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**SURVEILLANCE** REPORT

# Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals

## 2022–2023

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This report of the European Centre for Disease Prevention and Control (ECDC) was coordinated by Carl Suetens.

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Acknowledgements

We would like to thank all the national PPS coordination team members, staff of participating hospitals involved in organising the PPS in their facility, and other contributing experts for their work and dedication in organising local trainings, collecting, validating and reporting the data, reviewing the draft report or otherwise contributing to the success of this survey. More detail can be found in the Acknowledgements section.

Suggested citation: European Centre for Disease Prevention and Control. Point prevalence survey of healthcare-associated infections and antimicrobial use in European acute care hospitals. Stockholm: ECDC; 2024.

Stockholm, May 2024

ISBN 978-92-9498-715-0
doi: 10.2900/88011
Catalogue number TQ-05-24-324-EN-N

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# Abbreviations

| | |
|---|---|
| AHR | Alcohol-based handrub |
| AMC | Antimicrobial consumption |
| AST | Antimicrobial susceptibility testing |
| ATC | Anatomical therapeutic chemical |
| BSI | Bloodstream infection |
| CDI | *Clostridioides difficile* infection |
| CEO | Chief Executive Officer |
| CI | Confidence interval |
| CRI | Catheter-related infection |
| CVC | Central vascular catheter |
| CVS | Cardio-vascular system |
| EARS-Net | European Antimicrobial Resistance Surveillance Network (ECDC) |
| EEA | European Economic Area |
| ESAC | European Surveillance of Antimicrobial Consumption project |
| ESAC-Net | European Surveillance of Antimicrobial Consumption Network (ECDC) |
| EU | European Union |
| FTE | Full-time equivalent |
| HAI | Healthcare-associated infection |
| HAI-Net | Healthcare-Associated Infections Surveillance Network (ECDC) |
| HELICS project | Hospitals in Europe Link for Infection Control through Surveillance project |
| ICU | Intensive care unit |
| IPC | Infection prevention and control |
| IQR | Inter-quartile range |
| LOS | Length of stay |
| LTCF | Long-term care facility |
| LRTI | Lower respiratory tract infection |
| Med | Median |
| MRSA | Meticillin-resistant *Staphylococcus aureus* |
| NHSN | National Healthcare Safety Network (CDC) |
| NS | Non-susceptible |
| OR | Odds ratio |
| PPS | Point prevalence survey |
| PVC | Peripheral vascular catheter |
| PRAISE network | Providing a Roadmap for Automated Infection Surveillance in Europe network |
| ROC | Receiver operating characteristic |
| SAUR | Standardised antimicrobial use ratio |
| SIR | Standardised infection ratio |
| UTI | Urinary tract infection |
| VRE | Vancomycin-resistant *Enterococcus* spp. |
| WHO | World Health Organization |

# Summary

## Participation

In 2022–2023, 28 EU/EEA countries and three Western Balkan countries (Kosovo[i], Montenegro and Serbia) participated in the third ECDC point prevalence survey (PPS) of healthcare-associated infections (HAIs) and antimicrobial use in European acute care hospitals.

Data from a total of 1 623 hospitals were submitted to ECDC. Of these, 309 504 patients from 1 332 hospitals were included in the final European sample for analysis. Data from a single ward were collected on a single day. The total time frame for data collection for all wards of a single hospital was 11 days on average (median eight days). Aggregated results were only reported for the EU/EEA, corresponding to 293 581 patients from 1 250 hospitals.

## Healthcare-associated infections

The prevalence of patients with at least one HAI in the EU/EEA sample was 7.1% (country range: 3.1–13.8%). When extrapolated to the average daily number of occupied beds per country, the weighted HAI prevalence was 6.3% (cumulative 95% confidence interval [CI]: 5.3–7.4%). Correcting for results of national validation studies, the adjusted prevalence of patients with at least one HAI was estimated at 8.0% (95% confidence interval: 6.6–9.6%). After adjustment for the one non-participating EU/EEA country (Denmark), this corresponded to an estimated total of 93 305 (95% CI: 76 427–111 899) patients with at least one HAI on any given day, 4.3 million (95% CI: 3.1–5.8 million) patients with at least one HAI and 4.8 million (95% CI: 3.1–5.8 million) HAIs (infection episodes) per year in the period 2022 to 2023 in acute care hospitals in the EU/EEA.

Of a total of 22 806 reported HAIs in the EU/EEA, the most frequently reported types of HAI were respiratory tract infections (29.3% of the total, including pneumonia 19.0%, COVID-19 7.0% and other lower respiratory tract infections 3.3%), urinary tract infections (19.2%), surgical site infections (16.1%), bloodstream infections (11.9%) and gastro-intestinal infections (9.5%), with *C. difficile* infections accounting for 62.1% of the latter and 5.9% of all HAIs. Twenty-six percent of HAIs (n=5 945) were present on admission. The most frequent type of HAI on admission was surgical site infection (25.7%).

The prevalence of patients with at least one HAI varied between 4.4% in primary hospitals to 7.7% in tertiary hospitals. It was the highest in intensive care patients with 20.5% compared with 6.4% for all other specialties combined.

A total of 16 948 microorganisms were reported in 13 875 (60.8%) HAIs. The microorganisms most frequently isolated from HAIs were, in decreasing order, *Escherichia coli* (12.7%), *Klebsiella* spp. (11.7%), *Enterococcus* spp. (10.0%), SARS-CoV-2 (9.5%), *S. aureus* (9.0%), *C. difficile* (8.0%), *P. aeruginosa* (7.9%), coagulase-negative staphylococci (5.8%), *Candida* spp. (4.7%), *Proteus* spp. (3.2%), *Acinetobacter* spp. (3.2%) and *Enterobacter* spp. (3.0%). The PPS protocol required the reporting of antimicrobial susceptibility testing (AST) data only on specific bug-drug combinations. Selected AST data were available on the day of the survey for 90.4% of microorganisms selected for AST reporting in the PPS protocol. Meticillin resistance was reported in 23.7% of *S. aureus* isolates with known AST results. Vancomycin resistance was reported in 15.6% of isolated enterococci. Third-generation cephalosporin resistance was reported in 34.7% of all Enterobacterales and was the highest in *K. pneumoniae* with 58.1%. Carbapenem resistance was reported in 29.7% of *P. aeruginosa* isolates and 82.9% of *Acinetobacter baumannii* isolates. The combined index of these first-level antimicrobial resistance (AMR) markers (composite index of AMR) showed that in microbiologically documented HAIs, 32.0% of microorganisms were resistant to antimicrobials (mean of countries: 29.6%, median of countries: 21.8%). The second-level AMR markers showed that carbapenem resistance was reported in 9.3% of all included Enterobacterales (mean of countries: 9.5%, median of countries 3.4%) and was the highest (25.1%) in *K. pneumoniae*.

[i] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

# Antimicrobial use

The prevalence of patients receiving at least one antimicrobial in the EU/EEA sample was 35.5% (country range 20.8–56.5%). The survey detected 138 208 antimicrobials that were used in 103 169 patients: 72.6% of the patients received one antimicrobial, 22.4% received two, and 5.4% received three or more. The weighted prevalence of antimicrobial use in the EU/EEA, accounting for the number of occupied acute care beds by country, was 32.4% (95% CI: 29.7–35.1%). The estimated number of patients receiving at least one antimicrobial on any given day in acute care hospitals in the EU/EEA was 390 957 patients (95% CI: 345 070–437 575), after correcting for the non-participating EU/EEA country (Denmark), and for the average results of the national validation studies.

Antimicrobials were administered parenterally for 80.3% of antimicrobials, and the reason for antimicrobial use was documented in the patient's medical record for 82.7% of antimicrobials.

The prevalence of antimicrobial use was the lowest in psychiatric patients (2.8%) and the highest in intensive care patients (59.5%). Antimicrobials were the most frequently prescribed for treatment of an infection (70.2%): of a community-acquired infection (49.3%), of a hospital-acquired infection (18.4%) and an infection acquired in a long-term care facility (2.5%). Surgical prophylaxis was the indication for 14.9% of the prescriptions and was prolonged for more than one day for 48.3% of surgical prophylaxis prescriptions. Medical prophylaxis was the indication for 10.2% of prescriptions.

Out of a total of 233 different antimicrobial agents reported at the fifth level of the ATC classification, 19 (7.5%) accounted for 75% of the total antimicrobial use in acute care hospitals in the EU/EEA. The most frequently prescribed antibiotic, ceftriaxone (ATC code J01DD04), accounted for 10.4% of all antimicrobial agents.

Information about change of antimicrobials during the treatment of an infection was reported for 83.0% of prescriptions. Most prescriptions (81.7%, country range: 68.7–93.8%) were not changed from the initiation of treatment to the date of the PPS. Escalation, de-escalation and switch from intravenous to oral use were reported for 10.9%, 3.9%, and 1.9% antimicrobial prescriptions, respectively. The change was reported as related to adverse effects for 0.4%, and to other reasons for 1.2% prescriptions.

At the country level, a lower prevalence of antimicrobial use and a higher percentage of antimicrobials changed during treatment were associated with a lower composite index of AMR.

# Structure and process indicators of infection prevention and control and antimicrobial stewardship

The percentage of hospitals in the EU/EEA that reported having an annual IPC plan and an annual IPC report that was approved by the hospital chief executive officer (CEO) or a senior executive officer was 81.6% and 81.5%, respectively. The median number of IPC nurse full-time equivalents per 250 beds was 1.25 (inter-quartile range [IQR]: 0.75–1.95), with 9.7%, mostly small, hospitals not having an IPC nurse. A high IPC nurse staffing level was significantly associated with a low composite index of AMR, with the lowest composite indices of AMR levels being reported by hospitals with two or more IPC nurse FTEs per 250 beds (corresponding to one IPC nurse FTE per 100 occupied beds). The median number of IPC doctor FTEs per 250 beds was 0.43 (IQR: 0.16–0.81), with 17.8% hospitals not reporting any IPC doctor worktime.

There was a wide variability for access to and use of clinical microbiology laboratory tests across EU/EEA countries. Full availability of clinical microbiology laboratory tests during both Saturdays and Sundays was reported by 55% of hospitals, ranging from 0% hospitals in Latvia to 100% hospitals in Iceland and Luxembourg. The median number of blood cultures per 1 000 patient-days was 30.7 (IQR: 10.1–61.9) and varied from less than 10 in Hungary and Lithuania, to more than 50 in Belgium, Finland, France, Iceland, Italy and Spain. The median number of stool tests for CDI per 1 000 patient-days was 4.7 (IQR: 2.1–8.4) and varied from 0.6 in Lithuania to 9.5 in Ireland. All three indicators of clinical microbiology laboratory support improved since the ECDC PPS 2016–2017. Blood culture and stool tests for CDI were strongly correlated with each other and with HAI prevalence. Countries with a high use of clinical microbiology laboratory tests identified more HAIs.

Participation in HAI surveillance networks (ECDC's Healthcare-Associated Infections Surveillance Network [HAI-Net] surveillance targets) was reported by 37% of hospitals for surveillance of surgical site infections (SSI), 41% of hospitals for surveillance of HAIs in intensive care units (ICU) and 50% of hospitals for surveillance of CDIs. Participation in AMR surveillance networks according to the European Antimicrobial Resistance Surveillance Network (EARS-Net) was reported by 54% hospitals, and participation in a network for hospital-based surveillance of antimicrobial consumption was reported by 42% hospitals.

Information about multimodal strategies for implementation of IPC interventions according to the WHO IPC assessment framework (IPCAF) question on core component 5, was reported by 816 hospitals. Seventy-five percent of these hospitals reported using multimodal strategies to implement IPC interventions. Individual elements of multimodal strategies were more frequently reported, e.g. education and training (89% of hospitals), communication and reminders (87%) and monitoring and feedback (85%). The median WHO IPCAF multimodal strategy score was 75 [IQR 60–90], ranging from 15 in Kosovo, 55 in Lithuania and 60 in Poland, Spain and Serbia, to 85 or more in Belgium, Ireland, Luxembourg, Portugal and Slovenia. At country level, the median WHO IPCAF multimodal strategy score was negatively correlated with the composite index of AMR.

Furthermore, two indicators measured monitoring and/or audit of hand hygiene practices. The median alcohol-based handrub (AHR) consumption (mostly reported for the year preceding the PPS) was 34.4 L per 1 000 patient-days (IQR: 20.8–57.0) and ranged from 17.0 in Hungary to more than 50 L per 1 000 patient-days in seven countries. The median was the lowest in psychiatry wards (10.5 L per 1 000 patient-days) and the highest in intensive care units (92.2 L per 1 000 patient-days). The second indicator was the number of observed hand hygiene opportunities in the previous year. The median was 3.6 observed opportunities per 1 000 patient-days (IQR: 0.1–19.6), with 23.3% hospitals not reporting any opportunity observation and 3.9% hospitals reporting more than 100 opportunities per 1 000 patient-days.

The median bed occupancy measured at midnight on the day of the PPS was 73.3% (IQR: 60.0–85.5) and the median bed occupancy in the previous year calculated from hospital denominator data was 62.6% (IQR: 50.8–74.2).

The core component 'built environment, materials and equipment for IPC' was evaluated by the availibility of AHR dispensers at the point-of-care, the number of single rooms and the number of airborne infection isolation rooms. The median percentage of beds with an AHR dispenser at the point-of-care was 63.0% (IQR: 18.0–100.0) and varied from less than 10% in Bulgaria, Romania, Kosovo and Serbia to more than 90% in Hungary, Luxembourg, Portugal and Spain. High availibility of AHR dispensers was significantly associated with high consumption of AHR and with a low composite index of AMR at country level. The median percentage of beds in single rooms was 11.3% [IQR 6.4–31.4] and ranged from less than 5% in Greece, Hungary, Romania, Kosovo, Montenegro and Serbia to more than 50% in France and Sweden. A high percentage of beds in single rooms was also associated with a low composite index of AMR at country level. The median number of airborne infection isolation rooms was 16.0 per 1 000 hospital beds and varied from less than one airborne infection isolation room per 1 000 hospital beds in Hungary, Montenegro and Serbia to 30 per 1 000 hospital beds or more in Finland, Italy and Sweden.

Specific prevention efforts against respiratory viral diseases were assessed by the presence of a policy of universal masking and the vaccination status of healthcare workers against COVID-19 and influenza. Overall, 80% of hospitals had a mandatory face mask policy in place at the time of the PPS; in 49% hospitals this was a policy of universal masking (i.e. all staff, patients, visitors, service providers etc are required to wear a face mask at all times) and in 31% it was a policy of targeted continuous medical use (i.e. staff are required to wear face masks during all routine care of non-COVID-19 patients). Vaccination coverage of healthcare workers against COVID-19 was high, with a median of 85% who were fully vaccinated overall, ranging from 56% in Montenegro and 57% in Spain to 100% in Malta and Kosovo. However, vaccination coverage of healthcare workers against influenza was much lower than for COVID-19, with a median of 29% (EU/EEA country range 3.0–92.5%.)

Data on antimicrobial stewardship consultant FTEs were collected separately from data on IPC doctor FTEs. The median was 0.18 antimicrobial stewardship consultant FTE per 250 beds (country range: 0–0.94), with 39.3% hospitals not reporting any antimicrobial stewardship consultant worktime. At the hospital level, the presence of any antimicrobial stewardship consultant worktime was significantly associated with a higher percentage of prescriptions with a change during treatment, and a lower percentage of antimicrobials administered parenterally, but it was not associated with the composite index of AMR. At the country level, none of the antimicrobial stewardship indicators measured at hospital or ward level (antimicrobial stewardship consultant FTE, presence of post-prescription review procedure or participation in a antimicrobial consumption surveillance network) were significantly associated with the composite index of AMR.

# Validation

A total of 16 EU/EEA countries, plus Montenegro and Serbia performed a national validation survey during the ECDC PPS 2022–2023, including a total of 106 validated hospitals and 6 058 validated patient files in the EU/EEA. On average, 3.0% (country range: 1.2–8.5%) of patients who were reported as not having a HAI by the primary PPS data collectors were found to have a HAI by the national validation teams (false negatives). Almost one in five (mean: 17.5%, country range: 0–37.3%) patients reported as having a HAI did not have a HAI according to the national validation team (false positives). This resulted in a mean sensitivity for detecting and reporting a patient with at least one HAI of 68.2% (country range: 40.1–85.1%) and a mean specificity of 98.4% (country range: 95.2–100%). At the country level, the HAI prevalence in the primary PPS was significantly associated with specificity (Spearman's rho -0.88, $p<0.001$), but not with sensitivity. The mean sensitivity for detecting and reporting a patient receiving at least one antimicrobial was 93.8% (country range: 87.8–98.7%) and the mean specificity was 97.4% (country range: 92.4–100%), with an average of 3.9% false negatives and 4.2% false positives.

# Discussion

The results of the ECDC PPS 2022–2023 confirmed that HAIs, and AMR in bacteria responsible for HAIs, represent a significant public health challenge for the EU/EEA, with a total estimated number of 4.3 million patients who acquired at least one HAI per year in EU/EEA acute care hospitals in 2022–2023. Overall results for the EU/EEA for HAIs and antimicrobial use were similar to those of the ECDC PPSs in 2011–2012 and ECDC PPS 2016–2017, even though at the individual country level, important differences were observed. An important difference in the ECDC PPS 2022–2023 compared to the previous two PPSs was the emergence of healthcare-associated COVID-19, which accounted for 7% of all HAIs. Further analysis should be performed to assess changes between the three PPSs, considering differences in participating countries and patient case-mix.

Despite the validation studies and advanced risk adjustment, the ECDC PPS 2022–2023 did not allow for improvement of the comparability of the HAI prevalence between countries. However, with important implications for all stakeholders, it confirmed the key reasons why HAI prevalence cannot be compared between EU/EEA countries which were identified in the ECDC PPS 2016–2017. The most important reason was (and is) the wide variability of microbiological testing use rates across countries – possibly also reflecting diagnostic testing barriers and opportunities as a whole – which explained almost half of the variation of the HAI prevalence between countries. Indeed, when test results are missing, some HAIs will frequently not match case definitions and consequently, will not be reported. We suggest this requires urgent attention at the national and European level in terms of harmonisation of diagnostic stewardship, in particular for optimal use of microbiology testing for infectious disease management.

Secondly, as expected, validation surveys showed wide variability in sensitivity and specificity of reporting HAIs by hospital PPS staff across countries, obviously influencing the reported HAI prevalence. However, because of limited validation sample sizes in two thirds of the countries, validation results could only be used to correct HAI prevalence at the EU/EEA level, not at the country level. Improving the performance of the hospital PPS staff in terms of validity requires further training in the PPS methodology, in particular of HAI case definitions. For future comparison of HAI prevalence between countries, a standardised indicator of HAI prevalence, adjusting for the frequency of diagnostic testing, resulting from nationally representative validation studies and differences in patient case mix should be considered.

The composite index of AMR in HAIs at country level appeared to be a more robust indicator than HAI prevalence, as shown by consistent correlations with the prevalence of antimicrobial use, other indicators of rational antimicrobial use measured at the antimicrobial level (e.g. the percentage of antimicrobials changed during treatment), staffing levels of infection prevention and control nurses, alcohol-based handrub consumption (or the percentage of beds with AHR dispensers), isolation capacity as measured by the percentage of single-room beds and the implementation of multimodal strategies for infection prevention and control. Most of these correlations were identified in the ECDC PPS 2016–2017 and were confirmed in the current PPS.

Antimicrobial use data collected in the PPS showed good validity and confirmed several areas for targeted improvement of antimicrobial use in several European countries including:

- reducing the use of broad-spectrum antimicrobials;
- adherence to single-dose surgical prophylaxis;
- reducing medical prophylaxis;
- targeting change from parenteral to oral administration of antibiotics;
- improving the documentation of the reason for antimicrobial prescribing in the patient's records.

The 2022–2023 PPS also updated the detailed picture of the organisation and performance of infection prevention and control and antimicrobial stewardship in European acute care hospitals provided by the ECDC PPS 2016–2017. It confirmed the large variability in the implementation of the core components of IPC and antimicrobial stewardship programmes between EU/EEA countries. Several indicators increased compared to 2016–2017, in particular the staffing levels of IPC nurses and the alcohol-based handrub consumption, reflecting increasing focus on IPC in EU/EEA hospitals, even though this increased focus was likely influenced by the COVID-19 pandemic. Structure and process indicators were often inter-correlated, showing that hospitals and countries who invested in one area often performed better in the other. Therefore, further multivariable analyses of the relationships of these indicators with outcome indicators (e.g. the composite indicator of AMR in HAIs or the prevalence of HAIs) are needed to assess their relative importance.

Continued prevention of HAIs and antimicrobial resistance in European acute care hospitals requires the continued implementation of existing recommendations and guidelines. Specific major recommendations from the findings of the ECDC PPS 2022–2023 are formulated, as follows:

- an urgent need to harmonise diagnostic stewardship and improve access to microbiological diagnostic testing in EU/EEA hospitals;
- increasing IPC nurse staffing levels to (ideally) one IPC nurse per 100 occupied beds;
- installing AHR dispensers at the point-of-care;
- increasing the percentage of single rooms to improve isolation capacity;
- implement multimodal strategies for IPC;
- ensure the implementation of preventive measures for COVID-19 and other respiratory viral infections;
- increasing post-prescription review of antimicrobial treatment, de-escalating and switching from intravenous to oral when possible;
- reduce the unnecessarily prolonged surgical prophylaxis and the use of antimicrobials for medical prophylaxis when not indicated;
- ensure training, dedicated skilled personnel and time for antimicrobial stewardship consultancy.

# Background and objectives

In 2008, ECDC estimated that each year, approximately 4.1 million patients acquire a healthcare-associated infection (HAI) in European acute care hospitals and that 37 000 of these patients die as a direct consequence of their infection [1]. This estimate was based on a review of 30 national or multicentre point prevalence surveys (PPSs) of HAIs in 19 countries that were conducted between 1996 and 2007, which showed an average HAI prevalence of 7.1%. However, major methodological differences between the surveys made comparison across countries impossible [2] and emphasised the need for a standardised methodology to estimate and monitor the complete health burden of HAIs in Europe.

ECDC subsequently developed a protocol for PPSs of HAIs and antimicrobial use in acute care hospitals through seven expert meetings organised from 2009 to 2011. More than 100 experts and representatives from all EU Member States, two EEA countries, four EU enlargement countries, international partners (the European Society of Intensive Care Medicine, WHO Regional Office for Europe, the United States Centers for Disease Control and Prevention (CDC)), the ESAC project, and ECDC, contributed to developing the protocol. It was agreed that national PPSs should be conducted at least once every five years. The first ECDC PPS was conducted in 2011–2012 (version 4.2 and 4.3 of the protocol, see [3]) and estimated that, each year, 3.2 million patients in acute care hospitals in the EU/EEA acquired a HAI [4]. A study using the data of the ECDC PPS 2011-2012 estimated 91 000 deaths attributable to six main types of HAIs (healthcare-associated pneumonia, urinary tract infection, surgical site infection, *Clostridioides difficile* infection, neonatal sepsis and primary bloodstream infection) each year in 2011–2012 [5].

The second ECDC PPS was conducted in 2016–2017, using an updated protocol v.5.3 [6] including more structure and process indicators for the prevention of HAIs and antimicrobial resistance (AMR) in acute care hospitals. This was based on a systematic review of such indicators performed upon ECDC's request [7], as well as on indicators for antimicrobial stewardship, based on a consensus process carried out by a working group of the Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) [8]. The second ECDC PPS estimated the weighted prevalence of patients with at least one HAI in the EU/EEA at 5.5% (cumulative 95% confidence interval [CI]: 4.5–6.6%). Correcting for results of national validation studies, the adjusted prevalence of patients with at least one HAI was estimated at 6.5% (95% confidence interval: 5.4–7.8%), which corresponded to an estimated total of 3.8 million (95% CI: 3.1–4.5 million) patients with at least one HAI per year in acute care hospitals in the EU/EEA [9–11]. Importantly, this second PPS found that the strongest determinants of HAI prevalence were the patient case-mix, the specificity of the PPS data collectors and diagnostic stewardship, measured by the proxy indicator blood culture sets per 1000 patient-days. On the other hand, the strongest determinants of AMR in HAIs were prevalence of antimicrobial use, the practice of changing the antimicrobial after prescription, the percentage of beds in single rooms (indicator of isolation capacity), the availability of alcohol handrub dispensers at the point of care, and the staffing levels of infection prevention and control (IPC) nurses [11,12].

The third ECDC PPS was organised in 2022–2023, one year later than originally planned due to delays related to the COVID-19 pandemic and the associated workload for IPC and HAI surveillance teams at hospital and national level, and at ECDC. The protocol was adapted in June 2021 with the addition of a specific case definition for healthcare-associated COVID-19, the addition of HAIs imported from long-term care facilities (LTCFs) to the acute care hospitals, simplification of antimicrobial use data and several changes (both additions and deletions) in the hospital-level data, while keeping the most important indicators unchanged (see below). An overview of changes is available in the published version of the protocol of the ECDC PPS 2022–2023 [13].

The objectives of the third ECDC PPS of HAIs and antimicrobial use in European acute care hospitals were:

- to estimate the total burden (prevalence) of HAIs and antimicrobial use in acute care hospitals in the EU/EEA;
- to describe HAIs (sites, microorganisms including markers of antimicrobial resistance) and prescribed antimicrobials (compounds, indications)
  - by type of patients, specialties or healthcare facilities;
  - by EU/EEA country, adjusted or stratified.
- to describe key structures and processes for the prevention of HAIs and AMR at the hospital and ward level in hospitals in the EU/EEA;
- to disseminate results to policy makers and practitioners at local, regional, national and EU levels to:
  - raise awareness of HAIs, IPC and antimicrobial use in acute care hospitals;
  - train and reinforce surveillance structures and skills;
  - identify common issues shared by EU/EEA countries and set up priorities accordingly;
  - evaluate the effect of strategies and to inform future local/regional/national policies (repeated PPS).
- to provide a standardised tool for hospitals to identify targets for quality improvement.

# Methodology

## Participation

National PPS contact points in EU Member States, Iceland, Norway and the Western Balkan countries (Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia) were invited to organise a PPS in their countries during one of three suggested periods, based on the PPS protocol. The three periods (April to June 2022, September to November 2022, and April to June 2023) were selected to fall outside the winter period (increased antimicrobial use) and summer holidays (decreased staffing). The national contact points for the PPS were the nominated operational contact points for the HAI-Net PPS and/or the nominated national focal points for HAIs. Countries were asked to confirm participation in one of the above-mentioned periods. One EU Member State (Denmark) declined to participate. As in the second ECDC PPS Norway contributed data collected using the national Norwegian PPS protocol, without adding elements of the ECDC PPS protocol (see below). Austria completed its PPS at the end of 2021 using the first version of the adapted protocol. Latvia was unable to organise a PPS using the new protocol because of issues with human resources, but could contribute data from a PPS organised in seven hospitals in May 2021, using the protocol of the second PPS. Western Balkan countries were invited in the framework of the Instrument for Pre-Accession Assistance (IPA) - 5 project, funded by the European Commission. Representatives of the Western Balkan countries were invited to (and attended) the virtual PPS training webinars in March and October 2022 and January 2023.

## Protocol

The PPS protocol used for the second PPS (version 6.0) was distributed to the invited countries in February 2022. The edited version of the protocol (version 6.1) was published on ECDC's website in October 2022 [13]. We refer to the latter document for methodological details.

As in the previous two PPSs, the protocol offered two options for data collection of denominators: a patient-based data collection (referred to as the 'standard' option) and a less labour-intensive unit-based data collection ('light' option). According to the 'standard' protocol option, demographic and risk factor data had to be collected for every inpatient, including for those without a HAI or not receiving any antimicrobial. According to the 'light' protocol option, denominator data were to be aggregated at the ward level and, within each ward, for each patient/consultant specialty (specialty of the main disease of the patient or of the consulting physician in charge of the patients, depending on what was the usual practice for this variable at the hospital or country level). Both protocol options used the same inclusion criteria, assumed the same case-finding process and were used to collect the exact same information on HAIs, antimicrobial use and structure and process indicators at hospital and ward level. Results for both protocol options are therefore reported combined, except for the analysis of patient risk factors, which was only possible for data collected using the 'standard' (patient-based) protocol.

## Sampling of hospitals

ECDC recommended that countries draw a representative sample of acute care hospitals, applying systematic random sampling to the national list of hospitals, ranked according to hospital type and size. In the absence of a European definition of an acute care hospital, national definitions were allowed. The required sample size per country was calculated for an estimated HAI prevalence of 6% with a precision of +/-1%. This resulted in a sample size between 10 000 and 23 000 patients in 25 to 60 hospitals, depending on the average hospital size in the country and the estimated design effect resulting from clustering of HAIs within hospitals (see protocol). Countries with fewer than 25 hospitals were recommended to include all hospitals. Countries had the possibility to submit more than the recommended number of hospitals to ECDC but were then asked to indicate for each hospital whether it belonged to the representative national sample or not. If the hospitals selected for the representative national sample were not indicated by the country (Hungary, Poland and Spain), a systematic random sampling was performed by ECDC to avoid over-representation. Submission of more hospitals than recommended was preferred by some countries, because ECDC offered analysis of the complete national dataset and individual feedback reports for all hospitals were provided to the national PPS coordinators.

Country representativeness of the sample of hospitals was evaluated and categorised into four levels (optimal, good, medium and poor) as follows, depending on compliance with the recommended sampling methodology:

1. Optimal

- systematic random sample of 25–60 hospitals (depending on hospital size in the country) and inclusion of at least 75% of these hospitals;
- inclusion of ≥75% of all acute care hospitals or occupied acute care hospital beds in the country, and recommended sample size achieved.

2. Good

- selection of at least 25 hospitals or at least 75% of the recommended number of hospitals and/or patients using another sampling methodology (e.g. voluntary participation);
- recommended sample size not achieved, but inclusion of ≥75% of all acute care hospitals or occupied acute care hospital beds in the country.

3. Medium

- between five and 25 hospitals included in countries with more than 25 acute care hospitals and 75% of required sample size not achieved;
- less than five hospitals included in countries with more than five acute care hospitals but inclusion of 50–75% of all acute care hospitals or occupied acute care hospital beds in the country.

4. Poor

- inclusion of less than five hospitals and less than 50% of all acute care hospitals, and less than 50% of all occupied acute care hospital beds.

Within a participating hospital, all eligible patients had to be included. Sampling of patients was not included as a methodological option because this would have increased the required number of hospitals and affected usefulness of the data at the hospital level.

# Inclusion criteria

All acute care hospitals were eligible for inclusion. An acute care hospital was defined in accordance with national definitions. There was no minimal size of hospitals. All wards in acute care hospitals were included, except for accident and emergency departments. Long-term care wards located in acute care hospitals were included.

All patients admitted to the ward before 8:00 am on the day of the survey and not discharged from the ward at the time of the survey were included. Neonates on maternity and paediatric wards were included if born before/at 8 am. Day cases were excluded, i.e.:

- patients undergoing same-day treatment or surgery;
- patients seen at an outpatient department;
- patients in the emergency room;
- dialysis patients (outpatients).

# Data levels and definitions

Data were collected at national, hospital, ward and patient level (for the latter, including HAI and antimicrobial use data, if any) on standardised data collection forms (questionnaires).

## Hospital data

The hospital questionnaire was used to collect data on the type and size (number of beds) of the hospital, hospital ownership, hospital statistics (number of patient-days and discharges in the preceding year) as well as structure and process indicators for IPC and antimicrobial stewardship (see below).

Four hospital type categories (primary, secondary, tertiary and specialised) were defined as follows:

1. Primary

- Often referred to as 'district hospital' or 'first-level referral';
- Few specialties (mainly internal medicine, obstetrics–gynaecology, paediatrics, general surgery or only general practice);
- Limited laboratory services are available for general, but not for specialised pathological analysis;
- Often corresponds to general hospital without teaching function.

2. Secondary

- Often referred to as 'provincial hospital';
- Hospital is highly differentiated by function with five to ten clinical specialties, such as haematology, oncology, nephrology, ICU;
- Takes some referrals from other (primary) hospitals;
- Often corresponds to general hospital with teaching function.

3. Tertiary

- Often referred to as 'central', 'regional' or 'tertiary-level' hospital;
- Highly specialised staff and technical equipment (ICU, haematology, transplantation, cardio-thoracic surgery, neurosurgery);
- Clinical services are highly differentiated by function;
- Specialised imaging units;
- Provides regional services and regularly takes referrals from other (primary and secondary) hospitals;
- Often a university hospital or associated with a university.

4. Specialised hospital

- Single clinical specialty, possibly with sub-specialties;
- Highly specialised staff and technical equipment.

Hospital ownership was defined as follows:

1. Public:

- Hospitals that are owned or controlled by a government unit or a public corporation (where control is defined as the ability to determine the general corporate policy).

2. Private, not-for-profit:

- Hospitals that are legal or social entities created for the purpose of producing goods and services, whose status does not permit them to be a source of income, profit, or other financial gain for the unit(s) that establish, control or finance them.

3. Private, for-profit:

- Hospitals that are legal entities set up for the purpose of producing goods and services and are capable of generating a profit or other financial gain for their owners.

4. Other or unknown:

- Hospital ownership cannot be categorised as one of one of the above, or hospital ownership is unknown.

## Ward data

Data collected at the ward level included the ward code, main ward specialty, ward survey date and aggregated denominators (number of eligible patients present on the ward) for the total ward and for each consultant/patient specialty. Broad specialty categories were used to describe ward specialty: surgery, medicine, intensive care, paediatrics, neonatology, gynaecology/obstetrics, geriatrics, psychiatry, rehabilitation, long-term care, mixed specialties and other specialties. The main ward specialty was defined as the specialty of at least 80% of the patients on the ward. If fewer than 80% of patients belonged to the same specialty, the ward specialty had to be reported as `mixed'. Collection of aggregated denominator data was only required for hospitals using the 'light' protocol option. Some of the structure and process indicator data were preferentially collected at ward level (see below). However, countries and/or hospitals could also choose to collect these indicators at hospital-level.

# Patient data

In the 'standard' protocol option, patient data were collected for all patients with or without a HAI or antimicrobials. Collected variables were age, gender, date of hospital admission, consultant/patient specialty, surgery since admission, the McCabe severity of underlying illness score [14], presence of invasive devices, COVID-19 vaccination status, and code of the current ward. If ward-level data were not collected in the 'standard' protocol option, then the ward specialty and ward survey date had to be collected at patient level as well.

In the 'light' protocol, patient data were only collected for patients with a HAI and/or receiving antimicrobials, and were limited to the consultant/patient specialty, age, gender and date of admission.

# HAI data

Healthcare-associated infection (HAI) data included the type of HAI corresponding to one of the HAI case definitions, the origin of HAI (current hospital, other hospital, long-term care facility or other/unknown), association of the HAI with the current ward, the date of onset if the HAI was not present on admission, the presence of invasive devices in the 48 hours before onset of the HAI (for pneumonia, urinary tract infections and bloodstream infections), use of vasopressors for the treatment of the HAI, isolated microorganisms and selected antimicrobial resistance data.

EU HAI case definitions that had been previously developed by HELICS or other European projects [15–18] and were used to develop the protocol of the first ECDC PPS in 2011–2012, underwent no or only minor changes for the subsequent ECDC PPS (see protocols [6,13] for details). For types of HAI for which an EU case definition did not exist at that time, case definitions from the National Healthcare Safety Network (NHSN, formerly NNIS) at the United States Centers for Disease Control and Prevention (CDC) [19] were adopted for the protocol of the first PPS and were kept stable for the subsequent PPS protocols (see protocols [6,13] for details). A new case definition for healthcare-associated COVID-19 was added for the third ECDC PPS in 2022–2023, including three categories - asymptomatic COVID-19 (COV-ASY), mild/moderate COVID-19 (COV-MM) and severe COVID-19 (COV-SEV) - and with adapted criteria for the key term 'healthcare-associated' [13]. The case definitions of the ECDC PPS 2016–2017 were also published as the Commission Implementing Decision under the EU legislation on communicable diseases [20] and is currently being revised.

A HAI was defined as active on the day of the survey when:

1. signs and symptoms were present on the date of the survey;

OR

2. signs and symptoms were no longer present, but the patient was still receiving treatment for that infection on the date of the survey. In this case, the symptoms and signs from the start of treatment until the date of the survey were checked to ascertain that the infection matched one of the type-specific HAI case definitions.

An active infection was defined as healthcare-associated (associated with acute care hospital stay only, for the purpose of this protocol) when:

1. the onset of the signs and symptoms was on Day 3 of the current admission or later (with Day 1 being the day of admission);

OR

2. the signs and symptoms were present on admission or became apparent before Day 3, but the patient had been discharged from an acute care hospital less than two days before admission;
OR

3. the signs and symptoms of an active surgical site infection were present on admission or started before Day 3, and the surgical site infection occurred within 30 days of a surgical intervention (or in the case of surgery involving an implant, a deep or organ/space surgical site infection that developed within 90 days of the intervention);

OR

4. the signs and symptoms of a *C. difficile* infection were present on admission or started before Day 3, with the patient having been discharged from an acute care hospital less than 28 days before the current admission;

OR

5. An invasive device was placed on Day 1 or Day 2, resulting in a HAI before Day 3;

OR

6. Onset of symptoms on Day 1 or Day 2 in a newborn;

OR

7. The patient was diagnosed with COVID-19 and the onset of symptoms (or first positive test if asymptomatic) was on Day 3 or later (day of admission = Day 1) of the current admission, or the patient has COVID-19 on admission (or onset before Day 3) and was (re-)admitted less than 48 hours after a stay of more than seven days in the same or another healthcare facility.

In the HAI section, data on microorganisms and the respective AMR phenotype were collected. Only results that were already available at the time of the survey were required.

# Antimicrobial use data

Data on antimicrobial use included the antimicrobial agent, the route of administration, the indication for antimicrobial use, the site of diagnosis for treatment intention of an infection (e.g. respiratory tract), whether there had been a change in prescribed antimicrobials during the treatment course (and, if so, why, e.g. de-escalation) and whether the reason for prescribing the antimicrobial agent was documented in the patient's chart or not.

For data on treatment intention, the aim was to record what physicians or other prescribers thought they were treating. To do so, it was recommended to check all patient records and to request additional information from doctors, nurses or pharmacists if needed. The appropriateness of prescriptions was not assessed, and suspected or confirmed infections for which a treatment was prescribed did not need to match any case definition.

The Anatomical Therapeutic Chemical (ATC) classification system of the WHO Collaborating Centre for Drug Statistics Methodology was used to classify antimicrobial agents [21]. Antimicrobial agents for systemic use within the following ATC groups were included: intestinal anti-infectives (A07AA), dermatological antifungals for systemic use (D01BA), antibacterials for systemic use (J01), antimycotics for systemic use (J02), antimycobacterials used as second-line treatment of e.g. MRSA infections or for treatment of mycobacterial infections other than tuberculosis (MOTT) (within ATC group J04) and nitroimidazole-derived antiprotozoals (P01AB) were included. Antiviral agents and antimicrobials for the treatment of tuberculosis were not included.

## National data

A national questionnaire was used to collect data on the method used for sampling hospitals, the number of acute care hospitals (both the total number in the country and the number included in the PPS), the previous year's aggregated hospital statistics for all acute care hospitals in the country (total number of beds, discharges and patient-days), and statistics for all beds and for only acute care beds. When national denominator data were missing, available data from Eurostat were used [22]. When Eurostat data were missing or incomplete, data from the ECDC PPS 2016–2017 or the ECDC PPS 2011–2012 were used.

An additional national questionnaire was sent to obtain information on the coordination of the national PPS, which training was provided to participating hospitals and which software tools were used.

# Structure and process indicators

## Infection prevention and control (IPC) indicators

Structure and process indicators for the prevention of HAIs and AMR were developed by ECDC and European country experts for the ECDC PPS 2016–2017 [6]. These were based on ten key components for hospital IPC programmes proposed by Zingg et al. [7], who performed a systematic review as part of the 'Systematic review and evidence-based guidance on organisation of hospital infection control programmes'. These indicators largely corresponded to the WHO core components proposed in the `Guidelines on core components of infection prevention and control programmes at the national and acute health care facility level' [23]. For the ECDC PPS 2022–2023, the questions on multimodal strategies (WHO core component 5) were replaced by the questions on multimodal strategies in the WHO self-assessment tool `Infection prevention and control assessment framework at the facility level' (IPCAF, [24]). Indicators on nursing staffing levels were removed from the protocol. To gather data to inform new initiatives in the area of digital surveillance, questions on automated surveillance of HAIs (i.e. current degree of implementation and feasibility of automated surveillance of HAIs) were proposed by the PRAISE network [25] and added in agreement with European country experts. Finally, indicators were added to assess the health burden of COVID-19 and prevention measures against transmission of COVID-19 in participating hospitals at the time of the PPS. As in the 2016–2017 report, indicators were reported according to WHO core components where possible (Table 1).

**Table 1. PPS indicators of IPC at hospital level, by WHO core components of IPC programmes at acute healthcare facility level**

| WHO core component | | Description[1] | ECDC PPS hospital indicators |
|---|---|---|---|
| 1 | **IPC programmes** | An effective infection control programme in an acute care hospital must include at least: one full-time specifically trained IC-nurse ≤ 250 beds; a dedicated physician trained infection control; microbiological support; data management support | - Full-time equivalent (FTE) IPC nurses and doctors<br>- Approved IPC plan and report<br>- Number of blood culture sets, stool tests for CDI<br>- Microbiology services during weekends |
| 2 | **IPC guidelines** | Evidence-based guidelines combined with education and training of relevant healthcare workers and monitoring of adherence with guideline | No specific indicators |
| 3 | **IPC education and training** | IPC education and training involves frontline staff, and is team- and task-oriented | No specific indicators |
| 4 | **Surveillance** | Participating in prospective surveillance and offering active feedback, preferably as part of a network | - Participation in networks for the surveillance of HAIs in the ICU, surveillance of SSIs, CDIs, AMR and AMC<br>- Automated surveillance of HAIs |
| 5 | **Multimodal strategies** | Implementing infection control programmes follow a multimodal strategy including tools such as bundles and checklists developed by multidisciplinary teams and taking into account local conditions | Questions on multimodal strategies from the WHO IPCAF tool. |
| 6 | **Monitoring/audit of IPC practices and feedback** | Organizing audits as a standardised (scored) and systematic review of practice with timely feedback | - Number of hand hygiene observations<br>- Alcohol-based handrub consumption<br>- Audit and feedback as part of multimodal strategy |
| 7 | **Workload, staffing and bed occupancy** | To make sure that the ward occupancy does not exceed the capacity for which it is designed and staffed; staffing and workload of frontline health-care workers must be adapted to acuity of care; and the number of pool/agency nurses and physicians minimised | - Bed occupancy at midnight<br>- Bed occupancy in the previous year calculated from denominator data |
| 8 | **Built environment, materials and equipment for IPC at the facility level** | Sufficient availability of and easy access to material and equipment and optimised ergonomics; adequate number of single rooms (preferably with private toilet facilities) and/or rooms suitable for patient cohorting for the isolation of suspected /infected patients, including those with TB and multidrug-resistant organisms, to prevent transmission to other patients, staff and visitors | - Alcohol-based handrub dispensers at point of care; carriage of alcohol-based hand rub bottles by healthcare workers<br>- Number of single rooms<br>- Number of airborne infection isolation rooms |

*[1]Adapted from reference [23]; IPC: infection prevention and control; IC: infection control; ICU: intensive care unit; FTE: full-time equivalent; CDI: C. difficile infection; BSI: bloodstream infection; PN: pneumonia; SSI: surgical site infection; UTI: urinary tract infection; AMR: antimicrobial resistance; AMC: antimicrobial consumption.*

## Antimicrobial stewardship indicators

Indicators of antimicrobial stewardship were based on a consensus process carried out by a working group of the Transatlantic Taskforce on Antimicrobial Resistance (TATFAR) [8]. Indicators for which data were collected at hospital or ward level included the number of full-time equivalent (FTE) antimicrobial stewardship consultants, and the presence of a formal procedure to review the appropriateness of an antimicrobial within 72 hours (three calendar days) from the initial prescription (post-prescription review), and participation in a national or regional hospital antimicrobial consumption (AMC) surveillance network. Indicators measured at the patient-antimicrobial level included prolonged surgical prophylaxis and change of prescribed antimicrobial(s) during treatment.

## Hospital- and ward-level indicator data collection

For some of the indicators, data were recommended to be collected at ward level, as the information is more readily available at that level than at hospital-wide level. These indicators were:

- alcohol-based handrub consumption;
- number of hand hygiene opportunities observed during the last year;
- number of alcohol-based handrub dispensers at the point of care;
- number of healthcare workers carrying alcohol-based handrub bottles;
- number of single rooms;
- number of beds occupied at midnight;
- presence of a formal procedure for post-prescription review of antimicrobials.

However, countries or hospitals also had the option to collect data on these indicators at the hospital-wide level (form H3 in the protocol [13]). For this report, when information was collected at both the ward and hospital level, data collected at ward level was prioritised over data collected at the hospital level.

## Data collection and processing

The protocol recommended that all data from any given ward should be collected on a single day. The total time frame for data collection for all wards of a single hospital was recommended to not exceed three weeks.

Data on wards, patients, HAIs and antimicrobial use were retrieved from patient charts in the hospital wards and/or other sources of information available in the hospital (e.g. hospital information system, laboratory database) using standardised data collection forms.

The number and type of healthcare workers involved in the data collection were not assessed. However, they were previously assessed during a pilot PPS carried out before the first ECDC PPS in 2011–2012. Healthcare workers involved in PPS data collection were – in decreasing order of frequency – IPC staff, ward nurses and physicians, infectious disease physicians, medical specialist trainees, microbiologists, pharmacists and other hospital staff [26]. In some countries, national or regional PPS coordination staff also participated in data collection.

To facilitate data entry at the hospital level, ECDC developed and provided an updated version of the standalone software HelicsWin.Net, which allows hospitals to enter and validate their PPS data, and export them in different formats, including the format required to upload data in The European Surveillance System (TESSy) [27]. Hospitals using HelicsWin.Net were asked to send the export files to the national PPS coordination centre. Export files did not contain any personal identifiers. Hospital data files were uploaded in TESSy by the national centre. National data were collected by the national contact points and submitted separately to TESSy.

Data quality reports were available in TESSy after their upload. In addition, detailed reports by hospital were produced by ECDC using Stata v14.1 and Excel, and sent to the national contact points within two weeks of data submission (except for a longer delay for the first countries submitting data), together with the national results. These Excel reports were produced for all submitted data, including hospitals which were not included in the national representative sample.

Preliminary European results were presented to a national PPS coordination staff at a meeting organised at ECDC in Stockholm in November 2023. When needed, countries re-uploaded corrected data in TESSy. This could be because of errors detected in the feedback reports provided by ECDC or because the comparative analysis of country results presented at the ARHAI meeting revealed errors that were not previously detected.

## National PPS protocols and tools

Most (75%) countries used an unmodified version of the ECDC PPS protocol version 6.0 or 6.1 [13]. The collection of structure and process indicators at ward level was optional and could be replaced by an aggregated collection of ward indicators at the hospital level (form H3 in the protocol) (see above).

Norway used a national protocol with aggregated denominator data, using the same case definitions as in the ECDC protocols, but only including the most frequent types of HAI (respiratory tract, urinary tract, surgical site, bloodstream infections). In addition, HAI data were collected in an aggregated manner, which had a large impact on available HAI data: HAI codes were only detailed at the group level (e.g. respiratory infections, not differentiating between pneumonia, COVID-19 or other lower respiratory tract infections); the date of HAI onset, presence of HAI on admission, association of the HAI with the current ward, microorganisms and AMR data were not collected. The origin of BSI was only specified in primary BSI *versus* secondary BSI, without any further details. As antimicrobial use data in the Norwegian protocol were case-based, missing types of HAI were imputed based on the reported diagnosis for antimicrobials prescribed for the indication `treatment of hospital infection or long-term care infection' (HI/LI). Imputation also considered the specialty (e.g. gynaecology and obstetrics for reproductive tract infections), age and gender of the patient and the denominators at ward/specialty level. After conversion of the Norwegian aggregated HAI data to case-based data in the TESSy format, 56 HAIs out of a total of 425 HAIs were imputed at case, i.e. patient level. Antimicrobial use data in the Norwegian protocol included all variables of the ECDC PPS protocol except data about change of the prescription. Data on structure and process indicators were not collected in the Norwegian protocol.

France, Italy, Lithuania, the Netherlands, Spain and Sweden used an adapted version of the PPS protocol.

In the Netherlands, data collection on antimicrobial use, as in the ECDC PPS protocol was optional, i.e. the detailed antimicrobial use data (ATC code, route, indication etc.). However, hospitals were required to indicate in the patient form and for each patient, whether they received at least one antimicrobial. Data collection on structure and process indicators was optional and was only performed by a very small number of hospitals. Most of the indicator data were therefore deleted by the national contact point.

Spain also adapted the national protocol, keeping additional variables (not submitted to ECDC) such as infection data on community-acquired infections. However, there were no discrepancies in the Spanish protocol for the variables included in the ECDC protocol.

In France, Italy, Lithuania and Sweden, data on some structure and process indicators were not included. Details on which indicator data were collected for each country are available in the Annex (Table A1.8). Other missing variables were, for example, the McCabe score in Lithuania and Sweden or change of the antimicrobial prescription in Sweden.

# Training

Training of hospital staff in the methodology of the PPS was considered a priority throughout the preparation of and the PPS. The training curriculum for a one-day course for participating hospitals, which was developed in 2010 (Framework Service Contract ECDC/10/017), was adapted to the new protocol. Training materials (presentation slides and case studies) were made available in English on the ECDC HAI-Net sftp server (a password-protected communication platform for national PPS coordinating teams). In addition, an FAQ was made available.

# Validation of PPS data

## National validation studies

Validation of PPS data was done by national validation teams visiting a subset of participating hospitals and re-examining a sample of patient files included in the national (primary) PPS, according to a slightly adapted version of the PPS validation protocol [28] available on the ECDC HAI-Net sftp server. The main objective of the validation PPS was to estimate the sensitivity and specificity of the primary PPS at EU/EEA level, based on the number of false-negative and false-positive patients with a HAI or antimicrobial use. Validation teams consisted of members of the national PPS coordination centre, possibly complemented by additional experts trained by the coordination centre for this purpose, and applied the PPS protocol as precisely as possible ('gold standard'), with special emphasis on HAI case definitions.

All PPS coordinating centres were invited to perform national validation of the primary PPS data with a modest financial support (direct service contract of 10 000 EUR per country) provided by ECDC to support the organisation of the national validation studies. The minimal requirement for sample size was set to re-examining the files of 250 patients in five participating hospitals per country. The objective was to obtain a representative validation sample at the EU/EEA level to assess the percentage of false positives and false negatives, and to correct the estimated prevalence at the EU/EEA level. The recommended sample size for national representativeness of the validation sample was 750 patients in 25 hospitals, to detect a sensitivity of 80% with a precision of 10%, assuming a HAI prevalence of 7%. Sixteen EU/EEA countries, as well as Montenegro and Serbia, performed a validation study. This was much less than in the ECDC PPS 2016–2017 and was attributed to continued resource constraints in the post-COVID-19 pandemic period. Slovakia, Montenegro and Serbia performed a validation study without a financial support contract. As in the second PPS, Portugal performed the largest validation study, this time with re-examination of 912 patient files in 25 hospitals.

The recommended validation method was:

- validation on the same day of primary PPS, so that the availability of data was as similar as possible between the primary PPS and the validation PPS;
- blinded, meaning no communication between the primary PPS staff and the national validation team regarding individual patient results, so that validation teams were not influenced by the judgement of the primary team and that primary PPS results would not be `corrected' according to the findings of the validation team;
- prioritise wards with high HAI prevalence to increase the precision of the estimates (higher number of expected HAIs).

It was recommended to include all patients present on the wards who were selected for the validation. This exhaustive inclusion of all patients on a selected ward was mandatory for countries performing the primary PPS using the 'light' option of the protocol, because matching patients at individual level was not possible with aggregated denominator data.

Validation data were entered separately in HelicsWin.Net which included specific fields for this purpose, or in a national software in accordance with the PPS validation metadata. Primary data of the validated hospitals needed to be submitted together with the validation datasets.

Validation data were matched to the primary PPS data using the 'primary PPS patient counter', which was collected by the national validation teams for the validated wards. False-positive and false-negative patients with a HAI or antimicrobial use were identified by cross-analysing primary data with validation data. To estimate the sensitivity and specificity of the national PPS, the percentage and 95% confidence intervals of false positives and false negatives of the validation sample were applied to the total national PPS population.

# Data analysis

Data were processed and analysed by ECDC using Stata version 14.

## Recoding of variables

Because of differences in interpretation leading to inconsistent reporting between hospitals and/or countries, the following variables were recoded before analysis:

- If the patient was in an ICU but had a patient/consultant specialty that was not an ICU specialty, the specialty of the main disease of the patient or of the consulting physician in charge of the patient (patient/consultant specialty) was recoded to the corresponding ICU specialty. For example, a patient in a mixed ICU ward with a patient/consultant specialty 'general surgery' (PPS protocol code: SURGEN) was attributed a patient/consultant specialty 'surgical ICU' (PPS protocol code: ICUSUR).
- Negative microorganism codes for reported *C. difficile* infections (CDIs) were replaced by the microorganism *C. difficile* in the analysis. This resulted in the addition of 195 (13.7%) of 1 426 *C. difficile* microorganism records in 16 of 27 countries which reported CDIs.
- Similarly, negative microorganism codes for reported COVID-19 infections were replaced by the microorganism code SARS-Cov-2. This resulted in the addition of 571 (35.8%) of 1 642 SARS-CoV-2 records in 19 of 26 countries which reported COVID-19 infections.
- If reported, the microorganism code ENBAER (*Enterobacter aerogenes*) was recoded to KLEAER (*Klebsiella aerogenes*) according to the new taxonomy included in protocol v6.1. This change should be considered for the interpretation of results for *Klebsiella* species and *Enterobacter* species.
- The presence of a HAI on admission was recoded from 'unknown' to 'no' if the date of onset was given and the day of onset of the HAI was on Day 3 or later (with Day 1 being the day of admission) (n=31 HAIs in 10 countries and 299 HAIs in Lithuania where the variable presence of the HAI on admission was unknown).

## Calculation of indicators

The prevalence of HAIs was reported as the percentage of patients with at least one HAI (rather than the total number of HAIs) over the total number of patients. This is because the ratio of HAIs (× 100) over the number of patients (often reported in HAI prevalence surveys) is not a correct percentage, as the numerator is not part of the denominator.

For types of HAI and microorganisms, the relative frequencies were reported using the total number of HAIs, or of microorganisms as the denominator.

Antimicrobial resistance (AMR) data were collected for selected bug–drug combinations only (see PPS protocol). Antimicrobial susceptibility data were collected as susceptible, standard dose (S), susceptible, increased exposure (I, previously referred to as intermediate), resistant (R) or unknown (U), and were reported as the percentage of resistant bacteria over the total number of isolates for which antimicrobial susceptibility testing (AST) results were available at the time of survey.

For *Enterococcus* spp., AMR was also reported for all species including enterococci other than *E. faecium* and *E. faecalis*. In the analysis by country, countries for which fewer than 10 isolates were reported were excluded, as per the standard EARS-Net analysis [29]. Antimicrobial resistance in HAIs was also evaluated using two indicators: a composite index of AMR and the percentage of carbapenem-resistant Enterobacterales. The composite index of AMR was calculated as the percentage of resistant isolates for the 'first level' AMR markers (see ECDC PPS protocol) divided by the sum of the isolates for which results from AST were reported. These first level markers were *Staphylococcus aureus* resistant to meticillin (MRSA), *Enterococcus faecium* and *Enterococcus faecalis* resistant to vancomycin, Enterobacterales resistant to third-generation cephalosporins, and *Pseudomonas aeruginosa* and *Acinetobacter baumannii* resistant to carbapenems. Selected Enterobacterales were *Escherichia coli*, *Klebsiella* spp., *Enterobacter* spp., *Proteus* spp., *Citrobacter* spp., *Serratia* spp. and *Morganella* spp.

The prevalence of antimicrobial use was reported as the percentage of patients receiving at least one antimicrobial agent. For antimicrobial agents, relative frequencies among the total number of antimicrobials are given in this report. The relative frequency at the fifth ATC level (chemical substance) was reported as the Drug Utilization 75% (DU75%), describing 75% of the antimicrobial use in participating hospitals [30].

The distribution of antimicrobial groups and agents followed the 2018 version of the ATC classification, except for further classification of quinolone antibacterials (ATC group J01M) into three generations based on their chemical structure and antimicrobial activity as described by the ESAC project and used by the European Surveillance of Antimicrobial Consumption Network (ESAC-Net) [31,32].

The proportion of the broad-spectrum antibacterials, among all antibacterials for systemic use (ATC J01), was calculated as proposed in the ECDC, European Food Safety Authority (EFSA) and European Medicines Agency (EMA) 'Joint Scientific Opinion on a list of outcome indicators for surveillance of AMR and antimicrobial consumption in humans and food producing animals' [33]. The following antimicrobial groups and agents were included under broad-spectrum antimicrobials: piperacillin and beta-lactamase inhibitor (ATC J01CR05), third- and fourth-generation cephalosporins (J01DD and J01DE), monobactams (J01DF), carbapenems (J01DH), fluoroquinolones (J01MA), glycopeptides (J01XA), polymyxins (J01XB), daptomycin (J01XX09) and oxazolidinones: linezolid (J01XX08) and tedizolid (J01XX11).

In addition to the relative use of antimicrobial groups and agents, the prevalence of antimicrobial use among the total number of hospitalised patients was also reported for carbapenems (ATC groups J01DH), for glycopeptide antibacterials (ATC group J01XA), for parenteral polymyxins (ATC group J01XB) and/or tigecycline (J01AA12) as an indicator of empirical or documented therapy of carbapenem-resistant gram-negative bacteria, for use of oral metronidazole (P01AB01), oral vancomycin (A07AA09) and/or fidaxomicin (A07AA12) as an indicator of the oral treatment of CDIs, and for the use of antimycotics (ATC group J02 and nystatin).

Dichotomous variables from the hospital and ward indicator questionnaires could have three values: yes, no and unknown. In several countries or hospitals, however, only 'yes' and 'unknown' answers were reported. In terms of data entering, software such as HelicsWin.Net would require active entering of the value `no', while no action would export the value as 'unknown'. In several countries, it was obvious that hospitals only actively reported 'yes' when the answer to the question (e.g. presence of a guideline) was 'yes', while left 'unknown' when the reply was actually 'no'. In the analysis, 'unknown' answers belonging to same group of questions were therefore considered as 'no' if the hospital replied at least once 'yes' or 'no' for the group of questions.

The number of FTE IPC nurses was reported per 250 beds in line with the standard derived from the SENIC study [34]. Based on data from the ECDC Training in Infection Control in Europe (TRICE) project, IPC doctors represent a more heterogeneous group of professionals in Europe, with a predominantly medical microbiology background, but also commonly a public health or epidemiological medical background, sometimes also other medical backgrounds or other professionals such as pharmacists, with a special training in IPC/hospital hygiene [35]. Given the heterogeneity of this group, a straightforward FTE standard is not available in literature. For this reason and to facilitate comparison with the number of FTE for IPC nurses, the number of FTE of IPC doctors, as well as the number of FTE antimicrobial stewardship consultant, were also reported per 250 hospital beds. As per the PPS protocol, the number of FTE antimicrobial stewardship consultants needed to be deducted from the FTE IPC doctors by the reporting hospital if antimicrobial stewardship was otherwise counted as part of the job description of the IPC doctor.

Alcohol-based handrub consumption was reported as the number of litres of alcohol-based handrub per 1 000 patient-days. Single beds were reported as the percentage of beds in single rooms among the total number of beds, which was preferred as a proxy indicator for isolation capacity rather than the percentage of rooms with a single bed among the total number of rooms, because of large variations in the number of beds per room between countries.

# Statistical analysis

## Univariate analyses

Relationships between two dichotomous variables were examined using the Chi-squared test and crude odds ratios with 95% confidence intervals. Categorical variables were examined using logistic regression. The analysis of continuous variables was done using linear regression and/or quantile regression, as appropriate. The correlation between two continuous variables was examined with the Pearson and/or Spearman correlation coefficients (rho).

## Risk adjustment of HAI and antimicrobial use prevalence

Multiple logistic regression models were developed on a systematic sample of two-thirds of the data and validated on the other third. One model was developed for the prediction of the presence of any HAI, and another model for receiving at least one antimicrobial agent on the day of the survey. For the prediction of HAIs, the following risk factors for a HAI with onset during the current hospital stay were considered before onset of the HAI: length of stay until the day of HAI onset, presence of invasive devices before HAI onset (by using the variable presence of invasive device before HAI in the infection data), and McCabe score estimated without the influence of the HAI, if any (as defined in the ECDC PPS protocol). The presence of a central vascular catheter was excluded from both models because of the correlation with the parenteral administration of antimicrobials.

After each model, risk scores were developed by multiplying and rounding each regression coefficient by a factor of 10, and goodness-of-fit and discriminatory accuracy of the model were assessed using the risk scores. Goodness-of-fit was assessed on eight smaller random sub-samples of the data using the Hosmer–Lemeshow Chi-squared test. The discriminatory accuracy of the multiple logistic regression models was assessed using receiver operating characteristic (ROC) analysis. Random effect logistic regression analysis models (including country-level random effects) were performed to examine the effect on regression coefficients. For data collected with the 'light protocol' with aggregated denominator data by patient/consultant specialty, logistic regression for grouped data was used to construct a risk model for HAIs and another risk model for antimicrobial use, including patient/consultant specialty, type of hospital and hospital size.

The level of statistical significance was set at 1 ‰ ($p<0.001$) for analyses of patient-level data and at 5% ($p<0.05$) for analyses of data aggregated at hospital- or country-level.

The standardised infection ratio (SIR) and the standardised antimicrobial use ratio (SAUR) were calculated as the number of observed patients divided by the number of predicted (or expected) patients with at least one HAI or at least one antimicrobial agent, respectively. The number of predicted patients with at least one HAI or at least one antimicrobial agent was calculated by summing up, for each country, the individual probabilities for each patient (values between 0 and 1) after fitting the European model. Standardised ratios <1 indicated a lower prevalence than predicted, standardised ratios >1 indicated a higher prevalence than predicted, based on the (country's) patient case mix after applying the European risk model. We preferred to use the terms 'predicted' instead of the more commonly used term 'expected' (statistically speaking these terms are synonyms in this context) as the term 'expected value' may be misinterpreted as referring to 'good practice'. In the case of the prevalence of HAIs and of antimicrobial use, the predicted value after applying the risk model based on the total European risk model does not mean that this value is a good practice standard.

## Country-weighted prevalence

The number of patients with at least one HAI or at least one antimicrobial agent on any given day was calculated by applying national prevalence values with 95% CIs on the total number of beds in acute care hospitals, multiplied by the occupancy rate in the year for which national denominator data were available. The occupancy rate was defined as the (national) number of patient-days in acute care hospitals × 100 / (number of beds in acute care hospitals × 365 days).

Country-weighted prevalence estimates for the EU/EEA were calculated as the sum of the country-specific, estimated number of patients with at least one HAI (for HAI prevalence) or the number of patients with at least one antimicrobial agent (for prevalence of antimicrobial use), divided by the sum of the country-specific occupied beds.

## Prevalence-to-incidence conversion

Estimates of the total number of patients with at least one HAI per year were calculated after conversion of the national prevalence (%) to incidence of HAIs using the formula by Rhame and Sudderth [36]:

$$I_{estimated} = P\frac{LA}{(LN\text{-}INT)}$$

Where:

*P = Prevalence, defined by the percentage of patients with at least one HAI on the survey day.*
*LA = Average length of hospital stay, derived from the number of patient-days and the number of discharges for the year preceding the PPS in the hospitals participating in the survey (hospital questionnaire data).*
*LN = Average length of hospital stay of infected patients (admission to discharge date). Since the discharge date was not known at the time of the PPS, the length of stay of infected patients was calculated as up to survey date.*
*INT = Average length between date of admission and date of onset of HAI. If a patient had multiple infections on the day of the survey, the date of onset of the first infection is considered.*

The term (LN-INT) or the length (duration) of infection (LOI) in the Rhame and Sudderth formula was estimated using the same method as in the ECDC PPS 2011–2012 [4]. After establishing the best mathematical relationship between the length of stay until the day of the PPS (date) in patient-based data, with the average length of stay from hospital denominator data, the LOI was estimated from the LOI until the day of the PPS (date of PPS – date of onset HAI +1) as the average between the mean and the median [mean $LOI_{PPS}$ + median $LOI_{PPS}$]/2. Because of the inherent poor precision of the prevalence-to-incidence conversion, confidence intervals were intentionally kept large, taking the lower limit of the estimate using the mean $LOI_{PPS}$ and the upper limit of the estimate using the median $LOI_{PPS}$. Further analyses of the prevalence-to-incidence conversion using a method developed by Willrich et al. [37], in which the estimates of the length of stay and length of infection were based on a Grenander estimator for discrete monotonously decreasing distributions [38], as performed for the ECDC PPS 2016–2017 (online appendix reference [9]), will be reported in a later separate publication.

## Confidence intervals

To adjust for clustering of HAIs and of antimicrobial use in selected hospitals (also referred to as over-dispersion or intra-cluster correlation), national prevalences of HAIs and of antimicrobial use were reported with 95% CIs adjusted for the design effect using the survey ('svy') procedure in Stata v14. To calculate the CIs around EU/EEA estimates, the number of patients with at least one HAI obtained from the lower and upper limits of the country-specific 95% CIs were summed up and divided by the total number of occupied beds (for prevalence) or the total number of discharges (for estimated incidence) in the EU/EEA. These 'cumulative 95% CI' (95% cCI) therefore reflect a larger, more conservative uncertainty than would be obtained by calculating 95% CI directly on the EU/EEA totals, which is in accordance with the limitations of the prevalence measurement and the uncertainty inherent to the conversion of prevalence to incidence.

## Validation study analysis

The sensitivity (percentage of truly positive patients that were detected/reported) and specificity (percentage of truly negative patients that were detected/reported) of the primary PPS teams were calculated for each national validation study by applying the percentages of false negatives to the total number of negative patients in the national primary PPS, and the percentage of false positives to the total number of positive patients. This was done because the sensitivity and specificity depend on the prevalence, which is often biased in the validation sample because the PPS validation protocol recommended selecting high risk wards for validation.

To correct the EU/EEA prevalence estimates for the results of the national validation studies, the EU/EEA mean percentage of false positives was applied to the total estimated number of patients with HAI on any given day, and the EU/EEA mean percentage of false negatives was applied to the total estimated number of patients without HAI on any given day. The lower limit of the cumulative confidence interval of the corrected estimate was calculated applying the lower limit of the weighted EU/EEA prevalence estimate, the upper limit of 95% confidence interval of the percentage of false positives and the lower limit of the 95% confidence interval of the percentage of false negatives. Similarly, the upper limit of the cumulative confidence interval of the corrected estimate was calculated applying the upper limit of the weighted EU/EEA prevalence estimate, the lower limit of 95% confidence interval of the percentage of false positives and the upper limit of the 95% confidence interval of the percentage of false negatives.

The validation-corrected HAI prevalence was converted using the Rhame and Sudderth formula to estimate the corrected HAI incidence, and total number of patients acquiring at least one HAI each year in 2022–2023, in acute care hospitals in the EU/EEA.

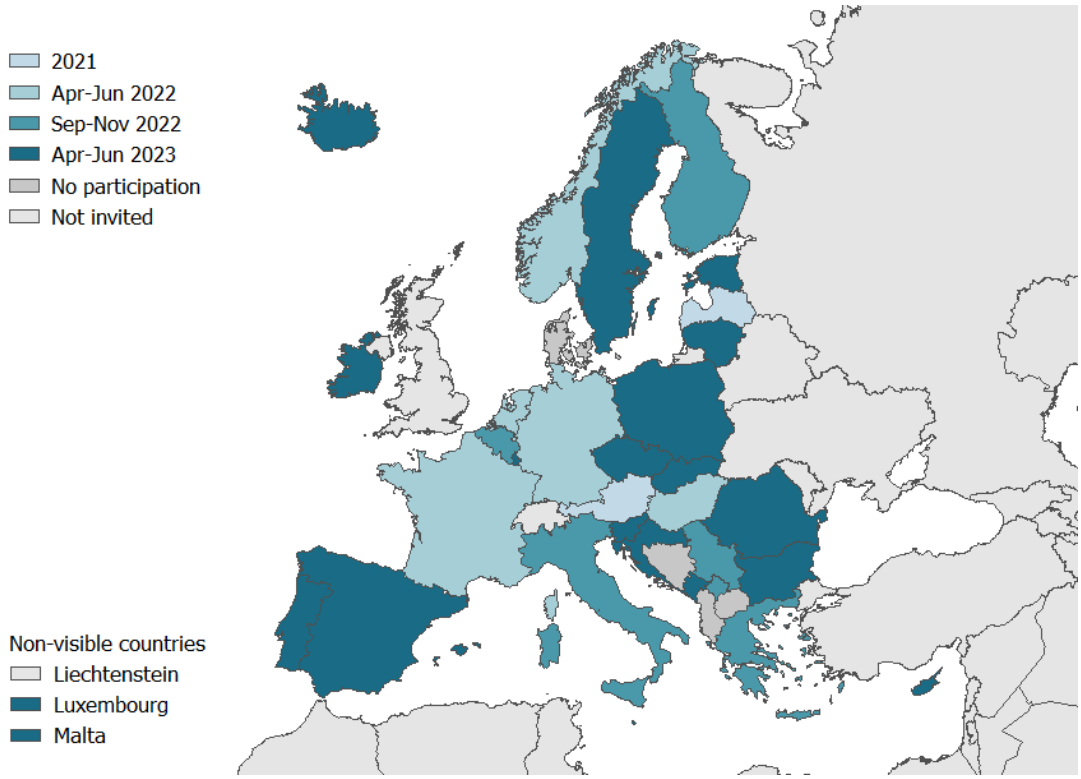
# Results

## Participation

A total of 31 countries including all EU Member States (except Denmark), two EEA countries (Norway and Iceland) and three Western Balkan countries (Kosovo, Montenegro and Serbia) participated in the third ECDC PPS. Most countries performed their PPS in May and June 2023 (Figure 1). Two countries performed the PPS in 2021 before the first period of April to June 2022, i.e. Austria that piloted the first version of the protocol from September 2021 to January 2022, and Latvia that performed a PPS in the spring of 2021 using protocol version 5.3 of the second PPS, but could not do a survey using the last protocol in 2022 or 2023 because of a lack of resources at the national level.

On average, the PPS data collection in a country (first ward in first hospital until last ward in last hospital) lasted 10.5 days (median five days). Overall, 2 921 hospitals participated, but Germany and France only submitted a representative sample of participating hospitals to ECDC. This resulted in data from 1 623 hospitals and 361 509 patients being submitted to ECDC. Furthermore, to obtain similar precision in prevalence estimates for all participating countries, further representative sub-samples of hospitals were drawn for countries (Hungary, Poland and Spain) that were overrepresented in the original sample. After this final adjustment, a total of 309 504 patients from 1 332 hospitals were included in the final dataset. Aggregated results were only reported for the EU/EEA, corresponding to 293 581 patients from 1 250 acute care hospitals.

**Figure 1. Period of participation, by country, ECDC PPS 2022–2023**



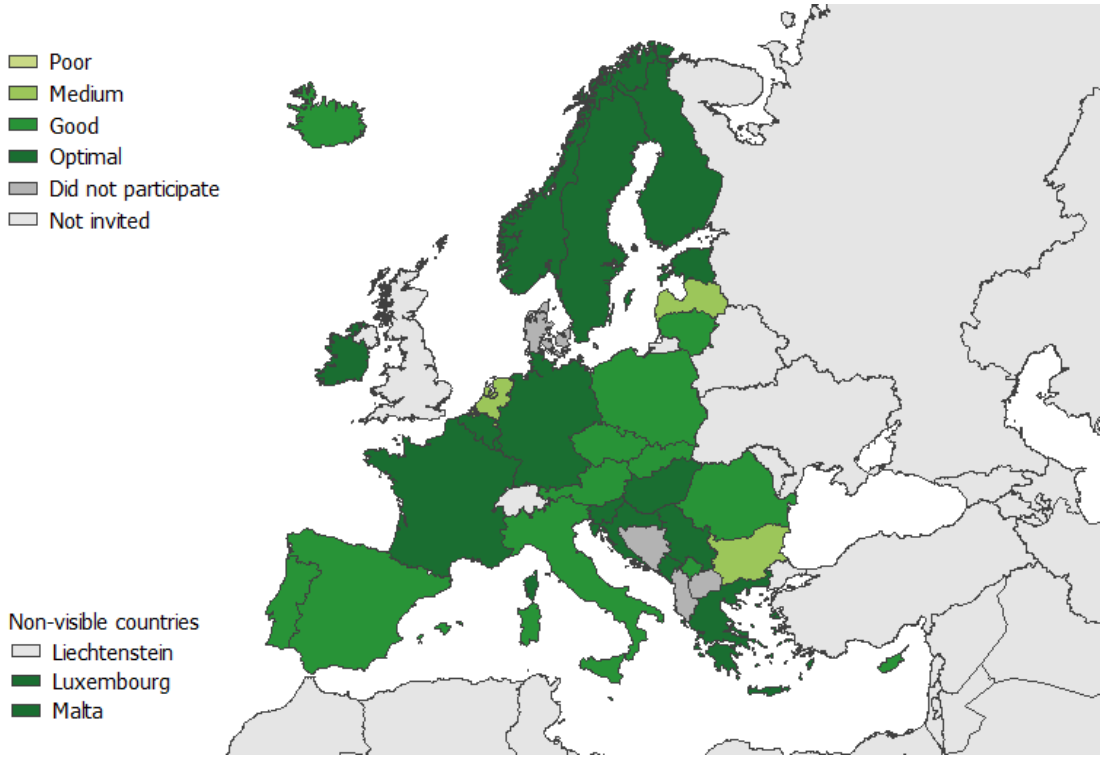

The recommended systematic random sampling methodology was not followed by all countries. Good or optimal representativeness was obtained in 28 of 31 national surveys (90%) (Table 2) by: either strictly following the recommendation (optimal); or inviting all hospitals, achieving a good response and drawing a systematic sample, if appropriate (good or optimal); or selecting a sufficient number of representative hospitals using another methodology (good); or including all (optimal) or nearly (>75%) all (good) hospitals or occupied hospital beds in smaller countries. Overall, approximately 15% of all acute care hospitals in EU/EEA countries and Serbia were included in the PPS sample. In three countries (Bulgaria, Latvia and the Netherlands), the number of hospitals or hospital beds included in the PPS sample was too small to consider the samples as representative of the total hospital population in these countries. These hospitals were nevertheless included, but care should be taken in interpreting results from these countries.

**Table 2. Number of acute care hospitals, hospital beds and participation, by country, ECDC PPS 2022–2023**

| Country | No/. of acute care hospitals in the country [a] | No. of hospital beds in acute care hospitals [b] | No. of hospitals in final PPS database | Hosp. in PPS, % of total | No. of patients in PPS | No. of beds in PPS, % of total[c] | PPS sampling method | Sample represen-tativeness[d] |
|---|---|---|---|---|---|---|---|---|
| Austria | 162 | 45 067 | 41 | 25 | 9 161 | 31 | Not available | Good |
| Belgium | 191 | 41 640 | 49 | 26 | 10 142 | 41 | Representative systemic random sample | Optimal |
| Bulgaria | 241 | 45 803 | 23 | 10 | 3 977 | 17 | Voluntary, representative sample - other* | Medium |
| Croatia | 32 | 14 286 | 31 | 97 | 8 066 | 91 | Not available | Optimal |
| Cyprus | 83 | 2 813 | 10 | 12 | 1 173 | 59 | Not available | Good |
| Czechia | 168 | 48 136 | 39 | 23 | 12 296 | 31 | All hospitals invited, voluntary | Good |
| Denmark | 52 | 14 716 | | | | | | No participation |
| Estonia | 27 | 5 919 | 20 | 74 | 3 875 | 100 | Voluntary | Optimal |
| Finland | 42 | 13 387 | 40 | 95 | 7 564 | 82 | All hospitals invited, mandatory | Optimal |
| France | 1 429 | 217 554 | 61 | 4 | 17 235 | 10 | Representative systemic random sample | Optimal |
| Germany | 2 233 | 484 534 | 50 | 2 | 8 857 | 3 | Representative systemic random sample | Optimal |
| Greece | 127 | 36 441 | 49 | 39 | 9 264 | 44 | Representative systemic random sample | Optimal |
| Hungary | 128 | 64 632 | 87 | 73 | 23 266 | 73 | All hospitals invited, mandatory | Optimal |
| Iceland | 8 | 1 020 | 2 | 25 | 678 | 82 | Representative systemic random sample | Good |
| Ireland | 65 | 13 725 | 65 | 100 | 12 472 | 100 | All hospitals | Optimal |
| Italy | 1 134 | 184 724 | 58 | 5 | 19 740 | 15 | Not available | Good |
| Latvia | 24 | 5 770 | 7 | 29 | 972 | 69 | Convenience sample | Medium |
| Lithuania | 64 | 16 957 | 41 | 64 | 9 491 | 86 | Not available | Good |
| Luxembourg | 6 | 2 706 | 5 | 83 | 1 699 | 83 | All hospitals, voluntary | Optimal |
| Malta | 8 | 1 640 | 7 | 88 | 1 082 | 94 | Not available | Optimal |
| Netherlands | 79 | 38 779 | 18 | 23 | 4 863 | 20 | Voluntary | Medium |
| Norway | 60 | 14 276 | 53 | 88 | 9 378 | 75 | Mandatory | Optimal |
| Poland | 936 | 166 338 | 93 | 10 | 23 661 | 22 | Not available | Good |
| Portugal | 225 | 34 456 | 120 | 53 | 20 367 | 79 | Not available | Good |
| Romania | 252 | 106 067 | 53 | 21 | 21 866 | 42 | Not available | Good |
| Slovakia | 107 | 30 911 | 47 | 44 | 10 533 | 63 | Not available | Good |
| Slovenia | 22 | 7 536 | 22 | 100 | 4 925 | 100 | Not available | Optimal |
| Spain | 549 | 123 031 | 105 | 19 | 23 266 | 28 | Voluntary | Good |
| Sweden | 61 | 15 801 | 54 | 89 | 13 526 | 93 | All hospitals invited | Optimal |
| **EU/EEA** | 8 591 | 1 783 949 | 1250 | 15 | 293 395 | 25 | | **Optimal or good in 25/28 countries** |
| Kosovo | 8 | 3 741 | 5 | 63 | 1 307 | 66 | Convenience sample | Good |
| Montenegro | 10 | 2 364 | 10 | 100 | 1 021 | 80 | Mandatory | Optimal |
| Serbia | 67 | 25 535 | 67 | 100 | 13 781 | 100 | Not available. All hospitals invited | Optimal |

*(a) Total number of hospital sites: in some countries, this number was corrected to a combination of hospital sites and administrative hospital groups because hospital indicator data were sometimes provided for a hospital group rather than by hospital site (b) Data submitted to ECDC (national denominator data) or data extracted from Eurostat, latest available year (mostly 2021); also see Annex 1 (Table A1.7) for national denominator data reported in TESSy. (c) Number of surveyed patients as a percentage of the number of occupied beds in acute care hospitals in the country (d) Sample representativeness assessment based on compliance with recommended sampling methodology of hospitals and sample size (see text).*

**Figure 2. Sample representativeness, by country, ECDC PPS 2022–2023**




*Country representativeness of the sample assessed based on compliance with recommended sampling methodology of hospitals and sample size (see text).*

In Iceland, country representativeness of the PPS sample was evaluated as good because the number of included beds was estimated to represent more than 80% of all acute care beds in the country, even though the PPS sample only included two hospitals (the two main acute care hospitals in the country). The other hospitals in Iceland are small, and represent a mixture of advanced primary care centres and nursing homes with only few truly acute care beds. For three countries, a sample of all participating hospitals was taken, either following the indications of the country (variable `sample hospital'), or randomly by ECDC, to avoid overrepresentation of these countries in the final dataset: Hungary (87/127 hospitals), Poland (93/192) and Spain (105/257). Hospitals that had participated in data validation were *de facto* included in the PPS sample.

The majority (87.1%) of hospitals used the patient-based (standard) protocol option. The unit-based (light) protocol option was used by all hospitals in Germany and Greece, by nine out of 31 hospitals in Croatia, by nine out of 20 hospitals in Estonia, and by two out of 47 hospitals in Slovakia. In Norway, all 53 hospitals used the national protocol and data were converted to the 'light' format (see methods).

The number of days spent by the data collectors for collecting data on 100 patients (excluding data entry and verification) was on average 2.9 days (median 2.0 days) for the light protocol option and 3.1 days (median 2.4 days) for the standard protocol. The median number of days spent by the hospital for complete data collection was four days (IQR: 1–7 days). The median time frame from the start of the PPS until the end of the PPS (including weekends), by hospital, was five days (IQR: 1–15 days). The median number of days spent for complete data collection varied from, one day in small hospitals (<200 beds), to 15 days in hospitals of 650 beds or more. However, the median time spent to collect data for 100 patients decreased with increasing hospital size, from 3.1 days per 100 patients in hospitals with less than 200 beds to 1.6 days per 100 patients in hospitals of 650 beds or more. Similarly, this median time was higher in primary hospitals (2.8 days per 100 patients) than in secondary hospitals (2.3 days per 100 patients) or tertiary hospitals (1.8 days per 100 patients).

# Hospital and patient characteristics

## Hospital type and size

The mean size of hospitals (total number of beds) included in the PPS was 371 beds (Table 3). The median size of hospitals included in the PPS was 267 beds and varied between 60 beds in Malta to 835 beds in Romania. The mean number of acute care beds in the included hospitals was 327 beds (median 230 beds) and the mean number of ICU beds was 20 (median 10 beds), with 80.2% of hospitals reporting at least one ICU bed. About one third (34.0%) of the hospitals reported to have excluded at least one ward from the PPS, often in agreement with the protocol (e.g. accident and emergency wards, day-case centres), but sometimes in disagreement with the exclusion criteria specified in the PPS protocol (e.g. psychiatric wards were frequently excluded in Finland, the Netherlands, Sweden and Serbia).

Of all included hospitals, 30.4% were primary hospitals, 35.0% were secondary hospitals, 23.8% were tertiary hospitals, and 10.0% were specialised hospitals (Table 3). The type of hospital was not reported for 0.9% of hospitals. Among specialised hospitals for which the specialty was specified, there were 26 surgical or orthopaedic hospitals, 23 geriatric or rehabilitation hospitals, 22 oncology hospitals, 20 paediatric, 15 cardiopulmonary (including cardiovascular surgery), 12 gynaecological and/or obstetric hospitals, three psychiatric hospitals, two infectious disease hospitals, two ophthalmology and/or otolaryngology centres, two other internal medicine hospitals and four other/unknown.

**Table 3. Type and size of hospitals, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | % of hospitals | No. of patients | % of patients | Hospital size (number of beds) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mean | P10 | P25 | P50 | P75 | P90 |
| Primary | 380 | 30.4 | 44 811 | 15.3 | 191 | 45 | 76 | 146 | 273 | 398 |
| Secondary | 437 | 35.0 | 105 677 | 36.0 | 387 | 93 | 175 | 314 | 493 | 785 |
| Tertiary | 297 | 23.8 | 126 721 | 43.2 | 649 | 139 | 280 | 585 | 861 | 1 209 |
| Specialised | 125 | 10.0 | 14 107 | 4.8 | 200 | 42 | 86 | 164 | 277 | 402 |
| Unknown | 11 | 0.9 | 2 079 | 0.7 | 362 | 100 | 111 | 200 | 631 | 708 |
| Total | 1 250 | 100.0 | 293 395 | 100.0 | 371 | 64 | 125 | 267 | 492 | 820 |

*P=percentile.*

**Figure 3. Hospital size (number of hospital beds, left) and type of hospital (right) in 1 250 hospitals, EU/EEA, ECDC PPS 2022–2023**

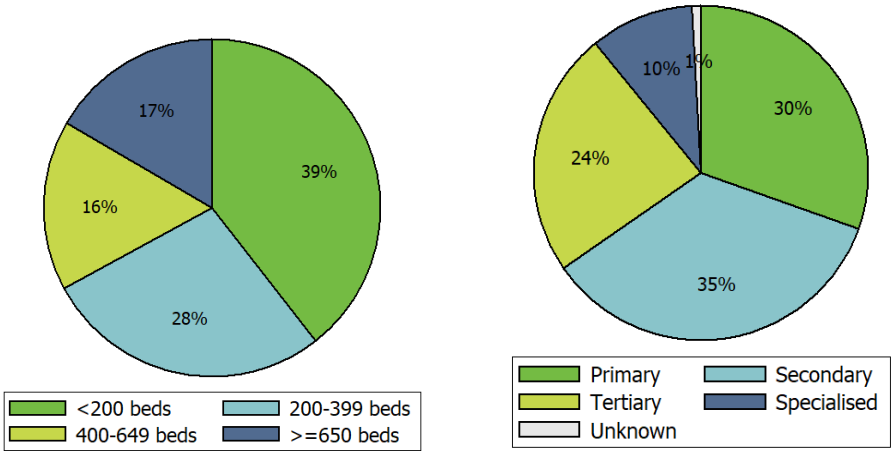
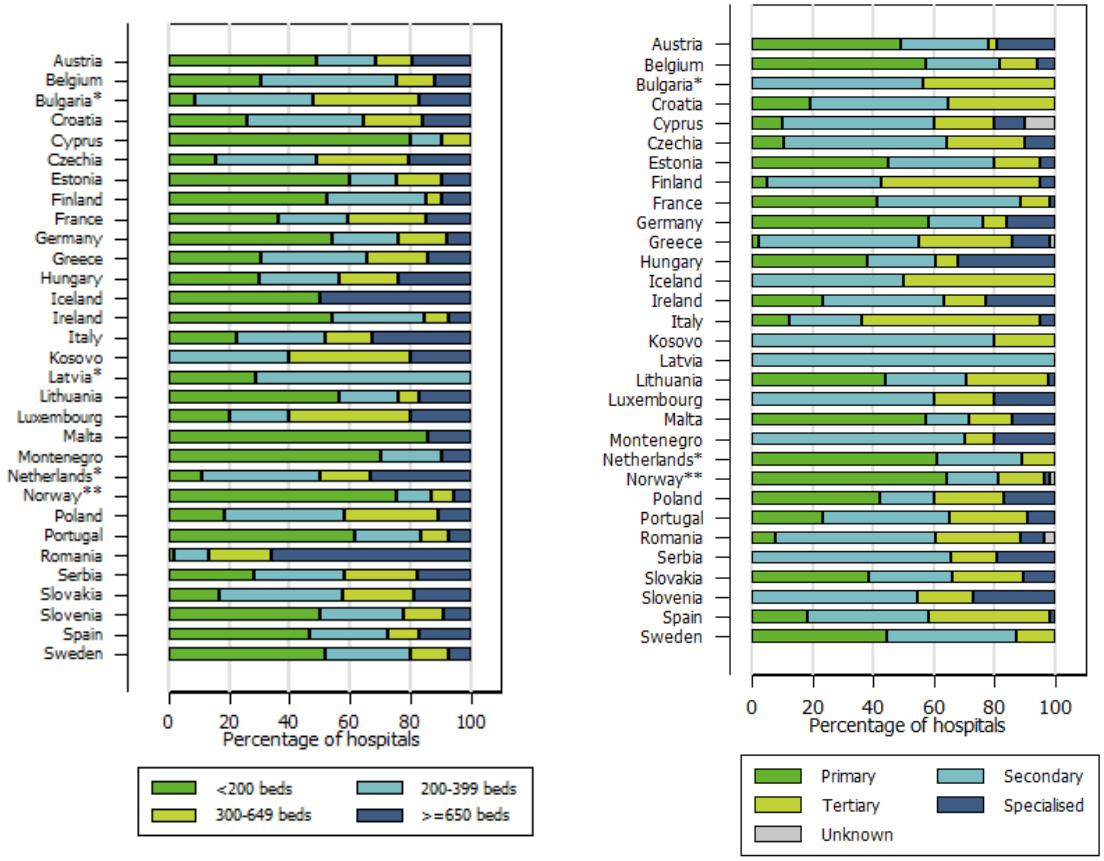


**Figure 4. Hospital size (number of hospital beds, left) and type of hospital (right) by country, ECDC PPS 2022–2023**



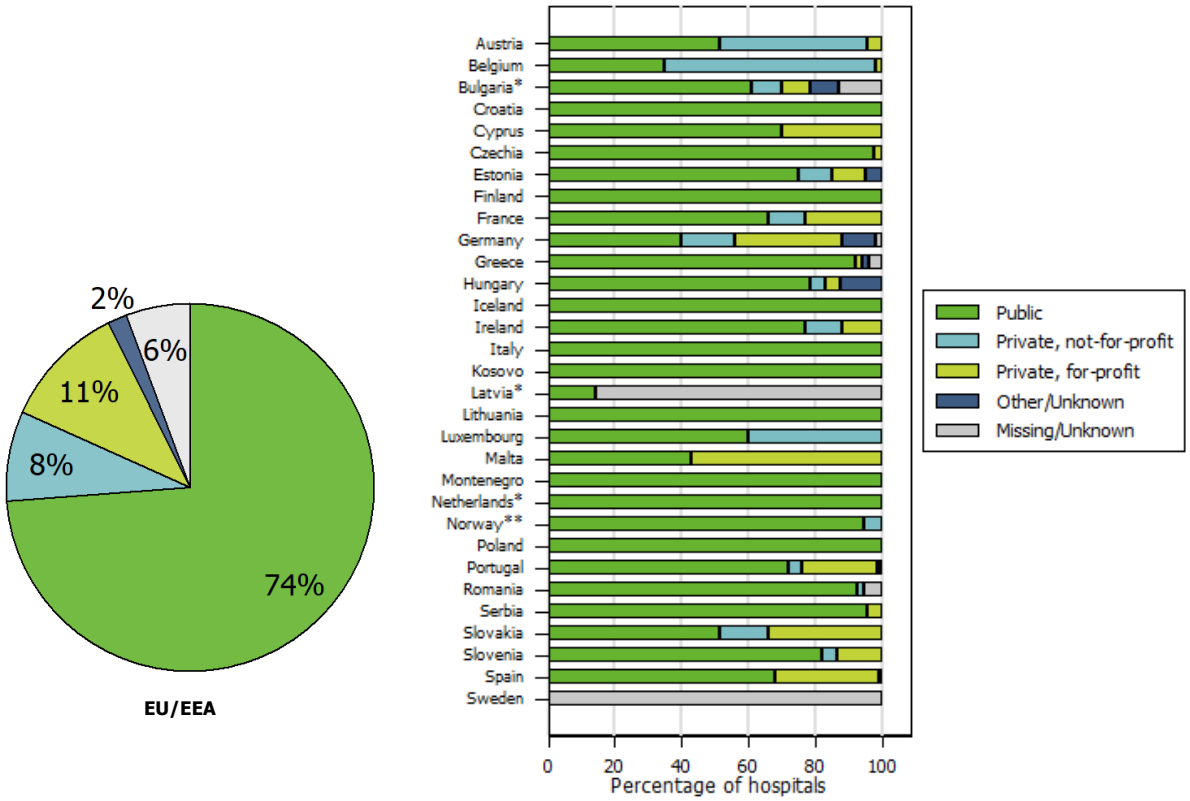

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national protocol.*

## Hospital ownership

Hospital ownership was reported by 1 179 (94.3%) out of 1 250 hospitals in the EU/EEA (Figure 5). Of 1 179 hospitals with information on ownership, 78.3% were public hospitals, 11.6% private for-profit hospitals and 8.3% private not-for-profit hospitals. The type of hospital ownership varied substantially by country. Where no private hospitals were reported, these hospitals were usually not included in the national PPS sample (e.g. they were not invited to participate), as reported by the national PPS coordination teams.

Hospital ownership varied significantly according to hospital type and size. Private hospitals were more likely to be primary hospitals than public hospitals (51.1% vs. 25.6%, $p<0.001$). Public hospitals had the highest number of beds (mean 419 beds, median 311 beds), followed by private not-for-profit hospitals (mean 264 beds, median 218 beds) and private for-profit hospitals (mean 156 beds, median 107 beds).

**Figure 5. Hospital ownership in hospitals, EU/EEA (left) and by country (right), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national protocol.*

## Length of hospital stay

Based on hospital statistics collected at the hospital level (number of discharges and patient-days in the most recent year), the average length of stay (LOS) in participating hospitals, was 8.1 days (mean of hospital means) and 5.6 days (overall aggregated mean). The country aggregated mean LOS varied from 3.6 days in Finland to 8.0 days in Italy. Overall, the hospital median LOS was 5.7 days (IQR: 4.1–7.2). The median occupancy rate in participating hospitals in the most recent year (year preceding the PPS for 98% of hospitals) was 62.1%.

At the national level, the average LOS in hospitals, for all discharges and patient-days in acute care hospitals, was 6.3 days (country median: 6.2 days). Considering national denominator data for only acute care beds (provided by nine countries), the average LOS was 5.4 days (country median: 5.5 days).

For hospitals that participated in the ECDC PPS 2022–2023, the aggregated LOS (based on hospital denominator data of the previous year) correlated with the overall national mean LOS (Spearman's rho 0.55, $p<0.01$) and with the national LOS for only acute care beds (Spearman's rho 0.68, $p<0.1$) (Figure 6)

As in the previous two PPSs, the median LOS from admission until the PPS day (patient data) was six days at the patient-level, at the hospital-level (median of hospital medians) and at the country-level (median of hospital medians by country). The mean LOS from admission until the PPS day (patient data) was 28.2 days (mean of hospital means 28.7 days, mean of aggregated country means 25.1 days), which was much higher than the mean LOS in the ECDC PPS 2016–2017 and more than twice as high as in the ECDC PPS 2011–2012 , when long-term care wards in acute care hospitals were excluded. Patients with a long hospital stay had a larger influence on the mean LOS than on the median LOS (until the PPS day) of the hospital or the country.

The mean LOS until the PPS day (patient data) was on average 3.4 times higher than the mean hospital LOS (hospital data), whereas the median LOS until the PPS day (patient data) was on average only 1.3 times higher than the mean hospital LOS (hospital data). The Spearman correlation coefficient rho between the mean hospital LOS (hospital data) and the median LOS until the day of the PPS (patient data) was 0.78 ($p<0.001$) (Figure 7).

**Figure 6. Correlation between the aggregated mean length of stay (in days) in participating hospitals (hospital data) and the mean length of stay for all hospitals in the country (national data), including all beds (left) and only acute care beds (right), ECDC PPS 2022–2023**

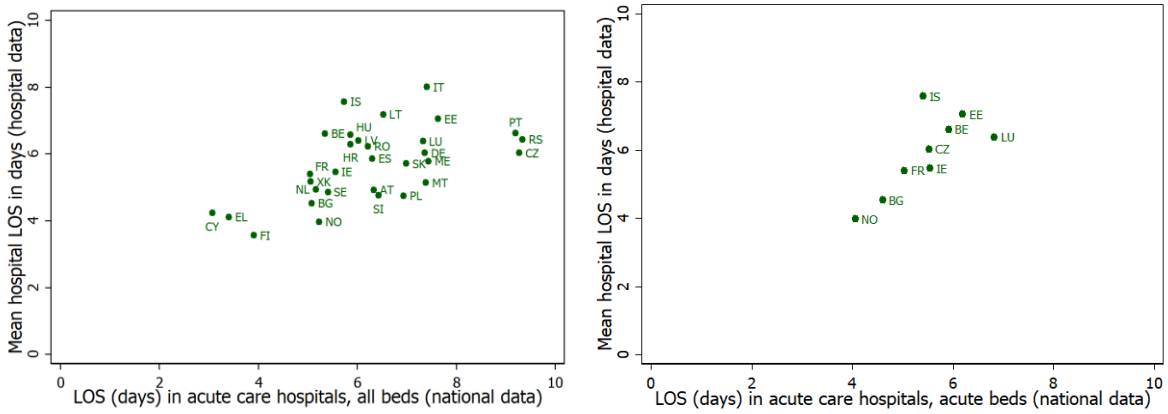
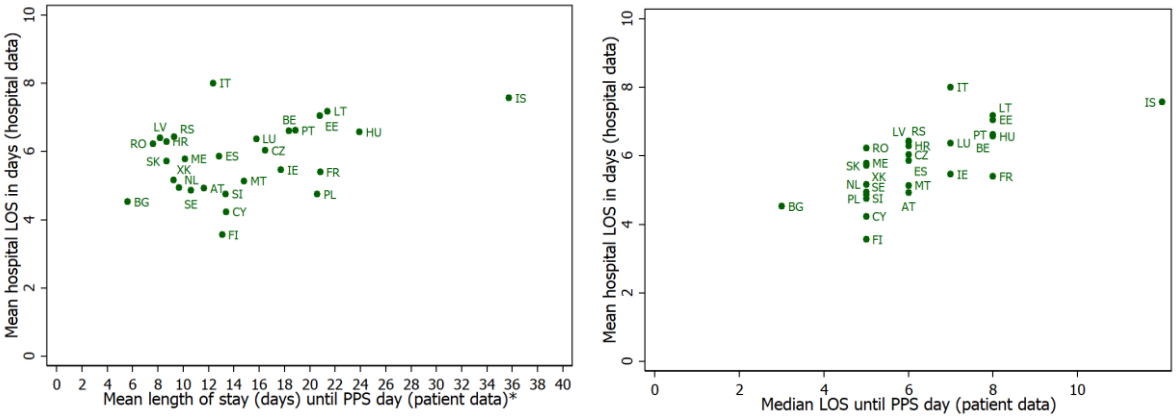



**Figure 7. Correlation between the mean length of stay (in days) in participating hospitals (hospital data) and the mean (left) and median (right) length of stay from date of admission until the survey date (patient data, n=28 countries with patient-based data), ECDC PPS 2022–2023**

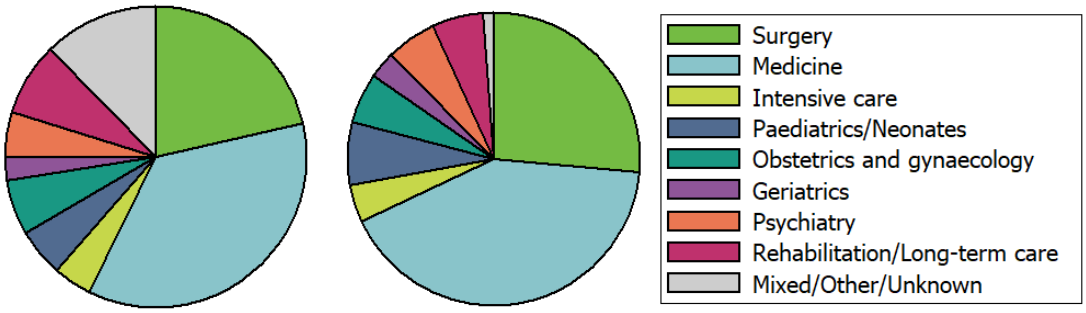



## Ward and patient/consultant specialty

Medical specialties such as general medicine, cardiology or neurology were the most commonly reported specialties accounting for 35.9% of the ward specialties and 41.6% of the specialties of the main disease of the patient or of the consultant in charge of the patient (Figure 8). Surgical specialties were the second most common category of ward specialties and patient/consultant specialties, with 21.4% and 26.5%, respectively. Intensive care unit patients represented 4.1% of patient/consultant specialties, paediatric specialties 6.9%, obstetrics and gynaecology 5.6%, geriatrics 2.9%, psychiatry 5.6%, rehabilitation and long-term care 5.7% and other, mixed or unknown specialties 1.1%.

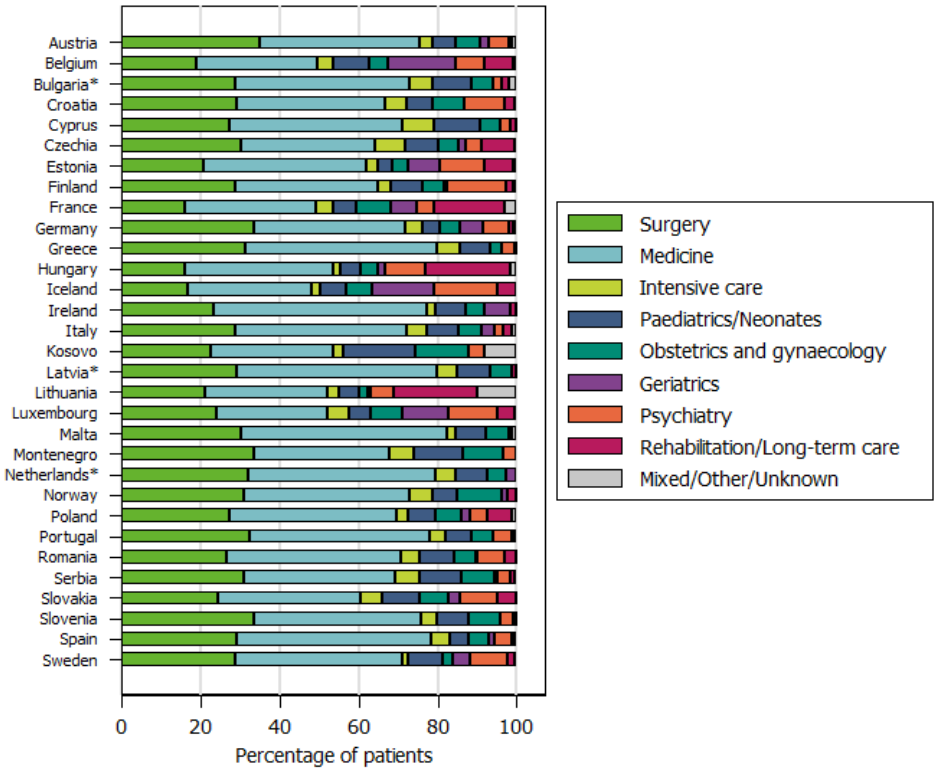
The distribution of patient/consultant specialties varied substantially between countries (Figure 9). The percentage of patient/consultant specialties reported as ICU (adult) varied from 1.5% in Sweden to 8.3% in Cyprus. Rehabilitation and long-term care ranged from 0% in Kosovo, Malta, Montenegro and the Netherlands to more than 15% in Hungary, France and Lithuania. The detailed distribution of patient/consultant specialties by country is given in Annex 1 (Table A1.2).

**Figure 8. Comparison of ward specialty (left) *versus* patient/consultant specialty (right), ECDC PPS 2022–2023**




*Kosovo, Montenegro and Serbia excluded. For this comparison, the patient specialty `Paediatrics/Neonates' in the right pie chart includes the specialties PEDGEN, PEDNEO, ICUPED, ICUNEO, SURPED and healthy neonates (PEDBAB and GOBAB).*

**Figure 9. Distribution of patient/consultant specialty by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national protocol. The patient specialty `Paediatrics/Neonates' in this figure includes the specialties PEDGEN (general paediatrics), PEDNEO (neonatology), ICUPED (paediatric ICU), ICUNEO (neonatal ICU), SURPED (paediatric surgery) and healthy neonates (PEDBAB and GOBAB).*

## Patient demographics and risk factors (patient-based data only)

Patient-based ('standard' protocol option) data were submitted by 25 EU/EEA countries (259 111 patients from 1 078 hospitals included in the analysed EU/EEA sample), and Kosovo, Montenegro and Serbia. The distribution of the patient demographics and risk factors is given in Table 4 and Table 5. Details by country are given in Annex 1 (Table A1.1).

The median age of the patients in EU/EEA hospitals was 67 years. This varied from 61 years in Bulgaria to 74 years in Estonia. Overall, 9.7% of the patients were under 18 years old, 36.2% were aged between 18 and 64 years and 54.7% were aged 65 years or older.

The average male-to-female ratio was 0.96:1 with the highest proportion of female patients in Hungary (M:F ratio 0.77:1) and the highest proportion of male patients in Spain (1.13:1).

Twenty-five percent of the patients had surgery since hospital admission, the lowest in Estonia (9.0%) and the highest in the Netherlands (33.1%).

'Rapidly fatal' (within one year), 'ultimately fatal' (within five years) and non-fatal diagnoses were reported for 5.6%, 15.0% and 62.3% of the patients, respectively. The percentage of patients with an expected 'rapidly fatal' outcome varied from 0.1% in Latvia to 8.4% in France. Information on the McCabe score was not available for 17.1% of the patients and varied between 0% in Spain and 100% in Lithuania.

A urinary catheter was present in 20.3% of patients, varying between 6.7% in Lithuania and 39.2% in Cyprus. A central vascular catheter was present in 9.5% of patients, varying from 4.2% in Estonia to 17.5% in Italy. Only 2.4% of patients were intubated at the time of the PPS and this varied from 1.2% in Iceland to 6.7% in Cyprus.

COVID-19 vaccination status was a new risk factor variable collected at patient level in the ECDC PPS 2022–2023. The information was provided by 20/25 EU/EEA countries which submitted patient-based data, for a total of 173 640 patients in 874 hospitals. Overall, 69.2% of hospitalised patients were vaccinated against COVID-19 with either the baseline full vaccine schedule (mostly two doses, 26.9%), the baseline schedule plus one additional dose (25.4%) or the baseline schedule plus two or more additional doses (16.9%), and 30.8% patients were either not vaccinated (26.9%) or partially vaccinated (3.9%). The percentage of patients vaccinated against COVID-19 varied between 23.9% in Bulgaria and 89.9% in Malta (Table A1.1).

**Table 4. Distribution of the patient demographics, patient-based data, ECDC PPS 2022–2023**

| | No. of patients | Median age (years) | Age category | | | | | | Sex ratio M:F | Median length of stay until day of PPS (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | % < 1 month | % 1–11 months | % 1–17 years | % 18–64 years | % 65–84 years | % 85+ years | | |
| EU/EEA | 259 111 | 67 | 2.8 | 2.0 | 4.9 | 36.2 | 42.0 | 12.1 | 0.96:1 | 7 |
| Country P25 | 3 977 | 65 | 2.8 | 1.0 | 3.3 | 33.4 | 39.7 | 9.9 | 0.91:1 | 6 |
| Country P50 | 9 491 | 67 | 3.2 | 1.4 | 5.0 | 35.1 | 41.5 | 11.3 | 0.96:1 | 8 |
| Country P75 | 17 235 | 68 | 4.0 | 2.0 | 6.2 | 38.6 | 43.4 | 15.3 | 1.02:1 | 8 |

*P: percentile.*

**Table 5. Distribution of the patient risk factors, patient-based data, ECDC PPS 2022–2023**

| | No. of patients | % Surgery since admission | McCabe score | | | | Invasive device use | | | % Vaccinated against COVID-19 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | % Non-fatal | % Ultimately fatal | % Rapidly fatal | % Missing | % CVC | % Urinary catheter | % Intubation | |
| EU/EEA | 259 111 | 25.3 | 62.3 | 15.0 | 5.6 | 17.1 | 9.5 | 20.3 | 2.4 | 69.2 |
| Country P25 | 3 977 | 21.1 | 64.8 | 12.4 | 3.2 | 1.6 | 6.0 | 15.3 | 1.5 | 60.0 |
| Country P50 | 9 491 | 25.5 | 70.0 | 18.5 | 4.5 | 5.1 | 9.0 | 19.5 | 2.0 | 70.9 |
| Country P75 | 17 235 | 28.9 | 73.7 | 20.6 | 6.0 | 17.6 | 11.8 | 21.8 | 2.9 | 79.8 |

*CVC: central vascular catheter; Vaccinated against COVID-19: full baseline schedule with or without additional doses* vs. *not or partially vaccinated; P: percentile; see Annex 1 (Table A1.1) for data by country.*

# Healthcare-associated infections

## Main results, aggregated

### *Prevalence and type of HAI*

Out of the total of 293 581 patients in the database, 20 869 patients (7.1%; 95% confidence interval 7.0–7.2%) were reported to have at least one HAI. Of those, 19 042 (91.2%) patients had one HAI, 1 725 (8.3%) had two HAIs and 102 (0.5%) had three or more HAIs on the day of the PPS. A total of 22 806 HAIs (1.09 HAI per infected patient) were reported. Ninety-three percent of patients with a HAI were receiving at least one antimicrobial agent on the day of the PPS.

The most frequently reported types of HAI were pneumonia and lower respiratory tract infection (29.3%), with COVID-19 accounting for 24.0% of reported pneumonia/lower respiratory tract infections and 7.0% of all HAIs (Table 6). A dedicated case definition and specific reporting instructions were developed for healthcare-associated COVID-19 for the ECDC PPS 2022–2023. Almost one third (29.0%) of the reported COVID-19 cases were asymptomatic at the time of the PPS, 54.7% were mild/moderate cases and 16.3% were severe. Of all COVID-19 cases, 19% were imported (either after a previous stay in the same hospital (33.4%) or from a long-term care facility (LTCF, 30.8%) or from another hospital (15.1%), and for 20.7% the origin was other or unknown), 16.9% were possibly healthcare-associated (onset from day three to day seven of the current hospitalisation), 29.9% were probably healthcare-associated (onset from day 8 to day 14), and 33.7% were definitely healthcare-associated (onset on day 15 or later). Severe healthcare-associated COVID-19 cases were more frequently imported (44.5%) than mild/moderate cases (16.2%) and asymptomatic cases (9.9%).

The second most frequently reported type of HAI was urinary tract infection (19.2%), followed by surgical site infection (16.1%), bloodstream infection (11.9%) and gastro-intestinal infection (9.5%), with *C. difficile* infections (CDIs) accounting for 62.1% of the latter or 5.9% of all HAIs.

Systemic infections (4.2% of total) included clinical sepsis in neonates (n=109) and treated infections of unknown origin in adults and children (SYS-CSEP, n=625).

Skin and soft tissue infections represented 3.7% of the total. Of these, 37.7% were skin infections, 28.2% soft tissue infections (necrotising fasciitis, infectious gangrene, necrotising cellulitis, infectious myositis, lymphadenitis, or lymphangitis), 28.9% decubitus ulcer infections and 2.1% burn infections.

The remaining types of HAI (n=1 406) made up 6.2% of HAI cases and included 442 eye, ear, nose, throat or mouth (EENT) infections (1.9%, of which 48.4% were infections of the oral cavity, 29.6% were upper respiratory tract infections, pharyngitis, laryngitis or epiglottitis and 10.6% were conjunctivitis or other eye infections), 300 bone and joint infections (1.3%, of which 47.3% were osteomyelitis, 35.3% were joint or bursa infections and 13.0% were disc space infections), 211 microbiologically confirmed catheter-related infections without positive blood culture (0.9%, of which 63.5% related to a central vascular catheter and 36.5% related to a peripheral vascular catheter), 179 cardiovascular system infections (0.8%, of which 52.0% were endocarditis, 30.2% were arterial or venous infections and 14.0% were mediastinitis), 137 central nervous system infections (0.6%, of which 61.3% were meningitis cases and 26.3% were intracranial infections) and 102 reproductive tract infections (0.4%, of which 21.6% were endometritis and 66.7% were other infections of the male or female reproductive tract). The detailed distribution of the types of HAI by country is summarised in Annex 1 (Table A1.3).

**Table 6. Prevalence of HAIs by type of HAI and relative frequency of types of HAI, ECDC PPS 2022–2023**

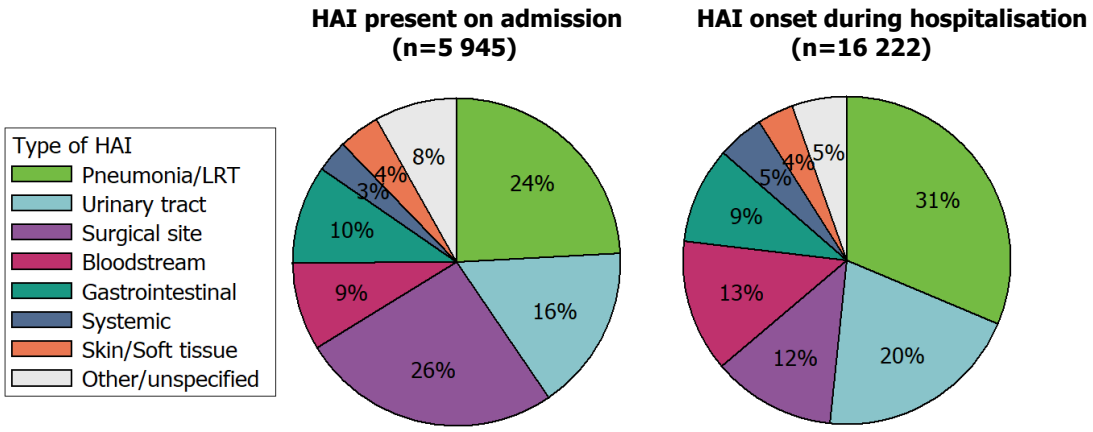
| Type of HAI | No. of patients with HAI | HAI% | No. of HAIs | Relative frequency % |
|---|---|---|---|---|
| **All types of HAI** | **20 869** | **7.0** | **22 806** | **100** |
| Pneumonia and lower respiratory tract infections (incl. COVID-19) | 6 679 | 2.3 | 6 686 | 29.3 |
| Pneumonia | 4 317 | 1.5 | 4 323 | 19.0 |
| COVID-19 | 1 606 | 0.5 | 1 606 | 7.0 |
| Other lower respiratory tract infections | 756 | 0.3 | 757 | 3.3 |
| Surgical site infection | 3 658 | 1.2 | 3 673 | 16.1 |
| Urinary tract infection | 4 375 | 1.5 | 4 381 | 19.2 |
| Bloodstream infection | 2 676 | 0.9 | 2 706 | 11.9 |
| Gastro-intestinal system infection | 2 143 | 0.7 | 2 155 | 9.5 |
| *Clostridioides difficile* infection | 1 338 | 0.5 | 1 338 | 5.9 |
| Other gastro-intestinal system infections | 805 | 0.3 | 817 | 4.6 |
| Systemic infection | 957 | 0.3 | 960 | 4.2 |
| Treated unidentified severe infection in adults and children | 626 | 0.3 | 626 | 2.7 |
| Clinical sepsis in neonates | 109 | <0.1 | 109 | 0.5 |
| Other systemic infection | 222 | 0.1 | 222 | 1.0 |
| Skin and soft tissue infection | 845 | 0.3 | 846 | 3.7 |
| Other type of HAI | 1 393 | 0.5 | 1 399 | 6.1 |
| Bone and joint infection | 297 | 0.1 | 299 | 1.3 |
| Catheter-related infection without bloodstream infection | 211 | 0.1 | 211 | 0.9 |
| Cardiovascular system infection | 180 | 0.1 | 180 | 0.8 |
| Central nervous system infection | 135 | <0.1 | 137 | 0.6 |
| Eye, ear, nose or throat, or mouth (EENT) infection | 435 | 0.1 | 437 | 1.9 |
| Reproductive tract infection | 100 | <0.1 | 100 | 0.4 |
| Other or unspecified HAI | 35 | <0.1 | 35 | 0.2 |

*HAI%: percentage of patients with at least one HAI. Relative frequency: percentage of all HAIs.*

## Characteristics: origin, time to infection onset, association to device use

A total of 5 946 (26%) HAIs were present on admission. Of those, 43.3% were associated with a previous stay in the same hospital, 24.1% with a previous stay in another hospital, 22.9% were imported from a LTCF (new category in the ECDC PPS 2022-2023, representing 6.3% of all HAIs) and for 9.7% the origin was reported as other or unknown (Table 7). Surgical site infections represented 26% of HAIs present on admission (Figure 10). The higher percentage 'Other or unspecified' types (8%) in HAIs present on admission rather than onset during hospitalisation was mainly due to bone and joint infections (3.6% of HAIs present on admission).

**Figure 10. Distribution of types of HAI by presence of HAI on admission (left) and HAI onset during hospitalisation (right), ECDC PPS 2022–2023**




*LRT: Lower respiratory tract.*

A total of 16 222 (71.1%) HAIs were attributed to the current hospital stay. These HAIs, starting during the current hospital stay, occurred in 14 778 patients, yielding an overall prevalence of 5.0%. The median duration of hospital stay until onset of the HAI was 12 days (mean 27.2 days).

For 638 (2.8%) HAIs, the presence on admission was unknown. Of those, 411 (64.6%) were attributed to the same hospital, 135 (21.2%) to another acute care hospital, 30 (4.7%) to a LTCF, and for 62 (9.4%) the origin was reported as other or unknown.

The presence of relevant invasive devices (intermittent or continuous) in the days preceding HAI onset was recorded for pneumonia (presence of intubation within the 48 hours before HAI onset), urinary tract infections (presence of a urinary catheter within the seven days before HAI onset) and bloodstream infections (presence of a vascular catheter within the 48 hours before HAI onset). Healthcare-associated pneumonia were device-associated in 31.5% of the cases and healthcare-associated urinary tract infections were device-associated in 61.9%. Healthcare-associated bloodstream infections were reported as catheter-related in 36.7% (central vascular catheter 28.4% and peripheral vascular catheter 8.3%) and secondary to another infection site in 32.4%. For 30.9% of the bloodstream infections, the origin was unknown, either after clinical ascertainment of possible sources of the infection (20.8%), or because data were missing (10.1%). Healthcare-associated primary bloodstream infections were catheter-associated (vascular catheter use within 48 hours before HAI onset) in 74.4% of the cases (Table 7).

The use of vasopressors for treatment of HAIs was added to the protocol of the ECDC PPS 2022–2023 as an indicator of septic shock in HAIs. Data were provided for 85.5% of HAIs. In those, vasopressor treatment was used for 8.8% (1 718/19 558) of HAIs, with a large variation across types of HAI. Vasopressor treatment was the highest in catheter-related infections without bloodstream infections (15.5%), followed by bloodstream infections (14.9%), pneumonia (14.3%, 23.4% in microbiologically documented pneumonia [PN 1–4] vs. 8.5% in PN5), systemic infections (14.0%), other lower respiratory tract infections (12.9%), central nervous system infections (10.0%), gastro-intestinal infections (7.3%), surgical site infections (5.9%), cardiovascular system infections (5.4%), skin and soft tissue infections (5.1%), COVID-19 (4.4%, 10.7% in severe, 2.9% in mild/moderate and 3.4% in asymptomatic COVID-19), urinary tract infections (4.3%), bone and joint infections (2.3%), reproductive tract infections (2.3%) and eye, ear, nose, throat or mouth (EENT) infection (1.8%).

**Table 7. Characteristics of (HAIs: origin, association with use of an invasive device use and origin of healthcare-associated bloodstream infections, ECDC PPS 2022–2023**

| Characteristics of HAIs | No. of HAIs | % |
|---|---|---|
| **Total number of HAIs** | **22 806** | **100.0** |
| **Origin of HAI** | | |
| HAI present on admission | 5 946 | 26.1 |
| Origin | | |
| Same hospital | 2 575 | 43.3 |
| Other hospital | 1 362 | 22.9 |
| LTCF | 1 430 | 24.1 |
| Other origin/unknown | 579 | 9.7 |
| HAI with onset during current hospitalisation | 16 222 | 71.1 |
| Day of HAI onset[a] | | |
| Day 1–2 | 6 68 | 4.1 |
| Day 3–4 | 1 555 | 9.6 |
| Day 5–7 | 26 55 | 16.4 |
| Day 8–14 | 4 236 | 26.1 |
| Day 15–21 | 2 245 | 13.8 |
| > Day 21 | 4 574 | 28.2 |
| Missing date of HAI onset | 289 | 1.8 |
| HAI presence at admission unknown | 638 | 2.8 |
| **HAI associated with current ward** | | |
| Yes | 12 434 | 54.5 |
| No | 6 118 | 26.8 |
| Missing/unknown | 4 251 | 18.6 |
| **Device-associated HAI** | | |
| Pneumonia, total[b] | 4 323 | 100.0 |
| Intubation within 48h before onset | 1 360 | 31.5 |
| No intubation | 2 700 | 62.5 |
| Presence of intubation unknown | 263 | 6.1 |

| Characteristics of HAIs | No. of HAIs | % |
|---|---|---|
| Urinary tract infection, total | 4 380 | 100.0 |
| Urinary catheter within 7d before onset | 2 713 | 61.9 |
| No urinary catheter | 1 436 | 32.8 |
| Presence of urinary catheter unknown | 231 | 5.3 |
| Bloodstream infection, primary[c] | 1 829 | 100.0 |
| Vascular catheter within 48h before onset[d] | 1 361 | 74.4 |
| No vascular catheter | 375 | 20.5 |
| Presence of vascular catheter unknown | 93 | 5.1 |
| **Bloodstream infection (BSI), by origin[d]** | | |
| BSI, total | 2 706 | 100.0 |
| Catheter-related (C) BSI[e] | 993 | 36.7 |
| C-CVC | 769 | 28.4 |
| Of which CRI3-CVC | 539 | 70.1 |
| C-PVC | 224 | 8.3 |
| Of which CRI3-PVC | 129 | 57.6 |
| Secondary (S) BSI[f] | 876 | 32.4 |
| S-Pulmonary infection | 125 | 4.6 |
| S-Urinary tract infection | 294 | 10.9 |
| S-Surgical site infection | 112 | 4.1 |
| S-Digestive tract infection | 147 | 5.4 |
| S-Skin/soft tissue infection | 83 | 3.1 |
| S-Other infection sites | 115 | 4.3 |
| BSI of unknown origin & missing | 836 | 30.9 |
| BSI of unknown origin[g] | 562 | 20.8 |
| Missing BSI origin | 274 | 10.1 |
| **Vasopressor treatment for HAI** | | |
| Yes | 1 718 | 7.5 |
| No | 17 840 | 78.2 |
| Missing/unknown | 3 248 | 14.2 |

*BSI: bloodstream infection; CVC: central vascular catheter; PVC: peripheral vascular catheter; CRI: catheter-related infection (with positive catheter tip microbiological results, see case definitions); CRI3: CRI with positive blood culture.*
*(a) HAIs with onset during current hospitalisation only.*
*(b) includes pneumonia subcategories PN1-PN5, PN-Nos and pneumonia in neonates (NEO-PNEU).*
*(c) Primary BSI = catheter-related BSI (including CRI3) and BSI of unknown origin.*
*(d) Including CRI3.*
*(e) C=catheter-related: clinical and/or microbiological (CRI3) evidence of relationship to central (C-CVC) or peripheral (C-PVC) vascular catheter.*
*(f) BSI secondary to another infection site.*
*(g) BSI origin was verified and confirmed to be unknown.*

## Microorganisms isolated from HAIs

A microorganism was reported for 60.8% of HAIs, ranging from 51.5% in pneumonia and lower respiratory tract infections to 87.4% in bloodstream infections. The microorganisms which were the most frequently reported for HAIs were, in decreasing order, *E. coli* (12.7%), *Klebsiella* spp. (11.7%), *Enterococcus* spp. (10.0%), SARS-CoV-2 (9.5%), *S. aureus* (9.0%), *C. difficile* (8.0%), *P. aeruginosa* (7.9%), coagulase-negative staphylococci (5.8%), *Candida* spp. (4.7%), *Proteus* spp. (3.2%), *Acinetobacter* spp. (3.2%) and *Enterobacter* spp. (3.0%). Other less common microorganisms, but important because of their epidemic potential or intrinsic AMR, were *Serratia* spp., *Stenotrophomonas maltophilia* and *Aspergillus* spp., that accounted for, respectively, 1.4%, 0.8% and 0.3% of all microorganisms. The higher percentage of *Klebsiella* spp. and the lower percentage of *Enterobacter* spp. in 2022–2023 compared to 2016–2017 (11.7% vs. 10.4% and 3.0% vs. 4.4%, respectively) was partially due to the taxonomical change of *Enterobacter aerogenes* to *Klebsiella aerogenes*. Nonetheless, the most frequent member of the *Klebsiella* genus, *Klebsiella pneumoniae,* represented 9.4% of all microorganisms vs. 8.8% in 2016–2017.

With the special emphasis on COVID-19 in the ECDC PPS 2022–2023 protocol and the epidemiological context, the most important emerging microorganism among the ten most frequent microorganisms in HAIs was SARS-CoV-2 (9.5%). Other viruses only represented 0.7% of the total, with the most frequently reported viruses being norovirus (n=20 cases), rotavirus (n=15), rhinovirus (n=14) and parainfluenza virus (n=11). The relative frequency of *Candida* spp. was slightly lower in 2022–2023 than in 2016–2017 (4.7% vs. 5.2%), and still mainly included *C. albicans* (2.5%) and *C. glabrata* (0.8%). Only five cases of *C. auris* (0.02% of all microorganisms) were reported in the ECDC PPS 2022–2023.

The predominant groups of microorganisms were gram-positive cocci in surgical site infections and bloodstream infections, Enterobacterales in urinary tract infections, viruses (mainly SARS-CoV-2) in respiratory tract infections, and anaerobes (mainly *C. difficile*) in gastro-intestinal tract infections (Table 8). It should be noted that the relative frequencies of SARS-CoV-2 and of *C. difficile* were overestimated in the PPS as the case definitions of these infections require a positive microbiological result.

**Table 8. Microorganisms isolated in HAIs by type of HAI, ECDC PPS 2022–2023**

| Microorganisms | All HAIs, Number | All HAIs, % | Pneumonia/lower respiratory tract infections | Surgical site infections | Urinary tract infections | Bloodstream infections | Gastro-intestinal tract infections |
|---|---|---|---|---|---|---|---|
| Number of HAIs, all | 22 806 | 100 | 6686 | 3673 | 4381 | 2706 | 2155 |
| Number of HAIs with microorganisms, all | 13 875 | 60.8 | 51.5 | 58.8 | 69.9 | 87.4 | 78.5 |
| Number of microorganisms | 16 948 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| **Gram-positive cocci** | 4 562 | 26.9 | 10.2 | 44.4 | 17.6 | 46.1 | 7.6 |
| *Staphylococcus aureus* | 1 524 | 9.0 | 6.4 | 15.3 | 1.3 | 15.4 | 0.4 |
| Coagulase-negative staphylococci | 986 | 5.8 | 0.9 | 9.6 | 0.8 | 16.4 | 0.6 |
| *Enterococcus* spp. | 1 687 | 10.0 | 1.7 | 15.4 | 14.8 | 11.6 | 5.5 |
| *Streptococcus* spp. | 326 | 1.9 | 1.1 | 3.7 | 0.5 | 2.2 | 1.1 |
| Other Gram-positive cocci | 39 | 0.2 | 0.0 | 0.4 | 0.2 | 0.4 | 0.0 |
| **Gram-negative cocci** | 30 | 0.2 | 0.4 | 0.2 | 0.1 | 0.1 | 0.0 |
| **Gram-positive bacilli** | 127 | 0.7 | 0.3 | 1.8 | 0.2 | 0.7 | 0.4 |
| **Enterobacterales** | 5 799 | 34.2 | 21.1 | 33.9 | 66.1 | 32.9 | 9.9 |
| *Citrobacter* spp. | 145 | 0.9 | 0.5 | 1.2 | 1.4 | 0.7 | 0.4 |
| *Enterobacter* spp. | 505 | 3.0 | 2.8 | 4.4 | 2.8 | 3.1 | 0.9 |
| *Escherichia coli* | 2 155 | 12.7 | 3.0 | 11.6 | 32.3 | 11.8 | 4.1 |
| *Klebsiella* spp. | 1 977 | 11.7 | 10.7 | 9.7 | 19.3 | 12.6 | 3.2 |
| *Proteus* spp. | 546 | 3.2 | 1.1 | 3.0 | 8.0 | 1.7 | 0.5 |
| *Serratia* spp. | 237 | 1.4 | 2.1 | 1.6 | 0.6 | 2.1 | 0.2 |
| Other Enterobacterales | 234 | 1.4 | 0.8 | 2.4 | 1.8 | 1.0 | 0.5 |
| **Other Gram-negative bacteria** | 2 188 | 12.9 | 20.8 | 11.4 | 10.6 | 11.7 | 3.1 |
| *Acinetobacter* spp. | 538 | 3.2 | 6.4 | 2.0 | 1.0 | 3.5 | 0.6 |
| *Pseudomonas aeruginosa* | 1 338 | 7.9 | 10.6 | 7.9 | 8.9 | 6.6 | 1.6 |
| *Stenotrophomonas maltophilia* | 129 | 0.8 | 1.9 | 0.6 | 0.1 | 0.7 | 0.3 |
| *Pseudomonadaceae* family, other | 60 | 0.4 | 0.4 | 0.3 | 0.4 | 0.4 | 0.1 |
| *Haemophilus* spp. | 57 | 0.3 | 1.1 | 0.2 | 0.0 | 0.1 | 0.0 |
| *Legionella* spp. | 1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Other Gram-negative bacteria | 65 | 0.4 | 0.3 | 0.5 | 0.2 | 0.5 | 0.5 |
| **Anaerobes** | 1 567 | 9.2 | 0.1 | 3.6 | 0.2 | 0.9 | 73.5 |
| *Bacteroides* spp. | 89 | 0.5 | 0.1 | 1.4 | 0.0 | 0.4 | 0.7 |
| *Clostridioides difficile* | 1 354 | 8.0 | 0.0 | 0.1 | 0.1 | 0.0 | 72.3 |
| Other anaerobes | 124 | 0.7 | 0.0 | 2.2 | 0.1 | 0.4 | 0.5 |
| **Other bacteria** | 36 | 0.2 | 0.3 | 0.4 | 0.0 | 0.1 | 0.1 |
| **Fungi** | 892 | 5.3 | 5.4 | 4.2 | 5.2 | 7.5 | 2.8 |
| *Candida* spp. | 793 | 4.7 | 3.7 | 4.0 | 5.2 | 7.2 | 2.7 |
| *Aspergillus* spp. | 59 | 0.3 | 1.3 | 0.1 | 0.0 | 0.0 | 0.0 |
| Other parasites | 40 | 0.2 | 0.4 | 0.2 | 0.1 | 0.3 | 0.1 |
| **Viruses** | 1 739 | 10.3 | 41.5 | 0.0 | 0.0 | 0.0 | 2.3 |
| SARS-CoV-2 | 1 612 | 9.5 | 40.1 | 0.0 | 0.0 | 0.0 | 0.1 |
| Other viruses | 127 | 0.7 | 1.4 | 0.0 | 0.0 | 0.0 | 2.3 |
| **Negative codes[a]** | 8 952 | 39.2 | 48.5 | 41.3 | 30.2 | 12.7 | 21.9 |
| Microorganism not identified | 934 | 4.1 | 5.0 | 4.2 | 3.2 | 0.4 | 2.7 |
| Examination not done | 1 790 | 7.8 | 12.6 | 7.3 | 3.8 | 0.4 | 3.8 |
| Sterile examination | 558 | 2.4 | 2.5 | 2.6 | 1.6 | 0.0 | 2.1 |
| Not (yet) available/missing | 5 670 | 24.9 | 28.4 | 27.2 | 21.6 | 11.9 | 13.4 |

*(a) Negative codes: percentage of total number of HAIs.*

Selected antimicrobial susceptibility testing (AST) data were available on the day of the survey for 90.4% of microorganisms reported for HAIs. Meticillin resistance was reported in 23.7% of *S. aureus* isolates with known AST results, a decrease from 31.0% in the ECDC PPS 2016–2017. Vancomycin resistance was reported in 15.6% of isolated *Enterococcus* spp. and was considerably higher among *E. faecium* than *E. faecalis* isolates (28.7% vs. 4.9%). Resistance to third-generation cephalosporins was reported in 34.7% of all included Enterobacterales included for the selected antimicrobial resistance markers (Table 9), and was the highest among *K. pneumoniae* and the lowest for *K. oxytoca* isolates. Resistance to carbapenems was reported for 9.3% of all included Enterobacterales, also the highest among *K. pneumoniae* isolates, and was reported in 29.7% of *P. aeruginosa* isolates and 82.9% of *A. baumannii* isolates. However, overall European AMR percentages were largely influenced by the data of a few countries reporting large numbers of isolates with AMR (see below, Annex A1.4 and Annex 2 for results by country).

**Table 9. Selected AMR markers in selected microorganisms reported in HAIs, ECDC PPS 2022–2023**

| Microorganisms and resistance | No. of isolates | No. with known result | % R |
|---|---|---|---|
| **Gram-positive cocci** | 3 211 | 2 845 | 19.6 |
| *Staphylococcus aureus*, METI-R (MRSA) | 1 524 | 1 414 | 23.7 |
| *Enterococcus* spp., VAN-R (VRE) | 1 687 | 1 431 | 15.6 |
| *Enterococcus faecalis*, VAN-R | 937 | 776 | 4.9 |
| *Enterococcus faecium*, VAN-R | 653 | 575 | 28.7 |
| **Enterobacterales, 3GC-R** | 5 711 | 5 165 | 34.7 |
| *Escherichia coli*, 3GC-R | 2 155 | 1 951 | 22.1 |
| *Klebsiella* spp., 3GC-R | 1 977 | 1 826 | 52.5 |
| *Klebsiella pneumoniae*, 3GC-R | 1 588 | 1 480 | 58.1 |
| *Klebsiella oxytoca*, 3GC-R | 183 | 158 | 12.7 |
| *Klebsiella aerogenes*, 3GC-R | 83 | 79 | 44.3 |
| *Enterobacter* spp., 3GC-R | 505 | 442 | 43.2 |
| *Enterobacter cloacae*, 3GC-R | 393 | 353 | 44.5 |
| *Citrobacter* spp., 3GC-R | 145 | 127 | 24.4 |
| *Proteus* spp., 3GC-R | 546 | 481 | 20.6 |
| *Serratia* spp., 3GC-R | 237 | 205 | 22.9 |
| *Morganella* spp., 3GC-R | 146 | 133 | 25.6 |
| **Enterobacterales, CAR-R** | 5 711 | 5 070 | 9.3 |
| *Escherichia coli*, CAR-R | 2 155 | 1 921 | 1.4 |
| *Klebsiella* spp., CAR-R | 1 977 | 1 754 | 21.9 |
| *Klebsiella pneumoniae*, CAR-R | 1 588 | 1 408 | 25.1 |
| *Klebsiella oxytoca*, CAR-R | 183 | 160 | 1.3 |
| *Klebsiella aerogenes*, CAR-R | 83 | 79 | 10.1 |
| *Enterobacter* spp., CAR-R | 505 | 437 | 5.7 |
| *Enterobacter cloacae*, CAR-R | 393 | 351 | 4.6 |
| *Citrobacter* spp., CAR-R | 145 | 134 | 3.7 |
| *Proteus* spp., CAR-R | 546 | 482 | 4.1 |
| *Serratia* spp., CAR-R | 237 | 207 | 2.9 |
| *Morganella* spp., CAR-R | 146 | 135 | 2.2 |
| **Other Gram-negative bacteria, CAR-R** | 1 818 | 1 700 | 44.1 |
| *Pseudomonas aeruginosa*, CAR-R | 1 338 | 1 239 | 29.7 |
| *Acinetobacter baumannii*, CAR-R | 480 | 461 | 82.9 |

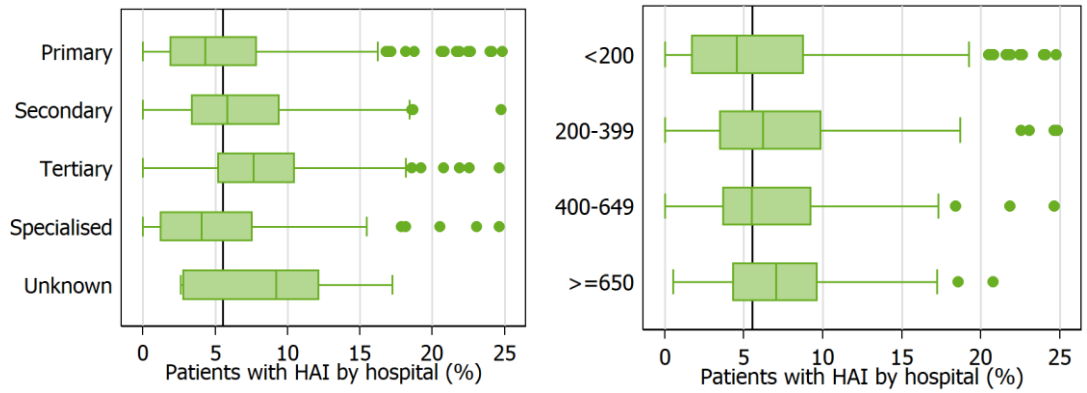
*N=number, R=resistant, N with known result: N of isolates with known susceptibility results (susceptible, intermediate, resistant), %R=N R/N with known results, MRSA=meticillin-resistant Staphylococcus aureus, VRE=vancomycin-resistant Enterococcus spp., METI=meticillin, VAN=vancomycin, 3GC=third-generation cephalosporin, CAR=carbapenem.*

## Results by type of hospital, medical specialty and patient risk factors

The prevalence of HAIs varied by type of hospital, and varied considerably within each type of hospital. The median HAI prevalence was 4.4% in primary hospitals (IQR: 1.9–8.0%), 5.9% in secondary hospitals (IQR: 3.4–9.5%), 7.7% in tertiary hospitals (IQR: 5.2–10.6%) and 4.1% in specialised hospitals (IQR 1.3–7.9%) (Figure 11).

The prevalence of HAIs also increased significantly with hospital size, from a median of 4.6% (IQR: 1.7–9.0%) in hospitals with fewer than 200 beds to a median of 7.1% (IQR: 4.4–9.8%) in hospitals with 650 beds or more (Figure 11).

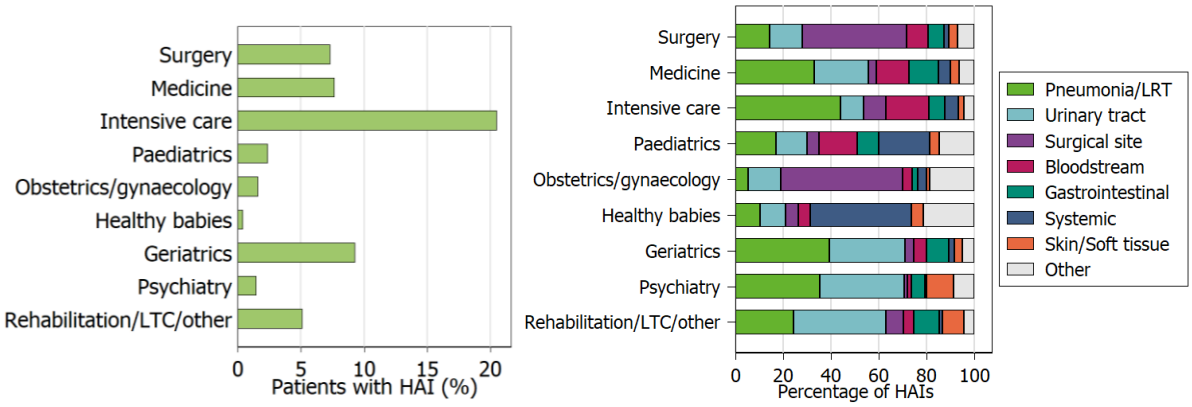
**Figure 11. Prevalence of HAI (percentage patients with at least one HAI) by hospital type (left) and size (n of beds) (right), n=1 250 hospitals, ECDC PPS 2022–2023**




*Vertical black line= median.*

HAI prevalence was the highest in patients admitted to ICUs, where 20.5% of patients had at least one HAI, compared to 7.3% for surgical specialties or 7.7% for internal medicine specialties (Figure 12). Patients in ICUs accounted for 5.1% of the total hospital population, but for 14.6% of all patients with a HAI. The most common types of HAI in ICUs were respiratory tract infections and bloodstream infections. Urinary tract infections were more frequent in geriatrics, psychiatry and rehabilitation/other specialties, while surgical site infection was the most common type of HAI in surgery and obstetrics and gynaecology. Among paediatric patients (paediatrics and healthy babies), clinical sepsis accounted for an important segment of HAIs, as shown by the high proportion of systemic infections in Figure 12.

**Figure 12. Prevalence of HAI (percentage of patients with at least one HAI) (left) and distribution of types of HAI (right) by patient/consultant specialty, ECDC PPS 2022-2023**




*LRT: Lower respiratory tract. LTC: long-term care*

Patient risk factors for HAIs could only be analysed for data collected according to the 'standard' (patient-based) protocol and included 275 406 patients. The overall HAI prevalence among these patients was 7.0% (Table 10). The strongest independent associations (adjusted odds ratio ≥2 or ≤0.5) were observed for length of stay in the hospital before HAI onset, for the presence of a urinary catheter (before onset of healthcare-associated urinary tract infection), for bone marrow transplantation and non-ICU COVID-19 specialties (higher risk of HAI than the reference specialty, i.e. general surgery), and for the low-risk specialties ophthalmology, dermatology, healthy neonates, obstetrics and maternity, and psychiatry (lower risk of HAI than the reference specialty, i.e. general surgery). The association of HAIs with the presence of a central vascular catheter was not included in the multivariable model because of the association of parenteral treatment (given through vascular catheters) with HAIs. The discriminatory power of the model, as measured by the area under the ROC curve, was 0.77 for the final model when performed on the full database.

**Table 10. Patient risk factors for HAI with crude and adjusted odds ratios derived from multiple logistic regression model, n=275 406 patients in 28 countries (standard protocol data only), ECDC PPS 2022–2023**

| Risk factor | Patients | | Patients with >=1 HAI | | Patient risk for HAI | | | |
|---|---|---|---|---|---|---|---|---|
| | No. | % of total | No. | % | Crude | | Adjusted* | |
| | | | | | OR | (95% CI) | OR | (95% CI) |
| All patients | 275 406 | 100.0 | 19 264 | 7.0 | - | | - | |
| **Age class** | | | | | | | | |
| 5–44 years | 55 027 | 20.0 | 2 549 | 4.6 | ref. | - | ref. | - |
| <1 month | 7 553 | 2.7 | 252 | 3.3 | 0.7 | (0.6–0.8) | 1.4 | (1.1–1.9) |
| 1–11 months | 5 832 | 2.1 | 275 | 4.7 | 1.0 | (0.9 – 1.2) | 1.2 | (1.2–1.5) |
| 1–4 years | 4 188 | 1.5 | 149 | 3.6 | 0.8 | (0.6 – 0.9) | 1.1 | (1.1–1.3) |
| 45–74 years | 117 642 | 42.7 | 8 468 | 7.2 | 1.6 | (1.5 – 1.7) | 1.1 | (1.1–1.1) |
| 75–84 years | 54 147 | 19.7 | 4 647 | 8.6 | 1.9 | (1.8 – 2.0) | 1.1 | (1.1–1.2) |
| ≥85 years | 31 017 | 11.3 | 2 924 | 9.4 | 2.1 | (2.0 – 2.3) | 1.2 | (1.2–1.3) |
| **Gender** | | | | | | | | |
| Female/other/unknown | 140 854 | 51.1 | 8 781 | 6.2 | ref. | - | ref. | - |
| Male | 134 552 | 48.9 | 10 483 | 7.8 | 1.3 | (1.2–1.3) | 1.1 | (1.1–1.1) |
| **Length of stay (days)[a]** | | | | | | | | |
| 1–3 days | 87 052 | 31.6 | 2 839 | 3.3 | ref. | - | ref. | - |
| 4–7 days | 72 126 | 26.2 | 4 663 | 6.5 | 2.1 | (2.0–2.2) | 1.7 | (1.6–1.8) |
| 8–14 days | 52 929 | 19.2 | 4 980 | 9.4 | 3.1 | (2.9–3.2) | 2.3 | (2.2–2.5) |
| 15–29 days | 32 535 | 11.8 | 3 835 | 11.8 | 4.0 | (3.8–4.2) | 2.9 | (2.8–3.1) |
| >=30 days | 29 940 | 10.9 | 2 926 | 9.8 | 3.2 | (3.0–3.4) | 2.8 | (2.6–2.9) |
| Unknown | 824 | 0.3 | 21 | 2.5 | 0.8 | (0.5–1.2) | 0.7 | (0.5–1.1) |
| **McCabe score** | | | | | | | | |
| Non-fatal | 174 175 | 63.2 | 8 905 | 5.1 | ref. | - | ref. | - |
| Ultimately fatal | 43 017 | 15.6 | 5 048 | 11.7 | 2.5 | (2.4–2.6) | 1.6 | (1.5–1.6) |
| Rapidly fatal | 13 546 | 4.9 | 2 022 | 14.9 | 3.3 | (3.1–3.4) | 1.7 | (1.6–1.8) |
| Unknown | 44 668 | 16.2 | 3 289 | 7.4 | 1.5 | (1.4–1.5) | 1.3 | (1.2–1.4) |
| **Surgery since admission (code)** | | | | | | | | |
| No surgery | 202 636 | 73.6 | 12 070 | 6.0 | ref. | - | ref. | - |
| NHSN surgery | | | | | | | | |
| NHSN surgery, not specified | 19 939 | 7.2 | 2 207 | 11.1 | 2.0 | (1.9–2.1) | 1.7 | (1.6–1.8) |
| AAA-Abdominal aortic aneurysm repair | 198 | 0.1 | 38 | 19.2 | 3.7 | (2.6 - 5.3) | 1.9 | (1.3–2.8) |
| AMP-Limb amputation | 1 192 | 0.4 | 168 | 14.1 | 2.6 | (2.2 - 3.1) | 1.7 | (1.4–2.0) |
| APPY-Appendix surgery | 713 | 0.3 | 27 | 3.8 | 0.6 | (0.4 - 0.9) | 1.1 | (0.7–1.6) |
| AVSD-Shunt for dialysis | 32 | 0.0 | 3 | 9.4 | 1.6 | (0.5 - 5.4) | 1.3 | (0.4–4.7) |
| BILI-Bile duct, liver or pancreatic surgery | 812 | 0.3 | 134 | 16.5 | 3.1 | (2.6 - 3.8) | 2.1 | (1.7–2.6) |
| BRST-Breast surgery | 655 | 0.2 | 16 | 2.4 | 0.4 | (0.2–0.6) | 0.7 | (0.4–1.1) |
| CARD-Cardiac surgery | 1 098 | 0.4 | 178 | 16.2 | 3.1 | (2.6–3.6) | 1.6 | (1.3–1.9) |
| CBGB-Coronary artery bypass graft with both chest and donor site incisions | 409 | 0.2 | 63 | 15.4 | 2.9 | (2.2–3.8) | 1.7 | (1.3–2.3) |
| CBGC-Coronary artery bypass graft with chest incision only | 196 | 0.1 | 33 | 16.8 | 3.2 | (2.2–4.6) | 1.7 | (1.1–2.5) |
| CEA-Carotid endarterectomy | 128 | 0.1 | 10 | 7.8 | 1.3 | (0.7–2.6) | 1.4 | (0.7–2.7) |
| CHOL-Gallbladder surgery | 844 | 0.3 | 53 | 6.3 | 1.1 | (0.8–1.4) | 1.3 | (1.0–1.7) |
| COLO-Colon surgery | 1 989 | 0.7 | 395 | 19.9 | 3.9 | (3.5–4.4) | 2.4 | (2.1–2.7) |
| CRAN-Craniotomy | 1 348 | 0.5 | 237 | 17.6 | 3.4 | (2.9–3.9) | 1.6 | (1.3–1.8) |
| CSEC-Caesarean section | 1 954 | 0.7 | 36 | 1.8 | 0.3 | (0.2–0.4) | 1.7 | (1.2–2.5) |
| FUSN-Spinal fusion | 615 | 0.2 | 63 | 10.2 | 1.8 | (1.4–2.3) | 1.6 | (1.2–2.1) |
| FX-Open reduction of fracture | 2 808 | 1.0 | 245 | 8.7 | 1.5 | (1.3–1.7) | 1.4 | (1.2–1.6) |
| GAST-Gastric surgery | 744 | 0.3 | 111 | 14.9 | 2.8 | (2.3–3.4) | 1.8 | (1.5–2.3) |
| HER-Herniorrhaphy | 959 | 0.4 | 41 | 4.3 | 0.7 | (0.5–1.0) | 1.1 | (0.8–1.5) |
| HPRO-Hip prosthesis | 2 992 | 1.1 | 255 | 8.5 | 1.5 | (1.3–1.7) | 1.5 | (1.3–1.7) |
| HTP-Heart transplant | 21 | 0.0 | 7 | 33.3 | 7.9 | (3.2–19.6) | 3.4 | (1.3–8.9) |
| HYST-Abdominal hysterectomy | 489 | 0.2 | 32 | 6.5 | 1.1 | (0.8–1.6) | 1.7 | (1.2–2.5) |
| KPRO-Knee prosthesis | 1 556 | 0.6 | 68 | 4.4 | 0.7 | (0.6–0.9) | 1.1 | (0.8–1.4) |
| KTP-Kidney transplant | 128 | 0.1 | 21 | 16.4 | 3.1 | (1.9–4.9) | 1.8 | (1.1–2.9) |
| LAM-Laminectomy | 631 | 0.2 | 71 | 11.3 | 2.0 | (1.6–2.6) | 2.1 | (1.6–2.7) |
| LTP-Liver transplant | 79 | 0.0 | 23 | 29.1 | 6.5 | (4.0–10.5) | 3.0 | (1.8–5.1) |
| NECK-Neck surgery | 520 | 0.2 | 73 | 14.0 | 2.6 | (2.0–3.3) | 2.2 | (1.7–2.9) |
| NEPH-Kidney surgery | 612 | 0.2 | 63 | 10.3 | 1.8 | (1.4–2.4) | 1.9 | (1.4–2.5) |
| OVRY-Ovarian surgery | 397 | 0.1 | 13 | 3.3 | 0.5 | (0.3–0.9) | 1.0 | (0.6–1.9) |
| PACE-Pacemaker surgery | 382 | 0.1 | 37 | 9.7 | 1.7 | (1.2–2.4) | 1.8 | (1.2–2.5) |
| PRST-Prostate surgery | 512 | 0.2 | 23 | 4.5 | 0.7 | (0.5–1.1) | 0.8 | (0.5–1.3) |
| PVBY-Peripheral vascular bypass surgery | 466 | 0.2 | 71 | 15.2 | 2.8 | (2.2–3.7) | 2.1 | (1.6–2.7) |
| REC-Rectal surgery | 450 | 0.2 | 72 | 16.0 | 3.0 | (2.3–3.9) | 2.5 | (1.9–3.2) |
| RFUSN-Refusion of spine | 121 | 0.0 | 14 | 11.6 | 2.1 | (1.2–3.6) | 1.9 | (1.0–3.3) |

| Risk factor | Patients | | Patients with >=1 HAI | | Patient risk for HAI | | | |
|---|---|---|---|---|---|---|---|---|
| | No. | % of total | No. | % | Crude | | Adjusted* | |
| | | | | | OR | (95% CI) | OR | (95% CI) |
| SB-Small bowel surgery | 615 | 0.2 | 126 | 20.5 | 4.1 | (3.3–5.0) | 2.5 | (2.0–3.1) |
| SPLE-Spleen surgery | 106 | 0.0 | 14 | 13.2 | 2.4 | (1.4–4.2) | 1.5 | (0.8–2.8) |
| THOR-Thoracic surgery | 713 | 0.3 | 92 | 12.9 | 2.3 | (1.9–2.9) | 1.7 | (1.3–2.2) |
| THYR-Thyroid and/or parathyroid surgery | 277 | 0.1 | 10 | 3.6 | 0.6 | (0.3–1.1) | 1.0 | (0.5–2.0) |
| VHYS-Vaginal hysterectomy | 321 | 0.1 | 10 | 3.1 | 0.5 | (0.3–1.0) | 0.9 | (0.5–1.8) |
| VSHN-Ventricular shunt | 174 | 0.1 | 42 | 24.1 | 5.0 | (3.5–7.1) | 2.8 | (1.9–4.1) |
| XLAP-Exploratory laparotomy | 869 | 0.3 | 172 | 19.8 | 3.9 | (3.3–4.6) | 2.4 | (2.0–2.9) |
| Minimal/non-NSHN surgery | 19 381 | 7.0 | 1 577 | 8.1 | 1.4 | (1.3–1.5) | 1.5 | (1.4–1.6) |
| Unknown | 4 325 | 1.6 | 250 | 5.8 | 1.0 | (0.9–1.1) | 1.1 | (0.9–1.2) |
| **Presence of invasive devices** | | | | | | | | |
| Intubation | 6 450 | 2.3 | 1 863 | 28.9 | 5.9 | (5.6–6.2) | 1.9 | (1.7–2.0) |
| Urinary catheter | 56 301 | 20.4 | 8 732 | 15.5 | 3.6 | (3.5–3.7) | 2.2 | (2.1–2.3) |
| Central vascular catheter (b) | 25 543 | 9.3 | 5 889 | 23.1 | 5.3 | (5.1–5.5) | - | - |
| **Patient/consultant specialty (code)** | | | | | | | | |
| General surgery | 17 899 | 6.5 | 1 409 | 7.9 | ref. | - | ref. | - |
| Digestive tract surgery | 4 240 | 1.5 | 405 | 9.6 | 1.2 | (1.1–1.4) | 1.1 | (0.9–1.2) |
| Orthopaedics and traumatology | 7 804 | 2.8 | 499 | 6.4 | 0.8 | (0.7–0.9) | 0.9 | (0.8–1.0) |
| Orthopaedics | 9 338 | 3.4 | 686 | 7.3 | 0.9 | (0.8–1.0) | 1.0 | (0.9–1.1) |
| Traumatology | 3 690 | 1.3 | 254 | 6.9 | 0.9 | (0.8–1.0) | 0.9 | (0.8–1.1) |
| Cardio surgery | 1 828 | 0.7 | 227 | 12.4 | 1.7 | (1.4–1.9) | 1.2 | (1.0–1.4) |
| Cardiovascular surgery | 565 | 0.2 | 47 | 8.3 | 1.1 | (0.8–1.4) | 0.9 | (0.7–1.3) |
| Vascular surgery | 3 431 | 1.3 | 327 | 9.5 | 1.2 | (1.1–1.4) | 1.1 | (0.9–1.2) |
| Thoracic surgery | 1 423 | 0.5 | 107 | 7.5 | 1.0 | (0.8–1.2) | 0.9 | (0.7–1.1) |
| Neurosurgery | 4 625 | 1.7 | 412 | 8.9 | 1.1 | (1.0–1.3) | 1.0 | (0.9–1.1) |
| Paediatric general surgery | 1 275 | 0.5 | 44 | 3.5 | 0.4 | (0.3–0.6) | 0.6 | (0.4–0.8) |
| Transplantation surgery | 357 | 0.1 | 51 | 14.3 | 2.0 | (1.4–2.6) | 1.4 | (1.0–1.9) |
| Surgery for cancer | 1 331 | 0.5 | 112 | 8.4 | 1.1 | (0.9–1.3) | 1.0 | (0.8–1.3) |
| ENT | 3 406 | 1.2 | 119 | 3.5 | 0.4 | (0.4–0.5) | 0.6 | (0.5–0.7) |
| Ophthalmology | 1 515 | 0.6 | 12 | 0.8 | 0.1 | (0.1–0.2) | 0.2 | (0.1–0.4) |
| Maxillo-facial surgery | 652 | 0.2 | 32 | 4.9 | 0.6 | (0.4–0.9) | 0.7 | (0.5–1.1) |
| Stomatology/ Dentistry | 59 | 0.0 | 4 | 6.8 | 0.9 | (0.3–2.4) | 1.0 | (0.4–3.0) |
| Burns care | 194 | 0.1 | 20 | 10.3 | 1.3 | (0.8–2.1) | 1.3 | (0.8–2.1) |
| Urology | 7 140 | 2.6 | 390 | 5.5 | 0.7 | (0.6–0.8) | 0.6 | (0.6–0.7) |
| Plastic and reconstructive surgery | 1 550 | 0.6 | 107 | 6.9 | 0.9 | (0.7–1.1) | 1.2 | (0.9–1.4) |
| Other surgery | 953 | 0.4 | 71 | 7.5 | 0.9 | (0.7–1.2) | 1.0 | (0.8–1.3) |
| General medicine | 36 242 | 13.2 | 3 150 | 8.7 | 1.1 | (1.0–1.2) | 1.2 | (1.1–1.3) |
| Gastro-enterology | 6 840 | 2.5 | 397 | 5.8 | 0.7 | (0.6–0.8) | 0.9 | (0.8–1.1) |
| Hepatology | 298 | 0.1 | 31 | 10.4 | 1.4 | (0.9–2.0) | 1.4 | (1.0–2.1) |
| Endocrinology | 2 072 | 0.8 | 81 | 3.9 | 0.5 | (0.4–0.6) | 0.7 | (0.5–0.9) |
| Nephrology | 3 990 | 1.5 | 404 | 10.1 | 1.3 | (1.2–1.5) | 1.4 | (1.2–1.6) |
| Cardiology | 14 402 | 5.2 | 626 | 4.3 | 0.5 | (0.5–0.6) | 0.7 | (0.6–0.8) |
| Dermatology | 1 194 | 0.4 | 16 | 1.3 | 0.2 | (0.1–0.3) | 0.3 | (0.2–0.5) |
| Haematology | 3 524 | 1.3 | 474 | 13.5 | 1.8 | (1.6–2.0) | 1.9 | (1.7–2.2) |
| Bone Marrow Transplantation (BMT) | 277 | 0.1 | 69 | 24.9 | 3.9 | (2.9–5.1) | 3.8 | (2.8–5.1) |
| Haematology/BMT | 694 | 0.3 | 127 | 18.3 | 2.6 | (2.1–3.2) | 2.7 | (2.2–3.4) |
| Oncology | 8 149 | 3.0 | 473 | 5.8 | 0.7 | (0.6–0.8) | 0.8 | (0.7–0.9) |
| Neurology | 13 005 | 4.7 | 801 | 6.2 | 0.8 | (0.7–0.8) | 1.0 | (0.9–1.1) |
| Pneumology | 9 792 | 3.6 | 561 | 5.7 | 0.7 | (0.6–0.8) | 0.9 | (0.8–1.0) |
| COVID-19 (non-ICU) | 1 516 | 0.6 | 315 | 20.8 | 3.1 | (2.7–3.5) | 3.5 | (3.0–4.1) |
| Rheumatology | 2 113 | 0.8 | 65 | 3.1 | 0.4 | (0.3–0.5) | 0.6 | (0.5–0.8) |
| Infectious diseases | 6 104 | 2.2 | 735 | 12.0 | 1.6 | (1.5–1.8) | 1.9 | (1.6–2.1) |
| Medical traumatology | 77 | 0.0 | 10 | 13.0 | 1.7 | (0.9–3.4) | 1.9 | (0.9–3.7) |
| Other medical | 3 761 | 1.4 | 271 | 7.2 | 0.9 | (0.8–1.0) | 1.1 | (1.0–1.3) |
| Healthy neonates (maternity) | 3 220 | 1.2 | 17 | 0.5 | 0.1 | (0.0–0.1) | 0.1 | (0.1–0.3) |
| Healthy neonates (paediatrics) | 1 512 | 0.6 | 7 | 0.5 | 0.1 | (0.0–0.1) | 0.1 | (0.1–0.3) |
| Neonatology | 3 233 | 1.2 | 145 | 4.5 | 0.5 | (0.5–0.7) | 0.8 | (0.6–1.2) |
| Paediatrics general, not specialised | 8 050 | 2.9 | 143 | 1.8 | 0.2 | (0.2–0.3) | 0.5 | (0.4–0.6) |
| Medical ICU | 3 071 | 1.1 | 585 | 19.0 | 2.8 | (2.5–3.1) | 1.4 | (1.2–1.7) |
| Surgical ICU | 2 203 | 0.8 | 504 | 22.9 | 3.5 | (3.1–3.9) | 1.2 | (1.0–1.5) |
| Paediatric ICU | 699 | 0.3 | 100 | 14.3 | 2.0 | (1.6–2.4) | 1.5 | (1.1–2.0) |
| Neonatal ICU | 2 039 | 0.7 | 214 | 10.5 | 1.4 | (1.2–1.6) | 1.2 | (0.9–1.7) |
| Mixed (polyvalent) ICU | 4 040 | 1.5 | 1 010 | 25.0 | 3.9 | (3.6–4.3) | 1.6 | (1.3–1.9) |
| Specialized ICU | 1 419 | 0.5 | 260 | 18.3 | 2.6 | (2.3–3.0) | 1.2 | (1.0–1.5) |
| COVID-19 ICU | 167 | 0.1 | 43 | 25.7 | 4.1 | (2.9–5.8) | 1.6 | (1.1–2.4) |
| Other ICU | 309 | 0.1 | 59 | 19.1 | 2.8 | (2.1–3.7) | 1.5 | (1.0–2.0) |
| Obstetrics / Maternity | 10 471 | 3.8 | 92 | 0.9 | 0.1 | (0.1–0.1) | 0.3 | (0.2–0.4) |

| Risk factor | Patients | | Patients with >=1 HAI | | Patient risk for HAI | | | |
|---|---|---|---|---|---|---|---|---|
| | No. | % of total | No. | % | Crude | | Adjusted* | |
| | | | | | OR | (95% CI) | OR | (95% CI) |
| Gynaecology | 5 173 | 1.9 | 164 | 3.2 | 0.4 | (0.3–0.5) | 0.7 | (0.5–0.9) |
| Geriatrics, care for the elderly | 7 875 | 2.9 | 770 | 9.8 | 1.3 | (1.2–1.4) | 1.2 | (1.0–1.4) |
| Psychiatrics | 15 108 | 5.5 | 206 | 1.4 | 0.2 | (0.1–0.2) | 0.3 | (0.2–0.4) |
| Rehabilitation | 10 143 | 3.7 | 472 | 4.7 | 0.6 | (0.5–0.6) | 0.9 | (0.8–1.1) |
| Long-term care | 6 011 | 2.2 | 336 | 5.6 | 0.7 | (0.6–0.8) | 0.9 | (0.8–1.1) |
| Others not listed | 1 864 | 0.7 | 66 | 3.5 | 0.4 | (0.3–0.6) | 0.6 | (0.5–0.8) |
| Combination of specialties | 1 381 | 0.5 | 129 | 9.3 | 1.2 | (1.0–1.5) | 1.4 | (1.1–1.7) |
| Unknown | 93 | | | | | | | |
| **Birth weight** | | | | | | | | |
| >=2500g | 6 749 | 2.5 | 127 | 1.9 | ref. | - | ref. | - |
| 1500-<2500g (low birth weight, LBW) | 1 655 | 0.6 | 75 | 4.5 | 2.5 | (1.9–3.3) | 0.9 | (0.7–1.2) |
| <1500g (very low birth weight, VLBW) | 1 132 | 0.4 | 139 | 12.3 | 7.3 | (5.7–9.4) | 1.6 | (1.2–2.2) |
| Unknown/Not applicable | 265 870 | 96.5 | 18 923 | 7.1 | 4.0 | (3.3–4.8) | 1.0 | (0.8–1.3) |
| **COVID-19 vaccination status** | | | | | | | | |
| Not vaccinated | 53 426 | 19.4 | 2 705 | 5.1 | ref. | - | ref. | – |
| Partial vaccination | 7 105 | 2.6 | 467 | 6.6 | 1.3 | (1.2–1.5) | 1.1 | (1.0–1.2) |
| Full baseline vaccination | 50 663 | 18.4 | 3 322 | 6.6 | 1.3 | (1.2–1.4) | 1.1 | (1.0–1.1) |
| 1 additional dose | 46 546 | 16.9 | 3 654 | 7.9 | 1.6 | (1.5–1.7) | 1.2 | (1.1–1.3) |
| >=2 additional doses | 29 746 | 10.8 | 2 966 | 10.0 | 2.1 | (2.0–2.2) | 1.4 | (1.3–1.5) |
| Unknown | 87 920 | 31.9 | 6 150 | 7.0 | 1.4 | (1.3–1.5) | 1.1 | (1.0–1.2) |
| **Unit specialty** | | | | | | | | |
| Surgery | 58 202 | 21.1 | 3 915 | 6.7 | ref. | - | ref. | - |
| Medicine | 99 053 | 36.0 | 7 525 | 7.6 | 1.1 | (1.1–1.2) | 1.1 | (1.0–1.2) |
| Neonatology | 4 787 | 1.7 | 237 | 5.0 | 0.7 | (0.6–0.8) | 1.0 | (0.8–1.3) |
| Paediatrics | 9 750 | 3.5 | 251 | 2.6 | 0.4 | (0.3–0.4) | 1.0 | (0.8–1.2) |
| Intensive care | 11 003 | 4.0 | 2 366 | 21.5 | 3.8 | (3.6–4.0) | 1.2 | (1.0–1.4) |
| Gynecology/Obstetrics | 16 845 | 6.1 | 234 | 1.4 | 0.2 | (0.2–0.2) | 0.9 | (0.7–1.2) |
| Geriatrics | 6 783 | 2.5 | 673 | 9.9 | 1.5 | (1.4–1.7) | 1.1 | (0.9–1.3) |
| Psychiatrics | 12 868 | 4.7 | 196 | 1.5 | 0.2 | (0.2–0.2) | 1.0 | (0.8–1.3) |
| Rehabilitation | 13 723 | 5.0 | 551 | 4.0 | 0.6 | (0.5–0.6) | 0.7 | (0.6–0.8) |
| Long-term care | 8 684 | 3.2 | 507 | 5.8 | 0.9 | (0.8–0.9) | 0.7 | (0.6–0.8) |
| Other | 4 378 | 1.6 | 178 | 4.1 | 0.6 | (0.5–0.7) | 0.8 | (0.6–0.9) |
| Mixed | 14 793 | 5.4 | 1 138 | 7.7 | 1.2 | (1.1–1.2) | 1.2 | (1.1–1.3) |
| Unknown | 14 537 | 5.3 | 1 493 | 10.3 | 1.6 | (1.5–1.7) | 1.2 | (1.1–1.3) |
| **Type of hospital** | | | | | | | | |
| Primary | 38 370 | 13.9 | 2 190 | 5.7 | ref. | - | ref. | – |
| Secondary | 104 765 | 38.0 | 6 691 | 6.4 | 1.1 | (1.1–1.2) | 1.1 | (1.1–1.2) |
| Tertiary | 116 696 | 42.4 | 9 517 | 8.2 | 1.5 | (1.4–1.5) | 1.3 | (1.2–1.4) |
| Specialised | 14 873 | 5.4 | 840 | 5.6 | 1.0 | (0.9–1.1) | 1.0 | (0.9–1.2) |
| Unknown | 702 | 0.3 | 26 | 3.7 | 0.6 | (0.4–0.9) | 0.4 | (0.2–0.5) |
| **Hospital specialty** | | | | | | | | |
| General hospital/unknown | 259 238 | 94.2 | 18 307 | 7.1 | ref. | - | ref. | - |
| Paediatrics/Neonates | 2 695 | 1.0 | 163 | 6.0 | 0.8 | (0.7–1.0) | 1.5 | (1.2–1.8) |
| Psychiatrics | 455 | 0.2 | 0 | 0.0 | - | - | - | - |
| Surgery/Orthopaedics/Traumatology | 1 755 | 0.6 | 105 | 6.0 | 0.8 | (0.7–1.0) | 1.0 | (0.8–1.3) |
| Heart/Lung | 1 766 | 0.6 | 101 | 5.7 | 0.8 | (0.7–1.0) | 0.8 | (0.6–1.0) |
| Haematology/Oncology | 3 348 | 1.2 | 281 | 8.4 | 1.2 | (1.1–1.4) | 1.3 | (1.1–1.6) |
| Gynaecology/Obstetrics | 1 496 | 0.5 | 62 | 4.1 | 0.6 | (0.4–0.7) | 1.8 | (1.4–2.4) |
| Infectious diseases | 585 | 0.2 | 65 | 11.1 | 1.6 | (1.3–2.1) | 1.2 | (0.9–1.6) |
| Geriatrics/Rehabilitation/Rheumatology | 2 804 | 1.0 | 109 | 3.9 | 0.5 | (0.4–0.6) | 1.1 | (0.8–1.4) |
| Other | 1 030 | 0.4 | 61 | 5.9 | 0.8 | (0.6–1.1) | 1.1 | (0.8–1.4) |
| **Hospital size** | | | | | | | | |
| <200 beds | 29 032 | 10.5 | 1 807 | 6.2 | ref. | - | ref. | - |
| 200-399 beds | 61 634 | 22.4 | 4 412 | 7.2 | 1.2 | (1.1–1.2) | 1.1 | (1.0–1.2) |
| 400-649 beds | 61 089 | 22.2 | 4 074 | 6.7 | 1.1 | (1.0–1.1) | 1.0 | (0.9–1.0) |
| 650-899 beds | 46 869 | 17.0 | 3 420 | 7.3 | 1.2 | (1.1–1.3) | 1.0 | (0.9–1.0) |
| >=900 beds | 76 782 | 27.9 | 5 551 | 7.2 | 1.2 | (1.1–1.2) | 0.9 | (0.9–1.0) |
| **Hospital ownership** | | | | | | | | |
| Public | 234 300 | 85.1 | 16 253 | 6.9 | ref. | - | | |
| Private, not-for-profit | 12 720 | 4.6 | 856 | 6.7 | 1.0 | (0.9–1.0) | 1.1 | (1.1–1.2) |
| Private, for profit | 9 286 | 3.4 | 480 | 5.2 | 0.7 | (0.7–0.8) | 0.9 | (0.8–1.0) |
| Other/Unknown | 19 100 | 6.9 | 1 675 | 8.8 | 1.3 | (1.2–1.4) | 1.4 | (1.3–1.5) |

**Adjusted odds ratio in fixed-effect multiple logistic regression model*
*(a) Length of stay in days until onset of HAI if HAI during current hospitalisation (b) CVC: adjusted odds ratios not calculated and variable not included in model because of correlation with treatment of HAI (parenteral antimicrobial treatment).*

# Results by country

## *Observed and predicted HAI prevalence based on patient case mix*

The prevalence of HAIs is known to be influenced by a variety of factors such as the type of hospital and healthcare system, the patient case mix (co-morbidities), methodological differences such as different interpretations of the case definitions of HAIs or application of the protocol, differences in microbiological sampling recommendations and/or practices, availability of diagnostic tests, differences in the level of training and skills of healthcare workers applying the definitions, and differences in reporting behaviour between hospitals and between countries. Comparing crude prevalence percentages of HAIs between countries without taking into account differences in patient case mix, representativeness and confidence intervals, differences in sensitivity and specificity, and differences in diagnostic (especially microbiological) support is not meaningful, and can lead to misleading or false conclusions.

Using the multiple logistic regression model shown in Table 10, a predicted prevalence was determined for each country applying the average European individual patient risk factors in that country and then summing up the individual patient probabilities for each country (sum of probabilities=predicted or 'expected' number of HAIs). For 'light' protocol data (11.7% of the patients), a model including patient/consultant specialty, type of hospital, hospital specialty and hospital size was used (model not shown).

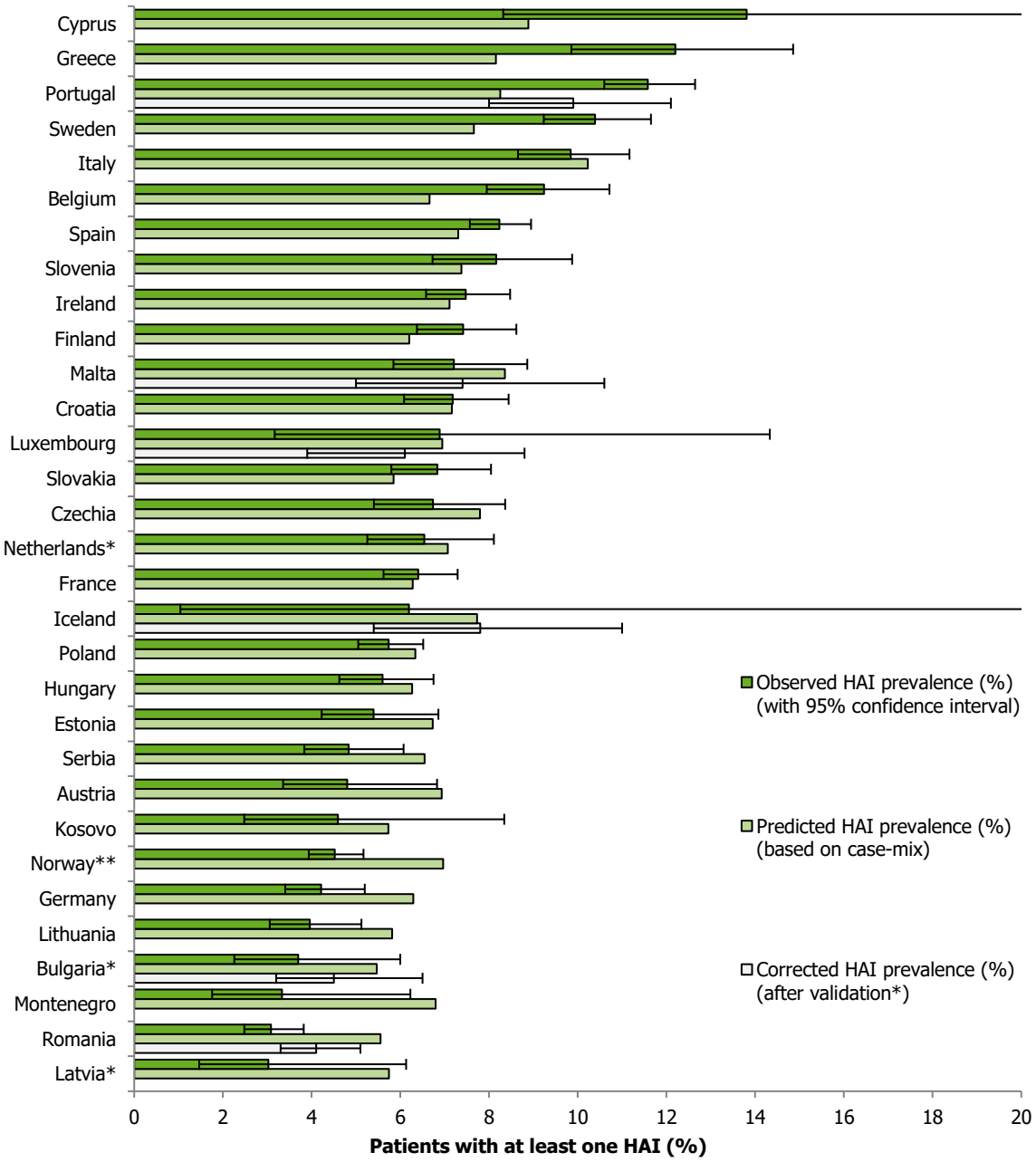
The observed and predicted HAI prevalences by country are presented in Figure 13. The observed HAI prevalence is displayed with 95% Cis to indicate uncertainty in the reported percentages, i.e. the HAI prevalence might as well, by chance, have been on the lower or the upper limit of the 95% CI, e.g. if other hospitals had been randomly selected or if the PPS had been performed on another day. As the width of confidence intervals decreases with sample size, countries with a small number of included patients and hospitals tend to have very large 95% Cis, especially – given the correction for the design effect - if the difference in prevalence between the hospitals is large (e.g. Cyprus, Iceland, Luxembourg, Kosovo).

Healthcare-associated infection prevalence (percentage of patients with at least one HAI) by country ranged from 3.0% (95% CI: 1.5–6.1%) in Latvia to 13.8% (95% CI: 8.3%–22.1%) in Cyprus. The mean of the EU/EEA country prevalence percentages was 7.0%, and the country median was 6.8%. For the comparison of the results of the current PPS with the ECDC PPS 2016–2017, the HAI prevalence was also calculated after removing HAIs that were not included in 2016–2017, i.e. healthcare-associated COVID-19 (7.0% of all HAIs) and HAIs imported from long-term care facilities (6.3% of all HAIs). The 'PPS2-adjusted' HAI prevalence in the EU/EEA database was 6.2% (before adjustment: 7.1%), with an EU/EEA country median of 6.2%, ranging from 2.8% in Romania to 11.7% in Cyprus. Results by country are provided in Annex 2 (country summary sheets).

When the total number of occupied acute care hospital beds per country was considered, the weighted HAI prevalence in the EU/EEA (without adjustment) was 6.3% (cumulative 95% confidence interval [cCI]: 5.3–7.4%). This result is lower than the country median of 6.8% because the HAI prevalence in countries with the highest number of occupied beds (France and Germany) was relatively low.

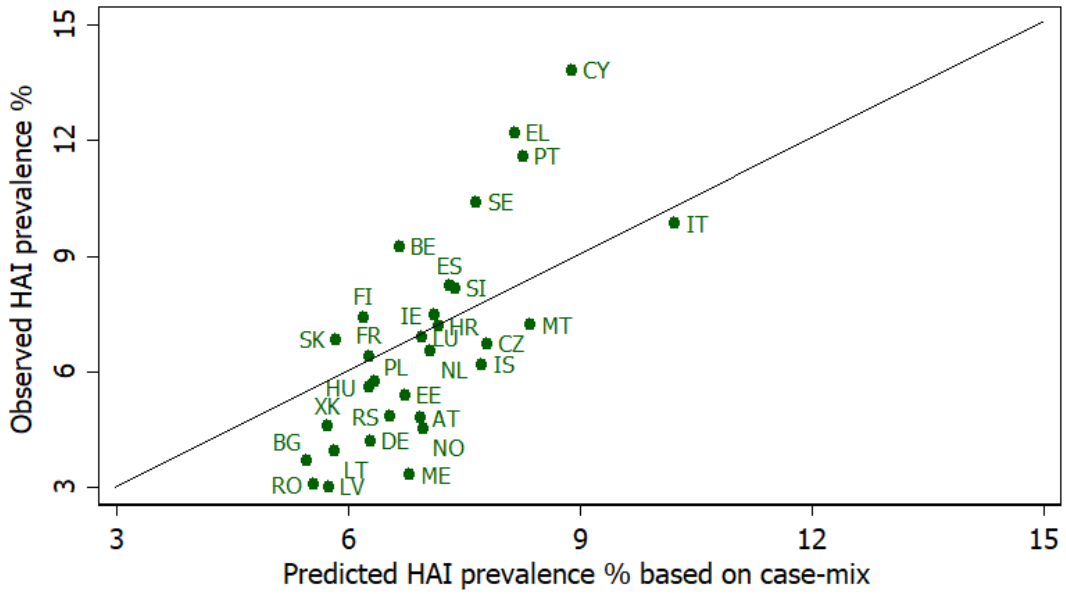
The correlation between the observed and predicted prevalence by country is shown in Figure 14 (Spearman's rho 0.73, $p<0.001$, R-squared 0.55). The ratio of the observed divided by the predicted prevalence (standardised infection ratio, SIR) varied from 0.49 in Montenegro to 1.55 in Cyprus.

**Figure 13. Observed and predicted HAI prevalence based on patient case-mix and hospital characteristics and corrected HAI prevalence after validation with 95% confidence intervals, by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The grey bars represent the prevalence corrected according to results of validation studies (only shown for countries with a representative validation sample, see Table 11).*

**Figure 14. Correlation between the observed and predicted prevalence of HAIs, by country, ECDC PPS 2022–2023**




*Line: Observed prevalence = predicted prevalence (Standardised Infection Ratio (SIR) =1). Countries below the line have a SIR lower than 1, countries above the line have a SIR higher than 1. The smaller the distance between the dot and the line, the closer the observed prevalence comes to the predicted prevalence based on patient case mix. Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. Norway used a national PPS protocol.*

## Validation of HAI data

### National validation studies

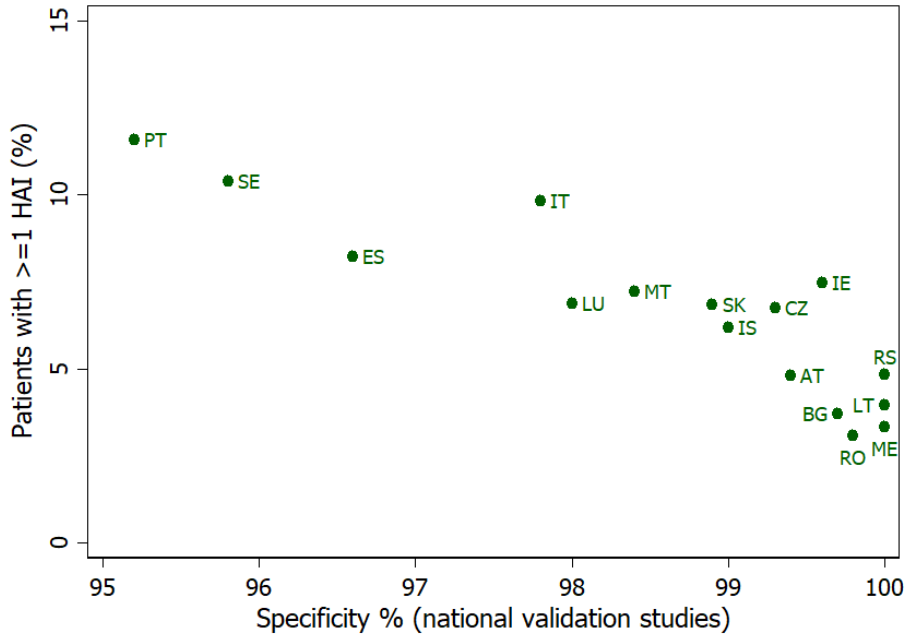
In 2022–2023, 16 EU/EEA countries, Montenegro and Serbia performed a validation study for the national PPS using the ECDC PPS validation protocol [28], which included a total of 106 validated hospitals and 6 058 validated patient files. Fewer countries performed a validation study than for the ECDC PPS 2016–2017 due to resource constraints in the post-COVID-19 pandemic period. Most of the countries only performed the validation for the recommended minimum sample. As Portugal provided a nationally representative sample (912 patients from 25 hospitals), the national corrected prevalence after validation is provided in Figure 13. The corrected HAI prevalence was also provided for Luxembourg, Malta and Iceland, where the sample could be considered as representative, because all participating hospitals were included in the validation study, and for Romania that validated a large number of patients (n=1 127), albeit from only seven hospitals. Results from Estonia and Greece were not considered for the EU/EEA summary results because of methodological issues related to the use of the 'light' protocol option for the primary PPS (pPPS).

All validation PPS data were collected by a national validation team, and in 97% of hospitals these data were collected on the same day as the pPPS in validated hospitals and wards. On average, 3.0% (country range: 1.2–8.5%) of patients who were reported as not having a HAI by the pPPS data collectors were found to have a HAI by the national validation teams (false negatives). On the other hand, 17.5% (country range: 0–37.3%) of patients reported as having a HAI did not have a HAI according to the national validation team (false positives). When applying the percentages of false positives and false negatives of the validation studies to HAI prevalence from the pPPS in these countries, the sensitivity of the pPPS data collectors for detecting and reporting a HAI was on average 68.2%, and ranged from 40.1% in Spain to 85.1% in Czechia (Table 11). The specificity for detecting and reporting a HAI was 98.4% on average and ranged from 95.2% in Portugal to 100% in Lithuania.

As in the ECDC PPS 2016–2017, there was a significant negative correlation between HAI prevalence in the pPPS and specificity (Spearman's rho -0.88, $p<0.001$), thus countries with high HAI prevalence in the pPPS tended to also have low specificity and the inverse was also true (Figure 15). There was no significant positive correlation between HAI prevalence in the pPPS and sensitivity (Spearman's rho -0.18, NS).

In the countries that performed a validation study, the mean corrected HAI prevalence was 8.3% compared to an average observed prevalence of 6.8% before correction. The estimated country-weighted corrected HAI prevalence, calculated by applying the mean percentages of false negatives and of false positives to the country-weighted EU/EEA prevalence, was 8.0% (95% cCI 6.6–9.6) compared to 6.3% (95% cCI 5.3–7.4) before correction (see Table 19).

**Figure 15. Correlation between the observed prevalence of HAIs and specificity of the primary PPS data collectors for reporting a HAI, by country, ECDC PPS 2022–2023**




*Spearman's rho -0.88, p<0.001*

**Table 11. Results of national PPS validation surveys: HAI prevalence, ECDC PPS 2022–2023**

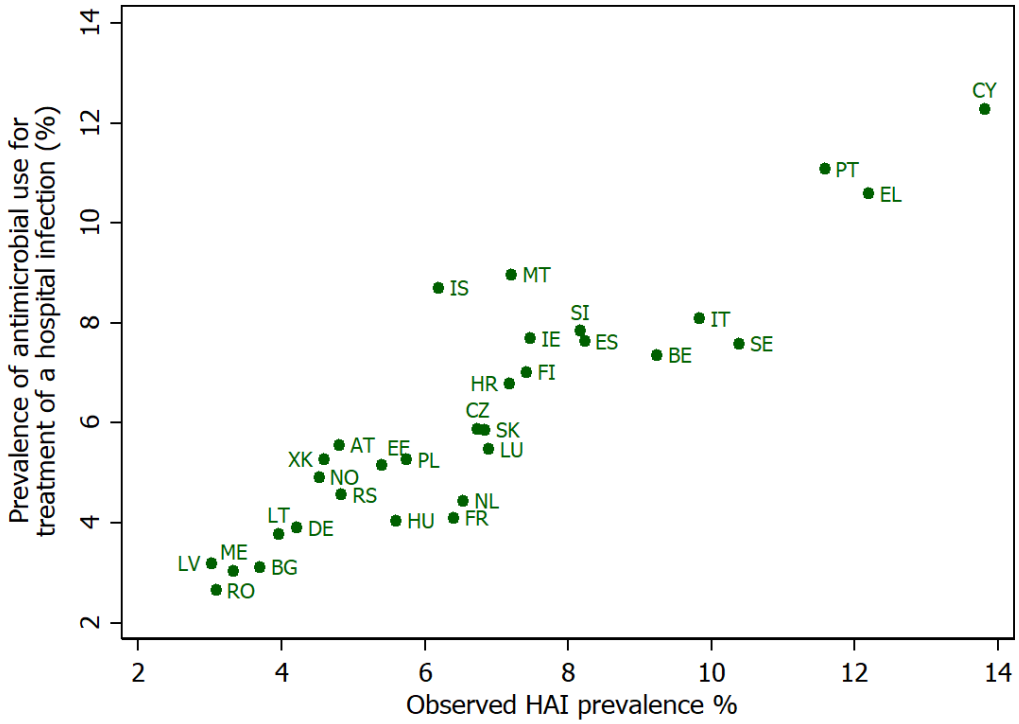
| Country | N of hospitals | N of patients | False negatives % | False positives % | Sensitivity % (95% CI) | Specificity % (95% CI) | pPPS HAI % | Corrected HAI % (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Austria | 5 | 261 | 3.3 | 11.1 | 57.7 (34.0–77.7) | 99.4 (98.2–99.9) | 4.8 | 7.4 (4.5–10.8) |
| Bulgaria | 7 | 379 | 1.2 | 7.7 | 75.1 (50.4–92.2) | 99.7 (99.2–99.9) | 3.7 | 4.5 (3.2– 6.5) |
| Czechia | 6 | 300 | 1.2 | 10.0 | 85.1 (62.7–96.8) | 99.3 (98.2–99.8) | 6.8 | 7.2 (5.4– 9.7) |
| Estonia* | 5 | 249 | 5.8 | 66.7 | 24.8 (8.4–50.3) | 96.1 (94.9–97.4) | 5.4 | 7.3 (3.8–12.1) |
| Greece* | 5 | 250 | 17.3 | 14.6 | 40.6 (30.1–51.3) | 97.6 (95.2–99.0) | 12.1 | 25.6 (19.7–31.9) |
| *Iceland* | *2* | *255* | *1.8* | *12.9* | *78.8 (54.2–93.8)* | *99 (97.7–99.7)* | *7.1* | *7.8 (5.4–11.0)* |
| Ireland | 5 | 250 | 3.9 | 5.0 | 66.2 (45.4–81.7) | 99.6 (97.9–100.0) | 7.5 | 10.7 (7.3–14.2) |
| Italy | 5 | 257 | 3.9 | 20.0 | 69.5 (41.4–89.1) | 97.8 (95.0–99.4) | 7.5 | 10.7 (7.3–14.2) |
| Lithuania | 6 | 313 | 3.8 | 0.0 | 52.3 (34.3–68.5) | 100.0 (99.3–100.0) | 4.0 | 7.6 (5.1–10.3) |
| *Luxembourg* | *5* | *365* | *1.2* | *27.6* | *81.8 (56.4–95.2)* | *98 (96.5–99.1)* | *6.9* | *6.1 (3.9– 8.8)* |
| *Malta* | *7* | *267* | *1.7* | *20.0* | *78.3 (52.9–93.8)* | *98.4 (97.1–99.3)* | *7.2* | *7.4 (5.0–10.6)* |
| *Portugal* | *25* | *912* | *3.0* | *37.3* | *73.3 (61.5–82.9)* | *95.2 (94.1–96.2)* | *11.6* | *9.9 (8.0–12.1)* |
| *Romania* | *7* | *1 127* | *1.3* | *6.7* | *70.0 (56.0–82.0)* | *99.8 (99.6–99.9)* | *3.1* | *4.1 (3.3– 5.1)* |
| Slovakia | 5 | 289 | 3.4 | 15.0 | 65.1 (42.1–82.2) | 98.9 (97.1–99.8) | 6.8 | 8.9 (5.7–12.4) |
| Spain | 6 | 296 | 8.5 | 36.0 | 40.1 (23.3–57.2) | 96.6 (94.5–98.3) | 8.1 | 13 (8.5–18.1) |
| Sweden | 5 | 288 | 4.5 | 36.4 | 62.1 (41.1–79.8) | 95.8 (93.8–97.4) | 10.4 | 10.7 (7.0–15.2) |
| **EU/EEA mean** | **106** | **6 058** | **3.0** | **17.5** | **68.2 (61.1–75.3)** | **98.8 (98.4–99.1)** | **6.8** | **8.3 (6.8–9.7)** |
| Montenegro | 5 | 258 | 1.2 | 27.6 | 74.2 (38.5–93.3) | 100.0 (98.7–100.0) | 3.3 | 4.5 (2.3– 6.7) |
| Serbia | 5 | 247 | 1.7 | 20.0 | 85.3 (57.2–97.9) | 100.0 (99.1–100.0) | 4.8 | 5.7 (4.1– 7.8) |

*N of hospitals: number of validated hospitals; N of patients: number of validated patients; CI: confidence interval; pPPS HAI %: HAI prevalence (% of patients with HAI) of the primary national PPS (see Table 19 for confidence intervals); Corrected HAI %: corrected HAI prevalence after adjustment for validation results. *Results of Estonia and Greece were not considered for the EU/EEA mean because of methodological issues related to the validation of data collected using the light protocol option in the primary PPS. Results in italics were considered representative validation results at country level.*

## HAI versus antimicrobial treatment of a hospital infection

In the pPPS, good correlation (Spearman's rho 0.89, p<0.001) is shown in Figure 16 between the percentage of patients with confirmed HAI as per the case definition (observed HAI prevalence) and the prevalence of patients receiving at least one antimicrobial for the treatment of a 'hospital infection' (which could be understood as the `physician-indicated HAI prevalence'). The mean prevalence of patients receiving at least one antimicrobial for the treatment of a 'hospital infection' was 6.4% (country range 2.7%–12.3%), and on average 10% lower than the observed HAI prevalence, while in the ECDC PPS 2016–2017 it was 10% higher than the observed HAI prevalence. This difference may be related to the inclusion of healthcare-associated COVID-19 in the ECDC PPS 2022–2023, whereby antimicrobial treatment was less frequently prescribed for mild/moderate (47.7%) and asymptomatic COVID-19 (35.0%) than in other HAIs (96.5%).

**Figure 16. Correlation between the observed prevalence of HAI and the prevalence of antimicrobial use for physician-labelled 'treatment of a hospital infection', by country, ECDC PPS 2022–2023**




*Spearman's rho 0.89, p<0.001*
*X-axis: observed HAI prevalence (reported by the primary PPS data collectors); Y-axis: percentage of patients receiving antimicrobials for treatment intention of a hospital infection.*

## Onset and origin of HAIs

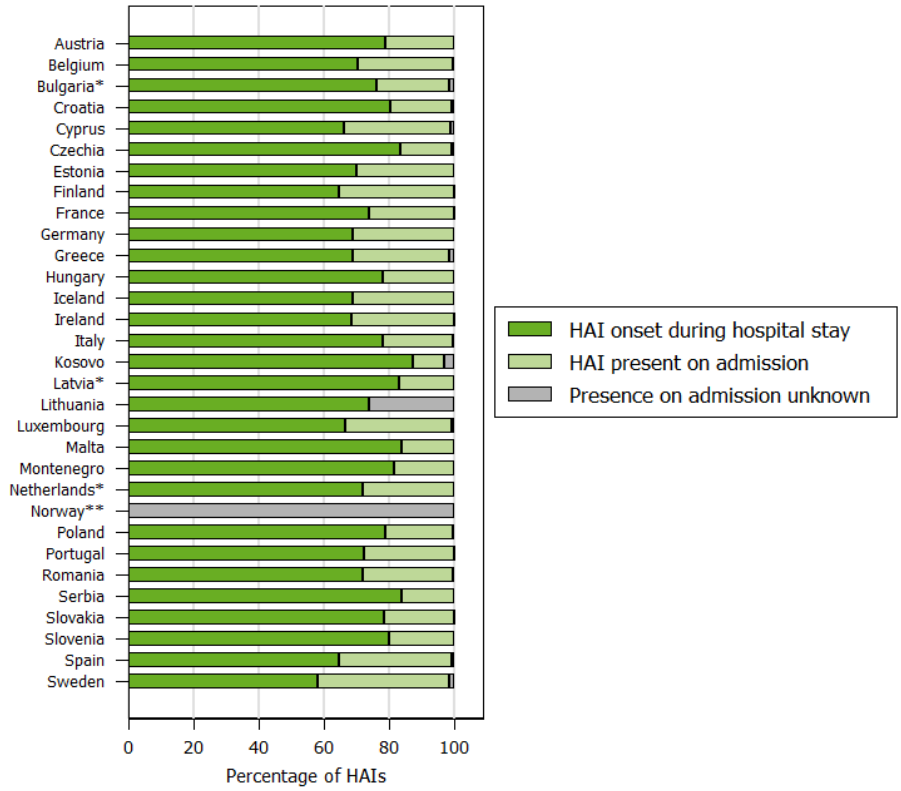
The percentage of HAIs present on admission ranged from 15.6% in Czechia to 41.2% in Sweden (Figure 17). Data were not available for Norway.

The percentage of HAIs attributed to the current hospital stay or to a previous stay in the same hospital ranged from 70.3% in Sweden to 97.1% in Latvia (Figure 18). The percentage of HAIs attributed to a stay in a LTCF (new category in the ECDC PPS 2022–2023) ranged from 0% in Bulgaria, Iceland, Lithuania, Latvia, Malta, the Netherlands and Slovenia to 18.0% in Sweden.

For HAIs starting during the current hospitalisation, the median time from hospital admission until HAI onset varied from eight days in Finland (mean 22.8 days) and Sweden (mean 14.8 days) to 22 days in Iceland (mean 45.6). The percentage of HAIs with onset before Day 3 ranged from 1.4% in Malta to 9.4% in Lithuania (Figure 19).

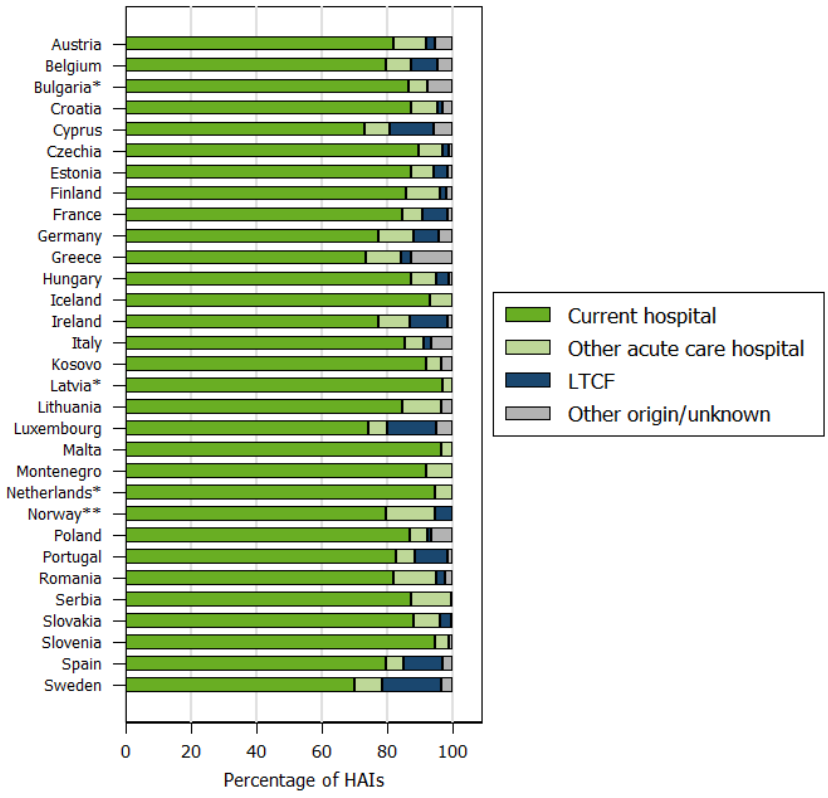
HAIs were on average associated with the current ward in 67.0% of cases, varying between 54.3% in Cyprus and 80.0% in Latvia.

**Figure 17. Percentage of HAIs present on admission, by country, ECDC PPS 2022–2023**



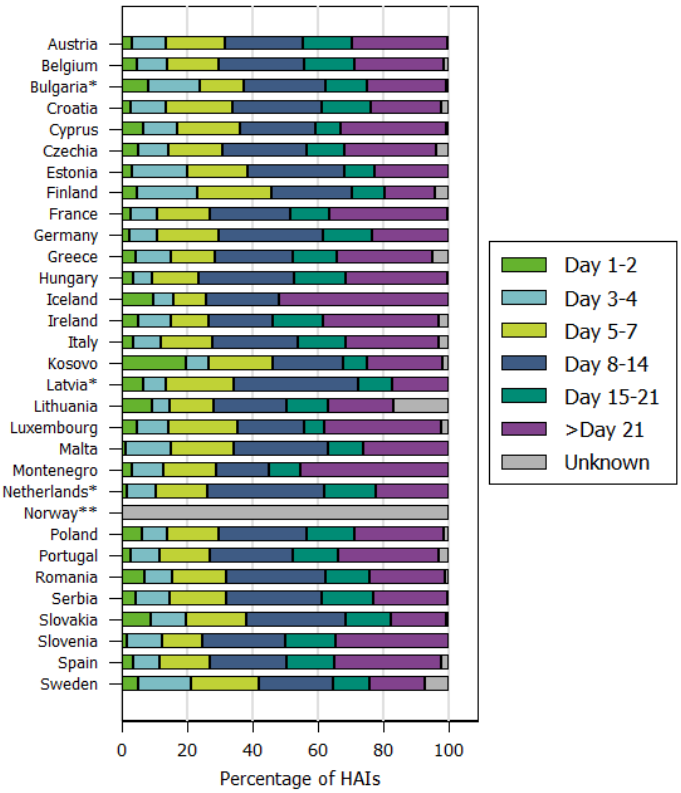

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 18. Origin of HAIs, by country, ECDC PPS 2022–2023**



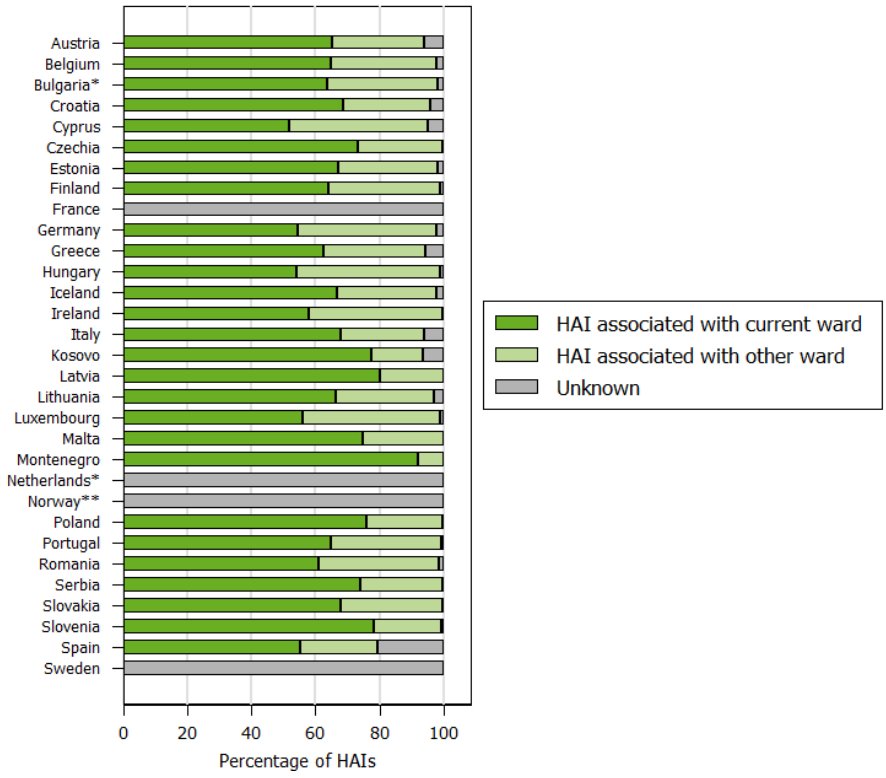

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol: aggregated HAI numerator data were collected separately by HAI origin (in two categories).*

**Figure 19. Distribution of the day of onset of (HAIs not present on admission, by country, ECDC PPS 2022–2023**




**Country representativeness was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 20. Healthcare-associated infections associated with the current ward, by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

## *Types of HAIs*

The majority of the countries reported the same three types of HAI as being the most common, i.e. pneumonia and lower respiratory tract infection, surgical site infection and urinary tract infection (Figure 21, Annex 1).

The percentage of pneumonia and lower respiratory infections varied between 19.5% in Malta to 60.0% in Latvia. Pneumonia were microbiologically confirmed (PN1, 2 or 3) in 20.8% cases, ranging from 0% in Iceland, Latvia and Malta to 73.8% in Bulgaria.

The percentage of urinary tract infections varied between 8.5% in Latvia and 30.0% in Iceland and were microbiologically confirmed (UTI-A) in 72.9% of cases, from 56.0% in Ireland to 89.7% in Bulgaria.

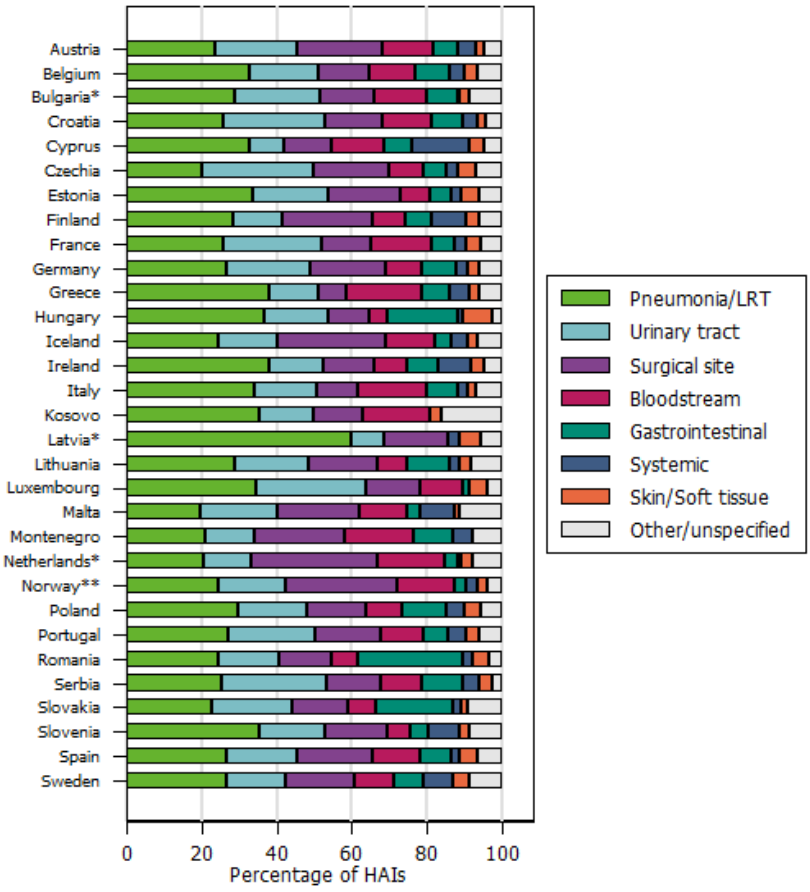
The percentage of surgical site infections varied between 7.3% in Greece and 33.9% in the Netherlands. Superficial surgical site infections accounted for 23.9% of surgical site infections, from 7.7% in Iceland to 57.5% in Slovakia.

The percentage of bloodstream infections varied between 0% in Latvia and 20.1% in Greece. Bloodstream infections were secondary to another infection in 32.4% of cases, ranging from 12.9% in Croatia to 72.2% in Estonia.

The proportion of gastro-intestinal infections ranged from 0% in Latvia to 28.1% in Romania.

Skin and soft tissue infections were a small category of HAIs, with a figure of 3.7% overall, varying from 1.1% in Malta to 7.9% in Hungary.

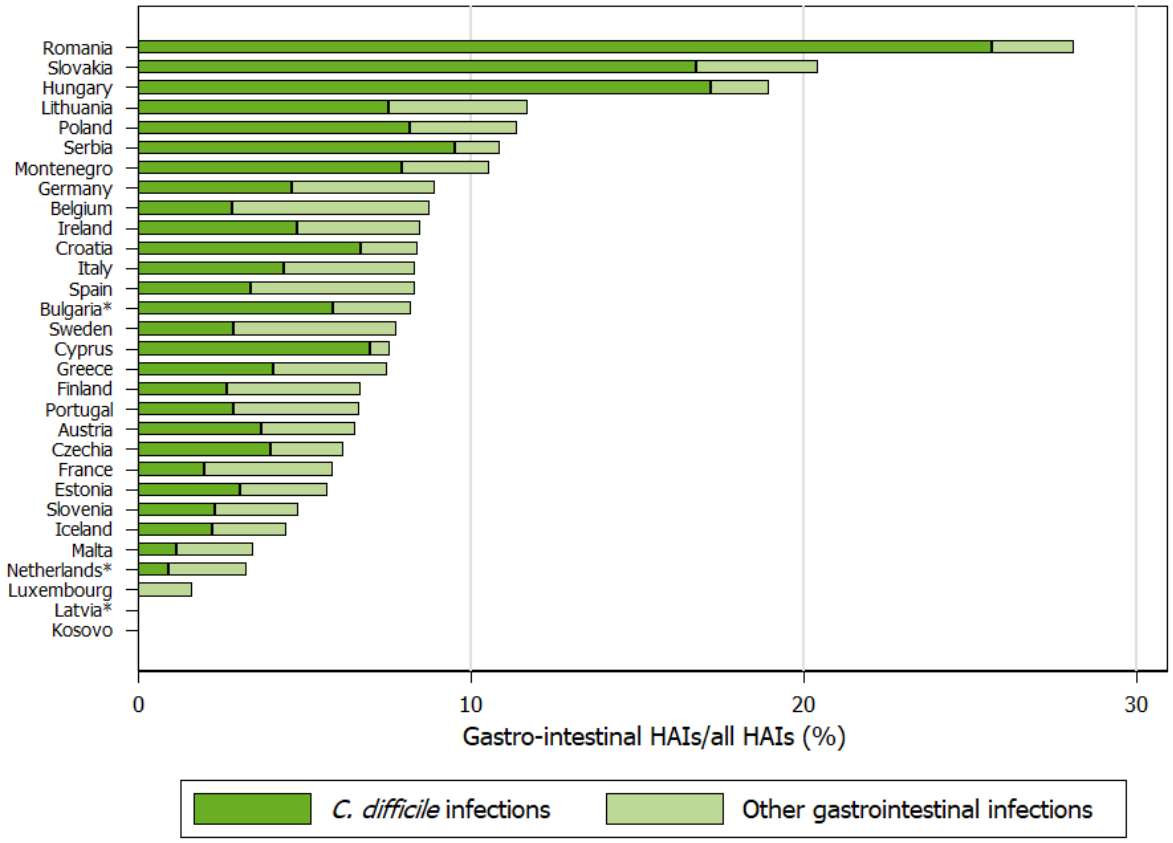
**Figure 21. Distribution of types of HAI, by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*
*LRT: Lower respiratory tract.*

Certain HAI diagnoses relied more on laboratory tests than others. Inter-country variation of epidemic/endemic clones, sampling practices, microbiology testing practices and laboratory methodology may have influenced the distribution of certain types of HAI. For example, the percentage of *C. difficile* infections ranged from 0% in Latvia and Luxembourg to 25.7% in Romania (Figure 22).

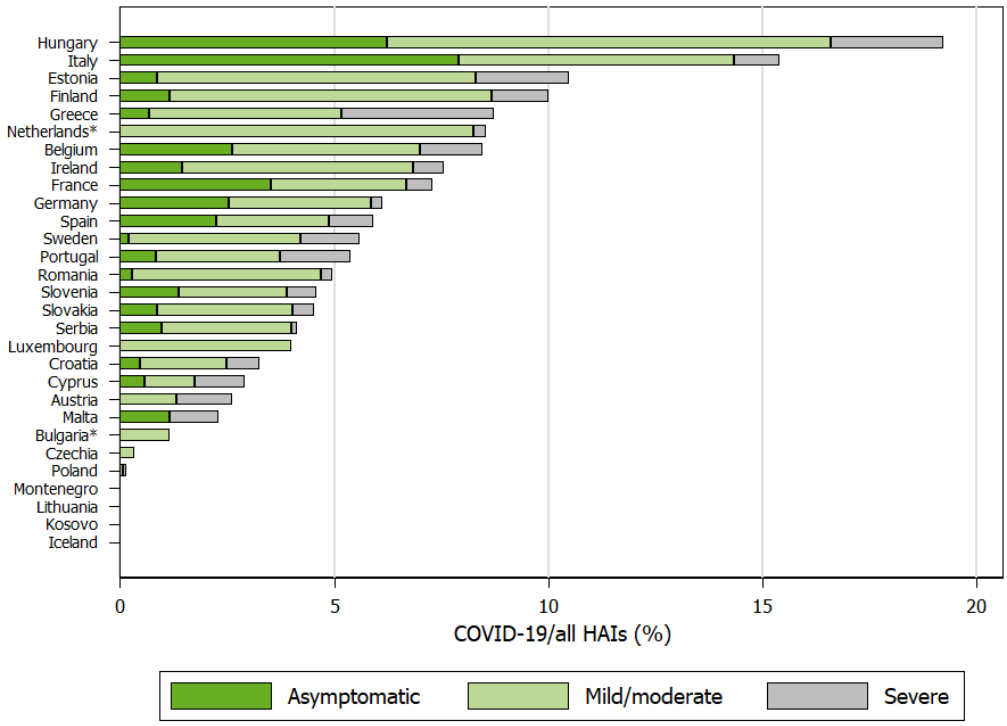
**Figure 22. *Clostridioides difficile* infections and other gastro-intestinal infections (excluding hepatitis) as a percentage of all HAIs, by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. Norway used a national PPS not including CDI and is not shown.*

The percentage of healthcare-associated COVID-19 also varied widely between countries from 0% in Iceland and Lithuania to 17.5% in Hungary, with large differences in the proportion of reported asymptomatic COVID-19 (Figure 23). This percentage probably also reflected differences in the COVID-19 prevalence in the community, as well as related testing policies during various phases of the COVID-19 pandemic, as the countries performed the PPS at various points of time during 2021–2023 (Figure 1). Indeed, the average percentage of healthcare-associated COVID-19 was higher (11.4%) in the 11 countries that performed the PPS in 2021 or 2022 than in the 18 countries that performed the PPS in 2023 (4.3%).

**Figure 23. Healthcare-associated COVID-19 as a percentage of all HAIs, by country, ECDC PPS 2022–2023**



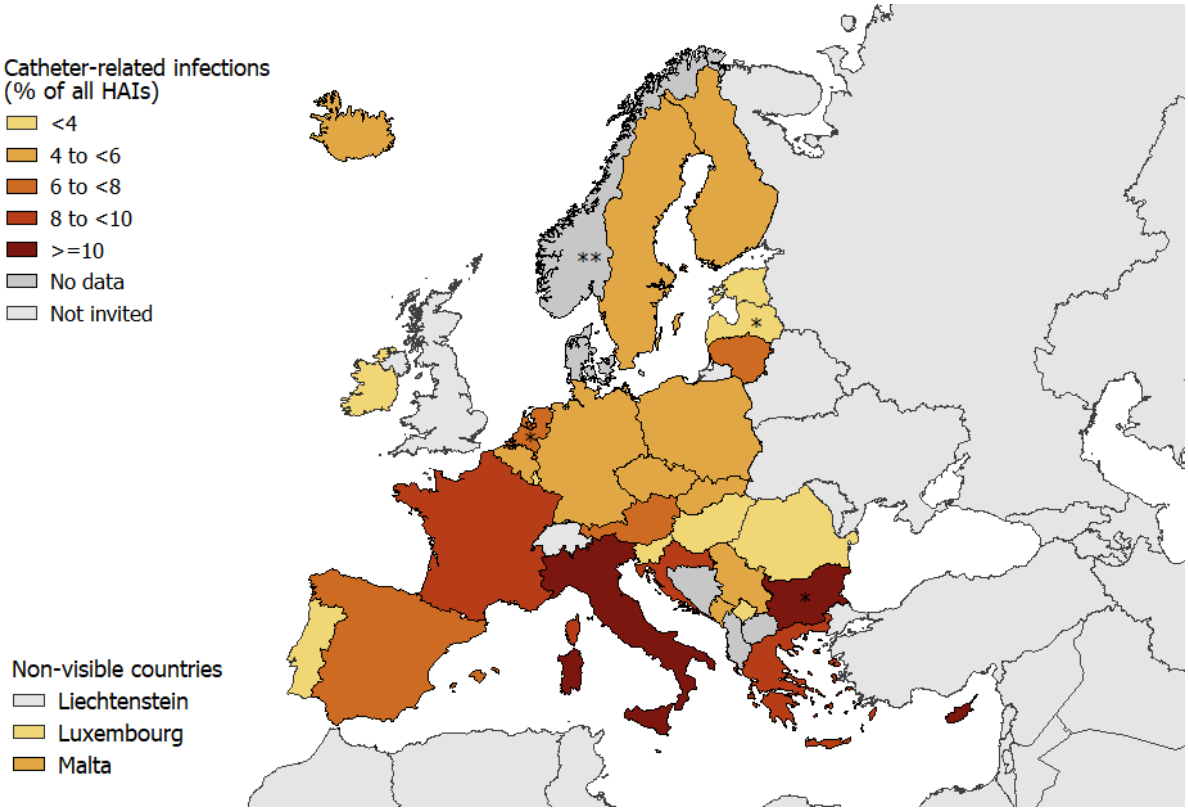

**Country representativeness of the sample was medium in Bulgaria and the Netherlands. Latvia and Norway did not apply the case-definitions for HA-COVID-19 and are not shown in the figure.*

Clinical sepsis, the prevalence of which is influenced by the availability of diagnostic tests, accounted for 76.6% of systemic infections and 3.2% of all HAIs, ranging from 0% in Luxembourg to 13.4% in Cyprus.

The proportion of 'other/unspecified' types of HAI varied between 2.6% in Hungary and 11.5% in Malta (Figure 21). Oral cavity infections accounted for 6.9% of all HAIs in Malta, while none were reported in Austria, Bulgaria, Croatia, Cyprus, Germany, Latvia, Lithuania and Romania. The proportion of bone and joint infections varied between 0% in Bulgaria, Iceland and Latvia and 4.1% of all HAIs in Slovenia. Central and peripheral vascular catheter-related infections without positive blood culture (CRI1 and CRI2) ranged from 0% in Latvia and Luxembourg to 2.3% in Bulgaria and Malta. Infections of the cardiovascular system varied between 0% in Estonia, Iceland, Luxembourg and Malta and 2.9% of all HAIs in Latvia. The detailed distribution of types of HAI by country is summarised in Annex 1 (Table A1.3).

Catheter-related infections, with or without positive blood culture or positive catheter tip culture (BSI with origin C-CVC or C-PVC, NEO-CNSB or NEO-LCBI with origin C-CVC or C-PVC, CRI of all types and CVS-VASC), represented 5.5% of all HAIs, ranging from 1.8% in Estonia to 11.7% in Bulgaria (Figure 24).

**Figure 24. Relative frequency of catheter-related infections as a total of all HAIs, by country, ECDC PPS 2022–2023**

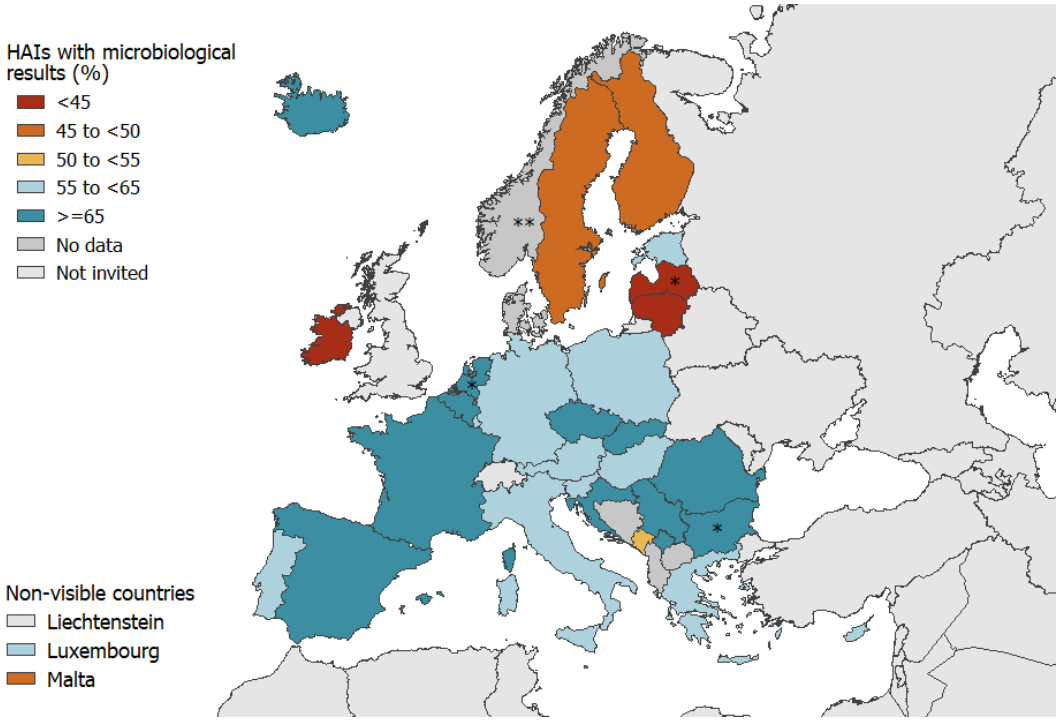



*Catheter-related infections with or without positive blood culture or positive catheter tip culture = BSI with origin C-CVC or C-PVC, NEO-CNSB or NEO-LCBI with origin C-CVC or C-PVC, CRI of all types and CVS-VASC.*
**Country representativeness of the samplewas medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol with insufficient details on types of HAIs to calculate this indicator.*

## *Microorganisms isolated from HAIs*

The percentage of HAIs documented with microbiological results ranged from 30.1% in Lithuania to 93.0% in Bulgaria (Figure 25). The detailed distribution of microorganisms and negative results (no examination done, result not (yet) available, sterile examination or microorganism non identified) is given by country in Annex 1 (Table A1.4).

**Figure 25. Percentage of HAIs with positive microbiological results on the day of the PPS, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

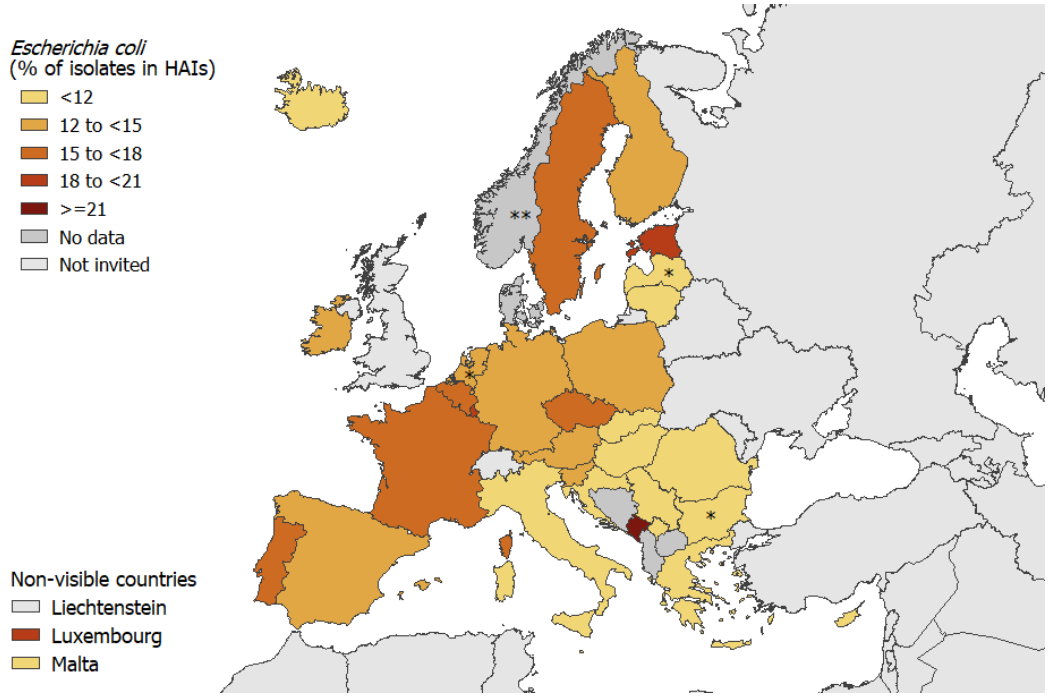
Overall, the most frequently reported microorganisms were *E. coli*, *Klebsiella* spp., *Enterococcus* spp., SARS-CoV-2, *S. aureus*, *C. difficile*, *P. aeruginosa*, coagulase-negative staphylococci, *Candida* spp., *Proteus* spp., and *Acinetobacter* spp. (Table 8). These 11 microorganisms accounted for 85.7% of all reported microorganisms in the EU/EEA, ranging from 65.0% in Iceland to 93.7% in Italy (Table 12). The highest percentage of *E. coli* was observed in Luxembourg (20.2%) and the lowest in Greece (3.3%). For *Klebsiella* spp. (78.3% of which were *K. pneumoniae,* Figure 27), the percentage varied from 0% in Iceland to 20.8% in Portugal. For *Enterococcus* spp., the percentage varied from 4.5% in Estonia to 16.8% of all microorganisms in Austria (Figure 28). SARS-CoV-2 was not reported in Iceland and Lithuania, but was the most commonly reported microorganism in Latvia (41.7%), Hungary (25.9%), Italy (24.2%) and Finland (16.7%); in the latter as frequently as *Staphylococcus aureus,* which was the most commonly reported microorganism in Iceland (20.0%) and the least commonly reported in Greece (3.9%) (Figure 29). The percentage of *C. difficile* ranged from 0% in Latvia to 26.0% (Romania), where it was the most commonly reported microorganism (Figure 30). For *P. aeruginosa*, the percentage varied from 0% in Latvia to 12.1% in Croatia. For coagulase-negative staphylococci, it varied from 0% in Latvia to 11.3% in the Netherlands. The highest percentages of *Candida* spp. were reported from Malta (9.4%), Greece (8.8%) and Slovakia (8.4%). *Proteus* spp. were the most common in Latvia (8.3%) and Estonia (7.4%). *Acinetobacter* spp. was not reported in three countries (Ireland, Luxembourg and Malta), but represented more than 10% of the reported microorganisms in Bulgaria (15.1%) and Greece (14.6%) (Figure 31).

**Table 12. Relative frequency (percentage) of the most commonly reported microorganisms in HAIs, by country, ECDC PPS 2022–2023**

| Country | Total number of isolates | *Escherichia coli* | *Klebsiella* spp. | *Enterococcus* spp. | SARS-CoV-2 | *Staphylococcus aureus* | *Clostridioides difficile* | *Pseudomonas aeruginosa* | Coagulase-negative staphylococci | *Candida* spp. | *Proteus* spp. | *Acinetobacter* spp. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Austria | 386 | 13.0 | 10.6 | 16.8 | 3.1 | 9.6 | 4.4 | 7.8 | 10.1 | 6.2 | 1.3 | 0.5 |
| Belgium | 887 | 16.5 | 10.0 | 7.8 | 9.7 | 10.6 | 3.5 | 7.7 | 6.0 | 4.1 | 3.3 | 0.3 |
| Bulgaria* | 199 | 6.0 | 15.1 | 9.5 | 0.5 | 5.0 | 5.0 | 11.1 | 6.0 | 5.0 | 3.5 | 15.1 |
| Croatia | 538 | 10.4 | 13.9 | 10.0 | 3.7 | 6.5 | 8.0 | 12.1 | 6.3 | 5.0 | 4.1 | 8.9 |
| Cyprus | 129 | 7.0 | 11.6 | 10.9 | 3.9 | 10.9 | 10.1 | 10.1 | 6.2 | 7.8 | 2.3 | 9.3 |
| Czechia | 813 | 15.6 | 14.8 | 9.3 | 0.4 | 10.9 | 4.9 | 7.7 | 5.7 | 6.9 | 4.7 | 1.5 |
| Estonia | 176 | 18.2 | 8.5 | 4.5 | 13.6 | 9.1 | 4.0 | 8.5 | 2.3 | 4.0 | 7.4 | 1.7 |
| Finland | 359 | 14.5 | 4.5 | 9.7 | 16.7 | 16.7 | 4.7 | 3.3 | 5.6 | 4.7 | 0.3 | 0.8 |
| France | 1 115 | 16.6 | 8.1 | 9.5 | 7.7 | 10.4 | 2.2 | 6.8 | 10.5 | 4.7 | 4.1 | 0.5 |
| Germany | 292 | 12.3 | 10.6 | 14.4 | 8.2 | 12.7 | 6.2 | 2.1 | 8.6 | 4.1 | 4.5 | 0.7 |
| Greece | 1 033 | 3.3 | 13.9 | 6.7 | 11.4 | 3.9 | 5.4 | 11.9 | 7.6 | 8.8 | 1.5 | 14.6 |
| Hungary | 1 077 | 7.5 | 6.4 | 9.0 | 25.9 | 6.2 | 23.2 | 4.6 | 1.9 | 2.0 | 3.5 | 2.9 |
| Iceland | 40 | 10.0 | 0.0 | 15.0 | 0.0 | 20.0 | 2.5 | 2.5 | 7.5 | 2.5 | 2.5 | 2.5 |
| Ireland | 515 | 14.2 | 7.0 | 10.1 | 14.2 | 13.8 | 8.9 | 4.1 | 6.4 | 4.9 | 2.3 | 0.0 |
| Italy | 1 371 | 11.7 | 16.5 | 9.6 | 24.2 | 8.3 | 6.9 | 9.1 | 0.1 | 0.0 | 3.5 | 3.9 |
| Latvia* | 12 | 8.3 | 8.3 | 8.3 | 41.7 | 8.3 | 0.0 | 0.0 | 0.0 | 0.0 | 8.3 | 8.3 |
| Lithuania | 137 | 10.9 | 11.7 | 16.1 | 0.0 | 11.7 | 21.2 | 6.6 | 6.6 | 0.0 | 2.9 | 5.1 |
| Luxembourg | 89 | 20.2 | 5.6 | 6.7 | 5.6 | 15.7 | 0.0 | 6.7 | 6.7 | 1.1 | 3.4 | 0.0 |
| Malta | 53 | 11.3 | 20.8 | 13.2 | 3.8 | 11.3 | 1.9 | 3.8 | 1.9 | 9.4 | 3.8 | 0.0 |
| Netherlands* | 335 | 13.1 | 4.2 | 14.0 | 8.7 | 15.8 | 0.9 | 4.5 | 11.3 | 4.2 | 1.8 | 0.3 |
| Norway** | - | | | | | | | | | | | |
| Poland | 980 | 12.4 | 16.0 | 11.6 | 0.2 | 8.8 | 12.3 | 7.0 | 6.4 | 4.7 | 2.9 | 5.7 |
| Portugal | 1 852 | 17.4 | 16.4 | 10.5 | 7.4 | 8.3 | 4.0 | 9.8 | 4.4 | 4.1 | 3.7 | 0.7 |
| Romania | 720 | 5.8 | 16.9 | 6.3 | 5.1 | 6.0 | 26.0 | 8.8 | 2.2 | 3.2 | 3.8 | 8.6 |
| Slovakia | 741 | 8.6 | 9.6 | 10.9 | 5.1 | 4.3 | 19.2 | 7.0 | 6.2 | 8.6 | 4.2 | 3.4 |
| Slovenia | 333 | 14.1 | 8.4 | 12.6 | 6.3 | 9.0 | 3.0 | 9.6 | 7.2 | 5.1 | 3.9 | 0.6 |
| Spain | 1 891 | 14.5 | 10.3 | 10.2 | 6.8 | 7.5 | 3.9 | 9.9 | 7.5 | 6.0 | 2.7 | 0.6 |
| Sweden | 867 | 16.4 | 6.7 | 10.6 | 9.7 | 16.0 | 5.1 | 3.6 | 7.4 | 5.0 | 2.2 | 0.2 |
| **EU/EEA** | **16 948** | **12.7** | **11.7** | **10.0** | **9.5** | **9.0** | **8.0** | **7.9** | **5.8** | **4.7** | **3.2** | **3.2** |
| EU/EEA P25 | 188 | 9.3 | 7.5 | 9.2 | 3.7 | 7.9 | 3.2 | 4.3 | 5.0 | 3.6 | 2.4 | 0.5 |
| EU/EEA P50 | 515 | 12.4 | 10.3 | 10.1 | 6.8 | 9.6 | 4.9 | 7.0 | 6.3 | 4.7 | 3.5 | 1.5 |
| EU/EEA P75 | 934 | 15.1 | 14.4 | 12.1 | 10.6 | 12.2 | 8.5 | 9.4 | 7.4 | 5.6 | 4.0 | 5.4 |
| Kosovo | 74 | 1.4 | 21.6 | 12.2 | 0.0 | 8.1 | 0.0 | 8.1 | 9.5 | 6.8 | 0.0 | 17.6 |
| Montenegro | 22 | 22.7 | 9.1 | 4.5 | 0.0 | 9.1 | 13.6 | 9.1 | 4.5 | 0.0 | 4.5 | 4.5 |
| Serbia | 651 | 6.5 | 23.5 | 8.9 | 4.6 | 3.7 | 10.6 | 11.2 | 4.0 | 1.7 | 5.2 | 10.1 |

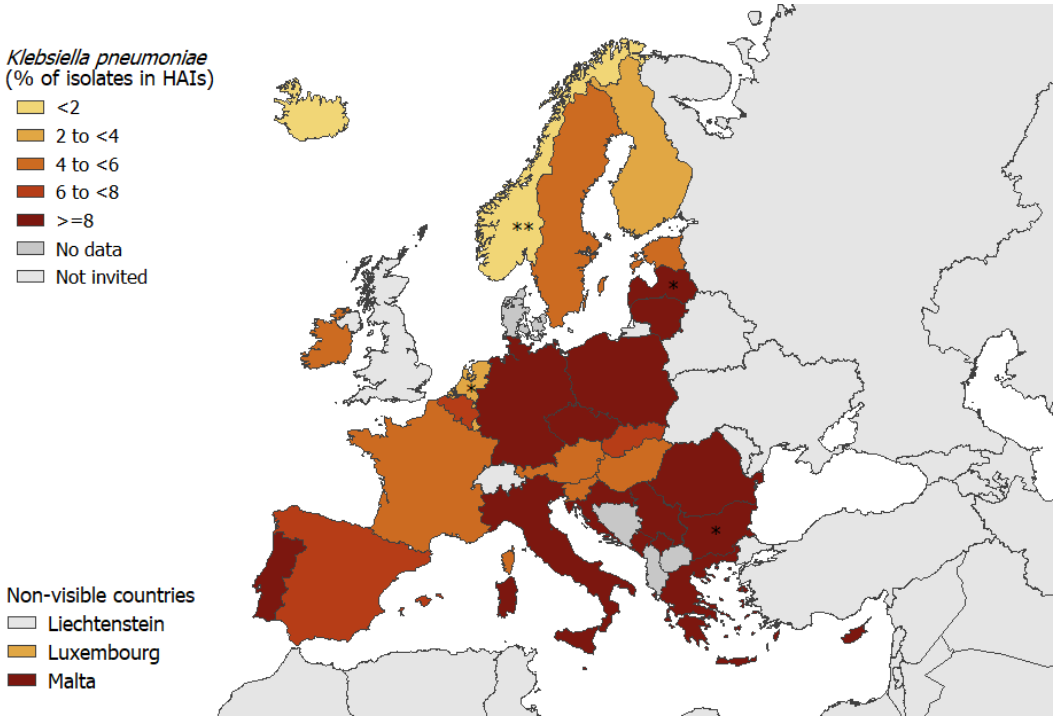
*P=percentile.*
**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol which did not include microbiological data.*

**Figure 26. Relative frequency of *Escherichia coli* isolates as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**



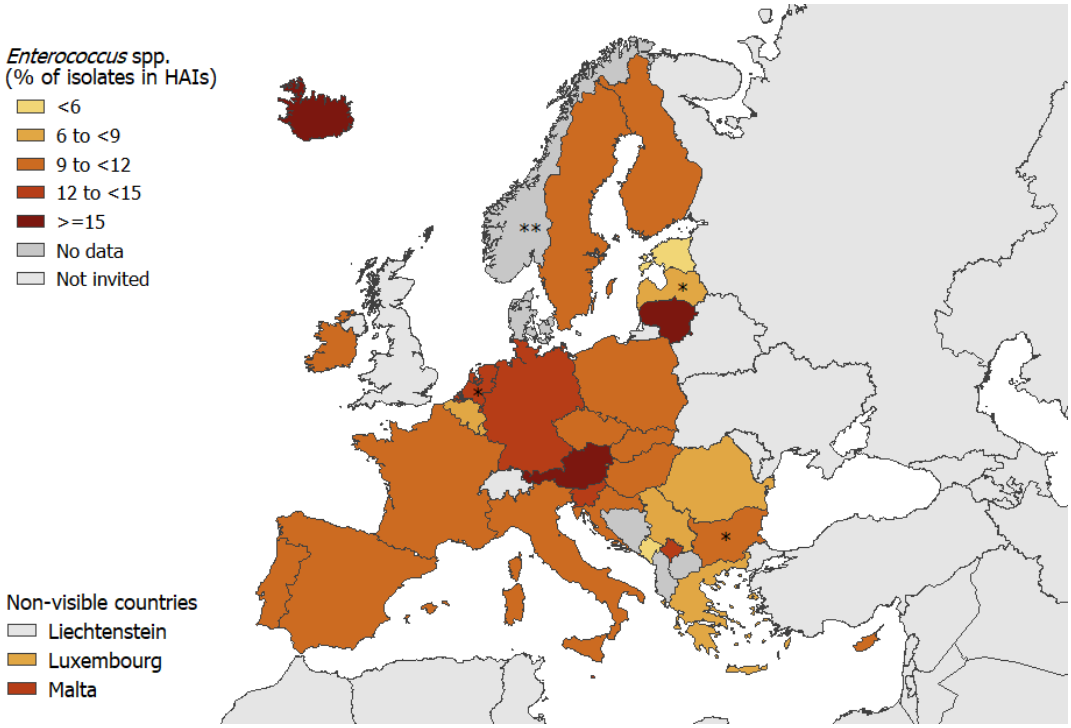

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 27. Relative frequency of *Klebsiella pneumoniae* as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**



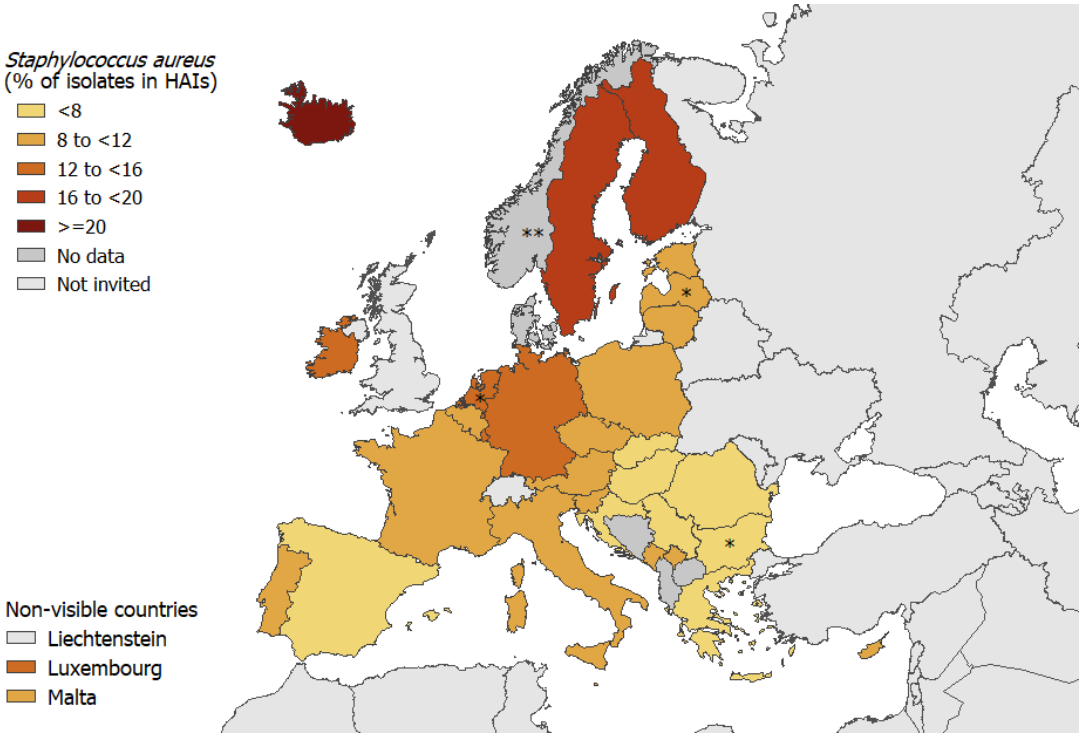

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 28. Relative frequency of *Enterococcus* spp. as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**



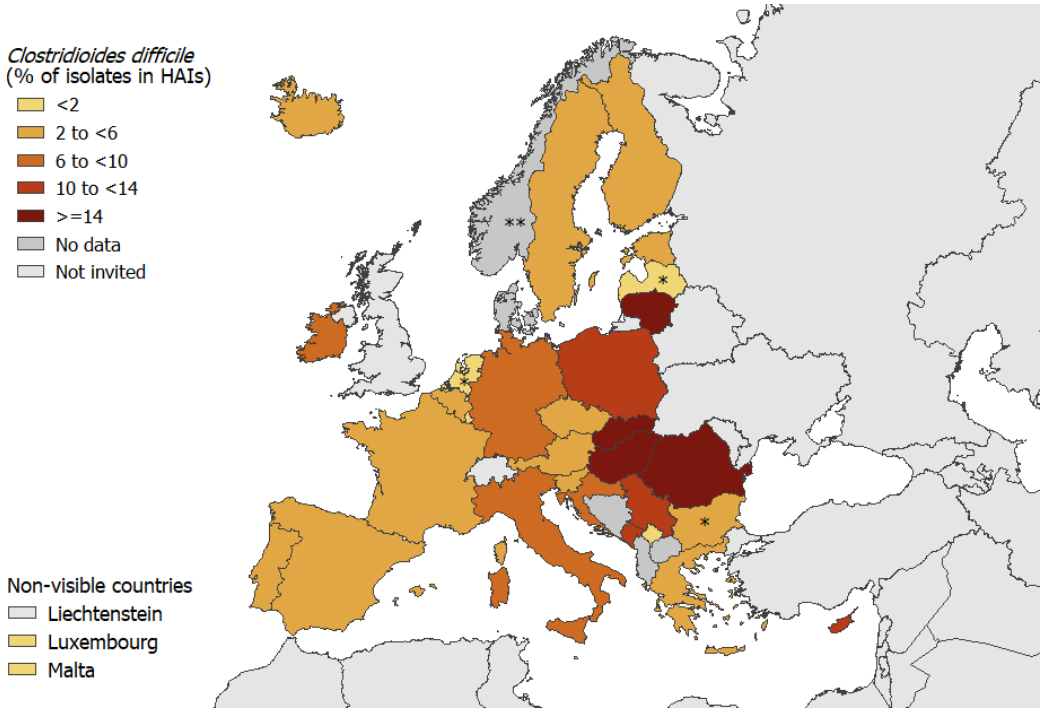

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 29. Relative frequency of *Staphylococcus aureus* as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**



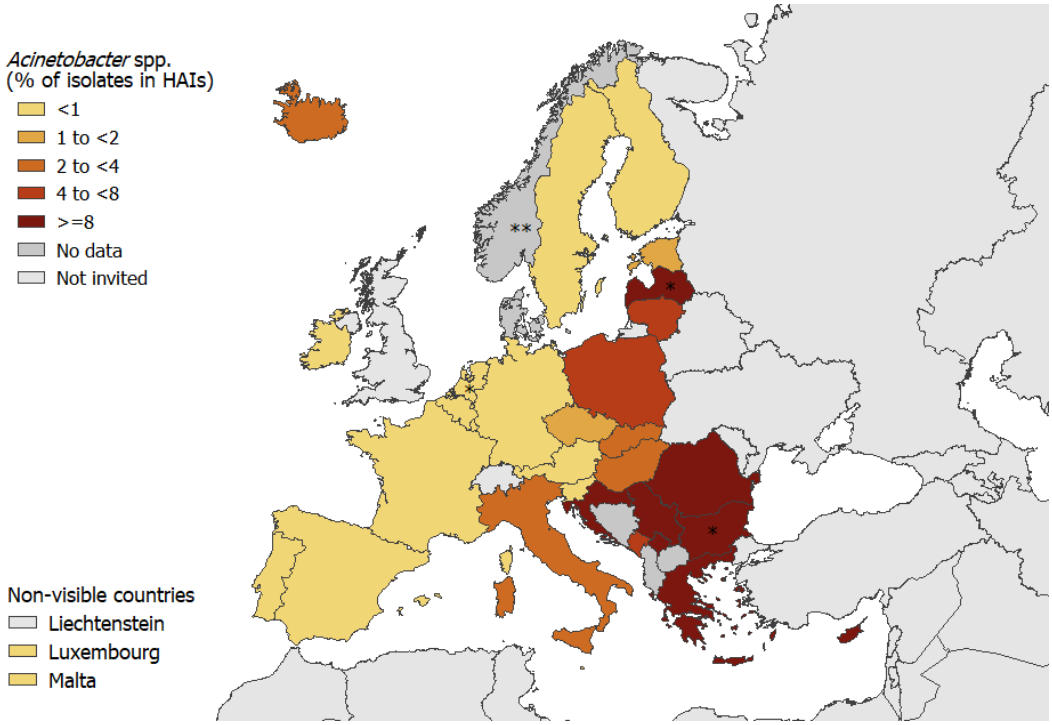

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 30. Relative frequency of *Clostridioides difficile* as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 31. Relative frequency of *Acinetobacter* spp. as a percentage of all isolates of microorganisms reported for HAIs, by country, ECDC PPS 2022–2023**

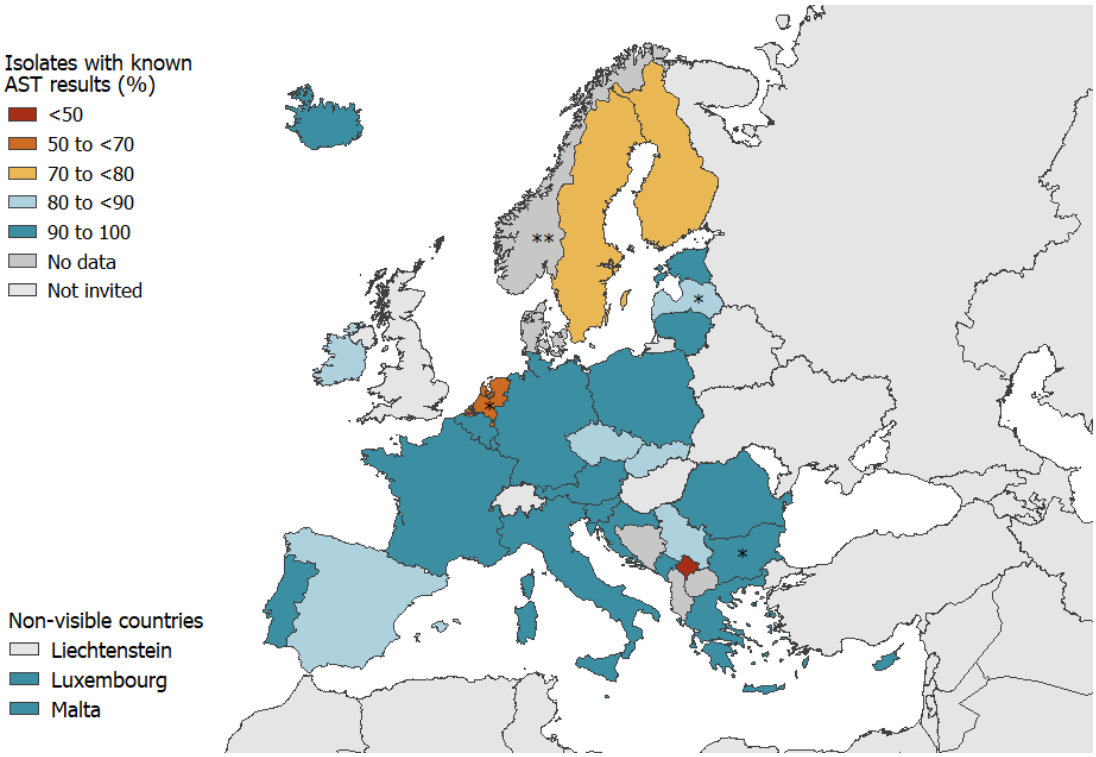



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

## Antimicrobial resistance in microorganisms from HAIs

In EU/EEA countries, the percentage of microorganisms with known AST results for the selected AMR markers varied from 50.7% of reported microorganisms in the Netherlands, to 100% in Cyprus, Iceland and Malta (Figure 32). This percentage was the lowest in Kosovo (10.7%), which did not reach the minimal number of 10 isolates to calculate the composite index of antimicrobial resistance (see below).

**Figure 32. Percentage of isolates with known antimicrobial susceptibility testing (AST) results (first-level AMR markers combined) for HAIs, by country, ECDC PPS 2022–2023**




*First-level antimicrobial resistance markers in PPS: MRSA, VRE, Enterobacterales non-susceptible to third-generation cephalosporins, Pseudomonas aeruginosa and Acinetobacter baumannii non-susceptible to carbapenems. *Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

## Staphylococcus aureus

Twenty-four EU/EEA countries reported at least 10 *S. aureus* isolates with known AST results for meticillin. Eleven countries reported less than 20% meticillin resistance (MRSA) in *S. aureus* isolates from HAIs. In Romania, 73.2% *S. aureus* isolates were MRSA (Figure 33).

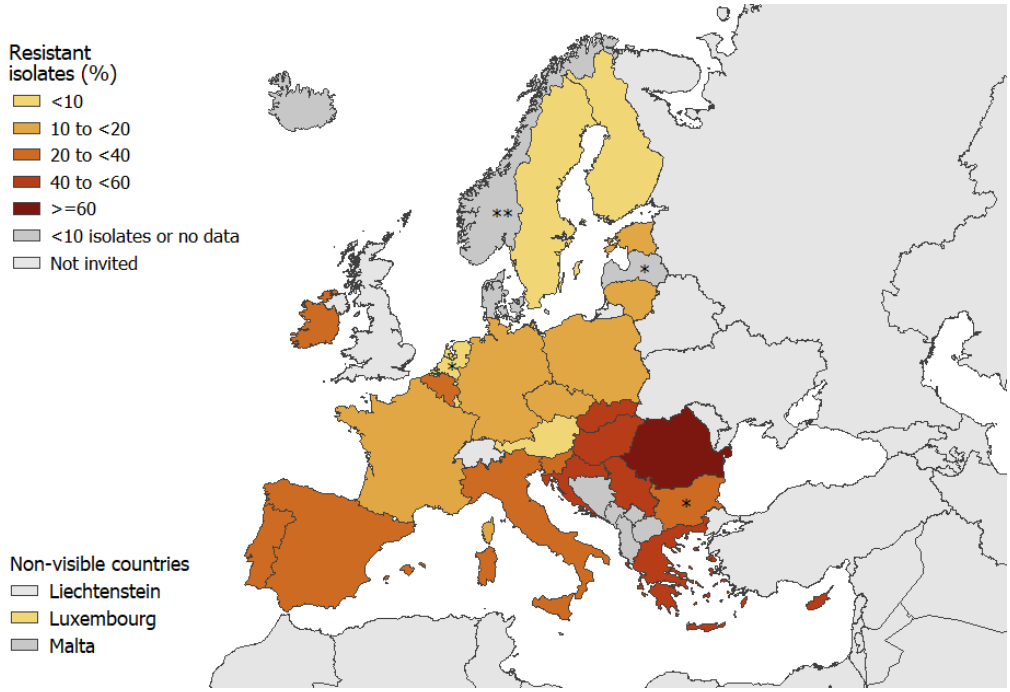
## Enterobacterales

Resistance to third-generation cephalosporins among Enterobacterales isolates from HAIs was the lowest in Malta (0%), and was over 40% in seven of 25 countries that reported at least 10 isolates with known AST results (Figure 34). The highest percentages of resistance to third-generation cephalosporins were observed in Romania (70.1% of 194 isolates), Bulgaria (66.1% of 62 isolates) and Cyprus (65.6% of 32 isolates).

Four out of 25 EU/EEA countries did not report any Enterobacterales isolate resistant to carbapenems. Two countries reported over 20% of Enterobacterales isolates resistant to carbapenems with the highest percentages observed in Romania (42.9%) and Greece (40.8%) (Figure 35).

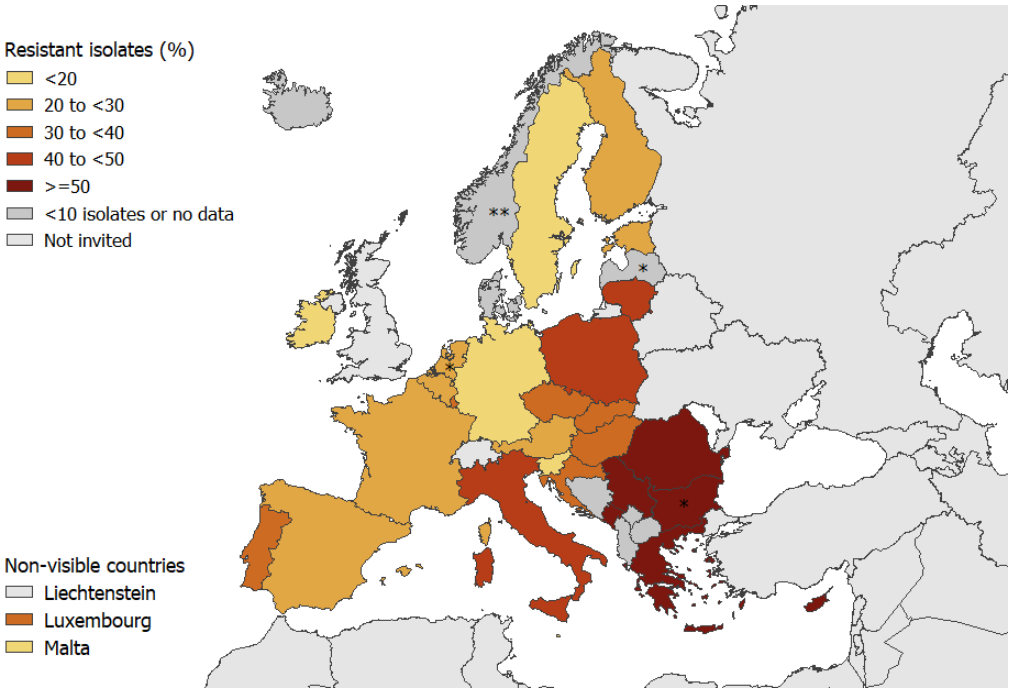
Twenty EU/EEA countries reported at least 10 isolates of *K. pneumoniae* with known AST results for carbapenems. Carbapenem resistance among *K. pneumoniae* isolates from HAIs varied from 0% in four countries to more than 25% in six countries: Slovakia (26.9%), Italy (32.8%), Cyprus (40.0%), Romania (63.3%), Greece (63.6%) and Bulgaria (70.4%) (Figure 36). In Serbia, the percentage of carbapenem resistance among 79 *K. pneumoniae* isolates was 81.0%.

**Figure 33. Percentage of *Staphylococcus aureus* isolates resistant to meticillin (MRSA) in HAIs, by country (n=1 399 isolates), ECDC PPS 2022–2023**



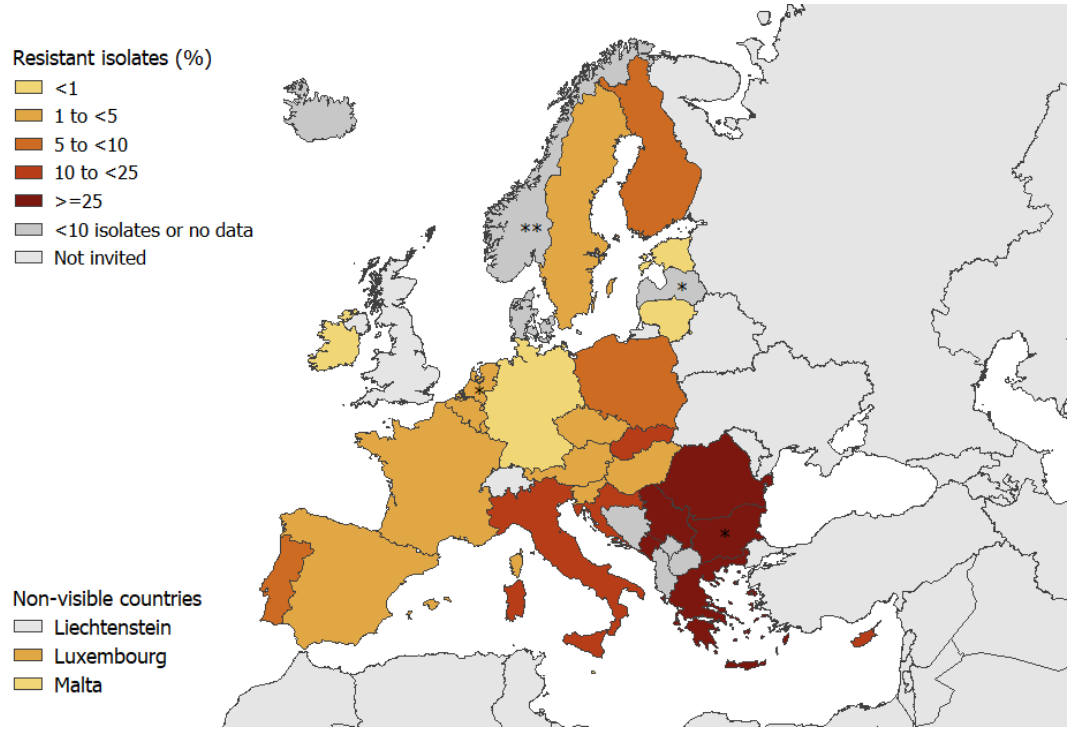

*Countries with <10 isolates with known antimicrobial susceptibility results not shown. *Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 34. Percentage of Enterobacterales isolates resistant to 3rd generation cephalosporins in HAIs, by country (n=5 153 isolates), ECDC PPS 2022–2023**



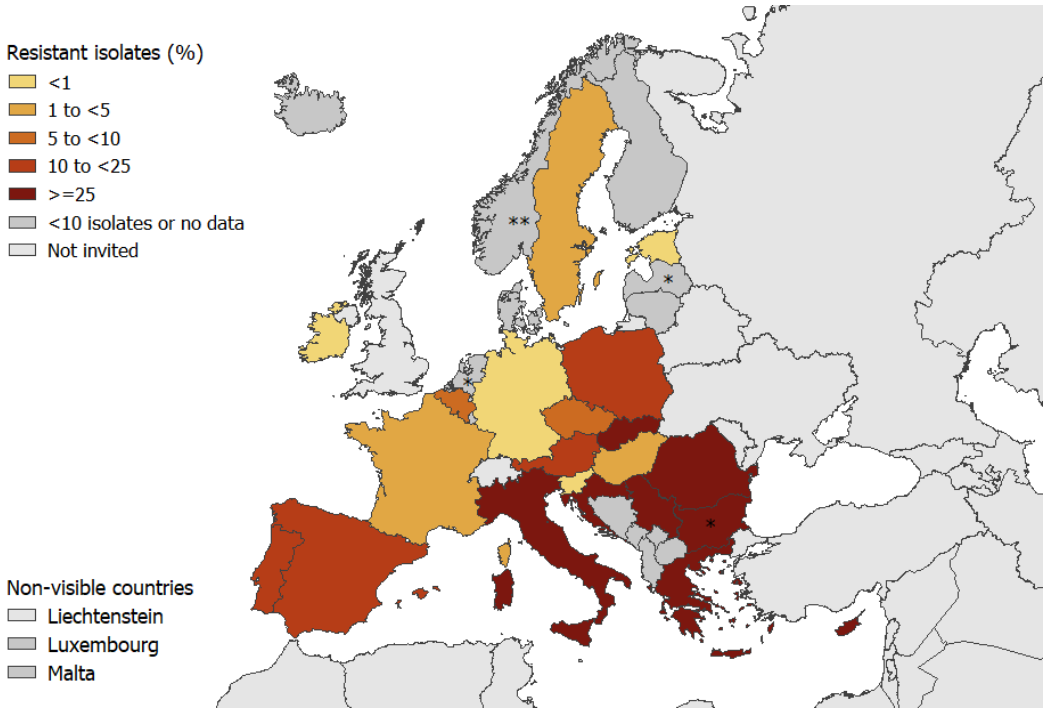

*Countries with <10 isolates with known antimicrobial susceptibility results not shown. *Country representativeness of the sample was medium. **Norway used a national PPS protocol.*

**Figure 35. Percentage of Enterobacterales isolates resistant to carbapenems in HAIs, by country (n=5 058 isolates), ECDC PPS 2022–2023**




*Countries with <10 isolates with known antimicrobial susceptibility results not shown. *Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

**Figure 36. Percentage of *K. pneumoniae* isolates resistant to carbapenems in HAIs, by country (n=1 377 isolates), ECDC PPS 2022–2023**

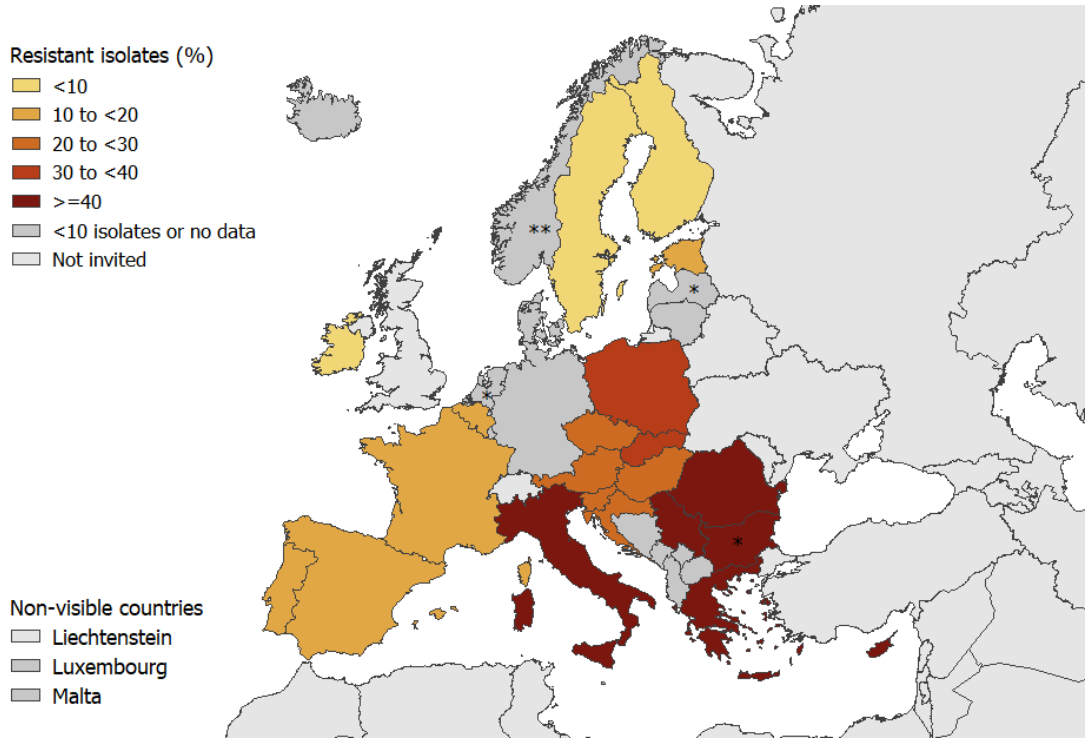



*Countries with <10 isolates with known antimicrobial susceptibility results not shown. *Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol.*

## *Non-fermenting gram-negative bacteria*

Twenty EU/EEA countries reported at least 10 *P. aeruginosa* isolates with known AST results for carbapenems. The percentage of carbapenem-resistant isolates varied from 0% in Finland and 5.0% in Ireland to 61.5% in Cyprus and Greece and 63.6% in Bulgaria (Figure 37).

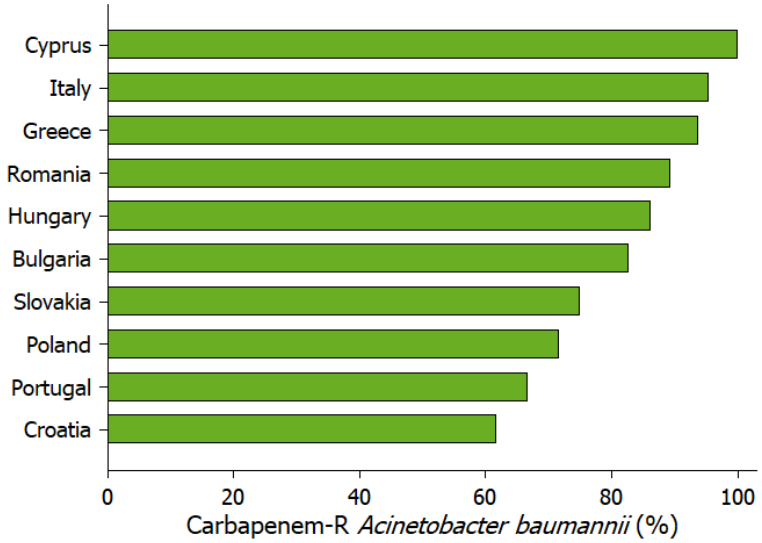
**Figure 37. Percentage of *P. aeruginosa* isolates resistant to carbapenems in HAIs, by country (n=1 208 isolates), ECDC PPS 2022–2023**




*Countries with <10 isolates with known antimicrobial susceptibility results not shown.*
**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol .*

Only ten EU/EEA countries reported AST data for at least 10 *Acinetobacter baumannii* isolates. In these countries, the percentage of resistance to carbapenems ranged from 61.7% in Croatia to 100% in Cyprus (Figure 38).

**Figure 38. Percentage of Acinetobacter baumannii isolates resistant to carbapenems inHAIs, by country (n=429 isolates), ECDC PPS 2022–2023**



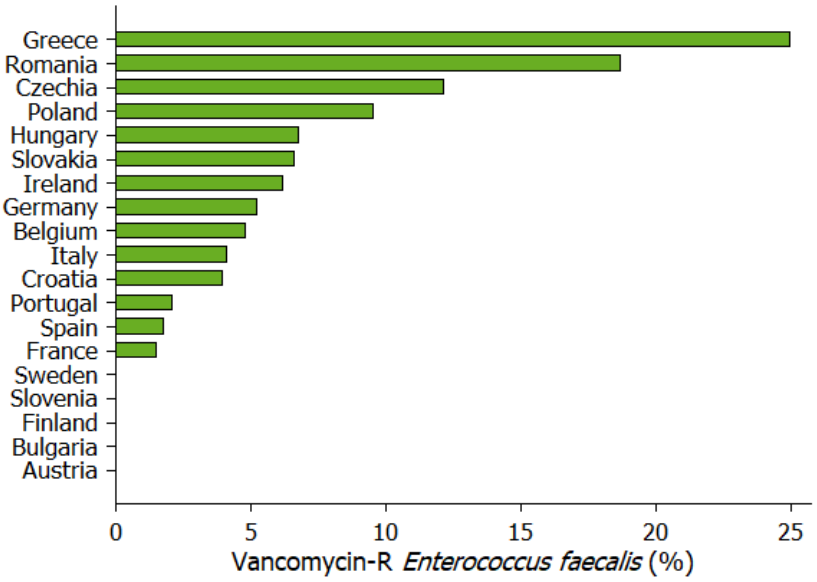

*Countries with <10 isolates with known AST results are not shown.*

## *Enterococcus spp.*

Nineteen EU/EEA countries reported at least 10 *E. faecalis* isolates with known AST results for glycopeptides. The percentage of vancomycin resistance varied from 0% in five countries to 25.0% in Greece (Figure 39).

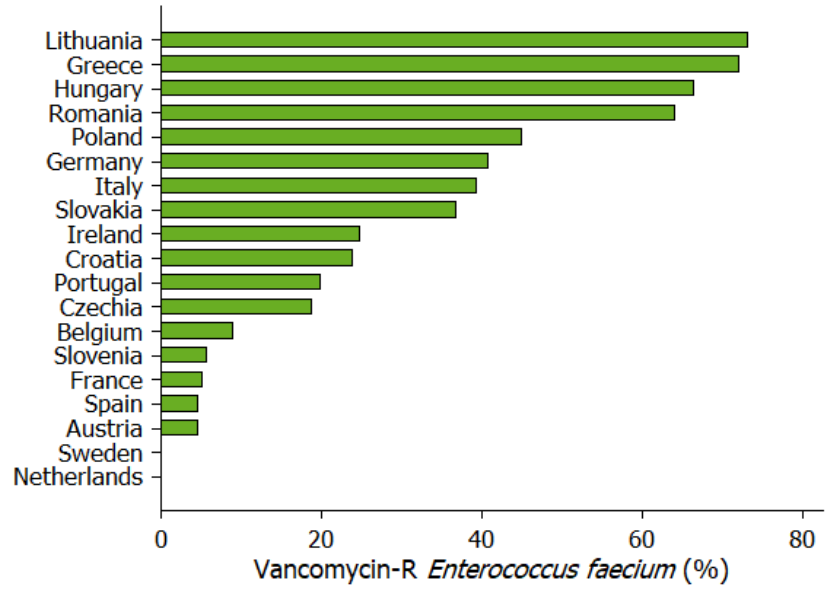
Nineteen EU/EEA countries reported at least 10 *E. faecium* isolates with known AST results for glycopeptides AST data for at least 10 *E. faecium* isolates were reported by nineteen countries. The percentage of vancomycin resistance varied from 0% in the Netherlands and Sweden, to 72.2% in Greece and 73.3% in Lithuania (Figure 40).

**Figure 39. Percentage of *E. faecalis* isolates resistant to glycopeptides in HAIs by country (n=752 isolates), ECDC PPS 2022–2023**




*Countries with <10 isolates with known AST results are not shown.*

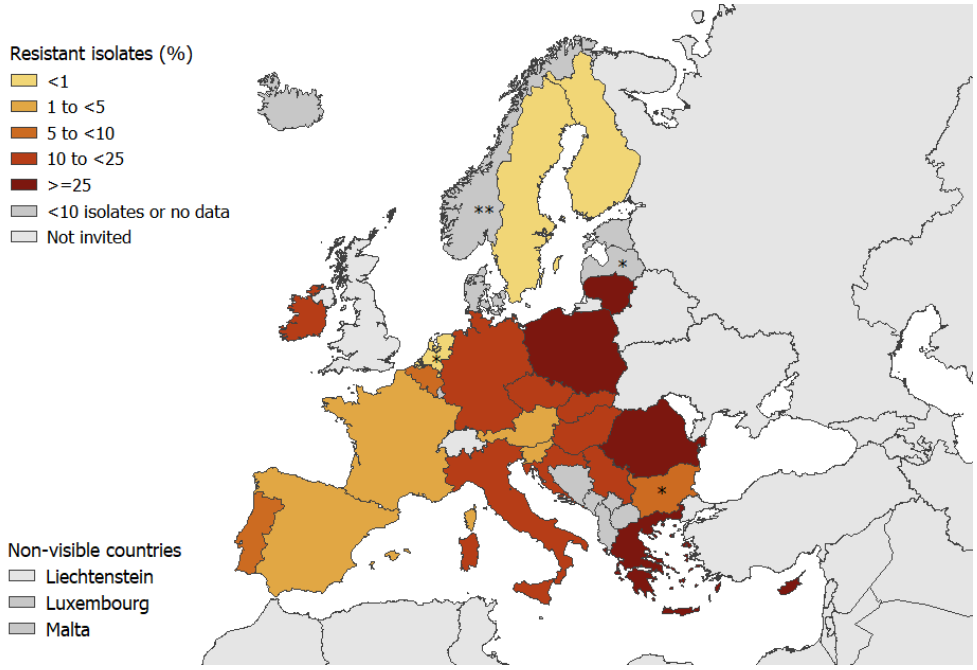
**Figure 40. Percentage of *E. faecium* isolates resistant to glycopeptide in HAIs, by country (n=313 isolates), ECDC PPS 2022–2023**




*Countries with <10 isolates with known AST results are not shown*

When all *Enterococcus* species were combined, AST data for at least 10 *Enterococcus* spp. isolates were available for 22 countries. The percentage of glycopeptide resistance (VRE) varied from 0% in Finland, the Netherlands and Sweden to more than 50% in Greece and Lithuania (Figure 41).

**Figure 41. Percentage of *Enterococcus* spp. resistant to glycopeptide (VRE) isolated in HAIs, by country (n=1 326 isolates), ECDC PPS 2022–2023**

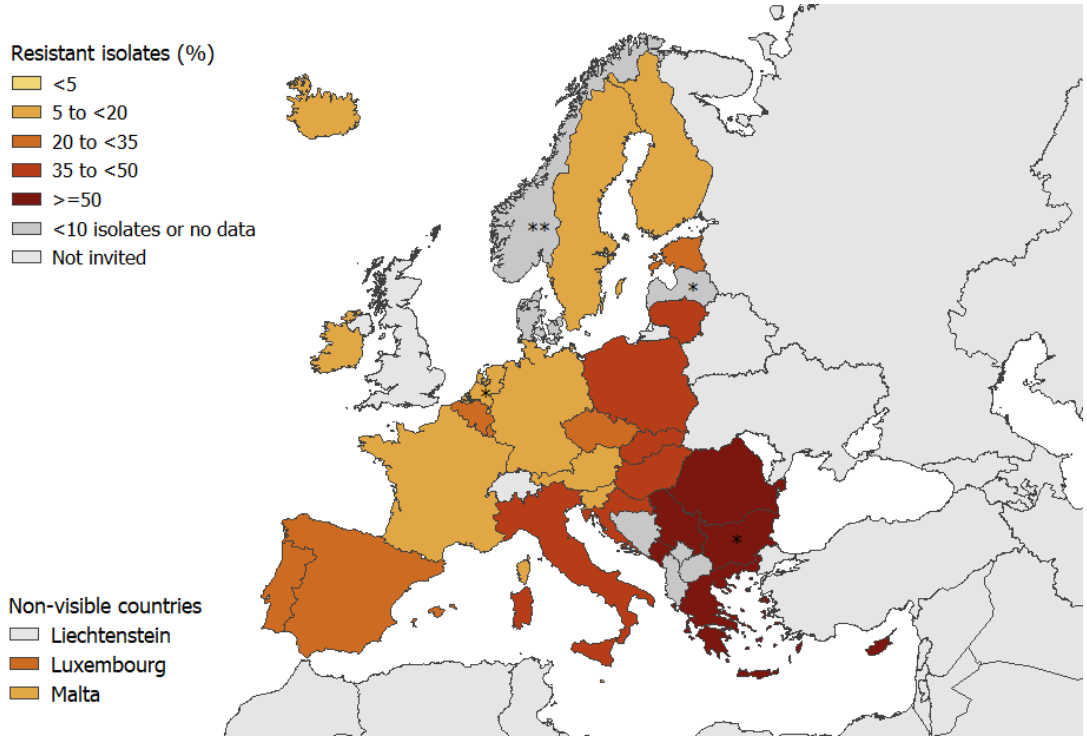



*Countries with <10 isolates with known antimicrobial susceptibility results not shown.*
**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol .*

## *Composite index of antimicrobial resistance (AMR)*

Twenty-six EU/EEA countries reported AST results for at least 10 isolates of the microorganisms included in the composite index of AMR. Out of a total of 9 630 isolates, 3 081 (32.0%) isolates (all microorganisms combined) were resistant to the first-level antimicrobial resistance markers, which was similar to the ECDC PPS 2016–2017 (31.6%). This percentage varied from less than 10% in Malta (7.9%), Iceland (8.3%) and Sweden (9.7%) to more than 60% in Cyprus (63.1%), Greece (68.2%) and Romania (68.7%) (Figure 42). In Montenegro and Serbia (not included in the aggregate EU/EEA percentage), the composite index of AMR was 56.3% and 69.3%, respectively.

**Figure 42. Composite index of AMR: percentage of isolates resistant to first-level antimicrobial resistance markers, by country (n=9 624 isolates), ECDC PPS 2022–2023**




*Composite index of antimicrobial resistance (AMR): MRSA, VRE, Enterobacterales resistant to third-generation cephalosporins, Pseudomonas aeruginosa and Acinetobacter baumannii resistant to carbapenems. *Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol which did not include microbiological data in HAIs. Countries with <10 isolates with known antimicrobial susceptibility results (Latvia and Kosovo) not shown.*

# Antimicrobial use

## Main results, aggregated

### Prevalence and indication of antimicrobial use

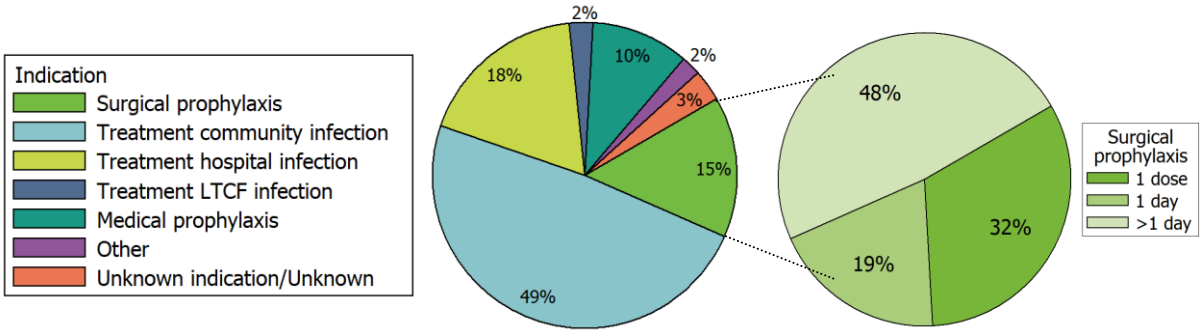
From a total of 293 581 patients in the database, 104 343 (35.5%) received at least one antimicrobial agent. Detailed antimicrobial use data were collected for only 103 169 patients (out of a total of 289 649 patients), as these data were optional in the Dutch protocol and were not collected by 10 of 18 hospitals in the Netherlands. Among those 103 169 patients, a total of 138 208 antimicrobial agents were reported, which is an average of 1.34 agents per patient receiving antimicrobials: 72.6% patients received one antimicrobial agent, 22.4% received two agents, and 5.4% received three or more agents (up to a maximum of nine antimicrobials agents for two patients). Antimicrobials were administered parenterally for 80.4% of agents. The reason for antimicrobial use was documented in the patient's medical records for 82.7% of prescriptions.

Antimicrobials were most frequently prescribed for treatment of an infection (70.2%), of which 70.3% were for a community-acquired infection (49.3% of all antimicrobials), 26.2% for a hospital infection (18.4% of all antimicrobials) and 3.6% for an infection acquired in a LTCF (2.5% of all antimicrobials).

Surgical prophylaxis was the indication for 14.9% of prescriptions. While this percentage was similar to the ECDC PPS 2016–2017 (14.2%), the proportion of surgical prophylaxis given for more than one day decreased from 54.3% in 2016–2017 to 48.3% (7.2% of all antimicrobials) in the ECDC PPS 2022–2023. The proportion of surgical prophylaxis given for one day remained stable at 19.3% (compared to 19.0% in 2016–2017), whereas the proportion of single dose surgical prophylaxis increased from 26.8% in 2016–2017 to 32.4% (4.8% of all antimicrobials) in the ECDC PPS 2022–2023 (Figure 42).

Overall, 71 533 of 293 581 (23.0%) patients were receiving antimicrobials for treatment for an infection. The prevalence of patients receiving treatment for a hospital infection was 6.2%. The prevalence of patients receiving surgical prophylaxis was 6.1% (Table 13).

**Figure 42. Indications for antimicrobial use in European acute care hospitals, ECDC PPS 2022–2023**




*LTCF: Long-term care facility.*

**Table 13. Indication for antimicrobial use, route of administration and documentation of the reason for antimicrobial use in the patients' notes, ECDC PPS 2022–2023**

| Characteristics of antimicrobial use | Patients No. | Prevalence % | Antimicrobials N | Relative frequency % |
|---|---|---|---|---|
| **Total** | 103 169 | 35.1 | 138 208 | 100.0 |
| **Indication** | | | | |
| Treatment | 71 532 | 24.4 | 97 073 | 70.2 |
| Community infection | 51 498 | 17.5 | 68 195 | 49.3 |
| Hospital infection | 18 131 | 6.2 | 25 392 | 18.4 |
| Long-term care facility infection | 2 745 | 0.9 | 3 496 | 2.5 |
| Surgical prophylaxis | 17 858 | 6.1 | 20 585 | 14.9 |
| Single dose | 6 228 | 2.1 | 6 687 | 4.8 |
| One day | 3 698 | 1.3 | 3 967 | 2.9 |
| >1 day | 8 159 | 2.8 | 9 947 | 7.2 |
| Medical prophylaxis | 11 222 | 3.8 | 14 089 | 10.2 |
| Other indication | 2 290 | 0.8 | 2 976 | 2.2 |
| Unknown indication, verified | 2 009 | 0.7 | 2 335 | 1.7 |
| Unknown/missing | 989 | 0.3 | 1 171 | 0.8 |
| **Route of administration** | | | | |
| Parenteral | 85 422 | 29.1 | 111 054 | 80.3 |
| Oral | 23 157 | 7.9 | 26 560 | 19.2 |
| Other/unknown | 557 | 0.2 | 594 | 0.4 |
| **Reason in notes** | | | | |
| Yes | 85 675 | 29.2 | 114 264 | 82.7 |
| No | 17 047 | 5.8 | 21 242 | 15.4 |
| Unknown | 2 108 | 0.7 | 2 702 | 2.0 |

A total of 74 534 infections diagnosed by a physician were treated with antimicrobials in 71 532 patients, which was an average of 1.04 infections per treated patient. The most common diagnosis site of infection was the respiratory tract (30.6%), with pneumonia and bronchitis accounting for 25.0% and 5.6%, respectively. Respiratory tract infections were more common among community-acquired infections (32.6%) and those acquired in long-term care (37.7%) than among hospital infections (24.3%). Urinary tract infections accounted for 17.0% of diagnoses, with symptomatic lower urinary tract infections accounting for 11.6% of diagnoses and upper urinary tract infections for 4.9%. Systemic infections, including laboratory-confirmed bacteraemia, accounted for 14.8% of diagnoses and were more common among hospital infections (20.2%) than community-acquired (12.8%) or long-term care (13.9%) infections (Table 14).

**Table 14. Site of diagnosis for antimicrobial treatment of infections, ECDC PPS 2022–2023**

| Site of diagnosis | Total | | Treatment intention of | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Community infection | | Hospital infection | | LTCF infection or other HAI | |
| | No. | % | No. | % | No. | % | No. | % |
| **Total no. of diagnoses (No. of infections)** | 74 534 | 100.0 | 52 491 | 100.0 | 19 201 | 100.0 | 2 842 | 100.0 |
| Respiratory tract | 22 831 | 30.6 | 17 090 | 32.6 | 4 669 | 24.3 | 1 072 | 37.7 |
| Pneumonia (PNEU) | 18 605 | 25.0 | 13 668 | 26.0 | 4 076 | 21.2 | 861 | 30.3 |
| Acute bronchitis or exacerbations of chronic bronchitis (BRON) | 4 143 | 5.6 | 3 342 | 6.4 | 592 | 3.1 | 209 | 7.4 |
| Cystic Fibrosis (CF) | 83 | 0.1 | 80 | 0.2 | 1 | 0.0 | 2 | 0.1 |
| Urinary tract | 12 698 | 17.0 | 8 395 | 16.0 | 3 559 | 18.5 | 744 | 26.2 |
| Symptomatic Lower UTI (CYS) | 8 682 | 11.6 | 5 341 | 10.2 | 2 799 | 14.6 | 542 | 19.1 |
| Symptomatic Upper UTI (PYE) | 3 689 | 4.9 | 2 851 | 5.4 | 650 | 3.4 | 188 | 6.6 |
| Asymptomatic bacteriuria (ASB) | 327 | 0.4 | 203 | 0.4 | 110 | 0.6 | 14 | 0.5 |
| Systemic infections | 10 994 | 14.8 | 6 727 | 12.8 | 3 873 | 20.2 | 394 | 13.9 |
| Lab-confirmed bacteraemia (LAB) | 3 830 | 5.1 | 1 755 | 3.3 | 1 919 | 10.0 | 156 | 5.5 |
| Clinical sepsis, excluding FN (CSEP) | 2 197 | 2.9 | 1 342 | 2.6 | 753 | 3.9 | 102 | 3.6 |
| Febrile neutropenia or other infection in immunocompromised host (FN) | 1 020 | 1.4 | 616 | 1.2 | 376 | 2.0 | 28 | 1.0 |
| Systematic inflammatory response with no clear anatomic site (SIRS) | 1 679 | 2.3 | 1 202 | 2.3 | 425 | 2.2 | 52 | 1.8 |
| Undefined, site with no systemic inflammation (UND) | 2 268 | 3.0 | 1 812 | 3.5 | 400 | 2.1 | 56 | 2.0 |
| Cardiovascular system | 1 003 | 1.3 | 785 | 1.5 | 197 | 1.0 | 21 | 0.7 |

| Site of diagnosis | Total | | Treatment intention of | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Community infection | | Hospital infection | | LTCF infection or other HAI | |
| | No. | % | No. | % | No. | % | No. | % |
| Gastro-intestinal system | 9 843 | 13.2 | 7 199 | 13.7 | 2 387 | 12.4 | 257 | 9.0 |
| GI Infections (salmonellosis, CDI) (GI) | 4 251 | 5.7 | 2 661 | 5.1 | 1 436 | 7.5 | 154 | 5.4 |
| Intra-abdominal sepsis including hepatobiliary (IA) | 5 592 | 7.5 | 4 538 | 8.6 | 951 | 5.0 | 103 | 3.6 |
| Skin/soft tissue/bone/joint – surgical site infection (SSI) | 3 903 | 5.2 | 1 005 | 1.9 | 2 837 | 14.8 | 61 | 2.1 |
| SSI involving skin or soft tissue but not bone (SST-SSI) | 3 018 | 4.0 | 701 | 1.3 | 2 274 | 11.8 | 43 | 1.5 |
| Septic arthritis, osteomyelitis of surgical site (BJ-SSI) | 885 | 1.2 | 304 | 0.6 | 563 | 2.9 | 18 | 0.6 |
| Skin/soft tissue/bone/joint - other | 7 929 | 10.6 | 6 819 | 13.0 | 891 | 4.6 | 219 | 7.7 |
| Cellulitis, wound, deep soft tissue not involving bone, not related to surgery (SST-O) | 6 188 | 8.3 | 5 305 | 10.1 | 721 | 3.8 | 162 | 5.7 |
| Septic arthritis, osteomyelitis, not related to surgery (BJ-O) | 1 741 | 2.3 | 1 514 | 2.9 | 170 | 0.9 | 57 | 2.0 |
| Central nervous system | 886 | 1.2 | 703 | 1.3 | 173 | 0.9 | 10 | 0.4 |
| Eye/ear/nose/throat | 2 760 | 3.7 | 2 354 | 4.5 | 374 | 1.9 | 32 | 1.1 |
| Endopthalmitis (EYE) | 151 | 0.2 | 127 | 0.2 | 21 | 0.1 | 3 | 0.1 |
| Infections of ear, mouth, nose, throat or larynx (ENT) | 2 609 | 3.5 | 2 227 | 4.2 | 353 | 1.8 | 29 | 1.0 |
| Genito-urinary system/obstetrics | 897 | 1.2 | 745 | 1.4 | 132 | 0.7 | 20 | 0.7 |
| Obstetric or gynaecological infections, STDs in women (OBGY) | 523 | 0.7 | 437 | 0.8 | 84 | 0.4 | 2 | 0.1 |
| Prostatitis, epididymoorchitis, STDs in men (GUM) | 374 | 0.5 | 308 | 0.6 | 48 | 0.2 | 18 | 0.6 |
| Missing/Unknown | 790 | 1.1 | 669 | 1.3 | 109 | 0.6 | 12 | 0.4 |

*LTCF: long-term care facility. HAI: healthcare-associated infection. STDs: sexually transmitted diseases*

## Distribution of antimicrobials

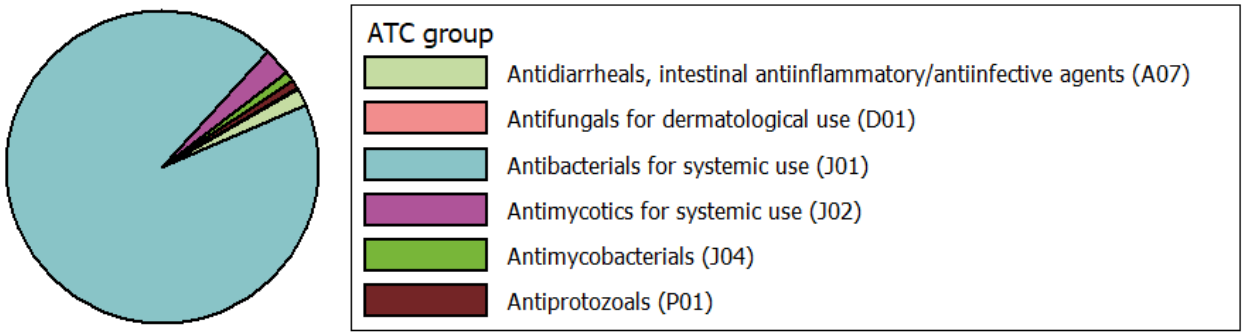
Antibacterials for systemic use (ATC group J01) were by far the most frequently used antimicrobials, representing 93.0% of all those reported (Figure 43).

Antimycotics for systemic use (ATC group J02) accounted for 2.9% overall. Triazole derivates accounted for 72.8% of antimycotics for systemic use (fluconazole 55.1%, voriconazole 6.9%, posaconazole 6.9%, isavuconazole 2.7% and itraconazole 1.2%), and amphotericin B 5.6%, imidazole derivates 0.4% and other antimycotics for systemic use 21.1% (caspofungin 10.1%, anidulafungin 7.1%, micafungin 3.8%). Only 18 (0.01% of total) antifungals were for dermatologic use (ATC group D01) were reported.

Antimycobacterials for indications other than treatment of tuberculosis (included in ATC group J04) made up 1.0% of the total, of which rifampicin accounted for 47.8%, ethambutol for 18.3%, isoniazid for 17.5%, pyrazinamide for 13.3%, and rifabutin for 1.0%.

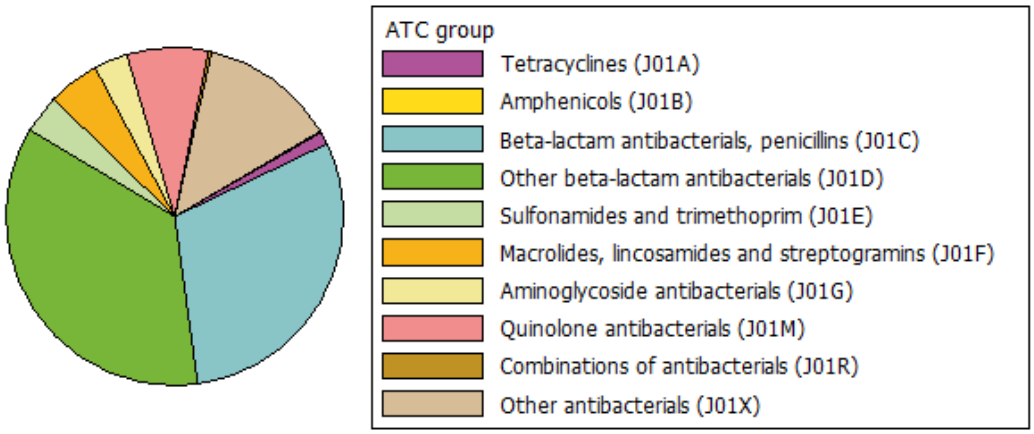
Antiprotozoals (ATC group P01) accounted for 1.0% of all antimicrobials, 98.0% of which were oral or rectal metronidazole. ATC group A07 made up 1.3% of the total, of which oral vancomycin accounted for 35.3%, nystatin for 32.2%, rifaximin for 21.0%, oral colistin for 3.8%, fidaxomicin for 2.2% and oral amphotericin B for 1.4%.

**Figure 43. Distribution of antimicrobials used in acute care hospitals on the day of the PPS, by group at 2nd ATC level (n= 138 208 reported antimicrobials), ECDC PPS 2022–2023**



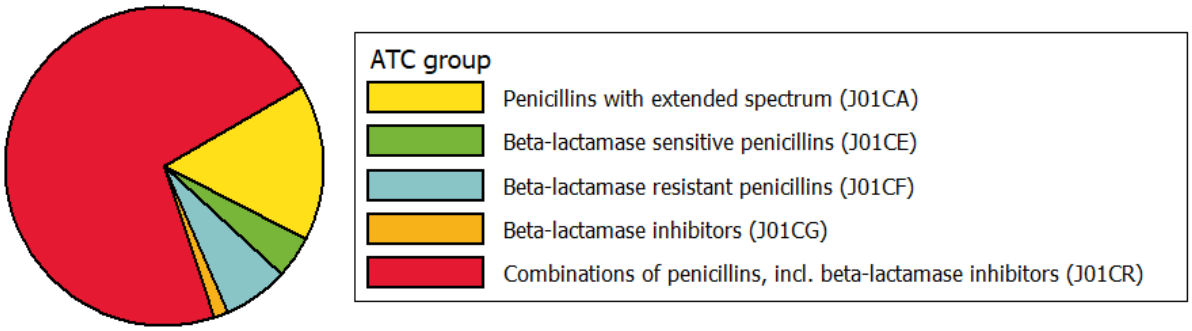

Within antibacterials for systemic use (ATC group J01), the most frequently used sub-groups were other beta-lactam antibacterials (35.6%), penicillins (30.0%), other antibacterials (13.1%) and quinolones (7.7%) (Figure 44).

**Figure 44. Distribution of antibacterials for systemic use (ATC group J01) used in acute care hospitals on the day of the PPS, by group at 3rd ATC level (n= 128 540 reported antibacterials), ECDC PPS 2022–2023**



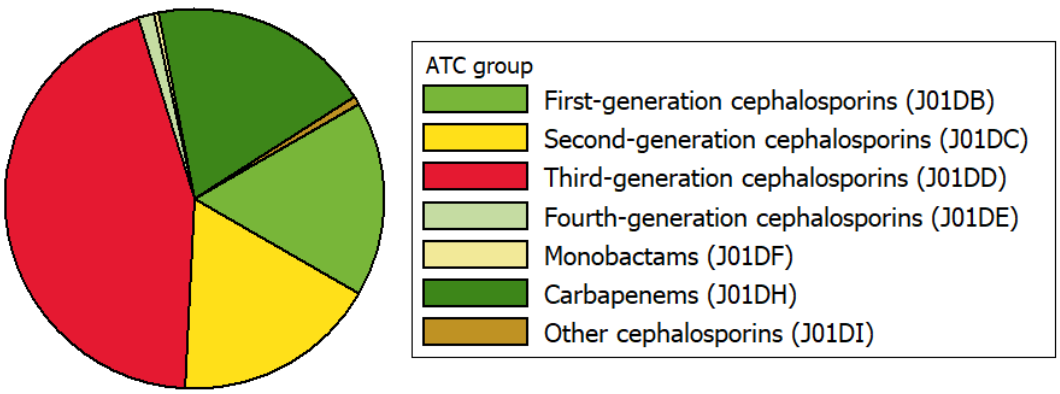

Combinations of penicillins including beta-lactam inhibitors (J01CR) accounted for 71.8% of all penicillins (Figure 45), of which amoxicillin and enzyme inhibitor (J01CR02) accounted for 47.4%, and piperacillin and enzyme inhibitor (J01CR05) for 44.2%. Penicillins with extended spectrum (J01CA) made up 16.0% of all penicillins and included predominantly amoxicillin (41.5%) and ampicillin (38.0%).

**Figure 45. Distribution of beta-lactam antibacterials, penicillins (ATC group C) used in acute care hospitals on the day of the PPS, by group at 4th ATC level (n= 38 512 reported antimicrobials), ECDC PPS 2022–2023**



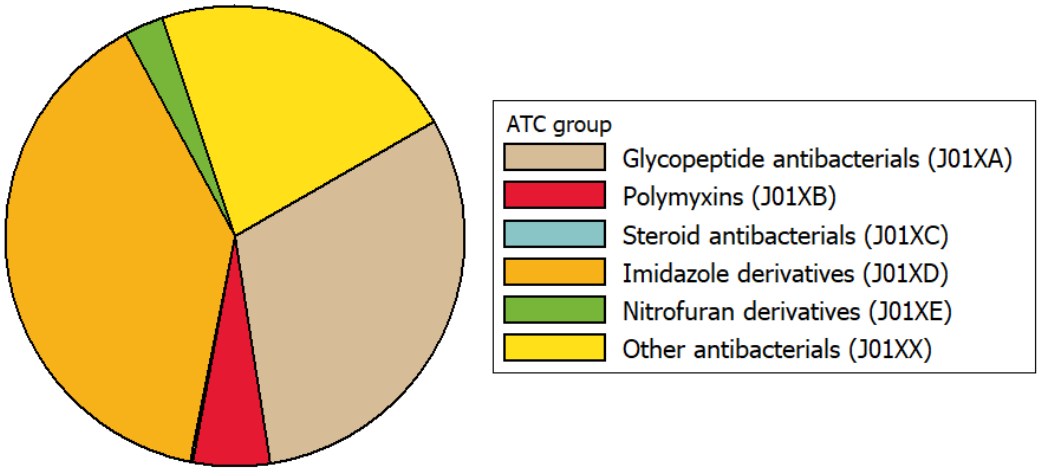

Among other beta-lactam antibacterials (ATC group J01D), third-generation cephalosporins were the most frequently used (44.4%), followed by carbapenems (19.0%), second-generation cephalosporins (17.5%), first-generation cephalosporins (16.7%) and fourth-generation cephalosporins (1.4%) (Figure 46).

**Figure 46. Distribution of other beta-lactam antibacterials (ATC group J01D) used in acute care hospitals on the day of the PPS, by group at 4th ATC level (n= 45 814 reported antimicrobials), ECDC PPS 2022–2023**



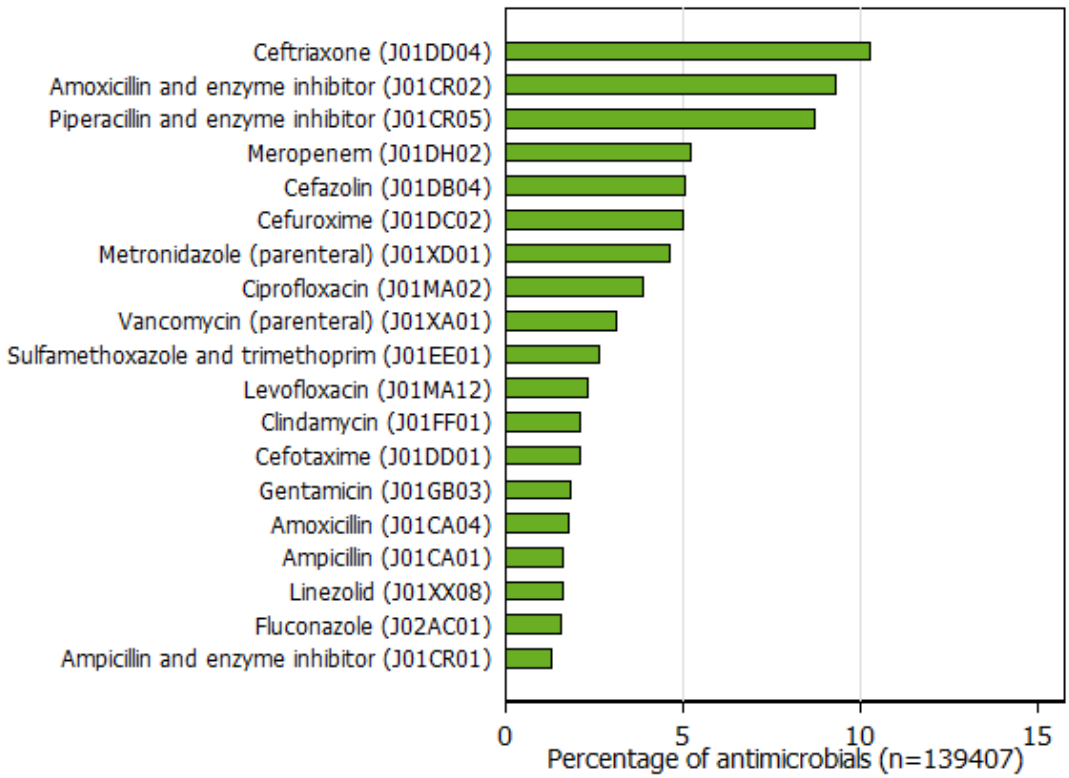
Among other antibacterials (ATC group J01X), imidazole derivates (99.4% parenteral metronidazole) accounted for 39.0% of antimicrobial agents, glycopeptide antibacterials 30.9% (86.2% parenteral vancomycin and 13.5% teicoplanin), polymyxins 5.4% (99.6% parenteral colistin), nitrofuran derivates 2.8%, steroid antibacterials (100% fusidic acid) 0.1% and other antibacterials (J01XX) 21.8% (linezolid 63.3%, daptomycin 23.4%, fosfomycin 9.5%) (Figure 47).

**Figure 47. Distribution of other antibacterials (ATC group J01X) used in acute care hospitals on the day of the PPS, by group at 4th ATC level (n= 16 883 antimicrobials), ECDC PPS 2022–2023**




Out of a total of 252 different antimicrobials reported at the fifth ATC level, 19 (7.5%) accounted for 75% of the total antimicrobial use in European acute care hospitals (Figure 48). The most frequently prescribed antibiotic in the ECDC PPS 2022–2023 was ceftriaxone (J01DD04), accounting for 10.4% of all reported antimicrobials and overtaking amoxicillin with enzyme inhibitor (J01CR02, 9.4%), which was the most frequently prescribed antibiotic in the previous two PPSs. The median number of different antimicrobials (ATC 5th level) reported by hospital was 19 (IQR: 12–27).

**Figure 48. Antimicrobial agents accounting for 75% of antimicrobial use in European acute care hospitals (DU 75%), by agent at 5th ATC level, ECDC PPS 2022–2023**




*DU: drug utilisation.*

The type of antimicrobials used varied considerably by indication (Table 15 and Table A1.6). Combinations of penicillins, including beta-lactamase inhibitors (ATC group J01CR) were the most commonly used antimicrobial group in all indications except for surgical prophylaxis. Combination of penicillins with beta-lactamase inhibitors (J01CR) were the most commonly used antimicrobial groups (18.9%) for the treatment of hospital infections, followed by carbapenems (J01DH) and third-generation cephalosporins (J01DD) with 12.0% and 9.3%, respectively. The three most commonly used antimicrobial groups for the treatment of community-acquired infections were combinations of penicillins and beta-lactamase inhibitors (J01CR), followed by third-generation cephalosporins (J01DD) and fluoroquinolones (J01MA), with 22.9%, 18.6% and 8.6%, respectively. The three most commonly used antimicrobial groups for surgical prophylaxis were first-generation cephalosporins (J01DB), second-generation cephalosporins (J01DC) and combinations of penicillins with beta-lactamase inhibitors (J01CR), with 30.4%, 16.9% and 13.4%, respectively. The most commonly used antimicrobials for medical prophylaxis were sulfomethoxazole and trimethoprim (J01EE01, 13.6%), ceftriaxone (J01DD04, 9.0%), amoxicillin and beta-lactamase inhibitor (J01CR02, 7.8%), fluoroquinolones (J01MA, 7.1%, mainly ciprofloxacin and levofloxacin), triazole derivates (J02AC, 7.0%, mainly fluconazole and posaconazole) and parenteral metronidazole (J01XD01, 4.4%).

Within combinations of penicillins, including beta-lactamase inhibitors (J01CR), amoxicillin and enzyme inhibitor (J01CR02) was the most frequently used antimicrobial in all indications except for the treatment of hospital infections and long-term care infections, where piperacillin and enzyme inhibitor (J01CR05) was the most frequently prescribed antimicrobial. Antimicrobial use intended to treat hospital infections was characterised by higher (significant at $p<0.001$ level) use of intestinal anti-infectives (ATC group A07AA), in particular of oral vancomycin (A07AA09, 3.3% for hospital infection *versus* 0.7% for community-acquired infection), tetracyclines (ATC group J01AA), in particular tigecycline (J01AA12, 1.1% *versus* 0.3%), piperacillin and enzyme inhibitor (J01CR05, 12.0% *versus* 9.0%), carbapenems (ATC group J01DH, 12.0% *versus* 6.2%), glycopeptide antibacterials (ATC group J01XA, 8.1% *versus* 2.9%), polymyxins (ATC group J01XB, 2.2% *versus* 0.3%), other antibacterials (ATC group J01XX, 5.8% *versus* 2.3%) and antimycotics for systemic use (ATC group J02, 5.6% *versus* 1.8%).

The distribution of antimicrobials for the treatment of infections associated with long-term care showed a profile in-between that for the treatment of community-acquired infections and hospital infections, with, for example, fluoroquinolone use similar to that for the treatment of community infections (8.7% *versus* 8.5%), but a higher use than for the treatment of community infections for piperacillin and enzyme inhibitor (15.1% *versus* 8.8%), oral vancomycin (1.8% *versus* 0.7%), carbapenems (9.0% *versus* 6.2%) or polymyxins (0.9% *versus* 0.3%). Macrolides (ATC group J01FA) were frequently used for 'other' indications (8.4% compared with 2.2% for all indications other than 'other' combined).

**Table 15. Distribution of antimicrobials (by group at 4th ATC level*) as a percentage of the total number of antimicrobials, by indication, ECDC PPS 2022–2023**

| Antimicrobial group (ATC code) | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis | Other indication | Unknown | Toral |
|---|---|---|---|---|---|---|---|---|
| | Community infectioin | Hopsital infection | LTCF infection or other HAI | | | | | |
| | % | % | % | % | % | % | % | % |
| **Number of antimicrobials** | 68 195 | 25 384 | 3 494 | 20 571 | 14 084 | 2 974 | 3 506 | 138 208 |
| Intestinal anti-infectives, antibiotics (A07AA) | 1.1 | 4.3 | 2.8 | 0.2 | 3.7 | 3.4 | 1.6 | 1.9 |
| Antifungals for systemic use (D01BA) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tetracyclines (J01AA) | 1.3 | 1.6 | 1.0 | 0.5 | 0.7 | 1.3 | 1.3 | 1.2 |
| Amphenicols (J01BA) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Penicillins, extended spectrum without anti-pseudomonal activity (J01CA) | 5.1 | 3.2 | 2.9 | 2.9 | 5.7 | 6.0 | 4.8 | 4.4 |
| Beta-lactamase sensitive penicillins (J01CE) | 1.7 | 0.5 | 0.8 | 0.3 | 1.0 | 0.7 | 1.4 | 1.2 |
| Beta-lactamase resistant penicillins (J01CF) | 2.1 | 2.3 | 1.1 | 1.6 | 0.4 | 0.5 | 1.3 | 1.8 |
| Beta-lactamase inhibitors (J01CG) | 0.4 | 0.4 | 0.7 | 0.3 | 0.5 | 0.6 | 0.9 | 0.4 |
| Combinations of penicillins, incl. beta-lactamase inhibitors (J01CR) | 22.9 | 18.9 | 28.9 | 13.4 | 13.9 | 19.7 | 26.2 | 20.0 |
| First-generation cephalosporins (J01DB) | 0.9 | 1.0 | 0.5 | 30.4 | 2.5 | 1.7 | 2.5 | 5.5 |
| Second-generation cephalosporins (J01DC) | 4.3 | 2.3 | 1.7 | 16.9 | 4.4 | 4.6 | 5.9 | 5.8 |
| Third-generation cephalosporins (J01DD) | 18.4 | 9.3 | 15.9 | 10.7 | 12.0 | 12.9 | 17.9 | 14.7 |
| Fourth-generation cephalosporins (J01DE) | 0.4 | 1.0 | 0.7 | 0.1 | 0.3 | 0.4 | 0.3 | 0.5 |
| Monobactams (J01DF) | 0.1 | 0.4 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 |
| Carbapenems (J01DH) | 6.2 | 12.0 | 9.0 | 1.1 | 3.8 | 5.9 | 4.8 | 6.3 |
| Other cephalosporins and penems (J01DI) | 0.2 | 0.5 | 0.4 | 0.1 | 0.1 | 0.3 | 0.2 | 0.2 |

| Antimicrobial group (ATC code) | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis | Other indication | Unknown | Toral |
|---|---|---|---|---|---|---|---|---|
| | Community infectioin | Hopsital infection | LTCF infection or other HAI | | | | | |
| | % | % | % | % | % | % | % | % |
| Trimethoprim and derivatives (J01EA) | 0.2 | 0.3 | 0.1 | 0.1 | 1.4 | 0.2 | 0.4 | 0.3 |
| Short-acting sulfonamides (J01EB) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Intermediate-acting sulfonamides (J01EC) | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 |
| Long-acting sulfonamides (J01ED) | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Combinations of sulfonamides and trimethoprim, incl. derivatives (J01EE) | 1.5 | 2.3 | 2.1 | 1.1 | 15.1 | 1.8 | 2.2 | 3.0 |
| Macrolides (J01FA) | 3.1 | 0.7 | 3.1 | 0.3 | 2.6 | 8.4 | 2.1 | 2.3 |
| Lincosamides (J01FF) | 2.7 | 1.4 | 1.7 | 2.5 | 1.3 | 1.8 | 1.8 | 2.2 |
| Streptogramins (J01FG) | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Streptomycins (J01GA) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Aminoglycosides (J01GB) | 3.1 | 3.3 | 2.0 | 3.1 | 3.5 | 4.5 | 2.0 | 3.1 |
| First-generation quinolones (J01M1) | 0.1 | 0.1 | 0.0 | 0.0 | 0.3 | 0.2 | 0.2 | 0.1 |
| Second-generation quinolones (J01M2) | 7.7 | 6.1 | 8.1 | 3.0 | 6.4 | 5.2 | 6.7 | 6.5 |
| Third-generation quinolones (J01M3) | 0.8 | 0.4 | 0.5 | 0.1 | 0.4 | 0.9 | 0.5 | 0.6 |
| Combinations of antibacterials (J01RA) | 0.4 | 0.1 | 0.1 | 0.3 | 0.4 | 0.3 | 0.2 | 0.3 |
| Glycopeptide antibacterials (J01XA) | 2.9 | 8.1 | 4.0 | 2.4 | 2.2 | 4.1 | 3.3 | 3.8 |
| Polymyxins (J01XB) | 0.3 | 2.2 | 0.9 | 0.1 | 0.6 | 0.5 | 0.3 | 0.7 |
| Steroid antibacterials (J01XC) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| Imidazole derivatives (J01XD) | 4.9 | 3.0 | 3.1 | 7.0 | 4.4 | 5.7 | 4.7 | 4.8 |
| Nitrofuran derivatives (J01XE) | 0.3 | 0.7 | 0.8 | 0.1 | 0.5 | 0.1 | 0.4 | 0.3 |
| Other antibacterials (J01XX) | 2.3 | 5.8 | 3.2 | 0.5 | 1.7 | 3.1 | 1.9 | 2.7 |
| Antimycotics, antibiotics (J02AA) | 0.1 | 0.4 | 0.1 | 0.0 | 0.5 | 0.3 | 0.1 | 0.2 |
| Imidazole derivatives (J02AB) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 |
| Triazole derivatives (J02AC) | 1.4 | 3.5 | 1.3 | 0.2 | 7.0 | 2.0 | 2.0 | 2.2 |
| Other antimycotics for systemic use (J02AX) | 0.3 | 1.8 | 0.4 | 0.1 | 1.2 | 0.6 | 0.6 | 0.7 |
| Antimycobacterials (J04) | 1.7 | 0.6 | 0.4 | 0.0 | 0.4 | 0.6 | 0.3 | 1.0 |
| Nitroimidazole derivatives (P01AB) | 1.0 | 1.2 | 1.2 | 0.6 | 0.7 | 1.2 | 1.0 | 1.0 |

**Fourth ATC level except for quinolone antibacterials (classified according to reference [31]) and antimycobacterials combined at second ATC level J04.*
*LTCF, long-term care facility. Unknown: unknown indication or missing data.*

## Results by type of hospital, specialty and patient risk factors

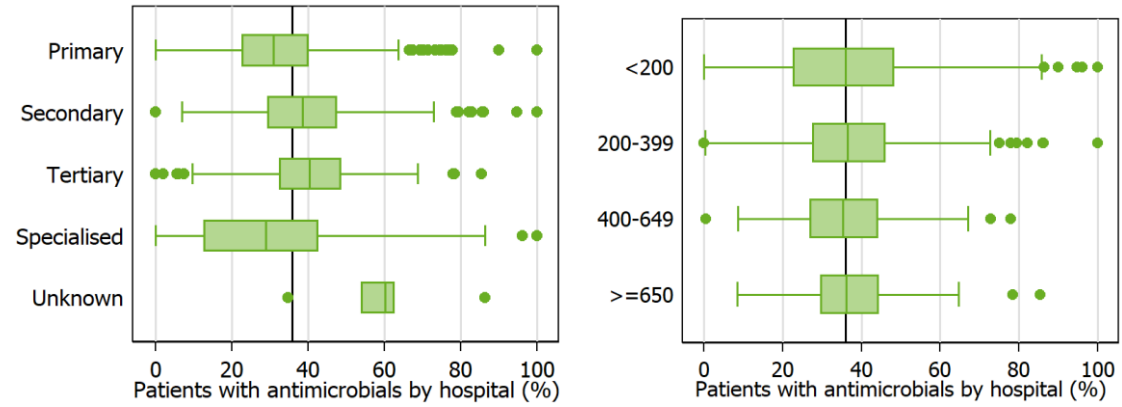
The prevalence of antimicrobial use varied significantly by type of hospital ($p<0.001$) and was the highest in tertiary hospitals. Specialised and primary hospitals reported the lowest prevalence (Table 16). Prevalence of antimicrobial use did not vary by hospital size (Figure 49).

**Table 16. Percentile distribution of the prevalence of antimicrobial use, by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | Hospitals No. | Patients No. | Patients with AMU No. | Prevalence of AMU % | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|---|---|---|
| Primary | 381 | 44 835 | 13 498 | 32.3 | 13.2 | 22.9 | 31.0 | 40.0 | 53.3 |
| Secondary | 442 | 106 929 | 37 973 | 39.2 | 21.6 | 29.5 | 38.6 | 47.5 | 58.2 |
| Tertiary | 294 | 126 227 | 48 342 | 40.3 | 23.6 | 32.7 | 40.4 | 48.6 | 55.6 |
| Specialised | 128 | 14 303 | 3 782 | 29.9 | 0.7 | 12.8 | 29.0 | 42.6 | 59.3 |
| Unknown | 5 | 1 287 | 748 | 59.6 | 34.7 | 54.0 | 60.3 | 62.6 | 86.5 |
| **Total** | 1 250 | 293 581 | 104 343 | 36.5 | 16.8 | 26.3 | 35.9 | 46.0 | 56.5 |

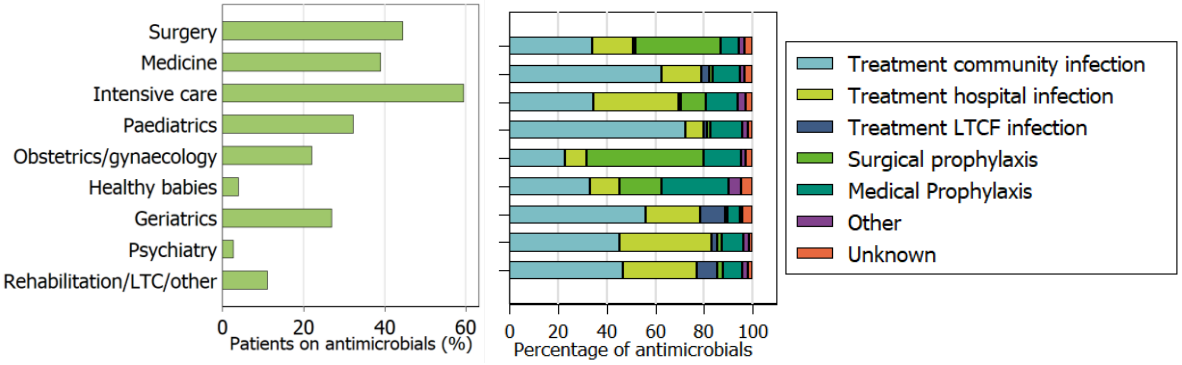
*Patients with AMU: patients receiving at least one antimicrobial agent; Prevalence of AMU: percentage of patients receiving at least one antimicrobial agent; P: percentile.*

**Figure 49. Prevalence of antimicrobial use (percentage of patients receiving at least one antimicrobial agent), by type of hospital (left) and hospital size (right), (vertical black line=overall median), ECDC PPS 2022–2023**




The prevalence of antimicrobial use was the highest among ICU patients (59.5%) and the lowest among psychiatric patients (2.8%) (Figure 50). The indications for antimicrobial use varied considerably by patient/consultant specialty. The highest relative use for treatment of community-acquired infections was reported in paediatric patients (72.5% of all antimicrobials). The highest use for treatment of hospital infections was reported in psychiatric and ICU patients (37.7% and 35.1%, respectively) and for the treatment of infections associated with long-term care in geriatric patients and rehabilitation and long-term care patients (10.4% and 8.1%, respectively). Surgical prophylaxis was the most common indication in obstetrics and gynaecology (48.0%) and surgery patients (34.9%). The relative frequency of medical prophylaxis varied between 5.3% in geriatrics and 27.9% in healthy babies. The percentage of patients receiving more than one antimicrobial varied between 5.9% in psychiatry and 47.7% in ICUs.

**Figure 50. Prevalence of antimicrobial use (percentage of patients receiving at least one antimicrobial agent) by patient/consultant specialty (left) and indication for antimicrobial use by patient/consultant specialty (right), ECDC PPS 2022–2023**




*LTC=long-term care, LTCF=long-term care facility.*

The distribution of antibacterials for systemic use by patient/consultant specialty showed the highest relative use of aminoglycosides in paediatric patients and the highest use of 'other antibacterials' in ICU patients (Figure 51).

**Figure 51. Distribution of antibacterials for systemic use (ATC group J01) used in acute care hospitals on the day of the PPS, by patient/consultant specialty and group and group at 3rd ATC level,, ECDC PPS 2022–2023**

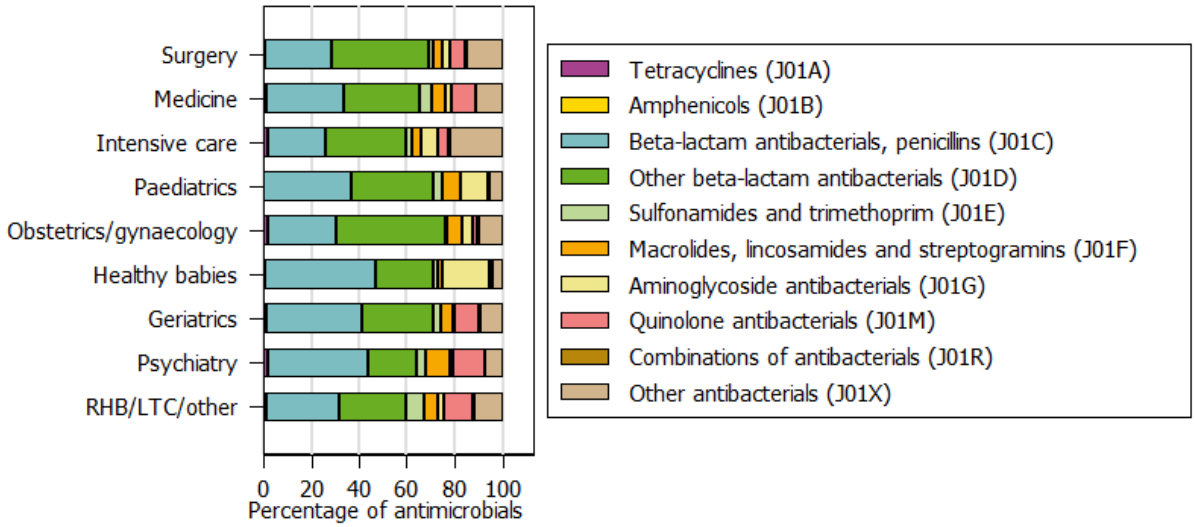



Table 17 shows the prevalence of antimicrobial use by patient risk factors for 275 406 patients in 28 countries that used the 'standard' (patient-based) protocol. In multiple logistic regression analysis, the highest independent risk for antimicrobial use (adjusted odds ratio ≥2.0) was observed in patients with a urinary catheter, for the patient/consultant specialties haematology and bone marrow transplant and for 19 types of surgery, with the highest adjusted odds ratios in heart transplant surgery and appendix surgery. The lowest independent risk for antimicrobial use (adjusted odds ratio ≤0.2) was observed in healthy neonates, psychiatrics, rehabilitation and long-term care. Central vascular catheters were not included in the model because of the association with parenteral antimicrobial use. The discriminatory power of the model as measured by the area under the ROC curve was 0.76 for the full sample.

**Table 17. Patient risk factors for antimicrobial use (AU) with crude and adjusted odds ratios from multiple logistic regression model, n=275 406 patients in 28 countries (standard protocol data only), ECDC PPS 2022–2023**

| Risk factor | Patients | | Patients with AU | | Patient risk for AU | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Crude | | Adjusted | |
| | No. | % of total | No. | % | OR | (95% CI) | OR | (95% CI) |
| All patients | 275 406 | 100.0 | 99 531 | 36.1 | - | | - | |
| **Age class** | | | | | | | | |
| 5–44 years | 55 027 | 20.0 | 18 046 | 32.8 | Ref. | - | Ref. | - |
| <1 month | 7 553 | 2.7 | 1 021 | 13.5 | 0.3 | (0.3–0.3) | 0.7 | (0.6–0.8) |
| 1–11 months | 5 832 | 2.1 | 1 656 | 28.4 | 0.8 | (0.8–0.9) | 0.9 | (0.9–1.0) |
| 1–4 years | 4 188 | 1.5 | 2 041 | 48.7 | 1.9 | (1.8–2.1) | 1.4 | (1.3–1.5) |
| 45-74 years | 117 642 | 42.7 | 44 486 | 37.8 | 1.2 | (1.2-1.3) | 1.0 | (1.0–1.0) |
| 75-84 years | 54 147 | 19.7 | 20 661 | 38.2 | 1.3 | (1.2-1.3) | 1.0 | (0.9–1.0) |
| ≥85 years | 31 017 | 11.3 | 11 620 | 37.5 | 1.2 | (1.2-1.3) | 1.0 | (0.9–1.0) |
| **Gender** | | | | | | | | |
| Female/other/unknown | 140 854 | 51.1 | 46 327 | 32.9 | Ref. | - | Ref. | - |
| Male | 134 552 | 48.9 | 53 204 | 39.5 | 1.3 | (1.3-1.4) | 1.2 | (1.2–1.2) |
| **Length of stay (days)[a]** | | | | | | | | |
| 1-3 days | 85 340 | 31.0 | 27 572 | 32.3 | Ref. | - | Ref. | - |
| 4-7 days | 70 168 | 25.5 | 29 108 | 41.5 | 1.5 | (1.5-1.5) | 1.5 | (1.5–1.5) |
| 8-14 days | 52 887 | 19.2 | 22 149 | 41.9 | 1.5 | (1.5-1.5) | 1.5 | (1.5–1.5) |
| 15-29 days | 35 627 | 12.9 | 13 006 | 36.5 | 1.2 | (1.2-1.2) | 1.2 | (1.2–1.3) |
| >=30 days | 30 557 | 11.1 | 7 368 | 24.1 | 0.7 | (0.6-0.7) | 0.9 | (0.8–0.9) |
| Unknown | 827 | 0.3 | 328 | 39.7 | 1.4 | (1.2-1.6) | 1.5 | (1.3–1.8) |
| **McCabe score** | | | | | | | | |
| Non-fatal | 174 175 | 63.2 | 59 465 | 34.1 | Ref. | - | Ref. | - |
| Ultimately fatal | 43 017 | 15.6 | 18 805 | 43.7 | 1.5 | (1.5-1.5) | 1.2 | (1.1–1.2) |
| Rapidly fatal | 13 546 | 4.9 | 6 564 | 48.5 | 1.8 | (1.8-1.9) | 1.3 | (1.2–1.3) |
| Unknown | 44 668 | 16.2 | 14 697 | 32.9 | 0.9 | (0.9-1.0) | 1.1 | (1.0–1.1) |

| Risk factor | Patients | | Patients with AU | | Patient risk for AU | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Crude | | Adjusted | |
| | No. | % of total | No. | % | OR | (95% CI) | OR | (95% CI) |
| **Surgery since admission** | | | | | | | | |
| No surgery | 202 636 | 73.6 | 64 779 | 32.0 | Ref. | - | Ref. | - |
| NHSN surgery | | | | | | | | |
| NHSN surgery, not specified | 19 939 | 7.2 | 8 533 | 42.8 | 1.6 | (1.5-1.6) | 1.3 | (1.3–1.4) |
| AAA-Abdominal aortic aneurysm repair | 198 | 0.1 | 109 | 55.1 | 2.6 | (2.0-3.4) | 1.4 | (1.0–1.9) |
| AMP-Limb amputation | 1 192 | 0.4 | 768 | 64.4 | 3.9 | (3.4-4.3) | 2.7 | (2.4–3.1) |
| APPY-Appendix surgery | 713 | 0.3 | 603 | 84.6 | 11.7 | (9.5-14.3) | 8.4 | (6.8–10.4) |
| AVSD-Shunt for dialysis | 32 | 0.0 | 17 | 53.1 | 2.4 | (1.2-4.8) | 1.7 | (0.8–3.4) |
| BILI-Bile duct, liver or pancreatic surgery | 812 | 0.3 | 547 | 67.4 | 4.4 | (3.8-5.1) | 2.3 | (2.0–2.7) |
| BRST-Breast surgery | 655 | 0.2 | 346 | 52.8 | 2.4 | (2.0-2.8) | 2.3 | (2.0–2.7) |
| CARD-Cardiac surgery | 1 098 | 0.4 | 510 | 46.4 | 1.8 | (1.6-2.1) | 1.4 | (1.2–1.6) |
| CBGB-Coronary artery bypass graft with both chest and donor site incisions | 409 | 0.2 | 181 | 44.3 | 1.7 | (1.4-2.1) | 1.4 | (1.1–1.8) |
| CBGC-Coronary artery bypass graft with chest incision only | 196 | 0.1 | 79 | 40.3 | 1.4 | (1.1-1.9) | 1.0 | (0.8–1.4) |
| CEA-Carotid endarterectomy | 128 | 0.1 | 61 | 47.7 | 1.9 | (1.4-2.7) | 1.7 | (1.2–2.5) |
| CHOL-Gallbladder surgery | 844 | 0.3 | 530 | 62.8 | 3.6 | (3.1-4.1) | 2.6 | (2.2–3.0) |
| COLO-Colon surgery | 1 989 | 0.7 | 1 228 | 61.7 | 3.4 | (3.1-3.8) | 1.7 | (1.5–1.8) |
| CRAN-Craniotomy | 1 348 | 0.5 | 644 | 47.8 | 1.9 | (1.7-2.2) | 1.4 | (1.2–1.6) |
| CSEC-Caesarean section | 1 954 | 0.7 | 874 | 44.7 | 1.7 | (1.6-1.9) | 3.7 | (3.3–4.1) |
| FUSN-Spinal fusion | 615 | 0.2 | 248 | 40.3 | 1.4 | (1.2-1.7) | 1.6 | (1.4–1.9) |
| FX-Open reduction of fracture | 2 808 | 1.0 | 1 293 | 46.0 | 1.8 | (1.7-2.0) | 1.9 | (1.8–2.1) |
| GAST-Gastric surgery | 744 | 0.3 | 421 | 56.6 | 2.8 | (2.4-3.2) | 1.5 | (1.3–1.8) |
| HER-Herniorrhaphy | 959 | 0.4 | 511 | 53.3 | 2.4 | (2.1-2.8) | 1.7 | (1.5–2.0) |
| HPRO-Hip prosthesis | 2 992 | 1.1 | 1 268 | 42.4 | 1.6 | (1.5-1.7) | 1.7 | (1.5–1.8) |
| HTP-Heart transplant | 21 | 0.0 | 17 | 81.0 | 9.0 | (3.0-26.9) | 8.8 | (2.7–29.1) |
| HYST-Abdominal hysterectomy | 489 | 0.2 | 311 | 63.6 | 3.7 | (3.1-4.5) | 3.6 | (2.9–4.4) |
| KPRO-Knee prosthesis | 1 556 | 0.6 | 691 | 44.4 | 1.7 | (1.5-1.9) | 2.2 | (2.0–2.4) |
| KTP-Kidney transplant | 128 | 0.1 | 106 | 82.8 | 10.3 | (6.5-16.2) | 4.7 | (2.9–7.6) |
| LAM-Laminectomy | 631 | 0.2 | 303 | 48.0 | 2.0 | (1.7-2.3) | 2.5 | (2.1–3.0) |
| LTP-Liver transplant | 79 | 0.0 | 65 | 82.3 | 9.9 | (5.5-17.6) | 4.7 | (2.6–8.6) |
| NECK-Neck surgery | 520 | 0.2 | 303 | 58.3 | 3.0 | (2.5-3.5) | 1.6 | (1.3–1.9) |
| NEPH-Kidney surgery | 612 | 0.2 | 424 | 69.3 | 4.8 | (4.0-5.7) | 1.6 | (1.3–1.9) |
| OVRY-Ovarian surgery | 397 | 0.1 | 225 | 56.7 | 2.8 | (2.3-3.4) | 3.1 | (2.5–3.8) |
| PACE-Pacemaker surgery | 382 | 0.1 | 216 | 56.5 | 2.8 | (2.3-3.4) | 4.6 | (3.7–5.7) |
| PRST-Prostate surgery | 512 | 0.2 | 329 | 64.3 | 3.8 | (3.2-4.6) | 1.1 | (0.9–1.3) |
| PVBY-Peripheral vascular bypass surgery | 466 | 0.2 | 253 | 54.3 | 2.5 | (2.1-3.0) | 1.6 | (1.3–2.0) |
| REC-Rectal surgery | 450 | 0.2 | 280 | 62.2 | 3.5 | (2.9-4.2) | 2.1 | (1.7–2.5) |
| RFUSN-Refusion of spine | 121 | 0.0 | 67 | 55.4 | 2.6 | (1.8-3.8) | 2.7 | (1.9–4.0) |
| SB-Small bowel surgery | 615 | 0.2 | 394 | 64.1 | 3.8 | (3.2-4.5) | 1.9 | (1.6–2.3) |
| SPLE-Spleen surgery | 106 | 0.0 | 72 | 67.9 | 4.5 | (3.0-6.8) | 2.2 | (1.4–3.3) |
| THOR-Thoracic surgery | 713 | 0.3 | 421 | 59.0 | 3.1 | (2.6-3.6) | 2.0 | (1.7–2.4) |
| THYR-Thyroid and/or parathyroid surgery | 277 | 0.1 | 85 | 30.7 | 0.9 | (0.7-1.2) | 0.8 | (0.6–1.0) |
| VHYS-Vaginal hysterectomy | 321 | 0.1 | 168 | 52.3 | 2.3 | (1.9-2.9) | 2.4 | (1.9–3.1) |
| VSHN-Ventricular shunt | 174 | 0.1 | 90 | 51.7 | 2.3 | (1.7-3.1) | 2.3 | (1.6–3.1) |
| XLAP-Exploratory laparotomy | 869 | 0.3 | 601 | 69.2 | 4.8 | (4.1-5.5) | 2.5 | (2.1–2.9) |
| Minimal/non-NSHN surgery | 19 381 | 7.0 | 9 505 | 49.0 | 2.0 | (2.0-2.1) | 1.7 | (1.7–1.8) |
| Unknown | 4 325 | 1.6 | 1 055 | 24.4 | 0.7 | (0.6-0.7) | 0.8 | (0.8–0.9) |
| **Presence of invasive devices** [b] | | | | | | | | |
| Intubation | 6 563 | 2.4 | 4 751 | 72.4 | 4.8 | (4.6-5.1) | 1.9 | (1.7–2.0) |
| Urinary catheter | 56 415 | 20.5 | 32 906 | 58.3 | 3.2 | (3.1-3.3) | 2.4 | (2.3–2.4) |
| Central vascular catheter | 25 543 | 9.3 | 16 822 | 65.9 | 3.9 | (3.8-4.0) | - | - |
| **Patient/consultant specialty** | | | | | | | | |
| General surgery | 17 899 | 6.5 | 9 206 | 51.4 | Ref. | - | Ref. | - |
| Digestive tract surgery | 4 240 | 1.5 | 2 115 | 49.9 | 0.9 | (0.9-1.0) | 0.9 | (0.8–0.9) |
| Orthopaedics and traumatology | 7 804 | 2.8 | 2 791 | 35.8 | 0.5 | (0.5-0.6) | 0.5 | (0.5–0.6) |
| Orthopaedics | 9 338 | 3.4 | 3 766 | 40.3 | 0.6 | (0.6-0.7) | 0.7 | (0.6–0.7) |
| Traumatology | 3 690 | 1.3 | 1 266 | 34.3 | 0.5 | (0.5-0.5) | 0.5 | (0.4–0.5) |

| Risk factor | Patients | | Patients with AU | | Patient risk for AU | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Crude | | Adjusted | |
| | No. | % of total | No. | % | OR | (95% CI) | OR | (95% CI) |
| Cardio surgery | 1 828 | 0.7 | 619 | 33.9 | 0.5 | (0.4-0.5) | 0.4 | (0.4–0.5) |
| Cardiovascular surgery | 565 | 0.2 | 229 | 40.5 | 0.6 | (0.5-0.8) | 0.6 | (0.5–0.7) |
| Vascular surgery | 3 431 | 1.3 | 1 681 | 49.0 | 0.9 | (0.8-1.0) | 0.9 | (0.8–1.0) |
| Thoracic surgery | 1 423 | 0.5 | 635 | 44.6 | 0.8 | (0.7-0.8) | 0.7 | (0.6–0.8) |
| Neurosurgery | 4 625 | 1.7 | 1 519 | 32.8 | 0.5 | (0.4-0.5) | 0.4 | (0.4–0.5) |
| Paediatric general surgery | 1 275 | 0.5 | 609 | 47.8 | 0.9 | (0.8-1.0) | 0.8 | (0.7–0.9) |
| Transplantation surgery | 357 | 0.1 | 226 | 63.3 | 1.6 | (1.3-2.0) | 1.3 | (1.0–1.7) |
| Surgery for cancer | 1 331 | 0.5 | 541 | 40.6 | 0.6 | (0.6-0.7) | 0.7 | (0.6–0.8) |
| ENT | 3 406 | 1.2 | 1 638 | 48.1 | 0.9 | (0.8-0.9) | 1.1 | (1.0–1.2) |
| Ophthalmology | 1 515 | 0.6 | 323 | 21.3 | 0.3 | (0.2-0.3) | 0.3 | (0.3–0.4) |
| Maxillo-facial surgery | 652 | 0.2 | 420 | 64.4 | 1.7 | (1.5-2.0) | 2.0 | (1.7–2.4) |
| Stomatology/ Dentistry | 59 | 0.0 | 38 | 64.4 | 1.7 | (1.0-2.9) | 2.1 | (1.2–3.7) |
| Burns care | 194 | 0.1 | 71 | 36.6 | 0.5 | (0.4-0.7) | 0.5 | (0.4–0.7) |
| Urology | 7 140 | 2.6 | 4 474 | 62.7 | 1.6 | (1.5-1.7) | 1.3 | (1.2–1.4) |
| Plastic and reconstructive surgery | 1 550 | 0.6 | 845 | 54.5 | 1.1 | (1.0-1.3) | 1.2 | (1.1–1.4) |
| Other surgery | 953 | 0.4 | 414 | 43.4 | 0.7 | (0.6-0.8) | 0.8 | (0.7–0.9) |
| General medicine | 36 242 | 13.2 | 16 037 | 44.2 | 0.7 | (0.7-0.8) | 1.0 | (1.0–1.1) |
| Gastro-enterology | 6 840 | 2.5 | 2 723 | 39.8 | 0.6 | (0.6-0.7) | 0.9 | (0.8–0.9) |
| Hepatology | 298 | 0.1 | 151 | 50.7 | 1.0 | (0.8-1.2) | 1.2 | (1.0–1.6) |
| Endocrinology | 2 072 | 0.8 | 530 | 25.6 | 0.3 | (0.3-0.4) | 0.5 | (0.4–0.5) |
| Nephrology | 3 990 | 1.5 | 2 036 | 51.0 | 1.0 | (0.9-1.1) | 1.2 | (1.1–1.3) |
| Cardiology | 14 402 | 5.2 | 3 151 | 21.9 | 0.3 | (0.3-0.3) | 0.3 | (0.3–0.4) |
| Dermatology | 1 194 | 0.4 | 451 | 37.8 | 0.6 | (0.5-0.6) | 0.9 | (0.8–1.1) |
| Haematology | 3 524 | 1.3 | 2 028 | 57.5 | 1.3 | (1.2-1.4) | 1.8 | (1.7–2.0) |
| Bone Marrow Transplantation (BMT) | 277 | 0.1 | 217 | 78.3 | 3.4 | (2.6-4.6) | 5.1 | (3.8–6.8) |
| Haematology/BMT | 694 | 0.3 | 478 | 68.9 | 2.1 | (1.8-2.5) | 3.1 | (2.6–3.7) |
| Oncology | 8 149 | 3.0 | 2 269 | 27.8 | 0.4 | (0.3-0.4) | 0.5 | (0.5–0.6) |
| Neurology | 13 005 | 4.7 | 2 358 | 18.1 | 0.2 | (0.2-0.2) | 0.3 | (0.3–0.3) |
| Pneumology | 9 792 | 3.6 | 5 548 | 56.7 | 1.2 | (1.2-1.3) | 1.9 | (1.8–2.0) |
| COVID-19 (non-ICU) | 1 516 | 0.6 | 646 | 42.6 | 0.7 | (0.6-0.8) | 0.9 | (0.8–1.0) |
| Rheumatology | 2 113 | 0.8 | 334 | 15.8 | 0.2 | (0.2-0.2) | 0.3 | (0.3–0.4) |
| Infectious diseases | 6 104 | 2.2 | 4 290 | 70.3 | 2.2 | (2.1-2.4) | 3.1 | (2.9–3.4) |
| Medical traumatology | 77 | 0.0 | 18 | 23.4 | 0.3 | (0.2-0.5) | 0.4 | (0.2–0.7) |
| Other medical | 3 761 | 1.4 | 1 295 | 34.4 | 0.5 | (0.5-0.5) | 0.7 | (0.6–0.8) |
| Healthy neonates (maternity) | 3 220 | 1.2 | 146 | 4.5 | 0.0 | (0.0-0.1) | 0.1 | (0.1–0.2) |
| Healthy neonates (paediatrics) | 1 512 | 0.6 | 66 | 4.4 | 0.0 | (0.0-0.1) | 0.1 | (0.1–0.2) |
| Neonatology | 3 233 | 1.2 | 593 | 18.3 | 0.2 | (0.2-0.2) | 0.5 | (0.5–0.6) |
| Paediatrics general, not specialised | 8 050 | 2.9 | 3 343 | 41.5 | 0.7 | (0.6-0.7) | 1.0 | (0.9–1.1) |
| Medical ICU | 3 071 | 1.1 | 1 874 | 61.0 | 1.5 | (1.4-1.6) | 0.9 | (0.8–1.0) |
| Surgical ICU | 2 203 | 0.8 | 1 590 | 72.2 | 2.4 | (2.2-2.7) | 1.1 | (0.9–1.2) |
| Paediatric ICU | 699 | 0.3 | 404 | 57.8 | 1.3 | (1.1-1.5) | 1.3 | (1.0–1.5) |
| Neonatal ICU | 2 039 | 0.7 | 693 | 34.0 | 0.5 | (0.4-0.5) | 1.0 | (0.8–1.2) |
| Mixed (polyvalent) ICU | 4 040 | 1.5 | 2 837 | 70.2 | 2.2 | (2.1-2.4) | 1.1 | (0.9–1.2) |
| Specialized ICU | 1 419 | 0.5 | 810 | 57.1 | 1.3 | (1.1-1.4) | 0.7 | (0.6–0.8) |
| COVID-19 ICU | 167 | 0.1 | 130 | 77.8 | 3.3 | (2.3-4.8) | 1.5 | (1.0–2.2) |
| Other ICU | 309 | 0.1 | 191 | 61.8 | 1.5 | (1.2-1.9) | 0.9 | (0.7–1.2) |
| Obstetrics / Maternity | 10 471 | 3.8 | 2 058 | 19.7 | 0.2 | (0.2-0.2) | 0.3 | (0.3–0.4) |
| Gynaecology | 5 173 | 1.9 | 1 845 | 35.7 | 0.5 | (0.5-0.6) | 0.6 | (0.6–0.7) |
| Geriatrics, care for the elderly | 7 875 | 2.9 | 2 255 | 28.6 | 0.4 | (0.4-0.4) | 0.8 | (0.7–0.9) |
| Psychiatrics | 15 108 | 5.5 | 431 | 2.9 | 0.0 | (0.0-0.0) | 0.1 | (0.1–0.1) |
| Rehabilitation | 10 143 | 3.7 | 681 | 6.7 | 0.1 | (0.1-0.1) | 0.2 | (0.2–0.2) |
| Long-term care | 6 011 | 2.2 | 479 | 8.0 | 0.1 | (0.1-0.1) | 0.5 | (0.4–0.6) |
| Others not listed | 1 864 | 0.7 | 559 | 30.0 | 0.4 | (0.4-0.4) | 0.6 | (0.5–0.7) |
| Combination of specialties | 1 381 | 0.5 | 534 | 38.7 | 0.6 | (0.5-0.7) | 0.8 | (0.7–0.9) |
| **Birth weight** | | | | | | | | |
| >=2500g | 6 749 | 2.5 | 725 | 10.7 | Ref. | - | Ref. | - |
| 1500-<2500 (low birth weight, LBW) | 1 655 | 0.6 | 323 | 19.5 | 2.0 | (1.7-2.3) | 1.0 | (0.9–1.2) |
| <1500g (very low birth weight, VLBW) | 1 132 | 0.4 | 322 | 28.4 | 3.3 | (2.8-3.8) | 1.2 | (1.0–1.4) |
| Unknown/Not applicable | 265 870 | 96.5 | 98 161 | 36.9 | 4.9 | (4.5-5.3) | 1.5 | (1.4–1.8) |
| **COVID-19 vaccination status** | | | | | | | | |
| Not vaccinated | 53 426 | 19.4 | 18 555 | 34.7 | Ref. | - | Ref. | - |

| Risk factor | Patients | | Patients with AU | | Patient risk for AU | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Crude | | Adjusted | |
| | No. | % of total | No. | % | OR | (95% CI) | OR | (95% CI) |
| Partial vaccination | 7 105 | 2.6 | 2 517 | 35.4 | 1.0 | (1.0-1.1) | 0.9 | (0.8–1.0) |
| Full baseline vaccination | 50 663 | 18.4 | 18 512 | 36.5 | 1.1 | (1.1-1.1) | 0.9 | (0.9–0.9) |
| 1 additional dose | 46 546 | 16.9 | 16 830 | 36.2 | 1.1 | (1.0-1.1) | 0.9 | (0.9–0.9) |
| >=2 additional doses | 29 746 | 10.8 | 12 837 | 43.2 | 1.4 | (1.4-1.5) | 1.0 | (1.0–1.0) |
| Unknown | 87 920 | 31.9 | 30 280 | 34.4 | 1.0 | (1.0-1.0) | 0.9 | (0.9–0.9) |
| **Unit specialty** | | | | | | | | |
| Surgery | 58 202 | 21.1 | 26 121 | 44.9 | Ref. | - | Ref. | - |
| Medicine | 99 053 | 36.0 | 38 952 | 39.3 | 0.8 | (0.8-0.8) | 0.9 | (0.9–1.0) |
| Neonatology | 4 787 | 1.7 | 898 | 18.8 | 0.3 | (0.3-0.3) | 1.0 | (0.9–1.2) |
| Paediatrics | 9 750 | 3.5 | 3 909 | 40.1 | 0.8 | (0.8-0.9) | 1.1 | (1.0–1.2) |
| Intensive care | 11 003 | 4.0 | 7 106 | 64.6 | 2.2 | (2.1-2.3) | 1.1 | (1.0–1.2) |
| Gynecology/Obstetrics | 16 845 | 6.1 | 3 504 | 20.8 | 0.3 | (0.3-0.3) | 0.8 | (0.8–0.9) |
| Geriatrics | 6 783 | 2.5 | 1 850 | 27.3 | 0.5 | (0.4-0.5) | 0.6 | (0.5–0.7) |
| Psychiatrics | 12 868 | 4.7 | 607 | 4.7 | 0.1 | (0.1-0.1) | 0.8 | (0.6–0.9) |
| Rehabilitation | 13 723 | 5.0 | 1 252 | 9.1 | 0.1 | (0.1-0.1) | 0.6 | (0.5–0.7) |
| Long-term care | 8 684 | 3.2 | 755 | 8.7 | 0.1 | (0.1-0.1) | 0.2 | (0.2–0.3) |
| Other | 4 378 | 1.6 | 1 552 | 35.4 | 0.7 | (0.6-0.7) | 1.0 | (0.9–1.1) |
| Mixed | 14 793 | 5.4 | 6 368 | 43.0 | 0.9 | (0.9-1.0) | 1.1 | (1.0–1.1) |
| Unknown | 14 537 | 5.3 | 6 657 | 45.8 | 1.0 | (1.0-1.1) | 1.0 | (0.9–1.0) |
| **Type of hospital** | | | | | | | | |
| Primary | 38 370 | 13.9 | 11 592 | 30.2 | Ref. | - | Ref. | - |
| Secondary | 104 765 | 38.0 | 37 862 | 36.1 | 1.3 | (1.3-1.3) | 1.3 | (1.2–1.3) |
| Tertiary | 116 696 | 42.4 | 45 567 | 39.0 | 1.5 | (1.4-1.5) | 1.3 | (1.2–1.3) |
| Specialised | 14 873 | 5.4 | 4 059 | 27.3 | 0.9 | (0.8-0.9) | 1.0 | (0.9–1.1) |
| Unknown | 702 | 0.3 | 451 | 64.2 | 4.2 | (3.6-4.9) | 2.6 | (2.2–3.1) |
| **Hospital specialty** | | | | | | | | |
| General hospital/unknown | 259 238 | 94.2 | 94 912 | 36.6 | Ref. | - | Ref. | - |
| Paediatrics/Neonates | 2 695 | 1.0 | 960 | 35.6 | 1.0 | (0.9-1.0) | 1.1 | (1.0–1.3) |
| Psychiatrics | 455 | 0.2 | 1 | 0.2 | 0.0 | (0.0-0.0) | 0.1 | (0.0–0.8) |
| Surgery/Orthopaedics/Traumatology | 1 755 | 0.6 | 550 | 31.3 | 0.8 | (0.7-0.9) | 0.9 | (0.7–1.0) |
| Heart/Lung | 1 766 | 0.6 | 627 | 35.5 | 1.0 | (0.9-1.1) | 0.7 | (0.7–0.9) |
| Haematology/Oncology | 3 348 | 1.2 | 1 116 | 33.3 | 0.9 | (0.8-0.9) | 0.9 | (0.8–0.9) |
| Gynaecology/Obstetrics | 1 496 | 0.5 | 383 | 25.6 | 0.6 | (0.5-0.7) | 1.4 | (1.2–1.6) |
| Infectious diseases | 585 | 0.2 | 390 | 66.7 | 3.5 | (2.9-4.1) | 1.1 | (0.9–1.3) |
| Geriatrics/Rehabilitation/Rheumatology | 2 804 | 1.0 | 162 | 5.8 | 0.1 | (0.1-0.1) | 0.5 | (0.4–0.6) |
| Other | 1 030 | 0.4 | 417 | 40.5 | 1.2 | (1.0-1.3) | 1.3 | (1.1–1.5) |
| **Hospital size** | | | | | | | | |
| <200 beds | 29 032 | 10.5 | 10 169 | 35.0 | Ref. | - | Ref. | - |
| 200-399 beds | 61 634 | 22.4 | 22 095 | 35.8 | 1.0 | (1.0-1.1) | 1.0 | (0.9–1.0) |
| 400-649 beds | 61 089 | 22.2 | 22 100 | 36.2 | 1.1 | (1.0-1.1) | 0.9 | (0.9–0.9) |
| 650-899 beds | 46 869 | 17.0 | 17 424 | 37.2 | 1.1 | (1.1-1.1) | 0.9 | (0.9–1.0) |
| >=900 beds | 76 782 | 27.9 | 27 743 | 36.1 | 1.0 | (1.0-1.1) | 0.9 | (0.8–0.9) |
| **Hospital ownership** | | | | | | | | |
| Public | 234 300 | 85.1 | 84 805 | 36.2 | Ref. | - | Ref. | - |
| Private, not-for-profit | 12 720 | 4.6 | 3 943 | 31.0 | 0.8 | (0.8-0.8) | 1.0 | (0.9–1.0) |
| Private, for profit | 9 286 | 3.4 | 3 676 | 39.6 | 1.2 | (1.1-1.2) | 1.1 | (1.1–1.2) |
| Other/Unknown | 19 100 | 6.9 | 7 107 | 37.2 | 1.0 | (1.0-1.1) | 1.0 | (1.0 –1.1) |

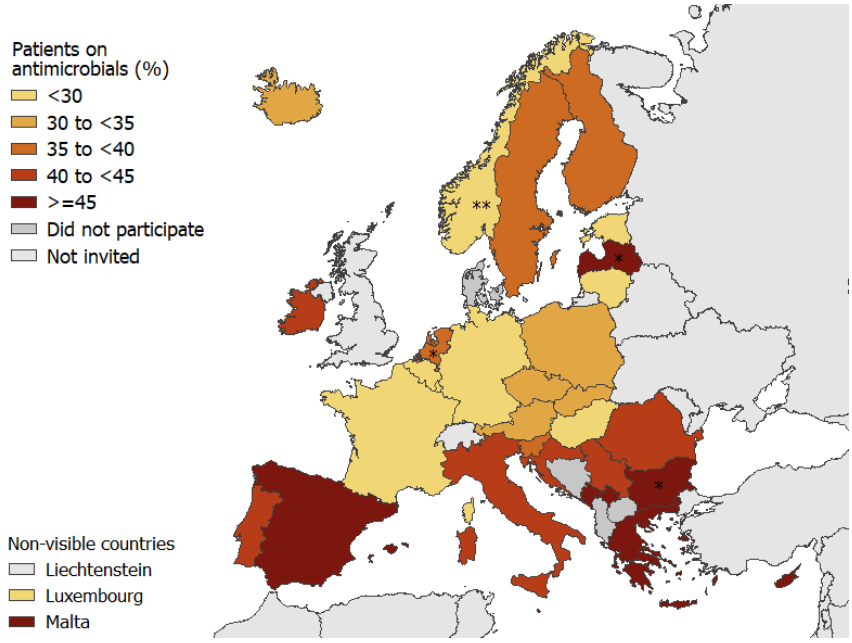
*AU: antimicrobial use; OR: odds ratio; ICU: intensive care unit*
**: Adjusted odds ratio in final multiple logistic regression model. (a) Total length of stay (not only before HAI onset as in HAI model), (b) invasive devices: total presence of intubation and urinary catheter (not only before healthcare-associated PN or urinary tract infections as in HAI model). CVC: variable not included in model because of strong correlation with parenteral antimicrobial treatment.*

# Results by country

## Observed and predicted prevalence of antimicrobial use

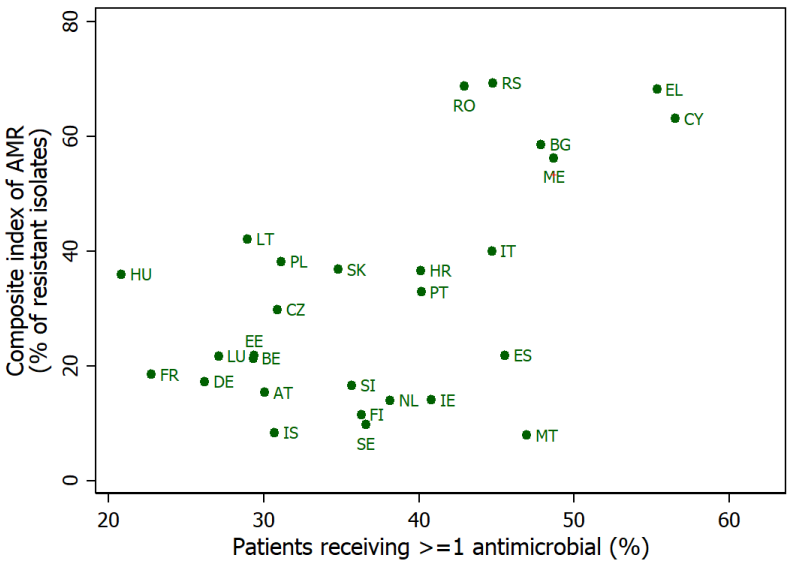
Among EU/EEA countries, the prevalence of antimicrobial use (percentage of patients receiving at least one antimicrobial agent) in acute care hospitals ranged from 20.8% (95% CI: 17.9–24.1%) in Hungary to 56.5% (95% CI: 48.3–64.4%) in Cyprus (Figure 52). Overall, the highest prevalence was observed in Kosovo (62.8%). The mean of the EU/EEA country prevalence percentages was 36.7% and the country median was 36.0%. The weighted prevalence of antimicrobial use in the EU/EEA, accounting for the number of occupied acute care beds by country was 32.4% (95% CI: 29.7–35.1%). Prevalence of antimicrobial use was correlated with the composite index of AMR at country level (Spearman's rho 0.38, p=0.04, Figure 53).

**Figure 52. Prevalence of antimicrobial use (percentage of patients receiving at least one antimicrobial agent) in acute care hospitals, ECDC PPS 2022–2023**



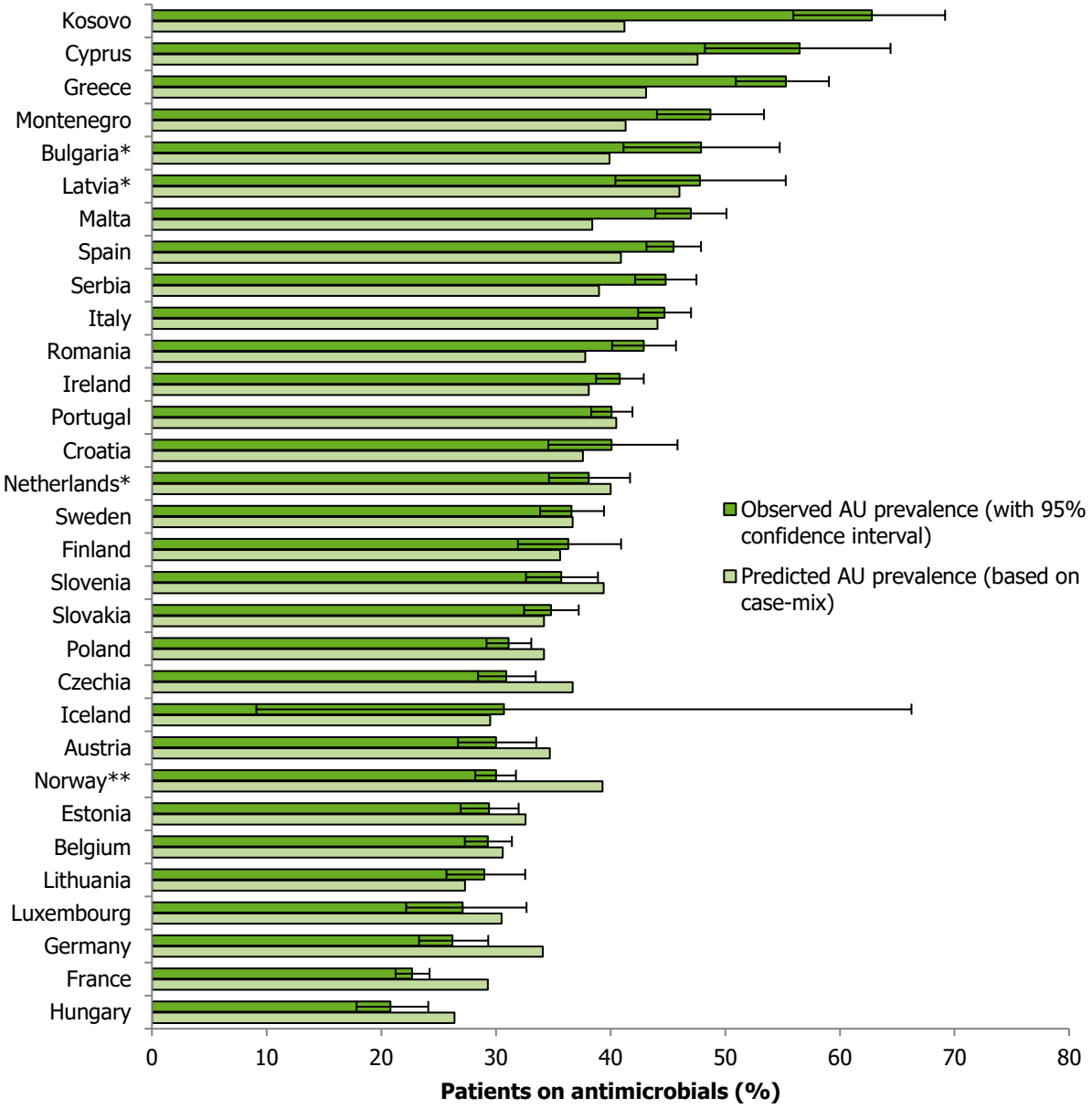

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

**Figure 53. Correlation between the prevalence of antimicrobial use (percentage of patients receiving at least one antimicrobial agent) and the composite index of AMR, ECDC PPS 2022–2023**




*Spearman's rho 0.38, p=0.04. Latvia and Kosovo not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

**Figure 54. Observed prevalence of antimicrobial use with 95% confidence intervals and predicted prevalence of antimicrobial use based on patient case-mix and hospital characteristics, by country, ECDC PPS 2022–2023**



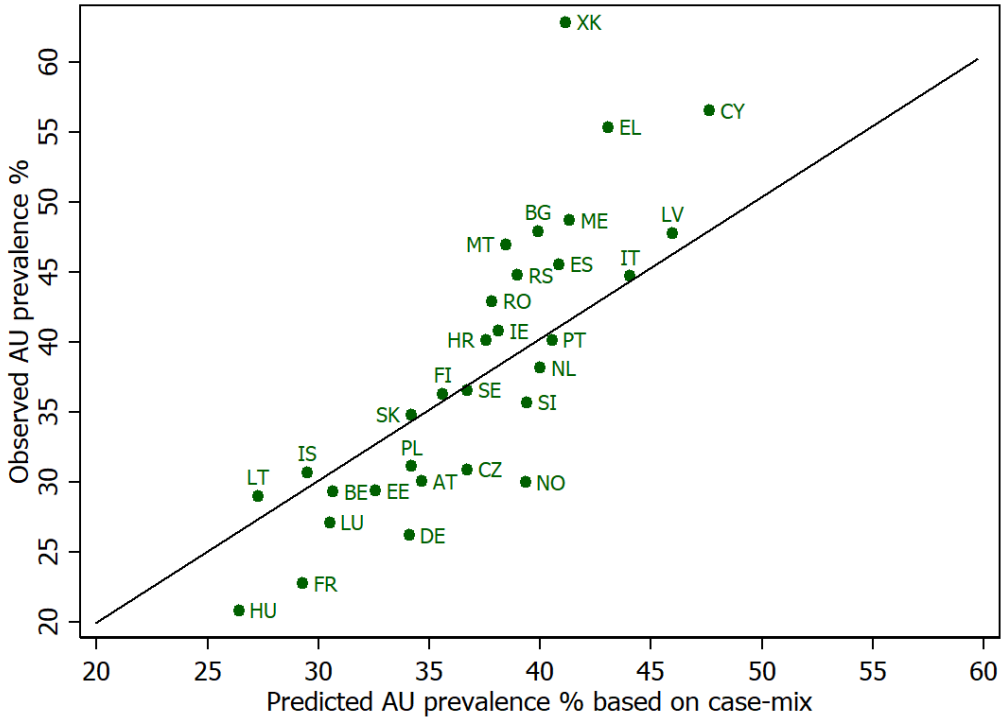

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

The predicted prevalence of antimicrobial use (Figure 54) was calculated based on patient case mix and hospital characteristics using the multiple logistic regression model in Table 17. For 'light' protocol data (11.1% of the patients), a model only including patient/consultant specialty, type of hospital and hospital size was used (model not shown).

Correlation between the observed and predicted prevalence by country is shown in Figure 55 (Spearman's rho 0.88, $p<0.001$; R-squared 0.70).

The ratio of the observed prevalence divided by the predicted prevalence (Standardised Antimicrobial Use Ratio, SAUR) varied from less than 0.80 in Norway (0.76), Germany (0.77), France (0.78) and Hungary (0.79) to more than 1.15 in Montenegro (1.18), Cyprus (1.19) Bulgaria (1.20), Malta (1.22), Greece (1.29) and Kosovo (1.53).

**Figure 55. Correlation between the observed and predicted prevalence of antimicrobial use by country, ECDC PPS 2022–2023**




*Line: observed prevalence = predicted prevalence (Standardised antimicrobial use ratio (SAUR) =1). Countries below the line have a SAUR lower than 1, countries above the line have a SAUR higher than 1. The smaller the distance between the dot and the line, the closer the observed prevalence comes to the predicted prevalence based on patient case mix.*

## Indications for antimicrobial use

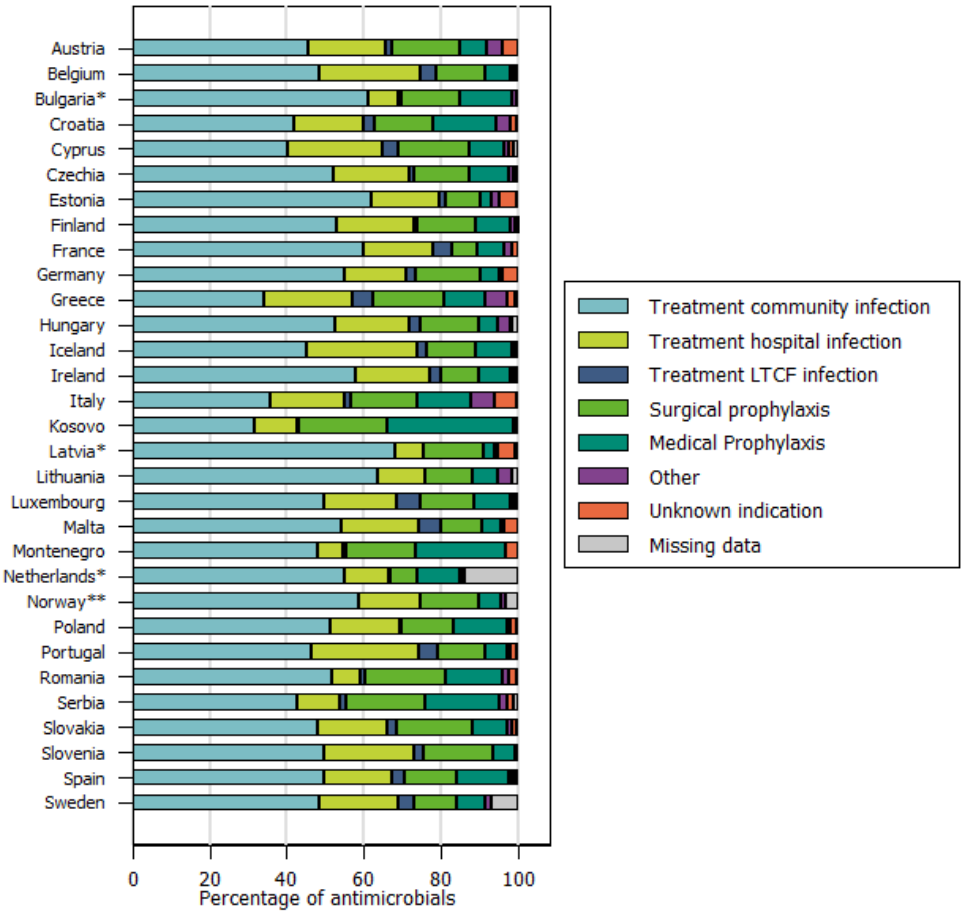
Indications for antimicrobial use varied considerably by country (Figure 56). The percentage of antimicrobials prescribed for treatment of a community-acquired infection was the lowest in Kosovo (31.5%) and Greece (34.2%) and the highest in Latvia (68.3%). Treatment of a hospital infection was closely correlated with the prevalence of HAIs as per case definition (see Figure 16), with a relative frequency varying from 7.1% of antimicrobials in Latvia to 28.6% of antimicrobials in Iceland. The percentage of antimicrobials prescribed for treatment of an infection associated with long-term care varied from 0% in Latvia and Lithuania to 5.3% in Greece.

Surgical prophylaxis accounted for less than 10% of antimicrobials in France (6.6%), the Netherlands (7.1%) and Estonia (9.0%), but for more than 20% of antimicrobials in Serbia (20.5%), Romania (21.2%) and Kosovo (22.9%). The percentage of surgical prophylaxis prescribed for more than one day was the lowest in Estonia (15.8% of surgical prophylaxes) and reached more than 70% of surgical prophylaxes in Bulgaria (72.4%), Serbia (74.8%), Greece (76.2%), Cyprus (78.1%), Latvia (79.8%) and Kosovo (85.5%) (Figure 57). The percentage of surgical prophylaxis prescribed for more than one day was correlated with the composite index of antimicrobial resistance in HAIs at country level (Spearman's rho 0.63, p<0.001) (Figure 58).

The proportion of medical prophylaxis ranged from less than 5% of antimicrobials in Estonia (2.8%), Latvia (2.9%), Malta (4.7%) and Germany (4.9%) to 16.4% in Croatia, 19.2% in Serbia, 23.4% in Montenegro and 32.9% in Kosovo (Figure 59). The percentage of medical prophylaxis was also correlated with the composite index of antimicrobial resistance in HAIs at country level (Spearman's rho 0.54, p=0.003) (Figure 60).

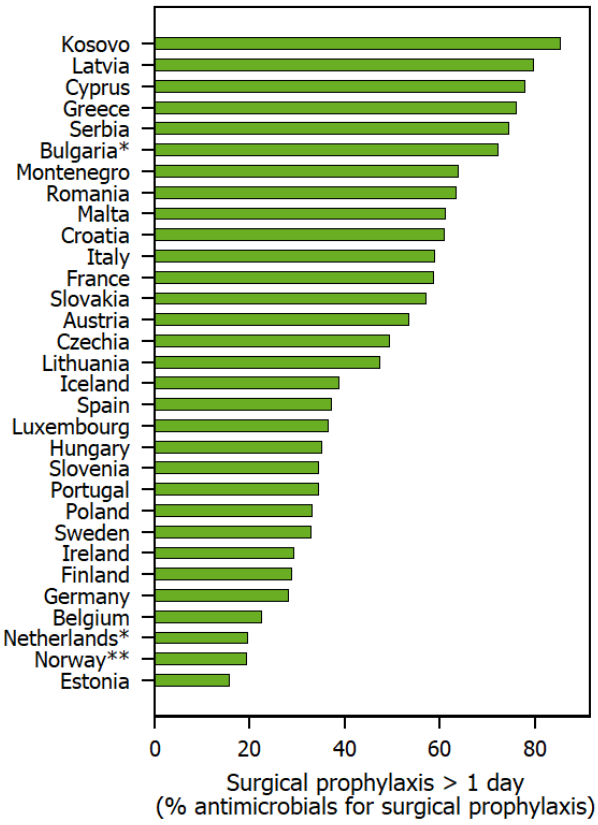
Antimicrobial use for an 'other indication' was the most common in Italy (6.0% of all antimicrobials). Antimicrobial use for an `unknown indication' was also the most frequent in Italy (5.6%).

**Figure 56. Indications for antimicrobial use by country, ECDC PPS 2022–2023**



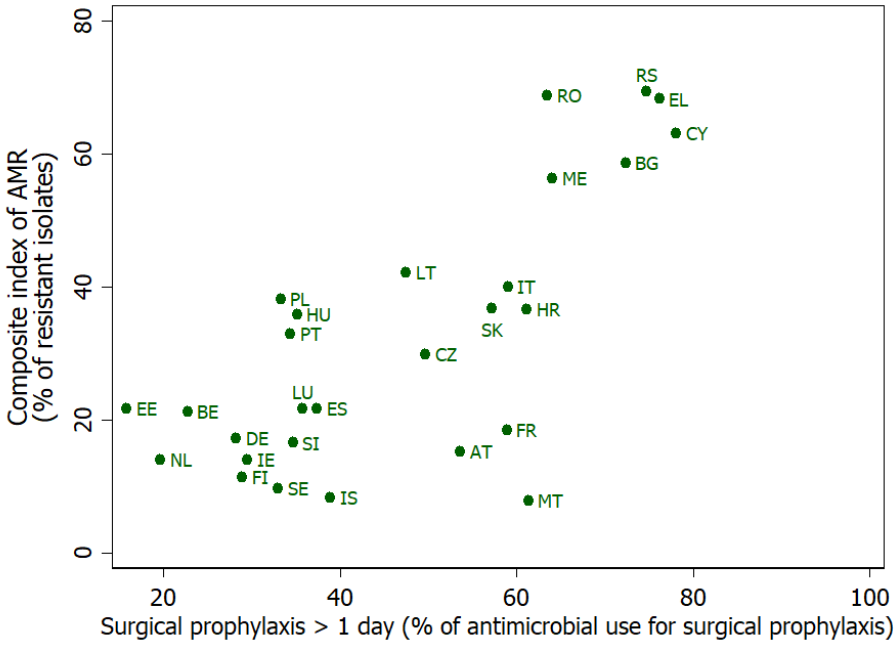

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

**Figure 57. Surgical prophylaxis given for more than one day as a percentage of the total antimicrobials prescribed for surgical prophylaxis, by country, ECDC PPS 2022–2023**



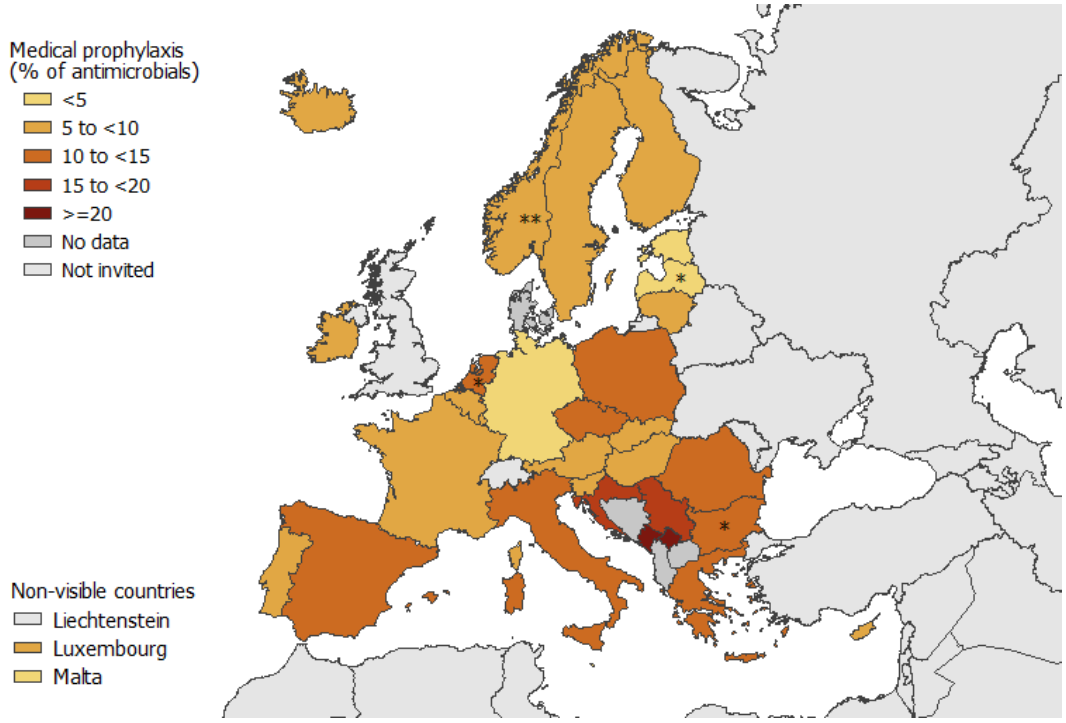

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

**Figure 58. Correlation between the percentage of surgical prophylaxis given for more than one day and the composite index of AMR, ECDC PPS 2022–2023**



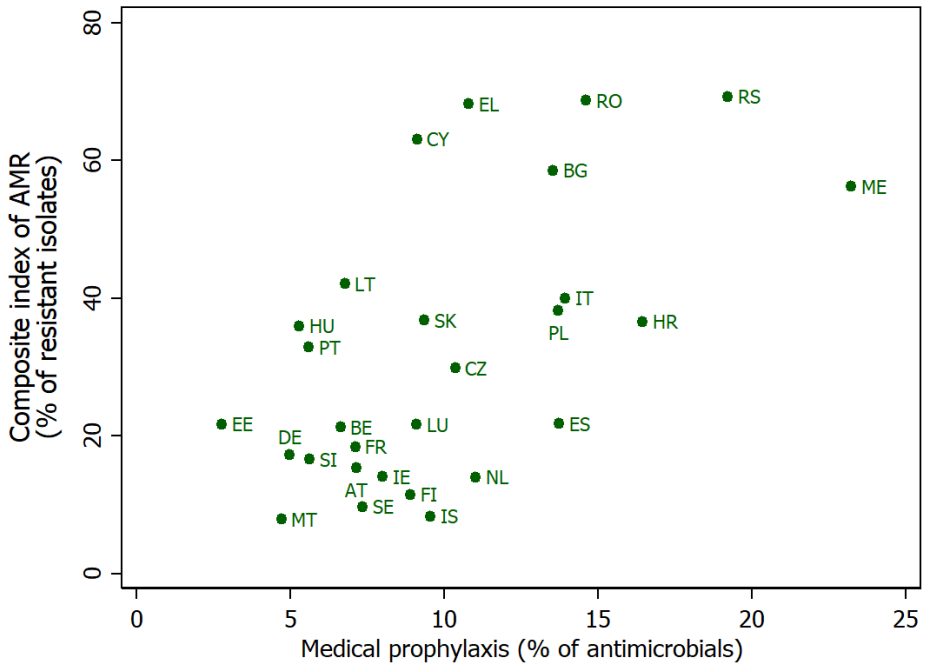

*Spearman's rho 0.63, p<0.001. Latvia and Kosovo not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

**Figure 59. Percentage of antimicrobials prescribed for medical prophylaxis, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

**Figure 60. Correlation between the percentage of antimicrobials prescribed for medical prophylaxis and the composite index of AMR, ECDC PPS 2022–2023**

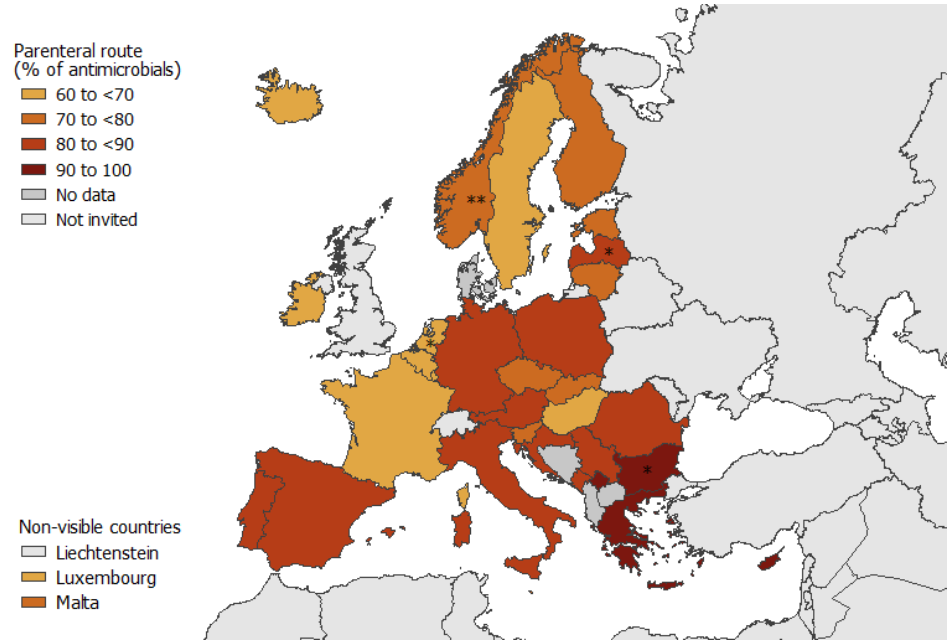



*Spearman's rho 0.54, p=0.003. Latvia and Kosovo not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

## Route of administration and documentation of the reason for antimicrobial use

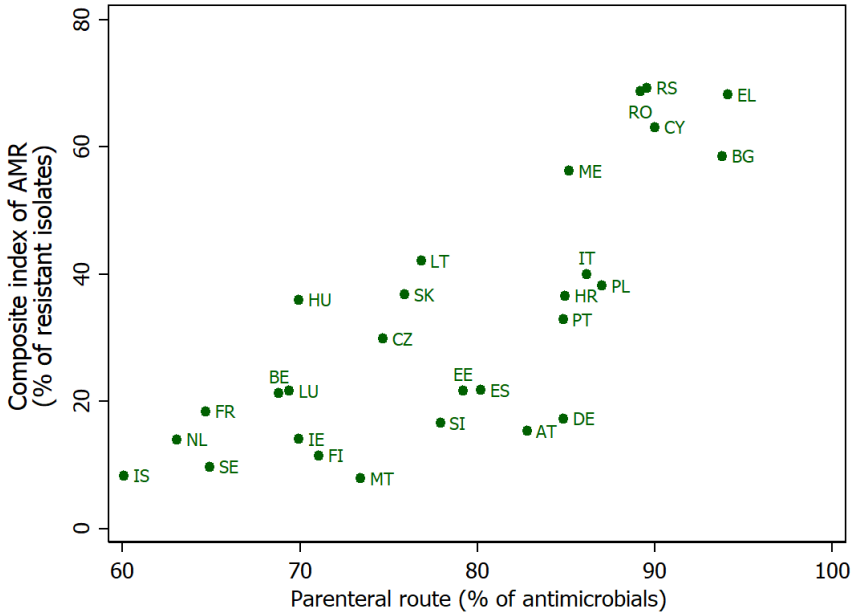
The percentage of antimicrobials for which the route of administration was parenteral ranged from 60.1% in Iceland to more than 90% in Cyprus, Bulgaria, Greece and Kosovo (Figure 61). The country median of this indicator increased from 69.6% in the ECDC PPS 2016–2017 to 79.2% in the ECDC PPS 2022–2023. Contrary to previous years, no country reported <60% in this category in 2022–2023. The percentage of antimicrobials for which the route of administration was parenteral was strongly correlated with the composite index of antimicrobial resistance in HAIs at country level (Spearman's rho 0.78, p<0.001) (Figure 62).

**Figure 61. Percentage of antimicrobials for which the route of administration was parenteral, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

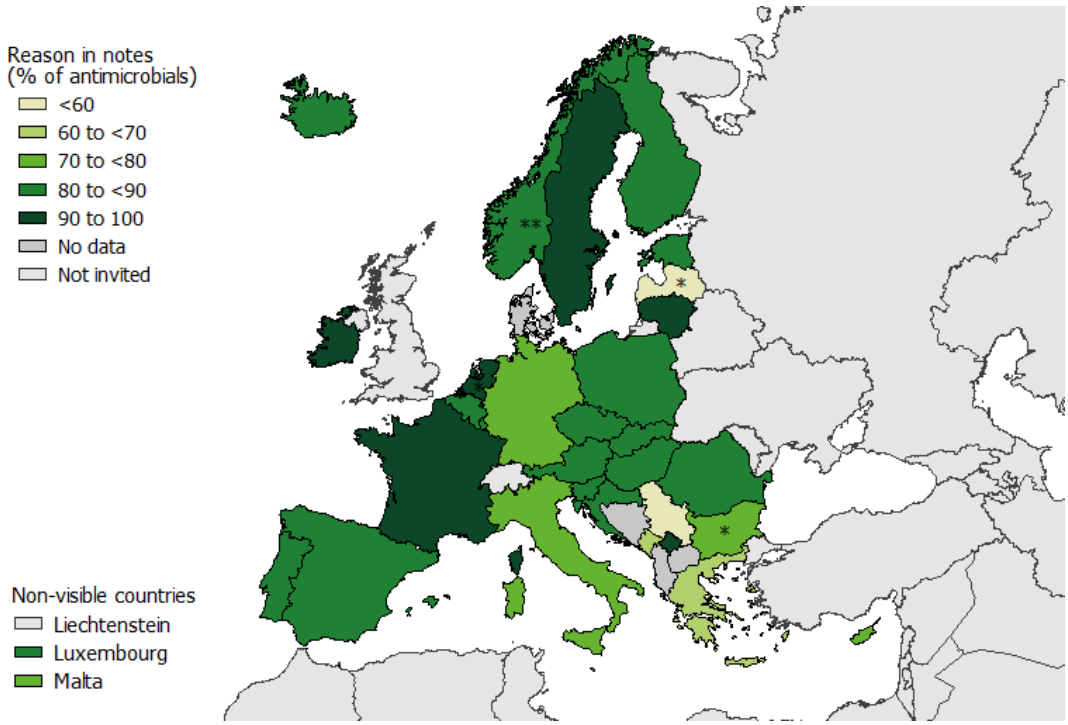
**Figure 62. Correlation between of the percentage of antimicrobials for which the route of administration was parenteral and the composite index of AMR, ECDC PPS 2022–2023**




*Spearman's rho 0.78, p<0.001 Latvia and Kosovo not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

The reason for antimicrobial use was documented in the patient's medical records for 82.2% of prescriptions (country median: 84.2%) and ranged from 49.6% in Serbia and 58.2% in Latvia to 94.9% in Lithuania (Figure 63). The percentage of antimicrobials for which the reason for use was documented in the patient's records was negatively correlated with the composite index of antimicrobial resistance in HAIs at the country level (Spearman's rho -0.55, p<0.01).

**Figure 63. Percentage of antimicrobials for which the reason for use was documented in the patient's records ('reason in notes'), ECDC PPS 2022–2023**

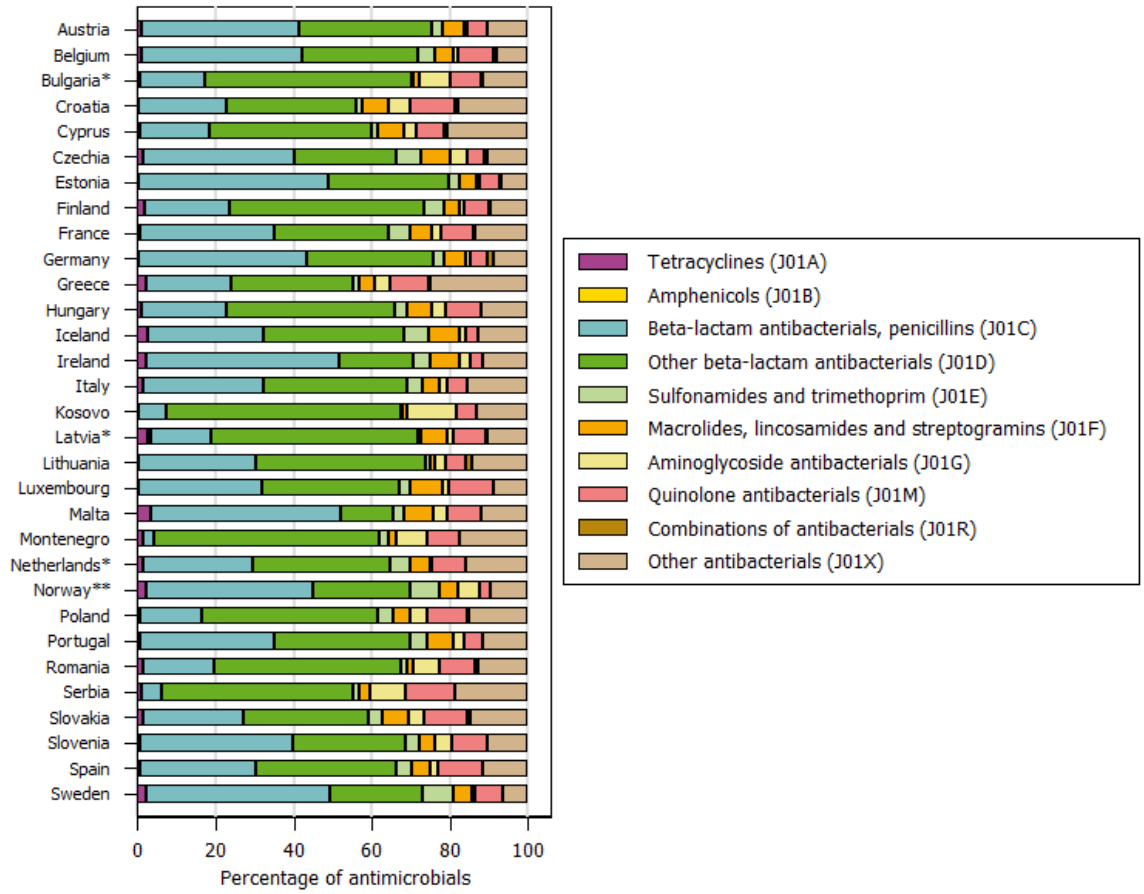



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

## Distribution of antimicrobial agents

Within antibacterials for systemic use (ATC group J01), the percentage of penicillins (J01C) varied between 16.5% in Bulgaria and 49.1% in Ireland, in the EU/EEA, and was less than 10% in the three participating Western Balkan countries (Figure 64). Other beta-lactam antibacterials (J01D) represented between 13.7% of antibacterials for systemic use in Malta to 53.2% in Bulgaria, and more than 57% in Kosovo and Montenegro. The percentage of sulfonamides and trimethoprim (J01E) ranged from 0.4% in Bulgaria to 7.8% in Norway. The percentage of macrolides, lincosamides and streptogramins (J01F) ranged from 0.9% in Kosovo, 1.3% in Lithuania to 8.5% in Luxembourg. The percentage of aminoglycosides (J01G) ranged from 0.6% in the Netherlands to 8.0% in Bulgaria and 12.8% in Kosovo. The percentage of quinolone antibacterials (J01M) ranged from 2.8% in Norway to 11.8% in Croatia and 12.6% in Serbia. The percentage of 'other antibacterials' (J01X) ranged from 6.4% in Sweden to 25.2% in Greece.

**Figure 64. Distribution of antibacterials for systemic use (ATC group J01) used in acute care hospitals on the day of the PPS, by country and group at 3rd ATC level, ECDC PPS 2022–2023**

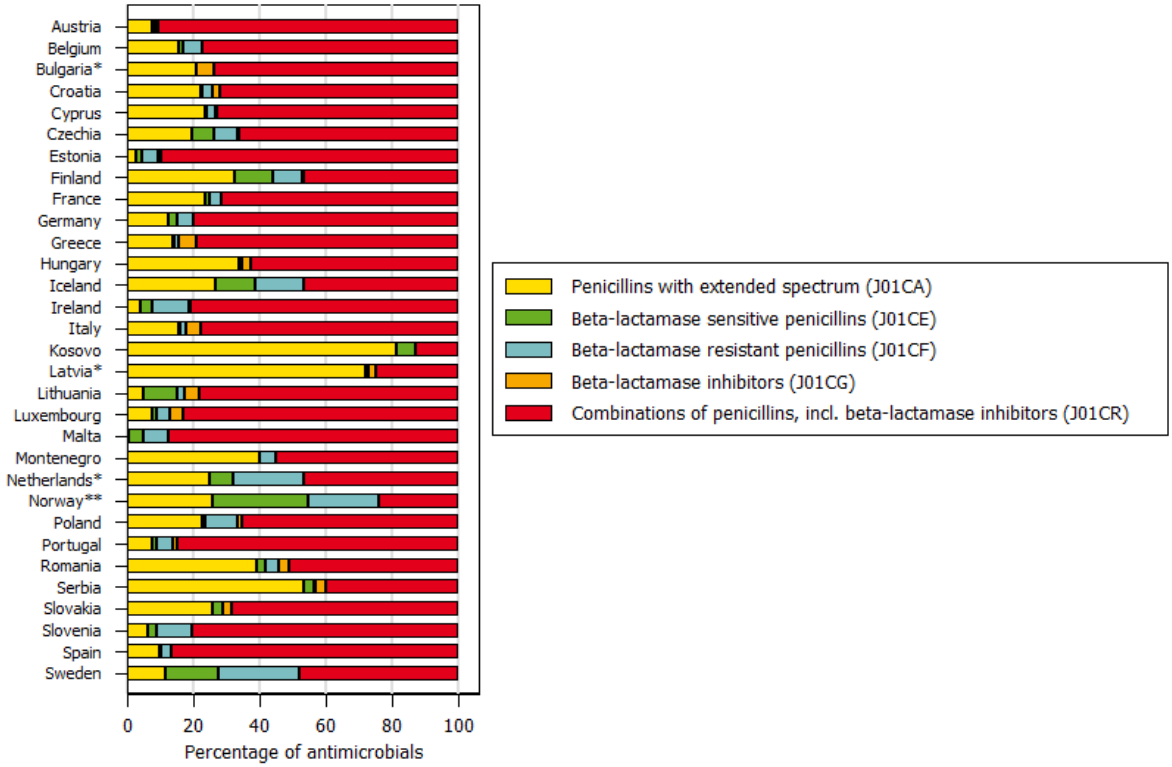



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

Within penicillins (ATC group J01C), the percentage of penicillins with extended spectrum (J01CA) ranged from 0.3% in Malta to 72.2% in Latvia and 81.2% in Kosovo (Figure 65). Beta-lactamase-sensitive penicillins (J01CE) represented 0.0% of penicillins in Latvia and Montenegro and 29.1% in Norway. Beta-lactamase-resistant penicillins (J01CF) represented 0.0% of penicillins in Bulgaria and Kosovo and more than 20% in the Netherlands and Norway. Combinations of penicillins, including beta-lactamase inhibitors (J01CR) were the most frequently used penicillins in all countries except Latvia, Norway, Kosovo and Serbia.

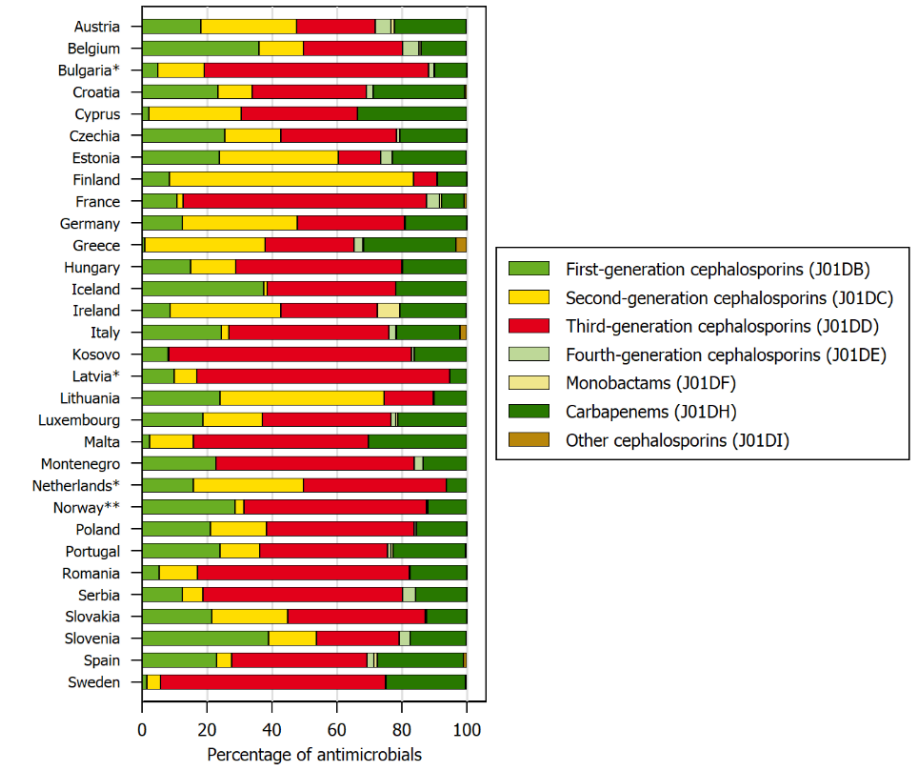
Within other beta-lactam antibacterials (ATC group J01D), the percentage of first-generation cephalosporins (J01DB) varied from 0.8% in Greece to 38.9% in Slovenia (Figure 66). Second-generation cephalosporins (J01DC) represented more than half of use of other beta-lactam antibacterials in Lithuania (50.5%) and Finland (75.3%). The percentage of third-generation cephalosporins (J01DD) varied from 7.1% in Finland to more than 70% in France (74.9%), Latvia (77.9%) and Kosovo (74.7%), and the percentage of fourth-generation cephalosporins (J01DE) ranged from 0.0% in eight countries to 5.0% in Belgium. Use of monobactams (ATC group J01DF) was the highest in Ireland (representing 6.9% of other beta-lactam antibacterials). The percentage of carbapenems (J01DH) ranged from 5.3% in Latvia to more than 30% in Malta and Cyprus.

**Figure 65. Distribution of beta-lactam antibacterials, penicillins (ATC group J01C) used in acute care hospitals on the day of the PPS, by country and group at 4th ATC level, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

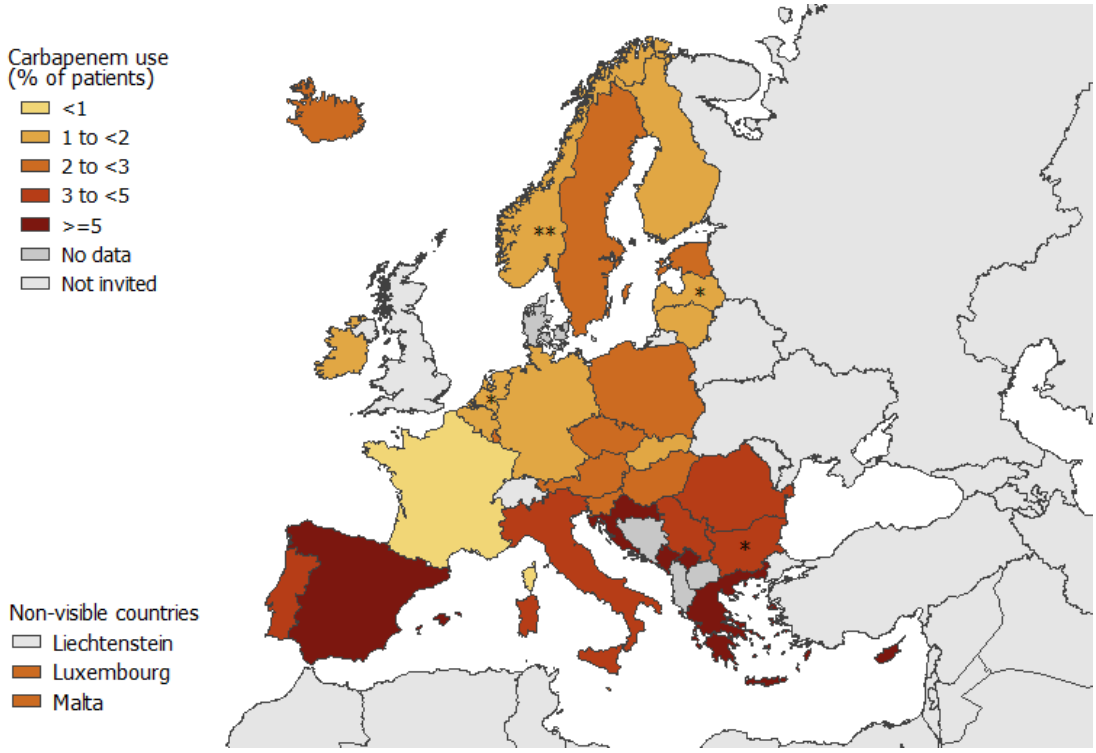
**Figure 66. Distribution of other beta-lactam antibacterials (ATC group J01D) used in acute care hospitals on the day of the PPS, by country and group at 4th ATC level, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

The prevalence of carbapenem use (percentage of hospitalised patients receiving at least one carbapenem) ranged from 0.6% of patients in France to 11.6% in Cyprus (Figure 67).

**Figure 67. Prevalence of use of carbapenems (ATC group J01DH) (percentage of hospitalised patients receiving carbapenems), ECDC PPS 2022–2023**



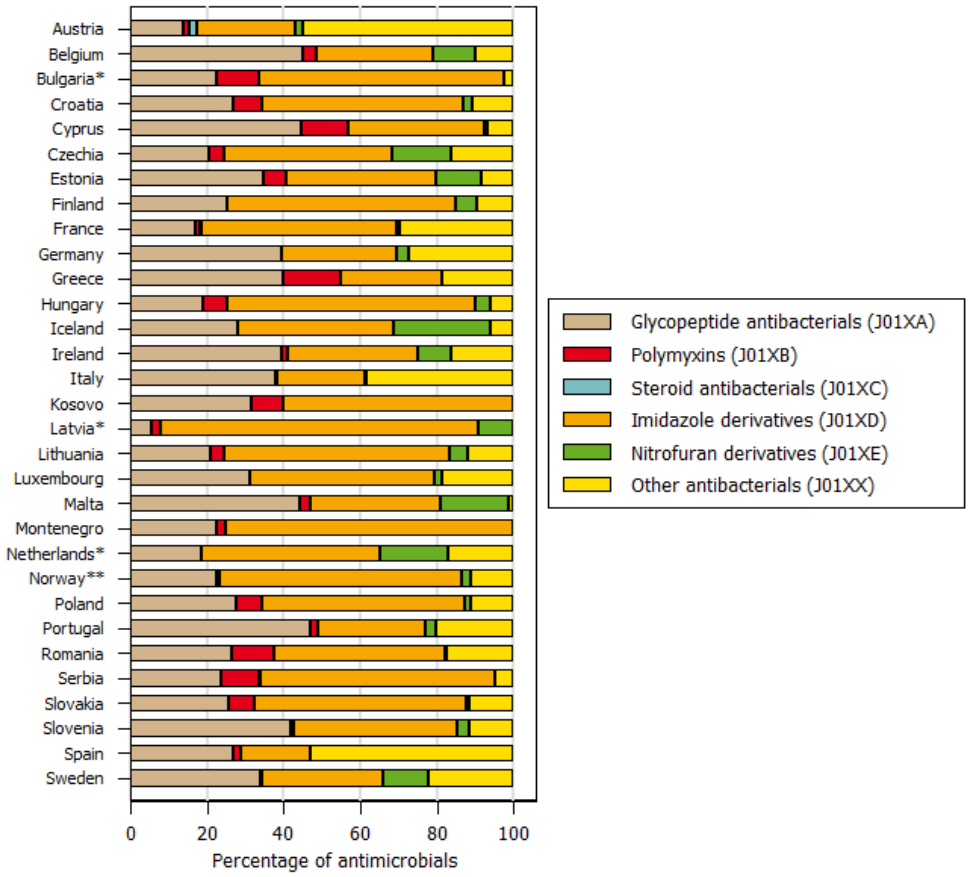

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

The most frequently used 'other antibacterials' (ATC group J01X) were imidazole derivates (J01XD), representing 18.2% of 'other antibacterials' in Spain to 82.7% in Latvia (Figure 68).

The second most important group of 'other antibacterials' was glycopeptide antibacterials (J01XA), varying from 5.3% in Latvia to 46.9% in Portugal. The prevalence of glycopeptide use (percentage of hospitalised patients receiving at least one glycopeptide) ranged from 0.3% of patients in Latvia to more than 3% in Malta (3.2%), Italy (3.3%), Kosovo (3.8%), Cyprus (7.6%) and Greece (8.7%) (Figure 69). The prevalence of glycopeptide use was associated with the percentage of meticillin resistance in *S. aureus* (MRSA) from HAIs at country level (Spearman's rho 0.72, $p<0.001$).

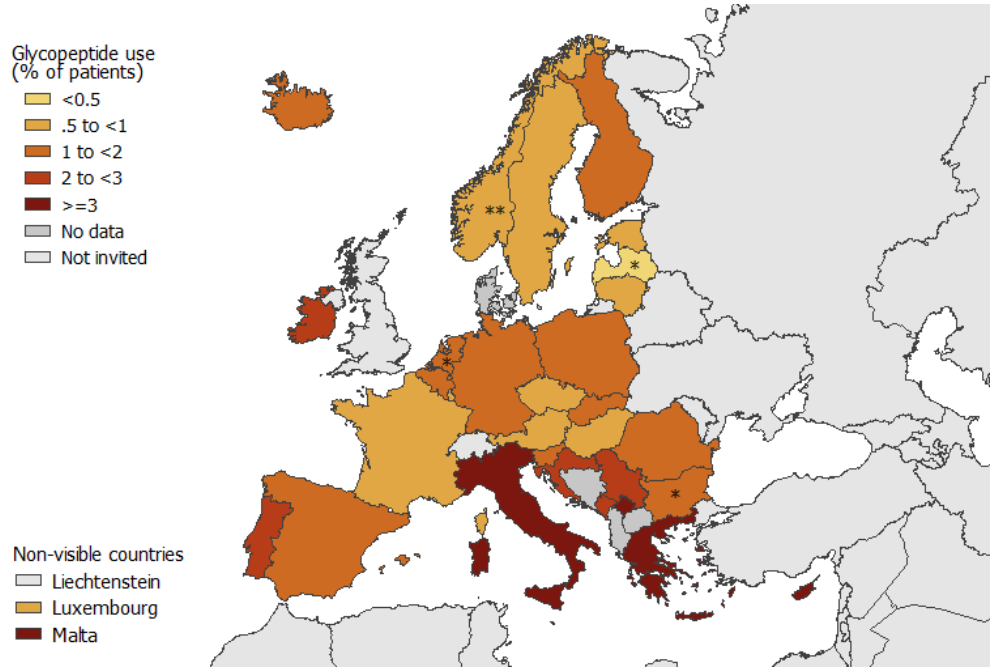
Polymyxins (J01XB) represented less than 1% of 'other antibacterials' in nine countries to more than 10% in Bulgaria (11.2%), Romania (11.2%), Cyprus (12.5%), Greece (15.2%) and Serbia (10.1%). Steroid antibacterials (J01XC) were not reported by 22 countries and accounted for 2.1% of 'other antibacterials' in Austria. Nitrofuran derivates (J01XE) accounted for less than 1% of 'other antibacterials' in ten countries and ranged up to 25.0% in Iceland. The remaining 'other antibacterials' (J01XX), including linezolid, daptomycin and fosfomycin, represented less than 1% of 'other antibacterials' group (J01X) in Latvia, Kosovo and Montenegro, and more than 20% in Portugal (20.2%), Sweden (22.3%), Germany (27.4%), France (29.6%), Italy (38.6%), Spain (52.9%) and Austria (55.0%).

**Figure 68. Distribution of other antibacterials (ATC group J01X) used in acute care hospitals on the day of the PPS, by country and group at 4th ATC level, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

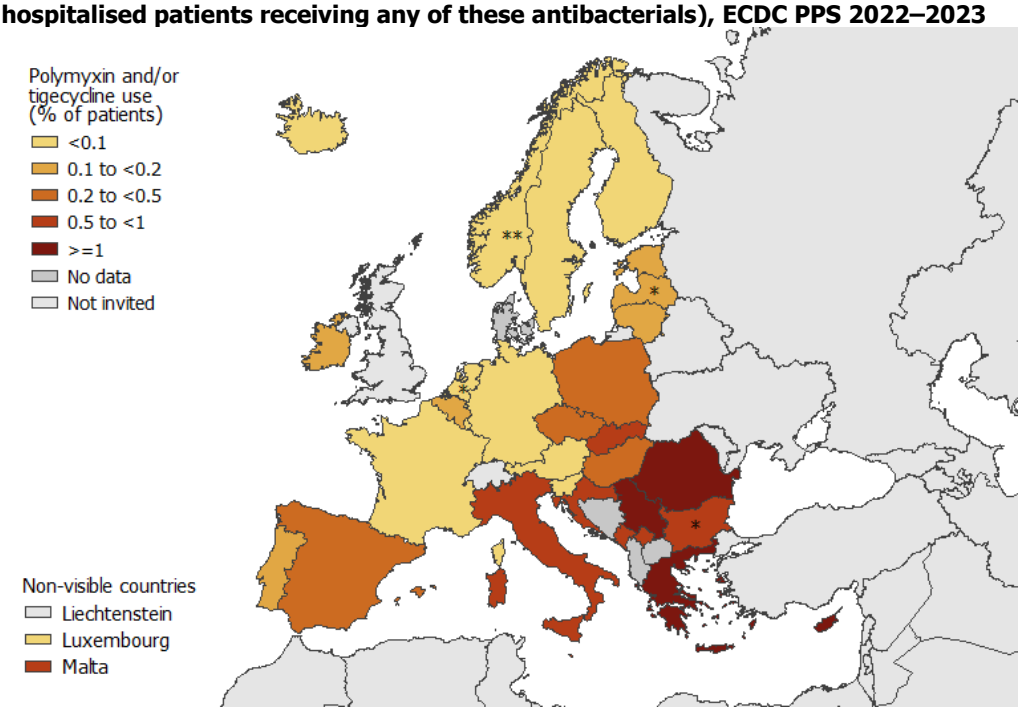
**Figure 69. Prevalence of use of glycopeptides (ATC group J01XA) (percentage of hospitalised patients receiving at least one glycopeptide), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

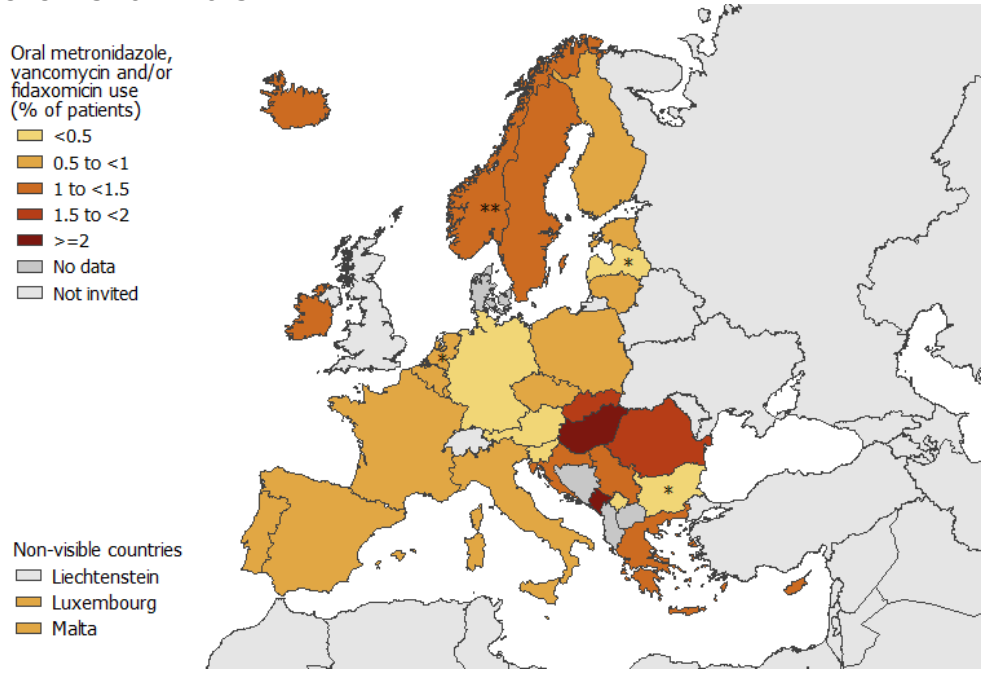
The prevalence of the use of polymyxins (J01XB) and/or tigecycline (J01AA12) varied from less than 1 per 1 000 patients (0.1%) in ten countries to approximately 1.0% of patients in Romania and Kosovo, 1.6% in Serbia, 2.3% in Cyprus, and 4.3% of patients in Greece (Figure 70). Prevalence of the use of polymyxins and/or tigecycline was associated with the percentage of Enterobacterales resistant to carbapenems reported for HAIs at the country level (Spearman's rho 0.67, p<0.001).

**Figure 70. Prevalence of use of polymyxins (ATC group J01XB) and/or tigecycline (percentage of hospitalised patients receiving any of these antibacterials), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

**Figure 71. Prevalence of use of oral metronidazole (P01AB01), oral vancomycin (A07AA09) and/or fidaxomicin (A07AA12) (percentage of hospitalised patients receiving any of these antimicrobials), ECDC PPS 2022–2023**

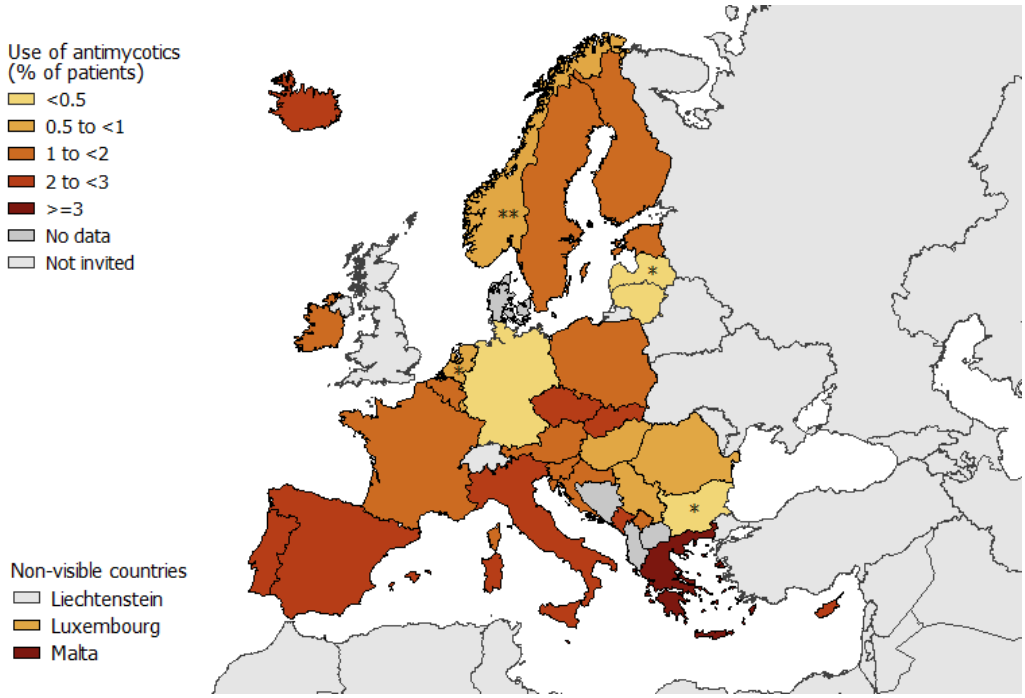



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

The prevalence of the use of oral metronidazole (P01AB01) and/or oral vancomycin (A07AA09) and/or oral fidaxomicin (A07AA12) as an indicator of oral treatment of *C. difficile* infections, varied from 0.2% in Kosovo and 0.3% in Bulgaria to 2.0% of patients in Hungary and 2.3% in Montenegro (Figure 71). The indicator was correlated at the country level with the relative frequency of healthcare-associated *C. difficile* infections at that level (Spearman's rho 0.66, p<0.001)

Finally, an important variation between countries was also observed for the prevalence of the use of antimycotics, including antimycotics for systemic use (ATC group J02) and nystatin (A07AA02), which together accounted for 3.3% of all antimicrobials, varying from less than 1% in Bulgaria (0.5%) and Latvia (0.7%) to 5.7% in Malta. Nystatin accounted for 7.3% of antimycotics (J02+A07AA02) overall, varying between 0.0% in nine countries to 26.0% in Spain. The prevalence of use of antimycotics (J02+A07AA02) ranged from 0.3% of patients in Bulgaria to 3.3% in Greece (Figure 72).

**Figure 72. Prevalence of use of antimycotics (ATC group J02, and nystatin A07AA02) (percentage of hospitalised patients receiving any antimycotic for systemic use), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

## Broad-spectrum antibacterials

The percentage of broad-spectrum antibacterials as defined in the ECDC, European Food Safety Authority (EFSA) and European Medicines Agency (EMA) Joint Scientific Opinion [33] among antibacterials for systemic use (ATC J01) increased from 41.3% in the ECDC PPS 2016–2017 to 47.7% in the ECDC PPS 2022–2023. This percentage varied widely across countries, from 25.4% in Lithuania to 59.2% in Italy (Figure 73). The prevalence of patients receiving at least one broad-spectrum antibacterial agent varied from 7.4% of patients in Lithuania to 37.4% of patients in Bulgaria and 50.9% of patients in Kosovo (Figure 74), with an EU/EEA country median of 14.5%.

The percentage of broad-spectrum antibacterials among antibacterials for systemic use (ATC J01) was significantly associated, at the country level, with the prevalence of antimicrobial use (Spearman's rho 0.66, p<0.001), the percentage of antimicrobials administered via parenteral route (Spearman's rho 0.66, p<0.001), the percentage of prolonged surgical prophylaxis (Spearman's rho 0.68, p<0.001), the percentage of antimicrobials prescribed for medical prophylaxis (Spearman's rho 0.56, p=0.004), and the composite index of AMR (Spearman's rho 0.58, p=0.001).

**Figure 73. Distribution of broad-spectrum antibacterials among all antibacterials for systemic use (ATC group J01) used in acute care hospitals on the day of the PPS, by country and group at 4th ATC level, ECDC PPS 2022–2023**

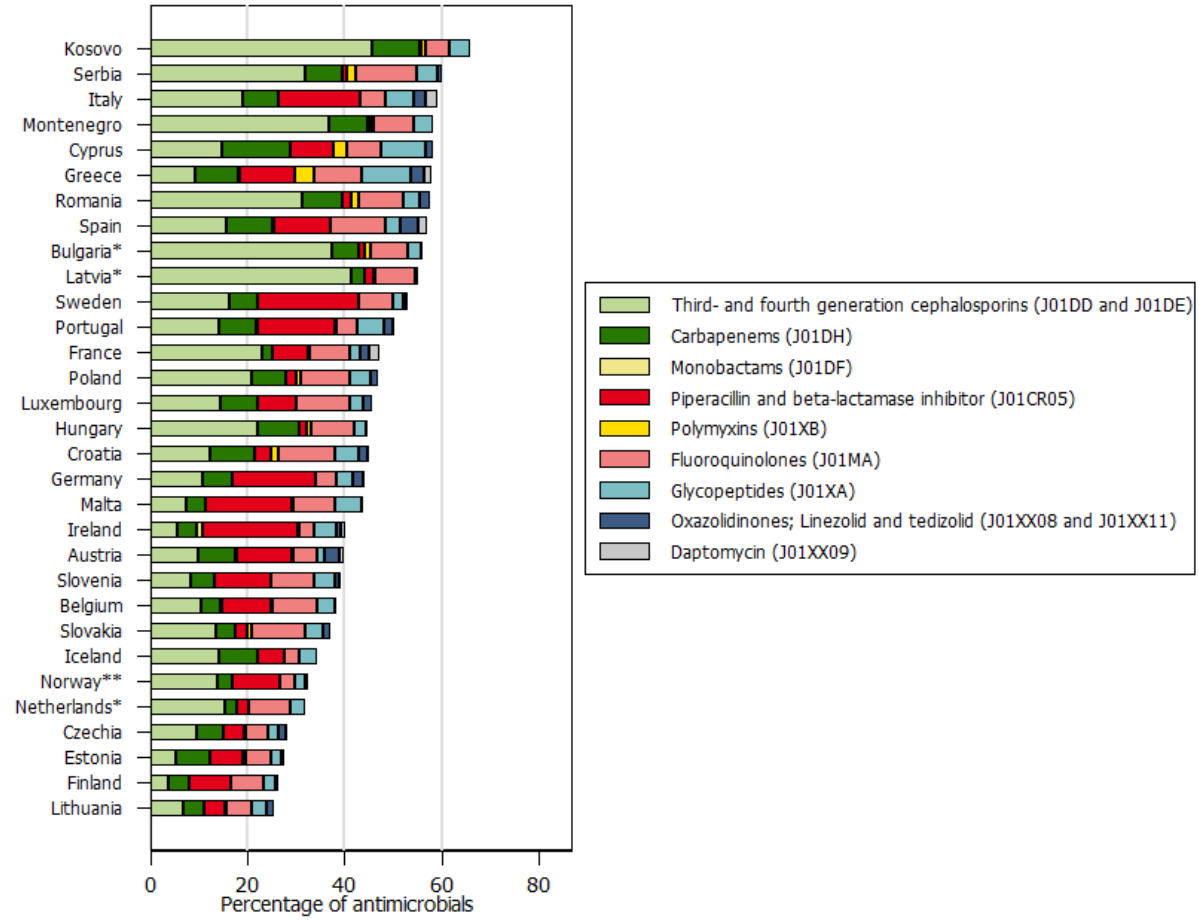
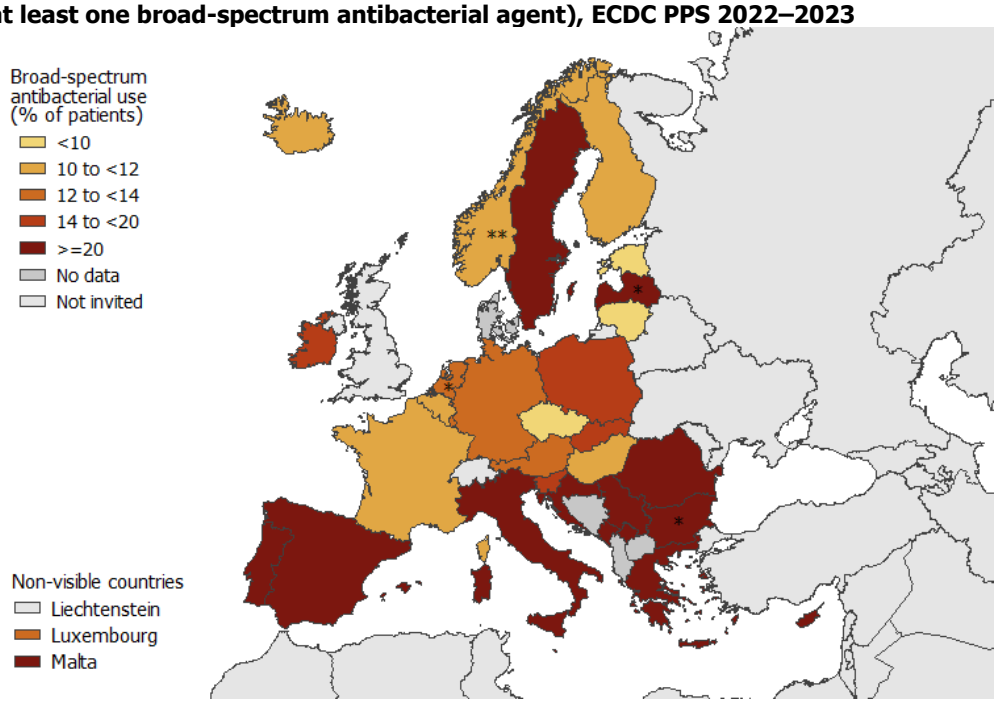



**Figure 74. Prevalence of use of broad-spectrum antibacterials (% of hospitalised patients receiving at least one broad-spectrum antibacterial agent), ECDC PPS 2022–2023**



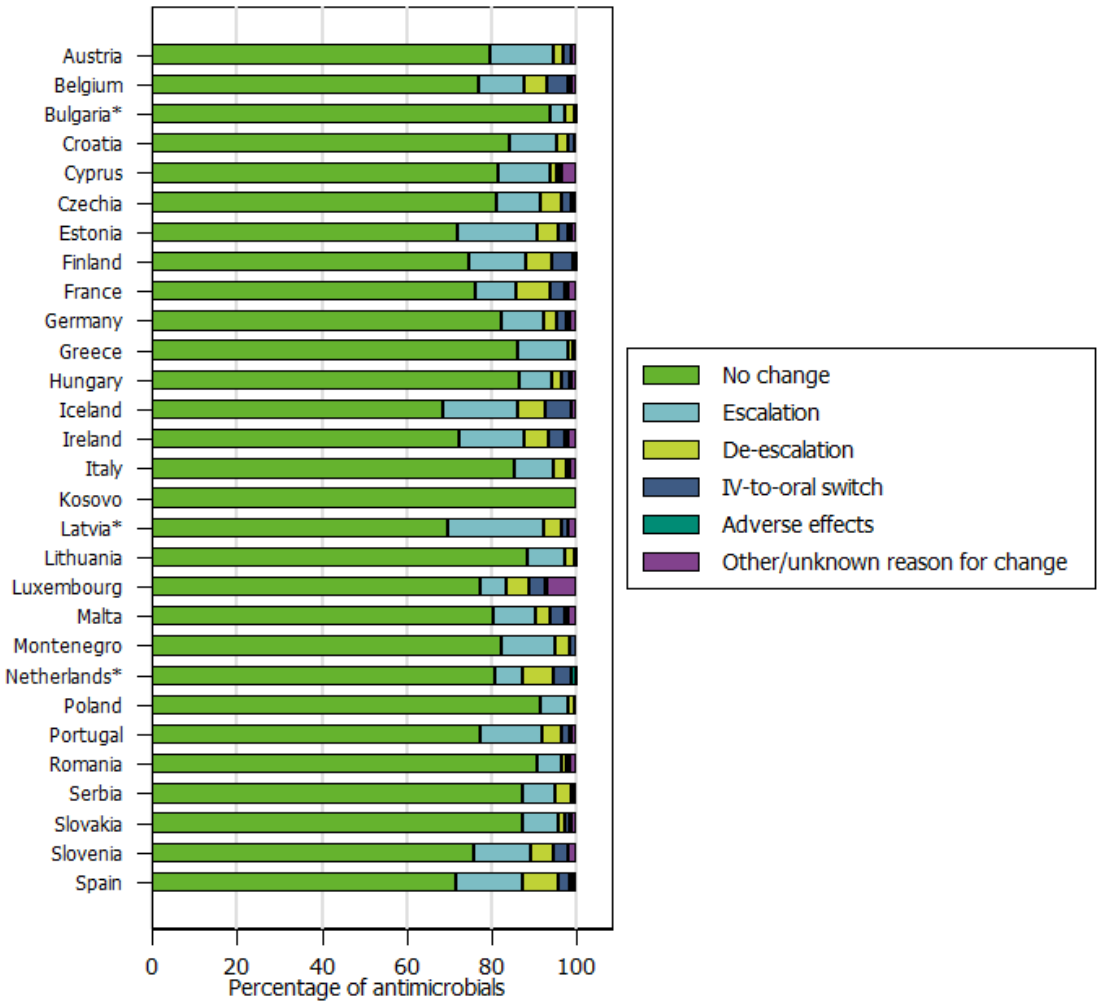

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol*

## Change of antimicrobial agent

Overall, information about change of antimicrobial agent was reported for 83.0% of antimicrobials prescribed in EU/EEA hospitals. Norway and Sweden did not include the variable in their national protocol. For the remaining countries, this information was available for 89.1% of prescribed antimicrobials. For antimicrobials for which the information was reported, 81.7% had not been changed since the initiation of the treatment, ranging from 68.7% in Iceland to 93.8% in Bulgaria and 100% in Kosovo (Figure 75). Escalation, de-escalation and switching from intravenous to oral use were reported for 10.9%, 3.9%, and 1.9% antimicrobial prescriptions, respectively. The change was due to adverse effects for 0.4% and to other reasons for 1.2% prescriptions. The large majority of antimicrobial agents that were changed (91.4%) were prescribed for treatment of an infection, whereas 2.7% were prescribed for surgical prophylaxis, 3.5% for medical prophylaxis, 1.3% for other indications and 1.2% for unknown indications. Change of antimicrobial agent was more frequent in antimicrobials prescribed for treatment of an infection (23.2%) than in antimicrobials prescribed for other indications (3.2% of surgical prophylaxis, 5.7% of medical prophylaxis, 10.9% of other indications and 9.6% of unknown indications).

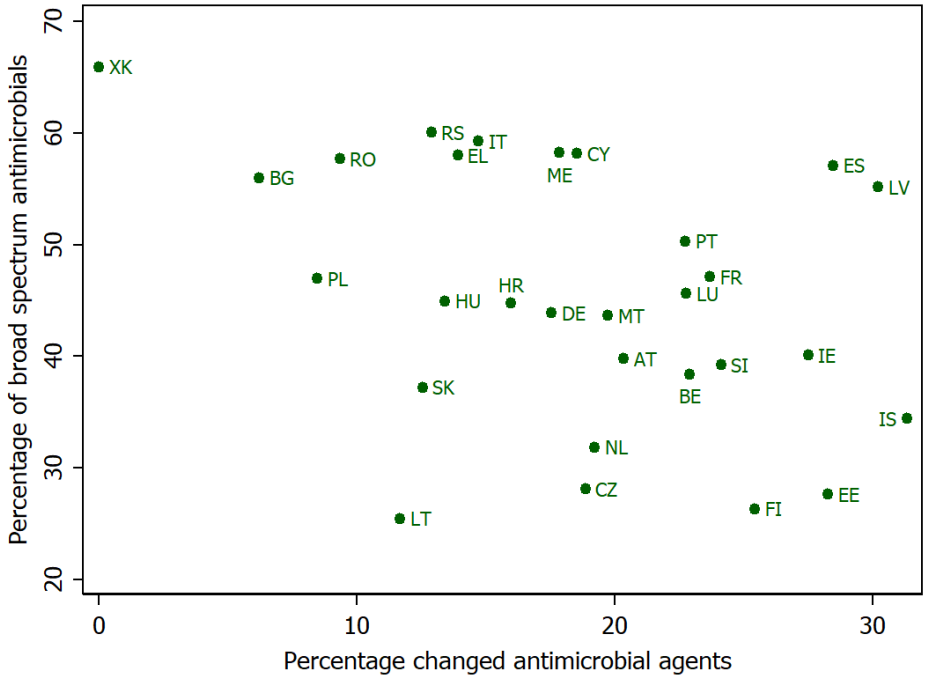
The proportion of prescriptions with a change during treatment was negatively correlated with the percentage of broad-spectrum antibacterials among all antibacterials used (Spearman's rho -0.37, p=0.046, Figure 76) , the percentage of surgical prophylaxis lasting longer than one day (Spearman's rho -0.40, p=0.029) and the composite index of AMR (Spearman's rho -0.74, p<0.001, Figure 77), but not with the prevalence of antimicrobial use.

**Figure 75. Change of antimicrobial agent and reported reason for change, ECDC PPS 2022–2023**



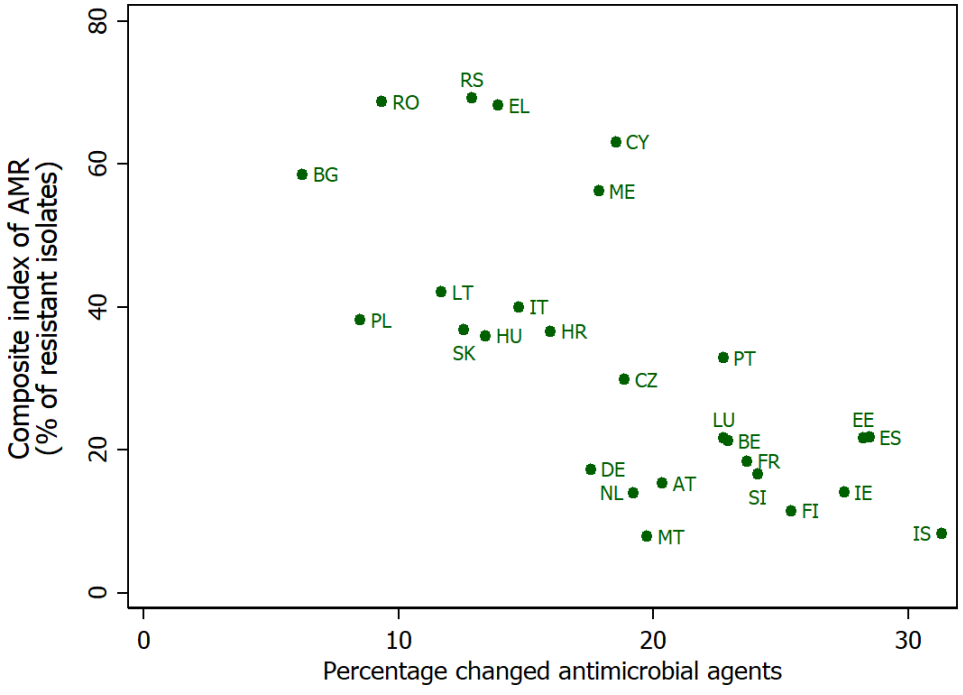

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. Norway and Sweden did not collect information on change of antimicrobials.*

**Figure 76. Correlation of the percentage of antimicrobial agents that were changed and the percentage of broad-spectrum antimicrobials, ECDC PPS 2022–2023**




*Spearman's rho -0.74, p=0.046*

**Figure 77. Correlation between the percentage of antimicrobial agents that were changed and the composite index of AMR, ECDC PPS 2022–2023**

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*Spearman's rho -0.74, p<0.001. Latvia and Kosovo not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

## Validation of antimicrobial use data

Of the 16 EU/EEA countries that validated their PPS data, only data from 14 countries were included for the EU/EEA validation results because of methodological issues with the validation of 'light' protocol option data in two countries (Estonia, Greece). In these 14 countries, 3.9% of patients who did not receive antimicrobials according to the primary PPS teams, had actually received antimicrobials according to the national validators (false negatives). On the other hand, 4.2% patients reported with antimicrobials had not received antimicrobials (false positives). These EU/EEA mean results were similar to the mean results of 28 countries which performed validation in the ECDC PPS 2016-2017 (3.2% and 4.4%, respectively). When applying the percentages of false negatives and false positives to the initially observed (primary PPS) antimicrobial use prevalence results in these countries, the sensitivity of the primary PPS data collectors for detecting and reporting a patient receiving antimicrobials was on average 93.8%, and ranged from 87.8% in Austria to 98.7% in Lithuania and 100% in Serbia (Table 18). The specificity for detecting and reporting a patient receiving antimicrobials was 97.4% on average, and the lowest in Italy (92.4%) and the highest in Czechia and Slovakia (100%).

**Table 18. Results of national PPS validation surveys: prevalence of antimicrobial use, ECDC PPS 2022–2023**

| Country | Hospitals No. | Patients No. | False Negatives % | False positives % | Sensitivity % (95% CI) | Specificity % (95% CI) | pPPS AU % | Corrected AU % (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Austria | 5 | 261 | 5.8 | 2.3 | 87.8 (79.1–93.8) | 99.0 (96.4–99.9) | 30.0 | 33.4 (29.6–37.3) |
| Bulgaria | 7 | 379 | 5.7 | 3.2 | 94.0 (89.1–97.2) | 97.0 (93.8–98.8) | 47.9 | 49.3 (46.2–52.7) |
| Czechia | 6 | 300 | 1.8 | 0.0 | 96.1 (89.2–99.2) | 100.0 (98.8–100.0) | 30.9 | 32.2 (30.4–34.5) |
| Estonia* | 5 | 249 | 4.2 | 3.0 | 90.6 (76.1–97.9) | 98.7 (95.3–99.8) | 29.4 | 31.4 (26.9–37.5) |
| *Iceland**** | *2* | *255* | *3.9* | *8.1* | *91.4 (82.1–96.8)* | *96.4 (93.1–98.4)* | *30.7* | *30.9 (27.0–35.3)* |
| Ireland | 5 | 250 | 5.1 | 0.9 | 93.0 (86.5–97.1) | 99.4 (96.5–100.0) | 40.8 | 43.5 (40.1–46.8) |
| Italy | 5 | 257 | 2.5 | 9.9 | 96.6 (88.1–99.6) | 92.4 (85.4–96.8) | 44.7 | 41.7 (36.2–47.8) |
| Lithuania | 6 | 313 | 0.5 | 2.3 | 98.7 (92.7–100.0) | 99.0 (97.3–99.8) | 29.0 | 28.7 (27.0–30.9) |
| *Luxembourg* | *5* | *365* | *2.3* | *14.0* | *93.2 (85.3–97.5)* | *94.9 (92.1–97.1)* | *27.1* | *25.0 (21.7–28.5)* |
| *Malta* | *7* | *267* | *5.2* | *3.0* | *94.3 (88.7–97.6)* | *97.3 (93.1–99.3)* | *47.0* | *48.3 (44.5–52.1)* |
| *Portugal* | *25* | *912* | *5.4* | *6.4* | *92.0 (88.5–94.8)* | *95.6 (93.8–97.1)* | *40.1* | *40.8 (38.6–43.1)* |
| *Romania* | *7* | *1127* | *1.2* | *3.0* | *98.4 (96.6–99.4)* | *97.8 (96.6–98.7)* | *42.9* | *42.3 (41.2–43.6)* |
| *Slovakia* | *5* | *289* | *3.4* | *0.0* | *94.0 (87.7–97.7)* | *100.0 (98.2–100.0)* | *34.8* | *37.0 (34.5–39.5)* |
| Spain | 6 | 296 | 5.7 | 3.2 | 94.0 (89.1–97.2) | 97.0 (93.8–98.8) | 47.9 | 49.3 (46.2–52.7) |
| Sweden | 5 | 288 | 6.2 | 2.8 | 90.0 (82.4–95.2) | 98.3 (95.6–99.5) | 36.6 | 39.5 (35.8–43.6) |
| **EU/EEA mean** | **106** | **6058** | **3.9** | **4.2** | **93.8 (92.1–95.6)** | **97.4 (96.2–98.7)** | **37.9** | **38.7 (34.2–43.2)** |
| Montenegro | 5 | 258 | 0.9 | 4.1 | 99.0 (94.6–100.0) | 96.2 (92.0–98.6) | 48.7 | 47.2 (44.5–50.5) |
| Serbia | 5 | 247 | 0.0 | 2.2 | 100.0 (95.8–100.0) | 98.3 (95.0–99.6) | 44.8 | 43.8 (42.0–46.4) |

*No. of hospitals: number of validated hospitals; No. of patients: number of validated patients; CI: confidence interval; AU: antimicrobial use; pPPS AU %: AU prevalence (% of patients receiving at least one antimicrobial) of the primary national PPS (see Table 19 for confidence intervals); Corrected AU %: corrected AU prevalence after adjustment for validation results.*
**Results of Estonia and Greece could not considered for calculating the EU/EEA mean because of methodological issues related to the validation of data collected using the 'light' protocol option in the primary PPS (Greece not included for AU validation results).*
**** Results in italics were considered representative validation results at country level.*

The mean corrected prevalence of antimicrobial use in EU/EEA countries performing a validation study was 38.7% compared with an average observed antimicrobial use prevalence of 37.9%. The estimated country-weighted corrected prevalence of antimicrobial use, calculated by applying the mean percentages of false negatives and false positives to the country-weighted EU/EEA prevalence, was 33.7% (95% CI 29.7–37.7), compared to 32.4% (95% cCI 29.7–35.1) before correction (see section `Burden estimates').

# Burden estimates

## Prevalence burden estimates: number of patients with at least one HAI or with at least one antimicrobial on any given day

Estimates for the EU/EEA on the total number of patients with at least one HAI or one antimicrobial were calculated correcting for the non-participating EU/EEA country (Denmark), and for the average results of the national validation studies. After these corrections, the number of patients with at least one HAI on any given day in acute care hospitals in EU/EEA countries was estimated at 93 305 patients, with a 95% confidence interval ranging from 76 427 to 111 899 patients. The number of patients receiving at least one antimicrobial on any given day in acute care hospitals in EU/EEA countries was estimated at 390 957 patients (95% CI: 345 070–437 575) (Table 19).

**Table 19. Estimation of the number of patients with at least one HAI and the number of patients with antimicrobial use on any day in acute care hospitals, ECDC PPS 2022-2023**

| Country | Occupied beds | | Estimated patients with HAI | | | Estimated patients with AU | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average no. Per day | % | (95%CI) | N | (95%CI) | % | (95%CI) | N | (95%CI) |
| Austria | 29 997 | 4.8 | (3.4–6.8) | 1 441 | (1 007–2 048) | 30.0 | (26.7–33.6) | 9 011 | (8 017–10 072) |
| Belgium | 32 827 | 9.2 | (7.9–10.7) | 3 033 | (2 609–3 517) | 29.3 | (27.3–31.4) | 9 619 | (8 959–10 308) |
| Bulgaria* | 24 894 | 3.7 | (2.3–6.0) | 920 | (562–1 493) | 47.9 | (41.1–54.7) | 11 918 | (10 232–13 624) |
| Croatia | 9 201 | 7.2 | (6.1–8.4) | 660 | (560–777) | 40.1 | (34.6–45.9) | 3 690 | (3 184–4 221) |
| Cyprus | 1 456 | 13.8 | (8.3–22.1) | 201 | (121–321) | 56.5 | (48.3–64.4) | 823 | (703–939) |
| Czechia | 50 147 | 6.7 | (5.4–8.4) | 3 377 | (2 710–4 194) | 30.9 | (28.4–33.5) | 15 486 | (14 252–16 776) |
| Estonia | 3 927 | 5.4 | (4.2–6.9) | 212 | (166–269) | 29.4 | (26.9–32.0) | 1 153 | (1 056–1 255) |
| Finland | 7 110 | 7.4 | (6.4–8.6) | 527 | (453–613) | 36.3 | (31.9–40.9) | 2 579 | (2 268–2 908) |
| France | 152 777 | 6.4 | (5.6–7.3) | 9 786 | (8 587–11 140) | 22.7 | (21.3–24.2) | 34 722 | (32 507–37 041) |
| Germany | 337 821 | 4.2 | (3.4–5.2) | 14 227 | (11 503–17 561) | 26.2 | (23.3–29.3) | 88 412 | (78 594–98 989) |
| Greece | 20 119 | 12.1 | (9.9–14.9) | 2 442 | (1 983–2 989) | 55.1 | (51.0–59.1) | 11 078 | (10 254–11 888) |
| Hungary | 31 216 | 5.6 | (4.6–6.7) | 1 746 | (1 443–2 106) | 20.8 | (17.9–24.1) | 6 492 | (5 574–7 518) |
| Iceland | 641 | 6.2 | (1.0–29.3) | 40 | (7–188) | 30.7 | (9.1–66.2) | 197 | (58–424) |
| Ireland | 12 249 | 7.5 | (6.6–8.5) | 915 | (806–1 038) | 40.8 | (38.7–42.9) | 4 996 | (4 743–5 253) |
| Italy | 105 683 | 9.8 | (8.7–11.2) | 10 397 | (9 144–11 801) | 44.7 | (42.4–47.0) | 47 231 | (44 804–49 682) |
| Latvia* | 3 737 | 3.0 | (1.5–6.1) | 113 | (55–229) | 47.8 | (40.4–55.2) | 1 785 | (1 509–2 064) |
| Lithuania | 7 924 | 4.0 | (3.1–5.1) | 314 | (242–406) | 29.0 | (25.6–32.5) | 2 294 | (2 032–2 576) |
| Luxembourg | 1 759 | 6.9 | (3.2–14.3) | 121 | (56–252) | 27.1 | (22.1–32.6) | 476 | (390–574) |
| Malta | 1 106 | 7.2 | (5.8–8.9) | 80 | (65– 98) | 47.0 | (43.9–50.1) | 519 | (485–554) |
| Netherlands* | 19 878 | 6.5 | (5.3–8.1) | 1 300 | (1 045–1 612) | 38.1 | (34.7–41.7) | 7 583 | (6 892–8 298) |
| Norway** | 11 264 | 4.5 | (3.9–5.2) | 508 | (443–582) | 29.9 | (28.2–31.7) | 3 370 | (3 173–3 573) |
| Poland | 101 038 | 5.7 | (5.1–6.5) | 5 799 | (5 103–6 584) | 31.1 | (29.2–33.1) | 31 424 | (29 485–33 432) |
| Portugal | 26 811 | 11.6 | (10.6–12.6) | 3 105 | (2 841–3 390) | 40.1 | (38.4–42.0) | 10 764 | (10 286–11 249) |
| Romania | 39 243 | 3.1 | (2.5–3.8) | 1 210 | (974–1 500) | 42.9 | (40.1–45.7) | 16 840 | (15 756–17 941) |
| Slovakia | 14 108 | 6.8 | (5.8–8.0) | 964 | (818–1 135) | 34.8 | (32.5–37.2) | 4 909 | (4 578–5 251) |
| Slovenia | 5 044 | 8.2 | (6.7–9.9) | 412 | (339–498) | 35.7 | (32.6–38.9) | 1 800 | (1 644–1 961) |
| Spain | 79 792 | 8.2 | (7.6–8.9) | 6 568 | (6 038–7 139) | 45.5 | (43.2–47.9) | 36 339 | (34 450–38 245) |
| Sweden | 17 241 | 10.4 | (9.2–11.7) | 1 790 | (1 592–2 009) | 36.6 | (33.8–39.4) | 6 305 | (5 832–6 793) |
| **EU/EEA** | **1 149 009** | **6.3** | **(5.3–7.4)** | **72 206** | **(61 272–85 489)** | **32.4** | **(29.7–35.1)** | **371 816** | **(341 716–403 409)** |
| EU/EEA, corrected[a] | 1 160 870 | 6.3 | (5.3–7.4) | 73 135 | (61 526–85 904) | 32.4 | (29.7–35.1) | 376 122 | (344 778–407 465) |
| **EU/EEA, corrected after validation** | **1 160 870** | **8.0** | **(6.6–9.6)** | **93 305** | **(76 427–111 899)** | **33.7** | **(29.7–37.7)** | **390 957** | **(345 070–437 575)** |
| Kosovo | 2 001 | 4.6 | (2.5–8.3) | 92 | (50–167) | 62.8 | (56.0–69.2) | 1 257 | (1 120–1 385) |
| Montenegro | 1 214 | 3.3 | (1.8–6.2) | 40 | (21–76) | 48.7 | (44.0–53.4) | 591 | (534–648) |
| Serbia | 11 313 | 4.8 | (3.8–6.1) | 547 | (434–687) | 44.8 | (42.1–47.5) | 5 065 | (4 765–5 369) |

*Mean number of occupied beds: number of patient-days/365; patient-days for all beds in acute care hospitals were used or for acute care beds if the former was unknown, for the year preceding the survey; Pts: patients; 95% CI: 95% confidence interval, adjusted for design effect. [a]Cumulative 95% CI for the EU/EEA (see methods).*
**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands.*
***Norway used a national PPS protocol. [a]Corrected for non-participating EU countries with estimation for Denmark.*

After applying the country-specific prevalence percentages to the estimated number of occupied acute care hospital beds per country, the country-weighted prevalence of patients with at least one HAI in the EU/EEA was

6.3% (cumulative 95% CI: 5.3–7.4%) before validation and 8.0% (cumulative 95% CI: 6.6–9.6%) corrected after validation. The country-weighted prevalence of patients receiving at least one antimicrobial in the EU/EEA was 32.4% (cumulative 95% CI: 29.7–35.1%) before validation and 33.7% (cumulative 95% CI: 29.7–37.7%) corrected after validation.

The country-weighted prevalence and estimated numbers of patients with a HAI on any given day, by type of HAI, is given in Table 20. After weighting for the number of occupied beds in each country, the prevalence of patients with pneumonia or lower respiratory tract infections was the highest (1.92%), followed by urinary tract infections (1.39%) and surgical site infections (1.11%). After correction for validation results, the total number of HAIs on any given day in the EU/EEA was estimated at 99 098 (cumulative 95% CI: 70 979–145 550) HAIs.

**Table 20. Estimated number of patients with a HAI on any given day, by type of HAI, EU/EEA, ECDC PPS 2022–2023**

| Type of HAI | Country-weighted HAI prevalence | Estimated HAIs on a given day, EU/EEA | Country-weighted proportion of HAIs |
|---|---|---|---|
| | % (95%cCI) | N (95%cCI) | % |
| Pneumonia and lower respiratory tract infections | 1.92 (1.52–2.53) | 22 088 (17 409–29 048) | 28.3 |
| Pneumonia | 1.26 (0.96–1.69) | 14 433 (11 025–19 400) | 18.5 |
| COVID-19 | 0.49 (0.32–0.77) | 5 600 (3 659–8 849) | 7.2 |
| Other lower respiratory tract infection[b] | 0.20 (0.13–0.40) | 2 285 (1 462–4 624) | 2.9 |
| Urinary tract infection | 1.39 (1.09–1.79) | 15 970 (12 551–20 577) | 20.5 |
| Surgical site infection | 1.11 (0.86–1.45) | 12 781 (9 938–16 632) | 16.4 |
| Bloodstream infection | 0.86 (0.63–1.20) | 9 848 (7 241–13 840) | 12.6 |
| Gastro-intestinal infections | 0.59 (0.43–0.89) | 6 793 (4 905–10 256) | 8.7 |
| *Clostridioides difficile* infection | 0.33 (0.23–0.57) | 3 819 (2 585–6 496) | 4.9 |
| Other gastrointestinal infection | 0.26 (0.17–0.42) | 3 000 (1 945–4 786) | 3.8 |
| Skin and soft tissue infection | 0.24 (0.15–0.39) | 2 713 (1 749–4 435) | 3.5 |
| Eye, ear, nose, throat or mouth infection | 0.11 (0.06–0.21) | 1 231 (713–2 389) | 1.6 |
| Systemic infection | 0.24 (0.15–0.40) | 2 755 (1 707–4 592) | 3.5 |
| Other infection | 0.31 (0.21–0.49) | 3 605 (2 421–5 575) | 4.6 |
| **All types of HAI EU/EEA** | **NA** | **78 040 (56 996–112 195)** | **100.0** |
| **All types of HAI, EU/EEA, corrected after validation** | **NA** | **99 098 (70 979–145 550)** | **100.0** |

*[a]95% cCI: cumulative 95% confidence interval - country-specific estimates of the numbers of each type of HAI were summed up to obtain the total number for EU/EEA and applied to the total number of occupied beds to obtain the prevalence and confidence intervals by type of HAI. Differences between the grouped categories (pneumonia and lower respiratory tract infections and gastro-intestinal infections) and the sum of the individual types of HAI are due to cumulative rounding errors in the weighting process.*
*[b]Other lower respiratory tract infections included bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess or empyema, without evidence of pneumonia or COVID-19.*
*NA: Not applicable*

# Estimates of the annual number of patients acquiring a HAI, by country

The incidence of patients acquiring at least one HAI per year in the period 2022–2023 was estimated using the Rhame and Sudderth formula [36] and is given by country in Table 21. The estimated incidence and 95% confidence interval were applied to the annual number of discharges from acute care hospitals to estimate the total number of patients with HAIs per country and per year, and summed up to obtain the total number for the EU/EEA. For the current report, the same method was used to estimate the parameters of the Rhame and Sudderth formula as in the ECDC PPS 2011–2012 and the ECDC PPS 2016–2017. For the length of a HAI, two estimates were calculated for each country, one using the country mean number of days from HAI onset until the day of the PPS and another using the country median time from HAI onset until the day of the PPS. The median was chosen because the median time from hospital admission to the day of the PPS for all patients in the PPS was similar to the overall length of stay in participating hospitals (Figure 7). However, since this relationship is not necessarily true for patients with HAIs, we also used the mean time from HAI onset until the day of the PPS to obtain a lower estimate of the incidence. The point estimate per country was calculated as the mean of the two estimates. The lower 95% confidence interval limit is given as the lower limit of the lowest estimate, and the upper 95% confidence interval limit as the upper limit of the highest estimate.

After correction for the non-participating EU/EEA country (Denmark) and validation, the total annual number of patients with at least one HAI in the EU/EEA was estimated at between 3.1 and 5.8 million patients, with a point estimate of 4.3 million patients with at least one HAI per year in acute care hospitals in the EU/EEA. The country-

weighted EU/EEA HAI incidence estimate was 4.3% (95% CI: 2.8–6.3%) before validation and 6.5% (95% CI 4.7–8.7%) after validation (Table 21).

**Table 21. Estimation of the annual number of patients acquiring at least one HAI in acute care hospitals, ECDC PPS 2022–2023**

| Country | Hospital discharges | LOS | Mean LN-INT | P50 (LN-INT) | Estimated HAI incidence | | Estimated patients with HAI per year | |
|---|---|---|---|---|---|---|---|---|
| | No. | Days | Days | Days | % | (95% CI) | No. | (95% CI) |
| Austria | 1 729 602 | 4.9 | 11.8 | 7 | 2.7 | (1.4–4.8) | 46 605 | (24 300–83 079) |
| Belgium | 2 243 315 | 6.6 | 11.5 | 7 | 7.0 | (4.6–10.1) | 157 229 | (102 100–227 049) |
| Bulgaria* | 1 789 821 | 4.5 | 7.7 | 6 | 2.5 | (1.3–4.5) | 44 414 | (23 773–80 956) |
| Croatia | 573 374 | 6.3 | 9.9 | 7 | 5.5 | (3.9–7.6) | 31 592 | (22 204–43 542) |
| Cyprus | 173 289 | 4.2 | 13.3 | 8 | 5.8 | (2.6–11.7) | 10 134 | (4 582–20 217) |
| Czechia | 1 973 170 | 6.0 | 9.1 | 7 | 5.1 | (3.6–7.2) | 101 278 | (70 634–142 241) |
| Estonia | 187 794 | 7.1 | 10.0 | 7 | 4.6 | (3.0–6.9) | 8 666 | (5 586–12 976) |
| Finland | 663 908 | 3.6 | 8.8 | 6 | 3.7 | (2.6–5.1) | 24 626 | (17 197–33 965) |
| France | 11 058 573 | 5.4 | 11.7 | 7 | 3.9 | (2.6–5.6) | 436 011 | (285 836–621 832) |
| Germany | 16 741 340 | 6.0 | 9.4 | 6 | 3.5 | (2.2–5.2) | 580 105 | (364 745–875 249) |
| Greece | 2 160 596 | 4.1 | 12.2 | 8 | 5.2 | (3.3–7.7) | 112 360 | (72 314–166 092) |
| Hungary | 1 554 878 | 6.6 | 11.9 | 8 | 3.8 | (2.5–5.5) | 59 654 | (39 599–86 184) |
| Iceland | 40 779 | 7.6 | 17.5 | 7 | 4.7 | (0.5–31.7) | 1 914 | (184–12 936) |
| Ireland | 805 039 | 5.5 | 10.0 | 6 | 5.4 | (3.6–7.7) | 43 766 | (28 823–62 151) |
| Italy | 5 209 994 | 8.0 | 11.9 | 8 | 8.2 | (5.8–11.2) | 429 272 | (303 917–582 238) |
| Latvia* | 226 648 | 6.4 | 10.9 | 8 | 2.1 | (0.9–4.9) | 4 749 | (1 945–11 129) |
| Lithuania | 443 652 | 7.2 | 10.7 | 7 | 3.4 | (2.0–5.3) | 14 908 | (9 080–23 331) |
| Luxembourg | 87 658 | 6.4 | 10.3 | 8 | 4.9 | (2.0–11.4) | 4 278 | (1 721–10 016) |
| Malta | 54 684 | 5.1 | 10.7 | 7 | 4.4 | (2.8–6.5) | 2 395 | (1 536–3 558) |
| Netherlands* | 1 406 112 | 4.9 | 9.4 | 6 | 4.4 | (2.8–6.7) | 62 116 | (38 944–93 972) |
| Norway** | 786 457 | 4.0 | 11.4 | 6.9 | 2.1 | (1.4–3.0) | 16 318 | (10 757–23 258) |
| Poland | 5 319 191 | 4.8 | 23.3 | 7 | 2.5 | (1.0–4.4) | 134 839 | (54 905–235 333) |
| Portugal | 1 063 757 | 6.6 | 11.3 | 7 | 8.9 | (6.2–12.0) | 94 374 | (66 031–127 283) |
| Romania | 2 306 062 | 6.3 | 10.1 | 8 | 2.2 | (1.5–3.0) | 49 757 | (35 416–68 859) |
| Slovakia | 737 036 | 5.7 | 9.0 | 7 | 5.0 | (3.7–6.6) | 36 599 | (27 209–48 384) |
| Slovenia | 286 523 | 4.8 | 10.2 | 7 | 4.7 | (3.1–6.7) | 13 394 | (8 967–19 240) |
| Spain | 4 432 867 | 5.9 | 11.0 | 7 | 5.7 | (4.0–7.5) | 250 486 | (179 385–332 471) |
| Sweden | 1 121 815 | 4.9 | 9.9 | 6 | 6.8 | (4.5–9.4) | 75 733 | (50 816–105 889) |
| **EU/EEA** | **65 862 794** | **5.7** | **11.2** | **7** | **4.3** | **(2.8–6.3)** | **2 847 572** | **(1 852 506–4 153 429)** |
| EU/EEA, corrected[a] | 66 655 131 | 5.7 | 11.2 | 7 | 4.3 | (2.8–6.3) | 2 881 829 | (1 874 792–4 203 395) |
| **EU/EEA, corrected after validation** | **66 655 131** | **5.7** | **11.2** | **7** | **6.5** | **(4.7–8.7)** | **4 311 065** | **(3 136 214–5 823 600)** |
| Kosovo | 144 602 | 5.2 | 17.0 | 10 | 1.9 | (0.8–4.3) | 2 724 | (1 089–6 239) |
| Montenegro | 59 558 | 5.8 | 10.6 | 8 | 2.1 | (1.0–4.5) | 1 256 | (568–2 681) |
| Serbia | 739 318 | 6.4 | 10.1 | 8 | 3.5 | (2.4–4.9) | 25 774 | (18 103–36 115) |

***Number of discharges**: source national denominator data reported in TESSy (national denominator data) or Eurostat, see Annex 1 Table A1.7.*
***LOS**: average length of hospital stay from PPS hospital data, previous year (=LA in Rhame and Sudderth formula);*
***LN**= length of stay in patients with HAI;*
***INT**: number of days from hospital admission to onset of HAI (onset of first HAI if more than one HAI in single patient);*
***LN-INT**: number of days from onset of HAI until discharge in incidence series (if hospital-wide HAI surveillance had been performed in the same period), approached by PPS survey date – date of HAI onset +1 (see text); for HAI present on admission, the date of onset was replaced by the date of admission; P50=percentile 50 or median;*
***Estimated HAI incidence %:** percentage of hospitalised patients with at least one HAI per year, estimated using formula by Rhame and Sudderth [6] I=P × LA/(LN-INT), where P is the prevalence of patients with at least one HAI with 95% confidence intervals corrected for the PPS country-specific design effect, LA is the length of stay for all patients and (LN-INT) is the length of stay until survey date from onset of infection in patients with a HAI. Two estimates were calculated per country, one based on the mean and one based on the median time from HAI onset to the day of the PPS, see text.*
***Estimated number of patients per year with HAI**: number of discharges multiplied by estimated HAI incidence and 95% confidence interval. The HAI incidence and 95% CI for Europe was calculated as the sum of the estimated country-specific numbers of patients with HAI × 100 /total number of discharges.*
**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. [a]Corrected for the non-participating EU country with estimation for Denmark included.*

# Estimates of the annual number of HAIs, by type of HAI

The country-weighted estimated incidence and total numbers of patients with HAIs, by type of HAI and per year and corrected for the non-participating EU/EEA country (Denmark) is given in Table 22. The most common single type of HAI in terms of number of HAIs per year was urinary tract infection with an estimated number of 769 336 per year, closely followed by pneumonia with 639 674 infections per year. Both types of HAI were estimated to affect about 1% of hospitalised patients per year in the EU/EEA. The total number of HAI episodes per year, after validation correction, ranged from 3.2 million HAIs to 7.6 million HAIs, with a point estimate of 4.8 million HAIs each year in the EU/EEA. This 95% confidence interval was wider than the interval around the estimated number of patients with at least one HAI, because of the cumulative uncertainty around each of the site-specific incidence estimates.

**Table 22. Estimation of the number of HAIs by type of HAI per year in acute care hospitals, EU/EEA, ECDC PPS 2022–2023**

| Type of HAI | Mean (LN-INT) | P50 (LN- INT) | Country-weighted HAI incidence (estimated) | Estimated HAIs per year, EU/EEA |
|---|---|---|---|---|
| | Days | Days | % (95% cCI[a]) | N (95% cCI[a]) |
| Pneumonia and lower respiratory tract infections | 9.1 | 6.6 | 1.43 (0.94–2.18) | 953 971 (626 128–1 449 959) |
| Pneumonia | 9.4 | 7.0 | 0.96 (0.60–1.49) | 639 674 (402 804–990 879) |
| COVID–19 | 7.4 | 5.7 | 0.50 (0.28–0.90) | 331 192 (183 908–602 732) |
| Other lower respiratory tract infection[b] | 11.3 | 8.9 | 0.16 (0.08–0.41) | 104 808 (54 186–275 585) |
| Urinary tract infection | 8.9 | 6.3 | 1.15 (0.77–1.68) | 769 336 (512 128–1 121 990) |
| Surgical site infection | 16.5 | 9.3 | 0.53 (0.31–0.86) | 356 393 (206 844–573 756) |
| Bloodstream infection | 11.9 | 8.6 | 0.54 (0.33–0.86) | 357 531 (220 173–570 433) |
| Gastro–intestinal infections | 10.7 | 7.2 | 0.40 (0.21–0.76) | 265 313 (141 321–508 461) |
| *Clostridioides difficile* infection | 10.8 | 7.6 | 0.23 (0.13–0.49) | 152 657 (83 404–325 432) |
| Other gastrointestinal infection | 10.8 | 7.2 | 0.19 (0.09–0.38) | 123 385 (58 704–253 061) |
| Skin and soft tissue infection | 23.6 | 19.8 | 0.13 (0.06–0.25) | 86 078 (43 091–166 114) |
| Eye, ear, nose, throat or mouth infection | 9.5 | 7.1 | 0.08 (0.04–0.20) | 56 512 (27 211–132 134) |
| Systemic infection | 8.7 | 5.5 | 0.21 (0.10–0.43) | 138 969 (66 156–284 437) |
| Other infection | 14.7 | 9.2 | 0.15 (0.08–0.30) | 102 681 (51 249– 97 265) |
| **All types of HAI, EU/EEA** | **11.2** | **7.0** | **NA** | **3 219 217 (1 909 858–5 493 819)** |
| **All types of HAI, EU/EEA, corrected after validation** | **11.2** | **7.0** | **NA** | **4 815 780 (3 194 873–7 611 420)** |

***LN**: length of stay in patients with HAI;*
***INT**: number of days from hospital admission to onset of HAI (onset of first HAI if more than one HAI in single patient);*
***LN-INT**: number of days from onset of HAI until discharge in incidence series (if hospital-wide HAI surveillance had been performed in the same period), approached by PPS survey date – date of HAI onset +1 (see text); for HAI present on admission, the date of onset was replaced by the date of admission; P50=percentile 50 or median;*
***Estimated HAI incidence %:** percentage of hospitalised patients with at least one HAI per year, estimated using formula by Rhame and Sudderth [36] I=P × LA/(LN-INT), where P is the prevalence of patients with at least one HAI with 95% confidence intervals corrected for the PPS country-specific design effect. Two estimates were calculated per country, one based on the mean and one based on the median time from HAI onset to the day of the PPS (LN-INT), see text.*
***Estimated number of patients per year with HAI**: number of discharges multiplied by estimated HAI incidence and 95% confidence interval. The HAI incidence and 95% CI for the EU/EEA was calculated as the sum of the estimated country-specific numbers of patients with HAI x100 /total number of discharges, with a correction for the non-participating country Denmark. Correction for validation results (last line) was done by applying the ratio of the corrected HAI incidence over the primary PPS HAI incidence from Table 21. [b]Other lower respiratory tract infections included bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess or empyema, without evidence of pneumonia. Differences between the grouped categories (pneumonia and lower respiratory tract infections and gastro-intestinal infections) and the sum of the individual types of HAI are due to cumulative rounding errors in the weighting process and the use of pooled estimates for the length of infection. NA=not applicable.*

# Estimates of the annual number of HAIs with antimicrobial-resistant bacteria

The annual number of patients with HAIs involving antimicrobial-resistant bacteria was estimated without corrections or imputations, assuming that antimicrobial-resistant bacteria were not present in HAIs for which microbiological data were not available, which certainly resulted in an underestimation. In other words, we assumed there were no HAIs with antimicrobial-resistant bacteria in either the country that did not participate in the PPS (Denmark), nor in the country that did not report microbiological data (Norway), nor in 39.2% of HAIs in other EU/EEA countries for which microbiological data were not reported, either because samples were not taken or because microbiological results were not yet available or negative. The resulting estimates, based on Rhame and Sudderth conversions for HAIs with antimicrobial-resistant bacteria, are given in Table 23. An estimated 262 833 (95% cCI: 149 423–455 753) patients, each year, acquire a HAI with at least one antimicrobial-resistant bacterium included in the composite index of AMR. An estimated 41 641 (95% cCI: 20 341–86 620) patients, acquire a HAI

with at least one carbapenem-resistant bacterium belonging to the group of selected Enterobacterales each year. This was an increase of 31% in absolute numbers compared to the ECDC PPS 2016-2017, despite a 27% decrease in reported hospital discharges in the EU/EEA. Indeed, the EU/EEA denominator decreased from 90 million hospital discharges in the ECDC PPS 2016–2017 to 66 million hospital discharges in the ECDC PPS 2022–2023, because the United Kingdom was no longer included and because many EU/EEA countries reported considerably less hospital discharges at the national level.

**Table 23. Estimation of the number of HAIs with antimicrobial-resistant bacteria per year in acute care hospitals, EU/EEA, ECDC PPS 2022–2023**

| Antimicrobial-resistant bacteria | Mean (LN-INT) | P50 (LN- INT) | Country-weighted HAI incidence (estimated) | Estimated HAIs per year, EU/EEA (uncorrected) |
|---|---|---|---|---|
| | Days | Days | % (95% cCI[a]) | N (95% cCI[b]) |
| Composite index of AMR[c] | 17 | 10.5 | 0.40 (0.23–0.69) | 262 833 (149 423–455 753) |
| Meticillin–resistant *Staphylococcus aureus* | 17.5 | 14.3 | 0.04 (0.02–0.10) | 28 124 (12 466–64 546) |
| Vancomycin-resistant *Enterococcus faecalis* | 18.7 | 18.1 | 0.01 (0.00–0.03) | 3 628 (619–21 005) |
| Vancomycin-resistant *Enterococcus faecium* | 18.9 | 14.5 | 0.03 (0.01–0.09) | 20 217 (8 594–61 640) |
| Enterobacterales resistant to third-generation cephalosporins[d] | 15.7 | 9.8 | 0.26 (0.15–0.47) | 174 427 (96 911–311 907) |
| Third-generation cephalosporin-resistant *Escherichia coli* | 14 | 9.6 | 0.07 (0.04–0.16) | 49 190 (23 430–102 223) |
| Third-generation cephalosporin-resistant *Klebsiella pneumoniae* | 18.7 | 15 | 0.11 (0.06–0.21) | 73 782 (39 794–139 137) |
| Carbapenem-resistant *Pseudomonas aeruginosa* | 19.3 | 14.9 | 0.05 (0.02–0.10) | 31 141 (14 479–68 748) |
| Carbapenem-resistant *Acinetobacter baumannii* | 29.8 | 44 | 0.05 (0.02–0.14) | 34 553 (13 993–89 321) |
| Carbapenem-resistant Enterobacterales[d] | 21.9 | 20.5 | 0.06 (0.03–0.13) | 41 641 (20 341–86 620) |
| Carbapenem-resistant *Escherichia coli* | 11 | 10.5 | 0.00 (0.00–0.02) | 2 115 (399–10 499) |
| Carbapenem-resistant *Klebsiella pneumoniae* | 19.5 | 17.3 | 0.05 (0.02–0.11) | 31 360 (14 532–71 646) |

*cCI: cumulative confidence interval*

[a] ***Country-weighted HAI incidence (estimated):*** *the incidence % by country was defined as the percentage of hospitalised patients acquiring at least one HAI per year, estimated using formula by Rhame and Sudderth [36] I=P × LA/(LN-INT), where P is the prevalence of patients with at least one HAI with a resistant pathogen,*

[a] ***Country-weighted HAI incidence (estimated):*** *the incidence % by country was defined as the percentage of hospitalised patients acquiring at least one HAI per year, estimated using formula by Rhame and Sudderth [36] I=P × LA/(LN-INT), where P is the prevalence of patients with at least one HAI with a resistant pathogen,*

***LA*** *is the average length of hospital stay from PPS hospital data, previous year;*

***LN-INT*** *is the number of days from onset of HAI until discharge in incidence series (if hospital-wide HAI surveillance had been performed in the same period), approached by PPS survey date – date of HAI onset +1 (see text); for HAI present on admission, the date of onset was replaced by the date of admission. The estimates by country were summed up to obtain the EU/EEA estimate. Point estimates by country were calculated as the average of two estimates, one based on the mean and one based on the median time from HAI onset to the day of the PPS(LN-INT).*

[b] ***Uncorrected EU/EEA estimates****: in this table, EU/EEA totals were not corrected for 1) the non-participating country Denmark; 2) countries not providing antimicrobial susceptibility data (Norway); 3) HAIs without microbiological results (39.8% of all HAIs, Norway excluded) and 4) HAIs with microbiological results for which antimicrobial susceptibility results were not yet available on the survey date (9.5% of 10 643 microorganisms included in the composite index of AMR).*

[c] ***Composite index of antimicrobial resistance (AMR)****:* Staphylococcus aureus *resistant to meticillin,* Enterococcus faecium *and* Enterococcus faecalis *resistant to vancomycin, Enterobacterales resistant to third-generation cephalosporins,* Pseudomonas aeruginosa *and* Acinetobacter baumannii *resistant to carbapenems. The sum of the estimated number of HAIs per resistant microorganism differs from the estimated total for the composite index because each calculation (each line) in the table uses a specific mean and median time from infection onset until the day of the PPS (LN-INT). In addition, in the first line (composite index of AMR), a patient with a HAI involving more than one resistant microorganism is only counted once.*

[d] ***Enterobacterales****: including* Escherichia coli, Klebsiella *spp.,* Enterobacter *spp.,* Proteus *spp.,* Citrobacter *spp.,* Serratia *spp. and* Morganella *spp. Details are only shown for* E. coli *and* K. pneumoniae*.*

# Structure and process indicators

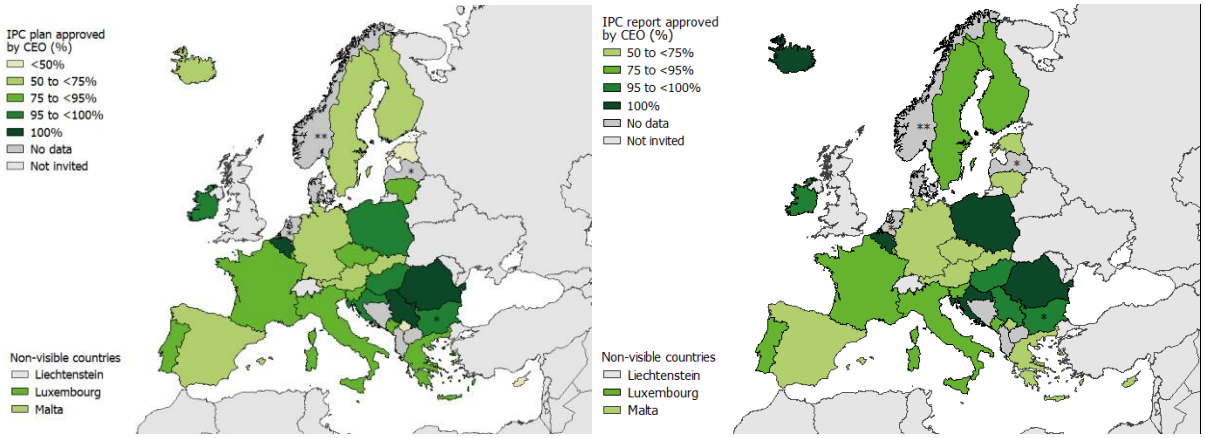
The number of hospitals reporting data on structure and process indicators varied according to the indicator and the level at which the data were collected (hospital or ward level). Denominators (number of responding hospitals) by indicator and by country are provided in the Annex (Table A.I.8). The Netherlands and Norway did not provide data for any of the indicators. Latvia, France, Lithuania and Sweden excluded some of the indicators, with variations depending on the country.

## Core component 1. Infection prevention and control programme

### Infection prevention and control plan and report, approved by the hospital chief executive officer or a senior executive officer

Overall, 81.6% of participating hospitals reported having an annual IPC plan and 81.5% reported having an annual IPC report, that were approved by the hospital CEO or a senior executive officer. The existence of both an approved plan and an approved report was reported by 78.0% (942/1 208) hospitals (Figure 78). Inversely, 13.2% (159/1 208) hospitals had neither an approved plan, nor an approved report; the latter being the most common in Cyprus (44% of hospitals), followed by Estonia (42.1%), Germany (37.2%), and Slovakia (36.2%).

**Figure 78. Percentage of hospitals reporting the presence of an annual IPC plan (left) and annual IPC report (right), approved by the hospital CEO or a senior executive officer, ECDC PPS 2022-2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands and Norway did not provide data. CEO: chief executive officer.*

### Infection prevention and control staffing levels

#### *Infection prevention and control nurses*

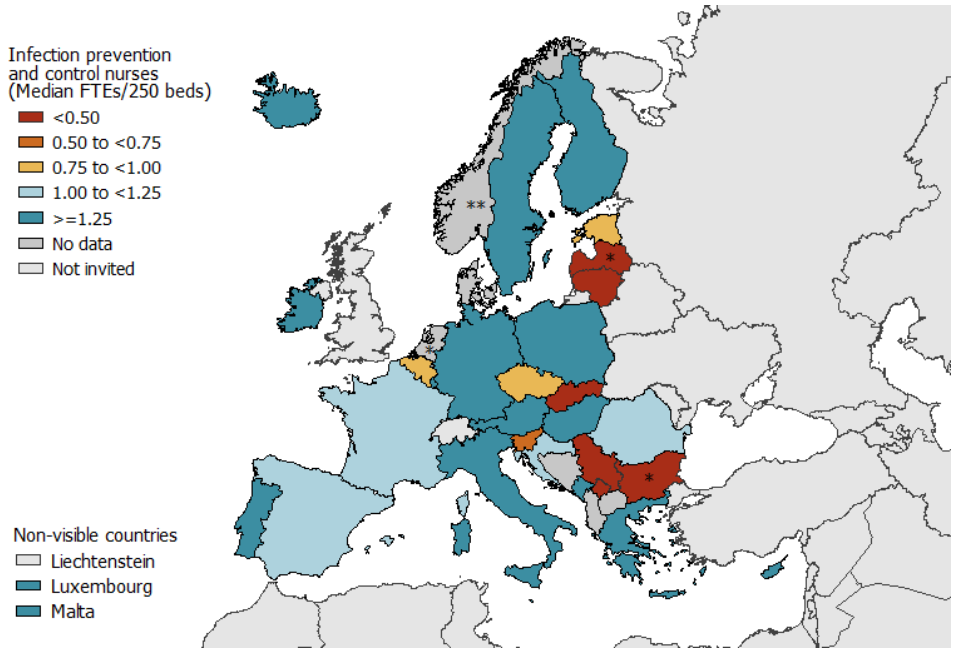
The number of infection prevention and control nurse (IPCN) full-time equivalents (FTEs) was provided by 1 128 hospitals from 26 EU/EEA countries. Data from seven hospitals were discarded as outliers. The median number of IPCN FTEs per 250 beds was 1.25 (IQR: 0.75–1.95) and ranged from 0.0 in Lithuania, Latvia and Slovakia to 2.75 IPCN FTEs per 250 beds in Cyprus and 3.13 in Ireland (Figure 79, Figure 80). The median number of IPCN FTEs per 250 beds in the ECDC PPS 2022–2023 was 20.2% higher than in the ECDC PPS 2016–2017, when it was 1.04 IPCN FTEs per 250 beds. The median number of IPCN FTEs per 250 beds decreased significantly with increasing hospital size ($p<0.001$, Table 24), and was significantly lower in tertiary ($p<0.001$) and secondary ($p=0.001$) hospitals than in primary hospitals (Table 25).

The percentage of hospitals that did not report any IPCN worktime decreased from 14.9% in the ECDC PPS 2016–2017 to 9.7% in the ECDC PPS 2022–2023. The percentage of hospitals without any reported IPCN worktime decreased with hospital size (p-value adjusted for country <0.001) and was higher in primary hospitals than in tertiary hospitals ($p<0.001$). The percentage of hospitals reporting at least 1.25 or at least 2.00 IPCN FTEs per 250 beds increased from 38.2% and 14.8% respectively, in the ECDC PPS 2016–2017 to 50.1% and 23.9%, respectively, in the ECDC PPS 2022–2023.

The number of IPCN FTEs per 250 beds was negatively associated with the composite index of AMR (p for trend =0.007), but this association was less pronounced than in the ECDC PPS 2016–2017 (reference [11], Figure 80). The median composite index of AMR was the highest in hospitals with less than 0.50 IPCN FTEs per 250 beds (32.5%), and by far the lowest in hospitals with at least 2.00 IPCN FTEs per 250 beds (14.8%) (Figure 81).

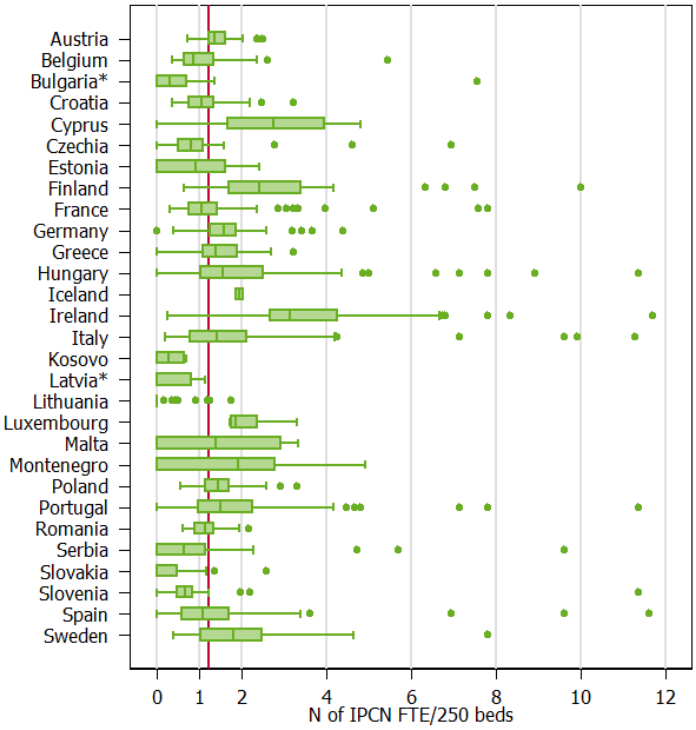
The number of IPCN FTEs per 250 beds was also significantly associated with HAI prevalence, but in the opposite direction. Hospitals without any reported IPCN worktime had a significantly lower HAI prevalence than hospitals with reported IPCN worktime (median 4.2% vs. 7.0%, p<0.001), but there was no significant difference in HAI prevalence between the IPCN staffing levels above zero FTE. The association of IPCN staffing levels with HAI prevalence did not remain statistically significant after adjustment for the number of blood culture sets per 1 000 patient-days (see 'Number of blood culture sets per year' below).

**Figure 79. Median number of IPCN full-time equivalents per 250 hospital beds (n=1 209 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The Netherlands and Norway did not provide data.*

**Figure 80. Number of IPCN full-time equivalents per 250 hospital beds by country (n=1 209 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria and Latvia. Red vertical line=median.*

**Table 24. Distribution of the number of IPCN full-time equivalents per 250 hospital beds by hospital size, ECDC PPS 2022–2023**

| No. of beds | No. of hospitals | IPCN FTEs per 250 hospital beds | | | | | | % hospitals without IPCN |
|---|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 | |
| <200 | 432 | 2.23 | 0.00 | 0.82 | 1.73 | 2.81 | 4.63 | 14.8 |
| 200–399 | 318 | 1.35 | 0.26 | 0.79 | 1.15 | 1.81 | 2.48 | 9.7 |
| 400–649 | 195 | 1.17 | 0.44 | 0.62 | 1.10 | 1.49 | 1.86 | 4.6 |
| ≥650 | 183 | 1.13 | 0.36 | 0.67 | 1.03 | 1.26 | 1.74 | 2.7 |
| **Total** | **1 128** | **1.62** | **0.16** | **0.75** | **1.25** | **1.95** | **3.16** | **9.7** |

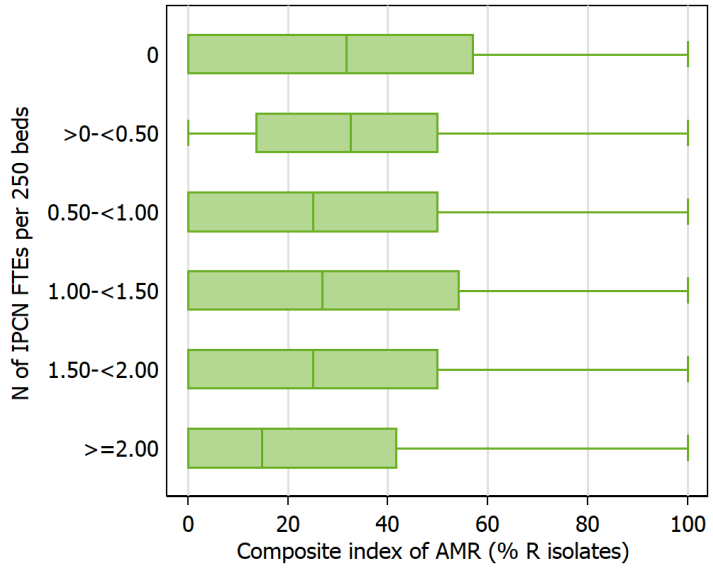
*P: percentile. IPCN: infection prevention and control nurse.*

**Table 25. Distribution of the number of IPCN full-time equivalents per 250 hospital beds by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | IPCN FTEs per 250 hospital beds | | | | | | % hospitals without IPCN |
|---|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 | |
| Primary | 320 | 1.75 | 0.00 | 0.76 | 1.45 | 2.13 | 3.45 | 14.1 |
| Secondary | 420 | 1.48 | 0.00 | 0.72 | 1.20 | 1.86 | 2.96 | 10.2 |
| Tertiary | 273 | 1.42 | 0.40 | 0.72 | 1.11 | 1.68 | 2.52 | 4.4 |
| Specialised | 113 | 2.23 | 0.39 | 0.94 | 1.63 | 2.58 | 5.00 | 8.0 |
| Unknown | 2 | 2.57 | 0.63 | 0.63 | 2.57 | 4.50 | 4.50 | 0.0 |
| **Total** | **1 128** | **1.62** | **0.16** | **0.75** | **1.25** | **1.95** | **3.16** | **9.7** |

*P: percentile. IPCN: infection prevention and control nurse*

**Figure 81. Composite index of AMR by levels of IPCN full-time equivalents per 250 beds, ECDC PPS 2022–2023**




*FTE: full-time equivalent. IPCN: infection prevention and control nurse.*
*The analysis only includes hospitals with at least one HAI with microbiological documentation of a microorganism included in the composite index of AMR with known antimicrobial susceptibility results (n=949 hospitals).*
*Composite index of AMR: Staphylococcus aureus resistant to meticillin, Enterococcus faecium and Enterococcus faecalis resistant to vancomycin, Enterobacterales resistant to third-generation cephalosporins, Pseudomonas aeruginosa and Acinetobacter baumannii resistant to carbapenems.*

# Infection prevention and control doctors

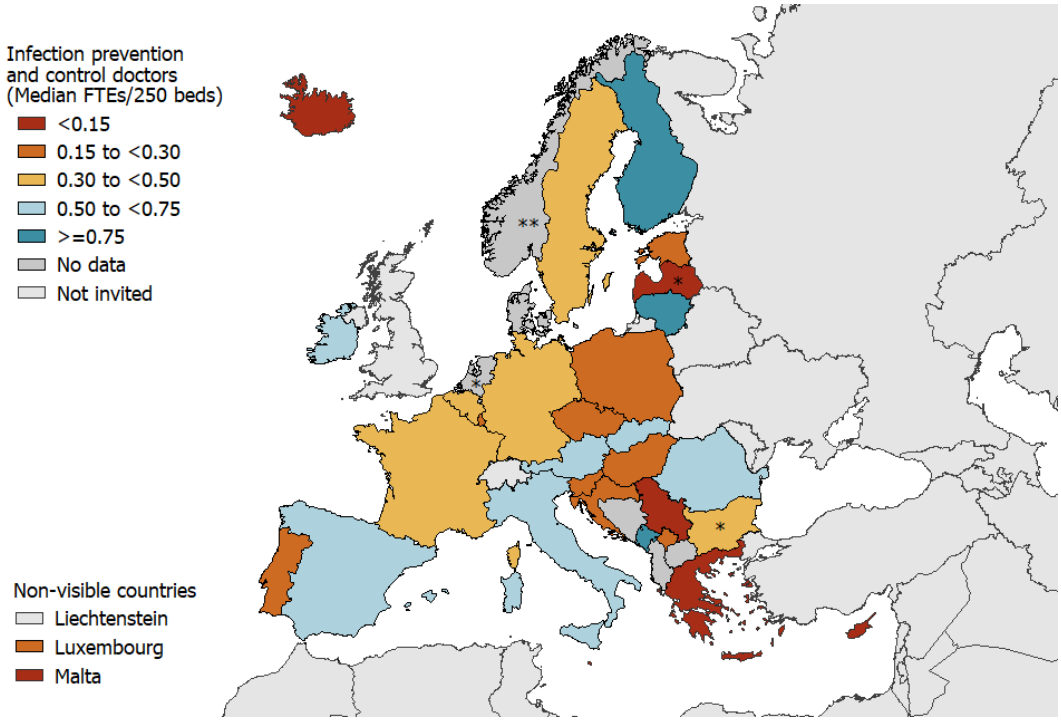
The number of infection prevention and control doctor (IPCD) FTEs was provided by 1 134 hospitals from 26 EU/EEA countries. Data from 10 hospitals were discarded as outliers. The median number of IPCD FTEs per 250 beds was 0.43 (IQR: 0.16–0.81) and increased by 53.6% compared to the ECDC PPS 2016–2017 when it was 0.28 IPCD FTEs per 250 beds. The median number of IPCD FTEs per 250 beds ranged from 0 in Cyprus, Greece, Latvia, Malta and Serbia to 1.39 FTEs per 250 beds in Finland (Figure 82, Figure 83). The median number of IPCD FTEs per 250 beds decreased with hospital size (Table 26, p=0.001), but did not vary significantly according to the type of hospital (Table 27).

In 17.8% (n=202) hospitals from 23 EU/EEA countries, no IPCD worktime was reported. This percentage decreased from 24.1% from the ECDC PPS 2016–2017. The percentage of hospitals without any reported IPCD worktime was 50% or higher in Cyprus, Greece, Iceland, Latvia, and Malta and decreased with hospital size (Table 26, p<0.001). Only 4.3% of hospitals with 650 beds or more (Table 26) and 9.9% of tertiary hospitals (Table 27) did not report any IPCD worktime.

Hospitals without an IPCD (no IPCD worktime reported) were more likely to be without an IPCN (54/197 or 27.4% without IPCN) than hospitals with an IPCD (54/907 or 6.0% without IPCN) (p<0.001). Hospitals with neither an IPCD nor an IPCN less frequently reported having an approved annual IPC plan (52.9% vs. 73.4% with either IPCN or IPCD, or 85.5% with both an IPCD and an IPCN, p<0.001) or an annual IPC report (41.2% vs. 67.4% with either IPCN or IPCD, or 87.1% with both an IPCD and an IPCN, p<0.001). As in the ECDC PPS 2016–2017, the median prevalence of HAIs was lower in hospitals with neither an IPCD nor an IPCN (3.0%) than in hospitals with either an IPCD or an IPCN (5.4%) or in hospitals with both an IPCD and an IPCN (6.3%) (p<0.001). Unlike for IPCNs, the composite index of AMR was not associated with IPCD staffing levels.

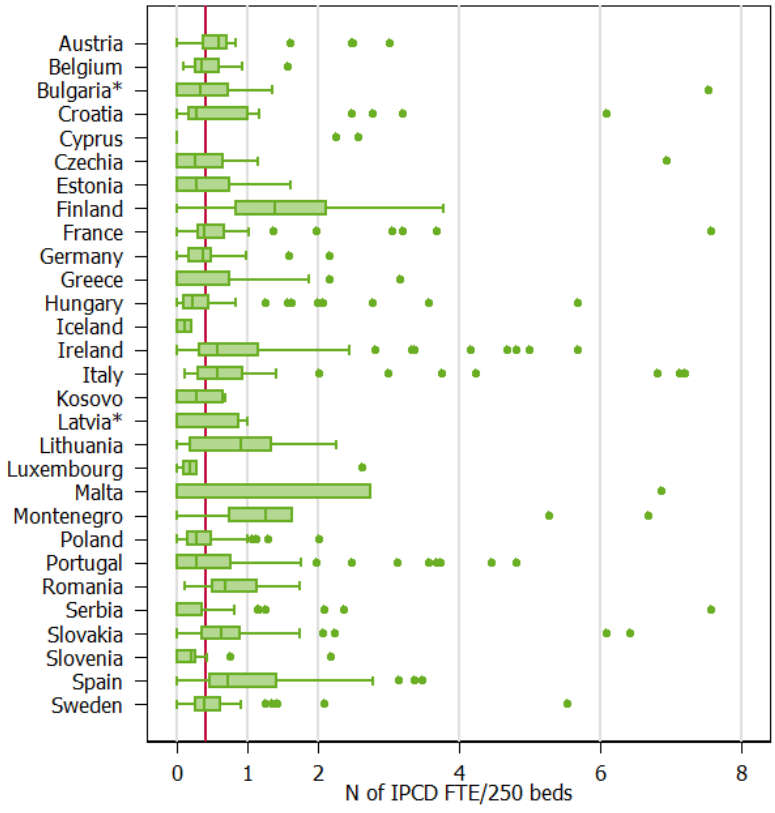
To note, as per definition of IPCD in the protocol, FTEs spent on antimicrobial stewardship activities mentioned as part of the job description had to be reported separately.

**Figure 82. Median number of IPCD full-time equivalents per 250 hospital beds (n=1 216 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The Netherlands and Norway did not provide data.*

**Figure 83. Number of IPCD full-time equivalents per 250 hospital beds, by country (n=1 216 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria and Latvia. The Netherlands and Norway did not provide data.*

**Table 26. Distribution of the number of IPCD full-time equivalents per 250 hospital beds by hospital size, ECDC PPS 2022–2023**

| No. of beds | No. of hospitals | IPCD FTEs per 250 hospital beds | | | | | | % hospitals without IPCD |
|---|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 | |
| <200 | 433 | 0.99 | 0.00 | 0.03 | 0.52 | 1.36 | 2.60 | 24.9 |
| 200–399 | 323 | 0.57 | 0.00 | 0.14 | 0.49 | 0.82 | 1.19 | 17.6 |
| 400–649 | 194 | 0.49 | 0.00 | 0.17 | 0.40 | 0.55 | 1.05 | 14.9 |
| ≥650 | 184 | 0.48 | 0.12 | 0.21 | 0.35 | 0.61 | 0.91 | 4.3 |
| **Total** | **1 134** | **0.70** | **0.00** | **0.16** | **0.43** | **0.81** | **1.61** | **17.8** |

*P: percentile.*

**Table 27. Distribution of the number of IPCD full-time equivalents per 250 hospital beds by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | IPCD FTEs per 250 hospital beds | | | | | | % hospitals without IPCD |
|---|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 | |
| Primary | 323 | 0.81 | 0.00 | 0.14 | 0.44 | 0.83 | 2.00 | 19.2 |
| Secondary | 417 | 0.61 | 0.00 | 0.13 | 0.42 | 0.73 | 1.37 | 21.1 |
| Tertiary | 272 | 0.71 | 0.07 | 0.22 | 0.46 | 0.92 | 1.49 | 9.9 |
| Specialised | 120 | 0.74 | 0.00 | 0.14 | 0.39 | 0.89 | 1.87 | 20.8 |
| Unknown | 2 | 1.76 | 1.27 | 1.27 | 1.76 | 2.25 | 2.25 | 0.0 |
| **Total** | **1 134** | **0.70** | **0.00** | **0.16** | **0.43** | **0.81** | **1.61** | **17.8** |

*P: percentile.*

# Microbiology laboratory support

## Microbiology laboratory support during weekends

Hospitals were asked whether clinicians could request routine clinical and screening microbiological tests and receive back results within the standard turnaround time during weekends (four questions). For hospitals that had replied 'yes' or `no' at least once ` to one of the four questions, missing answers for any of the other questions were interpreted as signifying `service not available'. This approach resulted in data being available for 1 039 hospitals in 25 EU/EEA countries. For clinical microbiology samples, requests and results would be available by 829 (79.8%) hospitals on Saturdays and by 697 (67.1%) hospitals on Sundays. For screening tests, requests and results would be available on Saturdays by 732 (70.5%) hospitals and on Sundays by 610 (58.7%) hospitals. Full availability of microbiology laboratory support, i.e. both for clinical and screening samples and on both Saturdays and Sundays, was reported by 557 (55.3%) hospitals, ranging from 0% in Latvia and Kosovo to 100% hospitals in Iceland and Luxembourg (Table 28). The percentage of hospitals with full availability of microbiology laboratory support during weekends was positively correlated with the prevalence of HAIs at country level (Spearman's rho 0.61, p=0.016), but there was no association with the composite index of AMR.

**Table 28. Availability of microbiology laboratory support during weekends, ECDC PPS 2022–2023**

| Country | Responding hospitals | | Clinical tests available | | Screening test available | | All four available |
|---|---|---|---|---|---|---|---|
| | | | Saturdays | Sundays | Saturdays | Sundays | |
| | No. | % | % | % | % | % | % |
| Austria | 38 | 92.7 | 86.8 | 52.6 | 76.3 | 55.3 | 47.4 |
| Belgium | 46 | 93.9 | 97.8 | 97.8 | 97.8 | 97.8 | 97.8 |
| Bulgaria* | 22 | 95.7 | 77.3 | 45.5 | 63.6 | 27.3 | 27.3 |
| Croatia | 28 | 90.3 | 75.0 | 42.9 | 71.4 | 39.3 | 39.3 |
| Cyprus | 9 | 90.0 | 77.8 | 66.7 | 55.6 | 55.6 | 55.6 |
| Czechia | 32 | 82.1 | 90.6 | 75.0 | 75.0 | 59.4 | 59.4 |
| Estonia | 19 | 95.0 | 68.4 | 52.6 | 63.2 | 52.6 | 47.4 |
| Finland | 40 | 100.0 | 100.0 | 97.5 | 62.5 | 55.0 | 55.0 |
| Germany | 46 | 92.0 | 100.0 | 93.5 | 97.8 | 89.1 | 89.1 |
| Greece | 41 | 83.7 | 80.5 | 75.6 | 65.9 | 70.7 | 58.5 |
| Hungary | 87 | 100.0 | 62.1 | 35.6 | 48.3 | 24.1 | 23.0 |
| Iceland | 2 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Ireland | 63 | 96.9 | 60.3 | 47.6 | 50.8 | 38.1 | 34.9 |
| Italy | 57 | 98.3 | 86.0 | 73.7 | 77.2 | 56.1 | 50.9 |

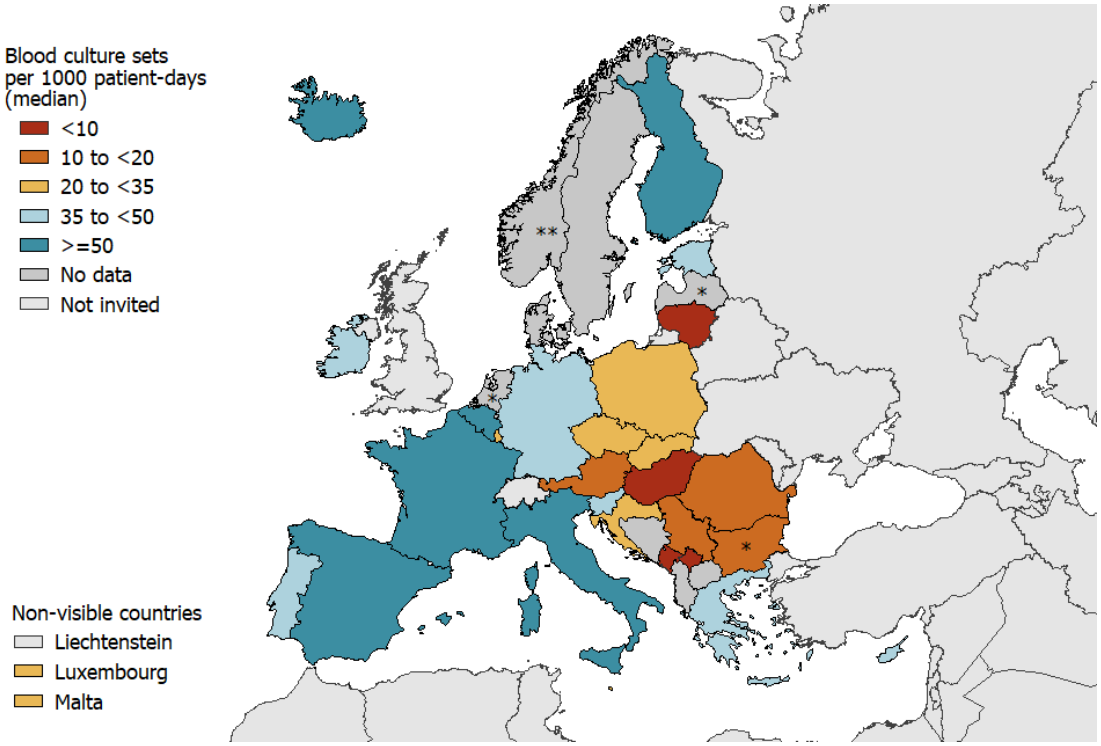
| Country | Responding hospitals | | Clinical tests available | | Screening test available | | All four available |
|---|---|---|---|---|---|---|---|
| | | | Saturdays | Sundays | Saturdays | Sundays | |
| | No. | % | % | % | % | % | % |
| Latvia* | 7 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lithuania | 41 | 100.0 | 80.5 | 63.4 | 31.7 | 29.3 | 26.8 |
| Luxembourg | 2 | 40.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Malta | 7 | 100.0 | 71.4 | 42.9 | 71.4 | 42.9 | 42.9 |
| Poland | 86 | 92.5 | 86.0 | 80.2 | 84.9 | 77.9 | 77.9 |
| Portugal | 99 | 82.5 | 78.8 | 70.7 | 82.8 | 77.8 | 68.7 |
| Romania | 44 | 83.0 | 72.7 | 63.6 | 63.6 | 56.8 | 54.5 |
| Slovakia | 45 | 95.7 | 95.6 | 80.0 | 84.4 | 68.9 | 68.9 |
| Slovenia | 22 | 100.0 | 86.4 | 54.5 | 77.3 | 40.9 | 40.9 |
| Spain | 102 | 97.1 | 70.6 | 63.7 | 67.6 | 57.8 | 50.0 |
| Sweden | 54 | 100.0 | 81.5 | 75.9 | 72.2 | 68.5 | 66.7 |
| **EU/EEA** | **1 039** | **92.9** | **79.8** | **67.1** | **70.5** | **58.7** | **55.3** |
| Kosovo | 5 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Montenegro | 10 | 100.0 | 60.0 | 30.0 | 30.0 | 20.0 | 20.0 |
| Serbia | 67 | 100.0 | 79.1 | 35.8 | 55.2 | 28.4 | 22.4 |

**Country representativeness of the sample was medium in Bulgaria and Latvia. France, the Netherlands and Norway did not provide data.*

## Number of blood culture sets per year

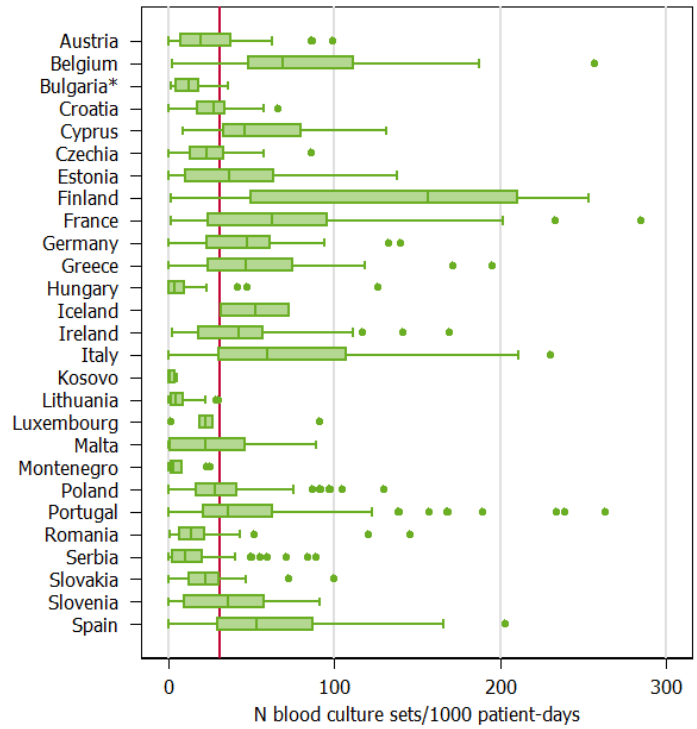
The number of blood culture sets received and processed by the clinical microbiology laboratory over a one-year period was provided by 1 077 (86.2%) hospitals from all EU/EEA countries except Latvia, the Netherlands, Norway and Sweden, and mostly (98.1%) for the year preceding the PPS. The median number of blood cultures per 1 000 patient-days increased from 22.8 [IQR 6.6 – 49.5] in the ECDC PPS 2016–2017 to 30.7 [IQR 10.1–61.9] in the ECDC PPS 2022–2023, and varied from less than 10 in Hungary, Lithuania, Kosovo and Montenegro to more than 50 in Iceland, Spain, Italy, France, Belgium and Finland (Figure 84, Figure 85). The median number of blood cultures per 1 000 patient-days was significantly associated with the type of hospital ($p<0.001$, Table 29) and increased significantly with hospital size ($p<0.001$, Table 30).

**Figure 84. Median number of blood culture sets per 1 000 patient-days (n=1 158 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Figure 85. Number of blood culture sets per 1 000 patient-days (n=1 158 hospitals), by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria. Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Table 29. Distribution of the number of blood culture sets per 1 000 patient-days by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | Blood culture sets per 1 000 patient-days | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| Primary | 299 | 34.6 | 1.3 | 6.5 | 21.4 | 46.3 | 87.6 |
| Secondary | 387 | 45.6 | 4.2 | 13.1 | 34.1 | 62.1 | 96.7 |
| Tertiary | 266 | 60.7 | 11.8 | 24.4 | 44.6 | 84.7 | 133.2 |
| Specialised | 123 | 31.4 | 0.0 | 1.6 | 8.0 | 39.6 | 99.9 |
| Unknown | 2 | 19.2 | 1.3 | 1.3 | 19.2 | 37.2 | 37.2 |
| **Total** | **1 077** | **44.6** | **2.2** | **10.1** | **30.7** | **61.9** | **107.6** |

*P: percentile.*

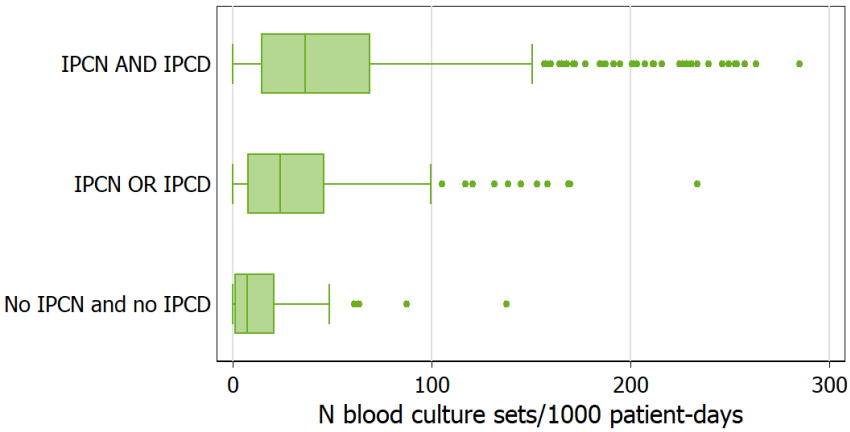
**Table 30. Distribution of the number of blood culture sets per 1 000 patient-days by hospital size, ECDC PPS 2022–2023**

| No. of beds | No. of hospitals | Blood culture sets per 1 000 patient-days | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| <200 | 407 | 36.2 | 0.3 | 4.5 | 20.6 | 48.1 | 96.2 |
| 200-399 | 299 | 49.7 | 3.1 | 16.4 | 36.2 | 66.2 | 112.0 |
| 400-649 | 183 | 47.4 | 7.0 | 16.5 | 38.5 | 64.1 | 93.0 |
| ≥650 | 188 | 51.8 | 7.0 | 14.8 | 35.0 | 74.1 | 125.0 |
| **Total** | **1 077** | **44.6** | **2.2** | **10.1** | **30.7** | **61.9** | **107.6** |

*P: percentile.*

The median number of blood culture sets per 1 000 patient-days was 14.9 when microbiology laboratory support was not available during weekends, 18.3 when support was only available onday during the weekend (usually only on Saturdays), and 33.1 when support was available on both Saturdays and Sundays ($p<0.001$). The median number of blood culture sets per 1 000 patient-days also significantly increased with increasing availability of IPC staff worktime, from 5.3 blood cultures per 1 000 patient-days in hospitals with neither an IPCN nor an IPCD, to 40.0 in hospitals with both an IPCN and an IPCD ($p<0.001$, Figure 86).

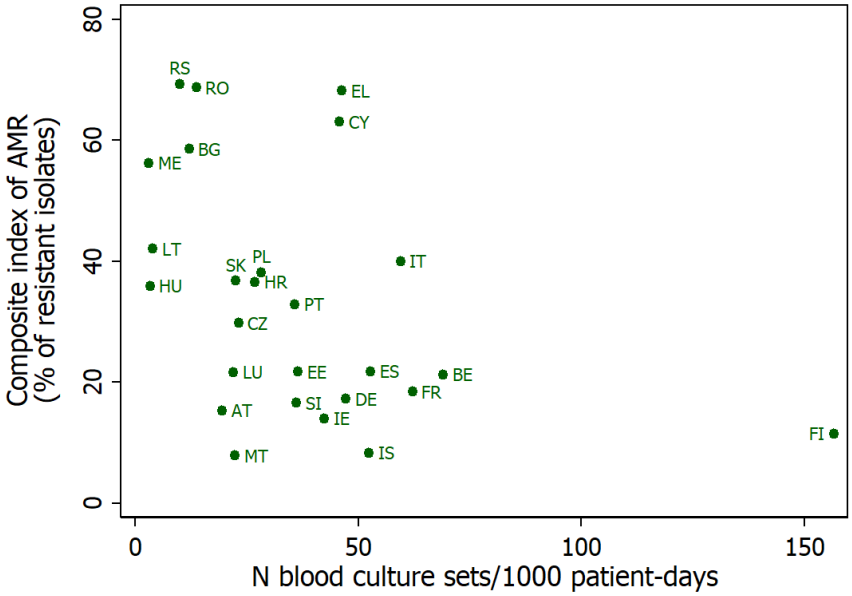
**Figure 86. Number of blood culture sets per 1 000 patient-days by presence of infection prevention and control staff in the hospital, ECDC PPS 2022–2023**




*IPCN: Infection prevention and control nurse; IPCD: Infection prevention and control doctor.*

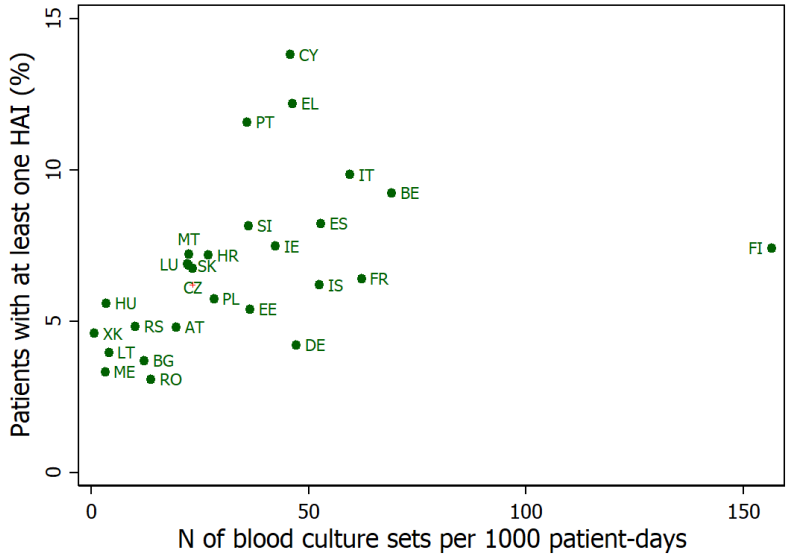
The number of blood culture sets per 1 000 patient-days was negatively correlated with the composite index of AMR at the country level (Spearman's rho -0.43, p=0.03; Figure 87). However, it was positively correlated with the prevalence of patients with at least one HAI, both at the hospital level (Spearman's rho 0.41, p<0.001) and at the country level (Spearman's rho 0.65, p<0.001; Figure 88).

**Figure 87. Correlation of the number of blood culture sets per 1 000 patient-days with the composite index of AMR, ECDC PPS 2022–2023**




*Spearman's rho -0.43, p=0.03*
*The number of blood cultures was reported for the year preceding the survey and was not reported by Latvia, the Netherlands, Norway and Sweden. Kosovo is not included because the composite index of AMR could not be calculated (<10 isolates reported with AMR results).*

**Figure 88. Correlation of the number of blood culture sets per 1 000 patient-days with the prevalence of patients with at least one HAI, ECDC PPS 2022–2023**



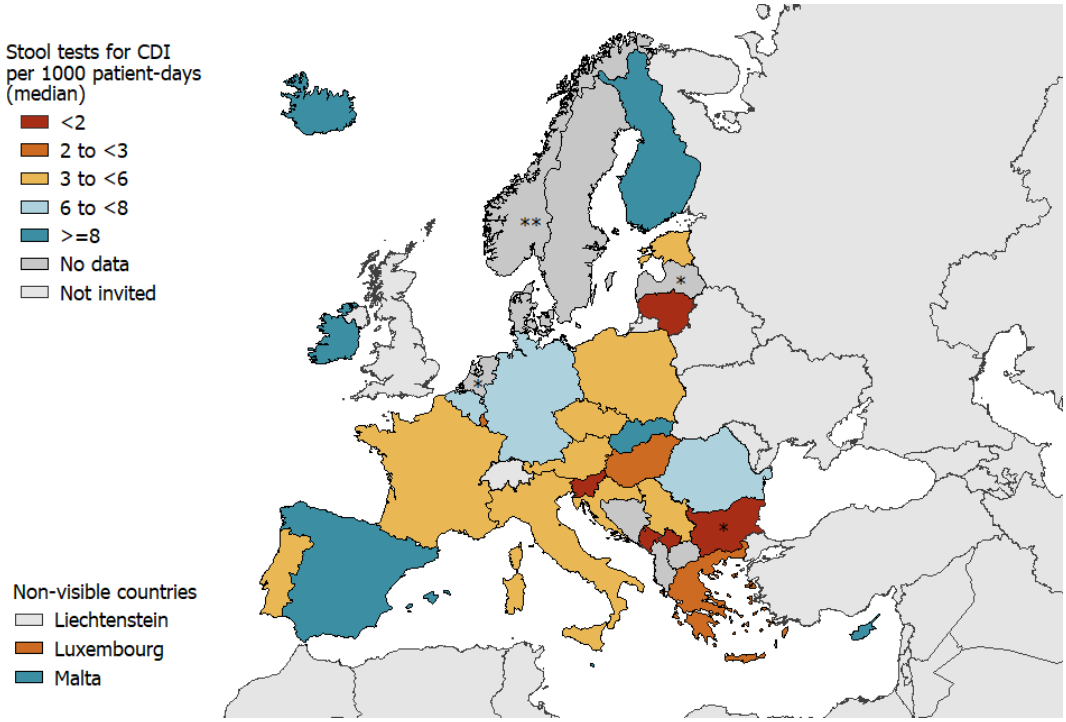

*Spearman's rho 0.65, p<0.001*

*The number of blood cultures was reported for the year preceding the survey and was not reported by Latvia, the Netherlands, Norway and Sweden.*

## *Number of stool tests for diagnosis of* C. difficile *infection per year*

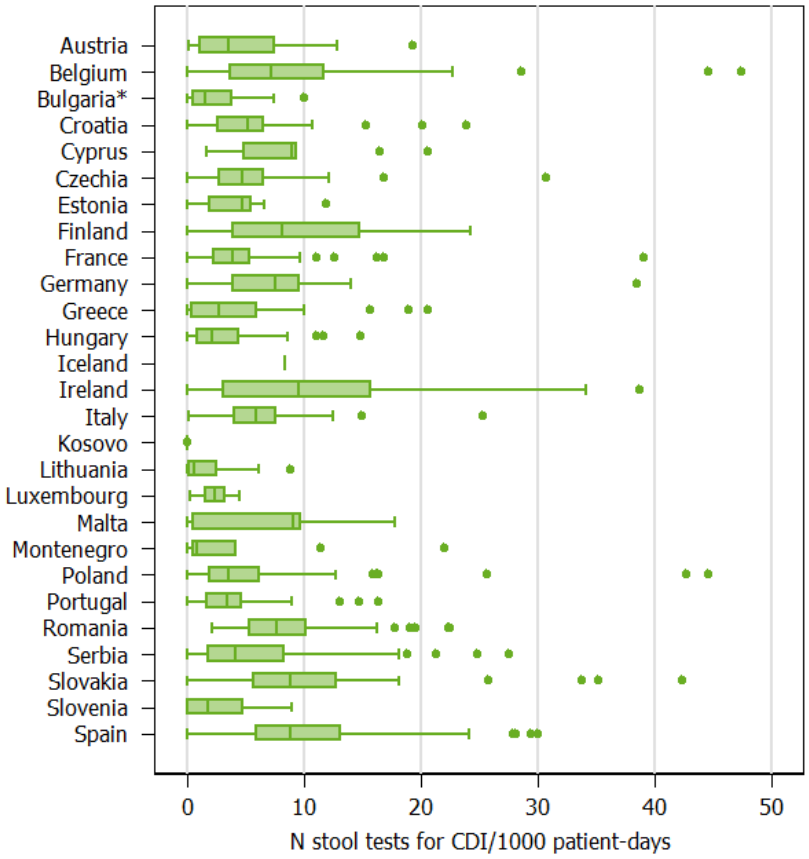
The number of inpatient stool tests peformed by the clinical microbiology laboratory for the diagnosis of *Clostridioides difficile* infection over a one-year period was provided by 1 058 (84.6%) hospitals from all EU/EEA countries countries except Latvia, the Netherlands, Norway and Sweden. In 98.4% of hospitals, data for the year preceding the survey were reported. The median number of stool tests for the diagnosis of CDI per 1 000 patient-days was 4.7 (IQR: 2.1–8.4), and varied from 0 in Kosovo and 0.6 in Lithuania to 9.5 in Ireland (Figure 89, Figure 90).

**Figure 89. Median number of stool tests for CDI per 1 000 patient-days (n=1 140 hospitals), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Figure 90. Number of stool tests for CDI per 1 000 patient-days (n=1 140 hospitals), by country, ECDC PPS 2022–2023**




*The number of cultures was reported for the year preceding the survey. *Country representativeness of the sample was medium in Bulgaria. Latvia, the Netherlands, Norway and Sweden did not provide data.*

The median number of stool tests for CDI per 1 000 patient-days was significantly lower in specialised hospitals and significantly higher in tertiary hospitals, than in primary hospitals (p<0.001, Table 31) and increased significanty with hospital size (p for trend<0.001, Table 32). The median number of stool tests for CDI per 1 000 patient-days was 3.5 in hospitals where microbiological tests could not be requested during weekends, 4.2 when such tests could be requested on only one day during the weekend, and 5.1 when microbiological tests were available on both Saturdays and Sundays (p=0.001). The number of stool tests for CDI per 1 000 patient-days was correlated with the number of blood culture sets per 1 000 patient-days, both at the hospital-level (Spearman's rho 0.52, p<0.001) and at the country-level (Spearman's rho 0.56, p=0.003) (Figure 91). The median number of stool tests for CDI per 1 000 patient-days also increased significantly with increasing availability of IPC staff, from 1.4 in hospitals with neither an IPCN nor an IPCD to 5.2 in hospitals with both an IPCN and an IPCD (p<0.001).

Similar to the number of blood cultures per 1 000 patient-days, the number of stool tests for CDI per 1 000 patient-days was associated with HAI prevalence, both at the hospital level (Spearman's rho 0.25, p<0.001) and at the country level (Spearman's rho 0.40, p=0.03). Surprisingly, however, the number of stool tests for CDI per 1 000 patient-days at the country level was neither associated with the prevalence of CDI (percentage of patients with CDI), nor with the relative percentage of CDI (CDI as a percentage of all HAIs).

**Table 31. Distribution of the number of stool tests for CDI diagnosis per 1 000 patient-days by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | Stool tests for CDI diagnosis per 1000 patient-days | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| Primary | 290 | 6.1 | 0.4 | 2.0 | 4.5 | 8.2 | 12.0 |
| Secondary | 384 | 6.6 | 0.6 | 2.6 | 5.0 | 8.9 | 14.8 |
| Tertiary | 262 | 7.2 | 1.4 | 3.4 | 5.9 | 9.0 | 15.2 |
| Specialised | 120 | 3.7 | 0.0 | 0.2 | 1.3 | 3.5 | 8.4 |
| Unknown | 2 | 12.0 | 4.8 | 4.8 | 12.0 | 19.1 | 19.1 |
| **Total** | **1 058** | **6.3** | **0.4** | **2.1** | **4.7** | **8.4** | **14.0** |

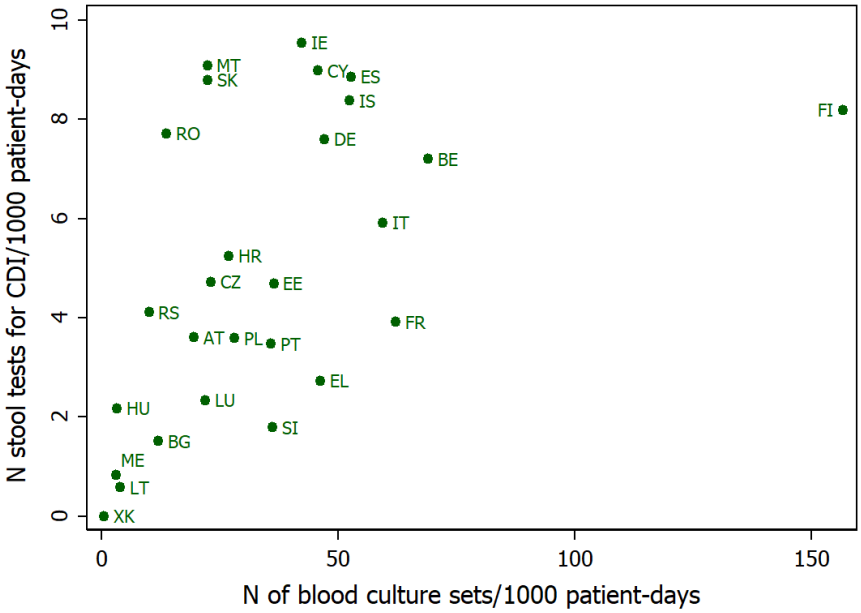
*P: percentile.*

**Table 32. Distribution of the number of stool tests for CDI diagnosis per 1 000 patient-days by hospital size, ECDC PPS 2022–2023**

| No. of beds | No. of hospitals | Stool tests for CDI diagnosis per 1 000 patient-days | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| <200 | 398 | 5.2 | 0.0 | 0.9 | 3.3 | 7.0 | 12.5 |
| 200-399 | 297 | 7.2 | 0.7 | 2.4 | 5.0 | 9.4 | 16.4 |
| 400-649 | 179 | 6.4 | 1.5 | 3.1 | 5.0 | 7.9 | 14.4 |
| ≥650 | 184 | 7.4 | 2.2 | 4.1 | 6.2 | 8.9 | 12.1 |
| **Total** | **1 058** | **6.3** | **0.4** | **2.1** | **4.7** | **8.4** | **14.0** |

*P: percentile.*

**Figure 91. Microbiology laboratory support: correlation between the annual numbers of stool tests for diagnosis of CDI and blood culture sets, per 1 000 patient-days, ECDC PPS 2022-2023**




*Spearman's rho 0.56, p=0.003*
*The number of cultures was reported for the year preceding the survey and was not reported by Latvia, the Netherlands, Norway and Sweden.*

# Core components 2 and 3: infection prevention and control guidelines and infection prevention and control education and training

Data on the presence of guidelines and education and/or training of frontline staff in IPC was collected as part of the multimodal strategies for the prevention of the major types of HAI in the ECDC PPS 2016–2017. As this composite variable was replaced by the questions on multimodal strategies from the WHO IPCAF tool, information on these core components was not collected for the ECDC PPS 2022–2023.

# Core component 4: surveillance of HAIs

Activities on surveillance of HAIs were collected through two sets of questions: questions on the hospital's participation in surveillance networks during the last year, and questions on the current status of implementation, and feasibility of automated surveillance.

## Participation in surveillance networks

Participation in national/regional surveillance networks was collected for four surveillance modules for which an ECDC-coordinated surveillance network is currently in place, surveillance of antimicrobial consumption (AMC) at hospital level (see antimicrobial stewardship indicators) and participation in other national surveillance networks for HAIs or antimicrobial resistance (AMR). Latvia, the Netherlands, Norway and Sweden did not report data on

participation in surveillance networks. France only reported data for participation in surveillance networks of SSIs, AMR and other surveillance networks of HAIs and/or AMR.

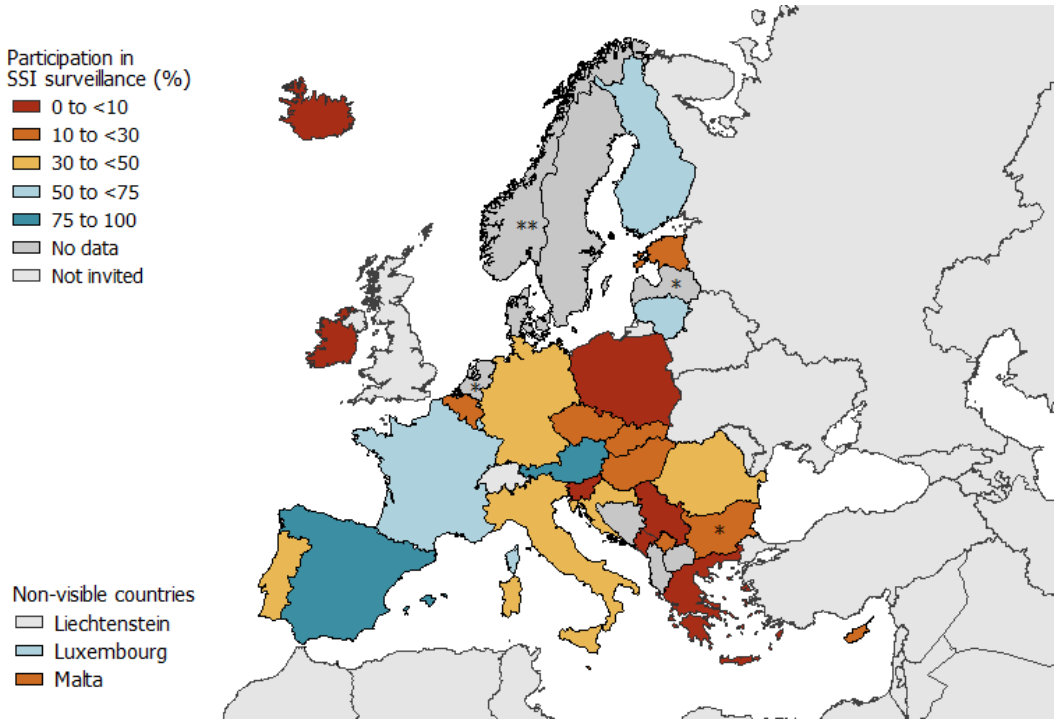
## Surveillance of surgical site infections

Participation in a network for surveillance of SSIs was reported by 37.1% (n=390/1 052) hospitals in 24 EU/EEA countries, which was an 18% decrease compared to 45.0% in the ECDC PPS 2016–2017. This was largely due to the United Kingdom no longer being included, where participation of this country in SSI surveillance had been high in 2016–2017. The percentage of hospital participation in a SSI surveillance network ranged from 0% in Iceland, Montenegro and Serbia, to 75% or more in Austria and Spain (Figure 92).

## Surveillance of HAIs in intensive care units

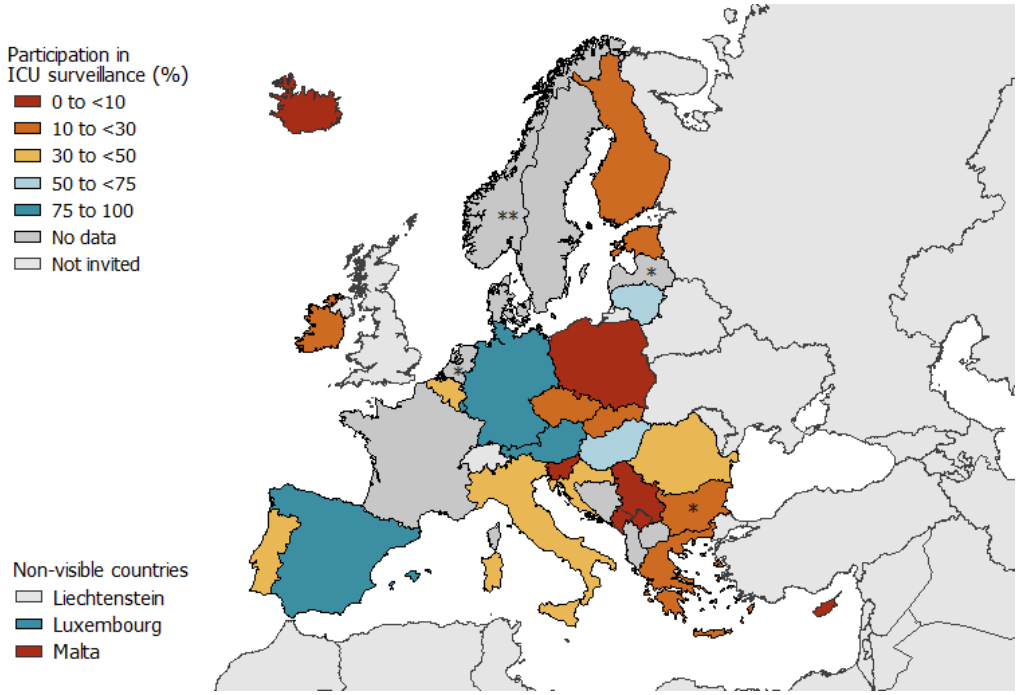
Participation in a network for surveillance of HAIs in ICUs was only calculated for hospitals reporting ICU beds, i.e. 771 (77.8%) of 991 hospitals in 23 EU/EEA countries reporting data on participation in a surveillance network of HAIs in ICUs. Overall, 41.3% (n=318/771) hospitals that reported having ICU beds reported participation in an ICU surveillance network, ranging from 0% in Cyprus, Iceland, Malta, Slovenia, Kosovo and Montenegro, to 75% or more in Austria, Germany, Luxembourg and Spain (Figure 93). The percentage of hospital participation was similar to the percentage reported in the ECDC PPS 2016–2017 (41.7%).

**Figure 92. Percentage hospitals reporting participation in a national or regional network for the surveillance of SSIs, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Figure 93. Percentage hospitals reporting participation in a national or regional network for the surveillance of HAIs in ICUs, ECDC PPS 2022–2023**

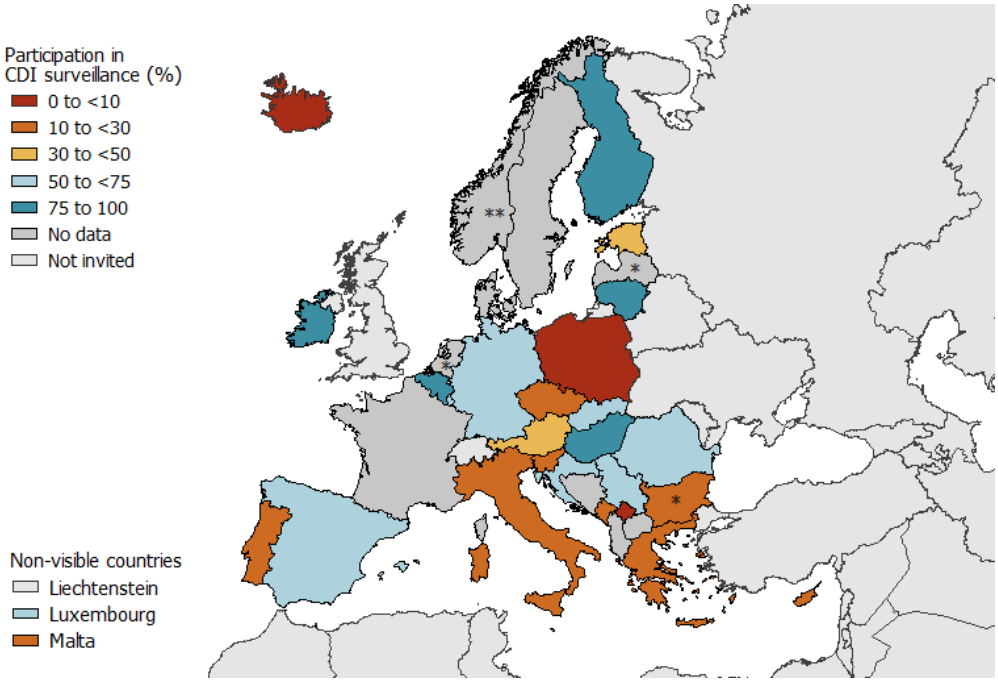



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

## Surveillance of C. difficile infections

Participation in a network for surveillance of CDIs was reported by 49.6% (n=491/991) hospitals in 23 EU/EEA countries, which was similar to the participation reported in the ECDC PPS 2016–2017 (48.2%). The percentage of hospital participation ranged from 0% in Iceland and Kosovo, to 75% or more in Belgium, Finland, Hungary, Ireland and Lithuania (Figure 94).

**Figure 94. Percentage of hospitals reporting participation in a national or regional network for the surveillance of CDIs, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

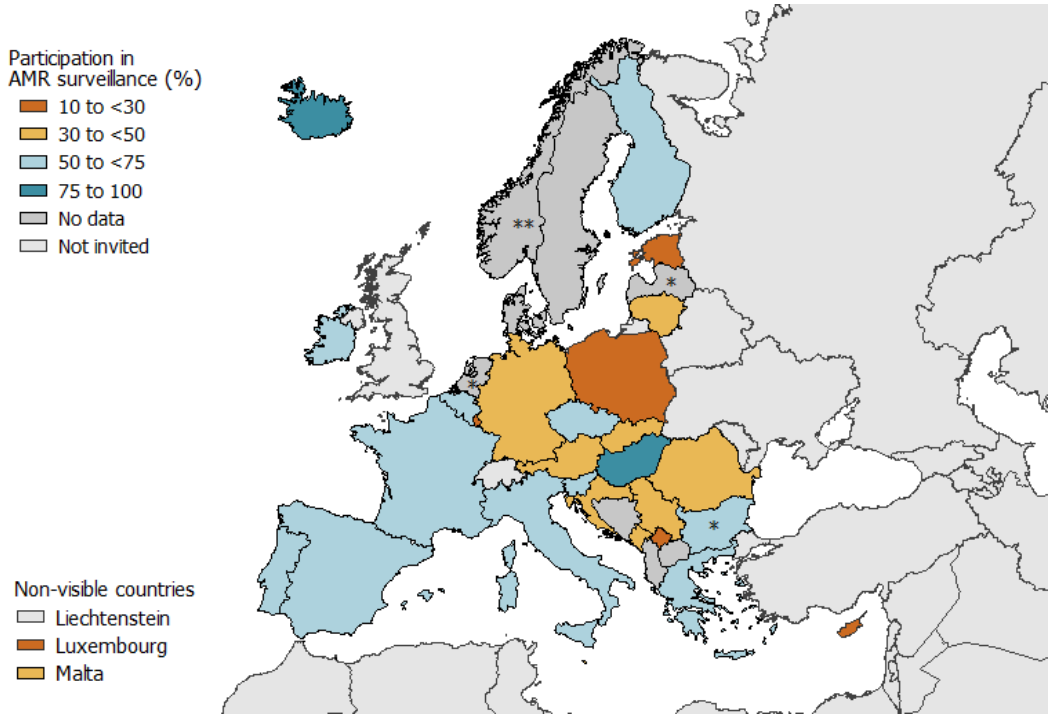
## Surveillance of antimicrobial resistance

Participation in a network for surveillance of AMR was reported by 54.3% (571/1 052) hospitals in 24 EU/EEA countries, similar to the participation reported in the ECDC PPS 2016-2017 (57.2%). Surveillance of AMR is specified, in the EDCD PPS protocol, as surveillance according to the EARS-Net protocol. Data are difficult to interpret as it was unclear whether the EARS-Net definition was always correctly applied (e.g. because of participation in another national or regional AMR surveillance network), and whether hospital PPS staff was always aware of the participation of the hospital in the laboratory-based national network contributing to EARS-Net. The percentage of hospital participation in a network for surveillance of AMR ranged from 16.7% in Cyprus and 17.6% in Poland, to 100% in Hungary and Iceland (Figure 95).

## Surveillance of antimicrobial consumption

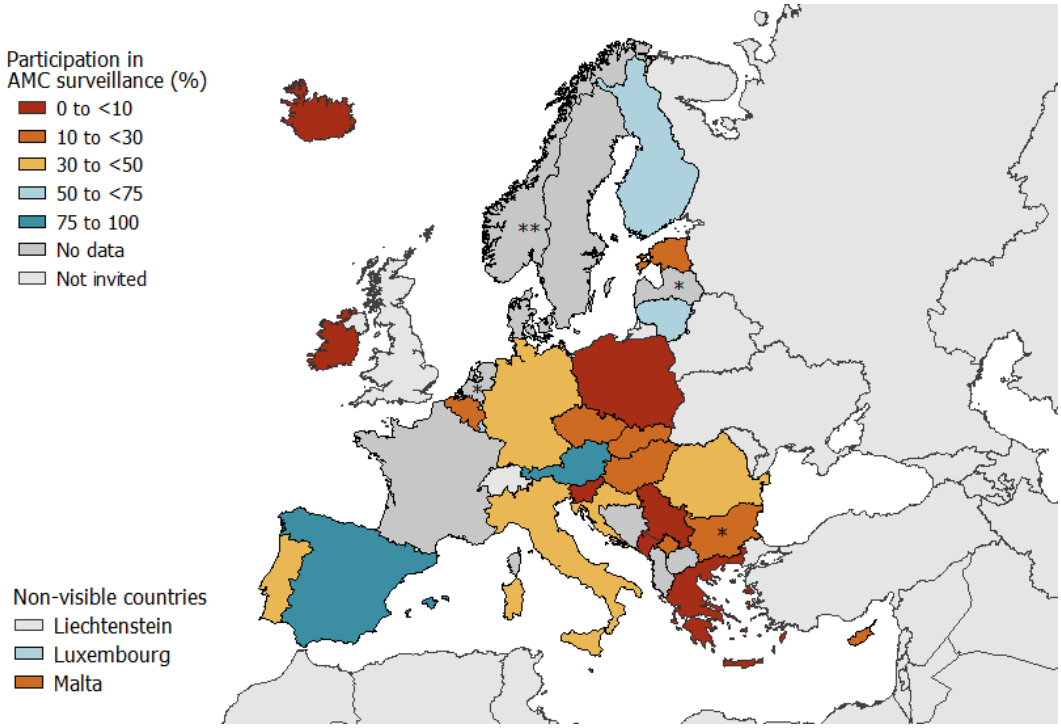
Participation in a national or regional network for surveillance of antimicrobial consumption at the hospital level was reported by 41.9% (415/991) hospitals in 23 EU/EEA countries, which was slightly lower than the participation reported in the ECDC PPS 2016–2017 (49.4%). The percentage hospital participation ranged from 0% in Hungary and Iceland, to 75% or more in Belgium, Lithuania and Slovenia (Figure 96).

**Figure 95. Percentage hospitals reporting participation in a national or regional network for the surveillance of AMR, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Figure 96. Percentage hospitals reporting participation in a national or regional network for the surveillance of AMC, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

## Participation in other surveillance networks

Participation in at least another national/regional surveillance network was reported by 41.4% (435/1 052) hospitals in 24 EU/EEA countries (Table 33). The most frequently reported other surveillance modules were surveillance of bloodstream infections (46.9%), surveillance of one or more multidrug-resistant microorganisms (43.0%) and surveillance of alcohol-based handrub (AHR) consumption or monitoring of hand hygiene compliance (26.7%). These results should also be interpreted with caution because the interpretation of `other surveillance network' was not uniform.

**Table 33. Number of hospitals reporting participation in other national/regional surveillance networks, ECDC PPS 2022–2023**

| Country | >=1 other surveillance network | Type of other surveillance network | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MDRO | BSI | Hand Hygiene | PPS | NICU | HAI | RESPI | Other | NoS |
| Austria | 15 | 6 | 0 | 4 | 1 | 1 | 11 | 0 | 2 | 1 |
| Belgium | 49 | 49 | 49 | 3 | 0 | 0 | 0 | 4 | 0 | 0 |
| Bulgaria* | 11 | 1 | 1 | 0 | 0 | 0 | 3 | 0 | 7 | 0 |
| Croatia | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| Cyprus | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Czechia | 8 | 1 | 2 | 0 | 1 | 1 | 0 | 1 | 4 | 0 |
| Estonia | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Finland | 11 | 0 | 10 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| France | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Germany | 23 | 13 | 0 | 10 | 0 | 3 | 13 | 0 | 1 | 0 |
| Greece | 9 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| Hungary | 87 | 87 | 87 | 87 | 0 | 1 | 0 | 0 | 0 | 0 |
| Iceland | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ireland | 14 | 7 | 7 | 0 | 2 | 1 | 0 | 1 | 1 | 0 |
| Italy | 18 | 9 | 5 | 6 | 0 | 0 | 1 | 0 | 4 | 0 |
| Lithuania | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Luxembourg | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Malta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Poland | 19 | 1 | 0 | 4 | 10 | 0 | 0 | 0 | 4 | 0 |
| Portugal | 55 | 2 | 41 | 2 | 0 | 2 | 1 | 0 | 6 | 2 |
| Romania | 7 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 0 |

| Country | >=1 other surveillance network | Type of other surveillance network | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | MDRO | BSI | Hand Hygiene | PPS | NICU | HAI | RESPI | Other | NoS |
| Slovakia | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Slovenia | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spain | 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61 |
| **EU/EEA** | **435** | **187** | **204** | **116** | **14** | **9** | **29** | **11** | **37** | **103** |
| Kosovo | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Montenegro | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 |
| Serbia | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 |

**Country representativeness of the sample was medium in Bulgaria. Latvia, the Netherlands, Norway and Sweden did not provide data. >= 1 other network: number of hospitals reporting participation in at least one other national/regional surveillance network; MDRO: surveillance of one or more multidrug-resistant microorganisms; BSI: hospital-wide surveillance of bloodstream infections; Hand hygiene: surveillance of alcohol-based handrub consumption or hand hygiene compliance; PPS: point prevalence survey; NICU: surveillance of HAIs in neonatal intensive care units; HAI: national HAI surveillance system, all HAIs or other types of HAI; RESPI: Respiratory diseases (e.g. COVID-19, Influenza); Other: other surveillance modules; NoS: not specified.*

Despite these issues with interpretation, the average hospital in the ECDC PPS 2022–2023 reported participation in 2.1 different surveillance modules, and 60.1% hospitals participated in at least one national or regional network covering the same targets as ECDC's HAI-Net surveillance modules (SSI, ICU and/or CDI), ranging from less than 10% in Iceland and Poland, to 75% or more in Austria, Belgium, Finland, Germany, Hungary, Ireland, Lithuania and Spain.

In the univariate analysis at country-level, there was no association between the percentage of hospitals participating in any of the HAI surveillance networks and HAI prevalence or the composite index of AMR.

## Automated surveillance of healthcare-associated infections

Questions proposed by the PRAISE (Providing a Roadmap for Automated Infection Surveillance in Europe) network were added in the protocol of the ECDC PPS 2022–2023 to evaluate the degree of implementation of automated surveillance of HAIs at the time of the PPS, as well as the feasibility of developing automated surveillance of HAIs in the future. Data on automated surveillance of HAIs were provided by 907 hospitals from 21 EU/EEA countries and 82 hospitals from Western Balkan countries. France, Italy, Latvia, Lithuania, the Netherlands, Norway and Sweden did not include these variables. Only summary results are included in this report and detailed results will be presented elsewhere.

## Current degree of automation of surveillance of HAIs

The most frequently targeted types of HAI for automated surveillance were *C. difficile* infections and bloodstream infections (hospital-onset and/or central line-associated). There was little variation of the degree of automation across types of HAI, with the highest level of any automation reported for surveillance of hospital-onset bloodstream infections (36.7%), *C. difficile* infections (36.3%) and surgical site infections (35.7%), and the lowest level of any automation was reported for hospital-acquired pneumonia (30.4%) (Table 34). Overall, 41.4% (375/907) hospitals reported having at least one of seven surveillance modules with some degree of automation. The percentage of hospitals with any automation of HAI surveillance ranged from 0% in Cyprus and Montenegro, to 82.5% in Finland and 100% in Iceland (Figure 97).

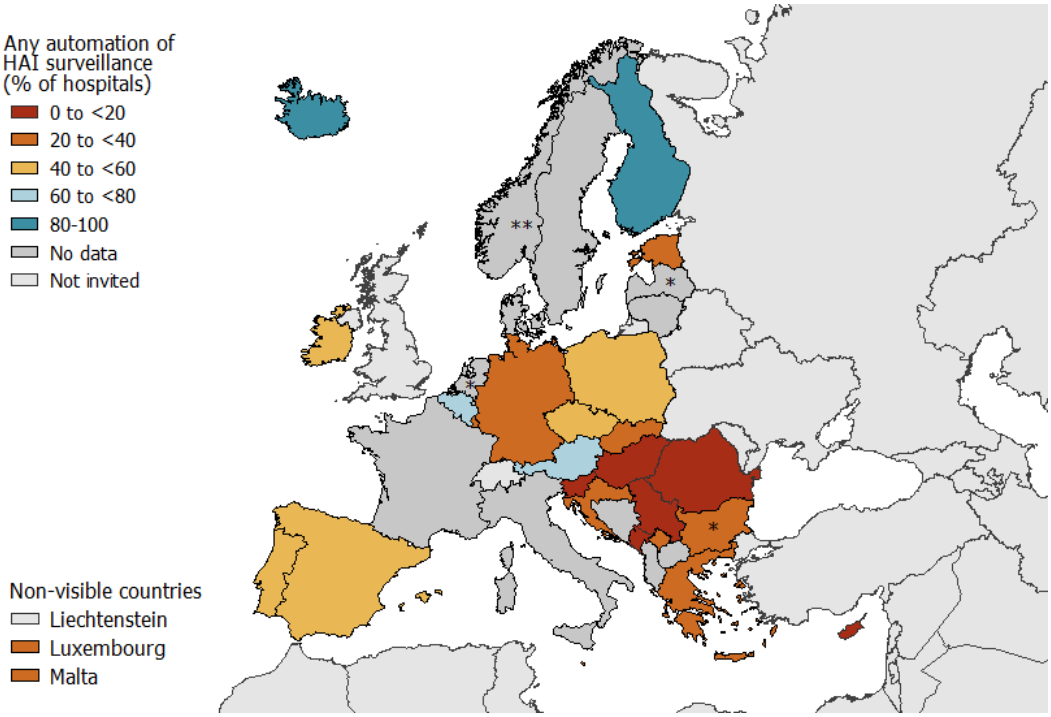
**Table 34. Current degree of automation of surveillance of HAIs in acute care hospitals (n=907), ECDC PPS 2022–2023**

| Type of HAI | No. of hospitals replying | % Surveillance not performed | No. of hospitals with surveillance | % Fully manual | % Use of electronic data without automation | % Automated denominator (a) | % Semi-automated (b) | % Fully automated (c) | % Any automation |
|---|---|---|---|---|---|---|---|---|---|
| Surgical site infection | 900 | 20.6 | 715 | 54.4 | 9.9 | 12.0 | 21.1 | 2.5 | 35.7 |
| Hospital-onset BSI | 902 | 14.5 | 771 | 51.8 | 11.5 | 12.7 | 21.1 | 2.9 | 36.7 |
| Central line-associated BSI | 900 | 15.2 | 763 | 54.3 | 11.5 | 11.5 | 19.7 | 3.0 | 34.2 |
| Catheter-associated UTI | 901 | 24.5 | 680 | 56.5 | 11.2 | 8.7 | 20.9 | 2.8 | 32.4 |
| Hospital-acquired pneumonia | 895 | 32.4 | 605 | 58.0 | 11.6 | 8.4 | 19.2 | 2.8 | 30.4 |
| Ventilator-associated pneumonia | 894 | 29.2 | 633 | 56.2 | 11.5 | 8.8 | 20.5 | 2.8 | 32.2 |
| *C. difficile* infection | 900 | 12.2 | 790 | 52.4 | 11.3 | 13.8 | 19.0 | 3.5 | 36.3 |

*(a) Automated denominator collection: Automated rule-based routine selection of procedures or patient- days to be included in the surveillance, e.g. based on admission to specific wards, surgical procedures or use of devices such as central lines; Codes are selected without manual steps and directly linked to a digital record for surveillance purposes. Subsequently charts are manually reviewed to detect HAI in the selected patients.*
*(b) Semi-automated: Automated selection of patients in surveillance as in (a) AND an automated algorithm flags patients with a high probability of a HAI that require manual confirmation of HAI presence, based on information extracted from electronic health records and linked to a digital record for surveillance purposes.*
*(c) Fully automated: Automated selection of patients in surveillance as in (a) AND fully automated algorithm for detection of HAI based on information extracted from electronic health records. This means that no manual selection or confirmation step is necessary. Any automation = (a)+(b)+(c).*
*BSI: bloodstream infection; UTI: urinary tract infection.*

To assess the feasibility of implementing automated surveillance of HAIs, hospitals were asked whether key variables or data sources for automation were available in a digital format, and if so, whether they were structured and well-defined (i.e. not available as free text notes, but as coded or standardised information). Information for at least one variable was provided by 862 hospitals in 23 EU/EEA countries. Key administrative data (admission and discharge dates) were the most likely to be both available in digital format and to be structured and well-defined, whereas availability was the lowest for the use of invasive devices (Table 35). The mean availability score of key variables in digital and structured format was correlated with the percentage of hospitals with any automation of HAI surveillance at country level (Spearman's rho 0.60, p=0.002).

**Figure 97. Percentage of hospitals reporting any automation of HAI surveillance by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Table 35. Feasibility of automation of surveillance of HAIs: availability of digital data for key variables, (n=862 hospitals), ECDC PPS 2022–2023**

| Type of variable/data source | No. of hospitals replying | Data exist in digital subsystem | | Data are structured and well-defined | |
|---|---|---|---|---|---|
| | | No. of hospitals | % | No. of hospitals | % |
| Surgical procedures (code, date of surgery) | 821 | 667 | 81.2 | 502 | 61.1 |
| Admission and discharge dates, hospital level | 837 | 773 | 92.4 | 634 | 75.8 |
| Admission and discharge dates, ward level | 836 | 771 | 92.2 | 630 | 75.4 |
| Use of central lines | 828 | 500 | 60.4 | 317 | 38.3 |
| Use of mechanical ventilation | 801 | 461 | 57.6 | 295 | 36.8 |
| Use of urinary catheter | 824 | 487 | 59.1 | 311 | 37.7 |
| Microbiology culture results | 837 | 741 | 88.5 | 563 | 67.3 |
| Antimicrobial prescriptions (ATC code, dates) | 785 | 534 | 68.0 | 376 | 47.9 |

# Core component 5: multimodal strategies for implementation of IPC interventions

The questions on the presence of seven elements of multimodal prevention strategies of the ECDC PPS 2016–2017 protocol were replaced by the more recent questions on core component 5 of the WHO IPCAF tool [23]. The exact wording of the WHO IPCAF questionnaire was used and the core component 5 score was calculated as defined by WHO. Information on at least one question on multimodal strategies was reported by 816 hospitals from 23 EU/EEA countries. Missing values were considered as negative answers if at least one of the questions was answered. France, Latvia, the Netherlands, Norway and Sweden did not provide data.

About three quarters (75.2%, 614/816) of EU/EEA hospitals reported using multimodal strategies to implement IPC interventions. Individual elements of multimodal strategies were more frequently reported, e.g. education and training (89.3% of hospitals), communication and reminders (86.9%) and monitoring and feedback (84.8%) (Table 36).

**Table 36. Answers to WHO IPCAF questions on multimodal strategies for the implementation of IPC interventions (n=816 hospitals), ECDC PPS 2022–2023**

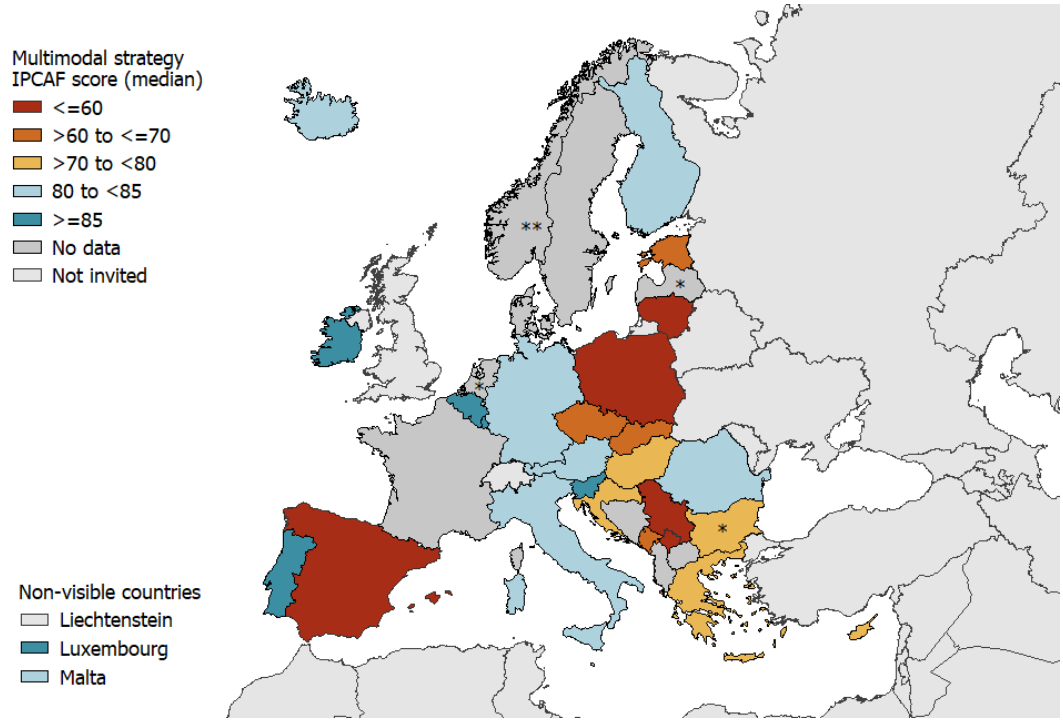
| Question | No. of hospitals | % |
|---|---|---|
| Do you use multimodal strategies to implement IPC interventions? | 614 | 75.2 |
| Do your multimodal strategies include any or all of the following elements? | | |
| System change | 678 | 83.1 |
| L1=Interventions to ensure the necessary infrastructure and continuous availability of supplies are in place | 322 | 39.5 |
| L2=Interventions to ensure the necessary infrastructure and continuous availability of supplies are in place and addressing ergonomics and accessibility (e.g. best placement of central venous catheter set and tray) | 356 | 43.6 |
| Education and training: | 729 | 89.3 |
| L1=Written information and/or oral instruction and/or e-learning only | 361 | 44.2 |
| L2=Additional interactive training sessions (includes simulation and/or bedside training) | 368 | 45.1 |
| Monitoring and feedback: | 692 | 84.8 |
| L1=Monitoring compliance with process or outcome indicators (e.g. audits of hand hygiene or catheter practices) | 271 | 33.2 |
| L2=Monitoring compliance and providing timely feedback of monitoring results to healthcare workers and key players | 421 | 51.6 |
| Communications and reminders: | 709 | 86.9 |
| L1=Reminders, posters, or other advocacy/awareness-raising tools to promote the intervention | 419 | 51.3 |
| L2=Additional methods/initiatives to improve team communication across units and disciplines (e.g. by establishing regular case conferences and feedback rounds) | 290 | 35.5 |
| Safety climate and culture change: | 625 | 76.6 |
| L1= Managers/leaders show visible support and act as champions and role models, promoting an adaptive approach and strengthening a culture that supports IPC, patient safety and quality | 412 | 50.5 |
| L2=Additionally, teams and individuals are empowered so that they perceive ownership of the intervention (e.g. by participatory feedback rounds) | 213 | 26.1 |
| Is a multidisciplinary team used to implement IPC multimodal strategies? | 600 | 73.5 |
| Do you regularly link to colleagues from quality improvement and patient safety to develop and promote IPC multimodal strategies? | 668 | 81.9 |
| Do these strategies include bundles or checklists? | 617 | 75.6 |

*Information on at least one question on multimodal strategies was reported by 816 hospitals from 23 EU/EEA countries. Missing values were considered as negative answers if one of the questions was answered. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

The median WHO IPCAF multimodal strategy (core component 5) score was 75 [IQR 60–90], ranging from 15 in Kosovo, 55 in Lithuania and 60 in Poland, Spain and Serbia, to 85 or more in Belgium, Ireland, Luxembourg, Portugal and Slovenia (Figure 98).

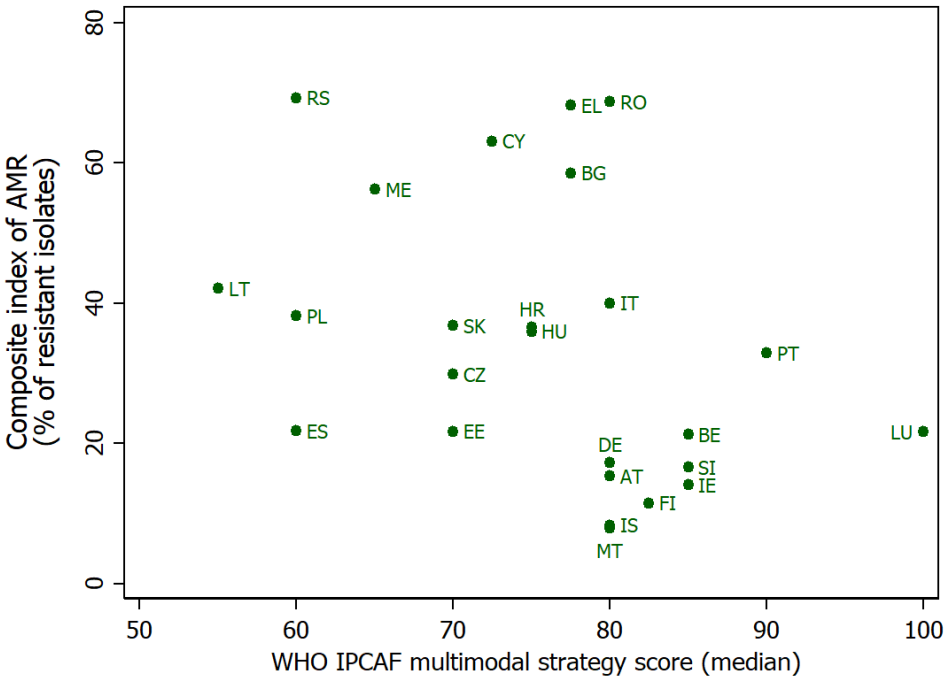
At the country level, the median WHO IPCAF multimodal strategy score was negatively correlated with the composite index of AMR (Spearman's rho -0.54, p=0.005, Figure 99), while there was a moderate positive correlation with HAI prevalence (Spearman's rho 0.40, p=0.04).

**Figure 98. Median WHO IPCAF multimodal strategy score by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

**Figure 99. Correlation of the median WHO IPCAF multimodal strategy score with the composite index of AMR, ECDC PPS 2022–2023**




*Spearman's rho -0.54, p=0.005. France, Latvia, the Netherlands, Norway and Sweden did not provide data on multimodal strategies. Kosovo is not included because the composite index of AMR could not be calculated (<10 isolates reported with AMR results).*

# Core component 6: Monitoring/audit of IPC practices and feedback

## Alcohol-based handrub consumption

Alcohol-based handrub consumption data at the hospital level were provided by 1 082 hospitals from 24 EU/EEA countries, of which 688 hospitals in 21 countries also provided data at ward level. Data from five hospitals were discarded as outliers. The Netherlands, Norway and Sweden did not provide data on AHR consumption. Latvia only reported AHR consumption at the national level for all hospitals combined. Data were provided for the year preceding the PPS by 98.9% hospitals.

The median AHR consumption was 34.4 litres per 1 000 patient-days (IQR: 20.8–57.0), which represented a 69.5% increase compared to 20.3 litres per 1 000 patient-days (IQR: 11.6–34.6) in the ECDC PPS 2016–2017. The median AHR consumption was significantly lower in primary hospitals than in tertiary hospitals (p=0.02, Table 37).

**Table 37. Alcohol-based handrub consumption (litres per 1 000 patient-days) by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | Alcohol-based hand rub consumption (litres per 1 000 patient-days) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| Primary | 299 | 43.2 | 11.5 | 18.6 | 31.1 | 54.0 | 92.3 |
| Secondary | 392 | 45.1 | 14.1 | 21.3 | 34.6 | 57.4 | 87.2 |
| Tertiary | 259 | 47.0 | 17.0 | 25.5 | 37.7 | 60.0 | 96.5 |
| Specialised | 123 | 43.6 | 7.8 | 16.0 | 33.5 | 54.4 | 89.9 |
| Unknown | 4 | 40.5 | 22.9 | 28.0 | 39.8 | 53.0 | 59.4 |
| **EU/EEA** | **1 077** | **44.8** | **12.9** | **20.8** | **34.4** | **57.0** | **89.9** |

*P: percentile.*

At the ward specialty level, the median AHR consumption ranged from 10.5 L per 1 000 patient-days (IQR: 5.5–21.0) in psychiatry wards to 92.2 L per 1 000 patient-days (IQR: 52.2–147.6) in intensive care units (Figure 100).

The median hospital AHR consumption varied greatly between countries, from 12.6 in Montenegro and 17.0 in Hungary to more than 50 L per 1 000 patient-days in seven countries (Figure 101, Figure 102). While in the ECDC PPS 2016–2017, the median AHR consumption was still lower than 10 L per 1 000 patient-days in five countries (Bulgaria, Hungary, Latvia, Lithuania and Italy), no country reported an AHR consumption of less than 10 L per 1 000 patient-days in the ECDC PPS 2022–2023.

**Figure 100. Alcohol-based handrub consumption (litres per 1 000 patient-days) by ward specialty, ECDC PPS 2022–2023**

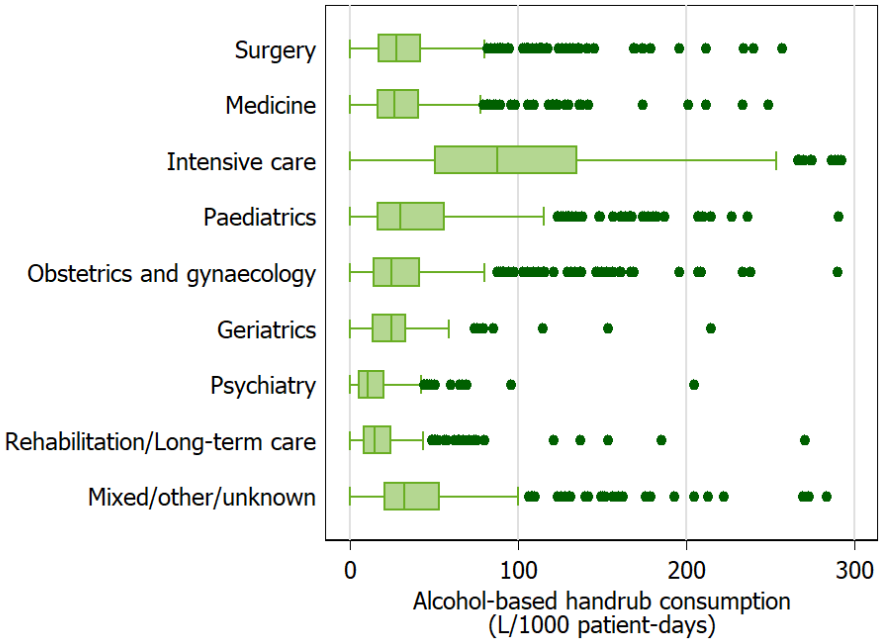
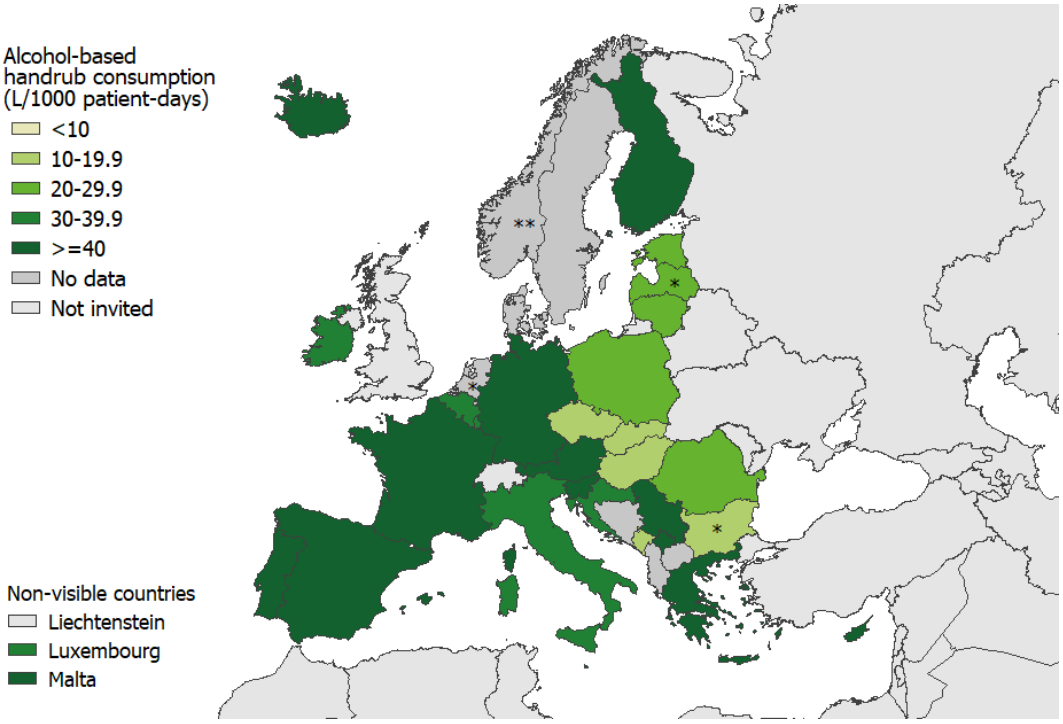
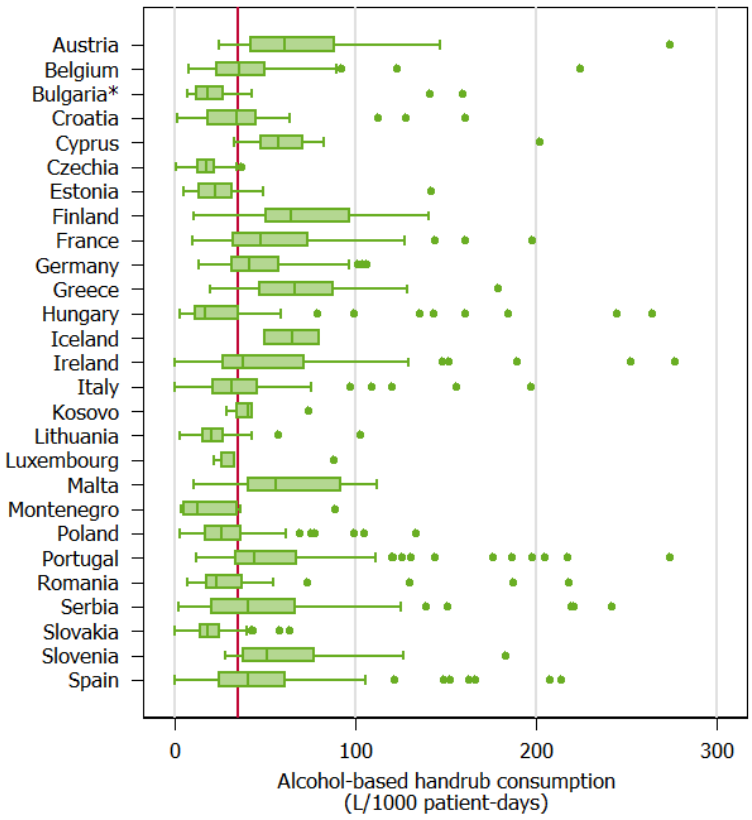


**Figure 101. Median alcohol-based handrub consumption (litres per 1 000 patient-days), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The Netherlands, Norway and Sweden did not provide data.*

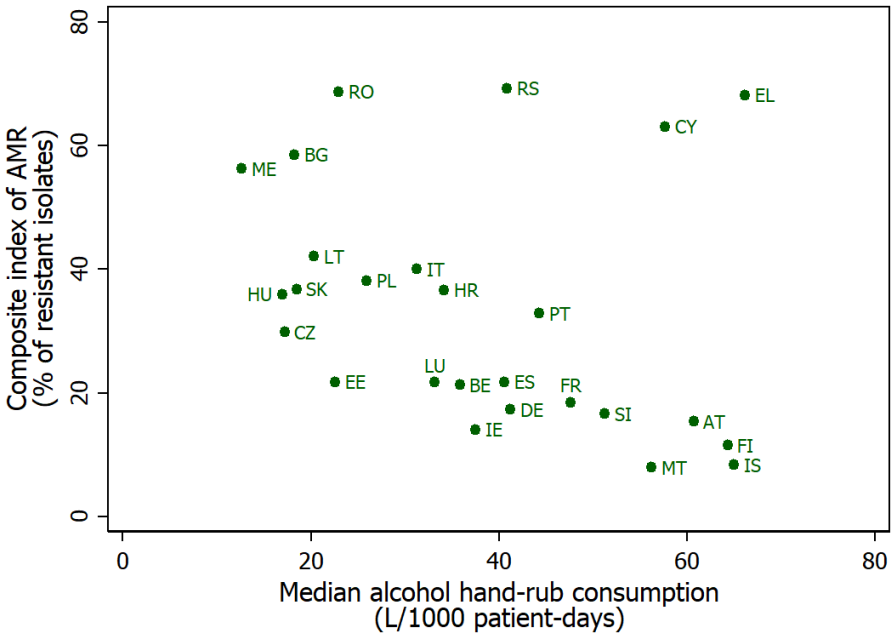
**Figure 102. Alcohol-based handrub consumption (litres per 1 000 patient-days) by country, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria and Latvia. The Netherlands, Norway and Sweden did not provide data. Red vertical line=median.*

The median AHR consumption at country level was negatively correlated with the composite index of AMR (Spearman's rho -0.43, p=0.03). As in the ECDC PPS 2016–2017, Cyprus and Greece (and to a certain extent Serbia) were outliers in the correlation (Figure 103). When excluding Cyprus and Greece, the Spearman's correlation coefficient rho was -0.72 (p<0.001). Personal communication with several IPC professionals in Greece to clarify this repeated observation suggested that a large proportion of the hospital consumption of AHR in Greece is attributable to private use by visitors of patients and staff outside the hospital, and to use within the hospital for other purposes than hand hygiene (e.g. disinfection of surfaces).

**Figure 103. Correlation between the median alcohol-based handrub consumption and the composite index of AMR, ECDC-PPS 2022–2023**




*Spearman's rho -0.43, p=0.03. The Netherlands, Norway and Sweden did not provide AHR consumption data. Kosovo is not included because the composite index of AMR could not be calculated (<10 isolates reported with AMR results).*

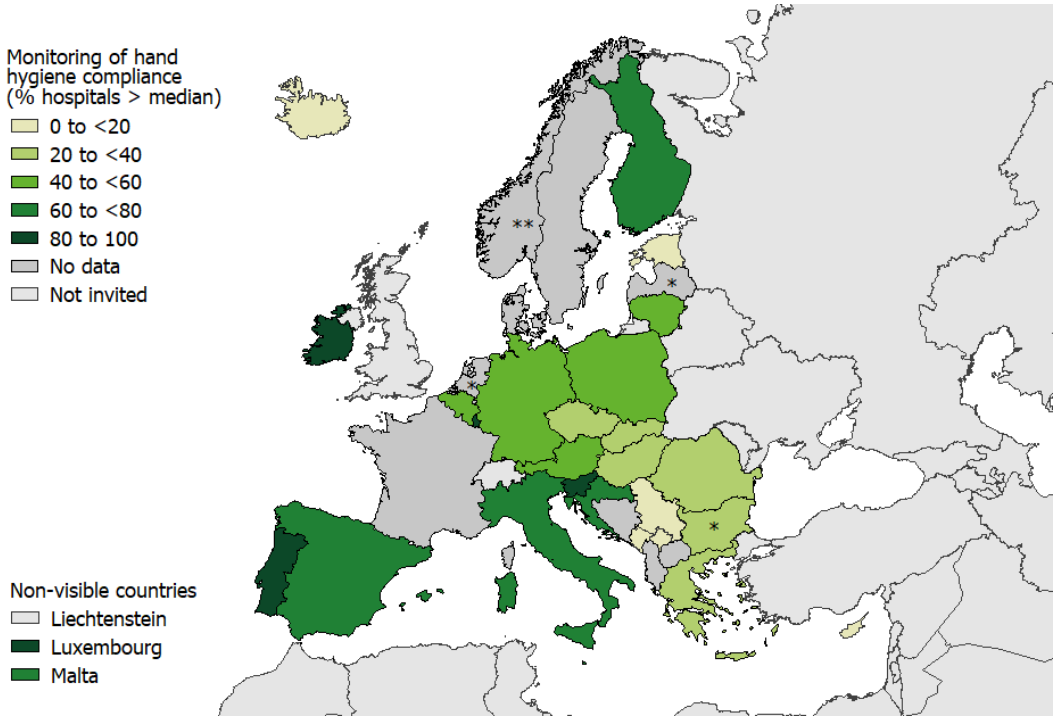
The median AHR consumption at the country level was associated with the number of blood cultures per 1 000 patient-days (Spearman's rho 0.52, p=006). There was also a positive correlation between the median AHR consumption and HAI prevalence (Spearman's rho 0.49, p=008), but this association did not remain significant after adjustment for the number of blood cultures per 1 000 patient-days.

## Number of observed hand hygiene opportunities

Data on the number of observed hand hygiene opportunities, reflecting the intensity of hand hygiene compliance monitoring, during the most recent year, were reported by 1 022 hospitals from 23 EU/EEA countries. The median number of observed hand hygiene opportunities in the previous year was 3.6 opportunities per 1 000 patient-days [IQR 0.1-19.6], with 23.3% hospitals not reporting any hand hygiene observations and 3.9% hospitals reporting more than 100 opportunities per 1 000 patient-days, mainly in Ireland, Italy and Portugal. Results by country are reported as the percentage of hospitals with a number of observed hand hygiene opportunities per 1 000 patient-days above the median. The percentage of hospitals with an above-median number of observed hand hygiene opportunities varied from 0% in Cyprus, Iceland, Kosovo and Montenegro to 80% or more in Ireland, Luxembourg, Portugal and Slovenia (Figure 104).

The median AHR consumption was 38.3 litres per 1 000 patient-days in hospitals with above-median observed hand hygiene opportunities, and 27.3 litres per 1 000 patient-days in hospitals with below median observed hand hygiene opportunities (p<0.001). The median number of observed hand hygiene opportunities increased significantly with increasing availability of IPC staff, from <0.1 opportunities per 1 000 patient-days in hospitals without IPCN nor IPCD to 4.2 in hospitals with both an IPCN and an IPCD in place (p=0.002).

**Figure 104. Percentage of hospitals with a number of observed hand hygiene opportunities above the median, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, Latvia, the Netherlands, Norway and Sweden did not provide data.*

# Core component 7: workload, staffing and bed occupancy

The indicators evaluating staffing levels (number of registered nurses and nursing assistants employed by the hospital at hospital level and separately for intensive care units) were collected in the ECDC 2016–2017 but were removed from the protocol of the ECDC PPS 2022–2023. Indicators of bed occupancy were maintained.

## Bed occupancy at midnight

The bed occupancy measured at midnight on the day of the PPS was reported by 1 063 hospitals from 25 EU/EEA countries. The median bed occupancy at midnight was 73.3% [IQR 60.0–85.5] and ranged from less than 50% in Kosovo, Montenegro and Serbia and less than 60% in Greece, Malta and Romania, to 90% or more in Finland, Spain and Sweden (Figure 105).

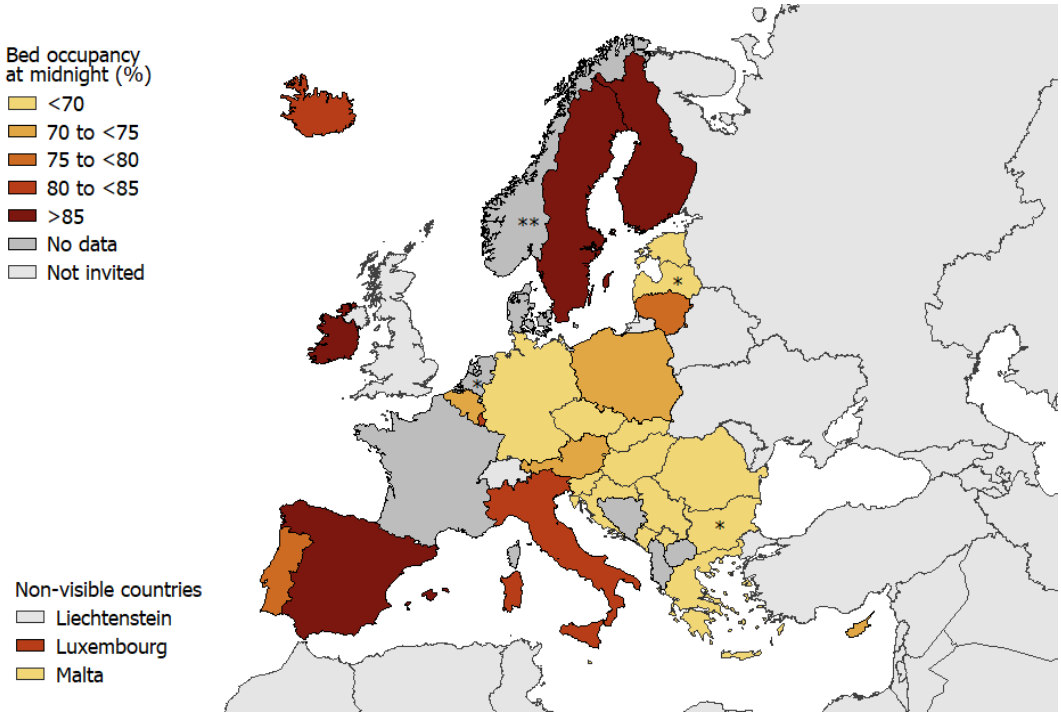
In the univariate analysis at country level, the bed occupancy at midnight was positively correlated with the prevalence of HAIs (Spearman's rho 0.48, p=0.01) and negatively correlated with the composite index of AMR (Spearman's rho -0.51, p=0.008), but these associations did not remain significant in a multivariable analysis.

## Bed occupancy in previous year

The bed occupancy for the previous year calculated from hospital denominator data (number of patient-days × 100/number of beds × 365) was available for 1 152 hospitals from 26 EU/EEA countries.

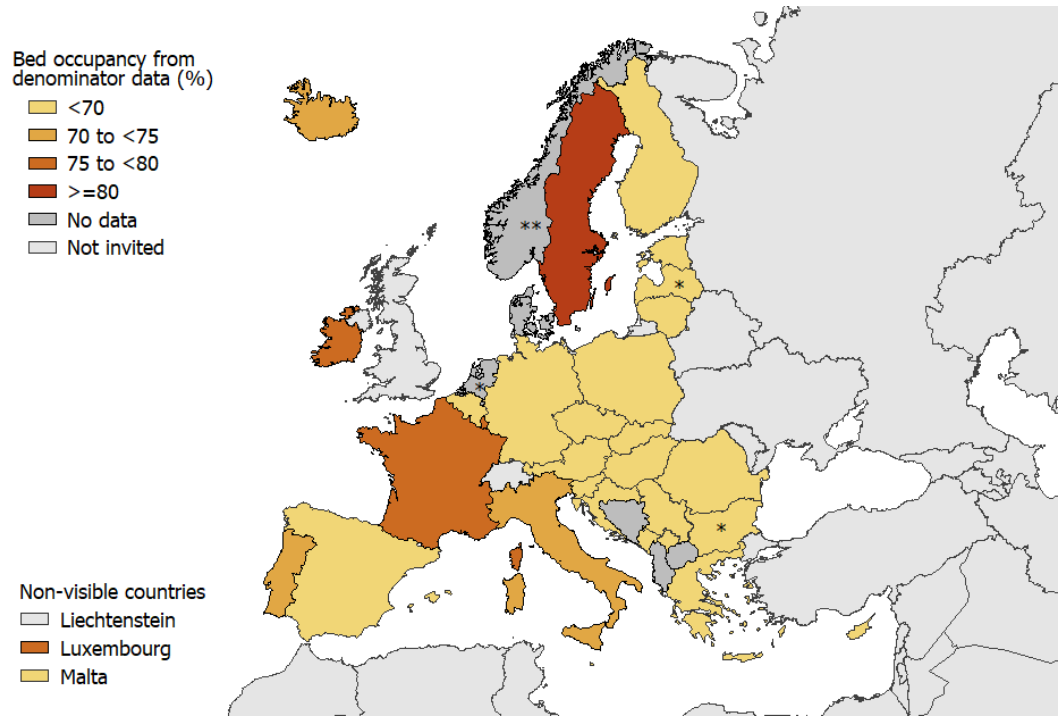
The median bed occupancy in the previous year was 62.6% [IQR 50.8–74.2], considerably lower than the median bed occupancy in the ECDC PPS 2016–2017 (72.9%). The median bed occupancy ranged from less than 50% in six countries (Hungary, Malta, Romania, Kosovo, Montenegro and Serbia) to 92.9% in Sweden (Figure 106). The two metrics of bed occupancy were correlated both at the hospital level (Spearman's rho 0.59, p<0.001) and for the medians at the hospital level (Spearman's rho 0.91, p<0.001) (Figure 107).

**Figure 105. Median percentage of occupied beds, measured at midnight, ECDC PPS 2022–2023**



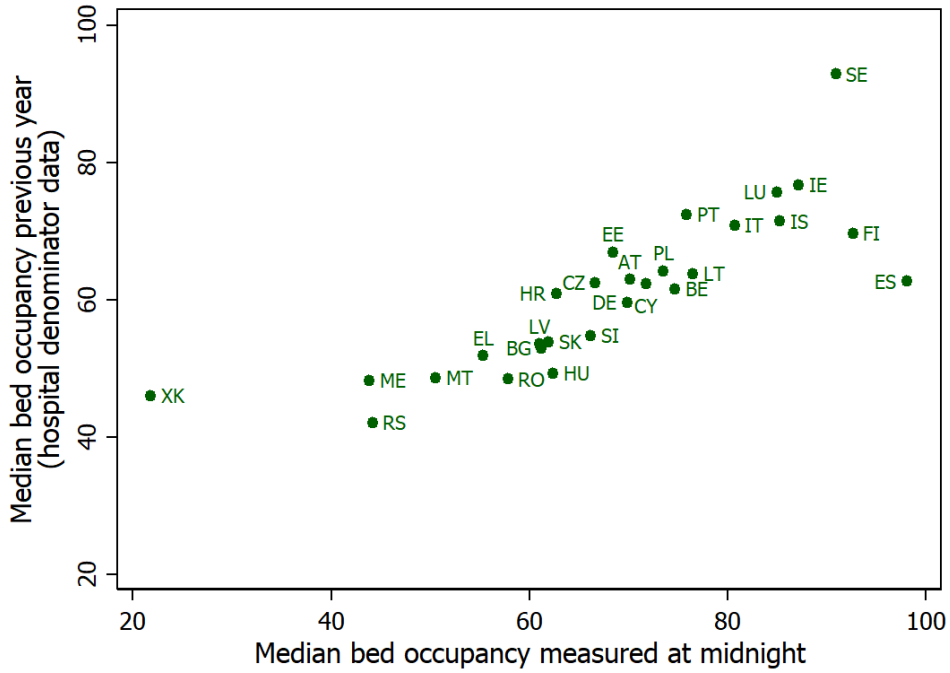

**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, the Netherlands, Norway and Sweden did not provide data.*

**Figure 106. Median bed occupancy in the previous year (from hospital denominator data), ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The Netherlands and Norway did not provide data.*

**Figure 107. Correlation between bed occupancy in the previous year with the bed occupancy measured at midnight, ECDC PPS 2022–2023**




*Spearman's rho 0.91, p<0.001. France, the Netherlands, Norway and Sweden did not provide data.*

# Core component 8: built environment, materials and equipment for IPC at the facility level

## Alcohol-based handrub dispensers at point-of-care

The number of beds with an alcohol-based handrub (AHR) dispenser at the point-of-care was reported by 24 EU/EEA countries, either at the hospital level by 685 hospitals, or at the ward level by 771, or at the hospital or ward level (together with denominator data (number of beds assessed for the presence of a AHR dispenser) by 1 023 hospitals.

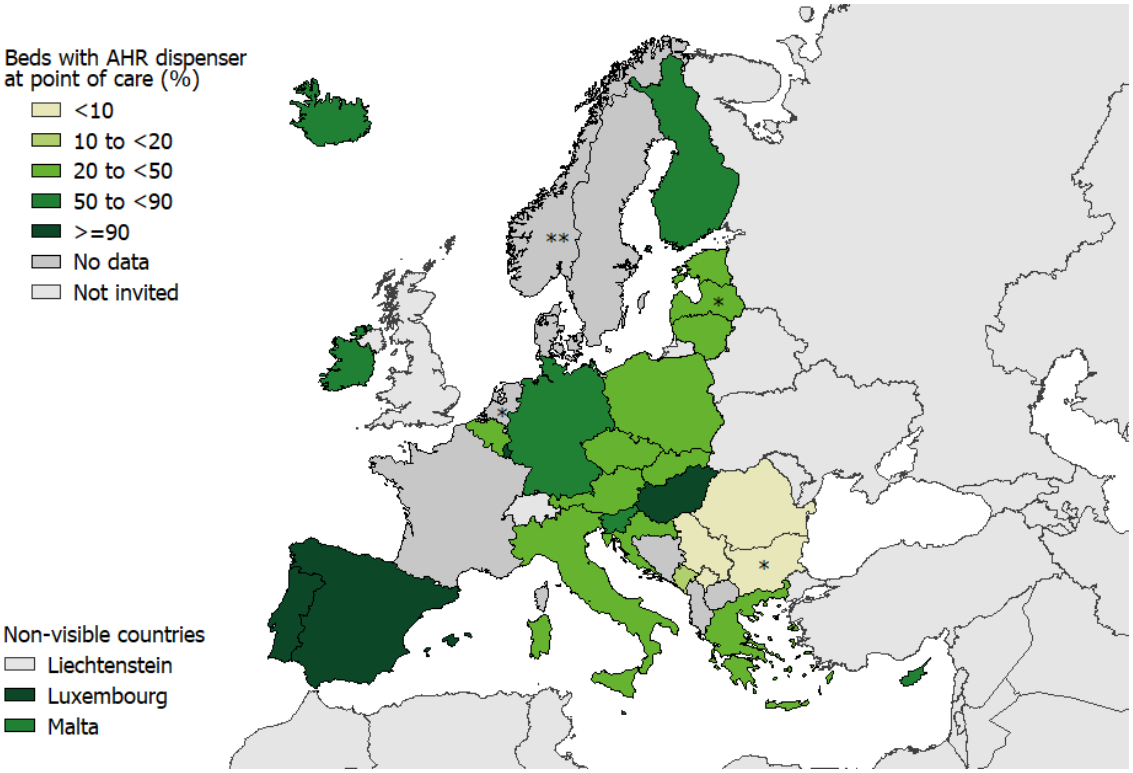
The median percentage of beds with an AHR dispenser at the point-of-care increased from 52.8% in the ECDC PPS 2016–2017 to 63.0% [IQR 18.0–100] in the ECDC PPS 2022–2023. The percentage varied from less than 10% in Bulgaria, Romania, Kosovo and Serbia to more than 90% in Hungary, Luxembourg, Portugal and Spain (Figure 108). The median percentage did not significantly vary by type of hospital (Table 38).

**Table 38. Distribution of the percentage of beds with an AHR dispenser at the point-of-care by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | Percentage of beds with an AHR dispenser at the point of care | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | P10 | P25 | P50 | P75 | P90 |
| Primary | 280 | 57.4 | 0.0 | 16.7 | 58.5 | 100.0 | 100.0 |
| Secondary | 364 | 56.2 | 2.5 | 16.9 | 62.0 | 93.9 | 100.0 |
| Tertiary | 252 | 59.6 | 5.0 | 18.7 | 67.5 | 100.0 | 100.0 |
| Specialised | 123 | 60.0 | 0.0 | 17.4 | 65.9 | 100.0 | 100.0 |
| Unknown | 4 | 68.5 | 23.5 | 46.5 | 75.2 | 90.4 | 100.0 |
| **Total** | 1 023 | 57.9 | 2.1 | 18.0 | 63.0 | 100.0 | 100.0 |

*P: percentile.*

**Figure 108. Median percentage of beds with an AHR dispenser at the point of care, ECDC PPS 2022–2023**

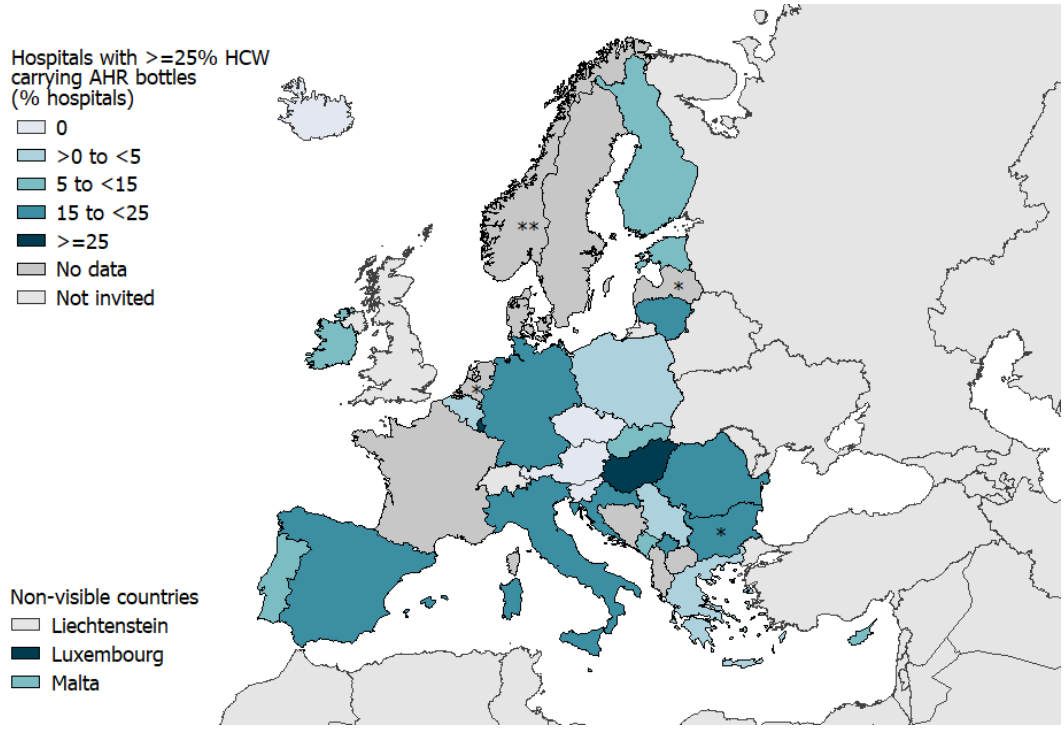



**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, the Netherlands, Norway and Sweden did not provide data. AHR=alcohol-based handrub.*

## Healthcare workers with a personal AHR bottle

To allow better interpretation of the availibility of AHR dispensers at the point-of-care, information on the percentage of HCWs with a personal AHR bottle was also collected. This variable was reported by 24 EU/EEA countries, either at the hospital level (in five categories) by 716 hospitals, or at the ward level by 679 hospitals, or at hopsital or ward level (together with denominator data and excluding outliers) by 984 hospitals. Of those, 56.7% hospitals reported the percentage of HCWs with a personal AHR bottle to be zero, 30.1% hospitals between 0 and <25% of HCWs, 7.2% hospitals between 25% and <50%, 2.2% hospitals between 50% and <75%, and 3.8% hospitals reported ≥75% HCWs with a personal AHR bottle. The percentage of hospitals where ≥25% HCWs had a personal AHR bottle varied between 0% in four countries to 25% or more in Hungary and Luxembourg (Figure 109).

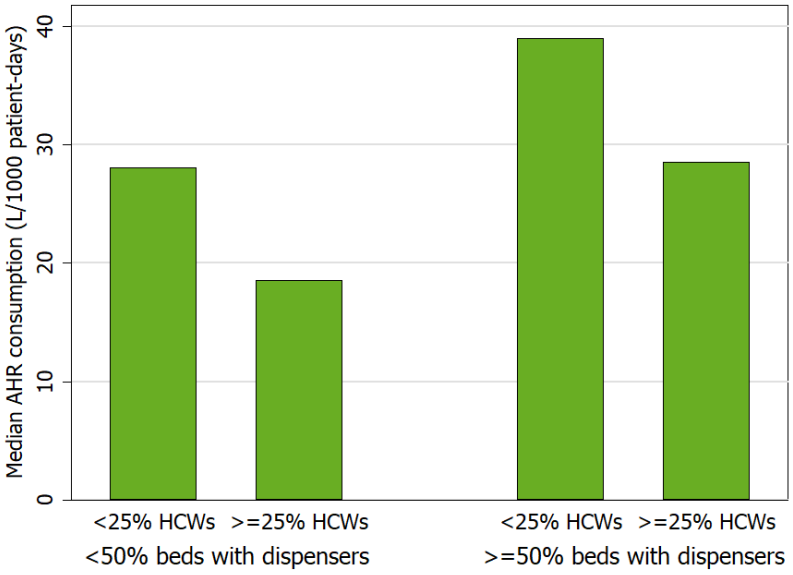
**Figure 109. Percentage of hospitals where ≥25% of healthcare workers had a personal alcohol-based handrub bottle, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, the Netherlands, Norway and Sweden did not provide data. AHR=alcohol-based handrub.*

At the hospital level, alcohol-based handrub consumption (in L/1 000 patient-days – see core component 6) was the highest in hospitals with a high availability of AHR dispensers at the point-of-care and a low percentage of HCWs with a personal AHR bottle (Figure 110).

**Figure 110. Median AHR consumption by levels of availability of AHR dispensers at point-of-care and percentage of HCWs with a personal AHR bottle, ECDC PPS 2022–2023**

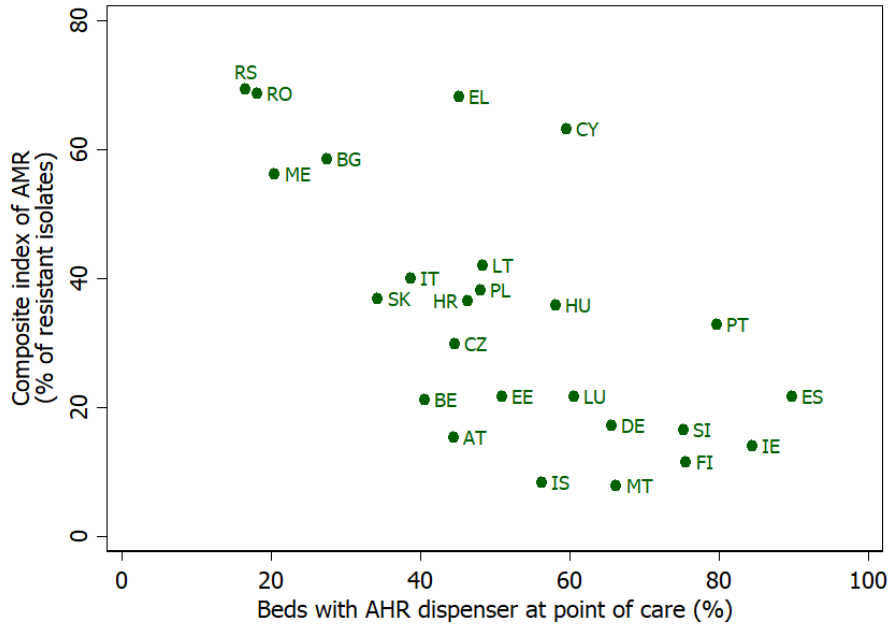



*<25% HCWs, ≥25% HCWs: percentage of healthcare workers having an AHR bottle; <50%, ≥50% beds with dispensers: percentage of beds with an AHR dispenser at the point of care (within arm's reach). AHR=alcohol-based handrub.*

In the univariate analysis at country level, the percentage of beds with an AHR dispenser at the point-of-care was negatively associated with the composite index of AMR (Spearman's rho -0.55, p=0.004, Figure 111), whereas the percentage of hospitals where more than 25% of HCWs had a personal AHR bottle was not associated with the composite index of AMR (p=0.24).

Similar to the AHR consumption and the nurse staffing levels, the percentage of beds with an AHR dispenser at the point-of-care was positively correlated with the number of blood cultures per 1 000 patient-days (Spearman's rho 0.74, p<0.001) and with HAI prevalence (Spearman's rho 0.59, p<0.01), but the association with HAI prevalence did not remain significant after adjustment for the number of blood cultures per 1 000 patient-days.

**Figure 111. Correlation between the percentage of beds with an AHR dispenser at the point-of-care and the composite index of AMR, ECDC-PPS 2022–2023**




*Spearman's rho -0.55 p=0.004. France, the Netherlands, Norway and Sweden did not provide data on AHR dispensers at the point of care. Kosovo and Latvia are not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results).*

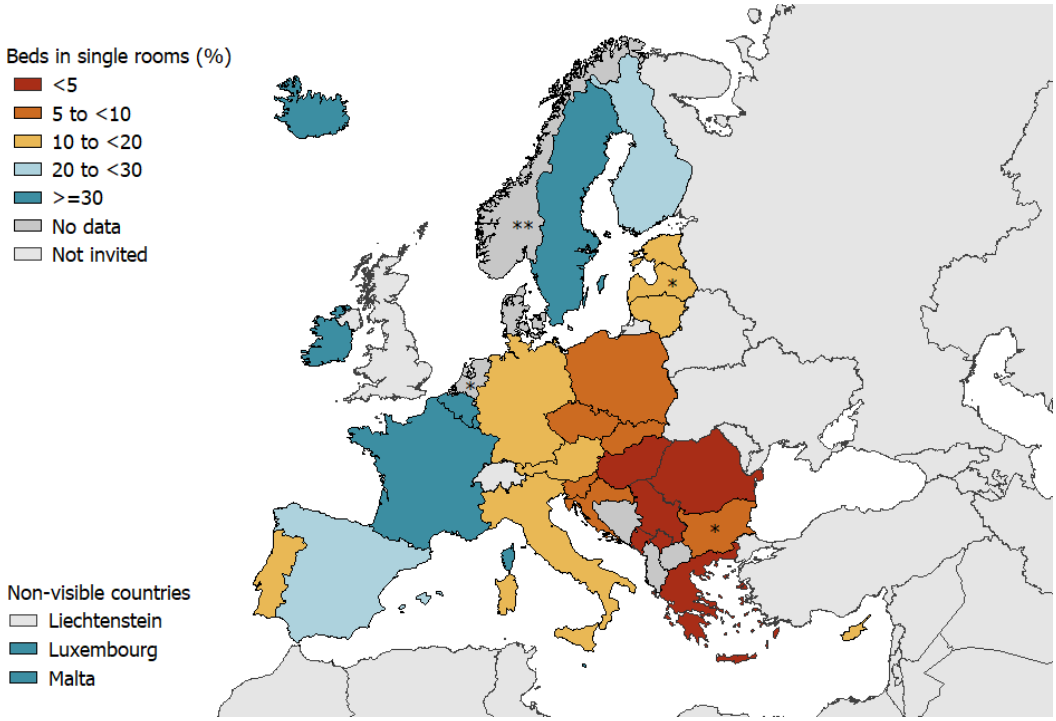
## *Single rooms and beds in single rooms*

The number of single rooms (i.e. rooms with only one bed), was available for 26 EU/EEA countries and was provided at the hospital level by 739 hospitals, at the ward level by 837 hospitals, and at either level (together with denominator data and excluding outliers) by 1 119 hospitals. The EU/EEA country median percentage of single rooms (as a percentage of the total number of rooms) was 25.0% [IQR 16.0-46.2], and the EU/EEA country median percentage of beds in single rooms (as a percentage of the total number of beds) was 11.3% [IQR 6.4–31.4]. The median percentage of beds in single rooms was less than 5% in Greece, Hungary, Romania, Kosovo, Montenegro and Serbia, but more than 50% in France and Sweden (Figure 112, Figure 113). The overall hospital median was 24.3% [IQR 13.1–49.4] single rooms and 10.3% [IQR 5.0–26.1] beds in single rooms, with a median room capacityof 2.2 [IQR 1.6–2.8] beds per room.

In 23 countries where data were collected at ward level, the median percentage of beds in single rooms by ward specialty ranged from 5.3% in rehabilitation and long-term care wards to 14.0% in geriatric wards and 20.0% in intensive care units (Figure 114). The percentage of beds in single rooms did not vary significantly according to the type of hospital (Table 39).

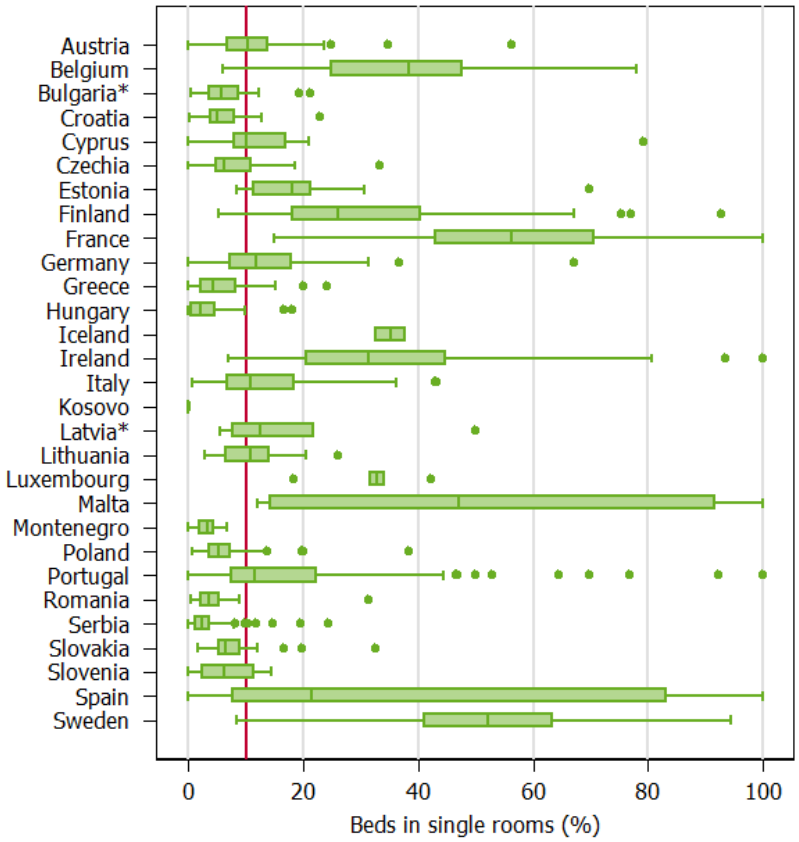
The mean percentage of beds in single rooms at the country level was associated with the composite index of AMR (Spearman's rho -0.72, p<0.001, Figure 115), the percentage of beds with AHR dispensers at the point-of-care (Spearman's rho 0.62, p<0.001), the number of blood cultures per 1 000 patient-days (Spearman's rho 0.69, p<0.001), the prevalence of HAIs (Spearman's rho 0.42, p=0.02), the median AHR consumption (Spearman's rho 0.39, p=0.04), the percentage of hospitals with any automation of HAI surveillance (Spearman's rho 0.65, p<0.001) and the multimodal strategy IPCAF score (Spearman's rho 0.49, p=0.01), but it was not associated with IPC staffing levels or participation in surveillance networks.

**Figure 112. Median percentage of beds in single rooms among the total number of hospital beds, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. The Netherlands and Norway did not provide data.*

**Figure 113. Distribution of the percentage of beds in single rooms by country, ECDC PPS 2022–2023**




**Country representativeness of the data was medium in Bulgaria and Latvia. The Netherlands and Norway did not provide data.*

**Table 39. Percentage of beds in single rooms among the total number of hospital beds by type of hospital, ECDC PPS 2022–2023**

| Type of hospital | No. of hospitals | Percentage of beds in single rooms | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean of means | P10 | P25 | P50 | P75 | P90 |
| Primary | 316 | 21.8 | 2.9 | 5.9 | 11.4 | 32.5 | 59.3 |
| Secondary | 407 | 20.9 | 2.0 | 4.5 | 10.2 | 25.2 | 58.1 |
| Tertiary | 268 | 20.3 | 2.9 | 5.5 | 10.1 | 21.9 | 57.2 |
| Specialised | 124 | 16.7 | 0.0 | 2.0 | 7.8 | 20.7 | 46.7 |
| Unknown | 4 | 25.7 | 5.2 | 7.1 | 9.2 | 44.3 | 79.3 |
| **Total** | **1 119** | **20.6** | **2.0** | **5.0** | **10.3** | **26.1** | **57.7** |

*P: percentile.*

**Figure 114. Distribution of the percentage of beds in single rooms by ward specialty, ECDC PPS 2022–2023**

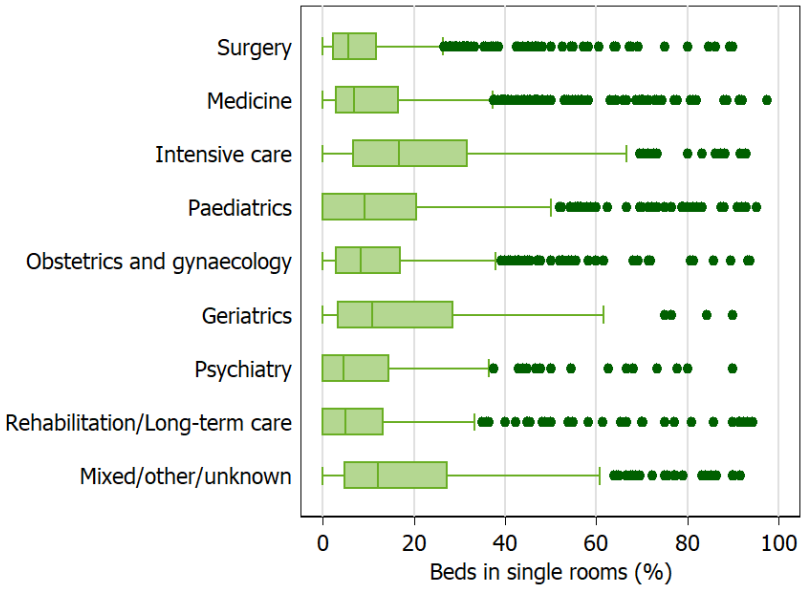
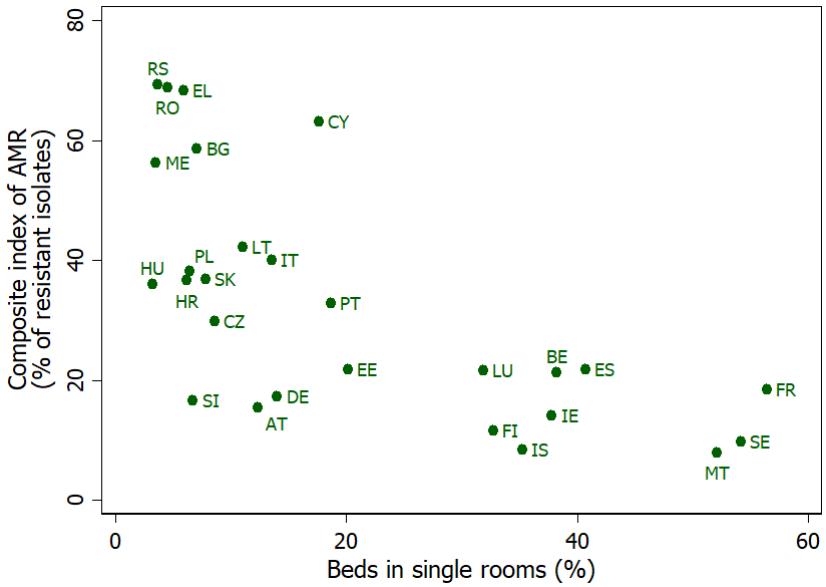



**Figure 115. Correlation between the percentage of beds in single rooms and the composite index of AMR, ECDC-PPS 2022–2023**



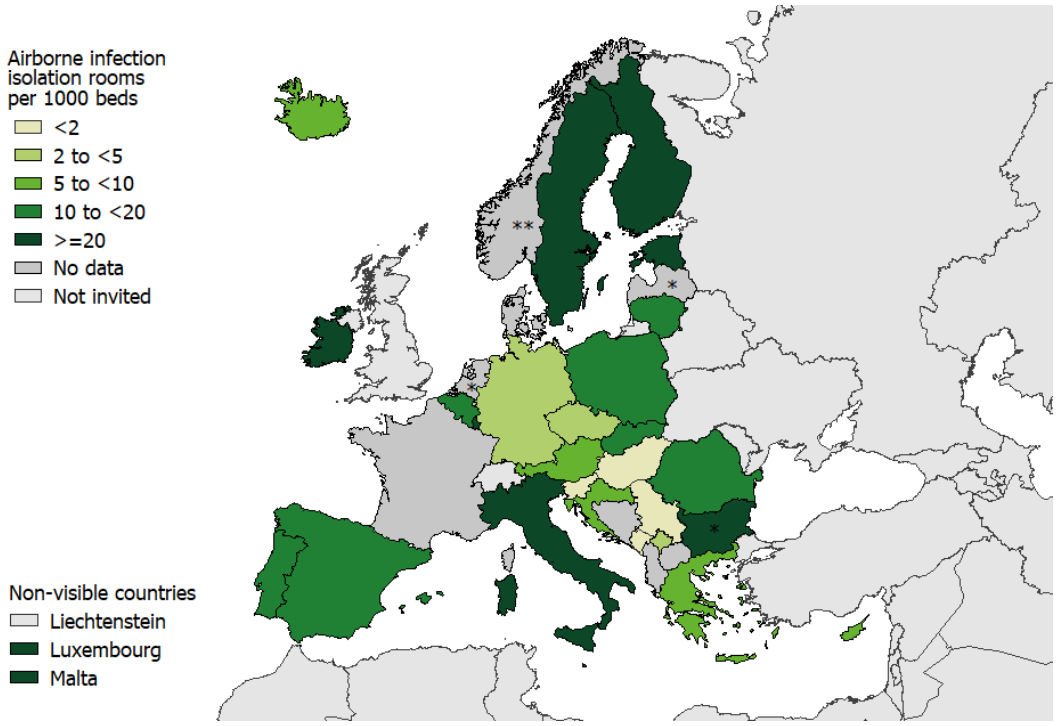

*Spearman's rho -0.72, p<0.001. Kosovo and Latvia are not included because the composite index of AMR could not be calculated for these countries (<10 isolates reported with AMR results). The Netherlands and Norway did not provide data on beds in single rooms.*

### *Number of airborne infection isolation rooms*

The number of airborne infection isolation rooms was reported by 1 052 hospitals from 24 EU/EEA countries, including hospitals reporting not having any isolation room. France, the Netherlands and Norway did not collect this information. Hospitals that did not reply in countries that collected the information were assumed to have no isolation rooms.

The EU/EEA country median number of isolation rooms was 16.0 airborne infection isolation rooms per 1 000 hospital beds. This number varied between less than one per 1 000 hospital beds in Hungary, Montenegro and Serbia to 30 per 1 000 hospital beds or more in Finland, Italy and Sweden (Figure 116).

**Figure 116. Number of airborne infection isolation rooms per 1 000 hospital beds, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, the Netherlands and Norway did not provide data on the number of airborne infection isolation rooms.*

The number of airborne infection isolation rooms per 1 000 hospital beds was associated with the percentage of beds in single rooms (Spearman's rho 0.74, $p<0.001$). However, it was not associated with neither the composite index of AMR, nor with the prevalence of patients with at least one HAI.

# COVID-19 indicators and vaccination of healthcare workers

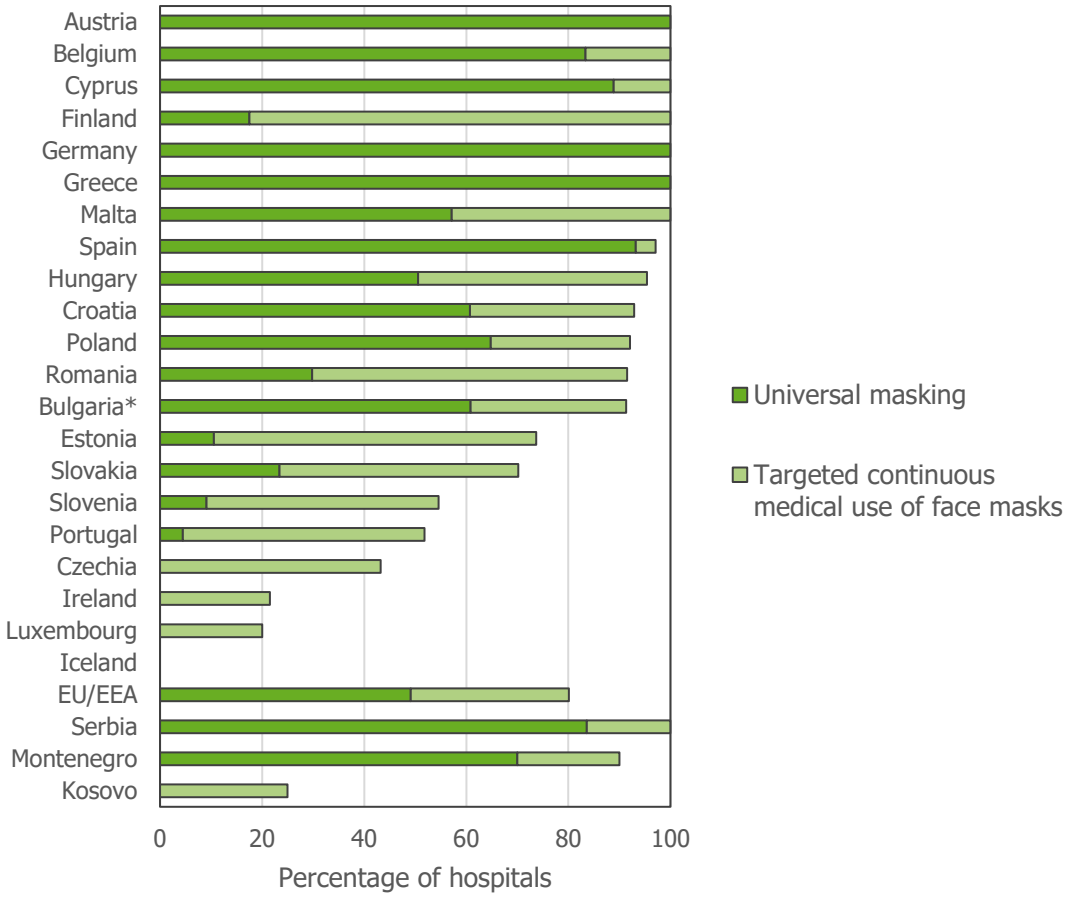
COVID-19 indicators included in the ECDC PPS 2022–2023 protocol were the presence of a policy of universal masking at the time of the PPS (i.e. the mandatory wearing of face masks or respirators inside the hospital, during activities other than care for COVID-19 patients) and variables to estimate the burden of COVID-19 in the hospital (number of current hospitalised COVID-19 cases and number of cases and outbreaks in the previous year). Several national PPS contact points mentioned difficulties with the reporting of the number of current cases, cases in the year preceding the survey and number of COVID-19 outbreaks. These data will therefore need an in-depth review and will be reported elsewhere. The vaccination coverage of healthcare workers was collected for COVID-19 and for influenza.

## Policy for universal masking for COVID-19 prevention

Data on the presence of a policy for universal masking in the hospital at the time of the PPS were reported by 920 hospitals from 21 EU/EEA countries. France, Italy, Latvia, Lithuania, the Netherlands, Norway and Sweden did not provide information on the vaccination status of healthcare workers.

One fifth (19.9%) of the hospitals reported no policy for universal masking, i.e. face masks were only required during COVID-19 care and in other circumstances where use of face masks is recommended. Thirty-one percent of the hospitals reported a policy of mandatory face mask use during routine care (all contact with non-COVID-19 patients) but not in other areas of the hospital (targeted continuous medical use), and 49.1% hospitals reported a policy of universal masking, i.e. a requirement for all persons (staff, patients, visitors, service providers and others) to wear a mask at all times, except for when eating or drinking. The percentage of hospitals reporting any policy of face mask use ranged from 0% in Iceland to 100% in seven EU/EEA countries and Serbia (Figure 117). This percentage was higher (98.1%) in countries that performed the PPS in 2021 (Austria) or 2022 (Belgium, Finland, Germany, Greece, Hungary, Kosovo and Serbia) than in the other countries, which all performed the PPS in 2023 (71.2%, p<0.001).

**Figure 117. Policy of universal masking in acute care hospitals (percentage of hospitals), ECDC PPS 2022–2023**



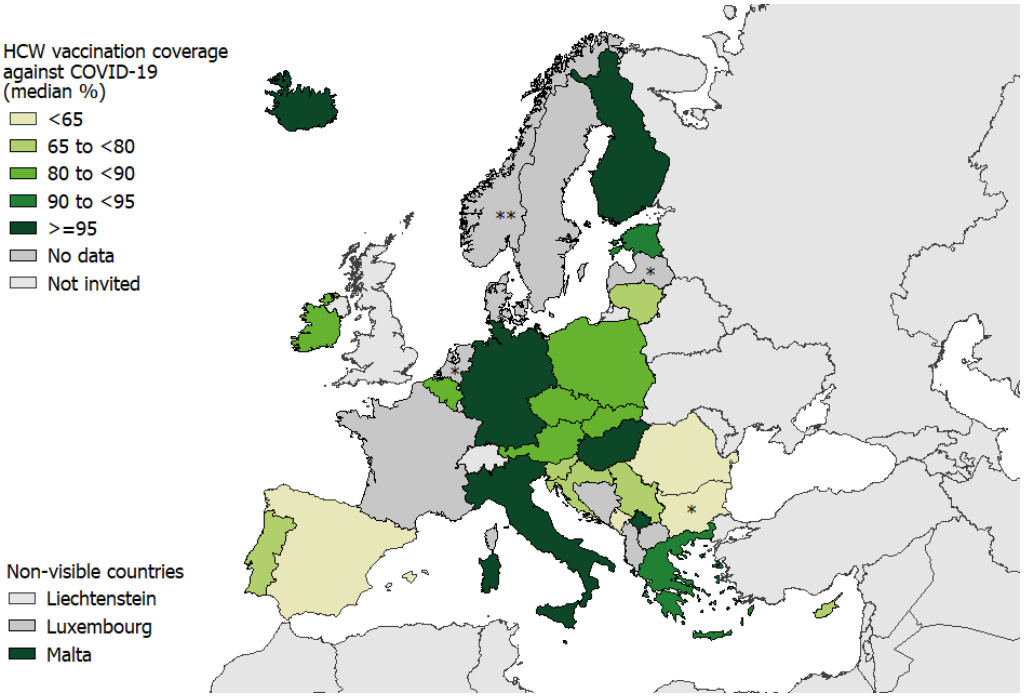

**Country representativeness of the sample was medium in Bulgaria. France, Italy, Latvia, Lithuania, the Netherlands, Norway and Sweden did not report data.*

## Vaccination coverage of healthcare workers against COVID-19 and influenza

Vaccination coverage of healthcare workers against COVID-19 and influenza was collected at the hospital level as a percentage. Data were provided by 853 EU/EEA hospitals for COVID-19 and 857 EU/EEA hospitals for influenza. France, Latvia, Luxembourg, the Netherlands, Norway and Sweden did not provide data on the vaccination status of healthcare workers. COVID-19 vaccination coverage was defined as the current percentage of healthcare workers fully vaccinated against COVID-19 according to the definition of full vaccination at the time of the PPS. Influenza vaccination coverage was defined as the percentage of healthcare workers vaccinated against influenza during the last influenza vaccination campaign, specifying the year of vaccination.

The median reported vaccination coverage of healthcare workers against COVID-19 in 853 EU/EEA hospitals was 85.0% [IQR 70.0–95.0] and varied between less than 65% in Bulgaria (64.0%), Romania (64.5%), Spain (57.0%) and Montenegro (56.1%) and 95% or more in seven countries with 100% in Malta and Kosovo (Figure 118).

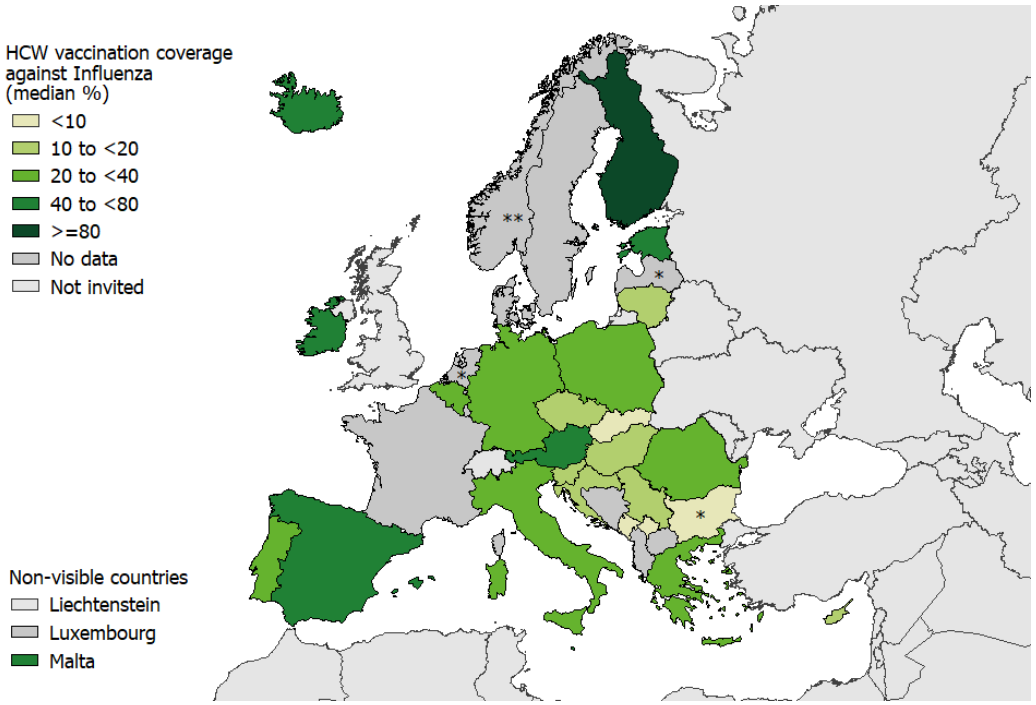
**Figure 118. Median reported vaccination coverage of hospital healthcare workers against COVID-19, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. HCW=healthcare worker. France, Latvia, the Netherlands and Norway did not provide data*

The reported vaccination coverage of healthcare workers against influenza in 857 EU/EEA hospitals was much lower with a median of 29.0% [IQR 14.0–50.0]. The reported year of vaccination against influenza was the year before the PPS for 89.4% hospitals, the same year as the PPS for 9.0% and two years before the PPS for 1.6%. The median vaccination coverage against influenza ranged from less than 5% in Bulgaria (4.5%), Slovakia (3.0%), Kosovo (0%) and Montenegro (3.0%) to 92.5% in Finland (Figure 119).

**Figure 119. Median reported vaccination coverage of hospital healthcare workers against influenza, ECDC PPS 2022–2023**




**Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. HCW=healthcare worker. France, Latvia, the Netherlands and Norway did not provide data.*

# Antimicrobial stewardship indicators

## Staffing levels of antimicrobial stewardship consultants

Data on FTEs for antimicrobial stewardship consultants were reported by 1 037 hospitals from 24 EU/EEA countries. Latvia, Lithuania, the Netherlands and Norway did not report data.

The median antimicrobial stewardship consultant FTE per 250 beds in hospitals in the EU/EEA was 0.18 [IQR 0–0.61], twice as high as the median of 0.08 reported in the ECDC PPS 2016–2017 and ranging from 0% in 13 countries to 0.94 in Ireland. The hospital mean was 0.48 antimicrobial stewardship consultant FTE per 250 beds, and this ranged from 0 in Iceland to 0.96 in Czechia (Table 39). The proportion of hospitals reporting some dedicated time for antimicrobial stewardship was 60.8%, varying from less than 20% in Iceland (0%) and Malta (14.3%) to 90% or more in France (91.1%), Italy (96.6%) and Romania (91.3%) (Figure 120)

## Post-prescription review of prescribed antimicrobial agents

The existence of a formal policy for post-prescription review was provided at the hospital level by 713 hospitals, at the ward level by 829 hospitals and at either level by 1 099 hospitals from 25 EU/EEA countries. France, the Netherlands and Norway did not report data.

The percentage of hospitals in EU/EEA participating countries that had implemented a formal policy for post-prescription review in at least one ward was 56.8%, only slightly higher than the 52.5% hospitals in the ECDC PPS 2016–2017. This percentage ranged from 0% in Latvia to 87.8% in Lithuania (Table 39, Figure 121).

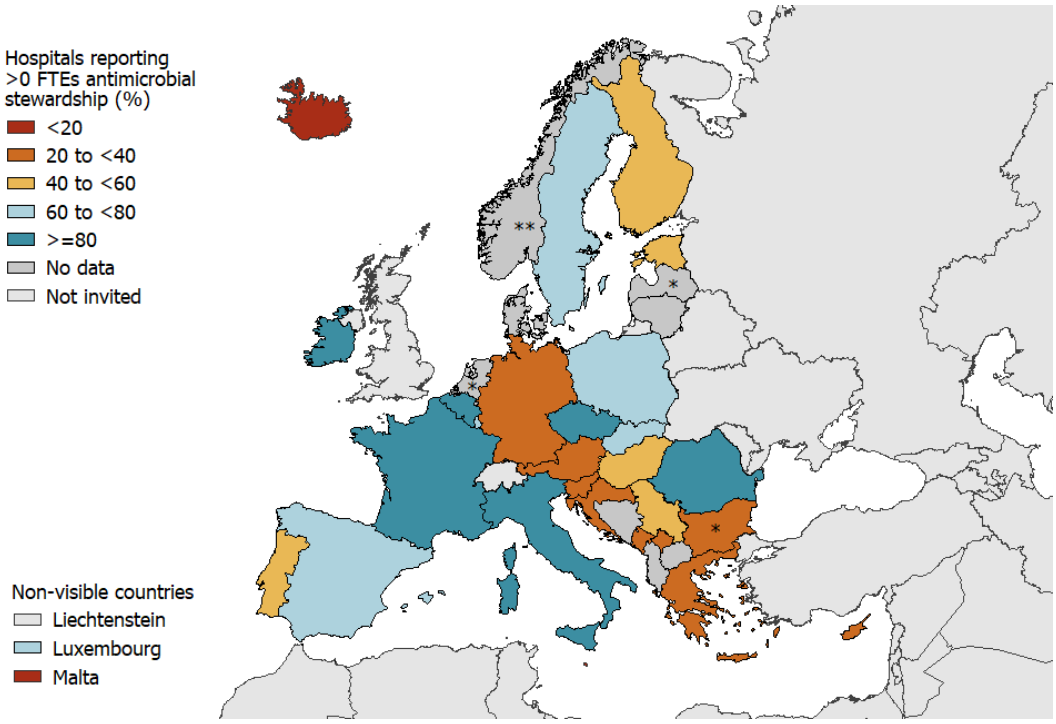
The percentage of hospitals participating in a national or regional hospital antimicrobial consumption surveillance network was 41.9%, and ranged from 0% in Hungary and Iceland to 100% in Belgium (Table 39, Figure 98).

**Table 39. Structure and process indicators of antimicrobial stewardship, by country, ECDC PPS 2022–2023**

| Country | No. of hospitals | Antimicrobial stewardship consultant in the hospital | | | Formal procedure for post-prescription review in the hospital[1] | | Participation in a national or regional hospital antimicrobial consumption surveillance network | |
|---|---|---|---|---|---|---|---|---|
| | | No. of hospitals providing a reply | Mean FTEs per 250 beds | Median FTEs per 250 beds | No. of hospitals providing a reply | % with procedure | No. of hospitals providing a reply | % with participation |
| Austria | 41 | 39 | 0.18 | 0.00 | 39 | 46.2 | 39 | 28.2 |
| Belgium | 49 | 48 | 0.64 | 0.32 | 48 | 31.3 | 49 | 100.0 |
| Bulgaria | 23 | 22 | 0.42 | 0.00 | 23 | 78.3 | 22 | 13.6 |
| Croatia | 31 | 28 | 0.19 | 0.00 | 30 | 20.0 | 29 | 51.7 |
| Cyprus | 10 | 9 | 0.38 | 0.00 | 10 | 40.0 | 6 | 33.3 |
| Czechia | 39 | 39 | 0.96 | 0.87 | 39 | 76.9 | 37 | 16.2 |
| Estonia | 20 | 19 | 0.18 | 0.00 | 19 | 52.6 | 18 | 11.1 |
| Finland | 40 | 38 | 0.42 | 0.00 | 39 | 66.7 | 40 | 37.5 |
| France | 61 | 56 | 0.71 | 0.33 | 0 | - | 0 | - |
| Germany | 50 | 50 | 0.17 | 0.00 | 50 | 50.0 | 50 | 62.0 |
| Greece | 49 | 40 | 0.95 | 0.00 | 48 | 41.7 | 41 | 46.3 |
| Hungary | 87 | 82 | 0.24 | 0.00 | 87 | 37.9 | 87 | 0.0 |
| Iceland | 2 | 2 | 0.00 | 0.00 | 2 | 50.0 | 1 | 0.0 |
| Ireland | 65 | 63 | 0.88 | 0.94 | 65 | 53.8 | 65 | 67.7 |
| Italy | 58 | 29 | 0.84 | 0.47 | 53 | 37.7 | 58 | 48.3 |
| Latvia | 7 | 0 | - | - | 7 | 0.0 | 0 | - |
| Lithuania | 41 | 0 | - | - | 41 | 87.8 | 41 | 87.8 |
| Luxembourg | 5 | 5 | 0.13 | 0.11 | 5 | 40.0 | 4 | 50.0 |
| Malta | 7 | 7 | 0.01 | 0.00 | 7 | 28.6 | 7 | 14.3 |
| Poland | 93 | 93 | 0.20 | 0.12 | 91 | 56.0 | 68 | 7.4 |
| Portugal | 120 | 116 | 0.33 | 0.00 | 117 | 54.7 | 111 | 47.7 |
| Romania | 53 | 46 | 0.39 | 0.33 | 52 | 67.3 | 45 | 22.2 |
| Slovakia | 47 | 45 | 0.67 | 0.58 | 46 | 69.6 | 46 | 21.7 |
| Slovenia | 22 | 21 | 0.15 | 0.00 | 22 | 36.4 | 22 | 95.5 |
| Spain | 105 | 87 | 0.94 | 0.47 | 105 | 70.5 | 105 | 49.5 |
| Sweden | 54 | 53 | 0.25 | 0.16 | 54 | 74.1 | 0 | - |
| **EU/EEA** | **1 179** | **1 037** | **0.48** | **0.18** | **1 099** | **56.8** | **991** | **41.9** |
| Kosovo | 5 | 5 | 0.59 | 0.00 | 5 | 80.0 | 5 | 0.0 |
| Montenegro | 10 | 9 | 0.31 | 0.00 | 10 | 50.0 | 10 | 30.0 |
| Serbia | 67 | 67 | 0.47 | 0.00 | 67 | 47.8 | 67 | 14.9 |

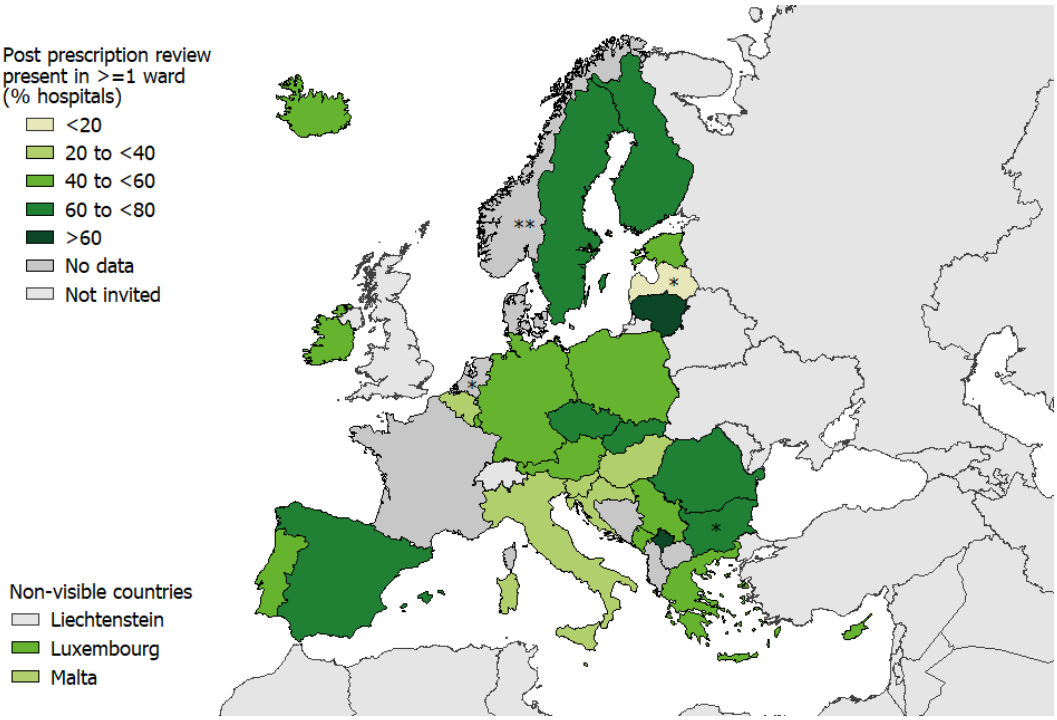
*(1)Review of the appropriateness of prescribed antimicrobials within 72 hours (three calendar days) from the initial order, in at least one of the hospital wards. *Country representativeness of the sample was medium in Bulgaria. The Netherlands and Norway did not provide data.*

**Figure 120. Percentage of hospitals reporting dedicated time (> zero FTE) for antimicrobial stewardship, ECDC PPS 2022–2023**




*Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. Latvia, the Netherlands and Norway did not provide data.*

**Figure 121. Percentage of hospitals with a post-prescription review policy in place in at least one ward, ECDC PPS 2022–2023**




*Country representativeness of the sample was medium in Bulgaria, Latvia and the Netherlands. **Norway used a national PPS protocol. France, the Netherlands and Norway did not provide data.*

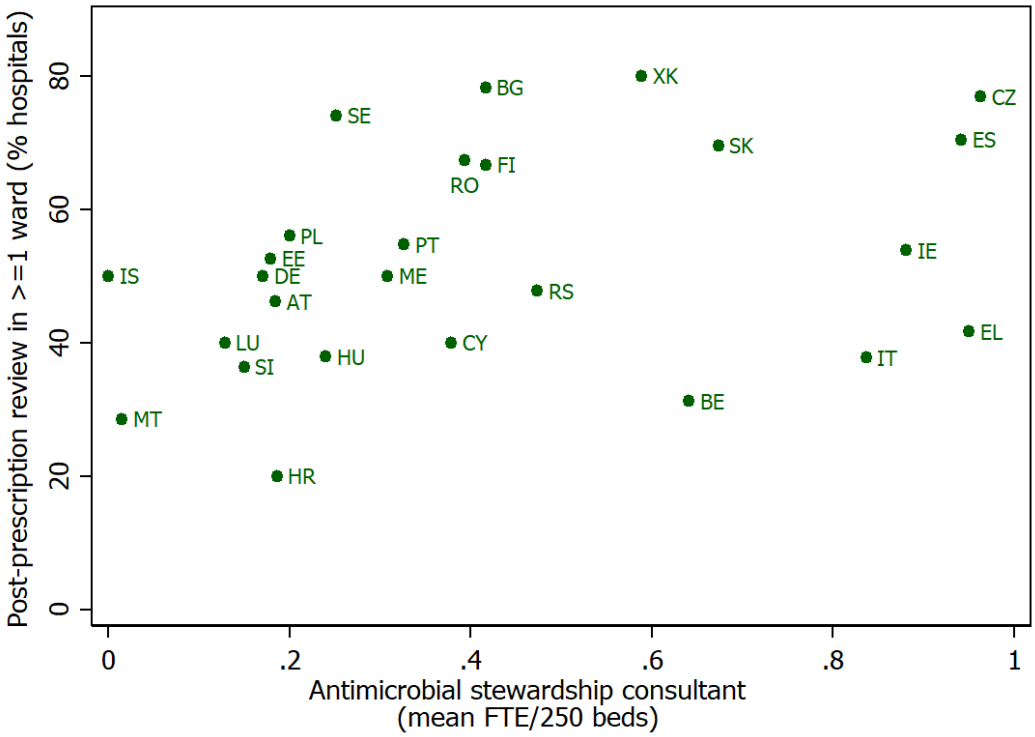
At the hospital level, having dedicated time for antimicrobial stewardship (>0 FTE) was associated with:

- a higher median percentage of antimicrobials changed during treatment (17.9 vs. 13.6%, p<0.001);
- a lower median percentage of antimicrobials administered parenterally (79.6 vs. 83.5%, p=0.003);
- higher presence of a policy for post-prescription review in at least one ward (66.9 vs. 41.6%, p<0.001);
- higher participation in an antimicrobial consumption surveillance network (46.9 vs. 30.7%, p<0.001).

It was not associated with the median percentage of broad-spectrum antimicrobials, the median percentage of prolonged surgical prophylaxis, or with the composite index of AMR at hospital level.

At the country level, none of the antimicrobial stewardship indicators measured at the hospital or ward level were significantly associated with indicators measured at the antimicrobial use level or with the composite index of AMR. However, the mean antimicrobial stewardship FTE per 250 beds was associated with the percentage of hospitals with presence of post-prescription review in at least one ward (Spearman's rho 0.40, p=0.05, Figure 122).

**Figure 122. Correlation between the percentage of hospitals reporting dedicated time for antimicrobial stewardship (> zero FTE) and the percentage of hospitals with presence of post-prescription review in at least one ward, ECDC PPS 2022–2023**



# Discussion

The ECDC PPS 2022–2023 provides an update on hospital-wide data on HAIs and antimicrobial use in acute care hospitals in EU/EEA countries, with a representative sample acquired in the majority of countries. The final ECDC PPS database included data reported from 1 250 acute care hospitals in the EU/EEA (15% of all acute care hospitals in these countries) and included records from 293 581 patients (approximately 25% of beds in acute care hospitals). Sixteen countries performed validation studies that helped to acquire more robust estimates on international HAI prevalence. Despite limitations and inherent difficulties arising from the magnitude of the survey and the need for adherence to uniform definitions, methodology and requirements, the 2022–2023 ECDC PPS has:

- provided a robust estimate of the overall burden of HAIs and use of antimicrobials in acute care hospitals in the EU/EEA;
- described HAIs and antimicrobial use by type of hospital, patient and by country;
- described key structures and processes for the prevention of HAIs and antimicrobial resistance at the hospital and ward level;
- increased surveillance skills through the training of healthcare workers across the EU/EEA;
- provided targets for quality improvement through rapid dissemination of results by hospital and country.

These objectives were achieved through the ECDC PPS protocol developed together with experts from all Member States and supporting tools such as free hospital software, hospital reports comparing local results to the national data, standardised training materials and a protocol as well as financial support for PPS data validation at national level.

## Healthcare-associated infections

The prevalence of patients with at least one HAI in acute care hospitals in the EU/EEA was 7.1% in the PPS sample and 8.0% (95% CI: 6.6–9.7%) after weighting by country and correcting for the results of the validation study. The country median of the EU/EEA country prevalence percentages (without correction) was 6.8%. The HAI prevalence point estimate in the PPS sample was higher than the 5.9% found in the previous ECDC PPS point prevalence survey in 2016–2017 [11]. This finding can be attributed to two factors: The first one is methodological, as in the PPS 2022–2023, infections with their origin in LTCFs were included for the first time. These HAIs accounted for approximately 6% of all reported HAIs. The second reason is related to the emergence of healthcare-associated COVID-19 (HA-COVID-19), which accounted for 7% of all HAIs. After excluding infections originating in LTCFs and COVID-19, the country median of the EU/EEA country prevalence percentages was 6.2%. This was not much higher than the country median HAI prevalence of 5.8% in the ECDC PPS 2016–2017.

The results of the validation study, as well as the risk adjustment model show that the national interpretation of the methods and definitions still affects the observed HAI prevalence significantly. In addition, similar to the PPS 2016–2017, the results of the PPS 2022–2023 suggested that the high variability of diagnostic testing resulted in under-ascertainment of HAI cases and lower HAI prevalence results in countries performing diagnostic testing less frequently, irrespective of the patient case-mix severity. Direct comparison of HAI prevalence figures between countries should be avoided for several reasons that were addressed in the results section and are further discussed below (see limitations). At least confidence intervals or predicted values based on patient case mix (preferably both), as well as the results of the validation studies (in particular the specificity) and the frequency of blood culture testing should be taken into account when interpreting the observed prevalence. Because of the risk of misinterpretation of the HAI prevalence by country presented as a single indicator, ECDC did not publish a map of the observed HAI prevalence and advises against doing so, even though the results by country are given in the report.

The total annual number of patients with at least one HAI in acute care hospitals in the EU/EEA after validation was estimated at 4.3 million patients per year, with a wide 95% confidence interval of 3.1 to 5.8 million patients per year. The point estimate before validation was 2.9 million and was similar to the estimate of 3.3 million patients per year with a HAI in the EU/EEA following the 2016–2017 PPS, and the confidence intervals of these estimates largely overlap.

The most common types of HAI in the ECDC PPS sample were respiratory tract infections (29.3% of the total, including pneumonia 19.0%, COVID-19 7.0% and other lower respiratory tract infections 3.3%), urinary tract infections (19.2%), surgical site infections (16.1%), and bloodstream infections (11.9%). With the exception of COVID-19, which was an emerging microorganism in the PPS 2023–2023, the distribution of the most frequent types of HAIs was similar to the distribution observed in the PPS 2016–2017. There was a further increase of *Clostridioides difficile* infections which represented 5.9% of HAIs in the ECDC PPS 2022–2023 compared to respectively 4.8% in the ECDC PPS 2016–2017.

Vasopressor treatment, which was as an indicator of septic shock, was used in 8.8% of HAIs. This is an important indicator of the severity of HAIs and was more frequently reported in pneumonia and other lower respiratory tract infections, catheter-related infections, and bloodstream infections.

The percentage of HAIs with microbiological results (60.8%) was higher than the results of the 2016–2017 PPS (52.7%), possibly reflecting improved diagnostics compared to the ECDC PPS 2016–2017 when this percentage was 52.7%. Overall however, the percentage in the ECDC PPS probably still underestimated the true percentage of HAIs that were microbiologically documented. A reason for this is that, as in the previous ECDC PPSs, PPS surveyors were not supposed to revisit files of patients with a HAI after the day of the PPS to collect microbiological data.

The five microorganisms most frequently isolated from HAIs in the ECDC PPS – *E. coli* (12.7%), *Klebsiella* spp. (11.7%), *Enterococcus* spp. (10.0%), SARS-CoV-2 (9.5%), *S. aureus* (9.0%),– show considerable changes from the PPS 2022–2023 in which *Klebsiella* spp. was third, *Enterococcus* spp. was fourth and *S. aureus* was second. Part of the increase of *Klebsiella* spp. was due to the recent taxonomical change of *Enterobacter aerogenes* to *Klebsiella aerogenes.*

Antimicrobial resistance data for microorganisms isolated from HAIs were only collected for selected bug–drug combinations. Because of the cross-sectional (single day) study design, some antimicrobial susceptibility data were were not yet available on the day of the survey, and results should be interpreted with caution. Antimicrobial susceptibility testing data were available for 90.4% of the microorganisms included in the composite index of AMR. The index was 32.0% overall, similar to the PPS 2016-2017 (31.6%) and varied from 7.9% in Malta to 68.7% in Romania. However, the percentage of carbapenem-resistant Enterobacterales among all Enterobacterales, increased from 6.2% in the ECDC PPS 2016–2017 to 9.3% in the ECDC PPS 2022–2023 but this was influenced by the data of relatively few countries that reported high numbers of these microorganisms.

Healthcare-associated COVID-19 was an emerging infection in this PPS, with SARS-COV-2 being the fourth most common microorganism among HAIs with a microbiologically documented pathogen. HA-COVID-19 accounted for 7% of all HAIs. This made HA-COVID-19 one of the main factors contributing to the increased prevalence of HAIs in this PPS. The majority of HA-COVID-19 were probably or definitely healthcare-associated, and of mild-to-moderate severity, but more than one in six infections were severe.

These are the first EU/EEA wide data on the prevalence of HA-COVID-19 and reflect a large burden of a potentially fatal but ultimately preventable infection. The prevalence of HA-COVID-19 varied considerably across participating countries, most likely related to the prevalence of COVID-19 in the community during the time the PPS was performed in each country. HA-COVID-19 is also a reminder of the high impact of respiratory virus transmission in healthcare facilities, reported to be detected in more than 1 in 4 non-ventilator-associated hospital acquired pneumonias [38]. They are also reported to be related with a similar mortality rate to bacterial pneumonias but are often neglected, as cases of HA-pneumonia have not been frequently tested for viruses. Influenza, another common respiratory virus, was not commonly detected in the PPS, but this can be explained by the fact that the PPS is performed out of the epidemic season for influenza. Another important factor is that the ECDC PPS protocol included a specific case definition for HA-COVID-19 but not for other viral diseases. However, one should note that while the median vaccination coverage of healthcare workers for COVID-19 was 89%, the median vaccination coverage of healthcare workers against influenza was 29%, indicating the need for promoting vaccination against influenza among this group.

To obtain a single summary predicted value and risk score by hospital and country, the risk model for HAIs presented in this report included all types of HAI. Whilst we could also have performed a risk analysis for each type of HAI separately, presenting results of multiple sub-models by type of HAI is beyond the scope of this report. The methodology for the standardisation was based on multiple logistic regression as in the ECDC PPS 2011–2012 and as frequently used for mortality and for other diseases, including HAIs [3, 40-46].

# Antimicrobial use

The prevalence of antimicrobial use (35.5%) was higher than the prevalence found in the previous ECDC PPS (32.9%) [3]. Because of lower antimicrobial use prevalence in Germany and France, the prevalence extrapolated to the average daily number of occupied beds per country was lower at 32.4%, with a 95% confidence interval (29.7–35.1) including the 2016–2017 point estimate of the country-weighted prevalence of 30.5%. For example, the prevalence of antimicrobial use among ICU patients in 2022–2023 was 59.5%, higher than the 55.6% in 2016–2017.

Patient case mix contributed in large part to the variation of antimicrobial use prevalence per country and explained 69.6% of the variation between countries. Varying proportions of patient groups with a lower or higher prevalence of antimicrobial use in a given country may result in a lower or higher predicted prevalence of antimicrobial use based on patient case mix. The countries with the lowest and the highest standardised antimicrobial use ratio were Norway and Greece, respectively.

The most frequently used antimicrobials in the ECDC PPS 2022–2023 were in line with the ECDC PPS 2016–2017, with the various beta-lactams (penicillins, cephalosporins and carbapenems) accounting for more than half of all antimicrobials used. The prevalence of use of third-generation cephalosporins (15%) was higher than in the ECDC PPS 2016–2017 (10%), while the prevalence of use of quinolones (7%) was lower than in the ECDC PPS 2016–2017 (10%). The pattern of antimicrobial use differed greatly between treatment of hospital infection versus treatment of community infection and was consistent with the type of infections and microbiological data reported in the HAI part of the PPS. The prevalence of the use of glycopeptides and the prevalence of the use of polymyxins/tigecycline was correlated with the percentage of MRSA and carbapenem-resistant Enterobacterales respectively.

The most common indication for antimicrobial use was treatment of a community-acquired infection, accounting for 49% of the prescriptions, same to the previous ECDC PPS (49%). Treatment of a HAI was the indication for 18% of antimicrobials, also similar to the previous ECDC PPS (19%). Contrary to the ECDC PPS 2022–2023, the prevalence of patients receiving antimicrobials for the treatment of a hospital infection (6.2%) was lower than the HAI prevalence (7.1%) found in the survey.

Surgical prophylaxis accounted for 15% of antimicrobials used, and was prolonged for more than one day in 48% of cases, lower than the respective proportion on the ECDC PPS 2016–2017 (54%). This may reflect the result of efforts to limit unnecessary prolonged surgical prophylaxis. Surgical prophylaxis should cover the peri-operative period only and a single dose is usually enough unless there is extensive blood loss or the procedure is prolonged. The percentage of prolonged surgical prophylaxis is overestimated in the PPS, because a different recall period is used for surgical prophylaxis (24 hours before 8am on the survey day) and a treatment given for more than one day has a higher probability of being captured in the PPS study than a treatment given for one day only. Nonetheless, comparing this indicator between hospitals (and countries) using the same methodology is valid, and countries with a high percentage of prolonged surgical prophylaxis should consider specific measures in this area.

Medical prophylaxis accounted for 10% of antimicrobial use, similar to the previous ECDC PPS (11%). Further details regarding medical prophylaxis are scarce in the PPS data because information regarding the infection site for which prophylaxis was given was not collected in the ECDC PPS protocol. The type of antimicrobials used suggested that a considerable proportion of medical prophylaxis was prescribed for the prevention of urinary tract and fungal infections.

The percentage of antimicrobials administered parenterally (80%) was higher than the previous ECDC PPS (73%). Promoting earlier change of parenteral to oral administration of antimicrobials seems to be a priority in several eastern European countries and Portugal. The reason for prescribing the antimicrobial was, on average, well documented but was still absent for almost one in five prescriptions.

The percentage of broad-spectrum antibacterials among all antibacterials for systemic use, as defined by the ECDC, EFSA and EMA Joint Scientific Opinion, reflects their level of consumption in hospitals and the corresponding selection pressure [33] and increased from 41.3% in the ECDC PPS 2016–2017 to 47.7% in the ECDC PPS 2022–2023. These antibacterials correspond to the 'Watch' and 'Reserve' groups of antimicrobials, as defined in the WHO Model Lists of Essential Medicines [48]. The proportion of broad-spectrum antibacterials in the PPS ranged from 25% to 59% across participating EU/EEA countries. This can, in part, be explained by the differences in prevalence of resistance among a number of reported microorganisms, e.g. MRSA, vancomycin-resistant enterococci or third-generation cephalosporin-resistant Enterobacterales. However, many of these antibacterials are also associated with the emergence and spread of healthcare-associated *Clostridioides difficile* and multidrug-resistant bacteria, and in particular for third-generation cephalosporins, fluoroquinolones and carbapenems, with the emergence of multidrug-resistant gram-negative bacteria [49]. The wide variation and sometimes extensive use of broad-spectrum antibacterials indicates the need to review their indications in many countries and hospitals. Antimicrobial stewardship programmes must be implemented to consider both the risk of emergence of AMR and patient safety. Ensuring that broad-spectrum antibacterials are used appropriately is a key element of any strategy against AMR [50].

Among the reasons for a change of antimicrobial during the infection episode, the proportion of de-escalation and switch from intravenous to oral administration varied among participating countries. In several countries, de-escalation or a switch to oral treatment was uncommon. It was not possible to assess the appropriateness of low proportions of change, as no information was collected about the reasons for continuing or changing antimicrobial. However, both de-escalation and a switch to oral treatment likely reflect the result of the review of antimicrobial treatment when microbiological information is available, or when the condition of the patient improves, and are recommended measures to support the prudent use of antimicrobials. The proportion of prescriptions that were the result of change was negatively correlated with the composite indicator of antimicrobial resistance, the proportion of broad-spectrum antibacterials among all antibacterials for systemic use and long surgical prophylaxis courses. On the one hand, the correlation partly reflects the challenges in de-escalation and the switch from intravenous to oral treatment in countries with high prevalence of antimicrobial resistance. On the other hand, the correlation demonstrates the value of the proportion of prescriptions that were the result of change as a process indicator for antimicrobial stewardship.

# Structure and process indicators

The ECDC PPS 2022–2023 provided data on hospital- and ward-level IPC structure and process indicators, developed by ECDC and Member State experts in 2013–2015 according to the key components of the SIGHT project [7]. For this report, the indicators were classified according to the similar WHO core components for hospital infection programmes at the healthcare facility level [23] (Table 1). For the ECDC PPS 2022–2023, the questions on multimodal strategies (WHO core component 5) were replaced by the questions on multimodal strategies in the WHO self-assessment tool `Infection prevention and control assessment framework at the facility level' (IPCAF, [24]).

Indicators for core component one (infection prevention and control programmes) included the presence of an approved annual IPC plan and report, IPC staffing levels and three indicators of microbiological lab support.

Infection prevention and control nurse (IPCN) and infection prevention and control doctor (IPCD) staffing levels considerably increased since the ECDC PPS 2016-2017, likely to some extent due to recruitment during the COVID-19 pandemic. IPCNs were present in 90% of hospitals (compared to 85% in 2016–2017) and IPCDs in 82% of hospitals (compared to 76% in 2016–2017). The median staffing levels were 1.25 IPCN FTEs per 250 beds (1.04 in 2016-2017) and 0.43 IPCD FTEs per 250 beds (0.28 in 2011–2012). The SENIC standard of 1 IPCN FTE per 250 beds was reached by 63.0% of hospitals, which was considerably higher than in 2016–2017 (51.5%) and in 2011–2012 (47%). The IPCN staffing level proposed in more recent scientific literature of 1 FTE per 100 occupied beds [,51 ,52] was reached by 24% hospitals compared to 17% in 2016–2017. In this survey we found that the lowest AMR levels were observed in hospitals with two or more IPCN FTEs per 250 beds, which indeed corresponds to approximately one FTE per 100 occupied beds.

The median antimicrobial stewardship consultant FTE was 0.18 FTE per 250 beds, but the mean was 0.48 FTE per 250 beds, showing an important investment in this function in a small group of hospitals, while a high percentage of hospitals (39.2%) reported no dedicated time for antimicrobial stewardship. There was a large variability among participating countries in the human resources available for antimicrobial stewardship as well as in the implemented antimicrobial stewardship strategies. Although in almost all participating countries, some hospitals had a consultant in charge of antimicrobial stewardship, the majority of hospitals still have no or very limited dedicated staff for antimicrobial stewardship.

There was high variability in microbiological testing frequency across EU/EEA countries, as indicated by the number of blood cultures per 1 000 patient days. This variability was only partially explained by differences in types of patients (case mix) and hospitals. Countries with very low testing frequency (<20 blood cultures per 1 000 patient-days) were all Central-Eastern EU countries, while countries in the highest testing frequency category (>=50 blood cultures per 1 000 patient-days) were all North- or West-European countries. As in the ECDC PPS 2016–2017, the blood culture use rate measured as number of blood culture sets per 1 000 patient-days was correlated with the prevalence of patients with at least one HAI, also after adjustment for patient case mix. It is likely that the blood culture use rate reflects the intensity of the diagnostic testing for HAIs as a whole, which is also supported by the correlation with the (seemingly unrelated) frequency of stool testing for CDI. Hospitals/countries that search more intensively for HAIs by microbiology testing, report a higher HAI prevalence, because they find more infections (for equal risk exposure) and/or because the HAIs in these hospitals are better documented and therefore more frequently match the HAI case definitions and are reported.

The association with blood culture frequency of use also remained significant after adjustment for patient case mix (expected HAI prevalence), indicating that it is not because more severely ill patients more frequently require diagnostic testing. In addition, the fact that there were no significant associations at country level between respectively 1) the blood culture use rate and the relative frequency of bloodstream infections and 2) the CDI stool testing frequency and the relative frequency of CDIs, supports the hypothesis that the inter-country variation of the testing frequency does not merely depend on the frequency of the disease they are designed to diagnose. Furthermore, it should be noted that infections which are not reported as a HAI because a diagnostic test is missing to confirm the case definition, will not be detected as a false negative by a validation process either. This means that validation studies alone are not enough to adjust for the variability of the case finding process between countries, and that HAI prevalence cannot be interpreted without taking into account an indicator of diagnostic testing (or case finding), in addition to validation parameters (sensitivity and specificity) and patient case-mix adjustment. So far, the blood culture use rate seems to be the best indicator to adjust for diagnostic test intensity of use/case finding, but indicators of other diagnostic processes (e.g. radiologic imaging for the diagnosis of pneumonia, other microbiological tests) should be considered for future PPSs.

Finally, the wide inter-country variation of microbiological sampling/testing frequency observed in this survey across the EU/EEA calls for medical practice guidelines in diagnostic stewardship [53-55]. The potential gap in testing emphasises the need to enhance access to diagnostic testing in especially low-resource EU/EEA countries because of its impact on the detection, treatment and prevention of infections in general, and HAIs specifically, and by consequence also on the prevention of antimicrobial resistance in EU/EEA hospitals. Without harmonised diagnostic stewardship pathways and case finding approaches, any comparison of HAI prevalence or incidence figures between countries will be compromised.

The median alcohol-based handrub consumption was 34.4 litres per 1 000 patient-days, higher than the 20.3 litres per 1 000 patient-days in 2016–2017, likely reflecting the results of the efforts to promote hand hygiene and to an extent by the effect of the COVID-19 pandemic on IPC practices. There were no countries with median consumption lower than 10 L/1 000 patient days in the ECDC PPS 2022–2023 but there was still a large variation from 17.0 litres per 1 000 patient-days in Hungary to more than 50 litres per 1 000 patient-days in five countries. These results are encouraging but show that further actions on hand hygiene are necessary. The median alcohol-based handrub consumption was higher in hospitals with higher availabilty of AHR dispensers at the point-of-care, higher number of hand hygiene opportunities (compliance monitoring) and increased availability of IPC staff, indicating the crucial role of these factors in ensuring better hand hygiene.

Three quarters of EU/EEA hospitals reported using multimodal strategies to implement IPC interventions, most commonly including training, communication and feedback. The median WHO IPCAF multimodal strategy score varied across the participating countries from 55 in Lithuania to more than 85 in Belgium, Ireland, Luxembourg, Portugal and Slovenia. These results are in line with the WHO 2019 Global report on infection prevention and control [56] and show a considerable effort to apply multimodal strategies and a need for these strategies to be further expanded in the EU/EEA. Contrary to the results of the indicator on multimodal strategies applied in the ECDC PPS 2016–2017, the WHO IPCAF multimodal strategy score included in the ECDC PPS 2022–2023 was associated with the composite index of AMR in line with the important role of such strategies in the implementation of IPC interventions.

The median percentage of beds in single-rooms in the 2016–2017 ECDC PPS hospitals was 11.3%, slightly lower than in the ECDC PPS 2016–2017 PPS (13.6%), and still with very low percentages in some countries, ranging from less than 5% in Greece, Hungary and Romania to more than 50% in several countries of Northwestern Europe. Isolation is strongly recommended for the prevention and control of infections by carbapenem-resistant Enterobacterales [57].

Structure and process indicators correlated with the composite index of AMR in HAIs. The composite index of AMR was negatively correlated with the blood culture rate at country level. However, the strength of the association was smaller than for HAI prevalence. A negative correlation of the blood culture frequency with AMR is expected, as cultures are likely to be performed at a later stage in countries performing less frequent microbiological testing, , when empiric treatment of the infection has failed. Importantly, the composite index of AMR was associated with several indicators of antimicrobial stewardship, the prevalence of antimicrobial use, the percentage of antimicrobials changed during treatment, prolonged surgical prophylaxis, the percentage of antimicrobials administered parenterally and the percentage of medical prophylaxis – and with five indicators of infection prevention and control – the percentage of beds in single rooms, the staffing levels of infection prevention and control nurses, the alcohol-based handrub consumption, the percentage of beds with alcohol-based handrub dispensers at the point-of-care and the WHO IPCAF multimodal strategy score. Although these observations need confirmation with further (multivariable) analyses, they suggest that antimicrobial stewardship aiming at decreasing the use of antimicrobials and changing to more appropriate antimicrobial use when indicated, hand hygiene (and optimal access to AHR dispensers), patient isolation, high staffing levels of infection prevention and control (ideally two FTEs per 250 beds) and implementation of multimodal strategies for IPC are crucial factors for the prevention of antimicrobial resistance in acute care hospitals.

Three structure and process indicators of antimicrobial stewardship were included in the ECDC PPS 2022–2023; the number of antimicrobial stewardship consultant FTE per 250 beds, the existence of a formal policy for post-prescription review at hospital or ward level and the participation in antimicrobial use surveillance network. The median for antimicrobial stewardship consultant FTE per 250 beds in EU/EEA hospitals was 0.18, twice as high as the median antimicrobial stewardship consultant FTE in the ECDC PPS 2016–2017. In France, Italy and Romania, more than 90% of the participating hospitals reported some dedicated time for antimicrobial stewardship. At the hospital level, the presence of any antimicrobial stewardship consultant worktime was significantly associated with a higher percentage of changed antimicrobials and a lower percentage of antimicrobials administered parenterally. The percentage of hospitals in the EU/EEA participating countries that reported a formal policy for post-prescription review in at least one ward was 56.8%, only slightly higher than the 52.5% hospitals in the ECDC PPS 2016–2017. Similar to indicators for IPC, the indicators for antimicrobial stewardship in the ECDC PPS 2022–2023 demonstrated a positive trend when compared with the ECDC PPS 2016–2017 reflecting wider implementation of antimicrobial stewardship programmes and processes, although with a high variability across EU/EEA countries.

# Limitations

## Data representativeness

Data representativeness in the 2022–2023 PPS was optimal (representative sample and sample size achieved) in 14 (52%) countries and good (sample size achieved) in 11 (41%) countries. Nonetheless, for all results presented in this report, one must keep in mind that the representativeness of the PPS sample was medium for two countries (Bulgaria and the Netherlands), even though in Bulgaria the representativeness was better than in the ECDC PPS 2016–2017 and with 23 participating hospitals almost reached the threshold for good representativeness. Results for these countries could be biased as a result of the low number of participating hospitals and the low sample size. Low sample size also results in large confidence intervals and might lead in a lack of sufficient numbers to calculate certain indicators, e.g. some of the antimicrobial resistance markers, for which a minimum of 10 isolates with known antimicrobial susceptibility results was required. In addition, one EU Member State (Denmark) did not participate in the 2022–2023 survey. This has an impact on the estimates (e.g. of the total number of patients with HAI per year) for the EU/EEA, where EU/EEA averages needed to be applied on the most recent national denominators of these countries. Additionally, in some countries with a sufficiently large sample size, the representativeness was less than optimal because hospitals participated on a voluntary basis rather than e.g. based on a systematic sampling process as recommended in the protocol. However, when the number of participating hospitals is sufficiently large, even voluntary participation often tends to result in fairly representative samples, as shown in many national HAI surveillance systems. In addition, risk adjustment compensated for differences in patient case mix, including those resulting from less representative samples. Finally, the average length of stay and size of the hospitals in the ECDC PPS were similar to the overall national averages in most countries, which also supported good overall representativeness of the data.

## Data validity

The ECDC PPS in 2011–2012 showed that the main result of the ECDC PPS – the HAI prevalence - was by far the most difficult indicator to interpret. The discrepancies between the observed and predicted HAI prevalence were too important to be explained by differences in quality of care and raised concerns about the validity of the data. As a consequence, validation during the national PPSs was made mandatory in 2016–2017, and ECDC provided financial support to all national PPS coordinating centres to organise a national validation study. Sixteen EU/EEA countries performed validation studies in the PPS 2022–2023 and found on average 3.0% false negatives and 17.5% of false positives for the presence of a HAI. This resulted in a rather low average sensitivity of 68.2% and a specificity of 98.4%, similar to the ECDC PPS 2016–2017.

As in the ECDC 2016-2017, countries with higher HAI prevalence found more false positives on average, resulting in lower specificity. In countries that performed a validation study in 2022–2023, variations in specificity alone explained 77% of the inter-country variation of the observed HAI prevalence (Spearman's rho -0.88, $R^2$ 0.774, Figure 15). This percentage was considerably higher than in 2016–2017 (37%), but needs to be interpreted with caution because much less countries performed validation in 2022–2023 (n=16) than in 2016–2017 (n=28). In addition, results of two countries needed to be excluded from the results in 2022–2023 because of methodological issues related to the validation of hospitals that performed the primary PPS using the light option of the protocol. Indeed, special emphasis should be given in future validation studies to the need to do meticulous patient-based validation of exactly all patients included in the aggregated denominators of wards in the light protocol. The fact that validation results were based on the results of validation studies of only 14 countries means that validation-based results in this report (such as the validation-corrected HAI incidence and estimated number of patients with a HAI per year) are less robust in the current PPS than in 2016–2017.

As in the ECDC PPS 2016–2017, higher sensitivity was not associated with higher primary PPS prevalence and the reported prevalence depended mainly on the intensity of the diagnostic process, as measured by the indicator number of blood culture sets per 1 000 patient-days. When infections lack diagnostic tests necessary to confirm the case definition, then neither the primary PPS team, nor the national validation teams are able to confirm the infection. In 2016–2017, external validation teams also flagged the lack of laboratory data (particularly the absence of microbiology data) in combination with the lack of notes, poorly written patient charts and illegible notes as frequently encountered problems during the validation studies. Nonetheless, with 68.2% sensitivity on average in EU/EEA countries, underreporting clearly did occur independently of microbiological or diagnostic testing, but not more in low prevalence countries than in high prevalence countries, at least not according to the national validation teams. Overall, the relatively low sensitivity resulted in a weighted EU/EEA prevalence of 8.0% (95% CI 6.6–9.6) corrected after validation compared to 6.3% (95% 5.3–7.4) before correction. This resulted in an increase of the estimated number of patients with HAI with approximately 1.4 million affected patients from 2.8 million to 4.3 million patients per year. This increase was much larger in the ECDC PPS 2022–2023 than the ECDC PPS 2016–2017 when the validation correction only resulted in an increase of 386 000 patients with HAI per year.

The main reason for this is that in the validation results of the current PPS (based on less countries than in 2016–2017), the percentage of false negatives was higher (3.0% vs. 2.3% in 2016–2017) while the percentage of false positives was lower (17.5% vs. 20.3%).

Low sensitivity (false negatives, or underreporting) of HAIs is a frequently encountered problem in national HAI surveillance systems [58-61]. Both low sensitivity and low specificity may be related to one or more of following factors:

- Difficulty in confirming the case definition of an infection if signs and symptoms were not well verified in the patient's records. If possible sources of information were not all verified during the primary PPS data collection, certain elements of a case definition may have been missed, which would result in false negatives if these sources were verified by the validation teams. If certain symptoms are assumed to be present even though they were not documented in any data source, this might result in false positives. Failure to systematically check criteria for all case definitions, included in the protocol, may also result in incomplete case ascertainment and therefore in false negatives, especially for less severe types of HAI. The external validation study indeed found sub-optimal knowledge of the ECDC protocol, especially of case definitions, to be a major reason for under-reporting.
- Not correctly reporting an infection as 'healthcare-associated': even if the case definition of an infection is matched, hospital PPS staff may decide not to report the infection as 'healthcare-associated' even though it should according to the definition in the protocol. For example, failure to report an infection with a typical community pathogen that starts after Day 2 of the current hospitalisation as a HAI. More detailed analysis of the national validation study results will allow partial assessment as to whether this occurred or not. The recognition of an infection as healthcare-associated still has a negative connotation in many countries, because a HAI is perceived as a medical error. Cultural differences between European countries may result in different reporting behaviour, particularly for the recognition of an infection as healthcare-associated. Such reporting behaviour is possibly influenced by historical or still existing punitive consequences of reporting HAIs (e.g. to health authorities) or by the fear of a negative financial impact of the (public) disclosure of an existing HAI problem.

While differences in data validity (sensitivity and specificity) and case ascertainment had a major impact on the prevalence of patients with HAIs, the validity of the other HAI data (e.g. isolated microorganisms, types of HAIs, antimicrobial resistance markers, origin of HAIs) are less affected. Therefore, indicators such as relative frequencies and percentage resistance are more valid even though they are based on smaller numbers (large confidence intervals) and the frequency of some types of HAI or microorganisms may be influenced by a specific lack of diagnostic testing or case ascertainment.

## Adjustment for patient case mix

Differences in HAI and antimicrobial use prevalence may also be explained largely by differences in patient case mix and types of hospitals and healthcare between countries. The ECDC PPS protocol was designed to be adjustable for many of these differences by including the most important known risk factors for HAIs and antimicrobial use in the protocol. We estimated the number of predicted infections in each hospital and country based on logistic regression models developed on two thirds of the total ECDC PPS database and validated on the remaining third. Standardised infection and antimicrobial use ratios (SIR and SAUR) were calculated as the number of observed over the number of predicted patients with a HAI or on antimicrobials, respectively.

An important limitation of this method of standardisation is that the prediction is made using the database of the ECDC PPS itself as the reference. The risk applied for each of the factors is the average (adjusted) risk for all countries together, i.e. it was not based on a model that assumes all possible infection prevention and antimicrobial stewardship measures were fully implemented. The predicted values should therefore not be interpreted as good practice targets.

Another limitation of applying the European average risk coefficients to each patient in every country is that we assume that each of the risk factors means the same thing across countries. This assumption is probably true for factors such as the presence of invasive devices, but for factors such as the medical specialty, the type of hospitals or even the McCabe score, country-specific differences in the definitions or in the interpretation of the definitions cannot be excluded. In addition, the same risk factor does not necessarily give rise to the same risk in each country. For the factor age for instance, it is well known that large inter-country or genetic differences exist regarding life expectancy and health status in older age groups. Another example is the patient/consultant specialty `intensive care', which was recoded for patients with a different specialty who were on an ICU ward (see methods section, `recoding of variables'). We followed this approach to harmonise data analysis for all countries, however it may have led to a higher number of ICU patients for some countries than e.g. published in the national PPS reports of these countries and may in some cases overestimate the true number of intensive care patients (e.g. Ireland).

We built a single model for HAIs and another for antimicrobial use. Prediction could be more precise with prediction models for specific types of HAI or antimicrobial use indications. This would, however, be beyond the scope of the current report. Another important limitation of the antimicrobial use model is that the presence of many risk factors could not be ascertained before the start of the antimicrobial treatment, because the start date was not collected for the risk factors. Prolonged length of stay, for instance, may also be the consequence of the reason for prescribing the antimicrobials (e.g. an infection), therefore the antimicrobial use model is conceptually less robust than the HAI model. In the HAI model, however, the length of stay was calculated as being until onset of infection, the presence of intubation, and urinary catheters was only included if present before onset of pneumonia or urinary tract infection, respectively, and the protocol specified that the McCabe score had to be estimated without (before) the influence of a HAI, if one was present. For both models, we excluded the presence of a central and peripheral vascular catheter because of the correlation with parenteral antimicrobial treatment.

## Burden estimates

Point prevalence surveys are generally accepted as a cost-effective way of gathering hospital-wide information on all types of HAI. Hospital-wide surveillance of HAIs is very resource-intensive and the United States Centers for Disease Control and Prevention (US CDC) National Nosocomial Infections Surveillance system (NNIS) discontinued its hospital-wide surveillance component in 1999 partly because too few hospitals had sufficient resources to perform hospital-wide surveillance using NNIS methods [62,63]. Since then, the US CDC and other national HAI surveillance systems have used only targeted surveillance protocols, most frequently for infections acquired in ICUs and targeted surveillance of surgical site infections, or for specific microorganisms. Repeated prevalence surveys at hospital-wide level are a valuable and sustainable alternative method for hospital-wide surveillance of all types of HAI, at least for specific surveillance objectives, e.g. estimation and follow-up of the burden of HAIs and antimicrobial use, identification of priorities for infection prevention and control and antimicrobial stewardship, increasing HAI surveillance and IPC skills, raising awareness at hospital-wide, regional, national and international level, evaluation of regional or national interventions (depending on the frequency of the outcome under evaluation and comparability of the repeated sampled populations). Objectives of continuous surveillance that cannot be met by prevalence surveys are HAI prevention at hospital level through continuous participation in surveillance networks with feedback of risk-adjusted HAI rates, as well as the detailed follow-up of trends, including evaluation of IPC measures and detection of new epidemics. As HAIs are relatively rare events, only surveillance can provide stabilised baseline infection rates needed for benchmarking at hospital level to meet these objectives.

Prevalence surveys only allow a direct estimate of the total number of patients with a HAI or on antimicrobials on a given day. There is, however, a mathematical relationship between prevalence and incidence which theoretically enables a conversion from prevalence into incidence and vice versa, taking into account the length of hospital stay of infected and non-infected patients as well as the time from admission to HAI onset [36,64]. To estimate the total annual number of patients with HAIs in the EU/EEA, we used the Rhame and Sudderth formula as was done in the 2011–2012 ECDC PPS [3]. A major problem with this method is that the formula is based on length-of-stay data of the 'incidence series', which would only be known if hospital-wide surveillance had been performed during the same period. In a study by Gastmeier, et al. [65] that combined the two approaches (simultaneous surveillance and nested PPS) to validate the relationship of incidence and prevalence, the Rhame and Sudderth formula performed well, even though the authors did not recommend its use on a routine basis because repeated PPSs are indeed inferior to continuous surveillance as a tool for HAI prevention, in particular for targeted surveillance.

For the ECDC PPS, length of stay for all patients was collected at the hospital level for the year preceding the survey, which was used as a proxy for the length of stay in the year of the survey. To approximate the length of stay for patients with a HAI, we used the observation that the hospital length of stay from the previous year was well correlated with the median length of stay until the survey date. We therefore used both the mean and median length of stay from HAI onset until the day of the PPS as the denominator in the Rhame and Sudderth formula. We calculated the point estimate of the incidence as the average, with a wide 95% confidence interval encompassing confidence intervals of both estimates and which expresses the high degree of uncertainty inherent in the incidence and burden estimates.

Finally, burden estimations are strongly dependent on the denominator data available both at hospital and at national level, and part of these differences may be due to different definitions of these denominator data (different inclusion of patients). In addition, different inclusion of patients in the total number of discharges at the national level will also influence the burden estimations, because the estimated incidence percentage from the Rhame and Sudderth conversion is applied to these national denominators in order to calculate the estimated number of patients with HAI per year.

Further work on the HAI burden estimates is planned using a recent methodology based on the Grenander estimator of the Rhame and Sudderth parameters [37] and with updated national denominator data, as part of ongoing work to standardise the burden estimation methods between countries that are member of the Transatlantic Taskforce on Antimicrobial Resistance (TATFAR). The estimates published in the current report which used the same method as in the previous two PPSs for comparability purposes, should therefore be considered as preliminary.

## Structure and process indicators

The infection control structure and process indicators collected at the hospital level in the ECDC PPS need to be interpreted with caution because they may, in some cases, not necessarily reflect what they are supposed to measure. In the ECDC PPS 2016–2017, questions about the interpretation of structure and process indicators were included in the validation protocol.

For example, several data quality problems were found during data validation for the question, 'antimicrobial stewardship consultant FTE'. Firstly, the definition of antimicrobial stewardship consultant which required mentioning of antimicrobial stewardship activities as part of the job description, was not respected in 25% of hospitals reporting at least some antimicrobial stewardship consultant FTE. Secondly, in some countries (e.g. France), antimicrobial stewardship consultant FTE for 250 beds were overestimated because the reported number of FTEs did not take account of the fact that antimicrobial stewardship consultants worked in several hospitals. Thirdly, national validation teams reported that in 28% hospitals, the antimicrobial stewardship consultant FTEs were not correctly distinguished from the IPCD FTEs. By consequence, in these hospitals, the reported IPCD FTEs was likely overestimated.

Another aspect which was verified during the national validation studies in the ECDC PPS 2016–2017 was the way the number of litres of alcohol-based handrub is collected. In more than half (57%) of the hospitals, this was based on volumes dispensed by the hospital pharmacy to the wards, and in 27% of hospitals on volumes purchased by the hospital pharmacy in the given year. These quantities were not necessarily used by healthcare workers in the same year. Used quantities were only reported by 14% of hospitals. In addition, the indicator does not consider the consumption of other hand hygiene agents (e.g. medicated liquid soap), the wastage of handrub (e.g. replacement of handrub dispensers before they are empty), handrub usage for other purposes than hand hygiene, and does not distinguish between usage by visitors, patients and healthcare workers.

Single rooms may be primarily used for private patients (against supplemental fees, thus generating additional income for the hospital) or for purposes other than the isolation of patients with 'alert' microorganisms.

## Correlations

The correlations presented in this report between structure and process indicators of IPC and antimicrobial stewardship and other indicators such as the composite index of AMR and the prevalence of HAIs should be interpreted with caution. Correlations of variables measured at the same time in cross-sectional observational studies do not imply that there is a causal relationship between them. Criteria of causality such as those proposed by Bradford Hill in 1965 [66], should be used to evaluate the correlations. In the best-case scenario - with some criteria being met and no criteria violated - the correlations can merely suggest hypotheses, support existing evidence and possibly recommend future studies.

The first criterion that needs to be considered for cross-sectional studies is the principle of temporality. An indicator could equally precede or be the consequence of the other indicator ('chicken or egg' question). For example, the observation that the composite index of AMR decreased for increasing levels of the consumption of alcohol-based handrub did not hold for Greece and to a lesser extent for Cyprus, suggested that the high AHR consumption in these countries may be the reflection of increased efforts to control high levels of antimicrobial resistance. However, as the high AHR consumption in Greece and Cyprus was also observed in the ECDC PPS 2012–2013 and the ECDC PPS 2016–2017, it also seems likely that use of AHR for other purposes than hand hygiene within the hospital (e.g. environmental cleaning and disinfection or use outside the hospital) may be one of the reasons for the unexpectedly high consumption in these countries. Furthermore, several structure and process indicators assumed to be on the `predictor-side' of the association were reported for the year preceding the PPS, while the `outcome' variables (composite index of AMR, prevalence of patients with at least one HAI or at least one antimicrobial) reflect the situation on the day of the PPS. Data for the most recent year were reported for AHR consumption, the number of blood cultures, the number of stool tests for CDI, the number of hand hygiene observations and the hospital denominator data (number of patient-days and number of discharges). For these indicators, it is thus known that they preceded the outcome. The other indicators such as the staffing levels (FTEs), the number of single rooms and airborne infection isolation rooms and the multimodal strategy components usually reflected the situation on the day of the PPS. Several of these indicators however can be expected to remain stable across months or even years (e.g. number of single rooms).

Secondly, any third variable related with both the `predictor' indicator and the `outcome' variable may explain an observed correlation (also referred to as confounding). We assumed that this was the case for the correlation between the blood culture rate and the frequency of stool testing for CDI, where we hypothesised that the underlying factor explaining the correlation is the overall intensity of diagnostic testing, or at least of microbiological laboratory support. Therefore, we also assumed that the correlation between the blood culture rate and the HAI prevalence was mainly explained by the intensity of diagnostic testing, as both correlations were independent of patient case-mix severity. More difficult to explain are associations between e.g. the blood culture rate and the IPC nurse FTEs. One possibility is a direct effect of IPC nurses on better implementation of guidelines for HAI prevention (including case finding algorithms). Another potential explanation is that when hospitals invest more in IPC and/or antimicrobial stewardship, this is reflected at different levels in several indicators, but not necessarily with a direct relationship between them. A third explanation is that all this is basically driven by the hospital's financial resources, which depend to a large extent on the national investment in health care, which depends on the gross domestic product per capita of the country and the percentage of the GDP dedicated to health functions.

Further multivariable analyses are needed to better understand and confirm the correlations described in the current report. In addition, other study designs may be required to confirm some of the hypotheses generated from these observations.

# Conclusions

The 2022–2023 ECDC PPS was the third EU-wide point prevalence survey of healthcare-associated infections and antimicrobial use in acute care hospitals. It was also the largest European PPS performed to-date in a total of more than 1 300 hospitals from 28 EU/EEA countries and Kosovo, Montenegro and Serbia. All countries used the same standardised protocol developed during a collaborative effort, involving numerous experts from Member States and from the international level, and including several support projects outsourced by ECDC to perform national validation studies and external (international) validation visits.

The ECDC PPS confirmed that healthcare-associated infections are a major public health problem in the EU/EEA with a corrected prevalence of 8.0% (95%cCI: 6.6–9.7%) or 93 305 (95%CI: 76 427-111 899) patients with a HAI on any given day in European acute care hospitals. Based on findings from the PPS, the estimated total annual number of patients with a HAI in acute care hospitals in EU/EEA was 4.2 million, albeit with a wide confidence interval of 3.0 million to 5.7 million patients. The number of HAI episodes per year in EU/EEA acute care hospitals was estimated at 4.6 million (95% CI: 3.3–6.2 million).

The epidemiology of healthcare-associated infections in 2016–2017 in the EU/EEA was similar to that in 2016–2017. Intensive care unit patients, haematology/bone marrow transplantation and burns care patients were at the highest risk of a HAI. The five most common types of HAI were pneumonia, urinary tract infections, surgical site infections, bloodstream infections and gastro-intestinal infections. However, among the five most frequently isolated microorganisms in HAIs, *Klebsiella* spp. increased from third in 2016–2017 (8.7% of microorganisms) to second in 2022–2023 (11.7%), continuing to reflect the ongoing epidemic of carbapenem-resistant gram-negative bacteria in Europe. *Enterococcus* spp. was, for the first time, more commonly isolated than *S. aureus,* contrary to the PPS 2016–2017. SARS-CoV-2 was an emerging microorganism with high relative frequency accounting for 10% of all identified microorganisms. The relative frequency of *C. difficile* increased from 5.4% of all microorganisms in 2011–2012 (rank 8) to 7.3% in 2016–2017 (sixth), reflecting the ongoing epidemic of virulent *C. difficile* strains across European countries as well as improved diagnostic testing.

Healthcare-associated COVID-19 (HA-COVID-19) was an emerging infection in this PPS, with SARS-COV-2 being the fourth most common microorganism among HAIs and accounting for 6% of all HAIs, with a microbiologically documented pathogen. However, the prevalence of HA-COVID-19 varied considerably across participating countries, most likely related to the prevalence of COVID-19 in the community during the time the PPS was performed in each country.

The overall prevalence of antimicrobial use extrapolated to the total number of occupied beds corrected after validation was 32.4% (29.7–35.1%) and 390 957 patients (95% CI: 345 070–437 575) (patients were estimated to receive at least one antimicrobial on any given day in European acute care hospitals in 2022–2023. Norway recorded the lowest standardised antimicrobial use ratio (adjusted for patient case mix) and Greece the highest. Prolonged surgical prophylaxis decreased when compared with the results of the ECDC PPS 2016–2017 but was still high. High use of broad-spectrum antimicrobials continued to be frequent in many European acute care hospitals. Both remain a priority target for future efforts on antimicrobial stewardship.

The ECDC PPS 2022–2023 collected a large number of structure and process indicators of infection prevention and control and antimicrobial stewardship. The most striking findings were the fact that the composite index of AMR in HAIs was associated with several indicators of antimicrobial stewardship, e.g. the prevalence of antimicrobial use, the percentage of antimicrobials changed during treatment and the percentage of prolonged surgical prophylaxis – and with five indicators of infection prevention and control – the percentage of beds in single rooms, the staffing levels of infection prevention and control nurses, the alcohol-based handrub consumption, the percentage of beds with alcohol-based handrub dispensers at the point-of-care and the WHO IPCAF multimodal strategy score. Although these observations need confirmation with further (multivariable) analyses, they suggest that antimicrobial stewardship, hand hygiene, patient isolation, high staffing levels of infection prevention and control (ideally 2 FTEs per 250 beds) and implementation of multimodal strategies for IPC are crucial factors for the prevention of antimicrobial resistance in acute care hospitals.

While major steps have been taken in increasing the HAI surveillance skills and awareness of healthcare workers across the EU/EEA, more training to harmonise the interpretation of case definitions as well as continued validation efforts are needed before reliable comparisons of – even risk-adjusted – prevalence figures for HAIs between countries can be made. Direct comparison of HAI prevalence between countries was not an objective of the ECDC PPS and these cannot be made without considering patient case mix, confidence intervals, indicators of diagnostic testing and data validity. Validation results could only be used to correct prevalence estimates at the EU/EEA level, as national validation samples were mostly too small and could only be considered as representative for the national PPS in five countries. With an average percentage of HAIs that were detected/reported (sensitivity) of 68.2%, and an average specificity of 98.4%, the overall performance of the primary PPS teams still showed room for improvement, emphasising again the importance of training in HAI case definitions.

Excluding the emergence of HA-COVID-19 and the infections originating in LTCFs that were for the first time included in the PPS, the results were largely comparable to those of the previous PPSs, which is reassuring in terms of methodology, but disappointing in terms of little change of prevention of HAIs and antimicrobial prescription practice in European acute care hospitals in the past 10 years. However, more precise comparisons of the results of the three ECDC PPSs are necessary to consider variations in participating countries and hospitals.

The prevention of HAIs and antimicrobial resistance in European acute care hospitals requires the continued implementation of existing guidelines and recommendations (see Recommendations chapter). Specific recommendations from the findings of the 2022–2023 ECDC PPS include:

- an urgent need for diagnostic stewardship and to improve access to microbiological diagnostic testing in EU/EEA hospitals;
- increasing IPC staffing levels to (ideally) one IPCN FTE per 100 occupied beds;
- improving hand hygiene, in particular by ensuring easy access to alcohol-based handrub dispensers at the point-of-care and ensuring appropriate nursing staffing levels in accordance with workload;
- ensuring sufficient isolation capacity for patients with alert microorganisms;
- ensuring the implementation of preventive measures for COVID-19 and other respiratory viral infections;
- implementing multimodal strategies for IPC;
- reducing inappropriate antimicrobial use by targeting prolonged surgical and medical prophylaxis, the use of broad-spectrum antimicrobials and the switch from intravenous to oral administration, increasing post-prescription review of antimicrobial treatments and ensuring dedicated skilled personnel and time for antimicrobial stewardship consultancy.

Further analyses of the ECDC PPS data are needed, e.g. to study risk-adjusted differences between the ECDC PPS 2022–2023 and the previous ECDC PPSs, to confirm and interpret observed correlations of indicators of IPC and antimicrobial stewardship with outcome indicators at the country and hospital level, to identify case definitions and other variables with validity problems in order to tailor PPS training materials, and improve the methodology of future PPSs.

# Recommendations

At least 20% of HAIs are estimated to be preventable by sustained and multifaceted IPC programmes, including surveillance of HAIs. The proportion preventable by employing current evidence-based strategies is the highest for device-associated infections and surgical site infections [34,67-69].

Optimal prevention of HAIs and antimicrobial resistance in European acute care hospitals requires the continued implementation of existing guidelines and recommendations such as the WHO guidelines on core components of infection prevention and control programmes [23] and on prevention of surgical site infection [70], the ESCMID guidance on prevention of *C. difficile* infections [71] and the EU Council Recommendation (2009/C 151/01) on Patient Safety, including the Prevention and Control of Healthcare Associated Infections [71].

Regarding recommendations for the improvement of antimicrobial prescribing in hospitals, it is important to consider the principles of the Council Recommendation of 15 November 2001 on the prudent use of antimicrobial agents in human medicine (2002/77/EC) [73], the EU Guidelines for the prudent use of antimicrobials in human health [74] and adhere to evidence-based guidance on antimicrobial use where available [75].

Based on ECDC PPS 2022–2023 results, we propose following specific recommendations in the area of prevention and control of HAIs, antimicrobial resistance and antimicrobial use in acute care hospitals.

- There is an urgent need to harmonise diagnostic stewardship [53-55] and support access to adequate diagnostic testing across EU/EEA countries. The need to improve diagnostic laboratory testing capacity for HAIs was already identified in the 2011–2012 ECDC PPS. The indicators collected in the ECDC PPS 2016–2017 and 2022–2023 showed an extreme variability of sampling practices/diagnostic testing use across European acute care hospitals and countries which compromise the validity of HAI prevalence data and also the prevention of HAIs and AMR because of poor case finding in countries with low diagnostic activity. Inappropriate diagnostic practices often lead to inappropriate empirical use of antimicrobials, such as prolonged treatment and unnecessary use of broad-spectrum antimicrobials, further compounding the problem of inappropriate antimicrobial use and antimicrobial resistance. Possible actions to tackle this problem include 1) performing an in-depth analysis of the mechanisms behind low diagnostic testing (e.g. clinical diagnostic algorithms, medical guidelines, laboratory test financing/reimbursement mechanisms, cultural aspects, etc.); 2) developing EU-wide guidance on best practice for diagnostic stewardship in EU/EEA acute care hospitals; 3) developing support mechanisms for low-resource countries to enable them to comply with agreed guidance and international standards of sampling practices/diagnostic testing; 4) monitoring the implementation of agreed guidance using an extended set of indicators of diagnostic testing, including blood culture and CDI testing, but also indicators of other crucial diagnostic tests e.g. X-rays for suspicion of pneumonia or urine cultures.
- Increase the target staffing level for IPC nurses in EU/EEA acute care hospitals from one per 250 beds (SENIC study-based standard, [34]) to the recently recommended ratio of one IPC nurse per 100 occupied beds [51 ,52].
- Prioritise the placement of alcohol-based handrub dispensers at the point-of-care, i.e. aim for 100% of hospital beds with AHR dispensers within arm's reach.
- Ensure sufficient isolation capacity for patients with alert microorganisms in acute care hospitals, especially when rebuilding hospitals.
- Ensure the implementation of preventive measures for COVID-19 and other respiratory viral infections in healthcare settings, such as early testing for timely diagnosis, application of transmission-based precautions and, during periods of high circulation in the community, consideration of universal or targeted clinical masking [76]. Equally important is that healthcare providers are advised of and offered vaccination against influenza and COVID-19 and are allowed to stay at home when they have symptoms of a respiratory viral infection. Increasing awareness of the frequency and impact of healthcare-associated respiratory viral infections among healthcare professionals is key for their prevention and control.
- Implement multimodal strategies for IPC measures. The implementation of multimodal strategies typically includes three out of five of the following components: system change; education; awareness raising; bundle-based strategies; promotion of a patient safety culture, including leadership engagement and positive reinforcement strategies; and increased accountability via monitoring and timely feedback [23]

- Establish or strengthen antimicrobial stewardship programmes to improve antimicrobial prescribing in acute care hospitals, in particular:
  - ensuring dedicated skilled personnel and time for antimicrobial stewardship;
  - promote the practice of post-prescription review of antimicrobial treatment and changing the prescribed treatment if appropriate, prioritising changing the route of administration from parenteral to oral when possible and de-escalation of the antimicrobial spectrum;
  - rationalise the use of broad-spectrum antimicrobials (e.g. third-generation cephalosporins and carbapenems);
  - ensure the use of novel antimicrobials is limited to cases with clear indication;
  - reduce unnecessarily prolonged surgical prophylaxis;
  - reduce the use of antimicrobials for medical prophylaxis when not indicated;
  - improve the documentation of the reason for antimicrobial prescribing in the clinical notes.
- Implement standardised surveillance of HAIs, including surveillance of *C. difficile* infections at the local, national and EU level, and advance the development of electronic (semi)automated surveillance of HAIs to decrease workload and improve standardisation and robustness of HAI surveillance.
- Support the timely detection of outbreaks with multidrug-resistant organisms, and support the implementation of appropriate prevention and control measures accordingly.

In addition to the recommendations for the prevention of HAIs and the improvement of antimicrobial prescribing in acute care hospitals, the experience of the ECDC PPS suggests the following recommendations for future repeated PPSs in the EU/EEA:

- EU-wide PPS initiatives can increase surveillance skills in Member States as well as enable countries to execute studies using a common protocol. However, considerable additional training of healthcare workers is needed to harmonise the interpretation of HAI case definitions, IPC and antimicrobial stewardship indicators and other key terms in the ECDC PPS protocol.
- National PPSs should be repeated at least once every five years. ECDC will organise a fourth coordinated PPS in European acute care hospitals in 2027, but will also support the organisation, data collection, validation and analysis of national PPSs during the years in between.
- The ECDC PPS protocol should be evaluated and adjusted where needed. Particular emphasis should be placed on revising, replacing or removing indicators or variables with important validity problems (especially yes/no indicators), adding more indicators of the frequency of diagnostic testing and removing variables for which the added value is questioned.
- Develop a standardised indicator of HAI prevalence considering differences in patient case mix and type of hospital, differences in diagnostic (especially microbiological) testing and results of nationally representative validation studies.

Finally, a number of results from the ECDC PPS 2022–2023 support recommending electronic (automated) surveillance of HAIs and/or antimicrobial resistance in European acute care hospitals:

- Automated data transmission from hospital microbiological laboratories improves the timeliness of detecting alert microorganisms at the regional, national and European level and thereby enables timely national and international coordinated response to outbreaks.
- The recommendation to harmonise diagnostic stewardship and support access to adequate diagnostic testing should also improve the availability of electronic data in European acute care hospitals.
- Conventional surveillance of HAIs and/or AMR as part of surveillance networks is still only performed by approximately half of European acute care hospitals (with 25% of hospitals not participating in any such surveillance network), even though surveillance has been recommended as an essential measure for HAI and AMR prevention since several decennia. Electronic surveillance could reduce the workload of surveillance and may increase the sustainability and coverage of surveillance systems in the longer term.
- The implementation of automated case detection algorithms will improve the comparability of HAI incidence rates, as the case finding process of surveillance staff with variable specificity and sensitivity is replaced by standardised automated algorithms, which do not vary between hospitals with similar availability of electronic (diagnostic, pharmaceutical, clinical, administrative) databases.

# Acknowledgements

First and foremost, ECDC would like to thank all participating hospitals, in particular the hospital staff that collected, validated and entered the data during the ECDC PPS and transferred these data to the respective national PPS coordinating centres. Thanks to their efforts, we were able to provide, for the second time, the most comprehensive picture of the epidemiology and burden of healthcare-associated infections and antimicrobial use in acute care hospitals in Europe to date. The identity of the hospitals participating in the EU-wide PPS were not collected for reasons of confidentiality and are therefore not listed.

Secondly, ECDC is very much indebted to the national PPS coordination teams who did an invaluable job in preparing the national PPS tools including translating the ECDC PPS protocol and tools, developing national software, recruiting participating hospitals, preparing and providing training to hospital PPS staff, providing continuous support to hospitals during the data collection process with regard to methodological and technical questions, organising and conducting the national validation studies, participating in the data collection process in some countries, carrying out data management, preparing the national database, providing feedback to participating hospitals and uploading the national database into ECDC's TESSy system. The composition of the national PPS coordination teams was as follows:

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Greece: Antonios Maragkos, Kassiani Mellou, Kyriaki Tryfinopoulou, Konstantinos Palaiopanos, Dimitra Krystallaki, Christina-Anna Kavakioti, Petros Kotoulas, Styliani Vorre, Maria Gkova (National Public Health Organization, Athens), Aristotelis Papadimitriou (Agios Savvas Regional Cancer Hospital, Athens).

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Netherlands: Sabine de Greeff, Titia Hopmans, Tjallie van der Kooi, Wouter van den Reek, Stephanie van Rooden, Britt de Wit, Charlotte de Bruijn-Onstwedder, Cathalijne Dodemont-van Breen, Wilma Dedecker-Veenhof, Sarah Valk (National Institute for Public Health and the Environment, Centre for Infectious Disease Control Netherlands).

Norway: Hanne-Merete Eriksen-Volle, Torunn Alberg, Thale Cathrine Berg, Hege Line Løwer, Ragnhild Raastad (Norwegian Institute of Public Health, Oslo).

Poland: Aleksander Deptuła (Ludwik Rydygier Collegium Medicum in Bydgoszcz and Nicolaus Copernicus University in Torun); Ewa Trejnowska (Silesian Centre for Heart Diseases, Zabrze).

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Slovakia: Mária Štefkovičová, Slavka Litvová (Regional Public Health Authority in Trenčín), Jana Námešná (Regional Public Health Authority in Banská Bystrrica).

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We would also like to reiterate our gratitude to the more than 150 experts in the countries, and international organisations that participated in the ECDC PPS protocol meetings.

Finally, the authors would like to thank all ECDC colleagues who contributed to one or more of the various aspects of the ECDC PPS project and report, especially Angelo d'Ambrosio, Aikaterini Mougkou and Dominique L. Monnet.

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# Annex 1. Tables

**Table A1.1. Distribution of patient risk factors by country, patient-based data only, ECDC PPS 2022-2023**

| Country | No. of patients | Median age (years) | Age category | | | | | | Sex ratio M:F | Median length of stay until day of the PPS (days) | % Surgery since admission | McCabe score | | | | Invasive device use | | | % Vaccinated against COVID-19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % < 1 month | % 1–11 months | % 1–17 years | % 18–64 years | % 65–84 years | % 85+ years | | | | % Non-fatal | % Ultimately fatal | % Rapidly fatal | % Missing | % CVC | % Urinary catheter | % Intubation | |
| Austria | 9 161 | 68 | 2.9 | 1.1 | 3.0 | 37.9 | 43.8 | 11.3 | 0.92:1 | 6 | 31.2 | 63.8 | 20.6 | 3.1 | 12.5 | 12.0 | 18.2 | 2.0 | 68.5 |
| Belgium | 10 142 | 68 | 4.0 | 2.6 | 4.7 | 33.2 | 40.2 | 15.3 | 0.85:1 | 7 | 28.4 | 69.3 | 18.6 | 7.2 | 5.0 | 11.8 | 14.5 | 2.0 | 76.9 |
| Bulgaria | 3 977 | 61 | 3.3 | 1.8 | 9.2 | 43.2 | 38.6 | 3.9 | 0.95:1 | 4 | 22.5 | 81.3 | 11.8 | 3.0 | 3.8 | 6.0 | 18.5 | 3.9 | 23.9 |
| Croatia | 4 315 | 65 | 2.9 | 1.6 | 5.6 | 38.6 | 43.4 | 7.9 | 1.02:1 | 7 | 27.5 | 65.9 | 25.7 | 5.8 | 2.7 | 9.9 | 28.1 | 3.1 | 52.0 |
| Cyprus | 1 173 | 63 | 5.7 | 2.7 | 9.0 | 35.1 | 36.1 | 11.3 | 1.08:1 | 6 | 23.1 | 72.4 | 15.8 | 4.4 | 7.4 | 11.1 | 39.2 | 6.7 | 59.0 |
| Czechia | 12 296 | 68 | 3.0 | 1.4 | 6.2 | 32.9 | 45.6 | 10.7 | 0.92:1 | 6 | 31.1 | 62.6 | 24.7 | 7.7 | 5.1 | 12.6 | 27.6 | 2.8 | 69.0 |
| Estonia | 1 202 | 74 | 1.4 | 0.1 | 2.2 | 30.3 | 44.0 | 22.0 | 0.87:1 | 8 | 9.9 | 75.5 | 18.5 | 4.5 | 1.6 | 4.2 | 13.3 | 1.3 | 64.6 |
| Finland | 7 564 | 64 | 5.2 | 1.4 | 6.4 | 38.3 | 38.9 | 9.9 | 0.96:1 | 4 | 27.7 | 69.7 | 24.2 | 3.6 | 2.4 | 7.1 | 20.7 | 1.3 | 75.6 |
| France | 17 235 | 71 | 0.0 | 6.4 | 2.7 | 31.0 | 38.6 | 21.3 | 0.91:1 | 8 | 18.9 | 54.2 | 19.8 | 8.4 | 17.6 | 3.2 | 13.6 | 1.3 | - |
| Hungary | 23 266 | 68 | 1.2 | 2.1 | 4.0 | 34.8 | 46.7 | 11.2 | 0.77:1 | 6 | 19.9 | 61.2 | 12.9 | 5.0 | 20.9 | 4.5 | 19.5 | 1.7 | 72.9 |
| Iceland | 678 | 67 | 4.1 | 0.4 | 2.7 | 37.3 | 39.7 | 15.8 | 0.96:1 | 9 | 27.9 | 70.1 | 26.4 | 3.2 | 0.3 | 9.0 | 16.7 | 1.2 | 86.7 |
| Ireland | 12 472 | 70 | 3.2 | 1.4 | 4.0 | 32.8 | 43.2 | 15.4 | 0.98:1 | 10 | 18.2 | 71.1 | 24.6 | 3.8 | 0.6 | 8.4 | 14.3 | 1.5 | 84.2 |
| Italy | 19 740 | 66 | 2.5 | 4.8 | 5.7 | 34.5 | 40.0 | 12.5 | 1.10:1 | 6 | 32.4 | 67.6 | 18.6 | 6.7 | 7.1 | 17.5 | 35.1 | 3.7 | 79.6 |
| Latvia | 972 | 65 | 3.2 | 1.0 | 5.0 | 40.7 | 41.2 | 8.8 | 0.84:1 | 7 | 21.1 | 94.1 | 4.6 | 0.1 | 1.1 | 3.8 | 15.3 | 2.4 | - |
| Lithuania | 9 491 | 67 | 1.6 | 0.9 | 6.7 | 35.1 | 41.7 | 14.0 | 0.83:1 | 5 | 14.8 | - | - | - | 100.0 | 4.9 | 6.7 | 1.3 | - |
| Luxembourg | 1 699 | 65 | 4.2 | 0.9 | 4.4 | 39.2 | 36.9 | 14.3 | 0.93:1 | 7 | 29.0 | 15.8 | 8.2 | 1.5 | 74.5 | 8.9 | 13.0 | 2.0 | 76.9 |
| Malta | 1 082 | 71 | 3.7 | 1.1 | 3.3 | 31.5 | 42.7 | 17.7 | 1.06:1 | 8 | 20.6 | 1.4 | 1.5 | 0.2 | 97.0 | 6.7 | 17.4 | 1.3 | 89.9 |
| Netherlands | 4 863 | 68 | 3.4 | 0.0 | 6.0 | 33.6 | 46.0 | 11.0 | 1.10:1 | 6 | 33.1 | 66.0 | 9.8 | 3.2 | 21.0 | 10.2 | 20.7 | 3.0 | - |
| Poland | 23 661 | 64 | 2.4 | 2.0 | 7.2 | 38.9 | 41.6 | 8.0 | 0.93:1 | 5 | 25.5 | 70.0 | 13.0 | 4.5 | 12.6 | 10.9 | 21.1 | 2.8 | 60.3 |
| Portugal | 20 367 | 69 | 4.0 | 1.1 | 2.8 | 34.3 | 41.5 | 16.3 | 1.01:1 | 5 | 27.7 | 72.6 | 20.7 | 5.3 | 1.4 | 8.6 | 21.7 | 2.6 | 80.4 |
| Romania | 21 866 | 62 | 3.1 | 2.2 | 6.0 | 43.1 | 40.8 | 4.9 | 0.98:1 | 8 | 23.8 | 74.9 | 9.7 | 6.2 | 9.3 | 5.7 | 16.0 | 2.8 | 36.8 |
| Slovakia | 10 172 | 62 | 4.6 | 2.0 | 6.3 | 41.5 | 39.3 | 6.3 | 0.91:1 | 4 | 23.3 | 76.9 | 15.9 | 3.5 | 3.7 | 9.3 | 23.4 | 1.9 | 51.0 |
| Slovenia | 4 925 | 66 | 4.0 | 0.9 | 5.5 | 36.5 | 42.9 | 10.2 | 1.00:1 | 5 | 33.0 | 71.5 | 19.4 | 7.9 | 1.2 | 12.9 | 22.7 | 3.4 | 61.9 |
| Spain | 23 266 | 68 | 2.8 | 1.1 | 3.1 | 36.6 | 41.3 | 15.1 | 1.13:1 | 6 | 28.9 | 77.9 | 17.2 | 4.9 | 0.0 | 12.9 | 20.0 | 2.9 | 85.5 |
| Sweden | 13 526 | 70 | 2.9 | 1.3 | 4.0 | 33.4 | 44.4 | 13.9 | 1.05:1 | 6 | 23.1 | - | - | - | 100.0 | 14.1 | 21.8 | 1.7 | - |
| **EU/EEA** | **259 111** | **67** | **2.8** | **2.0** | **4.9** | **36.2** | **42.0** | **12.1** | **0.96:1** | **7** | **25.3** | **62.3** | **15.0** | **5.6** | **17.1** | **9.5** | **20.3** | **2.4** | **69.2** |
| EU/EEA P25 | 3 977 | 65 | 2.8 | 1.0 | 3.3 | 33.4 | 39.7 | 9.9 | 0.91:1 | 6 | 21.1 | 64.8 | 12.4 | 3.2 | 1.6 | 6.0 | 15.3 | 1.5 | 60.0 |
| EU/EEA P50 | 9 491 | 67 | 3.2 | 1.4 | 5.0 | 35.1 | 41.5 | 11.3 | 0.96:1 | 8 | 25.5 | 70.0 | 18.5 | 4.5 | 5.1 | 9.0 | 19.5 | 2.0 | 70.9 |
| EU/EEA P75 | 17 235 | 68 | 4.0 | 2.0 | 6.2 | 38.6 | 43.4 | 15.3 | 1.02:1 | 8 | 28.9 | 73.7 | 20.6 | 6.0 | 17.6 | 11.8 | 21.8 | 2.9 | 79.8 |
| Kosovo | 1 307 | 45 | 0.5 | 11.2 | 12.1 | 48.5 | 25.9 | 1.8 | 0.83:1 | 6 | 23.6 | 66.8 | 11.6 | 13.0 | 8.6 | 4.6 | 21.4 | 1.7 | 49.4 |
| Montenegro | 1 021 | 60 | 6.1 | 2.3 | 5.2 | 44.6 | 38.3 | 3.6 | 1.07:1 | 6 | 26.2 | 70.6 | 20.7 | 8.7 | 0.0 | 3.6 | 28.3 | 2.3 | 49.9 |
| Serbia | 13 781 | 62 | 3.5 | 4.2 | 5.5 | 42.8 | 40.2 | 3.8 | 0.94:1 | 6 | 24.6 | 79.0 | 15.0 | 4.3 | 1.8 | 6.2 | 24.5 | 2.7 | 48.4 |

*CVC: central vascular catheter; EU/EEA P25: 25th percentile of EU/EEA countries and the UK; P50: 50th percentile (median); P75: 75th percentile. Vaccinated against COVID-19: full baseline vaccination or full baseline plus additional dose(s) vs not or partially vaccinated*

## Table A1.2. Distribution of patient/consultant specialty by country, ECDC PPS 2022–2023

| Patient/consultant specialty | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of patients, all specialties | 9 161 | 10 142 | 3 977 | 8 066 | 1 173 | 12 296 | 3 875 | 7 564 | 17 235 | 8 857 | 9 264 | 23 266 | 678 | 12 472 | 19 740 | 972 | 9 491 | 1 699 | 1 082 | 4 863 | 9 378 | 23 661 | 20 367 | 21 866 | 10 533 | 4 925 | 23 266 | 13 526 | **293 395** | 1 307 | 1 021 | 13 781 |
| **Surgery** | 33.4 | 19.0 | 28.8 | 29.2 | 26.9 | 30.1 | 20.6 | 28.8 | 15.9 | 33.4 | 31.5 | 15.7 | 17.0 | 23.5 | 28.3 | 29.0 | 21.1 | 24.1 | 30.4 | 32.2 | 31.1 | 27.3 | 32.3 | 26.5 | 24.6 | 33.4 | 29.1 | 28.7 | **26.5** | 22.5 | 33.7 | 30.7 |
| General surgery | 6.4 | 1.0 | 10.5 | 2.4 | 9.3 | 9.8 | 7.4 | 1.2 | 0.3 | 5.6 | 9.5 | 3.9 | 3.2 | 7.2 | 6.0 | 12.1 | 4.7 | 1.2 | 11.7 | 8.0 | 8.6 | 6.2 | 10.2 | 9.4 | 9.1 | 1.8 | 6.4 | 11.8 | **6.5** | 2.9 | 9.0 | 8.3 |
| Digestive tract surgery | 1.8 | 3.8 | 0.5 | 4.9 | 0.0 | 0.5 | 0.4 | 8.7 | 3.9 | 2.2 | 0.0 | 0.2 | 0.6 | 1.4 | 0.8 | 0.0 | 0.0 | 3.5 | 0.1 | 4.2 | 5.3 | 0.7 | 0.7 | 0.0 | 0.3 | 4.8 | 1.8 | 0.0 | **1.6** | 2.5 | 2.1 | 2.4 |
| Orthopaedics and traumatology | 15.8 | 6.2 | 5.3 | 7.4 | 8.4 | 9.4 | 4.7 | 8.6 | 5.7 | 12.7 | 8.6 | 5.3 | 7.1 | 7.7 | 7.0 | 8.2 | 4.5 | 11.1 | 10.3 | 8.1 | 9.5 | 6.3 | 10.3 | 5.0 | 7.3 | 13.7 | 8.9 | 9.0 | **7.8** | 3.1 | 8.1 | 7.0 |
| Cardiovascular surgery | 2.5 | 2.1 | 1.5 | 3.2 | 0.9 | 1.6 | 1.9 | 2.8 | 1.6 | 3.0 | 2.6 | 1.0 | 1.9 | 2.5 | 3.6 | 0.0 | 1.7 | 2.9 | 3.1 | 1.9 | 1.1 | 3.1 | 2.2 | 1.3 | 1.0 | 2.6 | 3.0 | 0.8 | **2.1** | 2.7 | 3.3 | 2.0 |
| Thoracic surgery | 0.4 | 0.1 | 0.9 | 0.5 | 1.1 | 0.2 | 0.4 | 0.2 | 0.3 | 0.3 | 0.9 | 0.2 | 0.3 | 0.2 | 0.8 | 0.0 | 0.3 | 0.1 | 0.0 | 0.4 | 0.8 | 1.0 | 0.3 | 0.6 | 0.2 | 1.0 | 0.6 | 1.0 | **0.5** | 1.4 | 1.1 | 0.8 |
| Neurosurgery | 1.1 | 1.5 | 1.7 | 2.0 | 1.9 | 2.1 | 1.0 | 1.6 | 0.9 | 1.4 | 2.2 | 0.7 | 1.3 | 0.9 | 2.8 | 0.4 | 1.7 | 2.4 | 2.0 | 3.5 | 1.5 | 1.7 | 2.0 | 1.9 | 1.5 | 1.5 | 2.5 | 1.0 | **1.7** | 0.9 | 2.4 | 1.5 |
| Transplantation surgery | 0.2 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.6 | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.0 | 0.2 | 0.0 | 0.1 | 0.2 | **0.1** | 0.0 | 0.0 | 0.0 |
| Surgery for cancer | 0.1 | 0.3 | 0.0 | 0.9 | 0.1 | 0.6 | 1.7 | 0.3 | 0.1 | 0.1 | 0.5 | 0.5 | 0.6 | 0.1 | 0.7 | 1.3 | 1.3 | 0.0 | 0.0 | 0.5 | 0.0 | 1.4 | 0.8 | 0.3 | 0.7 | 0.7 | 0.1 | 0.1 | **0.5** | 0.0 | 0.0 | 0.4 |
| ENT | 1.2 | 0.4 | 3.4 | 2.2 | 1.7 | 1.6 | 0.8 | 0.7 | 0.7 | 1.7 | 2.3 | 1.5 | 0.7 | 0.9 | 1.1 | 0.4 | 0.8 | 0.7 | 1.0 | 0.1 | 1.5 | 1.7 | 1.1 | 1.7 | 0.9 | 1.7 | 1.1 | 1.0 | **1.3** | 2.8 | 1.6 | 1.8 |
| Ophthalmology | 0.6 | 0.2 | 0.9 | 1.3 | 0.0 | 0.6 | 0.0 | 0.4 | 0.1 | 1.1 | 0.5 | 0.5 | 0.1 | 0.2 | 0.3 | 1.0 | 0.6 | 0.0 | 0.2 | 0.0 | 0.3 | 1.3 | 0.2 | 1.3 | 0.5 | 0.9 | 0.1 | 0.1 | **0.5** | 1.8 | 0.6 | 1.3 |
| Maxillo-facial surgery | 0.1 | 0.2 | 0.1 | 0.7 | 0.3 | 0.3 | 0.1 | 0.0 | 0.1 | 0.2 | 0.2 | 0.1 | 0.0 | 0.1 | 0.4 | 0.0 | 0.3 | 0.0 | 0.0 | 0.6 | 0.1 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.0 | **0.2** | 0.8 | 0.7 | 0.1 |
| Stomatology/ Dentistry | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | **0.0** | 0.0 | 0.0 | 0.0 |
| Burns care | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.1 |
| Urology | 2.4 | 2.0 | 3.8 | 2.6 | 2.0 | 2.8 | 1.9 | 2.6 | 1.8 | 4.3 | 2.9 | 1.3 | 0.4 | 1.6 | 3.4 | 4.6 | 1.1 | 1.8 | 1.4 | 3.5 | 1.8 | 2.8 | 2.9 | 3.0 | 2.1 | 3.3 | 3.3 | 2.2 | **2.5** | 2.8 | 4.0 | 4.0 |
| Plastic and reconstructive surgery | 0.6 | 0.7 | 0.1 | 0.7 | 0.6 | 0.2 | 0.2 | 1.2 | 0.2 | 0.2 | 0.4 | 0.1 | 0.4 | 0.4 | 0.4 | 0.0 | 0.1 | 0.2 | 0.6 | 0.7 | 0.5 | 0.2 | 0.9 | 1.5 | 0.6 | 1.1 | 0.7 | 0.4 | **0.5** | 0.9 | 0.8 | 0.9 |
| Other surgery | 0.2 | 0.4 | 0.0 | 0.3 | 0.0 | 0.3 | 0.1 | 0.1 | 0.2 | 0.4 | 0.1 | 0.2 | 0.1 | 0.2 | 0.3 | 0.8 | 3.7 | 0.1 | 0.0 | 0.8 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.9 | **0.3** | 0.0 | 0.0 | 0.3 |
| **Medicine** | 42.7 | 30.5 | 44.0 | 37.5 | 44.4 | 34.0 | 41.3 | 36.4 | 33.4 | 38.4 | 48.3 | 39.0 | 31.3 | 53.6 | 44.3 | 50.7 | 30.9 | 28.2 | 51.9 | 47.2 | 41.9 | 42.5 | 45.7 | 44.3 | 36.0 | 42.4 | 49.3 | 42.2 | **41.6** | 31.0 | 34.3 | 38.6 |
| General medicine | 8.7 | 3.4 | 2.5 | 2.5 | 23.4 | 12.7 | 18.4 | 11.3 | 6.1 | 8.9 | 21.1 | 11.1 | 11.1 | 31.2 | 14.4 | 10.8 | 9.3 | 2.5 | 36.2 | 12.7 | 19.2 | 9.3 | 29.8 | 6.8 | 15.2 | 6.3 | 23.3 | 11.7 | **13.8** | 0.0 | 9.5 | 3.9 |
| Gastro-enterology | 3.3 | 3.6 | 4.6 | 4.6 | 0.3 | 1.0 | 1.1 | 0.4 | 3.4 | 5.3 | 1.3 | 2.6 | 2.2 | 2.4 | 2.0 | 0.0 | 1.6 | 2.8 | 2.9 | 4.0 | 2.0 | 1.9 | 1.2 | 3.9 | 0.5 | 3.8 | 4.2 | 1.1 | **2.5** | 1.4 | 0.5 | 2.5 |
| Hepatology | 0.1 | 0.1 | 0.0 | 0.6 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.4 | 0.1 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Endocrinology | 0.9 | 0.7 | 2.3 | 1.8 | 0.0 | 0.1 | 0.2 | 0.3 | 1.5 | 0.2 | 0.2 | 0.6 | 0.0 | 1.3 | 0.7 | 0.1 | 0.8 | 1.6 | 1.6 | 0.0 | 0.1 | 1.0 | 0.2 | 0.5 | 0.2 | 1.2 | 0.2 | 0.5 | **0.6** | 1.4 | 0.9 | 2.1 |
| Nephrology | 1.9 | 1.2 | 5.0 | 2.7 | 2.0 | 0.3 | 1.4 | 0.7 | 1.6 | 2.0 | 1.2 | 0.7 | 1.8 | 2.0 | 2.1 | 0.1 | 1.0 | 1.4 | 0.0 | 0.0 | 1.2 | 1.7 | 1.3 | 1.9 | 0.4 | 2.3 | 1.5 | 1.4 | **1.5** | 0.9 | 1.0 | 1.5 |
| Cardiology | 5.4 | 4.6 | 6.7 | 6.0 | 6.0 | 3.3 | 4.6 | 6.0 | 6.0 | 10.1 | 7.8 | 4.8 | 4.0 | 3.7 | 5.0 | 4.8 | 3.7 | 3.8 | 2.6 | 10.2 | 3.8 | 7.7 | 2.9 | 6.6 | 1.9 | 6.3 | 4.6 | 6.4 | **5.4** | 4.0 | 6.0 | 6.4 |
| Dermatology | 1.2 | 0.1 | 0.9 | 0.3 | 0.0 | 0.9 | 0.4 | 0.1 | 0.3 | 0.4 | 0.3 | 0.4 | 0.0 | 0.0 | 0.1 | 0.0 | 0.4 | 0.1 | 0.3 | 0.1 | 0.3 | 0.6 | 0.2 | 1.2 | 1.0 | 0.2 | 0.1 | 0.1 | **0.4** | 1.5 | 0.1 | 0.6 |
| Haematology / BMT | 1.1 | 1.2 | 3.0 | 2.1 | 1.4 | 1.4 | 1.5 | 1.8 | 0.9 | 0.6 | 2.8 | 1.3 | 1.8 | 1.9 | 2.7 | 0.0 | 0.9 | 1.5 | 2.1 | 1.6 | 1.2 | 1.6 | 1.3 | 1.4 | 0.8 | 1.5 | 2.3 | 2.1 | **1.6** | 0.8 | 0.6 | 2.1 |
| Oncology | 4.2 | 3.5 | 1.0 | 2.8 | 2.0 | 2.8 | 3.0 | 2.2 | 2.3 | 2.2 | 1.9 | 2.1 | 2.2 | 4.2 | 2.6 | 3.0 | 2.9 | 6.5 | 1.0 | 1.7 | 3.6 | 4.4 | 1.5 | 3.6 | 4.5 | 1.9 | 3.0 | 2.5 | **2.9** | 0.0 | 2.8 | 4.0 |
| Neurology | 5.7 | 4.6 | 8.7 | 5.7 | 1.4 | 5.3 | 4.4 | 6.1 | 4.1 | 4.7 | 2.5 | 3.8 | 2.9 | 1.3 | 3.9 | 5.3 | 6.4 | 3.2 | 2.4 | 7.4 | 4.5 | 6.5 | 2.4 | 5.7 | 7.7 | 5.9 | 3.6 | 4.3 | **4.6** | 4.7 | 3.0 | 5.3 |
| Pneumology | 2.2 | 4.7 | 5.1 | 4.2 | 4.7 | 2.2 | 2.8 | 3.8 | 3.4 | 2.1 | 6.5 | 3.1 | 2.9 | 2.8 | 3.1 | 2.9 | 1.2 | 3.4 | 1.7 | 7.6 | 3.1 | 4.6 | 2.5 | 3.4 | 1.9 | 5.5 | 4.6 | 2.0 | **3.4** | 8.1 | 6.3 | 5.8 |
| COVID-19 (non-ICU) | 4.0 | 0.1 | 0.0 | 0.1 | 1.8 | 0.0 | 0.0 | 0.6 | 0.0 | 0.6 | 0.0 | 2.8 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | **0.5** | 0.0 | 0.0 | 0.9 |
| Rheumatology | 1.0 | 0.1 | 1.6 | 0.7 | 0.0 | 0.7 | 0.4 | 0.1 | 1.3 | 0.0 | 0.4 | 2.4 | 0.0 | 1.0 | 0.4 | 0.0 | 0.6 | 0.0 | 0.0 | 0.1 | 0.5 | 0.9 | 0.1 | 1.1 | 0.1 | 1.3 | 0.2 | 0.2 | **0.7** | 1.8 | 0.9 | 1.0 |
| Infectious diseases | 0.3 | 1.4 | 2.5 | 2.6 | 0.1 | 1.7 | 2.5 | 2.5 | 1.2 | 0.2 | 0.9 | 1.7 | 2.4 | 0.8 | 4.1 | 23.1 | 2.0 | 1.0 | 1.2 | 0.0 | 2.5 | 1.4 | 1.3 | 5.0 | 1.4 | 4.0 | 1.0 | 4.8 | **2.1** | 6.3 | 2.7 | 1.6 |
| Medical traumatology | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.0** | 0.0 | 0.0 | 0.0 |
| Other Medical | 2.6 | 0.9 | 0.3 | 0.7 | 1.4 | 1.4 | 0.7 | 0.3 | 1.2 | 0.9 | 1.4 | 1.6 | 0.0 | 0.9 | 1.4 | 0.5 | 0.0 | 0.4 | 0.0 | 1.4 | 0.0 | 0.7 | 1.0 | 3.3 | 0.2 | 2.0 | 0.4 | 5.2 | **1.3** | 0.2 | 0.0 | 1.0 |
| **Intensive care** | 3.8 | 4.1 | 6.0 | 5.5 | 8.3 | 7.8 | 3.0 | 3.1 | 4.2 | 4.4 | 6.0 | 1.9 | 2.2 | 2.3 | 5.2 | 5.1 | 3.1 | 5.3 | 2.1 | 5.0 | 5.7 | 2.7 | 4.1 | 4.5 | 5.3 | 4.1 | 4.7 | 1.4 | **4.1** | 2.5 | 5.9 | 6.3 |
| Medical ICU | 1.0 | 2.0 | 1.4 | 1.8 | 2.4 | 2.7 | 0.3 | 0.8 | 1.2 | 2.0 | 2.2 | 0.3 | 0.9 | 1.0 | 0.7 | 1.4 | 0.0 | 1.9 | 0.7 | 2.6 | 2.2 | 1.1 | 0.8 | 1.0 | 1.6 | 1.8 | 1.2 | 0.2 | **1.2** | 0.3 | 3.3 | 2.0 |
| Surgical ICU | 1.6 | 0.9 | 0.8 | 1.4 | 1.0 | 1.9 | 0.4 | 1.2 | 0.5 | 1.2 | 0.5 | 0.2 | 1.3 | 0.9 | 0.6 | 0.1 | 0.1 | 0.7 | 0.5 | 0.9 | 2.0 | 0.4 | 0.9 | 0.7 | 0.9 | 1.5 | 0.9 | 0.1 | **0.8** | 0.0 | 2.5 | 2.1 |
| Mixed/polyvalent ICU | 0.5 | 0.9 | 3.8 | 0.9 | 3.6 | 1.6 | 2.3 | 0.8 | 2.5 | 0.5 | 1.8 | 1.0 | 0.0 | 0.3 | 2.2 | 2.8 | 2.5 | 2.4 | 0.2 | 1.5 | 0.0 | 0.9 | 2.1 | 2.4 | 1.6 | 0.1 | 2.4 | 0.7 | **1.5** | 2.2 | 0.0 | 1.1 |
| Specialized ICU | 0.1 | 0.3 | 0.0 | 1.3 | 1.2 | 1.6 | 0.1 | 0.1 | 0.1 | 0.5 | 1.0 | 0.3 | 0.0 | 0.0 | 1.6 | 0.8 | 0.5 | 0.3 | 0.7 | 0.0 | 0.0 | 0.3 | 0.3 | 0.3 | 1.2 | 0.7 | 0.2 | 0.5 | **0.5** | 0.0 | 0.0 | 1.0 |
| COVID-19 ICU | 0.6 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.2 |
| Other ICU | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |

| Patient/consultant specialty | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Paediatrics/Neonates | 5.5 | 9.2 | 9.9 | 6.6 | 11.3 | 8.2 | 3.5 | 8.0 | 5.9 | 4.4 | 7.4 | 4.9 | 6.5 | 7.8 | 7.6 | 8.4 | 4.9 | 5.7 | 7.8 | 8.1 | 6.2 | 7.0 | 6.7 | 8.9 | 9.4 | 7.8 | 4.7 | 8.9 | **6.9** | 18.2 | 12.3 | 10.4 |
| Paediatric surgery | 0.2 | 0.4 | 0.0 | 0.3 | 0.3 | 0.6 | 0.6 | 0.3 | 0.3 | 0.4 | 0.7 | 0.3 | 0.0 | 0.3 | 0.5 | 0.7 | 0.3 | 0.5 | 1.2 | 0.5 | 0.6 | 0.8 | 0.4 | 0.9 | 0.2 | 0.6 | 0.3 | 0.7 | **0.5** | 0.5 | 1.6 | 0.4 |
| Healthy neonates | 2.2 | 2.4 | 0.7 | 1.3 | 0.9 | 2.0 | 0.3 | 3.3 | 0.5 | 0.6 | 0.1 | 1.3 | 2.5 | 2.3 | 1.6 | 2.9 | 0.1 | 1.8 | 1.9 | 0.6 | 0.0 | 1.0 | 2.9 | 1.5 | 3.1 | 2.8 | 0.4 | 3.1 | **1.5** | 0.0 | 3.7 | 2.7 |
| Neonatology | 0.4 | 1.3 | 1.8 | 0.9 | 1.8 | 1.4 | 0.9 | 1.1 | 1.9 | 1.1 | 0.3 | 0.2 | 1.9 | 0.5 | 0.9 | 0.1 | 0.8 | 1.4 | 0.0 | 1.2 | 1.6 | 1.7 | 0.6 | 1.8 | 1.0 | 0.8 | 1.0 | 1.6 | **1.1** | 6.5 | 2.4 | 2.2 |
| Paediatrics | 1.6 | 4.0 | 5.6 | 2.5 | 4.2 | 2.8 | 1.3 | 2.0 | 2.7 | 1.5 | 4.7 | 2.2 | 2.1 | 3.9 | 2.7 | 4.4 | 3.4 | 2.1 | 2.6 | 4.7 | 3.8 | 2.7 | 1.8 | 3.9 | 3.8 | 2.8 | 2.2 | 2.8 | **2.9** | 9.9 | 3.4 | 4.0 |
| Paediatric ICU | 0.4 | 0.5 | 0.8 | 0.3 | 0.6 | 0.5 | 0.2 | 0.3 | 0.1 | 0.2 | 0.3 | 0.2 | 0.0 | 0.1 | 0.2 | 0.0 | 0.2 | 0.0 | 0.4 | 1.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0.3 | 0.3 | 0.3 | 0.2 | **0.2** | 1.0 | 0.2 | 0.3 |
| Neonatal ICU | 0.6 | 0.7 | 1.1 | 1.3 | 3.5 | 0.9 | 0.1 | 1.0 | 0.5 | 0.5 | 1.3 | 0.7 | 0.0 | 0.8 | 1.7 | 0.3 | 0.1 | 0.0 | 1.7 | 0.0 | 0.0 | 0.7 | 0.8 | 0.7 | 0.9 | 0.3 | 0.5 | 0.4 | **0.7** | 0.3 | 1.0 | 0.8 |
| **Obstetrics and gynaecology** | 5.7 | 4.6 | 5.2 | 7.8 | 4.9 | 5.1 | 4.2 | 5.4 | 8.9 | 5.1 | 2.9 | 4.4 | 6.3 | 4.7 | 5.8 | 5.3 | 2.2 | 7.8 | 5.9 | 4.8 | 11.1 | 6.8 | 5.1 | 5.5 | 7.5 | 8.1 | 5.1 | 2.5 | **5.6** | 13.6 | 10.4 | 8.6 |
| Obstetrics / Maternity | 3.4 | 3.6 | 3.5 | 4.1 | 3.7 | 1.9 | 3.0 | 4.1 | 8.3 | 2.5 | 2.3 | 3.1 | 4.1 | 4.0 | 4.0 | 4.2 | 1.3 | 6.6 | 4.2 | 4.0 | 9.7 | 3.6 | 3.9 | 4.0 | 3.4 | 4.6 | 3.6 | 0.8 | **3.8** | 12.8 | 4.3 | 4.7 |
| Gynaecology (incl. surgery) | 2.3 | 1.0 | 1.7 | 3.7 | 1.3 | 3.1 | 1.2 | 1.3 | 0.6 | 2.6 | 0.6 | 1.3 | 2.2 | 0.7 | 1.8 | 1.1 | 0.9 | 1.2 | 1.8 | 0.8 | 1.5 | 3.2 | 1.2 | 1.5 | 4.1 | 3.5 | 1.4 | 1.7 | **1.8** | 0.8 | 6.1 | 3.8 |
| **Geriatrics** | 2.3 | 17.2 | 0.0 | 0.1 | 0.0 | 2.0 | 8.1 | 1.0 | 6.5 | 5.8 | 0.0 | 1.8 | 15.8 | 6.4 | 3.2 | 0.0 | 0.8 | 11.6 | 0.0 | 2.6 | 1.6 | 2.1 | 0.2 | 0.4 | 2.8 | 0.1 | 1.6 | 4.5 | **2.9** | 0.0 | 0.0 | 0.6 |
| Geriatrics, care for the elderly | 2.3 | 17.2 | 0.0 | 0.1 | 0.0 | 2.0 | 8.1 | 1.0 | 6.5 | 5.8 | 0.0 | 1.8 | 15.8 | 6.4 | 3.2 | 0.0 | 0.8 | 11.6 | 0.0 | 2.6 | 1.6 | 2.1 | 0.2 | 0.4 | 2.8 | 0.1 | 1.6 | 4.5 | **2.9** | 0.0 | 0.0 | 0.6 |
| **Psychiatry** | 5.0 | 7.1 | 2.1 | 10.1 | 2.6 | 4.0 | 11.3 | 14.8 | 4.5 | 6.7 | 3.3 | 10.0 | 16.2 | 0.1 | 2.1 | 0.0 | 5.8 | 12.6 | 0.6 | 0.0 | 0.0 | 4.2 | 4.6 | 6.9 | 9.5 | 3.3 | 4.5 | 9.4 | **5.6** | 3.9 | 3.4 | 3.2 |
| Psychiatrics | 5.0 | 7.1 | 2.1 | 10.1 | 2.6 | 4.0 | 11.3 | 14.8 | 4.5 | 6.7 | 3.3 | 10.0 | 16.2 | 0.1 | 2.1 | 0.0 | 5.8 | 12.6 | 0.6 | 0.0 | 0.0 | 4.2 | 4.6 | 6.9 | 9.5 | 3.3 | 4.5 | 9.4 | **5.6** | 3.9 | 3.4 | 3.2 |
| **Rehabilitation/Long-term care** | 0.6 | 7.6 | 2.0 | 2.5 | 1.3 | 8.5 | 7.1 | 1.7 | 17.8 | 1.0 | 0.5 | 20.6 | 4.7 | 1.4 | 2.4 | 1.2 | 21.3 | 4.4 | 0.0 | 0.0 | 2.3 | 6.4 | 0.7 | 2.7 | 4.7 | 0.6 | 0.7 | 1.7 | **5.7** | 0.0 | 0.0 | 1.2 |
| Rehabilitation | 0.4 | 7.5 | 2.0 | 1.8 | 1.3 | 3.2 | 4.1 | 0.9 | 10.9 | 1.0 | 0.5 | 12.6 | 4.6 | 1.4 | 2.4 | 1.2 | 7.0 | 4.3 | 0.0 | 0.0 | 2.3 | 4.4 | 0.7 | 2.6 | 2.0 | 0.4 | 0.7 | 1.7 | **3.6** | 0.0 | 0.0 | 0.8 |
| Long-term care | 0.2 | 0.1 | 0.0 | 0.8 | 0.0 | 5.3 | 3.1 | 0.9 | 6.9 | 0.0 | 0.0 | 8.0 | 0.1 | 0.0 | 0.0 | 0.0 | 14.3 | 0.1 | 0.0 | 0.0 | 0.0 | 2.0 | 0.0 | 0.1 | 2.7 | 0.2 | 0.0 | 0.0 | **2.1** | 0.0 | 0.0 | 0.4 |
| **Mixed/Other/Unknown** | 1.1 | 0.7 | 2.0 | 0.6 | 0.2 | 0.4 | 0.9 | 0.9 | 3.0 | 0.9 | 0.1 | 1.6 | 0.0 | 0.3 | 1.1 | 0.1 | 9.9 | 0.5 | 1.3 | 0.0 | 0.1 | 1.1 | 0.6 | 0.3 | 0.1 | 0.2 | 0.4 | 0.7 | **1.1** | 8.3 | 0.0 | 0.4 |
| Others not listed | 0.6 | 0.5 | 1.4 | 0.2 | 0.2 | 0.2 | 0.9 | 0.1 | 0.0 | 0.6 | 0.1 | 1.0 | 0.0 | 0.2 | 0.7 | 0.1 | 9.5 | 0.5 | 1.3 | 0.0 | 0.1 | 0.4 | 0.4 | 0.2 | 0.1 | 0.1 | 0.4 | 0.6 | **0.7** | 2.5 | 0.0 | 0.0 |
| Combination of specialties | 0.5 | 0.3 | 0.6 | 0.4 | 0.0 | 0.3 | 0.0 | 0.8 | 3.0 | 0.2 | 0.0 | 0.6 | 0.0 | 0.1 | 0.4 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.3 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | **0.4** | 5.7 | 0.0 | 0.4 |

## Table A1.3. Distribution of types of HAI, by country

| Type of HAI (code) | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of HAIs | 459 | 1 029 | 171 | 643 | 172 | 907 | 229 | 600 | 1 167 | 392 | 1 353 | 1 446 | 45 | 966 | 2 162 | 35 | 385 | 125 | 87 | 339 | 425 | 1 458 | 2 599 | 725 | 817 | 436 | 2 134 | 1 498 | **22 806** | 62 | 38 | 727 |
| **Pneumonia** | 20.0 | 21.9 | 24.6 | 21.2 | 26.2 | 14.0 | 18.3 | 17.5 | 14.0 | 19.9 | 25.2 | 13.1 | 15.6 | 27.4 | 17.0 | 45.7 | 24.2 | 21.6 | 17.2 | 11.8 | 24.5 | 26.2 | 17.5 | 18.1 | 14.2 | 28.4 | 14.7 | 18.6 | **19.7** | 29.0 | 21.1 | 19.4 |
| Pneumonia, positive quantitative culture, minimally contaminated LRT specimen (PN1) | 3.1 | 3.0 | 15.8 | 3.6 | 1.2 | 1.5 | 0.4 | 0.2 | 3.0 | 1.8 | 3.4 | 0.6 | 0.0 | 1.1 | 3.7 | 0.0 | 5.5 | 0.8 | 0.0 | 0.0 | 0.0 | 4.3 | 0.4 | 1.8 | 1.3 | 3.0 | 1.4 | 0.7 | **2.2** | 11.3 | 2.6 | 3.4 |
| Pneumonia, positive quantitative culture, possibly contaminated LRT specimen (PN2) | 0.4 | 0.6 | 2.3 | 4.0 | 1.2 | 0.9 | 0.0 | 0.2 | 2.4 | 0.3 | 1.8 | 1.0 | 0.0 | 0.3 | 1.4 | 0.0 | 1.6 | 3.2 | 0.0 | 0.0 | 0.0 | 0.8 | 0.3 | 2.5 | 0.4 | 0.2 | 0.7 | 0.7 | **1.1** | 1.6 | 0.0 | 2.8 |
| Pneumonia, microbiological diagnosis by alternative microbiology methods (PN3) | 0.2 | 1.2 | 0.0 | 1.1 | 0.6 | 0.8 | 0.4 | 0.7 | 0.2 | 0.8 | 1.0 | 0.5 | 0.0 | 0.2 | 1.9 | 0.0 | 1.0 | 0.8 | 0.0 | 3.8 | 0.0 | 0.8 | 0.5 | 0.7 | 0.5 | 0.7 | 0.7 | 1.3 | **0.9** | 9.7 | 2.6 | 0.6 |
| Pneumonia, positive sputum culture or non-quantitative culture, LRT specimen (PN4) | 2.8 | 3.9 | 5.8 | 2.2 | 8.7 | 4.9 | 7.4 | 1.7 | 0.7 | 3.1 | 4.4 | 0.8 | 2.2 | 2.2 | 2.6 | 5.7 | 1.8 | 1.6 | 3.4 | 2.1 | 0.0 | 4.5 | 3.7 | 7.9 | 5.3 | 8.3 | 3.3 | 1.1 | **3.3** | 0.0 | 0.0 | 3.2 |
| Pneumonia, clinical signs of pneumonia without positive microbiology (PN5) | 13.3 | 12.4 | 0.6 | 8.6 | 14.0 | 5.7 | 9.6 | 14.7 | 7.7 | 14.0 | 13.8 | 10.1 | 13.3 | 23.3 | 7.2 | 37.1 | 14.3 | 15.2 | 13.8 | 5.3 | 0.0 | 14.8 | 12.5 | 4.7 | 6.4 | 16.3 | 8.6 | 14.8 | **11.3** | 1.6 | 10.5 | 8.0 |
| Pneumonia in neonates (NEO-PNEU) | 0.2 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.1 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 | **0.1** | 1.6 | 2.6 | 1.0 |
| Pneumonia, not specified (PN-Nos) | 0.0 | 0.6 | 0.0 | 1.6 | 0.6 | 0.2 | 0.4 | 0.2 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.1 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 24.5 | 1.0 | 0.0 | 0.4 | 0.1 | 0.0 | 0.0 | 0.0 | **0.7** | 3.2 | 2.6 | 0.6 |
| **COVID-19** | 2.6 | 8.5 | 1.2 | 3.3 | 2.9 | 0.3 | 10.5 | 10.0 | 7.3 | 6.1 | 8.7 | 19.2 | 0.0 | 7.6 | 15.4 | 0.0 | 0.0 | 4.0 | 2.3 | 8.6 | 0.0 | 0.1 | 5.4 | 5.0 | 4.5 | 4.6 | 5.9 | 5.6 | **7.2** | 0.0 | 0.0 | 4.1 |
| Asymptomatic COVID-19 (COV-ASY) | 0.0 | 2.6 | 0.0 | 0.5 | 0.6 | 0.0 | 0.9 | 1.2 | 3.5 | 2.6 | 0.7 | 6.2 | 0.0 | 1.4 | 7.9 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.8 | 0.3 | 0.9 | 1.4 | 2.2 | 0.2 | **2.1** | 0.0 | 0.0 | 1.0 |
| Mild/moderate COVID-19 (COV-MM) | 1.3 | 4.4 | 1.2 | 2.0 | 1.2 | 0.3 | 7.4 | 7.5 | 3.2 | 3.3 | 4.5 | 10.4 | 0.0 | 5.4 | 6.4 | 0.0 | 0.0 | 4.0 | 0.0 | 8.3 | 0.0 | 0.1 | 2.9 | 4.4 | 3.2 | 2.5 | 2.6 | 4.0 | **4.0** | 0.0 | 0.0 | 3.0 |
| Severe COVID-19 (COV-SEV) | 1.3 | 1.5 | 0.0 | 0.8 | 1.2 | 0.0 | 2.2 | 1.3 | 0.6 | 0.3 | 3.5 | 2.6 | 0.0 | 0.7 | 1.1 | 0.0 | 0.0 | 0.0 | 1.1 | 0.3 | 0.0 | 0.1 | 1.7 | 0.3 | 0.5 | 0.7 | 1.0 | 1.4 | **1.2** | 0.0 | 0.0 | 0.1 |
| **Other lower respiratory tract infections** | 1.1 | 2.4 | 2.9 | 1.2 | 3.5 | 5.5 | 4.8 | 0.7 | 4.7 | 0.5 | 3.9 | 4.5 | 8.9 | 3.0 | 1.6 | 14.3 | 4.7 | 8.8 | 0.0 | 0.3 | 0.0 | 3.5 | 4.0 | 1.4 | 3.9 | 2.3 | 5.9 | 2.2 | **3.4** | 6.5 | 0.0 | 1.7 |
| Bronchitis, tracheobronchitis, etc. without evidence of pneumonia (LRI-BRON) | 0.7 | 1.6 | 2.3 | 1.1 | 2.3 | 4.6 | 4.4 | 0.7 | 0.4 | 0.5 | 1.9 | 3.8 | 8.9 | 2.2 | 0.9 | 0.0 | 2.1 | 8.8 | 0.0 | 0.3 | 0.0 | 2.9 | 3.2 | 1.1 | 3.5 | 2.1 | 3.9 | 1.1 | **2.3** | 4.8 | 0.0 | 1.1 |
| Other infections of the lower respiratory tract (LRI-LUNG) | 0.4 | 0.7 | 0.6 | 0.2 | 1.2 | 0.9 | 0.0 | 0.0 | 4.3 | 0.0 | 1.9 | 0.7 | 0.0 | 0.7 | 0.6 | 14.3 | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.7 | 0.1 | 0.4 | 0.2 | 1.9 | 1.1 | **1.0** | 0.0 | 0.0 | 0.6 |
| Lower respiratory tract infection, other than pneumonia, not specified (LRI-Nos) | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 1.6 | 0.0 | 0.0 |
| **Surgical site infections** | 22.4 | 13.6 | 14.6 | 14.9 | 12.8 | 20.2 | 19.2 | 23.8 | 13.2 | 20.2 | 7.3 | 10.9 | 28.9 | 13.6 | 11.1 | 17.1 | 18.4 | 14.4 | 21.8 | 33.9 | 29.6 | 15.9 | 17.5 | 13.9 | 14.7 | 16.5 | 20.1 | 18.6 | **16.6** | 12.9 | 23.7 | 14.4 |
| Surgical site infection, Superficial incisional (SSI-S) | 4.4 | 1.9 | 5.8 | 2.6 | 2.3 | 8.0 | 4.4 | 4.0 | 4.5 | 6.4 | 1.3 | 3.7 | 2.2 | 3.3 | 1.3 | 2.9 | 4.2 | 7.2 | 6.9 | 7.1 | 4.0 | 5.3 | 2.9 | 5.2 | 8.4 | 1.8 | 4.4 | 3.7 | **4.0** | 9.7 | 7.9 | 5.1 |
| Surgical site infection, Deep incisional (SSI-D) | 9.2 | 3.6 | 7.0 | 7.3 | 4.1 | 7.2 | 5.2 | 7.0 | 7.5 | 8.7 | 2.3 | 4.2 | 17.8 | 5.7 | 5.6 | 8.6 | 7.5 | 3.2 | 6.9 | 17.4 | 13.4 | 6.4 | 4.3 | 5.1 | 3.7 | 8.0 | 6.3 | 7.5 | **6.2** | 0.0 | 7.9 | 5.5 |
| Surgical site infection, Organ/Space (SSI-O) | 8.9 | 8.1 | 1.8 | 4.7 | 6.4 | 4.9 | 9.6 | 12.8 | 1.1 | 5.1 | 3.5 | 3.0 | 8.9 | 4.6 | 4.3 | 5.7 | 6.8 | 4.0 | 8.0 | 9.4 | 12.2 | 4.1 | 10.4 | 3.6 | 2.3 | 6.7 | 9.4 | 7.3 | **6.3** | 1.6 | 7.9 | 3.9 |
| Surgical site infection, not specified (SSI-Nos) | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | **<0.1** | 1.6 | 0.0 | 0.0 |
| **Urinary tract infections** | 21.8 | 18.5 | 22.8 | 27.4 | 9.3 | 30.0 | 20.1 | 13.3 | 26.0 | 22.2 | 13.4 | 16.8 | 15.6 | 14.6 | 16.7 | 8.6 | 19.7 | 29.6 | 20.7 | 12.4 | 17.9 | 18.2 | 23.2 | 16.3 | 21.5 | 17.7 | 19.2 | 15.8 | **20.2** | 14.5 | 13.2 | 28.2 |
| Urinary tract infection, microbiologically confirmed (UTI-A) | 14.8 | 15.2 | 20.5 | 20.4 | 5.8 | 20.8 | 13.1 | 11.0 | 23.4 | 14.5 | 8.7 | 9.7 | 15.6 | 8.2 | 13.3 | 5.7 | 11.4 | 25.6 | 16.1 | 9.4 | 0.0 | 12.2 | 18.2 | 14.3 | 16.5 | 13.8 | 15.2 | 9.9 | **14.7** | 9.7 | 7.9 | 21.3 |
| Urinary tract infection, not microbiologically confirmed (UTI-B) | 7.0 | 3.0 | 0.6 | 6.8 | 3.5 | 8.6 | 7.0 | 2.2 | 2.6 | 7.7 | 4.6 | 7.1 | 0.0 | 6.4 | 3.3 | 2.9 | 8.3 | 4.0 | 4.6 | 2.7 | 0.0 | 5.6 | 5.0 | 1.4 | 5.0 | 3.9 | 4.0 | 5.9 | **5.0** | 4.8 | 5.3 | 6.6 |
| Urinary tract infection, not specified (UTI-Nos) | 0.0 | 0.3 | 1.8 | 0.2 | 0.0 | 0.6 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 17.9 | 0.5 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | **0.5** | 0.0 | 0.0 | 0.3 |
| **Bloodstream infections (a)** | 13.9 | 12.2 | 14.0 | 13.2 | 14.0 | 8.9 | 7.9 | 9.2 | 16.3 | 9.9 | 20.1 | 4.9 | 13.3 | 8.6 | 18.0 | 0.0 | 7.5 | 11.2 | 12.6 | 18.0 | 15.5 | 9.6 | 11.4 | 6.9 | 7.5 | 6.0 | 12.6 | 10.5 | **12.3** | 17.7 | 18.4 | 11.0 |
| Bloodstream infection (laboratory-confirmed) , other than CRI3 (BSI) | 10.9 | 10.4 | 9.4 | 8.2 | 9.9 | 6.9 | 7.4 | 7.0 | 10.5 | 7.4 | 15.4 | 3.8 | 11.1 | 7.5 | 9.9 | 0.0 | 4.9 | 8.8 | 9.2 | 13.6 | 15.5 | 7.1 | 9.2 | 5.4 | 5.3 | 4.6 | 10.1 | 7.3 | **9.0** | 17.7 | 18.4 | 6.9 |
| Microbiologically confirmed CVC-related bloodstream infection (CRI3-CVC) | 2.2 | 1.4 | 1.8 | 2.6 | 2.9 | 1.7 | 0.4 | 0.8 | 4.5 | 2.3 | 3.7 | 0.8 | 0.0 | 0.9 | 6.7 | 0.0 | 2.1 | 1.6 | 2.3 | 3.8 | 0.0 | 2.0 | 1.3 | 1.4 | 1.5 | 1.4 | 2.0 | 2.3 | **2.4** | 0.0 | 0.0 | 2.1 |
| Microbiologically confirmed PVC-related bloodstream infection (CRI3-PVC) | 0.4 | 0.1 | 2.3 | 2.3 | 1.2 | 0.2 | 0.0 | 0.8 | 0.8 | 0.3 | 1.0 | 0.2 | 0.0 | 0.0 | 1.3 | 0.0 | 0.5 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | 0.3 | 0.0 | 0.6 | 0.0 | 0.5 | 0.7 | **0.6** | 0.0 | 0.0 | 0.1 |
| Laboratory-confirmed bloodstream infection in neonates, non-CNS (NEO-LCBI) | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.0 | 2.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.6 | 0.0 | 0.0 | 0.5 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | **0.2** | 0.0 | 0.0 | 1.2 |
| Laboratory-confirmed BSI with CNS in neonates (NEO-CNSB) | 0.4 | 0.3 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | **0.1** | 0.0 | 0.0 | 0.7 |
| **Catheter-related infections without BSI** | 1.5 | 0.2 | 2.3 | 0.8 | 1.2 | 0.8 | 0.9 | 2.2 | 1.1 | 0.8 | 1.5 | 0.6 | 2.2 | 0.1 | 1.3 | 0.0 | 1.8 | 0.0 | 2.3 | 0.3 | 0.0 | 1.9 | 0.3 | 1.5 | 1.7 | 0.2 | 0.7 | 0.5 | **1.0** | 0.0 | 2.6 | 0.8 |

| Type of HAI (code) | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Local CVC-related infection (CRI1-CVC) | 0.9 | 0.1 | 0.0 | 0.2 | 1.2 | 0.7 | 0.0 | 0.3 | 0.6 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.5 | 0.0 | 0.0 | 0.3 | 0.0 | 0.5 | 0.1 | 0.4 | 0.5 | 0.0 | 0.2 | 0.1 | **0.3** | 0.0 | 2.6 | 0.1 |
| General CVC-related infection (CRI2-CVC) | 0.4 | 0.0 | 0.0 | 0.5 | 0.0 | 0.1 | 0.9 | 0.2 | 0.2 | 0.0 | 0.8 | 0.1 | 2.2 | 0.0 | 0.8 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.2 | 0.6 | 0.4 | 0.0 | 0.4 | 0.0 | **0.3** | 0.0 | 0.0 | 0.6 |
| Local PVC-related infection (CRI1-PVC) | 0.2 | 0.1 | 2.3 | 0.2 | 0.0 | 0.0 | 0.0 | 1.2 | 0.3 | 0.8 | 0.4 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 2.3 | 0.0 | 0.0 | 0.7 | 0.0 | 0.4 | 0.4 | 0.2 | 0.0 | 0.3 | **0.2** | 0.0 | 0.0 | 0.0 |
| General PVC-related infection (CRI2-PVC) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.1 | 0.5 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.1 |
| **Cardiovascular system infections** | 0.4 | 1.4 | 0.6 | 0.3 | 2.3 | 0.6 | 0.0 | 0.2 | 1.4 | 1.3 | 0.9 | 0.1 | 0.0 | 0.1 | 1.1 | 2.9 | 0.8 | 0.0 | 0.0 | 1.2 | 0.2 | 0.8 | 1.0 | 0.3 | 0.4 | 0.7 | 0.8 | 1.1 | **0.8** | 0.0 | 0.0 | 0.1 |
| Arterial or venous infection (CVS-VASC) | 0.2 | 0.5 | 0.0 | 0.2 | 2.3 | 0.0 | 0.0 | 0.2 | 0.3 | 0.5 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 2.9 | 0.8 | 0.0 | 0.0 | 0.3 | 0.0 | 0.2 | 0.3 | 0.1 | 0.1 | 0.2 | 0.5 | 0.3 | **0.2** | 0.0 | 0.0 | 0.0 |
| Endocarditis (CVS-ENDO) | 0.0 | 0.7 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 1.0 | 0.8 | 0.6 | 0.1 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.4 | 0.7 | 0.1 | 0.1 | 0.2 | 0.2 | 0.6 | **0.4** | 0.0 | 0.0 | 0.1 |
| Myocarditis or pericarditis (CVS-CARD) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Mediastinitis (CVS-MED) | 0.2 | 0.2 | 0.6 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.2 | **0.1** | 0.0 | 0.0 | 0.0 |
| Cardiovasular system infection, not specified (CVS-Nos) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Gastro-intestinal system infections** | 6.5 | 9.0 | 8.2 | 8.4 | 7.6 | 6.2 | 5.7 | 6.7 | 5.8 | 8.9 | 7.5 | 18.9 | 4.4 | 8.5 | 8.3 | 0.0 | 11.7 | 1.6 | 3.4 | 3.2 | 3.1 | 11.5 | 6.7 | 28.1 | 20.4 | 4.8 | 8.3 | 7.7 | **9.8** | 0.0 | 10.5 | 10.9 |
| Clostridium difficile infection (GI-CDI) | 3.7 | 2.8 | 5.8 | 6.7 | 7.0 | 4.0 | 3.1 | 2.7 | 2.0 | 4.6 | 4.1 | 17.2 | 2.2 | 4.8 | 4.3 | 0.0 | 7.5 | 0.0 | 1.1 | 0.9 | 1.9 | 8.2 | 2.8 | 25.7 | 16.8 | 2.3 | 3.4 | 2.9 | **6.2** | 0.0 | 7.9 | 9.5 |
| Gastroenteritis (excluding CDI) (GI-GE) | 0.4 | 0.3 | 1.2 | 0.0 | 0.0 | 0.6 | 0.4 | 0.3 | 0.2 | 0.5 | 0.8 | 1.0 | 0.0 | 0.4 | 0.6 | 0.0 | 1.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.4 | 0.4 | 1.4 | 2.2 | 0.2 | 0.8 | 1.1 | **0.7** | 0.0 | 0.0 | 1.1 |
| Gastrointestinal tract , excl. GE, CDI (GI-GIT) | 0.4 | 1.7 | 0.0 | 0.2 | 0.0 | 0.7 | 0.0 | 1.5 | 0.6 | 2.3 | 0.7 | 0.3 | 0.0 | 1.1 | 1.4 | 0.0 | 0.3 | 0.8 | 0.0 | 0.3 | 0.0 | 0.4 | 0.8 | 0.1 | 0.7 | 0.5 | 1.6 | 1.5 | **0.9** | 0.0 | 0.0 | 0.0 |
| Hepatitis (GI-HEP) | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Intraabdominal infection, not specified elsewhere (GI-IAB) | 1.5 | 3.3 | 0.6 | 1.4 | 0.6 | 1.0 | 2.2 | 2.2 | 3.1 | 1.5 | 1.8 | 0.5 | 2.2 | 2.2 | 1.8 | 0.0 | 2.6 | 0.8 | 1.1 | 2.1 | 0.0 | 2.3 | 2.6 | 0.8 | 0.7 | 1.8 | 2.5 | 2.1 | **1.9** | 0.0 | 0.0 | 0.0 |
| Necrotising enterocolitis (NEO-NEC) | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | **0.1** | 0.0 | 0.0 | 0.0 |
| Gastro-intesinal system infection, not specified (GI-Nos) | 0.0 | 0.2 | 0.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 2.6 | 0.3 |
| **Skin and soft tissue infections** | 2.0 | 3.4 | 2.3 | 2.2 | 4.1 | 4.9 | 4.8 | 3.5 | 3.8 | 2.8 | 2.7 | 7.9 | 2.2 | 3.7 | 2.4 | 5.7 | 2.9 | 4.8 | 1.1 | 3.2 | 2.6 | 4.4 | 3.4 | 4.0 | 1.5 | 2.8 | 4.5 | 4.1 | **3.8** | 3.2 | 0.0 | 3.3 |
| Skin infection (SST-SKIN) | 0.9 | 2.4 | 0.0 | 1.1 | 1.2 | 1.2 | 0.9 | 1.7 | 2.0 | 1.0 | 0.5 | 1.0 | 0.0 | 2.8 | 1.1 | 0.0 | 0.3 | 2.4 | 0.0 | 1.8 | 0.0 | 2.2 | 1.6 | 1.0 | 0.6 | 1.4 | 1.2 | 2.1 | **1.4** | 1.6 | 0.0 | 0.3 |
| Soft tissue (SST-ST) | 0.7 | 0.7 | 1.2 | 0.2 | 1.2 | 2.3 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 | 0.8 | 0.0 | 0.8 | 0.7 | 2.9 | 0.0 | 1.6 | 1.1 | 0.6 | 0.0 | 1.6 | 0.9 | 1.0 | 0.5 | 0.5 | 1.8 | 1.1 | **1.1** | 1.6 | 0.0 | 0.7 |
| Decubitus ulcer (SST-DECU) | 0.2 | 0.1 | 0.6 | 0.8 | 1.7 | 1.2 | 2.6 | 0.8 | 0.6 | 0.5 | 0.6 | 5.9 | 2.2 | 0.1 | 0.3 | 2.9 | 2.1 | 0.8 | 0.0 | 0.9 | 0.0 | 0.5 | 0.8 | 1.7 | 0.4 | 0.7 | 1.5 | 0.6 | **1.1** | 0.0 | 0.0 | 2.2 |
| Burn (SST-BURN) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.2 | 0.0 | 0.3 | **0.1** | 0.0 | 0.0 | 0.0 |
| Breast abscess or mastitis (SST-BRST) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Skin and soft tissue infections, not specified (SST-Nos) | 0.0 | 0.2 | 0.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 2.6 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.1 |
| **Bone and joint infections** | 1.7 | 3.3 | 0.0 | 2.0 | 1.2 | 0.7 | 2.2 | 0.8 | 1.1 | 1.5 | 1.4 | 0.4 | 0.0 | 2.2 | 0.9 | 0.0 | 0.8 | 2.4 | 1.1 | 1.2 | 1.6 | 0.9 | 1.5 | 0.6 | 0.4 | 4.1 | 1.5 | 1.0 | **1.3** | 0.0 | 0.0 | 0.0 |
| Osteomyelitis (BJ-BONE) | 1.1 | 1.7 | 0.0 | 1.6 | 0.6 | 0.2 | 0.9 | 0.3 | 0.3 | 0.3 | 0.7 | 0.2 | 0.0 | 0.8 | 0.6 | 0.0 | 0.3 | 0.8 | 0.0 | 0.9 | 0.0 | 0.5 | 0.8 | 0.0 | 0.1 | 1.8 | 0.6 | 0.7 | **0.6** | 0.0 | 0.0 | 0.0 |
| Joint or bursa (BJ-JNT) | 0.7 | 1.3 | 0.0 | 0.3 | 0.0 | 0.3 | 1.3 | 0.3 | 0.1 | 0.5 | 0.6 | 0.2 | 0.0 | 1.0 | 0.1 | 0.0 | 0.3 | 1.6 | 1.1 | 0.3 | 0.0 | 0.3 | 0.5 | 0.4 | 0.0 | 1.8 | 0.7 | 0.2 | **0.5** | 0.0 | 0.0 | 0.0 |
| Disc space infection (BJ-DISC) | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.2 | 0.7 | 0.8 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.1 | **0.2** | 0.0 | 0.0 | 0.0 |
| Bone and joint infection, not specified (BJ-Nos) | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Central nervous system infections | 0.2 | 0.4 | 1.8 | 0.9 | 0.0 | 0.6 | 0.4 | 0.3 | 0.1 | 2.3 | 0.8 | 0.4 | 0.0 | 0.5 | 0.8 | 2.9 | 0.5 | 0.0 | 0.0 | 1.8 | 0.5 | 0.1 | 0.7 | 0.1 | 0.2 | 1.4 | 0.7 | 0.7 | **0.6** | 11.3 | 0.0 | 0.6 |
| Intracranial infection (CNS-IC) | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.7 | 0.2 | 0.3 | **0.2** | 9.7 | 0.0 | 0.1 |
| Meningitis or ventriculitis (CNS-MEN) | 0.0 | 0.3 | 0.6 | 0.9 | 0.0 | 0.4 | 0.4 | 0.3 | 0.0 | 1.8 | 0.7 | 0.3 | 0.0 | 0.3 | 0.2 | 2.9 | 0.5 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.5 | 0.1 | 0.0 | 0.7 | 0.5 | 0.3 | **0.4** | 1.6 | 0.0 | 0.4 |
| Spinal abscess without meningitis (CNS-SA) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Central nervous system infection, not specified (CNS-Nos) | 0.0 | 0.1 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Eye, ear, nose, throat or mouth (EENT) infections** | 0.4 | 0.6 | 2.9 | 0.3 | 0.0 | 3.6 | 1.7 | 1.5 | 1.4 | 0.3 | 1.3 | 0.8 | 2.2 | 1.2 | 2.0 | 0.0 | 2.6 | 1.6 | 8.0 | 2.9 | 1.4 | 1.4 | 2.0 | 1.1 | 6.1 | 0.9 | 2.4 | 3.6 | **2.0** | 4.8 | 5.3 | 1.0 |
| Conjunctivitis (EENT-CONJ) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.8 | 0.0 | 1.1 | 0.6 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | **0.1** | 0.0 | 0.0 | 0.1 |
| Eye, other than conjunctivitis (EENT-EYE) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.3 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Ear mastoid (EENT-EAR) | 0.2 | 0.3 | 0.6 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.4 | 0.2 | 0.0 | 0.1 | **0.1** | 3.2 | 0.0 | 0.0 |
| Oral cavity (mouth, tongue, or gums) (EENT-ORAL) | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 1.9 | 1.3 | 1.2 | 1.1 | 0.0 | 0.4 | 0.3 | 2.2 | 1.0 | 0.5 | 0.0 | 0.0 | 1.6 | 6.9 | 2.4 | 0.0 | 0.8 | 1.0 | 0.0 | 1.0 | 0.5 | 1.7 | 2.8 | **0.9** | 0.0 | 2.6 | 0.1 |
| Sinusitis (EENT-SINU) | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.2 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Upper respiratory tract, pharyngitis, laryngitis, epiglottitis (EENT-UR) | 0.0 | 0.0 | 2.3 | 0.2 | 0.0 | 1.3 | 0.4 | 0.0 | 0.0 | 0.0 | 0.7 | 0.1 | 0.0 | 0.0 | 1.3 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.5 | 1.0 | 3.9 | 0.0 | 0.3 | 0.6 | **0.6** | 1.6 | 2.6 | 0.7 |
| Eye, ear, nose, throat or mouth infection, not specified (EENT-Nos) | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | 1.4 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |

| Type of HAI (code) | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reproductive tract infections** | 0.4 | 0.8 | 1.2 | 0.0 | 0.0 | 0.9 | 0.9 | 1.0 | 0.7 | 0.0 | 0.2 | 0.2 | 2.2 | 0.4 | 0.4 | 0.0 | 0.3 | 0.0 | 0.0 | 0.3 | 0.0 | 0.5 | 0.3 | 0.0 | 0.4 | 1.1 | 0.5 | 0.5 | **0.4** | 0.0 | 0.0 | 0.3 |
| Endometritis (REPR-EMET) | 0.0 | 0.1 | 0.6 | 0.0 | 0.0 | 0.2 | 0.4 | 0.5 | 0.2 | 0.0 | 0.0 | 0.1 | 2.2 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | **0.1** | 0.0 | 0.0 | 0.3 |
| Episiotomy (REPR-EPIS) | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Vaginal cuff (REPR-VCUF) | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other infections of the male or female reproductive tract (REPR-OREP) | 0.2 | 0.4 | 0.6 | 0.0 | 0.0 | 0.6 | 0.4 | 0.2 | 0.4 | 0.0 | 0.1 | 0.1 | 0.0 | 0.3 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.4 | 0.3 | 0.0 | 0.4 | 1.1 | 0.3 | 0.3 | **0.3** | 0.0 | 0.0 | 0.0 |
| Reproductive tract infections, not specified (REPR-Nos) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Systemic infections** | 4.8 | 3.9 | 0.6 | 3.9 | 15.1 | 3.0 | 2.6 | 9.3 | 3.3 | 3.3 | 5.1 | 1.2 | 4.4 | 8.5 | 2.6 | 2.9 | 2.6 | 0.0 | 9.2 | 0.9 | 3.1 | 5.0 | 4.8 | 2.8 | 2.6 | 8.5 | 2.2 | 8.1 | **4.4** | 0.0 | 5.3 | 4.3 |
| Disseminated infection (SYS-DI) | 2.8 | 0.3 | 0.0 | 0.2 | 0.6 | 0.8 | 0.9 | 3.3 | 0.5 | 2.6 | 1.0 | 0.0 | 0.0 | 0.2 | 0.9 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.5 | 0.4 | 1.0 | 0.0 | 0.0 | 0.6 | 3.1 | **0.8** | 0.0 | 0.0 | 0.4 |
| Treated unidentified severe infection in adults and children (SYS-CSEP) | 1.5 | 2.4 | 0.6 | 2.3 | 10.5 | 1.5 | 1.7 | 4.3 | 2.6 | 0.5 | 3.8 | 1.0 | 0.0 | 6.0 | 1.4 | 2.9 | 2.3 | 0.0 | 6.9 | 0.0 | 1.4 | 3.4 | 3.7 | 1.4 | 2.1 | 6.7 | 1.5 | 4.7 | **2.8** | 0.0 | 0.0 | 1.7 |
| Clinical sepsis in neonates (NEO-CSEP) | 0.4 | 0.6 | 0.0 | 0.3 | 2.9 | 0.3 | 0.0 | 1.7 | 0.2 | 0.3 | 0.1 | 0.1 | 4.4 | 2.0 | 0.3 | 0.0 | 0.3 | 0.0 | 1.1 | 0.6 | 0.0 | 0.5 | 0.7 | 0.0 | 0.5 | 1.8 | 0.1 | 0.2 | **0.6** | 0.0 | 5.3 | 2.1 |
| Systemic infections, not specified (SYS-Nos) | 0.0 | 0.6 | 0.0 | 1.1 | 1.2 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 1.6 | 0.5 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | **0.2** | 0.0 | 0.0 | 0.1 |

*(a) Bloodstream infections: the origin of bloodstream infections (catheter-related, secondary to another infection or unknown origin) was recorded in a separate variable and is not given in this table. Catheter-related bloodstream infections reported under Figure 1 in the country summary sheets (Annex 2) include bloodstream infections (BSI, NEO-CNBC and NEO-LCBI) with origin C-CVC and C-PVC and microbiologically confirmed catheter-related bloodstream infections (CRI3-CVC and CRI3-PVC). Norway used a national protocol which grouped different subtypes of HAI in a single category, e.g. a single category for pneumonia and lower respiratory tract infections.*

## Table A1.4. Microorganisms reported in HAIs, by country, ECDC PPS 2022–2023

| Microorganism | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of HAIs | 1 498 | 1 029 | 171 | 643 | 172 | 907 | 229 | 600 | 1 167 | 392 | 1 353 | 1 446 | 45 | 966 | 2 162 | 35 | 385 | 125 | 87 | 339 | 425 | 1 458 | 2 599 | 725 | 817 | 436 | 2 134 | 1 498 | **22 806** | 62 | 38 | 727 |
| HAIs with microorganisms (%) | 64.3 | 67.2 | 93.0 | 66.7 | 58.1 | 67.7 | 62.4 | 48.5 | 75.7 | 59.7 | 61.7 | 64.7 | 71.1 | 43.5 | 56.4 | 34.3 | 30.1 | 59.2 | 48.3 | 79.6 | 0.0 | 55.1 | 58.6 | 86.3 | 75.4 | 55.3 | 71.6 | 48.8 | **60.8** | 80.6 | 50.0 | 73.0 |
| Number of isolates | 386 | 887 | 199 | 538 | 129 | 813 | 176 | 359 | 1 115 | 292 | 1 033 | 1 077 | 40 | 515 | 1 371 | 12 | 137 | 89 | 53 | 335 | 0 | 980 | 1 852 | 720 | 741 | 333 | 1 891 | 867 | **16 940** | 74 | 22 | 651 |
| **Gram-positive cocci** | 41.5 | 28.5 | 21.6 | 23.4 | 28.7 | 29.2 | 19.3 | 34.5 | 33.4 | 38.7 | 19.2 | 18.3 | 52.5 | 32.2 | 17.9 | 16.7 | 34.3 | 37.1 | 28.3 | 47.2 | - | 29.8 | 24.8 | 15.0 | 22.1 | 31.2 | 27.6 | 38.1 | **26.9** | 35.1 | 18.2 | 17.7 |
| *Staphylococcus aureus* | 9.6 | 10.6 | 5.0 | 6.5 | 10.9 | 10.9 | 9.1 | 16.7 | 10.5 | 12.7 | 3.9 | 6.2 | 20.0 | 13.8 | 8.3 | 8.3 | 11.7 | 15.7 | 11.3 | 15.8 | - | 8.8 | 8.3 | 6.0 | 4.3 | 9.0 | 7.5 | 16.0 | **9.0** | 8.1 | 9.1 | 3.7 |
| Coagulase-negative staphylococci | 10.1 | 6.0 | 6.0 | 6.3 | 6.2 | 5.7 | 2.3 | 5.6 | 10.5 | 8.6 | 7.6 | 1.9 | 7.5 | 6.4 | 0.1 | 0.0 | 6.6 | 6.7 | 1.9 | 11.3 | - | 6.4 | 4.4 | 2.2 | 6.2 | 7.2 | 7.5 | 7.4 | **5.8** | 9.5 | 4.5 | 4.0 |
| *Staphylococcus epidermidis* | 7.3 | 3.4 | 0.5 | 2.4 | 3.1 | 3.0 | 1.7 | 4.2 | 5.9 | 5.1 | 3.8 | 1.1 | 5.0 | 2.9 | 0.0 | 0.0 | 3.6 | 5.6 | 0.0 | 7.2 | - | 4.5 | 2.9 | 0.7 | 2.4 | 4.5 | 4.6 | 4.6 | **3.3** | 1.4 | 4.5 | 0.0 |
| *Staphylococcus haemolyticus* | 1.8 | 1.4 | 3.5 | 0.9 | 0.8 | 1.4 | 0.0 | 0.6 | 1.6 | 0.7 | 1.5 | 0.0 | 0.0 | 1.2 | 0.1 | 0.0 | 0.0 | 1.1 | 0.0 | 0.9 | - | 1.1 | 0.6 | 0.6 | 2.2 | 0.9 | 1.1 | 0.3 | **0.9** | 0.0 | 0.0 | 0.3 |
| Other coagulase-negative staphylococci (CNS) | 1.0 | 1.2 | 2.0 | 3.0 | 2.3 | 1.4 | 0.6 | 0.8 | 3.0 | 2.7 | 2.4 | 0.8 | 2.5 | 2.3 | 0.0 | 0.0 | 2.9 | 0.0 | 1.9 | 3.3 | - | 0.8 | 1.0 | 1.0 | 1.6 | 1.8 | 1.7 | 2.4 | **1.5** | 8.1 | 0.0 | 3.7 |
| Coag-neg. staphylococci, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Streptococcus* species | 4.9 | 3.9 | 1.0 | 0.6 | 0.8 | 2.7 | 3.4 | 2.5 | 2.0 | 3.1 | 0.9 | 1.1 | 10.0 | 1.4 | 0.0 | 0.0 | 0.0 | 7.9 | 1.9 | 5.4 | - | 3.0 | 1.5 | 0.4 | 0.4 | 2.4 | 2.0 | 3.7 | **1.9** | 5.4 | 0.0 | 1.1 |
| *Streptococcus pneumoniae* | 0.0 | 0.3 | 0.5 | 0.0 | 0.0 | 0.1 | 0.6 | 0.3 | 0.3 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.0 | 0.6 | - | 0.5 | 0.3 | 0.0 | 0.1 | 0.0 | 0.5 | 0.2 | **0.2** | 1.4 | 0.0 | 0.0 |
| *Streptococcus agalactiae* (B) | 1.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.8 | 0.5 | 0.7 | 0.0 | 0.5 | 2.5 | 0.6 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.6 | - | 0.7 | 0.3 | 0.3 | 0.3 | 0.6 | 0.1 | 0.5 | **0.4** | 0.0 | 0.0 | 0.2 |
| *Streptococcus pyogenes* (A) | 0.3 | 0.2 | 0.0 | 0.0 | 0.8 | 0.4 | 0.6 | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 2.5 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.1 | 0.1 | 0.0 | 0.0 | 0.6 | 0.2 | 0.3 | **0.2** | 0.0 | 0.0 | 0.0 |
| Other haemol. streptococcae (C, G) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.6 | 0.6 | 0.3 | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | - | 0.2 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.6 | **0.1** | 0.0 | 0.0 | 0.2 |
| *Streptococcus* species, other | 3.6 | 2.8 | 0.5 | 0.6 | 0.0 | 1.1 | 1.7 | 0.8 | 0.7 | 1.7 | 0.6 | 0.5 | 5.0 | 0.2 | 0.0 | 0.0 | 0.0 | 4.5 | 1.9 | 2.7 | - | 1.2 | 0.7 | 0.0 | 0.0 | 0.9 | 0.7 | 2.0 | **0.9** | 4.1 | 0.0 | 0.8 |
| *Streptococcus* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.5 | 0.1 | **0.1** | 0.0 | 0.0 | 0.0 |
| *Enterococcus* species | 16.8 | 7.8 | 9.5 | 10.0 | 10.9 | 9.3 | 4.5 | 9.7 | 9.5 | 14.4 | 6.7 | 9.0 | 15.0 | 10.1 | 9.6 | 8.3 | 16.1 | 6.7 | 13.2 | 14.0 | - | 11.6 | 10.5 | 6.3 | 10.9 | 12.6 | 10.2 | 10.6 | **10.0** | 12.2 | 4.5 | 8.9 |
| *Enterococcus faecalis* | 10.1 | 5.0 | 7.0 | 4.6 | 5.4 | 6.0 | 1.7 | 7.2 | 7.1 | 6.5 | 2.0 | 6.1 | 7.5 | 3.5 | 5.8 | 8.3 | 5.1 | 1.1 | 3.8 | 5.7 | - | 5.3 | 5.7 | 2.5 | 5.4 | 6.6 | 6.5 | 6.1 | **5.5** | 6.8 | 4.5 | 1.2 |
| *Enterococcus faecium* | 6.0 | 2.7 | 2.0 | 5.0 | 5.4 | 3.1 | 2.8 | 1.4 | 2.0 | 7.5 | 3.8 | 2.2 | 7.5 | 5.6 | 3.4 | 0.0 | 10.9 | 4.5 | 9.4 | 8.4 | - | 5.3 | 4.0 | 2.1 | 3.9 | 5.7 | 3.6 | 4.3 | **3.9** | 5.4 | 0.0 | 0.8 |
| *Enterococcus* species, other | 0.5 | 0.1 | 0.0 | 0.4 | 0.0 | 0.2 | 0.0 | 0.8 | 0.4 | 0.3 | 0.3 | 0.0 | 0.0 | 0.6 | 0.3 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | - | 0.8 | 0.6 | 0.6 | 0.4 | 0.3 | 0.0 | 0.2 | **0.3** | 0.0 | 0.0 | 3.8 |
| *Enterococcus* species, not specified | 0.3 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.6 | 0.6 | 0.0 | 0.4 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.2 | 0.1 | 1.1 | 1.2 | 0.0 | 0.1 | 0.0 | **0.2** | 0.0 | 0.0 | 3.1 |
| Other gram-positive cocci | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.9 | 0.0 | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.0 | 0.2 | 0.1 | 0.3 | 0.0 | 0.4 | 0.3 | **0.2** | 0.0 | 0.0 | 0.0 |
| Other Gram-positive cocci | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.2 | 0.1 | 0.3 | 0.0 | 0.3 | 0.2 | **0.2** | 0.0 | 0.0 | 0.0 |
| Gram-positive cocci, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Gram-negative cocci** | 0.3 | 0.2 | 0.0 | 0.2 | 0.8 | 0.1 | 0.0 | 0.3 | 0.2 | 0.3 | 0.3 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.2 | 0.7 | **0.2** | 0.0 | 0.0 | 0.2 |
| *Moraxella catharralis* | 0.3 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.7 | **0.1** | 0.0 | 0.0 | 0.0 |
| *Moraxella* species, other | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.2 |
| *Moraxella* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Neisseria meningitidis* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other Gram-negative cocci | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Gram-negative cocci, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Gram-positive bacilli** | 2.1 | 1.2 | 4.5 | 0.9 | 0.8 | 1.1 | 0.0 | 1.7 | 1.3 | 0.7 | 0.4 | 0.4 | 2.5 | 0.8 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 1.8 | - | 0.4 | 0.4 | 0.6 | 1.1 | 0.0 | 0.6 | 0.7 | **0.7** | 2.7 | 4.5 | 0.8 |
| *Corynebacterium* species | 1.0 | 0.2 | 3.5 | 0.6 | 0.0 | 1.0 | 0.0 | 0.8 | 0.9 | 0.0 | 0.4 | 0.3 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 1.5 | - | 0.3 | 0.2 | 0.4 | 0.9 | 0.0 | 0.4 | 0.3 | **0.5** | 1.4 | 4.5 | 0.6 |

| Microorganism | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Bacillus* species | 0.8 | 0.3 | 1.0 | 0.4 | 0.8 | 0.0 | 0.0 | 0.6 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.3 | **0.1** | 1.4 | 0.0 | 0.0 |
| *Lactobacillus* species | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Listeria monocytogenes* | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other Gram-positive bacilli | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.1 | 0.3 | 0.0 | 0.1 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Gram-positive bacilli, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.2 |
| **Gram-negative bacilli, Enterobacterales** | 30.6 | 39.1 | 34.7 | 35.5 | 24.8 | 42.9 | 43.2 | 28.1 | 38.6 | 32.5 | 22.1 | 20.1 | 20.0 | 28.2 | 38.0 | 33.3 | 32.8 | 42.7 | 43.4 | 24.5 | - | 37.3 | 44.9 | 29.9 | 29.3 | 35.4 | 36.4 | 28.0 | **34.2** | 29.7 | 45.5 | 40.4 |
| *Citrobacter* species | 1.0 | 1.8 | 1.5 | 1.1 | 0.0 | 1.2 | 0.6 | 1.9 | 1.7 | 0.7 | 0.4 | 0.4 | 5.0 | 0.6 | 0.0 | 0.0 | 0.7 | 2.2 | 0.0 | 1.8 | - | 0.5 | 1.1 | 0.4 | 0.5 | 1.2 | 0.8 | 0.3 | **0.9** | 0.0 | 0.0 | 0.3 |
| *Citrobacter freundii* | 0.5 | 1.2 | 1.0 | 0.0 | 0.0 | 0.9 | 0.6 | 1.1 | 1.1 | 0.0 | 0.2 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.7 | 1.1 | 0.0 | 0.9 | - | 0.3 | 0.3 | 0.3 | 0.3 | 0.6 | 0.6 | 0.1 | **0.4** | 0.0 | 0.0 | 0.2 |
| *Citrobacter koseri* (ex. diversus) | 0.5 | 0.5 | 0.0 | 0.9 | 0.0 | 0.2 | 0.0 | 0.3 | 0.4 | 0.7 | 0.2 | 0.0 | 5.0 | 0.2 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.6 | - | 0.1 | 0.4 | 0.0 | 0.1 | 0.3 | 0.2 | 0.1 | **0.2** | 0.0 | 0.0 | 0.0 |
| *Citrobacter* species, other | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.3 | 0.2 | 0.0 | 0.0 | 0.3 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.1 | 0.4 | 0.1 | 0.1 | 0.3 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| *Citrobacter* species, not specified | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | **<0.1** | 0.0 | 0.0 | 0.2 |
| *Enterobacter* species | 2.8 | 4.7 | 3.5 | 3.3 | 2.3 | 2.5 | 4.5 | 4.2 | 4.9 | 2.1 | 1.1 | 1.1 | 2.5 | 1.6 | 3.9 | 0.0 | 5.8 | 6.7 | 3.8 | 1.8 | - | 3.2 | 2.6 | 1.0 | 3.4 | 5.1 | 3.8 | 1.6 | **3.0** | 2.7 | 0.0 | 2.6 |
| *Enterobacter cloacae* | 2.8 | 4.6 | 2.5 | 1.5 | 2.3 | 1.6 | 2.8 | 2.5 | 4.1 | 1.7 | 0.5 | 0.9 | 2.5 | 1.2 | 3.1 | 0.0 | 3.6 | 6.7 | 3.8 | 1.2 | - | 2.3 | 2.0 | 0.6 | 2.2 | 4.8 | 3.0 | 1.5 | **2.3** | 0.0 | 0.0 | 1.2 |
| *Enterobacter agglomerans* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Enterobacter sakazakii* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Enterobacter* species, other | 0.0 | 0.0 | 0.5 | 0.9 | 0.0 | 0.7 | 1.1 | 0.3 | 0.2 | 0.3 | 0.3 | 0.0 | 0.0 | 0.2 | 0.3 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | - | 0.8 | 0.6 | 0.1 | 1.1 | 0.3 | 0.0 | 0.0 | **0.3** | 0.0 | 0.0 | 0.6 |
| *Enterobacter* species, not specified | 0.0 | 0.1 | 0.5 | 0.9 | 0.0 | 0.1 | 0.6 | 1.4 | 0.6 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.7 | 0.1 | **0.3** | 2.7 | 0.0 | 0.8 |
| *Escherichia coli* | 13.0 | 16.5 | 6.0 | 10.4 | 7.0 | 15.6 | 18.2 | 14.5 | 16.6 | 12.3 | 3.3 | 7.5 | 10.0 | 14.2 | 11.7 | 8.3 | 10.9 | 20.2 | 11.3 | 13.1 | - | 12.4 | 17.4 | 5.8 | 8.6 | 14.1 | 14.5 | 16.4 | **12.7** | 1.4 | 22.7 | 6.5 |
| *Klebsiella* species | 10.6 | 10.0 | 15.1 | 13.9 | 11.6 | 14.8 | 8.5 | 4.5 | 8.1 | 10.6 | 13.9 | 6.4 | 0.0 | 7.0 | 16.5 | 8.3 | 11.7 | 5.6 | 20.8 | 4.2 | - | 16.0 | 16.4 | 16.9 | 9.6 | 8.4 | 10.3 | 6.7 | **11.7** | 21.6 | 9.1 | 23.5 |
| *Klebsiella pneumoniae* | 5.7 | 7.8 | 13.6 | 12.8 | 11.6 | 12.5 | 5.7 | 2.8 | 4.3 | 8.2 | 12.4 | 5.5 | 0.0 | 5.2 | 14.1 | 8.3 | 10.2 | 2.2 | 11.3 | 2.7 | - | 14.2 | 14.0 | 13.6 | 8.0 | 4.8 | 7.5 | 4.5 | **9.4** | 17.6 | 9.1 | 12.1 |
| *Klebsiella oxytoca* | 2.3 | 1.1 | 1.0 | 0.4 | 0.0 | 1.2 | 0.0 | 0.8 | 2.1 | 1.4 | 0.6 | 0.6 | 0.0 | 1.7 | 0.9 | 0.0 | 1.5 | 2.2 | 7.5 | 0.9 | - | 0.9 | 0.8 | 0.4 | 1.1 | 1.2 | 1.5 | 1.0 | **1.1** | 0.0 | 0.0 | 0.0 |
| *Klebsiella aerogenes* | 0.8 | 0.6 | 0.5 | 0.4 | 0.0 | 0.4 | 1.7 | 0.6 | 0.4 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 1.1 | 1.9 | 0.0 | - | 0.1 | 1.2 | 0.1 | 0.4 | 1.5 | 0.7 | 0.2 | **0.5** | 0.0 | 0.0 | 0.2 |
| *Klebsiella* species, other | 1.8 | 0.6 | 0.0 | 0.4 | 0.0 | 0.6 | 0.0 | 0.3 | 1.1 | 0.7 | 0.4 | 0.1 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.4 | 0.3 | 0.7 | 0.1 | 0.9 | 0.2 | 0.9 | **0.5** | 0.0 | 0.0 | 6.5 |
| *Klebsiella* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.3 | 0.0 | 0.4 | 0.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.4 | 0.1 | 2.1 | 0.0 | 0.0 | 0.3 | 0.0 | **0.3** | 4.1 | 0.0 | 4.8 |
| *Proteus* species | 1.3 | 3.3 | 3.5 | 4.1 | 2.3 | 4.7 | 7.4 | 0.3 | 4.1 | 4.5 | 1.5 | 3.5 | 2.5 | 2.3 | 3.5 | 8.3 | 2.9 | 3.4 | 3.8 | 1.8 | - | 2.9 | 3.7 | 3.8 | 4.2 | 3.9 | 2.7 | 2.2 | **3.2** | 0.0 | 4.5 | 5.2 |
| *Proteus mirabilis* | 1.3 | 2.8 | 3.5 | 3.9 | 2.3 | 4.4 | 6.8 | 0.3 | 3.6 | 4.1 | 1.3 | 3.2 | 2.5 | 2.3 | 3.5 | 8.3 | 2.2 | 3.4 | 3.8 | 1.8 | - | 2.9 | 3.4 | 2.5 | 3.9 | 3.0 | 2.4 | 1.6 | **2.9** | 0.0 | 4.5 | 4.3 |
| *Proteus vulgaris* | 0.0 | 0.3 | 0.0 | 0.2 | 0.0 | 0.1 | 0.6 | 0.0 | 0.4 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.3 | 0.0 | 0.1 | 0.6 | 0.1 | 0.6 | **0.2** | 0.0 | 0.0 | 0.2 |
| *Proteus* species, other | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.2 |
| *Proteus* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.6 |
| *Serratia* species | 1.8 | 1.5 | 1.0 | 0.7 | 1.6 | 1.4 | 2.3 | 2.2 | 1.1 | 1.7 | 0.7 | 0.6 | 0.0 | 1.2 | 1.5 | 8.3 | 0.7 | 1.1 | 0.0 | 1.5 | - | 1.0 | 2.2 | 0.6 | 1.6 | 1.5 | 2.5 | 0.3 | **1.4** | 4.1 | 9.1 | 1.2 |
| *Serratia marcescens* | 1.8 | 1.5 | 1.0 | 0.7 | 1.6 | 1.4 | 2.3 | 1.9 | 1.0 | 1.4 | 0.6 | 0.5 | 0.0 | 1.0 | 1.5 | 8.3 | 0.7 | 1.1 | 0.0 | 1.5 | - | 1.0 | 2.1 | 0.3 | 1.5 | 1.2 | 2.3 | 0.3 | **1.3** | 4.1 | 4.5 | 0.6 |
| *Serratia liquefaciens* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Serratia* species, other | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.1 | 0.1 | 0.3 | 0.1 | 0.0 | **<0.1** | 0.0 | 4.5 | 0.5 |
| *Serratia* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.2 |
| Other Enterobacterales | 0.0 | 1.4 | 4.0 | 1.9 | 0.0 | 2.8 | 1.7 | 0.6 | 2.1 | 0.7 | 1.3 | 0.6 | 0.0 | 1.4 | 0.9 | 0.0 | 0.0 | 3.4 | 3.8 | 0.3 | - | 1.3 | 1.6 | 1.4 | 1.3 | 1.2 | 1.9 | 0.5 | **1.4** | 0.0 | 0.0 | 1.1 |
| *Hafnia* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.7 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | - | 0.1 | 0.1 | 0.3 | 0.0 | 0.0 | 0.0 | 0.2 | **0.1** | 0.0 | 0.0 | 0.0 |

| Microorganism | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Morganella* species | 0.0 | 1.2 | 1.5 | 1.3 | 0.0 | 1.4 | 0.6 | 0.6 | 1.3 | 0.0 | 0.5 | 0.6 | 0.0 | 0.2 | 0.6 | 0.0 | 0.0 | 2.2 | 3.8 | 0.3 | - | 1.0 | 1.1 | 0.1 | 0.9 | 0.9 | 1.4 | 0.1 | **0.9** | 0.0 | 0.0 | 0.3 |
| *Providencia* species | 0.0 | 0.1 | 2.5 | 0.4 | 0.0 | 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.2 | 1.0 | 0.1 | 0.0 | 0.2 | 0.0 | **0.2** | 0.0 | 0.0 | 0.6 |
| *Salmonella enteritidis* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Salmonella* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Yersinia* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other enterobacterales | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 1.1 | 0.0 | 0.4 | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.1 | 0.0 | 0.3 | 0.3 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Enterobacterales, not specified | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | **0.1** | 0.0 | 0.0 | 0.2 |
| **Other Gram-negative bacilli** | 9.8 | 11.4 | 27.6 | 22.9 | 22.5 | 11.3 | 11.4 | 5.6 | 8.9 | 5.8 | 29.6 | 8.4 | 5.0 | 6.6 | 13.0 | 8.3 | 11.7 | 11.2 | 11.3 | 6.3 | - | 14.1 | 11.7 | 19.6 | 12.3 | 12.3 | 13.5 | 5.5 | **12.9** | 25.7 | 18.2 | 23.0 |
| *Acinetobacter* species | 0.5 | 0.3 | 15.1 | 8.9 | 9.3 | 1.5 | 1.7 | 0.8 | 0.5 | 0.7 | 14.6 | 2.9 | 2.5 | 0.0 | 3.9 | 8.3 | 5.1 | 0.0 | 0.0 | 0.3 | - | 5.7 | 0.7 | 8.6 | 3.4 | 0.6 | 0.6 | 0.2 | **3.2** | 17.6 | 4.5 | 10.1 |
| *Acinetobacter baumannii* | 0.3 | 0.0 | 14.6 | 8.9 | 8.5 | 0.7 | 1.7 | 0.6 | 0.1 | 0.3 | 14.4 | 2.7 | 2.5 | 0.0 | 3.6 | 8.3 | 5.1 | 0.0 | 0.0 | 0.0 | - | 5.4 | 0.6 | 6.8 | 2.2 | 0.6 | 0.5 | 0.1 | **2.8** | 17.6 | 4.5 | 4.6 |
| *Acinetobacter calcoaceticus* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Acinetobacter haemolyticus* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Acinetobacter lwoffii* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Acinetobacter* species, other | 0.3 | 0.2 | 0.5 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.4 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.8 | 0.5 | 0.0 | 0.0 | 0.1 | **0.2** | 0.0 | 0.0 | 3.5 |
| *Acinetobacter* species, not specified | 0.0 | 0.1 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.3 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.7 | 0.5 | 0.0 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 2.0 |
| *Pseudomonas aeruginosa* | 7.8 | 7.7 | 11.1 | 12.1 | 10.1 | 7.7 | 8.5 | 3.3 | 6.8 | 2.1 | 11.9 | 4.6 | 2.5 | 4.1 | 9.1 | 0.0 | 6.6 | 6.7 | 3.8 | 4.5 | - | 7.0 | 9.8 | 8.8 | 7.0 | 9.6 | 9.9 | 3.6 | **7.9** | 8.1 | 9.1 | 11.2 |
| *Stenotrophomonas maltophilia* | 1.3 | 1.0 | 0.5 | 0.6 | 0.8 | 0.7 | 0.0 | 0.8 | 0.6 | 0.3 | 1.7 | 0.6 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 1.1 | 3.8 | 0.3 | - | 0.7 | 0.4 | 1.1 | 0.7 | 1.2 | 1.2 | 0.7 | **0.8** | 0.0 | 0.0 | 0.5 |
| Pseudomonadaceae family, other | 0.0 | 0.3 | 1.0 | 0.6 | 1.6 | 0.6 | 0.0 | 0.3 | 0.2 | 2.1 | 0.6 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.3 | - | 0.1 | 0.1 | 1.0 | 0.3 | 0.0 | 0.6 | 0.1 | **0.4** | 0.0 | 0.0 | 0.9 |
| *Burkholderia cepacia* | 0.0 | 0.0 | 0.0 | 0.2 | 1.6 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 | 0.0 | **0.1** | 0.0 | 0.0 | 0.2 |
| Pseudomonadaceae family, other | 0.0 | 0.3 | 0.5 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 2.1 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.3 | - | 0.0 | 0.1 | 0.3 | 0.1 | 0.0 | 0.2 | 0.1 | **0.2** | 0.0 | 0.0 | 0.3 |
| Pseudomonadaceae family, not specified | 0.0 | 0.0 | 0.5 | 0.2 | 0.0 | 0.1 | 0.0 | 0.3 | 0.1 | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.6 | 0.0 | 0.0 | 0.3 | 0.0 | **0.1** | 0.0 | 0.0 | 0.5 |
| *Haemophilus* species | 0.3 | 1.1 | 0.0 | 0.4 | 0.8 | 0.2 | 1.1 | 0.3 | 0.5 | 0.0 | 0.0 | 0.1 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.3 | - | 0.4 | 0.2 | 0.0 | 0.4 | 0.6 | 0.4 | 0.6 | **0.3** | 0.0 | 0.0 | 0.0 |
| *Haemophilus influenzae* | 0.3 | 1.1 | 0.0 | 0.4 | 0.0 | 0.2 | 1.1 | 0.3 | 0.4 | 0.0 | 0.0 | 0.1 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.3 | - | 0.4 | 0.2 | 0.0 | 0.3 | 0.6 | 0.3 | 0.6 | **0.3** | 0.0 | 0.0 | 0.0 |
| *Haemophilus parainfluenzae* | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Haemophilus* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Legionella* species | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other Gram-negative bacilli | 0.0 | 0.9 | 0.0 | 0.2 | 0.0 | 0.5 | 0.0 | 0.0 | 0.2 | 0.7 | 0.8 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 2.2 | 1.9 | 0.6 | - | 0.1 | 0.4 | 0.1 | 0.5 | 0.3 | 0.7 | 0.3 | **0.4** | 0.0 | 4.5 | 0.3 |
| *Achromobacter* species | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | - | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | **0.1** | 0.0 | 4.5 | 0.3 |
| *Aeromonas* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Alcaligenes* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Campylobacter* species | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Flavobacterium* species | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Gardnerella* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.3 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Helicobacter pylori* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Pasteurella* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Gram-negative bacilli, not specified | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.2 | 0.2 | **0.1** | 0.0 | 0.0 | 0.0 |

| Microorganism | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other Gram-negative bacilli | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.2 | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| **Anaerobes** | 5.2 | 4.4 | 5.0 | 8.4 | 10.9 | 6.8 | 7.4 | 7.2 | 3.5 | 7.9 | 5.7 | 23.8 | 7.5 | 10.7 | 6.9 | 0.0 | 21.2 | 1.1 | 1.9 | 3.3 | - | 13.2 | 5.3 | 26.0 | 19.3 | 6.0 | 6.5 | 8.4 | **9.2** | 0.0 | 13.6 | 10.8 |
| *Bacteroides* species | 0.5 | 0.3 | 0.0 | 0.0 | 0.0 | 0.6 | 1.1 | 1.9 | 0.4 | 0.7 | 0.0 | 0.3 | 2.5 | 0.2 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 1.2 | - | 0.4 | 0.6 | 0.0 | 0.0 | 0.9 | 1.3 | 1.3 | **0.5** | 0.0 | 0.0 | 0.0 |
| *Bacteroides fragilis* | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.4 | 0.6 | 1.7 | 0.3 | 0.3 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.9 | - | 0.4 | 0.4 | 0.0 | 0.0 | 0.6 | 0.6 | 1.0 | **0.3** | 0.0 | 0.0 | 0.0 |
| *Bacteroides* species, other | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.6 | 0.3 | 0.1 | 0.3 | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.3 | 0.2 | **0.2** | 0.0 | 0.0 | 0.0 |
| *Bacteroides* species, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Clostridioides difficile* | 4.4 | 3.5 | 5.0 | 8.0 | 10.1 | 4.9 | 4.0 | 4.7 | 2.2 | 6.2 | 5.4 | 23.2 | 2.5 | 8.9 | 6.9 | 0.0 | 21.2 | 0.0 | 1.9 | 0.9 | - | 12.3 | 4.0 | 26.0 | 19.2 | 3.0 | 3.9 | 5.1 | **8.0** | 0.0 | 13.6 | 10.6 |
| Other anaerobes | 0.3 | 0.6 | 0.0 | 0.4 | 0.8 | 1.2 | 2.3 | 0.6 | 0.9 | 1.0 | 0.3 | 0.3 | 2.5 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | - | 0.4 | 0.6 | 0.0 | 0.1 | 2.1 | 1.3 | 2.1 | **0.7** | 0.0 | 0.0 | 0.2 |
| *Clostridioides* species, other | 0.0 | 0.1 | 0.0 | 0.2 | 0.0 | 0.4 | 0.0 | 0.6 | 0.2 | 0.7 | 0.1 | 0.2 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.1 | 0.1 | 0.0 | 0.0 | 0.6 | 0.6 | 0.3 | **0.2** | 0.0 | 0.0 | 0.0 |
| *Propionibacterium* species | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.2 | 1.3 | **0.2** | 0.0 | 0.0 | 0.2 |
| *Prevotella* species | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 1.1 | 0.0 | 0.2 | 0.3 | 0.1 | 0.1 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| Anaerobes, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.5 | **0.1** | 0.0 | 0.0 | 0.0 |
| Other anaerobes | 0.0 | 0.2 | 0.0 | 0.0 | 0.8 | 0.4 | 1.1 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.3 | 0.2 | 0.0 | 0.1 | 0.9 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.0 |
| **Other bacteria** | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.7 | 1.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.2 | 0.0 | 0.3 | 0.3 | 0.4 | 0.0 | **0.2** | 0.0 | 0.0 | 0.3 |
| Atypical mycobacteria | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Chlamydia* species | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Mycoplasma* species | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Actinomyces* species | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.7 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | **0.1** | 0.0 | 0.0 | 0.2 |
| Other bacteria | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| Other bacteria, not specified | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| **Fungi or parasites** | 6.5 | 4.7 | 5.0 | 5.0 | 7.8 | 7.4 | 4.0 | 4.7 | 5.4 | 4.5 | 10.4 | 2.3 | 2.5 | 5.4 | 0.0 | 0.0 | 0.0 | 1.1 | 9.4 | 6.6 | - | 5.0 | 4.5 | 3.3 | 8.9 | 8.1 | 7.0 | 5.8 | **5.3** | 6.8 | 0.0 | 2.3 |
| *Candida* species | 6.2 | 4.1 | 5.0 | 5.0 | 7.8 | 6.9 | 4.0 | 4.7 | 4.7 | 4.1 | 8.8 | 2.0 | 2.5 | 4.9 | 0.0 | 0.0 | 0.0 | 1.1 | 9.4 | 4.2 | - | 4.7 | 4.1 | 3.2 | 8.6 | 5.1 | 6.0 | 5.0 | **4.7** | 6.8 | 0.0 | 1.7 |
| *Candida albicans* | 3.4 | 2.0 | 2.0 | 1.9 | 3.9 | 4.2 | 3.4 | 3.6 | 2.8 | 2.7 | 2.1 | 1.1 | 2.5 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 2.4 | - | 2.6 | 2.3 | 1.0 | 6.1 | 3.0 | 4.0 | 3.2 | **2.5** | 2.7 | 0.0 | 0.6 |
| *Candida glabrata* | 0.8 | 1.1 | 2.0 | 1.1 | 1.6 | 1.1 | 0.6 | 0.6 | 0.5 | 1.0 | 0.3 | 0.5 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.1 | 1.9 | 0.0 | - | 0.9 | 0.6 | 1.0 | 1.3 | 1.8 | 1.2 | 0.3 | **0.8** | 0.0 | 0.0 | 0.2 |
| *Candida krusei* | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.1 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.3 | 0.2 | **0.1** | 0.0 | 0.0 | 0.0 |
| *Candida parapsilosis* | 0.3 | 0.6 | 0.5 | 1.1 | 1.6 | 0.5 | 0.0 | 0.0 | 0.7 | 0.0 | 2.8 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.1 | 0.5 | 0.0 | 0.5 | 0.0 | 0.4 | 0.0 | **0.5** | 0.0 | 0.0 | 0.3 |
| *Candida tropicalis* | 0.3 | 0.1 | 0.0 | 0.2 | 0.8 | 0.4 | 0.0 | 0.0 | 0.3 | 0.0 | 0.5 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.0 | - | 0.7 | 0.2 | 0.1 | 0.1 | 0.0 | 0.1 | 0.5 | **0.2** | 0.0 | 0.0 | 0.0 |
| *Candida auris* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.1 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |
| *Candida* species, other | 1.0 | 0.1 | 0.0 | 0.4 | 0.0 | 0.4 | 0.0 | 0.3 | 0.3 | 0.0 | 2.2 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | - | 0.2 | 0.2 | 0.3 | 0.4 | 0.3 | 0.0 | 0.3 | **0.3** | 4.1 | 0.0 | 0.3 |
| *Candida* species, not specified | 0.3 | 0.1 | 0.5 | 0.4 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.4 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | - | 0.1 | 0.1 | 0.3 | 0.1 | 0.0 | 0.1 | 0.3 | **0.2** | 0.0 | 0.0 | 0.3 |
| *Aspergillus* species | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.5 | 0.3 | 0.8 | 0.1 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | - | 0.2 | 0.2 | 0.1 | 0.1 | 3.0 | 0.5 | 0.2 | **0.3** | 0.0 | 0.0 | 0.0 |
| *Aspergillus fumigatus* | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.4 | 0.0 | 0.2 | 0.1 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | - | 0.1 | 0.1 | 0.0 | 0.1 | 3.0 | 0.3 | 0.1 | **0.2** | 0.0 | 0.0 | 0.0 |
| *Aspergillus niger* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | **<0.1** | 0.0 | 0.0 | 0.0 |

**Table A1.5. Prevalence of HAIs and antimicrobial use, by patient/consultant specialty**

| Specialty | Patients | | Patients with HAI | | Patients with AU | |
|---|---|---|---|---|---|---|
| | N | % of total | N | % | N | % |
| All specialties | 293 581 | 100.0 | 20 869 | 7.1 | 104 343 | 35.5 |
| Surgery | 79 041 | 26.9 | 5 802 | 7.3 | 35 206 | 44.5 |
| General surgery | 19 114 | 6.5 | 1 517 | 7.9 | 9 575 | 50.1 |
| Digestive tract surgery | 4 719 | 1.6 | 462 | 9.8 | 2 266 | 48.0 |
| Orthopaedics and traumatology | 23 006 | 7.8 | 1 603 | 7.0 | 8 518 | 37.0 |
| Cardiovascular surgery | 6 252 | 2.1 | 631 | 10.1 | 2 680 | 42.9 |
| Thoracic surgery | 1 496 | 0.5 | 109 | 7.3 | 643 | 43.0 |
| Neurosurgery | 4 973 | 1.7 | 442 | 8.9 | 1 566 | 31.5 |
| Paediatric surgery | 1 400 | 0.5 | 49 | 3.5 | 652 | 46.6 |
| Transplantation surgery | 409 | 0.1 | 59 | 14.4 | 260 | 63.6 |
| Surgery for cancer | 1 462 | 0.5 | 119 | 8.1 | 592 | 40.5 |
| ENT | 3 740 | 1.3 | 139 | 3.7 | 1 736 | 46.4 |
| Ophthalmology | 1 549 | 0.5 | 14 | 0.9 | 319 | 20.6 |
| Maxillo-facial surgery | 682 | 0.2 | 34 | 5.0 | 429 | 62.9 |
| Stomatology/ Dentistry | 62 | 0.0 | 4 | 6.5 | 40 | 64.5 |
| Burns care | 192 | 0.1 | 20 | 10.4 | 68 | 35.4 |
| Urology | 7 475 | 2.5 | 415 | 5.6 | 4 590 | 61.4 |
| Plastic and reconstructive surgery | 1 536 | 0.5 | 114 | 7.4 | 860 | 56.0 |
| Other surgery | 974 | 0.3 | 71 | 7.3 | 412 | 42.3 |
| Medicine | 122 084 | 41.6 | 9 379 | 7.7 | 47 636 | 39.0 |
| General medicine | 40 634 | 13.8 | 3 553 | 8.7 | 18 111 | 44.6 |
| Gastro-enterology | 7 444 | 2.5 | 425 | 5.7 | 2 901 | 39.0 |
| Hepatology | 350 | 0.1 | 34 | 9.7 | 174 | 49.7 |
| Endocrinology | 1 851 | 0.6 | 86 | 4.6 | 500 | 27.0 |
| Nephrology | 4 267 | 1.5 | 435 | 10.2 | 2 138 | 50.1 |
| Cardiology | 15 710 | 5.4 | 703 | 4.5 | 3 377 | 21.5 |
| Dermatology | 1 208 | 0.4 | 18 | 1.5 | 448 | 37.1 |
| Haematology / BMT | 4 712 | 1.6 | 731 | 15.5 | 2 857 | 60.6 |
| Oncology | 8 519 | 2.9 | 496 | 5.8 | 2 450 | 28.8 |
| Neurology | 13 617 | 4.6 | 827 | 6.1 | 2 322 | 17.1 |
| Pneumology | 10 065 | 3.4 | 674 | 6.7 | 5 726 | 56.9 |
| COVID-19 (non-ICU) | 1 451 | 0.5 | 297 | 20.5 | 563 | 38.8 |

| Specialty | Patients | | Patients with HAI | | Patients with AU | |
|---|---|---|---|---|---|---|
| | N | % of total | N | % | N | % |
| Rheumatology | 2 071 | 0.7 | 66 | 3.2 | 346 | 16.7 |
| Infectious diseases | 6 229 | 2.1 | 735 | 11.8 | 4 313 | 69.2 |
| Medical traumatology | 89 | 0.0 | 10 | 11.2 | 18 | 20.2 |
| Other Medical | 3 867 | 1.3 | 289 | 7.5 | 1 392 | 36.0 |
| Intensive care unit (ICU) | 14 883 | 5.1 | 3 055 | 20.5 | 8 862 | 59.5 |
| Medical ICU | 3 425 | 1.2 | 709 | 20.7 | 2 097 | 61.2 |
| Surgical ICU | 2 310 | 0.8 | 559 | 24.2 | 1 591 | 68.9 |
| Paediatric ICU | 725 | 0.2 | 94 | 13.0 | 391 | 53.9 |
| Neonatal ICU | 2 137 | 0.7 | 209 | 9.8 | 672 | 31.4 |
| Mixed/polyvalent ICU | 4 463 | 1.5 | 1 138 | 25.5 | 3 107 | 69.6 |
| Specialized ICU | 1 464 | 0.5 | 284 | 19.4 | 819 | 55.9 |
| COVID-19 ICU | 148 | 0.1 | 38 | 25.7 | 113 | 76.4 |
| Other ICU | 211 | 0.1 | 24 | 11.4 | 72 | 34.1 |
| Paediatrics | 11 639 | 4.0 | 277 | 2.4 | 3 767 | 32.4 |
| Neonatology | 3 184 | 1.1 | 111 | 3.5 | 509 | 16.0 |
| Paediatrics | 8 455 | 2.9 | 166 | 2.0 | 3 258 | 38.5 |
| Gynaecology/obstetrics | 16 453 | 5.6 | 267 | 1.6 | 3 641 | 22.1 |
| Obstetrics / Maternity | 11 241 | 3.8 | 95 | 0.8 | 1 907 | 17.0 |
| Gynaecology (incl. surgery) | 5 212 | 1.8 | 172 | 3.3 | 1 734 | 33.3 |
| Healthy neonates | 4 423 | 1.5 | 19 | 0.4 | 182 | 4.1 |
| Healthy neonates | 4 423 | 1.5 | 19 | 0.4 | 182 | 4.1 |
| Geriatrics | 8 625 | 2.9 | 802 | 9.3 | 2 329 | 27.0 |
| Geriatrics, care for the elderly | 8 625 | 2.9 | 802 | 9.3 | 2 329 | 27.0 |
| Psychiatry | 16 397 | 5.6 | 240 | 1.5 | 464 | 2.8 |
| Psychiatrics | 16 397 | 5.6 | 240 | 1.5 | 464 | 2.8 |
| Other specialties | 20 035 | 6.8 | 1 027 | 5.1 | 2 255 | 11.3 |
| Rehabilitation | 10 599 | 3.6 | 488 | 4.6 | 708 | 6.7 |
| Long-term care | 6 119 | 2.1 | 345 | 5.6 | 484 | 7.9 |
| Others not listed | 2 015 | 0.7 | 66 | 3.3 | 571 | 28.3 |
| Mixed | 1 302 | 0.4 | 128 | 9.8 | 492 | 37.8 |
| Combination of specialties | 1 302 | 0.4 | 128 | 9.8 | 492 | 37.8 |

*HAI: patients with at least one healthcare-associated infection; AU: patients receiving at least one antimicrobial agent; BMT: bone marrow transplant; ENT: ear-nose-throat (otorhinolaryngology); ICU: intensive care unit*

**Table A1.6. Antimicrobial agents (4th and 5th ATC levels), by indication**

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Total number of antimicrobial agents | 138 208 | 100 | 68 195 | 25 384 | 3 494 | 20 571 | 14 084 |
| Intestinal antiinfectives, antibiotics (A07AA) | 2 688 | 1.9 | 1.1 | 4.3 | 2.8 | 0.2 | 3.7 |
| Neomycin (oral) (A07AA01) | 18 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Nystatin (A07AA02) | 331 | 0.2 | 0.1 | 0.3 | 0.3 | <0.1 | 0.9 |
| Natamycin (A07AA03) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Polymyxin B (A07AA05) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| Paromomycin (A07AA06) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Amphotericin B (oral) (A07AA07) | 90 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.3 |
| Vancomycin (oral) (A07AA09) | 1 479 | 1.1 | 0.7 | 3.3 | 1.8 | <0.1 | 0.5 |
| Colistin (oral) (A07AA10) | 110 | <0.1 | <0.1 | 0.2 | 0.1 | 0.0 | 0.2 |
| Rifaximin (A07AA11) | 539 | 0.4 | 0.2 | 0.1 | 0.4 | <0.1 | 1.8 |
| Fidaxomicin (A07AA12) | 115 | <0.1 | <0.1 | 0.3 | 0.2 | 0.0 | <0.1 |
| Neomycin, combinations (oral) (A07AA51) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 |
| Other intestinal antiinfectives, unclassified (A07AX99) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Antifungals for systemic use (D01BA) | 7 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Terbinafine (D01BA02) | 7 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Tetracyclines (J01AA) | 1 601 | 1.2 | 1.3 | 1.6 | 1.0 | 0.5 | 0.7 |
| Doxycycline (J01AA02) | 988 | 0.7 | 1.0 | 0.5 | 0.7 | 0.3 | 0.5 |
| Chlortetracycline (J01AA03) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lymecycline (J01AA04) | 4 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Metacycline (J01AA05) | 2 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 |
| Oxytetracycline (J01AA06) | 3 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Tetracycline (J01AA07) | 20 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |
| Minocycline (J01AA08) | 36 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Penimepicycline (J01AA10) | 5 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tigecycline (J01AA12) | 539 | 0.4 | 0.3 | 1.1 | 0.3 | 0.1 | 0.2 |
| Combinations of tetracyclines (J01AA20) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Oxytetracycline, combinations (J01AA56) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Amphenicols (J01BA) | 18 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Chloramphenicol (J01BA01) | 8 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Thiamphenicol (J01BA02) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Thiamphenicol, combinations (J01BA52) | 6 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Amphenicols, unclassified (J01BA99) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Penicillins, extended spectrum without anti-pseudomonal activity (J01CA) | 6 141 | 4.4 | 5.1 | 3.2 | 2.9 | 2.9 | 5.7 |
| Ampicillin (J01CA01) | 2 336 | 1.7 | 1.8 | 1.0 | 0.5 | 1.5 | 3.0 |
| Pivampicillin (J01CA02) | 4 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Amoxicillin (J01CA04) | 2 548 | 1.8 | 2.3 | 1.2 | 1.3 | 1.0 | 2.0 |
| Bacampicillin (J01CA06) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Pivmecillinam (J01CA08) | 269 | 0.2 | 0.2 | 0.4 | 0.3 | <0.1 | <0.1 |
| Azlocillin (J01CA09) | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mecillinam (J01CA11) | 28 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 |
| Piperacillin (J01CA12) | 654 | 0.5 | 0.5 | 0.6 | 0.6 | 0.3 | 0.5 |
| Ticarcillin (J01CA13) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Metampicillin (J01CA14) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Talampicillin (J01CA15) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sulbenicillin (J01CA16) | 5 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Temocillin (J01CA17) | 48 | <0.1 | <0.1 | <0.1 | 0.2 | 0.0 | 0.0 |
| Hetacillin (J01CA18) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Aspoxicillin (J01CA19) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Combinations of penicillins with extended spectrum (J01CA20) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ampicillin, combinations (J01CA51) | 235 | 0.2 | 0.2 | <0.1 | <0.1 | 0.1 | 0.2 |
| Penicillins, extended spectrum without anti-pseudomonal activity, unclassified (J01CA99) | 4 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Beta-lactamase sensitive penicillins (J01CE) | 1 615 | 1.2 | 1.7 | 0.5 | 0.8 | 0.3 | 1.0 |
| Benzylpenicillin (J01CE01) | 1 283 | 0.9 | 1.4 | 0.4 | 0.6 | 0.3 | 0.6 |
| Phenoxymethylpenicillin (J01CE02) | 225 | 0.2 | 0.2 | <0.1 | 0.2 | <0.1 | 0.3 |
| Azidocillin (J01CE04) | 4 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Pheneticillin (J01CE05) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Penamecillin (J01CE06) | 15 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Benzathine benzylpenicillin (J01CE08) | 33 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Procaine benzylpenicillin (J01CE09) | 28 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Benzathine phenoxymethylpenicillin (J01CE10) | 5 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Combinations of beta-lactamase sensitive penicillins (J01CE30) | 21 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Beta-lactamase resistant penicillins (J01CF) | 2 544 | 1.8 | 2.1 | 2.3 | 1.1 | 1.6 | 0.4 |
| Dicloxacillin (J01CF01) | 81 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Cloxacillin (J01CF02) | 1 102 | 0.8 | 0.8 | 0.9 | 0.5 | 1.2 | 0.1 |
| Meticillin (J01CF03) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Oxacillin (J01CF04) | 304 | 0.2 | 0.3 | 0.3 | <0.1 | 0.1 | <0.1 |
| Flucloxacillin (J01CF05) | 1 055 | 0.8 | 1.0 | 1.1 | 0.5 | 0.2 | 0.2 |
| Nafcillin (J01CF06) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Beta-lactamase inhibitors (J01CG) | 573 | 0.4 | 0.4 | 0.4 | 0.7 | 0.3 | 0.5 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Sulbactam (J01CG01) | 100 | <0.1 | <0.1 | <0.1 | 0.0 | 0.1 | <0.1 |
| Tazobactam (J01CG02) | 473 | 0.3 | 0.3 | 0.4 | 0.7 | 0.2 | 0.4 |
| Combinations of penicillins, incl. beta-lactamase inhibitors (J01CR) | 27 639 | 20.0 | 22.9 | 18.9 | 28.9 | 13.4 | 13.9 |
| Ampicillin and enzyme inhibitor (J01CR01) | 1 922 | 1.4 | 1.6 | 0.9 | 1.4 | 1.3 | 1.2 |
| Amoxicillin and enzyme inhibitor (J01CR02) | 13 099 | 9.5 | 11.0 | 6.0 | 12.3 | 9.1 | 7.8 |
| Ticarcillin and enzyme inhibitor (J01CR03) | 7 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Sultamicillin (J01CR04) | 331 | 0.2 | 0.3 | <0.1 | 0.1 | 0.2 | 0.3 |
| Piperacillin and enzyme inhibitor (J01CR05) | 12 220 | 8.8 | 9.9 | 12.0 | 15.1 | 2.8 | 4.6 |
| Combinations of penicillins (J01CR50) | 60 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| First-generation cephalosporins (J01DB) | 7 641 | 5.5 | 0.9 | 1.0 | 0.5 | 30.4 | 2.5 |
| Cefalexin (J01DB01) | 338 | 0.2 | 0.2 | 0.2 | 0.1 | 0.3 | 0.4 |
| Cefaloridine (J01DB02) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefalotin (J01DB03) | 65 | <0.1 | <0.1 | 0.0 | 0.0 | 0.3 | 0.0 |
| Cefazolin (J01DB04) | 7 129 | 5.2 | 0.6 | 0.7 | 0.3 | 29.6 | 2.0 |
| Cefadroxil (J01DB05) | 31 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefazedone (J01DB06) | 13 | <0.1 | 0.0 | <0.1 | 0.0 | <0.1 | <0.1 |
| Cefatrizine (J01DB07) | 19 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefapirin (J01DB08) | 6 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Cefradine (J01DB09) | 15 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Cefacetrile (J01DB10) | 2 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 |
| Cefroxadine (J01DB11) | 19 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Ceftezole (J01DB12) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Second-generation cephalosporins (J01DC) | 8 011 | 5.8 | 4.3 | 2.3 | 1.7 | 16.9 | 4.4 |
| Cefoxitin (J01DC01) | 702 | 0.5 | 0.1 | <0.1 | 0.2 | 2.4 | 0.4 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Cefuroxime (J01DC02) | 7 115 | 5.1 | 4.1 | 2.3 | 1.5 | 13.8 | 3.9 |
| Cefamandole (J01DC03) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | 0.0 |
| Cefaclor (J01DC04) | 27 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefonicide (J01DC06) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefmetazole (J01DC09) | 2 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefprozil (J01DC10) | 31 | <0.1 | <0.1 | <0.1 | 0.0 | 0.1 | <0.1 |
| Ceforanide (J01DC11) | 126 | <0.1 | <0.1 | 0.0 | 0.0 | 0.5 | <0.1 |
| Cefminox (J01DC12) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Cefbuperazone (J01DC13) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 |
| Second-generation cephalosporins, unclassified (J01DC99) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 | 0.0 |
| Third-generation cephalosporins (J01DD) | 20 330 | 14.7 | 18.4 | 9.3 | 15.9 | 10.7 | 12.0 |
| Cefotaxime (J01DD01) | 3 014 | 2.2 | 2.9 | 1.8 | 2.7 | 0.9 | 1.1 |
| Ceftazidime (J01DD02) | 1 341 | 1.0 | 0.9 | 1.4 | 1.0 | 0.7 | 0.9 |
| Cefsulodin (J01DD03) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ceftriaxone (J01DD04) | 14 431 | 10.4 | 13.5 | 4.6 | 11.2 | 7.9 | 9.0 |
| Cefmenoxime (J01DD05) | 1 | <0.1 | 0.0 | 0.0 | <0.1 | 0.0 | 0.0 |
| Ceftizoxime (J01DD07) | 37 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefixime (J01DD08) | 237 | 0.2 | 0.2 | 0.1 | 0.3 | 0.1 | 0.2 |
| Cefodizime (J01DD09) | 6 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefetamet (J01DD10) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefoperazone (J01DD12) | 164 | 0.1 | 0.2 | <0.1 | <0.1 | <0.1 | 0.2 |
| Cefpodoxime (J01DD13) | 38 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 |
| Ceftibuten (J01DD14) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Cefditoren (J01DD16) | 30 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Cefcapene (J01DD17) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cefotaxime, combinations (J01DD51) | 14 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |
| Ceftazidime, combinations (J01DD52) | 430 | 0.3 | 0.2 | 1.0 | 0.3 | <0.1 | 0.2 |
| Ceftriaxone, combinations (J01DD54) | 95 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefoperazone, combinations (J01DD62) | 485 | 0.4 | 0.3 | 0.2 | <0.1 | 0.8 | 0.3 |
| Cefpodoxime and beta-lactamase inhibitor (J01DD64) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fourth-generation cephalosporins (J01DE) | 622 | 0.5 | 0.4 | 1.0 | 0.7 | 0.1 | 0.3 |
| Cefepime (J01DE01) | 617 | 0.4 | 0.4 | 1.0 | 0.7 | 0.1 | 0.3 |
| Cefozopran (J01DE03) | 5 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |
| Monobactams (J01DF) | 194 | 0.1 | 0.1 | 0.4 | 0.2 | <0.1 | <0.1 |
| Aztreonam (J01DF01) | 194 | 0.1 | 0.1 | 0.4 | 0.2 | <0.1 | <0.1 |
| Carbapenems (J01DH) | 8 717 | 6.3 | 6.2 | 12.0 | 9.0 | 1.1 | 3.8 |
| Meropenem (J01DH02) | 7 415 | 5.4 | 5.2 | 10.4 | 6.9 | 1.0 | 3.4 |
| Ertapenem (J01DH03) | 555 | 0.4 | 0.4 | 0.7 | 1.6 | <0.1 | 0.1 |
| Doripenem (J01DH04) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Biapenem (J01DH05) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tebipenem pivoxil (J01DH06) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Imipenem and enzyme inhibitor (J01DH51) | 587 | 0.4 | 0.5 | 0.7 | 0.5 | <0.1 | 0.3 |
| Meropenem and vaborbactam (J01DH52) | 33 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Panipenem and betamipron (J01DH55) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Imipenem, cilastatin and relebactam (J01DH56) | 118 | <0.1 | 0.1 | 0.1 | <0.1 | <0.1 | <0.1 |
| Other cephalosporins and penems (J01DI) | 299 | 0.2 | 0.2 | 0.5 | 0.4 | <0.1 | <0.1 |
| Ceftobiprole medocaril (J01DI01) | 12 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Ceftaroline fosamil (J01DI02) | 102 | <0.1 | <0.1 | <0.1 | 0.2 | <0.1 | <0.1 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Cefiderocol (J01DI04) | 44 | <0.1 | <0.1 | 0.1 | <0.1 | 0.0 | 0.0 |
| Ceftolozane and enzyme inhibitor (J01DI54) | 140 | 0.1 | <0.1 | 0.3 | 0.1 | <0.1 | <0.1 |
| Other cephalosporins and penems, unclassified (J01DI99) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trimethoprim and derivatives (J01EA) | 466 | 0.3 | 0.2 | 0.3 | 0.1 | 0.1 | 1.4 |
| Trimethoprim (J01EA01) | 425 | 0.3 | 0.2 | 0.3 | 0.1 | 0.1 | 1.2 |
| Trimethoprim and derivatives, unclassified (J01EA99) | 41 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.2 |
| Short-acting sulfonamides (J01EB) | 16 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Sulfamethizole (J01EB02) | 9 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Sulfafurazole (J01EB05) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Sulfanilamide (J01EB06) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | <0.1 |
| Sulfathiazole (J01EB07) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Combinations of short-acting sulphonamides (J01EB20) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | <0.1 |
| Intermediate-acting sulfonamides (J01EC) | 73 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Sulfamethoxazole (J01EC01) | 60 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Sulfadiazine (J01EC02) | 7 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Combinations of intermediate-acting sulphonamides (J01EC20) | 6 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 |
| Long-acting sulfonamides (J01ED) | 13 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Sulfametoxydiazine (J01ED04) | 2 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Sulfamethoxypyridazine (J01ED05) | 2 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Sulfamerazine (J01ED07) | 8 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 | <0.1 |
| Sulfaphenazole (J01ED08) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Combinations of sulfonamides and trimethoprim, incl. derivatives (J01EE) | 4 162 | 3.0 | 1.5 | 2.3 | 2.1 | 1.1 | 15.1 |
| Sulfamethoxazole and trimethoprim (J01EE01) | 3 754 | 2.7 | 1.3 | 2.1 | 1.9 | 1.1 | 13.6 |
| Sulfadiazine and trimethoprim (J01EE02) | 130 | <0.1 | <0.1 | 0.1 | 0.0 | <0.1 | 0.5 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Sulfametrole and trimethoprim (J01EE03) | 128 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.6 |
| Sulfamoxole and trimethoprim (J01EE04) | 84 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 |
| Sulfadimidine and trimethoprim (J01EE05) | 31 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 |
| Sulfadiazine and tetroxoprim (J01EE06) | 5 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Sulfamerazine and trimethoprim (J01EE07) | 29 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Combinations of sulfonamides and trimethoprim, incl. derivatives, unclassified (J01EE99) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Sulfonamides and trimethoprim, unclassified (J01EE99) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Macrolides (J01FA) | 3 188 | 2.3 | 3.1 | 0.7 | 3.1 | 0.3 | 2.6 |
| Erythromycin (J01FA01) | 301 | 0.2 | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 |
| Spiramycin (J01FA02) | 76 | <0.1 | <0.1 | <0.1 | 0.1 | 0.0 | <0.1 |
| Midecamycin (J01FA03) | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Oleandomycin (J01FA05) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Roxithromycin (J01FA06) | 19 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 |
| Josamycin (J01FA07) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Clarithromycin (J01FA09) | 1 217 | 0.9 | 1.4 | 0.3 | 1.0 | 0.1 | 0.4 |
| Azithromycin (J01FA10) | 1 571 | 1.1 | 1.5 | 0.3 | 1.9 | 0.1 | 1.9 |
| Miocamycin (J01FA11) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Flurithromycin (J01FA14) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Lincosamides (J01FF) | 3 072 | 2.2 | 2.7 | 1.4 | 1.7 | 2.5 | 1.3 |
| Clindamycin (J01FF01) | 3 059 | 2.2 | 2.7 | 1.4 | 1.7 | 2.5 | 1.3 |
| Lincomycin (J01FF02) | 12 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | <0.1 |
| Lincosamides, unclassified (J01FF99) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Streptogramins (J01FG) | 25 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Pristinamycin (J01FG01) | 25 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Streptomycins (J01GA) | 8 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | <0.1 |
| Streptomycin (parenteral) (J01GA01) | 8 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | <0.1 |
| Aminoglycosides (J01GB) | 4 334 | 3.1 | 3.1 | 3.3 | 2.0 | 3.1 | 3.5 |
| Tobramycin (J01GB01) | 209 | 0.2 | 0.1 | 0.2 | <0.1 | 0.1 | 0.2 |
| Gentamicin (J01GB03) | 2 641 | 1.9 | 1.9 | 1.6 | 0.8 | 2.3 | 2.3 |
| Kanamycin (J01GB04) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Neomycin (injection, infusion) (J01GB05) | 7 | <0.1 | 0.0 | <0.1 | <0.1 | <0.1 | <0.1 |
| Amikacin (J01GB06) | 1 441 | 1.0 | 1.0 | 1.6 | 1.1 | 0.6 | 0.8 |
| Netilmicin (J01GB07) | 35 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Fluoroquinolones (J01MA) | 9 872 | 7.1 | 8.5 | 6.5 | 8.7 | 3.1 | 7.1 |
| Ofloxacin (J01MA01) | 153 | 0.1 | 0.1 | 0.1 | 0.3 | <0.1 | <0.1 |
| Ciprofloxacin (J01MA02) | 5 495 | 4.0 | 4.4 | 4.1 | 4.8 | 2.3 | 4.1 |
| Pefloxacin (J01MA03) | 10 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Norfloxacin (J01MA06) | 96 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.3 |
| Lomefloxacin (J01MA07) | 8 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Grepafloxacin (J01MA11) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Levofloxacin (J01MA12) | 3 295 | 2.4 | 3.1 | 1.9 | 3.0 | 0.6 | 2.2 |
| Trovafloxacin (J01MA13) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Moxifloxacin (J01MA14) | 783 | 0.6 | 0.8 | 0.4 | 0.5 | <0.1 | 0.4 |
| Gemifloxacin (J01MA15) | 4 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Gatifloxacin (J01MA16) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Sitafloxacin (J01MA21) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Delafloxacin (J01MA23) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Levonadifloxacin (J01MA24) | 19 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Lascufloxacin (J01MA25) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Other quinolones (J01MB) | 19 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Nalidixic acid (J01MB02) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Piromidic acid (J01MB03) | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pipemidic acid (J01MB04) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | 0.0 |
| Cinoxacin (J01MB06) | 13 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Flumequine (J01MB07) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Other quinolones, unclassified (J01MB99) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Combinations of antibacterials (J01RA) | 463 | 0.3 | 0.4 | 0.1 | <0.1 | 0.3 | 0.4 |
| Penicillins, combinations with other antibacterials (J01RA01) | 176 | 0.1 | 0.2 | <0.1 | 0.0 | <0.1 | 0.1 |
| Sulfonamides, combinations with other antibacterials (excl. trimethoprim) (J01RA02) | 38 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.1 |
| Cefuroxime and metronidazole (J01RA03) | 130 | <0.1 | <0.1 | <0.1 | 0.0 | 0.2 | <0.1 |
| Spiramycin and metronidazole (J01RA04) | 26 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Levofloxacin, combinations with other antibacterials (J01RA05) | 24 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |
| Cefepime and amikacin (J01RA06) | 4 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |
| Azithromycin, fluconazole and secnidazole (J01RA07) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Ciprofloxacin and metronidazole (J01RA10) | 61 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cefixime and ornidazole (J01RA15) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Glycopeptide antibacterials (J01XA) | 5 212 | 3.8 | 2.9 | 8.1 | 4.0 | 2.4 | 2.2 |
| Vancomycin (parenteral) (J01XA01) | 4 492 | 3.3 | 2.5 | 7.3 | 3.1 | 1.8 | 1.8 |
| Teicoplanin (J01XA02) | 702 | 0.5 | 0.3 | 0.7 | 0.9 | 0.7 | 0.4 |
| Dalbavancin (J01XA04) | 18 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Polymyxins (J01XB) | 919 | 0.7 | 0.3 | 2.2 | 0.9 | <0.1 | 0.6 |
| Colistin (injection, infusion) (J01XB01) | 915 | 0.7 | 0.3 | 2.2 | 0.9 | <0.1 | 0.6 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Polymyxin B (J01XB02) | 4 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Steroid antibacterials (J01XC) | 17 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 |
| Fusidic acid (J01XC01) | 17 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 |
| Imidazole derivatives (J01XD) | 6 589 | 4.8 | 4.9 | 3.0 | 3.1 | 7.0 | 4.4 |
| Metronidazole (parenteral) (J01XD01) | 6 551 | 4.7 | 4.9 | 3.0 | 3.1 | 6.9 | 4.4 |
| Tinidazole (parenteral) (J01XD02) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 | 0.0 |
| Ornidazole (parenteral) (J01XD03) | 35 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.0 |
| Nitrofuran derivatives (J01XE) | 464 | 0.3 | 0.3 | 0.7 | 0.8 | <0.1 | 0.5 |
| Nitrofurantoin (J01XE01) | 440 | 0.3 | 0.2 | 0.6 | 0.7 | <0.1 | 0.5 |
| Nifurtoinol (J01XE02) | 3 | <0.1 | 0.0 | <0.1 | 0.0 | <0.1 | <0.1 |
| Furazidin (J01XE03) | 19 | <0.1 | <0.1 | <0.1 | 0.1 | 0.0 | <0.1 |
| Nitrofurantoin, combinations (J01XE51) | 2 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Other antibacterials (J01XX) | 3 682 | 2.7 | 2.3 | 5.8 | 3.2 | 0.5 | 1.7 |
| Fosfomycin (J01XX01) | 351 | 0.3 | 0.2 | 0.6 | 0.5 | <0.1 | 0.2 |
| Xibornol (J01XX02) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Clofoctol (J01XX03) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Methenamine (J01XX05) | 35 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.2 |
| Nitroxoline (J01XX07) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Linezolid (J01XX08) | 2 331 | 1.7 | 1.6 | 3.7 | 2.0 | 0.2 | 0.7 |
| Daptomycin (J01XX09) | 862 | 0.6 | 0.5 | 1.4 | 0.7 | 0.2 | 0.3 |
| Bacitracin (J01XX10) | 4 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tedizolid (J01XX11) | 17 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 |
| Other antibacterials, unclassified (J01XX99) | 78 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | 0.3 |
| Antimycotics, antibiotics (J02AA) | 242 | 0.2 | 0.1 | 0.4 | <0.1 | <0.1 | 0.5 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Amphotericin B (parenteral) (J02AA01) | 241 | 0.2 | 0.1 | 0.4 | <0.1 | <0.1 | 0.5 |
| Hachimycin (J02AA02) | 1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Imidazole derivatives (J02AB) | 14 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Miconazole (J02AB01) | 10 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Ketoconazole (J02AB02) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Imidazole derivatives, unclassified (J02AB99) | 2 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | <0.1 |
| Triazole derivatives (J02AC) | 3 019 | 2.2 | 1.4 | 3.5 | 1.3 | 0.2 | 7.0 |
| Fluconazole (J02AC01) | 2 260 | 1.6 | 1.1 | 2.9 | 1.2 | 0.2 | 4.3 |
| Itraconazole (J02AC02) | 48 | <0.1 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 |
| Voriconazole (J02AC03) | 296 | 0.2 | 0.2 | 0.3 | 0.1 | <0.1 | 0.6 |
| Posaconazole (J02AC04) | 297 | 0.2 | <0.1 | <0.1 | <0.1 | 0.0 | 1.9 |
| Isavuconazole (J02AC05) | 118 | <0.1 | <0.1 | 0.2 | 0.0 | <0.1 | 0.2 |
| Other antimycotics for systemic use (J02AX) | 905 | 0.7 | 0.3 | 1.8 | 0.4 | <0.1 | 1.2 |
| Flucytosine (J02AX01) | 7 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | <0.1 |
| Caspofungin (J02AX04) | 431 | 0.3 | 0.2 | 0.9 | 0.3 | <0.1 | 0.4 |
| Micafungin (J02AX05) | 160 | 0.1 | <0.1 | 0.2 | <0.1 | <0.1 | 0.5 |
| Anidulafungin (J02AX06) | 305 | 0.2 | 0.1 | 0.6 | <0.1 | <0.1 | 0.3 |
| Other antimycotics for systemic use, unclassified (J02AX99) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | <0.1 |
| Antimycobacterials, antibiotics (J04AB) | 733 | 0.5 | 0.7 | 0.6 | 0.4 | <0.1 | 0.2 |
| Cycloserine (J04AB01) | 18 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rifampicin (J04AB02) | 692 | 0.5 | 0.7 | 0.6 | 0.4 | <0.1 | 0.2 |
| Rifabutin (J04AB04) | 14 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Antimycobacterials, antibiotics, unclassified (J04AB99) | 9 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Hydrazides (J04AC) | 254 | 0.2 | 0.3 | 0.0 | <0.1 | 0.0 | 0.2 |

| Antimicrobial agent (ATC code) | Total | | Treatment intention of | | | Surgical prophylaxis | Medical prophylaxis |
|---|---|---|---|---|---|---|---|
| | | | Community infection | Hospital infection | LTCF infection | | |
| | N | % | % | % | % | % | % |
| Isoniazid (J04AC01) | 253 | 0.2 | 0.3 | 0.0 | <0.1 | 0.0 | 0.2 |
| Hydrazides, unclassified (J04AC99) | 1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 | <0.1 |
| Other drugs for treatment of tuberculosis (J04AK) | 457 | 0.3 | 0.7 | <0.1 | <0.1 | 0.0 | <0.1 |
| Pyrazinamide (J04AK01) | 192 | 0.1 | 0.3 | <0.1 | <0.1 | 0.0 | 0.0 |
| Ethambutol (J04AK02) | 265 | 0.2 | 0.4 | 0.0 | 0.0 | 0.0 | <0.1 |
| Combinations of drugs for treatment of tuberculosis (J04AM) | 4 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Combinations of drugs for treatment of tuberculosis, unclassified (J04AM99) | 4 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Nitroimidazole derivatives (P01AB) | 1 341 | 1.0 | 1.0 | 1.2 | 1.2 | 0.6 | 0.7 |
| Metronidazole (oral, rectal) (P01AB01) | 1 306 | 0.9 | 1.0 | 1.2 | 1.2 | 0.6 | 0.7 |
| Tinidazole (oral, rectal) (P01AB02) | 1 | <0.1 | 0.0 | <0.1 | 0.0 | 0.0 | 0.0 |
| Ornidazole (oral) (P01AB03) | 3 | <0.1 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 |
| Azanidazole (P01AB04) | 3 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Secnidazole (P01AB07) | 2 | <0.1 | <0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Metronidazole, combinations (P01AB51) | 26 | <0.1 | <0.1 | <0.1 | 0.0 | <0.1 | <0.1 |

*LTCF: long-term care facility*

**Table A1.7. National denominator data**

| Country | No. of acute care hospitals | | No. of hospital beds | | No. of discharges / year | | No. of patient days/ year | |
|---|---|---|---|---|---|---|---|---|
| | Number | Source | Number | Source | Number | Source | Number | Source |
| Austria | 162 | PPS2 | 45 067 | Eurostat | 1 729 602 | Eurostat | 10 948 808 | Eurostat |
| Belgium | 191 | PPS3 | 41 640 | PPS3 | 2 243 315 | PPS3 | 11 981 712 | PPS3 |
| Bulgaria | 241 | PPS3 | 45 803 | Eurostat | 1 789 821 | Eurostat | 9 086 396 | Eurostat |
| Croatia | 32 | PPS2 | 14 286 | Eurostat | 573 374 | Eurostat | 3 358 412 | Eurostat |
| Cyprus | 83 | PPS2 | 2 813 | Eurostat | 173 289 | Eurostat | 531 570 | Eurostat |
| Czechia | 168 | PPS3 | 48 136 | PPS3 | 1 973 170 | PPS3 | 18 303 794 | PPS3 |
| Denmark | 52 | PPS1 | 11 957 | PPS1 | 792 337 | National | 4 329 265 | PPS1 |
| Estonia | 27 | PPS3 | 5 919 | PPS3 | 187 794 | PPS3 | 1 433 335 | PPS3 |
| Finland | 42 | PPS3 | 13 387 | Eurostat | 663 908 | PPS3 | 2 594 982 | PPS3 |
| France | 1 429 | PPS3 | 217 554 | PPS3 | 11 058 573 | PPS3 | 55 763 664 | PPS3 |
| Germany | 2 233 | PPS3 | 484 534 | PPS3 | 16 741 340 | Eurostat | 123 304 624 | Eurostat |
| Greece | 127 | PPS3 | 36 441 | PPS3 | 2 160 596 | PPS3 | 7 343 348 | PPS3 |
| Hungary | 128 | PPS3 | 64 632 | PPS3 | 1 554 878 | PPS3 | 11 393 658 | PPS3 |
| Iceland | 8 | PPS3 | 1 020 | PPS3 | 40 779 | PPS3 | 233 802 | PPS3 |
| Ireland | 65 | PPS3 | 13 725 | PPS3 | 805 039 | PPS3 | 4 470 890 | PPS3 |
| Italy | 1 134 | PPS2 | 184 724 | Eurostat | 5 209 994 | Eurostat | 38 574 320 | Eurostat |
| Latvia | 24 | PPS2 | 5 770 | Eurostat | 226 648 | Eurostat | 1 364 147 | Eurostat |
| Lithuania | 64 | PPS2 | 16 957 | Eurostat | 443 652 | Eurostat | 2 892 372 | Eurostat |
| Luxembourg | 6 | PPS3 | 2 706 | PPS3 | 87 658 | PPS3 | 642 071 | PPS3 |
| Malta | 8 | PPS2 | 1 640 | Eurostat | 54 684 | Eurostat | 403 620 | Eurostat |
| Netherlands | 79 | PPS2 | 38 779 | Eurostat | 1 406 112 | Eurostat | 7 255 592 | Eurostat |
| Norway | 60 | PPS3 | 14 276 | PPS3 | 786 457 | PPS3 | 4 111 455 | PPS3 |
| Poland | 936 | PPS2 | 166 338 | Eurostat | 5 319 191 | Eurostat | 36 878 700 | Eurostat |
| Portugal | 225 | PPS2 | 34 456 | Eurostat | 1 063 757 | Eurostat | 9 785 895 | Eurostat |
| Romania | 252 | PPS2 | 106 067 | Eurostat | 2 306 062 | Eurostat | 14 323 610 | Eurostat |
| Slovakia | 107 | PPS2 | 30 911 | Eurostat | 737 036 | Eurostat | 5 149 488 | Eurostat |
| Slovenia | 22 | PPS2 | 7 536 | Eurostat | 286 523 | Eurostat | 1 841 131 | Eurostat |
| Spain | 549 | PPS3 | 123 031 | PPS3 | 4 432 867 | PPS3 | 29 123 936 | PPS3 |
| Sweden | 61 | PPS3 | 15 801 | PPS3 | 1 121 815 | PPS3 | 6 293 060 | PPS3 |
| **EU/EEA** | **8 515** | **-** | **1 795 906** | **-** | **65 970 271** | **-** | **423 717 657** | **-** |
| Kosovo | 8 | PPS3 | 3 741 | PPS3 | 144 602 | PPS3 | 730 421 | PPS3 |
| Montenegro | 10 | PPS3 | 2 364 | PPS3 | 59 558 | PPS3 | 443 130 | PPS3 |
| Serbia | 67 | PPS3 | 25 535 | PPS3 | 739 318 | PPS3 | 4 129 350 | PPS3 |

*PPS3: national data submitted to ECDC as part of ECDC PPS 2022-2023; PPS2: national data submitted to ECDC as part of ECDC PPS 2016-2017; PPS1: national data submitted to ECDC as part of ECDC PPS 2011-2012; Eurostat: most recent data retrieved from Eurostat [Health care] datasets as from 3 March 2024, available from https://ec.europa.eu/eurostat/data/database. National data for number of discharges in Denmark retrieved from https://www.statbank.dk/INDL001 4 March 2024.*

**Table A1.8. Number of hospitals reporting structure and process indicators at hospital and ward level, by country**

| Variable or indicator | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of hospitals in database | 41 | 49 | 23 | 31 | 10 | 39 | 20 | 40 | 61 | 50 | 49 | 87 | 2 | 65 | 58 | 7 | 41 | 5 | 7 | 18 | 53 | 93 | 120 | 53 | 47 | 22 | 105 | 54 | **1 250** | 5 | 10 | 67 |
| Number of hospitals beds | 41 | 49 | 23 | 31 | 10 | 39 | 20 | 40 | 61 | 50 | 49 | 87 | 2 | 65 | 58 | 7 | 41 | 5 | 7 | 18 | 53 | 93 | 120 | 53 | 47 | 22 | 105 | 54 | **1 250** | 5 | 10 | 67 |
| Number of discharges previous year | 41 | 49 | 23 | 31 | 10 | 39 | 20 | 40 | 61 | 50 | 49 | 87 | 2 | 65 | 58 | 7 | 41 | 5 | 7 | 18 | 53 | 93 | 120 | 53 | 47 | 22 | 105 | 54 | **1 250** | 5 | 10 | 67 |
| Number of patient-days previous year, hospital | 41 | 49 | 23 | 31 | 9 | 39 | 20 | 25 | 61 | 49 | 45 | 87 | 2 | 63 | 51 | 7 | 40 | 5 | 7 | 0 | 0 | 93 | 117 | 51 | 47 | 22 | 102 | 54 | **1 140** | 5 | 10 | 67 |
| Number of ward beds | 40 | 48 | 23 | 31 | 10 | 39 | 18 | 0 | 0 | 50 | 48 | 0 | 2 | 65 | 40 | 7 | 23 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 0 | 54 | **838** | 5 | 10 | 67 |
| Number of patient-days previous year, ward | 40 | 46 | 22 | 29 | 9 | 39 | 19 | 0 | 0 | 49 | 47 | 0 | 2 | 3 | 37 | 0 | 22 | 5 | 7 | 0 | 0 | 93 | 115 | 52 | 44 | 22 | 0 | 0 | **702** | 5 | 10 | 67 |
| Number of HCWs present on ward | 38 | 41 | 20 | 28 | 10 | 38 | 18 | 0 | 0 | 49 | 36 | 0 | 2 | 55 | 37 | 0 | 0 | 5 | 7 | 0 | 0 | 93 | 107 | 53 | 39 | 22 | 0 | 0 | **698** | 5 | 10 | 67 |
| IPC Plan, CEO approved | 39 | 48 | 23 | 29 | 9 | 39 | 19 | 40 | 61 | 45 | 43 | 87 | 2 | 65 | 55 | 0 | 41 | 5 | 7 | 0 | 0 | 89 | 118 | 47 | 47 | 22 | 103 | 49 | **1 132** | 5 | 10 | 67 |
| IPC Report, CEO approved | 39 | 48 | 22 | 29 | 9 | 39 | 19 | 40 | 61 | 43 | 43 | 87 | 2 | 65 | 55 | 0 | 41 | 5 | 7 | 0 | 0 | 88 | 118 | 47 | 47 | 22 | 102 | 51 | **1 129** | 5 | 10 | 67 |
| FTE IPC nurse | 40 | 49 | 22 | 31 | 10 | 39 | 20 | 40 | 60 | 50 | 47 | 61 | 2 | 65 | 51 | 7 | 37 | 5 | 7 | 0 | 0 | 93 | 118 | 51 | 46 | 22 | 102 | 53 | **1 128** | 5 | 9 | 67 |
| FTE IPC doctor | 39 | 49 | 22 | 29 | 10 | 39 | 20 | 40 | 58 | 49 | 45 | 82 | 2 | 65 | 43 | 7 | 40 | 5 | 7 | 0 | 0 | 93 | 119 | 51 | 47 | 21 | 99 | 53 | **1 134** | 5 | 10 | 67 |
| Microbiology services in weekend | 38 | 46 | 22 | 28 | 9 | 32 | 19 | 40 | 0 | 46 | 41 | 87 | 2 | 63 | 57 | 7 | 41 | 2 | 7 | 0 | 0 | 86 | 99 | 44 | 45 | 22 | 102 | 54 | **1 039** | 5 | 10 | 67 |
| Number of blood cultures previous year | 40 | 46 | 23 | 29 | 10 | 38 | 19 | 39 | 57 | 46 | 45 | 87 | 2 | 65 | 54 | 0 | 39 | 5 | 7 | 0 | 0 | 93 | 116 | 51 | 46 | 22 | 98 | 0 | **1 077** | 5 | 9 | 67 |
| Number of stool tests for CDI previous year | 39 | 46 | 23 | 27 | 9 | 36 | 18 | 40 | 57 | 46 | 46 | 87 | 2 | 64 | 49 | 0 | 39 | 5 | 5 | 0 | 0 | 90 | 117 | 49 | 45 | 22 | 97 | 0 | **1 058** | 5 | 10 | 67 |
| Participation in surveillance network, SSI | 39 | 49 | 22 | 29 | 6 | 37 | 18 | 40 | 61 | 50 | 41 | 87 | 1 | 65 | 58 | 0 | 41 | 4 | 7 | 0 | 0 | 68 | 111 | 45 | 46 | 22 | 105 | 0 | **1 052** | 5 | 10 | 67 |
| Participation in surveillance network, ICU | 32 | 40 | 22 | 27 | 5 | 35 | 14 | 25 | 0 | 34 | 33 | 50 | 1 | 39 | 53 | 0 | 37 | 4 | 3 | 0 | 0 | 61 | 63 | 45 | 44 | 17 | 87 | 0 | **771** | 5 | 10 | 62 |
| Participation in surveillance network, CDI | 39 | 49 | 22 | 29 | 6 | 37 | 18 | 40 | 0 | 50 | 41 | 87 | 1 | 65 | 58 | 0 | 41 | 4 | 7 | 0 | 0 | 68 | 111 | 45 | 46 | 22 | 105 | 0 | **991** | 5 | 10 | 67 |
| Participation in surveillance network, AMR | 39 | 49 | 22 | 29 | 6 | 37 | 18 | 40 | 61 | 50 | 41 | 87 | 1 | 65 | 58 | 0 | 41 | 4 | 7 | 0 | 0 | 68 | 111 | 45 | 46 | 22 | 105 | 0 | **1 052** | 5 | 10 | 67 |
| Participation in surveillance network, AMC | 39 | 49 | 22 | 29 | 6 | 37 | 18 | 40 | 0 | 50 | 41 | 87 | 1 | 65 | 58 | 0 | 41 | 4 | 7 | 0 | 0 | 68 | 111 | 45 | 46 | 22 | 105 | 0 | **991** | 5 | 10 | 67 |
| Participation in surveillance network, other | 39 | 49 | 22 | 29 | 6 | 37 | 18 | 40 | 61 | 50 | 41 | 87 | 1 | 65 | 58 | 0 | 41 | 4 | 7 | 0 | 0 | 68 | 111 | 45 | 46 | 22 | 105 | 0 | **1 052** | 5 | 10 | 67 |
| Automated surveillance of HAIs, score | 41 | 48 | 21 | 29 | 9 | 39 | 17 | 40 | 0 | 50 | 45 | 87 | 2 | 64 | 0 | 0 | 0 | 4 | 7 | 0 | 0 | 83 | 110 | 46 | 42 | 22 | 101 | 0 | **907** | 5 | 10 | 67 |
| Multimodal strategy questions IPCAF, any | 35 | 19 | 18 | 15 | 8 | 33 | 13 | 40 | 0 | 47 | 40 | 87 | 1 | 55 | 56 | 0 | 37 | 3 | 7 | 0 | 0 | 33 | 90 | 29 | 36 | 22 | 92 | 0 | **816** | 5 | 10 | 67 |
| Filled full IPCAF questionnaire on WHO portal | 0 | 6 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 2 | 1 | 0 | 0 | 0 | **23** | 0 | 0 | 0 |
| Alcohol-based handrub consumption, hospital level | 41 | 46 | 22 | 30 | 10 | 38 | 20 | 38 | 60 | 50 | 45 | 87 | 2 | 61 | 51 | 0 | 41 | 5 | 7 | 0 | 0 | 93 | 120 | 50 | 47 | 22 | 96 | 0 | **1 082** | 5 | 10 | 67 |
| Alcohol-based handrub consumption, ward level | 40 | 46 | 20 | 28 | 8 | 38 | 17 | 0 | 0 | 48 | 44 | 0 | 2 | 3 | 36 | 0 | 22 | 5 | 7 | 0 | 0 | 93 | 115 | 50 | 44 | 22 | 0 | 0 | **688** | 5 | 10 | 67 |
| Hand hygiene opportunities | 40 | 48 | 20 | 30 | 10 | 39 | 20 | 39 | 0 | 50 | 47 | 87 | 2 | 63 | 45 | 0 | 40 | 5 | 7 | 0 | 0 | 93 | 120 | 52 | 47 | 22 | 96 | 0 | **1 022** | 5 | 10 | 67 |
| Number of occupied beds at midnight, hospital level | 0 | 5 | 14 | 21 | 9 | 37 | 10 | 38 | 0 | 38 | 32 | 87 | 2 | 4 | 51 | 0 | 40 | 4 | 1 | 0 | 0 | 66 | 26 | 33 | 41 | 22 | 84 | 0 | **665** | 5 | 10 | 67 |
| Number of occupied beds at midnight, ward level | 38 | 48 | 21 | 31 | 10 | 39 | 18 | 0 | 0 | 50 | 48 | 0 | 2 | 65 | 40 | 7 | 23 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 0 | 54 | **834** | 5 | 10 | 67 |
| Bed occupancy at midnight, hospital and/or ward | 38 | 47 | 22 | 29 | 10 | 39 | 19 | 35 | 0 | 50 | 48 | 87 | 2 | 65 | 52 | 7 | 39 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 84 | 50 | **1 063** | 5 | 10 | 67 |

| Variable or indicator | Austria | Belgium | Bulgaria | Croatia | Cyprus | Czechia | Estonia | Finland | France | Germany | Greece | Hungary | Iceland | Ireland | Italy | Latvia | Lithuania | Luxembourg | Malta | Netherlands | Norway | Poland | Portugal | Romania | Slovakia | Slovenia | Spain | Sweden | EU/EEA | Kosovo | Montenegro | Serbia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bed occupancy from hospital patient-days (previous year) and number of beds (hospital denominator data) | 41 | 49 | 23 | 31 | 9 | 39 | 20 | 36 | 60 | 50 | 49 | 87 | 2 | 65 | 57 | 5 | 41 | 5 | 7 | 0 | 0 | 92 | 118 | 53 | 47 | 22 | 101 | 43 | **1 152** | 5 | 10 | 66 |
| AHR dispensers at point of care, hospital level | 0 | 7 | 15 | 21 | 9 | 36 | 11 | 38 | 0 | 42 | 37 | 87 | 2 | 4 | 35 | 0 | 41 | 4 | 1 | 0 | 0 | 68 | 27 | 35 | 42 | 22 | 101 | 0 | **685** | 5 | 10 | 67 |
| AHR dispensers at point of care, ward level | 39 | 42 | 21 | 31 | 10 | 39 | 18 | 0 | 0 | 50 | 45 | 0 | 2 | 65 | 39 | 7 | 23 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 0 | 0 | **771** | 5 | 10 | 67 |
| AHR dispensers at point of care, hospital and/or ward | 39 | 42 | 22 | 31 | 10 | 39 | 19 | 38 | 0 | 50 | 45 | 87 | 2 | 65 | 45 | 7 | 41 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 101 | 0 | **1 023** | 5 | 10 | 67 |
| Percentage HCWs carrying AHR bottles, hospital level | 0 | 7 | 15 | 19 | 9 | 36 | 12 | 39 | 0 | 46 | 37 | 87 | 2 | 7 | 54 | 0 | 41 | 4 | 2 | 0 | 0 | 70 | 28 | 35 | 40 | 22 | 104 | 0 | **716** | 5 | 10 | 67 |
| Percentage HCWs carrying AHR bottles, ward level | 38 | 41 | 20 | 27 | 10 | 38 | 18 | 0 | 0 | 49 | 35 | 0 | 2 | 54 | 37 | 0 | 0 | 5 | 7 | 0 | 0 | 89 | 96 | 52 | 39 | 22 | 0 | 0 | **679** | 5 | 9 | 67 |
| Percentage HCWs carrying AHR bottles, hospital and/or ward level | 38 | 41 | 22 | 29 | 10 | 39 | 19 | 37 | 0 | 50 | 42 | 87 | 2 | 55 | 45 | 0 | 41 | 5 | 7 | 0 | 0 | 92 | 103 | 53 | 45 | 22 | 100 | 0 | **984** | 5 | 10 | 67 |
| Single rooms, hospital level | 0 | 6 | 15 | 22 | 9 | 37 | 11 | 38 | 44 | 40 | 37 | 87 | 2 | 4 | 46 | 0 | 41 | 4 | 1 | 0 | 0 | 64 | 29 | 34 | 42 | 22 | 104 | 0 | **739** | 5 | 10 | 67 |
| Single rooms, ward level | 41 | 48 | 21 | 31 | 10 | 39 | 18 | 0 | 0 | 50 | 48 | 0 | 2 | 65 | 40 | 7 | 23 | 5 | 7 | 0 | 0 | 93 | 115 | 53 | 45 | 22 | 0 | 54 | **837** | 5 | 10 | 67 |
| Single rooms, hospital and/or ward, per 100 beds | 40 | 45 | 22 | 30 | 10 | 37 | 18 | 38 | 44 | 50 | 48 | 87 | 2 | 64 | 50 | 7 | 41 | 5 | 6 | 0 | 0 | 92 | 107 | 53 | 45 | 22 | 103 | 53 | **1 119** | 5 | 10 | 67 |
| Number of airborne infection isolation rooms | 38 | 40 | 21 | 28 | 10 | 39 | 19 | 39 | 0 | 48 | 45 | 87 | 2 | 63 | 43 | 0 | 39 | 5 | 7 | 0 | 0 | 92 | 118 | 50 | 46 | 22 | 97 | 54 | **1 052** | 5 | 10 | 67 |
| COVID-19, number of cases previous year | 31 | 44 | 22 | 30 | 10 | 38 | 19 | 19 | 0 | 45 | 46 | 87 | 2 | 62 | 52 | 0 | 32 | 5 | 6 | 0 | 0 | 91 | 106 | 51 | 46 | 19 | 96 | 0 | **959** | 5 | 10 | 67 |
| COVID-19, current number of cases in hospital | 31 | 45 | 22 | 31 | 10 | 38 | 18 | 35 | 57 | 44 | 40 | 87 | 2 | 63 | 51 | 0 | 36 | 4 | 7 | 0 | 0 | 93 | 111 | 50 | 46 | 21 | 90 | 0 | **1 032** | 5 | 10 | 67 |
| COVID-19, number of outbreaks previous year | 27 | 35 | 23 | 25 | 10 | 34 | 18 | 24 | 0 | 45 | 38 | 87 | 2 | 64 | 38 | 0 | 34 | 5 | 6 | 0 | 0 | 92 | 94 | 51 | 37 | 16 | 87 | 0 | **892** | 5 | 8 | 67 |
| Universal masking policy | 41 | 48 | 23 | 28 | 9 | 37 | 19 | 40 | 0 | 46 | 44 | 87 | 2 | 65 | 0 | 0 | 0 | 5 | 7 | 0 | 0 | 88 | 112 | 47 | 47 | 22 | 103 | 0 | **920** | 4 | 10 | 67 |
| Vaccination coverage HCW COVID-19 | 26 | 31 | 18 | 30 | 10 | 34 | 15 | 24 | 0 | 37 | 45 | 87 | 2 | 34 | 51 | 0 | 28 | 0 | 7 | 0 | 0 | 86 | 101 | 50 | 42 | 18 | 77 | 0 | **853** | 5 | 9 | 67 |
| Vaccination coverage HCW influenza | 27 | 37 | 18 | 29 | 10 | 36 | 16 | 38 | 0 | 21 | 45 | 87 | 2 | 57 | 44 | 0 | 28 | 0 | 7 | 0 | 0 | 81 | 103 | 50 | 21 | 18 | 82 | 0 | **857** | 5 | 6 | 67 |
| FTE antimicrobial stewardship consultants | 39 | 48 | 22 | 28 | 9 | 39 | 19 | 38 | 56 | 50 | 40 | 82 | 2 | 63 | 29 | 0 | 0 | 5 | 7 | 0 | 0 | 93 | 116 | 46 | 45 | 21 | 87 | 53 | **1 037** | 5 | 9 | 67 |
| Post-prescription review, hospital | 0 | 9 | 16 | 20 | 9 | 37 | 12 | 39 | 0 | 45 | 38 | 87 | 2 | 8 | 45 | 0 | 41 | 3 | 2 | 0 | 0 | 69 | 29 | 34 | 41 | 22 | 105 | 0 | **713** | 5 | 10 | 67 |
| Post-prescription review, ward | 39 | 47 | 22 | 30 | 8 | 36 | 17 | 0 | 0 | 50 | 45 | 0 | 2 | 65 | 40 | 7 | 31 | 5 | 7 | 0 | 0 | 91 | 117 | 49 | 45 | 22 | 0 | 54 | **829** | 3 | 10 | 67 |
| Post-prescription review, any | 39 | 48 | 23 | 30 | 10 | 39 | 19 | 39 | 0 | 50 | 48 | 87 | 2 | 65 | 53 | 7 | 41 | 5 | 7 | 0 | 0 | 91 | 117 | 52 | 46 | 22 | 105 | 54 | **1 099** | 5 | 10 | 67 |

*IPC: infection prevention and control; CEO: hospital Chief Executive Officer; FTE: Fulltime equivalent; AHR: alcohol-based handrub; CDI: Clostridioides difficile infection; SSI: surgical site infection; ICU: intensive care unit; AMR: antimicrobial resistance; AMC: antimicrobial consumption; IPCAF: WHO's Infection Prevention and Control Assessment Framework; WHO: World Health Organization; HCW: healthcare worker.*

# Annex 2. Country summary sheets

Summary results of the ECDC PPS 2022–2023 by country are available as separate worksheets in an Excel file available online from here.

## Disclaimer

Comparisons between country results should not be made without taking into account the limitations outlined in the discussion section of this report. The country rank and corresponding percentiles of the indicators in section IV of the country summary sheets are primarily given to facilitate discussions about underlying factors that may explain inter-country differences such as differences in patient case mix, type of hospital, healthcare system, interpretation of definitions, under- and overreporting, selection bias and poor representativeness.

## Legend

Section IV (Indicators)

Mean: shows a mean, a percentage or a ratio. The mean is the pooled (aggregated) mean, not the hospital mean (mean of values by hospital). For example, the mean number of fulltime equivalent IPC nurses per 250 beds is the sum of all FTE IPC nurse for the country × 250 / total number of beds in participating hospitals for the country.

Hosp. P50: shows the hospital median of the indicator. It is not applicable when the mean shows a percentage of hospitals. The hospital median shows the "middle" value, separating the lower 50% of hospitals from the higher 50% hospitals.

N cntr: number of countries that reported the indicator

Rank: shows the position of the country out of all countries that reported the indicator, with position 1 being the highest.

Percentile: rank converted to a percentile (position if there were 100 countries)

Colour legend:

Negative (`more is bad') indicators:

| | |
|---|---|
| 95 | percentile 90–100 |
| 75 | percentile 75–<90 |
| 60 | percentile >50–<75 |
| 45 | percentile >25–50 |
| 15 | percentile >10–25 |
| 5 | percentile 1–10 |

Positive (`more is good') indicators:

| | |
|---|---|
| 95 | percentile 90–100 |
| 75 | percentile 75–<90 |
| 60 | percentile >50–<75 |
| 45 | percentile >25–50 |
| 15 | percentile >10–25 |
| 5 | percentile 1–10 |

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