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SURVEILLANCE REPORT

Surveillance of antimicrobial resistance in Europe

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Surveillance of antimicrobial resistance in Europe

Annual report of the European Antimicrobial Resistance Surveillance Network (EARS-Net)

2016

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Abbreviations and acronyms

AmpC	Ampicillinase C
AMR	Antimicrobial resistance
AST	Antimicrobial susceptibility testing
BSAC	British Society for Antimicrobial Chemotherapy
BSI	Bloodstream infection
CLSI	Clinical and Laboratory Standards Institute
CPE	Carbapenemase-producing Enterobacteriaceae
DNA	Deoxyribonucleic acid
EARSS	European Antimicrobial Resistance Surveillance System
EARS-Net	European Antimicrobial Resistance Surveillance Network
EEA	European Economic Area
EQA	External quality assessment
ESBL	Extended-spectrum beta-lactamase
EUCAST	European Committee on Antimicrobial Susceptibility Testing
EUSCAPE	European survey on carbapenemase-producing Enterobacteriaceae
ICU	Intensive care unit
KPC	*Klebsiella pneumoniae* carbapenemase
MIC	Minimum inhibitory concentration
MRSA	Meticillin-resistant *Staphylococcus aureus*
NDM	New Delhi metallo-beta-lactamase
OXA	Oxacillinase
PBP	Penicillin-binding protein
PCV	Pneumococcal conjugate vaccine
SFM	Comité de l'Antibiogramme de la Société Française de Microbiologie
SHV	Sulfhydryl-variable beta-lactamase
SIR	Susceptible, intermediate, resistant
ST	Sequence type
TESSy	The European Surveillance System (ECDC)
UK NEQAS	United Kingdom National External Quality Assessment Service for Microbiology
VIM	Verona integron-encoded metallo-beta-lactamase
WHO	World Health Organization

National institutions/organisations participating in EARS-Net

Austria

Federal Ministry of Health and Women's Affairs
www.bmgf.gv.at

Medical University Vienna
www.meduniwien.ac.at

Ordensklinikum Linz, Elisabethinen
www.ordensklinikum.at

Belgium

Scientific Institute of Public Health
https://www.wiv-isp.be/Nsih

Bulgaria

Alexander University Hospital, Sofia

National Center of Infectious and Parasitic Diseases

Croatia

Reference Center for Antimicrobial Resistance Surveillance, Ministry of Health

Zagreb University Hospital for Infectious Diseases 'Dr. Fran Mihaljević'

Cyprus

Microbiology Department, Nicosia General Hospital

Czech Republic

National Institute of Public Health
www.szu.cz

National Reference Laboratory for Antibiotics

Denmark

Statens Serum Institut, Danish Study Group for Antimicrobial Resistance Surveillance (DANRES)
www.danmap.org

Estonia

Health Board

East-Tallinn Central Hospital

Tartu University Hospital

Finland

National Institute for Health and Welfare, Finnish Hospital Infection Program (SIRO)
www.thl.fi/siro and Bacterial infections unit

Finnish Study Group for Antimicrobial Resistance (FiRe)
www.finres.fi

France

Santé Publique France, the French National Public Health Agency
www.santepubliquefrance.fr

Pitié-Salpêtrière Hospital

French National Observatory for the Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA): Azay-Résistance, Île-de-France and Réussir networks
www.onerba.org

National Reference Centre for Pneumococci (CNRP)

Germany

Robert Koch Institute
www.rki.de

Greece

Hellenic Pasteur Institute

National School of Public Health

National and Kapodistrian University of Athens, Medical School
www.mednet.gr/whonet

Hungary

National Centre for Epidemiology
www.oek.hu

Iceland

National University Hospital of Iceland

Centre for Health Security and Infectious Disease Control

Ireland

Health Protection Surveillance Centre (HPSC)
www.hpsc.ie

Italy

National Institute of Health
www.iss.it

Latvia

Disease Prevention and Control Center of Latvia
www.spkc.gov.lv

Lithuania

National Public Health Surveillance Laboratory
www.nvspl.lt

Institute of Hygiene
www.hi.lt

Luxembourg

National Health Laboratory

Microbiology Laboratory, Centre Hospitalier de Luxembourg

Malta

Mater Dei Hospital, Msida

Netherlands

National Institute for Public Health and the Environment
www.rivm.nl

Norway

University Hospital of North Norway

Norwegian Institute of Public Health

St. Olav University Hospital, Trondheim

Poland
National Medicines Institute
Department of Epidemiology and Clinical Microbiology
National Reference Centre for Susceptibility Testing

Portugal
National Institute of Health Doutor Ricardo Jorge
www.insarj.pt
Ministry of Health
Directorate-General of Health

Romania
National Institute of Public Health

Slovakia
National Reference Centre for Antimicrobial Resistance
Public Health Authority of the Slovak Republic
Regional Public Health Authority Banska Bystrica

Slovenia
National Institute of Public Health
www.nijz.si
Medical faculty, University of Ljubljana
National Laboratory of Health, Environment and Food

Spain
Health Institute Carlos lll
www.isciii.es
National Centre for Microbiology

Sweden
The Public Health Agency of Sweden
www.folkhalsomyndigheten.se

United Kingdom
Public Health England
www.gov.uk/government/organisations/public-health-england
Health Protection Scotland
Public Health Agency Northern Ireland

Summary

The results presented in this report are based on antimicrobial resistance data from invasive isolates reported to EARS-Net by 30 European Union (EU) and European Economic Area (EEA) countries in 2017 (data referring to 2016), and on trend analyses of data reported by the participating countries for the period 2013 to 2016.

As in previous years, the antimicrobial resistance situation in Europe displays wide variations depending on the bacterial species, antimicrobial group and geographical region. For several bacterial species–antimicrobial group combinations, a north-to-south and a west-to-east gradient is evident in Europe. In general, lower resistance percentages were reported by countries in the north while higher percentages were reported in the south and east of Europe. These differences are most likely related to variations in antimicrobial use, infection prevention and control practices, and dissimilarities in diagnostic and healthcare utilisation patterns in the countries.

For *E. coli*, significant increases in the EU/EEA population-weighted mean percentages for third-generation cephalosporin resistance and aminoglycoside resistance, as well as for combined resistance to three key antimicrobial groups (fluoroquinolones, third-generation cephalosporins and aminoglycosides) were observed for the period 2013 to 2016. This is a continuation of the increasing trends reported by EARS-Net in previous years.

By contrast, there was some indication that the overall resistance situation for *K. pneumoniae* was stabilising at the EU/EEA level during the same period. There were small though significant decreases in the EU/EEA population-weighted mean percentages for *K. pneumoniae* between 2013 and 2016 for most antimicrobial groups under regular surveillance, with the notable exception of carbapenem resistance. However, at the individual country level, the same encouraging development was not always seen, and increasing resistance percentages in *K. pneumoniae* were reported from several countries, mainly those with comparatively high resistance.

The percentages of extended-spectrum beta-lactamase (ESBL)-producing *E. coli* and *K. pneumoniae* reported to EARS-Net remained high in 2016. ESBL production was often seen in combination with resistance to multiple antimicrobial groups, leaving few remaining antimicrobial treatment options available, for example carbapenems.

Resistance to carbapenems in *E. coli* remained low in 2016 and decreased during the period 2013 to 2016. For *K. pneumoniae*, distinct country variation in the percentage of carbapenem-resistant *K. pneumoniae* was observed. A majority of the countries reported very low resistance while a smaller group of countries, mainly those with high percentages of resistance to other antimicrobial groups, reported considerably higher levels. Carbapenem resistance and resistance to multiple antimicrobial groups were also common in *Pseudomonas aeruginosa* and *Acinetobacter* species, with a higher proportion of countries reporting high resistance percentages compared to *E. coli* and *K. pneumoniae*.

Treatment alternatives for patients infected with bacteria resistant to both carbapenems and other important antimicrobial groups are often limited to combination therapy or to older antimicrobial agents with lower efficacy such as colistin. Although data on colistin susceptibility as part of EARS-Net surveillance are not complete and susceptibility testing of this agent is technically difficult, the reports of colistin-resistant isolates to EARS-Net are an indication of the further loss of effective antimicrobial treatment options for gram-negative bacterial infections.

The decline in the EU/EEA population-weighted mean percentage of meticillin-resistant *Staphylococcus aureus* (MRSA) reported in previous years continued in 2016. At the country level, MRSA percentages seem to be stabilising or decreasing in a majority of EU/EEA countries. However, MRSA remains an important pathogen in Europe, as the levels of MRSA are still high in several countries, and combined resistance to other antimicrobial groups was common.

For *Streptococcus pneumoniae*, resistance percentages were generally stable during the period 2013 and 2016, but with large inter-country variations. Macrolide non-susceptibility in *S. pneumoniae* was, for most countries, higher than penicillin non-susceptibility.

For enterococci, a significantly increasing trend for vancomycin-resistant *Enterococcus faecium* could be noted in several countries between 2013 and 2016, especially among countries reporting already high resistance percentages. Although the overall trend for EU/EEA countries was not statistically significant for the same period, this development needs to be monitored carefully.

The capacity of EU/EEA countries to report AMR data to EARS-Net remained high, with all 30 EU/EEA countries providing data for a majority of the bacterial species–antimicrobial groups under surveillance. In 2016, there were encouraging increases in the population coverage of reporting laboratories for several countries, indicating a strengthening of national AMR surveillance systems in Europe. The diagnostic capacity of the laboratories providing the data was generally high, as concluded by the EARS-Net external quality assessment

(EQA). The increased adoption of European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines for antibacterial susceptibility testing in Europe, and the high proportion of laboratories that participate in the EQA exercise, contributed to improved data quality and an increasing ability of EU/EEA countries to report comparable AMR data.

EARS-Net data for 2016 show that antimicrobial resistance remains a serious threat to public health in Europe. For invasive bacterial infections, prompt treatment with effective antimicrobial agents is especially important and is one of the single most effective interventions to reduce the risk of fatal outcome. The high percentages of isolates with resistance to key antimicrobial groups reported from many countries are therefore of great concern and represent a serious threat to patient safety in Europe.

Prudent antimicrobial use and comprehensive infection prevention and control strategies targeting all healthcare sectors are the cornerstones of effective interventions aiming to prevent selection and transmission of bacteria resistant to antimicrobial agents.

1 Introduction

Antimicrobial resistance

Antimicrobial resistance (AMR) is the ability of a microorganism to resist the action of one or more antimicrobial agents. The consequences can be severe, as prompt treatment with effective antimicrobials is the most important intervention to reduce the risk of poor outcome of serious infections.

Development of AMR is a natural phenomenon caused by mutations in bacterial genes, or acquisition of exogenous resistance genes carried by mobile genetic elements that can spread horizontally between bacteria. Bacteria can acquire multiple resistance mechanisms and hence become resistant to several antimicrobial agents, which is particularly problematic as it may severely limit the available treatment alternatives for the infection.

The major drivers behind the occurrence and spread of AMR are the use of antimicrobial agents and the transmission of antimicrobial-resistant microorganisms between humans; between animals; and between humans, animals and the environment. While antimicrobial use exerts ecological pressure on bacteria and contributes to the emergence and selection of AMR, poor infection prevention and control practices and inadequate sanitary conditions favour the further spread of these bacteria.

The problem of AMR calls for concerted efforts at the country level as well as close international cooperation. AMR is listed as a special health issue in Annex 1 of Commission Decision 2000/96/EC on the communicable diseases to be covered by the Community network under Decision No 1082/2013/EU of the European Parliament and of the Council on serious cross-border threats to health [1].

EARS-Net

The European Antimicrobial Resistance Surveillance Network (EARS-Net) is the main EU surveillance system for AMR in bacteria that cause serious infections. Data reported from the network serve as important indicators on the occurrence and spread of AMR in European countries. All 28 EU Member States and two EEA countries (Iceland and Norway) participate in EARS-Net. The vast majority of the countries regularly report data for all bacteria and antimicrobial groups under surveillance. The number of participating laboratories has continuously increased since the initiation of the network, indicating a strengthening of national AMR surveillance systems in Europe. The widespread and continuing implementation of European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines for antibacterial susceptibility testing in Europe, and the high proportion of laboratories that participate in the annual EARS-Net external quality assessment (EQA) exercise, contribute to improved data quality and an increasing ability of EU/EEA countries to report comparable AMR data.

EARS-Net is the continuation of the European Antimicrobial Resistance Surveillance System (EARSS), which was coordinated by the Dutch National Institute for Public Health and the Environment (RIVM). Established in 1998, EARSS successfully created an international network for AMR surveillance and demonstrated how international AMR data could inform decisions and raise awareness among stakeholders and policymakers. On 1 January 2010, the administration of EARSS was transferred from RIVM to ECDC, and the network was renamed EARS-Net. Data collected by the network from EU/EEA countries since 1999 were transferred to The European Surveillance System (TESSy) database at ECDC.

EARS-Net is based on a network of representatives from the EU/EEA countries collecting routine clinical antimicrobial susceptibility data from national AMR surveillance initiatives (for details, please refer to the list of national institutions and organisations participating in EARS-Net on page viii). Scientific guidance and support to the network is provided by the EARS-Net Coordination Committee. This group is composed of individual experts selected from among the appointed disease-specific contact points and experts from other organisations that are involved in AMR surveillance. EARS-Net activities are coordinated in close collaboration with two other major ECDC surveillance networks: the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) and the Healthcare-associated Infections Surveillance Network (HAI-Net). EARS-Net also collaborates with the European Society of Clinical Microbiology and Infectious Diseases (ESCMID), in particular with EUCAST, which is supported by ECDC and ESCMID.

The objectives of EARS-Net are:

- to collect comparable, representative and accurate AMR data;
- to analyse temporal and spatial trends of AMR in Europe;
- to provide timely AMR data for policy decisions;
- to encourage the implementation, maintenance and improvement of national AMR surveillance programmes; and
- to support national systems in their efforts to improve diagnostic accuracy by offering an annual external quality assessment.

2 EARS-Net data collection and analysis

A total of 30 countries, including all EU Member States and two EEA countries (Iceland and Norway) reported AMR data for 2016 to EARS-Net before the end of August 2017. Only data from invasive (blood and cerebrospinal fluid) isolates are included in EARS-Net. The panels of antimicrobial agent combinations under surveillance for each species are defined in the EARS-Net reporting protocol [2]. In addition, the EUCAST guidelines for detection of resistance mechanisms and specific types of resistance of clinical and/or epidemiological importance describe the mechanisms of resistance and recommend methods of detection for key EARS-Net species–antimicrobial group combinations [3].

Routine antimicrobial susceptibility test (AST) results were collected from clinical laboratories by the national network representative in each participating country. National data are uploaded directly to The European Surveillance System (TESSy) at ECDC on a yearly basis. Data presented by EARS-Net might diverge slightly from the data presented by the countries themselves, as analysis algorithms and population coverage might differ.

Data analysis

For the analysis, an isolate is considered resistant to an antimicrobial agent when tested and interpreted as resistant (R) in accordance with the clinical breakpoint criteria used by the local laboratory. An isolate is considered non-susceptible to an antimicrobial agent when tested and interpreted as either resistant (R) or intermediately susceptible (I) with the same local clinical breakpoint criteria. EARS-Net encourages the use of EUCAST breakpoints but results based on other interpretive criteria used by the reporting countries were accepted for the analysis. The use of EUCAST breakpoints has increased over the years [4]: in 2016, approximately 88 % of the participating laboratories used EUCAST, or EUCAST-related, clinical breakpoints (Annex 1), which improved the comparability of the data.

National percentages

As a general rule, data were expressed as a resistance percentage, i.e. the percentage of R isolates out of all isolates with AST information on that specific species–antimicrobial group, and for some bacteria as the percentage of non-susceptible (I+R) isolates out of all isolates with the relevant information. For selected analyses, a 95 % confidence interval was determined.

If fewer than 10 isolates were reported for a specific species–antimicrobial group combination in a country, the resistance percentage was not calculated and the results were not displayed on the maps presented in this report.

EU/EEA population-weighted mean percentage

A population-weighted EU/EEA mean percentage was determined by applying population-based weights to each country's data before calculating the arithmetic mean for all reporting countries. Country weightings were used to adjust for imbalances in reporting propensity and population coverage, as the total number of reported isolates by country in most cases does not reflect the population size. The weighting applied to each national data point represented the proportion of the country's population out of the total population of all countries included in the calculation. Annual population data were retrieved from the Eurostat online database [5].

Trend analyses

The statistical significance of temporal trends of antimicrobial resistance percentages by country and for the EU/EEA mean was calculated based on data from the last four years (2013 to 2016). The trend analyses were only based on data from laboratories that consistently reported data for the full four-year period in order to exclude some bias caused by changes in the population under surveillance. This restriction might in some cases result in a considerably lower number of isolates compared with the total numbers reported. Countries reporting fewer than 20 isolates per year were not included in the analysis. Statistical significance of trends was assessed by the Cochran-Armitage test, and a p-value of ≤ 0.05 was considered significant.

Data validity

Interpretation of the results

The results, both for inter-country comparison and in some cases national trends, should be interpreted with caution. A number of factors might influence the results and introduce bias to the data, resulting in over- as well as underestimation of resistance percentages. Some of the most important potential sources of bias in EARS-Net are explained below.

Population coverage

Population coverage varied among reporting countries. Some countries report data from large national surveillance systems with a high national coverage, while other countries report data from a smaller subset of local laboratories and hospitals. For an overview of the number of reporting laboratories, see Annex 3.

For countries reporting data from only a small number of hospitals and laboratories located in one specific

geographical area, the sample may not be representative for the whole country. Likewise, national trends may not be representative of regional situations as pooled data could mask variations at local level.

Sampling

EARS-Net data are exclusively based on invasive isolates from blood or cerebrospinal fluid. The clinical relevance of indicator organisms isolated from these sites is undisputable. This restriction prevents some of the inconsistencies that arise from differences in clinical case definitions, different sampling frames or heterogeneous healthcare utilisation that would otherwise confound the data analysis if isolates from all anatomical sites were accepted. However, invasive isolates may not be representative of isolates of the same bacterial species from other type of infections, i.e. urinary tract infections, pneumonia, wound infections, etc.

Case ascertainment of patients with bloodstream infections (BSIs) is strongly linked to diagnostic practices and the frequency with which blood cultures are taken. Therefore, variations in blood culture frequency (non-differential sampling) result in an increasing uncertainty when comparing resistance percentages between hospitals and countries.

Differential sampling can occur if blood cultures are typically only performed after empirical treatment shows no adequate therapeutic response. Predictably, this will lead to an overestimation of the resistance percentage by not including susceptible BSI isolates in the denominator.

Laboratory routines and capacity

The use of guidelines for clinical breakpoints varies among countries in Europe, and in some instances even between laboratories in the same country. At present, many European laboratories are changing from using CLSI to EUCAST clinical guidelines (Annex 1). As a result, the interpretation of AST results may vary, at least for resistance mechanisms resulting in MICs close to the breakpoints. In addition, clinical breakpoints may change over time, as breakpoints may be revised. As quantitative data (i.e. disk diffusion zone diameters or MIC values) are not provided by all participating laboratories, only the reported S, I, and R results are considered for the analyses.

The ability to identify the microorganism and its associated antimicrobial susceptibility pattern may differ among laboratories. All laboratories providing data for EARS-Net are offered participation in an annual EQA to assess the reliability of the laboratory test results. (For more information on the EARS-Net EQA and laboratory performance, see Annex 1.) The level of performance for EQA specimens was generally high, with over 95 % concordance with the intended results for most organism–antimicrobial agent combinations. Variation in the interpretation of susceptibility results was seen with organism–antimicrobial agent combinations that had borderline MIC values. Some differences in reporting were seen where breakpoints and interpretation differed between EUCAST and CLSI guidelines.

3 Antimicrobial resistance in Europe 2013–2016

3.1 *Escherichia coli*

Escherichia coli is part of the normal intestinal microbiota in humans, but is also a common cause of severe infections. It is the most frequent cause of bloodstream infections and urinary tract infections in Europe and involved in infections of both community and healthcare origin. In addition, it is associated with intra-abdominal infections, causes neonatal meningitis and is one of the leading causative agents in food-borne infections worldwide.

Resistance in *E. coli* readily develops either through mutations, as often seen for fluoroquinolone resistance, or by acquisition of mobile genetic elements encoding resistance mechanisms, such as the production of extended spectrum beta-lactamases (ESBL) and carbapenemases. ESBLs are enzymes that confer resistance to most beta-lactam antibiotics, including third-generation cephalosporins, and are often seen in combination with other resistance mechanisms, causing multidrug resistance. Carbapenems usually resist the effect of ESBLs and might remain as one of the few treatment options for severe infections. A recently emerging threat is carbapenem resistance in *E. coli* mediated by a range of carbapenemases, which may confer resistance to virtually all available beta-lactam antibacterial drugs.

Antimicrobial resistance

At the EU/EEA level, more than half (58.6 %) of the *E. coli* isolates reported to EARS-Net in 2016 were resistant to at least one of the antimicrobial groups under regular surveillance (aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems) (Table 3.1). The highest EU/EEA population-weighted mean resistance percentage in 2016 was reported for aminopenicillins (57.4 %), followed by fluoroquinolones (21.0 %), third-generation cephalosporins (12.4 %) and aminoglycosides (9.8 %) (Tables 3.2–3.5). Resistance to carbapenems remained rare in 2016 (‹0.1 %) (Table 3.6). Colistin resistance was only sporadically reported.

There were small but significant increases in the trends of the EU/EEA population-weighted mean percentages (based on data from laboratories reporting continuously during the period 2013–2016) for third-generation cephalosporin resistance and aminoglycoside resistance. By contrast, the EU/EEA trends for fluoroquinolone resistance and carbapenem resistance decreased significantly during the same period (Tables 3.2–3.6).

Resistance to fluoroquinolones, third-generation cephalosporins or aminoglycosides was most often seen in combination with resistance to other antimicrobial groups. Among the resistant phenotypes, resistance to two antimicrobial groups was the most common at the EU/EEA level (3.1). Combined resistance, measured as resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides, increased significantly during the period 2013–2016 (Table 3.7).

A majority of the third-generation cephalosporin-resistant isolates were ESBL-positive. Only data from laboratories reporting ESBL results for all isolates identified as resistant to third-generation cephalosporins (65.8 % of the laboratories reporting AST data for third-generation cephalosporins in *E. coli*), and only data from countries reporting at least 10 such isolates were included in the analysis (24 countries). Among the *E. coli* isolates meeting the inclusion criteria, 88.4 % were ascertained as ESBL-positive by the laboratories in 2016.

Except for carbapenem resistance, large inter-country variations were noted for all antimicrobial groups under regular surveillance, with generally higher resistance percentages reported from the southern and eastern parts of Europe than from northern Europe (Figures 3.2–3.6). Inter-country differences between the proportions of fully susceptible isolates (to included antimicrobial groups) were also present. The countries with the highest carbapenem resistance percentages generally reported the lowest percentage of fully susceptible isolates (Figure 3.1).

Discussion and conclusion

Antimicrobial resistance in *E. coli* was common in Europe in 2016. There were, however, large inter-country variations in the proportion of resistant isolates and the occurrence of combined resistance to multiple antimicrobial groups.

High percentages of ESBL-producing *E. coli* have been reported to EARS-Net over several years [6–7]. ESBL production is often seen in combination with other acquired resistance mechanisms, conferring resistance to other important treatment alternatives such as fluoroquinolones and aminoglycosides. For serious infections caused by *E. coli* resistant to multiple antimicrobial groups, few treatment options remain available, one of which is treatment with carbapenems. Although resistance to carbapenems in *E. coli* remains low in the invasive isolates reported to EARS-Net, close surveillance is required as carbapenemase-producing *E. coli* are becoming more widespread in Europe [8].

Previous use of broad-spectrum antimicrobials is a known risk factor for colonisation by resistant Enterobacteriaceae. Associations between national *E. coli* resistance levels reported to EARS-Net and antimicrobial consumption of the same antimicrobial groups

reported to ESAC-Net have been found for fluoroquinolones and third-generation cephalosporins. Significant correlations were found for antimicrobial use in both the hospital and community sector [9], underlining the importance of comprehensive antimicrobial stewardship programmes targeting both the community and healthcare settings [10].

As high *E. coli* resistance levels have been reported from food-producing animals in Europe, including isolates with carbapenemase production and plasmid-mediated colistin resistance [11], the need to ensure cross-sectoral collaboration between the veterinary and food production sectors is essential. ECDC is working closely with the European Medicines Agency (EMA) and the European Food Safety Authority (EFSA) to better understand the interrelationship between antimicrobial use and antimicrobial resistance across Europe. This work is underpinned by the European Commission's 'One Health' approach, which addresses resistance in both humans and animals.

Figure 3.1. *Escherichia coli*. Distribution of isolates: fully susceptible and resistant to one, two, three, four and five antimicrobial groups (among isolates tested against aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems), EU/EEA countries, 2016

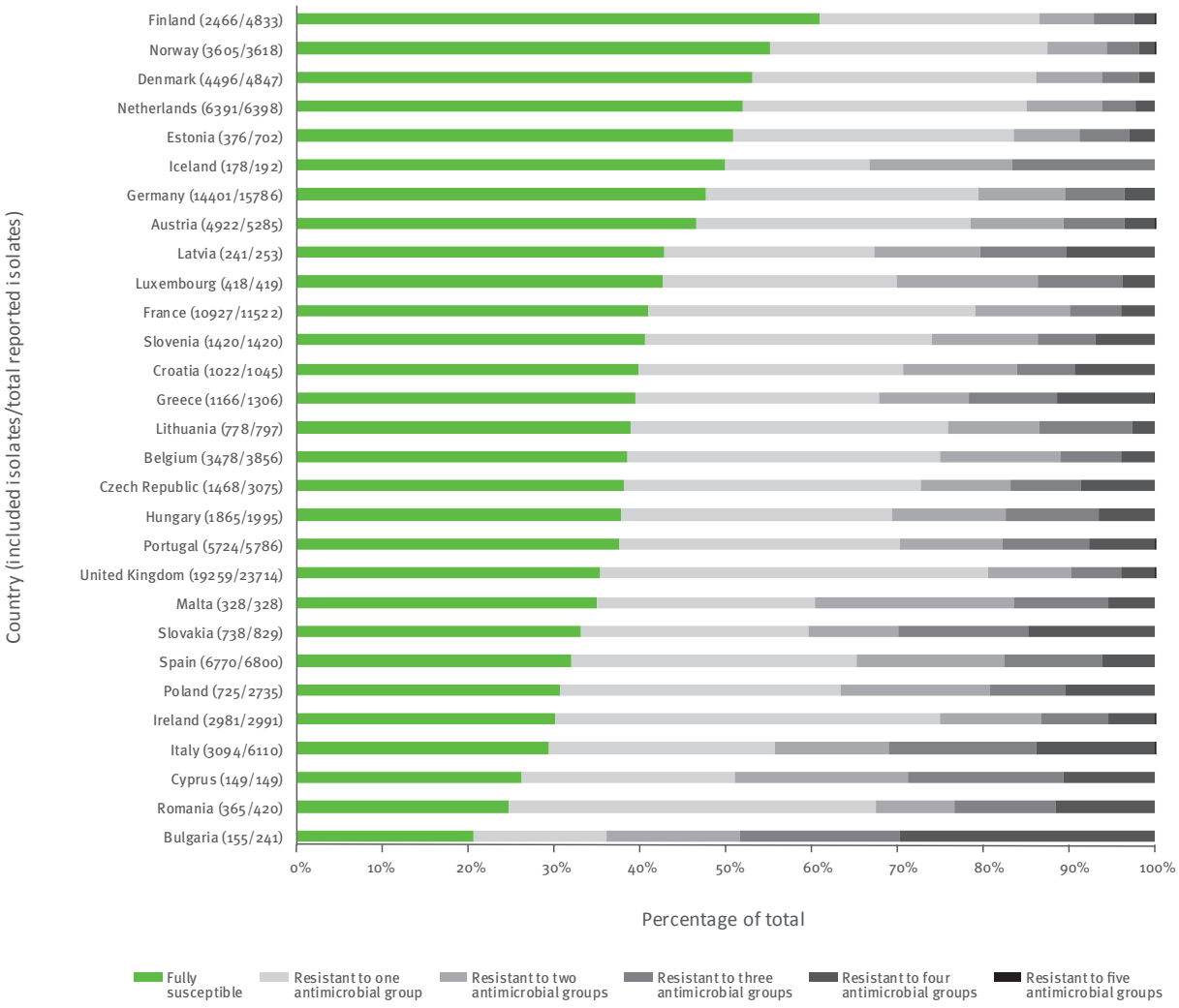


Table 3.1. ***Escherichia coli*****. Total number of tested isolates* and resistance combinations among invasive isolates tested against aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems (n = 99 734), EU/EEA countries, 2016**

Resistance pattern	Number of isolates	% of total**
Fully susceptible	**41 330**	**41.4**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance)	**35 468**	**35.6**
Aminopenicillins	33 034	33.1
Fluoroquinolones	2 238	2.2
Other antimicrobial groups	196	0.2
Resistance to two antimicrobial groups		
Total (all two-group combinations)	**10 873**	**10.9**
Aminopenicillins + fluoroquinolones	6 830	6.8
Aminopenicillins + third-generation cephalosporins	2 242	2.2
Aminopenicillins + aminoglycosides	1 659	1.7
Other antimicrobial group combinations	142	0.1
Resistance to three antimicrobial groups		
Total (all three-group combinations)	**7 284**	**7.3**
Aminopenicillins + third-generation cephalosporins + fluoroquinolones	4 309	4.3
Aminopenicillins + fluoroquinolones + aminoglycosides	2 513	2.5
Other antimicrobial group combinations	462	0.5
Resistance to four antimicrobial groups		
Total (all four-group combinations)	**4 768**	**4.8**
Aminopenicillins + third-generation cephalosporins + fluoroquinolones + aminoglycosides	4 758	4.8
Other antimicrobial group combinations	10	<0.1
Resistance to five antimicrobial groups		
Aminopenicillins + third-generation cephalosporins + fluoroquinolones + aminoglycosides + carbapenems	11	<0.1

Only resistance combinations >1% of the total are specified.

* Only data from isolates tested against all five antimicrobial groups were included in the analysis.

** Not adjusted for population differences in the reporting countries.

Figure 3.2. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2016**

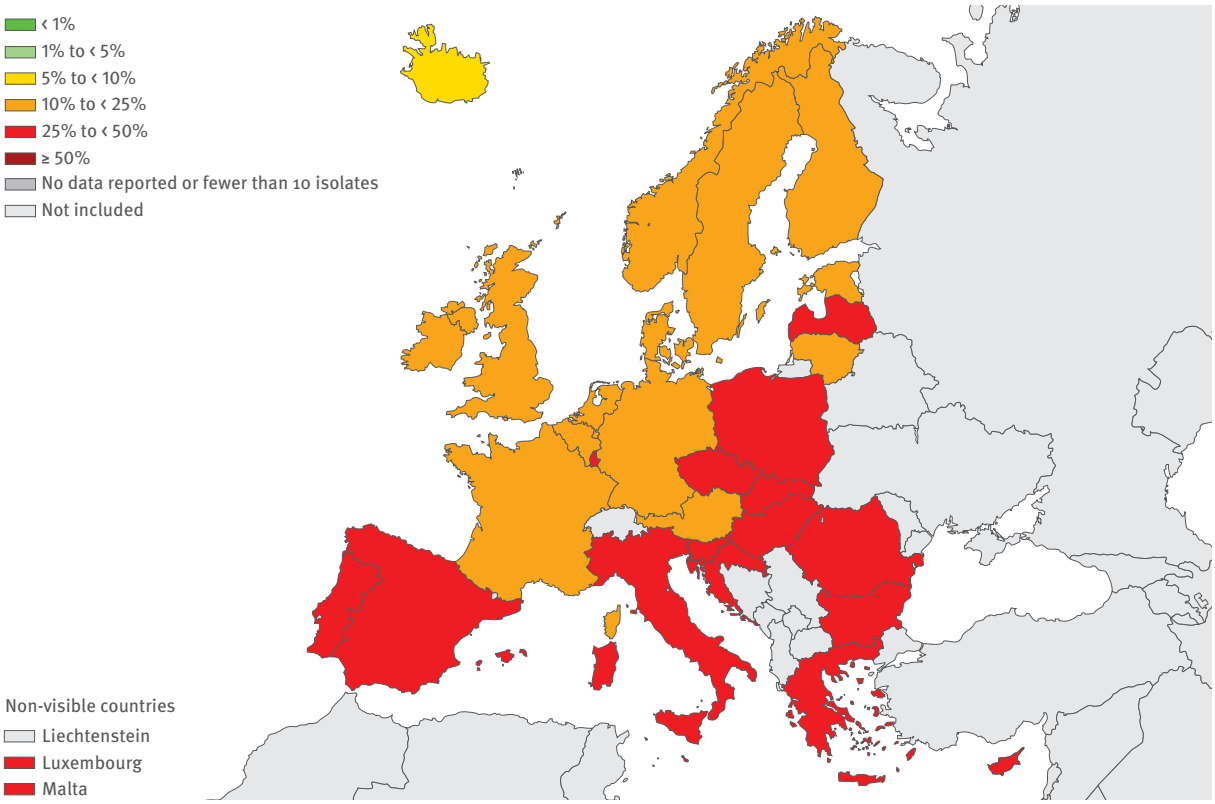


Figure 3.3. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU/EEA countries, 2016**

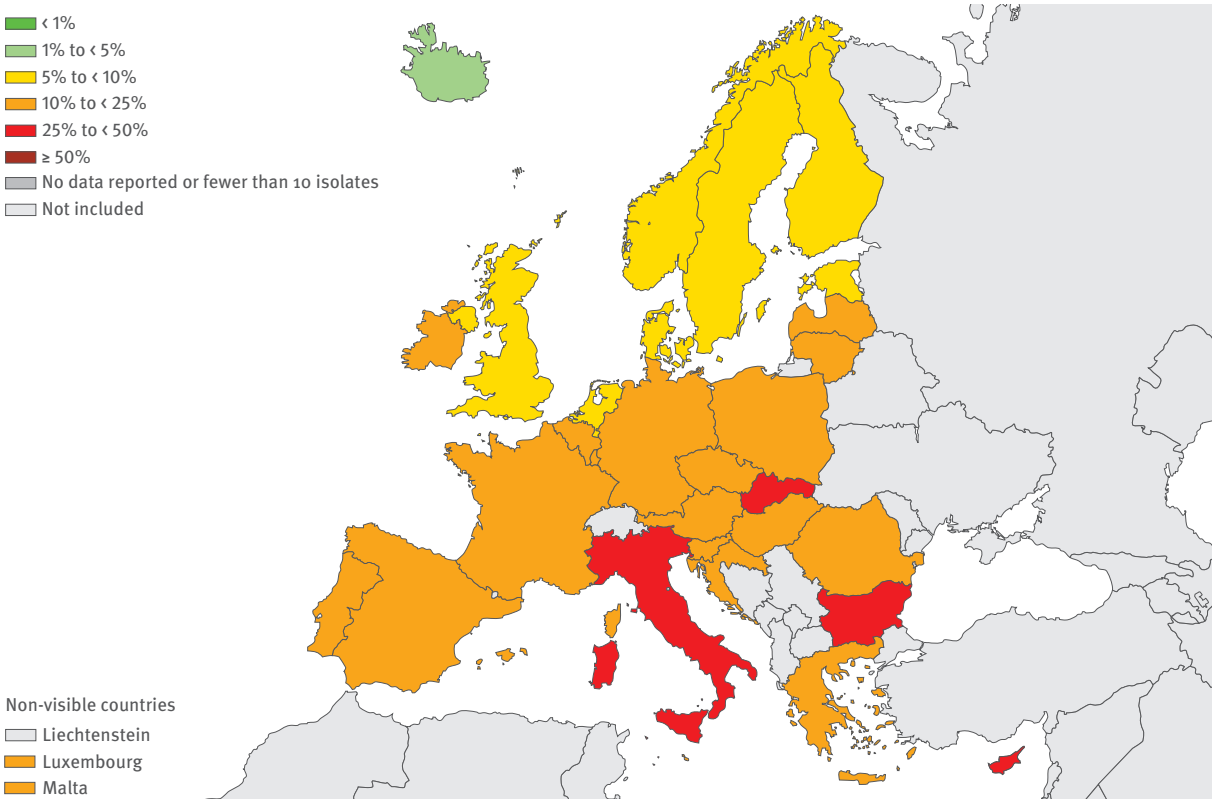


Figure 3.4. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2016**

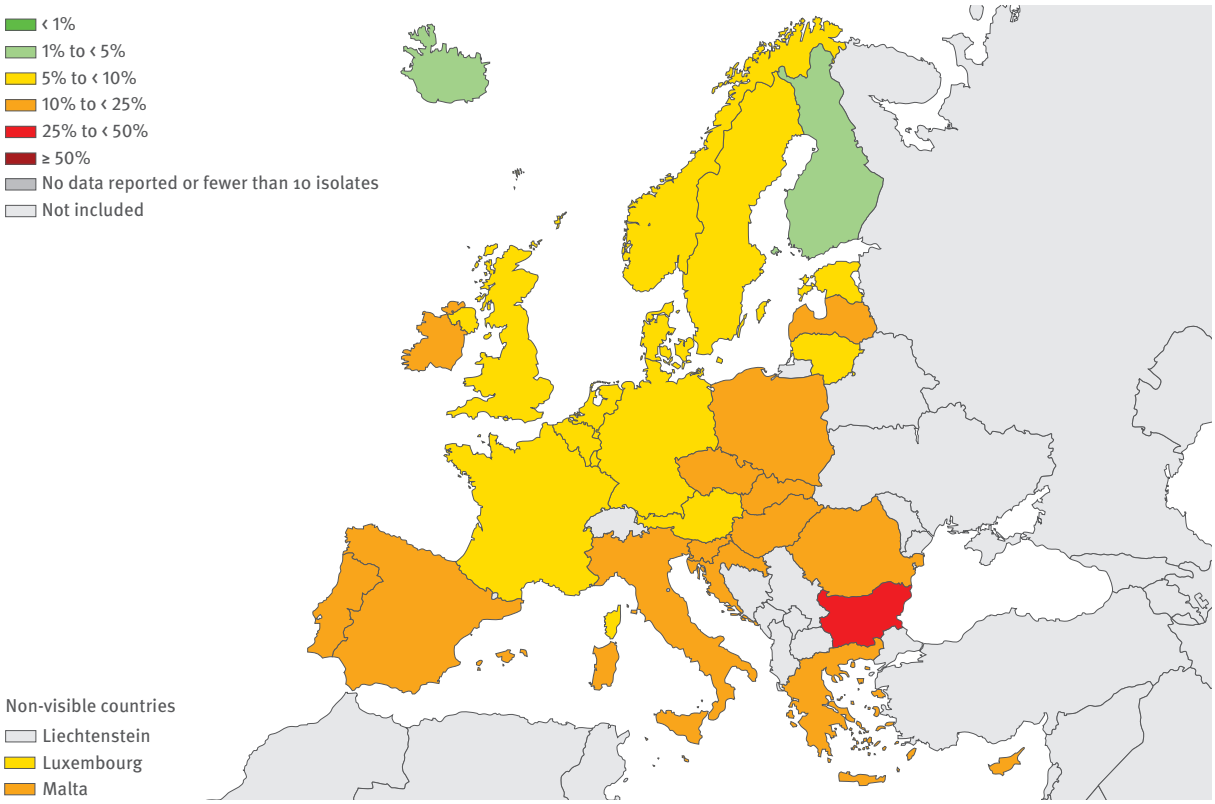


Figure 3.5. ***Escherichia coli*. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2016**

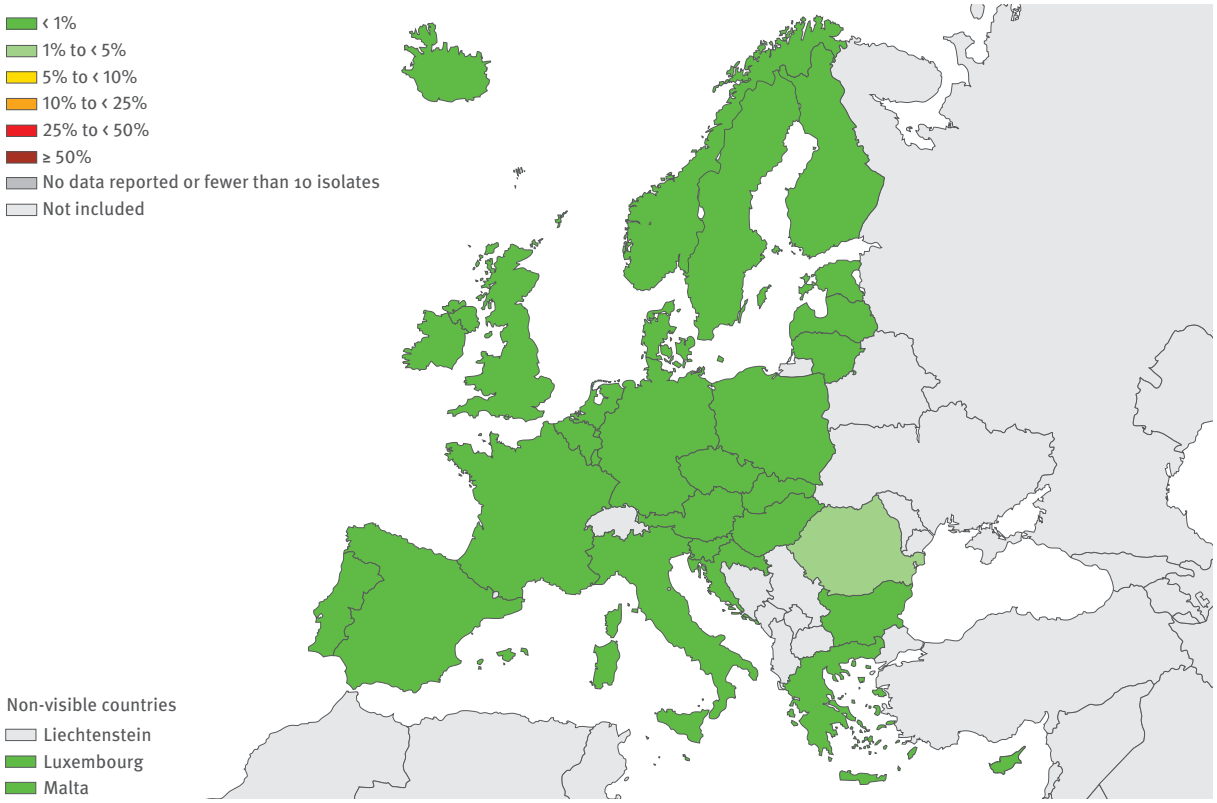


Figure 3.6. ***Escherichia coli*. Percentage (%) of invasive isolates with combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides, by country, EU/EEA countries, 2016**

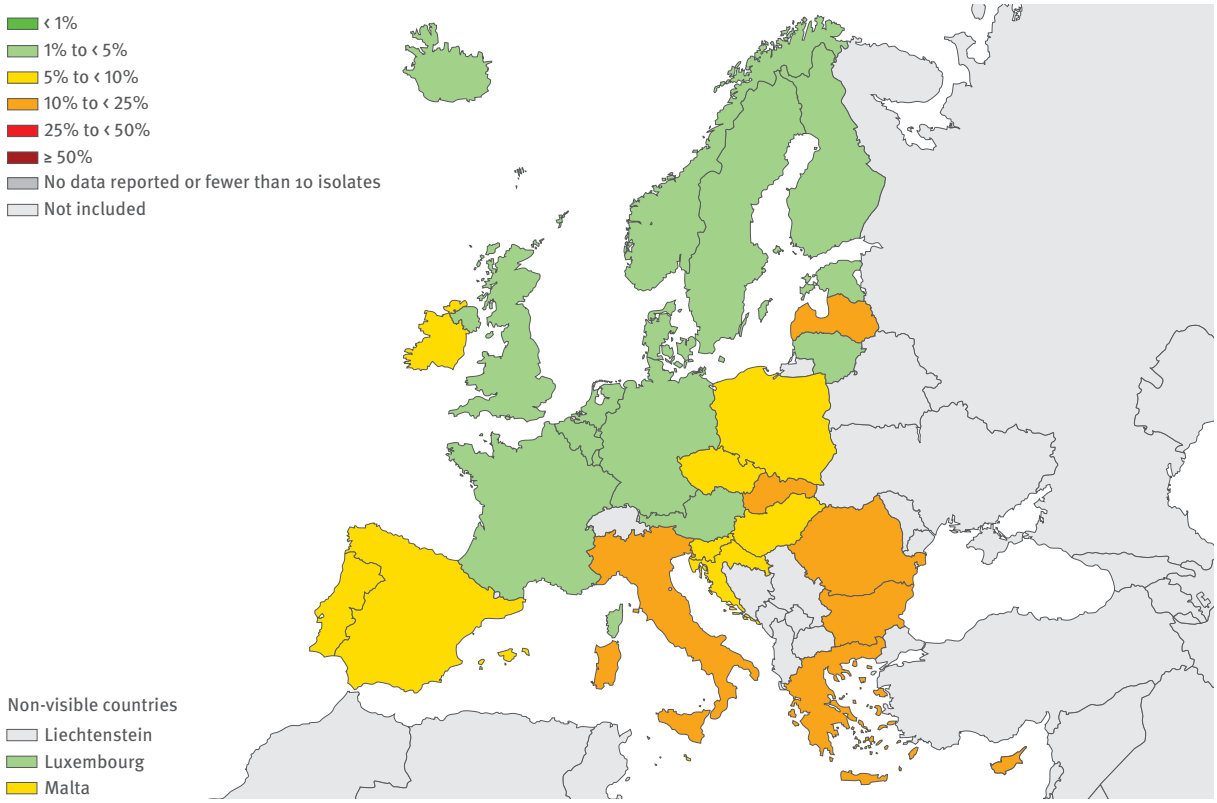


Table 3.2. ***Escherichia coli*. Total number of invasive isolates tested (N) and percentage with resistance to aminopenicillins (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories *
Finland	2124	37.3	(35–39)	2365	34.7	(33–37)	2472	36.0	(34–38)	2690	35.8	(34–38)			
Norway	3016	43.0	(41–45)	3404	41.8	(40–43)	3299	45.8	(44–48)	3615	42.9	(41–45)			
Iceland	121	46.3	(37–56)	151	43.0	(35–51)	173	44.5	(38–52)	192	43.8	(37–51)			
Denmark	3965	46.3	(45–48)	4490	44.9	(43–46)	4594	45.3	(44–47)	4698	45.0	(44–46)			
Netherlands	4656	47.5	(46–49)	6458	46.0	(45–47)	5376	47.2	(46–49)	6394	45.9	(45–47)			
Estonia	235	46.4	(40–53)	261	47.1	(41–53)	196	47.4	(40–55)	471	46.7	(42–51)			
Germany	5306	52.9	(52–54)	5543	51.7	(50–53)	8053	49.3	(48–50)	14578	49.3	(48–50)			↓
Austria	4379	51.3	(50–53)	4742	50.4	(49–52)	4880	49.9	(48–51)	5094	50.5	(49–52)			
Luxembourg	299	54.5	(49–60)	371	59.6	(54–65)	347	60.2	(55–65)	419	53.2	(48–58)			
Czech Republic	2954	54.9	(53–57)	2978	54.4	(53–56)	3172	54.3	(53–56)	3055	55.1	(53–57)			
Latvia	135	51.9	(43–61)	182	48.4	(41–56)	192	53.6	(46–61)	247	55.1	(49–61)			
Greece	1149	56.4	(53–59)	1057	55.7	(53–59)	1079	56.1	(53–59)	1170	56.9	(54–60)			
Slovenia	1224	51.5	(49–54)	1216	52.6	(50–55)	1326	54.8	(52–58)	1420	57.1	(54–60)			↑
France	10146	55.1	(54–56)	10325	55.9	(55–57)	10946	57.0	(56–58)	11248	57.2	(56–58)			↑
Croatia	1036	53.7	(51–57)	1077	54.0	(51–57)	1042	55.3	(52–58)	1043	57.3	(54–60)			
EU/EEA population-weighted mean)	**69164**	**57.7**	**(57–58)**	**73881**	**57.2**	**(56–59)**	**77508**	**57.2**	**(57–58)**	**106004**	**57.4**	**(56–58)**			
Hungary	1411	60.9	(58–64)	1603	59.1	(57–61)	1970	60.6	(58–63)	1969	57.4	(55–60)			
Belgium	4350	56.8	(55–58)	2876	58.9	(57–61)	2674	58.0	(56–60)	3736	58.0	(56–60)			
Lithuania	434	54.1	(49–59)	590	57.8	(54–62)	582	59.6	(56–64)	794	59.2	(56–63)			
Portugal	2677	59.4	(58–61)	4899	58.9	(57–60)	5177	57.8	(56–59)	5772	59.2	(58–61)			
Malta	242	54.1	(48–61)	268	53.0	(47–59)	238	55.5	(49–62)	328	60.1	(55–65)			
Slovakia	786	61.5	(58–65)	866	64.5	(61–68)	878	62.8	(59–66)	817	62.3	(59–66)			
United Kingdom	6648	63.1	(62–64)	6637	62.7	(62–64)	5117	65.8	(64–67)	21614	62.7	(62–63)			
Spain	5720	65.1	(64–66)	5817	64.9	(64–66)	6427	63.9	(63–65)	6791	64.1	(63–65)			
Poland	277	65.3	(59–71)	268	59.7	(54–66)	346	64.7	(59–70)	1034	64.5	(62–67)			
Italy	2356	65.7	(64–68)	2178	65.4	(63–67)	3385	67.4	(66–69)	3114	66.9	(65–69)			
Ireland	2465	69.4	(68–71)	2694	68.7	(67–70)	2646	66.2	(64–68)	2990	68.1	(66–70)			
Cyprus	162	77.2	(70–83)	153	71.2	(63–78)	123	68.3	(59–76)	149	69.1	(61–76)			
Romania	279	67.4	(62–73)	253	68.0	(62–74)	259	73.0	(67–78)	376	72.3	(68–77)			
Bulgaria	160	74.4	(67–81)	159	73.0	(65–80)	143	66.4	(58–74)	186	78.0	(71–84)			
Sweden	452	34.1	(30–39)	–	–	(–)	396	34.1	(29–39)	–	–	(–)		N/A	

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.3 ***Escherichia coli*. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Iceland	116	14.7	(9–22)	141	7.8	(4–14)	162	6.8	(3–12)	178	9.6	(6–15)			
Norway	2975	10.9	(10–12)	3415	11.0	(10–12)	3298	10.2	(9–11)	3611	10.9	(10–12)			
Denmark	3963	12.4	(11–14)	4489	12.3	(11–13)	4570	11.9	(11–13)	4827	11.0	(10–12)			↓
Finland	3618	13.2	(12–14)	3987	11.0	(10–12)	4404	11.2	(10–12)	4808	11.5	(11–12)			
Netherlands	4730	14.1	(13–15)	6444	13.3	(12–14)	5379	13.2	(12–14)	6398	12.8	(12–14)			
Sweden	7356	11.6	(11–12)	5142	11.3	(10–12)	5525	12.6	(12–14)	6947	13.7	(13–14)		N/A	
Estonia	338	11.8	(9–16)	407	12.3	(9–16)	256	15.2	(11–20)	699	13.9	(11–17)			
United Kingdom	6998	16.3	(15–17)	6921	16.8	(16–18)	5812	15.6	(15–17)	22883	16.3	(16–17)			
France	10069	16.7	(16–17)	10307	17.6	(17–18)	10998	17.7	(17–18)	11251	16.7	(16–17)			
Germany	5296	22.1	(21–23)	6163	20.6	(20–22)	8712	19.5	(19–20)	15785	19.7	(19–20)			↓
Lithuania	433	15.9	(13–20)	592	12.8	(10–16)	583	20.6	(17–24)	790	19.7	(17–23)			↑
Austria	4279	22.0	(21–23)	4642	19.8	(19–21)	4808	20.0	(19–21)	5278	19.8	(19–21)			↓
EU/EEA (population-weighted mean)	**80339**	**22.5**	**(22–23)**	**83863**	**22.5**	**(22–23)**	**89830**	**22.8**	**(23–23)**	**122895**	**21.0**	**(21–21)**			↓
Ireland	2478	24.2	(22–26)	2703	24.5	(23–26)	2631	23.1	(21–25)	2990	22.9	(21–24)			
Belgium	4113	23.0	(22–24)	2599	26.7	(25–28)	2565	26.6	(25–28)	3854	24.5	(23–26)			
Slovenia	1224	19.9	(18–22)	1216	23.3	(21–26)	1325	24.6	(22–27)	1420	25.6	(23–28)			↑
Hungary	1432	30.3	(28–33)	1614	28.4	(26–31)	2021	29.0	(27–31)	1986	26.8	(25–29)			↓
Czech Republic	2953	20.8	(19–22)	2976	21.6	(20–23)	3165	22.6	(21–24)	3061	27.6	(26–29)			↑
Latvia	134	18.7	(12–26)	181	17.7	(12–24)	194	27.8	(22–35)	245	27.8	(22–34)			↑
Croatia	1026	20.2	(18–23)	1072	20.1	(18–23)	1038	24.0	(21–27)	1041	27.9	(25–31)			↑
Luxembourg	295	27.8	(23–33)	368	24.7	(20–29)	347	24.2	(20–29)	418	28.9	(25–34)			
Portugal	2685	31.6	(30–33)	5027	32.4	(31–34)	5371	29.7	(28–31)	5783	28.9	(28–30)			↓
Romania	300	31.0	(26–37)	307	31.3	(26–37)	371	30.7	(26–36)	418	30.6	(26–35)			
Greece	1240	30.9	(28–34)	1105	32.8	(30–36)	1191	30.6	(28–33)	1304	32.1	(30–35)			
Spain	5926	34.9	(34–36)	5818	34.0	(33–35)	6484	31.6	(30–33)	6793	32.8	(32–34)			↓
Poland	1035	27.3	(25–30)	1057	29.2	(27–32)	1571	27.9	(26–30)	2637	33.1	(31–35)			
Slovakia	808	40.3	(37–44)	887	43.0	(40–46)	894	44.2	(41–48)	826	40.4	(37–44)			
Malta	242	29.8	(24–36)	268	28.7	(23–35)	238	37.4	(31–44)	328	41.5	(36–47)			↑
Bulgaria	187	37.4	(30–45)	215	38.6	(32–45)	204	35.3	(29–42)	237	42.2	(36–49)			
Italy	3928	42.2	(41–44)	3647	43.9	(42–46)	5590	44.4	(43–46)	5950	43.3	(42–45)			
Cyprus	162	51.9	(44–60)	153	46.4	(38–55)	123	45.5	(37–55)	149	47.0	(39–55)			

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.4. ***Escherichia coli*****. Total number of invasive isolates tested (N) and percentage with resistance to third-generation cephalosporins (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Iceland	121	5.0	(2–10)	152	3.3	(1–8)	173	1.7	(0–5)	192	4.2	(2–8)			
Norway	3077	5.5	(5–6)	3421	5.8	(5–7)	3301	6.0	(5–7)	3617	5.6	(5–6)			
Netherlands	4740	5.8	(5–7)	6497	5.7	(5–6)	5378	5.7	(5–6)	6397	6.4	(6–7)			
Denmark	2451	8.1	(7–9)	4410	7.0	(6–8)	4561	7.5	(7–8)	4659	6.6	(6–7)			
Finland	3720	7.1	(6–8)	4009	5.4	(5–6)	4342	6.1	(5–7)	4742	6.9	(6–8)			
Sweden	7532	5.2	(5–6)	6546	5.6	(5–6)	5995	6.2	(6–7)	6958	8.3	(8–9)		N/A	
Estonia	340	7.4	(5–11)	410	9.3	(7–12)	246	11.4	(8–16)	701	9.0	(7–11)			
United Kingdom	6586	14.7	(14–16)	6221	10.3	(10–11)	5169	11.3	(10–12)	21846	9.2	(9–10)			↓
Austria	4376	9.8	(9–11)	4739	9.4	(9–10)	4900	9.7	(9–11)	5267	10.0	(9–11)			
Belgium	4051	8.0	(7–9)	2802	9.7	(9–11)	2593	9.7	(9–11)	3737	10.5	(10–12)			↑
France	10154	9.5	(9–10)	10349	9.9	(9–11)	11051	11.0	(10–12)	11313	11.2	(11–12)			↑
Ireland	2480	10.6	(9–12)	2691	10.7	(10–12)	2638	11.4	(10–13)	2985	11.4	(10–13)			
Germany	5335	10.7	(10–12)	6246	10.5	(10–11)	8724	10.4	(10–11)	15777	11.5	(11–12)			
EU/EEA (population-weighted mean)	**79076**	**12.6**	**(12–13)**	**85092**	**12.0**	**(12–12)**	**89819**	**13.1**	**(13–13)**	**121674**	**12.4**	**(12–13)**			↑
Slovenia	1224	8.7	(7–10)	1216	12.7	(11–15)	1326	13.7	(12–16)	1420	12.5	(11–14)			↑
Luxembourg	301	10.6	(7–15)	368	12.0	(9–16)	347	12.7	(9–17)	418	13.6	(10–17)			
Poland	1036	10.9	(9–13)	1085	10.5	(9–12)	1610	11.9	(10–14)	2719	13.7	(12–15)			
Malta	242	8.7	(5–13)	268	10.8	(7–15)	238	11.8	(8–17)	328	14.6	(11–19)			↑
Croatia	1040	8.8	(7–11)	1079	10.8	(9–13)	1046	12.5	(11–15)	1045	14.7	(13–17)			↑
Lithuania	434	7.6	(5–11)	594	8.1	(6–11)	581	16.0	(13–19)	795	14.7	(12–17)			↑
Spain	5932	13.3	(12–14)	5821	12.3	(12–13)	6428	11.6	(11–12)	6796	15.0	(14–16)			↑
Czech Republic	2954	13.1	(12–14)	2978	14.0	(13–15)	3172	14.5	(13–16)	3061	15.1	(14–16)			↑
Portugal	2678	14.9	(14–16)	5024	16.4	(15–17)	5376	16.1	(15–17)	5784	16.1	(15–17)			
Hungary	1437	18.9	(17–21)	1619	16.4	(15–18)	2026	16.7	(15–18)	1993	16.7	(15–18)			
Greece	1255	17.2	(15–19)	1122	21.0	(19–24)	1215	19.8	(18–22)	1304	17.6	(16–20)			
Romania	298	22.8	(18–28)	306	29.4	(24–35)	369	26.8	(22–32)	418	23.4	(19–28)			
Latvia	136	14.0	(9–21)	165	10.9	(7–17)	201	17.9	(13–24)	253	24.1	(19–30)			↑
Slovakia	807	29.7	(27–33)	889	31.8	(29–35)	893	30.0	(27–33)	824	29.7	(27–33)			
Italy	3990	26.2	(25–28)	3694	28.7	(27–30)	5592	30.1	(29–31)	5938	29.8	(29–31)			↑
Cyprus	162	38.9	(31–47)	153	28.8	(22–37)	123	28.5	(21–37)	149	30.2	(23–38)			
Bulgaria	187	39.6	(33–47)	218	40.4	(34–47)	205	38.5	(32–46)	238	41.6	(35–48)			

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.5. ***Escherichia coli*. Total number of invasive isolates tested (N) and percentage with resistance to aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories *
Iceland	121	4.1	(1–9)	152	5.3	(2–10)	173	2.9	(1–7)	192	3.6	(1–7)			
Finland	3561	6.5	(6–7)	3817	4.6	(4–5)	4135	5.4	(5–6)	4519	4.9	(4–6)			↓
Norway	3079	6.4	(6–7)	3419	5.9	(5–7)	3301	6.0	(5–7)	3614	5.5	(5–6)			
Denmark	3887	6.5	(6–7)	4493	7.3	(7–8)	4591	6.8	(6–8)	4846	6.1	(5–7)			
Netherlands	4741	6.2	(6–7)	6485	6.3	(6–7)	5378	6.0	(5–7)	6397	6.2	(6–7)			
Germany	5337	7.0	(6–8)	6244	6.9	(6–8)	8723	7.2	(7–8)	15613	7.1	(7–8)			
Sweden	7100	6.0	(5–7)	5606	6.1	(5–7)	5761	6.4	(6–7)	6949	7.2	(7–8)		N/A	
Estonia	341	7.3	(5–11)	411	6.8	(5–10)	257	9.3	(6–14)	702	7.4	(6–10)			
Austria	4367	7.2	(6–8)	4726	7.1	(6–8)	4884	7.0	(6–8)	5248	7.8	(7–9)			
France	10156	7.8	(7–8)	10341	7.7	(7–8)	11055	8.2	(8–9)	11135	7.9	(7–8)			
Lithuania	429	10.7	(8–14)	584	10.6	(8–13)	583	10.1	(8–13)	791	8.0	(6–10)			
Belgium	3309	7.3	(6–8)	2045	8.9	(8–10)	2286	8.4	(7–10)	3499	8.4	(8–9)			
Luxembourg	299	7.0	(4–11)	367	7.9	(5–11)	347	8.9	(6–12)	418	9.1	(7–12)			
EU/EEA (population-weighted mean)	**79531**	**9.9**	**(10–10)**	**84015**	**9.7**	**(10–10)**	**89744**	**10.4**	**(10–11)**	**122215**	**10.4**	**(10–10)**			↑
United Kingdom	7166	9.0	(8–10)	7274	8.9	(8–10)	6052	9.9	(9–11)	23166	9.9	(9–10)			↑
Malta	242	9.1	(6–13)	268	9.7	(6–14)	238	12.2	(8–17)	328	10.4	(7–14)			
Slovenia	1224	9.3	(8–11)	1216	11.3	(10–13)	1326	12.9	(11–15)	1420	10.6	(9–12)			
Ireland	2481	11.2	(10–12)	2705	12.1	(11–13)	2646	11.8	(11–13)	2991	11.2	(10–12)			
Czech Republic	2957	9.1	(8–10)	2979	10.7	(10–12)	3172	11.3	(10–13)	3061	12.2	(11–13)			↑
Latvia	134	5.2	(2–10)	181	8.3	(5–13)	191	14.1	(10–20)	244	12.7	(9–18)			↑
Portugal	2684	15.2	(14–17)	4991	15.1	(14–16)	5372	13.8	(13–15)	5765	13.1	(12–14)			↓
Hungary	1427	17.0	(15–19)	1610	14.7	(13–17)	2020	13.6	(12–15)	1992	13.3	(12–15)			↓
Poland	1049	10.7	(9–13)	1068	9.8	(8–12)	1581	11.2	(10–13)	2521	13.3	(12–15)			
Spain	5929	15.3	(14–16)	5820	15.1	(14–16)	6489	14.7	(14–16)	6796	14.5	(14–15)			
Romania	298	14.8	(11–19)	303	17.2	(13–22)	366	18.3	(14–23)	414	15.0	(12–19)			
Croatia	1016	7.7	(6–9)	1077	10.9	(9–13)	1008	12.7	(11–15)	1027	15.7	(14–18)			↑
Cyprus	162	24.7	(18–32)	153	17.6	(12–25)	123	13.8	(8–21)	149	16.1	(11–23)			↓
Greece	1239	16.9	(15–19)	1110	15.6	(14–18)	1200	16.1	(14–18)	1301	16.8	(15–19)			
Italy	3802	19.0	(18–20)	3493	19.4	(18–21)	5408	20.2	(19–21)	6079	19.0	(18–20)			
Slovakia	807	24.0	(21–27)	888	22.7	(20–26)	896	24.2	(21–27)	828	20.2	(17–23)			
Bulgaria	187	31.0	(24–38)	189	29.1	(23–36)	182	19.8	(14–26)	210	34.8	(28–42)			

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.6. ***Escherichia coli.*** **Total number of invasive isolates tested (N) and percentage with resistance to carbapenems (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Croatia	1038	0.0	(0–0)	1079	0.0	(0–0)	1046	0.00	(0–0)	1045	0.0	(0–0)			
Cyprus	162	0.0	(0–2)	153	0.0	(0–2)	123	0.00	(0–3)	149	0.0	(0–2)			
Czech Republic	1733	0.0	(0–0)	1702	0.0	(0–0)	1471	0.00	(0–0)	1483	0.0	(0–0)			
Denmark	2832	<0.1	(0–0)	3946	<0.1	(0–0)	4046	<0.1	(0–0)	4671	0.0	(0–0)			
Estonia	283	0.0	(0–1)	254	0.0	(0–1)	219	0.00	(0–2)	602	0.0	(0–1)			
Hungary	1355	0.1	(0–1)	1517	0.0	(0–0)	1922	0.00	(0–0)	1905	0.0	(0–0)			↓
Iceland	121	0.0	(0–3)	140	0.0	(0–3)	162	0.00	(0–0)	192	0.0	(0–0)			
Latvia	135	0.0	(0–3)	182	0.0	(0–2)	192	0.00	(0–2)	246	0.0	(0–1)			
Lithuania	433	0.0	(0–1)	593	0.0	(0–1)	579	0.00	(0–1)	793	0.0	(0–0)			
Luxembourg	295	0.0	(0–1)	368	0.3	(0–2)	347	0.00	(0–1)	418	0.0	(0–1)			
Malta	242	0.0	(0–2)	268	0.0	(0–1)	238	0.00	(0–2)	328	0.0	(0–1)			
Netherlands	4726	<0.1	(0–0)	6475	0.0	(0–0)	5375	<0.1	(0–0)	6394	0.0	(0–0)			
Slovakia	588	0	(0–1)	820	0.0	(0–0)	830	0.00	(0–0)	751	0.0	(0–0)			
Slovenia	1224	0.1	(0–0)	1216	0.0	(0–0)	1326	0.0	(0–0)	1420	0.0	(0–0)			
Germany	5333	0.1	(0–0)	6247	0.1	(0–0)	8725	<0.1	(0–0)	15783	<0.1	(0–0)			
France	9585	0.1	(0–0)	9693	<0.1	(0–0)	10481	<0.1	(0–0)	10929	<0.1	(0–0)			↓
Portugal	2668	0.1	(0–0)	4998	<0.1	(0–0)	5354	0.10	(0–0)	5760	<0.1	(0–0)			
Austria	4257	<0.1	(0–0)	4600	<0.1	(0–0)	4760	<0.1	(0–0)	5134	<0.1	(0–0)			
Finland	3721	0.0	(0–0)	4013	0.0	(0–0)	4425	0.00	(0–0)	4832	<0.1	(0–0)			
United Kingdom	6251	<0.1	(0–0)	6367	0.1	(0–0)	5497	0.30	(0–0)	22762	<0.1	(0–0)			
Ireland	2476	<0.1	(0–0)	2697	<0.1	(0–0)	2615	<0.1	(0–0)	2989	<0.1	(0–0)			
Poland	938	0.0	(0–0)	979	0.2	(0–1)	1499	0.10	(0–0)	2553	<0.1	(0–0)			
EU/EEA (population-weighted mean)	**76709**	**0.2**	**(0–0)**	**81776**	**0.1**	**(0–0)**	**86180**	**0.1**	**(0–0)**	**120361**	**<0.1**	**(0–0)**			↓
Belgium	4246	<0.1	(0–0)	2614	<0.1	(0–0)	2588	0.00	(0–0)	3845	0.1	(0–0)			
Norway	3079	0.1	(0–0)	3420	0.0	(0–0)	3297	<0.1	(0–0)	3616	0.1	(0–0)			
Spain	5921	0.7	(1–1)	5817	0.1	(0–0)	6399	<0.1	(0–0)	6790	0.1	(0–0)			↓
Sweden	7347	<0.1	(0–0)	6298	0.0	(0–0)	5307	0.10	(0–0)	6927	0.1	(0–0)		N/A	
Italy	3989	0.6	(0–1)	3696	0.2	(0–0)	5592	0.20	(0–0)	6106	0.3	(0–0)			↓
Bulgaria	176	2.8	(1–7)	197	0.5	(0–3)	182	0.00	(0–2)	224	0.9	(0–3)			
Greece	1256	1.4	(1–2)	1122	1.2	(1–2)	1215	1.20	(1–2)	1303	0.9	(0–2)			
Romania	299	0.0	(0–1)	305	0.7	(0–2)	368	1.90	(1–4)	411	1.0	(0–2)			

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.7. ***Escherichia coli*. Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Iceland	116	0.9	(0–5)	141	1.4	(0–5)	162	0.0	(0–2)	178	1.1	(0–4)			
Denmark	2377	2.2	(2–3)	4406	1.9	(1–2)	4531	2.5	(2–3)	4640	1.8	(1–2)			
Norway	2971	2.5	(2–3)	3413	2.0	(2–2)	3298	1.9	(1–2)	3609	1.9	(2–2)			
Netherlands	4722	1.9	(2–2)	6425	2.1	(2–3)	5377	2.0	(2–2)	6396	2.3	(2–3)			
Finland	3457	3.2	(3–4)	3787	2.2	(2–3)	4103	2.6	(2–3)	4492	2.4	(2–3)			
Lithuania	428	1.9	(1–4)	582	2.6	(1–4)	581	4.3	(3–6)	783	2.6	(2–4)			
Sweden	7094	2.0	(2–2)	4203	2.0	(2–2)	5257	2.5	(2–3)	6939	3.1	(3–4)		N/A	
Austria	4258	3.1	(3–4)	4609	2.6	(2–3)	4785	2.9	(2–3)	5235	3.5	(3–4)			
Germany	5282	2.7	(2–3)	6158	3.0	(3–3)	8707	3.0	(3–3)	15605	3.5	(3–4)			↑
Belgium	3138	2.7	(2–3)	2045	3.9	(3–5)	2285	3.5	(3–4)	3496	3.8	(3–4)			
France	10068	3.2	(3–4)	10299	3.5	(3–4)	10988	3.9	(4–4)	11082	3.8	(3–4)			↑
Luxembourg	283	2.1	(1–5)	367	3.8	(2–6)	347	5.2	(3–8)	418	3.8	(2–6)			
Estonia	335	3.3	(2–6)	404	3.5	(2–6)	233	5.2	(3–9)	698	4.0	(3–6)			
United Kingdom	6535	4.4	(4–5)	6191	4.4	(4–5)	5119	4.5	(4–5)	21101	4.0	(4–4)			
EU/EEA (population-weighted mean)	**76493**	**4.6**	**(4–5)**	**80896**	**4.7**	**(5–5)**	**87778**	**5.3**	**(5–5)**	**119319**	**4.8**	**(5–5)**			↑
Ireland	2477	4.7	(4–6)	2689	4.7	(4–6)	2621	5.4	(5–6)	2984	5.3	(5–6)			
Malta	242	5.0	(3–9)	268	6.7	(4–10)	238	7.1	(4–11)	328	5.5	(3–9)			
Spain	5921	5.8	(5–6)	5814	5.3	(5–6)	6416	5.5	(5–6)	6787	6.2	(6–7)			
Hungary	1418	11.0	(9–13)	1599	8.2	(7–10)	2015	6.7	(6–8)	1981	6.4	(5–8)			↓
Slovenia	1224	4.5	(3–6)	1216	7.1	(6–9)	1325	8.1	(7–10)	1420	6.9	(6–8)			↑
Portugal	2676	8.1	(7–9)	4989	8.2	(7–9)	5366	7.6	(7–8)	5762	7.7	(7–8)			
Czech Republic	2953	4.9	(4–6)	2976	6.4	(6–7)	3165	6.9	(6–8)	3061	7.9	(7–9)			↑
Poland	978	5.0	(4–7)	1026	5.6	(4–7)	1532	6.1	(5–7)	2411	8.5	(7–10)			
Croatia	1003	3.5	(2–5)	1070	6.0	(5–8)	1000	6.9	(5–9)	1023	9.4	(8–11)			↑
Latvia	132	3.8	(1–9)	163	2.5	(1–6)	191	10.5	(7–16)	242	10.3	(7–15)			↑
Greece	1234	10.3	(9–12)	1102	10.7	(9–13)	1187	10.6	(9–13)	1300	10.4	(9–12)			
Cyprus	162	20.4	(14–27)	153	13.1	(8–19)	123	9.8	(5–16)	149	11.4	(7–18)			↓
Romania	292	9.2	(6–13)	298	14.4	(11–19)	364	13.5	(10–17)	410	11.7	(9–15)			
Italy	3724	12.5	(11–14)	3428	13.7	(13–15)	5389	14.6	(14–16)	5763	12.9	(12–14)			
Slovakia	806	17.2	(15–20)	887	17.0	(15–20)	891	17.1	(15–20)	822	14.8	(12–17)			
Bulgaria	187	18.7	(13–25)	188	20.2	(15–27)	182	12.6	(8–18)	204	22.1	(17–28)			

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

3.2 *Klebsiella pneumoniae*

Klebsiella pneumoniae predominantly colonise hospitalised individuals, where it is mainly found in the gastrointestinal tract, skin and the respiratory tract. The majority of infections caused by *K. pneumoniae* are healthcare-associated and can spread rapidly between patients and via the hands of hospital personnel, leading to nosocomial outbreaks. Infections include urinary tract infections, lower respiratory tract infections, intra-abdominal infections and bloodstream infections. Some hypervirulent strains can cause severe invasive infections (often liver abscesses with bacteraemia and metastatic infections) also occurring in healthy subjects.

Similar to *E. coli*, *K. pneumoniae* can be resistant to multiple antimicrobial agents, and resistance traits are frequently acquired through plasmids. In contrast to *E. coli*, *K. pneumoniae* has a chromosomally encoded class A beta-lactamase and is thus intrinsically resistant to aminopenicillins. Many novel ESBL variants were initially identified in *K. pneumoniae* and were only subsequently found in *E. coli*. Carbapenems frequently resist the effect of ESBLs and might remain as one of the few treatment options for severe infections. A recently emerging threat is carbapenem resistance in *K. pneumoniae* mediated by a range of carbapenemases, which may confer resistance to virtually all available beta-lactam antibacterial drugs.

Antimicrobial resistance 2013–2016

At the EU/EEA level, more than a third (34.5 %) of the *K. pneumoniae* isolates reported to EARS-Net in 2016 were resistant to at least one of the antimicrobial groups under regular surveillance (fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems) (Table 3.8). The highest EU/EEA population-weighted mean resistance percentage in 2016 was reported for third-generation cephalosporins (25.7 %), followed by fluoroquinolones (24.6 %), aminoglycosides (19.0 %) and carbapenems (6.1 %) (Tables 3.9–3.12).

There were small but significant decreases in the EU/EEA population-weighted mean percentages (based on data limited to laboratories reporting consistently during that period) for all antimicrobial groups except carbapenems between 2013 and 2016 (Tables 3.8–3.11). The trend for carbapenem resistance did not change significantly for the same period (Table 3.12).

Single resistance was less commonly reported compared to resistance to two or more antimicrobial groups, with the most common resistance phenotype being combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (Table 3.8). However, the EU/EEA population-weighted mean percentage (based on data limited to laboratories reporting consistently during the period) for combined resistance to these three antimicrobial groups decreased significantly during the period 2013 to 2016 (Table 3.13).

A majority of the third-generation cephalosporin resistant isolates were ESBL-positive. Only data from laboratories reporting ESBL results for all isolates identified as resistant to third-generation cephalosporins (72 % of the laboratories reporting AST data for third-generation cephalosporins in *K. pneumoniae*), and only data from countries reporting at least 10 such isolates were included (23 countries). Among the *K. pneumoniae* isolates meeting the inclusion criteria, 87.1 % were ascertained as ESBL-positive by the laboratories in 2016.

Colistin susceptibility data were reported for 27.6 % of all *K. pneumoniae* isolates. Only eight countries provided colistin susceptibility results for more than half of the reported isolates. Overall, 8.5 % of the tested isolates were resistant to colistin (2.4 % of all reported *K. pneumoniae* isolates, regardless of colistin susceptibility data availability). The vast majority (88.5 %) of these were reported from Greece and Italy. Due to the lower number of isolates tested, the relatively high proportion of isolates from high-resistance areas, and severe technical challenges with colistin susceptibility testing, these findings should be interpreted with caution and may not be representative for Europe as a whole.

Large inter-country variations could be noted for all antimicrobial groups under regular surveillance, with generally higher resistance percentages reported from southern and eastern parts of Europe than the north (Figures 3.8–3.12). The countries reporting the highest percentages of carbapenem resistance were also among the countries reporting the highest resistance percentages for the other antimicrobial groups. Similar distinct variations could be seen in the country-specific distributions between fully susceptible isolates and isolates with resistance to one, two, three or four antimicrobial groups (Figure 3.7).

Discussion and conclusion

In 2016, lower EU/EEA population-weighted mean percentages compared to 2015 were reported for a majority of the antimicrobial groups under surveillance by EARS-Net. Limiting the analyses to data from laboratories reporting consistently for all four years to exclude some bias caused by changes in the population under surveillance resulted in small but significantly decreasing trends for all antimicrobial groups under EARS-Net surveillance, except carbapenems, for the period 2013 to 2016. However, in the majority of countries the decreasing EU/EEA mean percentages were not supported by similar decreasing trends. Instead, increasing national trends were reported from several countries, mainly those with comparatively high resistance percentages.

The resistance situation for *K. pneumoniae* remains problematic, especially in a number of countries in the southern and eastern parts of Europe. Combined resistance to several key antimicrobial groups was common in 2016, and the frequency of ESBL-producing isolates was high. As for *E. coli*, treatment alternatives for infections caused by these bacteria are few, and they might be further limited by carbapenem resistance. The high levels of carbapenem resistance, almost always combined with resistance to several other key antimicrobial groups, reported from parts of Europe are therefore a

Figure 3.7. ***Klebsiella pneumoniae*****. Distribution of isolates: fully susceptible and resistant to one, two, three and four antimicrobial groups (among isolates tested against fluoroquinolone, third-generation cephalosporin, aminoglycoside and carbapenems), EU/EEA countries, 2016**

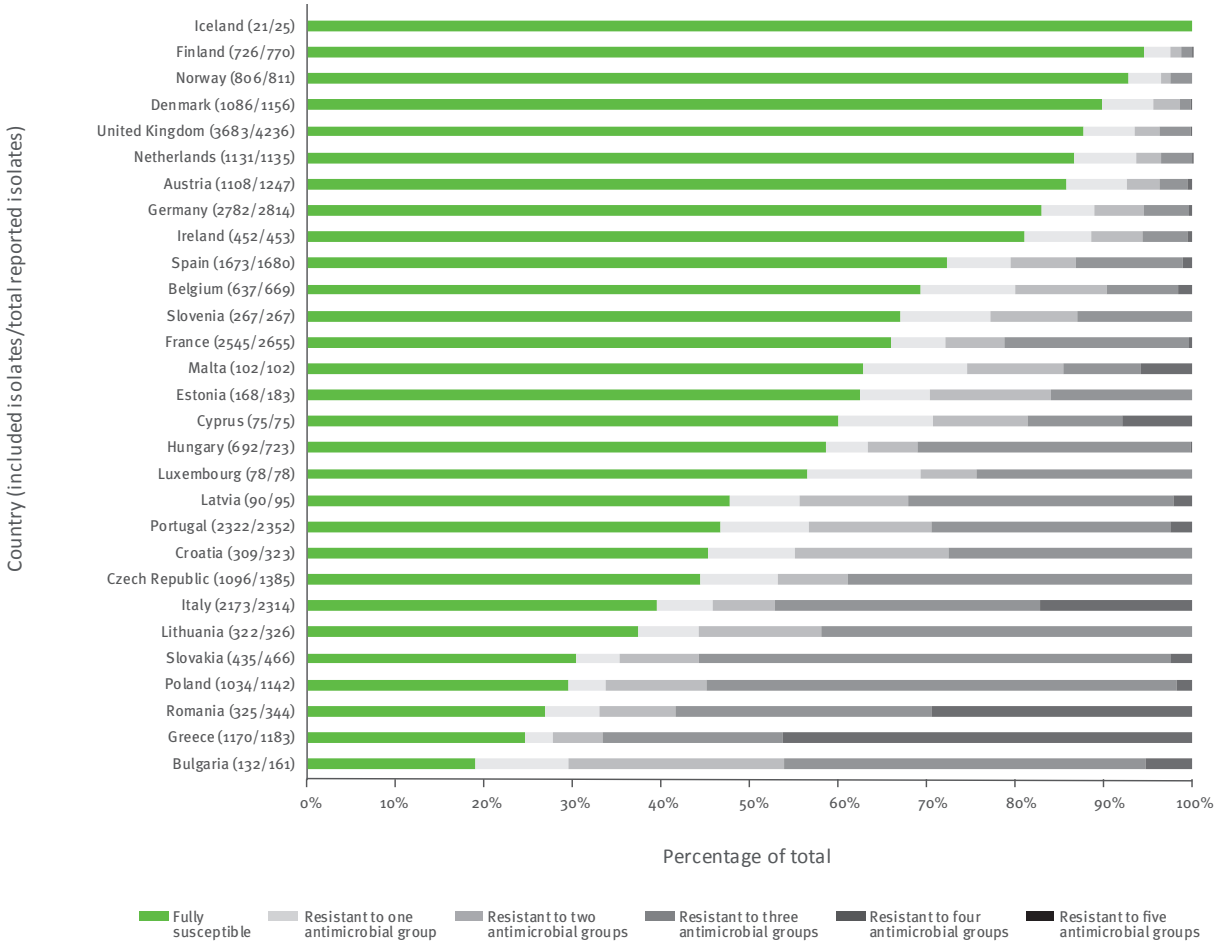


Table 3.8. ***Klebsiella pneumoniae*****. Total number of invasive isolates tested* and resistance combinations among isolates tested against fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems (n=27 420). EU/EEA countries, 2016**

Resistance pattern	Number of isolates	% of total**
Fully susceptible	**17 972**	**65.5**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance)	**1 792**	**6.5**
Third-generation cephalosporins	832	3.0
Fluoroquinolones	762	2.8
Other antimicrobial groups	198	0.7
Resistance to two antimicrobial groups		
Total (all two-group combinations)	**1 830**	**6.7**
Third-generation cephalosporins + fluoroquinolones	917	3.3
Third-generation cephalosporins + aminoglycosides	569	2.1
Fluoroquinolones + aminoglycosides	296	1.1
Other antimicrobial group combinations	48	0.2
Resistance to three antimicrobial groups		
Total (all three-group combinations)	**4 631**	**16.9**
Third-generation cephalosporins + fluoroquinolones + aminoglycosides	4 015	14.6
Third-generation cephalosporins + fluoroquinolones + carbapenems	573	2.1
Other antimicrobial group combinations	43	0.2
Resistance to four antimicrobial groups		
Third-generation cephalosporins + fluoroquinolones + aminoglycosides + carbapenems	**1 195**	**4.4**

Only resistance combinations >1% of the total are specified.

* Only data from isolates tested against all four antimicrobials groups were included in the analysis.

** Not adjusted for population differences in the reporting countries.

concern. Carbapenemases may confer resistance to virtually all beta-lactams, and carbapenemase-producing strains often also carry resistance mechanisms to a wide range of antibacterials outside the betalactam group. In Europe, *K. pneumoniae* with carbapenemase KPC, NDM, OXA-48-like, or VIM production has been reported, although with substantial variation in prevalence [8]. Remaining treatment alternatives for these infections are very limited, and the World Health Organization (WHO) sees a critical need for research, new antibiotic agents, and the development of new antibiotics which target third-generation cephalosporin and carbapenem resistance in Enterobacteriaceae, including *E. coli* and *K. pneumoniae* [12].

The emergence of resistance to colistin, one of the few remaining treatment alternatives for patients infected with *K. pneumoniae* resistant to both carbapenems and other important antimicrobial groups, is of major concern. However, as routine colistin susceptibility testing is associated with several methodological issues [13], the extent of the problem is difficult to assess based on EARS-Net data alone. To better identify globally disseminated high-risk colistin-resistant carbapenemase-producing Enterobacteriaceae (CPE) clones and monitor their geographical distribution across EU/EEA countries, ECDC plans to initiate a new EU sentinel surveillance module for extensively drug-resistant Enterobacteriaceae infections and CPE, based on whole genome sequencing [14].

As for *E. coli*, data from EARS-Net and ESAC-Net showed a correlation between national antimicrobial consumption levels and resistance to the same antimicrobial groups in *K. pneumoniae*. Higher total antimicrobial consumption correlated with a higher proportional increase in the occurrence of resistance for both carbapenems and colistin [9]. While antimicrobial use exerts ecological pressure on bacteria, poor infection prevention and control practices favour the further spread of resistant bacteria. A recently published ECDC rapid risk assessment on CPE concluded that the organism poses a significant threat to patients and healthcare systems in all EU/EEA countries [15]. Options for action include timely and appropriate diagnosis, high standards of infection prevention and control practice and antimicrobial stewardship. In recent years, many EU/EEA countries have also published recommendations and guidance documents on multidrug-resistant Enterobacteriaceae or CPE, indicating a trend towards a nationally coordinated response to this public health threat [16].

Figure 3.8. *Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2016

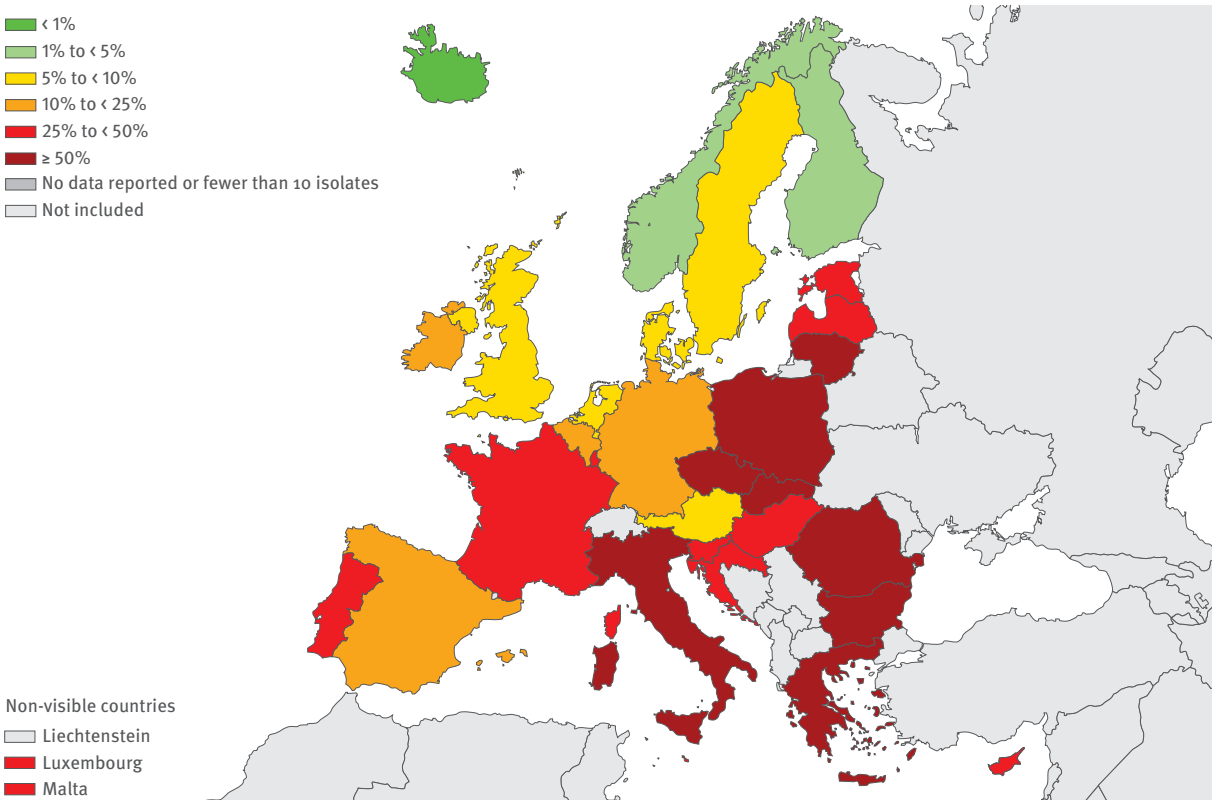


Figure 3.9. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU/EEA countries, 2016**

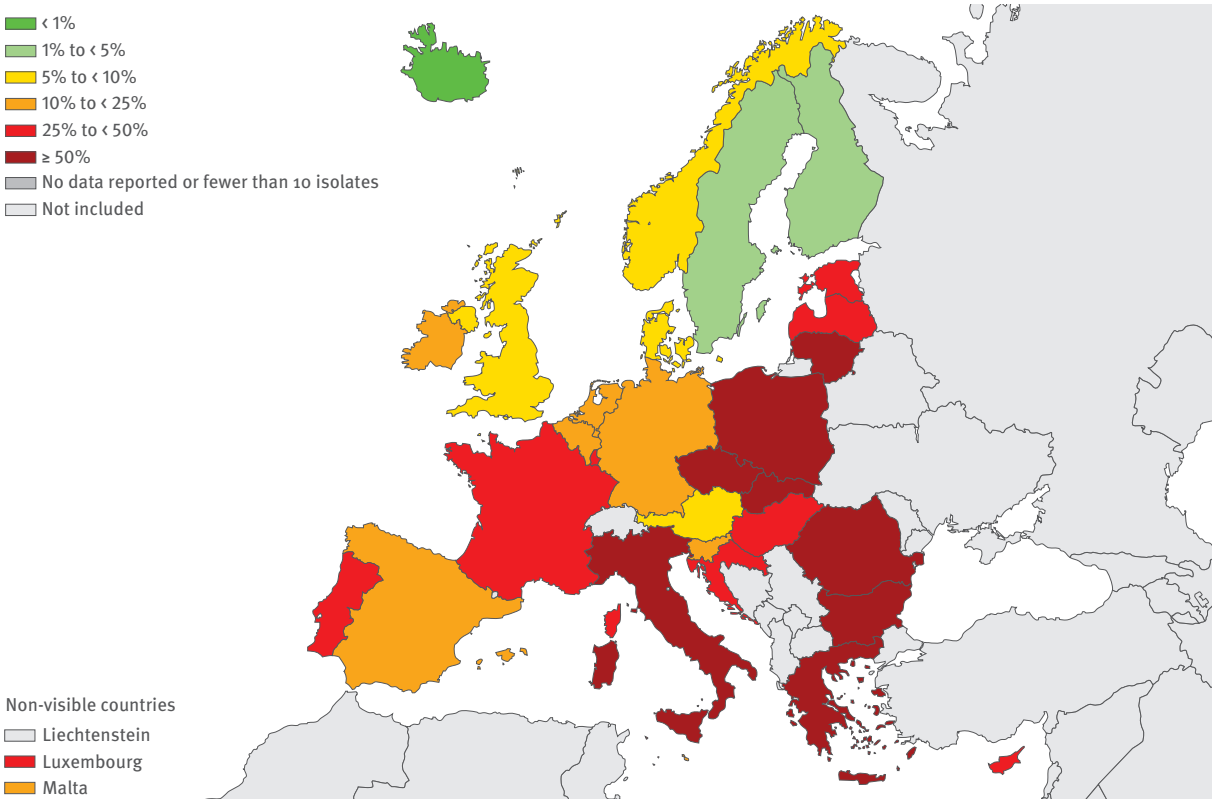


Figure 3.10. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2016**

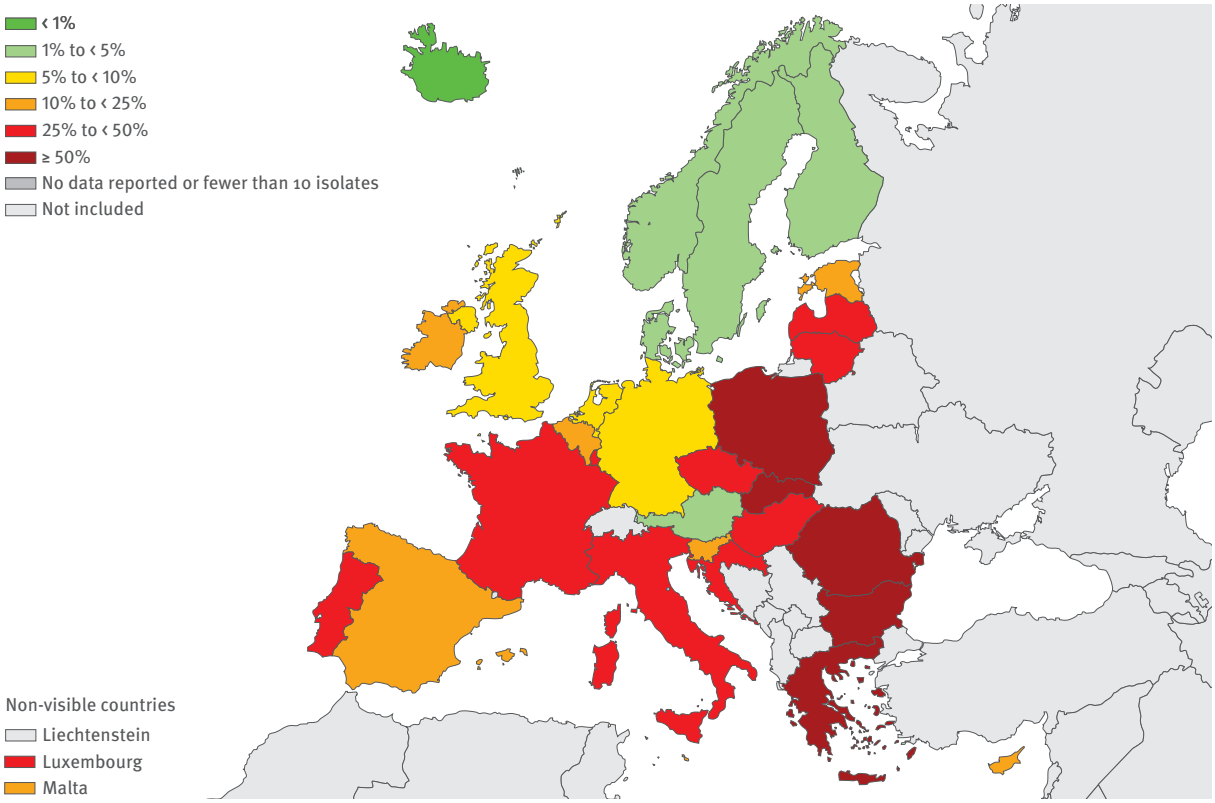


Figure 3.11. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2016**

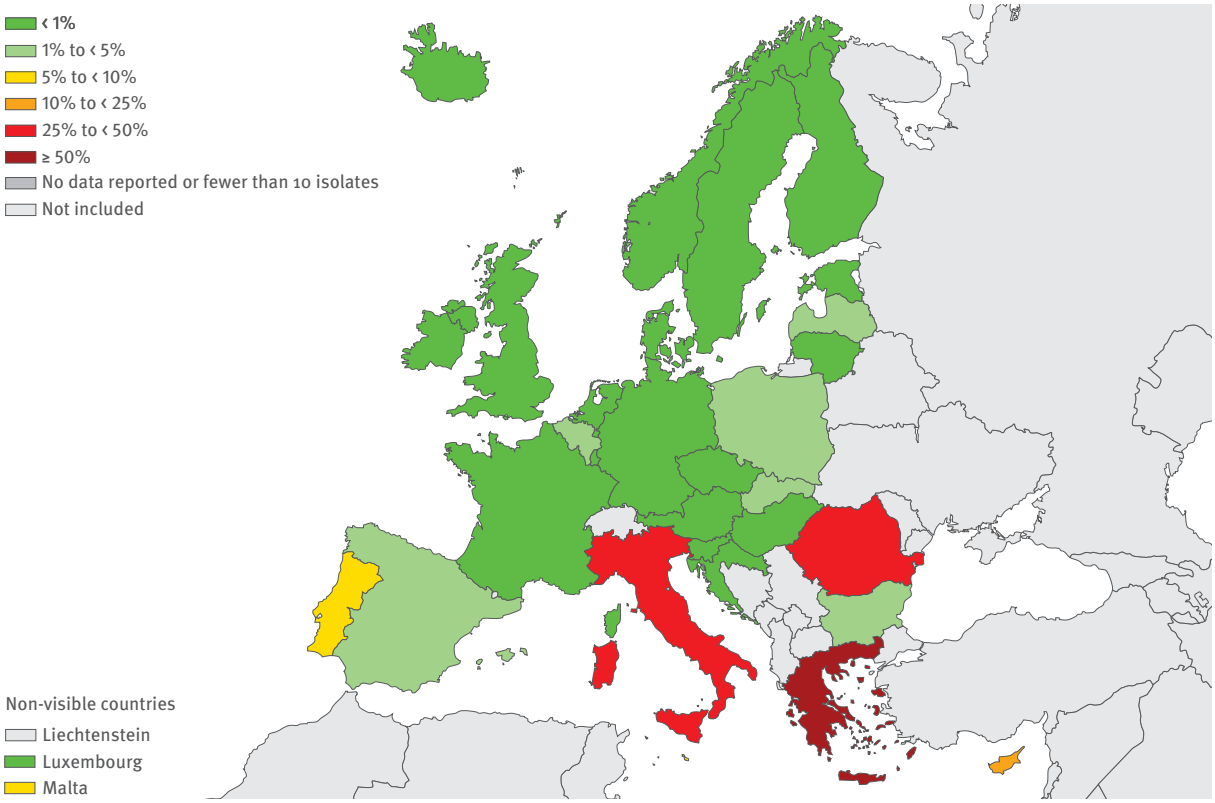


Figure 3.12. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides, by country, EU/EEA countries, 2016**

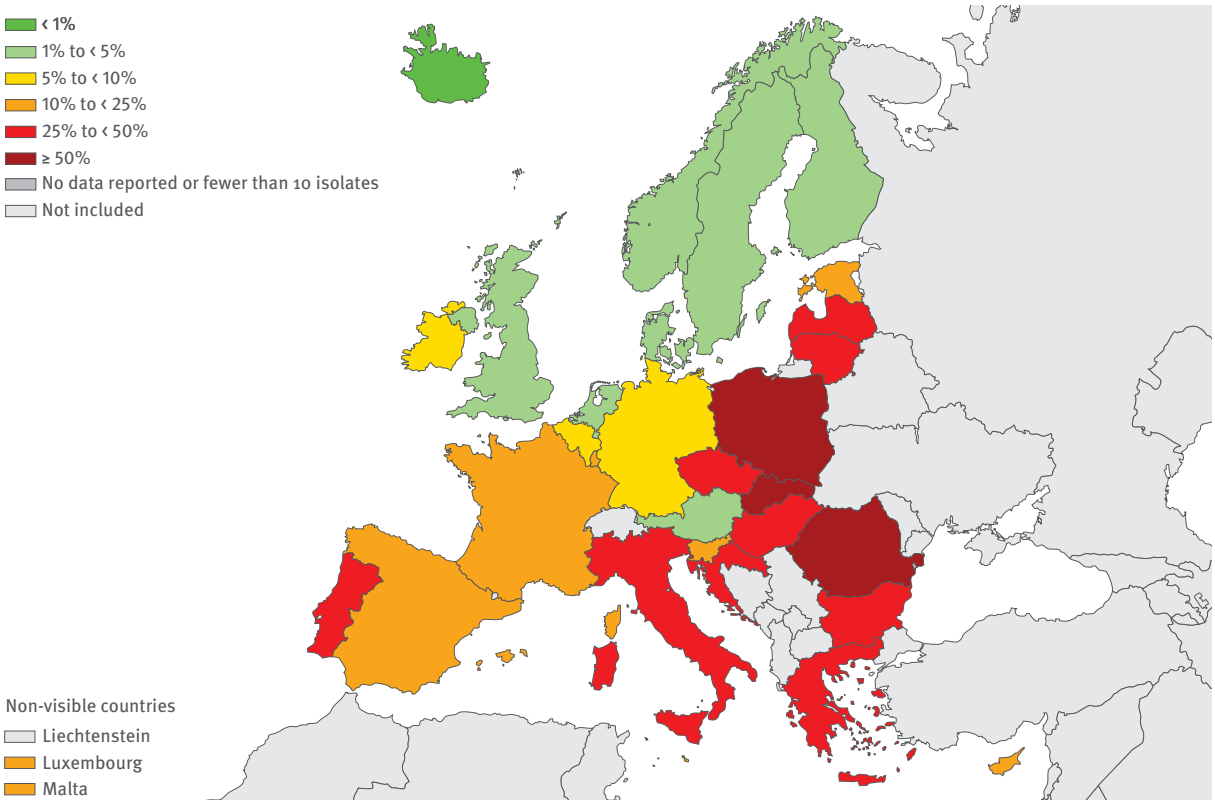


Table 3.9. ***Klebsiella pneumoniae*. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	28	0.0	(0–12)	28	3.6	(0–18)	35	2.9	(0–15)	21	0.0	(0–16)		
Finland	537	2.6	(1–4)	581	4.6	(3–7)	658	3.3	(2–5)	769	2.7	(2–4)		
Norway	616	4.9	(3–7)	746	6.2	(5–8)	700	5.0	(4–7)	808	4.3	(3–6)		
Denmark	874	8.9	(7–11)	943	6.9	(5–9)	935	5.3	(4–7)	1152	5.3	(4–7)		↓
Sweden	1270	3.9	(3–5)	763	4.1	(3–6)	907	4.5	(3–6)	1533	5.4	(4–7)	N/A	
Netherlands	638	6.1	(4–8)	886	4.7	(3–6)	908	6.8	(5–9)	1134	6.9	(5–9)		
United Kingdom	1155	8.7	(7–10)	1130	7.7	(6–9)	1011	13.3	(11–16)	4065	7.5	(7–8)		
Austria	925	15.8	(13–18)	971	10.4	(9–12)	1029	11.7	(10–14)	1246	9.8	(8–12)		↓
Ireland	316	14.6	(11–19)	355	13.5	(10–18)	388	17.0	(13–21)	453	11.3	(8–15)		
Germany	756	15.1	(13–18)	980	12.7	(11–15)	1517	9.6	(8–11)	2813	12.2	(11–13)		
Spain	1241	21.8	(20–24)	1266	18.6	(17–21)	1508	21.6	(20–24)	1677	22.7	(21–25)		
Belgium	639	22.2	(19–26)	506	18.2	(15–22)	379	22.7	(19–27)	669	23.6	(20–27)		
EU/EEA (population-weighted mean)	**18610**	**29.3**	**(29–30)**	**19990**	**28.7**	**(28–29)**	**22354**	**29.8**	**(29–30)**	**30329**	**24.6**	**(24–25)**		↓
France	1916	29.4	(27–32)	2175	31.0	(29–33)	2332	30.7	(29–33)	2589	27.7	(26–29)		
Estonia	90	26.7	(18–37)	133	21.8	(15–30)	62	33.9	(22–47)	183	29.5	(23–37)		
Slovenia	245	32.7	(27–39)	233	32.6	(27–39)	237	24.5	(19–30)	267	29.6	(24–35)		
Cyprus	68	23.5	(14–35)	80	26.3	(17–37)	62	37.1	(25–50)	75	32.0	(22–44)		
Malta	67	28.4	(18–41)	99	32.3	(23–42)	88	26.1	(17–37)	102	33.3	(24–43)		
Hungary	555	37.7	(34–42)	641	34.9	(31–39)	700	36.7	(33–40)	713	35.2	(32–39)		
Luxembourg	53	22.6	(12–36)	66	31.8	(21–44)	60	20.0	(11–32)	78	35.9	(25–48)		
Portugal	911	35.7	(33–39)	1712	36.5	(34–39)	2094	38.6	(36–41)	2350	41.7	(40–44)		↑
Latvia	88	43.2	(33–54)	116	44.8	(36–54)	112	42.0	(33–52)	91	41.8	(32–53)		
Croatia	373	43.2	(38–48)	330	44.8	(39–50)	380	48.7	(44–54)	318	43.4	(38–49)		
Czech Republic	1291	47.7	(45–50)	1382	48.0	(45–51)	1416	48.9	(46–52)	1384	50.5	(48–53)		
Lithuania	144	45.1	(37–54)	154	45.5	(37–54)	179	45.8	(38–53)	324	54.6	(49–60)		↑
Bulgaria	138	45.7	(37–54)	151	50.3	(42–59)	96	37.5	(28–48)	160	55.6	(48–63)		
Italy	1428	54.4	(52–57)	1295	55.7	(53–58)	2000	53.7	(51–56)	2248	56.0	(54–58)		
Romania	213	51.6	(45–59)	257	66.5	(60–72)	267	61.4	(55–67)	342	60.8	(55–66)		
Slovakia	489	66.9	(63–71)	493	70.8	(67–75)	474	70.0	(66–74)	466	66.3	(62–71)		
Poland	374	70.1	(65–75)	455	67.9	(63–72)	659	63.9	(60–68)	1119	66.8	(64–70)		
Greece	1172	67.6	(65–70)	1063	67.6	(65–70)	1161	66.4	(64–69)	1180	68.6	(66–71)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.10. ***Klebsiella pneumoniae*. Total number of invasive isolates tested (N) and percentage with resistance to third-generation cephalosporins (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	30	0.0	(0–12)	28	0.0	(0–12)	36	0.0	(0–10)	25	0.0	(0–14)		
Finland	550	2.2	(1–4)	582	2.4	(1–4)	644	3.0	(2–5)	760	4.1	(3–6)		↑
Sweden	1300	3.6	(3–5)	1000	4.5	(3–6)	1001	3.3	(2–5)	1537	4.9	(4–6)	N/A	
Norway	645	4.0	(3–6)	746	5.9	(4–8)	701	5.0	(4–7)	811	5.8	(4–8)		
Denmark	529	11.5	(9–15)	925	7.6	(6–9)	929	7.8	(6–10)	1118	7.5	(6–9)		↓
United Kingdom	1077	13.6	(12–16)	978	9.3	(8–11)	916	10.5	(9–13)	3914	8.9	(8–10)		↓
Austria	941	10.7	(9–13)	996	8.2	(7–10)	1050	8.4	(7–10)	1245	9.6	(8–11)		
Netherlands	644	7.5	(6–10)	911	5.5	(4–7)	908	8.6	(7–11)	1134	10.3	(9–12)		↑
Ireland	316	19.3	(15–24)	354	11.6	(8–15)	387	14.7	(11–19)	452	13.5	(10–17)		
Germany	766	16.1	(14–19)	1006	12.7	(11–15)	1518	10.1	(9–12)	2812	13.7	(12–15)		
Malta	67	28.4	(18–41)	99	28.3	(20–38)	88	15.9	(9–25)	102	21.6	(14–31)		
Spain	1241	19.8	(18–22)	1265	18.0	(16–20)	1491	20.3	(18–22)	1678	22.3	(20–24)		↑
Slovenia	245	29.0	(23–35)	233	26.6	(21–33)	237	22.8	(18–29)	267	22.8	(18–28)		
Belgium	594	15.3	(13–18)	485	16.3	(13–20)	406	19.7	(16–24)	669	22.9	(20–26)		
EU/EEA (population–weighted mean)	**18331**	**30.1**	**(29–31)**	**20188**	**29.3**	**(29–30)**	**22448**	**30.3**	**(30–31)**	**30192**	**25.7**	**(25–26)**		↓
France	1938	28.0	(26–30)	2192	29.6	(28–32)	2338	30.5	(29–32)	2597	28.9	(27–31)		
Cyprus	68	30.9	(20–43)	80	32.5	(22–44)	62	43.5	(31–57)	75	30.7	(21–42)		
Estonia	90	23.3	(15–33)	135	20.7	(14–29)	93	23.7	(15–34)	183	32.8	(26–40)		↑
Luxembourg	53	34.0	(22–48)	66	34.8	(24–48)	60	28.3	(17–41)	78	35.9	(25–48)		
Hungary	557	37.3	(33–42)	644	35.6	(32–39)	704	37.2	(34–41)	722	37.5	(34–41)		
Portugal	911	37.0	(34–40)	1712	40.9	(39–43)	2094	40.4	(38–43)	2349	46.7	(45–49)		↑
Latvia	92	66.3	(56–76)	104	52.9	(43–63)	115	47.0	(38–56)	95	47.4	(37–58)		↓
Croatia	376	50.0	(45–55)	334	47.9	(42–53)	380	46.8	(42–52)	321	48.6	(43–54)		
Czech Republic	1291	52.0	(49–55)	1383	52.9	(50–56)	1417	54.1	(51–57)	1384	51.8	(49–54)		
Italy	1441	55.1	(52–58)	1319	56.5	(54–59)	1999	55.9	(54–58)	2246	55.8	(54–58)		
Lithuania	145	44.1	(36–53)	154	52.6	(44–61)	178	51.7	(44–59)	326	56.7	(51–62)		↑
Slovakia	488	66.4	(62–71)	493	69.4	(65–73)	469	67.2	(63–71)	465	61.3	(57–66)		
Poland	376	65.2	(60–70)	465	68.2	(64–72)	676	64.2	(60–68)	1142	64.4	(62–67)		
Romania	214	67.3	(61–74)	256	73.8	(68–79)	270	70.7	(65–76)	344	68.0	(63–73)		
Bulgaria	138	69.6	(61–77)	151	74.8	(67–82)	96	75.0	(65–83)	160	72.5	(65–79)		
Greece	1208	70.1	(67–73)	1092	72.5	(70–75)	1185	69.5	(67–72)	1181	72.5	(70–75)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.11. ***Klebsiella pneumoniae*. Total number of invasive isolates tested (N) and percentage with resistance to aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	30	0.0	(0–12)	28	3.6	(0–18)	36	0.0	(0–10)	25	0.0	(0–14)		
Finland	527	1.7	(1–3)	559	2.3	(1–4)	625	1.9	(1–3)	727	2.3	(1–4)		
Denmark	864	4.4	(3–6)	943	4.9	(4–6)	938	2.6	(2–4)	1154	3.2	(2–4)		↓
Norway	644	2.3	(1–4)	744	4.8	(3–7)	700	3.6	(2–5)	809	3.3	(2–5)		
Sweden	1235	2.9	(2–4)	860	3.3	(2–5)	943	3.2	(2–5)	1141	3.4	(2–5)	N/A	
Austria	865	5.0	(4–7)	925	5.5	(4–7)	959	4.8	(4–6)	1157	4.8	(4–6)		
Netherlands	652	6.1	(4–8)	898	3.9	(3–5)	908	5.7	(4–7)	1134	6.1	(5–8)		
United Kingdom	1163	6.4	(5–8)	1174	5.5	(4–7)	1070	9.3	(8–11)	4135	6.7	(6–7)		
Germany	763	10.0	(8–12)	1006	7.1	(6–9)	1519	5.5	(4–7)	2787	7.8	(7–9)		
Ireland	317	17.4	(13–22)	354	12.1	(9–16)	389	15.9	(12–20)	453	11.5	(9–15)		
Belgium	486	11.9	(9–15)	341	10.9	(8–15)	354	11.6	(8–15)	637	13.8	(11–17)		
Spain	1241	15.9	(14–18)	1264	13.8	(12–16)	1509	16.0	(14–18)	1678	15.5	(14–17)		
Slovenia	245	20.0	(15–26)	233	20.2	(15–26)	237	19.0	(14–25)	267	16.5	(12–21)		
EU/EEA (population-weighted mean)	**18360**	**22.5**	**(22–23)**	**19828**	**22.4**	**(22–23)**	**22297**	**22.4**	**(22–23)**	**29768**	**19.0**	**(19–19)**		↓
Estonia	89	10.1	(5–18)	135	18.5	(12–26)	61	21.3	(12–34)	183	21.3	(16–28)		↑
Malta	67	26.9	(17–39)	99	28.3	(20–38)	88	22.7	(14–33)	102	22.5	(15–32)		
Cyprus	68	22.1	(13–34)	80	28.7	(19–40)	62	37.1	(25–50)	75	22.7	(14–34)		
France	1938	26.6	(25–29)	2188	27.7	(26–30)	2337	26.3	(25–28)	2569	26.2	(25–28)		
Luxembourg	53	28.3	(17–42)	66	19.7	(11–31)	60	15.0	(7–27)	78	26.9	(18–38)		
Hungary	554	37.0	(33–41)	639	31.8	(28–36)	706	34.6	(31–38)	720	34.7	(31–38)		
Portugal	912	29.4	(26–32)	1706	30.5	(28–33)	2090	32.6	(31–35)	2337	35.0	(33–37)		↑
Croatia	370	50.8	(46–56)	334	48.8	(43–54)	380	43.2	(38–48)	316	36.1	(31–42)		↓
Italy	1383	32.5	(30–35)	1190	36.2	(33–39)	1956	34.0	(32–36)	2300	36.1	(34–38)		
Latvia	92	48.9	(38–60)	118	43.2	(34–53)	113	43.4	(34–53)	91	38.5	(28–49)		
Czech Republic	1291	51.0	(48–54)	1383	50.7	(48–53)	1417	51.9	(49–55)	1385	47.1	(44–50)		
Lithuania	145	47.6	(39–56)	152	49.3	(41–58)	179	46.4	(39–54)	325	49.2	(44–55)		
Greece	1169	55.2	(52–58)	1067	59.3	(56–62)	1170	50.7	(48–54)	1171	52.9	(50–56)		↓
Poland	364	60.4	(55–65)	455	59.1	(54–64)	666	58.6	(55–62)	1075	56.7	(54–60)		
Romania	213	57.3	(50–64)	250	67.6	(61–73)	266	54.1	(48–60)	336	61.9	(56–67)		
Slovakia	488	63.9	(59–68)	494	68.2	(64–72)	475	66.5	(62–71)	466	62.4	(58–67)		
Bulgaria	132	50.8	(42–60)	143	65.7	(57–73)	84	59.5	(48–70)	135	64.4	(56–72)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.12. ***Klebsiella pneumoniae*. Total number of invasive isolates tested (N) and percentage with resistance to carbapenems (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Croatia	376	0.5	(0–2)	334	0.9	(0–3)	380	2.4	(1–4)	323	0.0	(0–1)			
Czech Republic	1133	0.5	(0–1)	1148	0.1	(0–0)	1100	0.3	(0–1)	1096	0.0	(0–0)			↓
Estonia	74	2.7	(0–9)	92	0.0	(0–4)	56	0.0	(0–6)	168	0.0	(0–2)			↓
Iceland	28	0.0	(0–12)	28	0.0	(0–12)	35	0.0	(0–12)	21	0.0	(0–12)			
Lithuania	144	0.0	(0–3)	154	1.3	(0–5)	177	0.0	(0–2)	325	0.0	(0–1)			
Luxembourg	53	1.9	(0–10)	66	1.5	(0–8)	60	0.0	(0–6)	78	0.0	(0–5)			
Norway	645	0.2	(0–1)	746	0.0	(0–0)	700	0.1	(0–1)	810	0.0	(0–0)			
Slovenia	245	0.4	(0–2)	233	0.9	(0–3)	237	1.3	(0–4)	267	0.0	(0–1)			
Netherlands	646	0.2	(0–1)	903	0.2	(0–1)	907	0.1	(0–1)	1131	0.1	(0–0)			
Sweden	1269	0.0	(0–0)	978	0.0	(0–0)	900	0.0	(0–0)	1531	0.1	(0–1)		N/A	
Denmark	645	0.2	(0–1)	830	0.2	(0–1)	846	0.0	(0–0)	1119	0.3	(0–1)			
Finland	550	0.0	(0–1)	583	0.0	(0–1)	658	0.0	(0–1)	770	0.3	(0–1)			
United Kingdom	1051	0.5	(0–1)	1069	0.8	(0–2)	962	0.4	(0–1)	4068	0.3	(0–0)			
France	1842	0.7	(0–1)	2103	0.5	(0–1)	2244	0.5	(0–1)	2528	0.4	(0–1)			
Hungary	531	1.7	(1–3)	621	1.1	(0–2)	687	0.1	(0–1)	703	0.4	(0–1)			↓
Germany	763	0.7	(0–2)	1006	0.7	(0–1)	1520	0.1	(0–0)	2812	0.5	(0–1)			
Austria	910	1.2	(1–2)	971	0.6	(0–1)	1022	0.8	(0–2)	1198	0.7	(0–1)			
Ireland	317	0.3	(0–2)	353	0.6	(0–2)	389	0.5	(0–2)	453	0.7	(0–2)			
Spain	1241	1.6	(1–2)	1266	2.3	(2–3)	1483	2.2	(1–3)	1677	2.1	(1–3)			
Poland	370	0.8	(0–2)	451	1.3	(0–3)	660	0.5	(0–1)	1123	2.1	(1–3)			
Latvia	92	0.0	(0–4)	118	1.7	(0–6)	112	0.0	(0–3)	90	2.2	(0–8)			
Belgium	618	0.3	(0–1)	429	0.5	(0–2)	389	0.5	(0–2)	669	2.4	(1–4)			
Slovakia	342	0.6	(0–2)	456	2.6	(1–5)	436	0.9	(0–2)	435	2.5	(1–4)			
Bulgaria	129	0.0	(0–3)	139	7.2	(4–13)	95	3.2	(1–9)	159	4.4	(2–9)			
Portugal	904	1.8	(1–3)	1701	1.8	(1–3)	2085	3.4	(3–4)	2340	5.2	(4–6)			↑
Malta	67	6.0	(2–15)	99	9.1	(4–17)	88	4.5	(1–11)	102	5.9	(2–12)			
EU/EEA (population-weighted mean)	**17930**	**8.2**	**(8–9)**	**19617**	**7.1**	**(7–7)**	**21745**	**8.1**	**(8–8)**	**29892**	**6.1**	**(6–6)**			
Cyprus	68	5.9	(2–14)	80	5.0	(1–12)	62	12.9	(6–24)	75	10.7	(5–20)			
Romania	215	20.5	(15–26)	257	31.5	(26–38)	271	24.7	(20–30)	334	31.4	(26–37)			
Italy	1453	34.3	(32–37)	1315	32.9	(30–36)	1999	33.5	(31–36)	2307	33.9	(32–36)			
Greece	1209	59.4	(57–62)	1088	62.3	(59–65)	1185	61.9	(59–65)	1180	66.9	(64–70)			↑

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.13. ***Klebsiella pneumoniae*. Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	28	0.0	(0–12)	28	0.0	(0–12)	35	0.0	(0–10)	21	0.0	(0–16)		
Finland	514	0.4	(0–1)	556	1.4	(1–3)	623	1.1	(0–2)	726	1.2	(1–2)		
Denmark	519	3.5	(2–5)	925	3.1	(2–4)	924	1.1	(1–2)	1112	1.4	(1–2)		↓
Sweden	1235	1.7	(1–3)	623	1.4	(1–3)	860	1.9	(1–3)	1141	2.1	(1–3)	N/A	
Norway	616	1.8	(1–3)	744	3.9	(3–6)	699	2.3	(1–4)	807	2.6	(2–4)		
Austria	837	3.6	(2–5)	900	3.2	(2–5)	936	3.3	(2–5)	1156	3.5	(3–5)		
Netherlands	630	2.2	(1–4)	865	2.0	(1–3)	908	3.0	(2–4)	1134	3.5	(3–5)		
United Kingdom	1070	4.8	(4–6)	975	3.1	(2–4)	906	4.2	(3–6)	3764	3.7	(3–4)		
Germany	753	7.0	(5–9)	979	5.3	(4–7)	1515	3.1	(2–4)	2784	5.4	(5–6)		
Ireland	316	7.9	(5–11)	353	7.4	(5–11)	387	7.2	(5–10)	452	5.8	(4–8)		
Belgium	464	8.2	(6–11)	341	7.9	(5–11)	353	9.3	(7–13)	637	9.3	(7–12)		
Spain	1241	11.2	(9–13)	1263	10.1	(8–12)	1488	11.7	(10–13)	1675	12.4	(11–14)		
Slovenia	245	15.9	(12–21)	233	18.9	(14–25)	237	16.9	(12–22)	267	13.1	(9–18)		
Malta	67	20.9	(12–33)	99	25.3	(17–35)	88	14.8	(8–24)	102	14.7	(8–23)		
EU/EEA (population-weighted mean)	**17709**	**18.9**	**(18–20)**	**19193**	**19.1**	**(19–20)**	**21867**	**18.6**	**(18–19)**	**29150**	**15.8**	**(15–16)**		↓
Estonia	87	9.2	(4–17)	131	11.5	(7–18)	36	22.2	(10–39)	183	16.9	(12–23)		↑
Cyprus	68	5.9	(2–14)	80	15.0	(8–25)	62	17.7	(9–30)	75	18.7	(11–29)		↑
France	1916	22.9	(21–25)	2172	23.7	(22–26)	2324	22.5	(21–24)	2556	21.3	(20–23)		
Luxembourg	53	17.0	(8–30)	66	16.7	(9–28)	60	13.3	(6–25)	78	24.4	(15–35)		
Portugal	909	21.7	(19–24)	1705	22.8	(21–25)	2084	25.0	(23–27)	2332	27.2	(25–29)		↑
Croatia	367	30.0	(25–35)	330	30.6	(26–36)	380	32.4	(28–37)	309	27.5	(23–33)		
Hungary	549	32.2	(28–36)	636	28.6	(25–32)	698	30.2	(27–34)	711	30.1	(27–34)		
Latvia	88	39.8	(29–51)	104	41.3	(32–51)	112	36.6	(28–46)	91	31.9	(22–42)		
Italy	1360	29.6	(27–32)	1164	32.0	(29–35)	1940	29.7	(28–32)	2174	32.7	(31–35)		
Czech Republic	1291	38.3	(36–41)	1382	38.7	(36–41)	1416	41.5	(39–44)	1384	40.8	(38–43)		
Lithuania	144	33.3	(26–42)	152	35.5	(28–44)	178	39.9	(33–47)	323	42.1	(37–48)		↑
Bulgaria	132	35.6	(27–44)	143	44.1	(36–53)	84	28.6	(19–39)	133	45.9	(37–55)		
Greece	1164	51.5	(49–54)	1061	55.1	(52–58)	1160	46.7	(44–50)	1171	48.4	(46–51)		↓
Poland	350	54.3	(49–60)	443	54.6	(50–59)	645	54.0	(50–58)	1052	53.6	(51–57)		
Romania	210	42.9	(36–50)	247	56.3	(50–63)	261	49.8	(44–56)	335	55.2	(50–61)		
Slovakia	486	57.8	(53–62)	493	63.3	(59–68)	468	59.6	(55–64)	465	55.7	(51–60)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

3.3 *Pseudomonas aeruginosa*

Pseudomonas aeruginosa is a non-fermenting gram-negative bacterium that is ubiquitous in aquatic environments in nature. It is an opportunistic pathogen and a major cause of infection in hospitalised patients with localised or systemic impairment of immune defences. It commonly causes hospital-acquired pneumonia (including ventilator-associated pneumonia), bloodstream and urinary tract infections.

P. aeruginosa is intrinsically resistant to the majority of antimicrobial agents due to its selective ability to prevent various antibiotic molecules from penetrating its outer membrane or to extrude them if they enter the cell. The antimicrobial groups that remain active include some fluoroquinolones (e.g. ciprofloxacin and levofloxacin), aminoglycosides (e.g. gentamicin, tobramycin and amikacin), some beta-lactams and polymyxins. Resistance of *P. aeruginosa* to these agents can be acquired through one or more of several mechanisms, including modified antimicrobial targets, efflux, and reduced permeability and degrading enzymes.

Antimicrobial resistance 2013–2016

In the EU/EEA, a third (33.9 %) of the *P. aeruginosa* isolates reported to EARS-Net in 2016 were resistant to at least one of the antimicrobial groups under regular surveillance (piperacillin ± tazobactam, fluoroquinolones, ceftazidime, aminoglycosides and carbapenems) (Table 3.14). The highest EU/EEA population-weighted mean resistance percentage in 2016 was reported for piperacillin ± tazobactam (16.3 %), followed by fluoroquinolones (15.0 %), carbapenems (15.0 %), ceftazidime (13.0 %) and aminoglycosides (10.0 %) (Tables 3.15–3.19).

While the EU/EEA population-weighted mean percentage (based on laboratories reporting consistently during the period) increased significantly between 2013 and 2016 for ceftazidime, there were significant decreases in the trends of the EU/EEA population-weighted mean percentages for fluoroquinolone resistance, aminoglycoside resistance and carbapenem resistance during the period 2013 to 2016. The trend for piperacillin ± tazobactam resistance did not change significantly during the same period (Tables 3.15–3.19).

Resistance to two or more antimicrobial groups was common (Table 3.14). However, the EU/EEA population-weighted mean percentage (based on laboratories reporting consistently during the period) for combined resistance, measured as resistance to three or more antimicrobial groups, decreased on EU/EEA level between 2013 and 2016 [Table 3.20].

Colistin susceptibility data were reported for 51.3 % of all *P. aeruginosa* isolates in 2016. Only twelve countries provided colistin susceptibility results for more than half of the reported *P. aeruginosa* isolates. Colistin resistance was very rare (‹1 %).

Large inter-country variations could be noted for all antimicrobial groups under regular surveillance, with generally higher resistance percentages reported from southern and eastern parts of Europe than the north (Figures 3.13–3.18).

Discussion and conclusions

Carbapenem resistance combined with resistance to other important antimicrobial groups was common in *P. aeruginosa* in many European countries in 2016. As *P. aeruginosa* is intrinsically resistant to the majority of antimicrobial agents, combined resistance to multiple antimicrobial groups is further complicating treatment of serious infections. Due to its ubiquitous nature and potential virulence, *P. aeruginosa* is a challenging pathogen to control in healthcare settings. Prudent antimicrobial use and high standards of infection control are essential to prevent the situation from deteriorating.

Table 3.14. ***Pseudomonas aeruginosa*. Total number of tested isolates and resistance combinations among invasive isolates tested against at least three antimicrobial groups among piperacillin ± tazobactam, ceftazidime, fluoroquinolones, aminoglycosides and carbapenems (n=12 711), EU/EEA countries, 2016**

Resistance pattern	Number of isolates	% of total*
Fully susceptible (to tested antibiotics)	**8 402**	**66.1**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance types)	**1 620**	**12.7**
Carbapenems	638	5.0
Fluoroquinolones	489	3.8
[Piperacillin ± tazobactam]	220	1.7
Aminoglycosides	152	1.2
Ceftazidime	121	1.0
Resistance to two antimicrobial groups		
Total (all two groups combinations)	**961**	**7.6**
[Piperacillin ± tazobactam] + ceftazidime	302	2.4
Fluoroquinolones + aminoglycosides	190	1.5
Fluoroquinolones + carbapenems	177	1.4
Other antimicrobial group combinations	292	2.3
Resistance to three antimicrobial groups		
Total (all three group combinations)	**620**	**4.9**
Fluoroquinolones + aminoglycosides + carbapenems	191	1.5
Other antimicrobial group combinations	429	3.4
Resistance to four antimicrobial groups		
Total (all four group combinations)	**543**	**4.3**
[Piperacillin ± tazobactam] + fluoroquinolones + aminoglycosides + carbapenems	148	1.2
Fluoroquinolones + ceftazidime + aminoglycosides + carbapenems	139	1.1
Other antimicrobial group combinations	256	2.0
Resistance to five antimicrobial groups		
[Piperacillin ± tazobactam] + fluoroquinolones + ceftazidime + aminoglycosides + carbapenems	**565**	**4.4**

Only resistance combinations >1% of the total are specified

* Only data from isolates tested against all four antimicrobials groups were included in the analysis

** Not adjusted for population differences in the reporting countries

Figure 3.13. ***Pseudomonas aeruginosa*****. Percentage (%) of invasive isolates with resistance to piperacillin ± tazobactam, by country, EU/EEA countries, 2016**

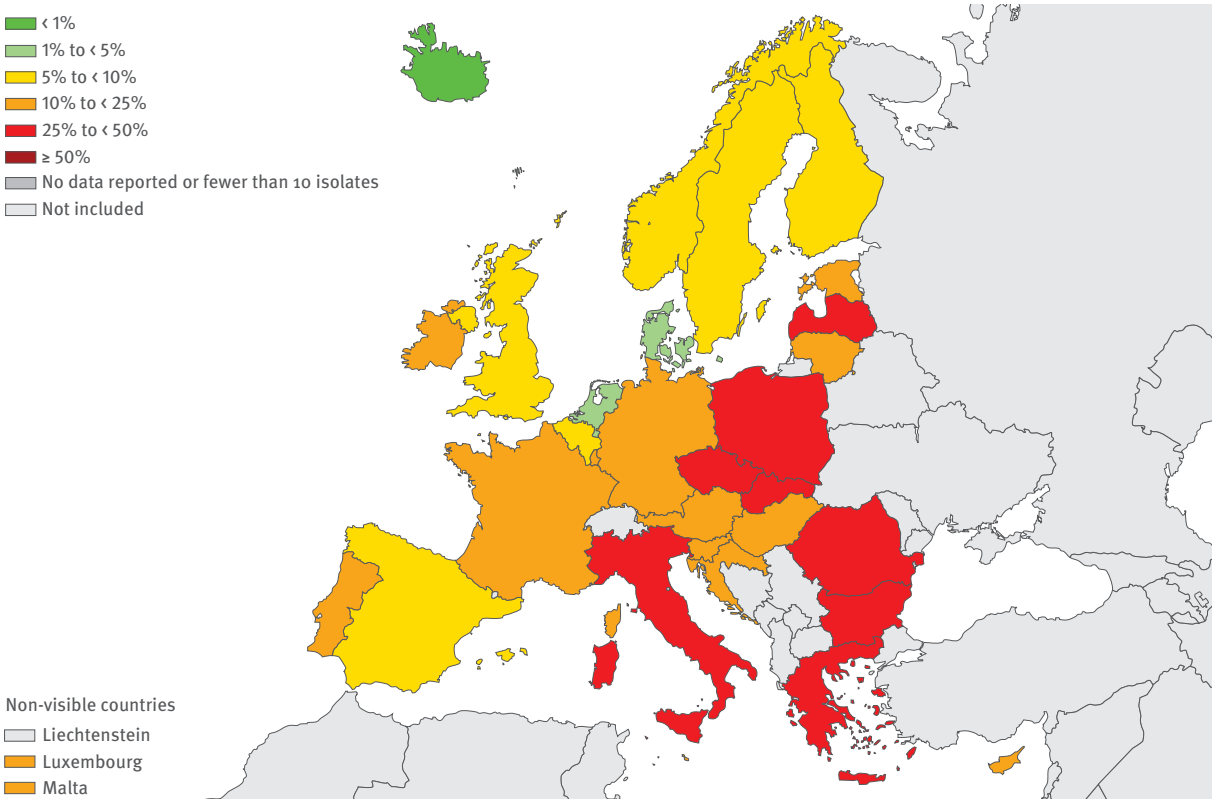


Figure 3.14. ***Pseudomonas aeruginosa*****. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2016**

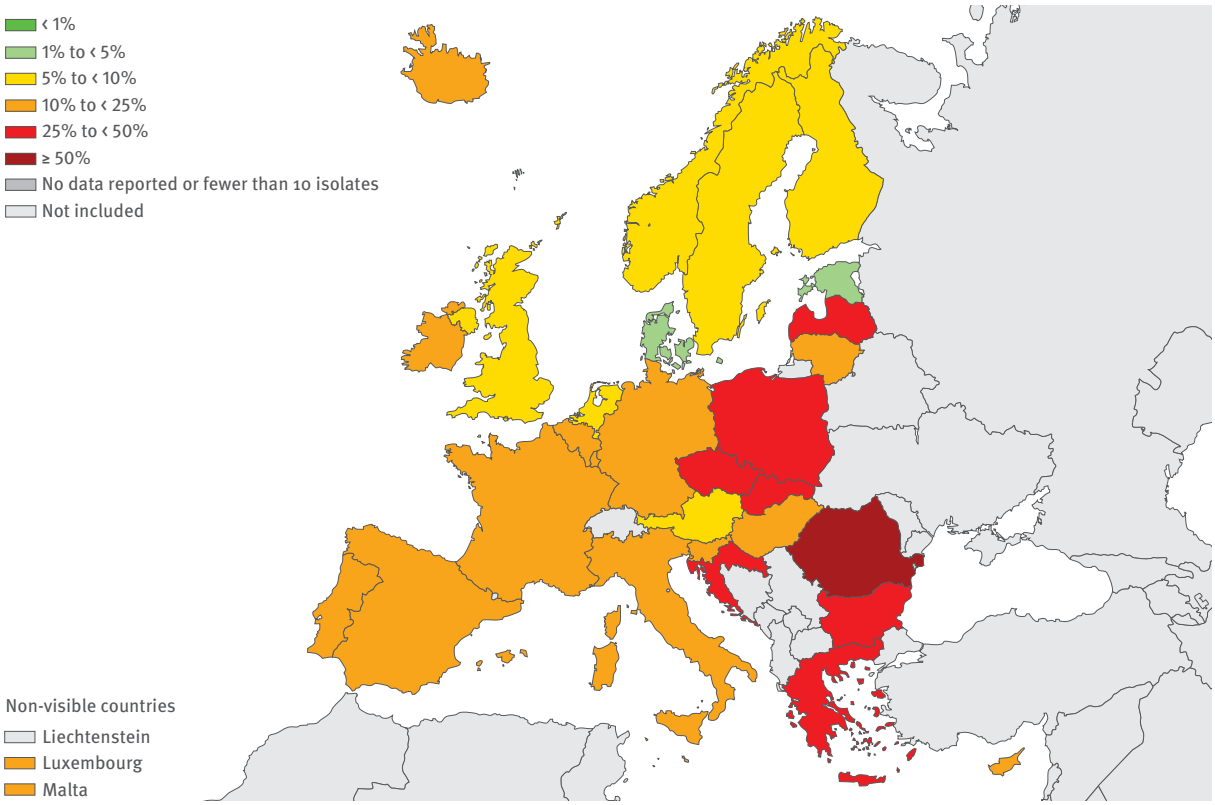


Figure 3.15. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to ceftazidime, by country, EU/EEA countries, 2016**

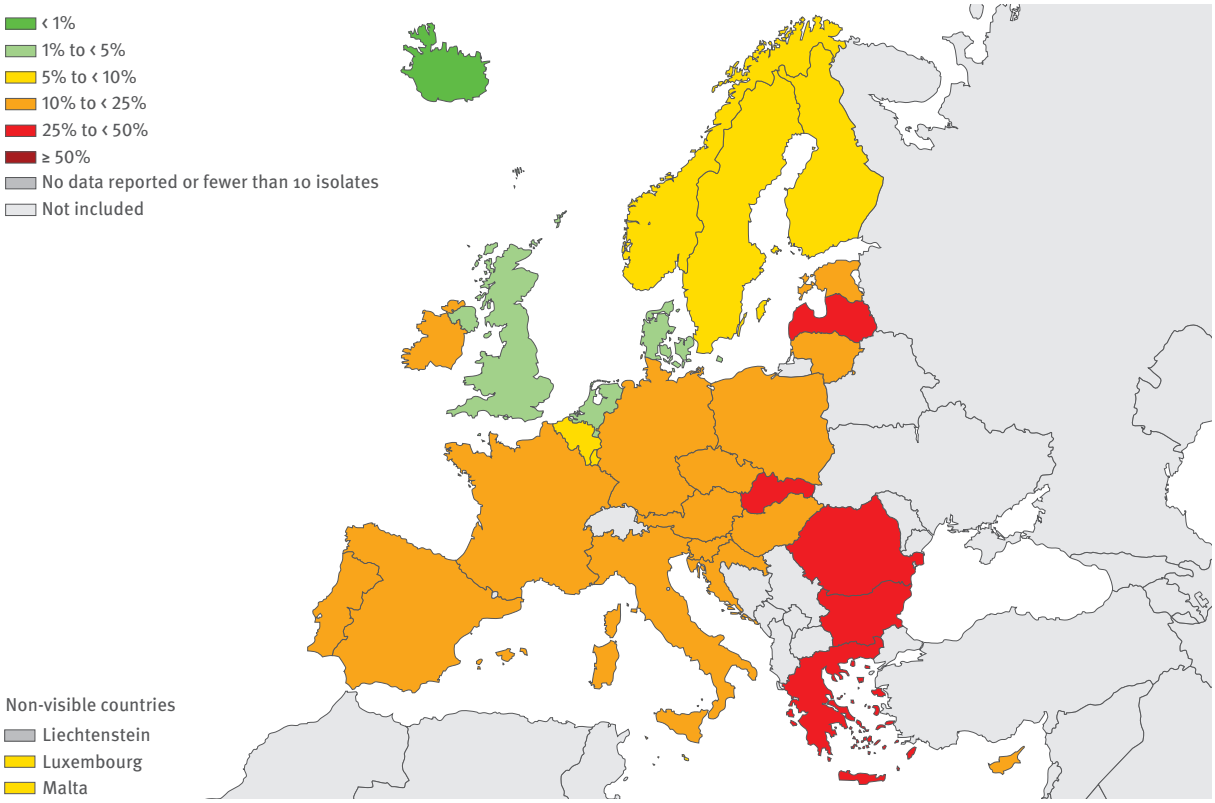


Figure 3.16. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2016**

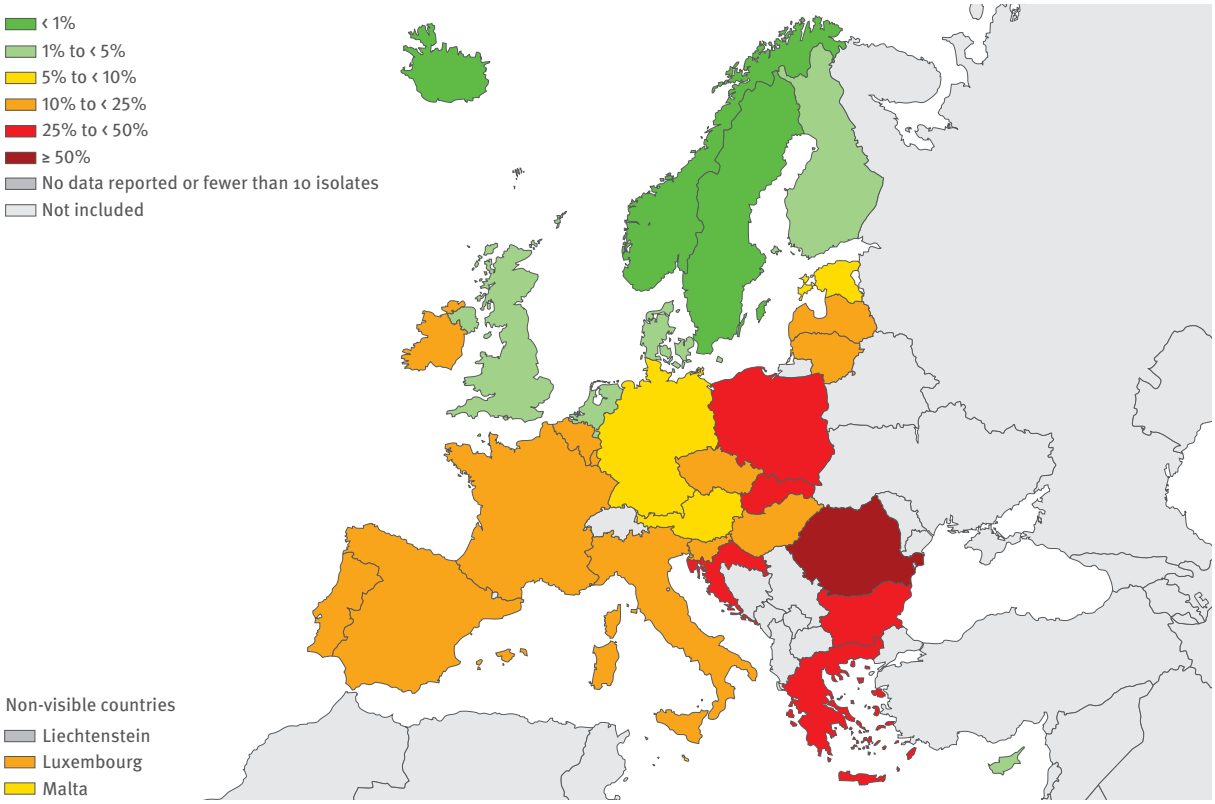


Figure 3.17. ***Pseudomonas aeruginosa*****. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2016**

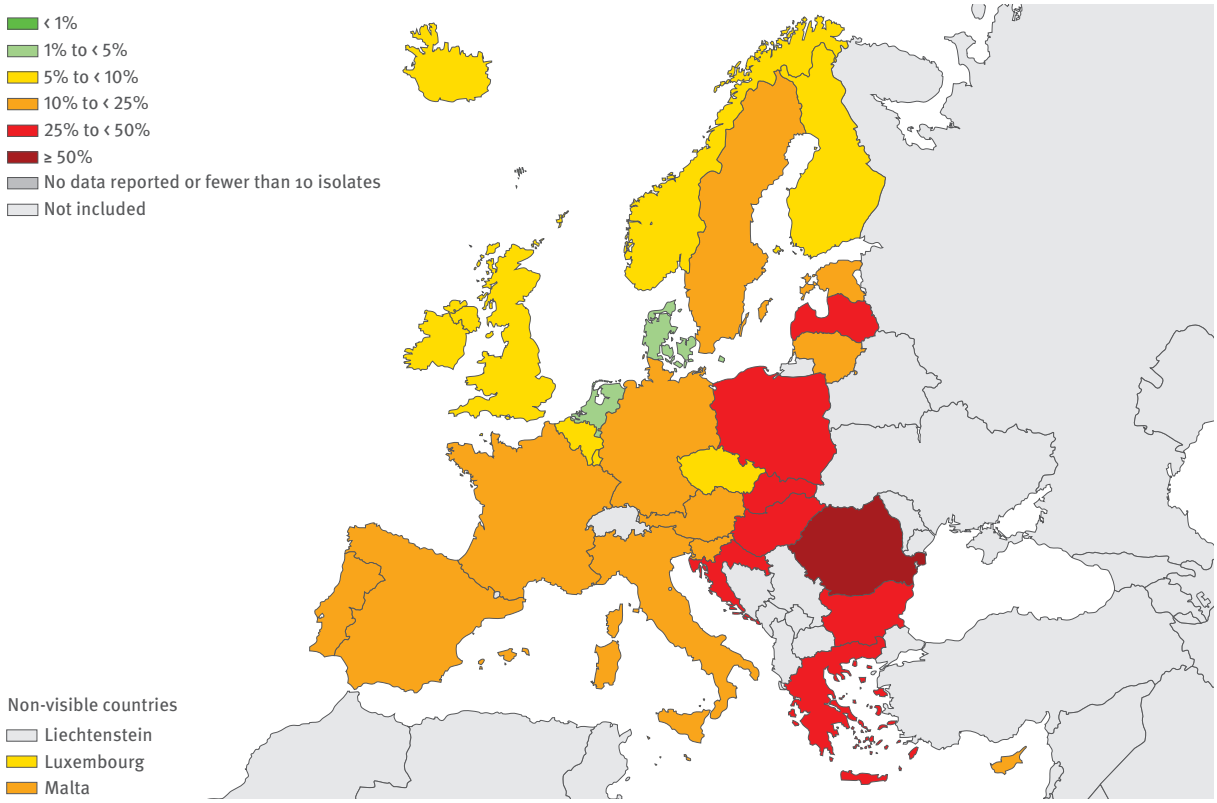


Figure 3.18. ***Pseudomonas aeruginosa*****. Percentage (%) of invasive isolates with combined resistance (resistance to three or more antimicrobial groups among piperacillin ± tazobactam, ceftazidime, fluoroquinolones, aminoglycosides and carbapenems), by country, EU/EEA countries, 2016**

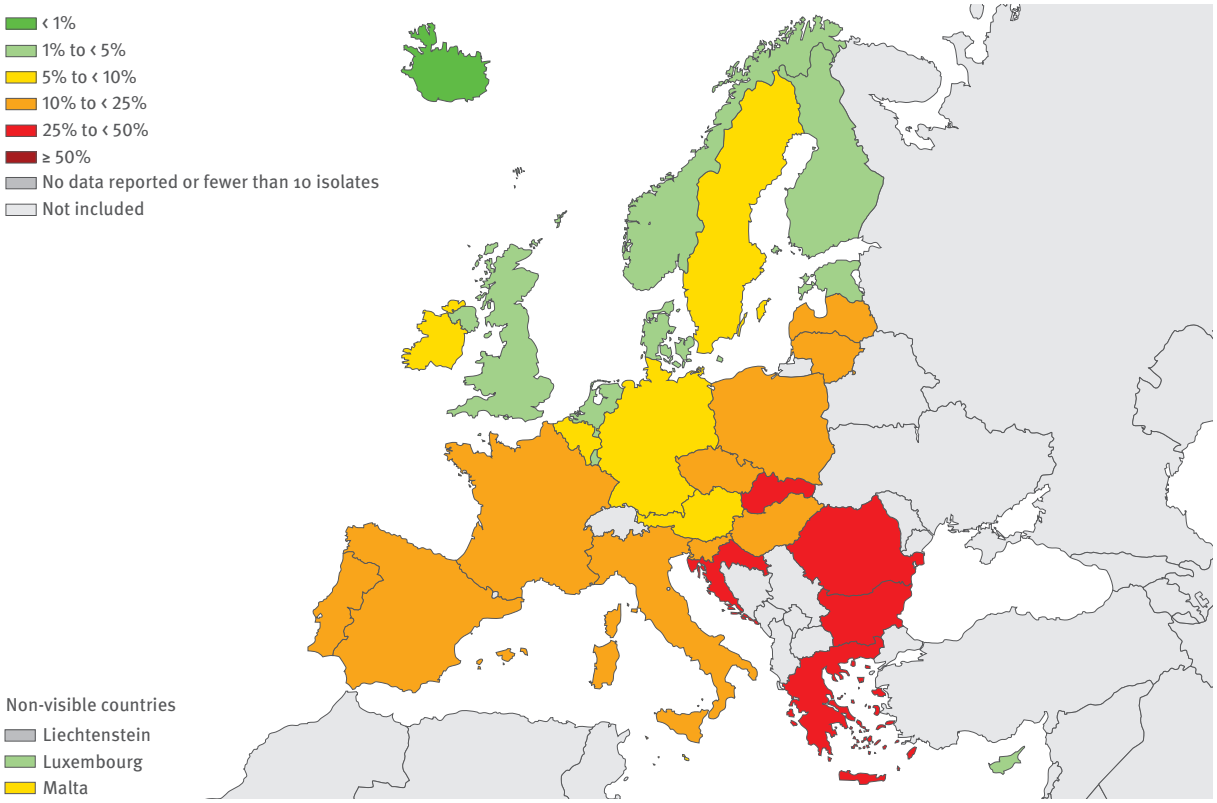


Table 3.15. ***Pseudomonas aeruginosa*. Total number of invasive isolates tested (N) and percentage with resistance to piperacillin ± tazobactam (%R), including 95 % confidence intervals (95 %CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	11	0.0	(0–28)	11	9.1	(0–4)	11	0.0	(0–28)	17	0.0	(0–20)	N/A	
Denmark	414	2.4	(1–4)	388	4.4	(3–7)	441	4.1	(2–6)	460	3.5	(2–6)		
Netherlands	381	6.6	(4–10)	530	8.1	(6–11)	494	6.5	(4–9)	520	4.0	(3–6)		
United Kingdom	671	4.8	(3–7)	610	4.8	(3–7)	493	10.3	(8–13)	2039	6.0	(5–7)		
Norway	198	9.1	(5–14)	254	7.9	(5–12)	227	5.7	(3–10)	215	7.4	(4–12)		
Sweden	531	7.3	(5–10)	337	4.7	(3–8)	399	5.8	(4–9)	472	7.4	(5–10)	N/A	
Spain	818	8.6	(7–11)	870	7.8	(6–10)	871	9.1	(7–11)	817	9.4	(8–12)		
Finland	327	8.6	(6–12)	306	6.9	(4–10)	333	7.2	(5–11)	351	9.4	(7–13)		
Belgium	431	13.2	(10–17)	294	9.5	(6–13)	251	8.0	(5–12)	318	9.7	(7–14)		
Malta	24	20.8	(7–42)	36	8.3	(2–22)	25	16.0	(5–36)	40	10.0	(4–27)		
Cyprus	47	8.5	(2–20)	42	16.7	(7–31)	43	4.7	(1–16)	64	12.5	(6–23)		
Luxembourg	34	11.8	(3–27)	37	10.8	(3–25)	27	0.0	(0–13)	40	12.5	(4–27)		
Ireland	202	11.4	(7–17)	178	11.2	(7–17)	195	9.2	(6–14)	243	12.8	(9–18)		
Lithuania	35	8.6	(2–23)	31	32.3	(17–51)	41	29.3	(16–46)	74	13.5	(7–23)		
Austria	616	13.3	(11–16)	636	11.8	(9–15)	675	11.9	(10–15)	689	13.8	(11–17)		
EU/EEA (population-weighted mean)	**10927**	**16.4**	**(16–17)**	**11525**	**17.2**	**(17–18)**	**12538**	**18.3**	**(17–19)**	**15049**	**16.3**	**(16–17)**		
Estonia	17	11.8	(1–36)	39	10.3	(3–24)	16	6.3	(0–30)	53	17.0	(8–30)	N/A	
France	1815	15.4	(14–17)	1783	17.0	(15–19)	1915	16.1	(15–18)	1958	17.4	(16–19)		
Germany	629	18.8	(16–22)	642	17.4	(15–21)	941	17.7	(15–20)	1320	17.7	(16–20)		
Croatia	233	23.6	(18–30)	216	24.5	(19–31)	249	24.5	(19–30)	252	18.7	(14–24)		
Slovenia	133	10.5	(8–21)	112	25.9	(18–35)	141	9.9	(6–16)	143	19.6	(13–27)		
Portugal	87	24.1	(16–35)	1061	28.5	(26–31)	1176	24.5	(22–27)	1230	22.7	(20–25)		↓
Hungary	657	19.8	(17–23)	736	23.5	(20–27)	747	26.9	(24–30)	720	23.6	(21–27)		↑
Czech Republic	516	27.5	(24–32)	429	23.1	(19–27)	463	25.3	(21–29)	458	25.3	(21–30)		
Latvia	24	20.8	(7–42)	3	**	(**)	13	23.1	(5–54)	15	26.7	(8–55)	N/A	
Greece	863	29.9	(27–33)	666	31.4	(28–35)	638	22.3	(19–26)	692	28.3	(25–32)		
Poland	55	23.6	(13–37)	185	32.4	(26–40)	249	37.8	(32–44)	393	30.0	(26–35)		
Italy	754	30.9	(28–34)	686	31.5	(28–35)	1074	29.5	(27–32)	1147	30.7	(28–33)		
Slovakia	265	41.5	(36–48)	269	36.1	(30–42)	257	42.4	(36–49)	168	36.9	(30–45)		
Bulgaria	59	13.6	(6–25)	48	31.3	(19–46)	55	27.3	(16–41)	55	40.0	(27–54)		↑
Romania	80	55.0	(43–66)	90	62.2	(51–72)	78	59.0	(47–70)	86	48.8	(38–60)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively. .

** Less than 10 isolates reported, no percentage calculated.

Table 3.16. ***Pseudomonas aeruginosa*. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Estonia	20	25.0	(9–49)	39	10.3	(3–24)	18	0.0	(0–19)	56	3.6	(0–12)	N/A	
Denmark	408	3.2	(2–5)	388	3.6	(2–6)	420	5.0	(3–8)	460	3.7	(2–6)		
Norway	205	8.8	(5–14)	257	3.1	(1–6)	230	5.2	(3–9)	227	5.7	(3–10)		
Sweden	531	6.0	(4–8)	338	7.7	(5–11)	382	4.7	(3–7)	469	6.0	(4–9)		
Netherlands	370	6.2	(4–9)	541	6.7	(5–9)	502	5.8	(4–8)	543	6.1	(4–8)		
United Kingdom	711	5.8	(4–8)	629	5.4	(4–7)	522	8.8	(7–12)	2119	6.9	(6–8)		
Austria	533	15.2	(12–19)	599	10.9	(8–14)	659	10.3	(8–13)	694	7.2	(5–9)		↓
Finland	317	11.4	(8–15)	289	10.0	(7–14)	302	8.9	(6–13)	292	7.9	(5–12)		
Malta	25	8.0	(1–26)	36	2.8	(0–15)	25	12.0	(3–31)	40	10.0	(3–24)		
Ireland	205	12.2	(8–17)	178	8.4	(5–14)	194	9.8	(6–15)	243	11.9	(8–17)		
Germany	611	16.4	(14–20)	623	13.0	(10–16)	940	14.4	(12–17)	1320	12.5	(11–14)		
Luxembourg	34	20.6	(9–38)	41	9.8	(3–23)	28	17.9	(6–37)	40	12.5	(4–27)		
France	1863	21.2	(19–23)	1779	20.6	(19–23)	1939	19.1	(17–21)	1971	13.6	(12–15)		↓
Belgium	486	16.9	(14–21)	309	12.6	(9–17)	261	11.1	(8–16)	366	14.5	(11–19)		
EU/EEA (population-weighted mean)	**11805**	**20.2**	**(19–21)**	**11629**	**19.7**	**(19–20)**	**12651**	**19.3**	**(19–20)**	**15285**	**15.0**	**(14–16)**		↓
Lithuania	37	10.8	(3–25)	31	25.8	(12–45)	41	26.8	(14–43)	73	15.1	(8–25)		
Iceland	11	0.0	(0–28)	11	0.0	(0–28)	12	8.3	(0–38)	17	17.6	(4–43)	N/A	
Portugal	735	23.9	(21–27)	1062	26.3	(24–29)	1185	22.7	(20–25)	1227	20.1	(18–22)		↓
Cyprus	47	10.6	(4–23)	42	16.7	(7–31)	43	11.6	(4–25)	64	20.3	(11–32)		
Slovenia	133	11.3	(6–18)	112	22.3	(15–31)	141	14.2	(9–21)	143	20.3	(14–28)		
Spain	825	22.7	(20–26)	873	24.6	(22–28)	881	23.0	(20–26)	843	23.0	(20–26)		
Hungary	667	23.4	(20–27)	743	24.6	(22–28)	769	24.7	(22–28)	736	24.3	(21–28)		
Italy	773	28.7	(26–32)	739	28.3	(25–32)	1080	24.6	(22–27)	1166	24.7	(22–27)		↓
Poland	194	29.4	(23–36)	184	35.3	(28–43)	257	36.2	(30–42)	400	31.0	(26–36)		
Latvia	25	24.0	(9–45)	18	16.7	(4–41)	13	23.1	(5–54)	16	31.3	(11–59)	N/A	
Greece	853	43.5	(40–47)	676	37.7	(34–41)	662	34.1	(31–38)	702	34.6	(31–38)		↓
Czech Republic	516	33.7	(30–38)	447	32.7	(28–37)	464	30.0	(26–34)	464	34.7	(30–39)		
Bulgaria	60	18.3	(10–30)	48	27.1	(15–42)	55	36.4	(24–50)	56	35.7	(23–50)		↑
Croatia	240	21.7	(17–27)	230	30.0	(24–36)	256	35.2	(29–41)	259	37.5	(32–44)		↑
Slovakia	286	53.1	(47–59)	275	45.5	(39–52)	278	52.2	(46–58)	190	47.4	(40–55)		
Romania	84	45.2	(34–56)	92	55.4	(45–66)	92	62.0	(51–72)	89	51.7	(41–62)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.17. ***Pseudomonas aeruginosa*. Total number of invasive isolates tested (N) and percentage with resistance to ceftazidime (%R), including 95% confidence intervals (95% CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	11	0.0	(0–28)	11	9.1	(0–41)	11	0.0	(0–28)	17	0.0	(0–20)	N/A	
Netherlands	371	3.8	(2–6)	534	4.9	(3–7)	502	4.4	(3–7)	543	3.3	(2–5)		
United Kingdom	695	3.7	(2–5)	588	4.6	(3–7)	472	6.1	(4–9)	2 021	4.3	(3–5)		
Denmark	357	3.1	(2–5)	386	3.9	(2–6)	439	3.6	(2–6)	447	4.5	(3–7)		
Luxembourg	34	11.8	(3–27)	41	2.4	(0–13)	28	7.1	(1–24)	40	5.0	(1–17)		
Finland	322	5.0	(3–8)	307	6.2	(4–9)	334	6.9	(4–10)	352	5.4	(3–8)		
Norway	193	6.2	(3–11)	251	5.2	(3–9)	216	5.6	(3–10)	224	7.1	(4–11)		
Sweden	531	6.8	(5–9)	433	5.5	(4–8)	379	4.5	(3–7)	473	7.4	(5–10)	N/A	
Malta	25	8.0	(1–26)	36	2.8	(0–15)	25	8.0	(1–26)	40	7.5	(2–20)		
Belgium	459	9.4	(7–12)	316	8.9	(6–13)	226	6.2	(3–10)	320	7.8	(5–11)		
Spain	825	9.0	(7–11)	864	9.6	(8–12)	816	10.4	(8–13)	836	10.2	(8–12)		
Germany	628	10.2	(8–13)	638	9.9	(8–12)	938	9.1	(7–11)	1318	10.5	(9–12)		
Ireland	204	7.8	(5–12)	175	8.0	(4–13)	195	7.2	(4–12)	243	10.7	(7–15)		
Lithuania	37	8.1	(2–22)	30	16.7	(6–35)	41	19.5	(9–35)	74	10.8	(5–20)		
Cyprus	47	12.8	(5–26)	42	23.8	(12–39)	43	4.7	(1–16)	64	10.9	(5–21)		
Austria	608	9.5	(7–12)	631	8.7	(7–11)	577	9.9	(8–13)	628	11.3	(9–14)		
France	1868	11.5	(10–13)	1778	12.0	(11–14)	1919	11.6	(10–13)	1956	11.3	(10–13)		
EU/EEA (population-weighted mean)	**11571**	**12.3**	**(12–13)**	**11588**	**13.2**	**(13–14)**	**12353**	**13.3**	**(13–14)**	**15076**	**13.0**	**(12–14)**		↑
Slovenia	133	13.5	(8–21)	112	20.5	(13–29)	141	9.9	(6–16)	143	17.5	(12–25)		
Estonia	19	0.0	(0–18)	28	7.1	(1–24)	7	**	(**)	17	17.6	(4–43)	N/A	
Portugal	737	15.5	(13–18)	1061	22.0	(20–25)	1185	19.2	(17–22)	1228	18.0	(16–20)		
Czech Republic	516	22.9	(19–27)	446	21.5	(18–26)	464	19.6	(16–24)	464	19.2	(16–23)		
Hungary	662	20.8	(18–24)	739	24.1	(21–27)	763	24.2	(21–27)	735	20.7	(18–24)		
Croatia	239	18.8	(14–24)	227	24.2	(19–30)	248	18.5	(14–24)	240	20.8	(16–27)		
Italy	722	23.7	(21–27)	683	24.9	(22–28)	1068	21.7	(19–24)	1160	23.0	(21–26)		
Poland	49	22.4	(12–37)	183	21.9	(16–29)	259	27.8	(22–34)	478	24.0	(19–27)		
Latvia	25	24.0	(9–45)	3	**	(**)	13	23.1	(5–54)	15	26.7	(8–55)	N/A	
Slovakia	285	30.9	(26–37)	261	29.5	(24–35)	247	34.8	(29–41)	164	31.1	(24–39)		
Greece	849	27.9	(25–31)	649	26.7	(23–30)	660	19.4	(16–23)	696	33.6	(30–37)		↑
Bulgaria	56	12.5	(5–24)	47	29.8	(17–45)	52	26.9	(16–41)	54	38.9	(26–53)		
Romania	64	43.8	(31–57)	88	59.1	(48–69)	85	65.9	(55–76)	86	44.2	(33–55)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

Table 3.18. ***Pseudomonas aeruginosa.*** **Total number of invasive isolates tested (N) and percentage with resistance to aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	11	0.0	(0–28)	11	0.0	(0–28)	12	0.0	(0–26)	17	0.0	(0–20)	N/A	
Sweden	519	2.9	(2–5)	313	0.6	(0–2)	387	1.3	(0–3)	471	0.8	(0–2)	N/A	
Norway	194	1.5	(0–4)	240	1.3	(0–4)	219	0.9	(0–3)	213	0.9	(0–3)		
Denmark	408	4.9	(3–7)	388	2.3	(1–4)	441	2.3	(1–4)	460	1.7	(1–3)		↓
Finland	327	3.1	(1–6)	305	2.3	(1–5)	341	1.8	(1–4)	352	2.3	(1–4)		
Netherlands	374	2.9	(1–5)	544	2.9	(2–5)	502	2.8	(2–5)	541	2.8	(2–5)		
United Kingdom	715	2.4	(1–4)	641	1.7	(1–3)	539	5.2	(3–7)	2140	3.6	(3–4)		
Cyprus	47	4.3	(1–15)	42	9.5	(3–23)	43	0.0	(0–8)	64	4.7	(1–13)		
Austria	618	7.4	(6–10)	638	6.6	(5–9)	678	6.3	(5–8)	692	6.1	(4–8)		
Germany	630	7.6	(6–10)	643	5.9	(4–8)	936	7.3	(6–9)	1318	6.9	(6–8)		
Estonia	19	10.5	(1–33)	40	7.5	(2–20)	17	5.9	(0–29)	54	7.4	(2–18)	N/A	
Malta	25	0.0	(0–14)	36	11.1	(3–26)	25	16.0	(5–36)	40	7.5	(2–20)		
EU/EEA (population-weighted mean)	**11792**	**14.4**	**(14–15)**	**11576**	**13.5**	**(14–15)**	**12673**	**12.7**	**(13–14)**	**15305**	**10.0**	**(9–11)**		↓
Ireland	205	10.7	(7–16)	178	5.6	(3–10)	195	4.1	(2–8)	243	10.3	(7–15)		
France	1863	16.0	(14–18)	1767	15.7	(14–18)	1950	14.1	(13–16)	1976	10.7	(10–12)		↓
Belgium	407	12.3	(9–16)	258	8.5	(5–13)	218	6.0	(3–10)	327	11.0	(8–15)		
Portugal	737	14.2	(12–17)	1064	17.6	(15–20)	1191	13.5	(12–16)	1230	11.5	(10–13)		↓
Slovenia	133	6.0	(3–12)	112	8.9	(4–15)	141	9.2	(5–15)	143	13.3	(7–18)		
Lithuania	37	13.5	(5–29)	30	26.7	(12–46)	41	24.4	(12–40)	74	14.9	(8–25)		
Luxembourg	34	23.5	(11–41)	39	7.7	(2–21)	28	3.6	(0–18)	40	15.0	(6–30)		
Spain	825	14.9	(13–18)	873	16.5	(14–19)	883	16.4	(14–19)	843	15.3	(13–18)		
Hungary	661	24.8	(22–28)	741	20.9	(18–24)	766	20.5	(18–24)	740	17.6	(15–21)		↓
Czech Republic	516	25.8	(22–30)	446	20.6	(17–25)	464	21.3	(18–25)	464	18.8	(15–23)		↓
Italy	741	24.7	(22–28)	704	23.2	(20–26)	1050	17.2	(15–20)	1203	19.1	(17–21)		↓
Latvia	25	20.0	(7–41)	18	5.6	(0–27)	11	9.1	(0–41)	15	20.0	(4–48)	N/A	
Poland	194	23.7	(18–30)	185	31.9	(25–39)	258	30.6	(25–37)	367	25.6	(21–30)		
Greece	858	38.7	(35–42)	676	35.8	(32–40)	667	26.4	(23–30)	701	28.0	(25–31)		↓
Slovakia	285	38.6	(33–45)	276	37.0	(31–43)	277	41.9	(36–48)	191	33.0	(26–40)		
Croatia	244	23.8	(19–30)	231	35.1	(29–42)	256	34.0	(28–40)	260	33.5	(28–40)		
Bulgaria	60	20.0	(11–32)	44	31.8	(19–48)	47	27.7	(16–43)	39	48.7	(32–65)		↑
Romania	80	51.2	(40–63)	93	63.4	(53–73)	90	63.3	(53–73)	87	50.6	(40–61)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.19 ***Pseudomonas aeruginosa*. Total number of invasive isolates tested (N) and percentage with resistance to carbapenems (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Denmark	410	2.9	(2–5)	386	4.7	(3–7)	437	4.6	(3–7)	458	2.4	(1–4)		
Netherlands	375	3.5	(2–6)	543	4.4	(3–7)	500	4.0	(2–6)	543	3.7	(2–6)		
United Kingdom	671	5.2	(4–7)	590	6.3	(4–9)	499	2.4	(1–4)	2 108	5.1	(4–6)		
Iceland	11	9.1	(0–41)	11	9.1	(0–41)	12	0.0	(0–26)	17	5.9	(0–29)	N/A	
Finland	327	10.4	(7–14)	307	7.2	(5–11)	341	4.7	(3–8)	352	6.0	(4–9)		↓
Ireland	204	9.3	(6–14)	177	8.5	(5–14)	195	9.2	(6–14)	243	6.2	(3–10)		
Luxembourg	34	17.6	(7–35)	42	4.8	(1–16)	24	8.3	(1–27)	31	6.5	(1–21)		
Norway	206	5.8	(3–10)	256	5.9	(3–9)	228	5.7	(3–10)	225	6.7	(4–11)		
Czech Republic	516	15.7	(13–19)	448	14.1	(11–18)	464	10.6	(8–14)	464	8.8	(6–12)		↓
Belgium	518	11.0	(8–14)	344	10.2	(7–14)	256	3.9	(2–7)	365	9.6	(7–13)		
Sweden	517	7.2	(5–10)	408	7.1	(5–10)	398	6.5	(4–9)	472	11.0	(8–14)	N/A	
Malta	25	16.0	(5–36)	36	13.9	(5–29)	25	16.0	(5–36)	40	12.5	(4–27)		
Austria	616	12.3	(10–15)	636	12.7	(10–16)	680	12.2	(10–15)	696	12.9	(11–16)		
EU/EEA (population-weighted mean)	**11864**	**17.8**	**(17–18)**	**11789**	**18.4**	**(18–19)**	**12689**	**17.8**	**(17–18)**	**15353**	**15.0**	**(15–16)**		↓
Germany	630	15.4	(13–18)	642	17.0	(14–20)	941	15.0	(13–17)	1319	15.0	(13–17)		
France	1862	17.2	(15–19)	1780	18.7	(17–21)	1925	16.4	(15–18)	1968	15.6	(14–17)		
Lithuania	37	18.9	(8–35)	31	29.0	(14–48)	41	26.8	(14–43)	74	16.2	(9–27)		
Cyprus	47	19.1	(9–33)	42	33.3	(20–50)	43	20.9	(10–36)	64	18.8	(10–30)		
Portugal	733	20.6	(18–24)	1064	22.5	(20–25)	1191	19.8	(18–22)	1227	19.2	(17–21)		
Slovenia	133	25.6	(18–34)	112	31.3	(23–41)	141	15.6	(10–23)	143	19.6	(13–27)		↓
Estonia	20	10.0	(1–32)	39	15.4	(6–31)	16	12.5	(2–38)	54	20.4	(11–34)	N/A	
Spain	825	17.6	(15–20)	872	18.5	(16–21)	872	22.7	(20–26)	842	21.4	(19–24)		↑
Italy	788	25.9	(23–29)	753	25.1	(22–28)	1082	23.0	(21–26)	1206	23.5	(21–26)		
Poland	189	32.3	(26–39)	185	27.6	(21–35)	254	37.0	(31–43)	397	26.2	(22–31)		
Bulgaria	59	13.6	(6–25)	48	29.2	(17–44)	55	25.5	(15–39)	56	30.4	(19–44)		
Latvia	25	28.0	(12–49)	18	16.7	(4–41)	13	15.4	(2–45)	16	31.3	(11–59)	N/A	
Hungary	668	30.2	(27–34)	744	33.5	(30–37)	770	35.8	(32–39)	739	33.3	(30–37)		
Greece	877	49.3	(46–53)	699	42.9	(39–47)	675	40.4	(37–44)	699	42.1	(38–46)		↓
Croatia	241	25.3	(20–31)	232	35.3	(29–42)	257	38.5	(33–45)	260	42.3	(36–49)		↑
Slovakia	214	58.9	(52–66)	250	38.4	(32–45)	262	51.9	(46–58)	182	42.3	(35–50)		↓
Romania	86	60.5	(49–71)	94	58.5	(48–69)	92	66.3	(56–76)	93	51.6	(41–62)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

Table 3.20. ***Pseudomonas aeruginosa.*** **Total number of invasive isolates tested (N) with combined resistance (resistance to three or more antimicrobial groups among piperacillin ± tazobactam, ceftazidime, fluoroquinolones, aminoglycosides and carbapenems) including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	11	0.0	(0–28)	11	0.0	(0–28)	12	0.0	(0–26)	17	0.0	(0–18)	N/A	
Denmark	414	1.7	(1–3)	388	1.5	(1–3)	441	2.3	(1–4)	460	1.3	(1–3)		
Luxembourg	34	5.9	(1–20)	41	4.9	(1–17)	28	3.6	(0–18)	40	2.5	(0–13)		
United Kingdom	711	2.4	(1–4)	627	1.6	(1–3)	501	3.8	(2–6)	2131	2.5	(2–3)		
Netherlands	375	2.4	(1–5)	542	2.8	(2–5)	502	2.8	(2–5)	543	2.6	(2–4)		
Norway	205	3.4	(1–7)	257	1.6	(0–4)	230	1.3	(0–4)	227	2.6	(1–6)		
Finland	327	4.6	(3–7)	306	3.9	(2–7)	341	4.7	(3–8)	352	3.4	(2–6)		
Estonia	21	0.0	(0–16)	40	0.0	(0–9)	15	0.0	(0–22)	56	3.6	(1–12)	N/A	
Cyprus	47	4.3	(1–15)	42	14.3	(5–29)	43	2.3	(0–12)	64	4.7	(2–13)		
Malta	25	8.0	(1–26)	36	5.6	(2–18)	25	12.0	(3–31)	40	5.0	(1–17)		
Sweden	531	4.1	(3–6)	436	1.6	(1–3)	386	2.6	(1–5)	472	5.3	(4–8)	N/A	
Belgium	486	10.9	(8–14)	297	8.4	(6–12)	260	4.6	(2–8)	366	6.3	(4–9)		↓
Austria	617	8.3	(6–11)	638	7.1	(5–9)	680	6.8	(5–9)	697	6.7	(5–9)		
Germany	630	9.2	(7–12)	643	8.9	(7–11)	941	8.2	(7–10)	1320	7.9	(7–9)		
Ireland	205	7.3	(4–12)	178	5.6	(3–10)	195	5.1	(2–9)	243	8.6	(6–13)		
EU/EEA (population-weighted mean)	**11940**	**13.0**	**(12–14)**	**11810**	**13.3**	**(13–14)**	**12711**	**13.1**	**(12–14)**	**15410**	**10.3**	**(10–11)**		↓
France	1869	12.5	(11–14)	1784	13.2	(12–15)	1940	12.0	(11–14)	1972	10.6	(9–12)		↓
Lithuania	37	8.1	(2–22)	31	25.8	(12–45)	41	24.4	(12–40)	74	10.8	(6–20)		
Spain	825	12.2	(10–15)	873	12.4	(10–15)	874	14.2	(12–17)	843	14.5	(12–17)		
Portugal	737	11.9	(10–15)	1064	20.6	(18–23)	1186	11.8	(10–14)	1230	14.8	(13–17)		
Slovenia	133	11.3	(6–18)	112	18.8	(12–27)	141	7.1	(3–13)	143	15.4	(10–22)		
Latvia	25	24.0	(9–45)	18	11.1	(1–35)	13	15.4	(2–45)	16	18.8	(7–43)	N/A	
Hungary	667	18.7	(16–22)	746	21.7	(19–25)	770	20.9	(18–24)	740	19.1	(16–22)		
Czech Republic	516	23.3	(20–27)	446	20.2	(17–24)	464	19.0	(15–23)	464	19.6	(16–23)		
Italy	774	24.3	(21–27)	746	22.9	(20–26)	1082	20.0	(18–22)	1206	20.1	(18–23)		
Poland	188	14.4	(10–20)	187	26.7	(21–34)	260	29.6	(24–36)	403	20.6	(17–25)		
Greece	859	39.1	(36–42)	679	36.1	(32–40)	666	28.4	(25–32)	702	31.6	(28–35)		↓
Croatia	244	18.4	(14–24)	232	31.5	(26–38)	257	28.0	(23–34)	260	31.9	(27–38)		↑
Slovakia	285	36.1	(31–42)	268	37.3	(32–43)	270	40.7	(35–47)	183	33.9	(27–41)		
Bulgaria	60	8.3	(3–18)	48	29.2	(17–44)	55	29.1	(18–43)	56	35.7	(24–59)		↑
Romania	82	50.0	(39–61)	94	59.6	(49–70)	92	63.0	(52–73)	90	48.9	(39–59)		

–: No data

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

3.4 *Acinetobacter* species

The *Acinetobacter* genus consists of a large number of species which can be divided into two complexes: the *Acinetobacter baumannii* complex – the group including most of the disease-causing species (*A. baumannii*, *A. pittii* and *A. nosocomialis*) – and the generally less pathogenic *Acinetobacter non-baumannii* group. The correct identification of *Acinetobacter* isolates to species level is difficult and usually only possible with genotypic methods, although many mass spectrometry databases have improved greatly.

Species belonging to the *Acinetobacter baumannii* group are opportunistic pathogens primarily associated with healthcare-associated infections including ventilator-associated pneumonia, central-line-associated bloodstream infections, urinary tract infections and wound infections. Risk factors for infection include advanced age, presence of serious underlying disease, immune suppression, major trauma or burn injuries, invasive procedures, presence of indwelling catheters, mechanical ventilation, extended hospital stay and previous administration of antibiotics.

Acinetobacter spp., particularly those belonging to the *A. baumannii*-complex, are intrinsically resistant to most antimicrobial agents due to their selective ability to prevent various molecules from penetrating their outer membrane. The antimicrobial groups that remain active include some fluoroquinolones (e.g. ciprofloxacin and levofloxacin), aminoglycosides (e.g. gentamicin, tobramycin and amikacin), carbapenems (imipenem and meropenem), polymyxins (polymyxin B and colistin) and, possibly, sulbactam and tigecycline. Acquired resistance results from mutational changes in the chromosome and acquisition of plasmid-mediated resistance genes.

Antimicrobial resistance 2013–2016

More than half (55.4 %) of the *Acinetobacter* spp. isolates reported to EARS-Net for 2016 by EU/EEA countries were resistant to at least one of the antimicrobial groups under regular surveillance (fluoroquinolones, aminoglycosides and carbapenems) (Table 3.21). The EU/EEA population-weighted mean percentage showed little variation between the antimicrobial groups in 2016 and ranged between 35.1 % and 39.0 % (Tables 3.22–3.24). No trend analyses were performed for the EU/EEA population-weighted means, as less than half of the laboratories submitting data for 2016 reported consistently for the full four-year period.

Resistance to one or two antimicrobial groups was considerably less common compared to combined resistance to all three groups under surveillance (Table 3.21). The population-weighted EU/EEA mean percentage for combined resistance to fluoroquinolones, aminoglycosides and carbapenems was 31.7 % in 2016 (Table 3.25).

Colistin susceptibility data were reported for 51.3 % of all *Acinetobacter* spp. isolates. Only eleven countries provided susceptibility results for more than half of the reported *Acinetobacter* spp. isolates. Overall, 4.0 % of the tested isolates were resistant to colistin (2.0 % of all reported *Acinetobacter* spp. isolates regardless of colistin susceptibility data availability). The vast majority (70.7 %) of the resistant isolates were reported from Greece and Italy. These findings may not be representative for Europe as a whole and should be interpreted with caution because of the low number of isolates tested, the relatively high proportion of isolates from high-resistance areas, and the technical complexities of colistin susceptibility testing.

Large inter-country variations were noted for all antimicrobial groups under regular EARS-Net surveillance, with generally higher resistance percentages reported from southern and eastern parts of Europe than the north (Figures 3.20–3.23). Single resistance to one antimicrobial group was less common in countries reporting comparatively low proportions of fully susceptible isolates (Figure 3.19).

Discussion and conclusions

More than half of the *Acinetobacter* spp. isolates reported to EARS-Net for 2016 were resistant to at least one antimicrobial group under surveillance. Combined resistance to multiple antimicrobial groups was common, and the most frequently reported resistance phenotype was resistance to all three groups under regular surveillance (fluoroquinolones, aminoglycosides and carbapenems). However, antimicrobial resistance varied largely across Europe, with generally high resistance percentages reported from the Baltic countries, from southern Europe and from south-eastern Europe. The presence of colistin-resistant isolates in countries already reporting high levels of resistance in *Acinetobacter* spp. indicates the loss of a last-line treatment alternative.

Antimicrobial resistant *Acinetobacter* spp. is a public health concern because it not only severely limits options for patient treatment, but also constitutes an infection control challenge. An ECDC rapid risk assessment on carbapenem-resistant *Acinetobacter baumannii* published in 2016 concluded that the epidemiological situation in parts of Europe has worsened in the past years. Options for response presented in the risk assessment included timely laboratory reporting, screening and pre-emptive isolation of high-risk patients, good infection control, and antimicrobial stewardship programmes [17].

As for *E. coli* and *K. pneumoniae*, resistance to carbapenems is often associated with production of carbapenemases. Results from the European survey of carbapenemase-producing Enterobacteriaceae project (EuSCAPE) showed that carbapenem-resistant *Acinetobacter* spp. might be more widely disseminated in Europe than CPE [18]. The high levels of carbapenem resistance in *Acinetobacter* spp. reported from many countries participating in EARS-Net, combined with resistance to other antimicrobial groups, support this assumption.

The EuSCAPE project also showed that in 2013, surveillance and reporting of carbapenem-resistant *A. baumannii* was not performed routinely in all the EU/EEA countries. In general, less information and more

limited data were available on the national capacity for surveillance and containment of carbapenem-resistant *A. baumannii* compared to carbapenem-resistant Enterobacteriaceae. The increasing number of countries and laboratories reporting data on *Acinetobacter* spp. to EARS-Net might indicate that surveillance of this pathogen in Europe has improved recently.

Table 3.21. *Acinetobacter* spp. Overall resistance and resistance combinations among invasive isolates tested to fluoroquinolones, aminoglycosides and carbapenems (n= 5 390), EU/EEA countries, 2016

Resistance pattern	Number of isolates	% of total*
Fully susceptible	2402	44.6
Single resistance (to indicated antimicrobial group)		
Total (any single resistance)	**213**	**4**
Fluoroquinolones	126	2.3
Aminoglycosides	52	1
Carbapenems	35	0.6
Resistance to two antimicrobial groups		
Total (any two-group combinations)	**441**	**8.2**
Fluoroquinolones + carbapenems	261	4.8
Fluoroquinolones + aminoglycosides	167	3.1
Aminoglycosides + carbapenems	13	0.2
Resistance to three antimicrobial groups		
Fluoroquinolones + aminoglycosides + carbapenems	2334	43.3

Only data from isolates tested against all three antimicrobial groups were included in the analysis.
* Not adjusted for population differences in the reporting countries.

Figure 3.19. *Acinetobacter spp.* Distribution of isolates: fully susceptible and resistant to one, two and three antimicrobial groups (among isolates tested against fluoroquinolone, aminoglycoside and carbapenems), EU/EEA countries, 2016

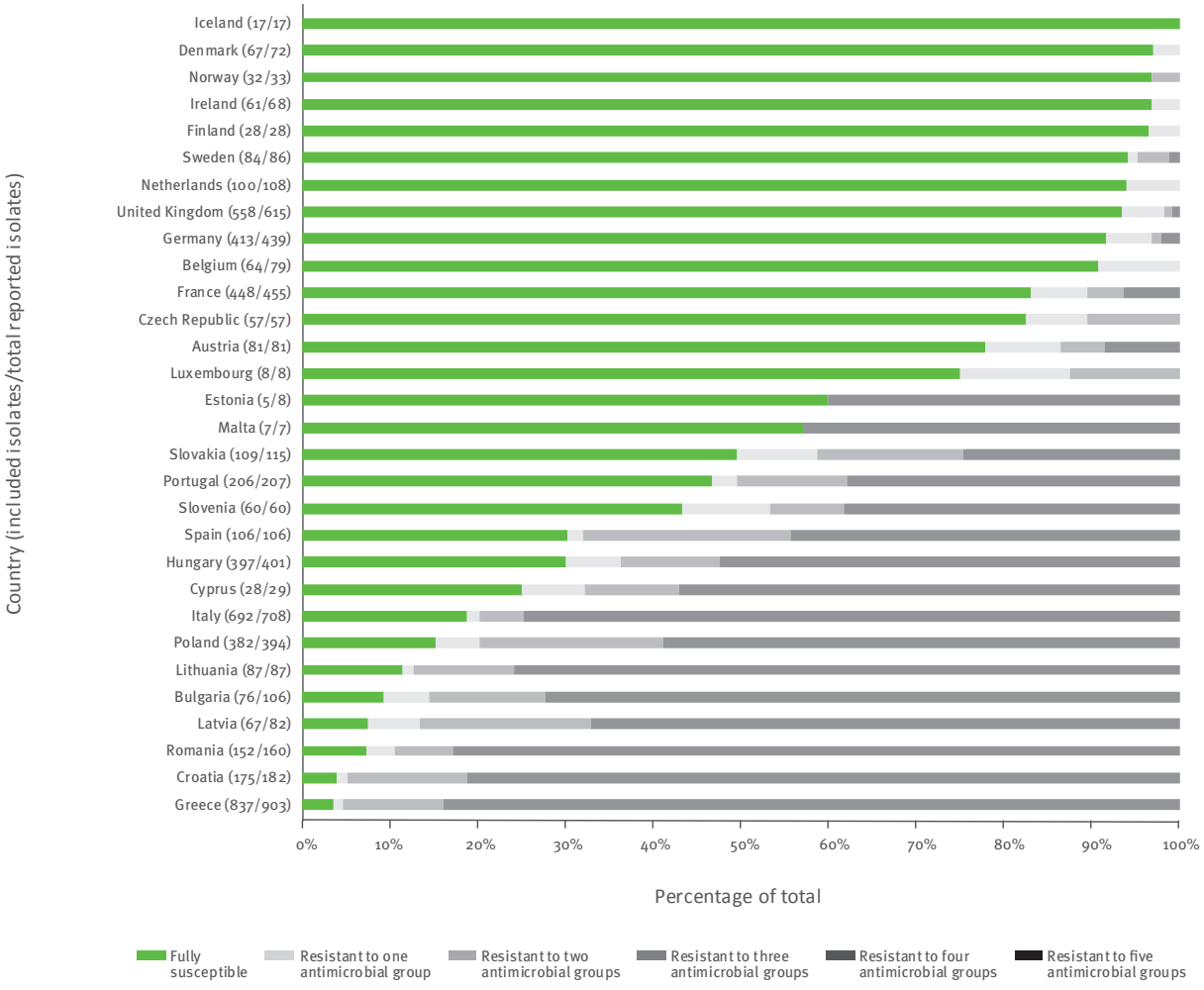


Figure 3.20. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2016**

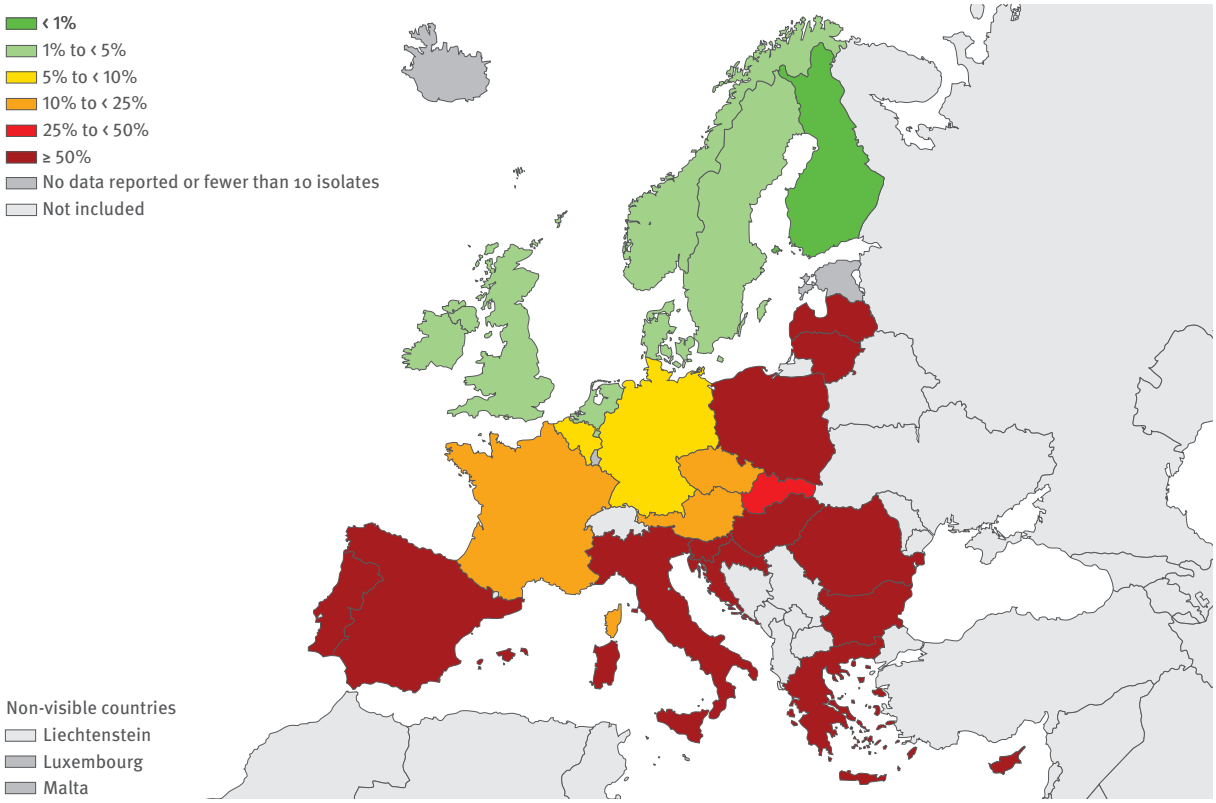


Figure 3.21. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2016**

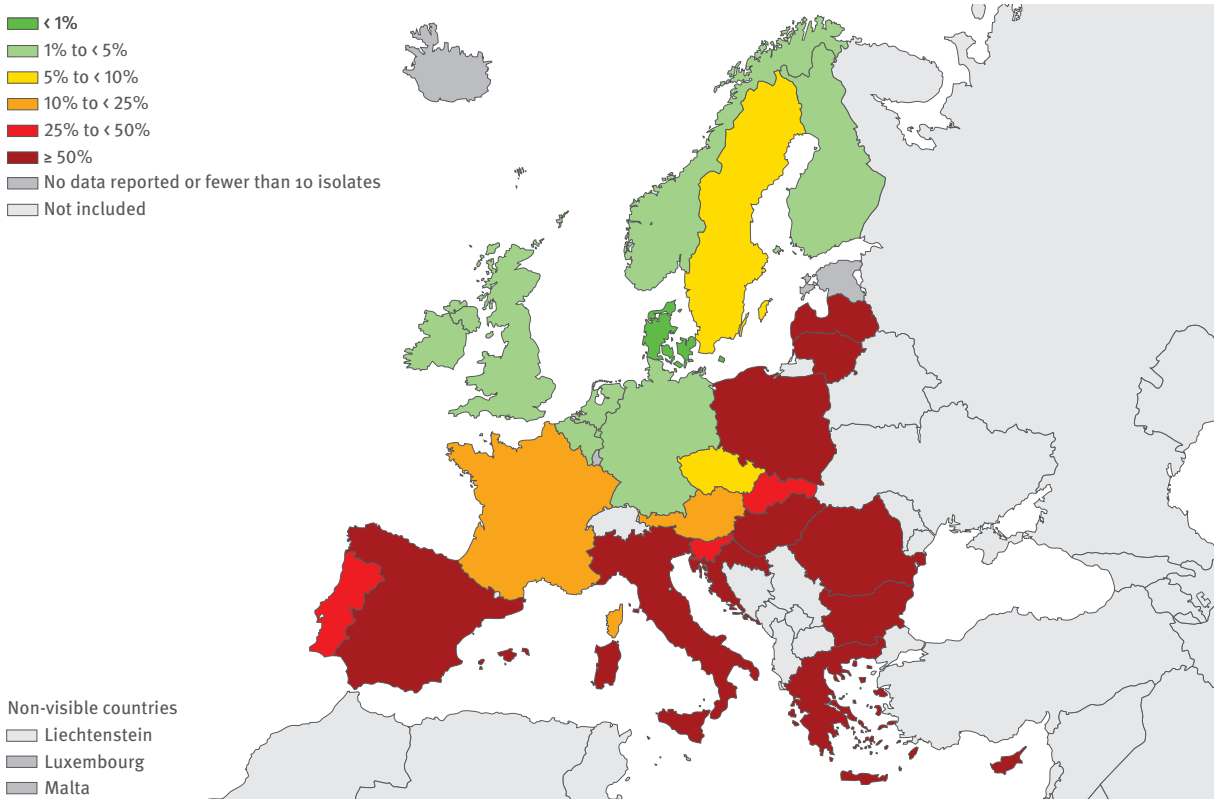


Figure 3.22. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2016**

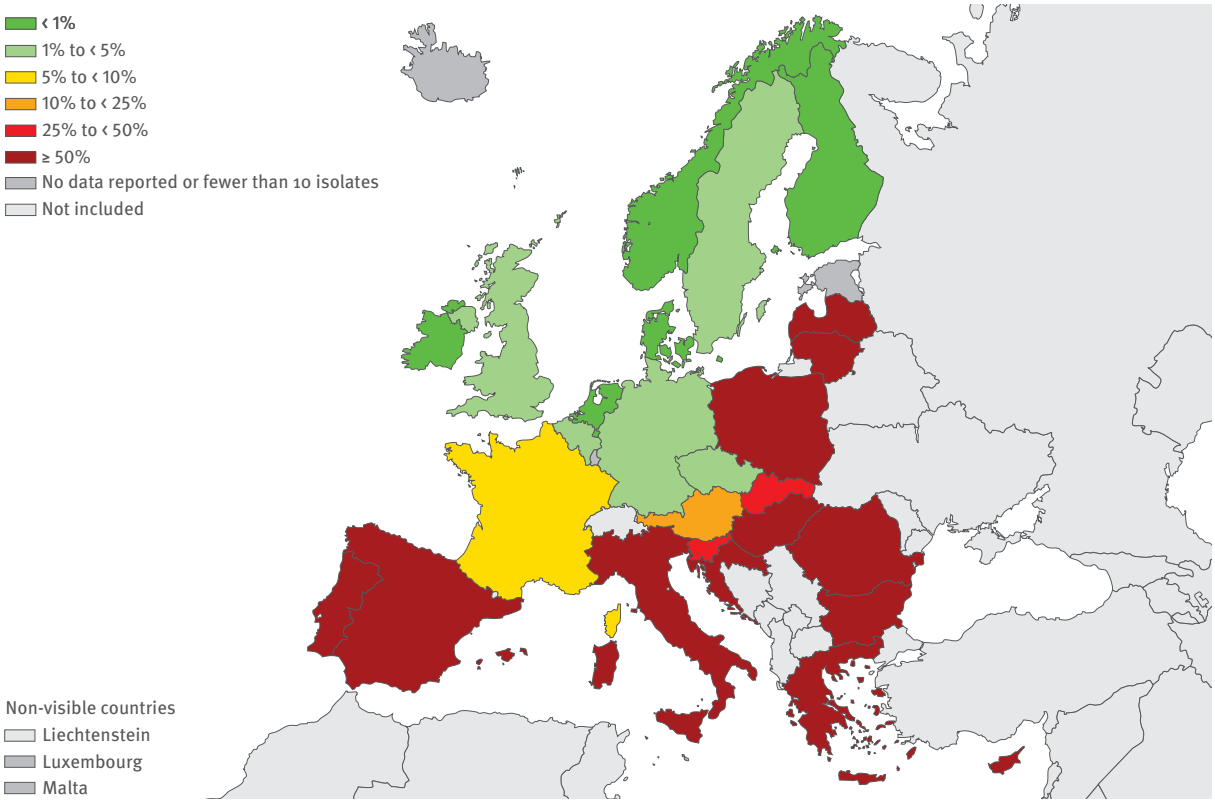


Figure 3.23. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with combined resistance to fluoroquinolones, aminoglycosides and carbapenems, by country, EU/EEA countries, 2016**

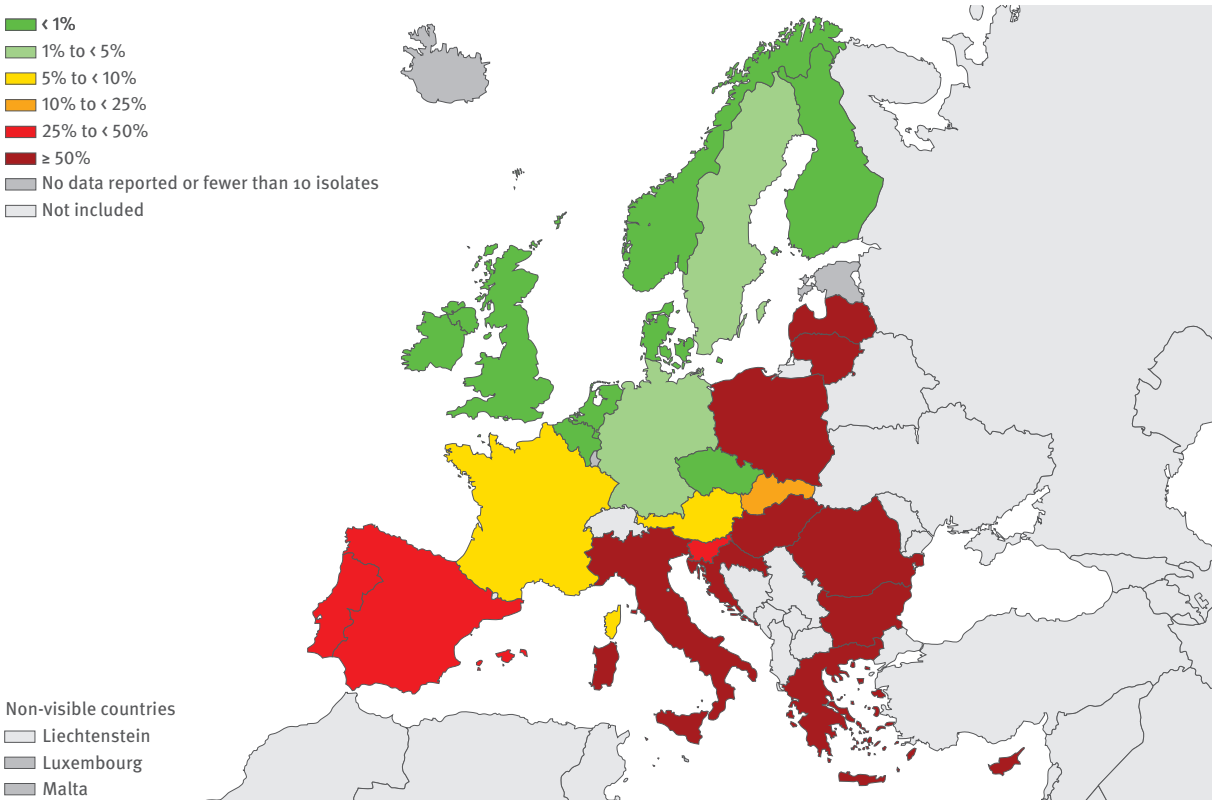


Table 3.22. ***Acinetobacter*** **spp. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Finland	36	2.8	(0–15)	31	6.5	(1–21)	43	2.3	(0–12)	28	0.0	(0–12)		
Ireland	88	1.1	(0–6)	86	4.7	(1–11)	83	4.8	(1–12)	68	1.5	(0–8)		
Denmark	79	6.3	(2–14)	69	2.9	(0–10)	68	5.9	(2–14)	72	2.8	(0–10)		
Netherlands	69	2.9	(0–10)	72	4.2	(1–12)	74	6.8	(2–15)	106	2.8	(1–8)		
Norway	36	0.0	(0–10)	34	5.9	(1–20)	32	9.4	(2–25)	33	3.0	(0–16)		
United Kingdom	165	3.6	(1–8)	123	11.4	(6–18)	139	7.2	(4–13)	589	4.4	(3–6)		
Sweden	74	5.4	(1–13)	52	11.5	(4–23)	26	3.8	(0–20)	86	4.7	(1–11)	N/A	
Germany	175	9.7	(6–15)	199	6.0	(3–10)	336	8.6	(6–12)	437	5.7	(4–8)		
Belgium	3	**	(**)	4	**	(**)	26	0.0	(0–13)	78	7.7	(3–16)	N/A	
France	397	13.6	(10–17)	395	11.9	(9–16)	430	13.5	(10–17)	452	15.0	(12–19)		
Austria	51	21.6	(11–35)	75	5.3	(1–13)	61	16.4	(8–28)	81	16.0	(9–26)		
Czech Republic	91	19.8	(12–29)	59	15.3	(7–27)	60	18.3	(10–30)	57	17.5	(9–30)		
EU/EEA (population-weighted mean)	**4108**	***		**4244**	***		**5025**	**48.1**	**(47–50)**	**5568**	**39.0**	**(38–40)**	N/A	
Slovakia	188	58.5	(51–66)	170	51.8	(44–59)	154	51.9	(44–60)	115	46.1	(37–56)		↓
Portugal	225	68.9	(62–75)	264	52.7	(46–59)	308	55.8	(50–61)	206	50.5	(43–58)		↓
Slovenia	25	28.0	(12–49)	34	41.2	(25–59)	31	58.1	(39–75)	60	55.0	(42–68)		↑
Bulgaria	94	70.2	(60–79)	115	73.9	(65–82)	131	78.6	(71–85)	106	67.9	(58–77)		
Hungary	472	73.5	(69–77)	441	66.4	(62–71)	464	68.1	(64–72)	397	68.0	(63–73)		
Spain	76	72.4	(61–82)	79	67.1	(56–77)	95	64.2	(54–74)	106	68.9	(59–78)		
Cyprus	33	60.6	(42–77)	58	77.6	(65–87)	60	83.3	(71–92)	28	71.4	(51–87)		
Italy	472	83.1	(79–86)	469	92.1	(89–94)	664	81.6	(78–85)	697	79.9	(77–83)		
Poland	188	81.4	(75–87)	185	82.7	(76–88)	243	88.1	(83–92)	393	83.0	(79–87)		
Latvia	–	–	(–)	52	88.5	(77–96)	60	78.3	(66–88)	68	85.3	(75–93)	N/A	
Lithuania	–	–	(–)	66	84.8	(74–92)	73	93.2	(85–98)	87	87.4	(79–94)	N/A	
Romania	137	90.5	(84–95)	123	83.7	(76–90)	189	82.5	(76–88)	157	91.1	(85–95)		
Greece	812	95.0	(93–96)	806	95.3	(94–97)	946	94.9	(93–96)	862	94.9	(93–96)		
Croatia	112	92.9	(86–97)	164	92.1	(87–96)	196	92.3	(88–96)	176	94.9	(91–98)		
Iceland	–	–	(–)	3	**	(**)	6	**	(**)	3	**	(**)	N/A	
Luxembourg	3	**	(**)	6	**	(**)	8	**	(**)	8	**	(**)	N/A	
Estonia	–	–	(–)	–	–	(–)	4	**	(**)	5	**	(**)	N/A	
Malta	7	**	(**)	10	30.0	(7–65)	15	13.3	(2–40)	7	**	(**)	N/A	

–: No data

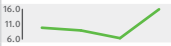
* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

*** Not calculated due to low laboratory completeness.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.23. ***Acinetobacter*** **spp. Total number of invasive isolates tested (N) and percentage with resistance to aminoglycosides (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Denmark	75	1.3	(0–7)	60	1.7	(0–9)	63	4.8	(1–13)	70	0.0	(0–5)			
Belgium	1	**	(**)	2	**	(**)	15	0.0	(0–22)	66	1.5	(0–8)		N/A	
Ireland	88	1.1	(0–6)	89	2.2	(0–8)	80	3.8	(1–11)	63	1.6	(0–9)			
Germany	180	6.1	(3–11)	197	4.1	(2–8)	328	5.5	(3–9)	413	2.9	(2–5)			
Norway	36	2.8	(0–15)	33	3.0	(0–16)	32	9.4	(2–25)	32	3.1	(0–16)			
United Kingdom	163	2.5	(1–6)	129	10.1	(5–17)	153	2.0	(0–6)	598	3.3	(2–5)			
Finland	36	0.0	(0–10)	31	3.2	(0–17)	42	2.4	(0–13)	28	3.6	(0–18)			
Netherlands	67	4.5	(1–13)	73	5.5	(2–13)	74	10.8	(5–20)	103	3.9	(1–10)			
Sweden	74	8.1	(3–17)	36	2.8	(0–15)	26	3.8	(0–20)	85	5.9	(2–13)		N/A	
Czech Republic	91	15.4	(9–24)	59	10.2	(4–21)	60	15.0	(7–27)	57	8.8	(3–19)			
France	409	11.2	(8–15)	409	8.3	(6–11)	431	10.9	(8–14)	449	12.2	(9–15)			
Austria	51	9.8	(3–21)	79	8.9	(4–17)	63	6.3	(2–15)	81	16.0	(9–26)			
EU/EEA (population-weighted mean)	**4102**	***		**4184**	***		**4992**	**41.6**	**(40–43)**	**5532**	**35.2**	**(34–36)**		N/A	
Portugal	231	56.3	(50–63)	265	42.3	(36–48)	310	46.5	(41–52)	206	39.3	(33–46)			↓
Slovakia	187	42.8	(36–50)	170	40.6	(33–48)	154	42.9	(35–51)	115	40.9	(32–50)			
Slovenia	25	16.0	(5–36)	34	32.4	(17–51)	31	38.7	(22–58)	60	43.3	(31–57)			↑
Spain	77	68.8	(57–79)	80	58.8	(47–70)	96	49.0	(39–59)	106	50.9	(41–61)			↓
Cyprus	33	60.6	(42–77)	57	73.7	(60–84)	59	74.6	(62–85)	28	57.1	(37–76)			
Hungary	473	63.2	(59–68)	444	59.5	(55–64)	465	60.6	(56–65)	401	59.1	(54–64)			
Poland	185	72.4	(65–79)	183	55.2	(48–63)	243	68.7	(62–74)	386	72.3	(68–77)			
Italy	456	81.8	(78–85)	444	88.3	(85–91)	656	74.7	(71–78)	704	76.4	(73–80)			
Latvia	–	–	(–)	52	69.2	(55–81)	61	59.0	(46–71)	81	77.8	(67–86)		N/A	
Bulgaria	91	58.2	(47–68)	87	60.9	(50–71)	116	74.1	(65–82)	79	81.0	(71–89)			↑
Lithuania	–	–	(–)	65	80.0	(68–89)	73	90.4	(81–96)	87	82.8	(73–90)		N/A	
Croatia	113	84.1	(76–90)	166	82.5	(76–88)	197	88.3	(83–92)	182	83.0	(77–88)			
Greece	813	82.0	(79–85)	799	83.9	(81–86)	945	83.5	(81–86)	877	84.9	(82–87)			
Romania	137	80.3	(73–87)	122	77.0	(69–84)	188	80.9	(74–86)	152	89.5	(83–94)			↑
Iceland	–	–	(–)	3	**	(**)	6	**	(**)	3	**	(**)		N/A	
Luxembourg	3	**	(**)	6	**	(**)	8	**	(**)	8	**	(**)		N/A	
Estonia	–	–	(–)	–	–	(–)	2	**	(**)	5	**	(**)		N/A	
Malta	7	**	(**)	10	30.0	(7–65)	15	13.3	(2–40)	7	**	(**)		N/A	

–: No data

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

*** Not calculated due to low laboratory completeness.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.24. ***Acinetobacter*** **spp. Total number of invasive isolates tested (N) and percentage with resistance to carbapenems (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016				Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)		All laboratories	Continuously reporting laboratories*
Denmark	61	1.6	(0–9)	62	1.6	(0–9)	65	4.6	(1–13)	69	0.0	(0–5)			
Finland	35	0.0	(0–10)	32	3.1	(0–16)	43	2.3	(0–12)	28	0.0	(0–12)			
Ireland	85	2.4	(0–8)	79	1.3	(0–7)	84	6.0	(2–13)	65	0.0	(0–6)			
Netherlands	65	1.5	(0–8)	74	0.0	(0–5)	73	4.1	(1–12)	104	0.0	(0–3)			
Norway	36	0.0	(0–10)	34	2.9	(0–15)	32	9.4	(2–25)	33	0.0	(0–11)			
Sweden	72	5.6	(2–14)	52	3.8	(0–13)	34	2.9	(0–15)	84	1.2	(0–6)		N/A	
United Kingdom	149	2.0	(0–6)	120	1.7	(0–6)	132	0.8	(0–4)	584	1.5	(1–3)			
Czech Republic	91	4.4	(1–11)	59	5.1	(1–14)	60	6.7	(2–16)	57	1.8	(0–9)			
Belgium	3	**	(**)	4	**	(**)	24	0.0	(0–14)	78	2.6	(0–9)		N/A	
Germany	180	8.9	(5–14)	201	5.5	(3–10)	334	6.6	(4–10)	429	4.9	(3–7)			
France	406	5.9	(4–9)	401	2.5	(1–5)	428	5.6	(4–8)	450	7.1	(5–10)			
Austria	51	7.8	(2–19)	78	6.4	(2–14)	64	9.4	(4–19)	81	12.3	(6–22)			
Slovakia	142	45.8	(37–54)	161	32.9	(26–41)	142	28.2	(21–36)	109	28.4	(20–38)			↓
EU/EEA (population-weighted mean)	**4092**	***		**4275**	***		**5049**	**42.8**	**(41–44)**	**5565**	**35.1**	**(34–36)**		N/A	
Slovenia	25	24.0	(9–45)	34	26.5	(13–44)	31	38.7	(22–58)	60	43.3	(31–57)			↑
Portugal	229	69.0	(63–75)	262	53.1	(47–59)	307	57.7	(52–63)	206	51.9	(45–59)			↓
Hungary	481	50.1	(46–55)	443	44.5	(40–49)	467	55.2	(51–60)	401	58.6	(54–63)			↑
Spain	95	75.8	(66–84)	78	65.4	(54–76)	95	53.7	(43–64)	106	62.3	(52–71)			↓
Poland	189	49.7	(42–57)	189	53.4	(46–61)	244	65.6	(59–72)	391	66.0	(61–71)			↑
Cyprus	33	60.6	(42–77)	58	77.6	(65–87)	59	83.1	(71–92)	28	71.4	(51–87)			
Latvia	–	–	(–)	52	78.8	(65–89)	61	68.9	(56–80)	82	73.2	(62–82)		N/A	
Bulgaria	89	59.6	(49–70)	110	59.1	(49–68)	130	73.8	(65–81)	103	74.8	(65–83)			↑
Italy	468	79.5	(76–83)	477	89.9	(87–92)	664	78.3	(75–81)	702	78.5	(75–81)			
Lithuania	–	–	(–)	66	69.7	(57–80)	73	80.8	(70–89)	87	81.6	(72–89)		N/A	
Romania	137	85.4	(78–91)	123	81.3	(73–88)	189	81.5	(75–87)	160	85.0	(79–90)			
Croatia	114	89.5	(82–94)	166	87.3	(81–92)	200	89.0	(84–93)	181	94.5	(90–97)			
Greece	848	90.6	(88–92)	841	93.2	(91–95)	983	93.5	(92–95)	861	95.4	(94–97)			↑
Iceland	–	–	(–)	3	**	(**)	6	**	(**)	3	**	(**)		N/A	
Luxembourg	1	**	(**)	6	**	(**)	7	**	(**)	8	**	(**)		N/A	
Estonia	–	–	(–)	–	–	(–)	3	**	(**)	8	**	(**)		N/A	
Malta	7	**	(**)	10	10.0	(0–45)	15	13.3	(2–40)	7	**	(**)		N/A	

–: No data

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

*** Not calculated due to low laboratory completeness.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.25. ***Acinetobacter*** **spp. Total number of isolates tested (N) and percentage with combined resistance to fluoroquinolones, aminoglycosides and carbapenems (%R), including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories *
Belgium	1	**	(**)	2	**	(**)	13	0.0	(0–25)	64	0.0	(0–6)	N/A	
Czech Republic	91	4.4	(1–11)	59	5.1	(1–14)	60	5.0	(1–14)	57	0.0	(0–6)		
Denmark	57	1.8	(0–9)	49	0.0	(0–7)	60	3.3	(0–12)	67	0.0	(0–5)		
Finland	34	0.0	(0–10)	30	0.0	(0–12)	42	2.4	(0–13)	28	0.0	(0–12)		
Ireland	84	0.0	(0–4)	79	1.3	(0–7)	75	1.3	(0–7)	61	0.0	(0–6)		
Netherlands	64	1.6	(0–8)	69	0.0	(0–5)	73	4.1	(1–12)	100	0.0	(0–4)		
Norway	36	0.0	(0–10)	33	3.0	(0–16)	32	9.4	(2–25)	32	0.0	(0–11)		
United Kingdom	149	1.3	(0–5)	119	1.7	(0–6)	131	0.0	(0–3)	558	0.9	(0–2)		
Sweden	71	5.6	(2–14)	36	2.8	(0–15)	26	3.8	(0–20)	84	1.2	(0–6)	N/A	
Germany	174	5.2	(2–10)	188	2.1	(1–5)	325	3.7	(2–6)	413	2.2	(1–4)		
France	389	4.1	(2–7)	391	1.5	(1–3)	424	5.2	(3–8)	448	6.7	(4–9)		↑
Austria	51	5.9	(1–16)	74	2.7	(0–9)	61	4.9	(1–14)	81	8.6	(4–17)		
Slovakia	141	24.8	(18–33)	160	24.4	(18–32)	142	23.2	(17–31)	109	24.8	(17–34)		
EU/EEA (population-weighted mean)	**3931**	***		**4068**	***		**4896**	**37.8**	**(36–39)**	**5390**	**31.7**	**(30–33)**	**N/A**	
Portugal	222	56.3	(50–63)	260	39.2	(33–45)	302	45.0	(39–51)	206	37.9	(31–45)		↓
Slovenia	25	16.0	(5–36)	34	20.6	(9–38)	31	32.3	(17–51)	60	38.3	(26–52)		↑
Spain	71	66.2	(54–77)	78	55.1	(43–66)	94	41.5	(31–52)	106	44.3	(35–54)		↓
Hungary	465	42.8	(38–47)	438	38.4	(34–43)	462	51.7	(47–56)	397	52.4	(47–57)		↑
Cyprus	33	60.6	(42–77)	57	73.7	(60–84)	59	72.9	(60–84)	28	57.1	(37–76)		
Poland	178	44.9	(37–53)	179	36.3	(29–44)	238	53.4	(47–60)	382	58.9	(54–64)		↑
Latvia	–	–	(–)	52	61.5	(47–75)	60	46.7	(34–60)	67	67.2	(55–78)		
Bulgaria	86	39.5	(29–51)	85	47.1	(36–58)	112	66.1	(57–75)	76	72.4	(61–82)		↑
Italy	444	78.8	(75–83)	437	86.3	(83–89)	650	72.6	(69–76)	692	74.7	(71–78)		↓
Lithuania	–	–	(–)	65	60.0	(47–72)	73	76.7	(65–86)	87	75.9	(65–84)	N/A	
Croatia	111	78.4	(70–86)	162	80.9	(74–87)	193	87.0	(81–91)	175	81.1	(75–87)		
Romania	137	74.5	(66–82)	121	76.9	(68–84)	186	76.9	(70–83)	152	82.9	(76–89)		
Greece	809	79.6	(77–82)	792	82.6	(80–85)	943	82.0	(79–84)	837	84.0	(81–86)		
Iceland	–	–	(–)	3	**	(**)	6	**	(**)	3	**	(**)	N/A	
Luxembourg	1	**	(**)	6	**	(**)	7	**	(**)	8	**	(**)	N/A	
Estonia	–	–	(–)	–	–	(–)	1	**	(**)	5	**	(**)	N/A	
Malta	7	**	(**)	10	10	(0–45)	15	6.7	(0–32)	7	**	(**)	N/A	

–: No data

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

*** Not calculated due to low laboratory completeness.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

3.5 *Streptococcus pneumoniae*

3.5.1 Clinical and epidemiological importance

Streptococcus pneumoniae is a common cause of disease, especially among young children, elderly people and patients with compromised immune functions. The clinical spectrum ranges from upper airway and middle ear infections to pneumonia, bloodstream infections and meningitis.

The mechanism of penicillin resistance in *S. pneumoniae* consists of alterations in penicillin-binding proteins (PBPs), which may result in reduced affinity to penicillin G and a variable spectrum of other beta-lactams. Alterations in PBPs are due to homologous DNA recombination with PBP gene sequences originating from commensal streptococci. Acquisition of mosaic PBP results in different degrees of resistance, ranging from low-level clinical resistance – conventionally termed intermediate (I) – to full clinical resistance (R).

In the absence of meningitis, infections with intermediate strains are often successfully treated with high doses of benzylpenicillin or aminopenicillins.

Antimicrobial resistance 2013–2016

As in previous years, wide inter-country variations could be noted in *S. pneumoniae* susceptibility in 2016. The national percentages of isolates with penicillin non-susceptibility ranged between 0.4% and 41.1% (Table 3.26, Figure 3.24) and between 0.0% and 60.0% for macrolide non-susceptibility (Table 3.27). Macrolide non-susceptibility was, for most countries, higher than penicillin non-susceptibility. Combined non-susceptibility to both penicillins and macrolides was less common, with a majority of the countries reporting this phenotype for less than 10% of the tested isolates (Table 3.28).

Data might not be comparable between all countries and between the years, as the clinical breakpoints used to determine penicillin susceptibility in *S. pneumoniae* differ depending on the used guidelines and the site of infection. Consequently, a population-weighted EU/EEA mean percentage was not calculated for *S. pneumoniae*.

Discussion and conclusions

The resistance situation in *S. pneumoniae* appears stable, with few countries reporting increasing or decreasing trends during the period 2013–2016. As in previous years, large inter-country variations could be noted in penicillin susceptibility. Differences in clinical breakpoints used for determining penicillin susceptibility in *S. pneumoniae* with regard to guidelines used and site of infection introduce bias when comparing national data reported to EARS-Net. Limited information on use of guidelines and incomplete quantitative susceptibility data hamper assessment of these inter-country differences.

In parallel to EARS-Net, the invasive pneumococcal disease (IPD) enhanced surveillance network, which is also coordinated by ECDC, collects additional data on IPD cases from reference laboratories throughout Europe [19]. For most countries, AST results reported to EARS-Net correspond well with the data reported to the IPD enhanced surveillance. However, a few countries show different results in the two surveillance systems, potentially caused by the difference in data sources. The IPD surveillance initiatives within ECDC are currently being harmonised to make best use of available data.

Most EU/EEA countries have implemented routine immunisation for children with multivalent pneumococcal conjugated vaccines (PCVs). In some countries, adult high-risk groups such as the elderly and immunocompromised are also targeted with the polysaccharide vaccine [20]. Increased immunisation and better serotype coverage of the available PCVs are likely to impact the epidemiology of non-susceptible *S. pneumoniae* in Europe, both in terms of changes in age-specific incidence and potential serotype replacement.

Figure 3.24. ***Streptococcus pneumoniae.*** **Percentage (%) of invasive isolates non-susceptible to macrolides, by country, EU/EEA countries, 2016**

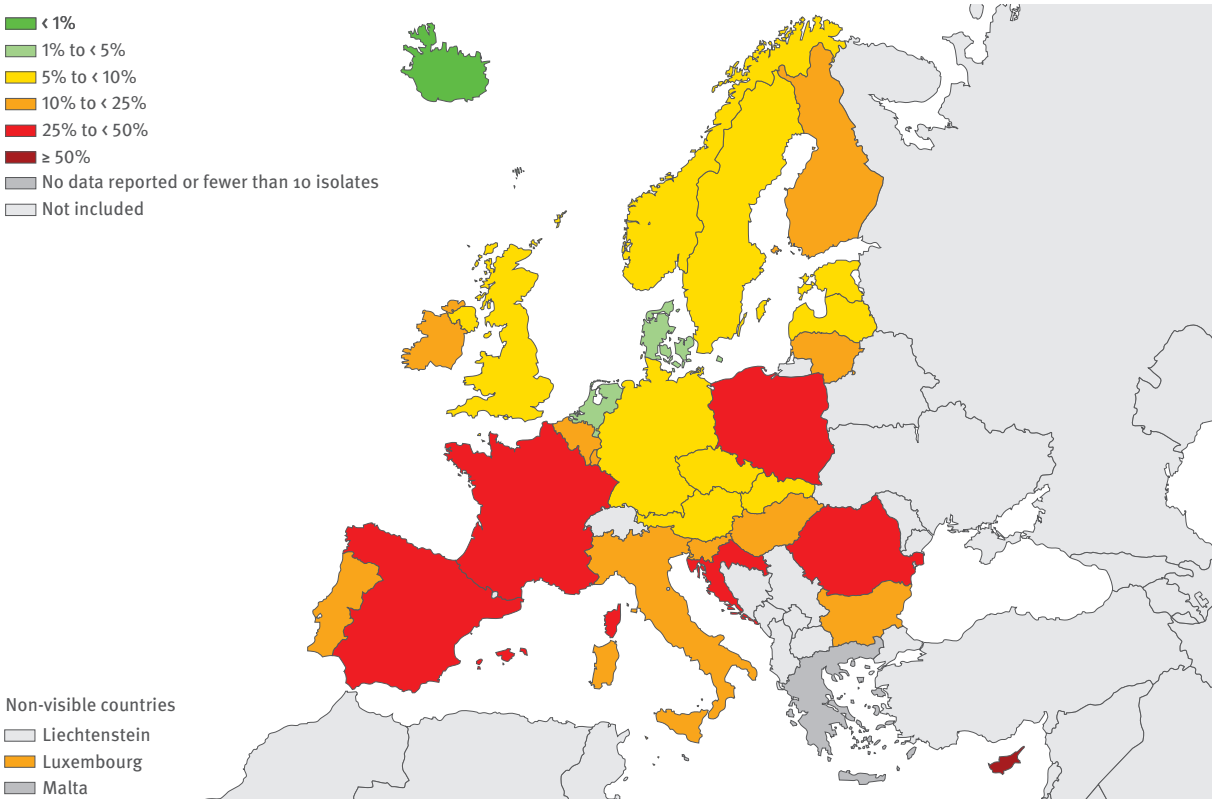


Table 3.26. ***Streptococcus pneumoniae*. Total number of tested isolates (N) and percentages non-susceptible to penicillin (%IR), including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	All laboratories	Continuously reporting laboratories*
Belgium	1536	1.7	(1–2)	1110	1.3	(1–2)	1361	0.6	(0–1)	1328	0.4	(0–1)		↓
Netherlands	1032	1.1	(1–2)	1139	2.1	(1–3)	1163	1.8	(1–3)	1391	2.2	(2–3)		
Austria	385	2.1	(1–4)	361	5.3	(3–8)	444	5.6	(4–8)	440	3.4	(2–6)		
Estonia	78	1.3	(0–7)	72	4.2	(1–12)	72	2.8	(0–10)	112	3.6	(1–9)		
Germany	475	6.9	(5–10)	499	4.4	(3–7)	725	6.2	(5–8)	1248	4.0	(3–5)		
Norway	549	3.3	(2–5)	534	5.1	(3–7)	429	5.4	(3–8)	500	4.4	(3–7)		
Czech Republic	333	2.1	(1–4)	274	5.8	(3–9)	284	3.2	(1–6)	266	4.5	(2–8)		
United Kingdom	1207	4.9	(4–6)	1288	5.1	(4–6)	1095	7.8	(6–10)	3201	4.9	(4–6)		
Denmark	789	6.6	(5–9)	709	5.6	(4–8)	747	4.7	(3–6)	707	6.1	(4–8)		
Italy	268	14.6	(11–19)	183	15.3	(10–21)	389	12.3	(9–16)	399	6.5	(4–9)		↓
Slovenia	279	7.9	(5–12)	300	9.7	(7–14)	323	9.0	(6–13)	269	6.7	(4–10)		
Sweden	696	6.8	(5–9)	696	7.9	(6–10)	420	9.8	(7–13)	882	7.1	(6–9)	N/A	
Slovakia	28	10.7	(2–28)	29	20.7	(8–40)	27	22.2	(9–42)	13	7.7	(0–36)		
Malta	7	**	(**)	8	**	(**)	20	35.0	(15–59)	10	10.0	(0–45)	N/A	
Finland	617	13.9	(11–17)	593	12.5	(10–15)	677	12.7	(10–15)	706	10.3	(8–13)		
Iceland	18	16.7	(4–41)	25	8.0	(1–26)	25	24.0	(9–45)	19	10.5	(1–33)		
Latvia	67	11.9	(5–22)	48	4.2	(1–14)	59	8.5	(3–19)	61	11.5	(5–22)		
Portugal	475	7.6	(5–10)	610	10.2	(8–13)	797	11.2	(9–14)	884	12.2	(10–15)		↑
Luxembourg	44	15.9	(7–30)	32	6.3	(1–21)	27	3.7	(0–19)	51	13.7	(6–26)		
Hungary	154	5.8	(3–11)	128	11.7	(7–19)	181	7.2	(4–12)	174	15.5	(10–22)		↑
Lithuania	59	23.7	(14–37)	67	16.4	(8–27)	87	16.1	(9–26)	99	16.2	(10–25)		
Ireland	310	20.3	(16–25)	328	17.7	(14–22)	303	17.5	(13–22)	363	16.5	(13–21)		
Poland	167	32.3	(25–40)	130	29.2	(22–38)	217	24.4	(19–31)	337	19.3	(15–24)		↓
Croatia	116	25.9	(18–35)	129	26.4	(19–35)	126	19.0	(13–27)	155	21.9	(16–29)		
Spain	569	30.1	(26–34)	551	27.9	(24–32)	665	23.5	(20–27)	643	25.0	(22–29)		↓
France	919	22.4	(20–25)	656	22.3	(19–26)	1068	22.9	(20–26)	1046	25.3	(23–28)		
Bulgaria	28	21.4	(8–41)	32	25.0	(11–43)	35	22.9	(10–40)	33	27.3	(13–46)		
Cyprus	15	40.0	(16–68)	12	0.0	(0–26)	7	**	(**)	10	40.0	(12–74)	N/A	
Romania	44	25.0	(13–40)	45	46.7	(32–62)	41	39.0	(24–55)	56	41.1	(28–55)		

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.27. ***Streptococcus pneumoniae*. Total number of tested isolates (N) and percentages non-susceptible to macrolides (%IR), including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	18	16.7	(4–41)	24	12.5	(3–32)	25	12.0	(3–31)	19	0.0	(0–18)		
Netherlands	1155	4.8	(4–6)	1287	4.3	(3–6)	1168	3.9	(3–5)	1389	3.1	(2–4)		
Denmark	789	4.8	(3–7)	709	6.6	(5–9)	747	5.2	(4–7)	707	4.8	(3–7)		
Latvia	66	1.5	(0–8)	49	4.1	(0–14)	58	6.9	(2–17)	52	5.8	(1–16)		
Sweden	1164	6.5	(5–8)	788	6.7	(5–9)	850	6.9	(5–9)	859	5.8	(4–8)	N/A	
United Kingdom	935	7.5	(6–9)	1260	7.1	(6–9)	1077	7.2	(6–9)	3423	6.5	(6–7)		
Czech Republic	333	8.7	(6–12)	274	7.7	(5–11)	284	6.7	(4–10)	263	7.2	(4–11)		
Germany	481	10.6	(8–14)	494	7.1	(5–10)	724	8.1	(6–10)	1275	7.8	(6–9)		
Estonia	59	3.4	(0–12)	54	5.6	(1–15)	54	7.4	(2–18)	100	8.0	(4–15)		
Slovakia	29	17.2	(6–36)	29	41.4	(24–61)	34	35.3	(20–54)	12	8.3	(0–38)		
Austria	421	10.2	(7–14)	400	10.5	(8–14)	439	8.7	(6–12)	455	8.8	(6–12)		
Norway	499	4.4	(3–7)	492	7.5	(5–10)	403	10.7	(8–14)	473	9.5	(7–13)		↑
Finland	657	18.6	(16–22)	636	14.5	(12–17)	765	14.4	(12–17)	791	12.0	(10–14)		↓
Hungary	139	14.4	(9–21)	123	14.6	(9–22)	170	11.2	(7–17)	166	13.3	(8–19)		
Slovenia	279	10.4	(7–15)	300	19.3	(15–24)	323	18.9	(15–24)	269	13.8	(10–18)		
Ireland	305	18.0	(14–23)	317	13.9	(10–18)	296	15.5	(12–20)	354	14.4	(11–19)		
Portugal	496	20.6	(17–24)	658	16.0	(13–19)	822	17.0	(15–20)	912	15.1	(13–18)		
Luxembourg	49	26.5	(15–41)	35	14.3	(5–30)	29	0.0	(0–12)	51	15.7	(7–29)		
Belgium	1574	22.9	(21–25)	1108	17.9	(16–20)	1361	18.7	(17–21)	1327	15.9	(14–18)		↓
Lithuania	56	25.0	(14–38)	62	22.6	(13–35)	72	12.5	(6–22)	94	18.1	(11–27)		
Bulgaria	27	18.5	(6–38)	30	26.7	(12–46)	33	21.2	(9–39)	32	21.9	(9–40)		
Italy	394	24.6	(20–29)	252	28.6	(23–35)	428	24.5	(21–29)	464	23.1	(19–27)		
Spain	560	25.7	(22–30)	544	20.0	(17–24)	631	23.5	(20–27)	630	25.9	(22–29)		
France	919	29.8	(27–33)	656	23.0	(20–26)	1068	24.4	(22–27)	1046	26.4	(24–29)		
Poland	142	31.7	(24–40)	121	29.8	(22–39)	206	31.1	(25–38)	277	30.7	(25–36)		
Croatia	116	32.8	(24–42)	116	21.6	(14–30)	126	19.8	(13–28)	154	35.1	(28–43)		
Romania	42	38.1	(24–54)	50	48.0	(34–63)	20	30.0	(12–54)	59	39.0	(27–53)		
Cyprus	15	26.7	(8–55)	11	0.0	(0–28)	7	**	(**)	10	60.0	(26–88)	N/A	
Malta	9	**	(**)	8	**	(**)	20	40.0	(19–64)	9	**	(**)	N/A	

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.28. ***Streptococcus pneumoniae*. Total number of tested isolates (N) and percentages non-susceptible to penicillins and macrolides (%IR), including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	N	%IR	(95%CI)	All laboratories	Continuously reporting laboratories*
Iceland	18	16.7	(4–41)	24	8.3	(1–27)	25	8.0	(1–26)	19	0.0	(0–18)		
Slovakia	28	7.1	(1–24)	26	19.2	(7–39)	27	22.2	(9–42)	12	0.0	(0–26)		
Belgium	1534	0.9	(0–2)	1069	0.7	(0–1)	1361	0.4	(0–1)	1327	0.3	(0–1)		↓
Netherlands	921	0.4	(0–1)	1025	1.2	(1–2)	1030	0.9	(0–2)	1263	0.4	(0–1)		
Estonia	59	0.0	(0–6)	54	1.9	(0–10)	27	3.7	(0–19)	100	1.0	(0–5)		
Czech Republic	333	1.2	(0–3)	274	3.3	(2–6)	284	1.8	(1–4)	263	1.1	(0–3)		
Austria	380	1.6	(1–3)	351	2.8	(1–5)	433	2.5	(1–4)	438	1.4	(1–3)		
Germany	467	2.6	(1–4)	491	1.4	(1–3)	714	2.5	(2–4)	1232	2.0	(1–3)		
Denmark	789	4.2	(3–6)	709	3.9	(3–6)	747	2.4	(1–4)	707	2.3	(1–4)		↓
United Kingdom	867	3.1	(2–4)	1190	2.9	(2–4)	1060	2.7	(2–4)	3136	2.6	(2–3)		
Norway	497	1.4	(1–3)	490	2.2	(1–4)	403	2.5	(1–5)	469	2.8	(1–5)		
Slovenia	279	2.9	(1–6)	300	4.7	(3–8)	323	5.0	(3–8)	269	3.7	(2–7)		
Latvia	66	0.0	(0–5)	46	4.3	(1–15)	53	1.9	(0–10)	51	3.9	(0–13)		
Sweden	694	3.2	(2–5)	693	4.2	(3–6)	409	5.6	(4–8)	877	4.0	(3–6)	N/A	
Italy	248	8.1	(5–12)	163	11.0	(7–17)	347	5.8	(4–9)	361	4.4	(3–7)		
Finland	599	7.7	(6–10)	570	6.5	(5–9)	654	7.0	(5–9)	687	6.1	(4–8)		
Portugal	467	4.3	(3–7)	601	5.8	(4–8)	776	6.6	(5–9)	868	6.7	(5–9)		
Hungary	139	3.6	(1–8)	123	7.3	(3–13)	170	1.8	(0–5)	166	7.8	(4–13)		
Luxembourg	44	11.4	(4–25)	32	6.3	(1–21)	27	0.0	(0–13)	51	7.8	(2–19)		
Bulgaria	26	7.7	(1–25)	30	10.0	(2–27)	32	12.5	(4–29)	32	9.4	(2–25)		
Ireland	305	13.1	(10–17)	317	11.4	(8–15)	296	10.8	(8–15)	354	9.9	(7–13)		
Lithuania	56	14.3	(6–26)	62	16.1	(8–28)	72	11.1	(5–21)	94	12.8	(7–21)		
Spain	556	16.0	(13–19)	526	12.2	(9–15)	624	12.0	(10–15)	612	14.4	(12–17)		
Croatia	116	15.5	(9–23)	116	10.3	(5–17)	126	7.9	(4–14)	154	15.6	(10–22)		
Poland	139	24.5	(18–32)	119	24.4	(17–33)	195	19.5	(14–26)	271	16.6	(12–22)		
France	919	18.9	(16–22)	656	15.9	(13–19)	1068	17.4	(15–20)	1046	18.3	(16–21)		
Romania	42	21.4	(10–37)	45	37.8	(24–53)	20	25.0	(9–49)	56	30.4	(19–44)		
Cyprus	15	26.7	(8–55)	11	0.0	(0–28)	7	**	(**)	10	40.0	(12–74)	N/A	
Malta	7	**	(**)	8	**	(**)	20	25.0	(9–49)	9	**	(**)	N/A	

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

3.6 *Staphylococcus aureus*

Staphylococcus aureus is a gram-positive bacterium that frequently colonises the skin of healthy humans. However, *S. aureus* is also an opportunistic microorganism involved in infections of both community and healthcare origin. Besides being a common cause of skin, soft tissue and bone infections, it is one of the leading causes of bloodstream infections in Europe.

S. aureus acquires resistance to meticillin and all other beta-lactam agents through expression of the exogenous mecA or less frequently mecC gene. It codes for a variant penicillin-binding protein PBP2' (PBP2a) with low affinity for beta-lactams and able to substitute for the function of the other PBSs, thus preventing the inhibition of cell wall synthesis by beta-lactams.

Antimicrobial resistance 2013–2016

The EU/EEA population-weighted mean MRSA percentage was 13.7% in 2016. The trend based on data from the cohort of laboratories reporting consistently during the period decreased significantly between 2013 and 2016.

Large differences in national MRSA percentages could be noted, ranging between 1.2% and 50.5% (Figur 3.25). Based on data from continuously reporting laboratories, more than a third of the countries reported significantly decreasing trends during the period 2013–2016, including countries with both low and high percentages of MRSA (Table 3.30).

Among the resistant isolates, combined resistance to multiple antimicrobial groups was common. The most common resistance combination was MRSA and resistance to fluoroquinolones. Rifampicin resistance was less common (Table 3.29). At the country level, differences in the distribution of single resistance and resistance to two or more antimicrobial groups could be noted. Resistance to three antimicrobial groups were mainly reported from countries with high MRSA percentages (Figure 3.26).

Discussion and conclusions

The decline in the EU/EEA population-weighted mean MRSA percentage reported for previous years continued in 2016. At the country level, resistance percentages seem to be stabilising or decreasing in a majority of EU/EEA countries. Many countries have introduced national recommendations and guidance documents on the prevention of spread of MRSA in recent years, foucusing on both improved infection prevention and control and prudent antimicrobial use [17].

MRSA remains an important pathogen in Europe, as the levels of resistance continue to be high in some countries and combined resistance to other antimicrobial groups is common. Despite MRSA still being a major cause of healthcare-associated infections, community-associated MRSA are increasingly being reported from many parts of the world. In addition, the proportion of community-onset infections caused by MRSA clones that are usually associated with healthcare-associated infections has increased, indicating transfer of healthcare-associated MRSA clones into the community [21]. In order to further slow the spread of MRSA in Europe, comprehensive MRSA strategies targeting all healthcare sectors remain essential.

Figure 3.25. *Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), by country, EU/EEA countries, 2016

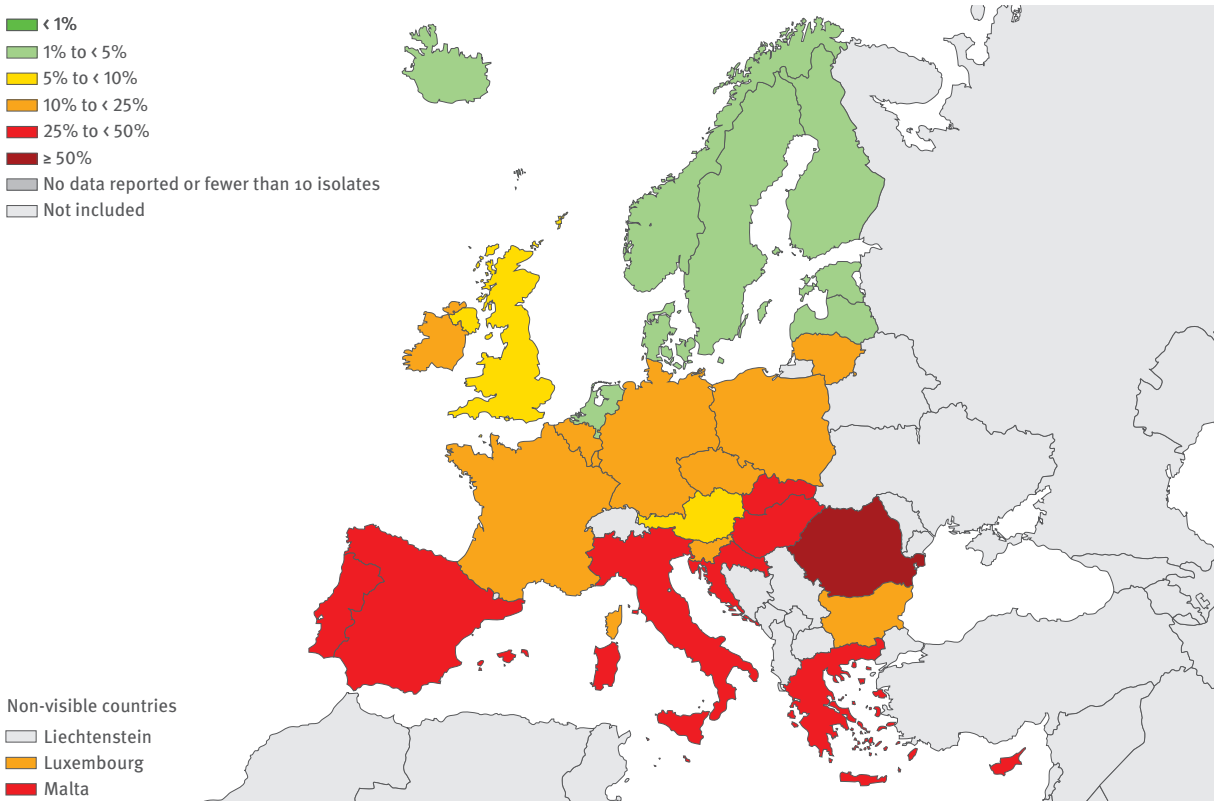


Table 3.29. ***Staphylococcus aureus*. Total number of tested isolates* and resistance combinations among invasive isolates tested against meticillin, fluoroquinolones and rifampicin (n=40 235), EU/EEA countries, 2016**

Resistance pattern	Number of isolates	% of total*
Fully susceptible	**32 268**	**80.2**
Single resistance (to indicated antimicrobial group)		
Total (any single resistance)	**3334**	**8.3**
MRSA	1043	2.6
Fluoroquinolones	2129	5.3
Rifampicin	162	0.4
Resistance to two antimicrobial groups		
Total (any two-group combinations)	**4386**	**10.9**
MRSA + fluoroquinolones	4325	10.7
Other resistance combinations	61	0.2
Resistance to three antimicrobial groups		
MRSA + fluoroquinolones + rifampicin	**247**	**0.6**

Only resistance combinations >1% of the total are specified.
Only data from isolates tested against all three antimicrobial groups were included in the analysis.
* Not adjusted for population differences in the reporting countries.

Figure 3.26. ***Staphylococcus aureus*. Distribution of isolates: fully susceptible and resistant to one, two and three antimicrobial groups (among isolates tested for meticillin, fluoroquinolones and rifampicin. By country, EU/EEA countries, 2016**

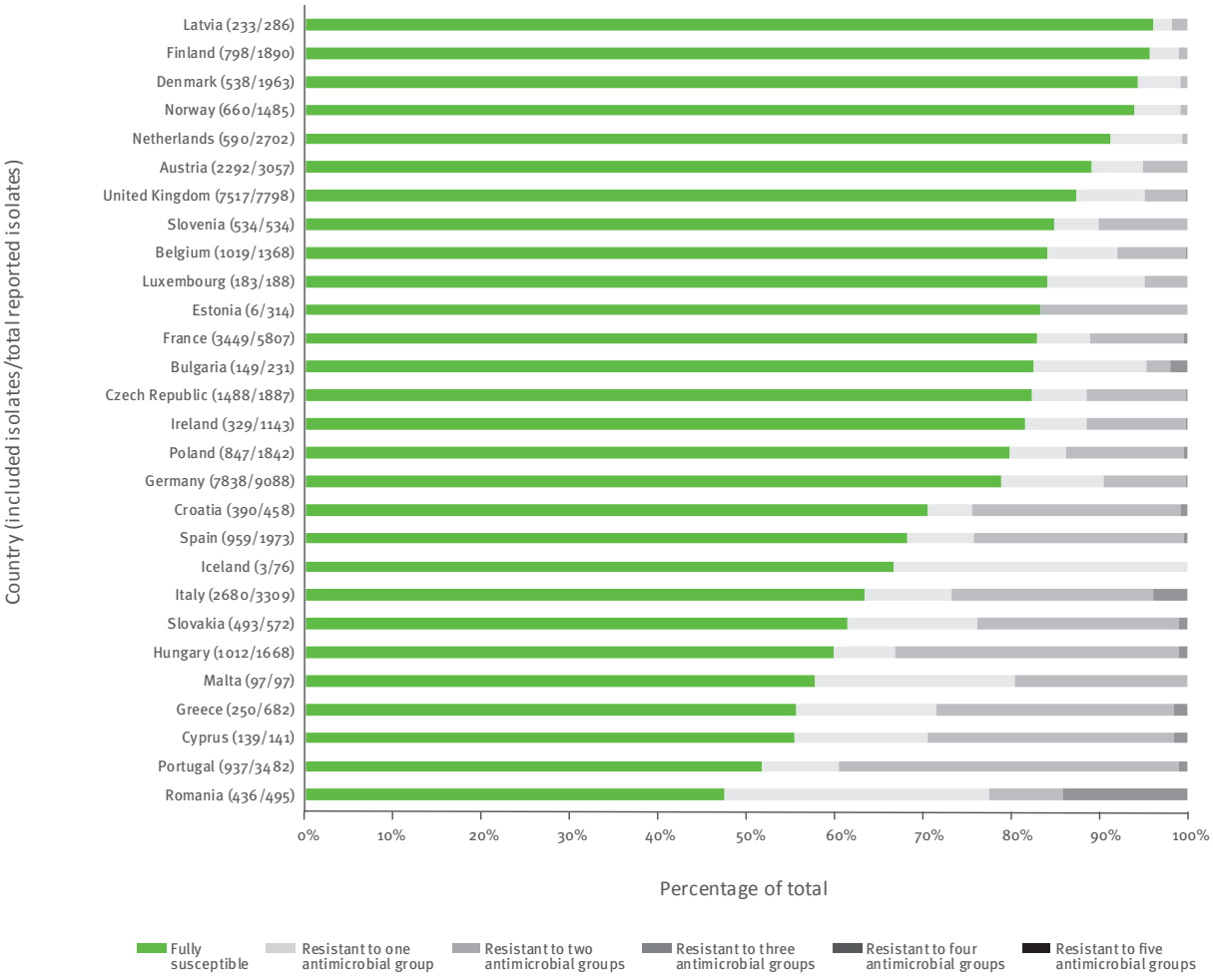


Table 3-30. ***Staphylococcus aureus*. Total number of invasive isolates tested (N) and percentage with resistance to meticillin (MRSA) including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Netherlands	2062	1.2	(1–2)	2524	1.0	(1–1)	2107	1.3	(1–2)	2699	1.2	(1–2)		
Norway	1473	0.7	(0–1)	1544	1.0	(1–2)	1453	1.2	(1–2)	1448	1.2	(1–2)		
Iceland	69	0.0	(0–5)	61	3.3	(0–11)	88	0.0	(0–4)	76	1.3	(0–7)		
Denmark	1685	1.7	(1–2)	1874	2.5	(2–3)	1876	1.6	(1–2)	1963	2.0	(1–3)		
Finland	1580	1.8	(1–3)	1831	2.6	(2–3)	2070	1.9	(1–3)	1890	2.2	(2–3)		
Sweden	4099	1.0	(1–1)	2745	1.0	(1–1)	3124	0.8	(1–1)	3450	2.3	(2–3)	N/A	
Estonia	170	3.5	(1–8)	223	3.1	(1–6)	151	4.0	(1–8)	314	3.5	(2–6)		
Latvia	172	7.0	(4–12)	220	8.2	(5–13)	251	5.6	(3–9)	284	4.2	(2–7)		
United Kingdom	2117	13.7	(12–15)	2400	11.3	(10–13)	2757	10.8	(10–12)	6717	6.7	(6–7)		↓
Austria	2534	9.2	(8–10)	2651	7.8	(7–9)	2785	7.5	(7–9)	3053	7.1	(6–8)		↓
Luxembourg	135	8.9	(5–15)	125	12.0	(7–19)	135	8.9	(5–15)	187	10.2	(6–15)		
Germany	3128	12.8	(12–14)	3146	12.9	(12–14)	4871	11.2	(10–12)	9084	10.3	(10–11)		↓
Slovenia	465	9.0	(7–12)	495	13.1	(10–16)	513	9.2	(7–12)	534	11.0	(9–14)		
Lithuania	267	9.7	(6–14)	383	7.8	(5–11)	376	8.5	(6–12)	503	11.3	(9–14)		
Belgium	1612	16.9	(15–19)	988	13.5	(11–16)	913	12.3	(10–15)	1364	12.2	(10–14)		
EU/EEA (population-weighted mean)	**40968**	**18.1**	**(18–18)**	**40906**	**17.5**	**(17–18)**	**45360**	**16.9**	**(17–17)**	**56606**	**13.7**	**(13–14)**		↓
France	5431	17.1	(16–18)	5484	17.4	(16–18)	5535	15.7	(15–17)	5578	13.8	(13–15)		↓
Czech Republic	1707	13.2	(12–15)	1695	13.0	(11–15)	1806	13.7	(12–15)	1887	13.9	(12–16)		
Bulgaria	214	19.2	(14–25)	216	20.8	(16–27)	222	13.1	(9–18)	231	14.3	(10–19)		↓
Ireland	1069	19.9	(18–22)	1075	19.4	(17–22)	1057	18.1	(16–21)	1143	14.3	(12–17)		↓
Poland	743	16.0	(13–19)	490	20.6	(17–24)	958	15.8	(14–18)	1772	16.4	(15–18)		
Hungary	1200	24.0	(22–27)	1279	23.1	(21–25)	1517	24.7	(23–27)	1668	25.2	(23–27)		
Croatia	520	24.0	(20–28)	484	21.3	(18–25)	486	24.5	(21–29)	458	25.3	(21–30)		
Spain	1777	22.6	(21–25)	1920	22.1	(20–24)	1968	25.3	(23–27)	1945	25.8	(24–28)		↑
Slovakia	552	48.4	(44–53)	640	28.0	(25–32)	583	28.1	(25–32)	571	27.1	(24–31)		↓
Italy	2394	35.8	(34–38)	2134	33.6	(32–36)	3000	34.1	(32–36)	2981	33.6	(32–35)		
Malta	106	53.8	(44–64)	78	43.6	(32–55)	87	49.4	(39–60)	97	37.1	(28–48)		↓
Cyprus	157	32.5	(25–40)	136	36.0	(28–45)	143	43.4	(35–52)	139	38.8	(31–47)		
Greece	757	40.3	(37–44)	556	37.1	(33–41)	612	39.4	(35–43)	639	38.8	(35–43)		
Portugal	2390	46.8	(45–49)	3193	47.4	(46–49)	3619	46.8	(45–48)	3454	43.6	(42–45)		↓
Romania	383	64.5	(59–69)	316	56.0	(50–62)	297	57.2	(51–63)	477	50.5	(46–55)		↓

* The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively. The symbol # indicates a significant trend in the overall data which was not observed when only data from laboratories consistently reporting for all four years were included.

3.7 Enterococci

Enterococci belong to the normal bacterial microbiota of the gastrointestinal tract of humans. They are regarded harmless commensals but can cause invasive diseases when the commensal relationship with the host is disrupted. Enterococci can cause a variety of infections, including urinary tract infections, bloodstream infections and endocarditis, and are associated with peritonitis and intra-abdominal abscesses. The vast majority of clinical enterococcal infections in humans are caused by *Enterococcus faecalis* and *E. faecium*.

Enterococci are intrinsically resistant to a broad range of antimicrobial agents including cephalosporins, sulphonamides and low concentrations of aminoglycosides. By nature, enterococci also have low susceptibility to many beta-lactam agents as a consequence of their low-affinity penicillin-binding proteins. However, there is commonly synergy between aminoglycosides and penicillins or glycopeptides against enterococci without acquired high-level glycopeptide resistance. Some enterococci have acquired genes conferring high-level resistance to aminoglycosides, causing loss of any synergistic effect between beta-lactams and aminoglycosides.

Glycopeptide resistance of clinical relevance is mediated through two phenotypes: VanA, with high-level resistance to vancomycin and a variable level of resistance to teicoplanin; and VanB, with a variable level of resistance, in most cases to vancomycin only.

Antimicrobial resistance 2013–2016

Enterococcus faecalis

High-level gentamicin resistance

In 2016, the EU/EEA population-weighted mean percentage for high-level gentamicin resistance in *E. faecalis* was 30.5 %, with national percentages ranging from 12.5 % to 56.3 % (Figure 3.27). Although the EU/EEA trend, based on data from laboratories reporting consistently during the period, did not change significantly between 2013 and 2016, significant decreasing national trends were reported from almost one fourth of the countries (Table 3.31).

Vancomycin resistance

Vancomycin resistance in *E. faecalis* remained low in most countries. For more information, please refer to the online ECDC Surveillance Atlas of Infectious Diseases [22].

Enterococcus faecium

Vancomycin

The EU/EEA population-weighted mean percentage for vancomycin resistance in *E. faecium* was 11.8 % in 2016. The trend, based on data from laboratories reporting consistently during the period, did not change significantly during the period 2013–2016.

National percentages ranged from 0.0 % to 46.3 %, with a large group of countries reporting none or very low resistance percentages (Figure 3.28). Several of the countries reporting comparatively high percentages of resistance to vancomycin reported significantly increasing trends for the last four years (Table 3.32).

High-level gentamicin resistance

With few exceptions, national percentages for high-level aminoglycoside resistance in *E. faecium* were higher than for *E. faecalis*. For more information, please refer to the ECDC Surveillance Atlas of Infectious Diseases [22].

Discussion and conclusions

High levels of antimicrobial-resistant enterococci remain a major infection control challenge and an important cause of healthcare-associated infections in Europe. Besides the fact that infections caused by resistant strains are difficult to treat, enterococci easily disseminate in healthcare settings.

The increase in vancomycin resistance reported from countries with already high resistance levels requires close monitoring. Enterococci have intrinsic resistance to several antimicrobial classes, and any additional acquired resistance severely limits the number of treatment options. WHO has listed vancomycin-resistant *E. faecium* as a pathogen with high priority in its global priority list of antibiotic-resistant bacteria, highlighting the paucity of available and effective treatment options [13].

Figure 3.27. ***Enterococcus faecalis*. Percentage (%) of invasive isolates with high-level resistance to gentamicin, by country, EU/EEA countries, 2016**

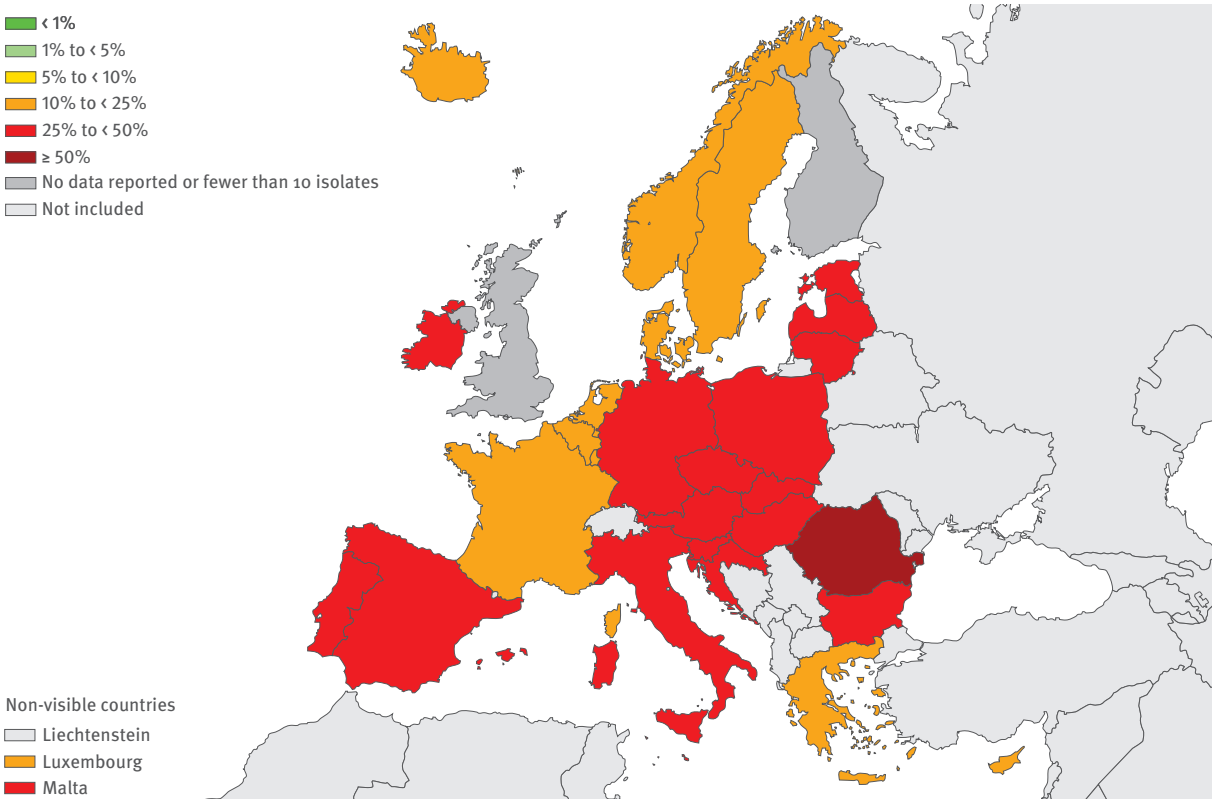


Figure 3.28. ***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, by country, EU/EEA countries, 2016**

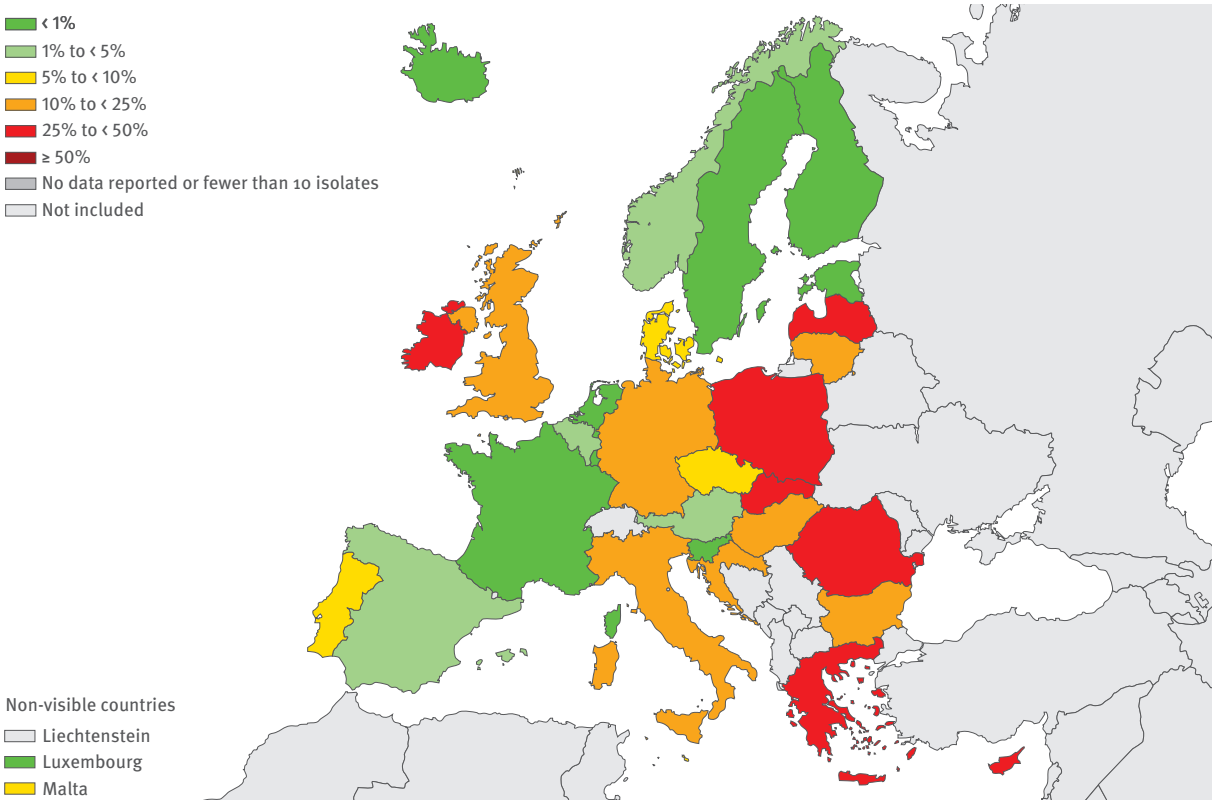


Table 3.31. ***Enterococcus faecalis*. Total number of invasive isolates tested (N) and percentage with high-level resistance to gentamicin including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Luxembourg	36	27.8	(14–45)	39	30.8	(17–48)	56	14.3	(6–26)	48	12.5	(5–25)		↓
Sweden	605	16.4	(14–20)	723	15.8	(13–19)	579	12.6	(10–16)	722	13.4	(11–16)	N/A	
France	1639	14.7	(13–17)	1741	13.7	(12–15)	1097	12.2	(10–14)	1057	15.0	(13–17)		
Norway	168	26.8	(20–34)	270	20.7	(16–26)	163	9.8	(6–15)	221	15.8	(11–21)		↓
Greece	548	23.5	(20–27)	407	20.1	(16–24)	460	13.3	(10–17)	540	15.9	(13–19)		↓
Iceland	15	33.3	(12–62)	12	8.3	(0–38)	21	14.3	(3–36)	24	16.7	(5–37)	N/A	
Denmark	48	27.1	(15–42)	60	30.0	(19–43)	63	25.4	(15–38)	56	19.6	(10–32)		
Belgium	398	27.6	(23–32)	170	22.9	(17–30)	249	13.3	(9–18)	328	19.8	(16–25)		↓
Cyprus	67	26.9	(17–39)	80	17.5	(10–28)	58	8.6	(3–19)	39	20.5	(9–36)		
Netherlands	279	26.9	(22–32)	403	28.8	(24–33)	343	23.0	(19–28)	451	24.4	(20–29)		
Germany	836	39.7	(36–43)	903	33.6	(30–37)	1249	31.1	(29–34)	2148	25.7	(24–28)		↓
Ireland	277	32.1	(27–38)	290	31.4	(26–37)	261	28.0	(23–34)	265	29.4	(24–35)		
EU/EEA (population-weighted mean)	**9815**	**31.3**	**30–32)**	**9737**	**29.3**	**(28–30)**	**10665**	**32.2**	**(30–33)**	**12505**	**30.5**	**(29–31)**		
Estonia	10	20.0	(3–56)	19	36.8	(16–62)	26	26.9	(12–48)	56	32.1	(20–46)	N/A	
Croatia	167	34.7	(28–42)	149	32.9	(25–41)	203	35.5	(29–42)	179	33.0	(26–40)		
Austria	503	31.4	(27–36)	421	37.1	(32–42)	501	33.7	(30–38)	447	33.3	(29–38)		
Portugal	545	37.2	(33–41)	607	32.6	(29–37)	872	33.3	(30–36)	851	33.8	(31–37)		
Lithuania	44	54.5	(39–70)	65	29.2	(19–42)	63	44.4	(32–58)	45	35.6	(22–51)		
Czech Republic	603	40.0	(36–44)	525	38.7	(34–43)	544	38.8	(35–43)	515	37.1	(33–41)		
Spain	899	42.6	(39–46)	970	38.9	(36–42)	936	40.0	(37–43)	950	37.5	(34–41)		
Malta	31	29.0	(14–48)	28	25.0	(11–45)	29	27.6	(13–47)	33	39.4	(23–58)		
Hungary	602	51.7	(48–56)	659	49.8	(46–54)	730	45.5	(42–49)	786	42.2	(39–46)		↓
Poland	184	45.1	(38–53)	148	43.9	(36–52)	388	46.4	(41–51)	666	43.1	(39–47)		
Slovenia	146	32.2	(25–40)	119	36.1	(28–45)	133	32.3	(24–41)	152	43.4	(35–52)		
Slovakia	209	57.4	(50–64)	261	41.0	(35–47)	234	49.1	(43–56)	213	45.1	(38–52)		
Italy	584	46.2	(42–50)	516	55.2	(51–60)	1249	47.8	(45–51)	1441	45.3	(43–48)		
Latvia	54	61.1	(47–74)	13	46.2	(19–75)	58	36.2	(24–50)	87	46.0	(35–57)		
Bulgaria	102	47.1	(37–57)	105	40.0	(31–50)	100	42.0	(32–52)	98	46.9	(37–57)		
Romania	80	58.8	(47–70)	34	76.5	(59–89)	–	–	(–)	87	56.3	(45–67)	N/A	
United Kingdom	136	30.9	(23–39)	–	–	(–)	–	–	(–)	–	–	(–)	N/A	

–: No data

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

Table 3.32. ***Enterococcus faecium.*** **Total number of invasive isolates tested (N) and percentage with resistance to vancomycin, including 95 % confidence intervals (95 % CI), EU/EEA countries, 2013–2016**

Country	2013			2014			2015			2016			Trend 2013–2016	
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	All laboratories	Continuously reporting laboratories*
Estonia	40	0.0	(0–9)	48	0.0	(0–7)	27	0.0	(0–13)	64	0.0	(0–6)		
Finland	304	0.3	(0–2)	368	0.0	(0–1)	298	0.3	(0–2)	294	0.0	(0–1)		
Iceland	17	5.9	(0–29)	11	0.0	(0–28)	20	0.0	(0–17)	16	0.0	(0–21)	N/A	
Luxembourg	19	5.3	(0–26)	31	3.2	(0–17)	23	0.0	(0–15)	31	0.0	(0–11)	N/A	
Slovenia	102	1.0	(0–5)	115	1.7	(0–6)	124	4.8	(2–10)	111	0.0	(0–3)		
Sweden	575	0.0	(0–1)	452	0.4	(0–2)	408	0.0	(0–1)	546	0.4	(0–1)	N/A	
France	733	0.1	(0–1)	737	0.5	(0–1)	849	0.8	(0–2)	808	0.6	(0–1)		
Netherlands	439	0.5	(0–2)	532	1.1	(0–2)	572	1.4	(1–3)	685	0.9	(0–2)		
Belgium	235	1.7	(0–4)	195	3.1	(1–7)	163	0.6	(0–3)	289	1.7	(1–4)		
Norway	211	2.4	(1–5)	227	1.8	(0–4)	185	0.0	(0–2)	213	1.9	(1–5)		
Spain	553	0.9	(0–2)	546	2.4	(1–4)	571	2.5	(1–4)	628	2.1	(1–4)		
Austria	437	5.9	(4–9)	480	4.4	(3–7)	483	3.1	(2–5)	533	4.3	(3–6)		
Denmark	644	3.4	(2–5)	715	4.5	(3–6)	690	3.2	(2–5)	679	7.5	(6–10)		↑
Portugal	350	22.0	(18–27)	363	20.1	(16–25)	459	20.3	(17–24)	411	7.5	(5–11)		↓
Czech Republic	268	9.0	(6–13)	250	4.4	(2–8)	322	9.6	(7–13)	258	7.8	(5–12)		
Malta	10	0.0	(0–31)	11	0.0	(0–28)	6	**	(**)	12	8.3	(0–38)	N/A	
EU/EEA (population-weighted mean)	**8307**	**9.0**	**(8–10)**	**8324**	**8.2**	**(8–9)**	**9123**	**8.3**	**(8–9)**	**12282**	**11.8**	**(11–13)**		
Germany	855	14.6	(12–17)	882	9.1	(7–11)	1312	10.2	(9–12)	1931	12.1	(11–14)		
Italy	563	4.4	(3–6)	472	8.5	(6–11)	756	11.2	(9–14)	941	13.4	(11–16)		↑
United Kingdom	442	23.3	(19–28)	423	21.3	(17–25)	218	17.0	(12–23)	1803	17.0	(15–19)		↓
Bulgaria	44	2.3	(0–12)	60	13.3	(6–25)	41	14.6	(6–29)	44	18.2	(8–33)		↑
Lithuania	25	0.0	(0–14)	44	4.5	(1–15)	52	17.3	(8–30)	61	21.3	(12–34)		
Croatia	74	6.8	(2–15)	67	10.4	(4–20)	93	25.8	(17–36)	104	22.1	(15–31)		↑
Hungary	210	7.1	(4–12)	224	8.5	(5–13)	240	16.7	(12–22)	272	22.4	(18–28)		↑
Poland	173	12.7	(8–19)	182	21.4	(16–28)	215	17.7	(13–23)	469	25.2	(22–31)		
Slovakia	132	7.6	(4–13)	129	10.1	(5–17)	143	14.7	(9–22)	125	26.4	(19–35)		↑
Greece	345	21.2	(17–26)	264	26.9	(22–33)	315	19.7	(15–25)	358	27.9	(23–33)		
Latvia	25	12.0	(3–31)	15	13.3	(2–40)	34	17.6	(7–35)	56	28.6	(17–42)	N/A	
Romania	54	11.1	(4–23)	56	25.0	(14–38)	72	25.0	(16–37)	77	39.0	(28–51)		↑
Ireland	398	42.7	(38–48)	390	45.1	(40–50)	404	45.8	(41–51)	422	44.1	(39–49)		
Cyprus	30	23.3	(10–42)	35	40.0	(24–58)	28	28.6	(13–49)	41	46.3	(31–63)		

* The trend analyses are only performed on data from laboratories reporting consistently for all four years during the period 2013–2016. The symbols ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

** Less than 10 isolates reported, no percentage calculated.

N/A: Not applicable as data were not reported for all years, a significant change in data source occurred during the period or number of isolates was below 20 in any year during the period.

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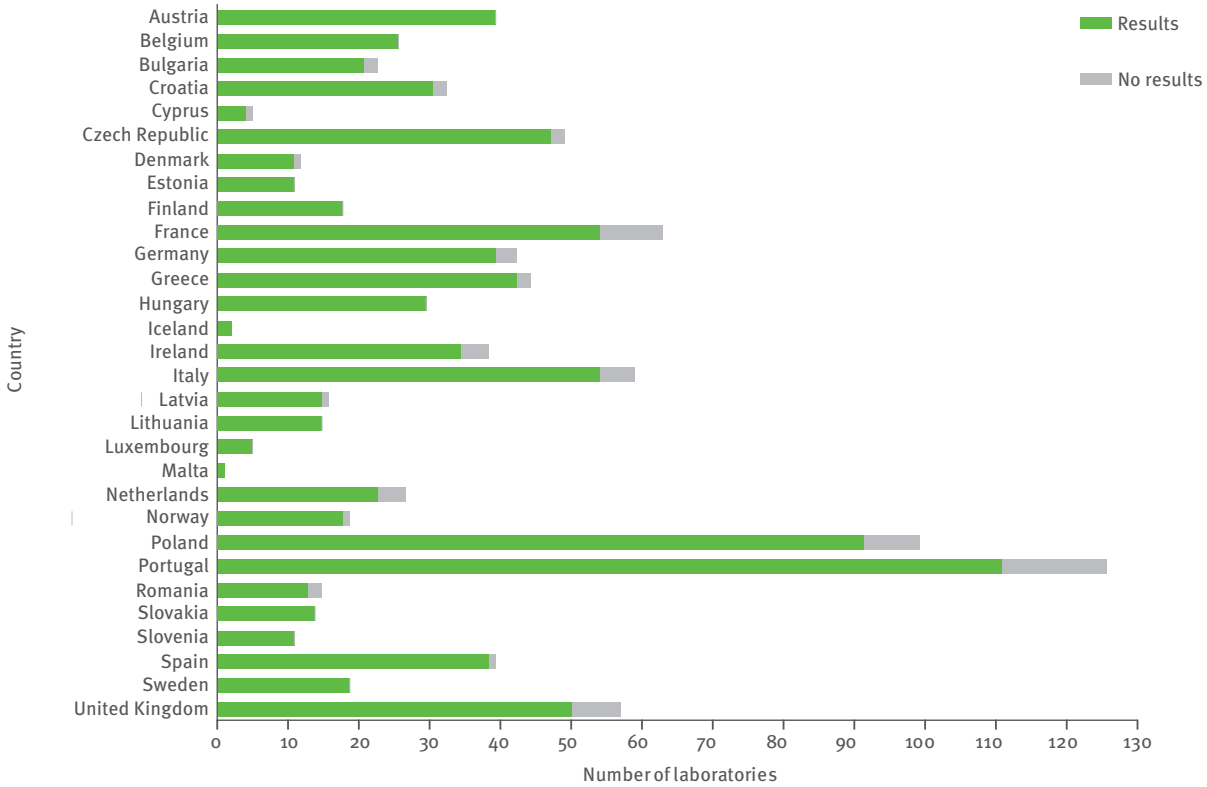
Annexes

Annex 1. External quality assessment 2016

Since 2000, EARSS/EARS-Net have organised external quality assessments (EQA) of antimicrobial susceptibility testing in collaboration with the United Kingdom National External Quality Assessment Service (UK NEQAS). UK NEQAS is based at Public Health England in London and is a non-profit organisation with more than 40 years of experience in conducting EQAs in different countries.

The purpose of the EARS-Net EQA 2016 was to determine the accuracy of antimicrobial susceptibility test (AST) results reported by individual laboratories and thereby estimate the overall comparability of routinely collected test results between laboratories and countries across Europe. A panel of six lyophilised strains was prepared and found fully compliant during in-house quality control testing, and confirmed by two expert reference laboratories. The panel included one strain of each of the following species: *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Acinetobacter baumannii* complex and *Streptococcus pneumoniae*, as agreed with ECDC. The strains were characterised and tested in two reference laboratories: Specialist Antimicrobial Chemotherapy Unit, Cardiff (UK), and EUCAST Reference and Development Laboratory, Växjö (Sweden). Both reference laboratories confirmed MICs and interpreted the results in accordance with the most frequently used breakpoint criteria (CLSI and EUCAST), as indicated in the summary for each species outlined in the results section below.

Figure A1.1. Number of participating laboratories returning EQA reports 2016, by country



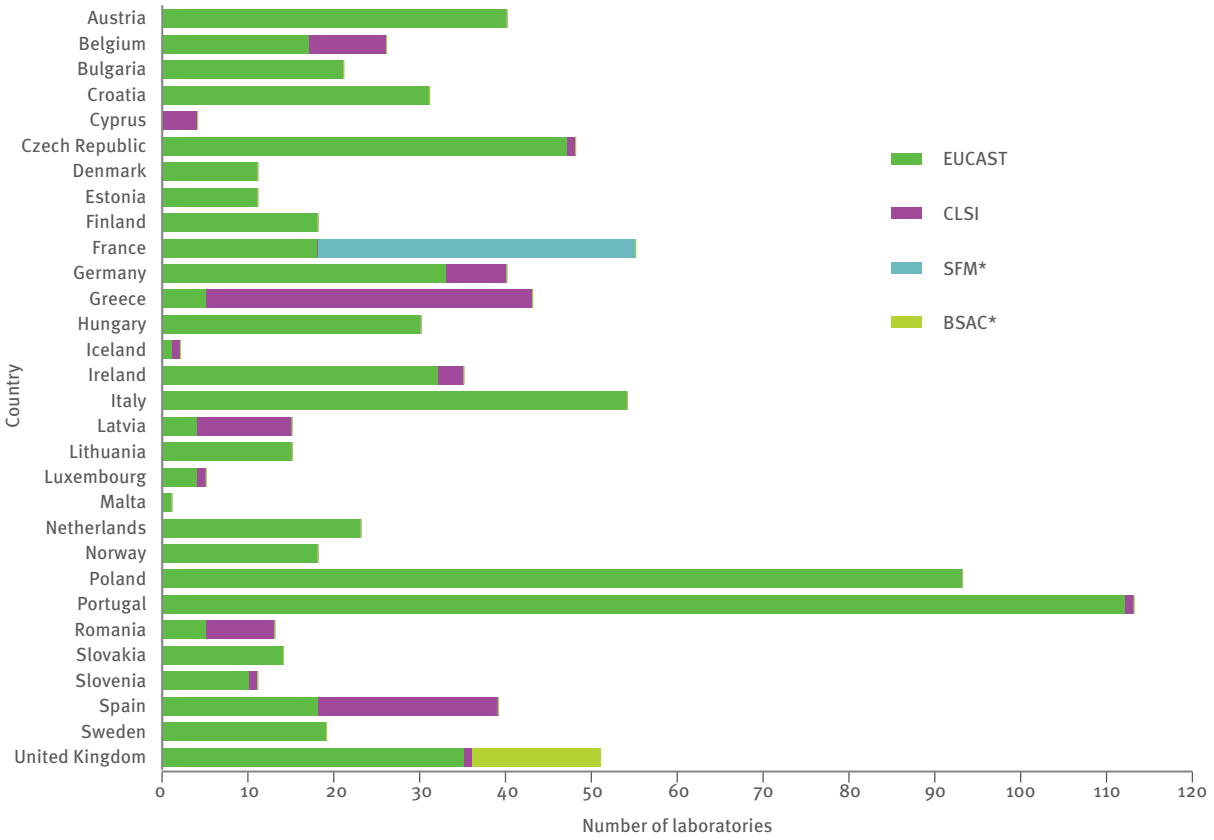
Use of methods and clinical guidelines

For the determination of AST results, laboratories used automated methods (52%), disk diffusion tests (39%), MIC (7%), gradient strip, or a combination of methods (1%). This was similar to the previous year. For species identification, 77% used an automated instrument and 23% used conventional methods. Increased use of conventional methods was associated with identification of *S. pneumoniae*. Twelve per cent of laboratories applied CLSI guidelines, a decline from the previous year when the proportion was 16%. EUCAST guidelines were reported by 82% of laboratories. France (SFM) and the United Kingdom (BSAC) used national guidelines; however, both countries implemented EUCAST breakpoints in their national MIC breakpoint recommendations because harmonised breakpoints were agreed upon and adjusted the interpretation of their disk diffusion methods accordingly. Therefore, a combined total of 88% of laboratories used EUCAST, or EUCAST-related, breakpoints. This represented an increase of 4% compared to 2015. Figure A1.2 shows the national and international guidelines used by laboratories in different countries.

Antimicrobial susceptibility results

The EQA panels were dispatched to a total of 970 participants in 30 countries. For each isolate, participants were asked to report the identification of the organism and clinical susceptibility characterisation as susceptible (S), intermediate (I) or resistant (R) in accordance with the guideline used. The 2016 return rate was similar to previous years; 900 (93%) laboratories returned reports. Figure A1.1 shows the proportion of participating laboratories returning results by country. Participants' results were analysed and considered concordant if the reported categorisation agreed with the interpretation of the reference laboratories.

Figure A1.2. Clinical guidelines reported to be used by laboratories: number of laboratories per country, 2016



* National guidelines harmonised with EUCAST: BSAC: British Society for Antimicrobial Chemotherapy; SFM: Société Française de Microbiologie.

Specimen 3676 – *Escherichia coli*

This isolate was an *Escherichia coli* strain with an acquired AmpC beta-lactamase enzyme (BIL-1) conferring resistance to all reference beta-lactam agents except imipenem and meropenem. A good concordance of results was seen for all antimicrobial agents except ertapenem and piperacillin-tazobactam (Table A1.1).

Reduced susceptibility to ertapenem is not uncommon among isolates expressing AmpC, although the MICs are not commonly raised sufficiently to be designated resistant, as seen with this isolate. Reporting of ertapenem results by 729 participants was variable, with 67.9% reporting susceptible, 8.2% intermediate and 23.9% resistant results. Participants using a disk diffusion or MIC method to test ertapenem were more likely to report reduced susceptibility than those using automated systems.

The isolate was resistant to piperacillin-tazobactam (MIC ≥128 mg/L) by both EUCAST and CLSI breakpoints. The 854 participants reporting piperacillin-tazobactam susceptibility reported variable results (31.5% susceptible, 24.3% intermediate and 44.1% resistant). Participants using automated systems or MIC methods were more likely to report reduced susceptibility than those using disk diffusion methods.

Specimen 3677 – *Klebsiella pneumoniae*

This isolate was a strain of *Klebsiella pneumoniae* with both OXA-1 and SHV-1 enzymes, expressing resistance to many beta-lactam agents, including inhibitor combinations, colistin (by EUCAST methods) and quinolones (Table A1.2).

The isolate was susceptible to imipenem, meropenem, ceftriaxone and ceftazidime. Cefotaxime was categorised as intermediate/resistant based on an MIC of 2-4 mg/L. The isolate expressed resistance to both gentamicin and tobramycin and intermediate susceptibility to amikacin. A good concordance of results was seen for quinolones, amoxicillin, third generation cephalosporins (despite the dissociated susceptibility among the different agents), inhibitor combinations, gentamicin, tobramycin and ertapenem.

The isolate expressed intermediate resistance to amikacin (MIC 16 mg/L) by EUCAST breakpoints. The 787 participants reporting amikacin susceptibility reported variable results (11.9% susceptible, 33.8% intermediate and 54.3% resistant). Participants using EUCAST or EUCAST-related methods were more likely to report amikacin as susceptible or intermediate than participants using CLSI methodology.

The isolate was susceptible to both imipenem and meropenem by EUCAST and CLSI breakpoints. Participants' results for these two agents were similar. Although there was good overall concordance for these agents, participants using EUCAST or EUCAST-related methods were more likely to report imipenem and meropenem as susceptible or intermediate than participants using CLSI methodology. Participants using disk diffusion or MIC methods were more likely to report imipenem and meropenem susceptible than participants using automated methods.

Specimen 3678 – *Pseudomonas aeruginosa*

This isolate was a strain of *Pseudomonas aeruginosa* resistant to ciprofloxacin, gentamicin, tobramycin, carbapenems, and piperacillin-tazobactam. A good concordance of results was obtained for all agents except ceftazidime. The carbapenem resistance in this isolate was likely to be mediated by porin loss/efflux as no known carbapenemase enzyme is present (Table A1.3).

The ceftazidime MIC (8 mg/L) was susceptible by both EUCAST and CLSI breakpoints. The 891 participants reported variable results (31.4% susceptible, 7.2% intermediate and 61.4% resistant). Participants using CLSI methodology were more likely to report ceftazidime as susceptible (or intermediate) than participants using EUCAST or EUCAST-related methods. Participants using disk diffusion or MIC methods were more likely to report the isolate as imipenem and meropenem susceptible than participants using automated methods.

The isolate was resistant and intermediate to piperacillin-tazobactam by EUCAST and CLSI breakpoints, respectively. Although there was good overall concordance for these agents, participants using EUCAST or EUCAST-related methods were more likely to report piperacillin-tazobactam as either intermediate or resistant than participants using CLSI methodology. In line with differences in breakpoints, participants following CLSI guidelines were more likely to report intermediate or susceptible than those following EUCAST guidelines. 22.1% of participants using CLSI methodology reported this result as susceptible. Participants using a disk diffusion method were also more likely to report this isolate susceptible than those using an automated or MIC method.

Specimen 3679 – *Staphylococcus aureus*

This isolate was a *Staphylococcus aureus* strain with the mecC gene, which was resistant to beta-lactam agents and susceptible to all other antibiotics examined. A good concordance was achieved with all agents tested (including cefoxitin) except oxacillin. The isolate was resistant to oxacillin by EUCAST and CLSI breakpoints. The 652 participants reported the following results: 22.6% susceptible; 0.3% intermediate; and 77.1% resistant. There was no difference in results obtained using EUCAST or EUCAST-related methods compared with CLSI methods, nor was there a difference in results obtained with automated, disk diffusion or MIC methods (Table A1.4).

Table A1.1. ***Escherichia coli*** **(3 676). Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories**

Antibiotic agent	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Amikacin	2	4	S	99.2
Amoxicillin	≥128	≥128	R	100
Amoxicillin-clavulanate	≥128 (64)*	≥128 (64)*	R	100
Ampicillin	≥128	≥128	R	100
Cefotaxime	≥128	≥128	R	99.0
Ceftazidime	≥128	≥128	R	99.9
Ceftriaxone	≥128	≥128	R	99.5
Ciprofloxacin	0.03	0.03	S	99.4
Colistin	≤0.25	≤0.25	S	99.3
Ertapenem	4	4	R	23.9
Gentamicin	0.5	2	S	99.2
Imipenem	0.5	0.5	S	98.9
Levofloxacin	–	–	S**	100
Meropenem	0.12	0.25	S	98.9
Ofloxacin	–	–	S**	98.3
Piperacillin-tazobactam	≥128	≥128	R	44.1
Tobramycin	1	1	S	97.7

* Reference results for amoxicillin-clavulanic acid MICs relate to tests with a fixed concentration of 2 mg/L clavulanic acid. MICs in parenthesis relate to tests with a 2:1 ratio of amoxicillin:clavulanic acid.

**There were no reference results for levofloxacin and ofloxacin: assigned results were based on participant consensus.

Table A1.2. ***Klebsiella pneumoniae (3 677).*** **Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories**

Antibiotic agent	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Amikacin	16	16	I/S	45.7
Amoxicillin	>32	>32	R	100
Amoxicillin-clavulanate	>64	>128	R	99.8
Ampicillin	>32	>64	R	100
Cefotaxime	2	4	I/R	90.6
Ceftazidime	1	1	S	75.9
Ceftriaxone	1	1	S	73.7
Ciprofloxacin	>4	>8	R	99.7
Colistin	32	32	R/–	91.8
Ertapenem	2	4	R	90.7
Gentamicin	>16	>32	R	99.4
Imipenem	0.5	1	S	86.0
Levofloxacin	–	–	R*	99.1
Meropenem	0.5	0.5	S	86.4
Ofloxacin	–	–	R*	98.7
Piperacillin-tazobactam	>64	>64	R	99.0
Tobramycin	>16	>32	R	99.9

* There were no reference results for levofloxacin and ofloxacin: assigned results were based on participant consensus.

Table A1.3. ***Pseudomonas aeruginosa*** **(3 678). Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories**

Guideline	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Amikacin	4	4	S	96.7
Ceftazidime	8	8	S	31.4
Ciprofloxacin	32	32	R	99.4
Colistin	2	2	S	98.2
Gentamicin	≥128	≥128	R	99.3
Imipenem	32	32	R	99.6
Levofloxacin	–	–	R*	99.6
Meropenem	32	32	R	99.5
Piperacillin-tazobactam	64	64	R	86.6
Tobramycin	≥128	≥128	R	99.9

* There were no reference results for levofloxacin: assigned results were based on participant consensus.

Specimen 3680 – *Acinetobacter baumannii* complex

This isolate was an *Acinetobacter baumannii* complex strain, susceptible to amikacin, colistin, imipenem, meropenem and tobramycin but resistant to gentamicin and ciprofloxacin (Table A1.5).

A good concordance of results was achieved with all tested agents, and there were no significant issues arising.

Specimen 3681 – *Streptococcus pneumoniae*

This isolate was a strain of *Streptococcus pneumoniae* which was resistant to erythromycin and clindamycin, but susceptible to all other agents examined (Table A1.6).

A good concordance of results was achieved with all tested agents, and there were no significant issues arising.

Table A1.4. *Staphylococcus aureus* (3679). Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories

Antibiotic agent	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Cefoxitin	16	16	R	89.4
Ciprofloxacin	0.25	0.25	S	97.7
Clindamycin	‹0.12	‹0.12	S	97.7
Erythromycin	‹0.25	‹0.25	S	99.3
Fusidic acid	‹0.12	‹0.12	S/–	99.4
Gentamicin	0.5	0.5	S	94.5
Oxacillin	–	–	R	77.1
Penicillin	›0.5	›0.5	R	99.2
Rifampicin	‹0.008	‹0.008	S	94.7
Teicoplanin	0.5	0.5	S	99.6
Tetracycline	0.25	0.25	S	99.5
Vancomycin	1	1	S	99.5

Table A1.5. *Acinetobacter baumannii* complex (3680). Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories

Antibiotic agent	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Amikacin	4	8	S	92.4
Ciprofloxacin	32	›128	R	99.5
Colistin	0.5	1	S	98.0
Gentamicin	≥128	≥128	R	99.3
Imipenem	1	2	S	96.4
Meropenem	2	2	S	85.7
Tobramycin	2	2	S	95.8

Table A1.6. *Streptococcus pneumoniae* (3681). Minimum inhibitory concentration (MIC) and intended results reported by the reference laboratories and the overall concordance of the participating laboratories

Antibiotic agent	MIC (mg/L)		Result	
	Reference laboratory 1	Reference laboratory 2	EUCAST/CLSI	Overall concordance (%)
Cefotaxime	≤0.015	≤0.015	S	99.5
Ceftriaxone	0.03	0.03	S	99.7
Clindamycin	–	–	R*	99.0
Erythromycin	›2	›2	R	98.6
Levofloxacin	1	1	S	98.0
Moxifloxacin	≤0.012	≤0.012	S	98.7
Norfloxacin	–	–	S*	98.8
Oxacillin	–	–	S	97.6
Penicillin				
non-meningitis	0.015	0.015	S	98.9
pneumonia			S	98.9
meningitis			S	96.7

* There were no reference results for clindamycin and norfloxacin: assigned results were based on participant consensus.

Annex 2. EARS-Net laboratory and hospital data 2016

Laboratory and hospital denominator data have been collected and presented in this Annex to aid the correct interpretation of the EARS-Net data on antimicrobial resistance.

Methods

Questionnaires were sent to the EARS-Net-appointed contact points for AMR in March 2017. The contact points distributed the questionnaires to the participating laboratories and hospitals in their country. Information was collected on the total number of blood culture sets processed in the laboratories, the number of hospital beds for each participating hospital, the type of hospital, the bed occupancy, and the number of admissions. The appointed contact points and/or national focal points for antimicrobial resistance completed the questionnaires, compiled them and produced the final format suitable for uploading to The European Surveillance System (TESSy).

Laboratories were defined as reporting denominator data if they provided the number of blood culture sets performed for one or more hospitals. Hospitals were defined as reporting denominator data if they provided at least the number of beds.

Organisation of healthcare systems and affiliation between laboratories and hospitals differ considerably between countries, which might influence data comparability. For countries submitting denominator data for a small percentage of the hospitals and/or laboratories that contributed data to EARS-Net, the reported figures might not be representative for the overall country profile.

Participation

Nineteen of the 30 countries reporting AMR data for 2016 also returned hospital denominator data referring to the same year, while for three countries, hospital denominator data referring to 2015 were available and included in the analysis. Eighteen countries could provide sufficient laboratory denominator data for calculating the number of blood culture sets per 1 000 patient-days for 2016 and two for 2015.

Hospital denominator information

The total number of hospital beds for hospitals reporting both AMR and denominator data in different countries ranged from 1374 in Cyprus to 128 154 in the United Kingdom, reflecting the size of the country as well as the rate of participation in EARS-Net and the rate of response to the questionnaires.

The percentage of ICU beds among total hospital beds shows wide variation by country, ranging from 2% in Finland and Hungary, to 11% in the Czech Republic. The annual occupancy rate was 85% or higher in four of the 21 countries that provided data for this variable (Table A2.1).

Hospital characteristics

Both the size of a hospital and the level of specialisation may influence the occurrence of antimicrobial resistance in the hospital. As can be seen from Table A2.1, the distribution of size and specialisation level of hospitals varied considerably between the reporting countries. This does not necessarily reflect different distributions of the origin of blood culture results reported to EARS-Net in each country, as not all hospitals contribute evenly to the EARS-Net database. On the other hand, this diversity can indicate differences in the patient case mix, which may confound comparison of AMR results between countries.

Type and size of hospitals were not always linked, and it was not rare, especially in smaller countries, that university hospitals have fewer than 500 beds.

Laboratory denominator information

In 2016/2015 (latest available data), a median of 29.6 blood culture sets per 1 000 patient-days were processed in the EARS-Net laboratories responding to the questionnaire. The highest rate was reported by Sweden (80.4 sets per 1 000 patient-days) and the lowest by Latvia (6.7 cultures per 1 000 patient-days) (Table A2.1). For the majority of the reporting countries, there are only minor changes in the number of blood culture sets per 1 000 patient-days when comparing 2016/2015 (latest available data) data with 2014/2013 (latest available data).

Discussion and conclusions

In summary, the situation for most countries as assessed from denominator data reported to EARS-Net in 2016/2015 appears stable and similar to that of 2014/2013. This indicates that based on EARS-Net data, the comparison of AMR percentages over time appears to remain valid.

Case ascertainment of patients with bloodstream infections is strongly linked to diagnostic practices and the frequency with which blood cultures are taken. Therefore, the wide range in blood culture rates observed in the countries providing denominator data has implications for inter-country comparisons of both

the incidence of bloodstream infections, which could be underestimated in some countries, and of the percentage of antimicrobial resistance. In particular, the percentage of resistance could be overestimated if blood cultures are not systematically performed before starting empiric therapy and if blood cultures are more likely to be performed in patients not responding to initial empiric treatment.

For future improvement of the denominator data collection and analysis, a further increase in the number of countries reporting denominator data, as well as an increased number of hospitals and laboratories participating within countries, would be desirable.

Table A2.1. Hospital denominator data for 2016 or 2015 (latest available data)

Country	Number of hospitals reporting		Total number of beds	Percentage of ICU beds (%)	Annual occupancy rate (%)	Percentage of hospitals by level of care				
	Denominator data	AMR data				Tertiary level	Secondary level	Primary level	Other	Unknown
Austria	146	154	58572	5	65	6	22	44	28	0
Bulgaria	18	21	8887	7	68	56	33	6	6	0
Cyprus	5	5	1374	9	71	20	20	40	20	0
Czech Republic	63	69	37545	11	74	38	46	13	3	0
Estonia	11	11	5059	6	75	31	54	8	8	0
Finland*	20	20	20491	2	–	28	35	33	4	0
France	194	190	131654	8	80	0	0	0	0	100
Germany	103	372	36608	6	78	17	39	24	17	3
Greece	31	31	16593	4	62	0	0	0	0	100
Hungary	69	69	58434	2	72	47	24	11	18	0
Ireland*	53	80	11291	–	85	17	47	15	21	0
Latvia	20	20	9043	3	68	18	45	18	20	0
Lithuania	16	41	13538	4	100	39	48	9	4	0
Luxembourg	8	9	2312	7	79	75	25	0	0	0
Malta	4	4	1541	4	73	25	25	0	50	0
Norway	15	42	10291	3	79	60	20	20	0	0
Poland	57	74	29268	3	71	32	58	0	11	0
Portugal*	69	78	22252	4	83	41	16	26	17	0
Slovakia	26	26	13585	9	66	54	15	8	23	0
Slovenia	16	16	7375	7	70	13	44	25	19	0
Spain	37	39	74373	4	74	58	27	16	0	0
Sweden*	47	49	15482	4	95	17	40	43	0	0
United Kingdom*	33	93	128154	5	86	50	32	12	6	0

Table A2.2. Laboratory denominator information for 2016 or 2015 (latest available data)

Country	Number of laboratories reporting		Total number of blood culture sets	Number of blood culture sets per 1000 patient days
	Denominator data	AMR data		
Austria	37	39	222949	16.2
Bulgaria	17	20	16976	7.1
Cyprus	5	5	17241	46.2
Czech Republic	45	46	159338	16.1
Estonia	11	11	30158	21.7
Finland*	20	20	320959	73.6
France**	43	51	883377	78.1
Germany	21	37	275001	25.9
Hungary	31	31	122413	8.0
Latvia	15	15	16438	6.7
Lithuania	15	18	36194	9.5
Luxembourg	4	4	16990	26.0
Malta	1	1	11000	25.0
Norway	15	18	186991	63.2
Poland	53	67	252620	33.3
Portugal*	115	61	322519	58.2
Slovakia	13	13	67481	20.3
Slovenia	10	10	67386	35.1
Spain	36	38	366818	60.4
Sweden*	18	15	431840	80.4
United Kingdom*	25	52	272385	65.4

– No information available

* Data from 2015

** Except laboratories who only transmitted *S. pneumoniae*

Annex 3. General information on EARS-Net participating laboratories

This section provides the number of laboratories and isolates reported by year and by pathogen under EARSS/EARS-Net surveillance for the period 2000–2016. The total number of laboratories participating in EARS-Net could in some countries be higher than the number presented, as only laboratories reporting at least one isolate during each specific year are included.

For an overview of antimicrobial susceptibility results for the period 2000–2016, please refer to the antimicrobial resistance section of the ECDC Surveillance atlas of infectious diseases, available from https://atlas.ecdc.europa.eu

Austria

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	9	63	10	385					–	–	–	–	–	–
2001	8	53	9	278	8	260	6	67	–	–	–	–	–	–
2002	10	80	11	456	10	479	10	181	–	–	–	–	–	–
2003	20	163	20	871	21	985	19	327	–	–	–	–	–	–
2004	28	257	30	1453	31	1862	28	604	–	–	–	–	–	–
2005	31	298	32	1481	33	2058	30	568	7	89	8	77	–	–
2006	32	293	33	1640	33	2483	33	699	30	434	31	405	–	–
2007	35	322	34	1577	34	2545	33	688	33	445	33	411	–	–
2008	38	380	38	1899	38	2985	38	864	38	583	38	510	–	–
2009	38	379	38	1794	38	2625	36	825	37	622	36	525	–	–
2010	35	375	39	1840	39	2937	39	944	39	722	39	504	–	–
2011	39	438	40	1982	40	3174	40	894	40	799	40	544	–	–
2012	38	356	40	2173	40	3766	39	1049	40	859	39	596	–	–
2013	37	426	38	2543	38	4390	38	1113	38	947	38	618	18	51
2014	39	410	39	2662	39	4757	39	1140	39	996	39	638	21	79
2015	38	450	39	2815	39	4919	39	1170	39	1065	39	680	21	64
2016	39	457	39	3057	39	5285	39	1212	38	1247	39	697	24	81

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Note: National data analysis allows for a more accurate validation. Due to differences in the validation algorithms used by EARS-Net and Austria, there are small discrepancies in the data presented by EARS-Net.

Belgium

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	90	964	42	657	–	–	–	–	–	–	–	–	–	–
2001	89	1093	47	941	23	226	19	42	–	–	–	–	–	–
2002	98	1210	48	1092	27	1184	23	205	–	–	–	–	–	–
2003	107	1488	47	1133	24	1326	16	146	–	–	–	–	–	–
2004	95	1443	49	1227	25	1601	18	228	–	–	–	–	–	–
2005	97	1539	41	1048	25	1592	19	223	–	–	–	–	–	–
2006	98	1427	33	858	21	1632	22	267	–	–	–	–	–	–
2007	105	1511	34	855	17	1460	20	245	–	–	–	–	–	–
2008	101	1647	38	906	16	1430	19	236	–	–	–	–	–	–
2009	101	1885	34	949	18	1610	14	227	8	142	8	136	–	–
2010	97	1797	40	1088	23	1966	22	323	14	145	15	130	–	–
2011	91	1829	50	1771	43	4039	46	754	44	676	43	460	–	–
2012	96	1739	44	1569	41	4137	41	742	41	549	40	392	–	–
2013	93	1612	41	1683	41	4408	39	922	41	639	40	518	2	3
2014	96	1181	27	1034	27	2895	25	558	26	506	27	357	3	4
2015	91	1361	25	994	25	2685	25	550	24	406	25	263	8	26
2016	97	1327	31	1368	31	3856	30	754	28	669	31	366	18	79

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Bulgaria

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	8	13	16	102					–	–	–	–	–	–
2001	8	16	17	103	15	98	11	30	–	–	–	–	–	–
2002	11	25	21	116	20	135	16	42	–	–	–	–	–	–
2003	13	22	20	157	20	158	16	49	–	–	–	–	–	–
2004	13	32	22	170	20	167	16	75	–	–	–	–	–	–
2005	16	43	26	160	23	203	21	95	15	34	9	34	–	–
2006	11	29	23	159	20	196	19	98	15	55	13	31	–	–
2007	10	32	14	121	15	127	13	65	9	29	6	14	–	–
2008	13	29	21	160	22	147	18	70	11	49	10	23	–	–
2009	10	27	20	221	17	194	16	92	12	95	11	29	–	–
2010	13	22	20	200	21	153	16	108	15	127	11	42	–	–
2011	16	33	19	214	19	179	16	117	15	121	12	48	–	–
2012	12	21	19	227	19	223	20	129	14	127	11	52	–	–
2013	14	29	20	214	17	187	19	154	17	138	13	60	13	94
2014	12	32	20	216	20	218	19	182	17	151	12	48	15	115
2015	10	36	20	222	19	205	19	156	16	96	13	55	18	133
2016	13	33	18	231	20	241	18	159	17	161	12	56	15	106

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Croatia

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2001–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2001	10	20	14	149	13	182	7	33	–	–	–	–	–	–
2002	14	90	14	279	15	490	13	96	–	–	–	–	–	–
2003	12	88	14	360	16	570	11	101	–	–	–	–	–	–
2004	12	103	13	392	14	535	11	115	–	–	–	–	–	–
2005	15	129	17	354	16	638	11	120	14	112	10	72	–	–
2006	14	116	17	391	17	780	16	178	15	205	15	170	–	–
2007	15	137	15	375	17	860	13	174	17	280	16	189	–	–
2008	13	100	18	474	17	914	16	232	17	334	14	221	–	–
2010	11	103	15	359	16	883	12	174	16	281	15	210	–	–
2011	16	125	13	417	15	986	14	226	13	300	14	227	–	–
2012	10	97	17	404	16	907	15	216	15	332	14	197	–	–
2013	16	116	19	520	18	1040	17	248	18	376	18	246	13	114
2014	14	129	16	485	18	1080	16	220	16	334	16	232	15	167
2015	15	126	16	488	18	1046	16	298	17	380	17	257	17	200
2016	17	155	18	458	18	1045	16	283	17	323	16	260	14	182

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Cyprus

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	1	3	1	28	1	19	1	28	–	–	–	–	–	–
2004	1	7	3	39	4	46	3	38	–	–	–	–	–	–
2005	4	16	5	54	5	75	3	40	4	9	4	8	–	–
2006	5	13	5	62	5	90	4	48	4	26	4	37	–	–
2007	4	15	4	85	5	109	3	63	4	39	3	52	–	–
2008	4	14	5	92	4	119	5	85	5	62	5	43	–	–
2009	4	11	5	89	5	136	5	80	5	53	5	62	–	–
2010	4	12	5	99	5	139	5	91	4	67	5	48	–	–
2011	2	12	4	113	5	138	4	71	4	83	4	51	–	–
2012	3	8	5	165	5	176	5	106	5	65	5	52	5	23
2013	4	15	5	160	5	162	5	97	5	68	5	47	5	33
2014	4	12	5	138	5	153	5	115	5	80	5	42	5	58
2015	4	7	5	145	5	123	5	86	5	62	5	43	5	61
2016	4	10	5	141	5	149	5	80	5	75	5	64	5	29

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Czech Republic

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	26	111	31	516	–	–	–	–	–	–	–	–	–	–
2001	32	154	39	1075	36	1176	34	461	–	–	–	–	–	–
2002	34	144	41	1168	40	1587	39	587	–	–	–	–	–	–
2003	32	204	45	1387	43	1766	44	630	–	–	–	–	–	–
2004	37	162	45	1444	44	1966	41	660	–	–	–	–	–	–
2005	39	195	47	1553	47	2234	45	758	37	478	36	257	–	–
2006	39	172	47	1527	47	2176	45	697	45	1130	43	490	–	–
2007	41	205	47	1653	48	2407	47	816	48	1230	41	517	–	–
2008	40	244	47	1715	46	2738	44	883	45	1493	42	568	–	–
2009	41	297	46	1695	45	2759	44	835	45	1415	45	575	–	–
2010	41	288	44	1593	43	2484	41	759	44	1264	41	511	–	–
2011	42	316	46	1555	45	2696	44	767	44	1287	42	448	–	–
2012	39	274	47	1611	44	2812	42	843	46	1399	44	489	–	–
2013	44	333	47	1707	46	2962	43	875	45	1291	43	516	19	91
2014	45	274	44	1695	45	2981	42	775	44	1383	40	448	18	59
2015	44	284	46	1806	45	3174	44	869	46	1418	44	464	15	60
2016	42	267	45	1887	44	3075	43	774	45	1385	43	465	15	57

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Denmark

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	5	410	4	501	–	–	–	–	–	–	–	–	–	–
2001	5	506	4	520	–	–	–	–	–	–	–	–	–	–
2002	5	366	5	752	–	–	–	–	–	–	–	–	–	–
2003	5	606	5	671	–	–	–	–	–	–	–	–	–	–
2004	15	1188	15	1436	–	–	–	–	–	–	–	–	–	–
2005	14	1081	15	1350	5	1283	–	–	–	–	–	–	–	–
2006	15	872	15	1279	11	2723	11	711	11	607	–	–	–	–
2007	15	1030	14	1315	12	3021	13	927	13	784	13	417	–	–
2008	15	934	15	1295	14	3283	14	1005	14	793	14	420	–	–
2009	15	996	15	1395	14	3532	14	1100	14	822	14	429	–	–
2010	15	954	15	1362	14	3418	14	1112	14	799	14	376	–	–
2011	13	896	13	1452	12	3642	12	1197	12	910	12	407	–	–
2012	13	867	13	1431	12	3925	12	1248	12	948	12	390	10	83
2013	12	789	12	1685	11	3967	11	1224	11	875	11	414	11	79
2014	11	709	11	1874	10	4496	10	1308	10	943	10	388	10	72
2015	11	747	11	1876	11	4597	11	1303	11	939	11	442	10	68
2016	10	707	10	1963	11	4847	11	1285	11	1156	11	460	11	72

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Estonia

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	1	1	–	–	–	–	–	–	–	–
2001	5	20	6	79	4	52	4	21	–	–	–	–	–	–
2002	5	21	8	82	6	67	3	13	–	–	–	–	–	–
2003	8	26	9	98	9	98	6	27	–	–	–	–	–	–
2004	6	40	9	104	10	167	5	63	–	–	–	–	–	–
2005	7	53	8	141	10	156	7	66	7	38	5	38	–	–
2006	8	52	9	154	9	215	8	85	6	47	6	43	–	–
2007	8	64	10	206	11	219	8	66	9	63	8	48	–	–
2008	10	66	11	185	11	267	11	86	10	72	8	41	–	–
2009	8	82	11	213	11	320	8	72	7	60	6	43	–	–
2010	10	64	9	152	11	317	8	66	9	82	8	43	–	–
2011	9	54	11	121	11	315	3	10	6	91	6	17	–	–
2012	9	71	10	163	11	306	8	76	9	91	7	33	–	–
2013	10	79	11	171	11	342	9	77	11	91	8	21	–	–
2014	10	72	11	226	11	412	9	81	10	136	7	40	–	–
2015	10	102	11	231	11	513	10	103	9	133	7	38	5	8
2016	11	112	11	314	11	702	9	120	10	183	8	56	3	8

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Finland

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	11	238	12	367	–	–	–	–	–	–	–	–	–	–
2001	13	468	13	607	14	1283	13	273	–	–	–	–	–	–
2002	15	454	15	721	15	1330	14	278	–	–	–	–	–	–
2003	16	517	16	727	15	1450	15	266	–	–	–	–	–	–
2004	17	548	17	883	17	1749	17	336	–	–	–	–	–	–
2005	17	543	17	790	17	1924	17	340	14	175	13	108	–	–
2006	15	501	15	894	15	1875	15	348	14	228	14	162	–	–
2007	16	547	16	814	16	1949	16	400	15	273	14	183	–	–
2008	15	643	15	923	15	2111	15	381	12	288	12	175	–	–
2009	20	688	20	978	20	2224	20	506	20	375	18	233	–	–
2010	20	622	20	1094	20	2551	20	521	20	401	20	281	–	–
2011	17	662	18	1319	17	3021	16	479	17	404	16	269	–	–
2012	16	607	17	1409	17	3162	17	651	17	536	17	327	–	–
2013	18	675	18	1580	18	3721	18	698	18	550	18	327	11	37
2014	19	659	19	1831	19	4013	19	844	19	583	19	307	14	32
2015	20	788	20	2070	20	4425	20	777	20	658	20	341	16	43
2016	20	810	18	1890	20	4833	20	794	20	770	20	352	12	28

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

France

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	–	–	21	1714	–	–	–	–	–	–	–	–	–	–
2002	–	–	21	1664	21	2495	21	467	–	–	–	–	–	–
2003	–	–	21	1710	21	2266	20	468	–	–	–	–	–	–
2004	–	–	50	3355	50	5678	46	871	–	–	–	–	–	–
2005	195	632	50	3484	50	6056	47	1023	49	838	48	993	–	–
2006	97	371	50	3824	50	6718	50	1152	50	963	47	1006	–	–
2007	168	663	57	4265	57	8093	56	1545	56	1187	56	1305	–	–
2008	127	557	56	4380	56	7993	54	1555	54	1138	54	1225	–	–
2009	225	826	54	4727	54	8451	54	1969	52	1378	32	1221	–	–
2010	181	1127	56	4883	56	9028	54	1970	56	1542	36	1191	–	–
2011	255	1413	52	4740	52	8790	46	2163	52	1691	52	1634	–	–
2012	160	824	55	5242	55	9610	52	2263	55	1712	54	1731	44	391
2013	229	919	54	5439	54	10157	53	2538	54	1940	54	1878	51	413
2014	150	656	53	5498	53	10350	53	2693	53	2196	53	1789	49	409
2015	198	1068	54	5597	54	11067	53	2852	53	2350	53	1956	48	434
2016	175	1046	50	5699	49	11337	49	2841	49	2608	49	1988	48	454

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Germany

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	18	204	19	890	1	180	1	28	–	–	–	–	–	–
2001	21	212	22	1220	21	1269	20	294	–	–	–	–	–	–
2002	17	248	18	1067	16	1068	14	290	–	–	–	–	–	–
2003	17	175	20	920	19	997	17	347	–	–	–	–	–	–
2004	16	145	22	1107	22	1217	22	606	–	–	1	1	–	–
2005	15	119	17	827	17	961	17	569	12	105	12	117	–	–
2006	15	85	18	799	18	850	16	529	14	148	12	162	–	–
2007	11	75	12	853	12	977	12	648	10	173	11	197	–	–
2008	11	209	14	1090	14	1615	13	451	11	235	11	167	–	–
2009	16	346	17	1893	17	2803	17	952	15	479	16	287	–	–
2010	16	363	17	1980	17	3024	16	1009	15	478	15	315	–	–
2011	18	359	19	2388	19	3650	17	1231	17	519	17	389	–	–
2012	20	326	21	2563	21	4194	21	1499	20	664	20	438	11	121
2013	21	492	23	3129	23	5345	23	1901	22	766	22	630	13	181
2014	21	502	21	3417	21	6251	21	2035	20	1008	20	643	17	208
2015	28	736	29	4876	29	8729	29	2991	28	1521	28	941	24	337
2016	36	1291	37	9088	37	15786	37	4666	36	2814	35	1320	34	439

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Greece

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	17	366	18	398	12	197	–	–	–	–	–	–
2001	–	–	25	363	26	620	25	304	–	–	–	–	–	–
2002	–	–	33	368	35	588	28	292	–	–	–	–	–	–
2003	–	–	34	682	35	1076	32	621	–	–	–	–	–	–
2004	–	–	35	610	39	1131	34	565	–	–	–	–	–	–
2005	–	–	35	682	35	1140	34	737	33	774	33	699	–	–
2006	–	–	42	828	41	1253	39	949	38	841	38	818	–	–
2007	–	–	41	819	43	1234	39	999	38	972	37	802	–	–
2008	–	–	46	907	44	1462	42	992	41	1093	42	920	–	–
2009	–	–	48	1025	49	1831	47	1190	47	1649	47	1123	–	–
2010	–	–	44	902	45	1549	43	1105	40	1703	42	1014	–	–
2011	–	–	39	826	37	1437	36	1122	38	1671	35	948	–	–
2012	–	–	38	877	37	1397	36	1121	37	1462	34	913	37	1254
2013	–	–	32	776	31	1258	31	930	30	1212	30	886	29	849
2014	–	–	27	575	26	1123	26	725	27	1093	26	700	26	844
2015	–	–	29	635	29	1218	28	826	28	1187	28	680	29	1001
2016	–	–	31	682	31	1306	29	934	30	1183	31	705	29	903

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Hungary

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	16	64	18	301	18	264	17	121	–	–	–	–	–	–
2002	17	61	24	416	24	354	23	169	–	–	–	–	–	–
2003	20	134	27	858	27	842	25	279	–	–	–	–	–	–
2004	26	143	30	1020	28	967	26	366	–	–	–	–	–	–
2005	23	133	28	1083	27	1046	27	476	21	314	24	507	–	–
2006	23	151	27	1127	26	1135	25	453	24	302	25	546	–	–
2007	22	146	26	1199	25	1179	26	400	23	322	24	518	–	–
2008	22	166	26	1181	25	1057	21	428	23	369	25	513	–	–
2009	22	143	26	1068	25	1057	27	444	24	361	25	518	–	–
2010	27	140	30	1224	29	1385	29	591	29	514	28	636	–	–
2011	27	139	28	1156	30	1227	28	582	27	432	29	606	–	–
2012	26	160	28	1143	28	1415	28	594	27	500	29	619	27	418
2013	26	154	26	1201	30	1440	29	813	28	559	30	670	28	482
2014	25	129	26	1279	30	1622	28	883	28	644	29	746	27	446
2015	27	181	27	1517	30	2026	28	970	27	706	29	770	25	467
2016	27	174	28	1668	29	1995	29	1058	29	723	29	740	26	401

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Iceland

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	1	36	1	40	–	–	–	–	–	–	–	–	–	–
2001	2	48	2	63	2	86	2	18	–	–	–	–	–	–
2002	2	43	2	60	2	83	2	25	–	–	–	–	–	–
2003	2	35	2	64	2	100	2	22	–	–	–	–	–	–
2004	2	54	2	55	2	119	1	27	–	–	–	–	–	–
2005	2	37	2	78	2	130	2	31	2	22	1	13	–	–
2006	2	52	2	57	2	130	2	40	2	13	1	9	–	–
2007	2	42	2	65	2	105	1	29	2	27	1	11	–	–
2008	2	46	2	63	2	123	2	17	1	24	2	7	–	–
2009	2	36	2	59	2	111	2	51	2	27	2	16	–	–
2010	2	37	2	65	2	104	2	31	2	27	2	12	–	–
2011	2	32	2	71	2	130	2	32	2	26	2	17	–	–
2012	2	28	2	58	2	143	2	30	2	16	1	10	1	2
2013	2	18	2	69	2	121	1	32	2	30	1	11	–	–
2014	2	25	2	61	2	152	1	23	1	28	1	11	1	3
2015	1	25	2	88	2	173	2	41	2	36	2	12	1	6
2016	2	19	2	76	2	192	2	40	2	25	2	17	1	3

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Ireland

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	17	131	18	549	–	–	–	–	–	–	–	–	–	–
2001	21	182	18	713	–	–	–	–	–	–	–	–	–	–
2002	20	277	22	998	20	736	15	250	–	–	–	–	–	–
2003	24	363	26	1108	26	978	21	348	–	–	–	–	–	–
2004	28	399	38	1286	37	1235	29	418	–	–	–	–	–	–
2005	31	397	38	1360	39	1424	33	502	15	42	11	29	–	–
2006	32	406	38	1347	39	1638	32	550	28	211	23	128	–	–
2007	33	435	41	1332	42	1750	37	598	31	237	29	172	–	–
2008	35	442	38	1242	41	1875	37	685	33	307	29	191	–	–
2009	34	356	41	1261	41	2012	38	671	37	316	30	236	–	–
2010	32	310	39	1207	40	2121	38	670	34	318	30	219	–	–
2011	32	324	39	1057	38	2167	36	608	34	304	28	181	–	–
2012	30	319	40	1038	40	2386	37	677	32	338	34	216	–	–
2013	33	310	39	1069	40	2482	38	726	32	317	33	205	22	89
2014	34	328	37	1075	39	2705	34	698	34	355	31	178	24	89
2015	30	303	37	1057	39	2649	36	697	30	389	29	195	21	86
2016	31	363	37	1143	39	2991	36	713	32	453	30	243	25	68

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Italy

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	37	118	51	473	–	–	–	–	–	–	–	–	–	–
2001	40	129	53	839	–	–	42	297	–	–	–	–	–	–
2002	51	300	53	1343	17	618	49	602	–	–	–	–	–	–
2003	44	293	46	1480	17	923	44	634	–	–	–	–	–	–
2004	37	271	42	1225	14	645	40	576	–	–	–	–	–	–
2005	38	331	41	1479	16	1195	40	714	38	344	–	–	–	–
2006	34	269	38	1164	13	910	35	650	32	321	12	183	–	–
2007	34	298	38	1167	14	1052	36	656	37	391	10	185	–	–
2008	27	194	30	939	14	957	31	580	27	331	11	168	–	–
2009	21	216	23	987	9	863	22	509	22	313	10	195	–	–
2010	33	323	35	1886	23	2623	35	1106	34	739	23	517	–	–
2011	29	294	31	1372	21	2098	31	841	30	688	21	355	–	–
2012	32	293	42	1772	42	3555	42	949	38	984	42	777	27	249
2013	43	436	52	2540	43	4097	50	1386	48	1486	42	796	38	480
2014	42	284	46	2270	38	3802	47	1421	45	1352	37	760	31	483
2015	39	479	46	3300	45	5605	46	2393	43	2015	41	1083	40	667
2016	43	515	46	3309	46	6110	47	2575	47	2314	43	1207	41	708

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Latvia

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2004	4	17	7	87	–	–	–	–	–	–	–	–	–	–
2005	5	36	7	127	–	–	–	–	–	–	–	–	–	–
2006	7	37	11	172	10	62	10	56	6	28	9	16	–	–
2007	6	31	12	169	9	76	8	57	7	27	6	16	–	–
2008	3	18	12	164	10	90	9	51	11	40	6	11	–	–
2009	7	30	12	188	9	86	8	48	10	44	7	18	–	–
2010	4	38	10	155	8	98	8	61	8	64	6	21	–	–
2011	5	51	11	197	9	132	8	59	9	65	4	12	–	–
2012	7	64	11	211	10	154	7	73	8	78	6	18	–	–
2013	10	67	13	207	12	136	10	83	10	92	6	25	–	–
2014	7	51	13	222	10	182	10	79	12	118	6	18	6	52
2015	9	64	15	253	11	201	12	94	11	115	6	13	6	61
2016	8	63	14	286	11	253	12	145	8	95	5	16	7	82

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Lithuania

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2002	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2003	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2004	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2005	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2006	9	35	13	167	11	171	8	30	8	35	7	14	–	–
2007	10	67	12	240	13	235	10	56	10	41	7	21	–	–
2008	11	48	12	278	12	304	10	67	11	54	7	21	–	–
2009	10	46	13	258	13	297	11	57	12	68	8	21	–	–
2010	9	40	11	257	10	333	10	59	9	81	8	31	–	–
2011	8	48	10	279	10	385	9	74	10	137	6	30	–	–
2012	9	37	11	323	11	462	11	97	11	186	9	28	–	–
2013	9	59	11	267	11	434	9	72	11	145	10	37	–	–
2014	10	67	13	383	13	594	12	122	12	154	9	31	11	66
2015	14	87	14	376	15	583	12	133	12	179	9	41	11	73
2016	12	99	17	505	17	797	13	147	16	326	13	74	11	87

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Luxembourg

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	5	22	4	67	–	–	–	–	–	–	–	–	–	–
2001	8	41	8	85	8	193	7	31	–	–	–	–	–	–
2002	9	33	9	97	9	193	8	30	–	–	–	–	–	–
2003	7	54	8	95	8	227	7	41	–	–	–	–	–	–
2004	6	36	7	96	7	216	5	28	–	–	–	–	–	–
2005	5	47	5	83	5	188	5	31	–	–	1	1	–	–
2006	5	31	5	77	5	167	4	42	4	21	4	23	–	–
2007	6	48	6	117	6	275	5	37	6	52	5	36	–	–
2008	6	59	5	117	6	303	5	61	6	52	4	33	–	–
2009	6	67	6	113	6	302	5	54	3	28	6	35	–	–
2010	6	50	6	134	6	354	6	70	6	59	6	32	–	–
2011	5	52	5	127	5	354	5	76	4	48	5	32	–	–
2012	6	39	6	131	6	335	5	74	4	50	5	31	2	6
2013	5	50	5	135	8	322	5	61	4	53	5	34	2	3
2014	5	35	5	125	5	371	5	77	4	66	5	42	3	6
2015	5	29	7	135	5	347	5	81	4	60	4	28	2	8
2016	4	51	4	188	4	419	4	79	4	78	4	40	2	8

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Malta

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	1	11	1	76	–	–	–	–	–	–	–	–	–	–
2001	1	13	1	82	1	129	1	24	–	–	–	–	–	–
2002	1	12	1	87	1	74	1	33	–	–	–	–	–	–
2003	1	9	1	121	1	91	1	26	–	–	–	–	–	–
2004	1	18	1	94	1	91	1	41	–	–	–	–	–	–
2005	1	13	1	77	1	85	1	38	1	18	1	45	–	–
2006	1	31	1	90	1	94	1	53	1	32	1	51	–	–
2007	1	13	1	105	1	117	1	37	1	28	1	36	–	–
2008	1	17	1	108	1	128	1	32	1	36	1	31	–	–
2009	1	8	1	85	1	158	1	36	1	38	1	58	–	–
2010	1	11	1	108	1	192	1	37	1	57	1	42	–	–
2011	1	11	1	130	1	219	1	53	1	52	1	42	–	–
2012	1	18	1	102	1	216	1	31	1	57	1	31	1	6
2013	1	9	1	116	1	248	1	41	1	69	1	25	1	7
2014	1	8	1	83	1	279	1	41	1	101	1	38	1	10
2015	1	20	1	89	1	258	1	37	1	92	1	25	1	15
2016	1	10	1	97	1	328	1	45	1	102	1	40	1	7

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Netherlands

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	23	728	23	1282	12	1312	8	81	–	–	–	–	–	–
2001	19	734	19	1291	20	1864	13	254	–	–	–	–	–	–
2002	23	892	23	1550	22	2427	22	530	–	–	–	–	–	–
2003	24	891	23	1422	23	2133	23	480	–	–	–	–	–	–
2004	22	758	22	1339	21	2111	22	444	–	–	–	–	–	–
2005	23	815	23	1407	23	2201	23	563	16	301	16	210	–	–
2006	22	1006	23	1636	22	2905	23	776	18	458	19	330	–	–
2007	21	940	21	1471	21	2801	21	827	19	497	19	338	–	–
2008	17	723	16	1191	16	2283	17	632	15	463	15	345	–	–
2009	17	746	16	1035	16	2398	16	522	15	408	15	235	–	–
2010	22	971	21	1565	21	3422	20	834	20	647	21	376	–	–
2011	25	1289	23	1815	23	4436	23	1108	23	729	23	434	–	–
2012	26	1246	25	1963	25	4738	24	1062	25	694	24	408	18	70
2013	27	1269	25	2088	27	4758	26	1019	25	663	25	381	22	70
2014	35	1406	35	2580	35	6514	35	1256	35	926	35	555	26	75
2015	27	1301	27	2107	27	5380	27	1220	27	908	27	502	21	74
2016	32	1517	32	2702	32	6398	32	1469	32	1135	31	543	31	108

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Norway

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	11	429	11	401	11	922	11	110	3	22	4	9	–	–
2001	11	429	11	413	11	966	11	154	4	26	4	20	–	–
2002	11	453	11	502	11	1119	11	177	4	29	4	27	–	–
2003	11	512	11	506	11	1179	11	192	4	46	4	25	–	–
2004	11	600	11	516	11	1212	11	235	4	51	4	27	–	–
2005	11	606	11	553	11	1331	11	304	11	193	11	97	–	–
2006	12	601	12	734	12	1574	12	349	12	263	12	96	–	–
2007	13	616	13	794	13	1713	13	416	13	320	13	105	–	–
2008	13	576	13	837	13	1799	13	403	13	349	13	148	–	–
2009	12	554	12	909	12	1846	12	478	12	396	12	166	–	–
2010	15	576	15	1050	15	2277	15	563	15	479	15	168	–	–
2011	17	622	17	1223	17	2620	17	588	17	450	17	148	–	–
2012	18	576	18	1430	18	3025	18	672	16	623	18	209	10	25
2013	18	551	18	1473	18	3080	18	710	17	645	18	206	12	36
2014	19	536	19	1546	19	3422	19	764	18	746	19	257	13	34
2015	18	429	18	1457	18	3302	18	625	18	701	18	230	11	32
2016	18	504	18	1485	18	3618	18	745	18	811	18	227	12	33

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Poland

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	4	6	19	151	20	103	16	57	–	–	–	–	–	–
2002	7	10	21	186	22	135	19	56	–	–	–	–	–	–
2003	11	16	24	166	25	124	16	64	–	–	–	–	–	–
2004	11	16	30	262	29	192	23	52	–	–	–	–	–	–
2005	6	6	30	198	30	176	21	54	17	53	14	26	–	–
2006	4	9	24	174	26	206	21	68	15	42	16	37	–	–
2007	10	22	24	185	27	256	20	71	18	32	23	67	–	–
2008	34	84	15	99	14	84	11	26	11	19	8	22	–	–
2009	21	71	30	551	29	625	28	267	25	151	27	153	–	–
2010	26	76	35	527	35	771	32	286	33	246	29	169	–	–
2011	41	166	45	868	45	1188	44	484	45	391	35	199	–	–
2012	30	121	41	791	41	1056	35	385	37	370	37	178	35	214
2013	38	170	38	750	38	1072	37	460	35	383	30	198	33	192
2014	31	133	32	750	32	1096	31	457	32	466	30	187	27	189
2015	40	230	48	1192	48	1616	48	648	47	679	40	260	38	246
2016	57	343	65	1842	67	2735	65	1148	66	1142	60	403	53	394

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Portugal

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	11	97	8	151	–	–	–	–	–	–	–	–	–	–
2001	16	155	16	521	13	418	12	185	–	–	–	–	–	–
2002	14	185	16	544	17	444	13	101	–	–	–	–	–	–
2003	12	95	22	1033	21	792	18	398	–	–	–	–	–	–
2004	14	166	23	1063	19	761	19	410	–	–	–	–	–	–
2005	13	202	19	1153	19	1171	17	405	1	1	–	–	–	–
2006	15	183	17	1306	18	1331	17	464	13	315	11	266	–	–
2007	12	202	20	1383	20	1432	19	518	18	370	16	340	–	–
2008	14	260	20	1557	21	1625	20	588	21	543	19	467	–	–
2009	17	237	20	1824	20	2040	19	675	20	564	18	536	–	–
2010	12	156	18	1633	19	1980	19	621	19	596	19	548	–	–
2011	17	455	18	1507	18	1963	18	684	18	619	18	526	–	–
2012	16	330	18	1455	18	2158	18	687	19	781	18	588	15	169
2013	37	504	44	2450	34	2687	41	963	32	913	40	737	34	234
2014	50	668	53	3241	56	5027	51	1958	53	1714	51	1064	40	266
2015	51	843	57	3645	58	5377	54	1440	58	2099	56	1192	43	312
2016	57	928	59	3482	60	5786	56	1383	59	2352	57	1230	39	207

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Romania

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2002	6	10	10	80	8	28	4	11	–	–	–	–	–	–
2003	5	26	9	85	9	50	5	12	–	–	–	–	–	–
2004	4	9	15	95	12	48	4	9	–	–	–	–	–	–
2005	5	18	13	93	13	84	7	14	1	3	2	23	–	–
2006	8	29	11	83	9	41	9	28	5	32	2	3	–	–
2007	5	27	9	42	9	63	5	14	6	30	2	4	–	–
2008	4	14	5	39	4	58	4	16	3	6	3	8	–	–
2009	3	17	6	48	7	90	5	27	4	27	4	24	–	–
2010	2	13	5	47	5	35	2	19	3	17	5	10	–	–
2011	3	36	5	109	3	95	3	31	4	25	4	10	–	–
2012	7	44	10	230	10	192	9	86	10	102	8	45	4	54
2013	8	44	15	384	14	302	14	135	16	221	15	94	16	138
2014	12	50	15	399	16	309	15	158	16	258	15	94	16	124
2015	9	70	13	424	12	371	12	185	13	271	11	92	13	190
2016	8	60	14	495	13	420	13	193	13	344	13	93	13	160

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Slovakia

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2001	4	6	7	37	8	45	6	17	–	–	–	–	–	–
2002	9	16	14	259	14	215	12	79	–	–	–	–	–	–
2003	14	27	16	269	16	239	10	75	–	–	–	–	–	–
2004	9	17	15	289	15	310	12	82	–	–	–	–	–	–
2005	4	8	12	147	13	134	8	46	–	–	–	–	–	–
2006	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2007	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2008	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2009	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2010	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2011	7	26	11	572	11	740	11	305	11	466	11	267	–	–
2012	10	22	14	478	14	696	14	274	14	378	14	199	–	–
2013	8	29	14	558	14	809	14	366	14	490	14	286	14	188
2014	9	32	14	640	14	889	13	411	14	494	14	276	14	171
2015	9	34	14	583	14	896	14	401	14	475	14	278	14	154
2016	5	13	13	572	13	829	13	359	13	466	12	191	13	115

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Slovenia

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	7	37	10	152	–	–	–	–	–	–	–	–	–	–
2001	10	156	10	270	10	398	10	54	–	–	–	–	–	–
2002	11	101	11	276	11	409	9	45	–	–	–	–	–	–
2003	11	172	11	299	11	401	10	76	–	–	–	–	–	–
2004	10	166	11	347	11	573	9	91	–	–	–	–	–	–
2005	11	208	11	349	11	657	11	119	10	78	8	38	–	–
2006	11	167	11	365	11	717	10	145	10	145	10	72	–	–
2007	10	195	10	422	10	851	9	183	10	170	9	88	–	–
2008	10	209	10	418	10	874	10	196	9	157	10	95	–	–
2009	10	253	10	471	10	893	10	198	10	189	10	107	–	–
2010	10	232	10	476	10	952	10	196	10	196	10	95	–	–
2011	10	253	10	464	10	1002	10	208	10	232	10	118	–	–
2012	10	251	10	445	10	1168	10	225	10	254	10	134	3	25
2013	10	279	10	465	10	1224	10	248	10	245	10	133	5	25
2014	10	300	10	495	10	1216	10	235	10	233	9	112	8	34
2015	10	323	10	513	10	1326	10	257	10	237	10	141	7	31
2016	10	269	10	534	10	1420	10	272	10	267	10	143	7	60

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Spain

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	33	621	31	857	–	–	–	–	–	–	–	–	–	–
2001	36	652	35	949	27	1944	26	371	–	–	–	–	–	–
2002	35	658	36	1196	29	2484	35	566	–	–	–	–	–	–
2003	35	656	36	1391	29	2650	36	608	–	–	–	–	–	–
2004	36	684	36	1527	36	3471	36	710	–	–	–	–	–	–
2005	34	740	34	1337	34	2997	35	623	14	56	13	70	–	–
2006	35	625	35	1483	35	3364	34	755	33	564	32	405	–	–
2007	35	862	35	1645	35	3678	35	885	33	618	35	448	–	–
2008	31	695	32	1505	32	3626	32	1002	30	639	32	548	–	–
2009	32	708	33	1715	33	3821	33	1093	32	628	33	544	–	–
2010	41	862	41	1986	41	5696	41	1467	41	1161	41	749	–	–
2011	40	763	40	1965	40	5605	39	1478	40	1145	40	839	–	–
2012	40	644	41	1904	40	5675	41	1508	40	1153	40	853	–	–
2013	38	596	39	1856	39	5933	39	1506	38	1241	39	825	19	100
2014	38	583	39	1943	38	5824	39	1552	39	1266	39	874	23	83
2015	36	672	39	2004	40	6493	39	1572	40	1510	40	884	26	96
2016	36	672	37	1973	38	6800	37	1616	38	1680	37	843	24	106

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

Sweden

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	19	810	19	1478	1	1	–	–	–	–	–	–	–	–
2001	20	790	20	1634	20	2798	20	671	–	–	–	–	–	–
2002	21	830	21	1837	21	3066	21	695	–	–	–	–	–	–
2003	21	919	21	1855	21	3350	21	850	–	–	–	–	–	–
2004	21	955	21	1906	21	3372	21	856	–	–	–	–	–	–
2005	21	1025	21	1774	21	3241	21	821	18	282	17	149	–	–
2006	21	996	21	1968	20	3539	21	884	20	621	18	300	–	–
2007	21	1032	21	2163	20	3749	21	932	20	649	20	343	–	–
2008	21	1219	21	2410	20	4032	21	1059	20	826	20	315	–	–
2009	19	1063	19	2460	18	4247	19	967	18	706	18	338	–	–
2010	19	1007	19	2792	18	4859	19	1132	18	886	18	378	–	–
2011	18	1016	18	3045	17	5273	18	1254	17	972	17	416	–	–
2012	18	1030	18	3263	17	5542	18	1211	17	977	17	357	–	–
2013	18	1166	18	4124	18	7538	18	1697	18	1300	18	533	9	75
2014	16	792	16	3501	16	6549	16	1358	16	1000	16	438	10	52
2015	17	867	17	3415	17	6768	17	1280	17	1141	17	435	9	35
2016**	14	905	15	3909	14	6972	14	1240	15	1537	13	471	12	86

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

** Due to a change in data source, data from 2016 cannot be compared to previous years

United Kingdom

General information on EARS-Net participating laboratories

Annual number of reporting laboratories* and number of reported isolates, 2000–2016

Year	*S. pneumoniae*		*S. aureus*		*E. coli*		Enterococci		*K. pneumoniae*		*P. aeruginosa*		*Acinetobacter* spp	
	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates	Labs	Isolates
2000	28	512	27	1419	–	–	–	–	–	–	–	–	–	–
2001	26	573	25	1422	20	1424	–	–	–	–	–	–	–	–
2002	23	617	21	1588	20	1958	–	–	–	–	–	–	–	–
2003	50	1334	51	3548	19	2253	–	–	–	–	–	–	–	–
2004	54	1059	54	3562	20	2091	–	–	–	–	–	–	–	–
2005	53	1375	58	3971	23	2359	27	591	23	420	25	438	–	–
2006	51	1514	55	4132	26	2438	22	547	22	404	24	353	–	–
2007	50	1785	55	4865	20	2374	18	435	18	382	19	370	–	–
2008	51	1223	55	3355	15	2456	14	274	15	350	14	345	–	–
2009	59	1396	69	2977	28	4712	26	712	27	725	26	639	–	–
2010	50	1459	55	2730	29	5389	28	651	28	840	28	588	–	–
2011	53	1513	53	3430	29	5971	28	723	28	1007	28	599	–	–
2012	54	1295	55	2696	29	6527	27	877	28	1075	28	681	24	109
2013	54	1337	56	3049	31	7294	30	964	31	1169	31	715	27	165
2014	56	1418	56	3569	31	7369	29	945	29	1180	29	649	27	129
2015	44	1126	47	3125	22	6117	22	776	22	1077	22	541	20	153
2016	90	3522	92	7798	91	23714	89	3787	89	4236	87	2187	77	615

* Number of laboratories reporting at least one isolate during the specific year. Please note that the total number of laboratories participating in EARS-Net might be higher.

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