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Surveillance of antimicrobial resistance in Europe

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

2017

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Summary

The results presented in this report are based on antimicrobial resistance data from invasive isolates reported to the European Antimicrobial Resistance Surveillance Network (EARS-Net) by 30 European Union (EU) and European Economic Area (EEA) countries in 2018 (data referring to 2017), and on trend analyses of data reported by the participating countries for the period 2014 to 2017.

Despite the political prioritisation of antimicrobial resistance as a threat to public health and the availability of evidence-based guidance for antimicrobial stewardship and infection prevention and control, high levels of resistance remain in the EU/EEA for several bacterial species–antimicrobial group combinations. Intercountry variations also indicate that that there is scope for significant reductions in antimicrobial resistance in many countries through strengthening of current best practice.

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 west-to-east gradient is evident. In general, lower resistance percentages were reported by countries in the north while higher percentages were reported in the south and east of Europe.

For *Escherichia coli* and *Klebsiella pneumoniae*, combined resistance to several antimicrobial groups was frequent, and extended-spectrum beta-lactamase (ESBL) production was common. Resistance percentages were generally higher in *K. pneumoniae* than in *E. coli*. For *E. coli*, there was a small but significant increase in the trend of the EU/EEA population-weighted mean percentage for third-generation cephalosporin resistance from 14.2% in 2014 to 14.9% in 2017, a trend that remained significant when only laboratories reporting consistently during all four years were included. By contrast, no significant trends were noted for the *K. pneumoniae* EU/EEA population-weighted mean resistance percentages when restricting analyses to the laboratories that consistently reported data during the four-year period.

While carbapenem resistance remained rare in *E. coli*, several countries reported carbapenem resistance percentages above 10% for *K. pneumoniae*. Carbapenem resistance was also common in *Pseudomonas aeruginosa* and *Acinetobacter* species, and at higher percentages compared with *K. pneumoniae*. For all four gram-negative bacteria, the countries reporting the highest carbapenem resistance percentages were also among the countries reporting the highest resistance percentages for other antimicrobial groups.

For *Streptococcus pneumoniae*, the resistance situation appeared stable between 2014 and 2017, but with large inter-country variations. Macrolide non-susceptibility was, for most countries, more frequent than penicillin non-susceptibility.

For *Staphylococcus aureus*, the decline in the percentage of meticillin-resistant, i.e. MRSA, isolates reported in previous years continued in 2017. The EU/EEA population-weighted mean MRSA percentage decreased significantly from 19.6% in 2014 to 16.9% in 2017, with similar decreasing trends reported from more than one fourth of the countries. Nevertheless, MRSA remains an important pathogen in the EU/EEA, as the levels of MRSA were still high in several countries, and combined resistance to other antimicrobial groups was common.

Among enterococci, the increasing trend of *Enterococcus faecium* resistant to vancomycin is a cause of concern. The EU/EEA population-weighted mean percentage increased significantly from 10.4% in 2014 to 14.9% in 2017, and corresponding increasing trends were noted in around one third of the countries.

EARS-Net data for 2017 show that antimicrobial resistance remains a serious threat 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 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 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 the Commission Implementing Decision (EU) 2018/945 of 22 June 2018 on the communicable diseases and related special health issues to be covered by epidemiological surveillance [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 Europe. 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 continuously increased since the initiation of the network, indicating a strengthening of national AMR surveillance systems in the EU/EEA. 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.

EARS-Net is based on a network of representatives (National Focal Points for AMR; Operational Contact Points for Epidemiology, for Microbiology and for TESSy interaction) from the EU/EEA countries that collect routine clinical antimicrobial susceptibility data from national AMR surveillance initiatives. Scientific guidance and support is provided by the EARS-Net Disease Network Coordination Committee, which is composed of individual experts elected from the appointed National Focal Points and Operational Contact Points, and completed by observers from other organisations 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 receives support from ECDC and ESCMID.

Through close collaboration and by using compatible methodology, the Central Asian and Eastern European Surveillance of Antimicrobial Resistance (CAESAR) Network, coordinated by the World Health Organization Regional Office for Europe, complements EARS-Net in non-EU/EEA countries to obtain a pan-European overview of the AMR situation [2].

The objectives of EARS-Net are to:

- collect comparable, representative and accurate AMR data
- analyse temporal and spatial trends of AMR in Europe
- provide timely AMR data for policy decisions
- encourage the implementation, maintenance and improvement of national AMR surveillance programmes; and
- 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 2017 to EARS-Net before the end of August 2018. Only data from invasive (blood and cerebrospinal fluid) isolates are included in EARS-Net. The panels of species-antimicrobial agent combinations under surveillance are defined in the EARS-Net reporting protocol [3]. 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 [4].

Routine antimicrobial susceptibility testing (AST) results are collected from clinical laboratories by the national network representatives 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

In terms of 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. In 2017, approximately 89% of the participating laboratories used EUCAST, or EUCAST-harmonised, clinical breakpoints, which is an improvement compared with previous years and increases comparability of the reported data [5].

National percentages

As a general rule, results were reported as a resistance percentage, i.e. the percentage of R isolates out of all isolates with AST information for that specific species–antimicrobial group. For some bacteria, results were reported 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 multiplying the percentage resistance for each country with the corresponding national population weight and summing up the results; weights were rescaled if resistance percentages were not available for one or more countries. Annual population data were retrieved from the Eurostat online database [6].

Country weightings were used to adjust for imbalances in reporting propensity and population coverage, as the total number of reported isolates by country does not, in most cases, reflect the population size. As an improvement compared to previous reports, the methodology for calculating the EU/EEA population-weighted mean percentage has been adjusted to better control for increasing differences in the national number of reported isolates. This sometimes resulted in differences compared with the EU/EEA population-weighted means in previous reports.

Trend analyses

The statistical significance of temporal trends of resistance percentages by country and for the EU/EEA population-weighted mean was calculated based on data from the last four years, i.e. 2014 to 2017. Countries reporting fewer than 20 isolates per year, or not providing data for all years within the considered period, were not included in the analysis. The statistical significance of trends was assessed by the Cochran–Armitage test, and a p-value of ≤ 0.05 was considered significant. An additional sensitivity analysis was performed by repeating the Cochran–Armitage test, including only laboratories that consistently reported data for the full four-year period, thus minimising selection bias when assessing the significance of the trends. This restriction might, in some cases, have resulted in a considerably lower number of isolates compared with the analysis that included all participating laboratories.

Data validity

The results, both for inter-country comparisons and in some cases national trends, should be interpreted with caution. Several factors might influence the results and result in over- as well as underestimation of resistance percentages.

Key indicators of the population coverage and data representativeness are presented in the country summary sheets, available in the Annex. 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, whereas other countries report data from a smaller subset of local laboratories and hospitals. For an overview of the population coverage and the number of reporting laboratories, see Annex. 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 of the whole country. Likewise, national trends may not be representative of regional situations because pooled data could mask variations at the local level.

Sampling

EARS-Net data are exclusively based on invasive isolates from blood or cerebrospinal fluid. The clinical relevance of indicator bacteria isolated from these body 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, e.g. urinary tract infections, pneumonia and wound infections.

Case ascertainment of patients with bloodstream infections 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 does not show an adequate therapeutic response. Predictably, this will lead to an overestimation of the resistance percentage by not including susceptible bloodstream infection 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. As a result, the interpretation of AST results may vary, at least for resistance mechanisms resulting in minimum inhibitory concentrations (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) were not always provided by participating laboratories, only the reported local interpretations as S, I or R were considered for the analyses.

All laboratories providing data to EARS-Net are offered participation in an annual EQA exercise to assess the reliability of their laboratory test results. The level of performance for EQA specimens is generally high [5].

3 Antimicrobial resistance in Europe 2014 to 2017

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 the EU/EEA and involved in infections of both community and healthcare origin. In addition, it is associated with intra-abdominal infections and causes neonatal meningitis.

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 (ESBLs) 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 mediated by a range of carbapenemases, which may confer resistance to virtually all available beta-lactam antibiotics. Carbapenamase genes are often located on plasmids that can be exchanged between Enterobacteriaceae, such as *E. coli*, and other gram-negative bacteria.

Antimicrobial resistance

At the EU/EEA level, more than half (58.2%) of the *E. coli* isolates reported to EARS-Net for 2017 were resistant to at least one of the antimicrobial groups under regular surveillance, i.e. aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems (Table 3.1). In 2017, the highest EU/EEA population-weighted mean resistance percentage was reported for aminopenicillins (58.7%), followed by fluoroquinolones (25.7%), third-generation cephalosporins (14.9%) and aminoglycosides (11.4%) (Tables 3.2–3.5). In 2017, resistance to carbapenems remained rare in *E. coli* (Table 3.6).

There were small but significant increasing trends in the EU/EEA population-weighted mean percentages of fluoroquinolone resistance and third-generation cephalosporin resistance between 2014 and 2017 (Tables 3.3–3.4). For carbapenem resistance, there was a very small but significantly decreasing trend at the EU/EEA level (Table 3.6). When restricting the analysis to only include the laboratories that consistently reported data during all four years, only the trend for third-generation cephalosporin resistance remained statistically significant.

Resistance to multiple antimicrobial groups was common. Among the resistant phenotypes, resistance to aminopenicillins, both as single resistance or in combination with other antimicrobial groups, was the most common at the EU/EEA level (Table 3.1). In 2017, combined resistance, measured as resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides was 6.3% (EU/EEA population-weighted mean) and did not significantly change during the period 2014–2017 (Table 3.7).

As in previous years, a majority (87.4%) of the third-generation cephalosporin-resistant isolates from 2017 were extended-spectrum beta-lactamase (ESBL)-positive. Only data from laboratories reporting ESBL results for all isolates identified as resistant to third-generation cephalosporins (64.9% 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).

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 isolates that were fully susceptible to the included antimicrobial groups were also present (Figure 3.1).

Discussion

As *E. coli* is the most common cause of bloodstream infection in Europe, prompt access to effective antimicrobial treatment is essential to reduce the health-related and economic burden associated with this type of infection. The high levels of ESBLs and the increasing frequency of resistance to key antimicrobial groups is a serious concern and reflects a continuous loss of effectiveness in treatment of patients with serious infections.

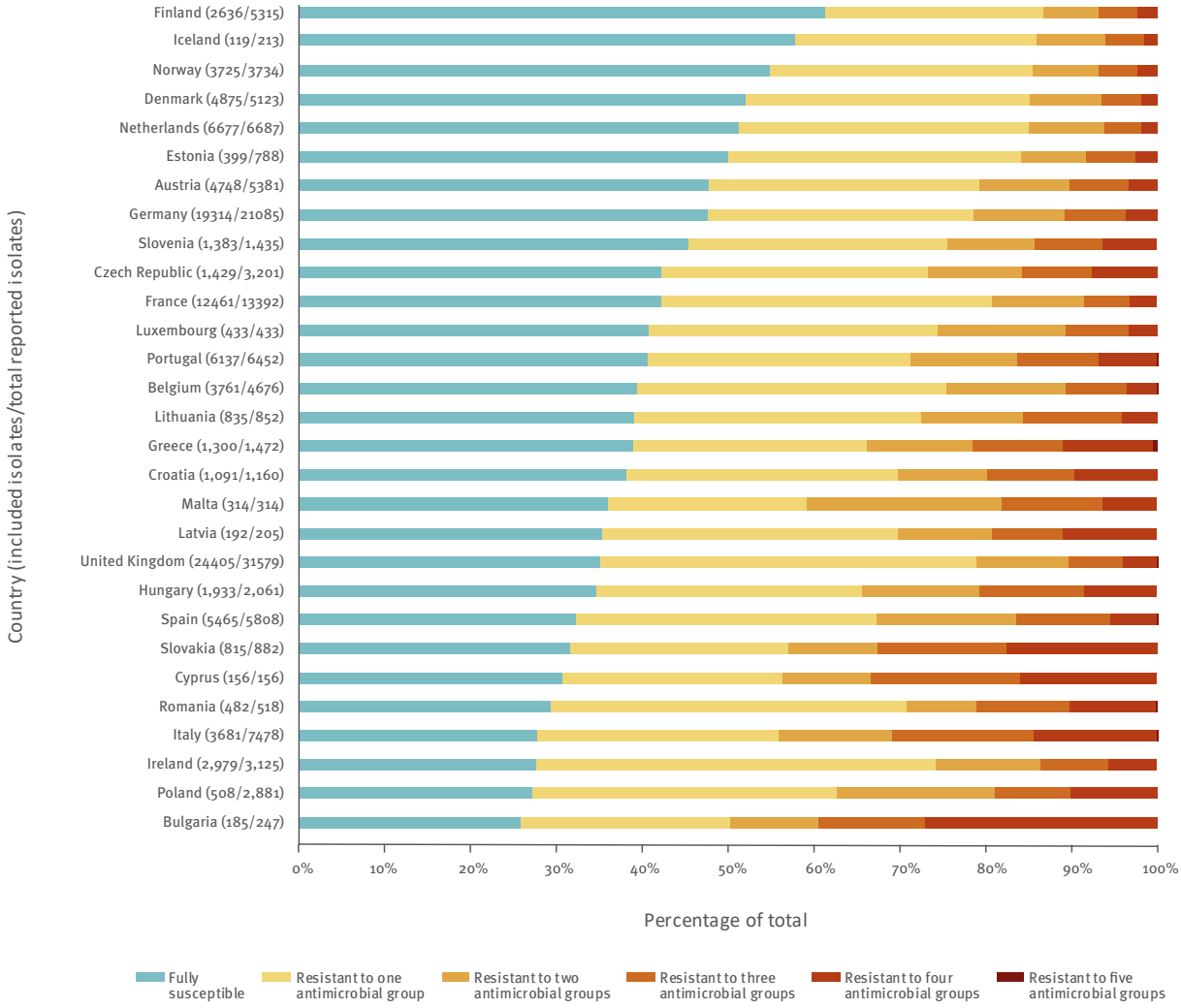
Use of broad-spectrum antimicrobials is a known risk factor for colonisation and spread of resistant Enterobacteriaceae, including *E. coli*. Associations between EARS-Net national *E. coli* resistance levels and national antimicrobial consumption in both the hospital and community sector have been found [7], underlining the importance of comprehensive antimicrobial stewardship programmes targeting both the community and healthcare settings [8].

The high levels of ESBLs and increasing resistance to key antimicrobial groups might also lead to an increased consumption of carbapenems, which in turn can increase the selection pressure and facilitated the spread of carbapenem-resistant Enterobacteriaceae (CRE). CRE infections are associated with high mortality, primarily

due to delays in effective treatment and the limited availability of treatment options. In 2017, the percentage of carbapenem resistance in the invasive *E. coli* isolates reported to EARS-Net remained low. However, continued and close monitoring remains essential as carbapenem-resistant *E. coli* are adapted to spread in healthcare settings and in the community. A recently updated ECDC rapid risk assessment on CRE highlights the need for high standards in infection prevention and control, combined with adequate microbiological capacity to detected and prevent further spread [9].

CRE can be resistant to carbapenems as a result of various mechanisms, including – with increasing frequency – production of carbapenemase enzymes. The overall presence and spread of carbapenemase-producing Enterobacteriaceae is not possible to assess by the data available from EARS-Net as some carbapenemases do not confer a fully carbapenem-resistant phenotype. One example is the OXA-48-like carbapenemase enzymes that present a particular problem for laboratory detection because of their weak hydrolysing capacity of carbapenems [10]. To address the need for enhanced CRE surveillance and to complement the phenotypic-based surveillance data available from EARS-Net, the European Antimicrobial Resistance Genes Surveillance Network (EURGen-Net), a new ECDC network for genomic-based surveillance of multidrug-resistant bacteria, was established. As part of this network, a carbapenem- and/or colistin-resistant Enterobacteriaceae (CCRE) project was initiated, covering a total of 37 EU/EEA countries and EU enlargement countries. The project's duration is from 2018 to 2020 [11]. The results of this project will provide information on the prevalence and distribution of carbapenemases and contribute to a better understanding of the dissemination of CRE in Europe and the risk factors associated with CRE infections.

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, 2017**



Only data from isolates tested against all included antimicrobial groups included in analysis.

Trends in fluoroquinolone resistance might be influenced by the fact that, in 2016, EUCAST lowered its clinical breakpoints for several fluoroquinolones in Enterobacteriaceae. As EARS-Net bases its results on SIR interpretations, it is not possible to assess when or to what degree this change has been implemented by the participating laboratories and how this change has influenced the results. As a consequence, trend analyses for fluoroquinolone resistance should be interpreted with caution.

As high *E. coli* resistance levels have been reported from food-producing animals in Europe, including isolates with carbapenemase production [12], the need to ensure cross-sectoral collaboration between the veterinary and food production sectors is essential. This work is underpinned by the European Commission's 'One Health' approach, which addresses resistance in both humans and animals. ECDC is working closely with the European Food Safety Authority and the European Medicines Agency to better understand the interrelationship between antimicrobial use and antimicrobial resistance in humans and animals across Europe.

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=112 327), EU/EEA countries, 2017

Resistance pattern	Number of isolates	Percentage (%) of total**
Fully susceptible	**46 913**	**41.8**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance)	**39 649**	**35.3**
Aminopenicillins	36 570	32.6
Fluoroquinolones	2 868	2.6
Other antimicrobial groups	211	0.2
Resistance to two antimicrobial groups		
Total (all two-group combinations)	**12 340**	**11.0**
Aminopenicillins + fluoroquinolones	7 730	6.9
Aminopenicillins + third-generation cephalosporins	2 501	2.2
Aminopenicillins + aminoglycosides	1 933	1.7
Other antimicrobial group combinations	176	0.2
Resistance to three antimicrobial groups		
Total (all three-group combinations)	**8 205**	**7.3**
Aminopenicillins + third-generation cephalosporins + fluoroquinolones	5 040	4.5
Aminopenicillins + fluoroquinolones + aminoglycosides	2 668	2.4
Other antimicrobial group combinations	497	0.4
Resistance to four antimicrobial groups		
Total (all four-group combinations)	**5 196**	**4.6**
Aminopenicillins + third-generation cephalosporins + fluoroquinolones + aminoglycosides	5 174	4.6
Other antimicrobial group combinations	22	‹0.1
Resistance to five antimicrobial groups		
Aminopenicillins + third-generation cephalosporins + fluoroquinolones + aminoglycosides + carbapenems	24	‹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, 2017**

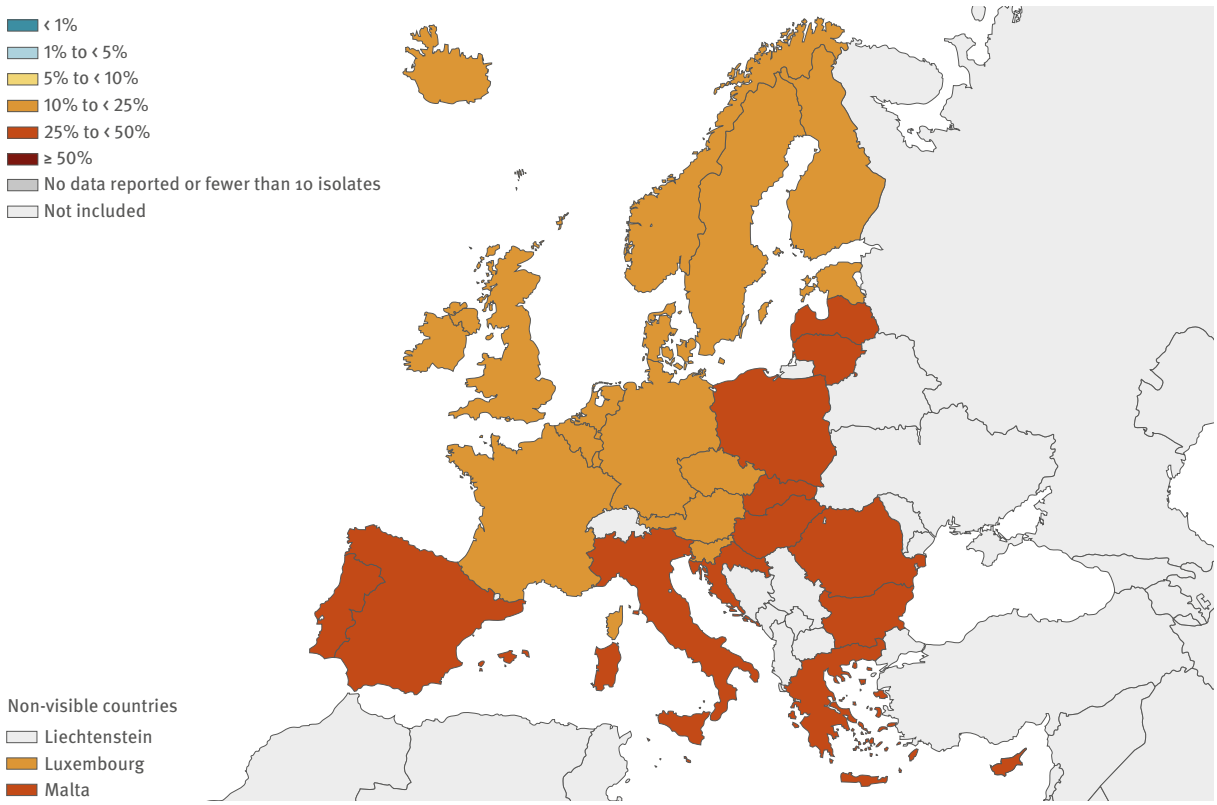


Figure 3.3. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU/EEA countries, 2017**

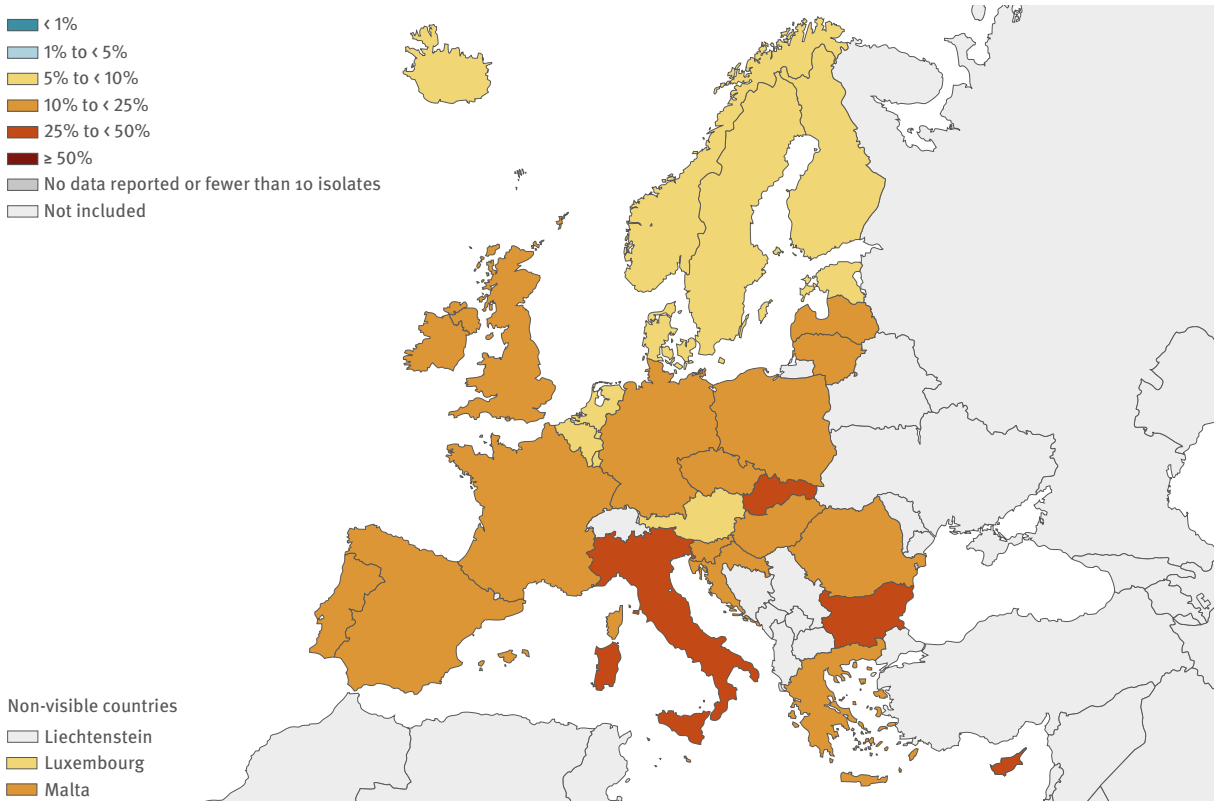


Figure 3.4. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2017**

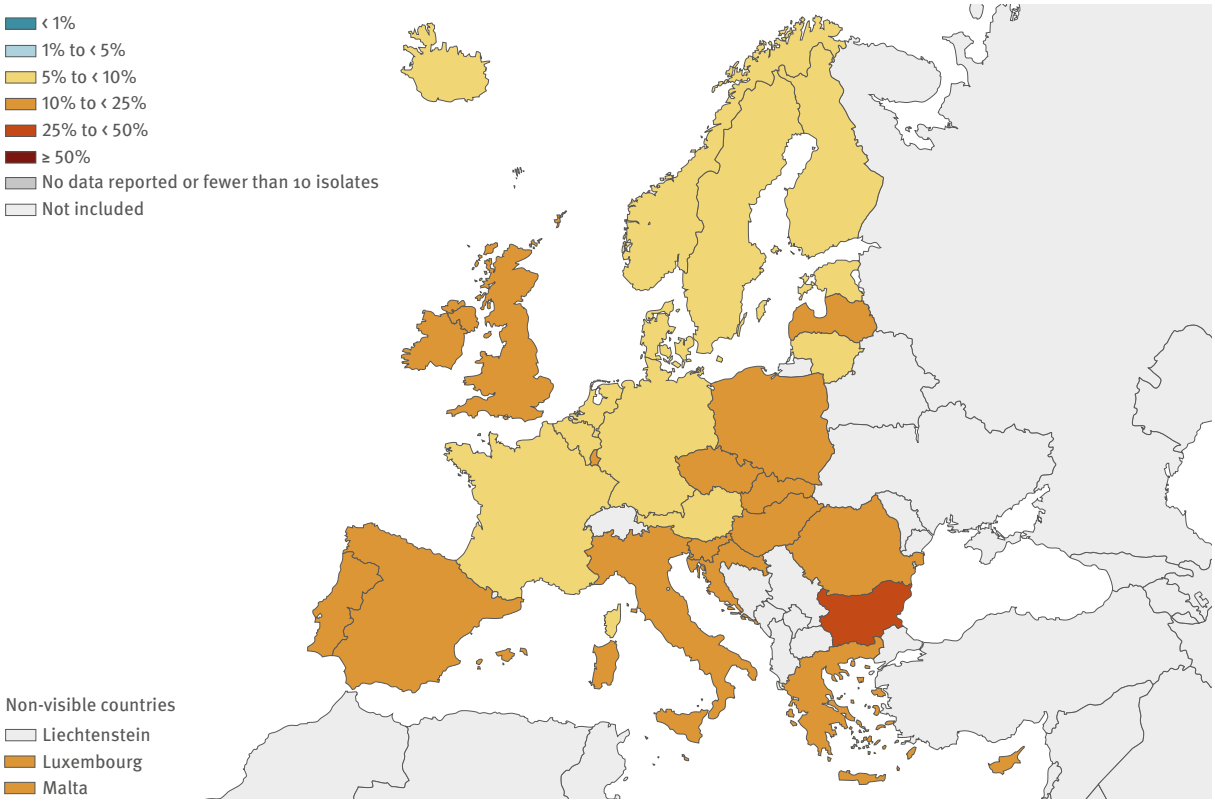


Figure 3.5. ***Escherichia coli*****. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2017**

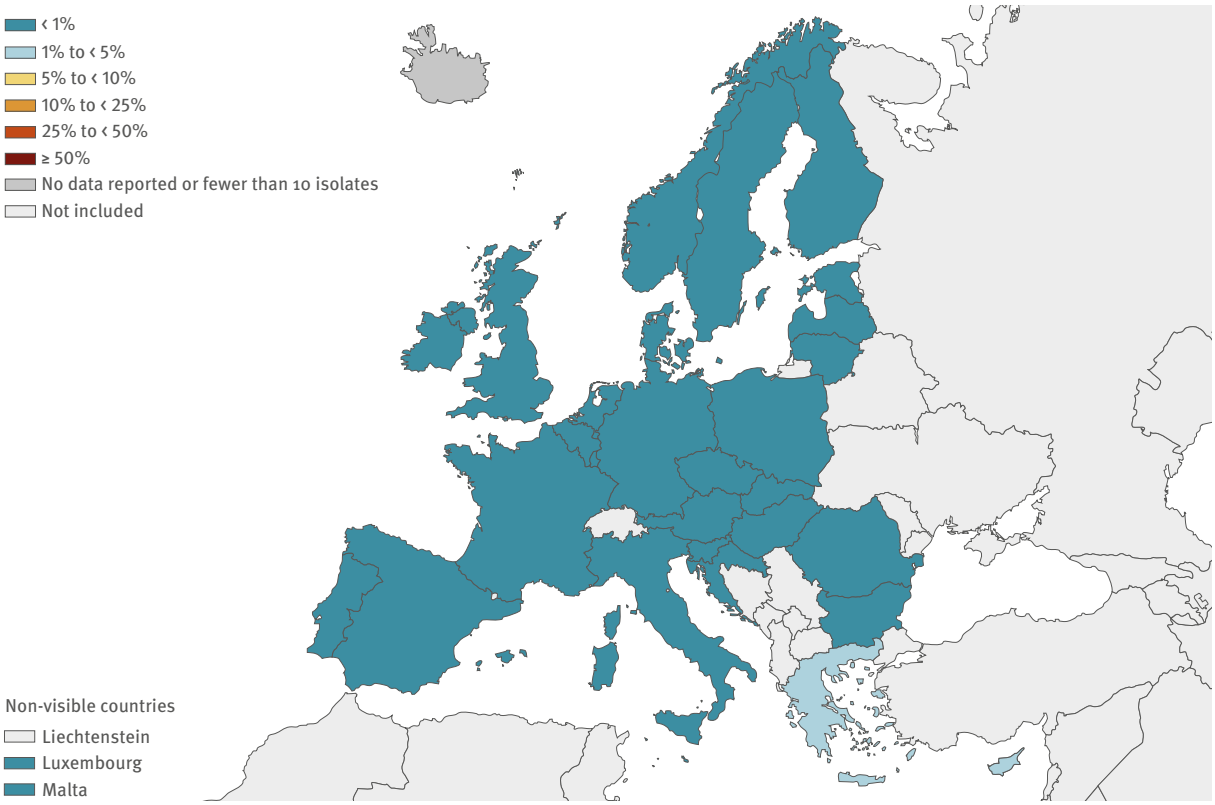


Figure 3.6. ***Escherichia coli.*** **Percentage (%) of invasive isolates with combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides, by country, EU/EEA countries, 2017**

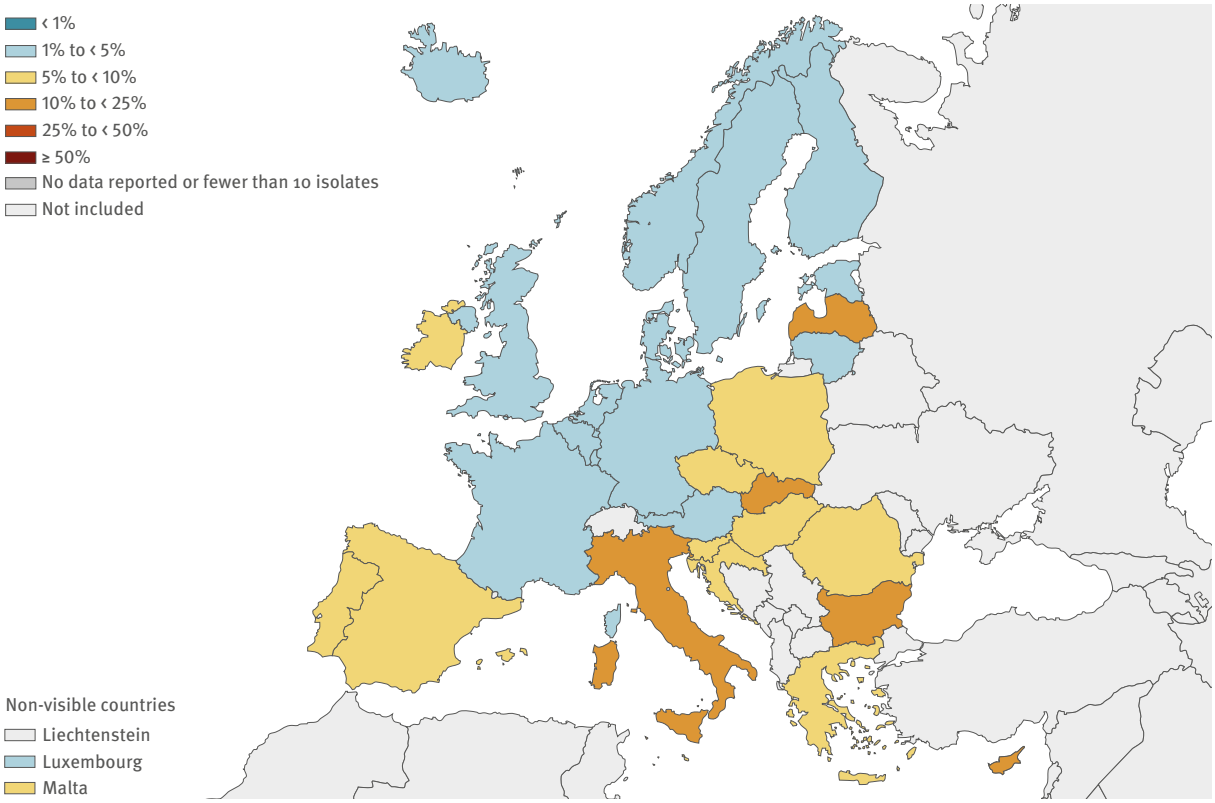


Table 3.2. ***Escherichia coli*. Total number of invasive isolates tested (N) and percentage with resistance to aminopenicillins (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Finland	2365	34.7	(33-37)	2472	36.0	(34-38)	2690	35.8	(34-38)	2874	35.2	(33-37)	
Iceland	151	43.0	(35-51)	173	44.5	(37-52)	192	43.8	(37-51)	213	41.3	(35-48)	
Norway	3404	41.8	(40-43)	3299	45.8	(44-48)	3615	42.9	(41-45)	3731	42.2	(41-44)	
Denmark	4490	44.9	(43-46)	4594	45.3	(44-47)	4698	45.0	(44-46)	4885	45.6	(44-47)	
Netherlands	6458	46.0	(45-47)	5376	47.2	(46-49)	6394	45.9	(45-47)	6684	45.9	(45-47)	
Estonia	261	47.1	(41-53)	196	47.4	(40-55)	471	46.7	(42-51)	439	47.8	(43-53)	
Germany	5543	51.7	(50-53)	8358	49.4	(48-50)	15957	49.0	(48-50)	19786	49.1	(48-50)	↓ #
Austria	4742	50.4	(49-52)	4880	49.9	(48-51)	5094	50.5	(49-52)	5188	49.5	(48-51)	
Slovenia	1216	52.6	(50-55)	1326	54.8	(52-58)	1420	57.1	(54-60)	1435	51.6	(49-54)	
Czech Republic	2978	54.4	(53-56)	3172	54.3	(53-56)	3055	55.1	(53-57)	3198	53.0	(51-55)	
France	10325	55.9	(55-57)	10946	57.0	(56-58)	11248	57.2	(56-58)	13293	55.6	(55-56)	
Luxembourg	371	59.6	(54-65)	347	60.2	(55-65)	419	53.2	(48-58)	433	55.9	(51-61)	
Portugal	4899	58.9	(57-60)	5177	57.8	(56-59)	5772	59.2	(58-61)	6245	56.2	(55-57)	↓
Belgium	2876	58.9	(57-61)	2674	58.0	(56-60)	3736	58.0	(56-60)	4669	57.5	(56-59)	
Greece	1057	55.7	(53-59)	1079	56.1	(53-59)	1170	56.9	(54-60)	1306	57.5	(55-60)	
Lithuania	590	57.8	(54-62)	582	59.6	(56-64)	794	59.2	(56-63)	845	57.8	(54-61)	
EU/EEA (population-weighted mean)	**73881**	**58.5**	**(58-59)**	**77813**	**58.9**	**(59-59)**	**107383**	**59.0**	**(59-59)**	**122955**	**58.7**	**(58-59)**	
Croatia	1077	54.0	(51-57)	1042	55.3	(52-58)	1043	57.3	(54-60)	1135	58.8	(56-62)	↑
Malta	268	53.0	(47-59)	238	55.5	(49-62)	328	60.1	(55-65)	314	59.6	(54-65)	
Hungary	1603	59.1	(57-61)	1970	60.6	(58-63)	1969	57.4	(55-60)	2021	60.3	(58-62)	
Latvia	182	48.4	(41-56)	192	53.6	(46-61)	247	55.1	(49-61)	202	60.4	(53-67)	↑
United Kingdom	6637	62.7	(62-64)	5117	65.8	(64-67)	21614	62.7	(62-63)	28647	62.5	(62-63)	↓ #
Spain	5817	64.9	(64-66)	6427	63.9	(63-65)	6791	64.1	(63-65)	5724	62.6	(61-64)	↓
Slovakia	866	64.5	(61-68)	878	62.8	(59-66)	817	62.3	(59-66)	853	64.9	(62-68)	
Cyprus	153	71.2	(63-78)	123	68.3	(59-76)	149	69.1	(61-76)	156	65.4	(57-73)	
Italy	2178	65.4	(63-67)	3385	67.4	(66-69)	3114	66.9	(65-69)	4078	67.1	(66-69)	
Romania	253	68.0	(62-74)	259	73.0	(67-78)	376	72.3	(68-77)	494	68.2	(64-72)	
Poland	268	59.7	(54-66)	346	64.7	(59-70)	1034	64.5	(62-67)	913	69.4	(66-72)	↑ #
Ireland	2694	68.7	(67-70)	2646	66.2	(64-68)	2990	68.1	(66-70)	2991	69.8	(68-71)	
Bulgaria	159	73.0	(65-80)	143	66.4	(58-74)	186	78.0	(71-84)	203	73.9	(67-80)	
Sweden	-	-	-	396	34.1	(29-39)	-	-	-	-	-	-	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.3 ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	141	7.8	(4-14)	162	6.8	(3-12)	178	9.6	(6-15)	199	11.6	(7-17)	
Finland	3987	11.0	(10-12)	4404	11.2	(10-12)	4808	11.5	(11-12)	5305	12.0	(11-13)	
Denmark	4489	12.3	(11-13)	4570	11.9	(11-13)	4827	11.0	(10-12)	5123	12.8	(12-14)	
Norway	3415	11.0	(10-12)	3298	10.2	(9-11)	3611	10.9	(10-12)	3731	13.6	(12-15)	↑
Netherlands	6444	13.3	(12-14)	5379	13.2	(12-14)	6398	12.8	(12-14)	6685	14.2	(13-15)	
France	10307	17.6	(17-18)	10998	17.7	(17-18)	11251	16.7	(16-17)	13328	15.0	(14-16)	↓
Sweden	5142	11.3	(10-12)	5525	12.6	(12-14)	6947	13.7	(13-14)	5762	15.8	(15-17)	N/A
Estonia	407	12.3	(9-16)	256	15.2	(11-20)	699	13.9	(11-17)	781	17.4	(15-20)	↑
United Kingdom	6921	16.8	(16-18)	5812	15.6	(15-17)	22883	16.3	(16-17)	30185	17.5	(17-18)	↑ #
Austria	4642	19.8	(19-21)	4808	20.0	(19-21)	5278	19.8	(19-21)	5367	20.5	(19-22)	
Germany	6163	20.6	(20-22)	9019	19.4	(19-20)	17196	19.4	(19-20)	21080	20.9	(20-21)	
Luxembourg	368	24.7	(20-29)	347	24.2	(20-29)	418	28.9	(25-34)	433	22.9	(19-27)	
Ireland	2703	24.5	(23-26)	2631	23.1	(21-25)	2990	22.9	(21-24)	3119	23.6	(22-25)	
Belgium	2599	26.7	(25-28)	2565	26.6	(25-28)	3854	24.5	(23-26)	4382	23.8	(23-25)	↓ #
Czech Republic	2976	21.6	(20-23)	3165	22.6	(21-24)	3061	27.6	(26-29)	3199	24.5	(23-26)	↑
Slovenia	1216	23.3	(21-26)	1325	24.6	(22-27)	1420	25.6	(23-28)	1383	24.9	(23-27)	
Lithuania	592	12.8	(10-16)	583	20.6	(17-24)	790	19.7	(17-23)	849	25.2	(22-28)	↑
EU/EEA (population-weighted mean)	**83863**	**25.4**	**(25-26)**	**90137**	**24.8**	**(24-25)**	**124306**	**25.2**	**(25-25)**	**138652**	**25.7**	**(25-26)**	↑ #
Romania	307	31.3	(26-37)	371	30.7	(26-36)	418	30.6	(26-35)	518	26.4	(23-30)	
Portugal	5027	32.4	(31-34)	5371	29.7	(28-31)	5783	28.9	(28-30)	6424	27.3	(26-28)	↓
Croatia	1072	20.1	(18-23)	1038	24.0	(21-27)	1041	27.9	(25-31)	1150	28.2	(26-31)	↑
Latvia	181	17.7	(12-24)	194	27.8	(22-35)	245	27.8	(22-34)	201	30.3	(24-37)	↑
Hungary	1614	28.4	(26-31)	2021	29.0	(27-31)	1986	26.8	(25-29)	2051	30.6	(29-33)	
Spain	5818	34.0	(33-35)	6484	31.6	(30-33)	6793	32.8	(32-34)	5557	32.5	(31-34)	
Greece	1105	32.8	(30-36)	1191	30.6	(28-33)	1304	32.1	(30-35)	1464	32.9	(31-35)	
Poland	1057	29.2	(27-32)	1571	27.9	(26-30)	2637	33.1	(31-35)	1832	35.9	(34-38)	↑ #
Bulgaria	215	38.6	(32-45)	204	35.3	(29-42)	237	42.2	(36-49)	247	42.1	(36-49)	
Cyprus	153	46.4	(38-55)	123	45.5	(37-55)	149	47.0	(39-55)	156	42.9	(35-51)	
Slovakia	887	43.0	(40-46)	894	44.2	(41-48)	826	40.4	(37-44)	882	43.2	(40-47)	
Malta	268	28.7	(23-35)	238	37.4	(31-44)	328	41.5	(36-47)	314	43.3	(38-49)	↑
Italy	3647	43.9	(42-46)	5590	44.4	(43-46)	5950	43.3	(42-45)	6945	44.9	(44-46)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.4. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Norway	3421	5.8	(5-7)	3301	6.0	(5-7)	3617	5.6	(5-6)	3734	5.9	(5-7)	
Iceland	152	3.3	(1-8)	173	1.7	(0-5)	192	4.2	(2-8)	213	6.1	(3-10)	
Netherlands	6497	5.7	(5-6)	5378	5.7	(5-6)	6397	6.4	(6-7)	6684	6.2	(6-7)	
Denmark	4410	7.0	(6-8)	4561	7.5	(7-8)	4659	6.6	(6-7)	4883	6.9	(6-8)	
Finland	4009	5.4	(5-6)	4342	6.1	(5-7)	4742	6.9	(6-8)	5223	6.9	(6-8)	↑
Sweden	6546	5.6	(5-6)	5995	6.2	(6-7)	6958	8.3	(8-9)	5790	7.4	(7-8)	N/A
Estonia	410	9.3	(7-12)	246	11.4	(8-16)	701	9.0	(7-11)	788	8.8	(7-11)	
Austria	4739	9.4	(9-10)	4900	9.7	(9-11)	5267	10.0	(9-11)	5129	9.6	(9-10)	
Belgium	2802	9.7	(9-11)	2593	9.7	(9-11)	3737	10.5	(10-12)	4672	9.7	(9-11)	
Luxembourg	368	12.0	(9-16)	347	12.7	(9-17)	418	13.6	(10-17)	433	9.7	(7-13)	
France	10349	9.9	(9-11)	11051	11.0	(10-12)	11313	11.2	(11-12)	13352	10.2	(10-11)	
United Kingdom	6221	10.3	(10-11)	5169	11.3	(10-12)	21846	9.2	(9-10)	27925	10.3	(10-11)	
Ireland	2691	10.7	(10-12)	2638	11.4	(10-13)	2985	11.4	(10-13)	3121	12.0	(11-13)	
Germany	6246	10.5	(10-11)	9031	10.3	(10-11)	17190	11.1	(11-12)	21070	12.3	(12-13)	↑
Slovenia	1216	12.7	(11-15)	1326	13.7	(12-16)	1420	12.5	(11-14)	1435	12.5	(11-14)	
Spain	5821	12.3	(12-13)	6428	11.6	(11-12)	6796	15.0	(14-16)	5804	12.8	(12-14)	↑ #
Czech Republic	2978	14.0	(13-15)	3172	14.5	(13-16)	3061	15.1	(14-16)	3199	14.2	(13-15)	
EU/EEA (population-weighted mean)	**85092**	**14.2**	**(14-14)**	**90126**	**14.6**	**(14-15)**	**123087**	**14.9**	**(15-15)**	**137677**	**14.9**	**(15-15)**	↑
Malta	268	10.8	(7-15)	238	11.8	(8-17)	328	14.6	(11-19)	314	15.6	(12-20)	
Portugal	5024	16.4	(15-17)	5376	16.1	(15-17)	5784	16.1	(15-17)	6441	15.6	(15-16)	
Croatia	1079	10.8	(9-13)	1046	12.5	(11-15)	1045	14.7	(13-17)	1148	16.5	(14-19)	↑
Poland	1085	10.5	(9-12)	1610	11.9	(10-14)	2719	13.7	(12-15)	2866	16.7	(15-18)	↑
Lithuania	594	8.1	(6-11)	581	16.0	(13-19)	795	14.7	(12-17)	852	16.8	(14-19)	↑
Greece	1122	21.0	(19-24)	1215	19.8	(18-22)	1304	17.6	(16-20)	1470	18.3	(16-20)	↓ #
Romania	306	29.4	(24-35)	369	26.8	(22-32)	418	23.4	(19-28)	518	18.7	(15-22)	↓
Hungary	1619	16.4	(15-18)	2026	16.7	(15-18)	1993	16.7	(15-18)	2058	20.1	(18-22)	↑
Latvia	165	10.9	(7-17)	201	17.9	(13-24)	253	24.1	(19-30)	205	22.0	(16-28)	↑
Italy	3694	28.7	(27-30)	5592	30.1	(29-31)	5938	29.8	(29-31)	7077	29.5	(28-31)	
Cyprus	153	28.8	(22-37)	123	28.5	(21-37)	149	30.2	(23-38)	156	30.8	(24-39)	
Slovakia	889	31.8	(29-35)	893	30.0	(27-33)	824	29.7	(27-33)	870	30.9	(28-34)	
Bulgaria	218	40.4	(34-47)	205	38.5	(32-46)	238	41.6	(35-48)	247	41.3	(35-48)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.5. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Finland	3817	4.6	(4-5)	4135	5.4	(5-6)	4519	4.9	(4-6)	4982	5.0	(4-6)	
Iceland	152	5.3	(2-10)	173	2.9	(1-7)	192	3.6	(1-7)	213	5.6	(3-10)	
Netherlands	6485	6.3	(6-7)	5378	6.0	(5-7)	6397	6.2	(6-7)	6686	5.6	(5-6)	
Estonia	411	6.8	(5-10)	257	9.3	(6-14)	702	7.4	(6-10)	786	5.7	(4-8)	
Denmark	4493	7.3	(7-8)	4591	6.8	(6-8)	4846	6.1	(5-7)	5122	6.0	(5-7)	↓
Sweden	5606	6.1	(5-7)	5761	6.4	(6-7)	6949	7.2	(7-8)	5758	6.5	(6-7)	N/A
Germany	6244	6.9	(6-8)	9029	7.1	(7-8)	17023	7.0	(7-7)	20623	6.9	(7-7)	
France	10341	7.7	(7-8)	11055	8.2	(8-9)	11135	7.9	(7-8)	13103	7.0	(7-7)	↓
Norway	3419	5.9	(5-7)	3301	6.0	(5-7)	3614	5.5	(5-6)	3732	7.2	(6-8)	
Austria	4726	7.1	(6-8)	4884	7.0	(6-8)	5248	7.8	(7-9)	5318	7.7	(7-8)	
Belgium	2045	8.9	(8-10)	2286	8.4	(7-10)	3499	8.4	(8-9)	3769	8.1	(7-9)	
Lithuania	584	10.6	(8-13)	583	10.1	(8-13)	791	8.0	(6-10)	848	8.3	(6-10)	
United Kingdom	7274	8.9	(8-10)	6052	9.9	(9-11)	23166	9.9	(9-10)	30739	10.0	(10-10)	↑
Luxembourg	367	7.9	(5-11)	347	8.9	(6-12)	418	9.1	(7-12)	433	10.4	(8-14)	
Czech Republic	2979	10.7	(10-12)	3172	11.3	(10-13)	3061	12.2	(11-13)	3199	10.7	(10-12)	
Malta	268	9.7	(6-14)	238	12.2	(8-17)	328	10.4	(7-14)	314	10.8	(8-15)	
EU/EEA (population-weighted mean)	**84015**	**11.3**	**(11-11)**	**90050**	**11.6**	**(11-12)**	**123625**	**11.6**	**(11-12)**	**138883**	**11.4**	**(11-12)**	
Slovenia	1216	11.3	(10-13)	1326	12.9	(11-15)	1420	10.6	(9-12)	1435	11.4	(10-13)	
Ireland	2705	12.1	(11-13)	2646	11.8	(11-13)	2991	11.2	(10-12)	3123	11.9	(11-13)	
Portugal	4991	15.1	(14-16)	5372	13.8	(13-15)	5765	13.1	(12-14)	6387	11.9	(11-13)	↓
Latvia	181	8.3	(5-13)	191	14.1	(10-20)	244	12.7	(9-18)	201	13.4	(9-19)	
Spain	5820	15.1	(14-16)	6489	14.7	(14-16)	6796	14.5	(14-15)	5805	13.8	(13-15)	
Poland	1068	9.8	(8-12)	1581	11.2	(10-13)	2521	13.3	(12-15)	2719	14.0	(13-15)	↑ #
Hungary	1610	14.7	(13-17)	2020	13.6	(12-15)	1992	13.3	(12-15)	2060	15.1	(14-17)	
Romania	303	17.2	(13-22)	366	18.3	(14-23)	414	15.0	(12-19)	513	15.2	(12-19)	
Croatia	1077	10.9	(9-13)	1008	12.7	(11-15)	1027	15.7	(14-18)	1154	16.6	(15-19)	↑
Greece	1110	15.6	(14-18)	1200	16.1	(14-18)	1301	16.8	(15-19)	1467	17.0	(15-19)	
Italy	3493	19.4	(18-21)	5408	20.2	(19-21)	6079	19.0	(18-20)	7134	18.4	(18-19)	
Cyprus	153	17.6	(12-25)	123	13.8	(8-21)	149	16.1	(11-23)	156	21.8	(16-29)	
Slovakia	888	22.7	(20-26)	896	24.2	(21-27)	828	20.2	(17-23)	875	22.5	(20-25)	
Bulgaria	189	29.1	(23-36)	182	19.8	(14-26)	210	34.8	(28-42)	229	36.2	(30-43)	↑

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.6. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Bulgaria	197	0.5	(0-3)	182	0.0	(0-2)	224	0.9	(0-3)	247	0.0	(0-1)	
Croatia	1079	0.0	(0-0)	1046	0.0	(0-0)	1045	0.0	(0-0)	1132	0.0	(0-0)	
Czech Republic	1702	0.0	(0-0)	1471	0.0	(0-0)	1483	0.0	(0-0)	1431	0.0	(0-0)	
Estonia	254	0.0	(0-1)	219	0.0	(0-2)	602	0.0	(0-1)	687	0.0	(0-1)	
Finland	4013	0.0	(0-0)	4425	0.0	(0-0)	4832	<0.1	(0-0)	5315	0.0	(0-0)	
Iceland	140	0.0	(0-3)	162	0.0	(0-0)	192	0.0	(0-0)	198	0.0	(0-0)	
Lithuania	593	0.0	(0-1)	579	0.0	(0-1)	793	0.0	(0-0)	849	0.0	(0-0)	
Luxembourg	368	0.3	(0-2)	347	0.0	(0-1)	418	0.0	(0-1)	433	0.0	(0-1)	
Latvia	182	0.0	(0-2)	192	0.0	(0-2)	246	0.0	(0-1)	203	0.0	(0-2)	
Malta	268	0.0	(0-1)	238	0.0	(0-2)	328	0.0	(0-1)	314	0.0	(0-1)	
Slovenia	1216	0.0	(0-0)	1326	0.0	(0-0)	1420	0.0	(0-0)	1435	0.0	(0-0)	
Slovakia	820	0.0	(0-0)	830	0.0	(0-0)	751	0.0	(0-0)	844	0.0	(0-0)	
Germany	6247	0.1	(0-0)	9032	<0.1	(0-0)	17196	<0.1	(0-0)	21080	<0.1	(0-0)	↓
Denmark	3946	<0.1	(0-0)	4046	<0.1	(0-0)	4671	0.0	(0-0)	5117	<0.1	(0-0)	
Austria	4600	<0.1	(0-0)	4760	<0.1	(0-0)	5134	<0.1	(0-0)	5227	<0.1	(0-0)	
Belgium	2614	<0.1	(0-0)	2588	0.0	(0-0)	3845	0.1	(0-0)	4672	<0.1	(0-0)	
Spain	5817	0.1	(0-0)	6399	<0.1	(0-0)	6790	0.1	(0-0)	5802	<0.1	(0-0)	
France	9693	<0.1	(0-0)	10481	<0.1	(0-0)	10929	<0.1	(0-0)	12843	<0.1	(0-0)	
Sweden	6298	0.0	(0-0)	5307	0.1	(0-0)	6927	0.1	(0-0)	5769	<0.1	(0-0)	N/A
United Kingdom	6367	0.1	(0-0)	5497	0.3	(0-0)	22762	<0.1	(0-0)	30074	<0.1	(0-0)	↓
Ireland	2697	<0.1	(0-0)	2615	<0.1	(0-0)	2989	<0.1	(0-0)	3116	<0.1	(0-0)	
Netherlands	6475	0.0	(0-0)	5375	<0.1	(0-0)	6394	0.0	(0-0)	6682	<0.1	(0-0)	
Poland	979	0.2	(0-1)	1499	0.1	(0-0)	2553	<0.1	(0-0)	2741	<0.1	(0-0)	
Hungary	1517	0.0	(0-0)	1922	0.0	(0-0)	1905	0.0	(0-0)	1987	0.1	(0-0)	
Norway	3420	0.0	(0-0)	3297	<0.1	(0-0)	3616	0.1	(0-0)	3733	0.1	(0-0)	
EU/EEA (population-weighted mean)	**81776**	**0.1**	**(0-0)**	**86487**	**0.2**	**(0-0)**	**121774**	**0.1**	**(0-0)**	**137728**	**0.1**	**(0-0)**	**↓ #**
Italy	3696	0.2	(0-0)	5592	0.2	(0-0)	6106	0.3	(0-0)	7280	0.3	(0-0)	
Portugal	4998	<0.1	(0-0)	5354	0.1	(0-0)	5760	<0.1	(0-0)	6384	0.3	(0-1)	↑
Romania	305	0.7	(0-2)	368	1.9	(1-4)	411	1.0	(0-2)	510	0.4	(0-1)	
Cyprus	153	0.0	(0-2)	123	0.0	(0-3)	149	0.0	(0-2)	156	1.3	(0-5)	
Greece	1122	1.2	(1-2)	1215	1.2	(1-2)	1303	0.9	(0-2)	1467	1.6	(1-2)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.7. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	141	1.4	(0-5)	162	0.0	(0-2)	178	1.1	(0-4)	199	1.5	(0-4)	
Denmark	4406	1.9	(1-2)	4531	2.5	(2-3)	4640	1.8	(1-2)	4883	1.8	(1-2)	
Netherlands	6425	2.1	(2-3)	5377	2.0	(2-2)	6396	2.3	(2-3)	6681	1.9	(2-2)	
Sweden	4203	2.0	(2-2)	5257	2.5	(2-3)	6939	3.1	(3-4)	5746	2.0	(2-2)	N/A
Finland	3787	2.2	(2-3)	4103	2.6	(2-3)	4492	2.4	(2-3)	4971	2.4	(2-3)	
Norway	3413	2.0	(2-2)	3298	1.9	(1-2)	3609	1.9	(2-2)	3729	2.4	(2-3)	
France	10299	3.5	(3-4)	10988	3.9	(4-4)	11082	3.8	(3-4)	13038	3.0	(3-3)	↓
Austria	4609	2.6	(2-3)	4785	2.9	(2-3)	5235	3.5	(3-4)	5071	3.3	(3-4)	↑
Belgium	2045	3.9	(3-5)	2285	3.5	(3-4)	3496	3.8	(3-4)	3765	3.5	(3-4)	
Luxembourg	367	3.8	(2-6)	347	5.2	(3-8)	418	3.8	(2-6)	433	3.5	(2-6)	
Germany	6158	3.0	(3-3)	9013	3.0	(3-3)	17013	3.4	(3-4)	20610	3.7	(3-4)	↑
Estonia	404	3.5	(2-6)	233	5.2	(3-9)	698	4.0	(3-6)	780	3.7	(3-5)	
United Kingdom	6191	4.4	(4-5)	5119	4.5	(4-5)	21101	4.0	(4-4)	26808	4.1	(4-4)	
Lithuania	582	2.6	(1-4)	581	4.3	(3-6)	783	2.6	(2-4)	845	4.4	(3-6)	
Spain	5814	5.3	(5-6)	6416	5.5	(5-6)	6787	6.2	(6-7)	5551	5.5	(5-6)	
Ireland	2689	4.7	(4-6)	2621	5.4	(5-6)	2984	5.3	(5-6)	3116	5.7	(5-7)	
Czech Republic	2976	6.4	(6-7)	3165	6.9	(6-8)	3061	7.9	(7-9)	3199	6.3	(5-7)	
Slovenia	1216	7.1	(6-9)	1325	8.1	(7-10)	1420	6.9	(6-8)	1383	6.3	(5-8)	
EU/EEA (population-weighted mean)	**80896**	**6.2**	**(6-6)**	**88084**	**6.3**	**(6-6)**	**120727**	**6.4**	**(6-7)**	**132208**	**6.3**	**(6-6)**	
Malta	268	6.7	(4-10)	238	7.1	(4-11)	328	5.5	(3-9)	314	6.4	(4-10)	
Portugal	4989	8.2	(7-9)	5366	7.6	(7-8)	5762	7.7	(7-8)	6365	6.6	(6-7)	↓
Hungary	1599	8.2	(7-10)	2015	6.7	(6-8)	1981	6.4	(5-8)	2047	8.2	(7-9)	
Poland	1026	5.6	(4-7)	1532	6.1	(5-7)	2411	8.5	(7-10)	1666	8.2	(7-10)	↑
Croatia	1070	6.0	(5-8)	1000	6.9	(5-9)	1023	9.4	(8-11)	1133	9.4	(8-11)	↑
Romania	298	14.4	(11-19)	364	13.5	(10-17)	410	11.7	(9-15)	513	9.7	(7-13)	↓
Greece	1102	10.7	(9-13)	1187	10.7	(9-13)	1300	10.4	(9-12)	1463	9.8	(8-11)	
Latvia	163	2.5	(1-6)	191	10.5	(7-16)	242	10.3	(7-15)	197	11.2	(7-16)	↑
Italy	3428	13.7	(13-15)	5389	14.6	(14-16)	5763	12.9	(12-14)	6454	13.7	(13-15)	
Cyprus	153	13.1	(8-19)	123	9.8	(5-16)	149	11.4	(7-18)	156	15.4	(10-22)	
Slovakia	887	17.0	(15-20)	891	17.1	(15-20)	822	14.8	(12-17)	863	17.7	(15-20)	
Bulgaria	188	20.2	(15-27)	182	12.6	(8-18)	204	22.1	(17-28)	229	24.9	(19-31)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

3.2 *Klebsiella pneumoniae*

Klebsiella pneumoniae predominantly colonises 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.

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 *K. pneumoniae* infections. A recently emerging threat is carbapenem resistance mediated by a range of carbapenemases, which may confer resistance to virtually all available beta-lactam antibacterial drugs. Carbapenamase genes are often located on plasmids that can be exchanged between Enterobacteriaceae, including *K. pneumoniae*, and other gram-negative bacteria.

Antimicrobial resistance

At the EU/EEA level, more than a third (34.1%) of the *K. pneumoniae* isolates reported to EARS-Net for 2017 were resistant to at least one of the antimicrobial groups under regular surveillance, i.e. fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems (Table 3.8). In 2017, the highest EU/EEA population-weighted mean resistance percentage was reported for fluoroquinolones (31.5%), followed by third-generation cephalosporins (31.2%), aminoglycosides (24.1%) and carbapenems (7.2%) (Tables 3.9–3.12). There was a small but significant increase in the EU/EEA population-weighted mean percentage for fluoroquinolone resistance, however the trend did not remain significant when the analysis was limited to the laboratories that consistently reported data during the period. No significant trend was noted for any of the other antimicrobial groups, including combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides (Tables 3.9–3.13).

Single resistance was less commonly reported than 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).

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 (76% 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, 87.8% were ascertained as ESBL-positive by the participating laboratories in 2017.

Large inter-country variations could be 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 3.8–3.12). 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

Despite the stabilising EU/EEA resistance levels in *K. pneumoniae* reported during the last four years, the *K. pneumoniae* resistance situation remains problematic in the EU/EEA. The high levels of carbapenem resistance reported in several countries in the southern and south-eastern parts of Europe, almost always combined with resistance to several other key antimicrobial groups, have serious public health implications and represent an increasing threat to European healthcare delivery and patient safety. Multidrug-resistance and carbapenem resistance have been associated with higher healthcare costs, prolonged hospital stays, treatment failures and mortality. Remaining treatment alternatives for these infections are very limited. The World Health Organization (WHO) sees a critical need for research and the development of new antibiotics which target third-generation cephalosporin and carbapenem resistance in Enterobacteriaceae, including *K. pneumoniae* and *E. coli* [13].

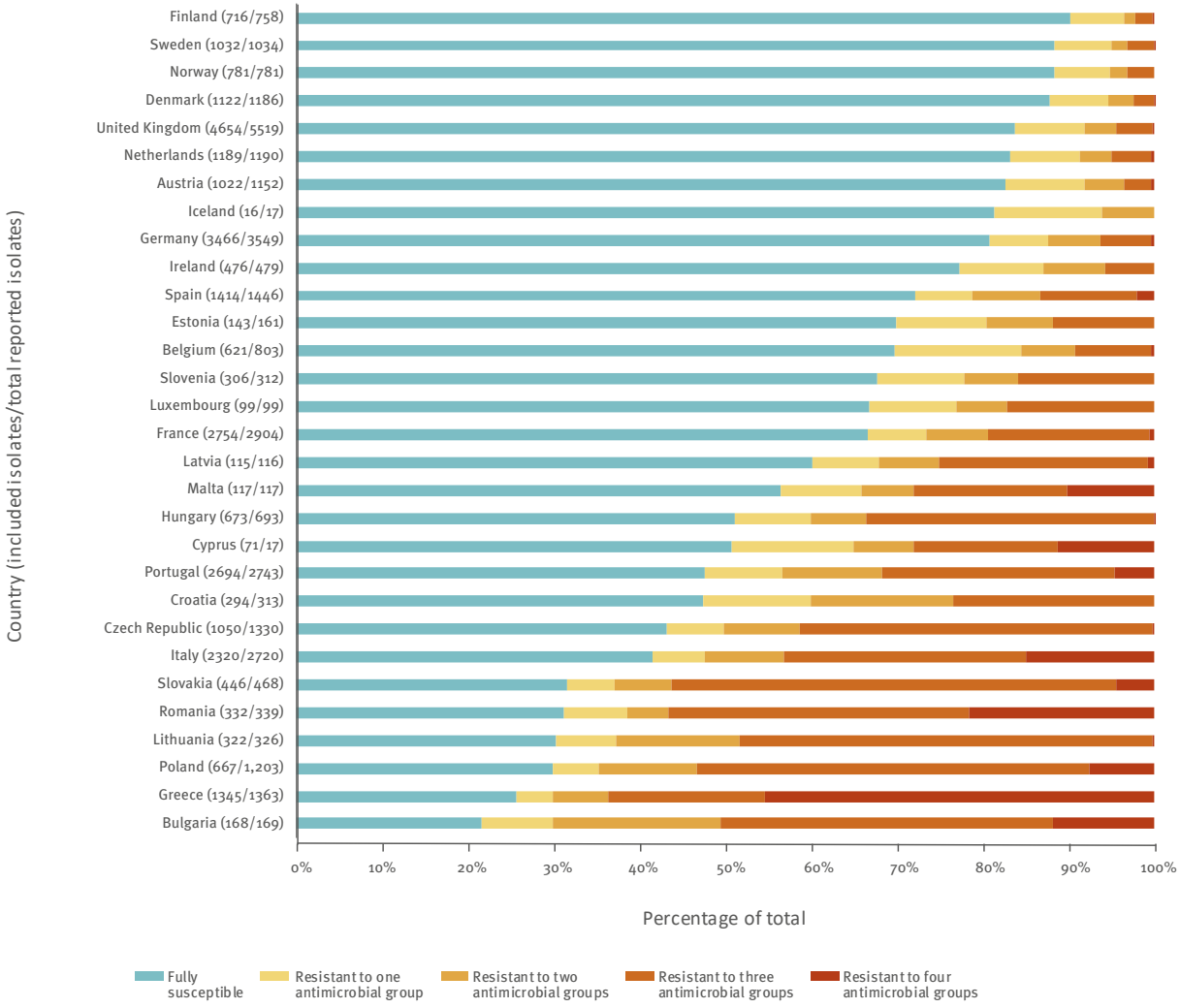
As highlighted in the recent updated ECDC rapid risk assessment on CRE, options for action include timely and appropriate diagnosis, high standards of infection prevention and control and antimicrobial stewardship [9]. In recent years, many EU/EEA countries have also developed and implemented recommendations and guidance documents on multidrug-resistant Enterobacteriaceae and/or CRE [14], indicating a trend towards nationally coordinated responses to this public health threat. In 2017, to support countries, ECDC published a guidance document on how to prevent the entry and spread of CRE into healthcare settings. The guidance outlines evidence-based best practices for the prevention of CRE, including measures for intervention that can be adopted or adapted to local needs depending on the availability of financial and structural resources [15].

As for *E. coli*, the frequency of carbapenem-resistant isolates determined by phenotypic methods might underestimate the distribution and spread of carbapenemase-producing *K. pneumoniae*, especially in countries where carbapenemases such as OXA-48 are common.

This is partly reflected by the substantially higher percentages of carbapenem non-susceptible *K. pneumoniae* compared to carbapenem-resistant *K. pneumoniae* in some countries [16]. The recently launched carbapenem- and/or colistin-resistant Enterobacteriaceae (CCRE) project as part of the European Antimicrobial Resistance Genes Surveillance Network (EURGen-Net) will provide updated and more detailed information on the distribution of carbapenemase-producing *K. pneumoniae* in Europe [11].

Colistin is frequently being used to treat CRE infections, but colistin resistance may develop in patients treated with colistin. The recent discovery of transferable plasmid-mediated colistin resistance genes that can transmit colistin resistance more easily between bacteria further increased the risk for spread of colistin resistance [17]. Colistin resistance poses a substantial public health risk to the EU/EEA because it further limits treatment options in patients with infections caused by multidrug-resistant gram-negative bacteria, including CRE. The distribution of colistin resistance is difficult to assess through EARS-Net, as colistin susceptibility testing is generally not part of the initial routine AST panel for Enterobacteriaceae, but rather performed at national level after referral of multidrug-resistant isolates to a reference laboratory. In addition, colistin susceptibility testing is methodologically challenging, substantially reducing the quality of results from agar dilution, disk diffusion and gradient diffusion. A joint EUCAST and CLSI subcommittee has issued recommendations confirming that broth microdilution is so far the only valid method for colistin susceptibility testing [18]. A survey among EARS-Net participating laboratories in 2017 showed that a majority of the responding local laboratories did not test for colistin susceptibility locally or used

Figure 3.7. *Klebsiella pneumoniae*. Distribution of isolates: fully susceptible and resistant to one, two, three and four antimicrobial groups (among isolates tested against fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems), EU/EEA countries, 2017



Only data from isolates tested against all included antimicrobial groups included in analysis.

methods that are not recommended by EUCAST (unpublished data, ECDC/UK NEQAS), leading to the conclusion that data sources other than EARS-Net are needed for colistin susceptibility surveillance until local laboratory capacity has improved. To better understand the capacity for colistin susceptibility testing and the distribution of colistin-resistant Enterobacteriaceae in Europe, ECDC included colistin in the surveillance panel of the CCRE project. This project includes a capacity building component fro reference laboratories, which hopefully will also improve diagnostic capacity at the local level.

Similar to *E. coli*, the trends in fluoroquinolone resistance may be influenced by the fact that in 2016, EUCAST lowered its clinical breakpoints for several fluoroquinolones in Enterobacteriaceae. As EARS-Net bases its results on SIR interpretations, it is not possible to assess when or to what degree this change has been implemented by participating laboratories and how these changes have influenced the results. As a consequence, trend analyses for fluoroquinolone resistance should be interpreted with caution.

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=30 409). EU/EEA countries, 2017

Resistance pattern	Number of isolates	Percentage (%) of total**
Fully susceptible	**20 045**	**65.9**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance)	**2 287**	**7.5**
Third-generation cephalosporins	1 215	4.0
Fluoroquinolones	842	2.8
Other antimicrobial groups	230	0.8
Resistance to two antimicrobial groups		
Total (all two-group combinations)	**1 993**	**6.6**
Third-generation cephalosporins + fluoroquinolones	1 127	3.7
Third-generation cephalosporins + aminoglycosides	468	1.5
Fluoroquinolones + aminoglycosides	333	1.1
Other antimicrobial group combinations	65	0.2
Resistance to three antimicrobial groups		
Total (all three-group combinations)	**4 719**	**15.5**
Third-generation cephalosporins + fluoroquinolones + aminoglycosides	4 114	13.5
Third-generation cephalosporins + fluoroquinolones + carbapenems	524	1.7
Other antimicrobial group combinations	81	0.3
Resistance to four antimicrobial groups		
Third-generation cephalosporins + fluoroquinolones + aminoglycosides + carbapenems	**1 365**	**4.5**

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 3.8. ***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2017**

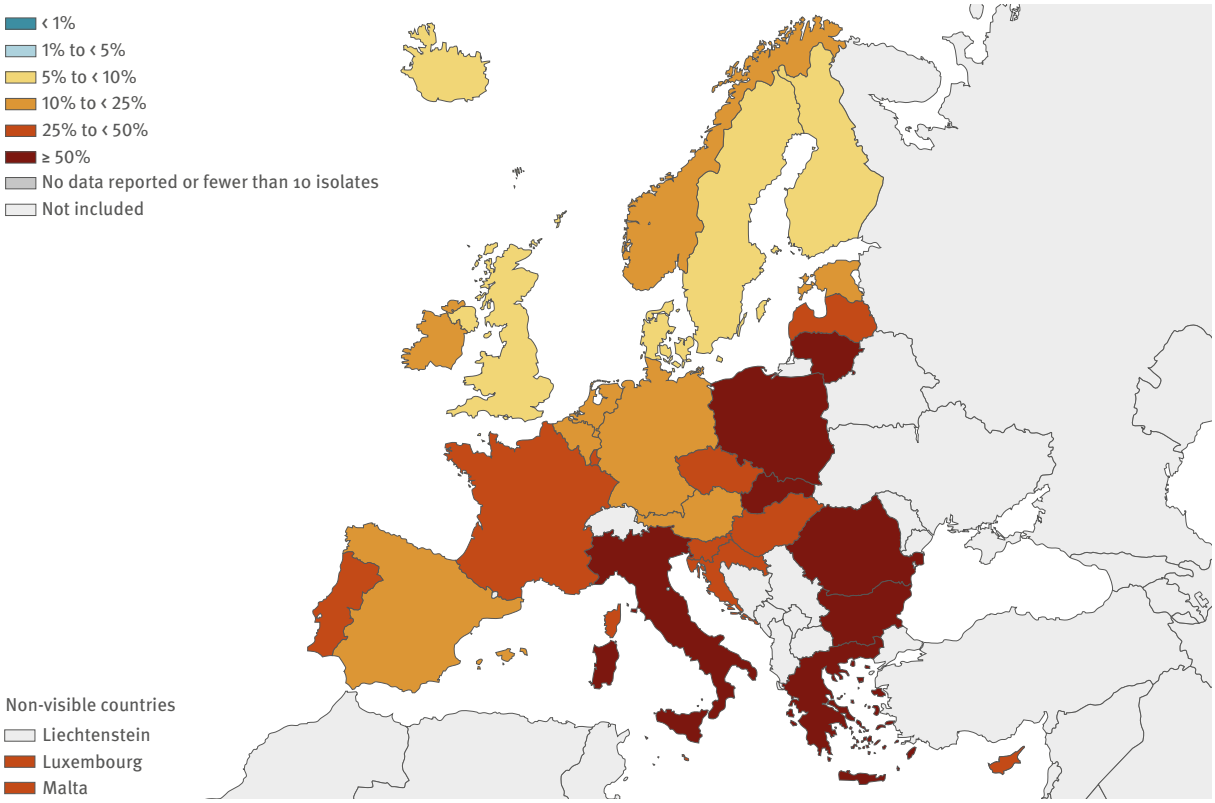


Figure 3.9. ***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, by country, EU/EEA countries, 2017**

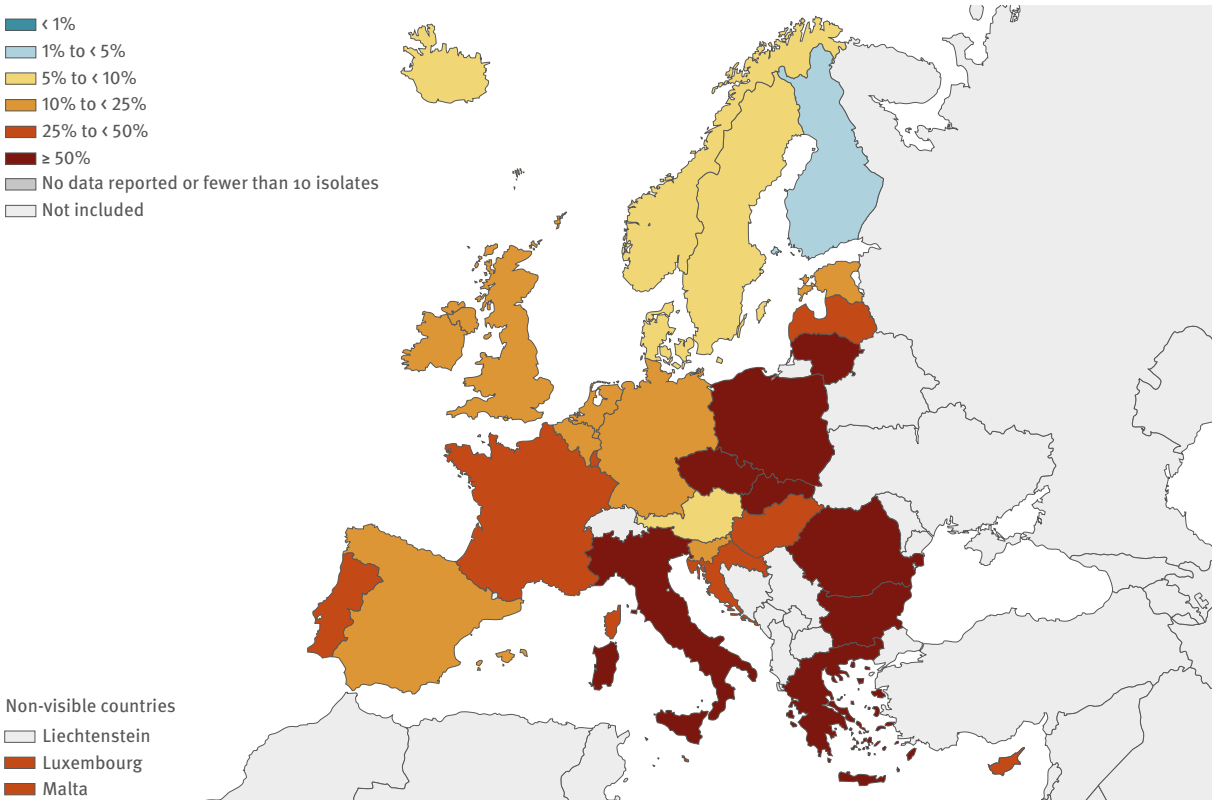


Figure 3.10. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2017**

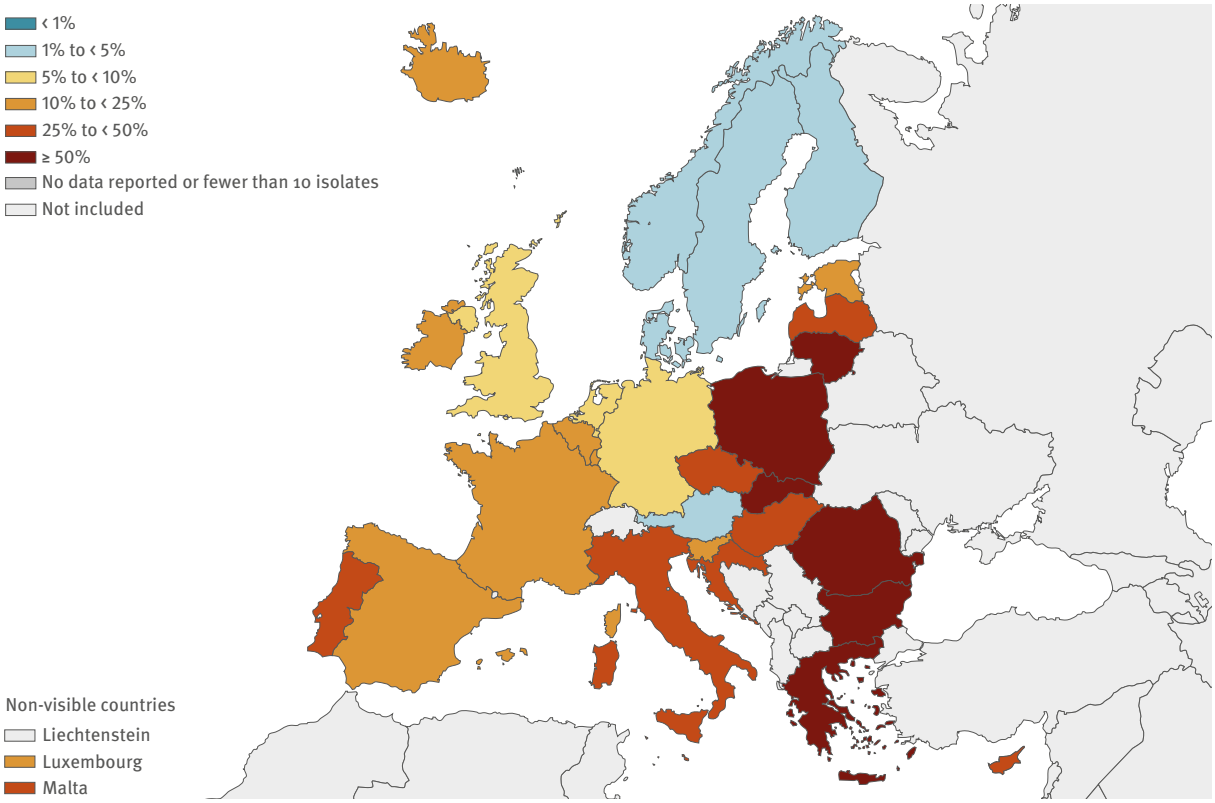


Figure 3.11. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2017**

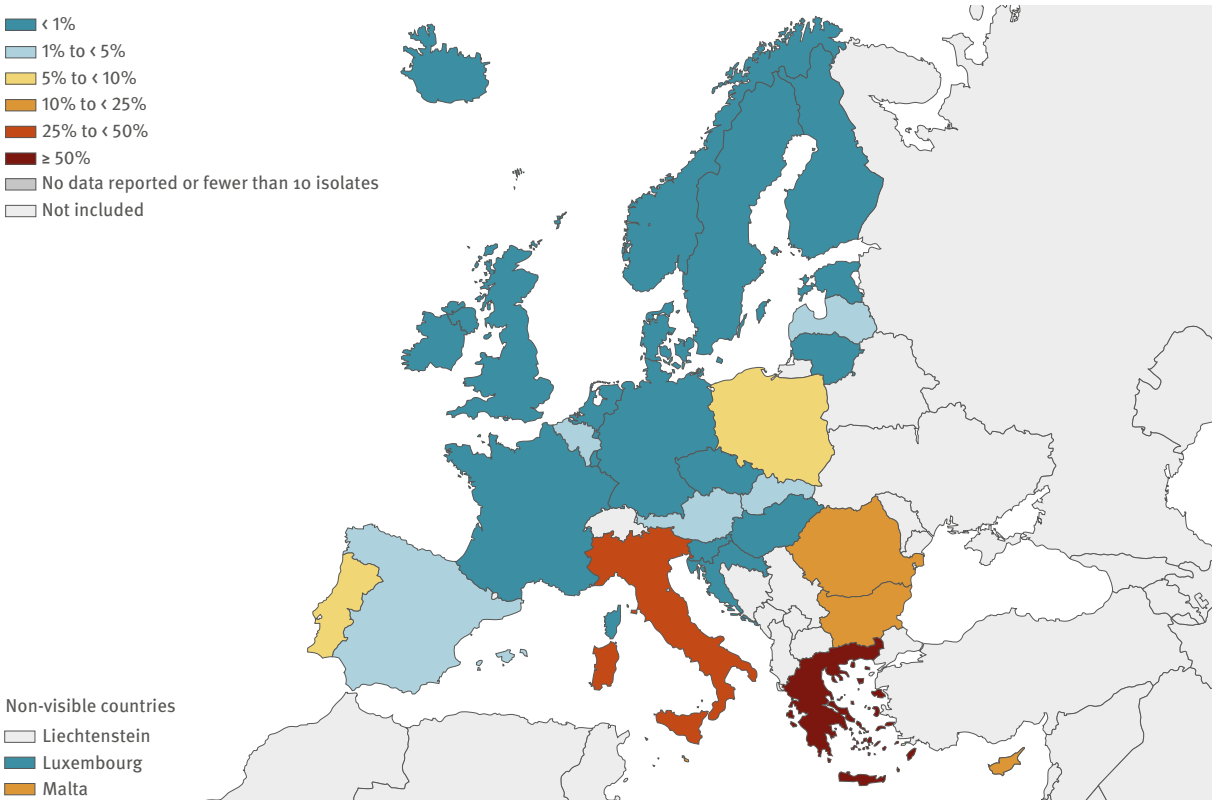


Figure 3.12. ***Klebsiella pneumoniae*****. Percentage (%) of invasive isolates with combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides, by country, EU/EEA countries, 2017**

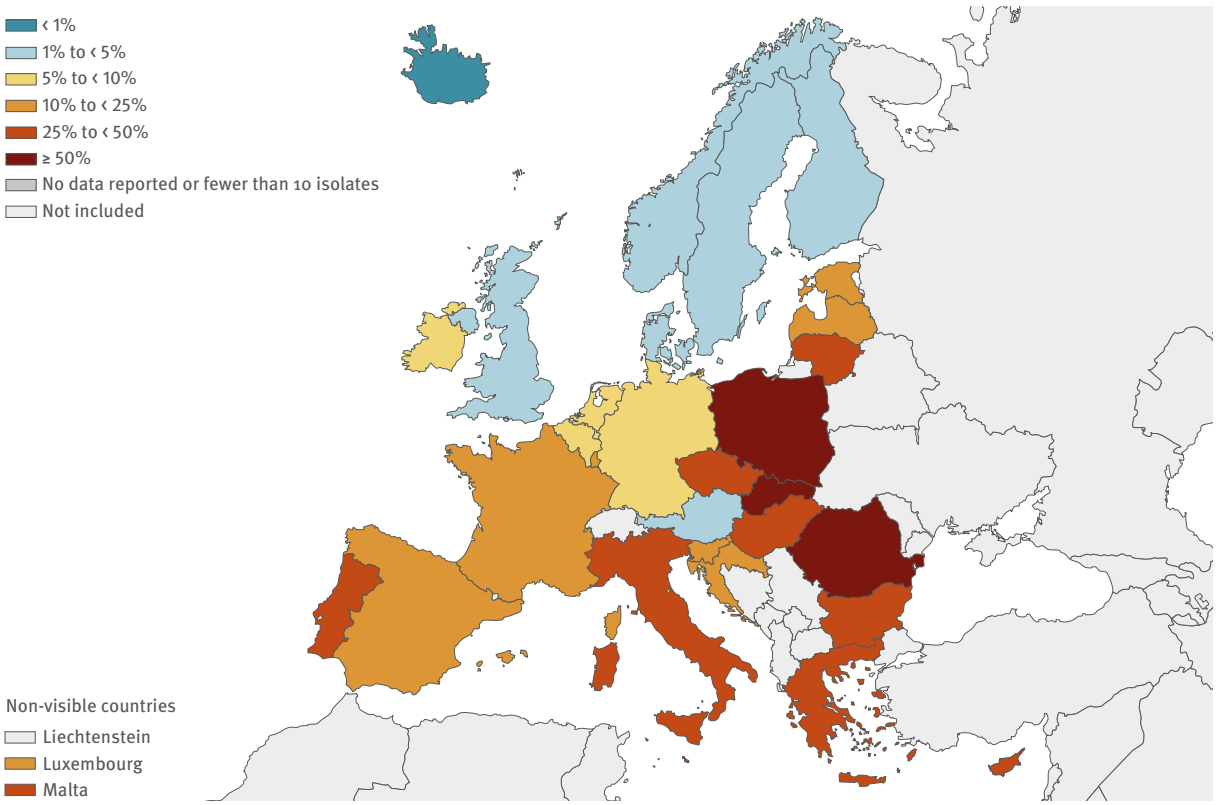


Table 3.9. ***Klebsiella pneumoniae*. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	28	3.6	(0-18)	35	2.9	(0-15)	21	0.0	(0-16)	16	6.3	(0-30)	N/A
Finland	581	4.6	(3-7)	658	3.3	(2-5)	769	2.7	(2-4)	756	7.9	(6-10)	↑
Denmark	943	6.9	(5-9)	935	5.3	(4-7)	1152	5.3	(4-7)	1183	9.1	(8-11)	↑ #
United Kingdom	1130	7.7	(6-9)	1011	13.3	(11-16)	4065	7.5	(7-8)	5293	9.3	(9-10)	
Sweden	763	4.1	(3-6)	907	4.5	(3-6)	1533	5.4	(4-7)	1034	9.8	(8-12)	N/A
Norway	746	6.2	(5-8)	700	5.0	(4-7)	808	4.3	(3-6)	781	10.2	(8-13)	↑
Netherlands	886	4.7	(3-6)	908	6.8	(5-9)	1134	6.9	(5-9)	1190	11.9	(10-14)	↑
Austria	971	10.4	(9-12)	1029	11.7	(10-14)	1246	9.8	(8-12)	1147	14.2	(12-16)	↑
Ireland	355	13.5	(10-18)	388	17.0	(13-21)	453	11.3	(8-15)	478	14.9	(12-18)	
Germany	980	12.7	(11-15)	1580	9.6	(8-11)	3068	12.6	(11-14)	3549	15.6	(14-17)	↑
Spain	1266	18.6	(17-21)	1508	21.6	(20-24)	1676	22.7	(21-25)	1419	22.6	(20-25)	↑
Belgium	506	18.2	(15-22)	379	22.7	(19-27)	669	23.6	(20-27)	803	23.7	(21-27)	↑ #
Estonia	133	21.8	(15-30)	62	33.9	(22-47)	183	29.5	(23-37)	161	24.8	(18-32)	
France	2175	31.0	(29-33)	2332	30.7	(29-33)	2589	27.7	(26-29)	2886	26.8	(25-28)	↓
Luxembourg	66	31.8	(21-44)	60	20.0	(11-32)	78	35.9	(25-48)	99	28.3	(20-38)	
Slovenia	233	32.6	(27-39)	237	24.5	(19-30)	267	29.6	(24-35)	306	30.4	(25-36)	
EU/EEA (population-weighted mean)	**19990**	**30.4**	**(30-31)**	**22417**	**30.1**	**(30-31)**	**30583**	**30.3**	**(30-31)**	**32409**	**31.5**	**(31-32)**	↑ #
Latvia	116	44.8	(36-54)	112	42.0	(33-52)	91	41.8	(32-53)	116	32.8	(24-42)	
Cyprus	80	26.3	(17-37)	62	37.1	(25-50)	75	32.0	(22-44)	71	35.2	(24-47)	
Malta	99	32.3	(23-42)	88	26.1	(17-37)	102	33.3	(24-43)	117	39.3	(30-49)	
Croatia	330	44.8	(39-50)	380	48.7	(44-54)	318	43.4	(38-49)	309	40.8	(35-46)	
Hungary	641	34.9	(31-39)	700	36.7	(33-40)	713	35.2	(32-39)	685	41.5	(38-45)	↑
Portugal	1712	36.5	(34-39)	2094	38.6	(36-41)	2350	41.7	(40-44)	2736	45.7	(44-48)	↑
Czech Republic	1382	48.0	(45-51)	1416	48.9	(46-52)	1384	50.5	(48-53)	1329	49.2	(46-52)	
Italy	1295	55.7	(53-58)	2000	53.7	(51-56)	2248	56.0	(54-58)	2562	55.7	(54-58)	
Bulgaria	151	50.3	(42-59)	96	37.5	(28-48)	160	55.6	(48-63)	169	59.8	(52-67)	↑
Romania	257	66.5	(60-72)	267	61.4	(55-67)	342	60.8	(55-66)	337	64.1	(59-69)	
Lithuania	154	45.5	(37-54)	179	45.8	(38-53)	324	54.6	(49-60)	326	64.7	(59-70)	↑
Poland	455	67.9	(63-72)	659	63.9	(60-68)	1119	66.8	(64-70)	739	66.3	(63-70)	
Slovakia	493	70.8	(67-75)	474	70.0	(66-74)	466	66.3	(62-71)	466	66.7	(62-71)	
Greece	1063	67.6	(65-70)	1161	66.4	(64-69)	1180	68.6	(66-71)	1346	66.9	(64-69)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.10. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Finland	582	2.4	(1-4)	644	3.0	(2-5)	760	4.1	(3-6)	744	4.6	(3-6)	↑
Sweden	1000	4.5	(3-6)	1001	3.3	(2-5)	1537	4.9	(4-6)	1034	5.6	(4-7)	N/A
Norway	746	5.9	(4-8)	701	5.0	(4-7)	811	5.8	(4-8)	781	5.8	(4-8)	
Iceland	28	0.0	(0-12)	36	0.0	(0-10)	25	0.0	(0-14)	17	5.9	(0-29)	N/A
Denmark	925	7.6	(6-9)	929	7.8	(6-10)	1118	7.5	(6-9)	1125	7.3	(6-9)	
Austria	996	8.2	(7-10)	1050	8.4	(7-10)	1245	9.6	(8-11)	1072	8.6	(7-10)	
Netherlands	911	5.5	(4-7)	908	8.6	(7-11)	1134	10.3	(9-12)	1189	10.9	(9-13)	↑
United Kingdom	978	9.3	(8-11)	916	10.5	(9-13)	3914	8.9	(8-10)	4973	11.4	(10-12)	↑ #
Ireland	354	11.6	(8-15)	387	14.7	(11-19)	452	13.5	(10-17)	478	14.6	(12-18)	
Germany	1006	12.7	(11-15)	1581	10.2	(9-12)	3068	13.6	(12-15)	3546	14.7	(14-16)	↑
Belgium	485	16.3	(13-20)	406	19.7	(16-24)	669	22.9	(20-26)	803	19.3	(17-22)	
Estonia	135	20.7	(14-29)	93	23.7	(15-34)	183	32.8	(26-40)	161	21.1	(15-28)	
Spain	1265	18.0	(16-20)	1491	20.3	(18-22)	1677	22.4	(20-24)	1445	21.4	(19-24)	↑
Slovenia	233	26.6	(21-33)	237	22.8	(18-29)	267	22.8	(18-28)	312	23.7	(19-29)	
Luxembourg	66	34.8	(24-48)	60	28.3	(17-41)	78	35.9	(25-48)	99	27.3	(19-37)	
France	2192	29.6	(28-32)	2338	30.5	(29-32)	2597	28.9	(27-31)	2892	28.8	(27-31)	
EU/EEA (population-weighted mean)	**20188**	**31.4**	**(31-32)**	**22511**	**31.0**	**(31-32)**	**30447**	**31.4**	**(31-32)**	**32453**	**31.2**	**(31-32)**	
Latvia	104	52.9	(43-63)	115	47.0	(38-56)	95	47.4	(37-58)	116	33.6	(25-43)	↓
Malta	99	28.3	(20-38)	88	15.9	(9-25)	102	21.6	(14-31)	117	35.0	(26-44)	
Hungary	644	35.6	(32-39)	704	37.2	(34-41)	722	37.5	(34-41)	693	41.1	(37-45)	↑
Croatia	334	47.9	(42-53)	380	46.8	(42-52)	321	48.6	(43-54)	309	41.7	(36-47)	
Portugal	1712	40.9	(39-43)	2094	40.4	(38-43)	2349	46.7	(45-49)	2743	44.9	(43-47)	↑
Cyprus	80	32.5	(22-44)	62	43.5	(31-57)	75	30.7	(21-42)	71	46.5	(35-59)	
Czech Republic	1383	52.9	(50-56)	1417	54.1	(51-57)	1384	51.8	(49-54)	1329	53.2	(50-56)	
Italy	1319	56.5	(54-59)	1999	55.9	(54-58)	2246	55.8	(54-58)	2546	54.6	(53-57)	
Romania	256	73.8	(68-79)	270	70.7	(65-76)	344	68.0	(63-73)	339	62.5	(57-68)	↓
Poland	465	68.2	(64-72)	676	64.2	(60-68)	1142	64.4	(62-67)	1203	63.0	(60-66)	
Lithuania	154	52.6	(44-61)	178	51.7	(44-59)	326	56.7	(51-62)	326	63.2	(58-68)	↑
Slovakia	493	69.4	(65-73)	469	67.2	(63-71)	465	61.3	(57-66)	459	63.2	(59-68)	↓
Greece	1092	72.5	(70-75)	1185	69.5	(67-72)	1181	72.5	(70-75)	1362	69.2	(67-72)	
Bulgaria	151	74.8	(67-82)	96	75.0	(65-83)	160	72.5	(65-79)	169	76.3	(69-83)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.11. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Finland	559	2.3	(1-4)	625	1.9	(1-3)	727	2.3	(1-4)	721	2.9	(2-4)	
Denmark	943	4.9	(4-6)	938	2.6	(2-4)	1154	3.2	(2-4)	1186	3.2	(2-4)	
Norway	744	4.8	(3-7)	700	3.6	(2-5)	809	3.3	(2-5)	781	4.2	(3-6)	
Sweden	860	3.3	(2-5)	943	3.2	(2-5)	1141	3.4	(2-5)	1033	4.7	(4-6)	N/A
Austria	925	5.5	(4-7)	959	4.8	(4-6)	1157	4.8	(4-6)	1141	4.8	(4-6)	
Netherlands	898	3.9	(3-5)	908	5.7	(4-7)	1134	6.1	(5-8)	1190	7.6	(6-9)	↑ #
United Kingdom	1174	5.5	(4-7)	1070	9.3	(8-11)	4135	6.7	(6-7)	5363	7.9	(7-9)	↑ #
Germany	1006	7.1	(6-9)	1582	5.6	(5-7)	3042	7.7	(7-9)	3468	8.0	(7-9)	↑
Iceland	28	3.6	(0-18)	36	0.0	(0-10)	25	0.0	(0-14)	17	11.8	(1-36)	N/A
Ireland	354	12.1	(9-16)	389	15.9	(12-20)	453	11.5	(9-15)	479	11.9	(9-15)	
Estonia	135	18.5	(12-26)	61	21.3	(12-34)	183	21.3	(16-28)	161	12.4	(8-19)	
Belgium	341	10.9	(8-15)	354	11.6	(8-15)	637	13.8	(11-17)	633	12.5	(10-15)	
Slovenia	233	20.2	(15-26)	237	19.0	(14-25)	267	16.5	(12-21)	312	16.0	(12-21)	
Spain	1264	13.8	(12-16)	1509	16.0	(14-18)	1678	15.5	(14-17)	1445	17.6	(16-20)	↑
Luxembourg	66	19.7	(11-31)	60	15.0	(7-27)	78	26.9	(18-38)	99	18.2	(11-27)	
France	2188	27.7	(26-30)	2337	26.3	(25-28)	2569	26.2	(25-28)	2857	23.8	(22-25)	↓
EU/EEA (population-weighted mean)	**19828**	**25.0**	**(24-26)**	**22360**	**24.2**	**(24-25)**	**30023**	**24.4**	**(24-25)**	**32620**	**24.1**	**(24-25)**	
Cyprus	80	28.7	(19-40)	62	37.1	(25-50)	75	22.7	(14-34)	71	26.8	(17-39)	
Latvia	118	43.2	(34-53)	113	43.4	(34-53)	91	38.5	(28-49)	115	29.6	(21-39)	↓
Croatia	334	48.8	(43-54)	380	43.2	(38-48)	316	36.1	(31-42)	311	30.9	(26-36)	↓
Malta	99	28.3	(20-38)	88	22.7	(14-33)	102	22.5	(15-32)	117	31.6	(23-41)	
Portugal	1706	30.5	(28-33)	2090	32.6	(31-35)	2337	35.0	(33-37)	2717	33.5	(32-35)	↑
Italy	1190	36.2	(33-39)	1956	34.0	(32-36)	2300	36.1	(34-38)	2571	34.5	(33-36)	
Hungary	639	31.8	(28-36)	706	34.6	(31-38)	720	34.7	(31-38)	693	37.8	(34-42)	↑
Czech Republic	1383	50.7	(48-53)	1417	51.9	(49-55)	1385	47.1	(44-50)	1330	49.6	(47-52)	
Greece	1067	59.3	(56-62)	1170	50.7	(48-54)	1171	52.9	(50-56)	1348	53.2	(50-56)	↓
Lithuania	152	49.3	(41-58)	179	46.4	(39-54)	325	49.2	(44-55)	322	53.7	(48-59)	
Poland	455	59.1	(54-64)	666	58.6	(55-62)	1075	56.7	(54-60)	1165	55.5	(53-58)	
Romania	250	67.6	(61-73)	266	54.1	(48-60)	336	61.9	(56-67)	338	58.6	(53-64)	
Slovakia	494	68.2	(64-72)	475	66.5	(62-71)	466	62.4	(58-67)	468	61.1	(57-66)	↓
Bulgaria	143	65.7	(57-73)	84	59.5	(48-70)	135	64.4	(56-72)	168	63.1	(55-70)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.12. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Estonia	92	0.0	(0-4)	56	0.0	(0-6)	168	0.0	(0-2)	143	0.0	(0-3)	
Croatia	334	0.9	(0-3)	380	2.4	(1-4)	323	0.0	(0-1)	302	0.0	(0-1)	↓
Iceland	28	0.0	(0-12)	35	0.0	(0-12)	21	0.0	(0-12)	16	0.0	(0-13)	N/A
Luxembourg	66	1.5	(0-8)	60	0.0	(0-6)	78	0.0	(0-5)	99	0.0	(0-4)	
Norway	746	0.0	(0-0)	700	0.1	(0-1)	810	0.0	(0-0)	781	0.0	(0-0)	
Slovenia	233	0.9	(0-3)	237	1.3	(0-4)	267	0.0	(0-1)	312	0.0	(0-1)	↓
Hungary	621	1.1	(0-2)	687	0.1	(0-1)	703	0.4	(0-1)	681	0.1	(0-1)	
Sweden	978	0.0	(0-0)	900	0.0	(0-0)	1531	0.1	(0-0)	1033	0.1	(0-1)	N/A
Ireland	353	0.6	(0-2)	389	0.5	(0-2)	453	0.7	(0-2)	478	0.2	(0-1)	
Denmark	830	0.2	(0-1)	846	0.0	(0-0)	1119	0.3	(0-1)	1185	0.3	(0-1)	
Finland	583	0.0	(0-1)	658	0.0	(0-1)	770	0.3	(0-1)	758	0.3	(0-1)	
Czech Republic	1148	0.1	(0-0)	1100	0.3	(0-1)	1096	0.0	(0-0)	1051	0.4	(0-1)	
Germany	1006	0.7	(0-1)	1583	0.1	(0-0)	3068	0.5	(0-1)	3549	0.5	(0-1)	
Netherlands	903	0.2	(0-1)	907	0.1	(0-1)	1131	0.1	(0-0)	1190	0.5	(0-1)	
Lithuania	154	1.3	(0-5)	177	0.0	(0-2)	325	0.0	(0-1)	325	0.6	(0-2)	
United Kingdom	1069	0.8	(0-2)	962	0.4	(0-1)	4068	0.3	(0-0)	5274	0.6	(0-1)	
France	2103	0.5	(0-1)	2244	0.5	(0-1)	2528	0.4	(0-1)	2807	0.7	(0-1)	
Austria	971	0.6	(0-1)	1022	0.8	(0-2)	1198	0.7	(0-1)	1109	1.0	(0-2)	
Belgium	429	0.5	(0-2)	389	0.5	(0-2)	669	2.4	(1-4)	791	1.1	(1-2)	
Latvia	118	1.7	(0-6)	112	0.0	(0-3)	90	2.2	(0-8)	116	1.7	(0-6)	
Spain	1266	2.3	(2-3)	1483	2.2	(1-3)	1677	2.1	(1-3)	1442	2.7	(2-4)	
Slovakia	456	2.6	(1-5)	436	0.9	(0-2)	435	2.5	(1-4)	450	4.4	(3-7)	↑
Poland	451	1.3	(0-3)	660	0.5	(0-1)	1123	2.1	(1-3)	1161	6.4	(5-8)	↑
EU/EEA (population-weighted mean)	**19617**	**7.3**	**(7-8)**	**21808**	**6.8**	**(6-7)**	**30148**	**7.4**	**(7-8)**	**32461**	**7.2**	**(7-7)**	
Portugal	1701	1.8	(1-3)	2085	3.4	(3-4)	2340	5.2	(4-6)	2720	8.6	(8-10)	↑
Malta	99	9.1	(4-17)	88	4.5	(1-11)	102	5.9	(2-12)	117	10.3	(5-17)	
Bulgaria	139	7.2	(4-13)	95	3.2	(1-9)	159	4.4	(2-9)	169	12.4	(8-18)	
Cyprus	80	5.0	(1-12)	62	12.9	(6-24)	75	10.7	(5-20)	71	15.5	(8-26)	
Romania	257	31.5	(26-38)	271	24.7	(20-30)	334	31.4	(26-37)	334	22.5	(18-27)	
Italy	1315	32.9	(30-36)	1999	33.5	(31-36)	2307	33.9	(32-36)	2634	29.7	(28-31)	↓
Greece	1088	62.3	(59-65)	1185	61.9	(59-65)	1180	66.9	(64-70)	1363	64.7	(62-67)	

* ↑ 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 3.13. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	28	0.0	(0-12)	35	0.0	(0-10)	21	0.0	(0-16)	16	0.0	(0-21)	N/A
Denmark	925	3.1	(2-4)	924	1.1	(1-2)	1112	1.4	(1-2)	1122	2.4	(2-3)	
Finland	556	1.4	(1-3)	623	1.1	(0-2)	726	1.2	(1-2)	716	2.4	(1-4)	
Austria	900	3.2	(2-5)	936	3.3	(2-5)	1156	3.5	(3-5)	1062	3.0	(2-4)	
Norway	744	3.9	(3-6)	699	2.3	(1-4)	807	2.6	(2-4)	781	3.2	(2-5)	
Sweden	623	1.4	(1-3)	860	1.9	(1-3)	1141	2.1	(1-3)	1033	3.3	(2-5)	N/A
United Kingdom	975	3.1	(2-4)	906	4.2	(3-6)	3764	3.7	(3-4)	4760	4.2	(4-5)	
Netherlands	865	2.0	(1-3)	908	3.0	(2-4)	1134	3.5	(3-5)	1189	5.0	(4-6)	↑
Ireland	353	7.4	(5-11)	387	7.2	(5-10)	452	5.8	(4-8)	477	5.9	(4-8)	
Germany	979	5.3	(4-7)	1578	3.2	(2-4)	3038	5.3	(5-6)	3466	6.3	(5-7)	↑
Belgium	341	7.9	(5-11)	353	9.3	(7-13)	637	9.3	(7-12)	633	8.5	(6-11)	
Estonia	131	11.5	(7-18)	36	22.2	(10-39)	183	16.9	(12-23)	161	11.8	(7-18)	
Spain	1263	10.1	(8-12)	1488	11.7	(10-13)	1674	12.4	(11-14)	1417	13.0	(11-15)	↑
Slovenia	233	18.9	(14-25)	237	16.9	(12-22)	267	13.1	(9-18)	306	16.0	(12-21)	
Luxembourg	66	16.7	(9-28)	60	13.3	(6-25)	78	24.4	(15-35)	99	17.2	(10-26)	
France	2172	23.7	(22-26)	2324	22.5	(21-24)	2556	21.3	(20-23)	2844	19.4	(18-21)	↓
EU/EEA (population-weighted mean)	**19193**	**20.8**	**(20-21)**	**21930**	**19.7**	**(19-20)**	**29403**	**20.6**	**(20-21)**	**31098**	**20.5**	**(20-21)**	
Croatia	330	30.6	(26-36)	380	32.4	(28-37)	309	27.5	(23-33)	305	23.0	(18-28)	↓
Latvia	104	41.3	(32-51)	112	36.6	(28-46)	91	31.9	(22-42)	115	24.3	(17-33)	↓
Cyprus	80	15.0	(8-25)	62	17.7	(9-30)	75	18.7	(11-29)	71	25.4	(16-37)	
Malta	99	25.3	(17-35)	88	14.8	(8-24)	102	14.7	(8-23)	117	28.2	(20-37)	
Portugal	1705	22.8	(21-25)	2084	25.0	(23-27)	2332	27.2	(25-29)	2711	28.4	(27-30)	↑
Italy	1164	32.0	(29-35)	1940	29.7	(28-32)	2174	32.7	(31-35)	2352	31.6	(30-34)	
Hungary	636	28.6	(25-32)	698	30.2	(27-34)	711	30.1	(27-34)	685	33.1	(30-37)	
Czech Republic	1382	38.7	(36-41)	1416	41.5	(39-44)	1384	40.8	(38-43)	1329	41.8	(39-44)	
Greece	1061	55.1	(52-58)	1160	46.7	(44-50)	1171	48.4	(46-51)	1345	47.9	(45-51)	↓
Lithuania	152	35.5	(28-44)	178	39.9	(33-47)	323	42.1	(37-48)	322	48.1	(43-54)	↑
Bulgaria	143	44.1	(36-53)	84	28.6	(19-39)	133	45.9	(37-55)	168	50.0	(42-58)	
Poland	443	54.6	(50-59)	645	54.0	(50-58)	1052	53.6	(51-57)	703	52.6	(49-56)	
Romania	247	56.3	(50-63)	261	49.8	(44-56)	335	55.2	(50-61)	336	55.4	(50-61)	
Slovakia	493	63.3	(59-68)	468	59.6	(55-64)	465	55.7	(51-60)	457	57.1	(52-62)	↓

* ↑ 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.

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 healthcare-associated pneumonia (including ventilator-associated pneumonia), bloodstream infections 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 (e.g. piperacillin-tazobactam, ceftazidime, cefepime, ceftolozane-tazobactam, ceftazidime-avibactam, imipenem, meropenem, doripenem) and polymyxins. Resistance of *P. aeruginosa* to these agents can be acquired through one or more of several mechanisms, including modified antimicrobial targets, efflux, reduced permeability and degrading enzymes.

Antimicrobial resistance

In the EU/EEA, 30.8% of the *P. aeruginosa* isolates reported to EARS-Net for 2017 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 2017 was reported for fluoroquinolones (20.3%), followed by piperacillin ± tazobactam (18.3%), carbapenems (17.4%), ceftazidime (14.7%) and aminoglycosides (13.2%) (Tables 3.15–3.19). For all antimicrobial groups under regular surveillance, the EU/EEA population-weighted mean percentage decreased significantly between 2014 and 2017 (Tables 3.15–3.19). When only considering the laboratories that consistently reported data during all four years, only the decreasing trends for piperacillin ± tazobactam resistance, aminoglycoside resistance and carbapenem resistance remained statistically significant (Tables 3.15–3.19).

Resistance to two or more antimicrobial groups was common and seen in 18.3% of all tested isolates. (Table 3.14). The EU/EEA population-weighted mean percentage of combined resistance, defined as resistance to at least three of the antimicrobial groups under surveillance, significantly decreased between 2014 and 2017 (Table 3.20).

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

Discussion and conclusion

EARS-Net data showed that at the EU/EEA level, small but significantly decreasing trends in resistance were noted for *P. aeruginosa* for all antimicrobial groups under surveillance during the period 2014 to 2017, although these trends did not always remain statistically significant when only the laboratories that consistently reported data during the period were included. Nevertheless, high resistance percentages and combined resistance persisted in many countries, especially in the eastern and south-eastern parts of Europe. As *P. aeruginosa* is intrinsically resistant to many antimicrobial agents, additional acquired resistance is further complicating treatment of serious infections in already vulnerable patient groups.

The public health implications of resistant *P. aeruginosa* should not be neglected, as the bacterium remains one of the major causes of healthcare-associated infection in Europe [19–20]. 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 prevention and control are essential to prevent the situation from further 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=16 885), EU/EEA countries, 2017**

Resistance pattern	Number of isolates	Percentage (%) of total*
Fully susceptible (to tested antibiotics)	**11691**	**69.2**
Single resistance (to indicated antimicrobial group)		
Total (all single resistance types)	**2104**	**12.5**
Carbapenems	775	4.6
Fluoroquinolones	696	4.1
[Piperacillin ± tazobactam]	339	2.0
Aminoglycosides	185	1.1
Ceftazidime	109	0.6
Resistance to two antimicrobial groups		
Total (all two groups combinations)	**1185**	**7.0**
[Piperacillin ± tazobactam] + ceftazidime	444	2.6
Fluoroquinolones + aminoglycosides	173	1.0
Fluoroquinolones + carbapenems	232	1.4
Other antimicrobial group combinations	336	2.0
Resistance to three antimicrobial groups		
Total (all three group combinations)	**669**	**4.0**
Fluoroquinolones + aminoglycosides + carbapenems	163	1.0
Other antimicrobial group combinations	506	3.0
Resistance to four antimicrobial groups		
Total (all four group combinations)	**577**	**3.4**
[Piperacillin ± tazobactam] + fluoroquinolones + aminoglycosides + carbapenems	185	1.1
Fluoroquinolones + ceftazidime + aminoglycosides + carbapenems	174	1.0
Other antimicrobial group combinations	218	1.3
Resistance to five antimicrobial groups		
[Piperacillin ± tazobactam] + fluoroquinolones + ceftazidime + aminoglycosides + carbapenems	**659**	**3.9**

Only resistance combinations >1% of the total are specified

* 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, 2017**

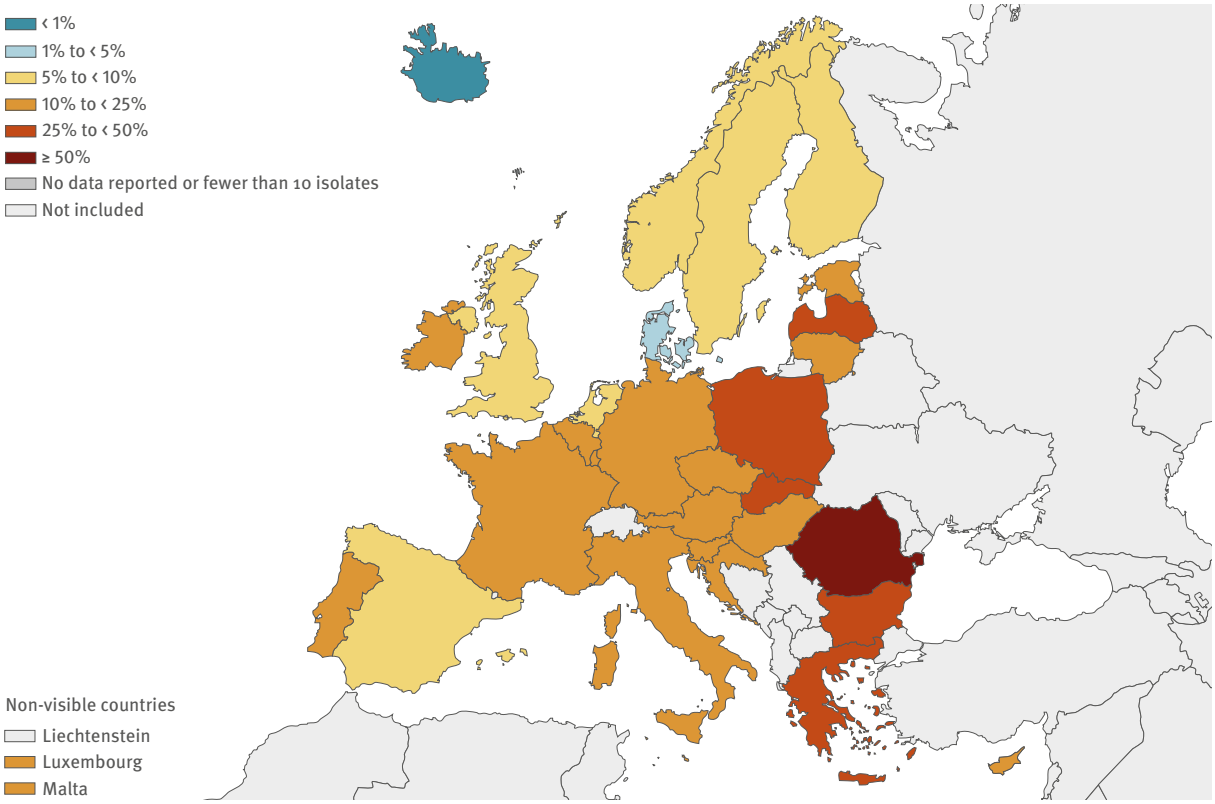


Figure 3.14. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2017**

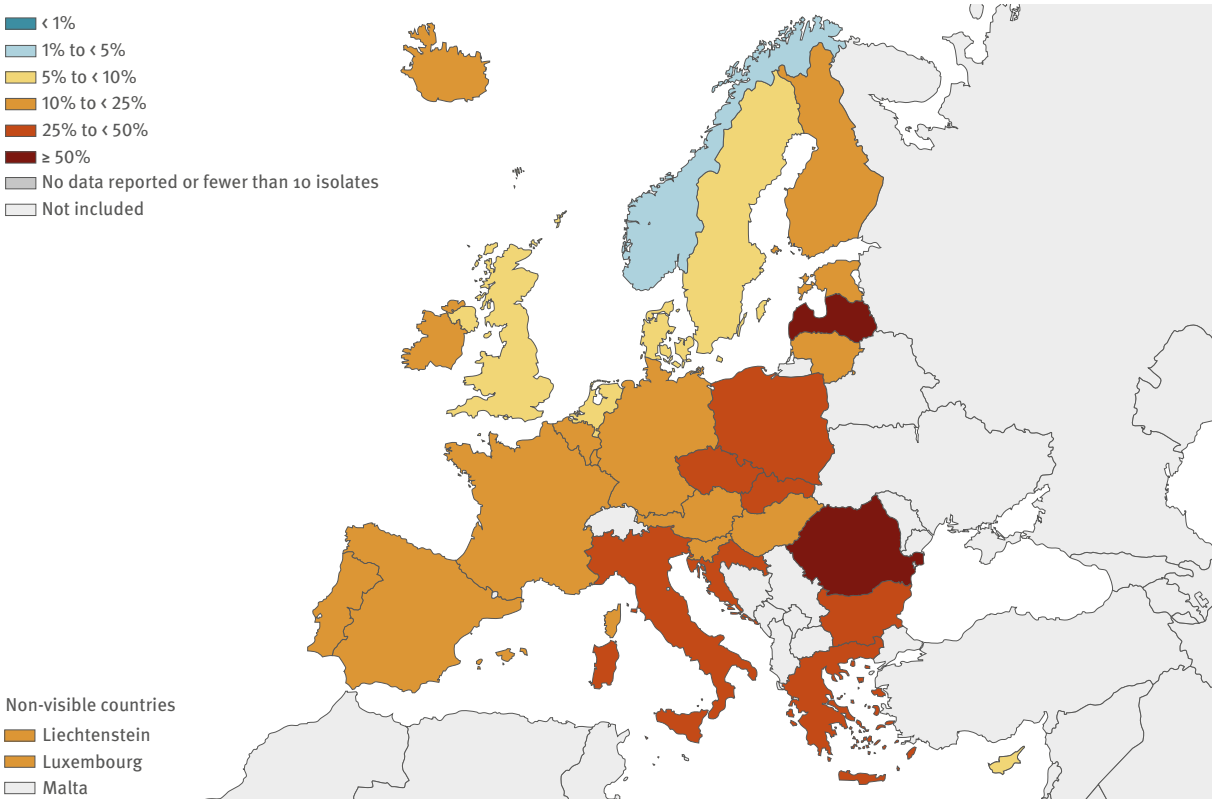


Figure 3.15. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to ceftazidime, by country, EU/EEA countries, 2017**

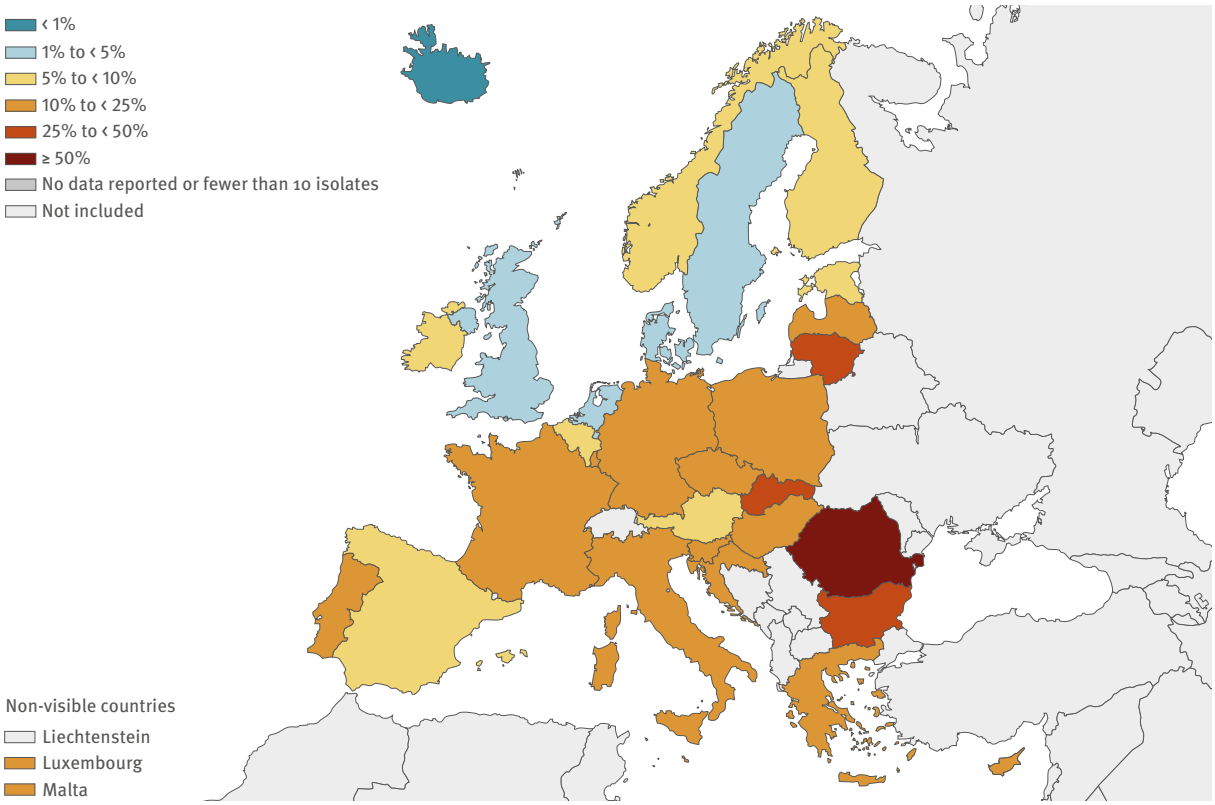


Figure 3.16. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2017**

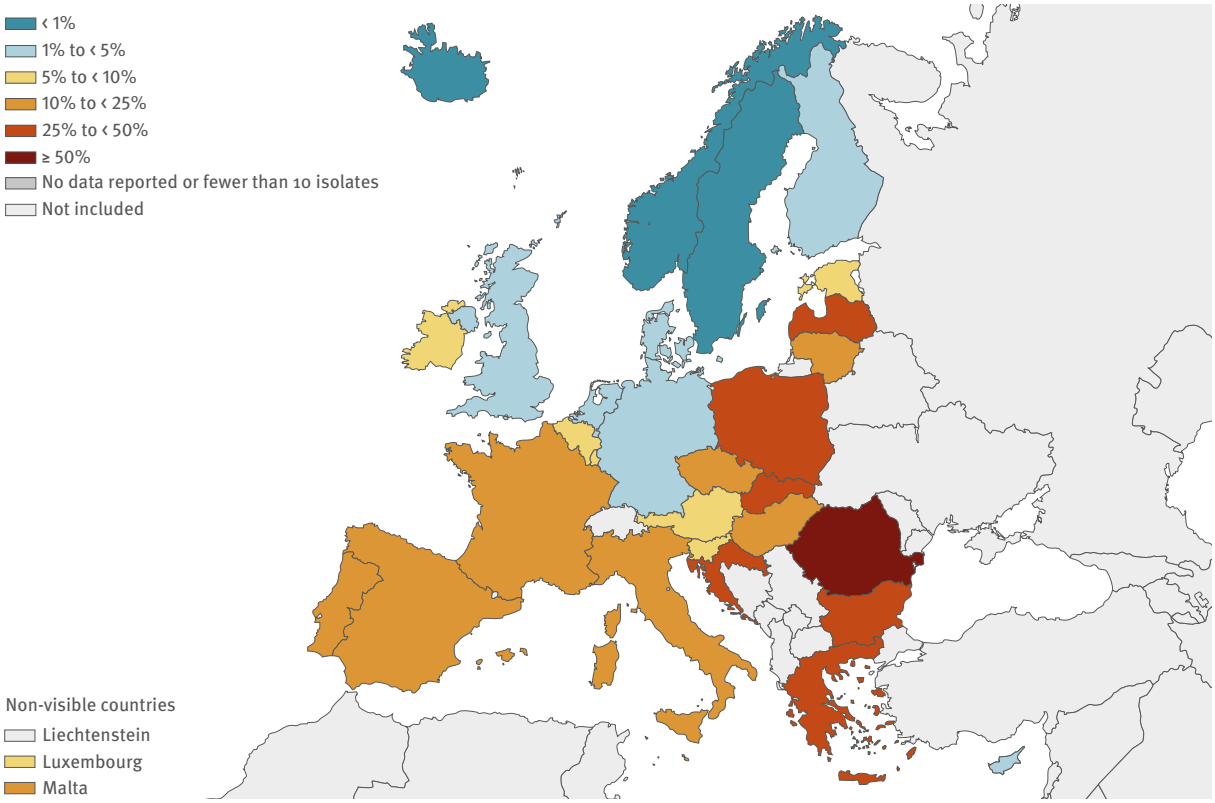


Figure 3.17. ***Pseudomonas aeruginosa*. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2017**

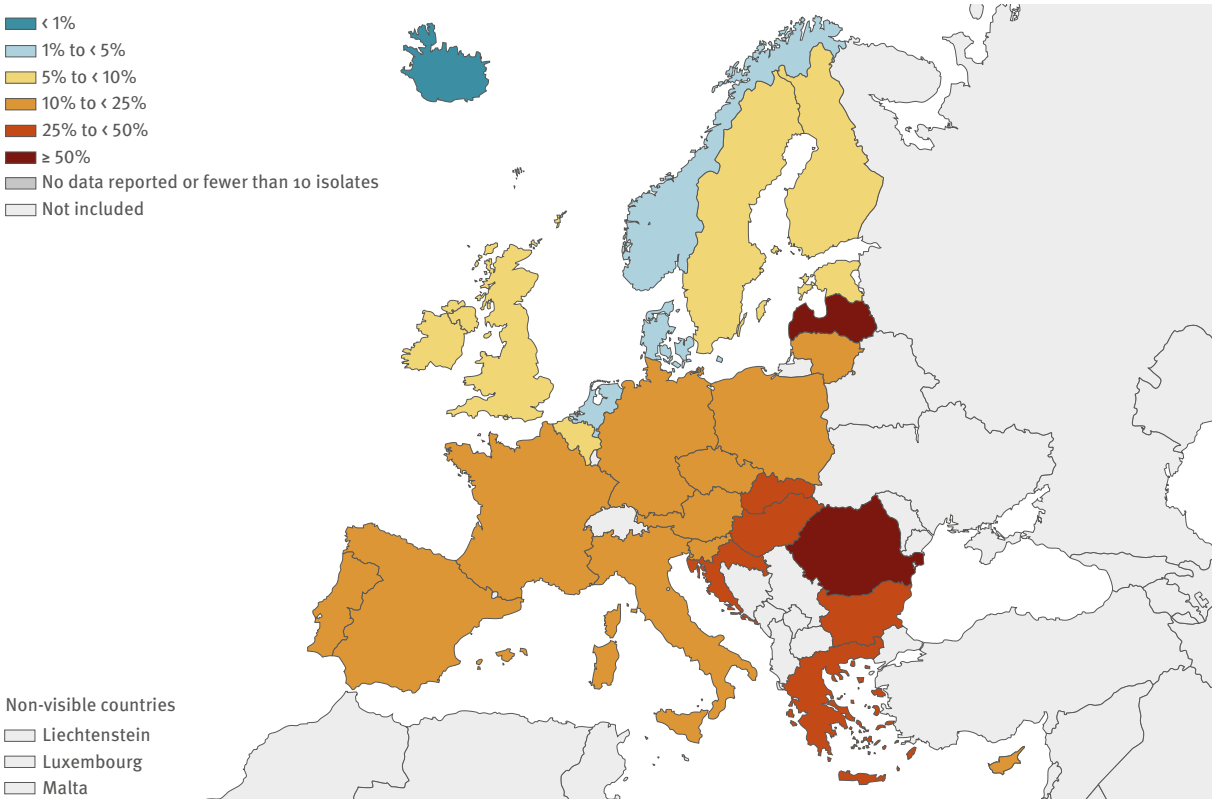


Figure 3.18. ***Pseudomonas aeruginosa.*** **Percentage (%) of invasive isolates with combined resistance (resistance to three or more antimicrobial groups among piperacillin ± tazobactam, ceftazidime, fluoroquinolones, aminoglycosides and carbapenems), by country, EU/EEA countries, 2017**

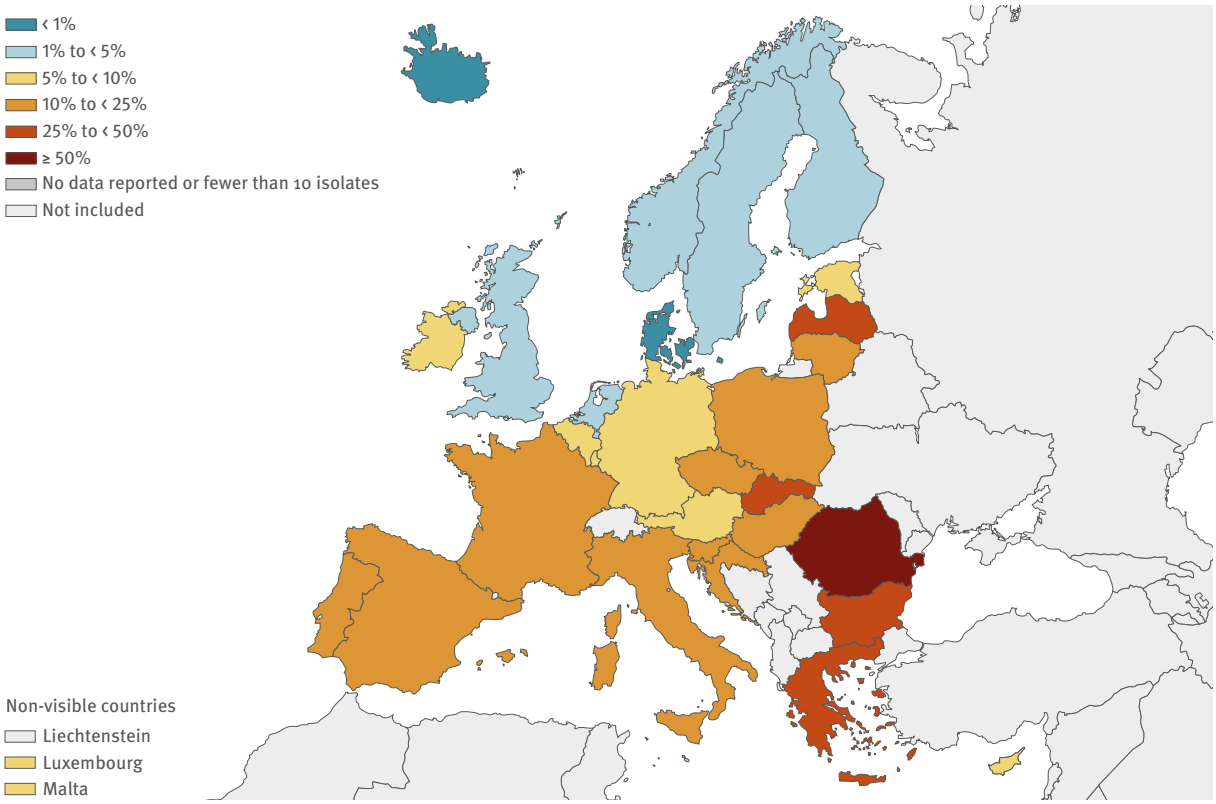


Table 3.15. ***Pseudomonas aeruginosa*. Total number of invasive isolates tested (N) and percentage with resistance to piperacillin ± tazobactam (%R), including 95 % confidence intervals (95 %CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	9.1	(0-41)	11	0.0	(0-28)	17	0.0	(0-20)	17	0.0	(0-20)	N/A
Denmark	388	4.4	(3-7)	441	4.1	(2-6)	460	3.5	(2-6)	484	2.9	(2-5)	
United Kingdom	610	4.8	(3-7)	493	10.3	(8-13)	2039	6.0	(5-7)	2697	5.3	(4-6)	
Norway	254	7.9	(5-12)	227	5.7	(3-10)	215	7.4	(4-12)	183	6.0	(3-11)	
Sweden	337	4.7	(3-8)	399	5.8	(4-9)	472	7.4	(5-10)	446	6.3	(4-9)	N/A
Finland	306	6.9	(4-10)	333	7.2	(5-11)	351	9.4	(7-13)	377	6.4	(4-9)	
Netherlands	530	8.1	(6-11)	494	6.5	(4-9)	520	4.0	(3-6)	620	7.1	(5-9)	
Spain	870	7.8	(6-10)	871	9.1	(7-11)	817	9.4	(8-12)	788	8.2	(6-10)	
Belgium	294	9.5	(6-13)	251	8.0	(5-12)	318	9.7	(7-14)	439	10.5	(8-14)	
Luxembourg	37	10.8	(3-25)	27	0.0	(0-13)	40	12.5	(4-27)	54	11.1	(4-23)	
Slovenia	112	25.9	(18-35)	141	9.9	(6-16)	143	19.6	(13-27)	138	13.0	(8-20)	
Austria	636	11.8	(9-15)	675	11.9	(10-15)	689	13.8	(11-17)	721	13.5	(11-16)	
Ireland	178	11.2	(7-17)	195	9.2	(6-14)	243	12.8	(9-18)	286	14.0	(10-19)	
Estonia	39	10.3	(3-24)	16	6.3	(0-30)	53	17.0	(8-30)	55	14.5	(6-27)	N/A
Germany	642	17.4	(15-21)	972	17.5	(15-20)	1423	17.2	(15-19)	1755	16.2	(14-18)	
Croatia	216	24.5	(19-31)	249	24.5	(19-30)	252	18.7	(14-24)	234	16.2	(12-22)	↓
Cyprus	42	16.7	(7-31)	43	4.7	(1-16)	64	12.5	(6-23)	53	17.0	(8-30)	
Lithuania	31	32.3	(17-51)	41	29.3	(16-46)	74	13.5	(7-23)	89	18.0	(11-28)	↓ #
EU/EEA (population-weighted mean)	**11525**	**19.5**	**(19-20)**	**12569**	**19.9**	**(19-21)**	**15152**	**18.8**	**(18-19)**	**16414**	**18.3**	**(18-19)**	↓
France	1783	17.0	(15-19)	1915	16.1	(15-18)	1958	17.4	(16-19)	1690	19.2	(17-21)	
Malta	36	8.3	(2-22)	25	16.0	(5-36)	40	12.5	(4-27)	37	21.6	(10-38)	
Czech Republic	429	23.1	(19-27)	463	25.3	(21-29)	458	25.3	(21-30)	409	23.0	(19-27)	
Italy	686	31.5	(28-35)	1074	29.5	(27-32)	1147	30.7	(28-33)	1312	24.2	(22-27)	↓
Portugal	1061	28.5	(26-31)	1176	24.5	(22-27)	1230	22.7	(20-25)	1206	24.2	(22-27)	↓
Hungary	736	23.5	(20-27)	747	26.9	(24-30)	720	23.6	(21-27)	721	24.3	(21-28)	
Greece	666	31.4	(28-35)	638	22.3	(19-26)	692	28.3	(25-32)	813	29.6	(27-33)	
Poland	185	32.4	(26-40)	249	37.8	(32-44)	393	30.0	(26-35)	389	32.1	(28-37)	
Bulgaria	48	31.3	(19-46)	55	27.3	(16-41)	55	40.0	(27-54)	69	33.3	22-46)	
Latvia	3	**	(**)	13	23.1	(5-54)	15	26.7	(8-55)	14	35.7	(13-65)	N/A
Slovakia	269	36.1	(30-42)	257	42.4	(36-49)	168	36.9	(30-45)	187	42.8	(36-50)	
Romania	90	62.2	(51-72)	78	59.0	(47-70)	86	48.8	(38-60)	131	53.4	(45-62)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** 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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Norway	257	3.1	(1-6)	230	5.2	(3-9)	227	5.7	(3-10)	205	4.9	(2-9)	
Denmark	388	3.6	(2-6)	420	5.0	(3-8)	460	3.7	(2-6)	484	5.0	(3-7)	
Cyprus	42	16.7	(7-31)	43	11.6	(4-25)	64	20.3	(11-32)	53	5.7	(1-16)	
United Kingdom	629	5.4	(4-7)	522	8.8	(7-12)	2119	6.9	(6-8)	2802	7.7	(7-9)	
Sweden	338	7.7	(5-11)	382	4.7	(3-7)	469	6.0	(4-9)	445	9.0	(6-12)	N/A
Netherlands	541	6.7	(5-9)	502	5.8	(4-8)	543	6.1	(4-8)	657	9.9	(8-12)	↑ #
Belgium	309	12.6	(9-17)	261	11.1	(8-16)	366	14.5	(11-19)	430	10.5	(8-14)	
Malta	36	2.8	(0-15)	25	12.0	(3-31)	40	10.0	(3-24)	37	10.8	(3-25)	
Finland	289	10.0	(7-14)	302	8.9	(6-13)	292	7.9	(5-12)	356	11.2	(8-15)	
Iceland	11	0.0	(0-28)	12	8.3	(0-38)	17	17.6	(4-43)	17	11.8	(1-36)	N/A
Austria	599	10.9	(8-14)	659	10.3	(8-13)	694	7.2	(5-9)	721	12.3	(10-15)	
Estonia	39	10.3	(3-24)	18	0.0	(0-19)	56	3.6	(0-12)	56	12.5	(5-24)	N/A
Luxembourg	41	9.8	(3-23)	28	17.9	(6-37)	40	12.5	(4-27)	56	12.5	(5-24)	
Ireland	178	8.4	(5-14)	194	9.8	(6-15)	243	11.9	(8-17)	287	13.9	(10-18)	↑
Germany	623	13.0	(10-16)	970	14.3	(12-17)	1423	12.4	(11-14)	1755	14.2	(13-16)	
France	1779	20.6	(19-23)	1939	19.1	(17-21)	1971	13.6	(12-15)	1709	15.1	(13-17)	↓
Spain	873	24.6	(22-28)	881	23.0	(20-26)	843	23.0	(20-26)	842	20.1	(17-23)	↓
EU/EEA (population-weighted mean)	**11629**	**20.8**	**(20-22)**	**12681**	**20.9**	**(20-22)**	**15388**	**18.8**	**(18-19)**	**16704**	**20.3**	**(20-21)**	↓ #
Slovenia	112	22.3	(15-31)	141	14.2	(9-21)	143	20.3	(14-28)	123	20.3	(14-29)	
Lithuania	31	25.8	(12-45)	41	26.8	(14-43)	73	15.1	(8-25)	89	21.3	(13-31)	
Hungary	743	24.6	(22-28)	769	24.7	(22-28)	736	24.3	(21-28)	732	23.4	(20-27)	
Portugal	1062	26.3	(24-29)	1185	22.7	(20-25)	1227	20.1	(18-22)	1208	23.7	(21-26)	
Italy	739	28.3	(25-32)	1080	24.6	(22-27)	1166	24.7	(22-27)	1390	25.1	(23-27)	
Bulgaria	48	27.1	(15-42)	55	36.4	(24-50)	56	35.7	(23-50)	71	28.2	(18-40)	
Czech Republic	447	32.7	(28-37)	464	30.0	(26-34)	464	34.7	(30-39)	411	30.2	(26-35)	
Croatia	230	30.0	(24-36)	256	35.2	(29-41)	259	37.5	(32-44)	237	32.9	(27-39)	
Greece	676	37.7	(34-41)	662	34.1	(31-38)	702	34.6	(31-38)	816	35.3	(32-39)	
Poland	184	35.3	(28-43)	257	36.2	(30-42)	400	31.0	(26-36)	358	37.2	(32-42)	
Slovakia	275	45.5	(39-52)	278	52.2	(46-58)	190	47.4	(40-55)	211	46.9	(40-54)	
Romania	92	55.4	(45-66)	92	62.0	(51-72)	89	51.7	(41-62)	132	62.1	(53-70)	
Latvia	18	16.7	(4-41)	13	23.1	(5-54)	16	31.3	(11-59)	14	64.3	(35-87)	N/A

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.17. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	9.1	(0-41)	11	0.0	(0-28)	17	0.0	(0-20)	17	0.0	(0-20)	N/A
Denmark	386	3.9	(2-6)	439	3.6	(2-6)	447	4.5	(3-7)	461	3.5	(2-6)	
Netherlands	534	4.9	(3-7)	502	4.4	(3-7)	543	3.3	(2-5)	657	3.5	(2-5)	
Sweden	433	5.5	(4-8)	379	4.5	(3-7)	473	7.4	(5-10)	446	4.5	(3-7)	N/A
United Kingdom	588	4.6	(3-7)	472	6.1	(4-9)	2021	4.3	(3-5)	2680	4.7	(4-6)	
Norway	251	5.2	(3-9)	216	5.6	(3-10)	224	7.1	(4-11)	197	5.1	(2-9)	
Finland	307	6.2	(4-9)	334	6.9	(4-10)	352	5.4	(3-8)	378	6.1	(4-9)	
Belgium	316	8.9	(6-13)	226	6.2	(3-10)	320	7.8	(5-11)	431	7.2	(5-10)	
Estonia	28	7.1	(1-24)	7	**	(**)	17	17.6	(4-43)	47	8.5	(2-20)	N/A
Austria	631	8.7	(7-11)	577	9.9	(8-13)	628	11.3	(9-14)	620	8.7	(7-11)	
Spain	864	9.6	(8-12)	816	10.4	(8-13)	836	10.2	(8-12)	836	9.6	(8-12)	
Ireland	175	8.0	(4-13)	195	7.2	(4-12)	243	10.7	(7-15)	272	9.6	(6-14)	
Germany	638	9.9	(8-12)	968	8.9	(7-11)	1421	10.1	(9-12)	1744	10.1	(9-12)	
France	1778	12.0	(11-14)	1919	11.6	(10-13)	1956	11.3	(10-13)	1568	12.2	(11-14)	
Luxembourg	41	2.4	(0-13)	28	7.1	(1-24)	40	5.0	(1-17)	56	12.5	(5-24)	
Slovenia	112	20.5	(13-29)	141	9.9	(6-16)	143	17.5	(12-25)	138	13.0	(8-20)	
Cyprus	42	23.8	(12-39)	43	4.7	(1-16)	64	10.9	(5-21)	53	13.2	(5-25)	
Czech Republic	446	21.5	(18-26)	464	19.6	(16-24)	464	19.2	(16-23)	411	13.4	(10-17)	
Malta	36	2.8	(0-15)	25	8.0	(1-26)	40	7.5	(2-20)	37	13.5	(5-29)	
EU/EEA (population-weighted mean)	**11588**	**15.4**	**(15-16)**	**12383**	**15.4**	**(15-16)**	**15102**	**14.4**	**(14-15)**	**16266**	**14.7**	**(14-15)**	**↓ #**
Lithuania	30	16.7	(6-35)	41	19.5	(9-35)	74	10.8	(5-20)	88	14.8	(8-24)	
Portugal	1061	22.0	(20-25)	1185	19.2	(17-22)	1228	18.0	(16-20)	1216	18.6	(16-21)	↓
Croatia	227	24.2	(19-30)	248	18.5	(14-24)	240	20.8	(16-27)	231	19.5	(15-25)	
Italy	683	24.9	(22-28)	1068	21.7	(19-24)	1160	23.0	(21-26)	1332	20.0	(18-22)	↓ #
Hungary	739	24.1	(21-27)	763	24.2	(21-27)	735	20.7	(18-24)	729	23.9	(21-27)	
Poland	183	21.9	(16-29)	259	27.8	(22-34)	401	19.5	(16-24)	415	24.6	(21-29)	
Greece	649	26.7	(23-30)	660	19.4	(16-23)	696	33.6	(30-37)	814	24.9	(22-28)	
Slovakia	261	29.5	(24-35)	247	34.8	(29-41)	164	31.1	(24-39)	180	35.6	(29-43)	
Bulgaria	47	29.8	(17-45)	52	26.9	(16-41)	54	38.9	(26-53)	71	38.0	(27-50)	
Latvia	3	**	(**)	13	23.1	(5-54)	15	26.7	(8-55)	14	42.9	(18-71)	N/A
Romania	88	59.1	(48-69)	85	65.9	(55-76)	86	44.2	(33-55)	127	55.9	(47-65)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** 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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	0.0	(0-28)	12	0.0	(0-26)	17	0.0	(0-20)	17	0.0	(0-20)	N/A
Norway	240	1.3	(0-4)	219	0.9	(0-3)	213	0.9	(0-3)	183	0.5	(0-3)	
Sweden	313	0.6	(0-2)	387	1.3	(0-3)	471	0.8	(0-2)	444	0.9	(0-2)	N/A
Denmark	388	2.3	(1-4)	441	2.3	(1-4)	460	1.7	(1-3)	484	1.0	(0-2)	
Cyprus	42	9.5	(3-23)	43	0.0	(0-8)	64	4.7	(1-13)	53	1.9	(0-10)	
Finland	305	2.3	(1-5)	341	1.8	(1-4)	352	2.3	(1-4)	378	1.9	(1-4)	
United Kingdom	641	1.7	(1-3)	539	5.2	(3-7)	2140	3.6	(3-4)	2831	3.9	(3-5)	
Netherlands	544	2.9	(2-5)	502	2.8	(2-5)	541	2.8	(2-5)	657	4.0	(3-6)	
Germany	643	5.9	(4-8)	966	7.1	(6-9)	1421	6.8	(6-8)	1729	4.8	(4-6)	
Austria	638	6.6	(5-9)	678	6.3	(5-8)	692	6.1	(4-8)	717	5.0	(4-7)	
Estonia	40	7.5	(2-20)	17	5.9	(0-29)	54	7.4	(2-18)	56	5.4	(1-15)	N/A
Luxembourg	39	7.7	(2-21)	28	3.6	(0-18)	40	15.0	(6-30)	56	5.4	(1-15)	
Belgium	258	8.5	(5-13)	218	6.0	(3-10)	327	11.0	(8-15)	377	7.7	(5-11)	
Ireland	178	5.6	(3-10)	195	4.1	(2-8)	243	10.3	(7-15)	288	8.7	(6-13)	
Slovenia	112	8.9	(4-16)	141	9.2	(5-15)	143	13.3	(8-20)	138	8.7	(5-15)	
Malta	36	11.1	(3-26)	25	16.0	(5-36)	40	7.5	(2-20)	37	10.8	(3-25)	
France	1767	15.7	(14-18)	1950	14.1	(13-16)	1976	10.7	(9-12)	1713	10.9	(9-12)	↓
Portugal	1064	17.6	(15-20)	1191	13.5	(12-16)	1230	11.6	(10-14)	1210	12.1	(10-14)	↓
Spain	873	16.5	(14-19)	883	16.4	(14-19)	843	15.3	(13-18)	838	12.5	(10-15)	↓
EU/EEA (population-weighted mean)	**11576**	**16.1**	**(15-17)**	**12703**	**15.3**	**(15-16)**	**15408**	**14.1**	**(14-15)**	**16732**	**13.2**	**(13-14)**	↓
Lithuania	30	26.7	(12-46)	41	24.4	(12-40)	74	14.9	(8-25)	89	13.5	(7-22)	↓
Czech Republic	446	20.6	(17-25)	464	21.3	(18-25)	464	18.8	(15-23)	411	14.4	(11-18)	↓ #
Hungary	741	21.1	(18-24)	766	20.5	(18-24)	740	17.6	(15-21)	734	14.6	(12-17)	↓
Italy	704	23.2	(20-26)	1050	17.2	(15-20)	1203	19.1	(17-21)	1428	18.0	(16-20)	↓
Poland	185	31.9	(25-39)	258	30.6	(25-37)	367	25.6	(21-30)	384	25.5	(21-30)	↓
Croatia	231	35.1	(29-42)	256	34.0	(28-40)	260	33.5	(28-40)	237	26.6	(21-33)	
Bulgaria	44	31.8	(19-48)	47	27.7	(16-43)	39	48.7	(32-65)	71	28.2	(18-40)	
Greece	676	35.8	(32-40)	667	26.4	(23-30)	701	28.0	(25-31)	815	30.2	(27-33)	
Slovakia	276	37.0	(31-43)	277	41.9	(36-48)	191	33.0	(26-40)	211	36.0	(30-43)	
Latvia	18	5.6	(0-27)	11	9.1	(0-41)	15	20.0	(4-48)	14	42.9	(18-71)	N/A
Romania	93	63.4	(53-73)	90	63.3	(53-73)	87	50.6	(40-61)	132	57.6	(49-66)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.19 ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	9.1	(0-41)	12	0.0	(0-26)	17	5.9	(0-29)	17	0.0	(0-20)	N/A
Denmark	386	4.7	(3-7)	437	4.6	(3-7)	458	2.4	(1-4)	484	2.5	(1-4)	↓
Norway	256	5.9	(3-9)	228	5.7	(3-10)	225	6.7	(4-11)	205	3.4	(1-7)	
Netherlands	543	4.4	(3-7)	500	4.0	(2-6)	543	3.7	(2-6)	655	4.4	(3-6)	
United Kingdom	590	6.3	(4-9)	499	2.4	(1-4)	2108	5.1	(4-6)	2804	5.7	(5-7)	
Finland	307	7.2	(5-11)	341	4.7	(3-8)	352	6.0	(4-9)	377	6.1	(4-9)	
Belgium	344	10.2	(7-14)	256	3.9	(2-7)	365	9.6	(7-13)	474	8.2	(6-11)	
Ireland	177	8.5	(5-14)	195	9.2	(6-14)	243	6.2	(3-10)	288	9.0	(6-13)	
Sweden	408	7.1	(5-10)	398	6.5	(4-9)	472	11.0	(8-14)	446	9.0	(6-12)	N/A
Estonia	39	15.4	(6-31)	16	12.5	(2-38)	54	20.4	(11-34)	55	9.1	(3-20)	N/A
Luxembourg	42	4.8	(1-16)	24	8.3	(1-27)	31	6.5	(1-21)	56	10.7	(4-22)	
Malta	36	13.9	(5-29)	25	16.0	(5-36)	40	12.5	(4-27)	37	10.8	(3-25)	
Germany	642	17.0	(14-20)	971	14.7	(13-17)	1422	14.5	(13-16)	1753	12.7	(11-14)	↓
Austria	636	12.7	(10-16)	680	12.2	(10-15)	696	12.9	(11-16)	725	13.9	(11-17)	
France	1780	18.7	(17-21)	1925	16.4	(15-18)	1968	15.6	(14-17)	1710	13.9	(12-16)	↓
Czech Republic	448	14.1	(11-18)	464	10.6	(8-14)	464	8.8	(6-12)	411	14.8	(12-19)	
Cyprus	42	33.3	(20-50)	43	20.9	(10-36)	64	18.8	(10-30)	53	17.0	(8-30)	
EU/EEA (population-weighted mean)	**11789**	**19.7**	**(19-20)**	**12719**	**19.4**	**(19-20)**	**15456**	**18.2**	**(18-19)**	**16864**	**17.4**	**(17-18)**	↓
Slovenia	112	31.3	(23-41)	141	15.6	(10-23)	143	19.6	(13-27)	138	17.4	(11-25)	↓
Portugal	1064	22.5	(20-25)	1191	19.8	(18-22)	1227	19.2	(17-21)	1215	18.3	(16-21)	↓
Spain	872	18.5	(16-21)	872	22.7	(20-26)	842	21.4	(19-24)	835	18.4	(16-21)	
Italy	753	25.1	(22-28)	1082	23.0	(21-26)	1206	23.5	(21-26)	1434	19.9	(18-22)	↓
Poland	185	27.6	(21-35)	254	37.0	(31-43)	397	26.2	(22-31)	393	24.2	(20-29)	↓ #
Lithuania	31	29.0	(14-48)	41	26.8	(14-43)	74	16.2	(9-27)	89	24.7	(16-35)	
Bulgaria	48	29.2	(17-44)	55	25.5	(15-39)	56	30.4	(19-44)	71	25.4	(16-37)	
Croatia	232	35.3	(29-42)	257	38.5	(33-45)	260	42.3	(36-49)	238	30.7	(25-37)	
Hungary	744	33.5	(30-37)	770	35.8	(32-39)	739	33.3	(30-37)	733	36.6	(33-40)	
Greece	699	42.9	(39-47)	675	40.4	(37-44)	699	42.1	(38-46)	821	39.3	(36-43)	
Slovakia	250	38.4	(32-45)	262	51.9	(46-58)	182	42.3	(35-50)	202	47.0	(40-54)	
Latvia	18	16.7	(4-41)	13	15.4	(2-45)	16	31.3	(11-59)	14	57.1	(29-82)	N/A
Romania	94	58.5	(48-69)	92	66.3	(56-76)	93	51.6	(41-62)	131	63.4	(54-72)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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 3.20. ***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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	0.0	(0-28)	12	0.0	(0-26)	17	0.0	(0-18)	17	0.0	(0-18)	N/A
Denmark	388	1.5	(1-3)	441	2.3	(1-4)	460	1.3	(1-3)	484	0.4	(0-1)	
Norway	257	1.6	(0-4)	230	1.3	(0-4)	227	2.6	(1-6)	205	1.5	(0-4)	
Netherlands	542	2.8	(2-5)	502	2.8	(2-5)	543	2.6	(2-4)	657	2.1	(1-4)	
United Kingdom	627	1.6	(1-3)	501	3.8	(2-6)	2131	2.5	(2-3)	2830	2.4	(2-3)	
Sweden	436	1.6	(1-3)	386	2.6	(1-5)	472	5.3	(4-8)	446	3.1	(2-5)	
Finland	306	3.9	(2-7)	341	4.7	(3-8)	352	3.4	(2-6)	378	3.4	(2-6)	
Luxembourg	41	4.9	(1-17)	28	3.6	(0-18)	40	2.5	(0-13)	56	5.4	(2-15)	
Belgium	297	8.4	(6-12)	260	4.6	(2-8)	366	6.3	(4-9)	439	6.6	(5-9)	
Austria	638	7.1	(5-9)	680	6.8	(5-9)	697	6.7	(5-9)	724	7.0	(5-9)	
Germany	643	8.9	(7-11)	941	8.2	(7-10)	1320	7.9	(7-9)	1755	7.2	(6-9)	
Ireland	178	5.6	(3-10)	195	5.1	(2-9)	243	8.6	(6-13)	288	7.6	(5-11)	
Malta	36	5.6	(2-18)	25	12.0	(3-31)	40	5.0	(1-17)	37	8.1	(3-21)	
Estonia	40	0.0	(0-9)	15	0.0	(0-22)	56	3.6	(1-12)	57	8.8	(4-19)	N/A
Cyprus	42	14.3	(5-29)	43	2.3	(0-12)	64	4.7	(2-13)	53	9.4	(4-20)	
France	1784	13.2	(12-15)	1940	12.0	(11-14)	1972	10.7	(9-12)	1709	10.6	(9-12)	↓ #
Slovenia	112	18.8	(12-27)	141	7.1	(3-13)	143	15.4	(10-22)	138	10.9	(7-17)	
Spain	873	12.4	(10-15)	874	14.2	(12-17)	843	14.5	(12-17)	837	10.9	(9-13)	
EU/EEA (population-weighted mean)	**11810**	**15.4**	**(15-16)**	**12711**	**15.1**	**(14-16)**	**15410**	**13.7**	**(13-14)**	**16885**	**13.3**	**(13-14)**	↓
Portugal	1064	20.6	(18-23)	1186	16.9	(14-18)	1230	14.8	(13-17)	1214	16.1	(14-18)	↓
Lithuania	31	25.8	(12-45)	41	24.4	(12-40)	74	10.8	(6-20)	89	16.9	(10-26)	
Czech Republic	446	20.2	(17-24)	464	19.0	(15-23)	464	19.6	(16-23)	411	17.3	(14-21)	
Italy	746	22.9	(20-26)	1082	20.0	(18-22)	1206	20.1	(18-23)	1436	17.5	(16-20)	↓
Hungary	746	21.7	(19-25)	770	20.9	(18-24)	740	19.1	(16-22)	735	18.1	(15-21)	
Croatia	232	31.5	(26-38)	257	28.0	(23-34)	260	31.9	(27-38)	238	21.4	(17-27)	↓
Poland	187	26.7	(21-34)	260	29.6	(24-36)	403	20.6	(17-25)	417	22.8	(19-27)	
Bulgaria	48	29.2	(17-44)	55	29.1	(18-43)	56	35.7	(24-59)	71	26.8	(18-38)	
Greece	679	36.1	(32-40)	666	28.4	(25-32)	702	31.6	(28-35)	816	32.4	(29-36)	
Slovakia	268	37.3	(32-43)	270	40.7	(35-47)	183	33.9	(27-41)	202	39.1	(33-46)	
Latvia	18	11.1	(1-35)	13	15.4	(2-45)	16	18.8	(7-43)	14	42.9	(20-66)	N/A
Romania	94	59.6	(49-70)	92	63.0	(52-73)	90	42.9	(39-59)	132	59.1	(51-67)	

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

3.4 *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, although possible with mass spectrometry and genotypic methods.

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

More than half of the *Acinetobacter* spp. isolates reported by EU/EEA countries to EARS-Net for 2017 (55.0%) were resistant to at least one of the antimicrobial groups under regular surveillance, i.e. fluoroquinolones, aminoglycosides and carbapenems (Table 3.21). In 2017, the EU/EEA population-weighted mean percentage showed little variation between the antimicrobial groups and varied between 32.4% and 37.6% (Tables 3.22–3.24). Trend analyses were not performed for the EU/EEA population-weighted means as the proportion of laboratories that consistently reported data for the full four-year period remained low.

Resistance to one or two antimicrobial groups was considerably less common than combined resistance to all three groups under surveillance (Table 3.21). In 2017, the population-weighted EU/EEA mean percentage for combined resistance to fluoroquinolones, aminoglycosides and carbapenems was 28.4% (Table 3.25).

Large inter-country variations were noted for all antimicrobial groups under regular surveillance, with generally higher resistance percentages reported from southern and eastern parts of Europe than from northern Europe (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 conclusion

As in previous years, antimicrobial resistance in *Acinetobacter* spp. varied largely across Europe, with generally high resistance percentages reported from the Baltic countries and from southern and south-eastern Europe. More than half of the *Acinetobacter* spp. isolates reported to EARS-Net for 2017 were resistant to at least one antimicrobial group under surveillance. Combined resistance to multiple antimicrobial groups was common. The most frequently reported resistance phenotype was resistance to all three groups under regular surveillance, i.e. fluoroquinolones, aminoglycosides and carbapenems. This is a public health concern because it not only severely limits options for patient treatment but also constitutes an infection prevention

Table 3.21. *Acinetobacter* spp. Overall resistance and resistance combinations among invasive isolates tested to fluoroquinolones, aminoglycosides and carbapenems (n=5 853)*, EU/EEA countries, 2017

Resistance pattern	Number of isolates	% of total**
Fully susceptible	**2 633**	**45.0**
Single resistance (to indicated antimicrobial group)		
Total (any single resistance)	**249**	**4.3**
Fluoroquinolones	158	2.7
Aminoglycosides	56	1.0
Carbapenems	35	0.6
Resistance to two antimicrobial groups		
Total (any two-group combinations)	**441**	**7.5**
Fluoroquinolones + carbapenems	283	4.8
Fluoroquinolones + aminoglycosides	145	2.5
Aminoglycosides + carbapenems	13	0.2
Resistance to three antimicrobial groups		
Fluoroquinolones + aminoglycosides + carbapenems	**2 530**	**43.2**

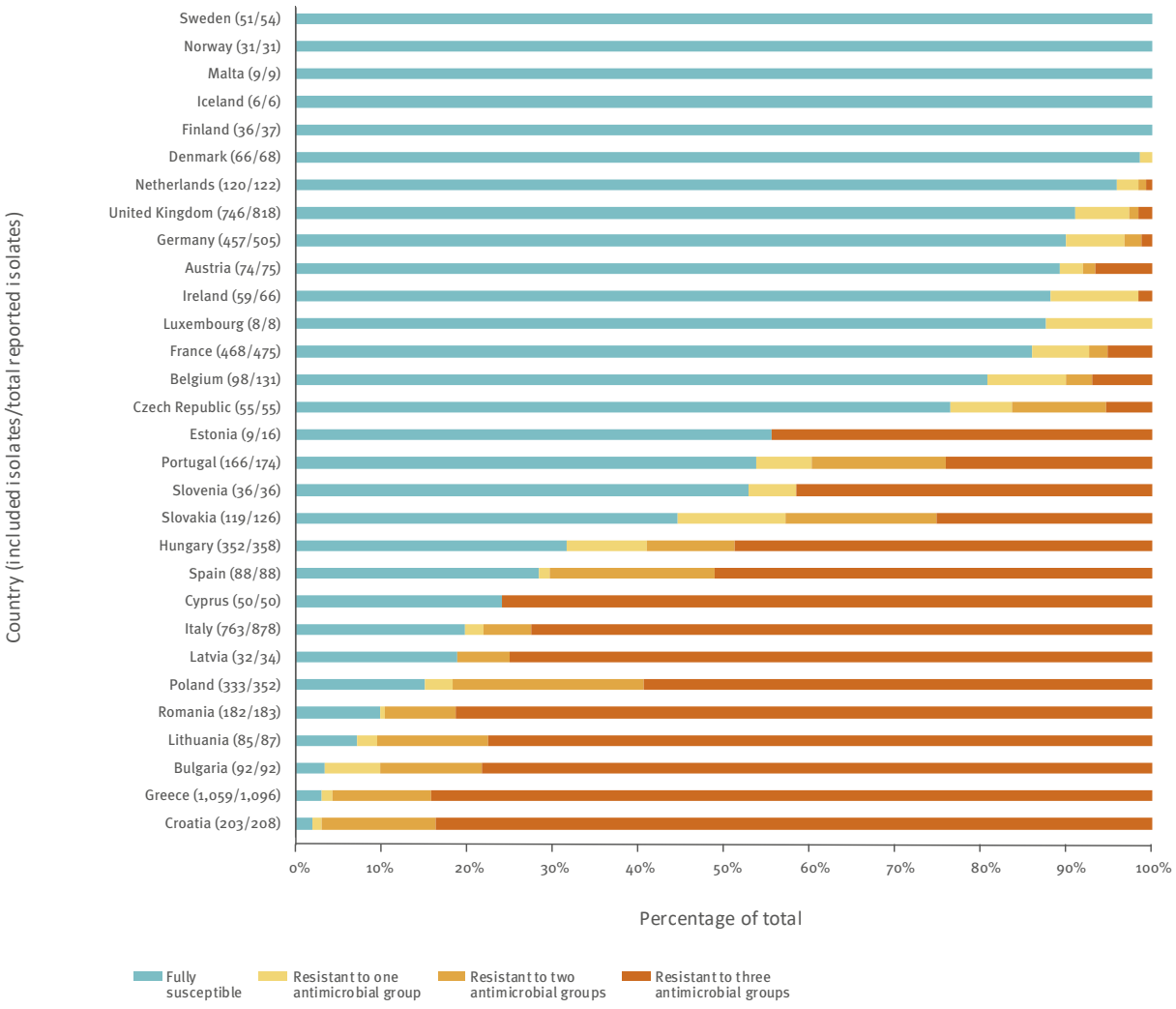
* Only data from isolates tested against all three antimicrobial groups were included in the analysis.

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

and control challenge. The presence of multidrug-resistant *Acinetobacter* spp. in the healthcare environment is problematic: the bacterium can persist in the environment for long periods and is notoriously difficult to eradicate once established.

ECDC's risk assessment on carbapenem-resistant *Acinetobacter baumannii* in healthcare highlights the need of increased efforts to face this significant threat to patients and healthcare systems in all EU/EEA countries. The document outlines options to reduce risks through clinical management, prevention of transmission in hospitals and other healthcare settings, prevention of cross-border transmission, and improvement of preparedness of EU/EEA countries. Options for response presented in the risk assessment included timely laboratory reporting, screening and pre-emptive isolation of high-risk patients, high-standard infection control and antimicrobial stewardship programmes [21].

Figure 3.19. *Acinetobacter* spp. Distribution of isolates: fully susceptible and resistant to one, two and three antimicrobial groups (among isolates tested against fluoroquinolones, aminoglycosides and carbapenems), EU/EEA countries, 2017



Only data from isolates tested against all included antimicrobial groups included in analysis.

Figure 3.20. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to fluoroquinolones, by country, EU/EEA countries, 2017**

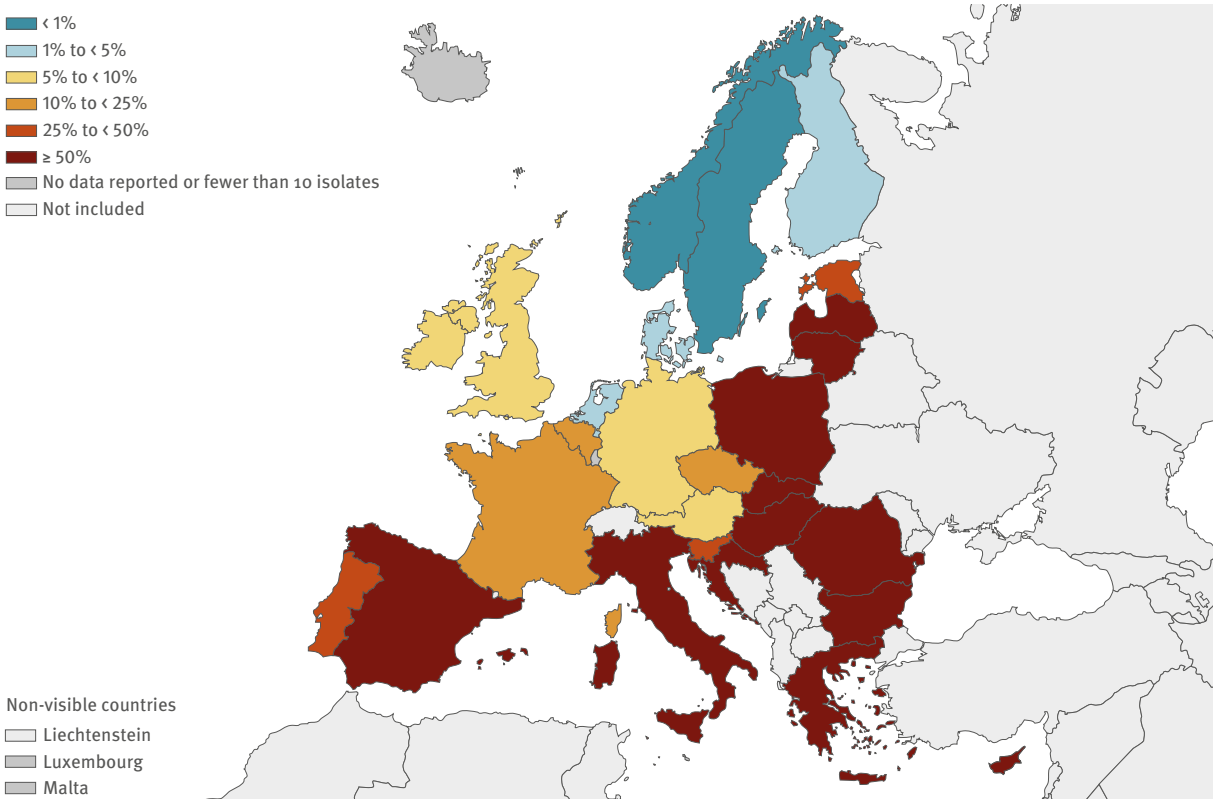


Figure 3.21. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to aminoglycosides, by country, EU/EEA countries, 2017**

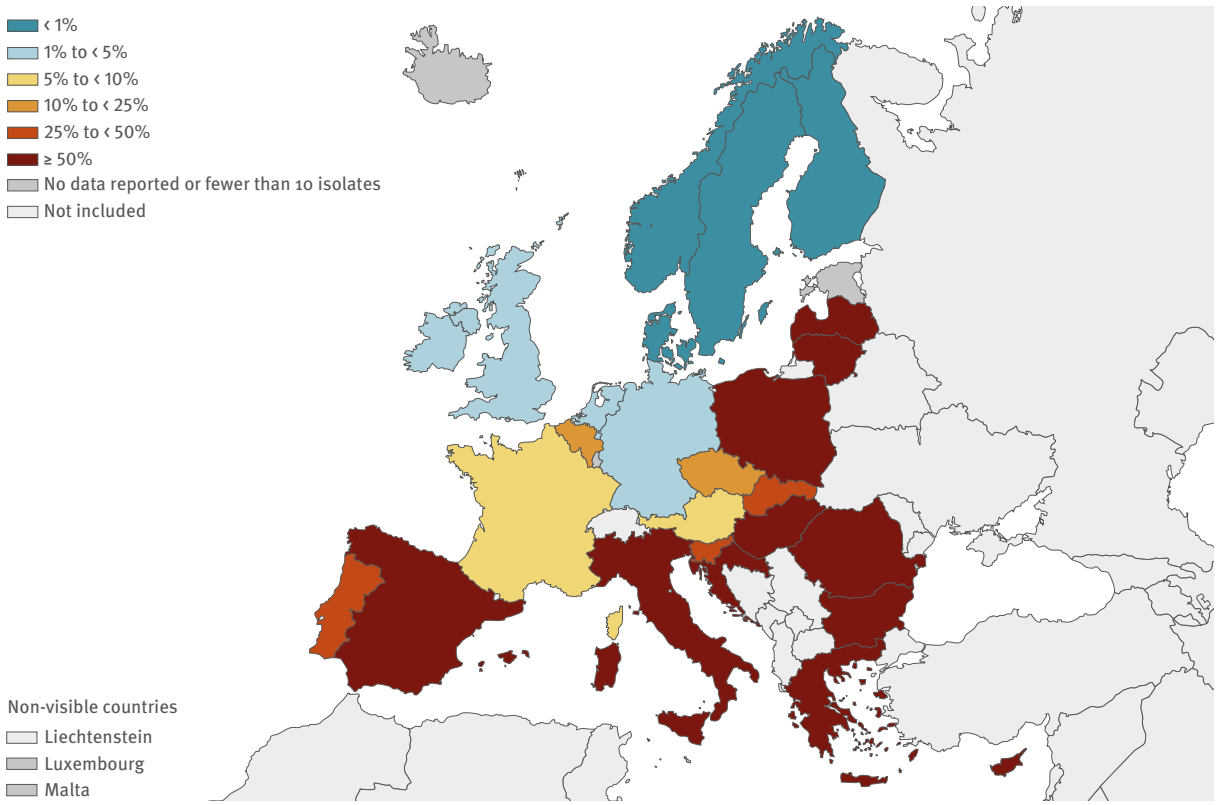


Figure 3.22. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with resistance to carbapenems, by country, EU/EEA countries, 2017**

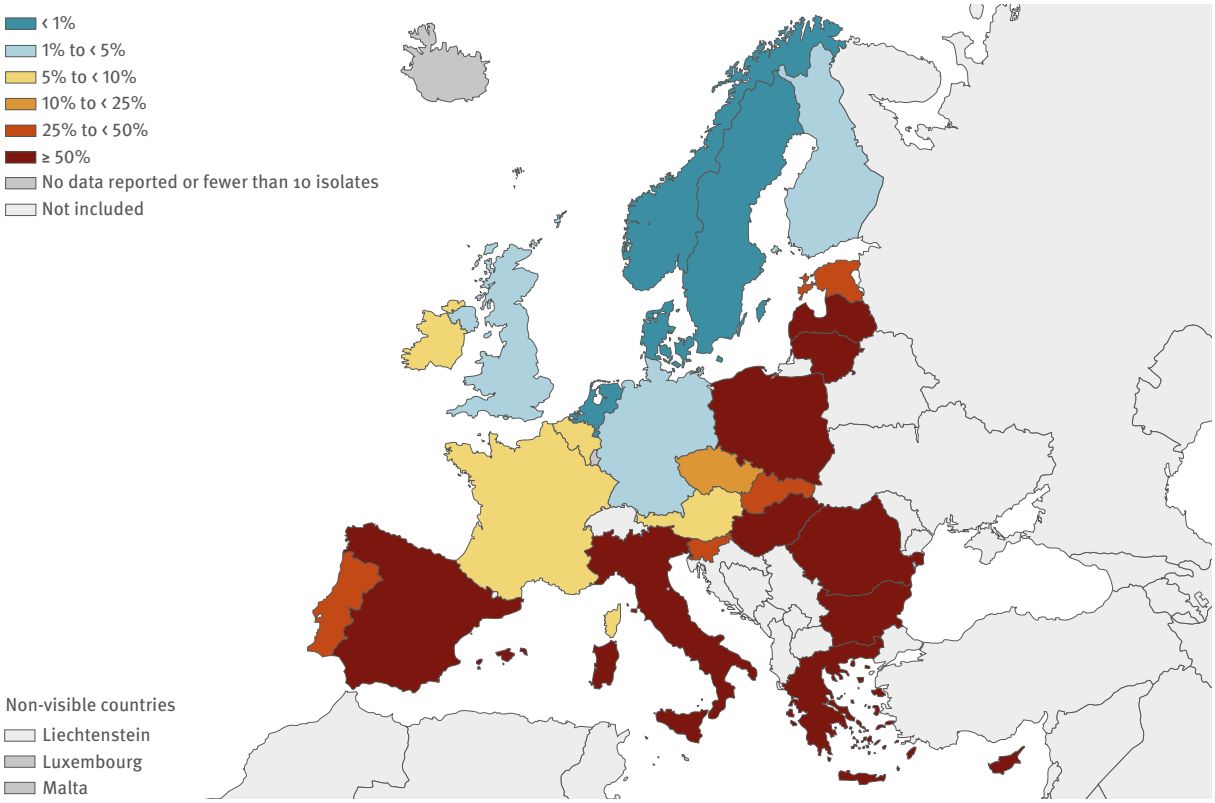


Figure 3.23. ***Acinetobacter*** **spp. Percentage (%) of invasive isolates with combined resistance to fluoroquinolones, aminoglycosides and carbapenems, by country, EU/EEA countries, 2017**

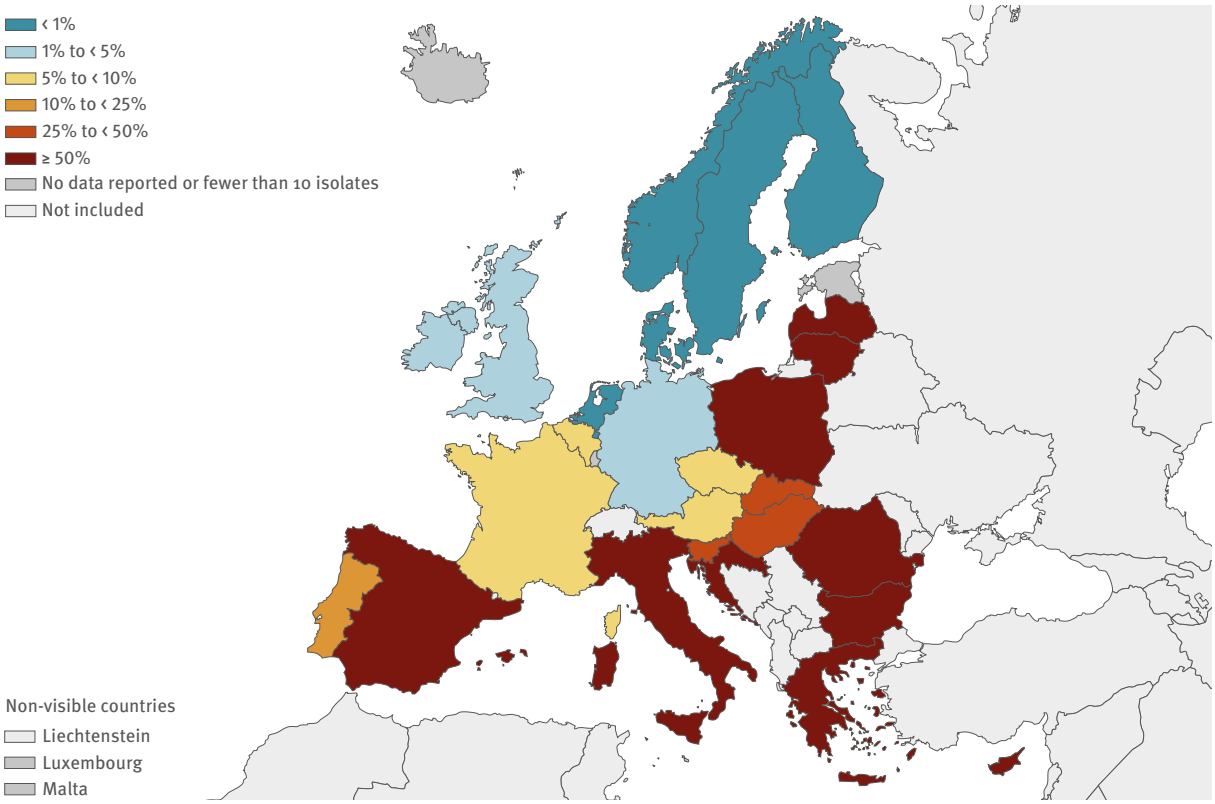


Table 3.22. ***Acinetobacter*** **spp. Total number of invasive isolates tested (N) and percentage with resistance to fluoroquinolones (%R), including 95 % confidence intervals (95 % CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Norway	34	5.9	(1-20)	32	9.4	(2-25)	33	3.0	(0-16)	31	0.0	(0-11)	
Sweden	52	11.5	(4-23)	26	3.8	(0-20)	86	4.7	(1-11)	54	0.0	(0-7)	N/A
Denmark	69	2.9	(0-10)	68	5.9	(2-14)	72	2.8	(0-10)	68	1.5	(0-8)	
Finland	31	6.5	(1-21)	43	2.3	(0-12)	28	0.0	(0-12)	37	2.7	(0-14)	
Netherlands	72	4.2	(1-12)	74	6.8	(2-15)	106	2.8	(1-8)	122	3.3	(1-8)	
United Kingdom	123	11.4	(6-18)	139	7.2	(4-13)	589	4.4	(3-6)	793	6.3	(5-8)	
Germany	199	6.0	(3-10)	339	8.6	(6-12)	460	5.7	(4-8)	498	6.8	(5-9)	
Ireland	86	4.7	(1-11)	83	4.8	(1-12)	68	1.5	(0-8)	66	7.6	(3-17)	
Austria	75	5.3	(1-13)	61	16.4	(8-28)	81	16.0	(9-26)	74	9.5	(4-19)	
Belgium	4	**	(**)	26	0.0	(0-13)	78	7.7	(3-16)	130	10.8	(6-17)	N/A
France	395	11.9	(9-16)	430	13.5	(10-17)	452	15.0	(12-19)	473	12.3	(9-16)	
Czech Republic	59	15.3	(7-27)	60	18.3	(10-30)	57	17.5	(9-30)	55	20.0	(10-33)	
Estonia	-	-	(-)	4	**	(**)	5	**	(**)	11	36.4	(11-69)	N/A
EU/EEA (population-weighted mean)	**4244**	**40.2**	**(39-42)**	**5028**	**38.6**	**(37-40)**	**5591**	**37.5**	**(36-39)**	**6069**	**37.6**	**(36-39)**	**N/A**
Portugal	264	52.7	(46-59)	308	55.8	(50-61)	206	50.5	(43-58)	172	38.4	(31-46)	↓
Slovenia	34	41.2	(25-59)	31	58.1	(39-75)	60	55.0	(42-68)	36	47.2	(30-65)	
Slovakia	170	51.8	(44-59)	154	51.9	(44-60)	115	46.1	(37-56)	126	52.4	(43-61)	
Hungary	441	66.4	(62-71)	464	68.1	(64-72)	397	68.0	(63-73)	352	67.0	(62-72)	
Spain	79	67.1	(56-77)	95	64.2	(54-74)	106	68.9	(59-78)	88	70.5	(60-80)	
Cyprus	58	77.6	(65-87)	60	83.3	(71-92)	28	71.4	(51-87)	50	76.0	(62-87)	
Italy	469	92.1	(89-94)	664	81.6	(78-85)	697	79.9	(77-83)	804	79.2	(76-82)	↓
Latvia	52	88.5	(77-96)	60	78.3	(66-88)	68	85.3	(75-93)	33	81.8	(65-93)	
Poland	185	82.7	(76-88)	243	88.1	(83-92)	393	83.0	(79-87)	348	83.0	(79-87)	
Romania	123	83.7	(76-90)	189	82.5	(76-88)	157	91.1	(85-95)	183	89.1	(84-93)	↑
Lithuania	66	84.8	(74-92)	73	93.2	(85-98)	87	87.4	(79-94)	86	91.9	(84-97)	
Bulgaria	115	73.9	(65-82)	131	78.6	(71-85)	106	67.9	(58-77)	92	95.7	(89-99)	↑
Greece	806	95.3	(94-97)	946	94.9	(93-96)	862	94.9	(93-96)	1060	96.0	(95-97)	
Croatia	164	92.1	(87-96)	196	92.3	(88-96)	176	94.9	(91-98)	204	98.0	(95-99)	↑
Iceland	3	**	(**)	6	**	(**)	3	**	(**)	6	**	(**)	N/A
Luxembourg	6	**	(**)	8	**	(**)	8	**	(**)	8	**	(**)	N/A
Malta	10	30.0	(7-65)	15	13.3	(2-40)	7	**	(**)	9	**	(**)	N/A

–: No data

* ↑ 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.

** Less than 10 isolates reported, no percentage calculated

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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Denmark	60	1.7	(0-9)	63	4.8	(1-13)	70	0.0	(0-5)	68	0.0	(0-5)	
Finland	31	3.2	(0-17)	42	2.4	(0-13)	28	3.6	(0-18)	36	0.0	(0-10)	
Norway	33	3.0	(0-16)	32	9.4	(2-25)	32	3.1	(0-16)	31	0.0	(0-11)	
Sweden	36	2.8	(0-15)	26	3.8	(0-20)	85	5.9	(2-13)	51	0.0	(0-7)	N/A
Netherlands	73	5.5	(2-13)	74	10.8	(5-20)	103	3.9	(1-10)	120	2.5	(1-7)	
Ireland	89	2.2	(0-8)	80	3.8	(1-11)	63	1.6	(0-9)	62	3.2	(0-11)	
Germany	197	4.1	(2-8)	331	5.4	(3-8)	436	3.0	(2-5)	460	3.5	(2-6)	
United Kingdom	129	10.1	(5-17)	153	2.0	(0-6)	598	3.3	(2-5)	790	4.6	(3-6)	
France	409	8.3	(6-11)	431	11.1	(8-14)	449	12.2	(9-16)	474	9.1	(7-12)	
Austria	79	8.9	(4-17)	63	6.3	(2-15)	81	16.0	(9-26)	75	9.3	(4-18)	
Czech Republic	59	10.2	(4-21)	60	15.0	(7-27)	57	8.8	(3-19)	55	12.7	(5-24)	
Belgium	2	**	(**)	15	0.0	(0-22)	66	1.5	(0-8)	99	13.1	(7-21)	N/A
Portugal	265	42.3	(36-48)	310	46.5	(41-52)	206	39.3	(33-46)	168	28.6	(22-36)	
EU/EEA (population-weighted mean)	**4190**	**34.5**	**(33-36)**	**4997**	**32.4**	**(31-34)**	**5557**	**32.8**	**(32-34)**	**6022**	**32.4**	**(31-34)**	**N/A**
Slovakia	170	40.6	(33-48)	154	42.9	(35-51)	115	40.9	(32-50)	125	40.0	(31-49)	
Slovenia	34	32.4	(17-51)	31	41.9	(25-61)	60	43.3	(31-57)	36	41.7	(26-59)	
Spain	80	58.8	(47-70)	96	49.0	(39-59)	106	50.9	(41-61)	88	54.5	(44-65)	
Hungary	444	59.5	(55-64)	465	60.6	(56-65)	401	59.1	(54-64)	358	56.1	(51-61)	
Poland	188	58.5	(51-66)	245	70.2	(64-76)	387	72.6	(68-77)	344	72.7	(68-77)	↑
Cyprus	57	73.7	(60-84)	59	74.6	(62-85)	28	57.1	(37-76)	50	76.0	(62-87)	
Italy	444	88.3	(85-91)	656	74.7	(71-78)	704	76.4	(73-80)	836	76.1	(73-79)	↓
Latvia	52	69.2	(55-81)	61	59.0	(46-71)	81	77.8	(67-86)	33	78.8	(61-91)	
Lithuania	65	80.0	(68-89)	73	90.4	(81-96)	87	82.8	(73-90)	86	81.4	(72-89)	
Romania	122	77.0	(69-84)	188	80.9	(74-86)	152	89.5	(83-94)	183	83.6	(77-89)	
Croatia	166	82.5	(76-88)	197	88.3	(83-92)	182	83.0	(77-88)	206	84.0	(78-89)	
Greece	800	83.9	(81-86)	945	83.7	(81-86)	878	85.0	(82-87)	1064	85.6	(83-88)	
Bulgaria	87	60.9	(50-71)	116	74.1	(65-82)	79	81.0	(71-89)	92	89.1	(81-95)	↑
Estonia	-	-	(-)	2	**	(**)	5	**	(**)	9	**	(**)	N/A
Iceland	3	**	(**)	6	**	(**)	3	**	(**)	6	**	(**)	N/A
Luxembourg	6	**	(**)	8	**	(**)	8	12.5	(0-53)	8	**	(**)	N/A
Malta	10	30.0	(7-65)	15	13.3	(2-40)	7	**	(**)	9	**	(**)	N/A

–: No data

* ↑ 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.

** Less than 10 isolates reported, no percentage calculated

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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Denmark	62	1.6	(0-9)	65	4.6	(1-13)	69	0.0	(0-5)	66	0.0	(0-5)	
Norway	34	2.9	(0-15)	32	9.4	(2-25)	33	0.0	(0-11)	31	0.0	(0-11)	
Sweden	52	3.8	(0-13)	34	2.9	(0-15)	84	1.2	(0-6)	54	0.0	(0-7)	N/A
Netherlands	74	0.0	(0-5)	73	4.1	(1-12)	104	0.0	(0-3)	121	0.8	(0-5)	
Finland	32	3.1	(0-16)	43	2.3	(0-12)	28	0.0	(0-12)	37	2.7	(0-14)	
United Kingdom	120	1.7	(0-6)	132	0.8	(0-4)	584	1.5	(1-3)	782	2.8	(2-4)	
Germany	201	5.5	(3-10)	337	6.5	(4-10)	452	4.9	(3-7)	502	4.4	(3-7)	
France	401	2.5	(1-5)	428	5.6	(4-8)	450	7.1	(5-10)	469	6.2	(4-9)	↑
Ireland	79	1.3	(0-7)	84	6.0	(2-13)	65	0.0	(0-6)	63	6.3	(2-15)	
Austria	78	6.4	(2-14)	64	9.4	(4-19)	81	12.3	(6-22)	75	6.7	(2-15)	
Belgium	4	**	(**)	24	0.0	(0-14)	78	2.6	(0-9)	131	6.9	(3-13)	N/A
Czech Republic	59	5.1	(1-14)	60	6.7	(2-16)	57	1.8	(0-9)	55	12.7	(5-24)	
Slovakia	161	32.9	(26-41)	142	28.2	(21-36)	109	28.4	(20-38)	120	31.7	(23-41)	
Estonia	-	-	(-)	3	**	(**)	8	**	(**)	15	33.3	(12-62)	N/A
EU/EEA (population-weighted mean)	**4275**	**33.2**	**(32-35)**	**5052**	**32.1**	**(31-33)**	**5588**	**32.6**	**(31-34)**	**6158**	**33.4**	**(32-35)**	**N/A**
Portugal	262	53.1	(47-59)	307	57.7	(52-63)	206	51.9	(45-59)	172	40.7	(33-48)	↓
Slovenia	34	26.5	(13-44)	31	38.7	(22-58)	60	43.3	(31-57)	36	41.7	(26-59)	
Hungary	443	44.5	(40-49)	467	55.2	(51-60)	401	58.6	(54-63)	358	52.5	(47-58)	↑
Poland	189	53.4	(46-61)	244	65.6	(59-72)	391	66.0	(61-71)	344	67.4	(62-72)	↑ #
Spain	78	65.4	(54-76)	95	53.7	(43-64)	106	62.3	(52-71)	88	68.2	(57-78)	
Cyprus	58	77.6	(65-87)	59	83.1	(71-92)	28	71.4	(51-87)	50	76.0	(62-87)	
Italy	477	89.9	(87-92)	664	78.3	(75-81)	702	78.5	(75-81)	868	78.7	(76-81)	↓
Latvia	52	78.8	(65-89)	61	68.9	(56-80)	82	73.2	(62-82)	34	79.4	(62-91)	
Bulgaria	110	59.1	(49-68)	130	73.8	(65-81)	103	74.8	(65-83)	92	80.4	(71-88)	↑
Romania	123	81.3	(73-88)	189	81.5	(75-87)	160	85.0	(79-90)	182	87.4	(82-92)	
Lithuania	66	69.7	(57-80)	73	80.8	(70-89)	87	81.6	(72-89)	87	88.5	(80-94)	↑
Greece	841	93.2	(91-95)	983	93.5	(92-95)	861	95.4	(94-97)	1095	94.8	(93-96)	
Croatia	166	87.3	(81-92)	200	89.0	(84-93)	181	94.5	(90-97)	208	96.2	(93-98)	↑
Iceland	3	**	(**)	6	**	(**)	3	**	(**)	6	**	(**)	N/A
Luxembourg	6	**	(**)	7	**	(**)	8	**	(**)	8	**	(**)	N/A
Malta	10	10.0	(0-45)	15	13.3	(2-40)	7	**	(**)	9	**	(**)	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Denmark	49	0.0	(0-7)	60	3.3	(0-12)	67	0.0	(0-5)	66	0.0	(0-5)	
Finland	30	0.0	(0-12)	42	2.4	(0-13)	28	0.0	(0-12)	36	0.0	(0-10)	
Norway	33	3.0	(0-16)	32	9.4	(2-25)	32	0.0	(0-11)	31	0.0	(0-11)	
Sweden	36	2.8	(0-15)	26	3.8	(0-20)	84	1.2	(0-6)	51	0.0	(0-7)	N/A
Netherlands	69	0.0	(0-5)	73	4.1	(1-12)	100	0.0	(0-4)	120	0.8	(0-5)	
Germany	188	2.1	(1-5)	328	3.7	(2-6)	435	2.3	(1-4)	457	1.3	(0-3)	
Ireland	79	1.3	(0-7)	75	1.3	(0-7)	61	0.0	(0-6)	59	1.7	(0-9)	
United Kingdom	119	1.7	(0-6)	131	0.0	(0-3)	558	0.9	(0-2)	746	1.7	(1-3)	
France	391	1.5	(1-3)	424	5.2	(3-8)	447	6.7	(5-9)	468	5.3	(3-8)	↑
Czech Republic	59	5.1	(1-14)	60	5.0	(1-14)	57	0.0	(0-6)	55	5.5	(1-15)	
Austria	74	2.7	(0-9)	61	4.9	(1-14)	81	8.6	(4-17)	74	6.8	(2-15)	
Belgium	2	**	(**)	13	0.0	(0-25)	64	0.0	(0-6)	98	7.1	(3-14)	N/A
Portugal	260	39.2	(33-45)	302	45.0	(39-51)	206	37.9	(31-45)	166	24.1	(18-31)	↓
Slovakia	160	24.4	(18-32)	142	23.2	(17-31)	109	24.8	(17-34)	119	25.2	(18-34)	
EU/EEA (population-weighted mean)	**4074**	**28.5**	**(27-30)**	**4901**	**27.7**	**(26-29)**	**5413**	**28.3**	**(27-30)**	**5853**	**28.4**	**(27-30)**	**N/A**
Slovenia	34	20.6	(9-38)	31	35.5	(19-55)	60	38.3	(26-52)	36	41.7	(26-59)	
Hungary	438	38.4	(34-43)	462	51.7	(47-56)	397	52.4	(47-57)	352	48.9	(44-54)	↑
Spain	78	55.1	(43-66)	94	41.5	(31-52)	106	44.3	(35-54)	88	51.1	(40-62)	
Poland	184	38.0	(31-45)	240	54.6	(48-61)	383	59.3	(54-64)	333	59.5	(54-65)	↓
Italy	437	86.3	(83-89)	650	72.6	(69-76)	692	74.7	(71-78)	763	72.6	(69-76)	↓
Latvia	52	61.5	(47-75)	60	46.7	(34-60)	67	67.2	(55-78)	32	75.0	(57-89)	
Cyprus	57	73.7	(60-84)	59	72.9	(60-84)	28	57.1	(37-76)	50	76.0	(62-87)	
Lithuania	65	60.0	(47-72)	73	76.7	(65-86)	87	75.9	(65-84)	85	77.6	(67-86)	↑
Bulgaria	85	47.1	(36-58)	112	66.1	(57-75)	76	72.4	(61-82)	92	78.3	(68-86)	↑
Romania	121	76.9	(68-84)	186	76.9	(70-83)	152	82.9	(76-89)	182	81.3	(75-87)	
Croatia	162	80.9	(74-87)	193	87.0	(81-91)	175	81.1	(75-87)	203	83.7	(78-89)	
Greece	793	82.6	(80-85)	943	82.2	(80-85)	838	84.0	(81-86)	1059	84.3	(82-86)	
Estonia	-	-	(-)	1	**	(**)	5	**	(**)	9	**	(**)	N/A
Iceland	3	**	(**)	6	**	(**)	3	**	(**)	6	**	(**)	N/A
Luxembourg	6	**	(**)	7	**	(**)	8	**	(**)	8	**	(**)	N/A
Malta	10	10.0	(0-45)	15	6.7	(0-32)	7	**	(**)	9	**	(**)	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

3.5 *Streptococcus pneumoniae*

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 infection to pneumonia, bloodstream infection 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 isolates are often successfully treated with high doses of benzylpenicillin or of an aminopenicillin.

Macrolide resistance is mainly due to acquisition of either an erythromycin ribosomal methylation gene or a macrolide efflux system gene.

Antimicrobial resistance

In 2017, as in previous years, wide inter-country variations could be noted in *S. pneumoniae* susceptibility. The national percentages of isolates with penicillin non-susceptibility ranged from 0.2% to 45.5% (Table 3.26) and from 3.6% to 36.8% for macrolide non-susceptibility (Table 3.27, Figure 3.24). 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 across all countries and years as the clinical breakpoints used to determine penicillin susceptibility in *S. pneumoniae* differ depending on the sites of infection and the guidelines used for interpretation. Consequently, a population-weighted EU/EEA mean percentage was not calculated for *S. pneumoniae*.

Discussion and conclusion

Based on EARS-Net data, the resistance situation in *S. pneumoniae* appears stable in the EU/EEA, with few countries reporting increasing or decreasing trends during the period 2014–2017. As in previous years, large inter-country variations could be noted for penicillin susceptibility. Differences in the clinical breakpoints used for determining penicillin susceptibility in *S. pneumoniae* with regard to guidelines used and the sites of infection introduce bias when comparing national data reported to EARS-Net. Limited information on the guidelines used for interpretation and incomplete quantitative susceptibility data hamper any assessment of inter-country differences.

In parallel to EARS-Net, the invasive pneumococcal disease (IPD) enhanced surveillance initiative, which is also coordinated by ECDC, collects additional data on IPD cases from reference laboratories throughout the EU/EEA [22]. Data from this surveillance initiative show that the prevalence of non-susceptibility increased for penicillin and erythromycin in all countries that consistently reported antimicrobial susceptibility data between 2014 and 2016. It is, however, difficult to compare data from the two surveillance systems due to differences in data sources and completeness of reporting. The two surveillance systems 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 or with PCVs [23]. Increased immunisation and better serotype coverage of the available PCVs are likely to impact the epidemiology of non-susceptible *S. pneumoniae* in the EU/EEA, both in terms of changes in the age-specific incidence and potential serotype replacement. Continued long-term monitoring of antimicrobial non-susceptibility is crucial to detect the emergence of non-vaccine, non-susceptible serotypes.

Figure 3.24. ***Streptococcus pneumoniae.*** **Percentage (%) of invasive isolates non-susceptible to macrolides, by country, EU/EEA countries, 2017**

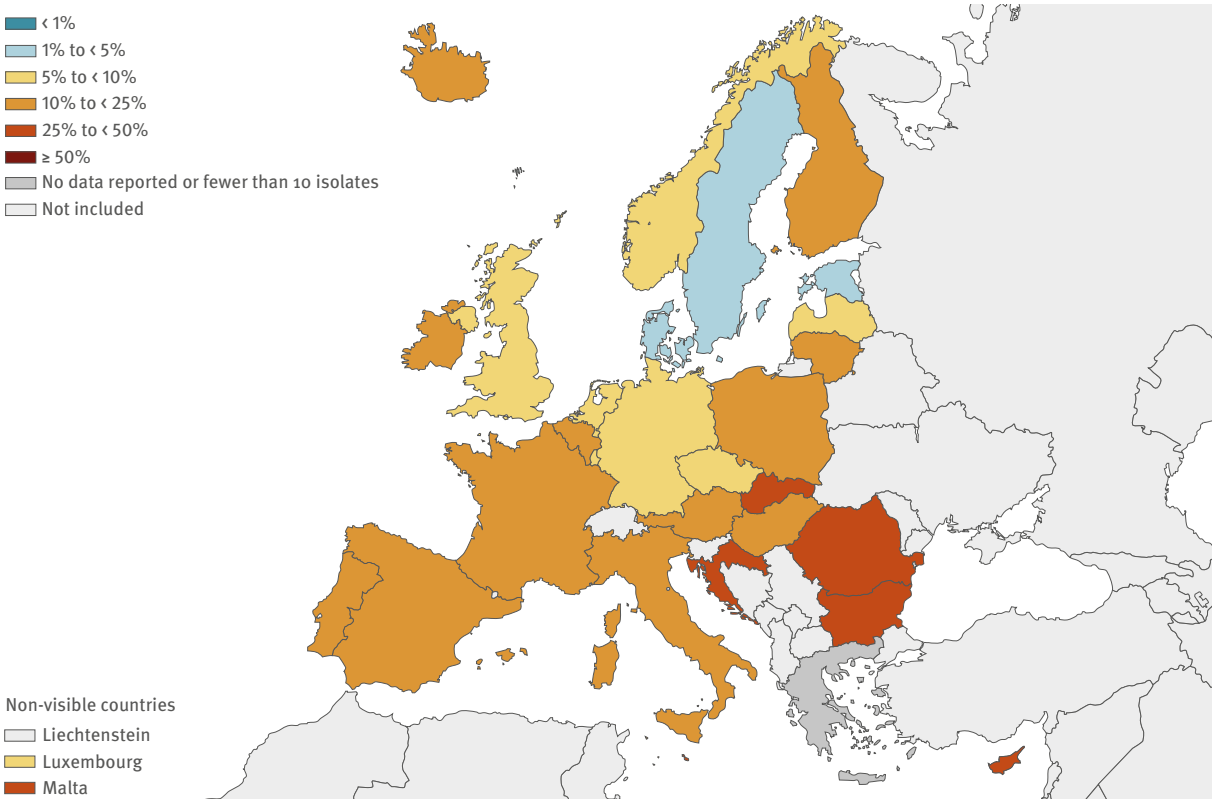


Table 3.26. ***Streptococcus pneumoniae*. Total number of tested isolates (N) and percentages non-susceptible to penicillin (%IR), including 95 % confidence intervals (95 % CI), by country, EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Belgium	1110	1.3	(1-2)	1361	0.6	(0-1)	1327	0.4	(0-1)	1472	0.2	(0-1)	↓
Estonia	72	4.2	(1-12)	72	2.8	(0-10)	112	3.6	(1-9)	141	2.1	(0-6)	
Netherlands	1139	2.1	(1-3)	1163	1.8	(1-3)	1391	2.2	(2-3)	1401	3.4	(3-5)	↑
Denmark	709	5.6	(4-8)	747	4.7	(3-6)	707	6.1	(4-8)	727	3.9	(3-6)	
Germany	499	4.4	(3-7)	761	6.2	(5-8)	1359	4.6	(4-6)	1823	4.8	(4-6)	
Norway	534	5.1	(3-7)	429	5.4	(3-8)	500	4.4	(3-7)	480	4.8	(3-7)	
Czech Republic	274	5.8	(3-9)	284	3.2	(1-6)	266	4.5	(2-8)	366	4.9	(3-8)	
United Kingdom	1288	5.1	(4-6)	1095	7.8	(6-10)	3201	4.9	(4-6)	3963	5.3	(5-6)	
Austria	361	5.3	(3-8)	444	5.6	(4-8)	440	3.4	(2-6)	463	6.0	(4-9)	
Sweden	696	7.9	(6-10)	420	9.8	(7-13)	882	7.1	(6-9)	750	6.1	(5-8)	
Luxembourg	32	6.3	(1-21)	27	3.7	(0-19)	51	13.7	(6-26)	45	6.7	(1-18)	
Hungary	128	11.7	(7-19)	181	7.2	(4-12)	174	15.5	(10-22)	204	6.9	(4-11)	
Slovenia	300	9.7	(7-14)	323	9.0	(6-13)	269	6.7	(4-10)	319	10.0	(7-14)	
Finland	593	12.5	(10-15)	677	12.7	(10-15)	706	10.3	(8-13)	698	10.5	(8-13)	
Italy	183	15.3	(10-21)	389	12.3	(9-16)	399	6.5	(4-9)	522	10.5	(8-13)	↓ #
Portugal	610	10.2	(8-13)	797	11.2	(9-14)	884	12.2	(10-15)	997	12.8	(11-15)	
Lithuania	67	16.4	(8-27)	87	16.1	(9-26)	99	16.2	(10-25)	109	15.6	(9-24)	
Ireland	328	17.7	(14-22)	303	17.5	(13-22)	363	16.5	(13-21)	412	15.8	(12-20)	
Poland	130	29.2	(22-38)	217	24.4	(19-31)	337	19.3	(15-24)	290	16.6	(12-21)	↓
Latvia	48	4.2	(1-14)	59	8.5	(3-19)	61	11.5	(5-22)	51	17.6	(8-31)	↑
Iceland	25	8.0	(1-26)	25	24.0	(9-45)	19	10.5	(1-33)	27	18.5	(6-38)	N/A
Spain	551	27.9	(24-32)	665	23.5	(20-27)	643	25.0	(22-29)	706	22.5	(19-26)	
Croatia	129	26.4	(19-35)	126	19.0	(13-27)	155	21.9	(16-29)	129	22.5	(16-31)	
Slovakia	29	20.7	(8-40)	27	22.2	(9-42)	13	7.7	(0-36)	39	25.6	(13-42)	N/A
France	656	22.3	(19-26)	1068	22.9	(20-26)	1046	25.3	(23-28)	614	25.9	(22-30)	
Bulgaria	32	25.0	(11-43)	35	22.9	(10-40)	33	27.3	(13-46)	29	27.6	(13-47)	
Romania	45	46.7	(32-62)	41	39.0	(24-55)	56	41.1	(28-55)	79	29.1	(19-40)	
Malta	8	**	(**)	20	35	(15-59)	10	10	(0-45)	19	31.6	(13-57)	N/A
Cyprus	12	0	(0-26)	7	**	(**)	10	40	(12-74)	11	45.5	(17-77)	N/A
Greece	-	-	(-)	-	-	(-)	-	-	(-)	-	-	(-)	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Denmark	709	6.6	(5-9)	747	5.2	(4-7)	707	4.8	(3-7)	727	3.6	(2-5)	↓
Estonia	54	5.6	(1-15)	54	7.4	(2-18)	100	8.0	(4-15)	127	3.9	(1-9)	
Sweden	788	6.7	(5-9)	850	6.9	(5-9)	899	5.8	(4-8)	750	4.8	(3-7)	N/A
Netherlands	1287	4.3	(3-6)	1168	3.9	(3-5)	1389	3.1	(2-4)	1406	5.7	(5-7)	
Norway	492	7.5	(5-10)	403	10.7	(8-14)	473	9.5	(7-13)	439	5.9	(4-9)	
United Kingdom	1260	7.1	(6-9)	1077	7.2	(6-9)	3423	6.5	(6-7)	4273	6.0	(5-7)	
Germany	494	7.1	(5-10)	758	8.4	(7-11)	1386	8.2	(7-10)	1852	7.1	(6-8)	
Latvia	49	4.1	(0-14)	58	6.9	(2-17)	52	5.8	(1-16)	28	7.1	(1-24)	
Luxembourg	35	14.3	(5-30)	29	0.0	(0-12)	51	15.7	(7-29)	49	8.2	(2-20)	
Czech Republic	274	7.7	(5-11)	284	6.7	(4-10)	263	7.2	(4-11)	366	9.3	(7-13)	
Austria	400	10.5	(8-14)	439	8.7	(6-12)	455	8.8	(6-12)	507	11.2	(9-14)	
Hungary	123	14.6	(9-22)	170	11.2	(7-17)	166	13.3	(8-19)	187	11.8	(8-17)	
Ireland	317	13.9	(10-18)	296	15.5	(12-20)	354	14.4	(11-19)	396	13.1	(10-17)	
Finland	636	14.5	(12-17)	765	14.4	(12-17)	791	12.0	(10-14)	808	15.5	(13-18)	
Portugal	658	16.0	(13-19)	822	17.0	(15-20)	912	15.1	(13-18)	1024	15.5	(13-18)	
Belgium	1108	17.9	(16-20)	1361	18.7	(17-21)	1327	15.9	(14-18)	1472	15.6	(14-18)	↓ #
Slovenia	300	19.3	(15-24)	323	18.9	(15-24)	269	13.8	(10-18)	216	15.7	(11-21)	
Lithuania	62	22.6	(13-35)	72	12.5	(6-22)	94	18.1	(11-27)	107	15.9	(10-24)	
Iceland	24	12.5	(3-32)	25	12.0	(3-31)	19	0.0	(0-18)	27	18.5	(6-38)	N/A
Spain	544	20.0	(17-24)	631	23.5	(20-27)	630	25.9	(22-29)	691	21.6	(19-25)	
France	656	23.0	(20-26)	1068	24.4	(22-27)	1046	26.4	(24-29)	614	23.3	(20-27)	
Italy	252	28.6	(23-35)	428	24.5	(21-29)	464	23.1	(19-27)	599	23.4	(20-27)	
Poland	121	29.8	(22-39)	206	31.1	(25-38)	277	30.7	(25-36)	253	24.9	(20-31)	
Cyprus	11	0.0	(0-28)	7	**	(**)	10	60.0	(26-88)	19	26.3	(9-51)	N/A
Bulgaria	30	26.7	(12-46)	33	21.2	(9-39)	32	21.9	(9-40)	29	27.6	(13-47)	
Romania	50	48.0	(34-63)	20	30.0	(12-54)	59	39.0	(27-53)	76	27.6	(18-39)	↓ #
Slovakia	29	41.4	(24-61)	34	35.3	(20-54)	12	8.3	(0-38)	31	35.5	(19-55)	N/A
Croatia	116	21.6	(14-30)	126	19.8	(13-28)	154	35.1	(28-43)	127	36.2	(28-45)	↑
Malta	8	**	(**)	20	40.0	(19-64)	9	**	(**)	19	36.8	(16-62)	N/A
Greece	-	-	(-)	-	-	(-)	-	-	(-)	-	-	(-)	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Belgium	1069	0.7	(0-1)	1361	0.4	(0-1)	1327	0.3	(0-1)	1472	0.1	(0-0)	↓
Netherlands	1025	1.2	(1-2)	1030	0.9	(0-2)	1263	0.4	(0-1)	1297	1.1	(1-2)	
Estonia	54	1.9	(0-10)	27	3.7	(0-19)	100	1.0	(0-5)	127	1.6	(0-6)	
Denmark	709	3.9	(3-6)	747	2.4	(1-4)	707	2.3	(1-4)	727	1.8	(1-3)	↓
United Kingdom	1190	2.9	(2-4)	1060	2.7	(2-4)	3136	2.6	(2-3)	3885	2.0	(2-2)	↓ #
Germany	491	1.4	(1-3)	748	2.7	(2-4)	1342	2.2	(1-3)	1803	2.4	(2-3)	
Norway	490	2.2	(1-4)	403	2.5	(1-5)	469	2.8	(1-5)	439	2.5	(1-4)	
Czech Republic	274	3.3	(2-6)	284	1.8	(1-4)	263	1.1	(0-3)	366	3.0	(2-5)	
Sweden	693	4.2	(3-6)	409	5.6	(4-8)	877	4.0	(3-6)	745	3.0	(2-4)	N/A
Austria	351	2.8	(1-5)	433	2.5	(1-4)	438	1.4	(1-3)	457	3.3	(2-5)	
Latvia	46	4.3	(1-15)	53	1.9	(0-10)	51	3.9	(0-13)	28	3.6	(0-18)	
Luxembourg	32	6.3	(1-21)	27	0.0	(0-13)	51	7.8	(2-19)	45	4.4	(1-15)	
Italy	163	11.0	(7-17)	347	5.8	(4-9)	361	4.4	(3-7)	474	5.3	(3-8)	↓ #
Hungary	123	7.3	(3-13)	170	1.8	(0-5)	166	7.8	(4-13)	187	6.4	(3-11)	
Slovenia	300	4.7	(3-8)	323	5.0	(3-8)	269	3.7	(2-7)	216	6.5	(4-11)	
Finland	570	6.5	(5-9)	654	7.0	(5-9)	687	6.1	(4-8)	671	6.7	(5-9)	
Portugal	601	5.8	(4-8)	776	6.6	(5-9)	868	6.7	(5-9)	978	7.2	(6-9)	
Ireland	317	11.4	(8-15)	296	10.8	(8-15)	354	9.9	(7-13)	396	9.6	(7-13)	
Lithuania	62	16.1	(8-28)	72	11.1	(5-21)	94	12.8	(7-21)	107	11.2	(6-19)	
Spain	526	12.2	(9-15)	624	12.0	(10-15)	612	14.4	(12-17)	676	12.4	(10-15)	
Poland	119	24.4	(17-33)	195	19.5	(14-26)	271	16.6	(12-22)	241	14.1	(10-19)	↓ #
Iceland	24	8.3	(1-27)	25	8.0	(1-26)	19	0.0	(0-18)	27	14.8	(4-34)	N/A
Croatia	116	10.3	(5-17)	126	7.9	(4-14)	154	15.6	(10-22)	126	15.9	(10-23)	
Bulgaria	30	10.0	(2-27)	32	12.5	(4-29)	32	9.4	(2-25)	29	17.2	(6-36)	
France	656	15.9	(13-19)	1068	17.4	(15-20)	1046	18.3	(16-21)	614	17.8	(15-21)	
Slovakia	26	19.2	(7-39)	27	22.2	(9-42)	12	0.0	(0-26)	30	23.3	(10-42)	N/A
Romania	45	37.8	(24-53)	20	25.0	(9-49)	56	30.4	(19-44)	75	24.0	(15-35)	
Malta	8	**	(**)	20	25.0	(9-49)	9	**	(**)	19	26.3	(9-51)	N/A
Cyprus	11	0.0	(0-28)	7	**	(**)	10	40.0	(12-74)	11	45.5	(17-77)	N/A
Greece	-	-	(-)	-	-	(-)	-	-	(-)	-	-	(-)	N/A

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

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 some other beta-lactam agents through expression of the exogenous *mecA*, or less frequently, the *mecC* gene. These genes code for a variant penicillin-binding protein PBP2' (PBP2a) with low affinity for beta-lactams and able to substitute for the function of the other penicillin-binding proteins, thus preventing the inhibition of cell wall synthesis by beta-lactams.

Antimicrobial resistance

The EU/EEA population-weighted mean MRSA percentage was 16.9% in 2017. This is a result of a significantly decreasing trend between 2014 and 2017 (Table 3.30).

In 2017, large differences in national MRSA percentages could be noted, ranging from 1.0% to 44.4% (Figure 3.30). Close to a third of the countries reported significantly decreasing trends during the period 2014–2017, including countries with both low and high percentages of MRSA (Table 3.30).

Among MRSA, combined resistance to other antimicrobial groups was common. The most common resistance combination was MRSA and resistance to fluoroquinolones. Rifampicin resistance was less common (Table 3.29).

Discussion and conclusion

MRSA percentages seem to be stabilising or still decreasing in a majority of EU/EEA countries, which is also reflected in the continuously decreasing EU/EEA population-weighted mean. Many countries have developed and implemented national recommendations and guidance documents on the prevention of spread of MRSA, focusing on both improved infection prevention and control and prudent antimicrobial use [14].

Despite this positive development, MRSA remains an important pathogen in Europe. *S. aureus* is one of the most common causes of serious bacterial infections, exhibiting high rates of morbidity and mortality. The high percentages of MRSA in some countries, often combined with resistance to other antimicrobials, are a concern and contributing to the burden of AMR. Carriage and infection with MRSA is only associated with healthcare exposure, and community-associated MRSA (CA-MRSA) are increasingly being reported from many parts of the world. The proportion of community-onset infections caused by MRSA clones that are usually associated with healthcare (HA-MRSA) has also increased, indicating transfer of HA-MRSA clones into the community [24]. In order to further slow the spread of MRSA in Europe, comprehensive MRSA strategies targeting all healthcare sectors remain essential.

The monitoring of MRSA in animals and food is currently voluntary and only performed in a limited number of countries, but shows a constantly evolving situation including detection of livestock-associated MRSA (LA-MRSA), HA-MRSA and CA-MRSA from companion animals and/or livestock [12]. Recently, LA-MRSA has gained increasing attention, as it poses a zoonotic risk, particularly for those working in close contact with livestock. An ECDC survey documents the increasing detection and geographical dispersion of LA-MRSA in humans in the EU/EEA between 2007 and 2013 and highlights the public health and veterinary importance of LA-MRSA as a One Health issue [25].

Table 3.29. *Staphylococcus aureus*. Total number of tested isolates* and resistance combinations among invasive isolates tested against meticillin, fluoroquinolones and rifampicin (n=49 424), EU/EEA countries, 2017

Resistance pattern	Number of isolates	Percentage (%) of total**
Fully susceptible	**40 088**	**81.1**
Single resistance (to indicated antimicrobial group)		
Total (any single resistance)	**3 940**	**8.0**
MRSA	1 094	2.2
Fluoroquinolones	2 665	5.4
Rifampicin	181	0.4
Resistance to two antimicrobial groups		
Total (any two-group combinations)	**5 187**	**10.5**
MRSA + fluoroquinolones	5 133	10.4
Other resistance combinations	54	0.1
Resistance to three antimicrobial groups		
MRSA + fluoroquinolones + rifampicin	**209**	**0.4**

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 3.25. ***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), by country, EU/EEA countries, 2017**

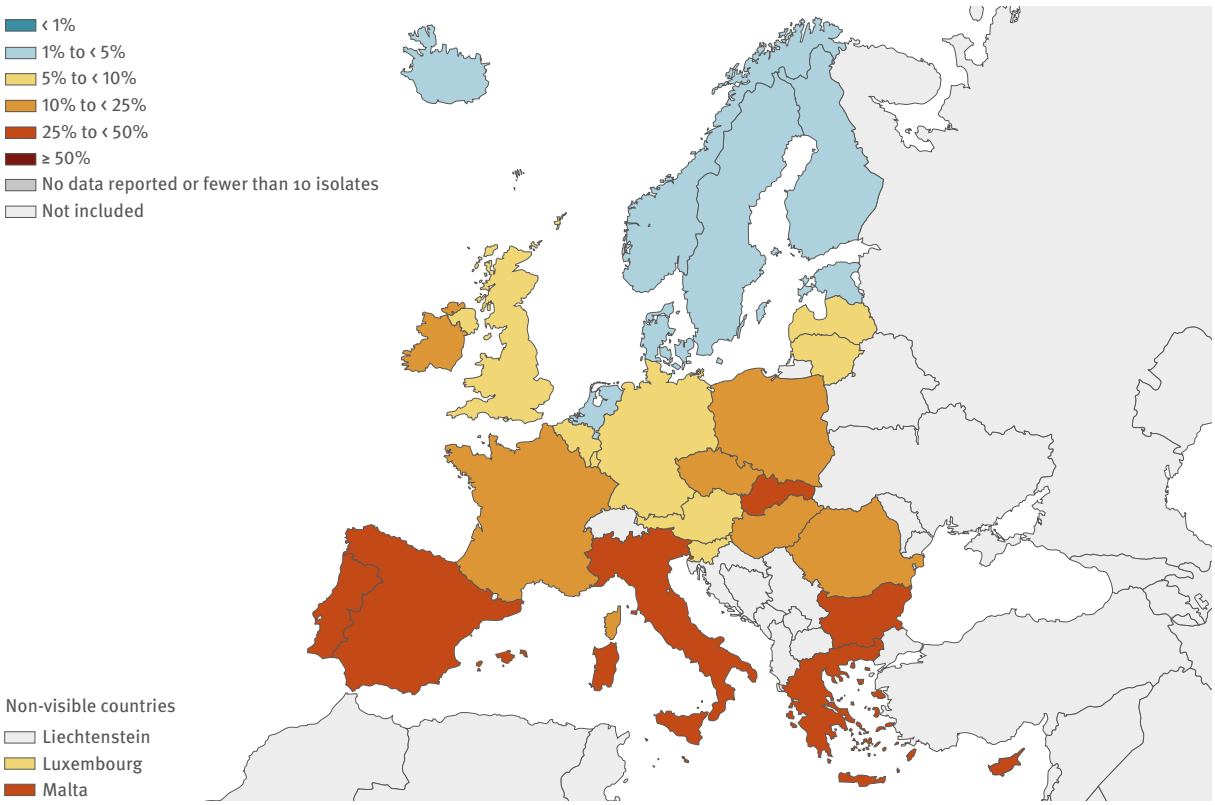


Table 3.30. ***Staphylococcus aureus*. Total number of invasive isolates tested (N) and percentage with resistance to meticillin (MRSA) including 95 % confidence intervals (95 % CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Norway	1544	1.0	(1-2)	1453	1.2	(1-2)	1448	1.2	(1-2)	1462	1.0	(1-2)	
Sweden	2745	1.0	(1-1)	3124	0.8	(1-1)	3450	2.3	(2-3)	3787	1.2	(1-2)	N/A
Iceland	61	3.3	(0-11)	88	0.0	(0-4)	76	1.3	(0-7)	69	1.4	(0-8)	
Netherlands	2524	1.0	(1-1)	2107	1.3	(1-2)	2699	1.2	(1-2)	2694	1.5	(1-2)	
Finland	1831	2.6	(2-3)	2070	1.9	(1-3)	1890	2.2	(2-3)	2439	2.0	(1-3)	
Estonia	223	3.1	(1-6)	151	4.0	(1-8)	314	3.5	(2-6)	290	2.1	(1-4)	
Denmark	1874	2.5	(2-3)	1876	1.6	(1-2)	1963	2.0	(1-3)	1996	2.5	(2-3)	
Latvia	220	8.2	(5-13)	251	5.6	(3-9)	284	4.2	(2-7)	210	5.7	(3-10)	
Austria	2651	7.8	(7-9)	2785	7.5	(7-9)	3053	7.1	(6-8)	3158	5.9	(5-7)	↓
United Kingdom	2400	11.3	(10-13)	2757	10.8	(10-12)	6717	6.7	(6-7)	8883	6.9	(6-7)	↓
Belgium	988	13.5	(11-16)	913	12.3	(10-15)	1364	12.2	(10-14)	1511	8.5	(7-10)	↓
Lithuania	383	7.8	(5-11)	376	8.5	(6-12)	503	11.3	(9-14)	514	8.8	(6-12)	
Slovenia	495	13.1	(10-16)	513	9.2	(7-12)	534	11.0	(9-14)	576	9.0	(7-12)	
Germany	3146	12.9	(12-14)	5020	11.3	(10-12)	9866	10.2	(10-11)	12021	9.1	(9-10)	↓
Luxembourg	125	12.0	(7-19)	135	8.9	(5-15)	187	10.2	(6-15)	200	9.5	(6-14)	
France	5484	17.4	(16-18)	5535	15.7	(15-17)	5578	13.8	(13-15)	6472	12.9	(12-14)	↓
Czech Republic	1695	13.0	(11-15)	1806	13.7	(12-15)	1887	13.9	(12-16)	1944	13.2	(12-15)	
Bulgaria	216	20.8	(16-27)	222	13.1	(9-18)	231	14.3	(10-19)	227	13.7	(9-19)	
Poland	490	20.6	(17-24)	958	15.8	(14-18)	1772	16.4	(15-18)	1805	15.2	(14-17)	↓ #
Ireland	1075	19.4	(17-22)	1057	18.1	(16-21)	1143	14.3	(12-17)	1140	16.3	(14-19)	↓
EU/EEA (population-weighted mean)	**40906**	**19.6**	**(19-20)**	**45509**	**19.0**	**(19-19)**	**57387**	**17.7**	**(17-18)**	**64769**	**16.9**	**(17-17)**	↓
Hungary	1279	23.1	(21-25)	1517	24.7	(23-27)	1668	25.2	(23-27)	1566	23.6	(22-26)	
Spain	1920	22.1	(20-24)	1968	25.3	(23-27)	1944	25.8	(24-28)	1804	25.3	(23-27)	↑
Croatia	484	21.3	(18-25)	486	24.5	(21-29)	458	25.3	(21-30)	520	28.5	(25-33)	↑
Slovakia	640	28.0	(25-32)	583	28.1	(25-32)	571	27.1	(24-31)	613	29.2	(26-33)	
Cyprus	136	36.0	(28-45)	143	43.4	(35-52)	139	38.8	(31-47)	125	31.2	(23-40)	
Italy	2134	33.6	(32-36)	3000	34.1	(32-36)	2981	33.6	(32-35)	3591	33.9	(32-35)	
Greece	556	37.1	(33-41)	612	39.4	(35-43)	639	38.8	(35-43)	822	38.4	(35-42)	
Portugal	3193	47.4	(46-49)	3619	46.8	(45-48)	3454	43.6	(42-45)	3728	39.2	(38-41)	↓
Malta	78	43.6	(32-55)	87	49.4	(39-60)	97	37.1	(28-48)	95	42.1	(32-53)	
Romania	316	56.0	(50-62)	297	57.2	(51-63)	477	50.5	(46-55)	507	44.4	(40-49)	↓

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

\# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

3.7 Enterococci

Enterococci belong to the normal bacterial microbiota of the gastrointestinal tract of humans. They are regarded 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 mostly 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

Enterococcus faecalis: high-level gentamicin resistance

In 2017, the EU/EEA population-weighted mean percentage for high-level gentamicin resistance in *E. faecalis* was 30.0%, with national percentages ranging from 7.1% to 45.9% (Figure 3.26). The EU/EEA trend decreased significantly between 2014 and 2017, with similar significantly decreasing national trends reported from almost one fourth of the countries (Table 3.31).

Enterococcus faecalis: 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* [16].

Enterococcus faecium: vancomycin resistance

The EU/EEA population-weighted mean percentage for vancomycin resistance in *E. faecium* was 14.9% in 2017, which represents a significant increase from 2014 when the percentage was 10.4%.

In 2017, national percentages ranged from 0.0% to 43.9%. Eleven out of the 30 reporting countries reported resistance percentages below 5% (Figure 3.27). Several of the countries reporting comparatively high percentages of resistance to vancomycin also reported significantly increasing trends for the last four years (Table 3.32). For several countries, the increase during the four-year period was considerable.

Enterococcus faecium: 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 ECDC's *Surveillance Atlas of Infectious Diseases* [16].

Discussion and conclusion

Data from EARS-Net indicate that vancomycin-resistant *E. faecium* is becoming a cause for concern in Europe. The significantly increasing trend, observed at the EU/EEA level and in many of the individual countries, highlights the need for 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, emphasising the paucity of available and effective treatment options [13]. 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 reason behind the increase of vancomycin-resistant *E. faecium* in Europe remains unclear. Studies performed in individual EU/EEA countries show highly regional spread with multiple hospital outbreaks [26–28]. Contrary to many other bacterium–antimicrobial group combinations under surveillance by EARS-Net, no distinct geographical pattern could be seen for vancomycin-resistant *E. faecium*, as high resistance levels were reported from countries in both southern, eastern and northern Europe. Better knowledge of the epidemiology of vancomycin-resistant enterococci is needed to guide prevention and control strategies.

Figure 3.26. ***Enterococcus faecalis*. Percentage (%) of invasive isolates with high-level resistance to gentamicin, by country, EU/EEA countries, 2017**

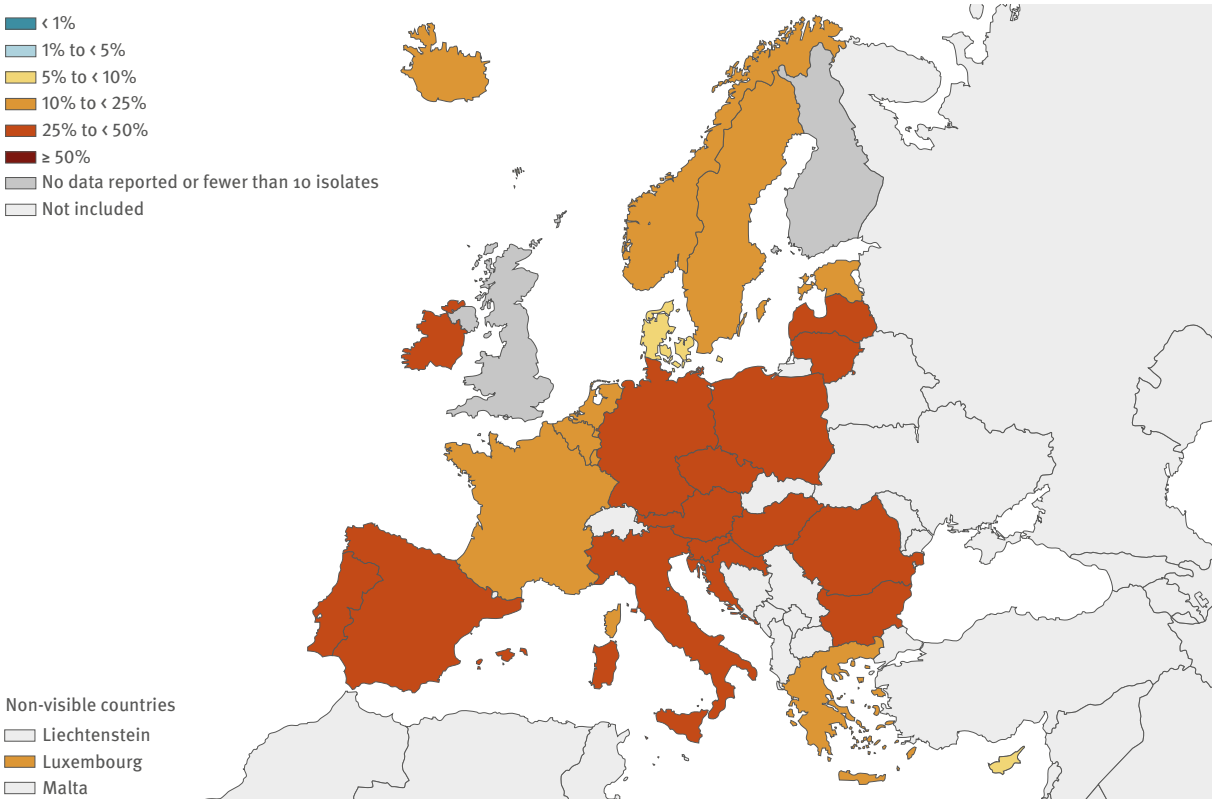


Figure 3.27. ***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, by country, EU/EEA countries, 2017**

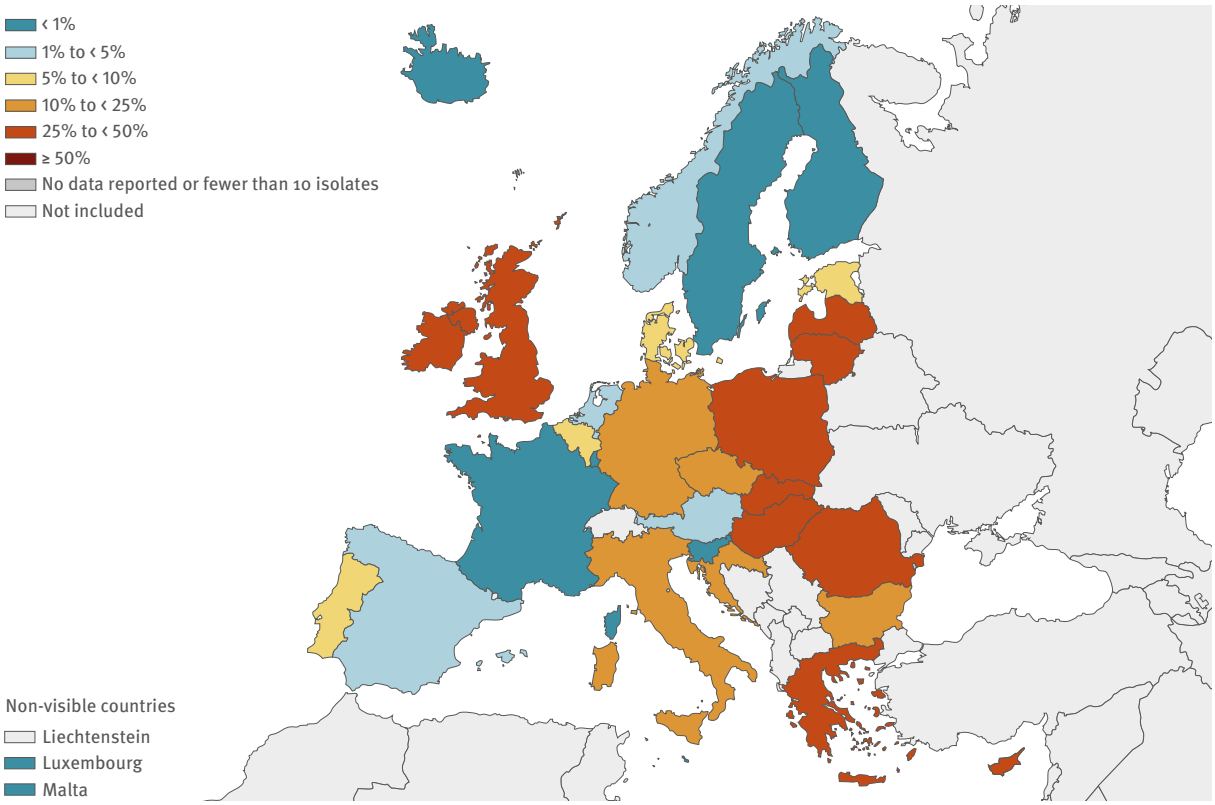


Table 3.31. ***Enterococcus faecalis*. Total number of invasive isolates tested (N) and percentage with high-level resistance to gentamicin including 95 % confidence intervals (95 % CI), EU/EEA countries, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Denmark	60	30.0	(19-43)	63	25.4	(15-38)	56	19.6	(10-32)	56	7.1	(2-17)	↓
Cyprus	80	17.5	(10-28)	58	8.6	(3-19)	39	20.5	(9-36)	70	8.6	(3-18)	
Greece	407	20.1	(16-24)	460	13.3	(10-17)	540	15.9	(13-19)	621	12.2	(10-15)	↓
France	1741	13.7	(12-15)	1097	12.2	(10-14)	1057	15.0	(13-17)	795	12.7	(10-15)	
Sweden	723	15.8	(13-19)	579	12.6	(10-16)	722	13.4	(11-16)	945	13.3	(11-16)	N/A
Norway	270	20.7	(16-26)	163	9.8	(6-15)	221	15.8	(11-21)	216	14.4	(10-20)	
Belgium	170	22.9	(17-30)	249	13.3	(9-18)	328	19.8	(16-25)	304	16.4	(12-21)	
Iceland	12	8.3	(0-38)	21	14.3	(3-36)	24	16.7	(5-37)	33	18.2	(7-35)	N/A
Estonia	19	36.8	(16-62)	26	26.9	(12-48)	56	32.1	(20-46)	71	19.7	(11-31)	N/A
Luxembourg	39	30.8	(17-48)	56	14.3	(6-26)	48	12.5	(5-25)	82	22.0	(14-32)	
Netherlands	403	28.8	(24-33)	343	23.0	(19-28)	451	24.4	(20-29)	537	24.4	(21-28)	
Germany	903	33.6	(30-37)	1295	30.7	(28-33)	2341	25.2	(23-27)	2658	25.7	(24-27)	↓
Portugal	607	32.6	(29-37)	872	33.3	(30-36)	851	33.8	(31-37)	931	25.8	(23-29)	↓
EU/EEA (population-weighted mean)	**9737**	**36.3**	**(35-37)**	**10711**	**31.9**	**(31-33)**	**12698**	**31.8**	**(31-33)**	**13459**	**30.0**	**(29-31)**	↓
Slovakia	261	41.0	(35-47)	234	49.1	(43-56)	213	45.1	(38-52)	213	25.8	(20-32)	↓
Ireland	290	31.4	(26-37)	261	28.0	(23-34)	265	29.4	(24-35)	302	30.8	(26-36)	
Austria	421	37.1	(32-42)	501	33.7	(30-38)	447	33.3	(29-38)	474	33.1	(29-38)	
Croatia	149	32.9	(25-41)	203	35.5	(29-42)	179	33.0	(26-40)	171	33.3	(26-41)	
Slovenia	119	36.1	(28-45)	133	32.3	(24-41)	152	43.4	(35-52)	167	33.5	(26-41)	
Czech Republic	525	38.7	(34-43)	544	38.8	(35-43)	515	37.1	(33-41)	526	34.0	(30-38)	
Malta	28	25.0	(11-45)	29	27.6	(13-47)	33	39.4	(23-58)	29	34.5	(18-54)	
Spain	970	38.9	(36-42)	936	40.0	(37-43)	950	37.5	(34-41)	845	36.7	(33-40)	
Lithuania	65	29.2	(19-42)	63	44.4	(32-58)	45	35.6	(22-51)	60	36.7	(25-50)	
Poland	148	43.9	(36-52)	388	46.4	(41-51)	666	43.1	(39-47)	660	41.2	(37-45)	
Hungary	659	49.8	(46-54)	730	45.5	(42-49)	786	42.2	(39-46)	769	41.5	(38-45)	↓
Bulgaria	105	40.0	(31-50)	100	42.0	(32-52)	98	46.9	(37-57)	133	43.6	(35-52)	
Romania	34	76.5	(59-89)	-	-	(-)	87	56.3	(45-67)	89	44.9	(34-56)	N/A
Latvia	13	46.2	(19-75)	58	36.2	(24-50)	87	46.0	(35-57)	72	45.8	(34-58)	N/A
Italy	516	55.2	(51-60)	1249	47.8	(45-51)	1441	45.3	(43-48)	1630	45.9	(43-48)	↓
Finland	-	-	(-)	-	-	(-)	-	-	(-)	-	-	(-)	N/A
United Kingdom	-	-	(-)	-	-	(-)	-	-	(-)	-	-	(-)	N/A

–: No data

* ↑ 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, 2014 to 2017**

Country	2014			2015			2016			2017			Trend 2014-2017*
	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	N	%R	(95%CI)	
Iceland	11	0.0	(0-28)	20	0.0	(0-17)	16	0.0	(0-21)	17	0.0	(0-20)	N/A
Luxembourg	31	3.2	(0-17)	23	0.0	(0-15)	31	0.0	(0-11)	34	0.0	(0-10)	
Malta	11	0.0	(0-28)	6	**	(**)	12	8.3	(0-38)	13	0.0	(0-25)	N/A
Sweden	452	0.4	(0-2)	408	0.0	(0-1)	546	0.4	(0-1)	530	0.0	(0-1)	N/A
Finland	368	0.0	(0-1)	298	0.3	(0-2)	294	0.0	(0-1)	301	0.7	(0-2)	
Slovenia	115	1.7	(0-6)	124	4.8	(2-10)	111	0.0	(0-3)	149	0.7	(0-4)	
France	737	0.5	(0-1)	849	0.8	(0-2)	808	0.6	(0-1)	986	0.8	(0-2)	
Netherlands	532	1.1	(0-2)	572	1.4	(1-3)	685	0.9	(0-2)	807	1.4	(1-2)	
Spain	546	2.4	(1-4)	571	2.5	(1-4)	628	2.1	(1-4)	545	1.8	(1-3)	
Austria	480	4.4	(3-7)	483	3.1	(2-5)	533	4.3	(3-6)	570	3.2	(2-5)	
Norway	227	1.8	(0-4)	185	0.0	(0-2)	213	1.9	(1-5)	202	4.5	(2-8)	↑
Belgium	195	3.1	(1-7)	163	0.6	(0-3)	289	1.7	(1-4)	417	5.5	(4-8)	↑ #
Estonia	48	0.0	(0-7)	27	0.0	(0-13)	64	0.0	(0-6)	52	5.8	(1-16)	↑
Denmark	715	4.5	(3-6)	690	3.2	(2-5)	679	7.5	(6-10)	785	7.0	(5-9)	↑
Portugal	363	20.1	(16-25)	459	20.3	(17-24)	411	7.5	(5-11)	461	7.2	(5-10)	↓
Czech Republic	250	4.4	(2-8)	322	9.6	(7-13)	258	7.8	(5-12)	264	13.3	(9-18)	↑
Italy	472	8.5	(6-11)	756	11.2	(9-14)	941	13.4	(11-16)	1049	14.6	(13-17)	↑
EU/EEA (population-weighted mean)	**8324**	**10.4**	**(10-11)**	**9152**	**10.5**	**(10-11)**	**12330**	**12.3**	**(12-13)**	**13920**	**14.9**	**(14-16)**	↑
Germany	882	9.1	(7-11)	1347	10.5	(9-12)	2043	11.9	(11-13)	2448	16.5	(15-18)	↑
Bulgaria	60	13.3	(6-25)	41	14.6	(6-29)	44	18.2	(8-33)	84	19.0	(11-29)	
Croatia	67	10.4	(4-20)	93	25.8	(17-36)	104	22.1	(15-31)	89	19.1	(12-29)	
Latvia	15	13.3	(2-40)	34	17.6	(7-35)	56	28.6	(17-42)	39	25.6	(13-42)	N/A
United Kingdom	423	21.3	(17-25)	218	17.0	(12-23)	1803	17.0	(15-19)	2202	25.8	(24-28)	↑
Hungary	224	8.5	(5-13)	240	16.7	(12-22)	272	22.4	(18-28)	315	28.3	(23-34)	↑
Greece	264	26.9	(22-33)	315	19.7	(15-25)	358	27.9	(23-33)	412	30.8	(26-36)	↑ #
Poland	182	21.4	(16-28)	215	17.7	(13-23)	405	26.2	(22-31)	400	31.5	(27-36)	↑ #
Slovakia	129	10.1	(5-17)	143	14.7	(9-22)	125	26.4	(19-35)	122	32.0	(24-41)	↑
Romania	56	25.0	(14-38)	72	25.0	(16-37)	77	39.0	(28-51)	64	34.4	(23-47)	
Lithuania	44	4.5	(1-15)	52	17.3	(8-30)	61	21.3	(12-34)	80	36.3	(26-48)	↑ #
Ireland	390	45.1	(40-50)	404	45.8	(41-51)	422	44.1	(39-49)	442	38.2	(34-43)	↓
Cyprus	35	40.0	(24-58)	28	28.6	(13-49)	41	46.3	(31-63)	41	43.9	(28-60)	

–: No data

* ↑ and ↓ indicate significant increasing and decreasing trends, respectively.

# indicates a significant trend in the overall data; when only data from laboratories consistently reporting all four years included, no trend could be detected.

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.

** Less than 10 isolates reported, no percentage calculated

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Annex

National institutions/organisations participating in EARS-Net

Austria

Federal Ministry of Labour, Social Affairs, Health and Consumer Protection
www.sozialministerium.at/site

Medical University Vienna
www.meduniwien.ac.at

Ordensklinikum Linz, Elisabethinen
www.ordensklinikum.at

Belgium

Sciensano
www.sciensano.be

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

Estonian Health Board

East-Tallinn Central Hospital

Tartu University Hospital

Finland

National Institute for Health and Welfare
www.thl.fi

Finnish Hospital Infection Program (SIRO)
www.thl.fi/siro

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

France

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

French National Observatory for the Epidemiology of Bacterial Resistance to Antimicrobials (ONERBA) through 3 participating networks:

Azay-Résistance, Île-de-France and Réussir networks
www.onerba.org

National Reference Centre for Pneumococci
www.cnr-pneumo.com

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 Public Health Institute

Iceland

National University Hospital of Iceland

Centre for Health Security and Infectious Disease Control

Ireland

Health Protection Surveillance Centre
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

Public Health Agency of Sweden
www.folkhalsomyndigheten.se

United Kingdom

Public Health England
www.gov.uk/government/organisations/public-health-england

Health Protection Scotland
www.hps.scot.nhs.uk

Public Health Agency Northern Ireland

Public Health Wales
www.publichealthwales.org

Country summaries

The country summaries provide information on the population coverage, hospital coverage and representativeness of data provided by the laboratories that reported data to EARS-Net. The summaries include quantitative and qualitative measures related to the population under surveillance, the hospitals served by participating laboratories, laboratory practices, and the use of blood cultures. For more information on how differences in patient sampling and laboratory practices might impact data validity, please refer to Chapter 2.

In addition, national resistance percentages from 2010 to 2017 are presented together with the EU/EEA population-weighted mean percentages for selected bacterium–antimicrobial group combinations. Data for all bacterium–antimicrobial groups under regular surveillance by EARS-Net for the period 2000–2017 are available in ECDC's Surveillance Atlas of Infectious Diseases [16].

The following section describes the format and methodology underpinning the country-specific information listed in the tables and figures of this annex.

Coverage and representativeness of population, hospitals and isolates included in EARS-Net

Data sources

The collection of national surveillance system characteristics as part of the EARS-Net data call is currently under revision; therefore, two separate data sources were used.

In addition to the data reported to TESSy, a questionnaire covering all indicators was sent to the nominated National Focal Points for Antimicrobial Resistance in June and July 2018. For countries not responding or indicating that similar data had already been provided to TESSy, TESSy data were used as data source to the extent possible.

Indicators

Estimated national population coverage is expressed as the estimated percentage of the national population under surveillance by the laboratories contributing data to EARS-Net. It should be considered as an indication of the national coverage because the exact proportion of the population under surveillance is often difficult to assess.

Country coverage was calculated as the mean of the population coverages of the following microorganisms: *E. coli*, *K. pneumoniae*, *S. aureus*, *E. faecalis* and *E. faecium*. Due to outliers in some countries, *S. pneumoniae*, *P. aeruginosa* and *Acinetobacter* spp. were not included in the calculation.

Population sample representativeness is a qualitative indicator referring to the geographical representativeness of data. The categories are:

- High: All main geographical regions are covered and data are considered as representative of the national epidemiology.
- Medium: Most geographical regions are covered and data are considered of medium representativeness of the national epidemiology.
- Poor: Only a few geographical areas are covered and data are poorly representative of the national epidemiology.
- Unknown: unknown or no data provided.

Hospital sample representativeness is a qualitative indicator referring to the representativeness of hospitals served by the EARS-Net participating laboratories, compared to the national distribution of the types of hospitals (specialised, tertiary care, secondary care and primary care). The categories are:

- High: The hospital sample is representative of the acute care hospital distribution in the country.
- Medium: The hospital sample is partly representative of the acute care hospital distribution in the country.
- Poor: The hospital sample is poorly representative of the acute care hospital distribution in the country.
- Unknown: Unknown or no data provided.

Blood culture sets/1000 patient-days refers to the number of blood culture sets per 1000 inpatient occupied bed-days in hospitals served by EARS-Net laboratories. The definition of an inpatient bed day might differ between countries, and influence the estimate.

Isolate sample representativeness is a qualitative indicator referring to representativeness of blood cultures reported by EARS-Net laboratories. The categories are:

- High: The isolate sample is representative of microorganisms causing invasive infections and of patient case-mix of the included hospitals.
- Medium: The isolate sample is partly representative of microorganisms causing invasive infections and of patient case-mix of the included hospitals.
- Poor: The isolate sample is poorly representative of microorganisms causing invasive infections and of patient case-mix of the included hospitals.
- Unknown: Unknown or no data provided.

Laboratories contributing data to EARS-Net – participation in EARS-Net EQA exercise and use of EUCAST guidelines

Data source

Data were provided from the annual EARS-Net external quality assessment (EQA) exercise, coordinated by the ECDC contractor United Kingdom National External Quality Assessment Service (UK NEQAS). For more information on the EARS-Net EQA exercise, please refer to the separate EQA report [5].

Indicators

'Percentage of laboratories participating in EARS-Net EQA' represents the proportion of laboratories invited to participate in the EARS-Net EQA exercise that returned reports within the agreed time.

Percentage of laboratories using EUCAST or EUCAST harmonised guidelines' refers to the proportion of laboratories reporting to use EUCAST or EUCAST-harmonised clinical guidelines among laboratories returning reports on the EARS-Net EQA exercise. Guidelines from the British Society for Antimicrobial Chemotherapy (BSAC) and the Société Française de Microbiologie (SFM) were considered as harmonised with EUCAST as both have implemented EUCAST breakpoints in their national MIC breakpoint recommendations and adjusted the interpretation of their disk diffusion methods accordingly.

Annual number of reporting laboratories, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU)

Data source

EARS-Net data 2014 to 2017.

Indicators

Table 3 provides information on the number of laboratories, the number of isolates and the proportion of isolates from patients in intensive care units (ICUs), by year and by pathogen. The percentage of isolates from patients in ICUs was only calculated if information on hospital unit type was available from more than 50% of the isolates.

The actual total number of laboratories participating in EARS-Net could for some countries be higher than the number presented, as only laboratories reporting at least one isolate during each specific year are included.

Percentage (%) of invasive isolates with resistance to selected antimicrobial groups

Data source

EARS-Net data 2010–2017. For an explanation on the methodology used for the EU/EEA population-weighted mean, please refer to Chapter 2.

Indicators

Percentage of invasive isolates with resistance to selected antimicrobial groups: *Staphylococcus aureus* with resistance to meticillin (MRSA), *Escherichia coli* with resistance to third-generation cephalosporins, *Klebsiella pneumoniae* with resistance to carbapenems and *Enterococcus faecium* with resistance to vancomycin.

Austria

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Austria, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	90	90	90	Unknown
Population sample representativeness	High	High	High	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	16.0	15.7	16.2	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Austria, 2014–2017

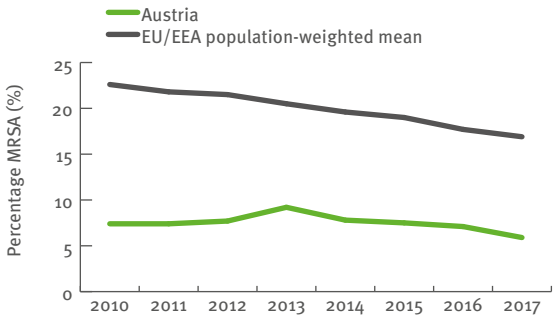
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	95	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Austria 2014–2017

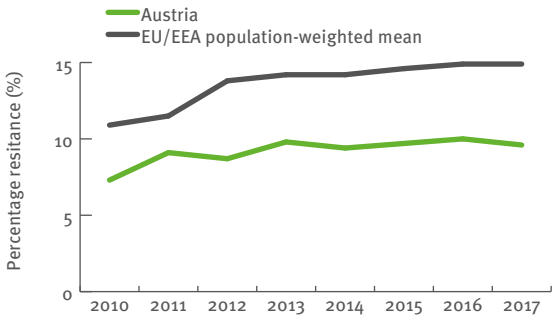
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	39	4757	9	39	4919	8	39	5285	8	39	5381	9
K. pneumoniae	39	996	13	39	1065	13	38	1247	12	39	1152	13
P. aeruginosa	39	638	14	39	680	17	39	697	17	39	725	16
Acinetobacter spp.	21	79	17	21	64	17	24	81	14	25	75	11
S. pneumoniae	39	410	14	38	450	20	39	457	21	39	513	18
S. aureus	39	2662	11	39	2815	13	39	3057	13	39	3162	13
E. faecalis	38	660	16	39	685	15	38	677	15	38	769	18
E. faecium	37	480	27	38	485	31	38	535	28	38	573	31

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

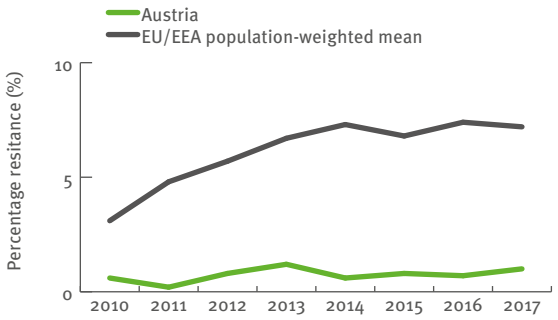
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Austria and EU/EEA population-weighted mean, 2010–2017**



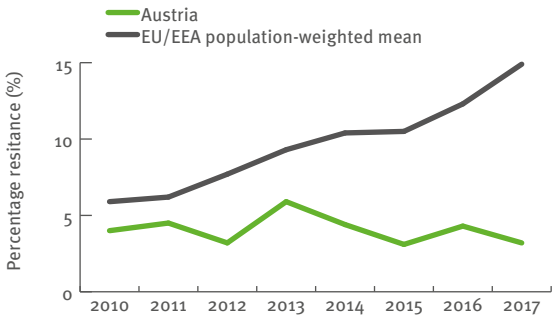
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Austria and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Austria and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Austria and EU/EEA population-weighted mean, 2010–2017**



Belgium

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Belgium, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	25	24	29	30
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	Unknown	Unknown	Unknown	Unknown
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Belgium, 2014–2017

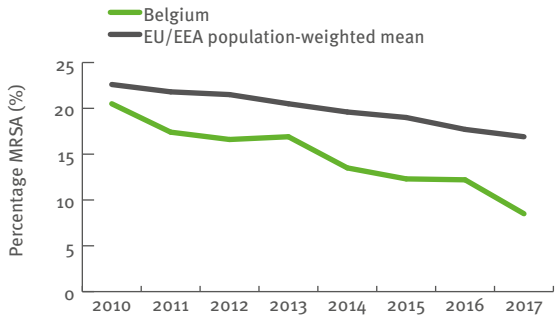
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	87	87	100	90
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	60	67	65	68

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Belgium 2014–2017

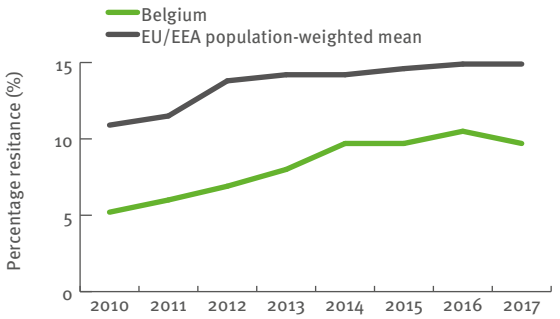
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	27	2895	Unknown	25	2685	Unknown	31	3856	Unknown	32	4676	Unknown
K. pneumoniae	26	506	Unknown	24	406	Unknown	28	669	Unknown	31	803	Unknown
P. aeruginosa	27	357	Unknown	25	263	Unknown	31	366	Unknown	31	474	Unknown
Acinetobacter spp.	3	4	Unknown	8	26	Unknown	18	79	Unknown	21	131	Unknown
S. pneumoniae	96	1181	Unknown	91	1361	Unknown	97	1327	Unknown	91	1472	Unknown
S. aureus	27	1034	Unknown	25	994	Unknown	31	1368	Unknown	31	1531	Unknown
E. faecalis	25	363	Unknown	25	386	Unknown	30	465	Unknown	31	551	Unknown
E. faecium	23	195	Unknown	23	164	Unknown	27	289	Unknown	30	418	Unknown

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

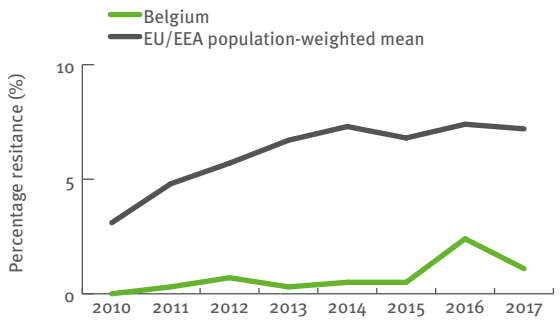
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Belgium and EU/EEA population-weighted mean, 2010–2017**



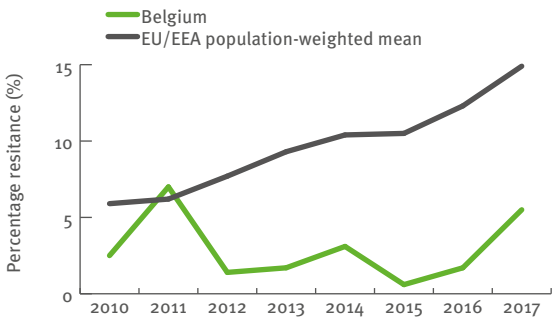
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Belgium and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Belgium and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Belgium and EU/EEA population-weighted mean, 2010–2017**



Bulgaria

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Bulgaria, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	30	30	30	30
Population sample representativeness	Medium	Medium	Medium	Medium
Hospital sample representativeness	Poor	Poor	Poor	Poor
Blood culture sets/1000 patient-days	Unknown	8.2	7.2	8.3
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Bulgaria, 2014–2017

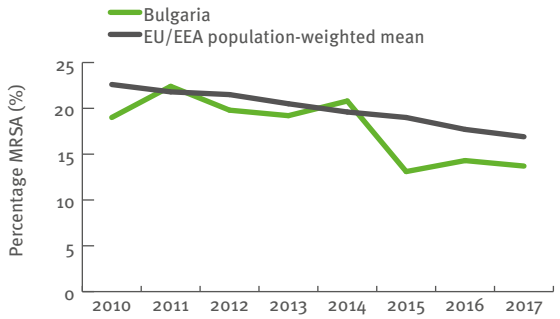
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	91	95
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	5	5	100	95

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Bulgaria 2014–2017

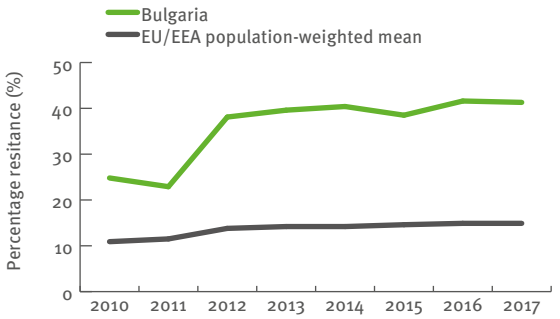
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	20	218	12	19	205	18	20	241	13	20	247	16
K. pneumoniae	17	151	28	16	96	19	17	161	29	18	169	33
P. aeruginosa	12	48	38	13	55	22	12	56	39	16	71	24
Acinetobacter spp.	15	115	57	18	133	59	15	106	48	15	92	62
S. pneumoniae	12	32	19	10	36	28	13	33	18	12	29	38
S. aureus	20	216	25	20	222	20	18	231	19	18	227	23
E. faecalis	19	122	30	19	113	35	17	114	25	17	133	26
E. faecium	13	60	37	13	43	42	12	45	53	17	84	39

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

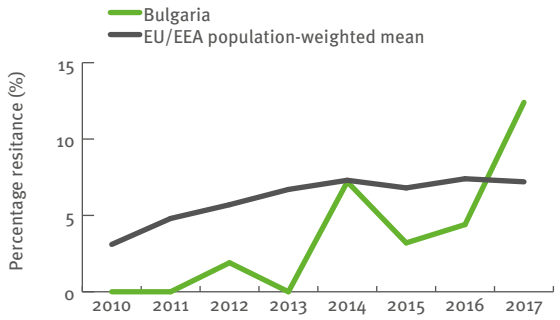
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Bulgaria and EU/EEA population-weighted mean, 2010–2017**



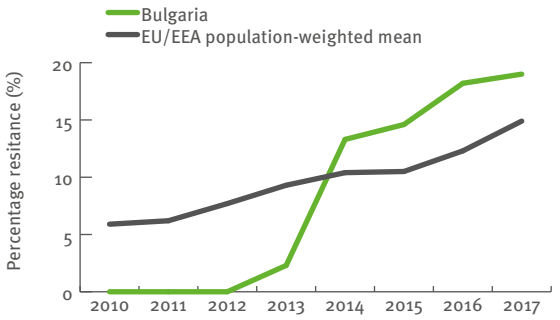
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Bulgaria and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Bulgaria and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Bulgaria and EU/EEA population-weighted mean, 2010–2017**



Croatia

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Croatia, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	80	78	78	80
Population sample representativeness	High	High	High	High
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	Unknown	Unknown	Unknown	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Croatia, 2014–2017

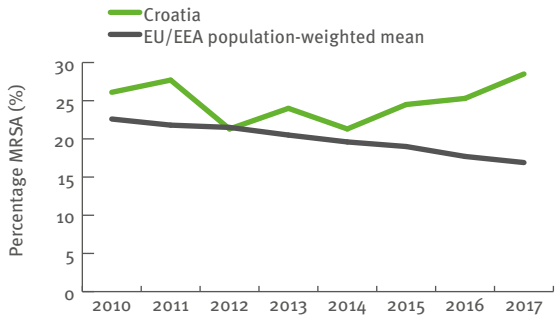
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	91	94	94
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Croatia 2014–2017

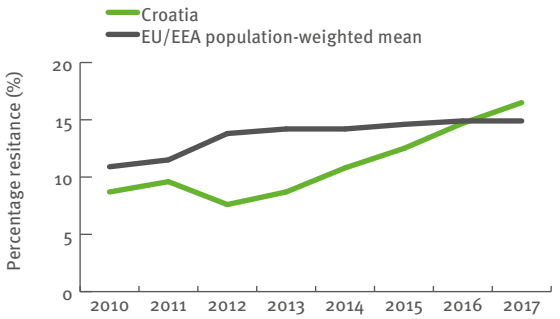
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	18	1080	4	18	1046	5	18	1045	6	19	1160	6
K. pneumoniae	16	334	12	17	380	17	17	323	19	19	313	18
P. aeruginosa	16	232	25	17	257	11	16	260	23	17	238	17
Acinetobacter spp.	15	167	37	17	200	27	14	182	41	17	208	42
S. pneumoniae	14	129	19	15	126	7	17	155	22	16	130	13
S. aureus	16	485	13	16	488	12	18	458	12	18	520	16
E. faecalis	15	152	16	13	205	13	15	179	12	17	171	11
E. faecium	13	68	12	14	93	18	15	104	17	12	89	12

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

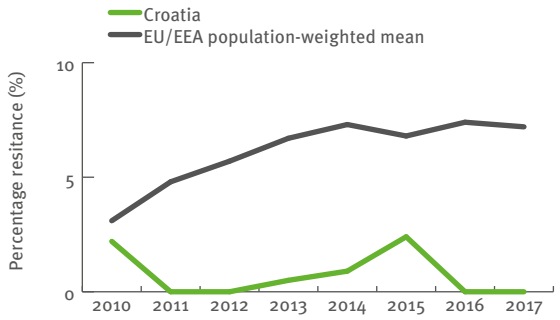
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Croatia and EU/EEA population-weighted mean, 2010–2017**



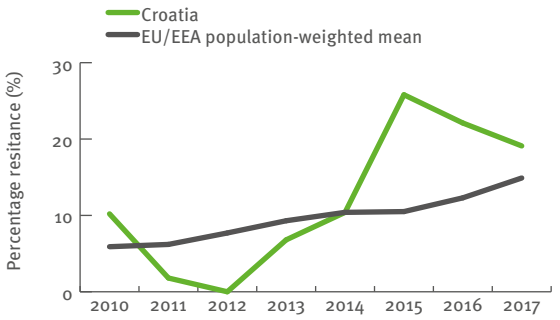
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Croatia and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Croatia and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Croatia and EU/EEA population-weighted mean, 2010–2017**



Cyprus

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Cyprus, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	85	85	85	85
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	38.7	41.4	46.2	44.9
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Cyprus, 2014–2017

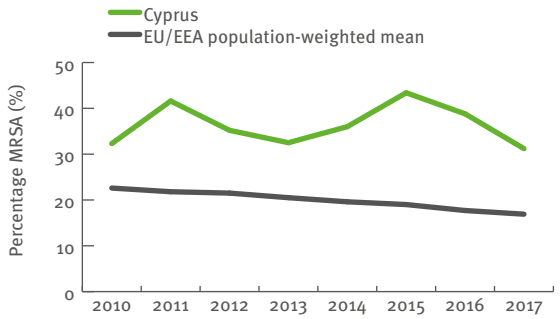
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	80	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	0	0	0	20

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Cyprus 2014–2017

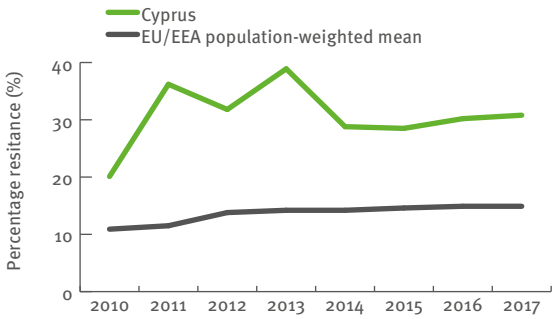
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	5	153	17	5	123	12	5	149	16	5	156	14
K. pneumoniae	5	80	41	5	62	43	5	75	30	5	71	33
P. aeruginosa	5	42	28	5	43	47	5	64	40	4	53	33
Acinetobacter spp.	5	58	68	5	61	66	5	29	69	5	50	46
S. pneumoniae	4	12	17	4	7	14	4	10	11	4	19	37
S. aureus	5	138	23	5	145	22	5	141	21	5	129	26
E. faecalis	5	80	51	5	58	49	5	39	42	5	70	30
E. faecium	5	35	50	5	28	50	4	41	28	5	41	26

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

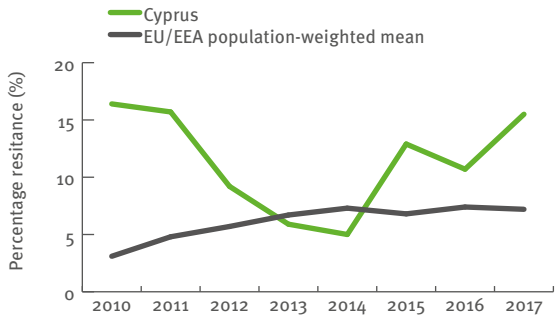
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Cyprus and EU/EEA population-weighted mean, 2010–2017**



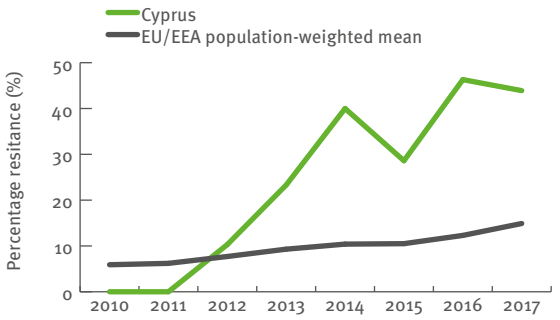
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Cyprus and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Cyprus and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Cyprus and EU/EEA population-weighted mean, 2010–2017**



Czech Republic

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Austria, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	79	85	85	85
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	18.8	18.6	18.0	18.0
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Austria, 2014–2017

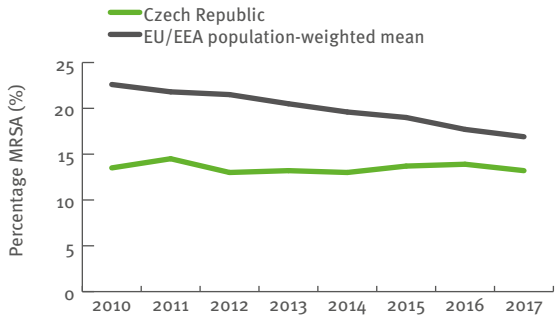
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	96	94	96	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	98	98	98	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Czech Republic 2014–2017

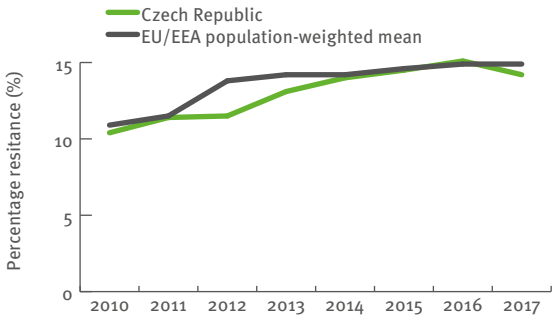
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	45	2981	17	45	3174	17	44	3075	16	43	3201	17
K. pneumoniae	44	1383	37	46	1418	34	45	1385	30	46	1330	27
P. aeruginosa	40	448	42	44	464	37	43	465	37	44	411	36
Acinetobacter spp.	18	59	53	15	60	33	15	57	22	17	55	31
S. pneumoniae	45	274	28	44	284	32	42	267	32	46	366	24
S. aureus	44	1695	25	46	1806	23	45	1887	21	47	1944	21
E. faecalis	42	525	40	43	547	35	42	515	31	41	529	30
E. faecium	34	250	32	36	322	40	38	259	39	39	264	36

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

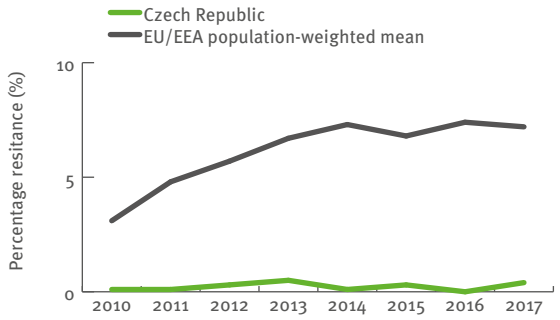
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Czech Republic and EU/EEA population-weighted mean, 2010–2017**



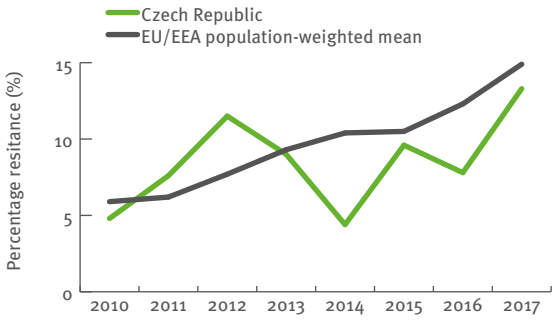
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Czech Republic and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Czech Republic and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Czech Republic and EU/EEA population-weighted mean, 2010–2017**



Denmark

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Denmark, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	100	100	100
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	108.1	117.2	121.9	138.5
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Denmark, 2014–2017

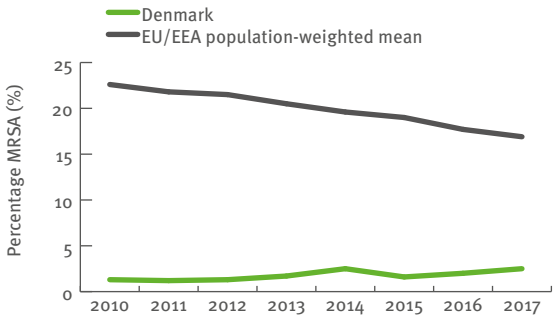
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	77	100	92	91
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Denmark 2014–2017

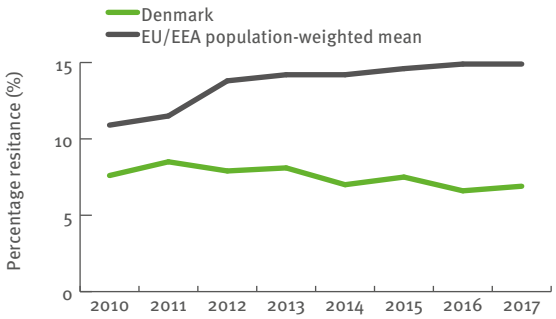
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	10	4496	4	11	4597	3	11	4847	2	10	5123	2
K. pneumoniae	10	943	5	11	939	5	11	1156	4	10	1186	3
P. aeruginosa	10	388	7	11	442	4	11	460	5	10	484	6
Acinetobacter spp.	10	72	3	10	68	Unknown	11	72	8	9	68	5
S. pneumoniae	11	709	Unknown	11	747	Unknown	10	707	Unknown	10	727	Unknown
S. aureus	11	1874	Unknown	11	1876	Unknown	10	1963	Unknown	10	1996	Unknown
E. faecalis	10	587	9	11	610	8	11	600	8	10	674	6
E. faecium	10	721	32	11	693	35	11	685	31	10	786	30

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

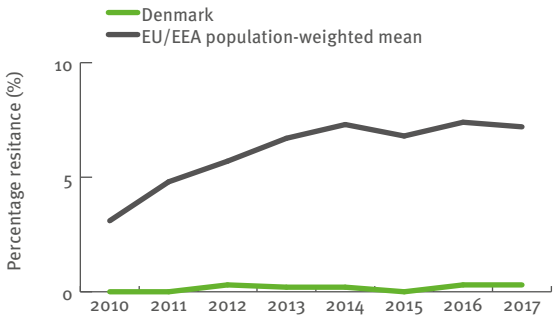
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Denmark and EU/EEA population-weighted mean, 2010–2017**



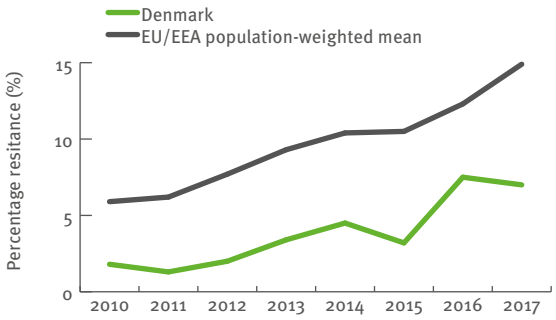
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Denmark and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Denmark and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Denmark and EU/EEA population-weighted mean, 2010–2017**



Estonia

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Estonia, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	100	100	100
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	16.7	23.2	26.6	34.1
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Estonia, 2014–2017

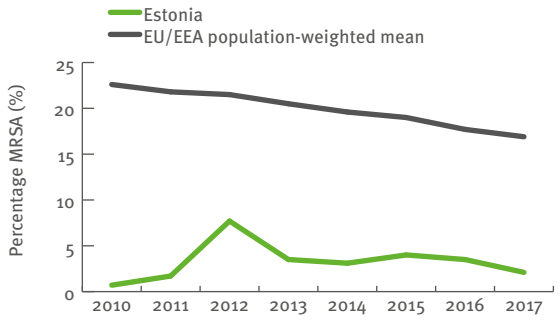
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	91	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Estonia 2014–2017

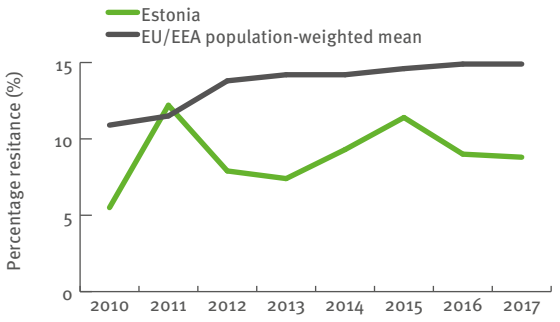
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	11	412	18	11	513	13	11	702	10	10	788	9
K. pneumoniae	10	136	31	9	133	28	10	183	20	10	161	20
P. aeruginosa	7	40	25	7	38	37	8	56	33	9	57	39
Acinetobacter spp.	-	-	-	5	8	25	3	8	13	9	16	19
S. pneumoniae	10	72	19	10	102	19	11	112	16	11	141	10
S. aureus	11	226	16	11	231	15	11	314	12	10	290	8
E. faecalis	8	31	32	10	59	34	9	56	25	10	71	23
E. faecium	7	50	40	7	44	34	8	64	38	10	52	37

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

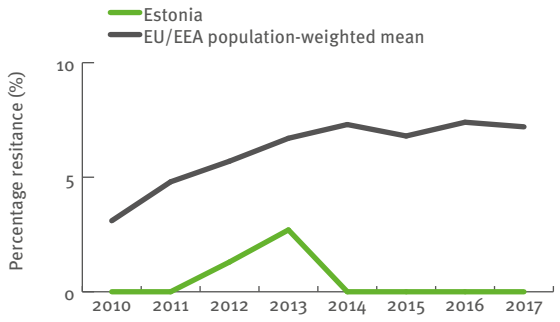
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Estonia and EU/EEA population-weighted mean, 2010–2017**



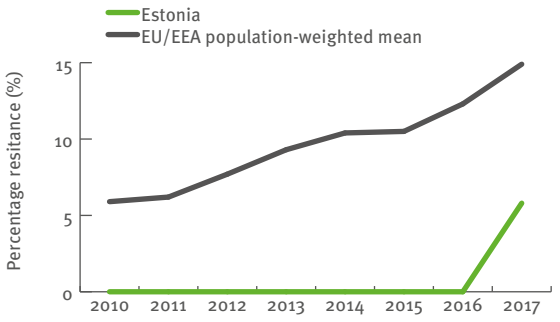
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Estonia and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Estonia and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Estonia and EU/EEA population-weighted mean, 2010–2017**



Finland

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Finland, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	98	100	98	100
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	Unknown	High
Blood culture sets/1000 patient-days	88.3	104.7	Unknown	154.9
Isolate sample representativeness	High	High	Unknown	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Finland, 2014–2017

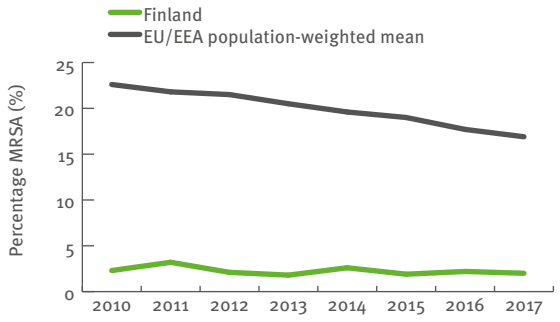
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	94	100	94
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Finland 2014–2017

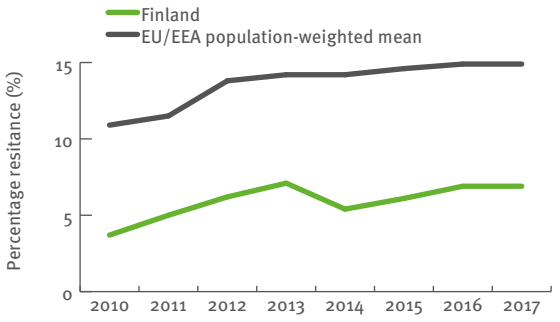
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	19	4013	1	20	4425	1	20	4833	1	20	5315	1
K. pneumoniae	19	583	2	20	658	3	20	770	3	20	758	2
P. aeruginosa	19	307	4	20	341	4	20	352	6	20	378	3
Acinetobacter spp.	14	32	0	16	43	4	12	28	0	11	37	0
S. pneumoniae	19	659	1	20	788	2	20	810	1	20	835	1
S. aureus	19	1831	3	20	2070	2	18	1890	3	20	2439	3
E. faecalis	19	476	2	20	478	2	20	499	3	20	549	0
E. faecium	19	368	13	20	299	7	20	295	10	20	301	6

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

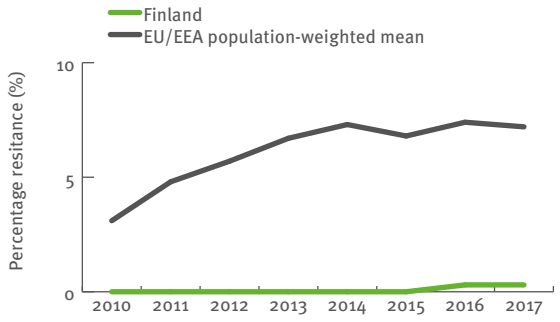
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Finland and EU/EEA population-weighted mean, 2010–2017**



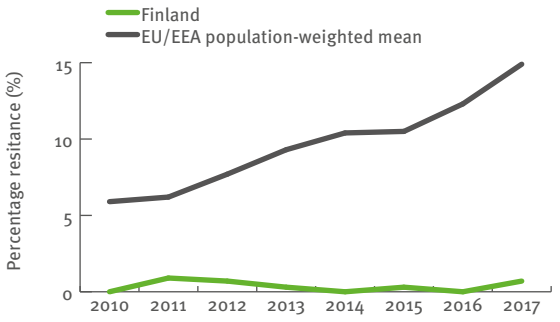
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Finland and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Finland and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Finland and EU/EEA population-weighted mean, 2010–2017**



France

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, France, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)*				
Laboratories collecting *S. pneumoniae* (CNRP)	44	67	51	58**
Laboratories collecting others species (Onerba)	19	19	20	22
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days***	81.2	79.9	77.1	88.1
Isolate sample representativeness	High	High	High	High

* Calculation based on proportion hospital days in participating hospitals out of total hospital days in the country / ** Restricted to first half of the year / *** Calculated only for Onerba Network

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, France, 2014–2017

	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	89	95	86	87
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

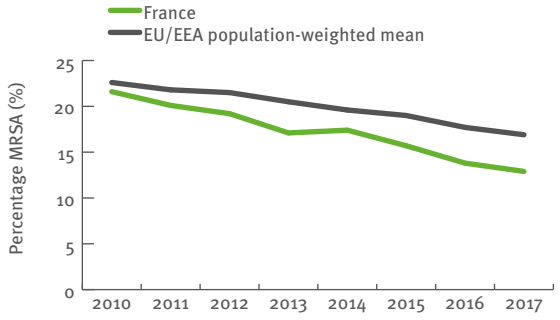
Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), France 2014–2017

Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	53	10350	8	54	11067	8	49	11337	9	54	13392	8
K. pneumoniae	53	2196	16	53	2350	17	49	2608	17	54	2904	16
P. aeruginosa	53	1789	24	53	1956	24	49	1988	23	36	1721	22
Acinetobacter spp.	49	409	13	48	434	14	48	454	18	52	475	16
S. pneumoniae	150	656	Unknown	198	1068	Unknown	175	1046	Unknown	169**	614**	Unknown
S. aureus	53	5498	13	54	5597	15	50	5699	14	54	6668	14
E. faecalis	53	1940	19	53	1999	21	49	2022	19	53	2259	19
E. faecium	51	753	28	53	853	29	48	819	28	53	1000	27

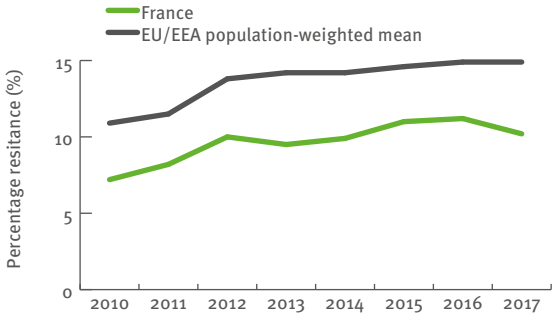
* Number of laboratories reporting at least one isolate during the specific year. Total number of laboratories participating in EARS-Net might be higher.

** Restricted to first half of the year for 2017

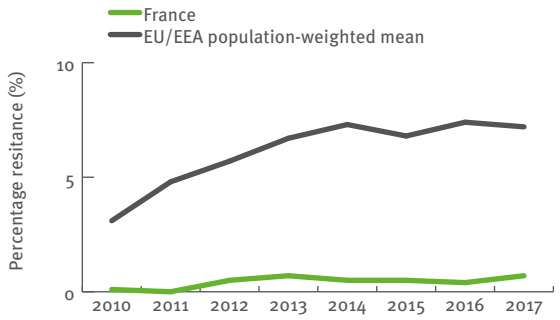
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), France and EU/EEA population-weighted mean, 2010–2017**



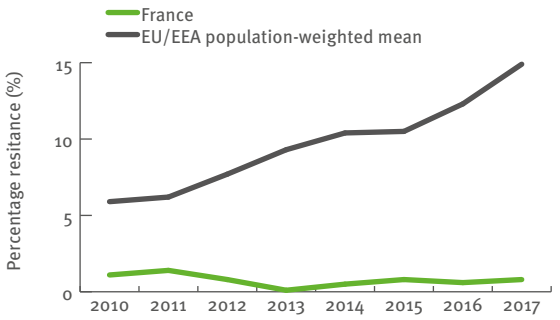
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, France and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, France and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, France and EU/EEA population-weighted mean, 2010–2017**



Germany

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Germany, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	15	22	26	30
Population sample representativeness	Medium	High	High	High
Hospital sample representativeness	Medium	Medium	Medium	Medium
Blood culture sets/1000 patient-days	16.3	24.9	26.2	27.2
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Germany, 2014–2017

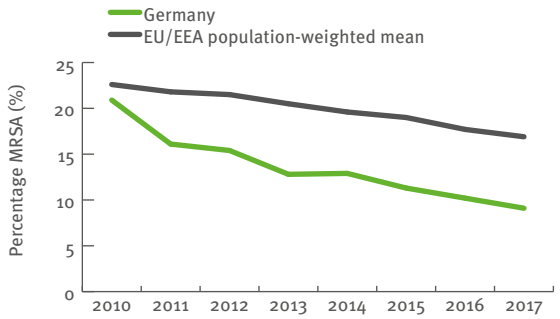
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	92	93	91
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	88	94	83	81

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Germany 2014–2017

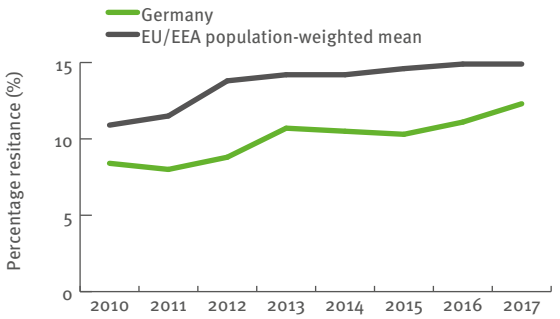
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	21	6251	16	30	9036	14	41	17199	14	53	21085	14
K. pneumoniae	20	1008	25	29	1584	20	40	3070	22	52	3549	22
P. aeruginosa	20	643	28	29	972	27	39	1423	27	52	1756	26
Acinetobacter spp.	17	208	17	25	340	19	38	463	18	48	505	17
S. pneumoniae	21	502	22	29	772	21	40	1403	23	51	1872	22
S. aureus	21	3417	23	30	5026	21	41	9870	20	53	12034	21
E. faecalis	21	1146	26	30	1725	23	41	2959	24	53	3725	24
E. faecium	21	889	40	29	1348	42	41	2049	40	53	2454	40

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

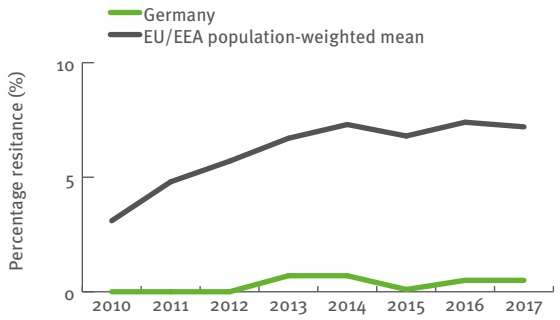
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Germany and EU/EEA population-weighted mean, 2010–2017**



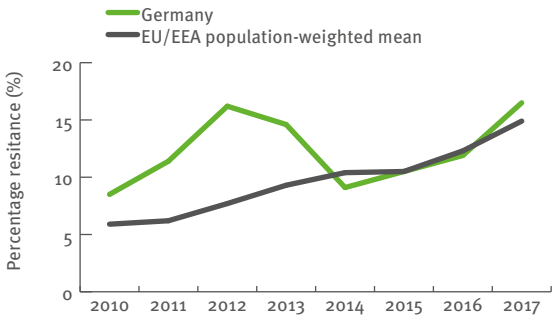
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Germany and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Germany and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Germany and EU/EEA population-weighted mean, 2010–2017**



Greece

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Greece, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	56	55	55	Unknown
Population sample representativeness	Unknown	Unknown	Unknown	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	Unknown	Unknown	Unknown	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Greece, 2014–2017

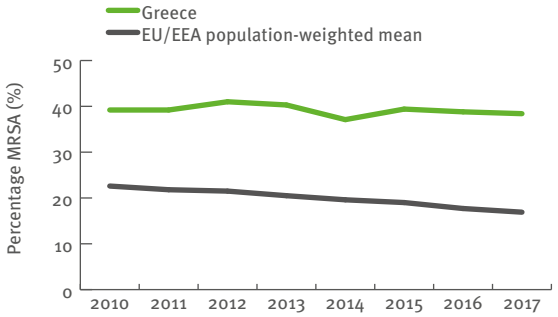
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	89	89	96	89
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	8	7	12	13

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Greece 2014–2017

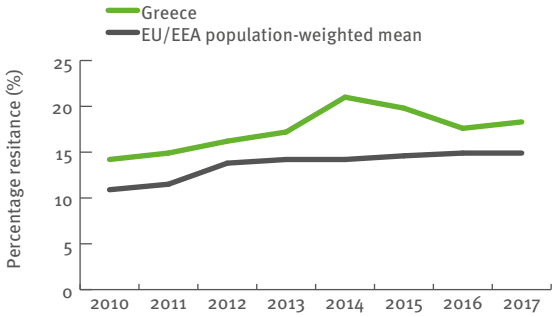
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	26	1123	4	29	1218	3	31	1306	4	32	1472	5
K. pneumoniae	27	1093	43	28	1187	37	30	1183	40	33	1363	37
P. aeruginosa	26	700	46	28	680	35	31	705	41	31	821	37
Acinetobacter spp.	26	844	62	29	1001	52	29	903	57	32	1096	50
S. pneumoniae	-	-	-	-	-	-	-	-	-	-	-	-
S. aureus	27	575	12	29	635	8	31	682	10	33	833	10
E. faecalis	26	449	31	28	506	27	28	576	34	33	638	24
E. faecium	25	276	30	26	320	30	28	358	31	31	412	25

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

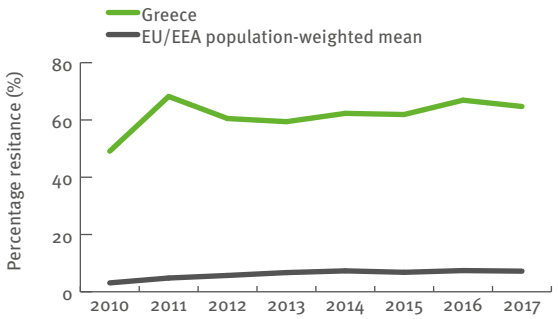
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Greece and EU/EEA population-weighted mean, 2010–2017**



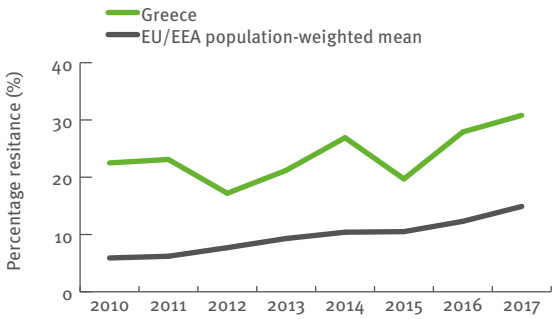
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Greece and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Greece and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Greece and EU/EEA population-weighted mean, 2010–2017**



Hungary

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Hungary, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	90	90	90	Unknown
Population sample representativeness	High	High	High	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	11.7	10.4	9.8	11.5
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Hungary, 2014–2017

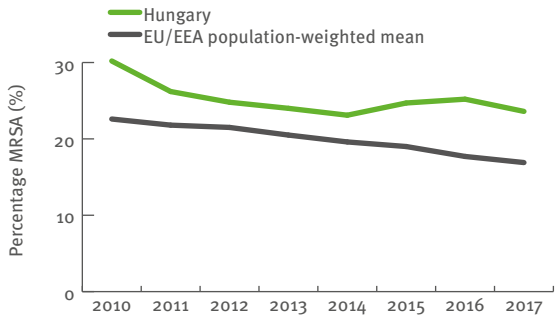
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	97	100	100	97
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Hungary 2014–2017

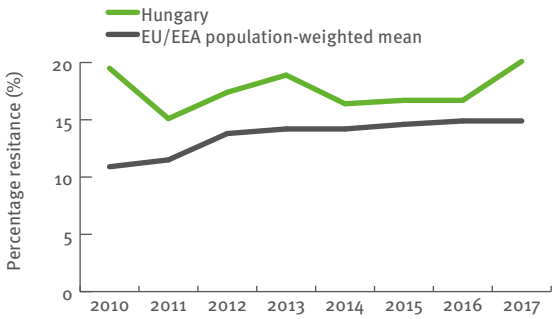
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	30	1622	14	30	2026	14	29	1995	12	31	2061	12
K. pneumoniae	28	644	26	27	706	31	29	723	27	29	693	24
P. aeruginosa	29	746	46	29	770	47	29	740	44	30	735	49
Acinetobacter spp.	27	446	59	25	467	53	26	401	56	31	358	50
S. pneumoniae	25	129	32	27	181	28	27	174	24	27	204	16
S. aureus	26	1279	22	27	1517	20	28	1668	19	28	1566	18
E. faecalis	28	659	36	27	730	35	28	786	36	30	769	36
E. faecium	21	224	46	23	240	44	25	272	46	27	315	44

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

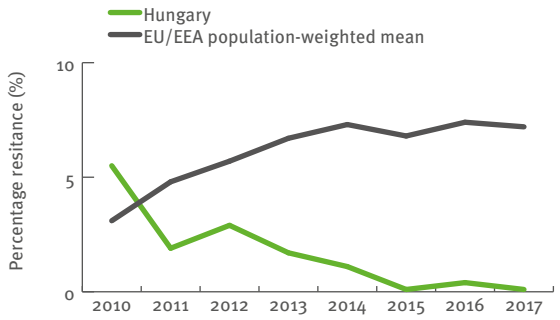
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Hungary and EU/EEA population-weighted mean, 2010–2017**



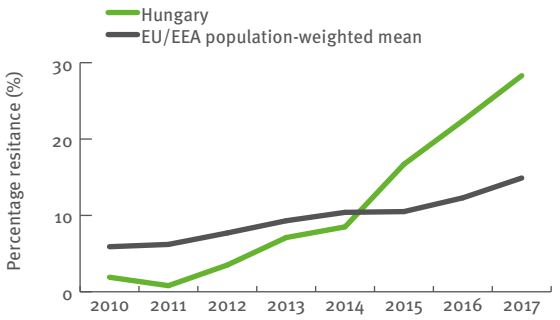
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Hungary and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Hungary and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Hungary and EU/EEA population-weighted mean, 2010–2017**



Iceland

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Iceland, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	100	100	Unknown
Population sample representativeness	High	High	High	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	Unknown	Unknown	Unknown	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Iceland, 2014–2017

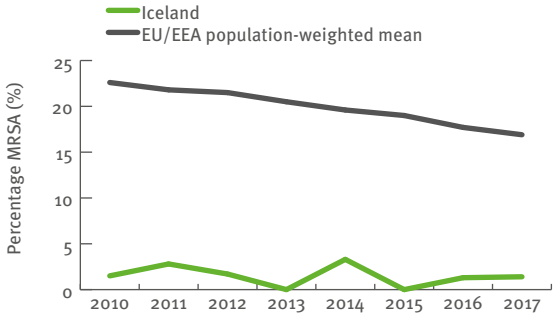
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	50	50	50	50

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Iceland 2014–2017

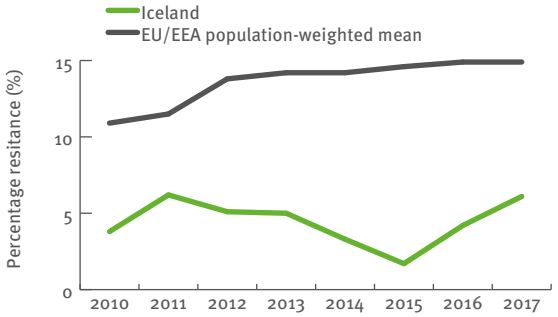
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	2	152	2	2	173	1	2	192	1	2	213	0
K. pneumoniae	1	28	4	2	36	0	2	25	4	2	17	0
P. aeruginosa	1	11	22	2	12	0	2	17	13	1	17	18
Acinetobacter spp.	1	3	50	1	6	17	1	3	0	1	6	0
S. pneumoniae	2	25	0	1	25	0	2	19	5	2	27	4
S. aureus	2	61	9	2	88	3	2	76	1	2	69	7
E. faecalis	1	12	9	2	21	0	2	24	5	2	33	3
E. faecium	1	11	20	1	20	16	1	16	13	1	17	12

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

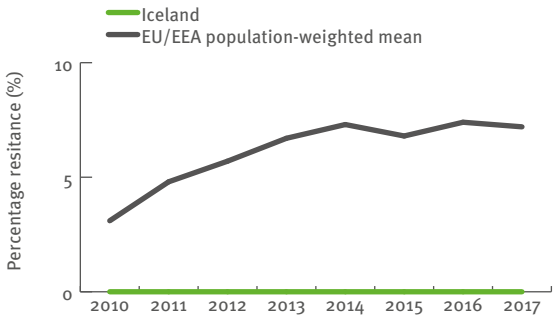
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Iceland and EU/EEA population-weighted mean, 2010–2017**



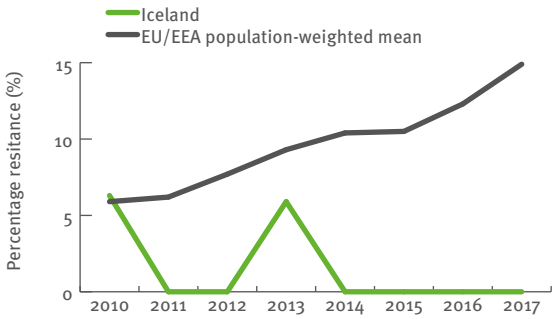
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Iceland and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Iceland and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Iceland and EU/EEA population-weighted mean, 2010–2017**



Ireland

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Ireland, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	97	99	100
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	52.3	53.0	57.5	58.0
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Ireland, 2014–2017

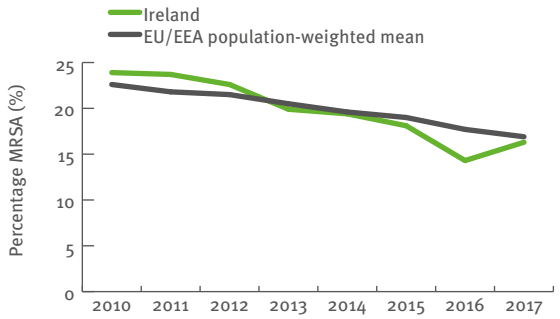
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	92	92	90	85
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	86	92	91	94

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Ireland 2014–2017

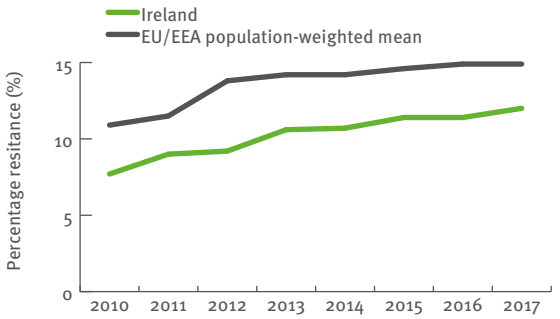
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	39	2705	Unknown	39	2649	Unknown	39	2991	5	39	3125	Unknown
K. pneumoniae	34	355	Unknown	30	389	Unknown	32	453	10	35	479	Unknown
P. aeruginosa	31	178	Unknown	29	195	Unknown	30	243	11	33	288	Unknown
Acinetobacter spp.	24	89	Unknown	21	86	Unknown	25	68	9	23	66	Unknown
S. pneumoniae	34	328	Unknown	30	303	Unknown	31	363	3	31	412	Unknown
S. aureus	37	1075	Unknown	37	1057	Unknown	37	1143	6	37	1144	Unknown
E. faecalis	32	308	Unknown	35	292	Unknown	34	290	8	33	340	Unknown
E. faecium	29	390	Unknown	29	405	Unknown	31	423	26	33	442	Unknown

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

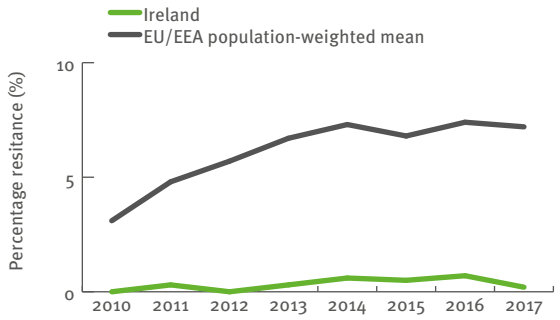
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Ireland and EU/EEA population-weighted mean, 2010–2017**



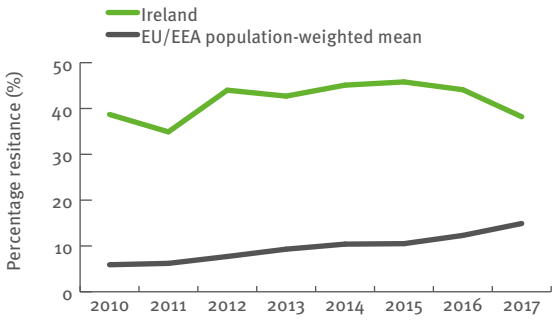
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Ireland and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Ireland and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Ireland and EU/EEA population-weighted mean, 2010–2017**



Italy

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Italy, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	16	15	17	21
Population sample representativeness	Unknown	Unknown	Unknown	Medium
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	31.6	Unknown	Unknown	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Italy, 2014–2017

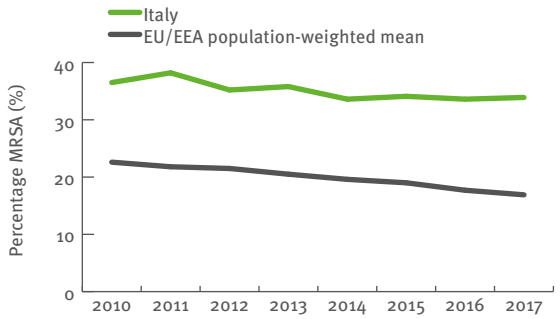
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	86	95	92	97
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	98	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Italy 2014–2017

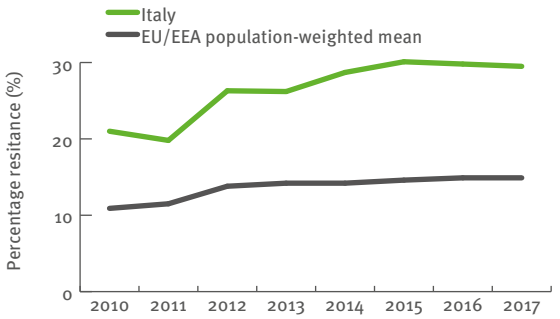
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	38	3802	7	45	5605	8	46	6110	7	54	7478	6
K. pneumoniae	45	1352	27	43	2015	28	47	2314	27	55	2720	25
P. aeruginosa	37	760	32	41	1083	29	43	1207	25	54	1455	24
Acinetobacter spp.	31	483	58	40	667	56	41	708	46	48	878	42
S. pneumoniae	42	284	12	39	479	10	43	515	11	52	673	9
S. aureus	46	2270	11	46	3300	15	46	3309	13	55	4213	14
E. faecalis	32	863	21	45	1622	24	47	1617	22	55	2004	23
E. faecium	46	558	22	45	771	27	47	958	21	54	1085	20

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

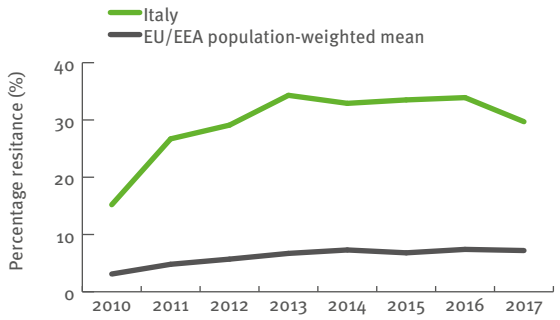
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Italy and EU/EEA population-weighted mean, 2010–2017**



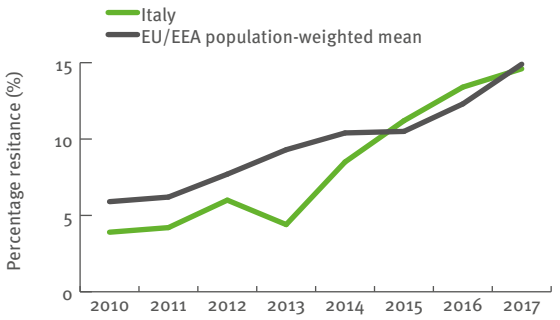
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Italy and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Italy and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Italy and EU/EEA population-weighted mean, 2010–2017**



Latvia

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Latvia, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	90	90	90	90
Population sample representativeness	Medium	Medium	High	High
Hospital sample representativeness	Medium	Medium	Medium	Medium
Blood culture sets/1000 patient-days	5.7	6.7	6.6	6.1
Isolate sample representativeness	Medium	Medium	Medium	Medium

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Latvia, 2014–2017

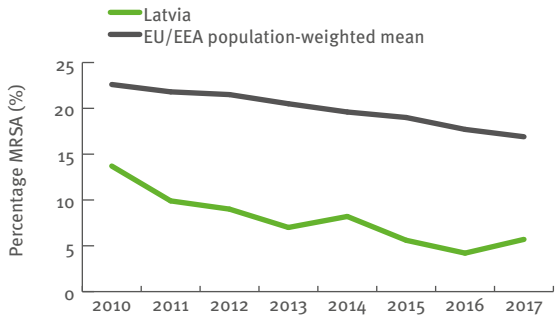
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	94	88
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	13	13	27	21

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Latvia 2014–2017

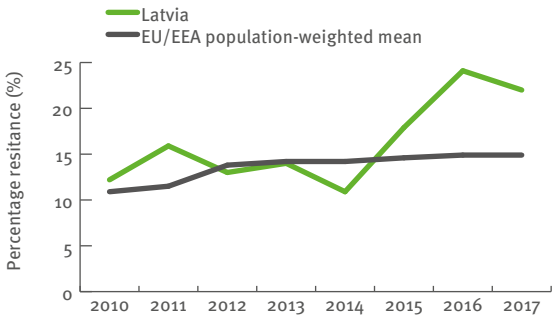
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	10	182	33	11	201	29	11	253	18	12	205	20
K. pneumoniae	12	118	47	11	115	51	8	95	33	7	116	41
P. aeruginosa	6	18	44	6	13	15	5	16	31	4	14	64
Acinetobacter spp.	6	52	60	6	61	56	7	82	56	7	34	62
S. pneumoniae	7	51	71	9	64	53	8	63	60	9	53	38
S. aureus	13	222	25	15	253	18	14	286	19	11	229	22
E. faecalis	8	44	30	10	60	37	12	89	33	8	74	36
E. faecium	6	35	37	10	34	47	6	56	46	5	39	54

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

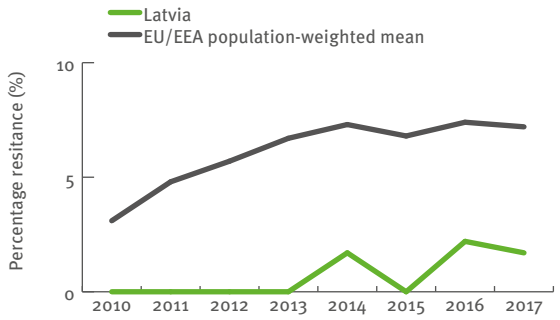
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Latvia and EU/EEA population-weighted mean, 2010–2017**



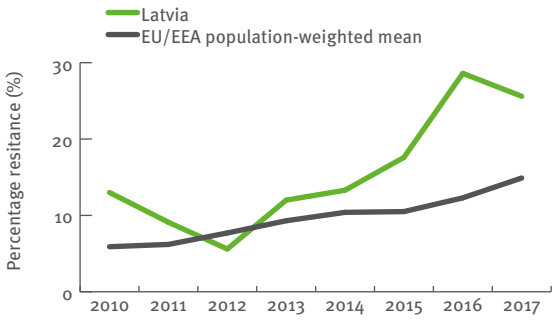
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Latvia and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Latvia and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Latvia and EU/EEA population-weighted mean, 2010–2017**



Lithuania

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Lithuania, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	Unknown	90	100	100
Population sample representativeness	Unknown	High	High	High
Hospital sample representativeness	Unknown	Unknown	High	High
Blood culture sets/1000 patient-days	Unknown	Unknown	7.1	6.3
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Lithuania, 2014–2017

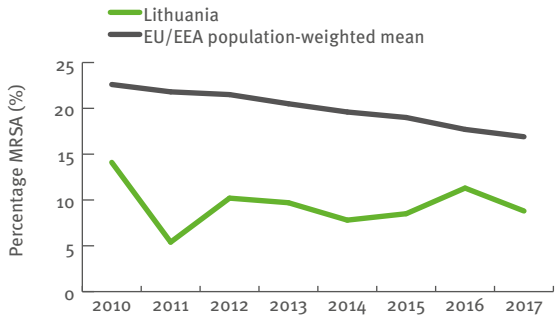
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	91	100	100	94
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	80	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Lithuania 2014–2017

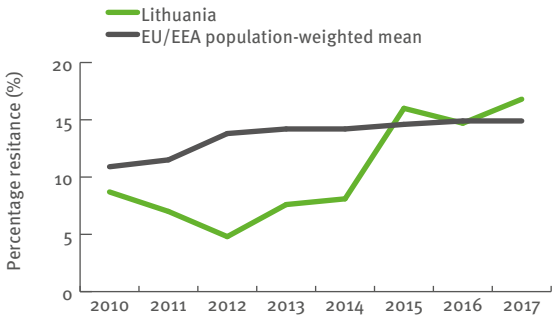
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	13	594	18	15	583	22	17	797	21	16	852	19
K. pneumoniae	12	154	38	12	179	39	16	326	31	15	326	30
P. aeruginosa	9	31	52	9	41	37	13	74	36	13	89	36
Acinetobacter spp.	11	66	52	11	73	62	11	87	64	12	87	56
S. pneumoniae	10	67	39	14	87	41	12	99	24	14	109	24
S. aureus	13	383	22	14	376	24	17	505	22	16	515	19
E. faecalis	12	78	38	12	81	37	13	86	25	13	111	23
E. faecium	10	44	23	8	52	40	13	61	38	13	80	31

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

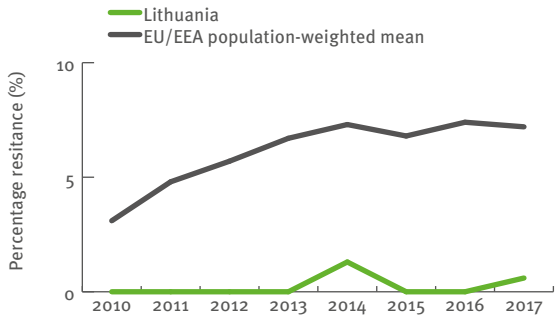
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Lithuania and EU/EEA population-weighted mean, 2010–2017**



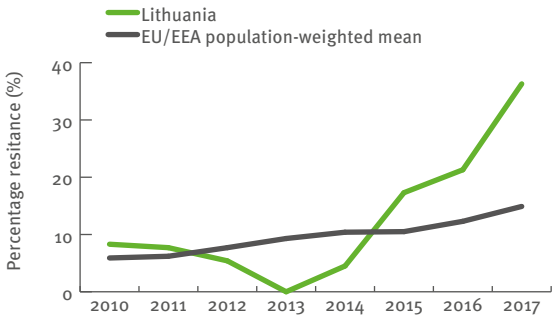
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Lithuania and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Lithuania and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Lithuania and EU/EEA population-weighted mean, 2010–2017**



Luxembourg

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Luxembourg, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	100	100	Unknown
Population sample representativeness	High	High	High	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	Unknown	Unknown	26.0	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Luxembourg, 2014–2017

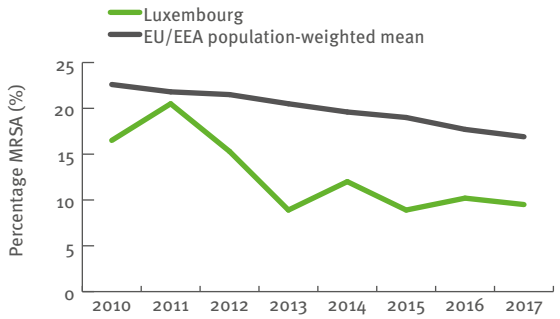
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	83	100	50
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	67	60	80	80

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Luxembourg 2014–2017

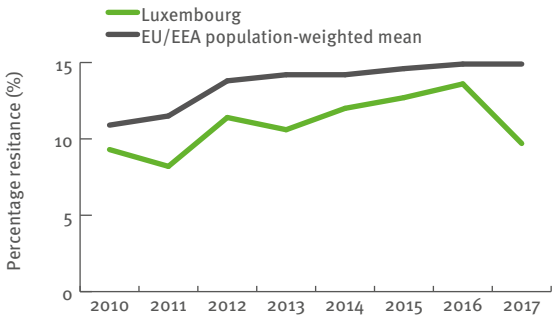
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	5	371	7	5	347	7	4	419	11	4	433	8
K. pneumoniae	4	66	10	4	60	19	4	78	25	4	99	21
P. aeruginosa	5	42	13	4	28	17	4	40	15	4	56	21
Acinetobacter spp.	3	6	20	2	8	0	2	8	38	2	8	0
S. pneumoniae	5	35	12	5	29	17	4	51	10	4	49	12
S. aureus	5	125	19	7	135	21	4	188	25	4	200	17
E. faecalis	5	45	23	5	58	17	4	48	24	4	87	27
E. faecium	4	32	41	4	23	55	4	31	20	4	34	32

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

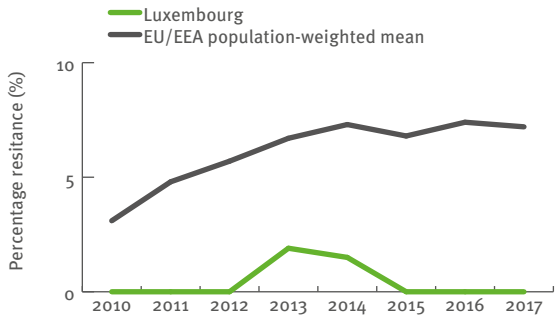
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Luxembourg and EU/EEA population-weighted mean, 2010–2017**



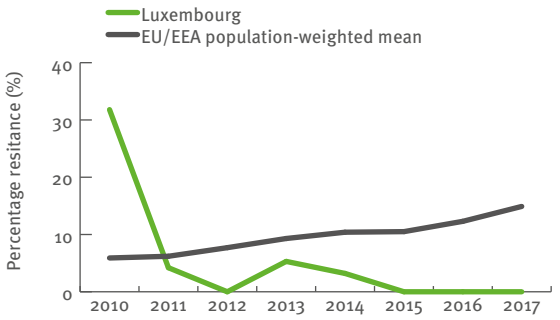
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Luxembourg and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Luxembourg and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Luxembourg and EU/EEA population-weighted mean, 2010–2017**



Malta

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Malta, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	95	95	95	95
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	21.0	22.7	25.0	26.3
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Malta, 2014–2017

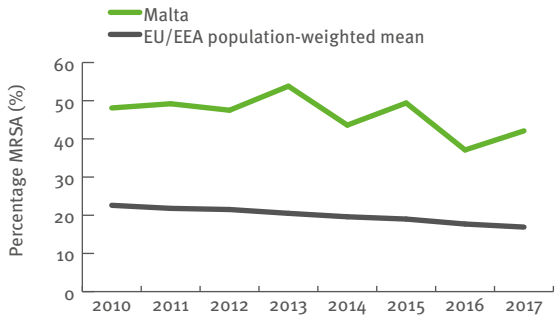
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Malta 2014–2017

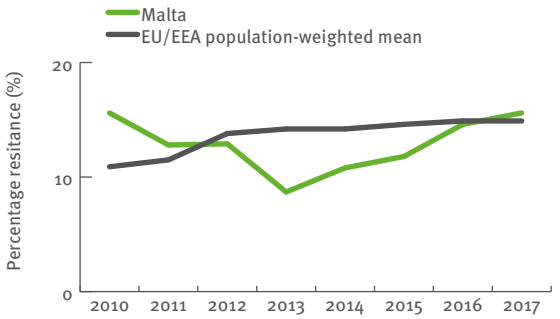
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	1	268	2	1	238	2	1	328	4	1	314	1
K. pneumoniae	1	99	11	1	88	10	1	102	9	1	117	10
P. aeruginosa	1	36	18	1	25	8	1	40	5	1	37	19
Acinetobacter spp.	1	10	20	1	15	0	1	7	14	1	9	0
S. pneumoniae	1	8	0	1	20	5	1	10	0	1	19	7
S. aureus	1	79	3	1	87	4	1	97	4	1	97	1
E. faecalis	1	30	3	1	31	7	1	33	0	1	29	5
E. faecium	1	11	0	1	6	0	1	12	25	1	13	10

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

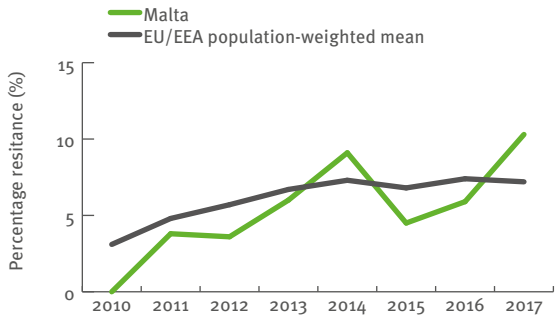
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Malta and EU/EEA population-weighted mean, 2010–2017**



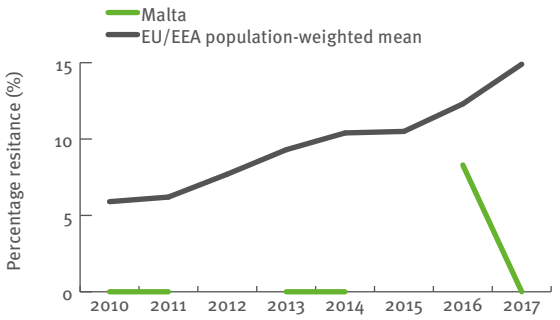
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Malta and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Malta and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Malta and EU/EEA population-weighted mean, 2010–2017**



As less than 10 isolates were reported for Malta for 2012 and 2015, no resistance percentages are displayed for these years.

Netherlands

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Netherlands, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	65	65	65	65
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	Unknown	Unknown	Unknown	Unknown
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Netherlands, 2014–2017

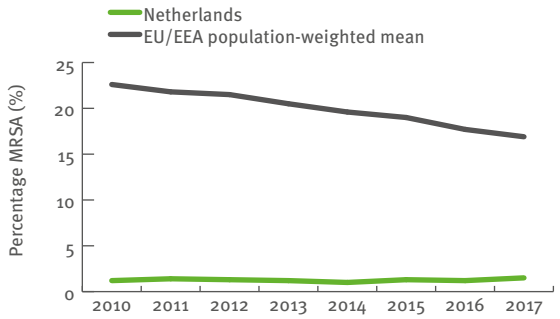
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	82	73	85	85
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	96	93	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Netherlands 2014–2017

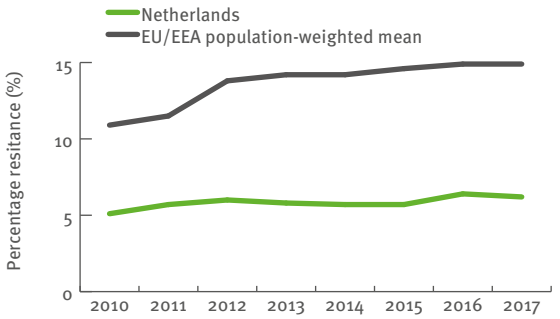
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	35	6514	10	27	5380	10	32	6398	9	33	6687	7
K. pneumoniae	35	926	14	27	908	13	32	1135	11	33	1190	11
P. aeruginosa	35	555	24	27	502	22	31	543	14	33	657	17
Acinetobacter spp.	26	75	22	21	74	19	31	108	13	30	122	21
S. pneumoniae	35	1406	16	27	1301	15	32	1517	12	33	1511	10
S. aureus	35	2580	15	27	2107	15	32	2702	11	33	2695	11
E. faecalis	35	721	23	27	648	22	32	783	21	33	895	19
E. faecium	34	535	50	27	572	53	32	686	50	33	808	47

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

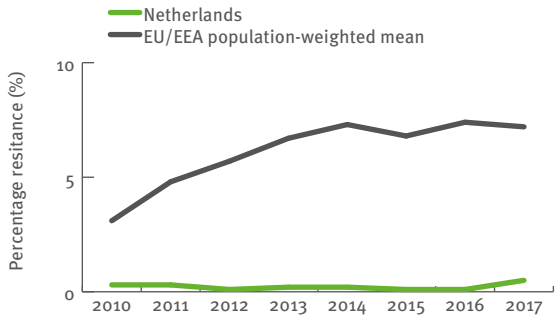
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Netherlands and EU/EEA population-weighted mean, 2010–2017**



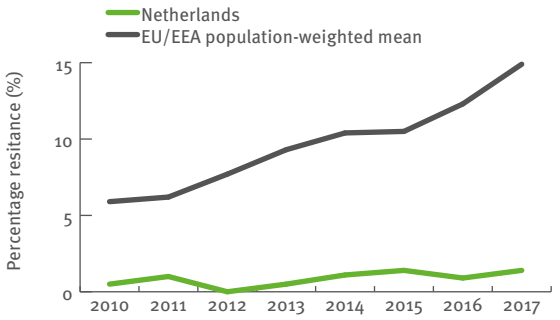
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Netherlands and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Netherlands and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Netherlands and EU/EEA population-weighted mean, 2010–2017**



Norway

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Norway, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	100	100	100	100
Population sample representativeness	High	High	High	High
Hospital sample representativeness	Unknown	Unknown	Unknown	High
Blood culture sets/1000 patient-days	55.4	56.9	63.2	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Norway, 2014–2017

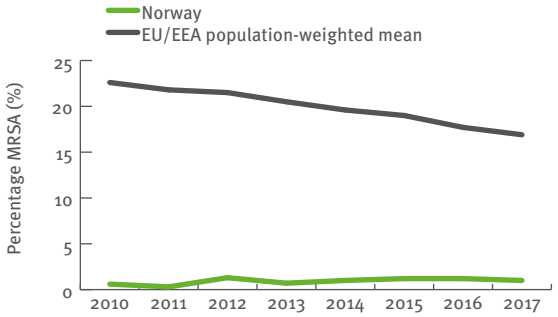
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	89	100	95	95
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Norway 2014–2017

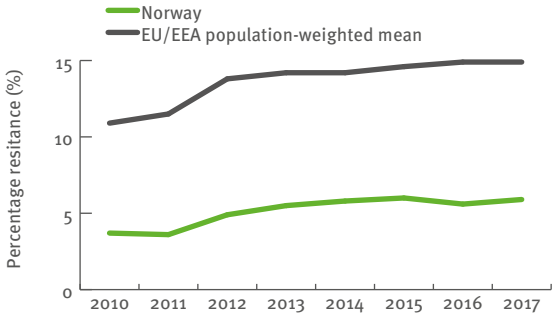
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	19	3422	4	18	3302	4	18	3618	4	18	3734	3
K. pneumoniae	18	746	5	18	701	6	18	811	5	18	781	4
P. aeruginosa	19	257	7	18	230	7	18	227	5	18	205	5
Acinetobacter spp.	13	34	3	11	32	13	12	33	6	12	31	10
S. pneumoniae	19	536	7	18	429	5	18	504	3	18	482	6
S. aureus	19	1546	6	18	1457	6	18	1485	4	18	1507	5
E. faecalis	19	536	6	18	439	5	18	530	6	18	526	5
E. faecium	18	228	11	18	186	11	18	215	15	18	209	10

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

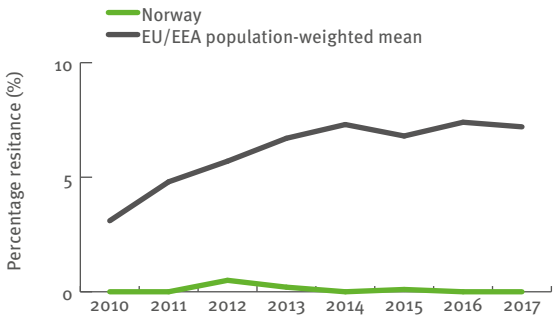
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Norway and EU/EEA population-weighted mean, 2010–2017**



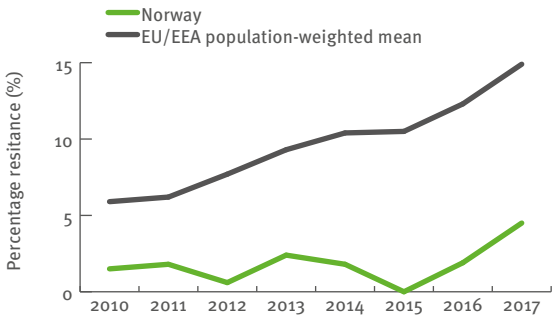
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Norway and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Norway and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Norway and EU/EEA population-weighted mean, 2010–2017**



Poland

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Poland, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	11	14	20	19
Population sample representativeness	Medium	Medium	Medium/ High	Medium/ High
Hospital sample representativeness	Medium	Medium	High	High
Blood culture sets/1000 patient-days	28.3	31.9	30.3	38.1
Isolate sample representativeness	Medium	Medium	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Poland, 2014–2017

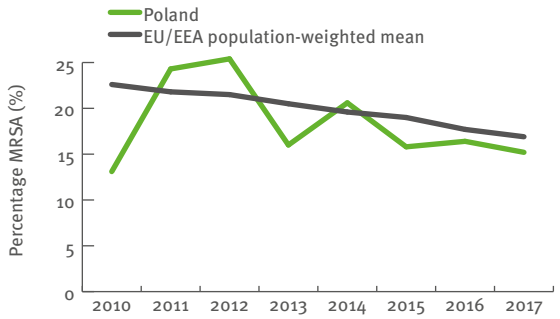
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	96	93	92	96
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Poland 2014–2017

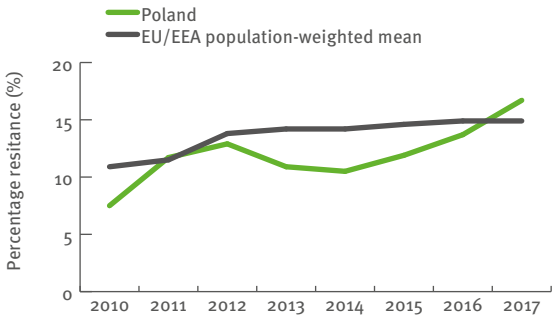
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	32	1096	11	48	1616	12	67	2735	13	65	2881	28
K. pneumoniae	32	466	33	47	679	36	66	1142	35	65	1203	41
P. aeruginosa	30	187	43	40	260	38	60	403	32	64	417	45
Acinetobacter spp.	27	189	58	38	246	59	53	394	50	56	352	59
S. pneumoniae	31	133	14	40	230	14	57	343	14	60	374	30
S. aureus	32	750	14	48	1192	16	65	1842	16	66	1848	32
E. faecalis	29	272	35	47	432	37	65	743	29	65	758	46
E. faecium	28	185	36	41	216	37	55	405	30	60	410	43

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

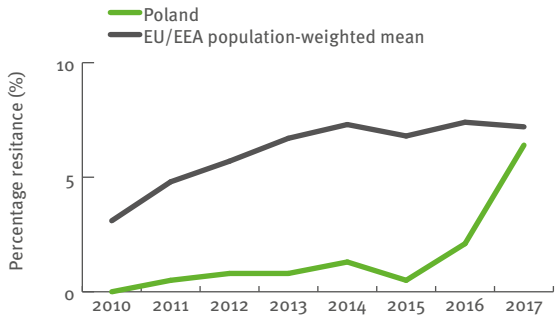
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Poland and EU/EEA population-weighted mean, 2010–2017**



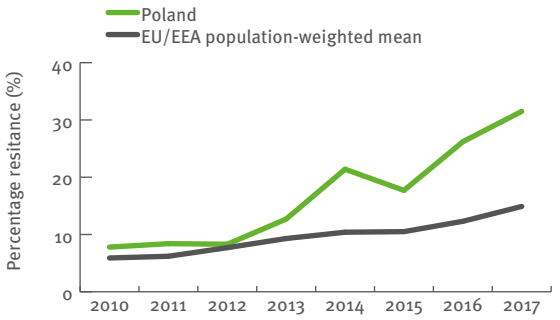
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Poland and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Poland and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Poland and EU/EEA population-weighted mean, 2010–2017**



Portugal

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Portugal, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	95	96	97	97
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	196.8	195.4	Unknown	148.1
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Portugal, 2014–2017

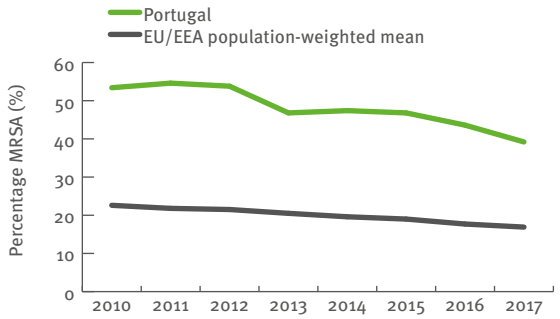
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	94	92	88	88
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	98	97	99	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Portugal 2014–2017

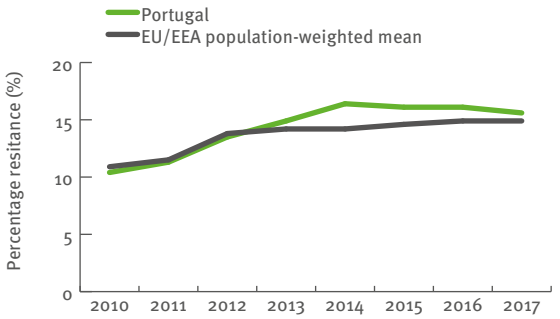
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	56	5027	4	58	5377	5	60	5786	4	62	6452	4
K. pneumoniae	53	1714	9	58	2099	10	59	2352	10	61	2743	9
P. aeruginosa	51	1064	12	56	1192	15	57	1230	13	57	1220	12
Acinetobacter spp.	40	266	24	43	312	17	39	207	21	36	174	16
S. pneumoniae	50	668	3	51	843	3	57	928	2	54	1056	1
S. aureus	53	3241	8	57	3645	7	59	3482	7	64	3789	5
E. faecalis	50	1324	16	53	981	10	56	972	1	58	1014	8
E. faecium	42	634	26	43	459	22	45	411	2	46	467	16

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

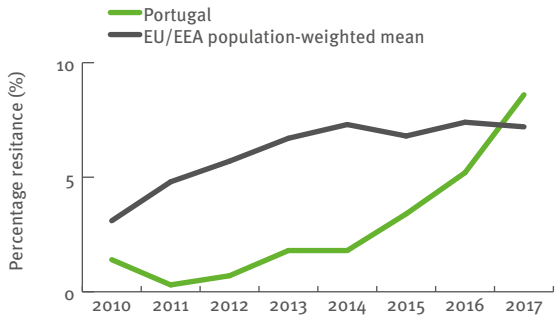
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Portugal and EU/EEA population-weighted mean, 2010–2017**



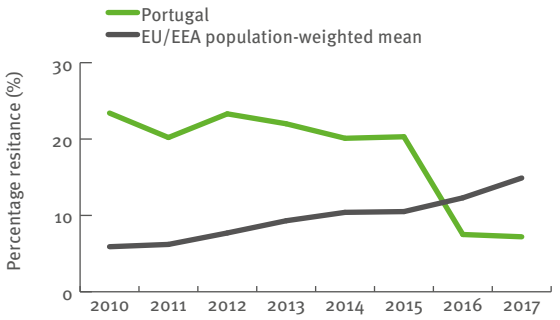
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Portugal and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Portugal and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Portugal and EU/EEA population-weighted mean, 2010–2017**



Romania

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Romania, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	Unknown	15	Unknown	Unknown
Population sample representativeness	Unknown	Unknown	Unknown	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	24.4	Unknown	Unknown	Unknown
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Romania, 2014–2017

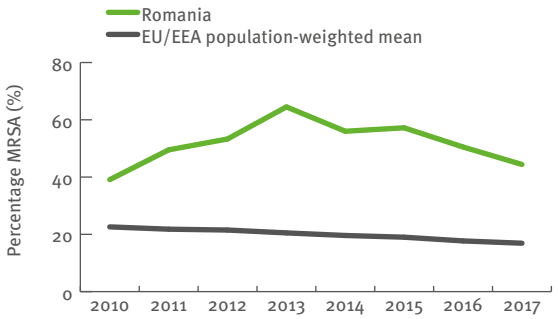
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	95	94	87	93
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	28	31	38	77

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Romania 2014–2017

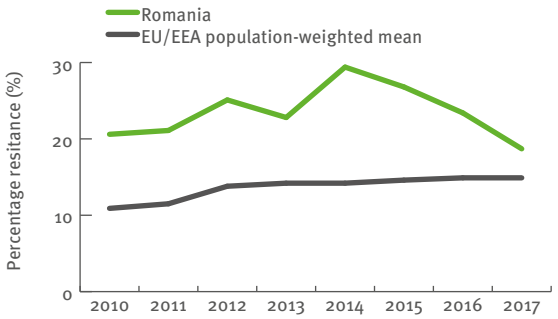
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	16	309	8	12	371	10	13	420	10	14	518	12
K. pneumoniae	16	258	39	13	271	39	13	344	38	14	339	40
P. aeruginosa	15	94	40	11	92	49	13	93	39	14	132	45
Acinetobacter spp.	16	124	67	13	190	56	13	160	54	12	183	70
S. pneumoniae	12	50	8	9	70	1	8	60	12	11	81	21
S. aureus	15	399	19	13	424	21	14	495	25	14	535	21
E. faecalis	15	102	25	12	113	21	13	115	34	14	128	33
E. faecium	12	56	45	10	72	35	13	78	46	13	64	44

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

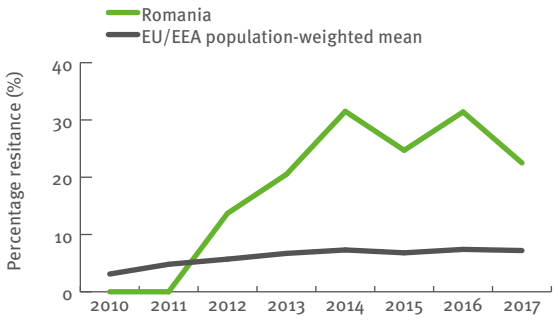
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Romania and EU/EEA population-weighted mean, 2010–2017**



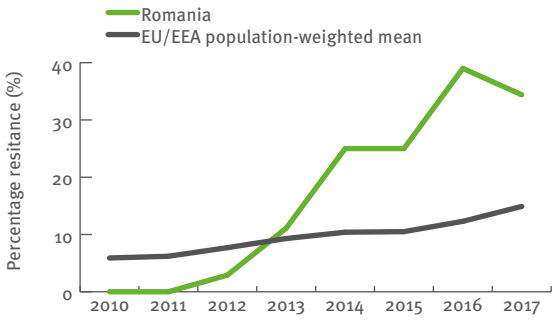
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Romania and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Romania and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Romania and EU/EEA population-weighted mean, 2010–2017**



Slovakia

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Slovakia, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	75	75	70	68
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	19.4	20.1	20.3	20.8
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Slovakia, 2014–2017

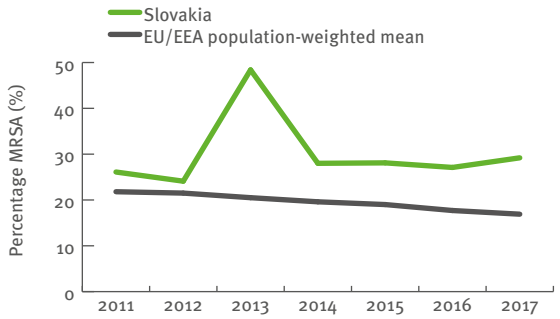
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Slovakia 2014–2017

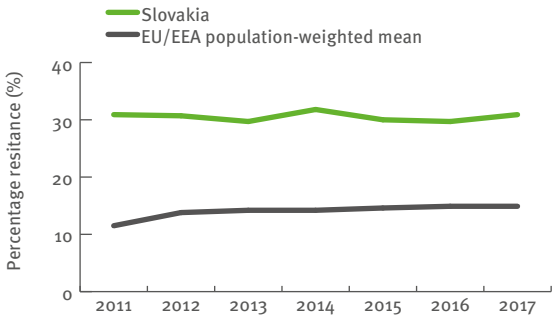
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	14	889	11	14	896	14	13	829	14	13	882	13
K. pneumoniae	14	494	30	14	475	31	13	466	26	13	468	28
P. aeruginosa	14	276	30	14	278	35	12	191	35	13	211	27
Acinetobacter spp.	14	171	37	14	154	33	13	115	32	13	126	35
S. pneumoniae	9	32	47	9	34	35	5	13	31	10	40	28
S. aureus	14	640	16	14	583	16	13	572	19	13	614	16
E. faecalis	13	282	29	14	255	31	13	233	22	13	226	28
E. faecium	13	129	25	14	146	36	12	126	27	11	122	32

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

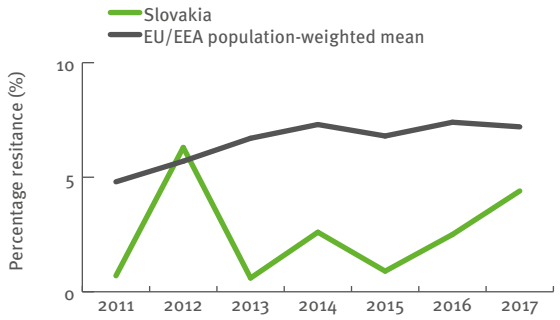
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Slovakia and EU/EEA population-weighted mean, 2011–2017**



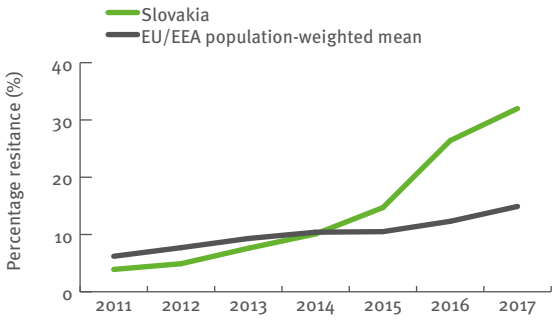
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Slovakia and EU/EEA population-weighted mean, 2011–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Slovakia and EU/EEA population-weighted mean, 2011–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Slovakia and EU/EEA population-weighted mean, 2011–2017**



Slovenia

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Slovenia, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	99	99	99	99
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	34.8	35.1	35.0	41.2
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Slovenia, 2014–2017

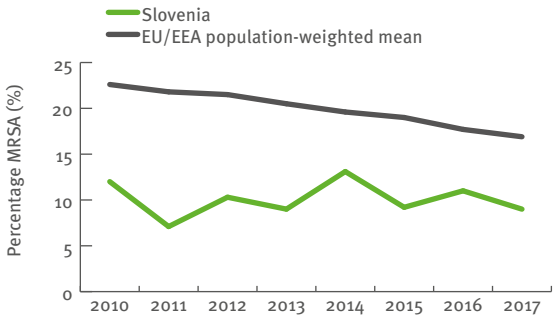
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	100	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	91	91	91	91

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Slovenia 2014–2017

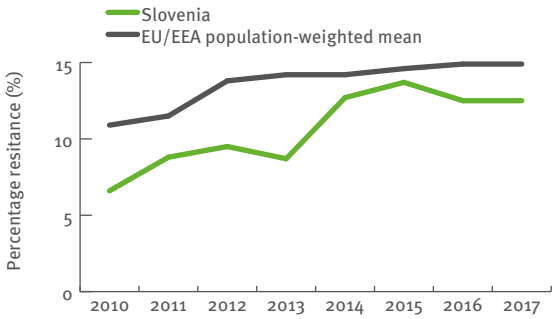
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	10	1216	8	10	1326	8	10	1420	10	10	1435	9
K. pneumoniae	10	233	18	10	237	17	10	267	19	10	312	18
P. aeruginosa	9	112	34	10	141	26	10	143	38	10	138	28
Acinetobacter spp.	8	34	35	7	31	29	7	60	35	4	36	50
S. pneumoniae	10	300	9	10	323	14	10	269	12	10	319	10
S. aureus	10	495	11	10	513	11	10	534	11	10	576	12
E. faecalis	10	120	23	10	133	17	10	161	24	10	171	16
E. faecium	10	115	38	9	124	34	9	111	42	9	149	41

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

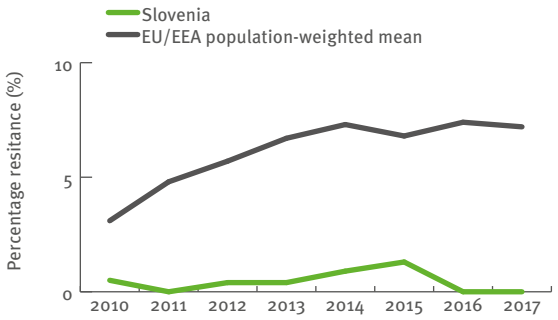
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Slovenia and EU/EEA population-weighted mean, 2010–2017**



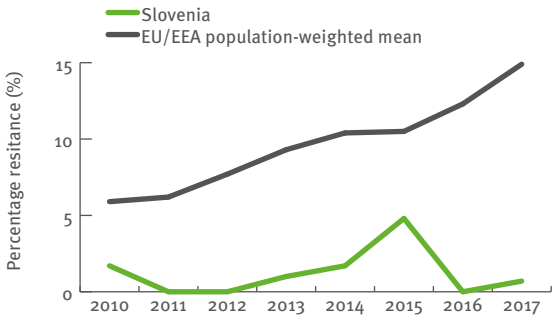
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Slovenia and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Slovenia and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Slovenia and EU/EEA population-weighted mean, 2010–2017**



Spain

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Spain, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	39	40	38	37
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	43.7	46.2	60.4	Unknown
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Spain, 2014–2017

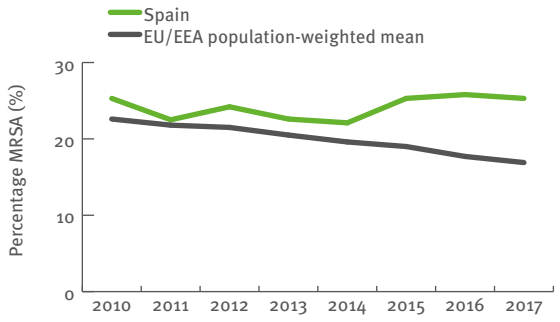
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	88	98	98	90
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	39	43	46	58

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Spain 2014–2017

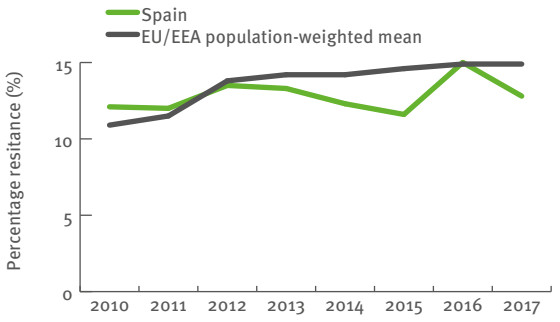
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	38	5824	5	40	6493	5	38	6800	5	36	5808	5
K. pneumoniae	39	1266	11	40	1510	12	38	1680	11	35	1446	11
P. aeruginosa	39	874	16	40	884	21	37	843	19	35	843	16
Acinetobacter spp.	23	83	24	26	96	41	24	106	37	21	88	47
S. pneumoniae	38	583	9	36	672	9	36	672	7	33	722	7
S. aureus	39	1943	10	39	2002	11	37	1972	10	36	1873	10
E. faecalis	39	998	15	39	992	15	37	986	13	35	931	14
E. faecium	37	554	17	38	580	15	35	630	18	34	574	15

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

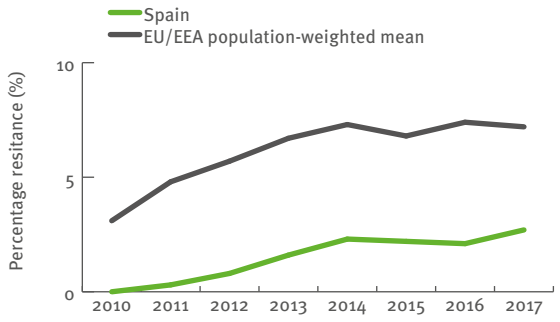
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Spain and EU/EEA population-weighted mean, 2010–2017**



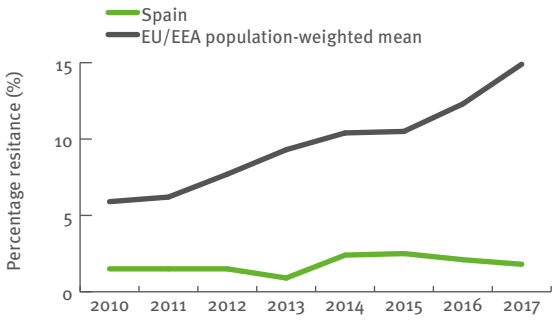
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Spain and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Spain and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Spain and EU/EEA population-weighted mean, 2010–2017**



Sweden

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, Sweden, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	73	75	75	57
Population sample representativeness	High	High	High	High
Hospital sample representativeness	High	High	High	High
Blood culture sets/1000 patient-days	118.8	128.2	139.0	156.7
Isolate sample representativeness	High	High	High	High

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, Sweden, 2014–2017

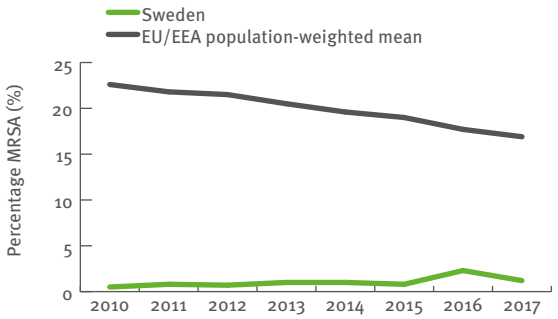
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	100	89	100	100
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	100	100	100

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), Sweden 2014–2017

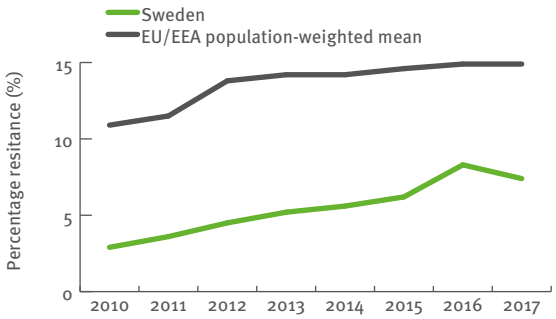
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	16	6549	1	17	6768	Unknown	14	6970	Unknown	10	5807	Unknown
K. pneumoniae	16	1000	3	17	1141	Unknown	15	1537	Unknown	10	1034	Unknown
P. aeruginosa	16	438	Unknown	17	435	Unknown	13	473	Unknown	10	446	Unknown
Acinetobacter spp.	10	52	7	9	35	Unknown	12	86	Unknown	1	54	Unknown
S. pneumoniae	16	792	1	17	867	Unknown	14	904	Unknown	11	755	Unknown
S. aureus	16	3501	3	17	3415	Unknown	15	3903	Unknown	11	3800	Unknown
E. faecalis	16	905	2	17	868	Unknown	14	1019	Unknown	11	1630	Unknown
E. faecium	16	453	9	17	412	Unknown	14	561	Unknown	11	622	Unknown

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

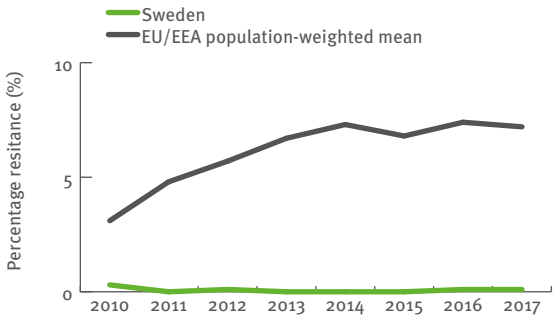
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), Sweden and EU/EEA population-weighted mean, 2010–2017**



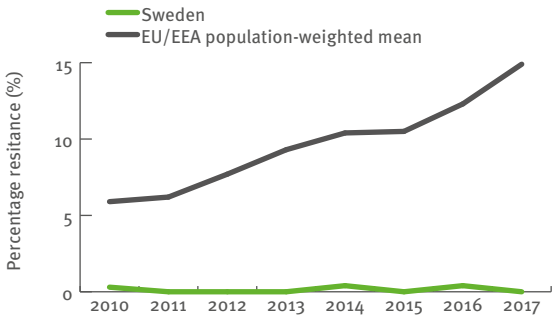
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, Sweden and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, Sweden and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, Sweden and EU/EEA population-weighted mean, 2010–2017**



United Kingdom

Coverage and representativeness of population, hospitals and isolates included in EARS-Net, United Kingdom, 2014–2017

	2014	2015	2016	2017
Estimated national population coverage (%)	Unknown	Unknown	Unknown	Unknown
Population sample representativeness	Unknown	Unknown	Unknown	Unknown
Hospital sample representativeness	Unknown	Unknown	Unknown	Unknown
Blood culture sets/1000 patient-days	44.5	65.4	59.8	52.0
Isolate sample representativeness	Unknown	Unknown	Unknown	Unknown

Laboratories contributing data to EARS-Net: participation in EARS-Net EQA and use of clinical guidelines, United Kingdom, 2014–2017

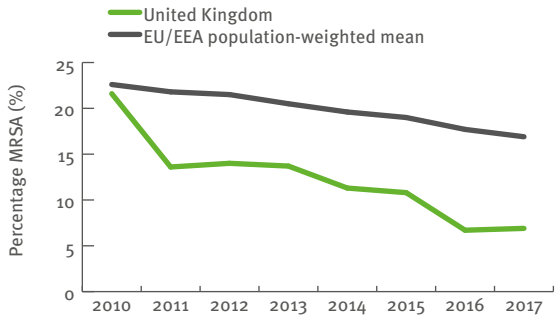
	2014	2015	2016	2017
Percentage laboratories participating in EARS-Net EQA	90	90	88	82
Percentage laboratories using EUCAST or EUCAST harmonised guidelines	100	98	98	96

Annual number of reporting laboratories*, number of reported isolates and proportion of isolates reported from patients in intensive care units (ICU), United Kingdom 2014–2017

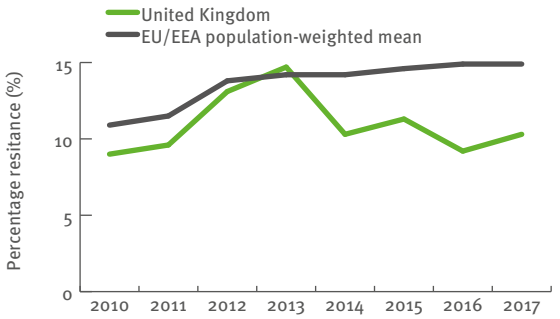
Pathogen	2014			2015			2016			2017		
	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)	Laboratories (N)	Isolates (N)	Isolates from ICUs (%)
E. coli	31	7369	Unknown	22	6117	Unknown	91	23714	Unknown	106	31579	Unknown
K. pneumoniae	29	1180	Unknown	22	1077	Unknown	89	4236	Unknown	105	5519	Unknown
P. aeruginosa	29	649	Unknown	22	541	Unknown	87	2187	Unknown	104	2911	Unknown
Acinetobacter spp.	27	129	Unknown	20	153	Unknown	77	615	Unknown	96	818	Unknown
S. pneumoniae	56	1418	Unknown	44	1126	Unknown	90	3522	Unknown	102	4373	Unknown
S. aureus	56	3569	Unknown	47	3125	Unknown	92	7798	Unknown	106	10031	Unknown
E. faecalis	29	512	Unknown	22	422	Unknown	87	1868	Unknown	103	2792	Unknown
E. faecium	28	433	Unknown	20	354	Unknown	85	1919	Unknown	101	2306	Unknown

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

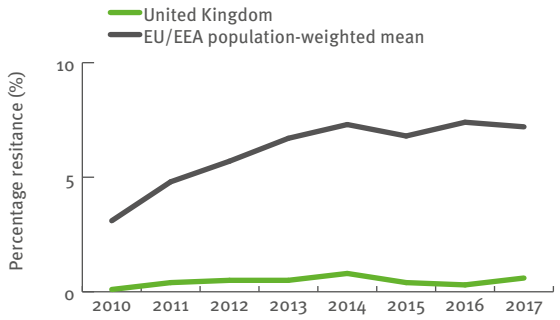
***Staphylococcus aureus*. Percentage (%) of invasive isolates with resistance to meticillin (MRSA), United Kingdom and EU/EEA population-weighted mean, 2010–2017**



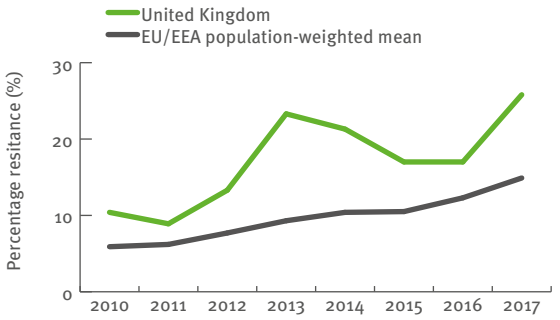
***Escherichia coli*. Percentage (%) of invasive isolates with resistance to third-generation cephalosporins, United Kingdom and EU/EEA population-weighted mean, 2010–2017**



***Klebsiella pneumoniae*. Percentage (%) of invasive isolates with resistance to carbapenems, United Kingdom and EU/EEA population-weighted mean, 2010–2017**



***Enterococcus faecium*. Percentage (%) of invasive isolates with resistance to vancomycin, United Kingdom and EU/EEA population-weighted mean, 2010–2017**



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