonas aeruginosa*
  - *Acinetobacter* species
  - *Streptococcus pneumoniae*
  - *Staphylococcus aureus*
  - *Enterococcus faecalis*
  - *Enterococcus faecium*
- 30 standard antimicrobial group-pathogen combinations.<sup>1</sup> + new antibiotics and combinations
- Case definition refers to [European Committee on Antimicrobial Susceptibility Testing \(EUCAST\) clinical breakpoints](#).

<sup>1</sup> <https://www.ecdc.europa.eu/en/publications-data/antimicrobial-resistance-amr-reporting-protocol-2024>

## EARS-Net AMR data collection

- The network was established in 1998.
- Data for the previous year are collected annually.
  - For example, in 2024 data for 2023 are collected.
  - The data collection starts in Q2, and data are frozen in Q3.
- Data consist of two datasets:
  1. Isolate level antimicrobial susceptibility data. There are case definitions for these data.
  2. Aggregated data on population coverage, representativeness, and data for calculation of the blood culture rate.
- Data to be reported are defined in detail in the EARS-Net reporting protocol.

# EARS-Net data outputs

- ECDC Surveillance Atlas of Infectious Diseases
- Annual Epidemiological Report
- Joint ECDC WHO/Europe report/summary – Antimicrobial resistance surveillance in Europe
- Joint inter-agency report on integrated analysis of antimicrobial agent consumption and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals (JIACRA)
- Burden of Disease article/report
- Peer-reviewed articles – in-depth analysis of surveillance data
- Data for research
- Global Antimicrobial Resistance and Use Surveillance System (GLASS) report



## Examples of other AMR surveillance at ECDC

- food- and waterborne bacteria
- sexually transmitted infections
- tuberculosis

# **AST surveillance Problems and possibilities - the example of EARS-Net**



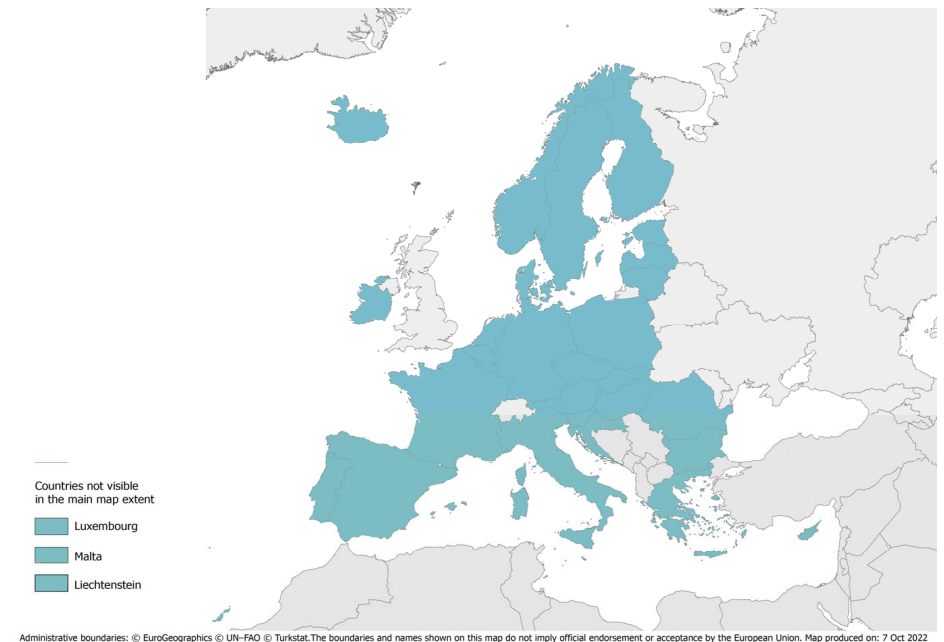


## Coverage

- If there is no or intermittent AST data reporting – surveillance is challenging.
- Requires commitment.
  - Legal basis
  - Interaction

EARS-Net:

All EU Member States and EEA countries report data annually.



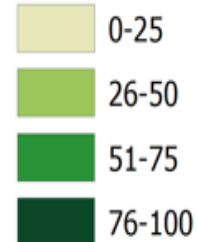
## Country participation

In 2023, all EU Member States and EEA countries reported data for 2022 to EARS-Net.

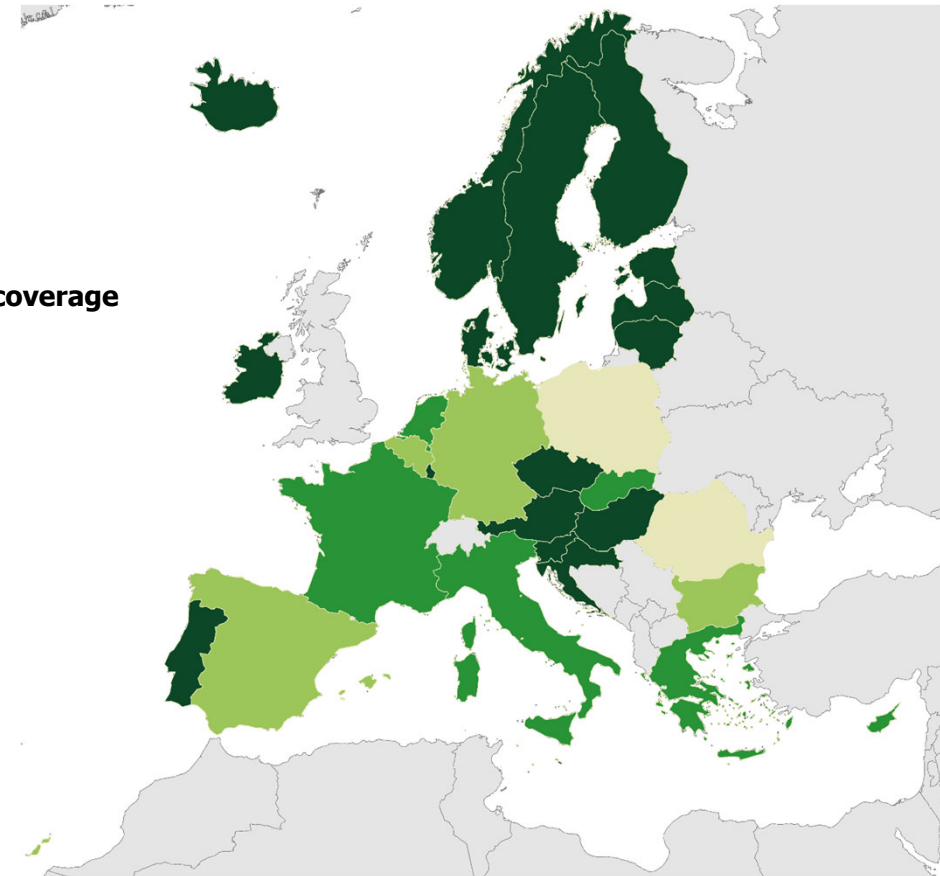
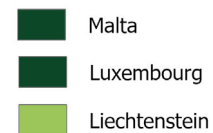
Twenty (66.7%) of these 30 countries reported that their participating laboratories had a population coverage of over two-thirds of the national population.

Seven countries reported data for less than half of their population.

### Estimated population coverage (%)



### Countries not visible in the main map extent



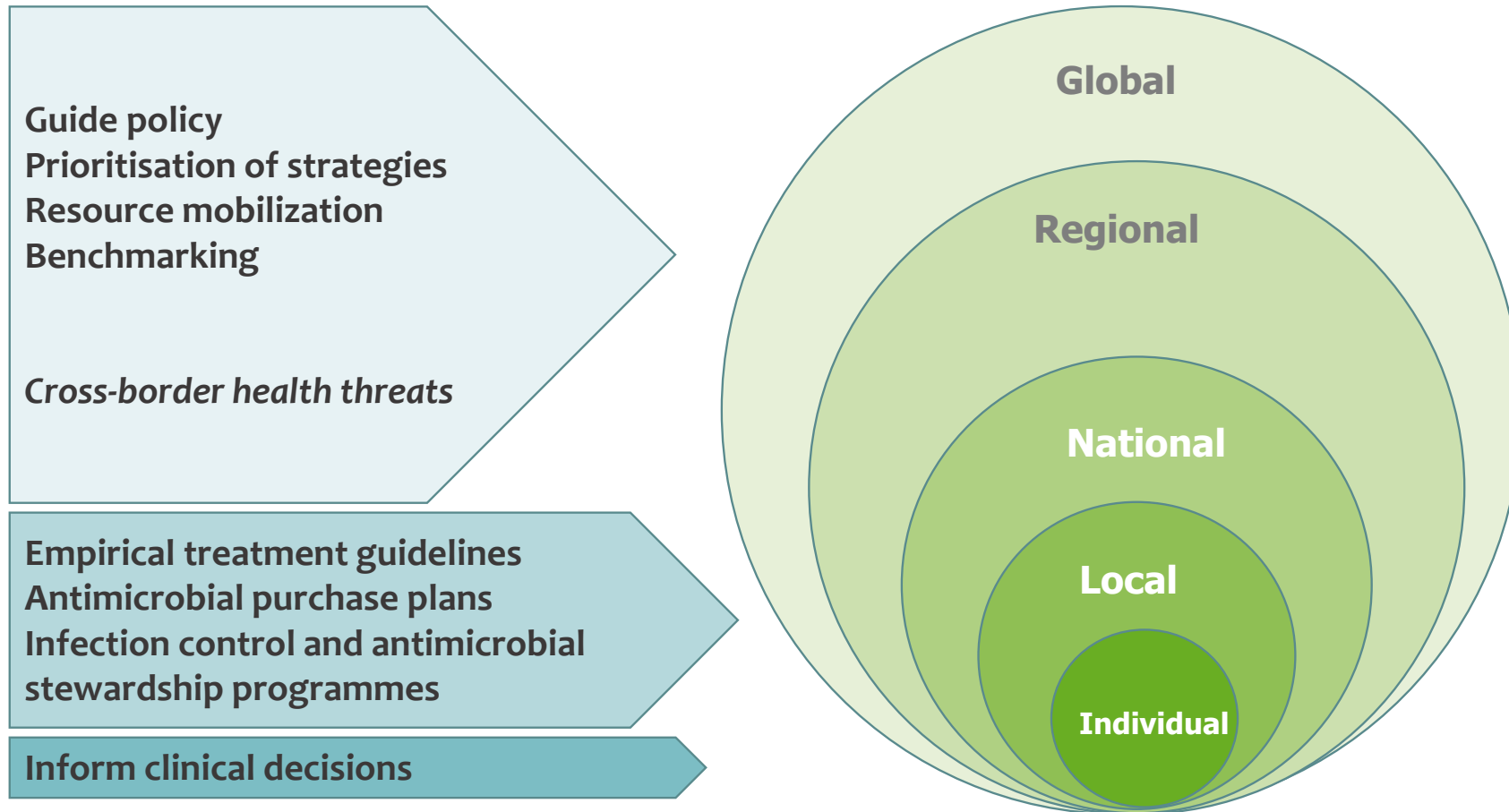
# Continuity

Facilitated by being feasible and relying on routine.

- AST surveillance is based on laboratory data.
- Electronic laboratory information systems when available.
- Electronic surveillance data systems when available.

EARS-Net uses EpiPulse to collect AST data and offers assistance for countries to turn data into a reportable format.

# Use of routine laboratory data – difference in aim



## Use of routine laboratory data – lacking clinical data

- Separate data collection/investigation often necessary for results that include clinical aspects.

## Inconsistent reporting

- Reporting protocol
- Case definitions
- Focussed reporting

### EARS-Net:

- Data to be reported are defined in detail in the [EARS-Net reporting protocol](#). The protocol is reviewed annually ahead of the data collection.
- Case definition refers to [European Committee on Antimicrobial Susceptibility Testing \(EUCAST\) clinical breakpoints](#).
- Collects data only on blood and cerebrospinal fluid samples.

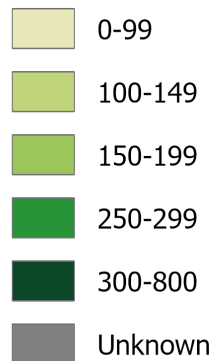
## Comparability over time and by place

- Changes to AST surveillance systems include for example:
  - Increase/decrease in coverage over time
  - Changes to clinical routines/funding affecting testing (Y/N and timing) and analysis (antimicrobials included in AST)
  - Use of breakpoint guidelines (CLSI/EUCAST/other)
  - Changes to breakpoints over time (limited quantitative data)
  - Differences in data cleaning and analysis (one analysis for all)
  - Quality of the laboratory work
  - Novel antimicrobials – selective testing/routine testing – depending for example on resistance levels

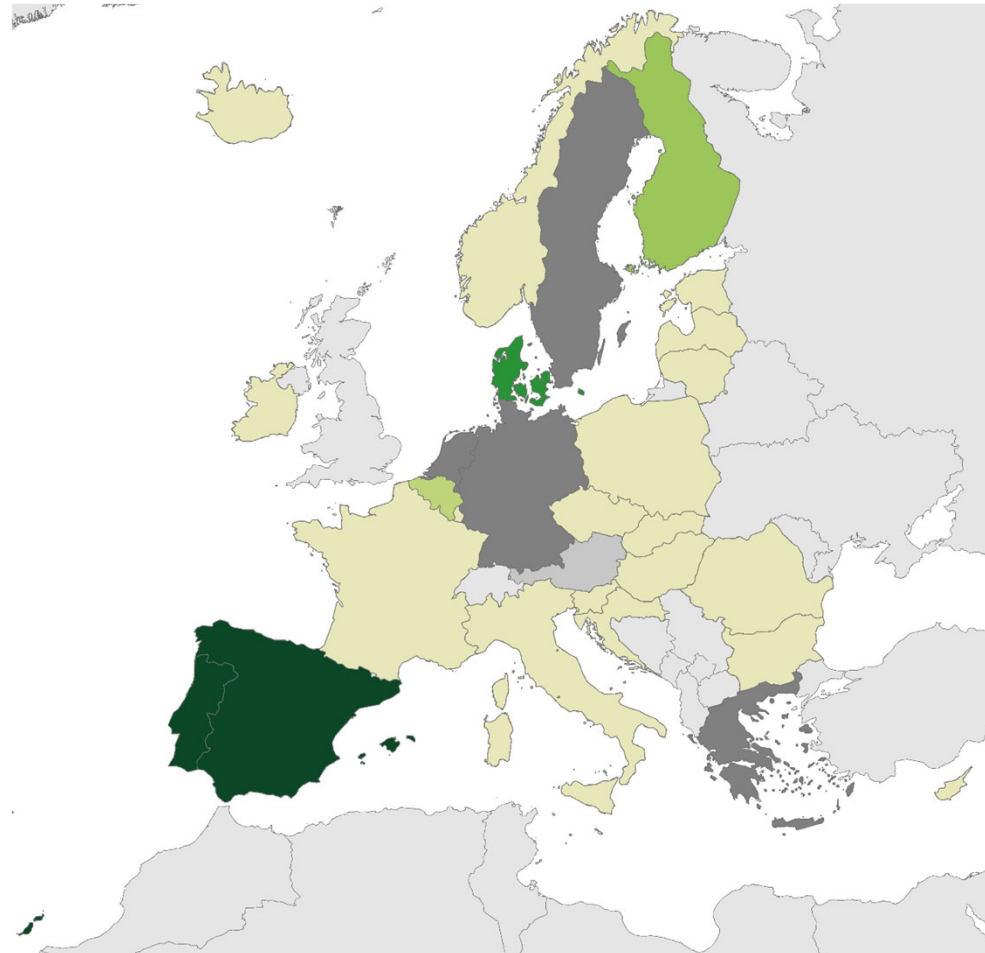
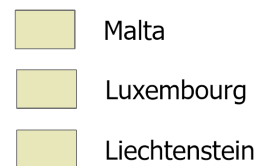
EARS-Net collects data on population coverage and blood culture rate, currently allows only EUCAST breakpoints, allows reporting of quantitative data, applies the same data cleaning and analysis to all data from the EU/EEA countries, conducts annual EQAs, is exploring routines for the addition and analysis of novel antimicrobials.

# EARS-Net blood culture rate, EU/EEA countries, 2022\*

## Blood culture sets/ 1000 patient-days



## Countries not visible in the main map extent



\* As estimated by the national focal points for AMR and/or operational contact points for AMR. Source: <https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2022>



# Timeliness

- Daily/Weekly/Monthly/Annual
  - Ability to detect signal of emerging resistance
  - Potential effects on data cleaning
- EARS-Net collects data annually
  - Data are cleaned and de-duplicated to generate a dataset that includes one record per patient/microorganism/specimen/antimicrobial agent combination and year.
  - There is also event-based reporting via
    - EpiPulse Events - Voluntary exchange of information
    - Early Warning and Response System of the European Union (EWRS) - Legally binding notification

## Resistance genes

Surveillance of resistance genes is affected by for example

- Laboratory routine
- Laboratory capacity
- Surveillance system

EARS-Net focuses on phenotypic data.

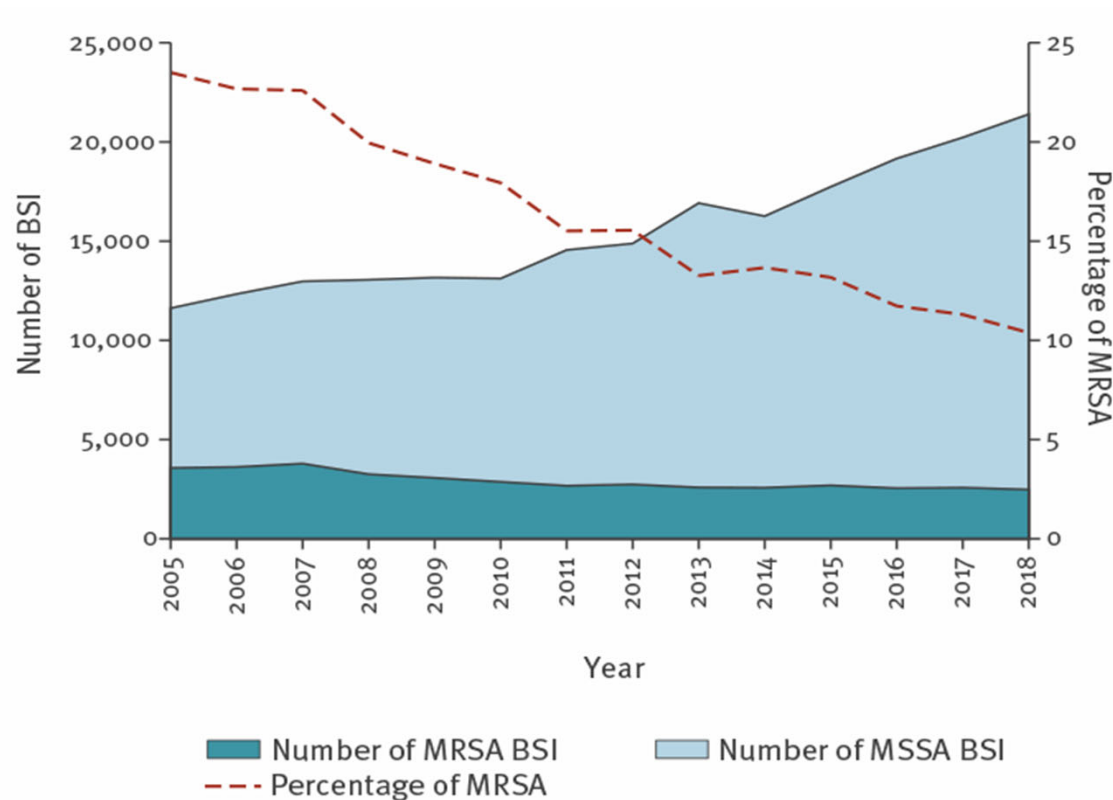
- European Antimicrobial Resistance Genes Surveillance Network (EURGen-Net). Periodic carbapenem- and/or colistin-resistant Enterobacterales (CCRE) surveys. A similar survey of carbapenem-resistant *Acinetobacter baumannii* is under way.
- ECDC is also able, to a limited extent, to provide Member States with access to whole-genome sequencing services, primarily for investigation of potential multi-country outbreaks.

## Analysis

- Number of resistant isolates
- Percentage of resistance
- Estimated resistance incidence
  
- Triangulate
- Context – coverage, culture rate, representativeness

EARS-Net provides percentages, estimated incidence and context.

# EARS-Net: Bloodstream infections caused by meticillin-resistant and meticillin-susceptible *Staphylococcus aureus*, EU/EEA, 2005-2018

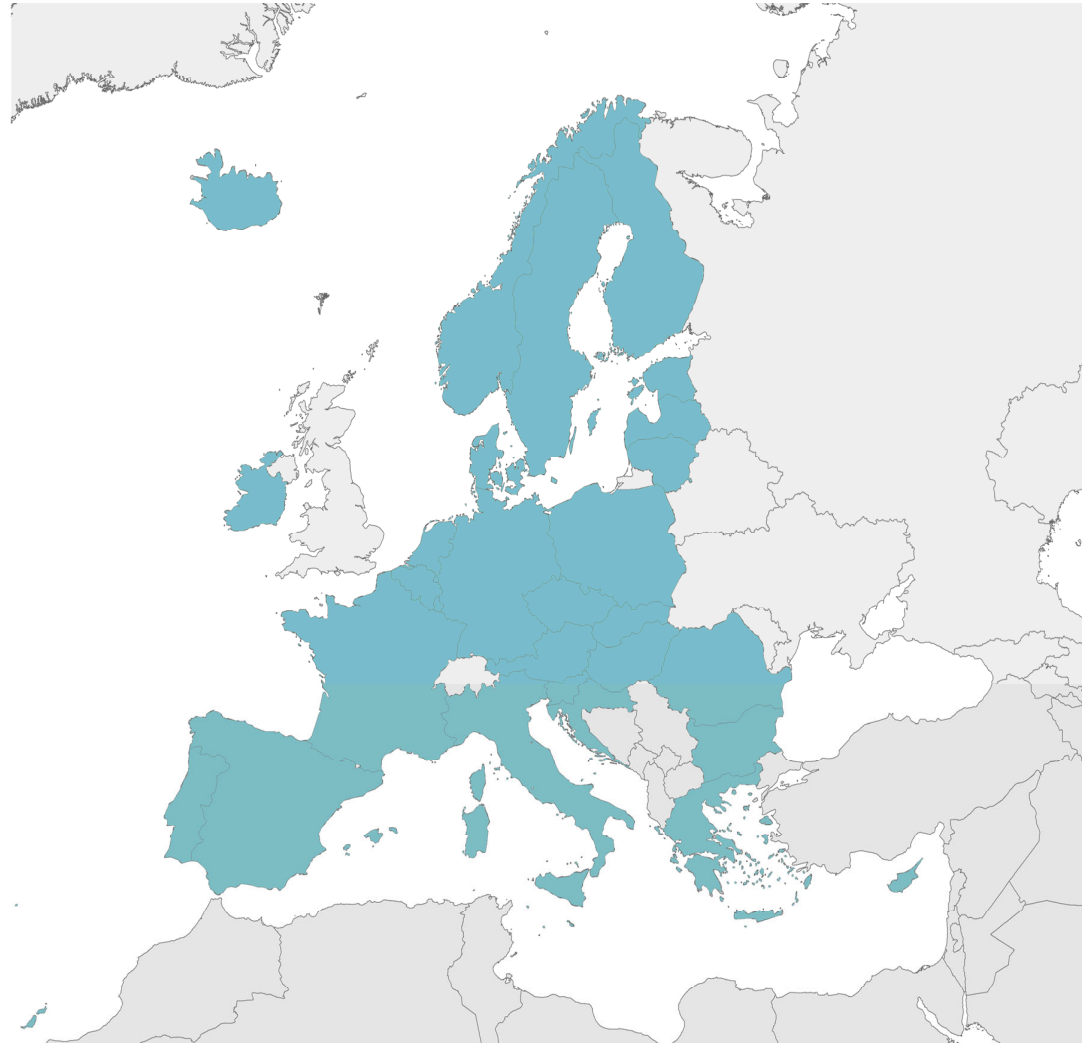


BSI: bloodstream infections; EEA: European Economic Area; EU: European Union; MRSA: meticillin-resistant *Staphylococcus aureus*; MSSA: meticillin-susceptible *S. aureus*. Results from 285 laboratories in 25 EU/EEA countries, which consistently reported data during 2005 to 2018

Gagliotti et al. *Staphylococcus aureus* bloodstream infections: diverging trends of meticillin-resistant and meticillin-susceptible isolates, EU/EEA, 2005 to 2018. *Eurosurveillance* 2021 Nov;26(46):2002094

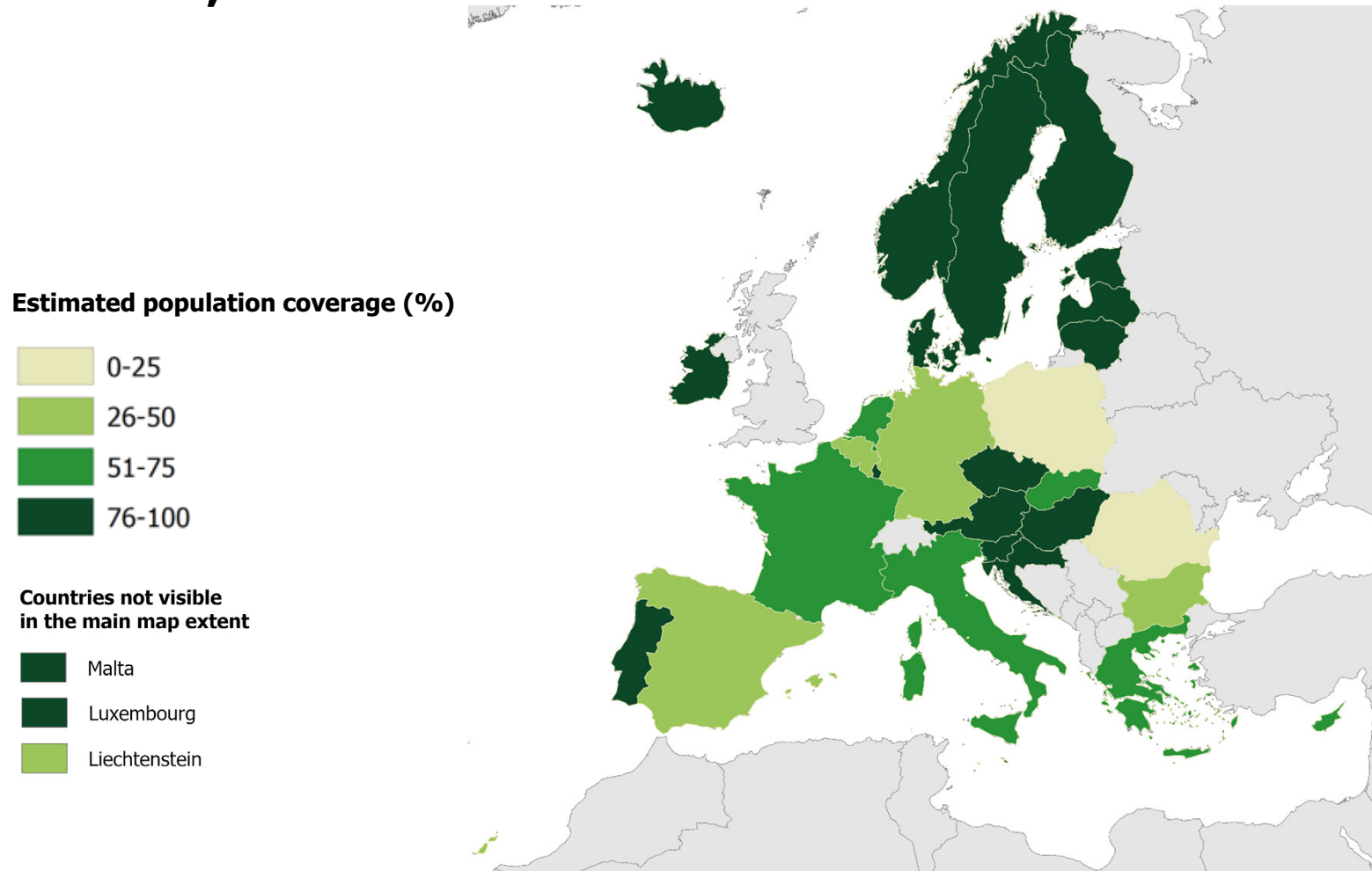
ECDC NORMAL

# Pick a country



Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. Map produced on: 7 Oct 2022

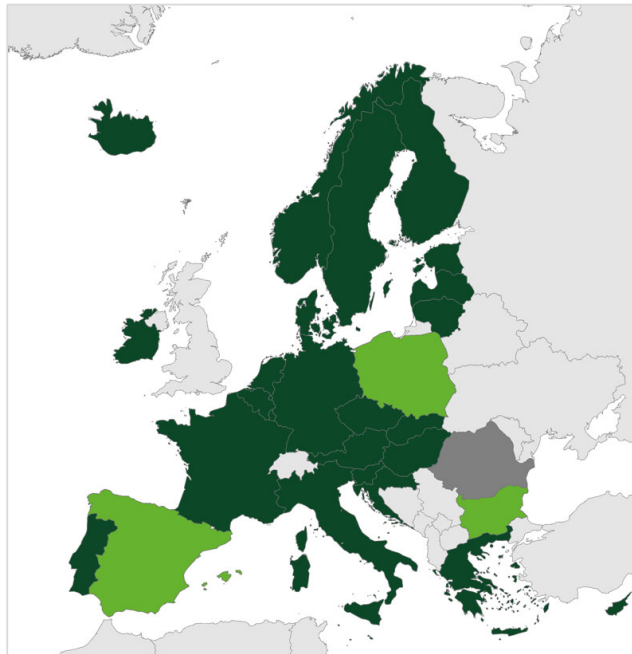
# EARS-Net national population coverage, EU/EEA countries, 2022\*



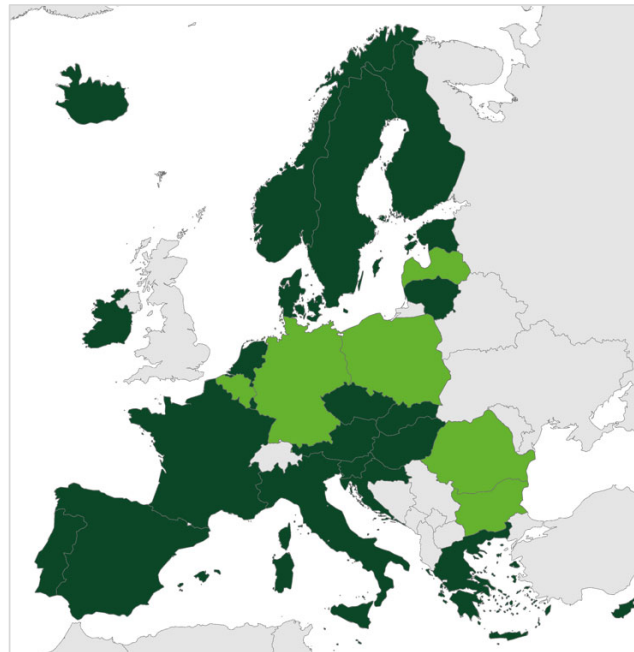
\* As estimated by the national focal points for AMR and/or operational contact points for AMR. Source: <https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2022>

# EARS-Net representativeness indicators, EU/EEA countries, 2022\*

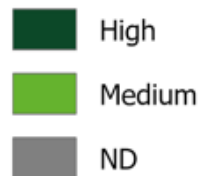
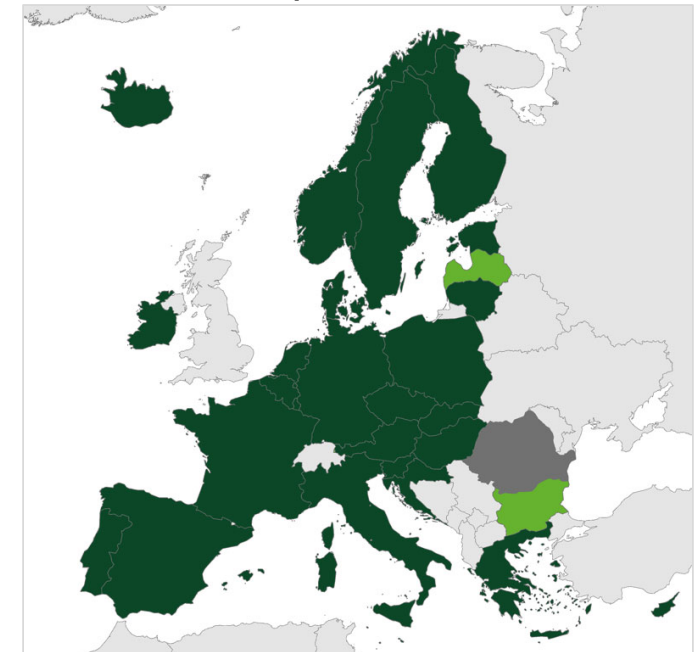
**Geographical** representativeness



**Hospital** representativeness



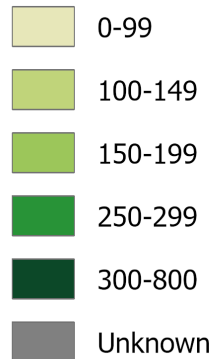
**Isolate** representativeness



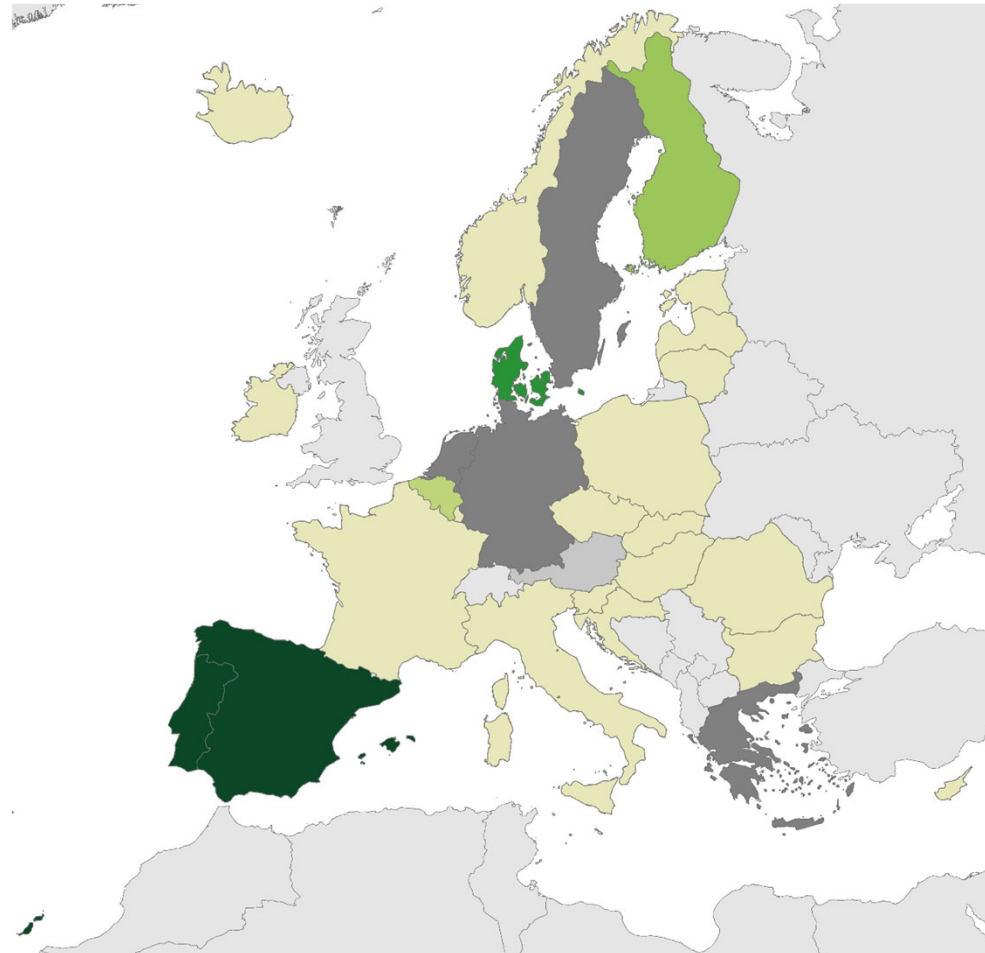
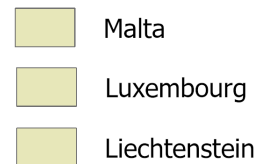
\* As estimated by the national focal points for AMR and/or operational contact points for AMR. Source: <https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2022>

# EARS-Net blood culture rate, EU/EEA countries, 2022\*

## Blood culture sets/ 1000 patient-days



## Countries not visible in the main map extent

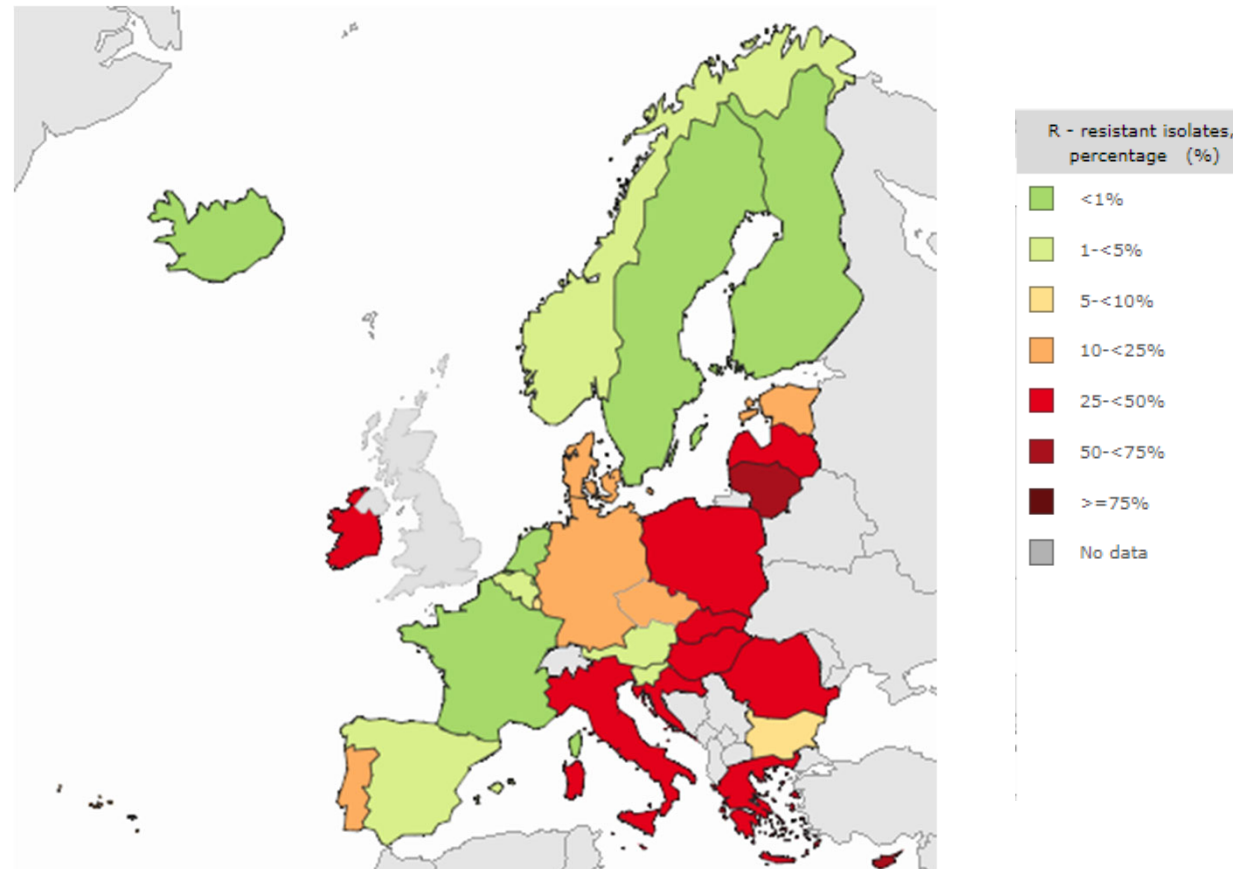


\* As estimated by the national focal points for AMR and/or operational contact points for AMR. Source: <https://www.ecdc.europa.eu/en/publications-data/surveillance-antimicrobial-resistance-europe-2022>



# Example from EARS-Net

## Percentage of vancomycin-resistant *Enterococcus faecium*, 2022



ECDC NORMAL






# Taking action



## Legend

Countries not visible in the main map extent

-  Luxembourg
-  Malta
-  Liechtenstein

Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. Map produced on: 7 Oct 2022

## Conclusions

- AST surveillance exhibits problems and possibilities both
  - Common to surveillance
  - More unique for AST surveillance
- Many of the problems can be mitigated
- AST surveillance allows taking action against antimicrobial resistance that will be an increasing concern unless governments respond more robustly to this threat to public health.

# Thank you for your attention

[hanna.merk@ecdc.europa.eu](mailto:hanna.merk@ecdc.europa.eu)

*Many thanks to all patients, hospitals, laboratories and national data managers providing data to EARS-Net and to all colleagues at ECDC who contributed to the results shown in this presentation.*

# Outputs with links

[ECDC Surveillance Atlas of Infectious Diseases](#)

[Annual Epidemiological Report](#)

Antimicrobial resistance surveillance in Europe – [report](#) / [summary](#)

Burden of Disease [article](#) / [report](#)

Articles – in-depth analysis of surveillance data

[Data for research](#)

[Antimicrobial consumption and resistance in bacteria from humans and food-producing animals](#)

[Global Antimicrobial Resistance and Use Surveillance System Report](#)

[European Antibiotic Awareness Day](#)

[External quality assessment \(EQA\) of the performance of laboratories participating in the European Antimicrobial Resistance Surveillance Network \(EARS-Net\)](#)

[EARS-Net reporting protocol](#)