

SURVEILLANCE REPORT

Antimicrobial consumption in the EU/EEA (ESAC-Net)

Annual Epidemiological Report for 2022

Key facts

- For 2022, 29 countries (27 European Union (EU) Member States and two European Economic Area (EEA) countries – Iceland and Norway) reported data on antimicrobial consumption. Twenty-seven countries reported consumption data for the community and hospital sectors separately, one country (Cyprus) reported total consumption for both sectors combined, and one country (Germany) reported only community consumption.
- Antimicrobial consumption is expressed as the number of defined daily doses (DDD) per 1 000 inhabitants per day. The Anatomical Therapeutic Chemical (ATC) classification index with Defined Daily Doses (DDDs) 2023 was used for the analysis of both 2022 data and historical data.
- The 2022 EU population-weighted mean total (community and hospital sectors combined) consumption of antibacterials for systemic use (ATC group J01) was 19.4 DDD per 1 000 inhabitants per day (country range: 9.1–33.5). While this represents a significant increase in consumption compared to 2020 and 2021, a statistically significant decrease was observed for the EU population-weighted mean consumption over the 10-year period 2013–2022. A statistically significant increasing 10-year trend was observed for two countries (Bulgaria and Cyprus).
- The EU population-weighted mean total consumption of antibacterials for systemic use has decreased by 2.5% since the baseline year of 2019, indicating slow progress towards the EU target reduction of 20% by 2030.
- In 2022, only 10 (36%) countries (nine EU Member States and one EEA country) met or exceeded the EU target of at least 65% of antibiotic consumption being from the 'Access' group, as per WHO's AWaRe classification of antibiotics, by 2030. The number of EU Member States at or above the 65% target has not changed since 2019.
- A statistically significant trend was not detected over the five-year period 2018–2022 for total consumption (community and hospital sectors combined) of antimycotics and antifungals for systemic use (ATC groups J02 and D01B). However, consumption of parenteral amphotericin B (ATC code J02AA01) significantly increased.

Community (primary care sector)

- In the community, the EU/EEA population-weighted mean consumption of antibacterials for systemic use (ATC group J01) was 17.0 DDD per 1 000 inhabitants per day (country range: 8.3–31.2). During the period 2013–2022, a statistically significant decrease was observed for the EU/EEA population-weighted mean overall, and for 11 individual countries. A statistically significant increasing trend was observed for one country (Bulgaria).
- Antibacterial sub-groups with statistically significant decreases in the EU/EEA population-weighted mean consumption within the community during 2013–2022 included: tetracyclines (J01A), cephalosporins and other beta-lactams (J01D), macrolides, lincosamides and streptogramins (J01F), and quinolones (J01M). There was a statistically significant increase in the EU/EEA population-weighted mean for consumption of sulfonamides and trimethoprim (J01E). No statistically significant trends were detected in the EU/EEA population-weighted mean for penicillins (J01C) or other antibacterials (J01X).

- The EU/EEA population-weighted mean ratio of consumption of broad-spectrum penicillins, cephalosporins, macrolides (except erythromycin) and fluoroquinolones to the consumption of narrow-spectrum penicillins, cephalosporins and erythromycin in the community was 4.0 (country range: 0.1–24.7). During the period 2013–2022, a statistically significant increasing trend was observed in the EU/EEA population-weighted mean for this indicator and for nine individual countries. Statistically significant decreasing trends were observed for nine countries.

Hospital sector

- In the hospital sector, the EU/EEA population-weighted mean consumption of antibacterials for systemic use (ATC group J01) was 1.61 DDD per 1 000 inhabitants per day (country range: 0.75–3.15). During the period 2013–2022, a statistically significant decrease was observed at the EU/EEA level. Statistically significant decreasing trends were observed for six countries, and a statistically significant increasing trend was observed for two countries (Bulgaria and Croatia).
- The hospital sector EU/EEA population-weighted mean consumption decreased significantly between 2013 and 2022 for quinolones (J01M) only. Statistically significant increases were observed in the hospital sector for tetracyclines (J01A), sulfonamides and trimethoprim (J01E), and other antibacterials (J01X). No significant EU/EEA trend was detected for consumption of penicillins (J01C), cephalosporins and other beta-lactams (J01D), and macrolides, lincosamides and streptogramins (J01F).
- Of the total consumption of antibacterials for systemic use in the hospital sector, the EU/EEA population-weighted proportion of glycopeptides, third- and fourth-generation cephalosporins, monobactams, carbapenems, fluoroquinolones, polymyxins, piperacillin and enzyme inhibitors, linezolid, tedizolid and daptomycin combined was 37.6% (country range: 17.6–67.5%). During the period 2013–2022, no statistically significant trend for this indicator was observed for the EU/EEA overall. However, eight countries had an increasing trend and one country (Finland) had a decreasing trend in antimicrobial consumption.

Opportunities for action

- Intensified efforts will be necessary to reach the antimicrobial consumption targets set by the European Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023/C 220/01).
- The rebound of total consumption in 2022 and the low number of EU Member States reaching the 'Access' target indicate that there will be challenges in reaching the EU antimicrobial consumption targets by 2030.
- For macrolides, lincosamides, and streptogramins (ATC group J01F), the mean consumption rate in the community was statistically significantly higher in 2022 than in 2019. The rise in macrolide consumption in 2022 might be associated with resurgences in respiratory infections, both viral and bacterial, during 2022. Efforts to reduce infections, alongside antimicrobial stewardship, may reduce antimicrobial consumption.
- In the community sector, the ratio of 'broad' to 'narrow' spectrum antibacterials for systemic use saw a statistically significant increase during the period 2013–2022, with an accelerated rise during 2019–2022.
- In the hospital sector, the percentage of consumption from the 'Reserve' group of antibiotics, as per WHO's AWaRe classification of antibiotics, rose significantly across the EU/EEA during the period 2013–2022, with increasing trends in 17 of 21 countries included in the trend analysis.

** Important note: data were updated using the ATC/DDD Index 2023. Additions and corrections to historical data have also been made since the last Annual Epidemiological Report. Data in this report should therefore not be compared with prior reports. For the most recent data on antimicrobial consumption and trends in EU/EEA countries, readers should refer to the most recent report, or the ESAC-Net interactive database.*

Methods

This report is based on data reported to the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) for the period 2013 to 2022, retrieved from The European Surveillance System (TESSy), hosted by the European Centre for Disease Prevention and Control (ECDC), on 5 September 2023. TESSy is a system for the collection, storage, analysis and dissemination of data on communicable diseases, allowing for correction and re-uploading of historical data by the reporting countries. Therefore, the latest published reports supersede previous reports and reflect the most recent available data. For a detailed description of the methods used to produce this report, please refer to the methods chapter in the introduction to the ECDC Annual Epidemiological Report [1] and the ESAC-Net reporting protocol [2]. A subset of the data used for this report is available from ECDC's online antimicrobial consumption (AMC) database [3]. Exceptionally, Sweden's 2022 AMC data were submitted outside of TESSy due to national reporting restrictions, and as a result, Sweden's 2022 AMC data are not included on the ECDC online AMC database.

AMC data were collected using the Anatomical Therapeutic Chemical (ATC) classification system and analysed using the defined daily dose (DDD) methodology developed by the World Health Organization (WHO) Collaborating Centre for Drug Statistics Methodology (Oslo, Norway). For the analysis, DDDs listed in the ATC Index for 2023 were used [4]. For more information about the ATC/DDD methodology, please refer to the Guidelines for ATC classification and DDD assignment published by the WHO Collaborating Centre for Drug Statistics Methodology [5].

There are four major categories of antimicrobials under surveillance:

- antibacterials for systemic use (ATC group J01);
- antimycotics and antifungals for systemic use (ATC groups J02 and D01B);
- antimycobacterials for treatment of tuberculosis (ATC group J04A);
- antivirals for systemic use (ATC group J05).

In addition, some antimicrobials under surveillance are classified in other ATC groups. Vancomycin and fidaxomicin for oral administration, used against *Clostridioides difficile* infections, are classified as 'intestinal anti-infectives, antibiotics' in ATC group A07AA. Metronidazole, which may be administered orally or rectally for *C. difficile*, is classified as an 'agent against amoebiasis and other protozoal diseases, nitroimidazole derivatives' in ATC group P01AB.

Consumption data were collected as a detailed list of all available antimicrobial products (national register) and the annual number of packages of each product consumed in the community (primary care) sector and the hospital (secondary care and tertiary care) sector, or, if unavailable, as the number of DDD per ATC substance and route of administration.

Reporting of data from long-term care facilities could be included, either for the community sector, hospital sector, or both.

For the calculation of population-based rates of AMC for each country, the Eurostat population for each country and respective year was used [6], unless the country chose to report another denominator.

Selected antimicrobial consumption indicators

The indicator 'defined daily doses (DDD) per 1 000 inhabitants per day' is used as the main AMC indicator in this report. It provides a rough estimate of the proportion of the population treated daily with antimicrobials. In 2017, total consumption (community and hospital sectors combined) of antibacterials for systemic use (ATC group J01) expressed as 'DDD per 1 000 inhabitants per day' was selected as the primary harmonised outcome indicator for AMC by ECDC, the European Food Safety Authority (EFSA) and the European Medicines Agency (EMA) to describe total AMC in humans, combining both the community and hospital sectors [7]. On 13 June 2023, the Council of the European Union adopted a Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023/C 220/01), which set a target of reducing total AMC in the EU by 20% between 2019 and 2030 [8].

Secondary outcome indicators, determined by the interagency expert group, describe patterns of AMC in the community and hospital sectors. For the community, the secondary indicator is the ratio of consumption of broad-spectrum penicillins, broad-spectrum cephalosporins, macrolides (except erythromycin) and fluoroquinolones (ATC groups J01(CR+DC+DD+(FA-FA01)+MA)) to the consumption of narrow-spectrum penicillins, narrow-spectrum cephalosporins and erythromycin (ATC groups J01(CA+CE+CF+DB+FA01)). For the hospital sector, the secondary indicator is the proportion of glycopeptides (ATC group J01XA), third- and fourth-generation cephalosporins (J01DD and J01DE), monobactams (J01DF), carbapenems (J01DH), fluoroquinolones (J01MA), polymyxins (J01XB), piperacillin and enzyme inhibitor (J01CR05), linezolid (J01XX08), tedizolid (J01XX11), and daptomycin (J01XX09) of total hospital consumption of antibacterials for systemic use.

An additional secondary indicator is based on the World Health Organization (WHO) Access, Watch and Reserve (AWaRe) classification of antimicrobials, developed in 2017 and updated every two years [9]. The AWaRe classification is a tool to evaluate and monitor antibiotic use and support antibiotic stewardship efforts, emphasising the importance of appropriate use. 'Access' antibiotics are mostly first-line and second-line therapies that offer the best therapeutic value, while minimising the potential for antimicrobial resistance (AMR). 'Watch' antibiotics are broader-spectrum and stewardship efforts should limit empiric use of these drugs to severe infections or infections that are more likely to be resistant to 'Access' antibiotics. 'Reserve' antibiotics include antibiotics of last-resort and should be saved for treatment of multidrug-resistant organisms. All 'Reserve' antibiotics are categorised as either high priority or highest priority in the WHO list of critically important antimicrobials for human medicine [10].

The percentage of 'Access' group antibiotics of all consumed antibiotics was selected as a secondary outcome indicator for AMC in humans. The WHO 13th General Programme of Work 2019–2023 set a target of at least 60% of total antibiotic consumption being 'Access' group antibiotics [11]. The Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach (2023/C 220/01) also set a target for the EU and for EU Member States of at least 65% of total AMC belonging to the 'Access' group [8]. In addition, this report examines the percentage of 'Reserve' group antibiotics of all consumed antibiotics in the hospital sector.

Data for findings discussed in this report that are not shown in tables and graphs in the report can be found in supplementary downloadable tables, published with each ESAC-Net Annual Epidemiological Report on ECDC's website: <https://www.ecdc.europa.eu/en/publications-data/antimicrobial-consumption-eueea-esac-net-annual-epidemiological-report-2022>.

Data analysis

The quantity metric 'DDD per 1 000 inhabitants per day' has been validated by international expert consensus as a standardised tool for comparing and benchmarking drug consumption in outpatient settings [12]. We also report hospital consumption as 'DDD per 1 000 inhabitants per day' because the recommended denominator 'patient-days' [13] is not currently available for all EU/EEA countries, and presenting data with the same denominator facilitates intersectoral comparison. ESAC-Net is currently piloting collection of data on 'occupied bed-days' for hospital AMC rates that could better reflect hospital AMC by national hospital utilisation levels.

For each AMC indicator, 'DDD per 1 000 inhabitants per day' was calculated by country and year using AMC data reported to TESSy. Exceptionally, for Sweden's 2022 AMC data, pre-calculated AMC values were provided separately. Missing data are displayed as empty cells in the tables. Consumption of antibacterials for systemic use (ATC group J01) is displayed by sector (community and hospital). In addition, for each sector consumption of antibacterials for systemic use (J01) is displayed at the ATC level 3 sub-group for each country. Due to sector allocation difficulties and differences in multiple countries, analyses of AMC data for antimycotics and antifungals for systemic use (ATC groups J02 and D01B), antimycobacterials for treatment of tuberculosis (ATC group J04A), and antivirals for systemic use (ATC group J05) combine AMC data for the community and hospital sectors.

Population-weighted mean consumption values

The calculated population-weighted means summarise the AMC data across multiple countries in a single AMC rate for each year (expressed as 'DDD per 1 000 inhabitants per day'). All mean consumption values in this report are population-weighted. Population-weighted mean AMC values were calculated by multiplying the DDD per 1 000 inhabitants per day for each country with the corresponding Eurostat population and dividing the product by the total population of all participating countries contributing data for that year. Annual population data were retrieved from the Eurostat online database on 29 August 2023 [6].

'EU' and 'EU/EEA' population-weighted means are used for assessing trends across multiple countries over time. Therefore, the countries included in the calculation of the 'EU' and 'EU/EEA' population-weighted means (and hence the population under surveillance) are consistent across all years in the tables with trend analyses. 'Reported EU/EEA' population-weighted means include all countries that reported data (as shown in tables) for the corresponding AMC indicator for each year. As some countries did not report AMC data for certain sectors (hospital or community) for certain years, the 'Reported EU/EEA' means cannot be used for trend analyses.

The 'EU' and 'EU/EEA' means do not include the United Kingdom (UK), as the UK left the EU in 2020 and no longer reports to ESAC-Net, whereas the 'Reported EU/EEA' means do include the UK, when available.

EU

The 'EU' population-weighted means were calculated for the EU target indicators. All 27 current EU Member States were included in the EU mean calculation for the primary AMC indicator (total consumption of antibacterials for systemic use), and the 26 EU Member States that reported AMC data for both the community and hospital sectors were included in the EU mean calculation for the secondary AMC indicator (percentage of 'Access' group antibiotics of all consumed antibiotics, as per WHO's AWaRe classification of antibiotics).

For the primary AMC indicator, imputations were performed where data on total (community and hospital sectors combined) AMC data were not available to allow for the inclusion of all current EU Member States in the trend analysis. Where total AMC data were missing, the community sector AMC value was divided by the EU/EEA population-weighted mean percentage of total AMC attributed to the community sector for the year. This population-weighted mean percentage of community AMC out of total AMC for each year was calculated for all EU/EEA countries that reported data for both the community and hospital sectors in the respective year.

Czechia did not report any AMC data during the period 2016–2018, so total AMC values were imputed using linear interpolation. Spain's AMC reporting switched from reimbursement to sales data in 2016, resulting in a substantial increase in reported AMC compared with previous years, as reimbursement data did not include consumption without a prescription and other non-reimbursed courses. Spain's total AMC values for 2013–2015 were therefore derived using proportionally-adjusted, reported community consumption data.

EU/EEA

The 'EU/EEA' population-weighted means were calculated for the AMC indicators other than those included in the EU targets and were used for trend analyses. Current EU Member States and EEA countries reporting to ESAC-Net (Iceland and Norway) were included in the EU/EEA mean calculations.

To facilitate trend analyses, only countries with consistent reporting of each corresponding measure over the entire period shown in each table were included in the 'EU/EEA' mean calculations for the table. Countries with missing data or data reporting inconsistencies are therefore not included in the EU/EEA population-weighted mean calculations for AMC measures, other than total consumption of antibacterials for systemic use.

Reported EU/EEA

The 'Reported EU/EEA' population-weighted means were calculating using all reported values, as shown in the corresponding table, and include UK data when available.

The 'Reported EU/EEA' mean better reflects available data and is presented for the sake of transparency, but is less suitable for trend assessments as the number of countries included differs between years. Therefore, no trend or compound annual growth rate (CAGR) is presented for this indicator.

'Reported EU/EEA' means are those shown in ECDC's online AMC Dashboard [3]. Exceptionally for 2022, EU/EEA means shown in the AMC Dashboard might differ from those shown in this report, due to the exclusion of Sweden's AMC data from the AMC Dashboard and inclusion of some of Sweden's AMC data in this report.

Trend analysis

Ten-year trends in consumption of antibacterials for systemic use (ATC group J01) and sub-groups were analysed. In the case of antimycotics and antifungals for systemic use (ATC groups J02 and D01B), antimycobacterials for treatment of tuberculosis (ATC group J04A), and antivirals for systemic use (ATC group J05), five-year trends were assessed due to reduced completeness of data for these ATC groups over the past ten years.

Where data were missing, trend analyses were only performed if the country reported eight or more consecutive years of data. Trend analyses were not performed for Luxembourg due to changes in the data collection process in 2020 (both sectors) and 2022 (hospital sector only), which could have had an impact on comparability with previous years. Similarly, trend analyses were not performed for Spain due to the change in data source in 2016. As the UK left the EU in 2020 and data are no longer reported to ESAC-Net, EU/EEA trend analyses do not include the UK and results cannot be directly compared with EU/EEA trends published in previous years. UK data for the period 2013 to 2019 are still presented for reference, but no trend analyses were performed.

Linear regression

To assess for statistically significant trends, a linear regression model was applied using STATA/SE 17.0. To describe the trends, the terms 'increase' or 'decrease' were used if the p-value for the regression coefficient was statistically significant ($P \leq 0.05$).

Compound annual growth rate

To illustrate changes in AMC rates over time, we calculated the compound annual growth rate (CAGR) of total antimicrobial consumption for each country. The CAGR corresponds to the mean annual change as a proportion (%) of the consumption in the first year included.

More details on the methods, collection, validation and reporting of AMC data from EU/EEA countries are available on the ESAC-Net pages of ECDC's website. The most recent data on AMC are available from the public ESAC-Net interactive database (data starting in 1997) on ECDC's website: www.ecdc.europa.eu/en/antimicrobial-consumption/surveillance-and-disease-data/database.

Results

Data availability

All 27 EU Member States and two EEA countries (Iceland and Norway) reported data on antimicrobial consumption (AMC) for 2022. Twenty-seven countries reported both community and hospital consumption, one country (Germany) only reported community consumption and one country (Cyprus) reported total consumption for both sectors combined.

For both the community and the hospital sector, consumption data were mainly based on sales of antimicrobials in the country, or a combination of sales and reimbursement data.

Inclusion of long-term care facility AMC data in the community versus the hospital sector varied greatly. Long-term care facility data was included within community sector reporting in 12 countries and within hospital sector reporting in three countries. Four countries reported long-term care facility AMC data partly as community sector AMC and partly as hospital sector AMC. Four countries did not report any long-term care AMC and five countries did not specify if long-term care AMC data was reported, or from which sector.

Total consumption (community and hospital sectors combined) of antibacterials for systemic use (ATC group J01)

In 2022, the mean total consumption (community and hospital sectors combined) of antibacterials for systemic use (ATC group J01) in the EU was 19.4 DDD per 1 000 inhabitants per day. Country-level total consumption ranged from 9.1 in the Netherlands to 33.5 in Cyprus. During the period 2013–2022, a statistically significant decrease was observed for the EU overall. Statistically significant decreasing trends were observed for 10 countries; a statistically significant increasing trend was observed for two countries (Bulgaria and Cyprus) (Table 1).

By 2022, there had been a 2.5% reduction in the mean total consumption of antibacterials for systemic use since the baseline year of 2019 towards the EU target reduction of 20% by 2030. At EU Member State level, changes in total AMC ranged from -14.9% (Finland) to +24.1% (Bulgaria). Twelve Member States had a higher total AMC in 2022 than in 2019, while 14 Member States had a lower total AMC in 2022.

Table 1. Total consumption (community and hospital sector) of antibacterials for systemic use (ATC group J01), EU/EEA and UK, 2013–2022 (expressed as DDD per 1 000 inhabitants per day)

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Time series 2013–2022	Trend	Compound annual growth rate (CAGR)	Change 2019–2022 (%)
Austria							11.6	8.8	8.8	10.5		N/A	N/A	-9.5%
Belgium	24.2	24.0	24.4	24.2	22.8	22.3	21.4	16.7	17.4	20.4		↓	-1.9%	-4.4%
Bulgaria	18.6	20.0	20.1	19.2	20.5	21.1	20.7	22.7	24.4	25.7		↑	3.6%	+24.1%
Croatia	19.2	19.4	19.7	18.7	18.6	18.8	18.8	15.7	18.2	20.2		-	0.5%	+7.3%
Cyprus	23.9	22.2	26.6	28.4	28.9	28.0	30.1	28.9	25.0	33.5		↑	3.8%	+11.4%
Czechia							16.9	13.4	13.7	17.1		N/A	N/A	+1.0%
Denmark	17.5	17.2	17.5	17.0	16.2	15.6	15.3	14.3	14.4	15.2		↓	-1.6%	-1.0%
Estonia	12.0	11.9	12.1	12.0	11.6	11.8	11.8	10.5	10.1	12.4		-	0.3%	+5.2%
Finland	19.6	19.1	18.1	17.4	15.7	15.4	14.7	11.9	11.3	12.5		↓	-4.9%	-14.9%
France	25.9	24.9	25.6	25.6	24.7	25.3	25.1	20.3	21.5	24.3		↓	-0.7%	-3.1%
Germany												N/A	N/A	N/A
Greece	29.8	31.0	33.2	33.1	34.2	34.1	34.1	28.1	23.5	32.9		-	1.1%	-3.5%
Hungary	14.5	15.2	15.8	14.4	14.6	14.8	14.4	11.2	11.9	14.4		-	0.0%	-0.3%
Iceland	19.4				20.7	20.4	19.3	16.5	16.8	18.6		N/A	N/A	-3.6%
Ireland	21.6	21.0	23.0	22.0	20.9	22.4	22.8	18.6	17.8	23.1		-	0.7%	+1.5%
Italy	25.2	24.5	24.5	24.0	20.9	21.4	21.7	18.4	17.5	21.9		↓	-1.6%	+0.8%
Latvia	13.7	13.0	12.6	13.4	13.9	13.8	13.9	11.9	11.6	15.0		-	1.0%	+7.8%
Lithuania	16.7	14.7	15.4	15.7	16.3	16.1	16.3	14.2	14.1	18.5		-	1.2%	+13.5%
Luxembourg	25.0	23.2	23.5	22.9	22.6	22.1	21.1	16.1	15.9	19.1		N/A	N/A	-9.9%
Malta	22.2	22.4	21.2	20.9	22.6	20.2	20.7	16.6	15.8	24.0		-	0.8%	+15.7%
Netherlands	10.5	10.3	10.4	10.1	9.8	9.7	9.5	8.5	8.3	9.1		↓	-1.6%	-4.3%
Norway	17.2	16.9	16.8	16.2	15.7	15.3	14.9	13.9	14.0	15.3		↓	-1.3%	+2.3%
Poland		21.2	24.1	22.0	25.4	24.4	23.6	18.5	20.2	23.6		-	1.3%	-0.3%
Portugal	17.6	18.0	18.8	19.0	18.3	19.1	19.3	15.2	15.3	18.8		-	0.7%	-2.6%
Romania	26.8	26.6	28.0	24.4	24.5	25.1	25.8	25.2	25.7	27.6		-	0.3%	+7.0%
Slovakia	23.2	21.2	24.2	23.6	20.0	22.0	19.3	14.4	16.0	20.8		↓	-1.2%	+7.5%
Slovenia	13.3	13.1	13.3	13.0	13.1	13.2	13.0	10.2	10.2	12.4		↓	-0.7%	-4.3%
Spain				27.5	26.8	26.2	24.9	19.7	20.0	23.2		N/A	N/A	-6.7%
Sweden	14.2	14.0	13.5	13.2	12.8	12.4	11.8	10.3	10.1	11.2		↓	-2.7%	-5.4%
EU Mean*	21.6	21.1	21.7	20.9	20.4	20.2	19.9	16.4	16.4	19.4		↓	-1.2%	-2.5%
United Kingdom	20.5	20.8	20.2	19.7	19.4	18.8	18.2					N/A	N/A	N/A
Reported EU/EEA**	22.0	21.7	22.3	22.2	21.7	21.7	21.0	17.8	18.1	21.2		N/A	N/A	N/A

 = Total care data (community and hospital sectors) not reported.

* EU mean refers to the population-weighted mean consumption based on data from all 27 current EU Member States. Imputations and adjustments were applied, as detailed in the Methods chapter.

** Reported EU/EEA refers to the population-weighted mean consumption, based on all reported data shown for each year, without imputations for missing data or adjustments for change in data source, and includes the UK for the years 2013–2019.

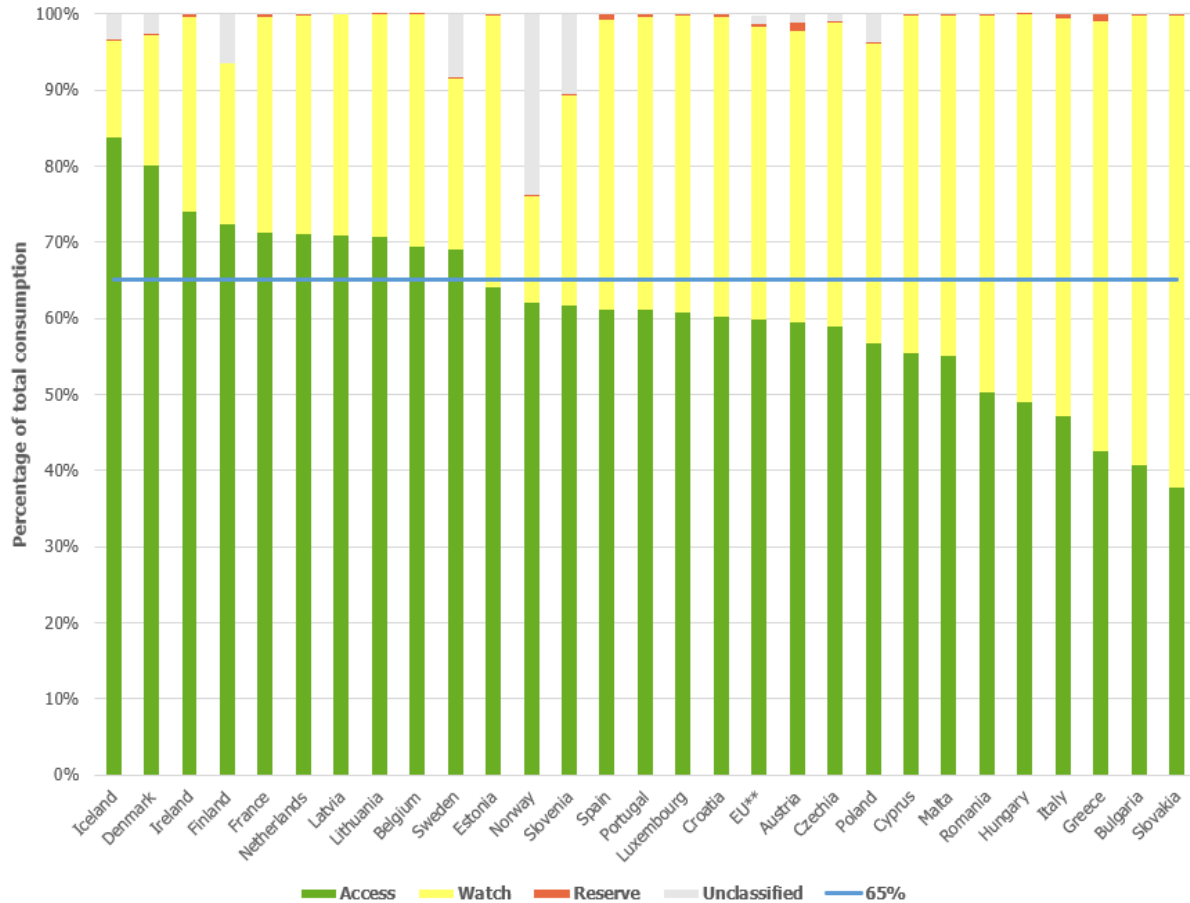
N/A = Not applicable. Trend analyses were not performed and CAGR not calculated because of missing data, changes in the type of data or change in data process. Luxembourg changed its data collection process in 2020 (both sectors) and 2022 (hospital sector only), which could have had an impact on comparability with previous years.

WHO Access, Watch, Reserve (AWaRe) classification of antibiotics for evaluation and monitoring of use

Among 26 EU Member States reporting consumption in both the community and hospital sectors in 2022, the population-weighted mean percentage of 'Access' group antibiotics of all consumed antibiotics was 59.8%.

Ten countries (nine EU Member States and Iceland) met or exceeded the EU target for 2030 of at least 65% of total antibiotic consumption being from agents in the 'Access' group of antibiotics, as per WHO's AWaRe classification of antibiotics (Figure 1). Eighteen countries (17 EU Member States and Norway) did not meet the EU target of at least 65% of total antibiotic consumption being from agents in the 'Access' group.

Figure 1. Total consumption of antibacterials* according to WHO AWaRe classification, percentage by class, EU/EEA countries, 2022



Only the 28 countries reporting data for both the community and the hospital sector are included.

AWaRe: Access, Watch and Reserve classification of antimicrobials (WHO, 2023).

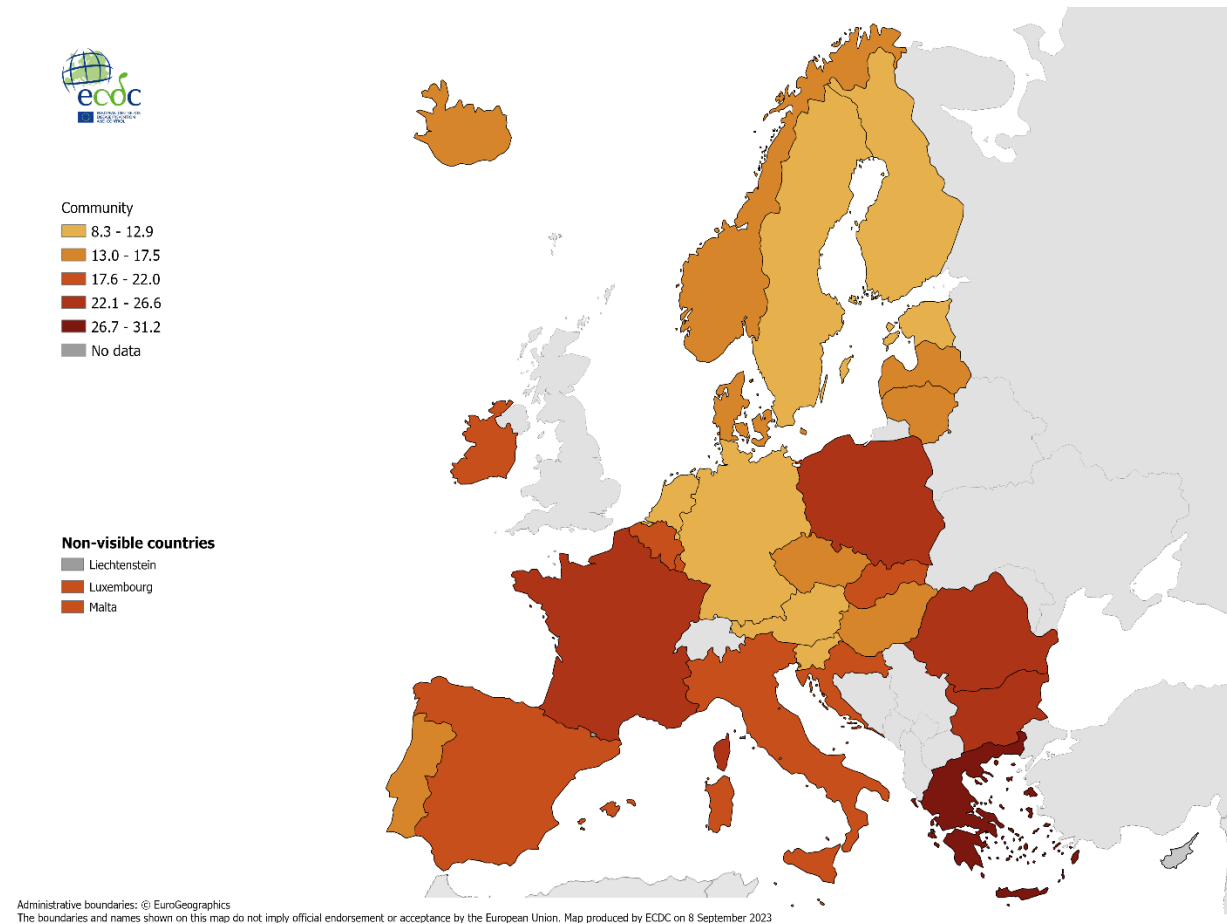
* Agents included in this analysis: antibacterials for systemic use, neomycin, streptomycin, polymyxin B, kanamycin, vancomycin, colistin, rifamixin, fidaxomicin, rifamycin, rifampicin, rifabutin, metronidazole, tinidazole, ornidazole and secnidazole. Consumption of 'Unclassified' mainly consisted of benzathine phenoxymethylpenicillin, combinations of benzylpenicillin/procaine-benzylpenicillin/benzathine-benzylpenicillin and methenamine.

**EU refers to the population-weighted mean percentage based on reported data for 2022 from the 26 EU countries included.

Community consumption of antibacterials for systemic use (ATC group J01)

In 2022, the EU/EEA population-weighted mean consumption of antibacterials for systemic use in the community (i.e. outside of the hospital sector) was 17.0 DDD per 1 000 inhabitants per day, ranging from 8.3 in the Netherlands to 31.2 in Greece (Figure 2).

Figure 2. Community consumption of antibacterials for systemic use (ATC group J01), EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)



Consumption of major sub-groups of antibacterials for systemic use (ATC group J01) in the community in 2022 is presented in Table 2 and Figure 3. Among the 28 countries reporting community data, penicillins (J01C) represented the highest proportion of community consumption in all but one country (Slovakia) where macrolides, lincosamides and streptogramins (J01F) represented the highest proportion of consumption.

The proportion of community consumption of other antibacterial sub-groups varied widely among countries. For example, the proportion of tetracyclines (J01A) ranged from 3% (Italy) to 26% (Iceland); the proportion of cephalosporins and other beta-lactams (J01D) ranged from 0.2% (Denmark) to 25% (Slovakia); the proportion of macrolides, lincosamides and streptogramins (J01F) ranged from 4% (Finland and Norway) to 32% (Slovakia), and the proportion of quinolones (J01M) ranged from 2% (Belgium, Ireland and Norway) to 13% (Romania).

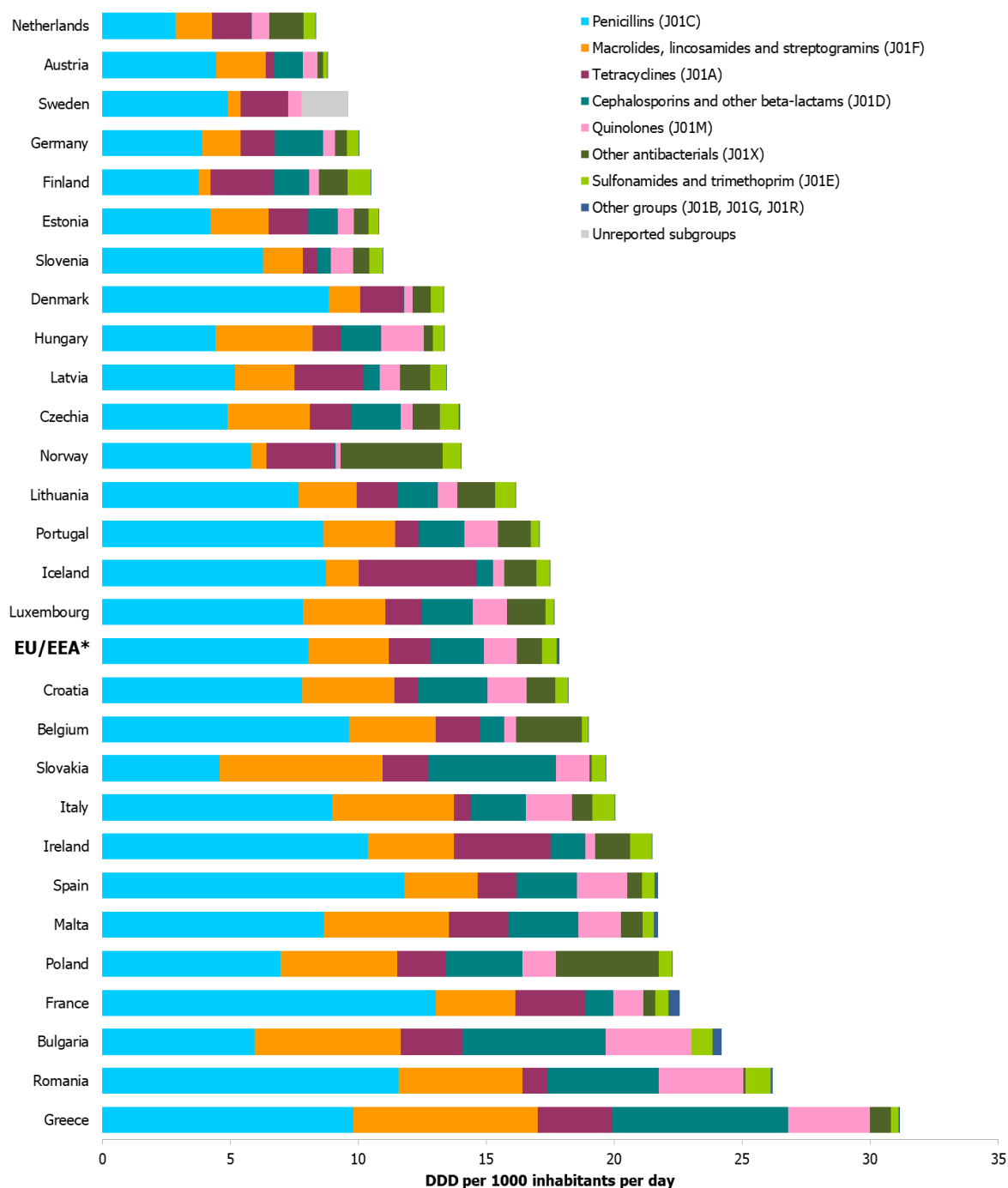
Table 2. Community consumption of antibacterials for systemic use (ATC group J01) at ATC level 3 sub-group, EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)

Country	Tetracyclines (J01A)	Beta-lactams, penicillins (J01C)	Other beta-lactam antibacterials (J01D)	Sulfonamides and trimethoprim (J01E)	Macrolides, lincosamides and streptogramins (J01F)	Quinolones (J01M)	Other antibacterials (J01X)	Other groups (J01B, J01G, and J01R)*	Total (ATC group J01)
Austria	0.3	4.5	1.1	0.2	1.9	0.6	0.2	0.0	8.8
Belgium	1.7	9.6	1.0	0.3	3.4	0.5	2.6	0.0	19.0
Bulgaria	2.4	5.9	5.6	0.8	5.7	3.4	0.0	0.4	24.2
Croatia	0.9	7.8	2.7	0.5	3.6	1.5	1.1	0.0	18.2
Czechia	1.6	4.9	1.9	0.7	3.2	0.5	1.1	0.0	13.9
Denmark	1.7	8.8	0.0	0.5	1.2	0.3	0.7	0.0	13.3
Estonia	1.5	4.2	1.2	0.4	2.3	0.6	0.6	0.0	10.8
Finland	2.4	3.8	1.4	0.9	0.5	0.4	1.1	0.0	10.5
France	2.8	13.0	1.1	0.5	3.1	1.1	0.5	0.4	22.6
Germany	1.4	3.9	1.9	0.5	1.5	0.5	0.5	0.0	10.0
Greece	2.9	9.8	6.9	0.3	7.2	3.2	0.8	0.1	31.2
Hungary	1.1	4.4	1.6	0.4	3.8	1.7	0.4	0.0	13.4
Iceland	4.6	8.7	0.6	0.5	1.3	0.4	1.2	0.0	17.5
Ireland	3.8	10.4	1.3	0.8	3.4	0.4	1.4	0.0	21.5
Italy	0.6	9.0	2.2	0.9	4.8	1.8	0.8	0.0	20.0
Latvia	2.7	5.2	0.6	0.6	2.3	0.8	1.2	0.0	13.4
Lithuania	1.6	7.7	1.6	0.8	2.3	0.8	1.5	0.0	16.2
Luxembourg	1.4	7.8	2.0	0.3	3.2	1.4	1.5	0.0	17.6
Malta	2.3	8.6	2.7	0.4	4.9	1.7	0.9	0.2	21.7
Netherlands	1.5	2.9	0.0	0.5	1.4	0.7	1.3	0.0	8.3
Norway	2.6	5.8	0.0	0.7	0.6	0.2	4.0	0.0	14.0
Poland	1.9	6.9	3.0	0.5	4.6	1.3	4.0	0.0	22.3
Portugal	0.9	8.6	1.8	0.3	2.8	1.3	1.3	0.0	17.1
Romania	1.0	11.6	4.4	1.0	4.8	3.3	0.1	0.1	26.2
Slovakia	1.8	4.6	5.0	0.5	6.4	1.3	0.1	0.0	19.7
Slovenia	0.6	6.3	0.5	0.5	1.6	0.9	0.6	0.0	11.0
Spain	1.5	11.8	2.3	0.5	2.9	2.0	0.6	0.1	21.7
Sweden**	1.9	4.9			0.5	0.5			9.6
Reported EU/EEA	1.6	8.0	2.1	0.6	3.1	1.3	1.0	0.1	17.8

*J01B: amphenicols; J01G: aminoglycoside antibacterials; J01R: combinations of antibacterials.

**Sweden was not able to report data for some ATC level 3 sub-groups due to national reporting restrictions. Sweden indicated that inclusion of unreported consumption data for Sweden in the calculation of the EU/EEA mean consumption rates resulted in no change in the EU/EEA means by ATC level 3 sub-group, as shown in this table.

Figure 3. Community consumption of antibacterials for systemic use (ATC group J01) at ATC level 3 sub-group, EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)



*EU/EEA refers to the population-weighted mean consumption, based on countries that provided community sector data for 2022 (28 countries).

The EU/EEA population-weighted mean consumption of antibacterials for systemic use (ATC J01) in the community had a statistically significant decrease over the 10-year period 2013–2022 (Table 3). Statistically decreasing trends were observed for 11 countries, while a significant increasing trend was observed for one country (Bulgaria).

Trends in consumption of sub-groups of antibacterials in the community are available in Tables D1–D7. Statistically significant decreases were observed in the EU/EEA population-weighted mean 10-year trends for community consumption of sub-groups of antibacterials: i.e. tetracyclines (J01A), cephalosporins and other beta-lactams (J01D), macrolides, lincosamides, streptogramins (J01F) and quinolones (J01M). Conversely, there was a statistically significant increasing 10-year trend in the EU/EEA population-weighted mean for consumption of sulfonamides and trimethoprim (J01E). No significant EU/EEA trends were detected for penicillins (J01C) or for other antibacterials (J01X).

Table 3. Community consumption of antibacterials for systemic use (ATC group J01), EU/EEA and UK, 2013–2022 (expressed as DDD per 1 000 inhabitants per day)

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Time series 2013–2022	Trend	Compound annual growth rate (CAGR)
Austria	14.2	12.1	12.1	11.4	11.9	10.4	9.8	7.1	7.2	8.8		↓	-5.2%
Belgium	22.6	22.4	22.8	22.5	21.1	20.7	19.8	15.3	16.0	19.0		↓	-1.9%
Bulgaria	17.3	18.6	18.8	17.6	18.9	19.5	19.1	20.7	22.4	24.2		↑	3.8%
Croatia	17.6	17.8	18.0	17.1	16.8	17.0	16.9	14.0	16.2	18.2		-	0.4%
Cyprus												N/A	N/A
Czechia	16.9	17.1	17.4						11.5	13.9		N/A	N/A
Denmark	15.7	15.2	15.3	15.2	14.3	13.6	13.4	12.5	12.6	13.3		↓	-1.8%
Estonia	10.3	10.2	10.5	10.4	9.9	10.2	10.2	8.8	8.7	10.8		-	0.5%
Finland	16.9	16.6	15.8	15.0	13.6	13.2	12.6	10.0	9.4	10.5		↓	-5.2%
France	24.1	23.1	23.8	23.9	23.0	23.6	23.3	18.7	19.9	22.6		↓	-0.7%
Germany	14.5	13.4	13.1	12.8	12.6	11.7	11.4	8.9	8.1	10.0		↓	-4.0%
Greece	28.0	29.2	31.3	31.0	32.1	32.5	32.4	26.4	21.8	31.2		-	1.2%
Hungary	13.4	14.0	14.7	13.3	13.4	13.7	13.3	10.0	10.8	13.4		-	0.0%
Iceland		17.2	17.5	18.3	19.1	18.8	18.0	15.4	15.7	17.5		N/A	0.2%
Ireland	20.0	19.5	21.3	20.4	19.4	20.7	21.0	17.1	16.3	21.5		-	0.8%
Italy	23.3	22.6	22.4	21.8	19.0	19.5	19.8	16.5	16.0	20.0		↓	-1.7%
Latvia	11.7	11.0	10.7	11.5	12.0	11.9	12.0	10.0	10.2	13.4		-	1.6%
Lithuania	14.8	12.8	13.3	13.5	14.1	13.9	14.0	11.9	12.1	16.2		-	1.0%
Luxembourg	23.1	21.6	21.8	21.4	20.9	20.7	19.8	14.8	14.6	17.6		N/A	-3.0%
Malta	20.7	20.5	18.8	18.4	19.8	18.0	18.7	14.4	14.1	21.7		-	0.5%
Netherlands	9.6	9.4	9.5	9.2	8.9	8.9	8.7	7.8	7.6	8.3		↓	-1.6%
Norway	15.8	15.5	15.4	14.9	14.4	14.0	13.6	12.8	12.8	14.0		↓	-1.3%
Poland	20.5	19.9	22.8	20.7	23.8	23.0	22.2	17.1	18.8	22.3		-	0.9%
Portugal	16.1	16.6	17.3	17.5	16.9	17.7	17.9	13.7	13.7	17.1		-	0.7%
Romania							24.0	23.7	24.3	26.2		N/A	N/A
Slovakia	21.1	18.9	22.0	21.3	18.5	20.2	18.0	13.2	14.5	19.7		-	-0.8%
Slovenia	11.9	11.6	11.9	11.5	11.6	11.7	11.5	8.8	8.7	11.0		↓	-0.9%
Spain	16.2†	17.1†	17.5†	25.6	25.0	24.5	23.3	18.2	18.5	21.7		N/A	N/A
Sweden	12.7	12.5	11.9	11.7	11.3	10.8	10.3	8.9	8.7	9.6		↓	-3.0%
EU/EEA*	18.9	18.3	18.8	18.3	17.8	17.7	17.4	14.1	14.2	17.0		↓	-1.2%
<i>United Kingdom</i>	<i>18.3</i>	<i>18.5</i>	<i>17.9</i>	<i>17.5</i>	<i>17.0</i>	<i>16.3</i>	<i>15.6</i>					N/A	N/A
<i>Reported EU/EEA**</i>	<i>18.5</i>	<i>18.2</i>	<i>18.5</i>	<i>18.9</i>	<i>18.4</i>	<i>18.2</i>	<i>18.0</i>	<i>15.0</i>	<i>15.0</i>	<i>17.8</i>		N/A	N/A

■ = Community sector data not reported.

* EU/EEA refers to the population-weighted mean consumption, based on data from the 23 EU/EEA countries with consistent reporting of community sector AMC for all 10 years.

** Reported EU/EEA refers to the population-weighted mean consumption, based on all reported data shown for each year, and includes the UK for the years 2013–2019.

† = Spain reported reimbursement data until 2016, when reported AMC data changed to sales data.

N/A = Not applicable. Trend analyses were not performed and CAGR not calculated because of missing data, changes in the type of data or change in data process. Luxembourg changed its data collection process in 2020, which could impact comparability with previous years.

ECDC/EFSA/EMA secondary indicator for consumption of antibacterials for systemic use (ATC group J01) in the community

The ratios of consumption of 'broad-spectrum' (ATC groups J01(CR+DC+DD+(FA-FA01)+MA)) to 'narrow-spectrum' (ATC groups J01(CA+CE+CF+DB+FA01)) antibiotics in the community sector is presented in Table 4.

In 2022, the EU/EEA population-weighted mean ratio was 4.0, ranging from 0.1 in Norway to 24.7 in Hungary. During the period 2013–2022, a statistically significant increasing trend was observed for the EU/EEA overall and for nine individual countries. Statistically significant decreasing 10-year trends were observed for nine countries.

Table 4. Ratio of consumption (DDD per 1 000 inhabitants per day) of broad-spectrum penicillins, cephalosporins, macrolides (except erythromycin) and fluoroquinolones to consumption of narrow-spectrum penicillins, cephalosporins and erythromycin in the community, EU/EEA and UK, 2013–2022

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Time series 2013–2022	Trend	Compound annual growth rate (CAGR)
Austria	4.4	4.4	4.4	4.2	4.2	3.9	3.6	3.5	3.7	3.9		↓	-1.5%
Belgium	2.0	2.2	2.2	2.2	2.2	2.1	1.9	2.1	1.9	1.7		↓	-1.7%
Bulgaria	2.3	3.0	3.5	4.2	4.0	4.2	4.5	4.9	5.6	5.8		↑	11.0%
Croatia	3.1	3.2	3.4	3.3	3.8	4.3	4.5	5.7	6.4	5.3		↑	6.1%
Cyprus												N/A	N/A
Czechia	2.6	2.9	3.0						5.0	4.3		N/A	N/A
Denmark	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3		↓	-2.6%
Estonia	2.5	2.5	2.7	2.8	2.9	3.0	3.0	3.3	3.3	3.3		↑	3.2%
Finland	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3		↓	-4.2%
France	1.5	1.4	1.3	1.2	1.1	1.0	0.9	1.1	1.0	1.0		↓	-3.9%
Germany	1.9	1.9	2.0	1.9	1.8	1.7	1.5	1.6	1.6	1.5		↓	-2.7%
Greece	4.4	7.0	4.8	3.8	4.9	4.9	5.1	4.4	4.3	6.6		-	4.6%
Hungary	6.6	9.6	11.3	10.9	11.6	12.7	13.6	15.2	20.7	24.7		↑	15.8%
Iceland		0.8	0.9	0.8	0.7	0.6	0.5	0.5	0.5	0.4		↓	-7.9%
Ireland	1.7	1.4	1.4	1.6	1.4	1.3	1.2	1.0	0.9	0.9		↓	-7.5%
Italy	6.1	6.6	6.9	6.9	7.1	7.5	7.5	8.1	8.3	9.4		↑	5.0%
Latvia	1.2	1.3	1.3	1.4	1.5	1.8	1.9	2.2	2.6	2.4		↑	8.2%
Lithuania	0.9	0.9	0.9	1.0	1.1	1.1	1.1	1.2	1.6	1.5		↑	5.4%
Luxembourg	4.4	4.4	3.9	3.6	3.7	3.5	3.2	3.2	3.1	3.0		N/A	-4.3%
Malta	23.4	31.4	32.7	19.2	23.2	24.0	20.1	19.1	18.5	24.5		-	0.5%
Netherlands	1.4	1.4	1.4	1.4	1.4	1.5	1.4	1.6	1.5	1.4		-	-0.5%
Norway	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		↓	-6.7%
Poland	2.4	2.5	2.6	2.6	2.9	3.2	3.0	3.3	3.5	3.1		↑	2.9%
Portugal	5.3	5.2	5.2	5.1	4.1	4.1	5.0	5.8	5.8	5.6		-	0.6%
Romania							4.1	4.7	5.3	4.3		N/A	N/A
Slovakia	5.3	5.6	6.6	6.5	6.6	8.0	8.3	9.3	12.5	14.1		↑	11.6%
Slovenia	1.4	1.5	1.5	1.4	1.4	1.4	1.5	2.1	2.3	1.6		-	1.7%
Spain	3.1†	3.0†	3.1†	2.4	2.4	2.4	2.3	2.5	2.5	2.4		N/A	N/A
Sweden	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		-	1.6%
EU/EEA*	2.9	3.1	3.2	3.1	3.1	3.3	3.2	3.5	3.7	4.0		↑	3.7%
United Kingdom	0.5	0.5	0.5	0.5	0.5	0.5	0.5					N/A	N/A
Reported EU/EEA**	2.6	2.8	2.8	2.7	2.7	2.8	2.8	3.4	3.7	3.8		N/A	N/A

= Community sector data not reported.

* EU/EEA refers to the population-weighted mean consumption, based on data from the 23 EU/EEA countries with consistent reporting of community sector AMC for all 10 years.

** Reported EU/EEA refers to the population-weighted mean consumption, based on all reported data shown for each year, and includes the UK for the years 2013–2019.

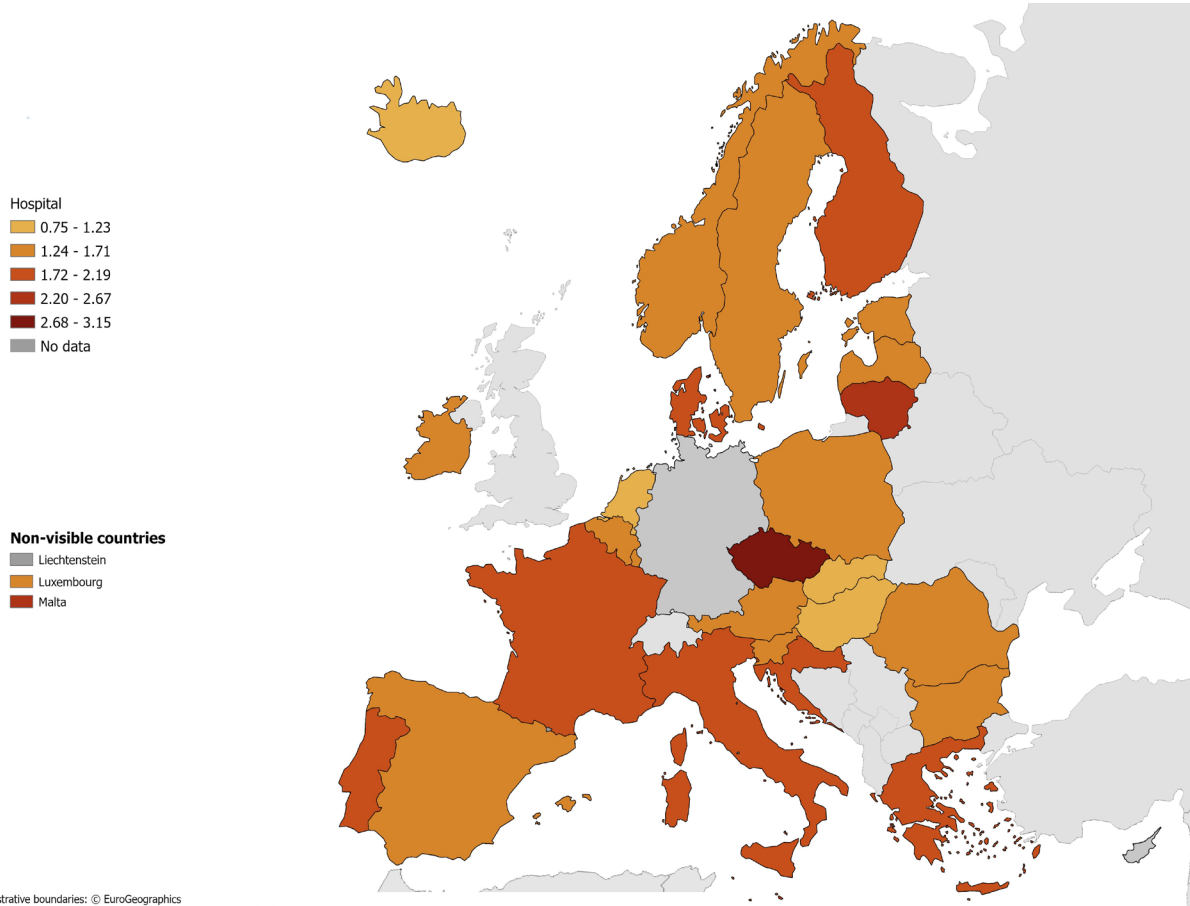
† = Spain reported reimbursement data until 2016, when reported AMC data changed to sales data.

N/A = Not applicable. Trend analyses were not performed and CAGR not calculated because of missing data, changes in the type of data or change in data process. Luxembourg changed its data collection process in 2020, which could impact comparability with previous years.

Hospital sector consumption of antibacterials for systemic use (ATC group J01)

In 2022, the EU/EEA population-weighted mean consumption of antibacterials for systemic use (ATC J01) in the hospital sector among reporting countries was 1.61 DDD per 1 000 inhabitants per day, ranging from 0.75 in the Netherlands to 3.15 in Czechia (Figure 4).

Figure 4. Hospital sector consumption of antibacterials for systemic use (ATC group J01), EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)*



Administrative boundaries: © EuroGeographics
The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union. Map produced by ECDC on 8 September 2023

* For Finland: data include consumption in remote primary healthcare centres and nursing homes.

Consumption of major sub-groups of antibacterials for systemic use (ATC group J01) in the hospital sector in 2022 is presented in Table 5 and Figure 5. Among the 27 countries reporting data for the hospital sector, penicillins (J01C) represented the highest proportion of hospital consumption in 18 countries, and cephalosporins and other beta-lactams (J01D) represented the highest proportion of hospital consumption in nine countries (Table 5).

Substantial variations were reported across countries: the percentage of penicillins (J01C) consumed out of hospital sector consumption of antibacterials for systemic use ranged from 7% (Bulgaria) to 58% (Denmark). For cephalosporins and other beta-lactams (J01D, including carbapenems), this percentage ranged from 11% (Denmark and Malta) to 61% (Bulgaria). For macrolides, lincosamides and streptogramins (J01F), this percentage ranged from 3% (Lithuania and Romania) to 23% (Czechia), and for quinolones (J01M) from 3% (Ireland and Norway) to 13% (Romania).

Table 5. Hospital sector consumption of antibacterials for systemic use (ATC group J01) at ATC level 3 sub-group, EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)

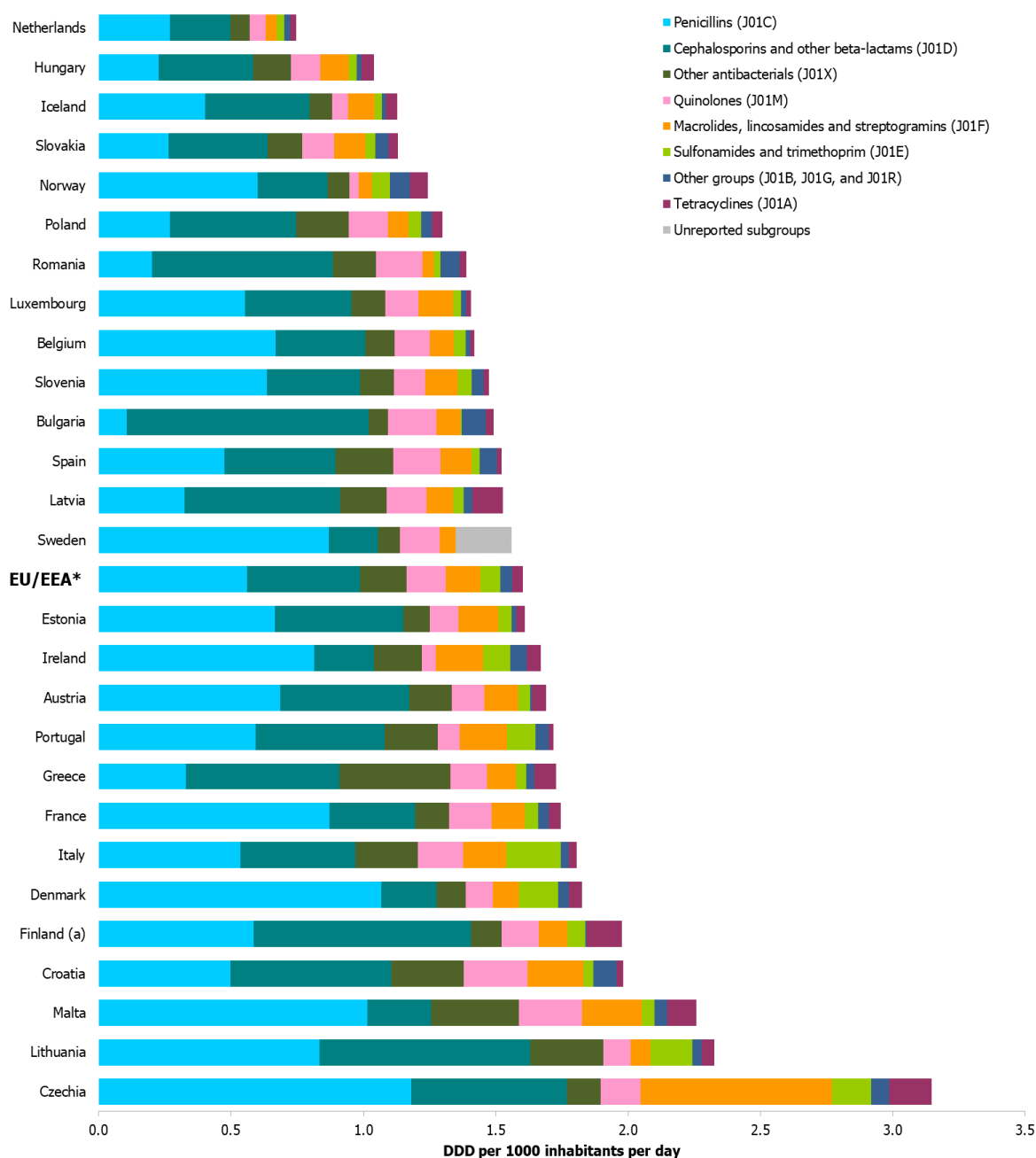
Country	Tetracyclines (J01A)	Beta-lactams, penicillins (J01C)	Other beta-lactam antibacterials (J01D)	Sulfonamides and trimethoprim (J01E)	Macrolides, lincosamides and streptogramins (J01F)	Quinolones (J01M)	Other antibacterials (J01X)	Other groups (J01B, J01G, and J01R)*	Total (ATC group J01)
Austria	0.05	0.69	0.49	0.04	0.13	0.13	0.16	0.01	1.69
Belgium	0.02	0.67	0.34	0.04	0.09	0.13	0.11	0.02	1.42
Bulgaria	0.03	0.11	0.91	0.00	0.09	0.18	0.07	0.09	1.49
Croatia	0.03	0.50	0.61	0.04	0.21	0.24	0.27	0.09	1.98
Czechia	0.16	1.18	0.59	0.15	0.72	0.15	0.13	0.07	3.15
Denmark	0.05	1.07	0.21	0.15	0.10	0.10	0.11	0.04	1.83
Estonia	0.03	0.67	0.48	0.05	0.15	0.11	0.10	0.02	1.61
Finland (a)	0.13	0.59	0.82	0.07	0.11	0.14	0.12	0.01	1.98
France	0.05	0.87	0.33	0.05	0.13	0.16	0.13	0.04	1.75
Greece	0.08	0.33	0.58	0.04	0.11	0.14	0.42	0.03	1.73
Hungary	0.05	0.23	0.36	0.03	0.11	0.11	0.14	0.02	1.04
Iceland	0.04	0.40	0.39	0.03	0.10	0.06	0.09	0.01	1.13
Ireland	0.05	0.81	0.23	0.10	0.18	0.05	0.18	0.06	1.67
Italy	0.03	0.54	0.43	0.21	0.16	0.17	0.24	0.03	1.81
Latvia	0.11	0.33	0.59	0.04	0.10	0.15	0.18	0.03	1.53
Lithuania	0.05	0.83	0.80	0.16	0.08	0.10	0.28	0.04	2.33
Luxembourg	0.02	0.55	0.40	0.03	0.13	0.13	0.13	0.02	1.41
Malta	0.11	1.02	0.24	0.05	0.23	0.24	0.33	0.05	2.26
Netherlands	0.02	0.27	0.23	0.03	0.04	0.06	0.07	0.02	0.75
Norway	0.07	0.60	0.26	0.07	0.05	0.03	0.08	0.08	1.24
Poland	0.04	0.27	0.48	0.05	0.08	0.15	0.20	0.04	1.30
Portugal	0.02	0.59	0.49	0.11	0.18	0.08	0.20	0.05	1.72
Romania	0.03	0.20	0.68	0.03	0.04	0.18	0.16	0.07	1.39
Slovakia	0.03	0.26	0.37	0.04	0.12	0.12	0.13	0.05	1.13
Slovenia	0.02	0.64	0.35	0.05	0.12	0.12	0.13	0.05	1.48
Spain	0.02	0.47	0.42	0.03	0.12	0.18	0.22	0.07	1.52
Sweden**		0.87	0.19		0.06	0.15	0.08		1.56
Reported EU/EEA	0.04	0.56	0.43	0.08	0.13	0.15	0.17	0.04	1.60

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

*J01B: amphenicols; J01G: aminoglycoside antibacterials; J01R: combinations of antibacterials.

**Sweden was not able to report data for some ATC level 3 sub-groups due to national reporting restrictions. Sweden indicated that inclusion of unreported consumption data for Sweden in the calculation of the EU/EEA mean consumption rates resulted in no change in the EU/EEA means by ATC level 3 sub-group, as shown in this table.

Figure 5. Hospital sector consumption of antibacterials for systemic use (ATC group J01) at ATC level 3 sub-group, EU/EEA countries, 2022 (expressed as DDD per 1 000 inhabitants per day)



*EU/EEA refers to the population-weighted mean consumption based on countries that provided hospital sector data for 2022 (27 countries).

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

The EU/EEA population-weighted mean consumption of antibacterials for systemic use in the hospital sector decreased from 1.68 DDD per 1 000 inhabitants per day in 2013 to 1.61 in 2022. In the individual countries, statistically decreasing trends were observed for six countries, and significant increasing trends were observed for two countries (Table 6).

Trends in consumption of sub-groups of antibacterials for the hospital sector during the period 2013–2022 are available in Tables D8–D16. During this period there was a statistically significant decreasing trend in the EU/EEA mean of hospital sector consumption of quinolones (J01M). During the same 10-year period, there were statistically significant increases for hospital sector consumption of tetracyclines (J01A), sulfonamides and trimethoprim (J01E), and other antibacterials (J0X). No significant EU/EEA trends were detected in antibacterial sub-groups for penicillins (J01C), cephalosporins and other beta-lactams (J01D), and macrolides, lincosamides and streptogramins (J01F).

Table 6. Hospital sector consumption of antibacterials for systemic use (ATC group J01), EU/EEA and UK, 2013–2022(expressed as DDD per 1 000 inhabitants per day)

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Time series 2013–2022	Trend	Compound annual growth rate (CAGR)
Austria							1.82	1.67	1.63	1.69		N/A	N/A
Belgium	1.64	1.62	1.64	1.64	1.62	1.62	1.59	1.41	1.43	1.42		↓	-1.6%
Bulgaria	1.34	1.35	1.32	1.58	1.52	1.62	1.64	1.98	2.08	1.49		↑	1.2%
Croatia	1.58	1.65	1.70	1.65	1.74	1.80	1.85	1.61	1.93	1.98		↑	2.5%
Cyprus												N/A	N/A
Czechia									2.21	3.15		N/A	N/A
Denmark	1.88	1.98	2.19	1.84	1.91	1.94	1.86	1.75	1.80	1.83		-	-0.3%
Estonia	1.69	1.71	1.62	1.58	1.65	1.55	1.54	1.65	1.41	1.61		-	-0.5%
Finland (a)	2.63	2.51	2.36	2.38	2.11	2.28	2.10	1.94	1.84	1.98		↓	-3.1%
France	1.76	1.79	1.77	1.76	1.73	1.77	1.74	1.64	1.69	1.75		-	-0.1%
Germany												N/A	N/A
Greece	1.79	1.87	1.91	2.15	2.07	1.66	1.68	1.74	1.77	1.73		-	-0.4%
Hungary	1.08	1.13	1.11	1.07	1.13	1.12	1.16	1.21	1.12	1.04		-	-0.5%
Iceland					1.66	1.53	1.33	1.11	1.02	1.13		N/A	N/A
Ireland	1.59	1.48	1.71	1.66	1.60	1.78	1.77	1.47	1.49	1.67		-	0.6%
Italy	1.87	1.86	2.09	2.21	1.89	1.91	1.89	1.92	1.54	1.81		-	-0.4%
Latvia	1.97	1.95	1.89	1.86	1.89	1.92	1.88	1.92	1.48	1.53		↓	-2.8%
Lithuania	1.92	1.91	2.10	2.13	2.25	2.25	2.30	2.31	1.95	2.33		-	2.1%
Luxembourg	1.82	1.64	1.61	1.57	1.62	1.40	1.38	1.27	1.28	1.41		N/A	N/A
Malta	1.56	1.95	2.49	2.52	2.78	2.24	1.99	2.17	1.68	2.26		-	4.2%
Netherlands	0.84	0.85	0.87	0.85	0.83	0.84	0.80	0.76	0.70	0.75		↓	-1.3%
Norway	1.35	1.36	1.36	1.34	1.38	1.30	1.30	1.16	1.14	1.24		↓	-0.9%
Poland		1.32	1.31	1.25	1.62	1.36	1.42	1.36	1.37	1.30		-	-0.2%
Portugal	1.51	1.43	1.45	1.46	1.44	1.40	1.40	1.45	1.54	1.72		-	1.4%
Romania							1.73	1.43	1.38	1.39		N/A	N/A
Slovakia	2.03	2.30	2.22	2.31	1.45	1.81	1.38	1.27	1.43	1.13		↓	-6.3%
Slovenia	1.38	1.43	1.49	1.50	1.52	1.50	1.50	1.32	1.42	1.48		-	0.8%
Spain				1.83	1.75	1.73	1.63	1.56	1.49	1.52		N/A	N/A
Sweden	1.60	1.49	1.59	1.56	1.51	1.65	1.47	1.42	1.40	1.56		-	-0.2%
EU/EEA*	1.68	1.69	1.75	1.79	1.67	1.69	1.65	1.61	1.53	1.61		↓	-0.4%
United Kingdom	2.18	2.30	2.25	2.27	2.30	2.47	2.53					N/A	N/A
Reported EU/EEA**	1.78	1.76	1.80	1.82	1.78	1.79	1.77	1.57	1.52	1.60		N/A	N/A

• = Hospital sector data not reported.

• (a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

* EU/EEA refers to the population-weighted mean consumption, based on data from the 20 current EU/EEA countries with consistent reporting of hospital sector AMC for all 10 years.

** Reported EU/EEA refers to the population-weighted mean consumption, based on all reported data shown for each year, and includes the UK for the years 2013–2019.

N/A = Not applicable. Trend analyses were not performed and CAGR not calculated because of missing data, changes in the type of data or change in data process. Luxembourg changed its data process in 2020, which could impact comparability with previous years.

ECDC/EFSA/EMA secondary indicator for consumption of antibacterials for systemic use (ATC group J01) in the hospital sector

The proportions of 'broad-spectrum' antibiotics (ATC groups J01XA, J01DD, J01DE, J01DF, J01DH, J01MA, J01XB, J01CR05, J01XX08, J01XX11, and J01XX09) out of all hospital consumption of antibacterials for systemic use are set out in Table 7.

In 2022, the EU/EEA population-weighted mean proportion among reporting countries was 37.6%, ranging from 17.6% in Lithuania to 67.5% in Bulgaria. During the period 2013–2022, no statistically significant trend was observed for the EU/EEA overall; however, eight countries had increasing trends in this indicator. Only one country (Finland) had a statistically significant decreasing trend.

Table 7. Proportion (%) of glycopeptides, third- and fourth-generation cephalosporins, monobactams, carbapenems, fluoroquinolones, polymyxins, piperacillin and enzyme inhibitor, linezolid, tedizolid and daptomycin out of total hospital consumption (DDD per 1 000 inhabitants per day) of antibacterials for systemic use, EU/EEA and UK, 2013–2022

Country	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Time series 2013–2022	Trend	Compound annual growth rate (CAGR)
Austria							34.0	34.8	36.5	35.3		N/A	N/A
Belgium	31.3	31.5	31.7	31.0	30.9	30.2	29.8	31.4	31.2	30.1		-	-0.5%
Bulgaria	52.7	57.5	55.2	59.8	58.1	57.5	58.5	62.6	71.1	67.5		↑	2.8%
Croatia	27.8	31.0	31.7	30.9	32.2	32.2	33.5	36.8	39.4	38.9		↑	3.8%
Cyprus												N/A	N/A
Czechia									23.5	15.9		N/A	N/A
Denmark	22.8	22.7	20.6	23.7	21.4	22.9	23.9	24.7	24.3	22.6		-	-0.1%
Estonia	19.3	20.0	20.0	20.6	23.2	19.8	21.8	24.6	24.8	23.2		↑	2.1%
Finland (a)	22.2	22.7	21.9	22.9	23.2	19.4	18.1	21.4	19.5	18.6		↓	-1.9%
France	31.3	32.3	32.2	31.3	31.6	32.6	30.1	32.4	33.4	36.3		-	1.7%
Germany												N/A	N/A
Greece	35.9	35.7	38.6	35.8	36.9	49.1	50.8	50.8	59.8	57.9		↑	5.4%
Hungary	37.8	37.4	38.8	39.4	40.1	40.6	36.3	40.8	42.4	39.7		-	0.6%
Iceland					16.4	18.1	17.0	18.7	21.3	29.3		N/A	N/A
Ireland	32.3	36.9	29.5	30.1	29.4	28.7	28.1	30.3	31.1	30.3		-	-0.7%
Italy	49.1	48.4	42.8	37.0	48.6	48.5	44.5	42.8	44.4	46.2		-	-0.7%
Latvia	40.1	39.9	40.1	39.9	38.4	38.1	40.8	36.9	41.9	40.2		-	0.0%
Lithuania	20.2	21.2	26.2	25.3	23.5	21.5	23.4	24.8	22.0	17.6		-	-1.5%
Luxembourg	31.1	31.8	33.3	36.0	34.0	35.7	35.1	37.9	37.5	35.1		N/A	1.4%
Malta	30.2	34.8	33.4	27.5	27.4	37.9	37.0	38.6	41.2	39.2		↑	2.9%
Netherlands	25.2	25.2	25.1	25.2	24.6	25.1	24.3	26.8	28.7	27.4		↑	0.9%
Norway	21.8	22.1	22.1	22.3	19.8	20.7	19.4	19.5	21.6	21.8		-	0.0%
Poland		23.6	24.1	34.2	24.3	31.8	29.2	34.3	44.1	37.9		N/A	6.1%
Portugal	42.6	43.8	43.6	43.5	42.2	42.8	42.6	43.3	44.2	42.6		-	0.0%
Romania							55.4	55.1	64.8	61.5		N/A	N/A
Slovakia	27.4	28.0	30.5	30.8	35.1	32.6	32.3	35.1	38.6	33.7		↑	2.3%
Slovenia	31.5	32.1	32.8	32.1	31.2	31.4	30.7	31.3	32.2	31.2		-	-0.1%
Spain				47.8	45.4	44.6	45.7	47.9	50.3	50.2		N/A	N/A
Sweden	25.2	27.1	26.5	27.4	26.9	24.5	27.9	28.6	30.4	30.0		↑	1.9%
EU/EEA*	35.8	36.4	35.0	33.4	36.2	36.8	35.0	36.1	37.8	37.6		-	0.6%
<i>United Kingdom</i>	<i>15.8</i>	<i>16.8</i>	<i>17.4</i>	<i>17.6</i>	<i>16.6</i>	<i>16.7</i>	<i>16.6</i>					N/A	N/A
<i>Reported EU/EEA**</i>	<i>31.6</i>	<i>31.3</i>	<i>30.5</i>	<i>32.5</i>	<i>32.8</i>	<i>33.8</i>	<i>33.7</i>	<i>38.4</i>	<i>41.0</i>	<i>40.2</i>		N/A	N/A

= Hospital sector data not reported.

(a) Finland: data include consumption in remote primary healthcare centres and nursing homes.

* EU/EEA refers to the population-weighted mean consumption, based on data from the 20 EU/EEA countries with consistent reporting of hospital sector AMC for all 10 years.

** Reported EU/EEA refers to the population-weighted mean consumption, based on all reported data shown for each year, and includes the UK for the years 2013–2019.

N/A = Not applicable. Trend analyses were not performed and CAGR not calculated because of missing data, changes in the type of data or change in data process. Luxembourg changed its data collection process in 2020, then again in 2022 for the hospital sector only, which could impact comparability with previous years.

Consumption of specific antimicrobial groups used to treat patients infected with resistant bacteria in the hospital sector

Trends in consumption of carbapenems (ATC group J01DH) and polymyxins (J01XB) in the hospital sector are available in Tables D11 and D16, respectively. Statistically significant increases in consumption were seen for both last-line antibiotic groups between 2013 and 2022.

The EU/EEA population-weighted mean consumption of carbapenems in the hospital sector was 0.05 DDD per 1 000 inhabitants per day and ranged from 0.01 (the Netherlands) to 0.19 (Greece) DDD per 1 000 inhabitants per day in 2022. Statistically significant increases over the past 10 years were observed for nine countries (Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, Lithuania, Poland and Slovakia) and statistically significant decreases were observed in six countries (Belgium, Denmark, Finland, Ireland, Norway and Portugal) during this 10-year period.

For polymyxin consumption in the hospital sector, the EU/EEA population-weighted mean in 2022 was 0.010 DDD per 1 000 inhabitants per day, with a range from less than 0.0001 (Finland) to 0.93 (Spain) DDD per 1 000 inhabitants per day. Statistically significant increases over the past 10 years were observed for seven countries (Bulgaria, Croatia, Greece, Hungary, Latvia, Poland and Portugal) and statistically significant decreasing trends were seen in four countries (Belgium, France, Ireland and the Netherlands).

Among the top five countries for carbapenem consumption in the hospital sector in 2022, four (Czechia, Greece, Portugal and Spain) were also in the top five countries for polymyxin consumption.

Trends in the percentage of 'Reserve' antibiotics consumed (as per WHO AWaRe classification) among total hospital antibiotic consumption are displayed in Table D22. In 2022, the EU/EEA population-weighted mean percentage of 'Reserve' antibiotics in the hospital sector was 5.25%. There was a statistically significant increase in this percentage between 2013 and 2022. Statistically significant increases in this percentage were observed for 17 countries during this period, and no country had a statistically significant decrease.

Consumption of antimicrobials from other ATC groups

Consumption of antibacterials against *Clostridioides difficile* in the hospital sector

Hospital consumption of oral vancomycin (ATC code A07AA09) and fidaxomicin (A07AA12), and oral and rectal metronidazole (P01AB01) is presented in Table D17.

In 2022, hospital consumption of oral vancomycin (A07AA09) and fidaxomicin (A07AA12) combined was below 0.01 DDD per 1 000 inhabitants per day for 18 countries and above 0.01 DDD per 1 000 inhabitants per day for two countries.

Oral and rectal metronidazole (P01AB01) consumption in the hospital sector was reported by 23 countries and ranged from 0.005 DDD per 1 000 inhabitants per day to 0.032 DDD per 1 000 inhabitants per day.

Consumption of antimycotics and antifungals for systemic use (ATC groups J02 and D01B) in both sectors (community and hospital sectors combined)

Total consumption of antimycotics and antifungals for systemic use (ATC groups J02 and D01B) during the five-year period 2018–2022 is presented in Tables D18 and D20. No statistically significant changes were observed over the five-year period for both J02 and D01B consumption.

Twenty-nine countries reported AMC data for both antimycotics for systemic use (ATC group J02) and antifungals for systemic use with dermatological indications (ATC group D01B). Twenty-eight countries reported data for all five years. One country (Austria) reported only community sector data for 2018, one country (Czechia) did not report any data for 2018, and three countries (Germany, the Netherlands and Spain) reported data for the community sector only for all five years. One country (Ireland) reported data for the hospital sector only for all five years.

The EU/EEA population-weighted mean consumption of antimycotics for systemic use (ATC group J02) in 2022 was 0.40 DDD per 1 000 inhabitants per day and varied among countries from 0.23 to 2.16 DDD per 1 000 inhabitants per day. Statistically significant increasing trends were observed for three countries (Bulgaria, Estonia and Latvia), and statistically significant decreasing trends were observed for three countries (Denmark, Finland and Italy).

The EU/EEA population-weighted mean consumption of antifungals for systemic use for dermatological indications (ATC group D01B) for 2022 was 0.62 DDD per 1 000 inhabitants per day and varied among countries from 0.14 to 2.48 DDD per 1 000 inhabitants per day. No statistically significant trends were observed in any of the countries over the five-year period.

Consumption of parenteral amphotericin B (ATC code J02AA01)

Total consumption of parenteral amphotericin B (ATC code J02AA01) across both sectors during the five-year period 2018–2022 is presented in Table D19. For 2022, the EU/EEA population-weighted mean consumption of parenteral amphotericin B was 0.029 DDD per 1 000 inhabitants per day and consumption varied from <0.001 (Bulgaria, Cyprus, and Romania) to 0.150 DDD per 1 000 inhabitants per day (France).

Amphotericin B represented between <1% and 30% of the total consumption of antimycotics for systemic use (ATC group J02) among the reporting countries.

There was a statistically significant increase observed in amphotericin B consumption over the five-year period 2018–2022 at EU/EEA level. Statistically significant increasing trends were also observed for four countries (France, Italy, Lithuania and Portugal) and one country (Belgium) had a statistically significant decreasing trend.

Consumption of oral terbinafine (ATC code D01BA02)

Total consumption of oral terbinafine (ATC code D01BA02) across both sectors during the five-year period 2018–2022 is presented in Table D21. For 2022, the EU/EEA population-weighted mean consumption of oral terbinafine was 0.36 DDD per 1 000 inhabitants per day and consumption varied from 0.12 (Italy) to 2.48 DDD per 1 000 inhabitants per day (Iceland).

Terbinafine represented 100% of the total consumption of antifungals for systemic use with dermatological indications (ATC group D01B) for 24 of the 27 countries reporting consumption of this antifungal for 2022. Among the other three countries, terbinafine represented 84%–97% of the total consumption of antifungals for systemic use with dermatological indications (ATC group D01B).

No statistically significant change was observed in the EU/EEA trend over the five-year period between 2018–2022 for oral terbinafine. One country (Cyprus) had a statistically significant increase, and one country (Estonia) had a statistically significant decrease over the five-year period.

Consumption of antimycobacterials for treatment of tuberculosis (ATC group J04A) in both sectors (community and hospital sectors combined)

Total consumption of antimycobacterials for treatment of tuberculosis (ATC group J04A) during the five-year period 2018–2022 is presented in Table D22.

Twenty-eight countries reported data on antimycobacterials for treatment of tuberculosis (ATC group J04A) for 2022. One country (Austria) reported only community sector data for 2018, one country (Czechia) did not report any consumption data for 2018, and three countries (Germany, the Netherlands and Spain) reported data for the community sector only.

The total EU/EEA population-weighted mean consumption of antimycobacterials for treatment of tuberculosis (ATC group J04A) was 0.21 DDD per 1 000 inhabitants per day in 2022. Consumption of antimycobacterials ranged from <0.01 (Cyprus) to 0.75 DDD per 1 000 inhabitants per day (Romania).

A statistically significant downward trend in consumption of antimycobacterials for treatment of tuberculosis (ATC group J04A) was observed over the five-year period 2018–2022. Statistically significant decreasing trends were observed for six countries (Belgium, Croatia, Denmark, Finland, Slovakia and Sweden). One country (Slovenia) showed a significantly increasing trend during the period 2018–2022.

Consumption of antivirals for systemic use (ATC group J05) in both sectors (community and hospital sectors combined)

Total consumption of antivirals for systemic use (ATC group J05) during the five-year period 2018–2022 is presented in Table D23.

Twenty-eight countries reported data on antivirals for systemic use (ATC group J05) in 2022. One country (Austria) reported only community sector data for 2018, one country (Czechia) did not report any consumption data for 2018, and three countries (Germany, the Netherlands and Spain) reported data for the community sector only.

The total EU/EEA population-weighted mean consumption of antivirals for systemic use (ATC group J05) was 4.49 DDD per 1 000 inhabitants per day in 2022. Among the 25 countries reporting data for both sectors in 2022, consumption of antivirals for systemic use (ATC group J05) ranged from 0.77 (Malta) to 11.19 DDD per 1 000 inhabitants per day (Italy).

No statistically significant change occurred in the EU/EEA population-weighted mean consumption over the five-year period 2018–2022; however, statistically significant increasing trends were observed for eight countries (Croatia, Germany, Norway, Portugal, Slovakia, Slovenia, Spain and Sweden) and no country had a statistically significant decreasing trend.

Discussion

ESAC-Net data show that, in 2022, after two years of reduced AMC during 2020 and 2021, AMC across the EU/EEA rose to levels close to those for 2019. For the 10-year period 2013–2022, while a general downward trend was observed for AMC in both the community and the hospital sector, secondary AMC indicators showed upward trends for antibiotics and antibiotic groups that need to be reversed. Intensified efforts will be necessary to reach the AMC targets set by the recently adopted Council Recommendation on stepping up EU actions to combat antimicrobial resistance (AMR) in a One Health approach [8], which extends and complements the 2017 EU One Health Action Plan against AMR [14].

Limitations of the data reported to ESAC-Net, based on national sales and reimbursement data, include the lack of data on clinical indications for antimicrobial use. ESAC-Net data may also be influenced by drug shortages and stockpiling, and therefore might not completely reflect adoption of prudent use guidelines or actual use. For example, caution should be used when comparing consumption of oral vancomycin (ATC code A07AA12) and fidaxomicin (A07AA12) with metronidazole (P01AB01) consumption (Table D17) to evaluate uptake of updated treatment guidelines published in 2021 for *Clostridioides difficile* infection [15]. Reporting countries have indicated that due to limited availability of oral vancomycin, parenteral vancomycin (J01XA01) is sometimes given orally for treatment of *C. difficile*. However, without data on indications for use we cannot determine what proportion of parenteral vancomycin consumption was used for treatment of *C. difficile* infection.

While ESAC-Net data cannot distinguish antimicrobial misuse from appropriate use, country comparisons and trends imply that there is room for improvement. ESAC-Net data should therefore be examined in the context of each country's prescribing practices to identify areas of potential antimicrobial overuse and misuse, one of the main drivers of AMR.

Slow progress toward EU targets for AMC in humans

An EU target on total antibiotic consumption to be reached by 2030 is set in the Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach [8], with ESAC-Net data as a guide for AMC reductions. Reductions from each Member State to its recommended target AMC level will contribute to reducing overall EU antibiotic consumption by 20% against the baseline year 2019. Although AMC reductions during 2020 and 2021 were promising, 2022 data show that action must be intensified to reduce AMC in the face of returning demand for antibiotics.

Almost half (46%) of the EU Member States reporting AMC for both the community and hospital sectors saw an increase in total AMC between 2019 and 2022 (Table 1). The fact that half of the Member States with AMC values above the EU mean consumption rate in 2019 (Bulgaria, Cyprus, Ireland, Italy, Malta, and Romania) had even higher AMC rates in 2022 is of concern. On the other hand, three EU Member States (Finland, the Netherlands, and Sweden) had already reached their recommended target AMC level for 2030 in 2022. These three Member States also met the EU target of 65% of total AMC being from the 'Access' group of antibiotics (Figure 1), although AMC target levels must be maintained.

The EU target of 65% of each Member State's total AMC being from the 'Access' group of antibiotics is aimed at reducing the consumption of 'Watch' and 'Reserve' group antibiotics, which contribute to AMR and the risk of untreatable infections. The number of countries that meet this AMC target has not increased since 2019; the same nine EU Member States that met this target in 2019 were the only nine Member States that met the target in 2022. The challenges to progressing towards the 65% target are evident, with increasing secondary indicators for 'broad-spectrum' antibiotic consumption and rising consumption of last-line antibiotics (discussed below), since increases in these indicators suggest increasing consumption of 'Watch' and 'Reserve' group antibiotics. As EU Member States work towards the 65% target for 'Access' group antibiotics by 2030, progress in proportions of 'Access', 'Watch', and 'Reserve' proportions can be tracked on the ECDC AMC Dashboard [3].

Rebounds in antibiotic consumption in 2022

After unprecedented reductions during 2020 and 2021, AMC across the EU/EEA rebounded in 2022, with consumption rates for both the community and hospital sectors much closer to 2019 levels than to those for 2021. While population-weighted mean consumption rate of antibacterials for systemic use (ATC group J01) in the community for 2022 remained below the 2019 rate (Table 3), the mean difference in community AMC between 2019 and 2022 was not statistically significant. Macrolides, lincosamides, and streptogramins (ATC group J01F, Table D5) was the only ATC level 3 sub-group with a mean community consumption rate that was statistically higher in 2022 than that in 2019 (by paired t-test of all EU/EEA countries reporting community sector data for 2019 and 2022).

Macrolides (ATC group J01FA) constituted most of the consumption for ATC group J01F in the EU/EEA, although they should rarely be used as first-line antibiotics for the most common bacterial infections in the EU/EEA. Macrolides are all in the 'Watch' group of antibiotics and are rarely a first-line treatment for most bacterial respiratory infections in the community sector [10]. They can be used for respiratory infections when penicillins (ATC group J01C) are not an option (e.g. penicillin allergy). However, misuse of macrolides for treatment of respiratory illness is common [16] and macrolide consumption has been shown to be associated with COVID-19 case numbers [17].

Given the known misuse of macrolides for respiratory illness and resurgences of both viral and bacterial respiratory infections not typically treated with macrolides during 2022 [18–23], it is probably that there was an increase in inappropriate use of macrolides in 2022. At the same time, known shortages of penicillins during 2022 [24, 25] also probably led to increased use of macrolides due to unavailability of the first-line penicillins, which did not have a statistically significant difference in mean consumption between 2019 and 2022 (Table D2).

Secondary indicators for antibiotic consumption and consumption of last-line antibiotics continue to rise

The secondary indicator for consumption of antibacterials for systemic use in the community showed a significant rise in the EU/EEA ratio of 'broad-spectrum' to 'narrow-spectrum' antibiotics over the past ten years (Table 4). While there was no statistically significant EU/EEA 10-year trend for the secondary indicator in the hospital sector, the number of countries with upward trends (eight) outnumbered the countries with downward trends (one) for this proportion of 'broad-spectrum' AMC in the hospital sector (Table 7). The above observations in the community and hospital sectors indicate a shift towards use of antibiotics with a broader spectrum of activity and regressions in prevention and control of AMR through prudent use of antibiotics [26].

Of even greater concern for AMR, the EU/EEA hospital sector has seen a rise in the percentage of AMC from the 'Reserve' group (i.e. antibiotics for the treatment of confirmed or suspected infections due to multidrug-resistant organisms) which can be considered as 'last-resort' options. Among 21 countries for which 10-year trends analyses were performed, 17 (81%) countries had increasing trends in the percentage of hospital AMC from the 'Reserve' group of antibiotics. Not one EU/EEA country has a decreasing trend in percentage of 'Reserve' group AMC in the hospital sector (Table D24).

There remain wide variations in AMR rates across the EU/EEA, which could explain the variation in consumption of last-line antibiotics. Nevertheless, such widespread increases in the consumption of last-line antibiotics in hospitals is a major concern as it promotes proliferation of multidrug-resistant organisms, as reflected in increasing trends in carbapenem-resistant *K. pneumoniae* and vancomycin-resistant *E. faecium* in the EU/EEA during 2018–2022 [27]. Care must therefore be taken to prevent misuse and overuse of last-line antibiotics for empiric treatment where AMR rates are high. Availability and use of rapid diagnostics and rapid testing for clinical AMR can reduce inappropriate use of last-line antibiotics. Importantly, prudent use of antimicrobials [26] and robust infection prevention and control (IPC) [28,29] remain the pillars of AMR prevention in hospitals and other healthcare settings, which in turn reduces consumption of last-line antibiotics for treatment and empiric therapy.

It should be noted that we have seen success in reducing EU/EEA consumption for one group of antibiotics – the quinolones (ATC group J01M). In 2019, the European Medicines Agency restricted the use of fluoroquinolones (J01MA) and suspended the marketing authorisation of other quinolones (all in ATC group J01MB) due to serious, disabling and potentially permanent effects [30]. Since this EU-level action was taken, there have been reductions in quinolone consumption in both the community (Table D6) and the hospital (Table D14) sectors.

A closer look at antifungal consumption

For the first time in this report, further analyses of data on consumption of antimycotics for systemic use (ATC group J02) and antifungals for systemic use with dermatological indications (ATC group D01B) were conducted using ESAC-Net data. Below we refer to both groups as 'antifungals'. Given the rise in antifungal resistance [31], antifungal consumption deserves a closer look, as should be the case for antifungal stewardship practices [32]. Increasing consumption of parenteral amphotericin B (ATC code J02AA01, Table D19) might be associated with emerging azole resistance among *Aspergillus* species and *Candida* species [33].

Reports of terbinafine-resistant *Trichophyton* species, particularly *T. indotineae*, have also emerged in Europe [34–37]. Overuse of topic terbinafine is thought to be a contributor to terbinafine resistance, although this driver is mainly attributed to the Indian subcontinent [38] and data from the EU/EEA do not show an increase in terbinafine consumption (Table D21).

The 'One-Health' challenges of antifungal resistance parallel those for antibiotic resistance and are often compounded by difficulties in diagnosing fungal infections and limited options for the choice of antifungal agent, with only three main classes of antifungals. Strategies to combat antifungal resistance therefore parallel those for antibiotic resistance: increasing availability of and enhancing rapid diagnostics and resistance testing for fungal organisms, investing in the development of new antifungals, and promoting the prudent use of existing antifungals [31].

Opportunities to use AMC data for action

Since coordination of AMC surveillance at EU level began more than two decades ago, the EU/EEA has seen progress in this surveillance. ESAC-Net's reporting completeness has increased over time, allowing for more accurate and complete analyses. As changes in reporting process impact trend analyses, the EU/EEA population-weighted means used for trend analyses have necessarily excluded countries that have changed data collection processes during the time series. We must therefore look beyond EU/EEA trends and examine country-level data and address country-level trends which are of concern.

Indicators in this report can be used by anyone involved in improving AMC at any level of government, healthcare, or advocacy. Further data are available on ECDC's online AMC Dashboard [3]. In addition, further analyses not included in this report (e.g. consumption of newer antibiotics for carbapenem-resistant infections) and analyses using data not available in ESAC-Net (e.g. AMC in long-term care settings, AMC by age) could be useful for targeting AMC interventions where they might have the greatest impact.

The secondary indicators for AMC, which exemplify increased proportion of 'Watch' and 'Reserve' group antibiotics as opposed to 'Access' group antibiotics, suggest systemic actions could be taken to ensure availability of first-line antibiotics such as penicillins; encourage appropriate use of second-line antibiotics such as macrolides and, for the hospital sector, limit

use of last-line antibiotics such as polymyxins and carbapenems.

While rigorous IPC in healthcare settings has long been known to limit the spread of multidrug-resistant organisms which lead to consumption of last-line antibiotics, the role of IPC in the community in reducing AMC has been difficult to study. With the COVID-19 pandemic, associations could be found between widespread non-pharmaceutical interventions (NPIs) for IPC and reductions in respiratory infections, and between the easing of NPIs and the resurgence of respiratory infections [23, 39, 40]. The respiratory infection resurgence probably contributed to the increases in community antibiotic consumption in 2022, as suggested above. Preventing the spread of illness in the community can therefore reduce AMC, although the impact of specific community IPC actions on AMC have yet to be studied in depth.

Prevention of infectious disease not only reduces AMC for the treatment of bacterial infections; it can also reduce inappropriate use for viral infections, particularly when rapid diagnostic testing is not available or used. There is increasing evidence that vaccination can serve as a means of reducing antibiotic use, particularly with influenza and pneumococcal vaccines [41, 42]. Vaccination as a strategy for reducing use of antibiotics is promoted by WHO [43]. While there is potential for increased prevalence of serotypes with AMR not covered by pneumococcal vaccines [44], pneumococcal conjugate vaccines have been associated with an overall decline in AMR in *S. pneumoniae* infections [45]. Given the observed increases in AMC with surges in respiratory infections, maximising use of existing vaccines, such as those for influenza and pneumococcal pneumonia, can suppress community outbreaks and lead to reductions in AMC for community-acquired infections.

Public health conclusions

AMR is a serious cross-border threat to health [46] leading to over 35 000 deaths in the EU/EEA each year [47]. Policies that tackle AMR with a 'One-Health' approach can save lives and healthcare costs [48]. AMC is one of the main drivers of the development of AMR among human pathogens. Reduction of AMC reduces selective pressures on the pathogens that contribute to the development of multi-drug resistance.

Although the primary indicator for human AMC in the EU/EEA (i.e. total consumption of antibacterials for systemic use; ATC group J01 in the community and hospital sectors combined) showed an overall reduction over the past ten years, the most recent data from ESAC-Net highlight opportunities for significant reductions in AMC.

Secondary indicators for AMC suggest that efforts to reduce antimicrobial overuse and misuse need to intensify, particularly for last-line antibiotics in the hospital sector, and for macrolides in the community sector. In the hospital sector, robust infection prevention and control (IPC) can stem the spread of multidrug-resistant organisms for which last-line antibiotics are used, and reduction of the use of last-line antibiotics in turn reduces the development of multi-drug resistance. In the community sector, intensified uptake of existing vaccines for community-acquired pneumonias might have a role in reducing AMC. Furthermore, in both sectors, robust antimicrobial stewardship programmes, availability of rapid diagnostic testing for pathogens, rapid antimicrobial susceptibility testing, and rigorous hand hygiene are all factors for reducing AMC.

As effective antimicrobial stewardship requires a continuous feedback loop of AMC and AMR data, continued investments in the strengthening of AMC and AMR surveillance and analyses at local, national and international level will strengthen the effectiveness of public health actions on reducing the burden of AMR. EU-wide initiatives, such as those recommended by the Council Recommendation on stepping up EU actions to combat antimicrobial resistance in a One Health approach [8], in conjunction with national and local interventions tailored to local AMR and AMC data can stem the impact of AMR on patient outcomes.

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Annex 1. List of downloadable tables

Available at: <https://www.ecdc.europa.eu/en/publications-data/downloadable-tables-antimicrobial-consumption-annual-epidemiological-report-2022>

Table D1. Trends in consumption of tetracyclines (ATC group J01A) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D2. Trends in consumption of beta-lactam antibacterials, penicillins (ATC group J01C) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D3. Trends in consumption of other beta-lactam antibacterials (ATC group J01D) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D4. Trends in consumption of sulfonamides and trimethoprim (ATC group J01E) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D5. Trends in consumption of macrolides, lincosamides and streptogramins (ATC group J01F) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D6. Trends in consumption of quinolones (ATC group J01M) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D7. Trends in consumption of other antibacterials (ATC group J01X) in the community, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D8. Trends in consumption of tetracyclines (ATC group J01A) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D9. Trends in consumption of beta-lactam antibacterials, penicillins (ATC group J01C) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D10. Trends in consumption of other beta-lactam antibacterials (ATC group J01D) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D11. Trends in consumption of carbapenems (ATC group J01DH) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D12. Trends in consumption of sulfonamides and trimethoprim (ATC group J01E) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D13. Trends in consumption of macrolides, lincosamides and streptogramins (ATC group J01F) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D14. Trends in consumption of quinolones (ATC group J01M) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D15. Trends in consumption of other antibacterials (ATC group J01X) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D16. Trends in consumption of polymyxins (ATC group J01XB) in the hospital sector, EU/EEA countries, 2013–2022, expressed as DDD per 1 000 inhabitants per day

Table D17. Consumption of oral vancomycin (A07AA09), fidaxomicin (A07AA12) and oral and rectal metronidazole (P01AB01) in the hospital sector, EU/EEA countries, 2022, expressed as DDD per 1 000 inhabitants per day

Table D18. Trends in total consumption (community and hospital sectors) of antimycotics for systemic use (ATC group J02A), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D19. Trends in total consumption (community and hospital sectors) of parenteral amphotericin B (ATC group J02AA01), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D20. Trends in total consumption (community and hospital sectors) of antifungals for systemic use for dermatological indications (ATC group D01B), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D21. Trends in total consumption (community and hospital sectors) of oral terbinafine (ATC group D01BA02), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D22. Trends in total consumption (community and hospital sectors) of antimycobacterials for treatment of tuberculosis (ATC group J04A), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D23. Trends in total consumption (community and hospital sectors) of antivirals for systemic use (ATC group J05), EU/EEA countries, 2018–2022, expressed as DDD per 1 000 inhabitants per day

Table D24. Trends in percentage of 'Reserve' antibiotics among all antibiotic consumption in the hospital sector, EU/EEA countries, 2013–2022