Surveillance of antimicrobial resistance in Europe, 2024 data

Executive summary

WHO European Region

This executive summary sets out results derived from 2024 antimicrobial resistance (AMR) data, sourced from invasive isolates reported to both the Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR) network and the European Antimicrobial Resistance Surveillance Network (EARS-Net). EARS-Net amassed data from 30 countries, encompassing the whole of the European Union/European Economic Area (EU/EEA) while CAESAR received reports from 14 countries from the remainder of the WHO European Region. EARS-Net and CAESAR use compatible methodologies for data gathering and analysis. However, given that each national surveillance system is shaped by country-specific protocols and practices, it is important to exercise caution when comparing AMR patterns between countries.

Epidemiology

Nine (64%) of the 14 countries that submitted data to CAESAR reported that their participating laboratories had an estimated population coverage of over two-thirds of the population, including six countries that reported having an estimated population coverage of 90% or more. However, four countries reported an estimated population coverage of less than half of their population and one did not report data on population coverage.

One (7%) of the 14 countries that reported data to CAESAR indicated that the reported data had a 'high' representativeness, in terms of three metrics: geographical representativeness, hospital representativeness and isolate representativeness. A further nine countries reported that the representativeness was 'high' for two of the three metrics, one country reported the representativeness as 'high' for one of the three metrics, and three countries reported the representativeness as 'low' for all three metrics. A 'low' score was more frequently reported for isolate representativeness than for the other two metrics.

The blood culture rate in hospitals served by laboratories reporting data to CAESAR in 2024 was reported by 11 countries. The reported blood culture rates, measured as blood culture sets per 1 000 patient-days, varied widely among countries. Blood culture rates were found to be 2.6 times higher in countries with 'high' representativeness for two of the three metrics listed above when compared to those with 'low' or 'medium' representativeness for at least two of the three metrics (19.3 versus 7.3 blood culture sets per 1 000 patient-days). One country reported 'high' representativeness across all three metrics, but no data on blood culture rate was available. These varying estimates should be interpreted with caution since the definitions of a 'blood culture set' and a 'patient-day' may differ between and within countries.

In 2024, twelve countries reported isolate data for all eight bacterial species to CAESAR. One country did not report isolate data for *Streptococcus pneumoniae and Enterococcus faecium*, and one country did not report isolate data for *S. pneumoniae* and *Acinetobacter* spp.. According to the data submitted to CAESAR for 2024 by 14 countries, the majority of isolates (74%) were *Escherichia coli* (55 394 isolates; 41%), *Staphylococcus aureus* (24 036 isolates; 18%) and *Klebsiella pneumoniae* (20 621 isolates; 15%). This ranking was also observed in 2023.

All 14 countries that reported data for 2024 also did so for 2023. Among these 14 countries, the total number of laboratories reporting data increased from 391 in 2023 to 412 in 2024.

Among the 14 countries that provided data to CAESAR for both 2023 and 2024, the total number of reported invasive isolates increased by 9%, from 125 663 in 2023 to 136 687 in 2024. This overall tendency was not always observed at country level.

Looking at the 14 countries that provided data to CAESAR for 2023 and 2024, the largest increases in the total number of reported isolates were for *S. pneumoniae* (+20.6%), followed by *K. pneumoniae* (+10.3%), *E. coli* (+10.2%), and *S. aureus* (+9.8%).

The AMR situation in bacterial species reported to CAESAR and EARS-Net in 2024 varied widely depending on species, antimicrobial group and geographical region. Within the WHO European Region, pronounced disparities are evident, echoing trends highlighted in past reports. A notable increasing resistance gradient emerges, with a clear pattern from north-to-south and west-to-east, i.e. the northern and western regions predominantly show lower resistance percentages, while the eastern and southern regions tend to report higher ones. Across the Region, resistance to third-generation cephalosporins and carbapenems was generally higher in *K. pneumoniae* than *E. coli*. Though 32% of countries reported carbapenem resistance percentages of 25% or higher in *K. pneumoniae*, carbapenem resistance in *Pseudomonas aeruginosa* and *Acinetobacter* spp. was generally at a higher percentage.

In terms of bacterial species-specific results from 2024, a resistance percentage to fluoroquinolones in *E. coli* below 25% was observed in 19 (46%) of 41 countries that reported data on this microorganism-antimicrobial group combination. This percentage was generally lowest in the northern parts of the WHO European Region and highest in the south. A resistance percentage of 25% or above was reported in 22 (54%) countries. A resistance percentage of 50% or above was observed in four (10%) countries. For third-generation cephalosporin resistance in *E. coli*, seven (17%) of 41 countries reported percentages below 10%, whereas resistance percentages equal to or above 50% were observed in five countries (12%). For carbapenem resistance in *E. coli*, 10 (24%) of 41 countries reported percentages of 1% or above.

In 2024, percentages for third-generation cephalosporin resistance in *K. pneumoniae* below 10% were observed in four (10%) of 41 countries in the Region reporting data on this microorganism-antimicrobial group combination, while 18 (44%), particularly in the southern and eastern parts of the Region, reported resistance percentages of 50% or above. This geographic trend has been consistent since 2019. For carbapenem resistance in *K. pneumoniae*, eight (20%) of 41 countries reported resistance percentages below 1%, whereas 10 (24%) countries reported resistance percentages equal to or above 50%.

Large differences were observed in the percentages of carbapenem-resistant *P. aeruginosa* in the WHO European Region. In 2024, resistance percentages of below 5% were observed in two (5%) of the 38 countries reporting data on this microorganism-antimicrobial group combination, whereas four (11%) countries reported percentages equal to or above 50%.

The percentages of carbapenem-resistant *Acinetobacter* spp. varied widely within the Region in 2024, from below 5% in 11 (30%) of the 37 countries that reported data on this microorganism-antimicrobial group combination, to equal to or above 50% in 18 (49%) countries, mostly in southern and eastern Europe.

In 2024, eight (20%) of 41 countries reporting data on *S. aureus* reported methicillin-resistant *S. aureus* (MRSA) percentages below 5%. An MRSA percentage equal to or above 50% was reported in one (2%) of 41 countries.

The percentages of penicillin non-wild-type *S. pneumoniae* varied markedly across the Region. Of the 34 countries reporting data on this microorganism-antimicrobial group combination, two (6%) registered percentages below 5%, while eight (24%) recorded rates of 25% or higher.

Resistance to vancomycin in *E. faecium* varied substantially among countries in the Region. In 2024, resistance percentages of below 1% were reported by five (14%) of 37 countries providing data on this microorganism-antimicrobial agent combination, while percentages equal to or above 50% were seen in eight (22%) countries.

Resistance maps, trends and country-specific information for each bacterial species, including information on patient age group and sex, are available on the WHO Regional Office for Europe AMR Dashboard, the Region's central platform for AMR surveillance data and interactive maps *(1)*.

Discussion

Although assessing the exact magnitude of AMR is challenging and the results should be interpreted with caution, the results from CAESAR and EARS-Net clearly show the presence of specific AMR patterns across clinical settings in the WHO European Region.

High percentages of resistance to third-generation cephalosporins and carbapenems in *K. pneumoniae* and of carbapenem-resistant *Acinetobacter* spp. in close to half of the countries are of serious concern. They suggest the dissemination of resistant clones in healthcare settings and indicate that many countries have serious limitations in treatment options for patients with infections caused by these pathogens, and that infection prevention and control (IPC) measures should be strengthened.

While the west-to-east gradient in AMR percentages is evident for gram-negative bacteria (*E. coli*, *K. pneumoniae*, *P. aeruginosa* and *Acinetobacter* spp.), it is less pronounced for gram-positive bacteria (*S. aureus*, *S. pneumoniae* and *E. faecium*). This variation in geographical patterns indicates that AMR is influenced by multiple, interconnected factors that extend beyond national borders, underscoring the need for strengthened international cooperation within the WHO European Region and globally.

The number of reported *S. pneumoniae* isolates continued to rise in 2024, extending the upward trend observed since 2021. This trend could be attributed to multiple factors. One possible explanation is the increased circulation of respiratory pathogens in communities following the lifting of lockdowns during the later stages of the COVID-19 pandemic. Additionally, improvements in microbiological diagnostics, such as a higher number of blood culture samples collected from patients in emergency departments, and expanded laboratory capacity to process *S. pneumoniae* isolates, including the availability of appropriate incubation conditions (5% CO_2) and specialized media for antimicrobial susceptibility testing (AST), may also have contributed to the observed increase.

Overall, more and more laboratories have been reporting data to CAESAR and EARS-Net since both networks were initiated, which is an encouraging development. However, surveillance across the WHO European Region remains uneven: 33% (16 out of 48) of countries still gather AMR data from individual facilities without consolidating it at national level or reporting it through standardized systems. This underlines the continuing need to strengthen and harmonise surveillance systems and methodologies as networks expand and mature *(2)*.

While surveillance data form the foundation for understanding AMR trends, resistance patterns are driven by a wider set of interconnected factors. These include how antimicrobials are used in human and animal health, the effectiveness of IPC measures, and the extent to which countries coordinate their responses through national action plans. The interaction of these elements determines not only the spread of resistance but also how effectively surveillance findings are translated into policy and practice.

Antimicrobial consumption patterns across EU/EEA countries have shown considerable variations in adherence to WHO targets. During 2024, 19 of 28 (68%) EU/EEA countries reported data through the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) for both the community and the hospital sector that met or exceeded the WHO country-level target of 60% of total antibacterial consumption coming from WHO's Access category, as defined in the Access, Watch, Reserve (AWaRe) classification list *(3,4)*. In contrast, only four (29%) of 14 countries that reported 2023 consumption data to the WHO Regional Office for Europe Antimicrobial Medicines Consumption (AMC) Network achieved this target in 2023 *(5)*.

With a response rate of 98% for the WHO European Region in the global Tracking Antimicrobial Resistance Country Self-Assessment Survey, 95% of countries reported having a National Action Plan (NAP) on AMR or developing a new one. However, only 39% reported implementing it with the necessary financing in place, supported by regular evaluation and feedback mechanisms *(2)*.

Recognizing that robust planning must be matched with effective implementation, the WHO Regional Office for Europe introduced the *Roadmap on Antimicrobial Resistance for the WHO European Region 2023–2030 (6)*. This Roadmap – which replaces the previous European strategic action plan *(7)* that concluded in 2020 – provides comprehensive guidance to help countries translate their strategic AMR ambitions into tangible actions. It serves as a high-level framework that guides countries through assessing national capacities, setting priorities, implementing targeted interventions, and monitoring progress, all with an emphasis on evidence-based and adaptable approaches tailored to local contexts. By focusing on reducing the infectious disease burden and preserving the effectiveness of treatments, the Roadmap encourages countries to move beyond planning and achieve concrete progress in their AMR responses.

Building on the Roadmap's momentum, WHO Regional Office for Europe (in partnership with the London School of Economics and with the support of the Novo Nordisk Foundation) is developing the world's first AMR Accountability Index *(8)*. This new tool will benchmark each country's progress in implementing AMR policies and promote mutual accountability. By publicly tracking performance, the Index will increase transparency, highlight best practices, and pinpoint areas needing improvement across Member States. The aim is to spur countries to learn from one another and invest where it matters most, moving beyond plans on paper to tangible progress in combating AMR.

Public health implications

AMR in the WHO European Region is increasingly shaped by hard-to-treat gram-negative infections. Recent WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) analyses *(9)* have shown that, globally, *E. coli* and *K. pneumoniae* remain the main drivers

of the overall resistance burden, with widespread resistance to third-generation cephalosporins and a continued rise in carbapenem-resistant *K. pneumoniae*. Carbapenem-resistant *A. baumannii* also persists at worrying levels in parts of the Region, where invasive infections carry high fatality *(10)*. These trends point to shrinking therapeutic options and the need for earlier detection of resistance shifts.

Layered onto this is the "convergence threat" in *K. pneumoniae*: hypervirulent lineages acquiring carbapenemase genes. Because most clinical laboratories do not routinely screen for hypervirulence markers, these strains can circulate under the radar, presenting late as severe, difficult-to-manage infections. At the same time, a parallel front is opening with drug-resistant *Candidozyma auris* (formerly *Candida auris*). Outbreaks have expanded across several EU/EEA countries *(11)*, and environmental persistence plus frequent multidrug resistance make routine infection-prevention measures less effective unless rigorously and consistently applied.

These pressures expose long-standing surveillance and detection gaps. More laboratories contribute data than ever, yet coverage and capabilities remain uneven across the broader Region, particularly for rapid genomics that could flag hypervirulent or highly resistant clones in real time. Inconsistent adoption of harmonised testing methods and fragmented data flows further slow actionable comparisons, allowing transmission advantages to outpace response.

Context matters as well. Ongoing conflicts in parts of the Region strain already-fragile systems: complex trauma care, overcrowding, supply interruptions and population movement, including evacuations and treatment in other countries, all heighten infection risks and complicate antimicrobial stewardship and IPC. In such settings, very high percentages of multidrug-resistant gram-negative pathogens, especially *A. baumannii*, have been documented, with potential spillover into civilian care networks if detection and control are delayed. Specifically, a recent study from Ukraine found that 56% of wounded soldiers' wounds yielded bacteria, predominantly gram-negative bacilli, and 85% of isolates were multidrug-resistant *(12)*.

Finally, budgetary tightening has forced difficult prioritisation across public-health portfolios. Recent restructuring at WHO Regional Office for Europe has reduced regional capacity to provide technical assistance and coordinate laboratory networks at previous scale. While partners and national programmes continue to advance stewardship, IPC and surveillance, sustaining momentum will require targeted investment and collaboration to close detection gaps, protect clinical practice from erosion by AMR, and prevent further escalation across the Region.

EU/EEA countries

In 2025, all EU Member States and EEA countries reported data for 2024 to EARS-Net. Twenty (66.7%) of these 30 countries reported that their participating laboratories had a population coverage of over two-thirds of the national population, including 13 countries that reported having a coverage of 90.0% or more. However, six countries reported data with a coverage of less than half of the population.

Twenty-three (76.7%) of the 30 participating countries indicated that their reported data had a high national representativeness based on three metrics: geographical areas covered, acute care hospitals included, and microorganisms that caused invasive infections in these hospitals. A further two countries reported that the representativeness was 'high' for two of the three metrics, and one country reported representativeness as 'low' for all three metrics.

The blood culture rate in hospitals served by the laboratories that reported data to EARS-Net for 2024 was reported by 26 countries. The blood culture rates, measured as blood culture sets per 1 000 patient-days, varied widely among the countries. However, these estimates should be interpreted with caution since the definitions of a 'blood culture set' and a 'patient-day' may differ between and within countries.

In 2024, all but one country reported isolate data for all eight bacterial species under surveillance by EARS-Net (*E. coli*, *K. pneumoniae*, *P. aeruginosa*, *Acinetobacter* spp., *S. pneumoniae*, *S. aureus*, *Enterococcus faecalis* and *E. faecium*). Liechtenstein reported isolate data for *E. coli*, *K. pneumoniae*, *S. pneumoniae*, *S. aureus*, *E. faecalis* and *E. faecium*.

Based on the laboratory identifiers provided by the countries, the number of laboratories participating in EARS-Net has increased since 2020, indicating that national AMR surveillance systems are being strengthened in the EU/EEA. For 2024, data were reported from 1 993 laboratories. Moreover, 791 laboratories were identified as having reported data for each year during the period 2020–2024.

Reporting of AST for novel antimicrobials (aztreonam-avibactam, cefiderocol, ceftazidime-avibactam, imipenem-relebactam, and meropenem-vaborbactam for *E. coli* and *K. pneumoniae*, and cefiderocol, ceftazidime-avibactam,ceftolozane-tazobactam,imipenem-relebactam, and meropenem-vaborbactam for *P. aeruginosa*, and cefiderocol for *Acinetobacter* spp.) began in 2025. As part of this reporting, 19 (65.5%) of the 29 countries that reported carbapenem-resistant gram-negative bacteria for 2024 reported data on susceptibility to at least one novel antimicrobial. Due to the amount missing, these data were analysed at country level, but not at EU/EEA level.

Epidemiology

Progress towards the EU targets on antimicrobial resistance

Since 2023, there have been recommended EU targets on AMR to reduce the total EU incidence of MRSA, third-generation cephalosporin-resistant *E. coli* and carbapenem-resistant *K. pneumoniae* bloodstream infections by 15%, 10% and 5%, respectively *(13)*. These targets are to be achieved by 2030 against the baseline year 2019 *(13)*.

In the data for 2024, the estimated total EU incidence of MRSA bloodstream infections was 4.48 per 100 000 population (EU country range 0.55–13.63) *(14)*. This was 20.4% lower than in 2019 (baseline year) and 0.31 per 100 000 population lower than the 2030 target of 4.79 per 100 000 population. For the EU overall, a statistically significant decreasing trend was detected between 2019 (baseline year) and 2024. At country level, 12 countries (Bulgaria, Czechia, Denmark, France, Germany, Ireland, Italy, Luxembourg, Malta, Poland, Portugal and Slovakia)[1] had already reached their respective target. However, six EU countries had seen a statistically significant increasing trend in the estimated incidence since 2019.

The estimated total EU incidence of third-generation cephalosporin-resistant *E. coli* bloodstream infections was 11.03 per 100 000 population (EU country range 3.75–22.79) in 2024 *(14)*. This was 5.9% higher than in 2019 (baseline year) and 1.65 per 100 000 population higher than the 2030 target of 9.38 per 100 000 population. For the EU overall, no statistically significant trend was detected between 2019 (baseline year) and 2024. At country level, four countries (Bulgaria, Denmark, Finland and France)[2] had already reached their respective targets. Meanwhile, eight EU countries had seen a statistically significant increasing trend in the estimated incidence since 2019.

The estimated total EU incidence of carbapenem-resistant *K. pneumoniae* bloodstream infections was 3.51 per 100 000 population (EU country range 0.02–20.31) in 2024 *(14)*. This was 61.0% higher than in 2019 (baseline year) and 1.44 per 100 000 population higher than the 2030 target of 2.07 per 100 000 population. For the EU overall, a statistically significant increasing trend was detected between 2019 (baseline year) and 2024. At country level, five countries had reached their respective target (Finland, France, Ireland, Luxembourg and Malta). However, since 2019 a statistically significant increasing trend in the estimated incidence has been noted in 18 EU countries.

1 The results for Bulgaria, Denmark, Germany and Poland should be interpreted with caution.

2 The results for Bulgaria and Denmark should be interpreted with caution.

Epidemiological summary

When interpreting the results presented in this executive summary, which mainly focusses on the five-year period 2020–2024, it is important to take into consideration the COVID-19 interventions and pandemic-associated pressures on healthcare in 2020 and 2021. Moreover, EU and EU/EEA analyses do not include countries that reported data to EARS-Net for less than three years during this period. For France, which lacked 2023 isolate-level data for bacteria other than *S. pneumoniae*, data could be imputed from 2022 and 2024 and these data were included in EU and EU/EEA analyses – unlike the previous executive summary where 2023 data for France were not included other than for *S. pneumoniae*.

Compared to 2020, the total number of reported invasive isolates for the EU/EEA increased from 339 189 to 474 364 in 2024. For bacteria, the highest estimated EU/EEA incidence of invasive isolates from all reporting laboratories in 2024 was *E. coli* (73.9 per 100 000 population), followed by *S. aureus* (37.9 per 100 000 population), *K. pneumoniae* (25.3 per 100 000 population), *E. faecalis* (14.6 per 100 000 population), *P. aeruginosa* (11.1 per 100 000 population), *E. faecium* (10.6 per 100 000 population), *S. pneumoniae* (8.0 per 100 000 population) and *Acinetobacter* spp. (4.5 per 100 000 population). This ranking did not differ from the ranking for 2023. Compared to 2020, all the estimated incidences of invasive isolates under EARS-Net surveillance in the EU/EEA had increased. The largest increase in estimated incidence occurred for *S. pneumoniae* (+116.2%; from 3.7 to 8.0) followed by *K. pneumoniae* (+31.8%; from 19.2 to 25.3). Since 2021, *S. pneumoniae* has increased on an annual basis, and there have also been annual increases for *E. coli*, *K. pneumoniae* and *P. aeruginosa*.

For AMR, the situation reported by EU/EEA countries to EARS-Net for 2024 varied widely, depending on the bacterial species, antimicrobial group and geographical region, as demonstrated by varying AMR percentages, and also often the estimated incidence of bloodstream infections with AMR.

Overall, in 2024 more than 80% of the estimated EU/EEA incidences of bloodstream infections with AMR under EARS-Net surveillance exceeded one per 100 000 population. Moreover, the results showed increases from 2020 to 2024 for more than two thirds (70.4%) of the combinations, ranging from +5.3% to +129.2%. In particular, there was a statistically significant increasing trend in all AMR combinations for *K. pneumoniae* and *S. pneumoniae*, and for aminopenicillin resistance, third-generation cephalosporin resistance, carbapenem resistance, fluoroquinolone resistance and combined third-generation cephalosporin, fluoroquinolone, and aminoglycoside resistance in *E. coli* and for piperacillin-tazobactam resistance and ceftazidime resistance in *P. aeruginosa*.

Overall, in 2024, the population-weighted EU/EEA mean AMR percentages exceeded 10% in 85.2% of the

combinations under regular surveillance. However, for some of the pathogens the pattern of change in the population-weighted EU/EEA mean AMR percentages differed from the estimated EU/EEA incidence of bloodstream infections with AMR. From 2020 to 2024, the results showed increases for just over a quarter (25.9%) of the combinations, ranging from +0.1% to +2.2%. The AMR percentage for most of the bacterial species/antimicrobial combinations showed either a significantly decreasing trend or no significant trend. The exceptions were aminopenicillin resistance, third-generation cephalosporin resistance and carbapenem resistance in *E. coli*, carbapenem resistance in *K. pneumoniae*, and penicillin non-wild-type and macrolide resistance, including the combination of these two types of resistance in *S. pneumoniae.*

The estimated AMR incidence and AMR percentage may move in different directions, as the AMR percentage also depends on the incidence of infections by susceptible bacteria.

In 2024, the bacterial species with the highest estimated EU/EEA incidence of invasive infections and the highest estimated EU/EEA incidences of bloodstream infections with AMR was *E. coli*. Although resistance to carbapenems was rare, all the estimated EU/EEA incidences of *E. coli* bloodstream infections with AMR under EARS-Net surveillance (aminopenicillins, fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems) increased compared to 2020, and there was a significantly increasing trend for aminopenicillin resistance, fluoroquinolone resistance, third-generation cephalosporin resistance, and carbapenem resistance. The trend pattern was similar for the respective EU/EEA population-weighted mean percentages, with one exception: a significant decreasing trend in the EU/EEA population-weighted mean percentage for fluoroquinolone resistance. Resistance to multiple antimicrobial groups was common. During the period 2020–2024, the estimated EU/EEA incidence of bloodstream infections with combined AMR showed a statistically significant increasing trend, however the equivalent EU/EEA population-weighted mean showed no statistically significant trend during the same period. With the exception of carbapenem resistance, which remained low in all countries, large inter-country variations were noted for all the antimicrobial groups under surveillance.

During the period 2020–2024, all the estimated EU/EEA incidences of *K. pneumoniae* bloodstream infections with AMR under EARS-Net surveillance (fluoroquinolones, third-generation cephalosporins, aminoglycosides and carbapenems) increased and showed significantly increasing trends. With the EU/EEA population-weighted mean percentage, this trend was only seen for carbapenem resistance. For the other antimicrobial groups, the EU/EEA population-weighted mean percentage showed statistically significant decreasing trends. The estimated EU/EEA incidence of combined resistance to fluoroquinolones, third-generation cephalosporins and aminoglycosides in *K. pneumoniae* bloodstream infections showed a statistically significant increasing trend between 2020 and 2024, whereas the equivalent EU/EEA population-weighted mean showed a statistically significant decreasing trend during the same period. Large inter-country variations were noted for all the antimicrobial groups under surveillance.

Between 2020 and 2024, the estimated EU/EEA incidence of *P. aeruginosa* bloodstream infections with resistance to piperacillin-tazobactam and ceftazidime increased and showed a significantly increasing trend. However, compared to 2023, all the estimated EU/EEA incidences of bloodstream infections with *P. aeruginosa* with AMR under EARS-Net surveillance (piperacillin-tazobactam, ceftazidime, fluoroquinolones, aminoglycosides and carbapenems) decreased. For aminoglycosides and combined resistance, these results should be interpreted with caution due to limited AST in many of the EU/EEA countries. For 2020–2024, the EU/EEA population-weighted mean AMR percentage trends decreased significantly for all the percentages. At country level for 2024, 20 countries reported >10% carbapenem resistance, nine of which reported >20% carbapenem resistance. Resistance to two or more antimicrobial groups was frequent. During the period 2020–2024, the estimated EU/EEA incidence of combined resistance, defined as resistance to at least three of the antimicrobial groups under surveillance, showed no statistically significant trend in *P. aeruginosa* bloodstream infections, whereas the equivalent EU/EEA population-weighted mean percentage showed a statistically significant decreasing trend. Large inter-country variations were noted in all antimicrobial groups for the AMR percentages, but less so for the estimated incidences of AMR bloodstream infections.

Between 2020 and 2024, only the estimated EU/EEA incidence of *Acinetobacter* spp. bloodstream infections with resistance to aminoglycosides showed a statistically significant decreasing trend. However, all the estimated EU/EEA resistance incidences had decreased compared to the high incidences observed in 2021 (particularly high) and 2023. The EU/EEA population-weighted mean AMR percentage showed statistically significant decreasing trends for all the antimicrobial groups under surveillance in the EU/EEA between 2020 and 2024. The estimated EU/EEA incidence of combined resistance to carbapenems, fluoroquinolones and aminoglycosides in bloodstream infections increased between 2020 and 2021, and then decreased until 2024. There was no statistically significant trend for the period 2020–2024. The EU/EEA population-weighted mean percentage of combined resistance showed a similar pattern, but with a statistically significant decreasing trend. Large inter-country variations were noted for all antimicrobial groups.

The estimated EU/EEA incidence of MRSA bloodstream infections showed no statistically significant trend for the period 2020–2024, whereas the EU/EEA

population-weighted mean MRSA percentage exhibited a significantly decreasing trend. Moreover, the MRSA percentage either showed a statistically significant decreasing trend or no statistically significant trend (i.e. neither decreasing nor increasing) in most EU/EEA countries. With MRSA, combined resistance to another antimicrobial group was quite common. Large inter-country variations were noted for MRSA.

Compared to 2020, the 2024 estimated EU/EEA incidences of bloodstream infections with resistant *S. pneumoniae* more than doubled and there was a statistically significant increasing trend for the EU/EEA for all incidences between 2020 and 2024. These trends were also seen in the equivalent EU/EEA population-weighted mean percentages. The estimated EU/EEA incidence of combined AMR (i.e. macrolide resistance and penicillin non-wild-type) in *S. pneumoniae* bloodstream infections had also more than doubled compared to 2020, and showed a statistically significant increasing trend during the period 2020–2024. The EU/EEA population-weighted mean percentage for combined resistance also showed a significantly increasing trend. At country level, 18 EU/EEA countries showed this trend in the incidence of penicillin non-wild-type *S. pneumoniae* bloodstream infections for 2020–2024, and 20 EU/EEA countries showed an equivalent trend in the incidence of macrolide-resistant *S. pneumoniae* bloodstream infections for 2020–2024. Large inter-country variations in AMR percentages were noted for all antimicrobial groups, although there was less inter-country variation in the estimated incidences.

During the period 2020–2024, the estimated EU/EEA incidence of high-level gentamicin-resistant *E. faecalis* bloodstream infections increased from 2020 to 2021, before decreasing until 2024 with a statistically significant decreasing trend. However, it should be noted that for each year more than one third of the countries reported that susceptibility to gentamicin was tested for <90% of isolates. The EU/EEA population-weighted mean percentage has been decreasing since 2020 and showed a significantly decreasing trend for the period 2020–2024. However, at country level seven countries reported an estimated incidence of high-level gentamicin resistance above three per 100 000 population. Large inter-country variations in AMR percentages were noted, although there was less variation in the estimated incidence.

Between 2020 and 2024, although the estimated EU/EEA incidence of vancomycin-resistant *E. faecium* bloodstream infections did increase compared to 2020, it did not show a significantly increasing trend. While at country level seven countries showed an increasing statistically significant trend, the incidence decreased compared to 2021 and 2022. The EU/EEA population-weighted mean percentage of vancomycin-resistant *E. faecium* was lower than that for 2020, but the trend was not significant. AMR to two or more antimicrobial groups was common. For the estimated incidence of vancomycin-resistant *E. faecium* bloodstream infections, 14 countries reported an incidence below 0.50 per 100 000 population and three countries reported an incidence above 5.00 per 100 000 population. Twelve countries reported vancomycin-resistant *E. faecium* percentages below 5% and 10 countries reported percentages above 25%.

In general, higher AMR percentages and estimated incidences of bloodstream infections with AMR were reported by countries in southern, central and eastern Europe.

In addition to this executive summary, published jointly by ECDC and the WHO Regional Office for Europe, an Annual Epidemiological Report on Antimicrobial Resistance in the EU/EEA (EARS-Net) using 2024 data has been published by ECDC *(14)*. For each bacterial species, country-specific information on the estimated incidence of antimicrobial-resistant bloodstream infections (including the recommended EU targets on AMR); the percentage of invasive isolates with AMR; data availability, and the percentage of intensive-care-unit (ICU) patients is available in country summaries that are published as an annex to the report. Results by age group and sex are available in ECDC's Surveillance Atlas of Infectious Diseases *(15)*. As of 2024, the country summaries also include information on susceptibility to novel antimicrobials among gram-negative carbapenem-resistant isolates.

Discussion

In 2025, all EU/EEA countries reported data for 2024 to EARS-Net. Representativeness, as reported by the countries, was high at 77%. This indicates that, although all EU/EEA countries are included in EARS-Net, in some countries work is still needed to improve surveillance representativeness.

The EARS-Net data indicated that there had been a general increase in the EU/EEA estimated incidences of invasive infections between 2020 and 2024. This could potentially reflect changes in the EU/EEA population, such as an increase in the number of people vulnerable to developing these severe infections over time, due to factors such as aging, invasive medical treatments and immunosuppression.

This summary report showed that while the EU target for the incidence of MRSA bloodstream infections had already been reached by 2024, the results for the other two EU targets were not on track. The estimated EU incidence of third-generation cephalosporin-resistant *E. coli* bloodstream infections with a 10% reduction target increased by more than 5% compared to 2019 (baseline year). Meanwhile, the estimated EU incidence of carbapenem-resistant *K. pneumoniae* bloodstream infections increased by over 60% compared to 2019 (baseline year), which differs substantially from the target of a 5% reduction by 2030. This indicates the need to rapidly strengthen prevention and control actions in the EU, as highlighted in the Council Recommendation

on stepping up EU actions to combat antimicrobial resistance in a One Health approach *(13)*.

Overall, AMR levels remained high in the EU/EEA in 2024, as in previous years. Nevertheless, the AMR situation reported by EU/EEA countries varied widely, depending on the bacterial species, antimicrobial group and geographical region. In general, higher AMR percentages and estimated incidences of bloodstream infections with AMR were reported by countries in southern, central and eastern Europe.

Increases in the estimated EU/EEA incidences of bloodstream infections with resistant bacteria were observed not only for two of the above-mentioned AMR-pathogen combinations with an EU target, but also for many other bacteria and antimicrobial groups under surveillance. Even though the COVID-19 pandemic-associated interventions and pressures on healthcare during 2020–2021 could have influenced the estimated incidence pattern for invasive isolates and their resistance during the period 2020–2024, the increases in the estimated incidences are a cause for concern.

Among the most worrying developments are:

- the increasing carbapenem resistance in *K. pneumoniae* together with the recent ECDC assessment that the probability of further spread in the EU/EEA can be considered high *(16)*, especially in combination with the presence of genetic markers of hypervirulence *(17)*;
- the increasing estimated AMR incidences (including for carbapenems) for *E. coli* – a bacterium that is one of the most common causes of bloodstream infections in Europe, indicating that the EU/EEA is not progressing in the right direction for *E. coli*;
- the doubling of the estimated AMR incidences for *S. pneumoniae* since 2020, with increasing trends in a majority of the EU/EEA countries. This increase could possibly reflect the lifting of non-pharmaceutical interventions (NPIs) for SARS-CoV-2, however this should not detract from the increasing AMR incidences and the trend noted at EU/EEA level and in a majority of EU/EEA countries;
- the increase in the estimated EU/EEA incidence of vancomycin-resistant *E. faecium* bloodstream infections compared to 2020, with statistically significant increasing trends observed for several countries.

On the other hand, there are also encouraging developments at EU/EEA level. For example, the population-weighted mean MRSA percentage and the estimated incidence of MRSA bloodstream infections have decreased overall during the last five years. In addition, the high levels of AMR among *Acinetobacter* spp. noted in 2021 decreased in subsequent years, suggesting that efforts to improve the situation may have had an effect. Another example is AMR in *P. aeruginosa*. All the estimated EU/EEA incidences of *P. aeruginosa* bloodstream infections with AMR have decreased since 2023, and the EU/EEA AMR percentages for 2020–2024 showed statistically significant decreasing trends. However, these results should be interpreted with caution for aminoglycosides and combined resistance due to limited AST in many of the EU/EEA countries.

Nevertheless, although there are signs that the AMR situation is improving at EU/EEA level for some of the EARS-Net pathogens, the situation at country level is still a cause for concern. For *S. aureus*, MRSA continues to show an increasing trend in some countries. For *P. aeruginosa*, high AMR percentages were observed in several countries and carbapenem resistance was common among the tested invasive isolates. As *P. aeruginosa* is intrinsically resistant to many antimicrobial agents, additional acquired resistance is further complicating the treatment of *P. aeruginosa* infections. Moreover, *P. aeruginosa* is one of the major causes of healthcare-associated infection in Europe *(18,19)*. In addition, *Acinetobacter* spp. continue to display high EU/EEA population-weighted mean AMR percentages and the estimated incidence of combined resistance in some countries is high. Since *Acinetobacter* spp. are also intrinsically resistant to many antimicrobial agents, additional acquired AMR is further complicating treatment of *Acinetobacter* spp. infections. For *E. faecalis*, a high estimated incidence of high-level gentamicin-resistant *E. faecalis* bloodstream infections was reported in over one fifth of the EU/EEA countries in 2024. Even though the results should be interpreted with caution due to limited AST in many of the EU/EEA countries, this indicates that antimicrobial-resistant enterococci remain a major challenge for IPC in Europe.

By providing an overview of the wide variability in the estimated incidences of bloodstream infections with AMR and AMR percentages across EU/EEA countries in 2024, the executive summary suggests that there are further opportunities for significant AMR reduction through interventions to improve IPC and antimicrobial stewardship practices. For example, for carbapenem-resistant *K. pneumoniae* and other carbapenem-resistant Enterobacterales (CRE), the recently updated ECDC rapid risk assessment on CRE noted that the spread could be reduced by consistently applied IPC and antimicrobial stewardship, and the impact mitigated by measures such as timely laboratory detection and infection management *(16)*.

The concerns raised regarding CRE, specifically carbapenem-resistant *K. pneumoniae* and carbapenem-resistant *E. coli*, led to the adoption of a Health Security Committee (HSC) opinion on this topic in May 2025 *(20)*. The HSC opinion noted that the deteriorating situation may have been influenced by the COVID-19 pandemic, as well as war casualties and patients transferred from Ukraine since 2022 *(21)*. The HSC opinion also stated that CRE pose a threat to EU preparedness in future pandemics or significant mass casualty events, and

emphasised the importance of reducing the spread. To counteract the deteriorating situation for CRE, the HSC opinion proposed measures for the EU/EEA, including support that can be provided by the recently established European Reference Laboratory on AMR (EURL-PH-AMR), the EU guidelines on IPC in human health developed by the European Commission in collaboration with ECDC, to be published in 2026, and the European Commission support of research and access to antimicrobials. Measures at EU/EEA country level include CRE national management teams and management plans.

When interpreting the EARS-Net data, it is important to be mindful of the structure of the surveillance system, including variations in national blood culture rates, as well as changes in the national surveillance systems and in EARS-Net over time. An example of a resulting limitation to EARS-Net is that, although ECDC published the report *Operational public health considerations for the prevention and control of infectious diseases in the context of Russia's aggression towards Ukraine (22)* which specifically raises the issue of multi-drug resistant organisms, data reported to EARS-Net cannot assess the magnitude of the impact of Russia's war of aggression on Ukraine in terms of AMR occurrence in the EU/EEA. Another limitation is that EARS-Net currently only covers eight pathogens. However, other relevant pathogens may be covered at country level and several of the pathogens are covered by other disease networks coordinated by ECDC. For example, EURGen-Net recently published an investigation into carbapenemase-producing *Providencia stuartii (23)*. This investigation concluded that systematic surveillance of carbapenem-resistant *P. stuartii* was needed in EU/EEA and adjacent countries. One previous limitation of EARS-Net was the lack of AST data on novel antimicrobials for treatment of carbapenem-resistant gram-negative bacteria. However, as of 2025 these data are now being collected and presented at country level.

The European Health Union was created in 2020 to better protect the health of EU citizens *(24)*. This included strengthened mandates for ECDC and the European Medicines Agency (EMA), the creation of the European Health Emergency preparedness and Response Authority (HERA) and a new Regulation on serious cross-border threats to health, adopted by the Council on 24 October 2022 *(25)*. Moreover, a large budget is available under the EU4Health programme (EUR 5.3 billion for the period 2021–2027), which is one of the main instruments for the European Health Union, dedicated to wider policy areas and including action on AMR.

At the global level, the Political Declaration of the High-Level Meeting on AMR at the United Nations (UN) General Assembly (September 2024) also highlighted the importance of AMR as a health threat *(26)*. The Declaration called for the establishment of an independent panel to collect evidence for action against AMR and the European Commission has declared that it will be providing funds for the establishment of such a panel *(27)*.

Public health implications

Estimates based on EARS-Net data from 2020 indicate that each year more than 35 000 people die in the EU/EEA as a direct consequence of antimicrobial-resistant infections *(28)*. The overall poor progress towards the EU targets on AMR and the many increases in the estimated EU/EEA incidences of bloodstream infections with resistant bacteria highlight the urgent need for intensified public health action against AMR.

The *Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach* (2023/C 220/01), adopted in 2023, encourages Member States to develop and implement national action plans against AMR, and highlights the need for them to allocate appropriate human and financial resources for the effective implementation of these plans *(13)*.

Public health interventions to tackle AMR can have a significant positive impact on population health and future healthcare expenditure in the EU/EEA. A mixed intervention package has been estimated to potentially prevent nearly 613 000 resistant infections and avoid more than 10 000 deaths per year in the EU/EEA. The combined health expenditure reduction and productivity gains from such a package would be about three times higher than the average cost of implementing the package *(29)*.

In the absence of stronger, and swifter public health action, it is unlikely that the EU will reach all its AMR targets by 2030. Moreover, AMR will continue to jeopardise EU preparedness, leading to an increased number of infections with antimicrobial-resistant bacteria that will be more difficult to treat, greater challenges for patient safety and a rise in AMR-related deaths.

References

1. World Health Organization (WHO) Regional Office for Europe. AMR Dashboard. Copenhagen: WHO Regional Office for Europe; 2025. Available at: https://whoamrdashboard.shinyapps.io/WHO-AMR-Dashboard/
2. World Health Organization (WHO). Global database for the tripartite antimicrobial resistance country self-assessment survey (TrACSS). Geneva: WHO; 2025. Available at: https://amrcountryprogress. org/#/map-view
3. World Health Organization (WHO). 2019 WHO AWaRe Classification Database of Antibiotics for evaluation and monitoring of use. Geneva: WHO; 2019. Available at: https://iris.who.int/handle/10665/327957
4. European Centre for Disease Prevention and Control (ECDC). EU/EEA consumption characteristics. In: Latest surveillance data on antimicrobial consumption. Stockholm: ECDC; 2025. Available at: https://qap.ecdc.europa.eu/public/extensions/AMC2_Dashboard/AMC2_Dashboard.html#eu-consumption-tab
5. World Health Organization (WHO) Regional Office for Europe Antimicrobial Medicines Consumption (AMC) Network. AMC data 2023. Copenhagen: WHO Regional Office for Europe; 2025. Available at: https://iris.who.int/handle/10665/380848

6. World Health Organization (WHO) Regional Office for Europe. Seventy-third Regional Committee for Europe: Astana, 24–26 October 2023: roadmap on antimicrobial resistance for the WHO European Region 2023–2030. Copenhagen: WHO Regional Office for Europe; 2023. Available at: https://iris.who.int/handle/10665/372503
7. World Health Organization (WHO) Regional Office for Europe. Regional Committee for Europe, 61st session (2011). Sixty-first Regional Committee for Europe: Baku, 12–15 September 2011: European strategic action plan on antibiotic resistance. WHO Regional Office for Europe; 2011. Available at: https://iris.who.int/handle/10665/335840
8. Anderson M, Kluge HHP, Lo Fo Wong et al. Promoting sustainable national action to tackle antimicrobial resistance: a proposal to develop an antimicrobial resistance accountability index. The Lancet Microbe, 2025; Volume 5, Issue 11, 100997. Available at: https://www.thelancet.com/journals/lanmic/article/PIIS2666-5247(24)00265-9/fulltext
9. World Health Organization (WHO). Global antibiotic resistance surveillance report 2025. WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS). WHO; 2025. Available at: https://iris.who.int/handle/10665/383106
10. Cavallo I, Oliva A, Pages R et al. *Acinetobacter baumannii* in the critically ill: complex infections get complicated. Front. Microbiol., 22 June 2023. Available at: https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2023.1196774/full
11. European Centre for Disease Prevention and Control (ECDC). Drug-resistant fungus *Candidozyma auris* confirmed to spread rapidly in European hospitals: ECDC calls for urgent action. Press Release. Stockholm: ECDC; 11 Sep 2025. Available at: https://www.ecdc.europa.eu/en/news-events/drug-resistant-fungus-candidozyma-auris-confirmed-spread-rapidly-european-hospitals
12. Holubnycha V and Kholodylo OV. War impact on antimicrobial resistance and bacteriological profile of wound infections in Ukraine. Commun Med 5, 394 (2025). Available at: https://www.nature.com/articles/s43856-025-01056-6
13. Council of the European Union. Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023/C 220/01). Brussels: Council of the European Union; 2023. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2023_220_R_0001
14. European Centre for Disease Prevention and Control (ECDC). Antimicrobial resistance in the EU/EEA (EARS-Net) - Annual Epidemiological Report for 2024. Stockholm: ECDC; 2025. Available at: https://www.ecdc.europa.eu/en/publications-data/antimicrobial-resistance-eueea-ears-net-annual-epidemiological-report-2024
15. European Centre for Disease Prevention and Control (ECDC). Surveillance Atlas of Infectious Diseases. Stockholm: ECDC; 2024. Available at: https://www.ecdc.europa.eu/en/surveillance-atlas-infectious-diseases
16. European Centre for Disease Prevention and Control (ECDC). Rapid risk assessment: Carbapenem-resistant Enterobacterales, third update - 3 February 2025. Stockholm: ECDC; 2025. Available at: https://www.ecdc.europa.eu/en/publications-data/carbapenem-resistant-enterobacterales-rapid-risk-assessment-third-update
17. European Centre for Disease Prevention and Control (ECDC). Rapid risk assessment: Emergence of hypervirulent *Klebsiella pneumoniae* ST23 carrying carbapenemase genes in EU/EEA countries, first update – 14 February 2024. Stockholm: ECDC; 2024. Available at: https://www.ecdc.europa.eu/en/publications-data/risk-assessment-emergence-hypervirulent-klebsiella-pneumoniae-eu-eea
18. European Centre for Disease Prevention and Control (ECDC). Healthcare-associated infections acquired in intensive care units. Annual epidemiological report for 2019. Stockholm: ECDC; 2023. Available at: https://www.ecdc.europa.eu/en/publications-data/healthcare-associated-infections-intensive-care-units-2019
19. European Centre for Disease Prevention and Control (ECDC). Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals, 2022-2023. Stockholm: ECDC; 2024. Available at: https://www.ecdc.europa.eu/en/publications-data/PPS-HAI-AMR-acute-care-europe-2022-2023
20. European Commission (EC). Senior-level Health Security Committee Meeting Luxembourg Tuesday 13 and Wednesday 14 May 2025. Summary Report. Brussels: EC; 2025. Available at: https://health.ec.europa.eu/document/download/8ee09286-2372-40ac-a712-0a0a613038fa_en?filename=security_20250513_sr_en.pdf
21. European Commission (EC). Opinion of the Health Security Committee on rapidly increasing incidence of carbapenem-resistant Enterobacterales (CRE) in healthcare settings, 13 May 2025. Brussels: EC; 2025. Available at: https://health.ec.europa.eu/publications/opinion-health-security-committee-rapidly-increasing-incidence-carbapenem-resistant-enterobacterales_en
22. European Centre for Disease Prevention and Control (ECDC). Operational public health considerations for the prevention and control of infectious diseases in the context of Russia's aggression towards Ukraine. 8 March 2022. Stockholm: ECDC; 2022. Available at: https://www.ecdc.europa.eu/en/publications-data/operational-public-health-considerations-prevention-and-control-infectious
23. European Centre for Disease Prevention and Control (ECDC). Rapid investigation of New Delhi metallo-beta lactamase (NDM)-1-producing *Providencia stuartii* in hospitals in Romania. November 2024. Stockholm: ECDC; 2024. Available at: https://www.ecdc.europa.eu/en/publications-data/rapid-investigation-new-delhi-metallo-beta-lactamase-ndm-1-producing-providencia
24. European Commission (EC). European Health Union - Protecting our health together. Brussels: EC; 2020. Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/promoting-our-european-way-life/european-health-union_en
25. European Commission (EC). European Health Union: building a stronger EU health response. EC; 2022. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6363
26. United Nations (UN) General Assembly High-Level Meeting on antimicrobial resistance 2024. Political Declaration of the High-level Meeting on Antimicrobial Resistance. New York: UN; 2024. Available at: https://www.un.org/pga/wp-content/uploads/sites/108/2024/09/FINAL-Text-AMR-to-PGA.pdf
27. European Commission (EC). Remarks by Commissioner Kyriakides at UNGA High-Level meeting on Antimicrobial Resistance. Brussels: EC; 2024. Available at: https://ec.europa.eu/commission/presscorner/detail/en/speech_24_4846
28. European Centre for Disease Prevention and Control (ECDC). Assessing the health burden of infections with antibiotic-resistant bacteria in the EU/EEA, 2016–2020. Stockholm: ECDC, 2022. Available at: https://www.ecdc.europa.eu/en/publications-data/health-burden-infections-antibiotic-resistant-bacteria-2016-2020
29. Organisation for Economic Co-operation and Development (OECD). Fighting Antimicrobial Resistance in EU and EEA countries. Paris: OECD, 2023. Available at: https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/fighting-antimicrobial-resistance-in-eu-and-eea-countries_aa49a732/fdb1629f-en.pdf

Suggested citation: WHO Regional Office for Europe and European Centre for Disease Prevention and Control. Surveillance of antimicrobial resistance in Europe, 2024 data: executive summary. Copenhagen: WHO Regional Office for Europe; 2025.

ECDC ISBN 978-92-9498-833-1

WHO ISBN 9789289062619 (PDF)