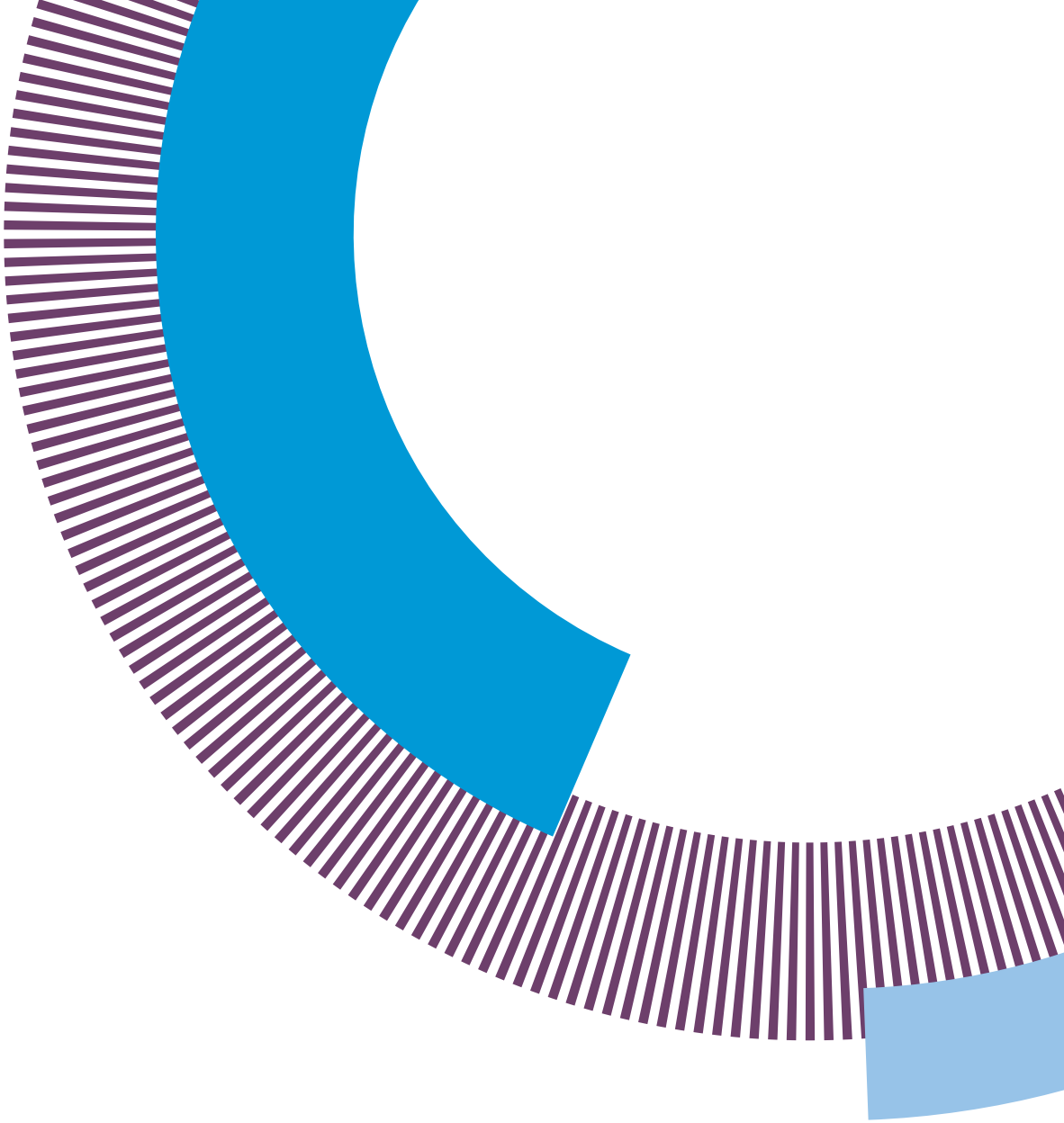

Global antibiotic resistance surveillance report 2025

WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS)

World Health Organization

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Contents

Foreword

Antimicrobial resistance (AMR) is one of the 10 top global health threats, undermining the effectiveness of essential treatments and placing millions at risk of untreatable infections. Countries striving to strengthen their health systems and accelerate progress towards universal health coverage and health security goals need reliable, representative, and timely AMR data.

Since its launch in 2015, the WHO Global Antimicrobial Resistance and Use Surveillance System (GLASS) has steadily expanded to support countries in building national surveillance systems, harmonizing data collection and generating evidence to guide action. By the end of 2024, 127 countries and three territories and areas had joined GLASS, over 100 of which contributed data on AMR for 2023.

Offering new insights into the AMR burden, this report marks a milestone. It presents the most comprehensive analysis of AMR prevalence to date, including regional and global estimates for 93 infection type–pathogen–antibiotic combinations and, for the first time, national estimates of prevalence and regional and global resistance trends for some of these combinations. It also describes progress and challenges in surveillance worldwide.

The report's main findings are concerning. Resistance to life-saving medicines is critically high and rising, especially in resource-limited settings. Such inequalities underline the urgent need to address AMR by investing in health systems, especially to prevent infections and to ensure access to timely, high-quality, affordable, appropriate diagnosis and treatment.

The 2024 United Nations General Assembly Political Declaration on AMR set clear targets for global action by 2030, including reducing deaths associated with bacterial AMR by at least 10% and ensuring that at least 70% of overall human antibiotic use is from the WHO AWaRe (Access, Watch, Reserve antibiotics) Access group. Surveillance data from GLASS serves as a compass to monitor outcomes in terms of resistance and guide policy.

It is therefore encouraging that country participation in GLASS continues to expand and national AMR surveillance coverage is improving in many areas. WHO is supporting countries to strengthen the foundations of AMR surveillance through updated guidance, capacity-building and more nationally representative surveys for estimating the prevalence and the health and economic burden of AMR, so that all countries can generate and use high-quality data.

This report represents the combined work of Member States, WHO regional and country offices, the WHO AMR Collaborating Centres Network and international partners. It reflects our shared commitment to building a global evidence base for action against AMR. With continued collaboration, surveillance data can – and must – drive meaningful changes: improving patient care, informing policy and preserving the effectiveness of antimicrobials for future generations.

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Assistant Director-General
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Data collection and compilation

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Abbreviations

AMR	antimicrobial (or antibiotic) resistance
AMU	antimicrobial (or antibiotic) use
AST	antimicrobial (or antibiotic) susceptibility testing
AWaRe	Access, Watch, Reserve antibiotics
CAESAR	Central Asian and European Surveillance of Antimicrobial Resistance
CI	confidence interval
CrI	credible interval
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Centre for Disease Prevention and Control
ESBL	extended-spectrum beta-lactamase
GLASS	Global Antimicrobial Resistance and Use Surveillance System
GLASS-EAR	GLASS Emerging Antimicrobial Resistance Reporting
LMIC	low- and middle-income countries
MRSA	methicillin-resistant *Staphylococcus aureus*
ReLAVRA	Latin American Network for Antimicrobial Resistance Surveillance
SDG	Sustainable Development Goal
UHC	universal health coverage
WHO	World Health Organization
WPRAMRSS	Western Pacific Regional Antimicrobial Resistance Surveillance System

Glossary

AMR surveillance coverage: The number of bacteriologically confirmed infections with antimicrobial (or antibiotic) susceptibility testing (AST) per million population in a defined area (country, WHO region or globally). While this metric is used throughout the report to describe and compare surveillance systems, variations may reflect differences in either the testing practices, the reporting of results or actual incidence.

GLASS: WHO's global system for surveillance of antimicrobial resistance (AMR) and antimicrobial use (AMU). In AMR and AMU reports and disseminated materials, GLASS may be referred to as GLASS-AMR and GLASS-AMU. Unless otherwise specified, the term "GLASS" in this report refers specifically to GLASS-AMR.

GLASS enrolment: The initial administrative step for a country to join the global surveillance system. It involves a formal expression of intent to contribute data on AMR to GLASS. Enrolment signals a country's intent to build AMR surveillance capacity, register on the GLASS platform and share data.

Infection: In this report, the primary unit of observation is a bacteriologically confirmed infection with AST results. It thus corresponds to a clinical episode in which a bacterial pathogen has been identified and for which AST results are available. Data are derived from bacterial isolate reports – de-duplicated by patient and bacterial pathogen – submitted by participating health facilities through GLASS. The terms "infection", "bacteriologically confirmed infection" and "infection episode" are used interchangeably in this report on the assumption that collection of a specimen was clinically indicated (i.e. prompted by signs and symptoms consistent with an infection).

Infection type: The anatomical or clinical site of the infection inferred from the type of specimen submitted for bacterial identification and AST. This report provides data on bloodstream, gastrointestinal, urinary tract and urogenital gonorrhoeal infections.

WHO legal classifications of countries, territories and areas: In this report, the term "countries" refers to the 216 countries, territories and areas recognized in WHO's legal framework. The group comprises 194 Member States, two Associate Members and 20 Territories and Areas.

WHO region: WHO classifies its Member States into six regions for the purposes of governance, epidemiological reporting and programme coordination: the African Region, the Region of the Americas, the South-East Asia Region, the European Region, the Eastern Mediterranean Region and the Western Pacific Region. In accordance with resolution *WHA78.25* (2025), Indonesia was reassigned to the WHO Western Pacific Region as of 27 May 2025. The data analysis for this report was completed prior to the reassignment; therefore, Indonesia is included in the South-East Asia Region in all analyses and reporting presented herein.

Summary

At a glance

1. Country participation in the World Health Organization's *Global Antimicrobial Resistance and Use Surveillance System* has increased four-fold since 2016, although regional gaps persist.
2. Global levels of antibiotic resistance are high and unevenly distributed across regions.
3. Increasing antibiotic resistance trends in Gram-negative bacterial pathogens pose a growing threat.
4. Countries with limited surveillance often report higher levels of antibiotic resistance.
5. Antibiotic resistance disproportionately affects low- and middle-income countries and countries with weak health systems.

Eniyoha had been abandoned. She had sepsis. The first antibiotics the doctors tried did not work, so they attempted even stronger drugs. Her parents left her at the hospital after they were asked to pay the bill. Babies like Eniyoha rely on nurses like Ibezim to survive.

Introduction

Antimicrobial resistance (AMR) is compromising the effectiveness of life-saving treatments, posing a serious, growing threat to global health and undermining the foundations of modern medicine. In response, World Health Organization (WHO) established the Global Antimicrobial Resistance and Use Surveillance System (GLASS) to strengthen evidence on AMR through standardized data collection, analysis, sharing and reporting. Launched in 2015 to monitor AMR and extended in 2020 to include antimicrobial use (AMU), the system receives data on AMR from the human health sector on infections of both hospital and community origin.

This report is based on over 23 million bacteriologically confirmed infections reported by 104 countries. Statistical modelling was used to generate adjusted estimates of resistance to 22 antibiotics used to treat eight common bacterial pathogens (*Acinetobacter* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Neisseria gonorrhoeae*, non-typhoidal *Salmonella* spp., *Shigella* spp., *Staphylococcus aureus* and *Streptococcus pneumoniae*). These pathogens are responsible for four types of infection under surveillance in GLASS – bloodstream, gastrointestinal, urinary tract and urogenital gonorrhoea – resulting in 93 infection type–pathogen–antibiotic combinations. The modelled estimates account for national differences in population structure and surveillance coverage and also for the distribution of AMR among patient groups over time, providing a reliable picture of resistance at national, regional and global levels.

To assess the maturity of AMR surveillance systems, this report includes examination of whether national AMR surveillance coverage has improved over time in different world regions and introduces a scoring framework to evaluate the completeness of data reported to GLASS. When reported in full, such data provide a comprehensive picture of a country's surveillance system, comprising alignment with core system components, the extent of health system coverage and the representativeness of AMR data. The scores also capture the availability and volume of AMR data for each infection type–pathogen–antibiotic combination and whether relevant patient demographic, clinical and epidemiological details were available, which improve interpretation of national estimates of resistance.

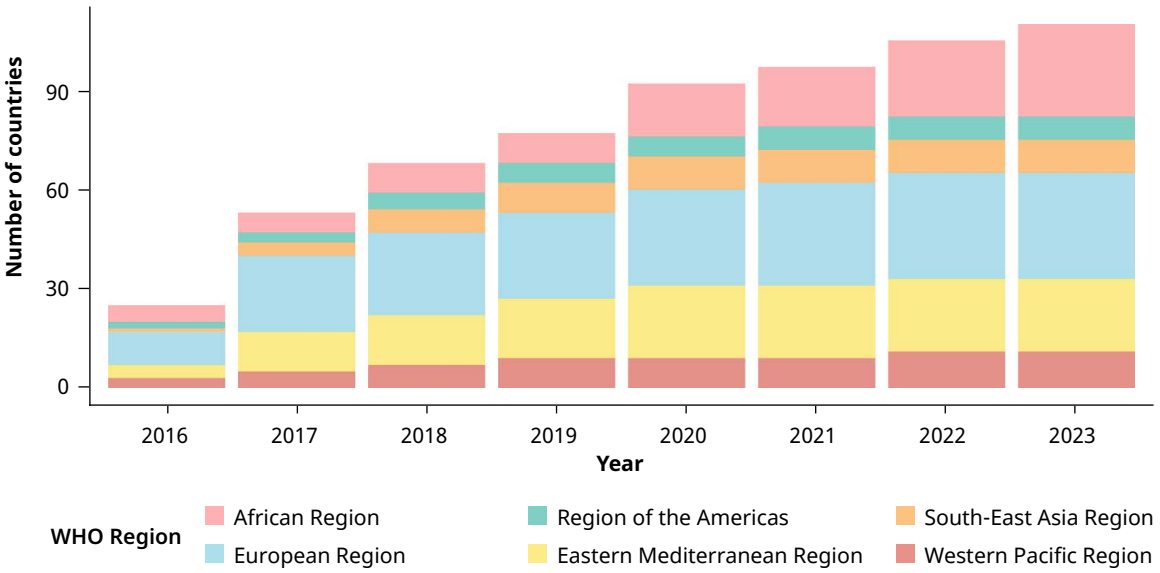
The findings are concerning. Resistance to essential antibiotics – particularly among Gram-negative bacteria – is widespread, increasing and unevenly distributed. The effectiveness of first-choice treatments for common infections of the bloodstream, urinary tract and gastrointestinal tract is increasingly compromised. The burden is highest in low- and middle-income countries (LMICs), where coverage of AMR surveillance and microbiological diagnostic capacity and access to effective alternative treatment may be limited, resulting in a syndemic of resistance and weak health systems that disproportionately impacts the most vulnerable populations.

Key findings

1. Country participation in GLASS has increased four-fold since 2016, but regional gaps persist.

Since 2016, 110 countries, including three territories and areas, have submitted AMR data to GLASS. In 2023, 104 countries reported data, an increase of over 300% compared to the 25 countries that reported in 2016, the first year of data collection (Fig. 1). GLASS has now reached a level of maturity that allows generation of global estimates. The upward trend reflects increased awareness in countries of the value of sharing data from AMR surveillance as a common public health good. Despite progress, major gaps remain. In 2023, participation among Member States was lowest in the Region of the Americas (20.0%, 7 of 35 countries) and the Western Pacific Region (37.0%, 10 of 27 countries), and only slightly over half of countries in the African (57.4%, 27 of 47 countries) and European (58.5%, 31 of 53 countries) regions reported data to GLASS. Participation was highest in the South-East Asia (90.9%, 10 of 11 countries) and Eastern Mediterranean (76.2%, 16 of 21 countries) regions.

Figure 1. Numbers of countries that reported AMR data to GLASS, by WHO region, 2016–2023[1]



Numbers of countries include three territories and areas

Contribution to global efforts on AMR surveillance has been steadily growing since 2016. By the end of 2024, 130 countries, including three territories and areas, were enrolled in GLASS. Of these, 104 countries, covering over 70% of the world's population, reported AMR data for 2023 – a more than 300% increase from only 25 countries in 2016.

National AMR surveillance coverage has also increased. Between 2016 and 2023, the number of infections with antimicrobial susceptibility test (AST) results reported to WHO per million population rose globally for three of the four infection types. National AMR surveillance data pointed to an annual median increase in AST reports for urinary tract infections of 26.0% (95% credible interval [CrI]: 17.3, 35.4), bloodstream infections of 20.0% (13.4, 26.8) and gastrointestinal infections of 11.4% (3.0, 20.4). These increases suggest that more countries are either conducting AST more frequently in routine clinical care or extending surveillance to additional health-care facilities.

Progress nevertheless remains uneven. GLASS coverage of urogenital gonorrhoea remained low in 2023. Global AMR estimates are vulnerable to bias because of differences in regional reporting. In addition, more than half of the reporting countries still lack the basic infrastructure necessary to generate reliable, comprehensive AMR data, posing a challenge to global monitoring of AMR. Only 46.2% (48 of 104) of countries reported that they had all WHO-recommended core components of a robust national surveillance system, including quality assurance for both a national reference laboratory and the broader surveillance laboratory network as well as adherence to international AST standards. The overall global score for national data completeness was only 53.8% among the 104 countries that reported AMR data in 2023, reflecting ongoing challenges in capturing the full scope and context of AMR. In addition, large parts of sub-Saharan Africa, Central Asia and Latin America still report limited or no data to GLASS, leaving major gaps in regional coverage and indicating persistent inequity in access to diagnostics.

Extension of surveillance coverage is an achievement that reflects growing global commitment to addressing AMR. To sustain this progress and to ensure that surveillance data are used in forming evidence-based policies,

[1]In accordance with resolution *WHA78.25* (2025), Indonesia was reassigned to the WHO Western Pacific Region as of 27 May 2025. The data analysis for this report was completed prior to the reassignment; therefore, Indonesia is included in the South-East Asia Region in all analyses and reporting presented herein.

countries must reinforce their surveillance systems to make them more representative. These include sustained investment in high-quality, comprehensive digital infrastructure for reliable data collection, management and reporting. Strengthening electronic systems will ensure that AMR surveillance can guide timely public health action.

2. Global resistance is extensive, with wide regional variations.

In 2023, approximately one in six laboratory-confirmed bacterial infections worldwide were caused by bacteria resistant to antibiotics. Median resistance was most common in urinary tract infections (approximately 1 in 3) and bloodstream infections (1 in 6) and less so in gastrointestinal (1 in 15) and urogenital gonorrhoeal infections (1 in 125). Resistance was most frequent in the South-East Asia and Eastern Mediterranean regions (almost 1 in 3 infections), followed by the African Region (1 in 5), all above the global median (Fig. 2). Resistance was less frequent in the European Region (1 in 10) and least frequent in the Western Pacific Region (1 in 11), indicating wide regional disparity.

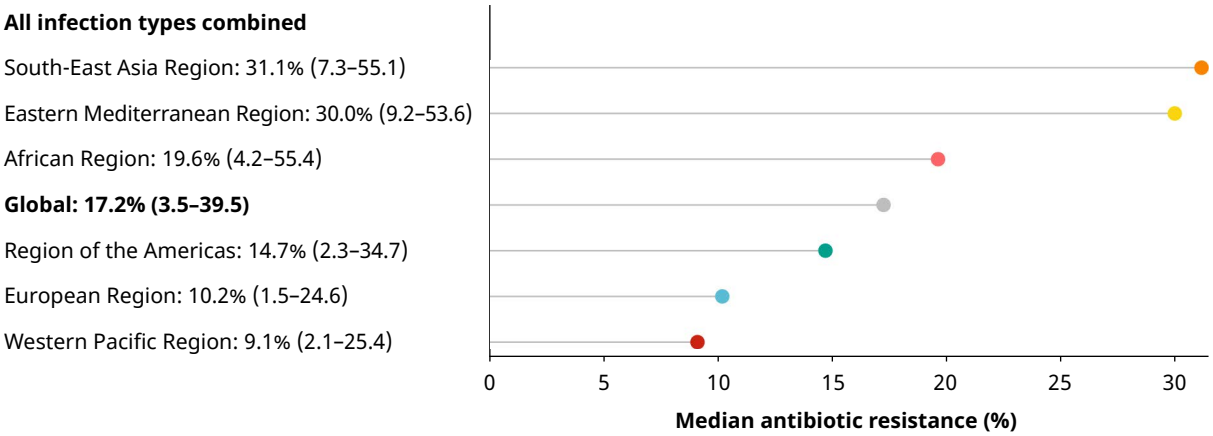
Analysis of the extent of resistance in 93 infection type–pathogen–antibiotic combinations indicates a global pattern of AMR characterized by widespread resistance to essential first-choice, second-choice and last-resort antibiotics, but with substantial variation among pathogens and regions.

In bloodstream infections, the most frequently reported drug-resistant pathogens globally were Gram-negative bacteria such as *E. coli* and *K. pneumoniae* resistant to fluoroquinolones and third-generation cephalosporins. Resistance to third-generation cephalosporins was reported in 44.8% (95% CrI: 39.3, 50.4) of infections with *E. coli* and 55.2% (48.5, 61.7) of those with *K. pneumoniae*. In the African Region, the extent of resistance was especially concerning, exceeding 70% for both pathogens.

Global resistance to essential broad-spectrum "Watch" antibiotics such as carbapenems was 54.3% (49.3, 59.2) in *Acinetobacter* spp., while, in the South-East Asia Region, the frequency of resistance of *K. pneumoniae* bloodstream infections to carbapenems reached 41.2% (30.3, 53.1).

Methicillin-resistant *S. aureus* (MRSA) remains a problem, with a global level of resistance in bloodstream infections of 27.1% (23.5, 31.0), highest in the Eastern Mediterranean Region at

Figure 2. Median AMR in 93 infection type–bacterial pathogen–antibiotic combinations, by WHO region, 2023



The median and interquartile ranges are useful summaries for comparing the percentage of resistance among regions, but they do not reflect the full variation in resistance in specific infection–pathogen–antibiotic combinations. For example, for urogenital gonorrhoea, the level of global resistance to four of the six commonly used antibiotics, including ceftriaxone (0.3%), is low (< 1.0%), but it is much higher to azithromycin (12.6%) and ciprofloxacin (75.0%).

Bilal, 22, has just been discharged from hospital after a bout of drug-resistant typhoid. Doctors said that typhoid was once an illness that you could cure with pills but is now leading to hospital admissions. Bilal's typhoid could be treated only with an antibiotic called meropenem, which is reserved for the most serious infections. It is also expensive – and it sold at a price families like his struggle to afford.

50.3% (39.8, 60.8). The percentage resistance of non-typhoidal *Salmonella* spp. in bloodstream infections to ciprofloxacin was 18.0% (13.9, 22.9) globally, highest in the European Region, at 36.2% (29.0, 44.2).

In gastrointestinal infections, resistance to fluoroquinolones in *Shigella* spp. was widespread globally, at 29.7% (22.9, 37.5), reaching 75.5% (58.1, 87.3) in the South-East Asia Region.

In urinary tract infections caused by *E. coli and K. pneumoniae*, resistance to commonly used antibiotics, including third-generation cephalosporins, fluoroquinoloes and co-trimoxazole was typically higher than 30% globally.

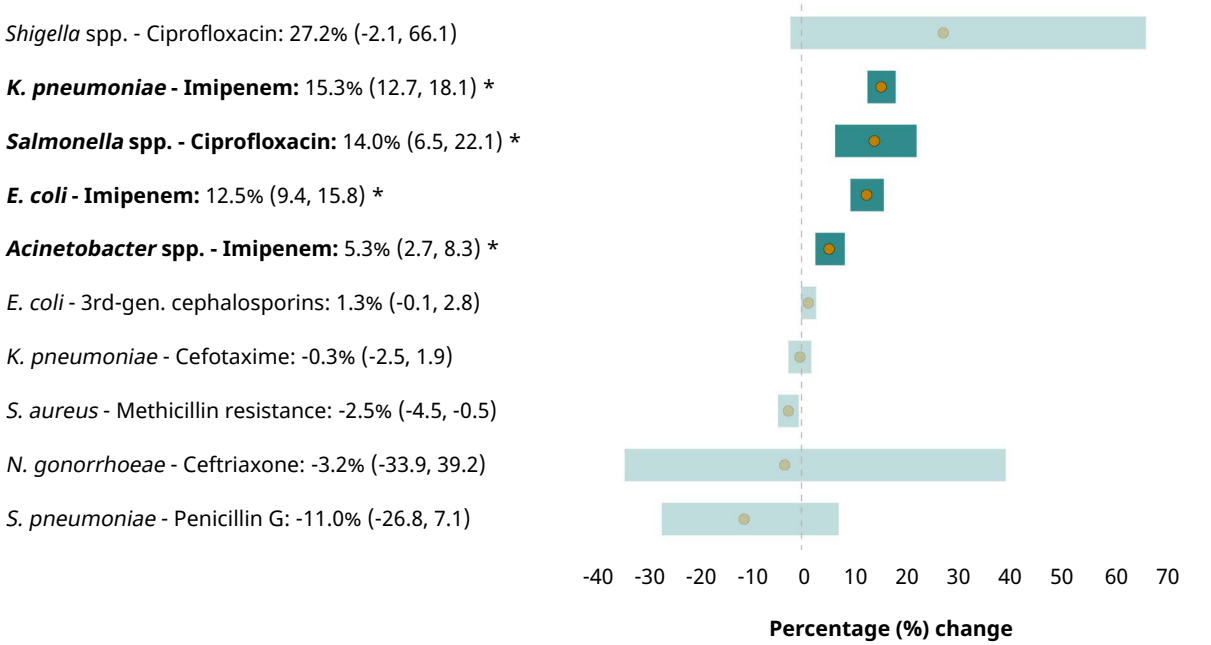
Fluoroquinolone resistance in *N. gonorrhoeae* was almost universal, at 75.0% (70.9, 78.8) globally. Although the level of resistance to ceftriaxone remained low, at 0.3% (0.1, 0.6), its emergence, particularly in the Eastern Mediterranean Region (2.5%, 0.8, 7.7), threatens the last effective empirical treatment for gonorrhoea.

A systematic review of literature conducted for this report (see Chapter 4) corroborated the high resistance observed in GLASS. Published studies often reported resistance levels that are even higher than those found in AMR surveillance data, probably reflecting a bias towards data collected in tertiary hospitals.

3. Trends in AMR indicate an increasing threat from Gram-negative bacterial pathogens.

AMR has increased in 40% of the pathogen–antibiotic combinations monitored for global temporal trends between 2018 and 2023, with annual relative increases ranging from 5% to 15%, depending on the combination (Fig. 3). Resistance to "Watch" antibiotics in the AWaRe (Access, Watch, Reserve antibiotics) system *(1)* – particularly carbapenems and fluoroquinolones – is increasing among key Gram-negative pathogens, including *Acinetobacter* spp., *E. coli, K. pneumoniae and Salmonella* spp. This is a concern, as these antibiotics are essential for the treatment of severe infections. Rising AMR is limiting empirical therapeutic choices and driving a shift from oral to intravenous treatments, including greater reliance on second-choice and last-resort antibiotics.

Figure 3. Trends of AMR: median annual change in percentage, 2018–2023



Population-weighted median annual percentage change in AMR between 2018 and 2023, represented by a dot, with 95% CrI. An asterisk (*) indicates a statistically meaningful trend. When trends were available for several infection types, only that with the highest annual percentage change is shown in the figure.

3rd– gen.: Third-generation.

The frequency of resistance to carbapenems is increasing among the three leading Gram-negative pathogens responsible for serious bloodstream infections: *E. coli, K. pneumoniae* and *Acinetobacter* spp. At the same time, resistance to fluoroquinolones in non-typhoidal *Salmonella* spp. is increasing in frequency globally.

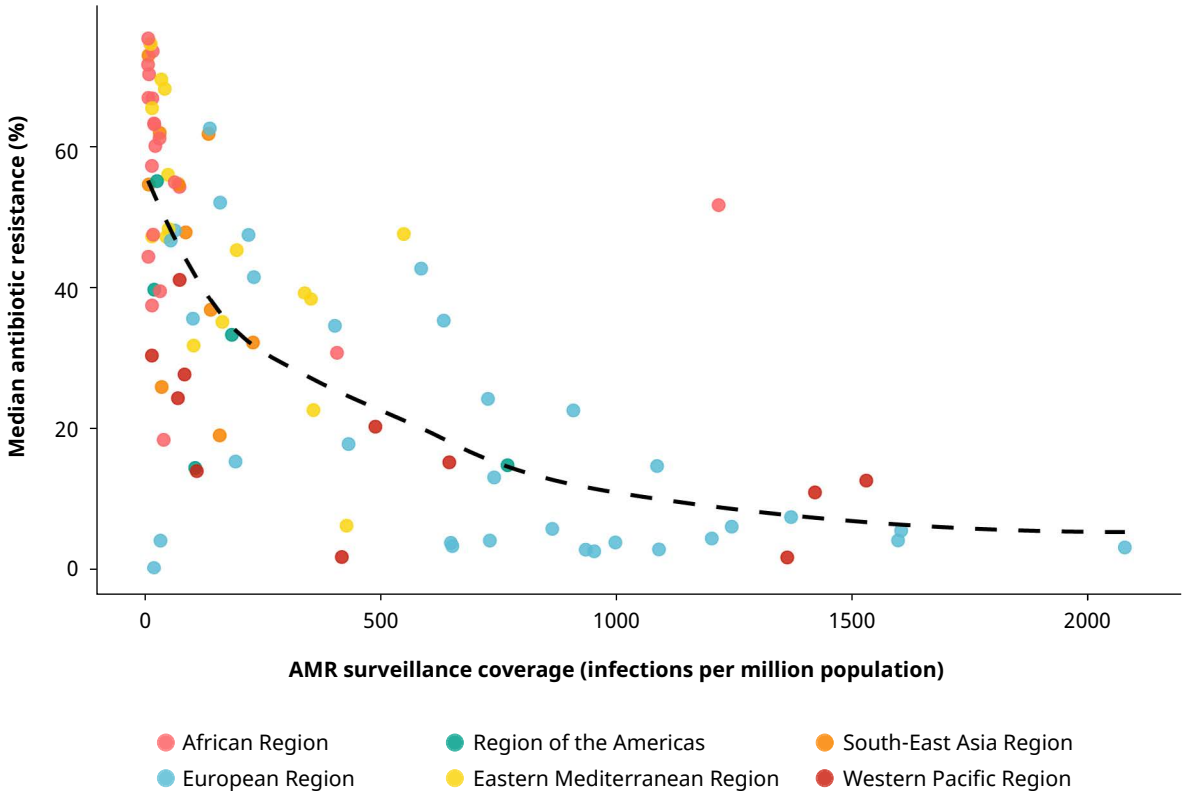
Many drug-resistant pathogens are associated with severe clinical outcomes and limited therapeutic options. Some, such as carbapenem-resistant *K. pneumoniae* and *Acinetobacter* spp., are associated with high fatality, exceeding 30% *(2)*. Others, including third-generation cephalosporin-resistant *E. coli* and MRSA, are characterized by high incidence and morbidity, with more than 10 000 cases and 1.5 years lived with disability per million population *(2).*

The treatability of infections by many of these resistant pathogens, including carbapenem-resistant *Acinetobacter* spp. and carbapenem-resistant *E. coli*, remains low to moderately low *(2).* Prevention of these infections is often difficult. Infections with fluoroquinolone-resistant non-typhoidal *Salmonella* spp. are particularly challenging to control due to widespread transmission. Meanwhile, the antibiotic development pipeline remains weak and is unlikely to deliver effective alternatives in the near future for several of the most pressing threats *(2).*

4. Settings with lower AMR surveillance coverage report higher levels of AMR.

The frequency of AMR is highest in countries with low surveillance coverage. In fact, there is a strong inverse correlation between a country's AMR surveillance coverage and its reported median AMR (Pearson correlation coefficient, r = –0.74, P < 0.0001, Fig. 4). This pattern may reflect both genuinely higher resistance in settings with limited national surveillance capacity, possibly paired with poor clinical practices, weak public health interventions and biases in the data, such as selective sampling in tertiary hospitals or of severe cases only.

Figure 4. Median national percentage of AMR in bloodstream infections by AMR surveillance coverage, 2023



The figure presents the relation, for each of 95 countries, between the median percentage resistance of all bacterial pathogen–antibiotic combinations reported for bloodstream infections and the number of infections for which AST results were reported per million population.

The relation between AMR surveillance coverage and reported resistance levels is shaped by both epidemiological realities and systemic limitations. In countries with limited surveillance infrastructure, data on resistance are often derived from a small number of tertiary hospitals, where patients typically present with more severe infections, multiple treatment failures, or treatment-resistant pathogens. This sampling bias can lead to overestimates of prevalence and limit the generalizability of findings to the broader population, thereby reducing the utility of AMR surveillance data for guiding national and global empirical treatment.

Insufficient diagnostic capacity limits both the generation of representative, reliable data on resistance, and the implementation of evidence-based infection prevention, control, and antibiotic stewardship. In sub-Saharan Africa, only 1.3% of clinical laboratories are designated to perform bacteriological testing and, of those, only 18% have access to automated AST systems *(3)*. Molecular diagnostics, which are essential for detecting resistance mechanisms and can help guide appropriate use of antibiotics, are largely inaccessible in many low-resource settings. In the absence of diagnostic infrastructure to assess bacterial susceptibility to antibiotics, clinicians must rely solely on empirical treatment, which may not align with individual or local resistance patterns. This diagnostic gap not only increases the risk of inappropriate prescribing and treatment failure but also undermines surveillance by reducing the accuracy and representativeness of data on resistance. Consequently, essential broad-spectrum "Watch" antibiotics such as carbapenems – intended exclusively for severe, hard-to-treat infections caused by multidrug-resistant pathogens and requiring careful monitoring to prevent overuse – are often used

as a precautionary measure to compensate for gaps in diagnostic and surveillance capacity, despite uncertainty about their efficacy and safety in such contexts. Addressing these challenges requires investment in both diagnostic capacity and surveillance systems to ensure that data on resistance are both actionable and reflect real-world clinical settings.

5. Antibiotic resistance disproportionately affects LMICs and fragile health systems, forming a syndemic.

Socioeconomic factors and the strength of health systems are key determinants of the AMR burden, with the frequency of AMR increasing when health systems are weaker. In fact, there was a strong inverse correlation between the universal health coverage (UHC) service coverage index *(4)* (a measure of access to essential health services), income classification, and the median percentage of AMR in bloodstream infections (Pearson $r = -0.77$, $P < 0.0001$, Fig. 5). This pattern points to a syndemic, in which AMR disproportionately affects countries with weaker health systems and lower income levels.

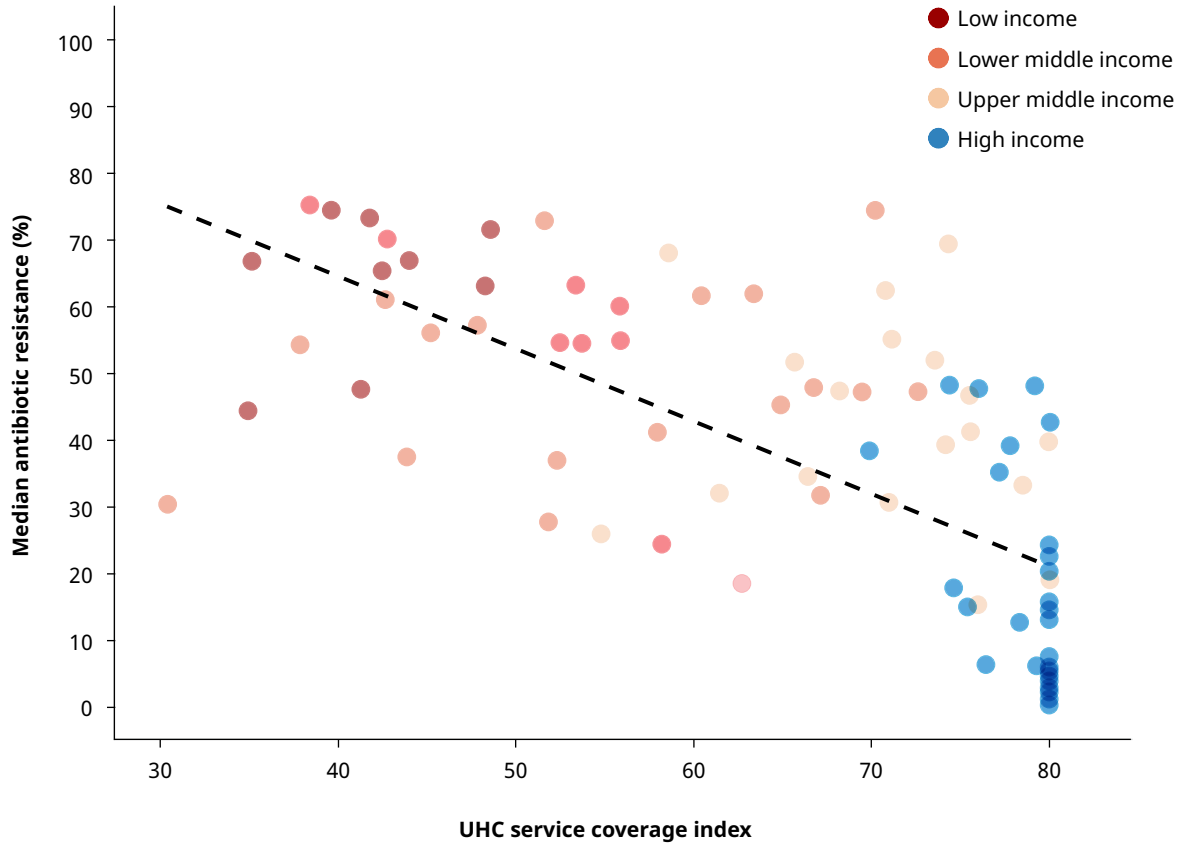
On 13 December 2021, Dr Adeyeye examines a slide under a microscope at the microbiology laboratory in the Department of Medical Microbiology and Parasitology at the Obafemi Awolowo University Teaching Hospitals.

The burden of AMR is not evenly distributed. It is heaviest in countries with weaker health systems, limited diagnostic capacity and restricted access to effective essential antibiotics, creating a syndemic of under-treatment and poor outcomes *(5).* The clinical implications are particularly concerning in intensive care units, neonatal wards and surgical settings, where infections caused by carbapenem-resistant *K. pneumoniae* and *Acinetobacter* spp. are increasingly common, and treatment options are limited. These challenges are particularly acute in many LMICs.

Disproportionate reliance on broad-spectrum antibiotics in the "Watch" group is a major driver of AMR. According to WHO's Global surveillance of AMU *(6),* "Access" antibiotics – recommended as first-choice treatments – comprised only 52.7% of global use in 2022. This proportion falls far short of the target of the political declaration of the United Nations General Assembly in 2024, which calls for at least 70% of antibiotics used in human health to be in the Access group by 2030 *(7).* Meanwhile, "Watch" antibiotics accounted for 45.3% of use, exceeding 70% of total antibiotic consumption in nearly one third of countries. "Reserve" antibiotics were seldom used, at only 0.3% *(6).* These patterns indicate an urgent need to strengthen antibiotic stewardship and ensure equitable access to effective essential antibiotics at all levels of care.

As resistance to widely used, lower-cost antibiotics such as third-generation cephalosporins continues to rise, clinicians are increasingly compelled to consider prescribing carbapenems. When resistance to carbapenems is encountered, however, treatment options for Gram-negative pathogens are often limited to antibiotics in the AWaRe "Reserve" group, which are frequently unaffordable, inconsistently available and require diagnostic confirmation

Figure 5. Median national percentage of AMR in bloodstream infections (2023), by income classification and universal health coverage (UHC) service coverage index



Relations between median resistance of bloodstream infections to antibiotics and two indicators, income classification and the 2021 UHC service coverage index, in 95 countries. Resistance is expressed as the median percentage in all reported pathogen–antibiotic combinations. The service coverage index (0–100), part of Sustainable Development Goal (SDG) indicator 3.8.1, is a measure of access to essential health services based on 14 indicators in four domains: reproductive, maternal, newborn and child health; infectious diseases; noncommunicable diseases; and service capacity and access. Service coverage must be assessed alongside SDG indicator 3.8.2, which measures catastrophic health spending, to monitor progress toward UHC, where people receive the high-quality care they need without financial hardship. Country service coverage index values of 80 and above are shown as "80" due to the index's limited ability to distinguish between countries with very high levels of service coverage. Income classification is based on the World Bank classification released in 2023, which reflects gross national income per capita for 2022. Each dot represents a country, colour-coded by income group.

that is rarely feasible in resource-limited settings. Global surveillance data on AMU show that many LMICs report no use of "Reserve" antibiotics *(6)*, due not to lack of clinical need but because of systemic barriers to access.

Priorities for action

The 2025 GLASS report presents a comprehensive, data-based assessment of the global AMR landscape. Messages and priorities for action in the control of AMR are summarized below.

1. National participation in WHO's GLASS has increased four-fold since 2016, although regional gaps persist.

Countries should overcome structural and operational barriers to data collection, improve the coverage and representativeness of their national AMR surveillance system, use the data for decision-making, and ensure timely sharing of national AMR data to GLASS by 2030, in line with the commitments made in the 2024 United Nations General Assembly political declaration on AMR *(7)*. Priority should be given to

increasing participation in underrepresented regions by expanding the number of contributing facilities and strengthening core surveillance infrastructure to close gaps in global coverage.

2. Global levels of resistance are high and unevenly distributed across regions.

Countries should implement integrated intervention packages that include infection prevention and control, water, sanitation and hygiene, vaccination, antimicrobial stewardship, and strengthening of laboratory services aligned with WHO's people-centred approach *(8).* These interventions should be implemented in the context of multi-sectoral national AMR action plans, which should be updated regularly, costed, implemented and aligned with international targets. The diverse, localized nature of AMR requires comprehensive, context-specific responses; interventions should be tailored to local resistance patterns and health system capacity, avoiding a one-size-fits-all approach.

3. Increasing resistance trends in Gram-negative bacterial pathogens pose a growing threat.

Countries should reduce use of AWaRe "Watch" antibiotics and increase use of "Access" antibiotics to at least 70% by 2030, to meet the target set in the 2024 political declaration on AMR *(7).* At the same time, they should also organize the next recourse to treatment by extending access – while ensuring prudent use – of "Reserve" antibiotics in settings with documented multidrug resistance. Greater investment in research and development of new antibiotics is an urgent priority, particularly against carbapenem-resistant *Acinetobacter* spp. and Enterobacterales, as indicated in the WHO list of priority bacterial pathogens in 2024 *(2).* Scaling-up of diagnostics for targeted antibiotic therapy is essential to preserve the efficacy of treatment.

4. Countries with limited surveillance often report higher resistance levels.

Countries must improve their capacity to conduct AMR surveillance, including enhancing representativeness and strengthening laboratories and data systems.

First, countries should integrate surveillance into routine clinical practice and develop nationally representative AMR surveillance systems for both community- and hospital-acquired infections, covering all levels of the health-care system and all geographical regions. Surveillance should be standardized according to GLASS recommendations, with patient-level, disaggregated reporting by pathogen and infection type *(9).*

Second, countries should strengthen access to quality-assured diagnostics for bacteriology and mycology at every tier of the health care system to ensure the capacity to test all bacterial and fungal pathogens prioritized by GLASS for resistance *(9).* This is essential to meet the target set in the 2024 political declaration on AMR, which calls for at least 80% of countries to achieve such diagnostic capacity by 2030 *(7).*

Third, countries should invest in robust digital information systems with standardized data formats, harmonized terminology and interoperable platforms to ensure that surveillance data are useful for setting treatment guidelines, guiding procurement decisions (e.g. essential medicines lists), supporting stewardship and monitoring the impact of interventions.

5. AMR disproportionately affects LMICs and countries with weak health systems.

Countries should address AMR through broader strategies that strengthen health systems, enhance resilience, and expand social protection, such as UHC and multisectoral initiatives, with equity and access at the core. These efforts should be supported primarily through domestic funding, complemented by global financing mechanisms such as the Pandemic Fund and the Global Fund.

1. Introduction

Colistin is one of very few antibiotics that can still treat certain drug-resistant infections.

1.1 Global commitments to addressing AMR

AMR is a global health threat and development challenge. It increases the risk that common infections become untreatable and routine medical procedures unsafe, potentially reversing decades of progress in modern medicine. Recent estimates position AMR as a leading cause of death worldwide, with the highest mortality in low-resource settings. In 2021, bacterial AMR was linked to approximately 1.14 million deaths *(10).* Allocating resources into AMR containment has been proposed as one of the highest-yield investments countries can make *(11).*

In 2015, the World Health Assembly at its sixty-eighth session adopted a global action plan to ensure the continuity of successful treatment and prevention of infectious diseases with effective, safe medicines *(12)*. WHO subsequently established GLASS to foster AMR surveillance and provide data for national and global mitigation strategies *(13)*. GLASS is a platform for collating, validating and sharing data from national AMR surveillance systems provided by ministries of health, ensuring harmonized global reporting of AMR in common bacteria and invasive fungi and of AMU in the human health sector *(13)*. These data are used to track the SDG indicator for AMR (3.d.2) – the proportion of bloodstream infections due to *E. coli* resistant to third-generation cephalosporins and MRSA *(14,15)*, which encourages national AMR programmes to strengthen monitoring of progress and to invest in response activities.

Despite progress in establishing global surveillance systems for AMR and AMU, disparities in surveillance capacity and in data-sharing limit a comprehensive response to AMR *(7).* As of 2024, only a minority of countries had dedicated funding in their national budgets for implementing national action plans on AMR *(7).* With a high incidence of health-care-associated infections *(16)* and limited access to essential medicines and diagnostics and basic water, sanitation and hygiene services in many low resource settings, the lack of dedicated funding could reverse progress towards achieving the SDGs *(7).*

To accelerate the response, Member States at the Seventy-sixth World Health Assembly in May 2024 adopted WHO's strategic and operational priorities for 2025–2035 to tackle drug-resistant bacterial infections in human health *(17)*. One of the four core strategic priorities is to increase strategic information on AMR, including through surveillance. Countries are urged to adopt a people-centred approach and to implement a package of 13 interventions *(8)* for effective governance, financing and robust surveillance to address AMR effectively in national action plans. To improve national AMR surveillance systems, WHO recommends complementary methods, such as nationally representative AMR surveys, to provide robust population-level data, especially where routine surveillance is limited *(9,18)*.

In September 2024, the second high-level meeting on AMR at the United Nations General Assembly resulted in a political declaration endorsed by heads of state *(7)*. The declaration outlines three bold commitments directly related to AMR surveillance: (i) all countries are expected to report high-quality surveillance data on AMR and AMU to GLASS by 2030; (ii) at least 80% of countries should be capable of testing all bacterial and fungal GLASS pathogens for resistance by 2030; and (iii) there should be a global 10% reduction in the number of deaths associated with bacterial AMR by 2030 from the baseline of 4.95 million deaths in 2019 *(19)*. Achieving these targets will require financial and other resources to strengthen national capacity for collecting nationally representative data on AMR prevalence, mortality and morbidity and for timely sharing of information on emerging trends for decision-making.

In line with WHO's strategic and operational priorities on AMR for 2020–2035 and the targets set in the political declaration, GLASS has increasingly focused on enhancing the quality, representativeness, interpretability and comparability of data reported by countries. This report represents an incremental step in operationalization of this vision, with improved analysis and interpretation of data reported by countries, providing the latest insights into the regional and global prevalence and trends of AMR in human health.

1.2 Global AMR surveillance: a pillar of the AMR response

WHO recommends establishment and extension of surveillance systems as a critical component of any national action plan on AMR *(20).* This complements the WHO AMR diagnostic initiative *(21)*, which supports equitable access to high-quality laboratory testing for bacterial and fungal pathogens throughout the health system (Box 1.1). It also promotes appropriate use of diagnostics to improve patient management, antimicrobial stewardship and infection prevention and control.

GLASS also supports WHO's global research agenda for AMR in human health by generating data to estimate the prevalence and burden of AMR and by promoting optimal surveillance methods that provide epidemiological data directly relevant to research priorities #22 and #25 of the agenda *(22).*

GLASS covers two areas – AMR and AMU – each with a complementary set of tools (see Table 1.1). Guidance for the collection and sharing of national, routinely collected AMR data is provided in the 2023 GLASS manual *(9).* GLASS also includes events-based surveillance, in GLASS Emerging Antimicrobial Resistance Reporting (GLASS-EAR), for detecting novel or emerging AMR threats and enabling a timely response *(23).* In acknowledgement of the importance of integration of surveillance across human health, animal health and the environment, WHO's recommended Tricycle survey – implemented to date in at least 15 LMICs – promotes a One Health[1] integrated surveillance approach by monitoring extended-spectrum beta-lactamase (ESBL)-producing *E. coli* in all three sectors *(24*). GLASS also integrates WHO's enhanced gonococcal antimicrobial surveillance programme *(25).*

Box 1.1 WHO's strategic roadmap for strengthening AMR surveillance

WHO's surveillance-centred roadmap to support countries in addressing AMR is informed by recommendations from the Strategic and Technical Advisory Group on Antimicrobial Resistance, WHO's principal advisory body on AMR. This group advises the WHO Director-General and the AMR Department on global policies and strategies, in alignment with World Health Assembly resolutions. The roadmap is anchored on three interdependent pillars: (1) expansion of bacteriology and mycology diagnostic capacity, (2) enhancement of surveillance and evidence generation and (3) translation of data into action. These pillars are embedded within a broader ecosystem of WHO-recommended interventions to address both upstream drivers and downstream consequences of AMR. Their collective aim is to reduce AMR-related morbidity and mortality and preserve antibiotic effectiveness for future generations.

Pillar 1: Increasing access to high-quality diagnostics and strengthening laboratory systems

Through its AMR diagnostic initiative *(21)*, WHO supports countries and collaborates with partners to build sustainable national laboratory systems capable of generating high-quality microbiological and AMR data. The work includes strengthening laboratory networks and specimen referral systems, improving diagnostic stewardship and laboratory information systems, and promoting the use of standardized testing procedures and external quality assurance mechanisms.

[1] "One Health" is an integrated, unifying approach to sustainable balancing and optimization of the health of people, animals and the environment. It recognizes that the health of humans, domestic and wild animals, plants and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines and communities at various levels of society to work together to foster well-being and to tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, action on climate change and contributions to sustainable development. One Health is particularly important to prevent, predict, detect and respond to global health threats, including AMR.

Expanding access of quality-assured, affordable microbiology testing – aligned with WHO's Essential Diagnostic list – is critical to extend AMR surveillance beyond tertiary hospitals to all levels of the health system. This ensures the generation of reliable, representative data that can inform policy and action. At the same time, the development, evaluation and uptake of scalable and context-appropriate diagnostic tools are being accelerated to improve diagnostic accuracy and support timely, targeted treatment. This is particularly important in low-resource settings, where diagnostic gaps remain a major barrier to an effective AMR response.

Pillar 2: Enhancing surveillance and evidence generation

Strengthening national and global routine surveillance systems for AMR

WHO supports countries to strengthen the quality, coverage and usefulness of AMR surveillance by providing updated guidance, tools and training. Adoption of GLASS-compatible data platforms such as WHONET is promoted to enable standardized data capture, local analysis and comparability across settings.

The scope of GLASS has extended to include *Candida* spp. invasive infections, 13 bacterial pathogens from nine infection types and 32 antibiotics. Countries are encouraged to report individual-level minimum inhibitory concentration values from phenotypic testing, linked with epidemiological and clinical information and molecular diagnostic results, to better characterize resistance mechanisms. Countries are encouraged to report detailed metadata on national AMR surveillance coverage to support more accurate interpretation of estimates of resistance.

A key advance is the new GLASS information technology platform, built on the DHIS2 architecture, which improves data integration, visualization and interoperability across surveillance domains, enabling countries to upload and visualize data more efficiently. The GLASS dashboard publishes data on AMU and unadjusted data on AMR annually, including country profiles, and is regularly reviewed to ensure its relevance and usefulness for countries.

To ensure that national teams are equipped to collect national AMR surveillance data, WHO provides capacity-building through the GLASS help desk and targeted training.

Implementing nationally representative AMR surveys

In countries where routine AMR surveillance is still being developed and the available AMR data are not yet suitable to guide policy, WHO recommends the periodic implementation of nationally representative surveys using standard WHO methods. These surveys generate robust, policy-relevant estimates of AMR prevalence, mortality, morbidity and economic burden. They also provide opportunities for integrated studies on AMU and resistance mechanisms, helping to fill critical data gaps and shape national strategies. In addition, such surveys can be used to validate routinely collected AMR prevalence data.

Convening a global AMR data collaborative

WHO collaborates with global stakeholders to harmonize AMR data sources, define quality standards and achieve consensus on methods for estimating national and global AMR burdens. The data collaborative aims to strengthen country ownership of AMR estimates and to monitor progress towards meeting the United Nations General Assembly political declaration target of a 10% reduction in AMR-associated deaths by 2030 *(7)*.

Pillar 3: Translating surveillance data into policy and practice

Developing a data-to-action framework

WHO "data-to-action" framework aims to support countries in the systematic translation of surveillance data into clinical and policy interventions. It includes adapting empirical treatment guidelines to local resistance patterns, revising national essential medicines lists and aligning national AMR action plans with evolving trends in resistance.

Strengthening stewardship and ensuring equitable access to effective essential antibiotics

Strengthening of antimicrobial stewardship programmes and improving equitable access to effective essential antibiotics, particularly

those in the "Watch" and "Reserve" groups, remain priorities. Work is being conducted to embed antibiotic stewardship in broader health system interventions to reduce AMR-related morbidity and mortality, preserve antimicrobial efficacy and ensure that effective treatments remain accessible to all who need them.

Supporting country-led action

While WHO provides the global framework, tools and technical guidance, the responsibility for turning data into action and preserving the effectiveness of existing antibiotics ultimately lies with national governments. Countries are encouraged to prioritize investment in surveillance infrastructure, diagnostics and stewardship, particularly in regions with the highest prevalence of resistance and the lowest surveillance coverage. The plan should include ensuring that all populations who seek care in health facilities, especially in underserved areas, have access to microbiology laboratory test results and quality-assured AST. Surveillance should also be integrated into routine clinical practice to ensure that data collection becomes a standard part of patient care.

National action plans should be updated to reflect the resistance patterns reported in this document. Antibiotic treatment guidelines should be revised to align them with local data on resistance, and essential medicines lists must be adapted to ensure that effective essential antibiotics are available, affordable and used appropriately. In many countries, this will require reform of procurement systems, updating of formularies and removal of regulatory barriers to accessing "Reserve" antibiotics.

Antimicrobial stewardship must become a national priority. This includes training health-care workers in responsible use of antibiotics, setting up stewardship programmes in hospitals and clinics and regulating the use of antibiotics in agriculture and animal health. Public awareness campaigns are essential to reduce demand for unnecessary antibiotics and to promote understanding of AMR as a shared societal threat.

Countries must commit sustained political and financial support for AMR control. This includes integrating AMR into broader health system strengthening and UHC strategies, with deliberate attention to structural inequities and the socioeconomic determinants of vulnerability to resistant pathogens. National strategies should be guided by the principle of equitable access to diagnostics, effective treatment and high-quality care, particularly in settings where health system capacity remains limited.

Strengthening health systems to address AMR must extend beyond infrastructure to include core service delivery such as infection prevention and control, which are essential to reduce the spread of resistant pathogens and improve patient safety. It also requires investment in workforce development, advocacy and leadership to build a well-informed, capable health workforce equipped to deliver high-quality, evidence-based care.

Collaboration with regional surveillance networks is essential to ensuring the timely reporting of quality-assured data for effective global monitoring of AMR. Networks such as the Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR), the European Antimicrobial Resistance Surveillance Network (EARS-Net) and the European Centre for Disease Prevention and Control (ECDC), the Latin American Network for Antimicrobial Resistance Surveillance (ReLAVRA), and the Western Pacific Regional Antimicrobial Resistance Surveillance System (WPRAMRSS) play a vital role in supporting country-level surveillance efforts, fostering engagement in global monitoring, and promoting the standardization of surveillance methods. These efforts contribute to improved quality, comparability, and coverage of AMR surveillance data—essential for guiding evidence-based policy decisions, strengthening public health responses, and tracking progress toward global AMR targets.

To ensure that surveillance data translates into meaningful impact, national strategies must be aligned with global targets for reducing AMR-related mortality and morbidity. Embedding AMR within national preparedness and health security agendas is critical to building resilient health systems that can respond effectively to current threats and adapt to future challenges.

Table 1.1. WHO Guidance on Surveillance of Antimicrobial Resistance (AMR) and Antimicrobial Use (AMU)

Activity	Approach	Guidance	Scope	Year of publication
AMR				
Surveillance of AMR	National routine surveillance	GLASS manual for AMR surveillance in common bacteria causing human infection	Methods, metrics and reporting mechanisms of national AMR surveillance data to GLASS-AMR	2023 [a]
		GLASS early implementation protocol for inclusion of *Candida* spp.	Methods for the surveillance of resistance in *Candida* spp. bloodstream infections	2019
	Surveys	Methodological principles of nationally representative AMR surveys in human bloodstream infections	Methods for planning and implementing nationally representative surveys to measure the prevalence of AMR in bloodstream infections in patients seeking acute inpatient care and mortality attributed to AMR	2023 [a]
		GLASS method for estimating mortality attributable to AMR in bloodstream infections		2020 [a]
Early detection of novel and emerging AMR	Events-based surveillance	GLASS-EAR	Framework for detection, management and reporting of novel or emerging AMR events	2018 [a]
One Health surveillance	Tricycle survey	Integrated surveillance of ESBL-producing *E. coli* using a One Health approach	Methods for a standardized, simplified, integrated multisectoral surveillance system for ESBL-producing *E. coli* in humans, animals and the environment	2021
AMU				
Surveillance of AMU	National routine surveillance	GLASS method for surveillance of national antimicrobial consumption	Methods, metrics and reporting to GLASS-AMU in national surveillance systems for AMU	2020 [a]
	Hospital routine surveillance	GLASS guide for national surveillance systems for monitoring antimicrobial consumption in hospitals	Methods and metrics for data on AMU volume and patterns in hospitals for antibiotic stewardship	2020
	Point prevalence surveys	WHO method for point prevalence surveys of AMU in hospitals	Methods for single- or multicentre surveys on prescribing practices for antibiotics in hospitalized patients	2019 [a]

[a]Documents currently being revised

1.3 Methodological principles and structure of the report

Early editions of the GLASS report were limited mainly to describing the operational activities of GLASS during its early implementation years *(26–29)*. Subsequent reports shifted the focus towards analytical rigour and interpretative depth *(30)*. Resistance to antibiotics for each infection type and antibiotic–pathogen combination was assessed only, however, as the unadjusted median and interquartile range of percentages reported by individual countries, limiting the interpretation and comparability of AMR findings among settings. Consequently, unadjusted summaries of AMR data were provided only at global scale.

Building on previous editions, this report is based on statistical models that account for biases including differences in surveillance coverage among settings, enabling contextual interpretation of AMR data. It presents national and regional estimates of AMR in bacterial infections and global and regional AMR trends, allowing meaningful comparisons.

Bayesian regression models were used to assess changes in national AMR surveillance coverage between 2016 and 2023. By analysing surveillance data for four infection types, eight bacterial pathogens and 11 antibiotic class combinations, we identify both regions with improved coverage and those that require strengthened surveillance (Chapter 2). We also map critical gaps in data reported to GLASS by each country and region (section 2.3). Addressing such gaps, particularly in terms of the number and size of health facilities that contribute data to GLASS relative to national totals, could substantially improve the interpretation of AMR findings in these settings.

To estimate the percentage of infections resistant to antibiotics, Bayesian regression models were independently fitted for 22 antibiotics and eight bacterial pathogens for four infection types (Table 1.2), resulting in 93 bacteria–antibiotic combinations in bloodstream, gastrointestinal, urinary tract and urogenital gonorrhoeal infections (Chapter 3). To estimate

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the prevalence of resistance in 2023 for the combinations under surveillance, the regression models included AMR data for multiple location–time points. They also account for: (i) the population of the countries that reported data; (ii) the number of isolates tested in relation to a country's population (i.e. AMR surveillance coverage); (iii) the reported distribution of AMR in the patient population by age and sex; and (iv) differences in the age–sex population structure of each country according to the United Nations' World Population Prospects 2024 *(31)*.

Of the 93 pathogen–antibiotic combinations, 16 were chosen to produce national estimates of resistance for 2023 (sections 3.1–3.4) and global and regional trends over a 6-year period (2018–2023) (section 3.5). These combinations are shown in Table 1.2.

To complement AMR surveillance findings in GLASS, this report presents estimates of the percentage of AMR in infection episodes based on a systematic review of literature from 2019-2024. The analysis covers bloodstream, urinary tract and gastrointestinal infections (Chapter 4). Descriptions of the analytical methods for GLASS data and systematic review data are given in Annexes 1 and 2, respectively.

This report is accompanied by digital content available on the WHO website. While the report provides adjusted modelled estimates - the GLASS dashboard *(34)* provides global and regional summaries, as well as country profiles based on *crude* AMR data, consistent with the 2022–2024 editions. It also includes access to detailed AMU data.

Table 1.2. Infection type, bacterial pathogen and antibiotic combinations under surveillance between 2016 and 2023 and included in this report

	Acinetobacter spp.	*E. coli*	*K. pneumoniae*	*N. gonorrhoeae*	*Salmonella* spp. [a]	*Shigella* spp.	*S. aureus*	*S. pneumoniae*
Aminoglycosides								
Amikacin	●							
Gentamicin	●			●				
Spectinomycin				●				
Carbapenems								
Doripenem	●	● ●	● ●		● ●			
Ertapenem		● ●	● ●		● ●			
Imipenem	▲	▲ ▲	▲ ▲		● ●			
Meropenem	●	● ●	● ●		● ●			
2nd– gen. cephalosporins								
Cefoxitin[b]							●	
3rd– gen. cephalosporins								
Ceftriaxone		● ●	● ●	▲	● ●	●		●
Ceftazidime		● ●	● ●		● ●	●		
Cefotaxime		▲ ▲	▲ ▲		● ●	●		●
Cefixime				●				
4th– gen. cephalosporins								
Cefepime		● ●	● ●					
Fluoroquinolones								
Ciprofloxacin		● ●	● ●	●	▲ ▲	▲		
Levofloxacin		● ●	● ●		● ●	●		
Macrolides								
Azithromycin				●		●		

	Acinetobacter spp.	*E. coli*	*K. pneumoniae*	*N. gonorrhoeae*	*Salmonella* spp.[a]	*Shigella* spp.	*S. aureus*	*S. pneumoniae*
Penicillins								
Oxacillin[b,c]							●	●
Penicillin G								▲
Polymyxins								
Colistin	●	● ●	● ●					
Sulfonamides and trimethoprim								
Co-trimoxazole		● ●	● ●					●
Tetracyclines								
Minocycline	●							
Tigecycline	●							

Coloured symbols indicate the infection types addressed in this report: ● bloodstream, ● gastrointestinal, ● urinary tract, ● urogenital gonorrhoea.

A triangle (▲) marks selected pathogen–antibiotic combinations for which national percentage resistance estimates and 2018–2023 resistance trends are reported. These are also presented for MRSA and third-generation cephalosporin-resistant *E. coli*.

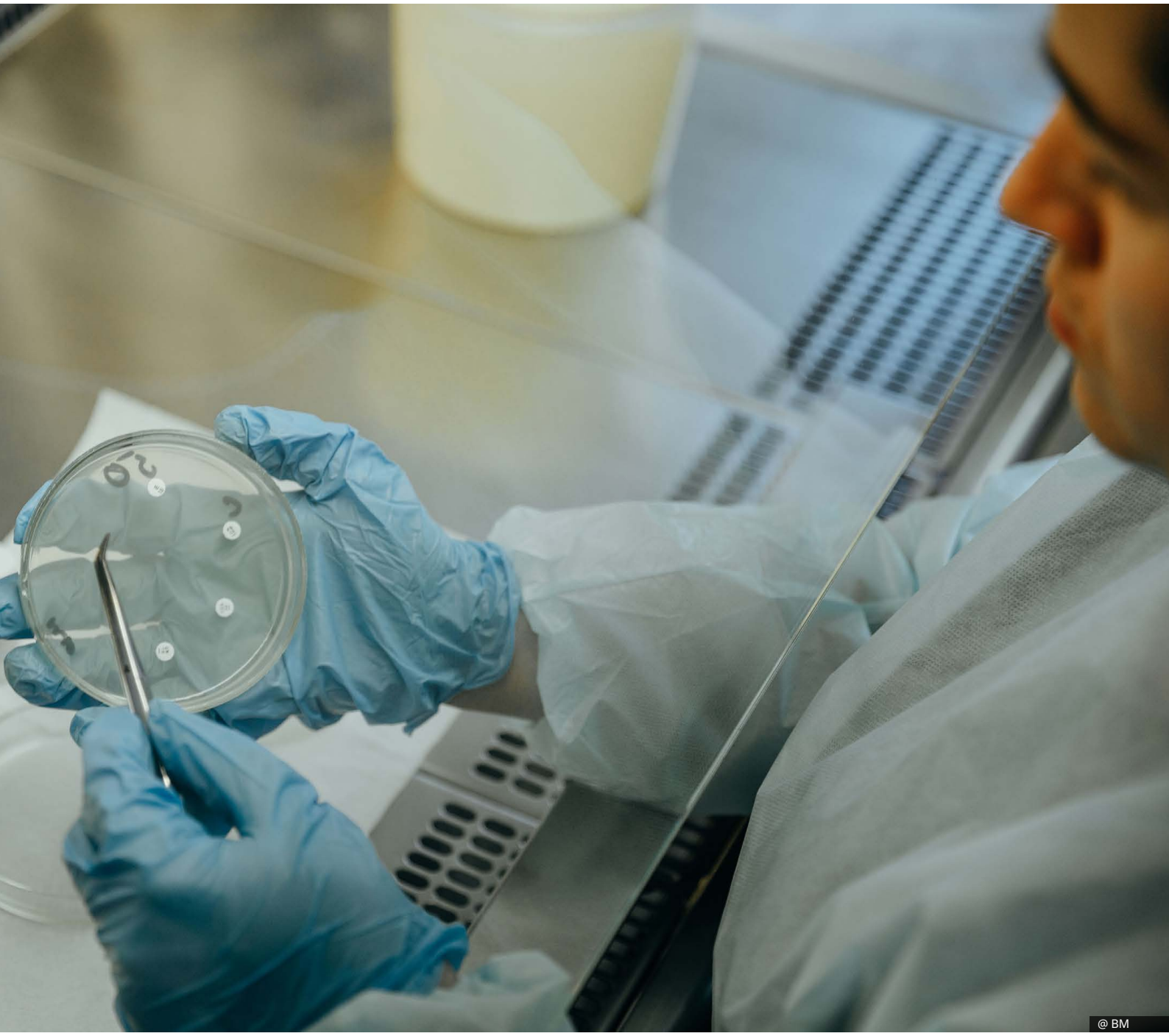
[a] *S.* Typhi and *S.* Paratyphi are not included in this report.

[b] Both cefoxitin and oxacillin are penicillinase-stable beta-lactams. The Clinical and Laboratory Standards Institute and the European Committee on Antimicrobial Susceptibility Testing recommend use of cefoxitin instead of oxacillin for disc diffusion testing to determine methicillin resistance in *S. aureus (32,33)*. Cefoxitin is used as a surrogate for assessing susceptibility to oxacillin (as well as methicillin and nafcillin). As countries reported results for either or both agents, in this report, MRSA is calculated from AST results for oxacillin and/or cefoxitin.

[c] Oxacillin AST can be used as a surrogate for benzylpenicillin susceptibility in *S. pneumoniae*. A susceptible oxacillin result indicates penicillin susceptibility, but an oxacillin-resistant result may not reflect true resistance to benzylpenicillin or other beta-lactams and may lead to overestimation of penicillin resistance. In such cases, targeted AST for benzylpenicillin is required to confirm resistance.

2nd-gen.: Second-generation. 3rd– gen.: Third-generation. 4th– gen.: Fourth-generation

2. Progress in global, regional and national AMR surveillance



AMR testing at a laboratory in Dushanbe, Tajikistan

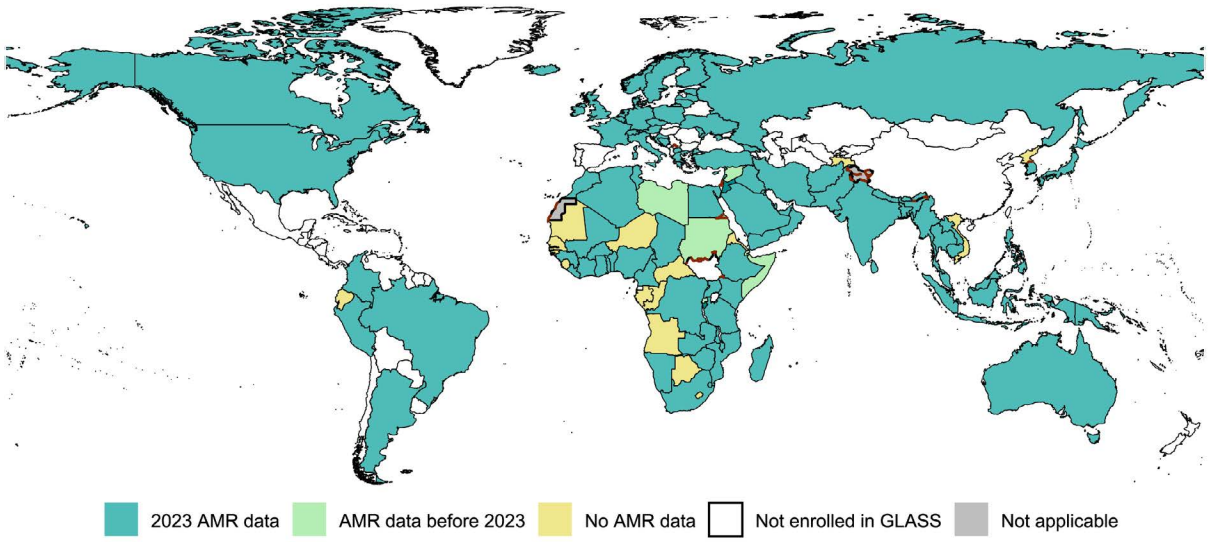
2.1 Participation in global AMR surveillance, 2016–2023

By the end of 2024, 127 of 194 WHO Member States (65.5%) and three territories and areas were enrolled in GLASS. Of these, 107 Member States (55.2%) submitted AMR surveillance data for at least one calendar year between 2016 and 2023, while 101 (52.1%) contributed data for the most recent year, 2023 (see Fig. 2.1). Participation has steadily increased, from 25 Member States in 2016 to 72 in 2019 and 101 in 2023, representing a 304% increase since 2016 and a 40% rise since 2019.

Overall, the percentage of WHO Member States that reported 2023 AMR data to GLASS was lowest in the Americas (20.0%, 7 of 35) and Western Pacific (37.0%, 10 of 27) regions, and highest in the South-East Asia (90.9%, 10 of 11) and Eastern Mediterranean (76.2%, 16 of 21) regions. More than half of Member States in the African (57.4%, 27 of 47) and European (58.5%, 31 of 53) regions submitted AMR data for 2023 (Table 2.1).

All summary statistics are based on AMR data reported to GLASS in 2023 by 104 countries, comprising 101 Member States and three territories and areas, collectively covering 70.9% of the world's population (approximately 5.7 billion people).

Figure 2.1. Countries reporting AMR data to WHO GLASS for at least one calendar year, 2016–2023



A country is considered to have reported AMR data if it has submitted AST results for at least one surveillance-defined infection type, pathogen and antibiotic combination under surveillance for at least one calendar year.

Table 2.1. Country and regional participation in global AMR surveillance, 2016–2023

Legal status	Number	Enrolled in GLASS (% (n))	Reported AMR data to GLASS (% (n))	
			2016–2023	2023
Member states	**194**	**65.5 (127)**	**55.2 (107)**	**52.1 (101)**
African Region	47	93.6 (44)	59.6 (28)	57.4 (27)
Region of the Americas	35	22.9 (8)	20.0 (7)	20.0 (7)
South-East Asia Region [a]	11	100.0 (11)	90.9 (10)	90.9 (10)
European Region	53	60.4 (32)	58.5 (31)	58.5 (31)
Eastern Mediterranean Region	21	100.0 (21)	100.0 (21)	76.2 (16)
Western Pacific Region	27	40.7 (11)	37.0 (10)	37.0 (10)
Associate members	**2**	**–**	**–**	**–**
Region of the Americas	1	–	–	–
Western Pacific Region	1	–	–	–
Territories or areas	**20**	**15.0 (3)**	**15.0 (3)**	**15.0 (3)**
Region of the Americas	9	–	–	–
European Region	2	50.0 (1)	50.0 (1)	50.0 (1)
Eastern Mediterranean Region	1	100.0 (1)	100.0 (1)	100.0 (1)
Western Pacific Region	8	12.5 (1)	12.5 (1)	12.5 (1)
Total	**216**	**60.2 (130)**	**50.9 (110)**	**48.1 (104)**
African Region	47	93.6 (44)	59.6 (28)	57.4 (27)
Region of the Americas	45	17.8 (8)	15.6 (7)	15.6 (7)
South-East Asia Region [a]	11	100.0 (11)	90.9 (10)	90.9 (10)
European Region	55	60.0 (33)	58.2 (32)	58.2 (32)
Eastern Mediterranean Region	22	100.0 (22)	100.0 (22)	77.3 (17)
Western Pacific Region	36	33.3 (12)	30.6 (11)	30.6 (11)

A country is considered to have reported AMR data if it has submitted AST results for at least one surveillance-defined infection type, pathogen and antibiotic combination for at least one calendar year.

[a] In accordance with resolution *WHA78.25* (2025), Indonesia was reassigned to the WHO Western Pacific Region as of 27 May 2025. The data analysis for this report was completed prior to the reassignment; therefore, Indonesia is included in the South-East Asia Region in all analyses and reporting presented herein.

2.2 Domains for assessing completeness of AMR surveillance data

Increasing the completeness of AMR surveillance data leads to more reliable, interpretable estimates of resistance. Gaps or inconsistencies in data can introduce bias and significantly limit their usefulness for national, regional and global decision-making.

Reliable AMR estimates depend on strong national surveillance systems that perform well in four key domains:

1. implementation of a national AMR surveillance system with its five core components (see section 2.2.1);
2. establishment of AMR surveillance coverage that is representative of the national health system structure and patient case load; essential for accurate interpretation and modelling (see section 2.2.2);
3. complete data for all GLASS-monitored infection types, including bloodstream, gastrointestinal and urinary tract infections, as well as urogenital gonorrhoea (see section 2.2.3); and
4. linkage of laboratory data to epidemiological, demographic and clinical information, such as patient age and sex, probable origin of infection (community or hospital) and the total number of patients sampled (see section 2.2.4).

These domains are described below.

2.2.1 Implementation of national AMR surveillance systems

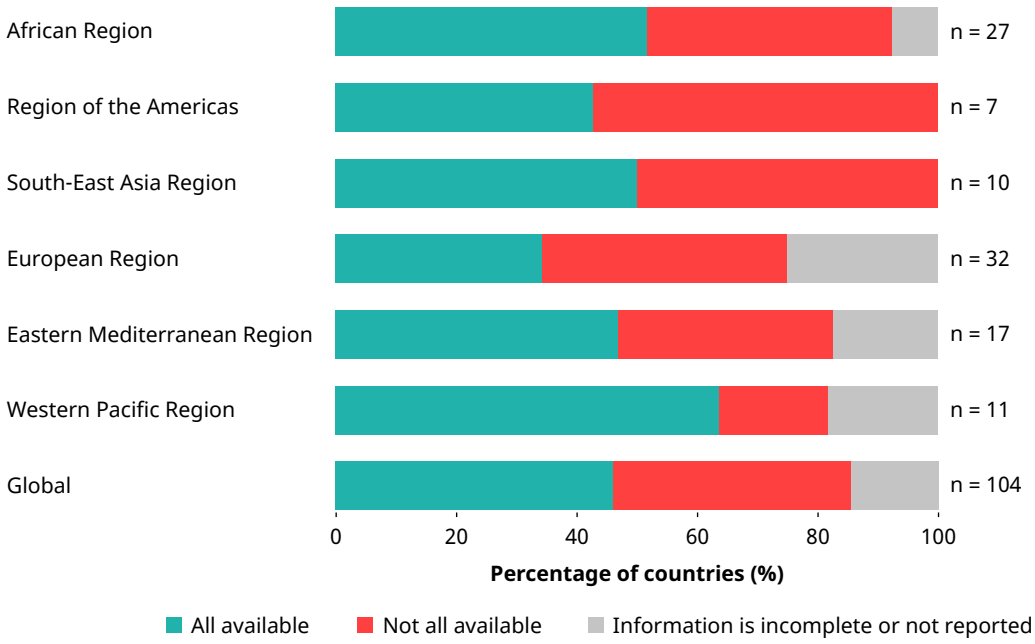
The data collected by GLASS provide insights into the implementation status of national AMR surveillance systems, based on AST results from routine clinical samples collected from patients presenting to health facilities for acute care. An effective AMR surveillance system has five core components:

1. Establishment of a national coordinating centre to oversee, collate and report surveillance data from participating facilities.
2. Establishment of a national reference laboratory to support and guide microbiology laboratories in the national surveillance network.
3. Participation of the reference laboratory in an external quality assurance scheme to ensure adherence to established standards.
4. Adherence of laboratories performing AST to international standards, such as those set by the European Committee on Antimicrobial Susceptibility Testing *(33)* and the Clinical and Laboratory Standards Institute *(32)*.
5. Enrolment of all laboratories in the surveillance network in an external quality assurance programme to maintain the quality and reliability of the data generated.

Of 104 countries reporting AMR surveillance data to WHO GLASS in 2023,[2] 89 (85.6%) submitted complete information for all five core components of a national AMR surveillance system, while 15 (14.4%) provided incomplete or no data.

The proportion of countries that reported full implementation of all five core components of a national AMR surveillance system differed among the WHO regions (Fig 2.2). The highest proportion was in the Western Pacific Region, where 63.6% (7 of 11 countries) reported having all components in place. In comparison, approximately half of the countries with AMR data for 2023 in the African Region (51.9%, 14 of 27), the South-East Asia Region (50.0%, 5 of 10) and the Eastern Mediterranean Region (47.1%, 8 of 17) reported full implementation.

Figure. 2.2. Global and regional implementation of the five core components of national AMR surveillance systems, 2023



[2]101 Member States and three territories and areas

For four years, Autumn has been prescribed the strongest possible antibiotics but she still tests positive for drug-resistant urinary tract infections. Despite having visited multiple doctors, the infections won't go away. The best she can do is manage her symptoms – which means self-administering antibiotics through a catheter. The condition has turned her life upside down.

The lowest proportions were in the Region of the Americas (42.9%, 3 of 7) and the European Region (34.4%, 11 of 32), although in the European Region data were incomplete or not reported for 25.0% of countries (8 of 32), limiting interpretability. Globally, 46.2% of countries that reported AMR surveillance data for 2023 to GLASS (48 of 104) had fully implemented all five core components of a national AMR surveillance system.

2.2.2 AMR surveillance coverage, 2016–2023

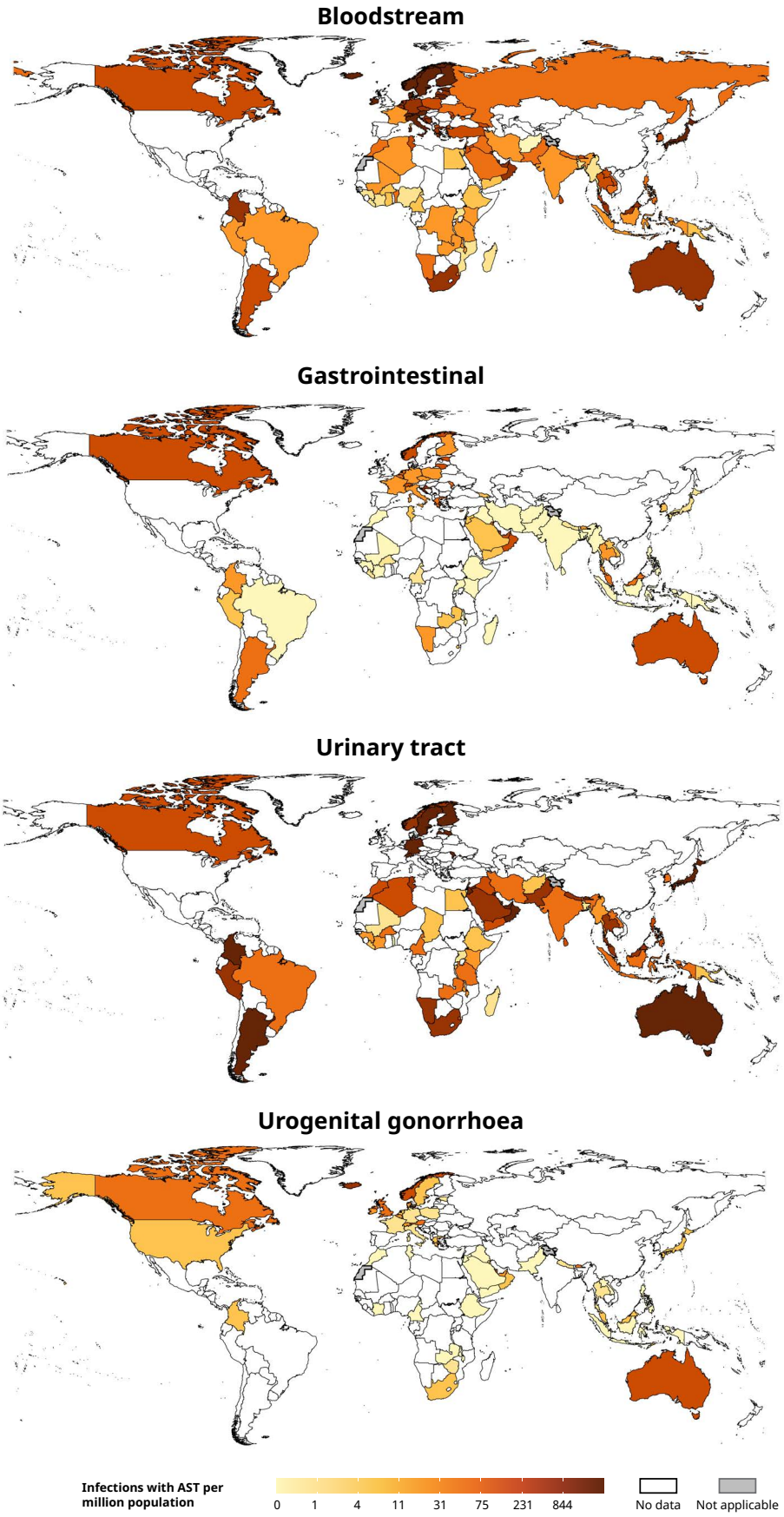
National AMR surveillance coverage is assessed by the number of infection episodes with AST results reported to GLASS, standardized per million population.

Between 2016 and 2023, GLASS received AST results for 23.9 million infection episodes from all WHO regions. In 2023, the number of infections with AST results reported to GLASS per million population indicated notable geographical disparities in AMR surveillance coverage by infection type (see Fig. 2.3). High coverage was concentrated mainly in a few high- or upper–middle-income countries: South Africa (African Region), Canada (Region of the Americas), Saudi Arabia (Eastern Mediterranean Region), western Europe (European region) and Australia and Japan (Western Pacific Region). Coverage was heterogeneous in most regions, many countries in the African and South-East Asian regions reporting low AMR surveillance coverage or providing no data at all.

These disparities indicate unequal access to surveillance infrastructure and laboratory capacity, which may limit effective AMR surveillance and response in under-resourced regions and undermine comparisons of resistance estimates among regions.

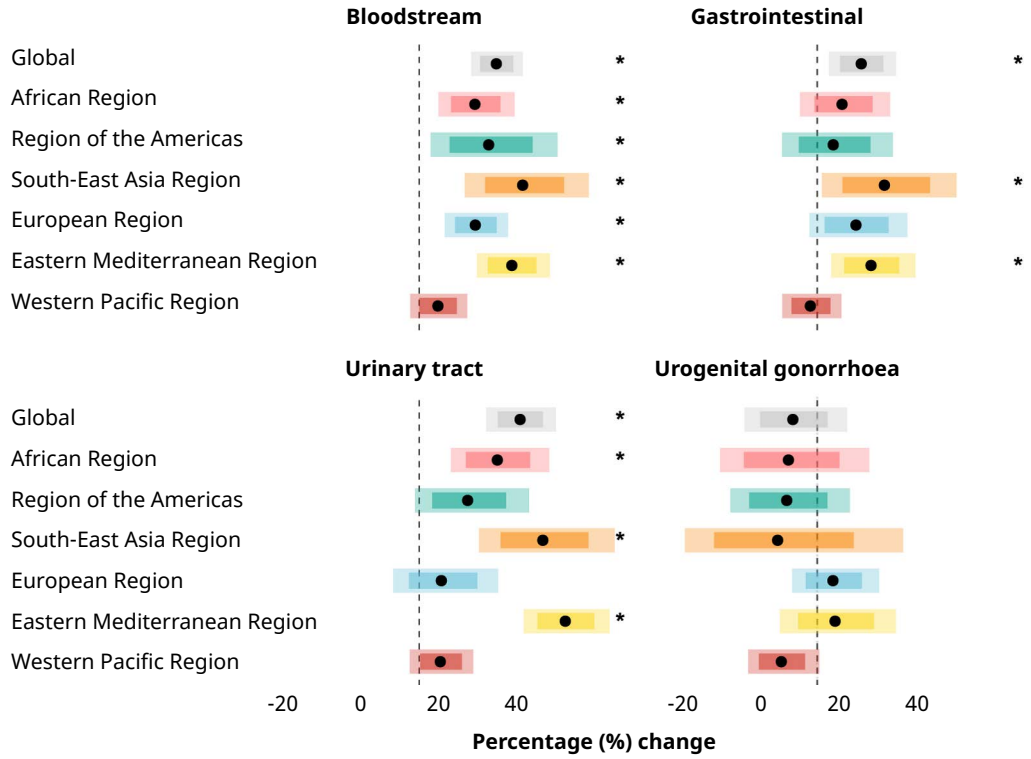
Globally, between 2016 and 2023, the population-weighted national coverage of AMR surveillance increased annually by a median of 26.0% (95% CrI: 17.3, 35.4) for urinary tract infections, 20.0% (13.4, 26.8) for bloodstream infections and 11.4% (3.0, 20.4) for gastrointestinal infections. There was no statistically meaningful change in AST results for gonorrhoea (Fig 2.4), with coverage remaining critically low in 2023 at just 4.8 (95% CrI: 3.9, 6.4) per million population (Annex 3).

Figure. 2.3. Numbers of infection episodes with AST results per million population, 2023



Maps show unadjusted (actual) number of infections with AST per million population.

Figure. 2.4. National median annual change in AMR surveillance coverage, by region and infection type, 2016–2023



National AMR surveillance coverage is assessed from the number of infection episodes with AST results reported to GLASS, standardized per million population over time. The figure, which is based on modelled estimates, shows population-weighted national median annual percentage changes in the number of infections with AST per million population, reported globally and by WHO region. Shading represents 95% and 80% CrI, from lighter to darker, respectively. An asterisk (*) denotes a statistically meaningful trend. A trend is considered statistically meaningful if ≥ 5 countries reported ≥ 10 infections with AST in ≥ 3 years between 2016 and 2023, and if the 95% CrI for the annual percentage change does not overlap with zero, with the lower bound ≥ 1% or the upper bound ≤ –1%. For methodological details, see Annex 1.

These annual increases led to expanded coverage of AMR surveillance. For urinary tract infections, surveillance coverage rose from 664.7 infection episodes with AST results (525.8, 901.1) per million population in 2016 to 769.5 (644.5, 943.2) in 2023. Coverage in bloodstream infections surveillance also increased, from 111.3 (95.5, 137.3) to 120.3 (107.3, 139.6) per million population over the same period. AMR surveillance coverage for gastrointestinal infections increased more modestly, from 7.7 (6.0, 12.0) to 8.3 (7.2, 9.9) infection episodes per million population (see Table 2.2).

National AMR surveillance coverage for bloodstream infections increased in all WHO regions between 2016 and 2023, except in the Western Pacific Region, where population-weighted coverage was already high because of early, sustained coverage in Australia and Japan (Fig. 2.4). Despite annual increases, the African and South-East Asia regions continued to report the lowest population-weighted median coverage of bloodstream infection testing in 2023, at 22.1 (16.8, 31.3) and 35.5 (25.8, 53.4) reported infections with AST per million population, respectively (Table 2.2).

There were notable annual increases in AMR surveillance coverage for urinary tract infections in some of the regions with historically limited surveillance infrastructure, including the African, South-East Asia and Eastern Mediterranean regions (Fig. 2.4). While surveillance coverage of gastrointestinal infections increased globally, regional progress remained uneven. The South-East Asia and Eastern Mediterranean regions showed improvements, while the African Region remained among those with the lowest coverage, at 3.0 (2.0, 5.2) infections with AST results reported per million population in 2023, compared with 38.4 (31.0, 52.2) in the European Region (Table 2.2).

Table 2.2. Trends and current AMR surveillance coverage: median annual change (2016–2023) and 2023 national coverage, by WHO region and infection type.

Infection type	Trend	Annual % change[a]	2023 AMR surveillance coverage[b]	No. of countries[c]
Bloodstream				
African Region	Increasing	14.5 (5.0, 24.7)	35.5 (25.8, 53.4)	17
Region of the Americas	Increasing	18.1 (3.0, 35.8)	64.6 (44.6, 103.3)	7
South-East Asia Region	Increasing	26.8 (11.7, 43.9)	22.1 (16.8, 31.3)	9
European Region	Increasing	14.5 (6.6, 23.0)	440.1 (384.7, 512.9)	31
Eastern Mediterranean Region	Increasing	24.0 (14.9, 33.8)	36.1 (30.3, 44.6)	19
Western Pacific Region	Stable	4.8 (–2.3, 12.4)	528.8 (394.0, 771.1)	9
Global	Increasing	20.0 (13.4, 26.8)	120.3 (107.3, 139.6)	92
Gastrointestinal				
African Region	Stable	6.5 (–4.5, 18.9)	3.0 (2.0, 5.2)	11
Region of the Americas	Stable	4.2 (–9.1, 19.6)	14.1 (10.4, 20.4)	6
South-East Asia Region	Increasing	17.4 (1.2, 36.1)	0.5 (0.4, 0.8)	6
European Region	Stable	9.9 (–2.0, 23.4)	38.4 (31.0, 52.2)	18
Eastern Mediterranean Region	Increasing	13.9 (3.6, 25.4)	5.0 (4.1, 6.5)	16
Western Pacific Region	Stable	–1.8 (–9.1, 6.3)	17.1 (12.9, 23.5)	7
Global	Increasing	11.4 (3.0, 20.4)	8.3 (7.2, 9.9)	64
Urinary tract				
African Region	Increasing	20.2 (8.2, 33.7)	93.2 (57.5, 185.2)	12
Region of the Americas	Stable	12.5 (–1.1, 28.4)	705.9 (473.7, 1218)	6
South-East Asia Region	Increasing	31.9 (15.5, 50.6)	47.4 (35.4, 68.1)	8
European Region	Stable	5.8 (–6.8, 20.4)	10 368.1 (8063, 13 832)	10
Eastern Mediterranean Region	Increasing	37.8 (27.0, 49.3)	211.2 (176.1, 264.9)	19
Western Pacific Region	Stable	5.5 (–2.4, 14.0)	1880.3 (1360.3, 2795.4)	7
Global	Increasing	26.0 (17.3, 35.4)	769.5 (644.5, 943.2)	62
Urogenital gonorrhoea				
African Region	Stable	–7.4 (–25.2, 13.4)	2.0 (1.4, 3.3)	6
Region of the Americas	Stable	–8.0 (–22.5, 8.4)	10.4 (6.8, 18.0)	5
South-East Asia Region	Stable	–10.3 (–34.3, 22.2)	0.1 (0.1, 0.2)	3
European Region	Stable	4.1 (–6.5, 16.0)	9.6 (7.6, 12.8)	18
Eastern Mediterranean Region	Stable	4.5 (–9.7, 20.3)	1.2 (0.9, 1.7)	10
Western Pacific Region	Stable	–9.3 (–17.9, 0.5)	18.9 (12.8, 30.9)	6
Global	Stable	–6.4 (–18.8, 7.8)	4.8 (3.9, 6.4)	48

The table presents modelled estimates with 95% CrI.

[a] Population-weighted median national yearly percentage change in the number of infections with AST per million population, reported globally and by WHO region

[b] Median population-weighted national coverage from Bayesian regression models

[c] Number of reporting countries included the analysis (including three territories and areas).

Blue shading reflects the magnitude of annual percentage change in AST infections per million population: light blue for ≤ 20%, medium for ≤ 30% and dark blue for > 30%.

Yusra also had drug-resistant sepsis. Her twin sister died at six days old. Yusra needed a "last-resort" antibiotic, in stock at the pharmacy by the hospital gate, but which her family could not afford. Yusra died a few days later.
Location: Dessie, Ethiopia

National AMR surveillance coverage increased in all the major infection type–pathogen–antibiotic class combinations assessed (Annex 3), in at least one of the six WHO regions. Two exceptions were *Salmonella* spp. bloodstream infections, for which only fluoroquinolones were assessed with no upward trend in coverage, and *N. gonorrhoeae*, for which surveillance coverage remained unchanged for the two antibiotic classes assessed, macrolides and third-generation cephalosporins. The largest increase in surveillance coverage was for carbapenem AST in *Acinetobacter* spp. bloodstream infections, with a median annual rise of 29.6% (22.2, 37.8) globally (Annex 3).

2.2.3 Availability of AMR data by type of infection

The most frequently reported of the four infection types under surveillance in GLASS were urinary tract and bloodstream infections (Table 2.3). More countries reported AST data on bloodstream infections than on the other types of infection; however, the number of urinary tract infections with AST results was nearly five times that of bloodstream infections and more than 100 times that of gastrointestinal and urogenital gonorrhoeal infections. This is consistent with the higher population-level incidence of urinary tract infections *(35)*.

Most AST results for bloodstream infections were reported from the European (47.2%) and the Western Pacific (35.3%) regions (Table 2.3). There was a similar distribution for urinary tract infections, with 63.0% of AST results from Europe and 23.8% from the Western Pacific Region.

In contrast, most AST results for gastrointestinal infections were reported from the European (35.7%) and Americas (29.0%) regions, while those for urogenital gonorrhoea were mainly from the Americas (37.6%) and the Western Pacific (37.1%) regions (Table 2.3).

Table 2.3. Numbers of infection episodes with AST results reported to GLASS, by infection type and bacterial pathogen, and numbers of countries that reported data, 2016–2023 overall and in 2023

	No. of infections with AST (no. of countries) [a]													
	Global		African Region		Region of the Americas		South-East Asia Region		European Region		Eastern Mediterranean Region		Western Pacific Region	
	2016-2023	2023	2016-2023	2023	2016-2023	2023	2016-2023	2023	2016-2023	2023	2016-2023	2023	2016-2023	2023
Total bloodstream	4 217 990 (106)	683 269 (99)	175 782 (24)	36 314 (23)	175 321 (7)	55 908 (6)	234 985 (10)	60 908 (10)	1 991 588 (32)	265 625 (32)	149 564 (22)	32 622 (17)	1 490 750 (11)	231 892 (11)
Acinetobacter spp.	216 201 (104)	49 409 (95)	31 412 (23)	7437 (23)	9695 (6)	2482 (4)	47 202 (10)	14 828 (10)	64 559 (32)	11 737 (31)	22 511 (22)	5595 (16)	40 822 (11)	7330 (11)
E. coli	2 070 346 (104)	306 783 (96)	33 168 (24)	6727 (22)	57 056 (6)	18 658 (6)	65 226 (10)	17 405 (10)	1 066 845 (32)	128 607 (31)	41 839 (21)	9847 (16)	806 212 (11)	125 539 (11)
K. pneumoniae	781 202 (105)	144 298 (97)	49 280 (24)	10 048 (23)	43 835 (6)	13 643 (6)	56 245 (10)	14 672 (10)	294 796 (32)	47 905 (31)	36 678 (22)	8650 (16)	300 368 (11)	49 380 (11)
Salmonella spp.	65 344 (95)	9375 (84)	7935 (22)	1714 (19)	9410 (6)	2140 (5)	11 593 (10)	896 (10)	5693 (28)	1850 (26)	17 001 (18)	596 (14)	13 712 (11)	2179 (10)
S. aureus	945 780 (104)	149 942 (96)	48 886 (23)	9827 (23)	46 633 (6)	14 499 (5)	53 473 (10)	12 710 (10)	466 990 (32)	61 781 (30)	28 308 (22)	6963 (17)	301 490 (11)	44 162 (11)
S. pneumoniae	139 117 (94)	23 462 (85)	5101 (20)	561 (15)	8692 (5)	4486 (4)	1246 (9)	397 (9)	92 705 (32)	13 745 (32)	3227 (17)	971 (14)	28 146 (11)	3302 (11)
Total gastrointestinal	168 212 (83)	39 579 (75)	9012 (16)	382 (15)	48 804 (6)	9280 (5)	5443 (10)	1817 (10)	60 099 (23)	18 263 (20)	16 292 (19)	3974 (16)	28 562 (9)	5863 (9)
Salmonella spp.	136 456 (83)	33 054 (74)	4590 (16)	214 (15)	30 531 (6)	6506 (5)	5012 (10)	1573 (10)	54 918 (23)	15 799 (20)	14 225 (19)	3418 (16)	27 180 (9)	5544 (8)
Shigella spp.	31 756 (68)	6525 (57)	4422 (13)	168 (11)	18 273 (5)	2774 (4)	431 (8)	244 (7)	5181 (17)	2464 (14)	2067 (17)	556 (14)	1382 (8)	319 (7)
Total urinary tract	19 361 029 (79)	3 761 957 (72)	146 621 (21)	63 480 (21)	1 066 798 (6)	315 354 (6)	478 345 (10)	142 905 (10)	12 198 316 (11)	2 205 725 (9)	866 864 (22)	239 747 (17)	4 604 085 (9)	794 746 (9)
E. coli	16 899 236 (79)	3 216 393 (72)	116 180 (21)	50 650 (21)	927 634 (6)	266 565 (6)	374 803 (10)	111 812 (10)	11 000 331 (11)	1 953 889 (9)	688 425 (22)	188 751 (17)	3 791 863 (9)	644 726 (9)
K. pneumoniae	2 461 793 (76)	545 564 (69)	30 441 (19)	12 830 (19)	139 164 (6)	48 789 (6)	103 542 (10)	31 093 (10)	1 197 985 (11)	251 836 (9)	178 439 (21)	50 996 (16)	812 222 (9)	150 020 (9)
Total urogenital [b]	118 474 (69)	21 208 (52)	6077 (13)	474 (6)	44 494 (5)	5517 (3)	1051 (6)	314 (5)	20 073 (25)	6441 (19)	2773 (12)	628 (12)	44 006 (8)	7834 (7)
Grand total	23 865 705 (110)	4 506 013 (104)	337 492 (28)	100 650 (27)	1 335 417 (7)	386 059 (7)	719 824 (10)	205 944 (10)	14 270 076 (32)	2 496 054 (32)	1 035 493 (22)	276 971 (17)	6 167 403 (11)	1 040 335 (11)

[a] Includes three territories and areas

[b] *N. gonorrhoeae*

Differences in the volume and regional distribution of AST data by infection type reflect not only the underlying prevalence of infections but also heterogeneity in national testing practices and country capacity to collect and report surveillance data. As some regions contributed a larger share of data, particularly for certain infection types, there are opportunities for correcting the geographical imbalance and strengthening global surveillance coverage.

2.2.4 Availability of epidemiological, demographic and clinical information

Linking AMR laboratory data to patient-level epidemiological, demographic and clinical information improves the interpretation, and therefore the use, of estimates of resistance. Information such as patients' age and sex, the origin of infections and the number of patients sampled provides critical context for interpreting resistance patterns, identifying at-risk populations and assessing potential biases in surveillance data.

In 2023, most countries that participated in GLASS reported highly complete demographic data, defined as variables reported for at least 70% of infections with AST, across all reported infection types. Specifically, 88 of 104 countries (84.6%) reported patients' ages, and 89 of 104 (85.6%) reported patients' sex at this level of completeness. These variables were consistently reported in all WHO regions, with the percentage of countries reporting complete data ranging from 71.4% to 92.6% depending on the variable and region, allowing their use in AMR analyses.

In contrast, the origin of infections, such as whether they were acquired in the community or a hospital, was reported far less frequently. Only 16 of 104 countries (15.4%) provided this information for at least 70% of infections with AST, for all reported infection types. Reporting completeness varied widely by region, ranging from just 6.3% (2 of 32 countries) in the European Region to 36.4% (4 of 11 countries) in the Western Pacific Region. This limits the ability to assess differences in resistance patterns based on the setting in which infections are acquired.

Reporting on the number of patients sampled was also limited. Only 46 of 104 countries (44.2%) reported this information for all the infection types included. Regional differences were marked: 8 of 10 countries (80.0%) in the South-East Asia Region and 20 of 27 (74.1%) in the African Region met the threshold, while only 2 of 32 (6.3%) countries in the European Region did so. This information enables estimation of surveillance coverage and identifying potential sampling bias.

The completeness of reporting of linkage variables directly affects the quality and interpretability of AMR surveillance. Demographic data allow the generation of stratified resistance estimates; information on infection origin helps to interpret resistance patterns in context; and patient sampling data are useful for assessing the representativeness of data. Without these elements, AMR estimates may be incomplete or misleading, limiting their value for public health decision-making.

2.3 Gaps in completeness of AMR surveillance data

Gaps or inconsistencies in AMR data can introduce bias and limit their usefulness for national, regional and global decision-making. To assess and monitor such gaps, scores for data completeness were calculated in the four domains introduced in previous sections, for data from the 104 countries that reported AMR data to GLASS in 2023. Global and regional gaps by domain are summarized in Table 2.4. The scoring method and domain definitions are described in Box 2.1.

The completeness of 2023 AMR surveillance data reported to GLASS varied considerably by region in the four domains assessed. The South-East Asia and Eastern Mediterranean regions had the highest overall scores (61.2% and 61.0%, respectively) while the Region of the Americas and the European Region had the lowest (46.7%).

Scores for the completeness of 2023 AMR surveillance data reported to GLASS are presented across four data domains. The total score for the second domain (national surveillance coverage) is based on six items: three related to national health infrastructure

Table 2.4. Global and regional composite scores for completeness of AMR surveillance data reported to GLASS, 2023

		Global	African Region	Region of the Americas	South-East Asia Region	European Region	Eastern Mediterranean Region	Western Pacific Region
Domain 1	National AMR surveillance system: Core components	83.7	92.6	85.7	85.0	75.0	79.4	90.9
Domain 2	National surveillance coverage	33.1	44.4	14.3	39.2	24.2	39.7	27.3
	National health infrastructure and service utilization	35.1	46.3	19.0	40.0	27.1	40.2	28.8
	Total health facilities	61.5	77.8	28.6	80.0	46.9	76.5	45.5
	Inpatient admissions and days of care per calendar year	6.3	9.3	0.0	10.0	6.3	2.9	4.5
	Outpatient consultations per calendar year	37.5	51.9	28.6	30.0	28.1	41.2	36.4
	Health infrastructure and utilization in facilities reporting to GLASS	31.1	42.6	9.5	38.3	21.4	39.2	25.8
	Total health facilities	59.1	72.2	28.6	80.0	43.8	76.5	45.5
	Inpatient admissions and days of care per calendar year	8.2	11.1	0.0	15.0	4.7	11.8	4.5
	Outpatient consultations per calendar year	26.0	44.4	0.0	20.0	15.6	29.4	27.3
	Data reported to GLASS (Domains 3 and 4)	65.6	60.2	66.1	74.4	60.0	75.0	72.7
Domain 3	AST by infection type	54.4	38.9	62.5	65.0	48.0	73.5	67.0
	Bloodstream	78.4	57.4	71.4	85.0	82.8	91.2	95.5
	Gastrointestinal	64.4	66.7	85.7	95.0	26.6	97.1	77.3
	Urinary tract	41.8	16.7	50.0	45.0	45.3	67.6	45.5
	Urogenital gonorrhoea	33.2	14.8	42.9	35.0	37.5	38.2	50.0
Domain 4	Epidemiological, demographic and clinical information	76.8	81.5	69.6	83.8	71.9	76.5	78.4
	Number of sampled patients	65.9	87.0	50.0	90.0	46.9	58.8	68.2
	Patient's age	91.8	88.9	85.7	95.0	95.3	94.1	86.4
	Patient's gender	92.3	94.4	85.7	90.0	92.2	94.1	90.9
	Infection origin (community or hospital)	57.2	55.6	57.1	60.0	53.1	58.8	68.2
	TOTAL SCORE	53.8	56.0	46.7	61.0	46.7	61.2	55.8

Completeness score: Low (≤20%) Medium-low (>20-50%) Medium-high (>50-80%) High (>80%)

and service use and three specific to facilities participating in GLASS. The total scores for the third and fourth domains (data reported to GLASS) are based on eight items: four infection types (third domain) and four epidemiological, demographic and clinical variables (fourth domain). Scoring was conducted for the 104 countries that reported data on AMR in 2023.

Among the four domains, data completeness was highest for the implementation status of the core components of a national AMR surveillance system (first domain; section 2.2.1), including whether external quality assurance was conducted in all the laboratories that reported AMR data. This domain scored 83.7%, classified as high.

The global score for completeness of data on the breadth of national AMR surveillance coverage (second domain; section 2.2.2) was the lowest, at 33.1%, classified as medium–low. Because of the limited data completeness, the national coverage indicators could not be included in the models used to estimate percentage AMR, and the number of tests performed per million population was used instead.

The global score for the third domain, availability of AMR data for the four infection types under surveillance in GLASS in 2016–2023 (section 2.2.3) was 54.4% (medium–low). Regional differences were substantial: the Eastern Mediterranean Region scored highest (73.5%), and the African Region scored lowest (38.9%). For example, only 37.0% of African countries that reported 2023 AMR data to GLASS (10 of 27) contributed data on more than 10 bloodstream infections with AST for over 50% of pathogen–antibiotic class combinations under surveillance, as compared with 88.2% (15 of 17) in the Eastern Mediterranean Region. The other four regions had medium–high scores for the third domain (Table 2.4), except for the European Region (48.0%).[3]

Globally, the most complete reporting of pathogen-antibiotic combinations under surveillance was for bloodstream infections (78.4%; medium-high score), followed by gastrointestinal infections (64.4%; medium-high), urinary tract infections (41.8%; medium-low) and urogenital gonorrhoeal infections (33.2%; medium-low). The African Region had the largest gaps in AMR data for urinary tract and urogenital gonorrhoeal infections (16.7% and 14.8%, respectively; low score), while the European Region had the lowest completeness score for gastrointestinal infections (26.6%; medium–low). See Table 2.4.

Reporting of epidemiological, demographic and clinical data to GLASS (fourth domain; section 2.2.4) was high overall, with a global score of 76.8% (medium–high). Patients' age and sex were the data most consistently reported, at 91.8% and 92.3%, respectively. In contrast, data on the number of sampled patients (65.9%) and the probable origin of infection (57.2%) were more limited. Because of the completeness of data on age and sex in all regions, these variables were included in the models used to estimate national, regional and global percentages of AMR (see section 1.2 and Annex 1).

Box 2.1. Method used to score the completeness of AMR surveillance data

Annex 4 provides a detailed overview of the completeness of 2023 data reported to GLASS by countries in the six WHO regions, based on a *"traffic light"* system. The national data were then used to calculate completeness scores at regional and global levels in four domains (Table 2.4), based on reports from the 104 countries (including three territories and areas) that reported data on AMR in 2023.

Domain 1. Implementation of national AMR surveillance systems

This domain is a measure of whether a country has implemented the five core components of national AMR surveillance (Fig. 2.2). The traffic light system indicates the completeness of information for each country: green = complete; orange = incomplete; red = not available.

[3] The European Antimicrobial Resistance Surveillance Network (EARS-Net) and the Central Asian and European Surveillance of Antimicrobial Resistance (CAESAR) networks report national AST results for bloodstream and central nervous system bacterial infections. Only data on bloodstream infections were included in this report.

Domain 2. AMR surveillance coverage

The second domain is a measure of the completeness of data on national AMR surveillance coverage in each country. These data are critical for evaluating national coverage, the representativeness of and potential bias in the AMR data underlying national and global resistance estimates. Countries are encouraged to report the number of health facilities and summaries of facility use that contribute to GLASS as compared with the national totals. Summaries of the use of health facilities that report data to GLASS, such as inpatient admissions, days of inpatient care or numbers of outpatient consultations per year, are also used to estimate the frequency of drug-resistant pathogens and microbiological testing and to identify potential sampling bias.

National information on health facilities includes the total number of health-care facilities and the number of those with inpatient beds. Similarly, the inpatient case load is assessed from the numbers of admissions and inpatient days. The traffic light system is applied for these indicators in a country, whereby green denotes settings in which all the required data are available; orange indicates that some of the required data are available; and red indicates that data are missing. For outpatient consultations, as only one variable is reported, a simplified scoring approach is used, in which green indicates that the data are available, while red indicates that the data are missing.

Domain 3. Availability of data on AMR in all infection types

The domain addresses the completeness of AMR data for the four infection types monitored in GLASS, bloodstream, gastrointestinal, urinary tract and urogenital gonorrhoeal infections. For each infection type, the completeness of reported data is assessed from the number of bacteriologically confirmed infections with AST results. The traffic light system is used, in which green indicates that AST results are available for > 10 isolates for > 50% of pathogen–antibiotic class combinations; orange indicates the availability of results for 25–50% of combinations; and red denotes the availability of results for < 25%.

Domain 4. Availability of epidemiological, demographic and clinical information

The domain addresses the completeness of patient demographic variables (age and sex) and infection origin (community or hospital) for reported infections with AST. These data are necessary for robust national and global estimates of percentage AMR, as resistance patterns may differ by demographic and infection origin *(36)*. For countries, completeness was again assessed with the traffic light system. Green indicates that a variable is available for at least 70% of bacteriologically confirmed infections with AST for all infection types reported to GLASS; orange indicates that this threshold is met for only some infection types; and red indicates that the threshold is not met for any infection type. This domain includes whether countries report the total number of patients sampled for each infection type. Green is assigned when this information is documented for all infection types, orange when it is available for some and red when it is not reported for any. This information is used to calculate testing frequency and to identify any sampling bias related to diagnostic or clinical practices.

Calculation of global and regional completeness scores

Global and regional completeness was scored for each domain and data item by assigning numerical values to country scores (green = 2, orange = 1, red = 0), summing them for all countries and dividing by the maximum possible score if all countries scored green. The resulting percentage is then categorized as: high (> 80%), medium–high (>50–80%), medium–low (>20–50%) and low (≤ 20%). These classifications illustrate the most significant gaps in surveillance data (see Table 2.4).

Calculation of national completeness scores

At country level (Annex 4), each data item is scored with the traffic light system. A country's overall completeness score is calculated by summing the scores for all items and dividing by the maximum possible score. This percentage is then categorized on the same four-level scale to provide a consistent, comparable measure of the strength of surveillance data for all participating countries.

3. AMR by type of infection

A first-time mother did not leave the side of her daughter who had sepsis. Being unable to hold and feed her daughter left her distraught. The sepsis was resistant to a number of drugs - but the last antibiotic they tried saved her daughter's life.

This chapter summarizes global, regional and national patterns of AMR in four major infection types: bloodstream, gastrointestinal, urinary tract and urogenital gonorrhoea. The clinical and public health relevance of these infections, their epidemiology, the most common associated pathogens and their empirical and targeted clinical management by pathogen are described in detail in the WHO AWaRe antibiotic book *(1)* (Box 3.1). The clinical and public health significance of drug-resistant bacterial pathogens linked to these infections is detailed in the WHO list of priority bacterial pathogens *(2)*.

For each infection type, estimates of global resistance are presented by pathogen, followed by key antibiotics under surveillance, categorized according to the WHO AWaRe classification. In contrast, regional estimates of AMR are organized first by AWaRe group, then by pathogen, to better reflect clinical realities in settings with limited microbiological capacity.

Unless otherwise specified, the data on pathogen distributions presented in this chapter are based on episodes of infection with reported AST results. As interpretable AST data were available for the vast majority of infections, the distributions closely reflect the overall frequency of reported pathogens in different infection types and regions.

Box 3.1. WHO AWaRe classification

Effective treatment of infections depends on appropriate AMU. The AWaRe classification provides a structured framework for antibiotic selection and for national essential medicines lists and treatment guidelines. By categorizing antibiotics into Access, Watch and Reserve groups according to their spectrum of activity, resistance potential and clinical indications, it promotes appropriate prescribing and helps to safeguard last-resort antibiotics.

- "Access" antibiotics are recommended as empirical first- or second-choice treatment for a wide range of common infections. These agents usually have a narrow spectrum of activity, cost less, have favourable safety profiles and generally have low resistance potential. Examples include amoxicillin, penicillin, co-trimoxazole, first-generation cephalosporins and most aminoglycosides. Their widespread availability and appropriate use are essential to ensuring effective treatment while minimizing the development of resistance.
- "Watch" antibiotics are broader-spectrum agents that generally cost more and are at greater risk of resistance selection. They are recommended as first-choice options only in specific clinical situations, such as severe infections or when the causative pathogens are likely to be resistant to "Access" antibiotics. This group includes third- and fourth-generation cephalosporins (e.g. ceftriaxone and cefepime), fluoroquinolones (e.g. ciprofloxacin), carbapenems (e.g. meropenem) and glycopeptides (e.g. vancomycin). Their use should be carefully monitored and restricted to appropriate indications within an antibiotic stewardship programme.
- "Reserve" antibiotics are last-resort agents used in the treatment of confirmed or suspected infections caused by multidrug-resistant organisms. These antibiotics, such as colistin, tigecycline, cefiderocol and novel beta-lactam–beta-lactamase inhibitor combinations (e.g. meropenem–vaborbactam, ceftazidime–avibactam and ceftolozane–tazobactam), are used only when necessary and under strict clinical oversight. Their use should be guided by microbiological diagnostics and specialist consultation.

3.1 AMR in bloodstream infections

3.1.1 Epidemiology of bloodstream infections

Bloodstream infections are among the most severe bacterial infections, as they often lead to sepsis, multi-organ failure and death. They are a major cause of admissions to hospital and to intensive care worldwide and are associated with high morbidity and mortality, particularly among neonates, the elderly and immunocompromised individuals *(37).*

Such infections can originate in the urinary, gastrointestinal or respiratory tract; result from invasive medical procedures; or arise from infections of the skin and soft tissue, the central nervous system (such as meningitis) or bones and joints. Their rapid progression and requirement for urgent intervention place a significant burden on health-care systems. Their clinical severity is compounded by the growing threat of AMR, which complicates treatment, prolongs hospital stays and increases the risk of adverse outcomes. In Europe, bloodstream infections caused by third-generation cephalosporin-resistant *E. coli* have been linked to increased mortality and extended lengths of stay in hospital *(38).* Infections caused by carbapenem-resistant *A. baumannii* or *E. coli* have been associated with 30-day mortality rates exceeding 50%, while those caused by carbapenem-resistant *K. pneumoniae* and MRSA have resulted in 30-day mortality rates of over 40% and 20%, respectively *(39).*

The epidemiology of bloodstream infections differs by region according to the health-care infrastructure, AMU and infection control practices. Nevertheless, certain pathogens are consistently the most common bacterial causes globally. *E. coli, K. pneumoniae and S. aureus* (including MRSA) are among the most frequently isolated organisms in both community- and hospital-acquired infections. Other significant pathogens include *Salmonella* spp. and *S. pneumoniae* in community settings and *Acinetobacter* spp. in hospital settings. These organisms are under surveillance in GLASS because of their widespread distribution and substantial clinical impact.

3.1.2 Global and regional distribution of bloodstream pathogens

In 2023, *E. coli* was the most frequently reported cause of bloodstream infections globally, accounting for nearly half of all reported infection episodes (306 783; 44.9%). It was reported twice as often as *S. aureus* (149 942; 21.9%), 2.1 times more often than *K. pneumoniae* (144 298; 21.1%), 6.2 times more often than *Acinetobacter* spp. (49 409; 7.2%), 13.1 times more often than *S. pneumoniae* (23 462; 3.4%) and 32.7 times more often than *Salmonella* spp. (9375; 1.4%). See Table 2.3 in section 2.2.3 for details.

E. coli was the predominant pathogen in most WHO regions, with reporting ratios relative to *K. pneumoniae* from 1.1 times in the Eastern Mediterranean Region (9847 vs 8650) to 2.5 times in the Western Pacific Region (125 539 vs 49 380) and 2.7 times in the European Region (128 607 vs. 47 905). The African Region was the only exception, as *K. pneumoniae* (10 048, 27.7%) was more commonly reported than *E. coli* (6727, 18.5%), for a ratio of 0.7 times.

While *E. coli* was particularly prominent in the European and Western Pacific regions, where it accounted for nearly half or more of all reported bloodstream infections, there was a more heterogeneous pathogen profile in the African and South-East Asia regions. In the African Region, for example, *S. aureus* and *K. pneumoniae* each contributed over 27% of reported cases, while *Acinetobacter* spp. accounted for 20.5%, a pattern that suggests a high incidence of hospital-acquired infections. These regional differences likely reflect variations in access to health care, diagnostic capacity and reporting practices, with more data coming from tertiary care facilities in LMICs, where infection prevention and control measures are more difficult to implement. In such settings, the frequent initiation of antibiotics before blood culture collection may reduce the sensitivity of cultures and result in a skewed representation of pathogen distribution.

Global and regional relative distributions of bloodstream pathogens in 2023 are summarized in Fig. 3.5 (section 3.1.5).

Figure 3.1. Percentage AMR in bloodstream infections: global and regional estimates, 2023

Error bars represent 95% CrI. Semi-transparent bars show pathogen–antibiotic combinations for which global and regional adjusted estimates are based on data from fewer than five countries. These estimates should be interpreted with caution, as they may not reflect the true regional or global situation. For methods, see Annex 1.

TMP-sulfa: Sulfonamides and trimethoprim.

3.1.3 Global estimates of AMR in bloodstream infections

***Acinetobacter* spp.**

Epidemiology: Of the bloodstream pathogens reported to GLASS, *Acinetobacter* spp. are predominantly associated with hospital-acquired infections, often in critically ill or immunocompromised patients. These infections are often challenging to treat due to high levels of resistance to multiple antibiotic classes *(1)*.

Resistance to "Access" group antibiotics: The global level of resistance to gentamicin was high, at 44.6% (40.2, 49.1). There was a similar level of resistance to amikacin, another aminoglycoside in the "Access" group, at 39.0% (34.3, 43.9).

Resistance to "Watch" group antibiotics: In 2023, the level of resistance to carbapenems, classified in the "Watch" group, was also high, at 54.3% (49.3, 59.2) for imipenem, 49.6% (44.7, 54.5) for meropenem and 40.9% (28.4, 54.7) for doripenem.

Resistance to "Reserve" group antibiotics: Tigecycline, in the "Reserve" group, and minocycline, in the "Watch" (oral) or "Reserve" (intravenous) group, showed lower resistance —13.0% (7.5, 21.7) and 13.5% (9.3, 19.1), respectively — making them viable options for managing infections with multidrug-resistant *Acinetobacter* spp., particularly as part of combination regimens. "Reserve" group antibiotics play a central role in the treatment of carbapenem-resistant *Acinetobacter* spp., colistin remaining an important option with a global resistance level of 4.7% (3.4, 6.6).

E. coli

Epidemiology: E. coli is one of the most common causes of community-acquired bloodstream infections; it usually originates from urinary or gastrointestinal sources *(1)*.

Resistance to "Access" group antibiotics: Treatment options in the "Access" group are limited, as *E. coli* is poorly susceptible to narrow-spectrum beta-lactam antibiotics. Co-trimoxazole is classified as an "Access" antibiotic, but the high level of global resistance — 61.2% (57.1, 65.2) in 2023 — limits its usefulness for empirical therapy.

Resistance to "Watch" group antibiotics: There was extensive resistance to fluoroquinolones and to third-generation cephalosporins, both of which are classified in the "Watch" group. Percentage resistance to ciprofloxacin, for example, was 40.7% (36.5, 45.1). Despite their excellent oral bioavailability, fluoroquinolones and co-trimoxazole should be considered as oral step-down options only when AST results are available. Resistance to third-generation cephalosporins, which is often indicative of ESBL production, was highest for ceftriaxone (43.5% [37.6, 49.6]), followed by cefotaxime (39.0% [33.5, 44.8]) and ceftazidime (31.8% [26.8, 37.3]). In contrast, percentage resistance to carbapenems —classified as "Watch" antibiotics or "Reserve" when combined with beta-lactamase inhibitors (e.g. meropenem-vaborbactam, imipenem-relebactam)— remained low (≤ 3.5% depending on the agent).

Resistance to "Reserve" group antibiotics: Resistance to colistin was also low globally, at 1.7% (1.1, 2.8) (Fig. 3.1).

K. pneumoniae

Epidemiology: K. pneumoniae is a leading cause of hospital-acquired bloodstream infections, particularly in intensive care units. It is frequently associated with the production of ESBLs and, in some settings, carbapenemases, both of which complicate effective treatment *(1)*. Geographical differences in the epidemiology of the various carbapenemase-encoding genes affect susceptibility patterns and the effectiveness of reserve antibiotics *(40)*.

Resistance to "Access" and "Watch" group antibiotics: In 2023, resistance to both "Access" and "Watch" group antibiotics was high (Fig. 3.1): over half of *K. pneumoniae* bloodstream infections were resistant to co-trimoxazole (59.0% [54.4, 63.5]) and third-generation cephalosporins, and the percentage resistance to ceftriaxone was 60.4% (54.0, 66.5). There was a high level of resistance to fourth-generation cephalosporins (cefepime: 46.4% [40.9, 52.1]). The level of resistance to fluoroquinolones was higher in *K. pneumoniae* than in *E. coli*, with ciprofloxacin resistance at 48.3% (43.4, 53.2). Percentage resistance to carbapenems was also higher in *K. pneumoniae* than in *E. coli*, with resistance to meropenem at 15.1% (12.6, 18.1).

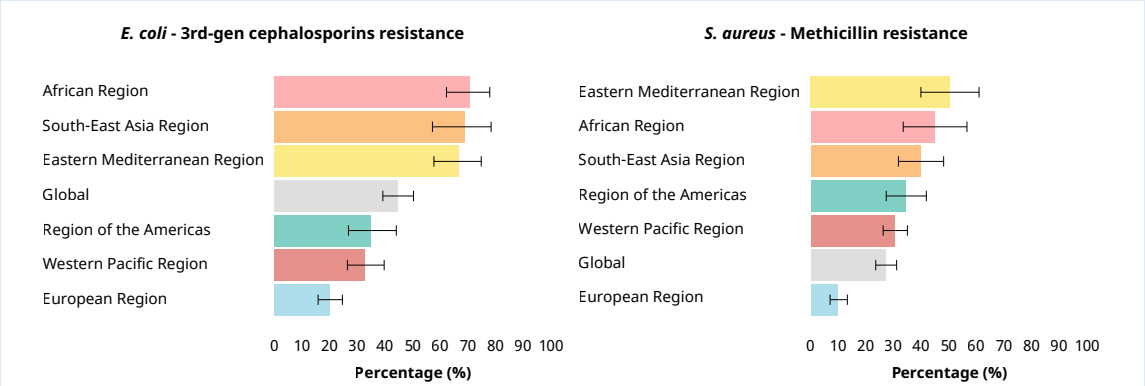
Resistance to "Reserve" group antibiotics: The percentage resistance to colistin was five times higher in *K. pneumoniae* than in E. coli, at 7.9% (5.9, 10.5%).

Box 3.2. Sustainable Development Goal indicators for AMR

The SDG indicator for AMR (3.d.2) is based on resistance of *E. coli* to third-generation cephalosporins and MRSA in bloodstream infections. This indicator is used to monitor progress toward the AMR-related SDG targets *(14,15).*

In 2023, the global level of resistance of *E. coli* to third-generation cephalosporins was 44.8% (95% CrI: 39.3, 50.4), with regional differences ranging from 19.9% (15.9, 24.7) in the European Region to 70.7% (62.3, 78.0) in the African Region. For *S. aureus*, the global level of methicillin resistance was 27.1% (23.5, 31.0), which is lower than previously reported crude median estimates based on data from all countries *(30)* because of inclusion of national surveillance coverage and population weights in the analysis and potential changes in MRSA epidemiology. The level of MRSA was lowest in the European Region (9.7% [7.0, 13.2]) and highest in the Eastern Mediterranean Region (50.3% [39.8, 60.8]). These findings demonstrate the continuing global burden of resistance to antibiotics used in bloodstream infections and the importance of targeted interventions, particularly in high-burden regions.

Figure 3.2. Percentage resistance to third-generation cephalosporins in *E. coli* and MRSA: global and regional estimates, 2023



Error bars represent 95% CrI. For methods, see Annex 1.

S. aureus

Epidemiology: MRSA is a major cause of both hospital-acquired and, increasingly, community-acquired bloodstream infections, often linked to invasive procedures or medical devices *(41)*. It is associated with severe complications, including endocarditis and osteomyelitis.

Resistance: Resistance to methicillin limits treatment options by rendering most beta-lactam antibiotics ineffective, increasing the risk of poor clinical outcomes. In 2023, the global level of MRSA in bloodstream infections was 27.1% (23.5, 31.0) (Box 3.2).

Salmonella spp.

Epidemiology: Salmonella spp. bloodstream infections in this report represent non-typhoidal strains,[4] which are typically community-acquired, especially in endemic regions *(1).*

Resistance: In 2023, "Watch" group antibiotics remained largely effective for management of *Salmonella* spp. The percentage resistance to third-generation cephalosporins was low, at 5.3% (3.0, 9.2), for ceftriaxone (Fig 3.1). In contrast, the level of resistance to fluoroquinolones ranged from 11.8% (6.9, 19.5) for levofloxacin to 18.0% (13.9, 22.9) for ciprofloxacin. Minimal resistance was observed to carbapenems, at < 0.5%.

[4] *S.* Typhi and *S.* Paratyphi are not included in this report.

S. pneumoniae

Epidemiology: Although the burden of *S. pneumoniae* has decreased with the introduction of pneumococcal conjugate vaccines, it remains an important cause of community-acquired bloodstream infections, often secondary to pneumonia and, less commonly, meningitis *(42).*

Resistance: Surveillance data for 2023 pointed to variable levels of resistance of *S. pneumoniae* to "Access" group antibiotics. Globally, 17.8% (12.0, 25.5) of infections were not susceptible to oxacillin,[5] a surrogate marker of reduced penicillin susceptibility due to altered penicillin-binding proteins, while the level of resistance to penicillin remained low, at 5.2% (3.6, 7.6). Resistance to co-trimoxazole, another "Access" antibiotic, was higher, at 35.1% (28.6, 42.2), limiting its empirical use in many settings. In contrast, resistance to "Watch" group antibiotics remained low: 0.7% (0.4, 1.1) for ceftriaxone and 0.8% (0.5, 1.3) for cefotaxime. These findings indicate the continued effectiveness of narrow-spectrum beta-lactam "Access" antibiotics such as ampicillin, amoxicillin and penicillin for most pneumococcal infections, and third-generation cephalosporins as reliable alternatives in severe or unresponsive cases.

3.1.4 Regional and national estimates of AMR in bloodstream infections

Data on AMR in bloodstream infections in 2023 varied by region. Overall, percentage resistance across all pathogen–antibiotic combinations was highest in the African Region, followed by the Eastern Mediterranean and South-East Asia regions. The lowest percentage resistance was observed in the European and Western Pacific regions, suggesting a disproportionate burden of AMR in LMICs (Fig. 3.1, Box 3.3, Annex 5). Higher resistance may also reflect testing bias associated with limited microbiological capacity in LMICs, with data contributions primarily from tertiary or reference hospitals caring for patients with previous exposure to antibiotics, severe infections, treatment failures and hospital-acquired infections *(3,43)*.

Box 3.3. AMR in relation to national health system capacity and socioeconomic context

In 2023, according to GLASS data, there was an inverse correlation between national AMR surveillance coverage and the median percentage AMR in bloodstream infections. In 95 countries for which data were available, median percentage resistance was calculated for all pathogen–antibiotic combinations from national modelled estimates. The number of bloodstream infection episodes with AST results reported per million population was negatively correlated with median resistance (Pearson $r = -0.74$, $P < 0.0001$).

There was a similar inverse relation between AMR and two structural indicators: income and the UHC service coverage index. The UHC index (range, 0–100), part of SDG indicator 3.8.1, is a measure of access to essential health services based on 14 tracer indicators in four domains: reproductive, maternal, newborn and child health; infectious diseases; noncommunicable diseases; and service capacity and access. Service coverage must be assessed alongside SDG indicator 3.8.2, which measures catastrophic health spending, to monitor progress toward UHC , where people receive the high-quality care they need without financial hardship.

According to GLASS data, the UHC service coverage index was inversely correlated with the national median of modelled resistance estimates in bloodstream infections (Pearson $r = -0.77$, $P < 0.0001$). Among the 95 countries for which data were analysed, those with lower UHC service coverage indexes and lower income classifications consistently reported higher resistance levels in all pathogen–antibiotic combinations. Visual representations of these relations are presented in the summary (Fig. 4 and Fig. 5).

[5] A susceptible oxacillin result indicates susceptibility to penicillin, but an oxacillin-resistant result may not reflect true resistance to benzylpenicillin or other beta-lactams and may lead to overestimation of resistance to penicillins.

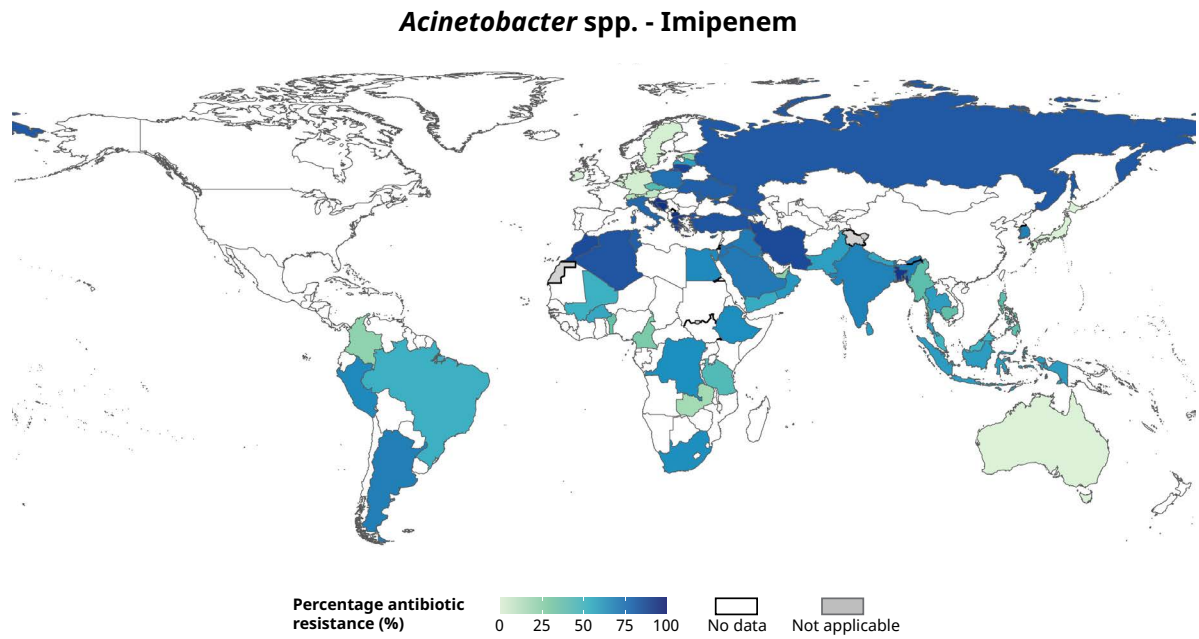
National estimates of percentage resistance to selected antibiotics are shown in Fig. 3.3 and for the SDG AMR indicators in Fig. 3.4. These data, with 95% CrI, are summarized in Annex 6.

With respect to "Access" antibiotics, percentage resistance to penicillin in *S. pneumoniae* was highest in the African Region (38.6% [29.2, 48.9]) and lowest in the Region of the Americas (2.5% [0.5, 10.8]). These estimates were, however, based on data from only three countries, limiting the reliability of interpretation at regional level (Fig. 3.3, Annex 5).

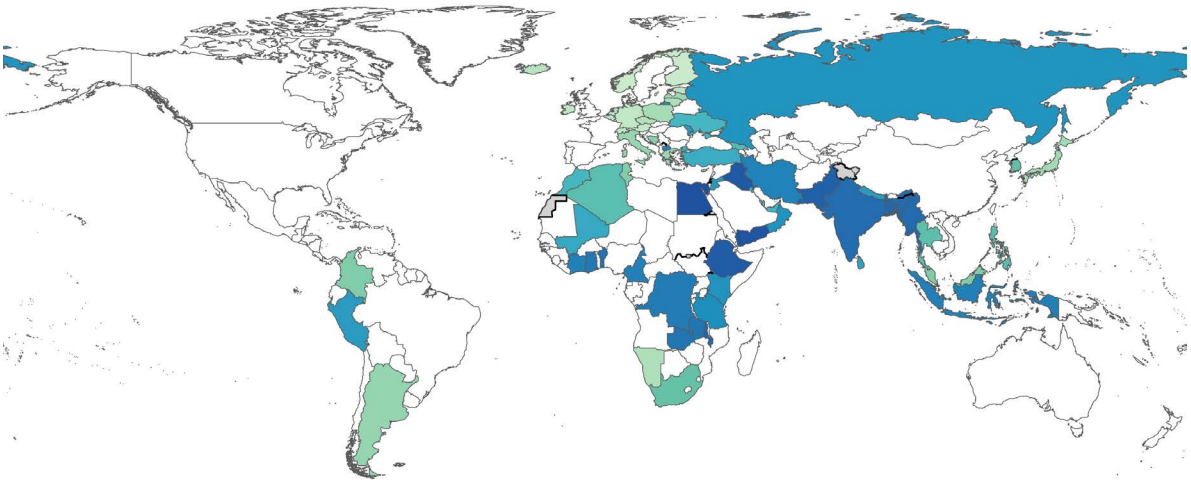
In the "Watch" group, the level of cefotaxime resistance in *K. pneumoniae* was highest in the African Region, at 77.8% (73.1, 81.9), while that in *E. coli* was highest in the South-East Asia Region, at 67.3% (54.4, 78.0). The lowest level of resistance to cefotaxime in these pathogens was in the Western Pacific (25.9% [15.7, 39.7]) and European regions (17.7% [14.4, 21.5]) for *K. pneumoniae* and *E. coli*, respectively. The level of ciprofloxacin resistance in *Salmonella* spp. was highest in the European Region at 36.2% (29.0, 44.2) and lowest in the Western Pacific at 4.9% (2.0, 11.5). The European Region consistently showed lower resistance levels for all other bloodstream pathogen–antibiotic combinations compared with the African, Eastern Mediterranean and South-East Asia regions.

For carbapenem antibiotics, percentage imipenem resistance in *Acinetobacter* spp. was highest in the Eastern Mediterranean Region at 66.5% (58.1, 73.9), while the level of resistance to *K. pneumoniae* was the highest in South-East Asia at 41.2% (30.3, 53.1). The percentage *E. coli* resistance to imipenem was also highest in South-East Asia, at 17.5% (12.4, 24.2). The percentage resistance in these pathogens was consistently lowest in the European and Western Pacific regions, the level of *E. coli* resistance to imipenem being as low as 0.4% (0.2, 0.8) in the European Region.

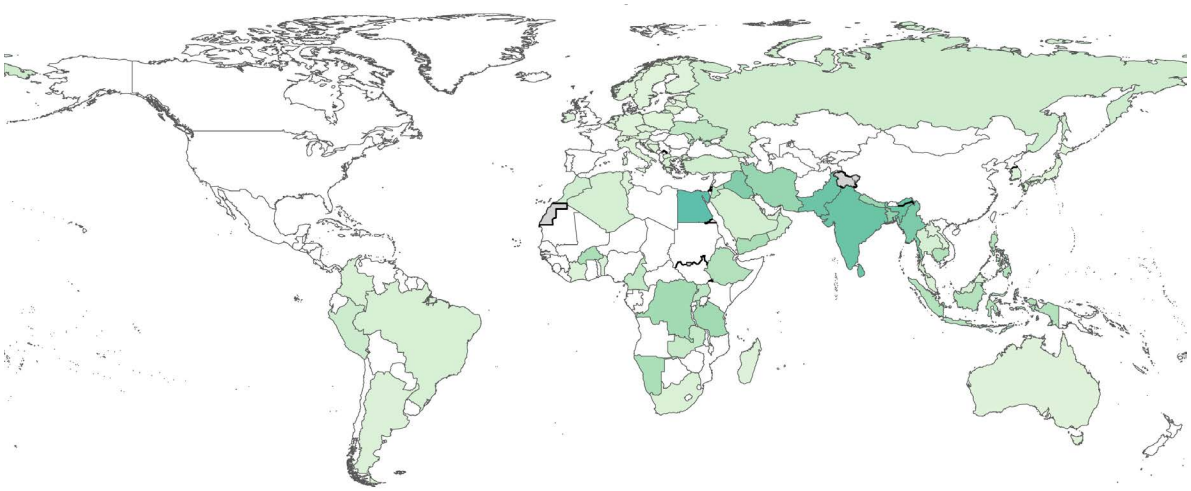
Figure 3.3. National percentage resistance to selected antibiotics in bloodstream infections, 2023



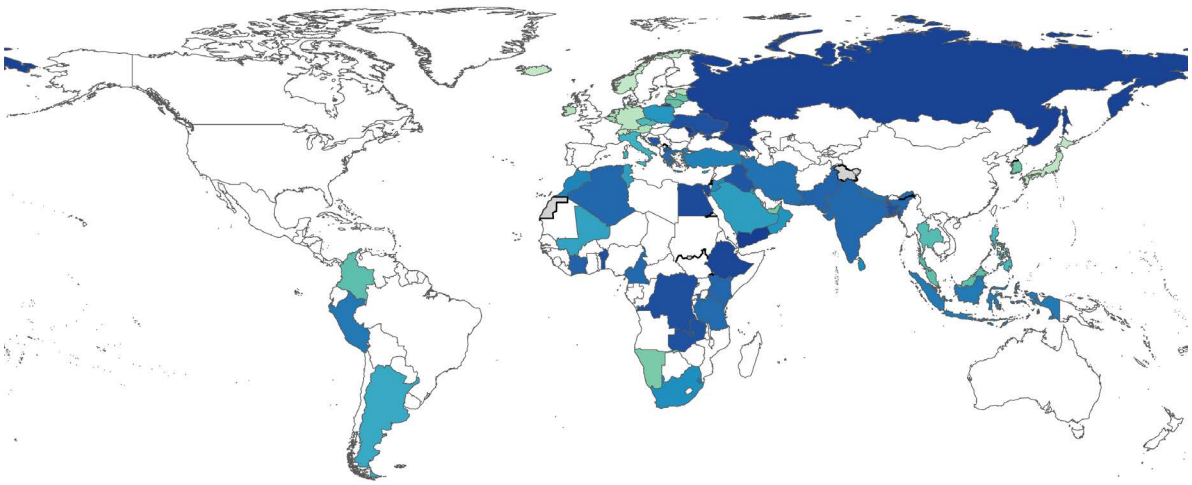
***E.coli* - Cefotaxime**

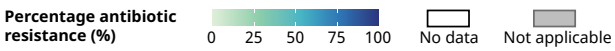


***E.coli* - Imipenem**

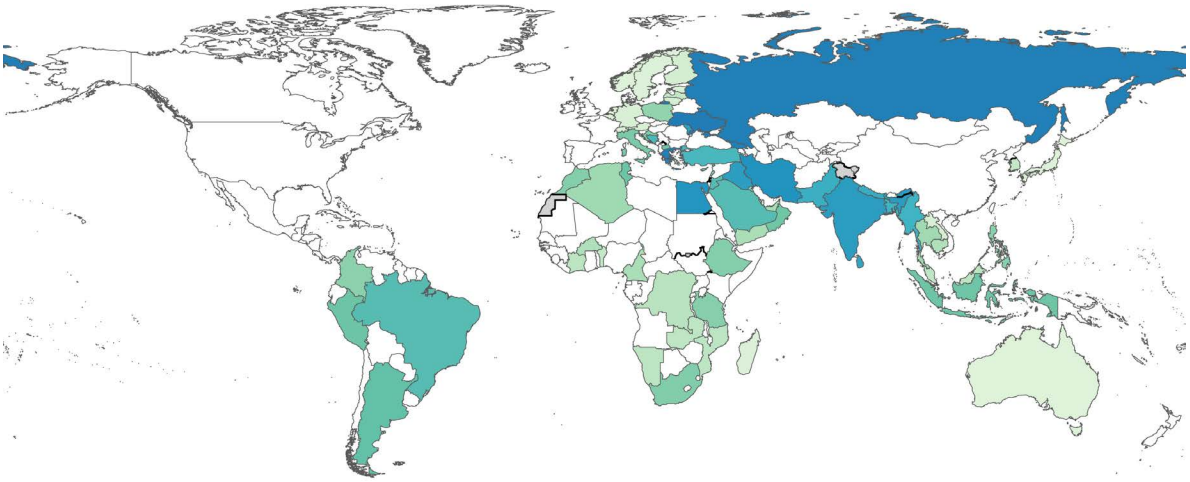


***K. pneumoniae* - Cefotaxime**

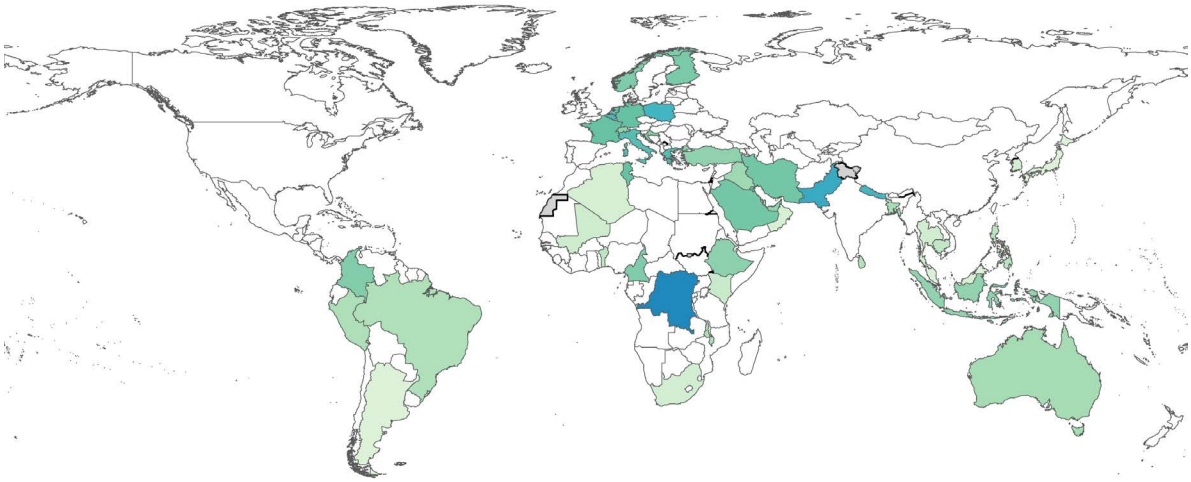




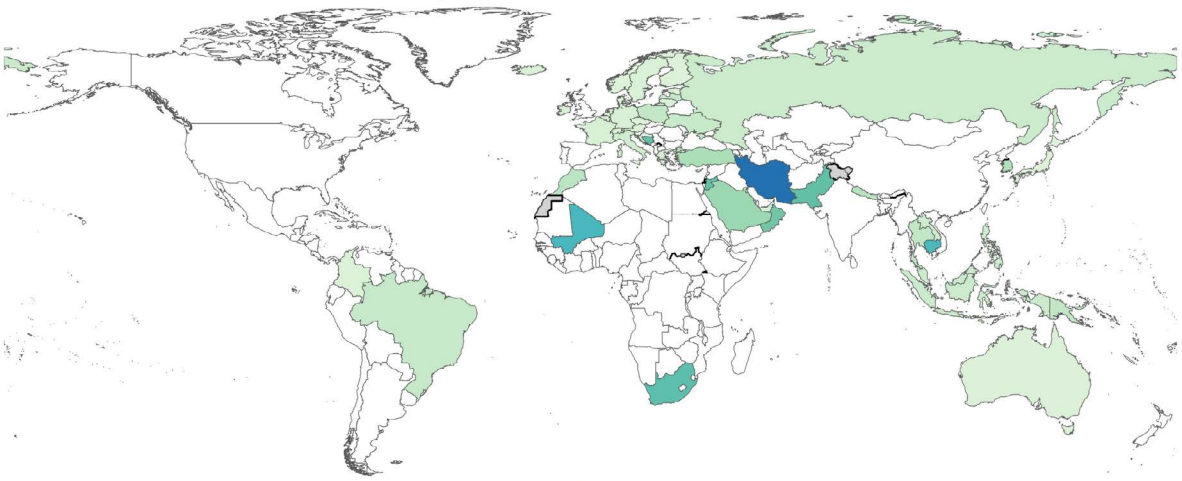
***K. pneumoniae* - Imipenem**



***Salmonella* spp. - Ciprofloxacin**

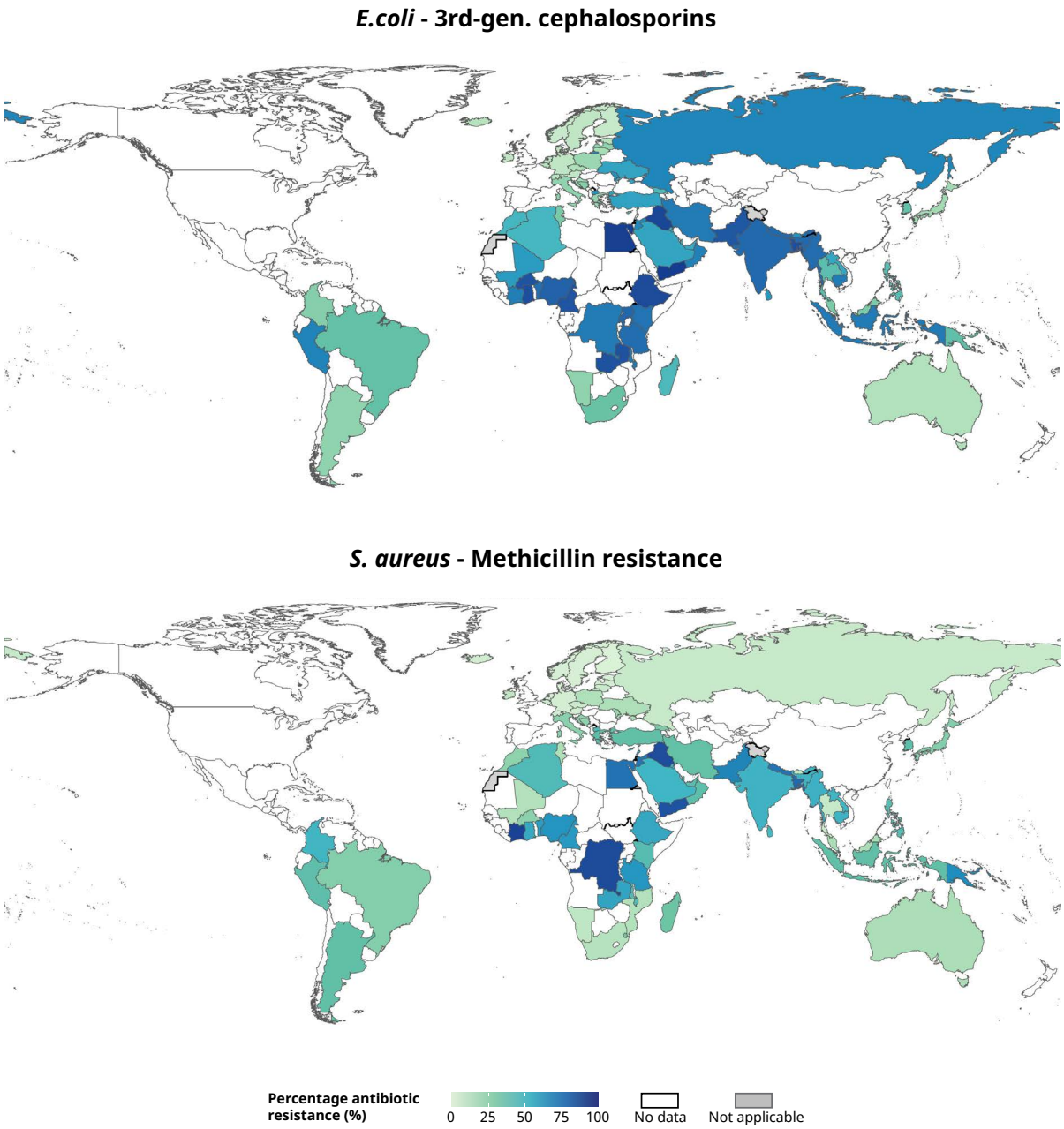


***S. pneumoniae* - Penicillin G**



Adjusted estimates of AMR are presented only for countries that reported data on the specific pathogen–antibiotic combination in 2023. Estimates are derived from multilevel Bayesian regression analyses that incorporate data from previous years to improve the accuracy of 2023 estimates. For further details of the method, see Annex 1.

Figure 3.4. National percentage resistance to third-generation cephalosporins in *E. coli* and MRSA bloodstream infections, 2023



Adjusted AMR estimates are presented only for countries that reported data for the specific pathogen–antibiotic combination in 2023. Estimates are derived from multilevel Bayesian regression analyses that incorporate data from previous years to improve the accuracy of 2023 estimates. For further details of the method, see Annex 1.

3.1.5 Global and regional distribution of drug-resistant bloodstream pathogens

Globally, *E. coli* and *K. pneumoniae* resistant to fluoroquinolones and third-generation cephalosporins were the most frequently reported drug-resistant bloodstream infections in 2023 (Fig. 3.5). The most common resistance combination was *E. coli* resistant to ciprofloxacin, followed by *E. coli* resistant to levofloxacin. Resistance to all "Watch" group third-generation cephalosporins — cefotaxime, ceftriaxone and ceftazidime — in both *E. coli* and *K. pneumoniae* also ranked among the top 10 globally.

In the African region, *K. pneumoniae* resistant to third-generation cephalosporins was the most frequently reported drug-resistant bloodstream infection. Additionally, resistance to carbapenems (specifically meropenem; see Fig. 3.5) and aminoglycosides in *Acinetobacter* spp. ranked among the most common resistance combinations.

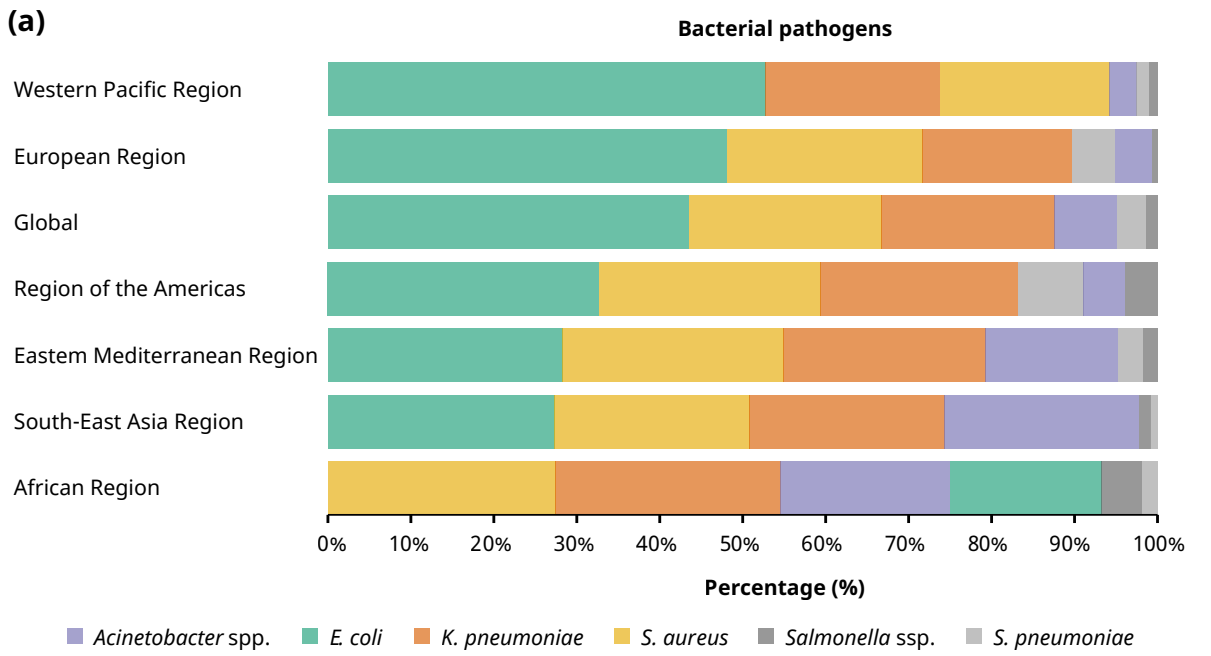
Meropenem- and imipenem-resistant *Acinetobacter* spp. also featured among the 10 most common drug-resistant pathogens in the South-East Asia Region, where resistance was more evenly distributed between *E. coli* and *K. pneumoniae*, both species showing high levels of resistance to fluoroquinolones and third-generation cephalosporins.

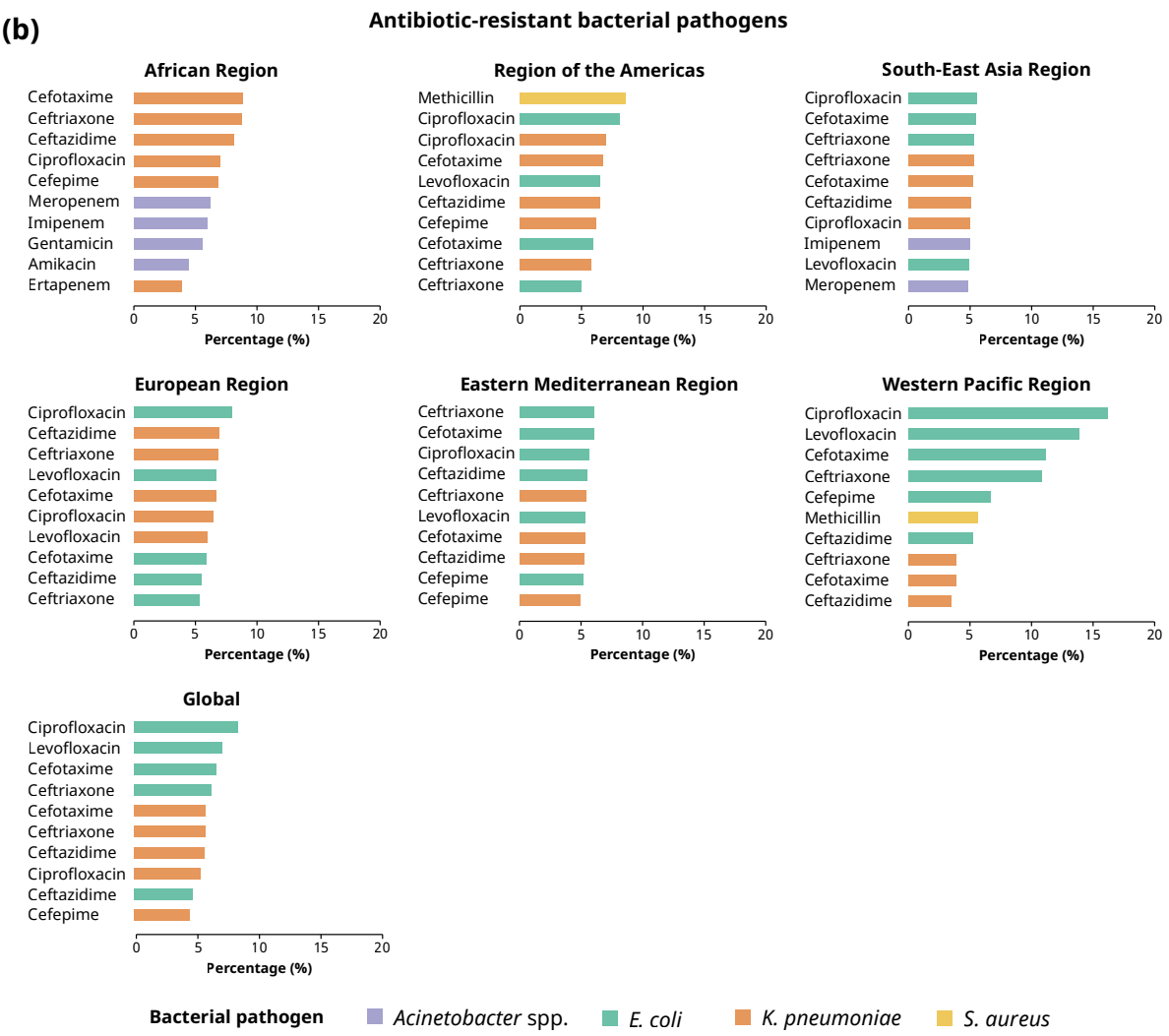
In the Region of the Americas, *E. coli* and *K. pneumoniae* resistant to fluoroquinolones or third-generation cephalosporins were among the most frequently reported drug-resistant pathogens, although MRSA was that most commonly identified overall. MRSA was also frequently reported in the Western Pacific Region, whilst it did not rank among the top 10 drug-resistant pathogens in the other regions.

These findings may have implications for empirical treatment strategies and highlight the importance of sustained surveillance to inform policy and clinical decision-making. Of note, among the "Access" group, resistance to co-trimoxazole was not among the top 10 resistance combinations in any WHO region in 2023.

The global and regional distribution of bloodstream pathogens is described in section 3.1.2.

Figure 3.5. Percentage distribution of bacterial pathogens (a) and the 10 most common antibiotic-resistant bacterial pathogens (b) in bloodstream infections, by WHO region, 2023





The figure presents the relative distribution of bloodstream infections by pathogen (a), and of the 10 most common antibiotic-resistant pathogens (b). The latter were identified by multiplying the total number of infections caused by each pathogen by the modelled proportion of resistance to each antibiotic. Drug-resistant pathogens were identified from individual antibiotic–pathogen pairs. The figure includes data from countries that reported in three or more years between 2018 and 2023.

Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

3.1.6 Clinical considerations

The 2023 resistance data for bloodstream infection pathogens highlight that selecting effective empirical therapy is increasingly challenging, particularly in regions with high prevalence of multidrug-resistant organisms (Box 3.4). In such settings, standard empirical regimens are more likely to be ineffective, increasing the risk of discordant therapy and adverse clinical outcomes.

High levels of resistance to both "Access" and "Watch" group antibiotics in *K. pneumoniae*, *Acinetobacter* spp. and *E. coli* significantly narrow the window for effective empirical treatment. Resistance to carbapenems in *K. pneumoniae* and *Acinetobacter* spp. and emerging resistance to "Reserve" agents such as colistin further complicate treatment decisions in settings with limited therapeutic options.

These findings reinforce the need for empirical regimens based on local resistance patterns and WHO AWaRe principles *(1)*. While broad-spectrum agents are often required initially, timely de-escalation according to clinical progress, culture results and susceptibility data is essential. Continuous surveillance and antibiotic stewardship remain critical to preserving the effectiveness of available therapies and ensuring appropriate use in all clinical settings.

Box 3.4. Management of bacterial bloodstream infections: WHO AWaRe principles

When microbiological results are not yet available, the choice of empirical broad-spectrum antibiotics is guided by national and international guidelines, the WHO AWaRe classification, local epidemiology and the suspected source of infection. Depending on whether the infection is community-acquired or health-care-associated, treatment frequently begins with a third-generation cephalosporin such as ceftriaxone. In severe cases, this may be combined with an aminoglycoside such as gentamicin. If resistance is suspected or confirmed, escalation to agents from the WHO "Reserve" group may be warranted.

Treatment of MRSA bloodstream infections

MRSA bloodstream infections are difficult to treat because the bacterium is resistant to most beta-lactam antibiotics, including penicillins, most cephalosporins and all carbapenems. As a result, treatment is usually with antibiotics in the "Watch" and "Reserve" groups. Vancomycin, an essential glycopeptide in the "Watch" group, is commonly used as first choice. When vancomycin cannot be administered, alternatives such as linezolid or daptomycin "Reserve" antibiotics are often used.

3.2 AMR in gastrointestinal infections

3.2.1 Epidemiology of gastrointestinal infections

Gastrointestinal infections continue to pose a major public health challenge worldwide and remain a leading global cause of illness and death, particularly among children under 5 years of age. These infections are closely associated with inadequate sanitation, unsafe water, poor hygiene and limited access to health-care services. They also contribute significantly to malnutrition and developmental delays in low-resource settings *(1,2).* Gastrointestinal infections are primarily caused by enteric pathogens transmitted via the faecal–oral route, often through contaminated food or water. Most diarrhoeal episodes are viral and do not require antibiotic treatment *(1).*

Non-typhoidal *Salmonella* spp. and *Shigella* spp. are among the most common bacterial causes of gastrointestinal infections and are both under surveillance in GLASS. These pathogens are frequently implicated in both sporadic cases and outbreaks *(2).* Clinical presentations can vary widely, from mild, self-limiting diarrhoea to severe dysentery and invasive disease, especially in vulnerable populations such as young children, the elderly and immunocompromised individuals.

Non-typhoidal *Salmonella* spp. are a leading cause of foodborne and invasive infections, typically acquired in community settings. While these pathogens often cause self-limiting gastrointestinal infections, they can progress to severe systemic illness – particularly in children, the elderly, malnourished individuals and people who are immunocompromised *(44).* Invasive infections may result in case fatality rates as high as 15–20%, and even higher rates are observed among individuals living with HIV *(44–47).* The emergence of fluoroquinolone-resistant non-typhoidal *Salmonella* spp. is a growing concern *(2,48)*. It is due largely to use of antibiotics in animal husbandry *(49).*

Shigella spp. are highly infectious and frequently associated with outbreaks, particularly in settings with inadequate hygiene and sanitation *(50).* They pose a significant threat to young children and displaced populations. Shigellosis is the second leading cause of diarrhoeal mortality globally *(51)* and is associated with severe outcomes such as dehydration, seizures and haemolytic uraemic syndrome. Increasing AMR, including multidrug-resistant and extensively drug-resistant strains, poses a serious threat to treatment efficacy, with outbreaks linked to specific community settings, including among men who have sex with men *(52,53).*

Vitaliy Karpenko, young pharmacist from Ukraine.

3.2.2 Global and regional distribution of gastrointestinal pathogens

In 2023, a total of 33 054 *Salmonella* spp. infections were reported to GLASS, 5.1 times more frequent than infections due to *Shigella* spp. (6 525 cases).

The European Region contributed the largest number, with 15 799 cases (47.8% of the global total), followed by the Region of the Americas (6506, 19.7%), Western Pacific (5544, 16.8%), Eastern Mediterranean (3418, 10.3%) South-East Asia (1573, 4.8%), and African (214, 0.6%) regions.

The Region of the Americas reported the highest number of *Shigella* spp. infections, with 2774 cases (42.5% of the global total), followed by the European (2464, 37.8%), Eastern Mediterranean (556, 8.5%), Western Pacific (319, 4.9%), South-East Asia (244, 3.7%), and African (168, 2.6%) regions.

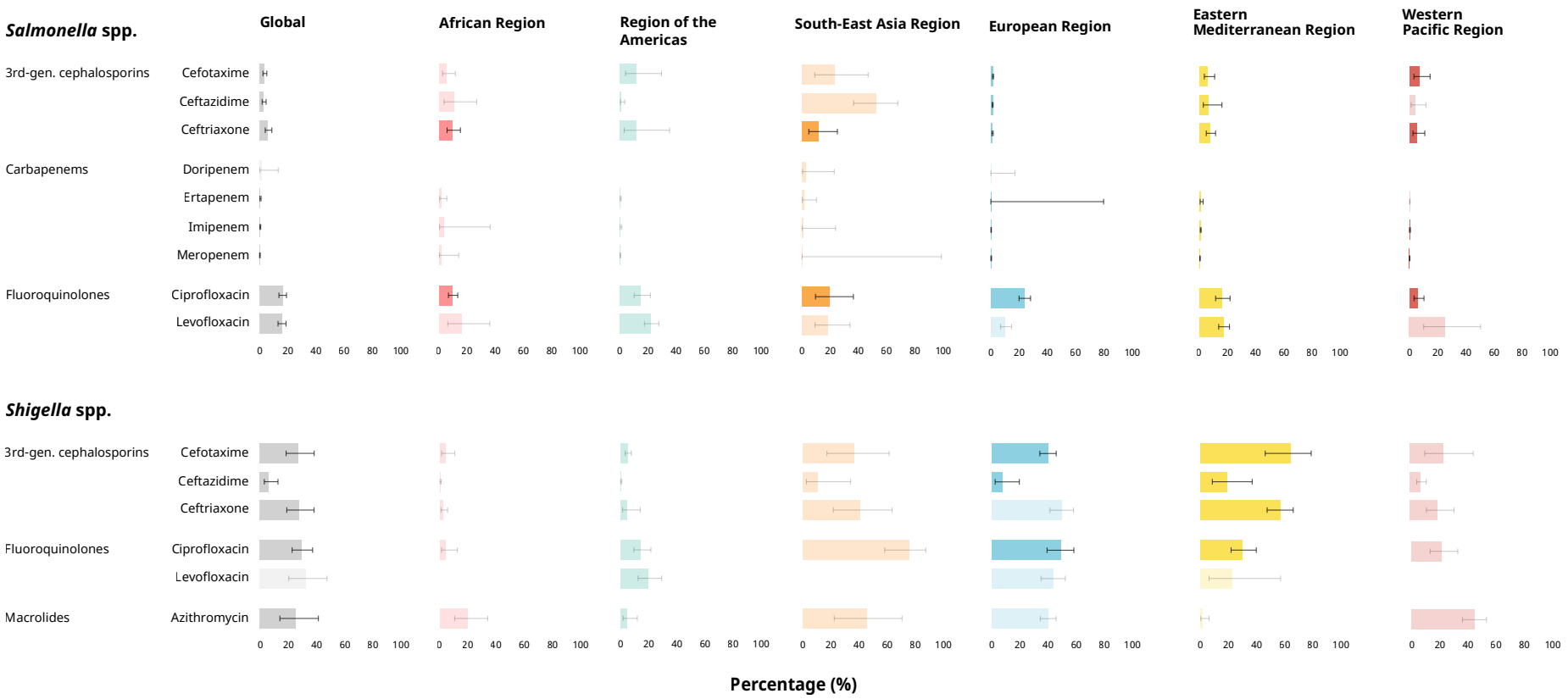
Salmonella spp. infections were reported more frequently than *Shigella* spp. infections in all regions, with the *Salmonella*-to-*Shigella* ratio ranging from 1.3 in the African Region to 17.4 in the Western Pacific Region. See Table 2.3 in section 2.2.3 for details.

3.2.3 Global estimates of AMR in gastrointestinal infections

***Salmonella* spp.**

In 2023, third-generation cephalosporins remained largely effective against *Salmonella* spp., the level of resistance to ceftriaxone being 6.0% (4.1, 8.7), that to cefotaxime 3.5% (2.4, 5.2) and that to ceftazidime 2.9% (1.8, 4.7). The percentage resistance to carbapenems was low, that to imipenem and ertapenem being 0.4% (0.2, 0.9) and 0.5% (0.3, 1.1), respectively, and that to meropenem being 0.1% (0.0, 0.5). In contrast, resistance to fluoroquinolones was higher, with 16.3% (13.8, 19.1) of isolates resistant to ciprofloxacin.

Figure 3.6. Percentage AMR in gastrointestinal infections: global and regional estimates, 2023



Error bars represent 95% CrI. Semi-transparent bars show pathogen–antibiotic combinations for which global and regional adjusted estimates are based on data from fewer than five countries. These estimates should be interpreted with caution, as they may not reflect the true regional or global situation. For methods, see Annex 1.

***Shigella* spp.**

The level of resistance to third-generation cephalosporins in *Shigella* spp. was higher than in *Salmonella* spp., at 27.8% (19.1, 38.5) to ceftriaxone, 27.5% (18.6, 38.6) to cefotaxime and 6.5% (3.2, 12.9) to ceftazidime. The level of resistance to fluoroquinolones was also high, at 29.7% (22.9, 37.5) for ciprofloxacin. The percentage resistance to azithromycin, a macrolide often used in paediatric and outpatient settings, was 25.6% (14.2, 41.5).

3.2.4 Regional and national estimates of AMR in gastrointestinal infections

Data on gastrointestinal infections in 2023 varied by regions, with distinct patterns between *Salmonella* spp. and *Shigella* spp. Overall, for *Salmonella* spp., the level of AMR was highest in the South-East Asia Region and lowest in the European and Western Pacific regions. In contrast, *Shigella* spp. had the highest level of resistance in the European and South-East Asia regions, while the lowest levels were in the African Region and the Region of the Americas (Fig 3.6, Annex 5).

For the "Watch" group, the highest resistance to third-generation cephalosporins in *Salmonella* spp. was in the South-East Asia Region, while the European Region had the lowest. In *Shigella* spp., the resistance level was highest in the Eastern Mediterranean Region and lowest in the African Region. For example, the percentage ceftriaxone resistance in *Salmonella* spp. was 11.5% (4.8, 25.1) in the South-East Asia Region and 1.1% (0.7, 1.7) in the European Region. In *Shigella* spp., percentage resistance to this antibiotic was 56.9% (47.3, 65.9) in the Eastern Mediterranean Region and 2.0% (0.7, 5.4) in the African Region.

The level of resistance to ciprofloxacin in *Salmonella* spp. was highest in the European Region at 23.9% (20.0, 28.2), followed by the South-East Asia Region at 19.7% (9.5, 36.4), and lowest in the Western Pacific Region at 5.9% (3.3, 10.4). In *Shigella* spp., the level of resistance to ciprofloxacin was highest in the South-East Asia Region at 75.5% (58.1, 87.3), followed by the European Region at 48.8% (39.4, 58.4) and the Eastern Mediterranean Region at 30.0% (21.8, 39.7). The lowest percentage resistance was in the African Region, at 3.8% (1.1, 12.4).

The level of resistance to azithromycin in *Shigella* spp. was highest in the South-East Asia Region at 45.3% (22.3, 70.4), followed closely by the Western Pacific Region at 44.6% (36.3, 53.3). The lowest level of resistance was observed in the Eastern Mediterranean Region at 1.2% (0.2, 6.2). Resistance to carbapenems in *Salmonella* spp. remained at a low level in all regions.

Estimated national percentage resistance to ciprofloxacin is presented in Fig. 3.7 and in Annex 6.

3.2.5 Clinical considerations

The data on resistance for 2023 suggest that managing gastrointestinal infections is a growing challenge (Box 3.5). In some regions, *Shigella* spp. showed high resistance to key "Watch" group antibiotics such as fluoroquinolones, azithromycin and third-generation cephalosporins. The high levels of resistance limit empirical treatment options, especially in regions with widespread resistance, and emphasize the importance of ongoing local surveillance and susceptibility testing to guide effective treatment strategies.

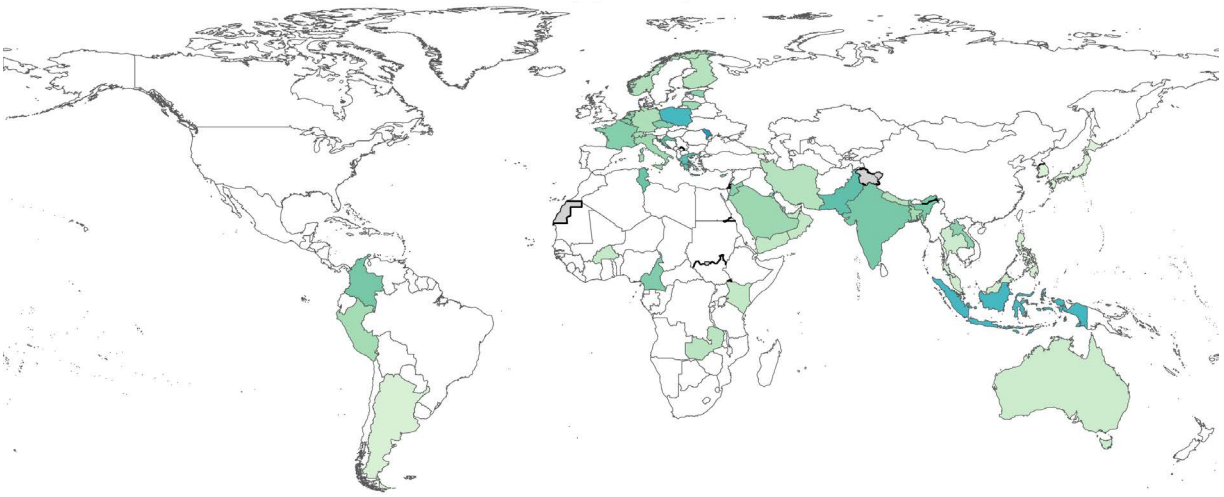
While non-typhoidal *Salmonella* spp. generally remain susceptible to most "Watch" group antibiotics, rising levels of resistance to fluoroquinolones are a major global concern. The resistant strains may indirectly increase resistance in typhoidal *Salmonella* spp. by contributing to the prevalence of resistance genes, compromising the effectiveness of fluoroquinolones in treating typhoid fever *(48)*.

The findings reinforce the importance of aligning empirical therapy with local resistance patterns and the WHO AWaRe framework, prioritizing Access group antibiotics where they are effective and reserving Watch and Reserve agents for cases of laboratory-confirmed resistance and patients at high risk of treatment failure due to clinical severity or previous exposure to antibiotics.

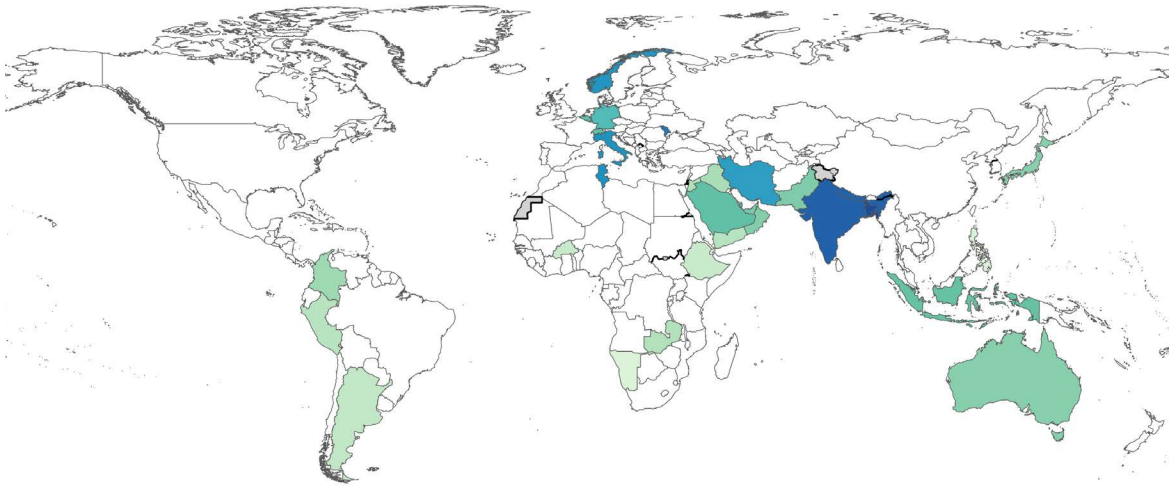
Enhanced surveillance and stewardship are essential to preserve the efficacy of antibiotics and to guide appropriate clinical decisions.

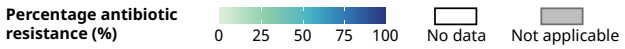
Figure 3.7. National percentage resistance to ciprofloxacin in gastrointestinal infections, 2023

***Salmonella* spp. - Ciprofloxacin**



***Shigella* spp. - Ciprofloxacin**





Adjusted AMR estimates are presented only for countries that reported data for the specific pathogen–antibiotic combination in 2023. Estimates are derived from multilevel Bayesian regression analyses that incorporate data from previous years to improve the accuracy of 2023 estimates. For further details of the method, see Annex 1.

Box 3.5. Management of bacterial gastrointestinal infections: WHO AWaRe principles

Empirical antibiotic treatment of gastrointestinal infections is generally reserved for cases of significant bloody diarrhoea or signs of systemic infection or for patients at increased risk of complications. Treatment decisions are based on the clinical scenario, local AMR patterns and global antibiotic stewardship frameworks such as the AWaRe classification. Broad-spectrum agents in the "Watch" group, including third-generation cephalosporins and fluoroquinolones, are frequently used because of their effectiveness and oral availability. Antibiotics such as carbapenems ("Watch" group) are usually limited to cases involving suspected or confirmed multidrug-resistant organisms, particularly in hospitalized patients with invasive disease.

For gastroenteritis due to *Salmonella* spp., antibiotic therapy is usually not indicated in otherwise healthy individuals with mild symptoms. In severe cases or in high-risk groups, however, treatment with ceftriaxone or ciprofloxacin may be warranted, and azithromycin (also a "Watch" antibiotic) can be used as an alternative, especially in areas of fluoroquinolone resistance.

In contrast, *Shigella* infections more often require antibiotic treatment, because of their severity and high transmissibility. Empirical therapy should be considered for severely ill and immunocompromised patients. Commonly used agents include azithromycin and ceftriaxone. Ciprofloxacin may also be considered if local susceptibility data support its use.

3.3 AMR in urinary tract infections

3.3.1 Epidemiology of urinary tract infections

Urinary tract infections are among the most common bacterial infections worldwide *(35)*, affecting individuals in all age groups and health-care settings. They are a leading cause of outpatient visits and antibiotic prescriptions, particularly among women, older adults and individuals with urinary catheters or structural abnormalities of the urinary tract.

Urinary infections are broadly classified as either uncomplicated or complicated. Uncomplicated cases typically occur in otherwise healthy individuals and are usually community-acquired, while complicated infections typically affect patients with comorbidities or anatomical abnormalities and in people who are pregnant or catheterized. Urinary tract infections are categorized anatomically into lower tract infections (e.g. cystitis) and upper tract infections (e.g. pyelonephritis), which differ in clinical severity and treatment approach.

The pathogens predominantly responsible for urinary tract infections are *E. coli* and *K. pneumoniae*. *E. coli* is the most frequent cause of community-acquired and recurrent infections and is a major contributor to urosepsis, particularly in older adults. *K. pneumoniae*, more commonly associated with health-care settings, is linked to severe infections such as catheter-associated urinary tract infections and complicated pyelonephritis. Both pathogens are under surveillance in GLASS.

3.3.2 Global and regional distribution of urinary tract pathogens

In 2023, urinary tract infections due to *E. coli* were reported to GLASS 5.9 times more frequently (total, 3 216 393) than those due to *K. pneumoniae* (545 564). The largest numbers of reported *E. coli* infections came from the European Region (1 953 889, 60.7% of the total global), followed by the Western Pacific (644 726, 20.0%), Americas (266 565, 8.3%), Eastern Mediterranean (188 751, 5.9%), South-East Asia (111 812, 3.5%) and African (50 650, 1.6%) regions. Similarly, the European Region reported the highest number of *K. pneumoniae* infections (251 836, 46.2% of the total global), followed by the Western Pacific (150 020, 27.5%), Eastern Mediterranean (50 996, 9.3%), Americas (48 789, 8.9%), South-East Asia (31 093, 5.7%) and African (12 830, 2.4%) regions.

E. coli was more commonly reported than *K. pneumoniae* by all regions, the ratio of *E. coli* to *K. pneumoniae* infections ranging from 3.6 in the South-East Asia Region to 7.8 in the European Region. See Table 2.3 in section 2.2.3 for details.

3.3.3 Global estimates of AMR in urinary tract infections

E. coli

Resistance to commonly used antibiotics in urinary tract infections caused by *E. coli* is a growing concern. In 2023, a high level of resistance to co-trimoxazole, an "Access" group antibiotic, was reported, at 53.2% (49.1, 57.2), limiting its empirical use in many settings. The global level of resistance to third-generation cephalosporins was 39.8% (33.9, 46.0) for cefotaxime, 41.0% (34.7, 47.5) for ceftriaxone and 31.2% (26.4, 36.4) for ceftazidime. Resistance to fluoroquinolones was also common, reaching 39.4% (35.1, 43.8) for ciprofloxacin. In contrast, the level of resistance to carbapenems remained low: meropenem at 2.0% (1.4, 2.8), imipenem at 2.6% (2.0, 3.5), and ertapenem at 2.8% (1.8, 4.5). The level of resistance to colistin remained low at 3.4% (2.1, 5.3).

K. pneumoniae

K. pneumoniae is a major cause of complicated and health care-associated urinary tract infections and is frequently linked to the production of ESBLs and carbapenemases *(1)*. In 2023, the level of resistance to co-trimoxazole was 46.4% (41.5, 51.4). The percentage resistance to third-generation cephalosporins approached 50% (cefotaxime: 45.5% (38.6, 52.5), ceftazidime: 42.5% (36.8, 48.5) and ceftriaxone: 47.3% (41.0, 53.7)). Resistance to fourth-generation cephalosporins was not much lower (cefepime: 39.4% (33.6, 45.6)). Among the fluoroquinolones, the level of resistance to ciprofloxacin was 39.1% (33.9, 44.6). Resistance to carbapenems was more frequent than in *E. coli* (meropenem: 8.9% (6.8, 11.5), ertapenem: 12.5% (9.2, 16.8) and doripenem: 19.4% (12.6, 28.7)). Colistin resistance in *K. pneumoniae* was more than twice that of *E. coli*, at 8.9% (6.6, 11.8).

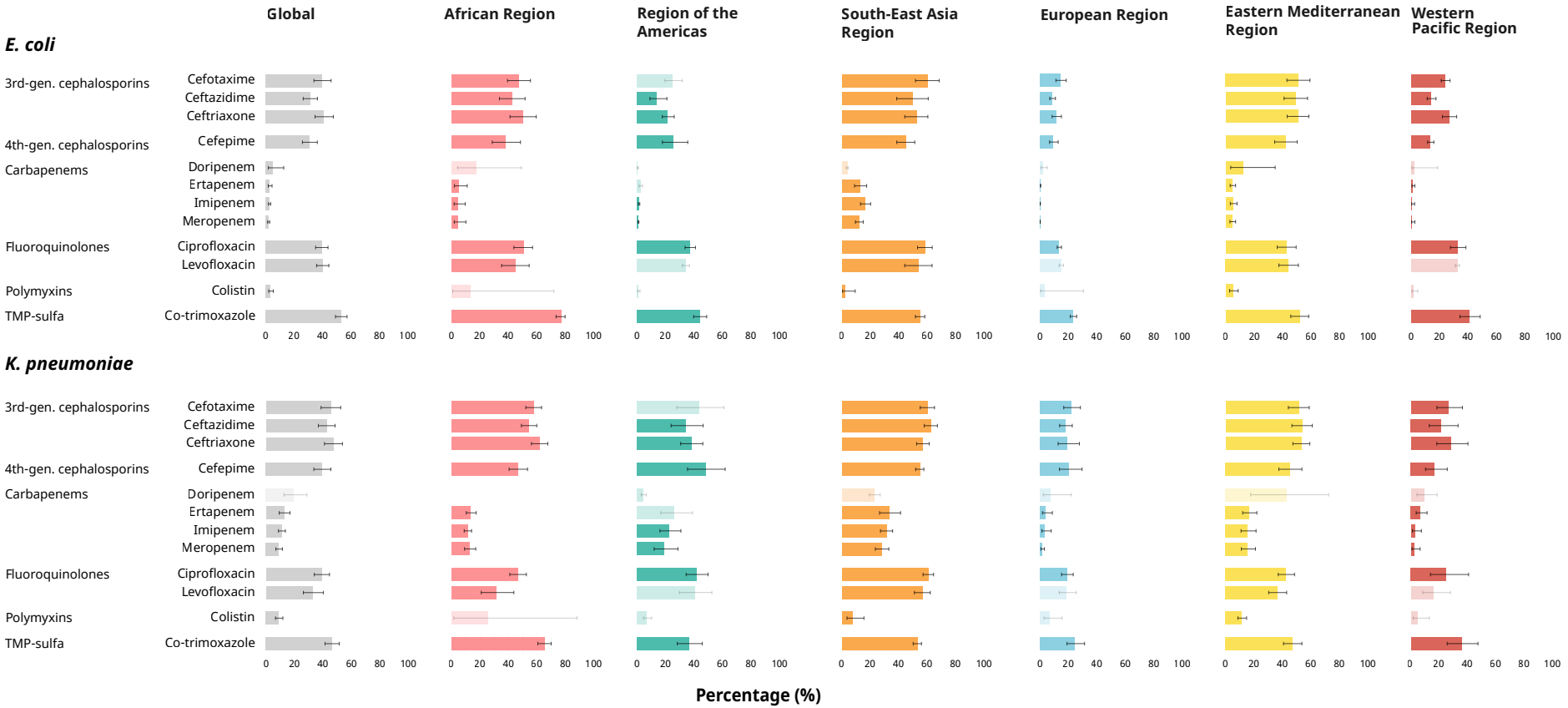
3.3.4 Regional and national estimates of AMR in urinary tract infections

In 2023, resistance patterns varied widely among WHO regions. The South-East Asia Region consistently reported the highest levels of resistance in most pathogen–antibiotic combinations, for both *E. coli* and *K. pneumoniae.* The lowest levels were reported by the European and Western Pacific regions (Fig. 3.8, Annex 5). These findings illustrate uneven progress in antibiotic stewardship and potential challenges to accessing effective treatment options globally.

For "Access" antibiotics, resistance to co-trimoxazole was highest in the African Region in both *E. coli* (76.9% [73.5, 79.9]) and *K. pneumoniae* (65.5% [60.6, 70.0]), probably due to widespread use of the drug including for prophylaxis *(54)*. The lowest level of resistance was in the European Region for *E. coli*, at 23.4% (21.2, 25.7) and for *K. pneumoniae*, at 24.6% (18.9, 31.3).

For the "Watch" antibiotics, the level of resistance to ciprofloxacin in *E. coli* was highest in the South-East Asia Region, at 58.4% (53.2, 63.5) and lower in the European Region, at 13.4% (12.0, 15.1). The level of resistance to ciprofloxacin in *K. pneumoniae* was also highest in South-East Asia, at 60.7% (57.0, 64.4), and lowest in the European Region, at 18.9 (15.1, 23.3). Overall, the percentage resistance to third-generation cephalosporins was generally higher in the South-East Asia Region for both pathogens. For example, the percentage resistance to cefotaxime in the South-East Asia Region was 60.4% (51.8, 68.4) in *E. coli* and 60.1% (54.9, 65.0) in *K. pneumoniae.* The lowest percentage resistance to this antibiotic was observed in the European Region, at 14.4% (11.1, 18.4) for *E. coli* and 22.0% (16.6, 28.4) for *K. pneumoniae*.

Figure 3.8. Percentage AMR in urinary tract infections: global and regional estimates, 2023



Error bars represent 95% CrI. Semi-transparent bars show pathogen–antibiotic combinations for which global and regional adjusted estimates are based on data from fewer than five countries. These estimates should be interpreted with caution, as they may not reflect the true regional or global situation. For methods, see Annex 1.

Overall, the level of resistance to carbapenems was higher in the South-East Asia Region, with few exceptions across pathogens and antibiotics. In this Region, the level of resistance to imipenem was highest in both *E. coli* (16.3% [13.1, 20.2]) and *K. pneumoniae* (31.1% [27.0, 35.6]). The lowest level was in the European Region for *E. coli*, at only 0.1% (0.1, 0.2), and in the Western Pacific Region for *K. pneumoniae*, at 2.7% (1.0, 7.3).

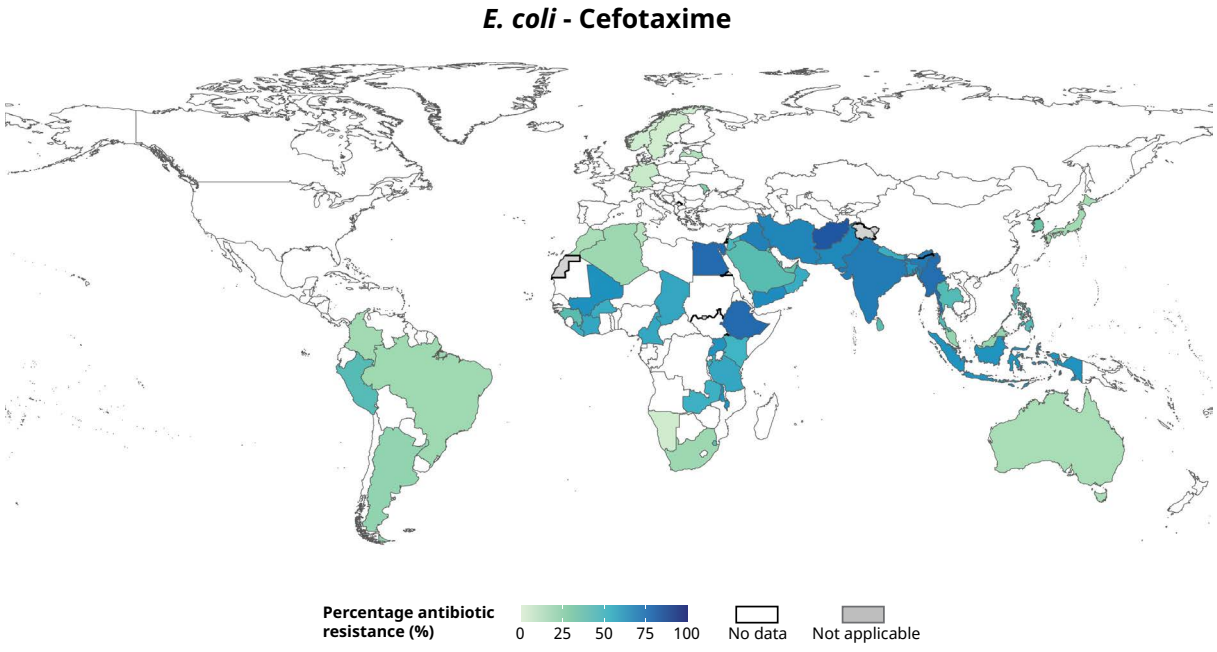
Estimates of national percentage resistance are presented for selected indicator antibiotics in Fig. 3.9 and Annex 6.

3.3.5 Clinical considerations

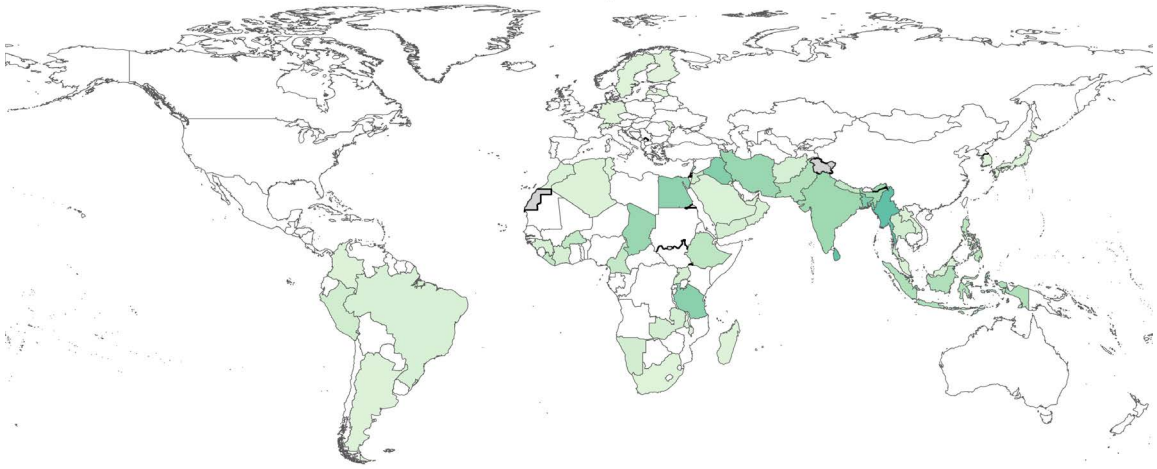
The data on resistance to antibiotics used for urinary tract infections in 2023 indicate significant constraints on the efficacy of empirical treatment due to widespread resistance to both "Access" and "Watch" group antibiotics in *E. coli* and *K. pneumoniae*. The levels of resistance to carbapenems in the latter, which is frequently implicated in complicated and health care-associated infections, raise concern about availability of optimal treatment regimens (Box 3.6).

These findings underscore the importance of tailoring treatment approaches according to infection severity and the origin of the infection, whether community- or hospital-acquired. In uncomplicated, community-acquired urinary tract infections, empirical use of "Access" antibiotics may remain appropriate, whereas complicated or health care-associated infections often require broader-spectrum agents, selected according to local resistance patterns.

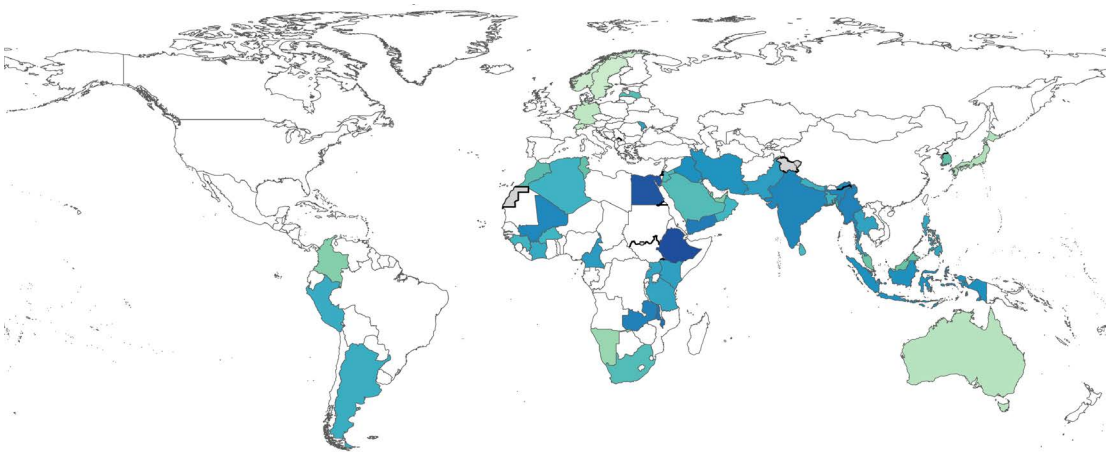
Figure 3.9. National percentage resistance to selected antibiotics in urinary tract infections, 2023



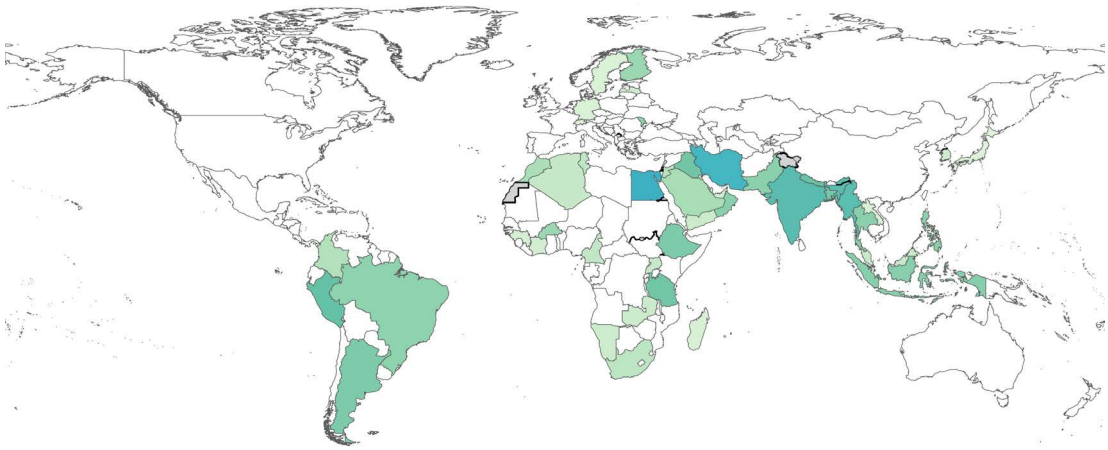
***E. coli* - Imipenem**



***K. pneumoniae* - Cefotaxime**



***K. pneumoniae* - Imipenem**



Adjusted AMR estimates are presented only for countries that reported data for the specific pathogen–antibiotic combination in 2023. Estimates are derived from multilevel Bayesian regression analyses that incorporate data from previous years to improve the accuracy of 2023 estimates. For further details of the method, see Annex 1.

Box 3.6. Management of urinary tract infections: WHO AWaRe principles

Empirical treatment of urinary tract infections is guided by clinical presentation, patient risk factors and local resistance patterns. According to the AWaRe antibiotic book *(1)*, "Access" group antibiotics are preferred for uncomplicated infections because of their narrow spectrum and lower risk of promoting resistance (e.g. nitrofurantoin). Trimethoprim or co-trimoxazole ("Access" group) may be considered only when local resistance levels are known to be low. For complicated urinary tract infections or pyelonephritis, "Watch" group antibiotics such as fluoroquinolones, third-generation cephalosporins or carbapenems may be used. "Reserve" group antibiotics are reserved for infections with multidrug-resistant pathogens or treatment failures, and their use is guided by susceptibility testing and specialist consultation.

3.4 AMR in urogenital gonorrhoeal infections

3.4.1 Epidemiology of urogenital gonorrhoeal infections

N. gonorrhoeae, the bacterial pathogen responsible for gonorrhoea, continues to pose a substantial global health burden. With over 82 million new infections estimated in 2020 among individuals aged 15–49 years *(55)*, the disease remains a major public health concern, particularly in low- and middle-income regions, and is re-emerging in several high-income countries *(55,56)*. Transmission occurs through unprotected sexual contact – vaginal, oral or anal – or perinatally during childbirth.

Clinical presentation differs by sex and site of infection. While urethral infections in men are typically symptomatic, a significant proportion of cervical infections in women are asymptomatic, complicating timely diagnosis and treatment. Extra-genital infections, such as those in the rectum and pharynx, are often silent and are frequently identified in men who have sex with men, although they also occur in women.

The health consequences of untreated gonorrhoea are particularly severe for women. They include pelvic inflammatory disease, infertility, ectopic pregnancy and chronic pelvic pain *(1, 57)*. Moreover, gonorrhoea increases the risk of acquiring HIV *(57)*. The combination of high incidence, diagnostic challenges, asymptomatic carriage and rising levels of resistance to key antibiotics – especially ceftriaxone – makes gonorrhoea a critical, evolving public health challenge.

3.4.2 Regional distribution of urogenital gonorrhoeal infections

In 2023, 21 208 urogenital gonorrhoeal infections were reported globally to GLASS. The Western Pacific Region accounted for the largest share (7834 infections with AST, 36.9%), followed by the European Region (6441, 30.4%), the Region of the Americas (5517, 26.0%), the Eastern Mediterranean Region (628, 3.0%), the African Region (474, 2.2%) and the South-East Asia Region (314, 1.5%). See Table 2.3 in section 2.2.3 for details.

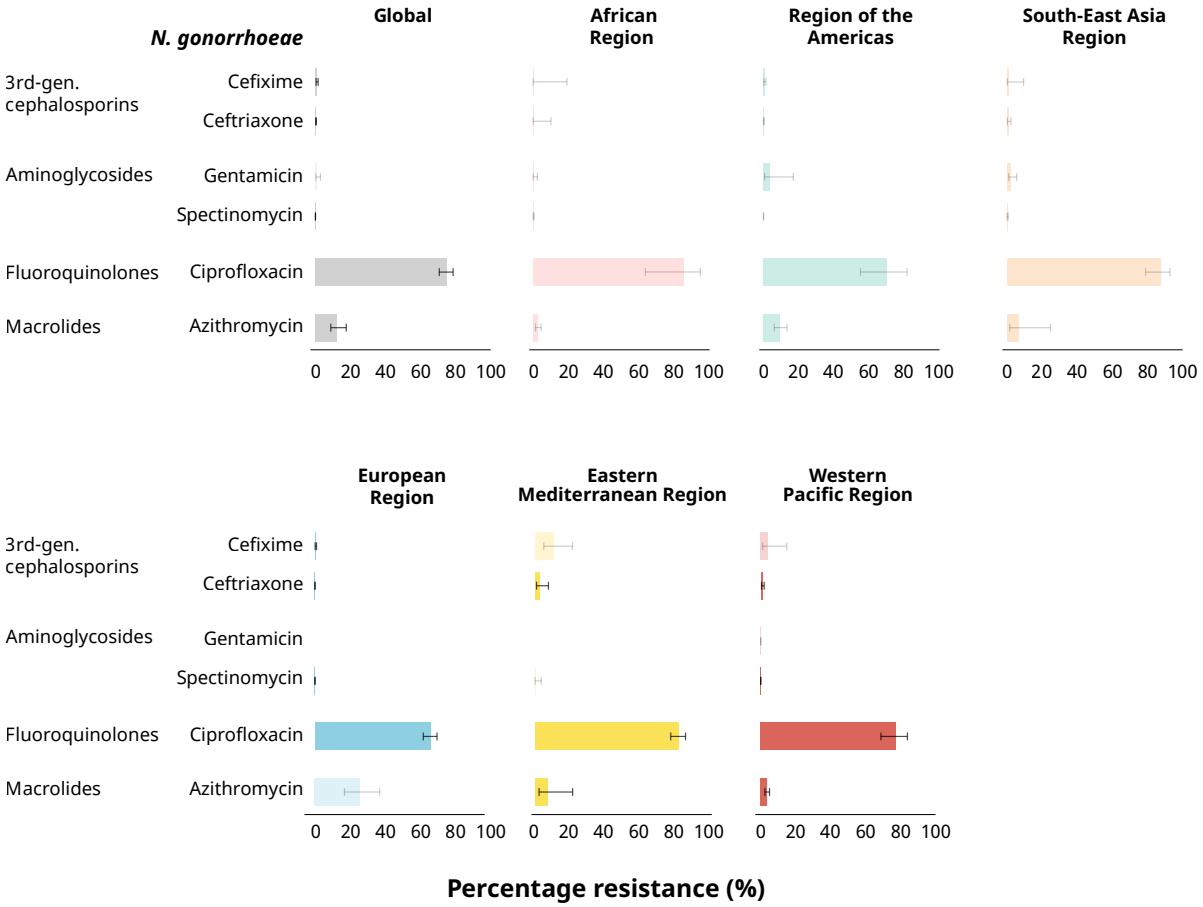
3.4.3 Global estimates of AMR in urogenital gonorrhoeal infections

Very low levels of resistance were detected globally to antibiotics in the "Access" group in 2023 (Fig. 3.10). The use of these antibiotics in routine empirical treatment is limited by clinical and practical constraints and confined to specific, non-routine clinical scenarios *(1)*. The percentage resistance to gentamicin was 0.9% (0.3, 2.9) while that for spectinomycin was 0.0% (0.0, 0.1).

In 2024, ceftriaxone (a "Watch" group antibiotic) was the WHO recommended first-choice therapy for uncomplicated urogenital and anorectal gonorrhoea. Low levels of resistance were reported to both ceftriaxone (0.3% [0.1, 0.6]) and the second-choice cephalosporin, cefixime (0.8% [0.4, 1.6]). The percentage resistance to azithromycin was 12.6% (8.8, 17.7) and that to ciprofloxacin reached 75.0% (70.9, 78.8), which limits use of these antibiotics for empirical use *(57)*.

No antibiotics in the "Reserve" group are currently recommended or routinely used for treating gonorrhoea.

Figure 3.10. Percentage AMR in *N. gonorrhoeae* urogenital infections: global and regional estimates, 2023



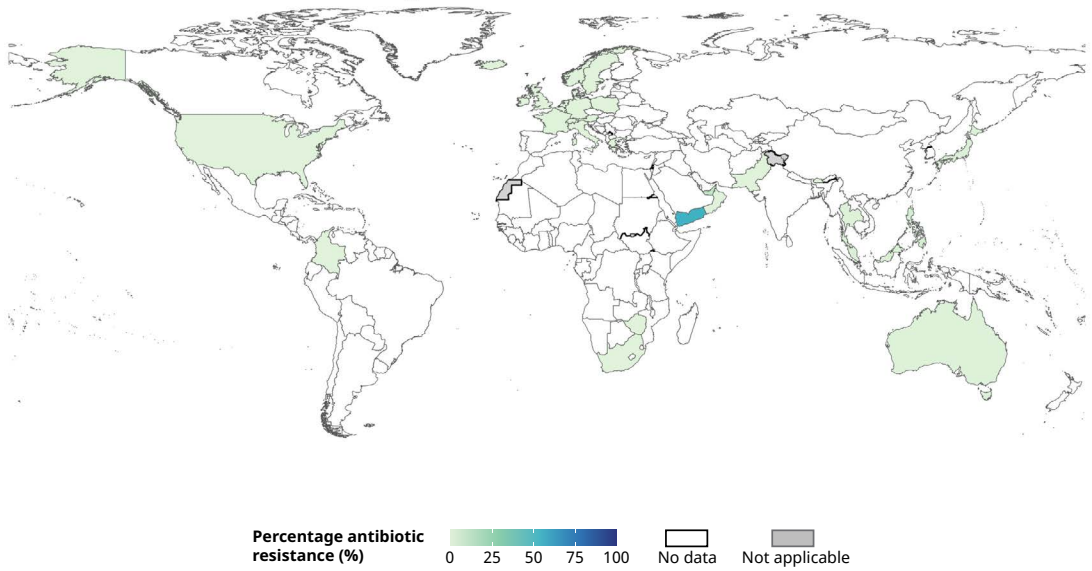
Error bars represent 95% CrI. Semi-transparent bars show pathogen–antibiotic combinations for which global and regional adjusted estimates are based on data from fewer than five countries. These estimates should be interpreted with caution, as they may not reflect the true regional or global situation. For methods, see Annex 1.

3.4.4 Regional and national estimates of AMR in urogenital gonorrhoeal infections

WHO regions differed with respect to the levels of resistance to antibiotics in urogenital gonorrhoeal infections (Fig. 3.10, Annex 5). The Eastern Mediterranean Region showed the highest resistance to third-generation cephalosporins (ceftriaxone: 2.5% [0.8, 7.7]; cefixime: 10.7% [5.0, 21.4]). In contrast, the lowest levels of resistance to ceftriaxone were observed in the European Region (0.1% [0.0, 0.2]) and the Region of the Americas (0.1% [0.0, 0.5]), while resistance to cefixime was lowest in the European Region (0.4% [0.2, 1.0]).

The level of resistance to azithromycin was highest in the European Region (25.8% [17.0, 37.2]) and lowest in the African Region (2.5% [1.3, 4.6]).

Figure 3.11. Percentage antibiotic resistance to ceftriaxone in *N. gonorrhoeae* urogenital infections, 2023



Adjusted AMR estimates are presented only for countries that reported data for the specific pathogen–antibiotic combination in 2023. Estimates are derived from multilevel Bayesian regression analyses that incorporate data from previous years to improve the accuracy of 2023 estimates. For further details of the method, see Annex 1.

Significant gaps remain, however, in global AMR surveillance of gonorrhoeal infections. In 2023, only 22 countries reported azithromycin AST results for at least 10 infection episodes — and just two of these were in the African Region (Fig. 3.11, Annex 5, Annex 6).

Estimates of national percentage resistance to ceftriaxone ("Watch" group) are presented in Fig. 3.11 and Annex 6.

3.4.5 Clinical considerations

For *N. gonorrhoeae*, there are concerns about the eventual development of untreatable gonococcal infections with serious sexual and reproductive health consequences. AMR in *N. gonorrhoeae* has emerged for every drug available for empirical first-line treatment, with the extended-spectrum cephalosporin, ceftriaxone, being the last option in most countries.

Ciprofloxacin is no longer suitable for empirical use due to widespread resistance and should be used only when susceptibility is confirmed *(57)*. Similarly, azithromycin has been removed from routine dual therapy due to increasing resistance and its role in driving macrolide resistance *(57)*. See Box 3.7.

These developments underscore the urgent need for novel antibiotics to cure gonorrhoea and limit the selection of resistance in gonococci *(58,59)*. Increasing resistance and decreasing susceptibility to ceftriaxone and cefixime, especially in the WHO Western Pacific Region as reported by the WHO Global Gonococcal Antimicrobial Surveillance Programme (2019–2022) *(60)* but also in Europe *(56, 61)*, further narrows treatment choices. Strengthening antibiotic stewardship, extending resistance surveillance and accelerating development of alternative treatments are essential to ensure continued effective management of this high-burden infection.

Health-care workers assist patients in a health-care facility in Tunisia

Box 3.7. Management of *N. gonorrhoeae* urogenital infections

Until 2024, the recommended first-choice regimen for uncomplicated urogenital and anorectal gonorrhoea was dual therapy with injectable ceftriaxone ("Watch" group) and oral azithromycin ("Watch" group). This combination was advised for use in settings with no local data on resistance to maximize treatment efficacy and delay development of resistance. The second-choice regimen was oral cefixime ("Watch" group) combined with oral azithromycin. Cefixime is less effective for pharyngeal infections and carries a higher risk of treatment failure. When local data confirm susceptibility, monotherapy with ceftriaxone, cefixime or spectinomycin ("Access" group) were considered, although use of spectinomycin is limited by poor availability and lack of effectiveness against pharyngeal infections. Gentamicin ("Access" group) may be used in combination regimens for patients with cephalosporin allergy, but it is unsuitable as monotherapy. No "Reserve" group antibiotics are currently recommended for routine treatment.

The 2024 WHO guidelines on sexually transmitted infections *(57)* have revised these recommendations. Azithromycin is no longer advised for routine dual therapy because of increasing resistance and its role in driving macrolide resistance. Its use is now limited to syndromic management or co-treatment of other sexually transmitted infections, such as *Chlamydia trachomatis.* Ciprofloxacin is also no longer suitable for empirical use due to widespread resistance and should be considered only when susceptibility is confirmed. As ceftriaxone is now the only reliably effective empirical option in most settings, the lack of alternative treatments is a growing concern.

3.5 Trends in AMR, 2018–2023

Trends in AMR were analysed for 16 infection type–pathogen–antibiotic combinations. Trends were assessed as the population-weighted median annual percentage change in resistance and were considered statistically meaningful only if they were based on data from at least five countries (Annex 1). Overall, the level of resistance increased in 43.8% (7 of 16) of these combinations and remained stable in the remainder (56.3%, 9 of 16) (Table 3.1). Decreasing trends in percentage resistance were only at the regional level (Fig. 3.12).

The European Region had the largest proportion of combinations with increasing resistance (46.7%; 7 of 15 combinations with data from at least five countries), followed by the South-East Asian (41.7%; 5 of 12), Eastern Mediterranean (37.5%; 6 of 16), African (36.4%; 4 of 11), Western Pacific (26.7%; 4 of 15) and Americas (16.7%; 1 of 6) regions. The statistically meaningful trends are marked by an asterisk in Fig. 3.12.

Table 3.1. Global trends in percentage AMR by infection type: median annual change (2018–2023) and 2023 percentage resistance estimates

Infection type	Antibiotic	Trend	Annual % change[a]	Resistance in 2023 (%)[b]	No. of countries[c]
Bloodstream					
Acinetobacter spp.	Imipenem	Increasing	5.3 (2.7, 8.3)	54.3 (49.3, 59.2)	64
E. coli	Cefotaxime	Stable	1.4 (–0.1, 2.9)	39.0 (33.5, 44.8)	64
	3rd-gen. cephalosporins	Stable	1.3 (–0.1, 2.8)	44.8 (39.3, 50.4)	83
	Imipenem	Increasing	12.5 (9.4, 15.8)	2.4 (1.8, 3.3)	74
K. pneumoniae	Cefotaxime	Stable	–0.3 (–2.5, 1.9)	55.2 (48.5, 61.7)	60
	Imipenem	Increasing	15.3 (12.7, 18.1)	16.7 (13.9, 19.9)	73
Salmonella spp.	Ciprofloxacin	Increasing	9.4 (3.9, 15.3)	18.0 (13.9, 22.9)	65
S. aureus	Methicillin resistance	Stable	–2.5 (–4.5, –0.5)	27.1 (23.5, 31.0)	84
S. pneumoniae	Penicillin G	Stable	–11.0 (–26.8, 7.1)	5.2 (3.6, 7.6)	44
Gastrointestinal					
Salmonella spp.	Ciprofloxacin	Increasing	14.0 (6.5, 22.1)	16.3 (13.8, 19.1)	46
Shigella spp.	Ciprofloxacin	Stable	27.2 (–2.1, 66.1)	29.7 (22.9, 37.5)	19
Urinary tract					
E. coli	Cefotaxime	Stable	–0.3 (–1.5, 1.0)	39.8 (33.9, 46.0)	53
	Imipenem	Increasing	8.5 (6.1, 11.0)	2.6 (2.0, 3.5)	55
K. pneumoniae	Cefotaxime	Stable	–0.4 (–2.3, 1.4)	45.5 (38.6, 52.5)	45
	Imipenem	Increasing	12.9 (10.6, 15.1)	10.9 (8.7, 13.6)	51
Urogenital					
N. gonorrhoeae	Ceftriaxone	Stable	–3.2 (–33.9, 39.2)	0.3 (0.1, 0.6)	38

The table reports modelled estimates.

[a] Population-weighted median annual percentage change in AMR between 2018 and 2023, with 95% CrI. A trend was considered statistically meaningful if ≥ 5 countries reported ≥ 10 infections with AST in ≥ 3 years between 2018 and 2023, and if the 95% CrI for the annual percentage change did not overlap with zero, with the lower bound ≥ 1% or the upper bound ≤ –1%.

[b] Estimated percentage AMR in 2023, derived from Bayesian regression models

[c] Number of countries included in the analysis (including three territories and areas).

Bloodstream infections

***Acinetobacter* spp.**

The global level of resistance to imipenem in *Acinetobacter* spp. increased by 5.3% per year (2.7, 8.3), with the largest regional increases in the Eastern Mediterranean Region (11.3% [6.9, 16.1]) and the South-East Asia Region (10.4% [6.5, 14.4]).

E. coli

The global level of resistance to imipenem in *E. coli* bloodstream infections also rose, at a median of 12.5% annually (9.4, 15.8). Resistance increased in all regions (highest in the African Region at 21.0% (10.5, 33.7)) except in the Region of the Americas. There was no overall trend in the level of resistance for third-generation cephalosporins in *E. coli*, although this could hide diverging trends in resistance to individual antibiotics within the class. For instance, resistance to cefotaxime increased in the Eastern Mediterranean Region by 5.8% (2.4, 9.6).

K. pneumoniae

The most pronounced global increase in resistance among bloodstream pathogens was for *K. pneumoniae* to imipenem, which increased by 15.3% per year (12.7, 18.1). The trend was similar in all WHO regions (highest in the African Region at 20.2% [8.2, 34.4]), except in the Region of the Americas. In contrast, no global increasing trend was observed for resistance to cefotaxime in *K. pneumoniae* bloodstream infections.

S. aureus

The level of methicillin resistance in *S. aureus* decreased in the European Region (–7.6% [–9.4, –5.6]), the South-East Asia Region (–6.0% [–9.0, –3.1]) and the Western Pacific Region (–4.5% [–5.8, –3.1]). There was no trend in the other regions, suggesting regional disparities in resistance dynamics and the importance of targeted strategies.

***Salmonella* spp.**

Globally, the percentage resistance to ciprofloxacin in *Salmonella* spp. increased by 9.4% annually (3.9, 15.3), with statistically meaningful rises in the European Region (29.4% [15.8, 44.8]) and the South-East Asia Region (22.3% [17.4, 27.4]).

S. pneumoniae

Overall, there were no global trends over time for resistance to penicillin in *S. pneumoniae*; however, resistance increased annually by 17.5% (3.0, 36.6) in the European Region.

Gastrointestinal infections

Percentage resistance to ciprofloxacin in gastrointestinal *Salmonella* spp. increased globally, with a median annual rise of 14.0% (6.5, 22.1). The European Region observed a sharp increase, of 40.4% per year (35.6, 45.6), pointing to the growing challenge of managing enteric infections. There were no statistically meaningful trends in other regions. For *Shigella* spp., no trends in resistance to ciprofloxacin were identified, although data were limited in most regions.

Urinary tract infections

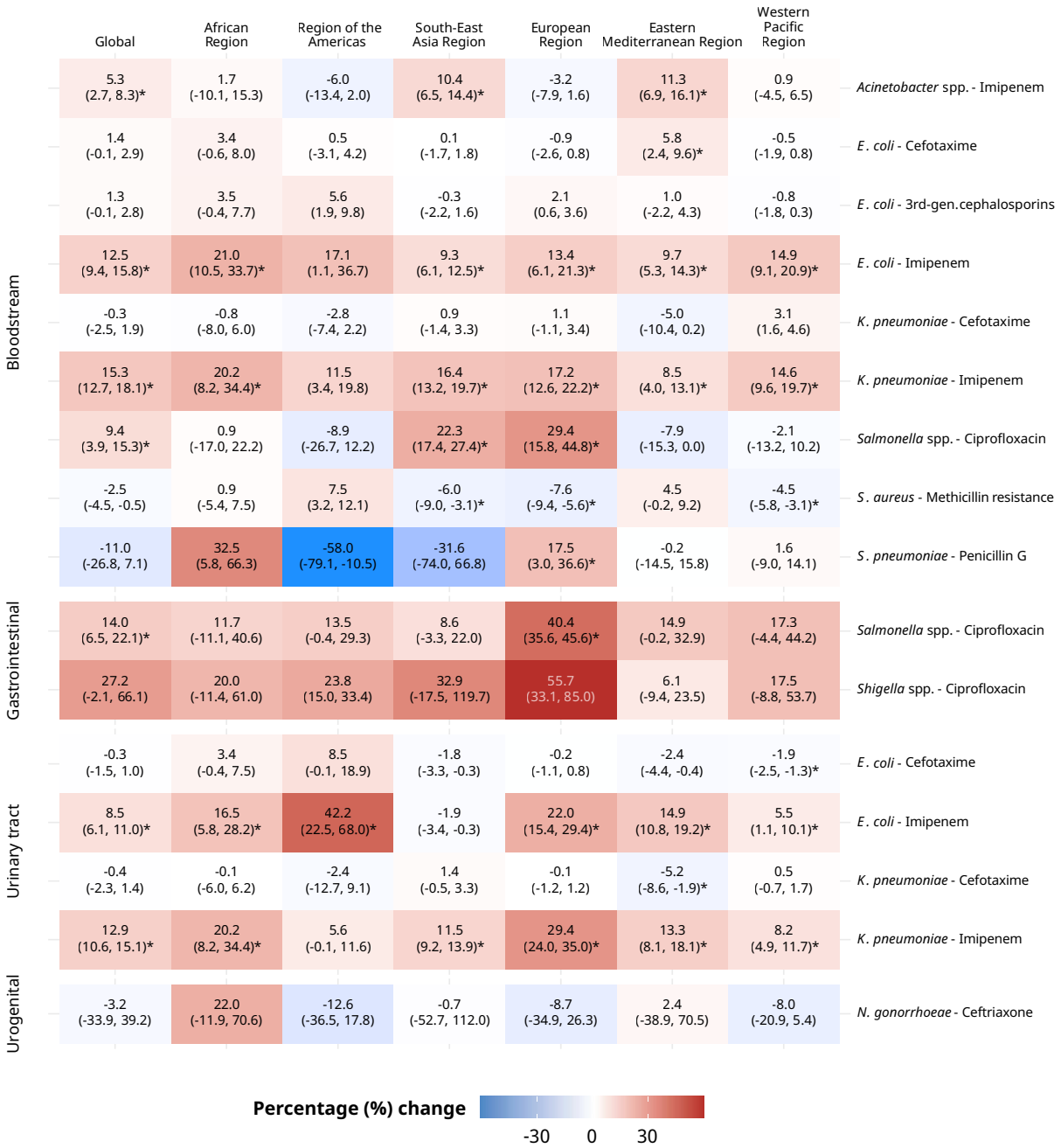
E. coli

The level of resistance to imipenem in *E. coli* increased globally by 8.5% annually (6.1, 11.0), with increases observed in all regions except the South-East Asia Region, which, on the other hand, had the highest baseline resistance level in 2023 (section 3.3.4). The Region of the Americas had the most pronounced rise, at 42.6% (22.5, 68.0). No global trend was identified for cefotaxime resistance in *E. coli*, although the level decreased in the Western Pacific Region by –1.9% (–2.5, –1.3).

K. pneumoniae

The percentage resistance to imipenem in treatment of *K. pneumoniae* urinary tract infections increased globally (12.9% per year [10.6, 15.1]), and in all regions except the Region of the Americas. The European Region showed the highest annual increase, at 29.4% (24.0, 35.0), followed by the African Region (20.2% [8.2, 34.4]). Notably, the level of cefotaxime resistance in *K. pneumoniae* decreased in the Eastern Mediterranean Region by –5.2% annually (–8.6, –1.9).

Figure 3.12. Trends in percentage AMR by WHO region and infection type: median annual change, 2018–2023



The heatmap displays the population-weighted median annual percentage change in AMR between 2018 and 2023, with 95% CrI. Trends are shown globally and by WHO region for selected antibiotics. Colour shading indicates the direction of the trend: blue for decreasing resistance and red for increasing resistance, on a continuous percentage change scale. An asterisk (*) denotes statistically meaningful trends. A trend was considered statistically meaningful if ≥ 5 countries reported ≥ 10 infections with AST in ≥ 3 years between 2018 and 2023 and if the 95% CrI for the annual percentage change did not overlap with zero, with the lower bound ≥ 1% or the upper bound ≤ –1%. For methodological details, see Annex 1. Numbers of countries and infections with AST included in the analyses are summarized in Annex 7.

N. gonorrhoeae urogenital infections

There was no global trend in the percentage resistance to ceftriaxone in *N. gonorrhoeae* urogenital infections; however, limited GLASS data were available globally. The WHO Global Gonococcal Antimicrobial Surveillance Programme (2019–2022) has reported a global increase in resistance or a decrease in susceptibility to ceftriaxone *(60).*

4. Systematic review of AMR in bloodstream, gastrointestinal and urinary tract infections

Eight-year-old Ukasha has drug-resistant typhoid. Typhoid patients normally start to recover in two to three days after taking antibiotics. But Ukasha had been in bed for months with a fever and headache.

Despite global progress in the coverage of data reported to GLASS, important gaps remain. A systematic review of peer-reviewed literature published between 2019 and 2024 was conducted to assess its usefulness as a complementary source of data to routine surveillance. The geographical coverage and consistency of AMR percentage estimates was compared between GLASS and the peer-reviewed literature for GLASS target pathogens for bloodstream (*Acinetobacter* spp., *E. coli*, *K. pneumoniae*, *Salmonella* spp., *S. aureus*, *S. pneumoniae*), gastrointestinal (*Salmonella* spp., *Shigella* spp.) and urinary tract infections (*E. coli, K. pneumoniae*).

Data were extracted on isolates collected between 2018 and 2023, to match the years of GLASS data used to generate AMR percentage estimates. Multilevel random-effects meta-analysis was used to estimate percentage resistance for the systematic review, globally and for each region, for each pathogen–antibiotic combination for which five or more articles were available. Data for each year were aggregated into a single time estimate. The methods are described in Annex 2.

Table 4.1 Numbers of articles and isolates included in the systematic review, by infection type

	Bloodstream [a]		Gastrointestinal [a]		Urinary tract [a]	
	No. of articles	No. of isolates	No. of articles	No. of isolates	No. of articles	No. of isolates
Year of isolate collection						
2018	120 (31.3)	81 711 (33.6)	128 (26.4)	360 704 (35.9)	11 (20.8)	1079 (20.0)
2019	117 (30.5)	90 334 (37.2)	133 (27.5)	333 603 (33.2)	20 (37.7)	2127 (39.3)
2020	71 (18.5)	42 560 (17.5)	94 (19.4)	143 926 (14.3)	13 (24.5)	1296 (24.0)
2021	50 (13.1)	18 627 (7.7)	73 (15.1)	92 516 (9.2)	5 (9.4)	610 (11.3)
2022	23 (6.0)	9497 (3.9)	47 (9.7)	73 287 (7.3)	2 (3.8)	296 (5.5)
2023	1 (0.3)	100 (0.0)	8 (1.7)	1614 (0.2)	0 (0.0)	0 (0.0)
Health-care level						
Tertiary	244 (80.0)	115 356 (47.5)	310 (71.3)	409 848 (40.8)	28 (59.6)	3482 (64.4)
Secondary	20 (6.6)	2707 (1.1)	32 (7.4)	8042 (0.8)	7 (14.9)	531 (9.8)
Primary	3 (1.0)	309 (0.1)	38 (8.7)	16 197 (1.6)	4 (8.5)	512 (9.5)
Unknown	38 (12.6)	124 457 (51.3)	54 (12.4)	571 563 (56.8)	6 (12.8)	883 (16.3)
WHO region						
African Region	30 (9.6)	5463 (2.2)	43 (9.6)	22 534 (2.2)	6 (13.0)	468 (8.7)
Region of the Americas	30 (9.6)	49 871 (20.5)	21 (4.7)	221 338 (22.0)	3 (6.5)	770 (14.2)
South-East Asia Region	70 (22.4)	17 209 (7.1)	94 (20.9)	22 947 (2.3)	6 (13.0)	638 (11.8)
European Region	48 (15.4)	35 530 (14.6)	77 (17.1)	379 376 (37.7)	2 (4.3)	107 (2.0)
Eastern Mediterranean Region	53 (17.0)	22 067 (9.1)	188 (41.9)	46 335 (4.6)	16 (34.8)	2330 (43.1)
Western Pacific Region	80 (25.6)	112 689 (46.4)	25 (5.6)	313 120 (31.1)	12 (26.1)	1095 (20.2)
Total	**305**	**242 829**	**45**	**5 408**	**434**	**1 005 650**

[a] The proportion of the total number of articles and isolates in different years, by health-care level and by WHO region is given in parentheses. Some articles are counted in more than one category.

4.1 Geographical coverage of data

A total of 11 469 unique records were identified for the three infection types (7254 for bloodstream infections, 573 for gastrointestinal infections and 3642 for urinary tract infections). Of these, 805 articles were included for analysis (305 for bloodstream infections with 242 829 isolates, 45 for gastrointestinal infections with 5408 isolates, and 434 for urinary tract infections with 1 005 650 isolates). The numbers of articles and bacterial isolates included in the systematic review, categorized by year of isolate collection, health-care level, geographical origin and infection type, are listed in Table 4.1. The findings of the systematic review are compared with data reported to GLASS in Table 4.2.

Table 4.2. Characteristics of data from the systematic review and from GLASS

		Systematic review [a]	GLASS [b]
Bloodstream infections			
No. of isolates		242 829	4 217 990
No. of countries		61	104
No. and percentage of articles by level of care			
	Primary	3 (1.0)	–
	Secondary	20 (6.6)	–
	Tertiary	244 (80)	–
	Unknown	38 (12.6)	–
Percentage resistance [c]			
Acinetobacter spp.	Gentamicin	67.3 (55.2, 78.3)	44.6 (40.2, 49.1)
	Imipenem	71.0 (57.1, 83.1)	54.3 (49.3, 59.2)
E. coli	Cefotaxime	44.7 (32.6, 57.1)	39.0 (33.5, 44.8)
	Ceftriaxone	53.6 (43.8, 63.3)	43.5 (37.6, 49.6)
	Imipenem	4.8 (1.8, 9.0)	2.4 (1.8, 3.3)
	Ciprofloxacin	47.6 (41.1, 54.2)	40.7 (36.5, 45.1)
K. pneumoniae	Cefotaxime	68.1 (55.1, 79.7)	55.2 (48.5, 61.7)
	Ceftriaxone	69.2 (57.8, 79.6)	60.4 (54.0, 66.5)
	Imipenem	25.8 (18.6, 33.9)	16.7 (13.9, 19.9)
Salmonella spp.	Ceftriaxone	6.5 (0.1, 21.5)	5.3 (3.0, 9.2)
	Ciprofloxacin	38.1 (19.0, 59.4)	18.0 (13.9, 22.9)
S. aureus	Methicillin resistance [d]	47.1 (38.8, 55.5)	27.1 (23.5, 31.0)
S. pneumonia	Penicillin G	12.0 (4.0, 23.3)	5.2 (3.6, 7.6)
Gastrointestinal infections			
No. of isolates		5408	168 212
No. of countries		18	77
No. and percentage of articles by level of care			
	Primary	38 (8.7)	–
	Secondary	32 (7.4)	–
	Tertiary	310 (71.3)	–
	Unknown	54 (12.4)	–
Percentage resistance [c]			
Salmonella spp.	Ceftriaxone	14.3 (2.2, 34.2)	6.0 (4.0, 8.7)
	Imipenem	2.7 (0.0, 18.5)	0.4 (0.2, 0.9)
	Ciprofloxacin	25.2 (10.4, 43.8)	16.3 (13.8, 19.1)
Shigella spp.	Ceftriaxone	30.9 (11.7, 54.5)	27.8 (19.1, 38.5)
	Ciprofloxacin	36.9 (18.6, 57.3)	29.7 (22.9, 37.5)
	Azithromycin	33.3 (19.7, 48.6)	25.6 (14.2, 41.5)

		Systematic review [a]	GLASS [b]
Urinary tract infections			
No. of isolates		1 005 650	19 361 029
No. of countries		74	78
No. and percentage of articles by level of care			
	Primary	4 (8.5)	–
	Secondary	7 (14.9)	–
	Tertiary	28 (59.6)	–
	Unknown	6 (12.8)	–
Percentage resistance [c]			
E. coli	Cefotaxime	41.5 (32.5, 50.7)	39.8 (33.9, 46.0)
	Ceftriaxone	39.8 (32.2, 47.6)	41.0 (34.7, 47.5)
	Imipenem	4.4 (2.3, 7.0)	2.6 (2.0, 3.5)
	Ciprofloxacin	39.8 (34.7, 45.0)	39.4 (35.1, 43.8)
	Co–trimoxazole	49.1 (43.3, 54.8)	53.2 (49.1, 57.2)
K. pneumoniae	Imipenem	14.8 (8.7, 22.2)	10.9 (8.7, 13.6)
	Cefotaxime	55.9 (40.9, 70.4)	45.5 (38.6, 52.5)
	Ceftriaxone	51.0 (39.6, 62.4)	47.3 (41.0, 53.7)
	Ciprofloxacin	50.9 (43.7, 58.1)	39.1 (33.9, 44.6)
	Co-trimoxazole	52.4 (43.5, 61.3)	46.4 (41.5, 51.4)

[a] Numbers and percentages are for the 2018-2023 period. Percentage resistance estimates for all 62 pathogen–antibiotic combinations included in the systematic review are provided in Annex 9.

[b] Numbers of isolates and countries are cumulative for the 2016-2023 period. Percentage resistance estimates are for 2023. Estimates for all 93 pathogen–antibiotic combinations included in GLASS are provided in Annex 5.

[c] 95% confidence intervals (CI) are given in parentheses for the systematic review; 95% credible intervals (CrI) are given in parentheses for GLASS.

[d] Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

When compared to GLASS data for 2023, the systematic review bridged some geographical gaps (Fig. 4.1). For bloodstream infections, data were available from both sources for 47 countries, only from GLASS for 51 and only from the systematic review for 14. For gastrointestinal infections, data were available from both sources for 9 countries, only from GLASS for 66 and only from the systematic review for 9. For urinary tract infections, data were available from both sources for 41 countries, only from GLASS for 31 and only from the systematic review for 33.

Most of the articles were from only a few countries (Fig. 4.2). Nearly half (41%) of the articles on bloodstream infections originated from three countries (China, India and Pakistan) of the 61 countries with data. Similarly, 42% of the articles on gastrointestinal infections were from two countries (China and Islamic Republic of Iran) of the 18 countries with data, while 42% of those on urinary tract infection were from four countries (India, Iraq, Islamic Republic of Iran and Pakistan) of the 74 countries with data. Few data were available from the African Region for all three infection types.

GLASS provides large-scale, standardized data from AMR surveillance aiming for national representativeness, as an essential baseline for global monitoring and policy. The systematic review, although limited by smaller sample sizes and geographical distribution, provides valuable insights into AMR in hospital settings to guide targeted clinical and intervention strategies. These two data sources complement each other: GLASS defines the “macro” picture of AMR prevalence, while the review identifies “micro” hotspots.

Figure 4.1. Data availability from the systematic review and GLASS, by infection type

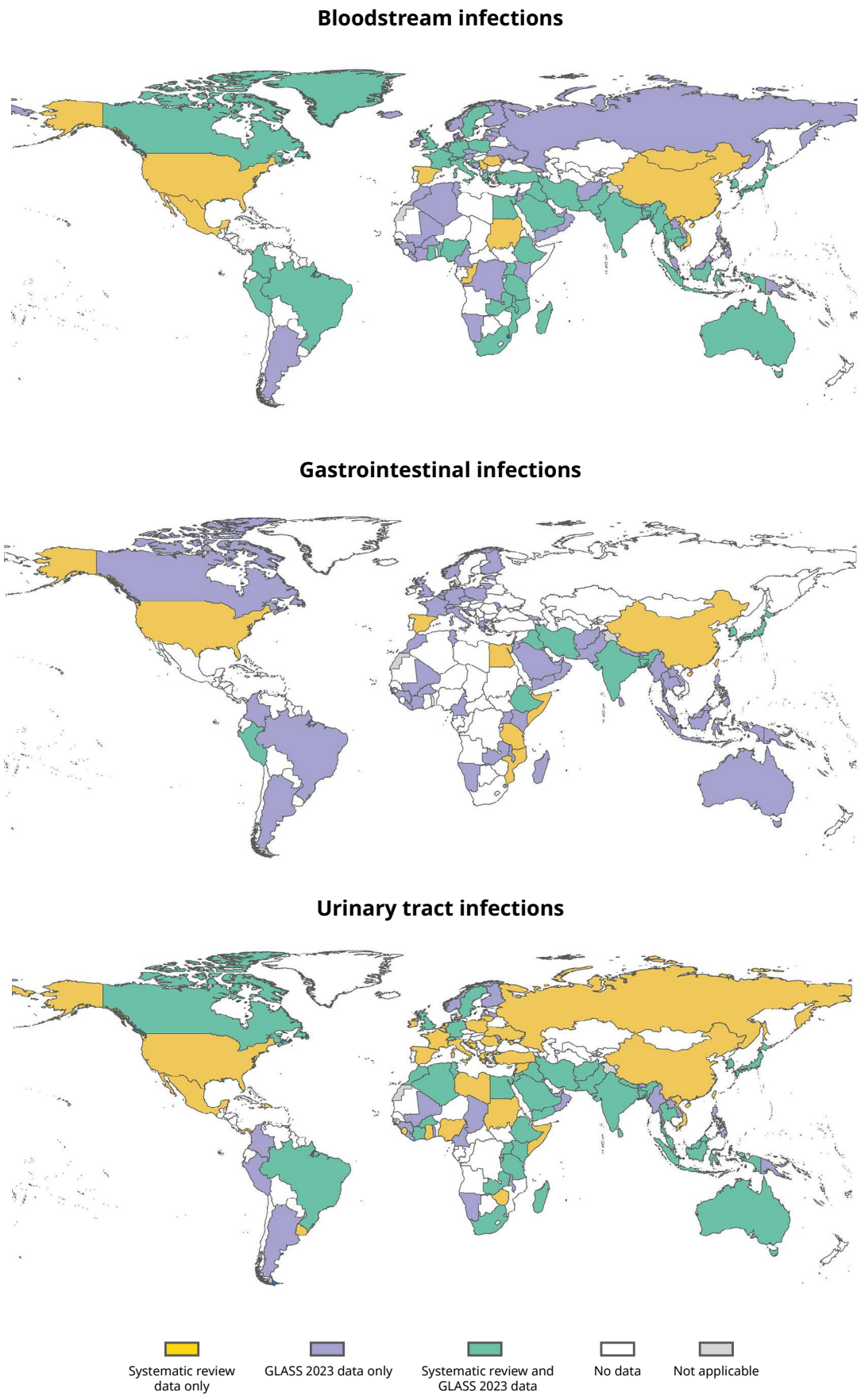
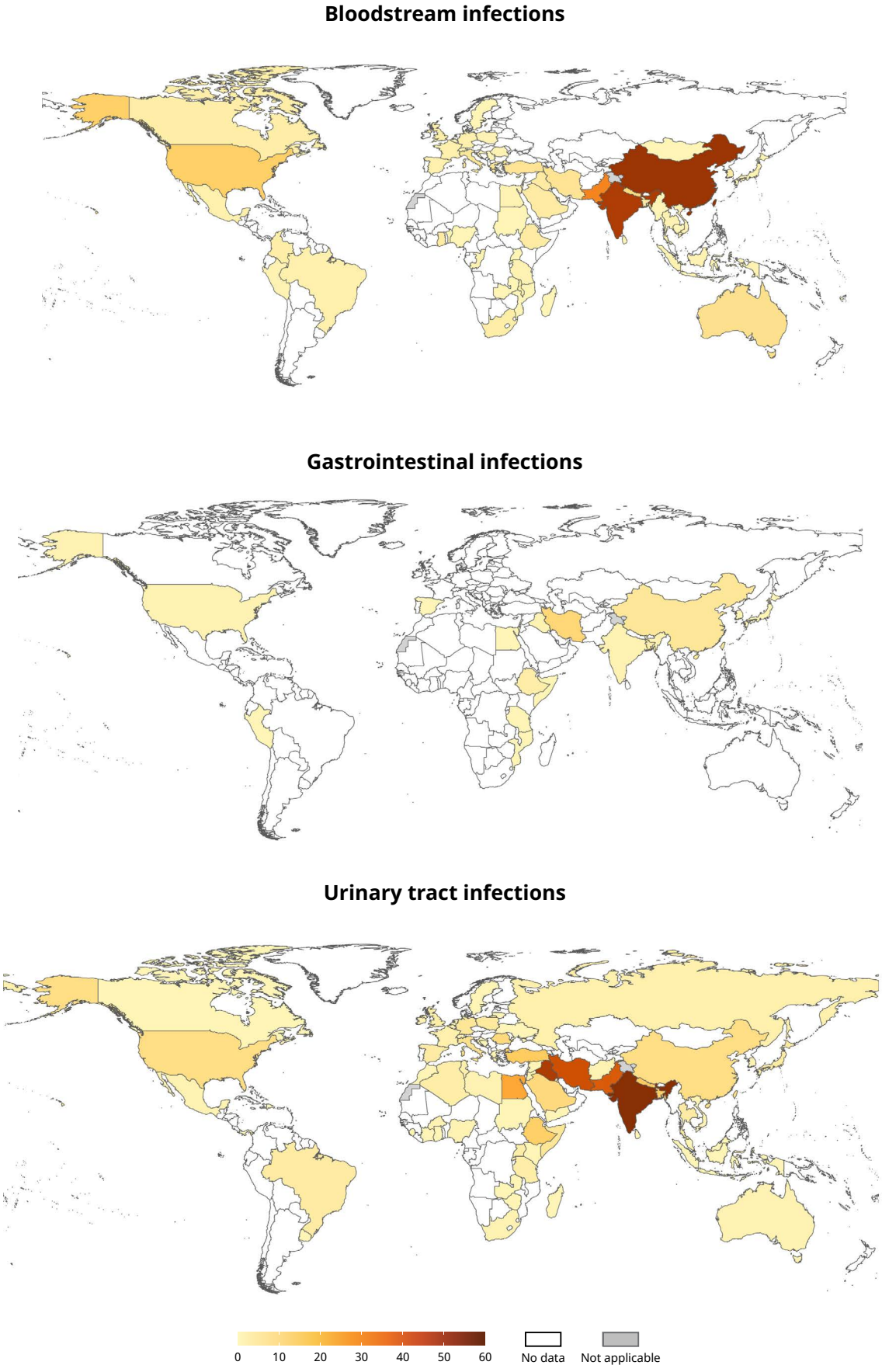


Figure 4.2. Number of articles from the systematic review



To strengthen AMR diagnostics and standardize antimicrobial susceptibility testing, WHO in Afghanistan held a 4-day training at the Central Public Health Laboratories, Kabul for 60 lab technicians from 28 WHO-supported laboratories and Essential Public Health Services.

4.2 AMR in bloodstream infections

The systematic review in bloodstream infections shows broadly similar patterns to the GLASS data presented in Chapter 3, although the resistance percentages tended to be higher in the review (Table 4.2, Fig. 4.3, Annex 9). The observed differences may reflect sampling bias in the data used by both GLASS and the systematic review. The majority (80%) of articles on bloodstream infections in the systematic review were from tertiary care facilities (Table 4.1), where more severe drug-resistant cases may be overrepresented. Additionally, the number of isolates available for each pathogen–antibiotic combination was often three or four times lower in the systematic review (Annex 9) than in GLASS data (Annex 5).

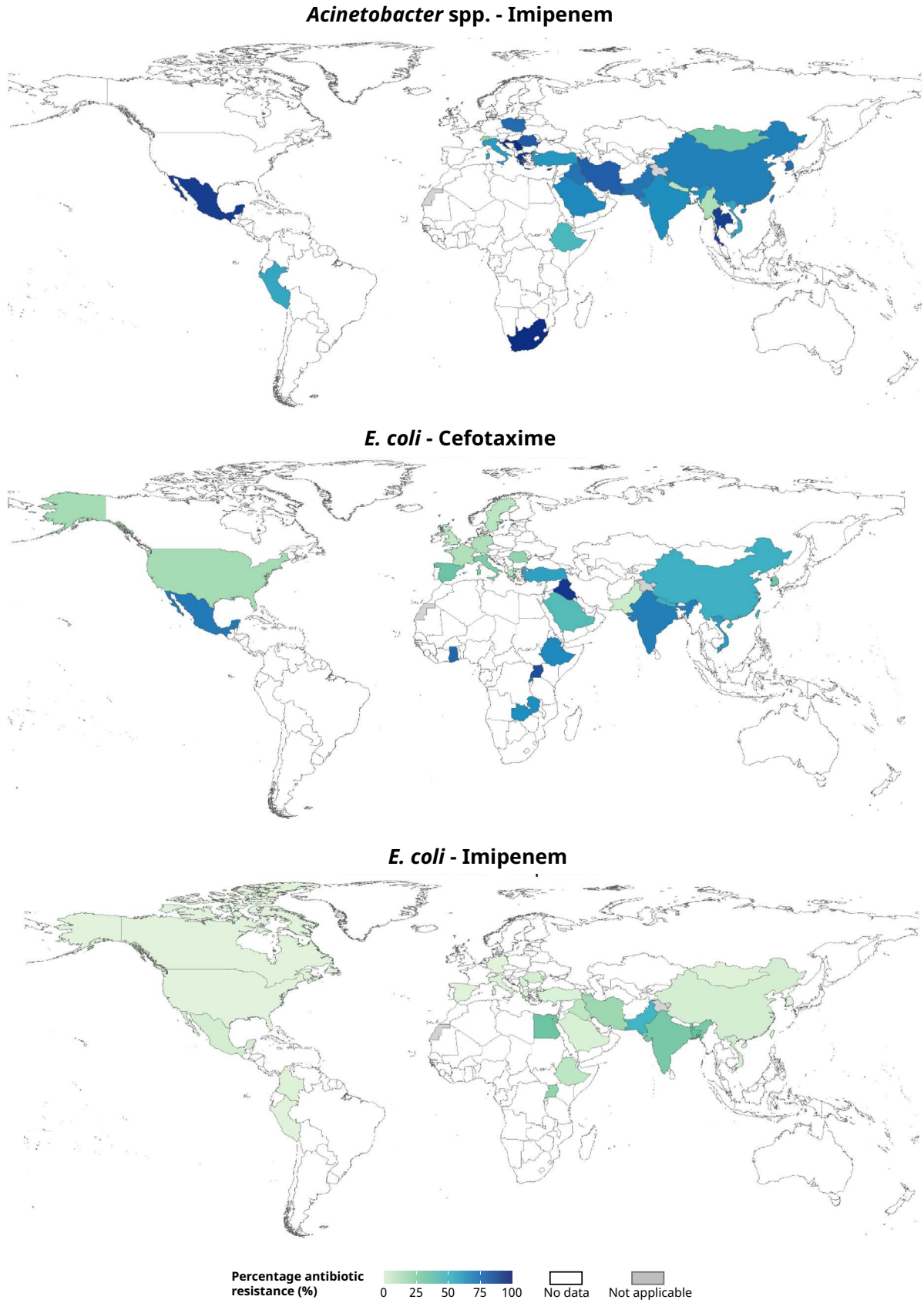
More than two thirds of *Acinetobacter* spp. were resistant to the "Access" group antibiotic gentamicin, at 67.3% (95% CI: 55.2, 78.3), as compared with less than half in GLASS, 44.6% (95% CrI: 40.2, 49.1). The levels of resistance to carbapenems were higher, the highest being imipenem at 71.0% (57.1, 83.1), as compared with 54.3% (49.3, 59.2) reported in GLASS.

For *E. coli*, the levels of resistance were high to third-generation cephalosporins, in the "Watch" group. More than half were resistant to ceftriaxone, at 53.6% (43.8, 63.3) (as compared with 43.5% [37.6, 49.6] in GLASS). Resistance to ciprofloxacin was slightly lower, at 47.6% (41.1, 54.2) (as compared with 40.7% [36.5, 45.1] in GLASS). As in the GLASS data, resistance to carbapenems was low, with imipenem resistance at 4.8% (1.8, 9.0) compared to 2.4% (1.8, 3.3) reported in GLASS. More than half of *K. pneumoniae* bloodstream isolates were resistant to third-generation cephalosporins, with ceftriaxone resistance at 69.2% (57.8, 79.6), compared with 60.4% (54.0, 66.5) in GLASS.

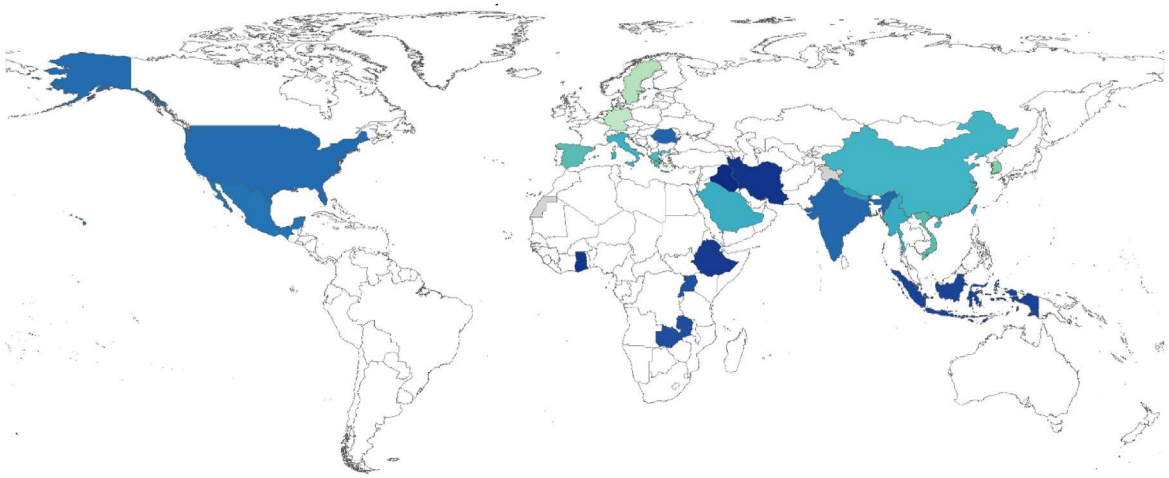
In GLASS data, antibiotics for the management of *Salmonella* spp. remained effective. In the systematic review, the levels of resistance to third-generation cephalosporins were low, at 6.5% (0.1, 21.5) for ceftriaxone (as compared with 5.3% [3.0, 9.2] in GLASS). Resistance to fluoroquinolones was high, at 38.1% (19.0, 59.4) for ciprofloxacin (as compared with 18.0% [13.9, 22.9] in GLASS).

Nearly half of the isolates of *S. aureus* were resistant to methicillin, at 47.1% (38.8, 55.5), which was higher than in GLASS (27.1%; 23.5, 31.0). Fewer data on *S. pneumoniae* were available in the systematic review than in GLASS. Resistance to penicillin was higher in the review, at 12.0% (4.0, 23.3) compared to 5.2% (3.6, 7.6) in GLASS.

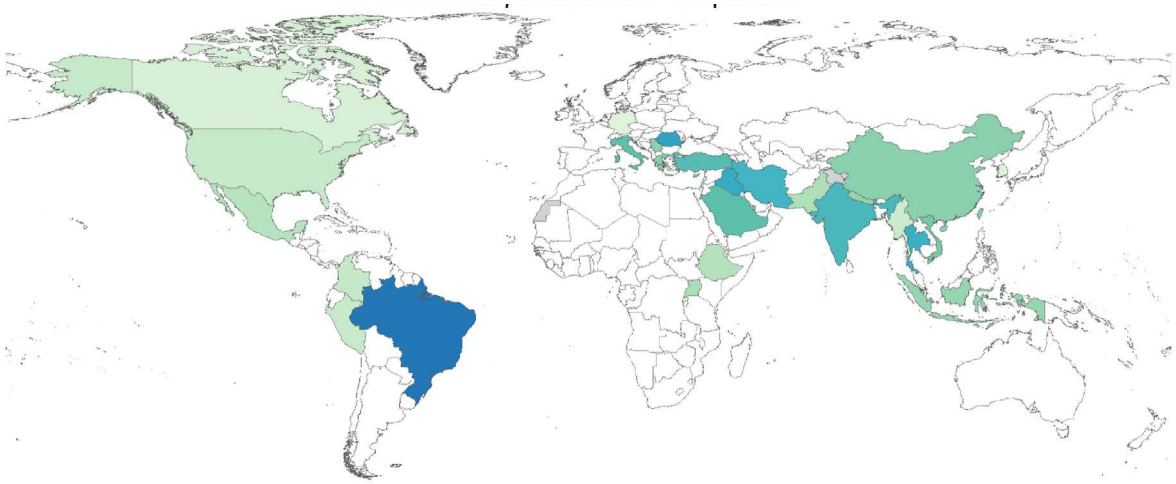
Figure 4.3. Percentage resistance to selected antibiotics in bloodstream infections in the systematic review



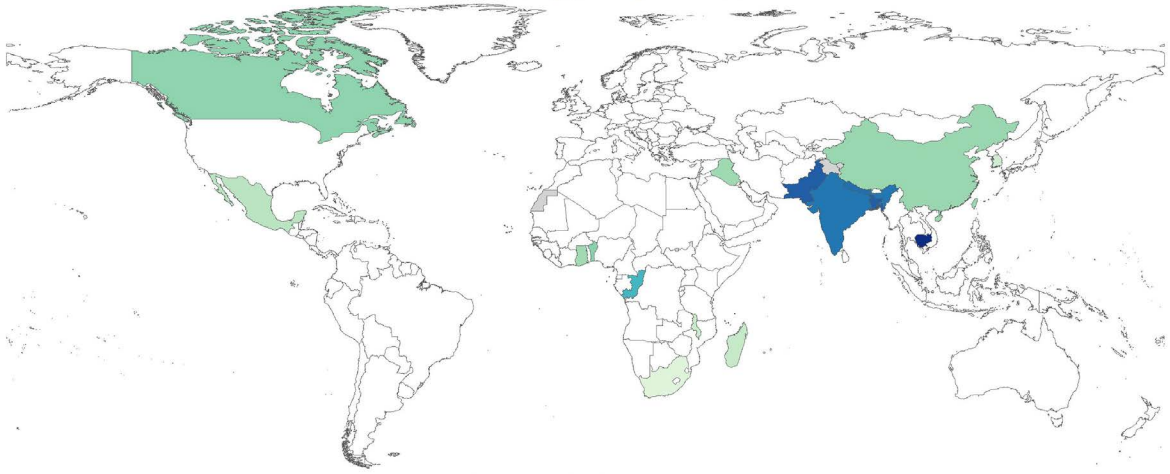
***K. pneumoniae* - Cefotaxime**

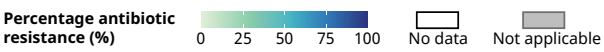


***K. pneumoniae* - Imipenem**

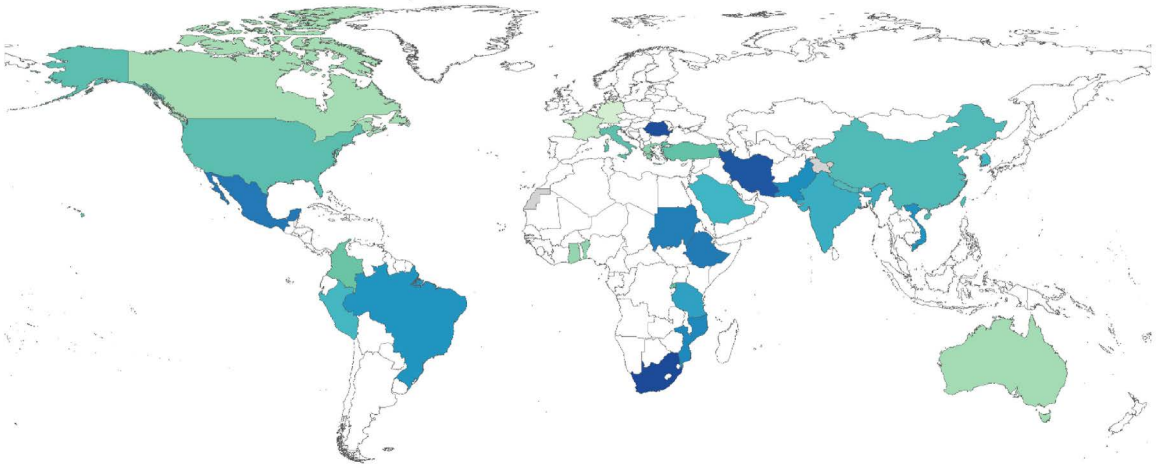


***Salmonella* spp. - Ciprofloxacin**

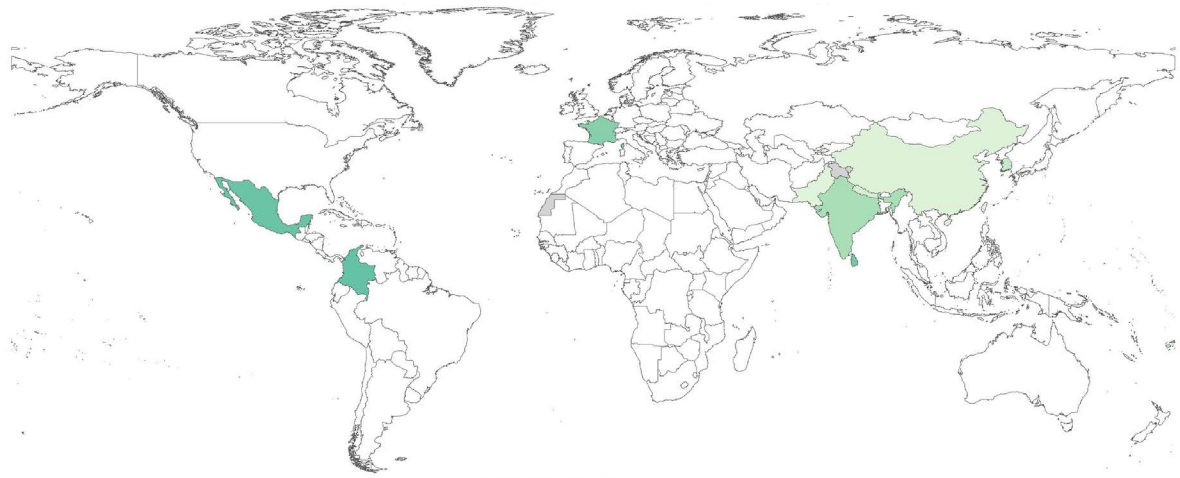




***S. aureus* - Methicillin resistance**



***S. pneumoniae* - Penicillin G**



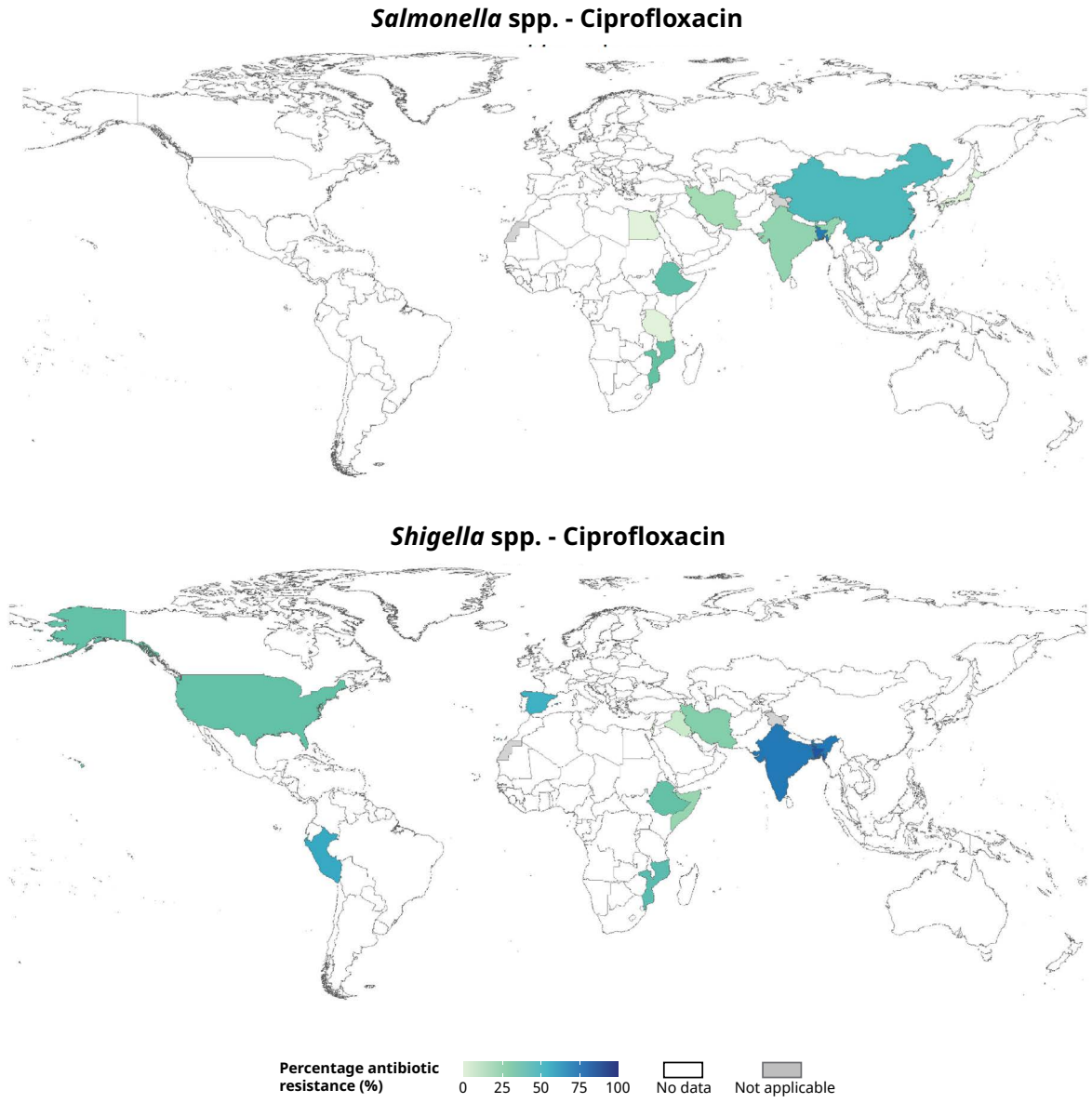
4.3 AMR in gastrointestinal infections

The levels of AMR in gastrointestinal tract infections showed broadly similar patterns to those reported in GLASS (Table 4.2, Fig. 4.4, Annex 9). More than two thirds of the articles (71.3%) were from tertiary care facilities (Table 4.1). While the number of isolates of *Shigella* spp. was similar to that in GLASS (Annex 5), the data for *Salmonella* spp. included 20–30 times fewer isolates for certain antibiotics, which may limit their representativeness (Annex 9).

Third-generation cephalosporins remained largely effective against *Salmonella* spp., with the level of resistance to ceftriaxone at 14.3% (2.2, 34.2) (as compared with GLASS at 6.0% [4.0, 8.7]). Resistance to carbapenems was lower, at 2.7% (0.0, 18.5) for imipenem (as compared with GLASS at 0.4% [0.2, 0.9]), while that to fluoroquinolones was higher, at 25.2% (10.4, 43.8) for ciprofloxacin (as compared with GLASS at 16.3% [13.8, 19.1]).

The levels of resistance to third-generation cephalosporins were higher in *Shigella* spp., that for ceftriaxone being 30.9% (11.7, 54.5) (as compared with GLASS at 27.8% [19.1, 38.5]). Resistance to fluoroquinolones was also high, that to ciprofloxacin being 36.9% (18.6, 57.3) (as compared with GLASS at 29.7% [22.9, 37.5]). Similarly, resistance to azithromycin reached 33.3% (19.7, 48.6) (as compared with GLASS at 25.6% [14.2, 41.5]).

Figure 4.4. Percentage resistance in gastrointestinal infections in the systematic review



4.4 AMR in urinary tract infections

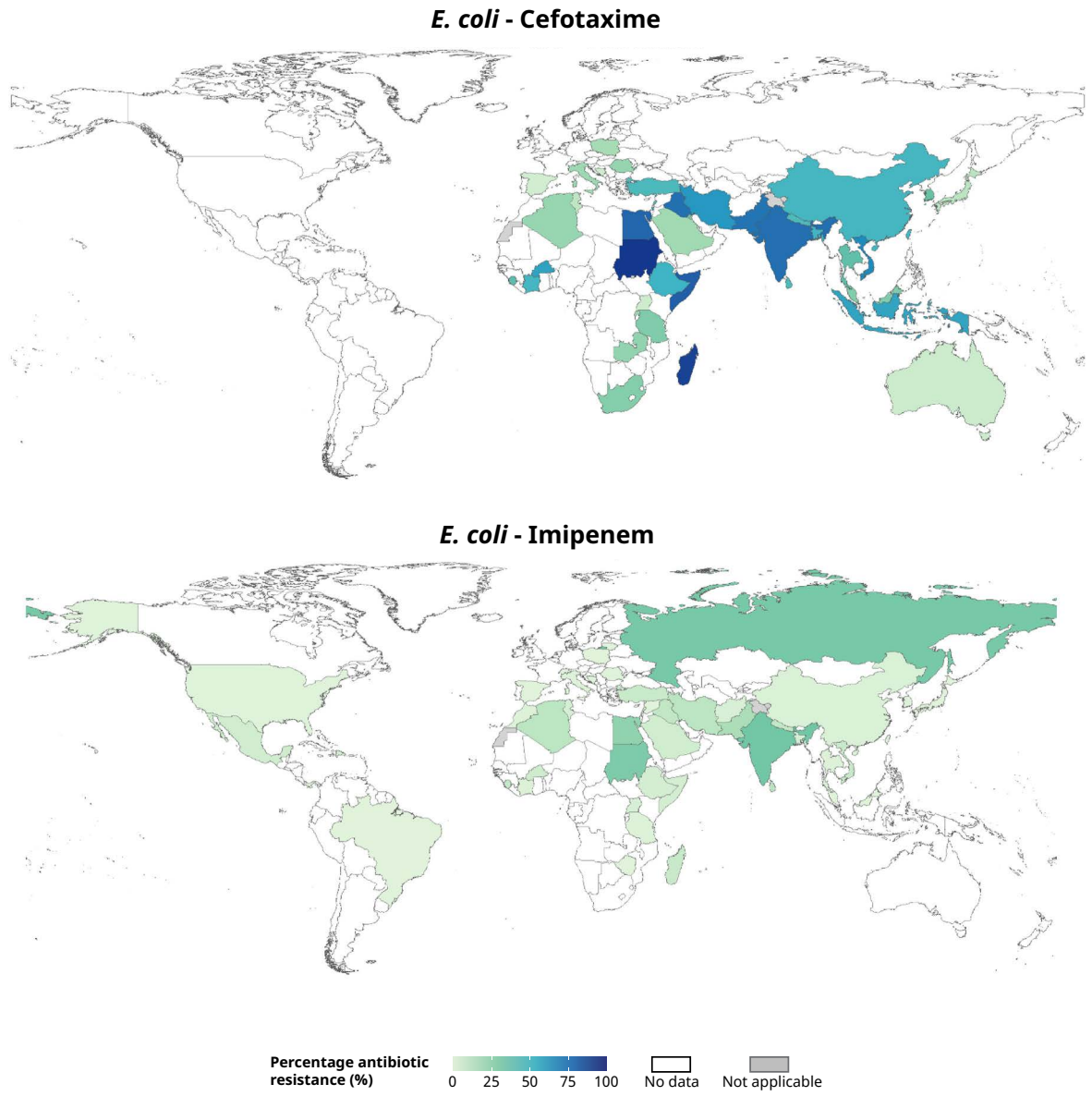
The levels of AMR in urinary tract infections from the systematic review showed broadly similar patterns to those from GLASS (Table 4.2, Fig. 4.5, Annex 9). Over half of the articles (59.6%) referred to tertiary care facilities; however, there were fewer articles than for bloodstream and gastrointestinal infections (Table 4.1). As for other infection types, the number of isolates available for each pathogen–antibiotic combination was often 20 times fewer in the systematic review than in GLASS data (Annexes 5 and 9).

For *E. coli,* resistance to "Access" and "Watch" agents was substantial. Resistance to co-trimoxazole reached 49.1% (43.3, 54.8), compared to 53.2% (49.1, 57.2) in GLASS. Resistance to ceftriaxone, a third-generation cephalosporin, was 39.8% (32.2, 47.6) compared to 41.0% (34.7, 47.5) in GLASS. Resistance to fluoroquinolones was also substantial, with ciprofloxacin at 39.8% (34.7, 45.0) in the systematic review compared to 39.4% (35.1, 43.8)

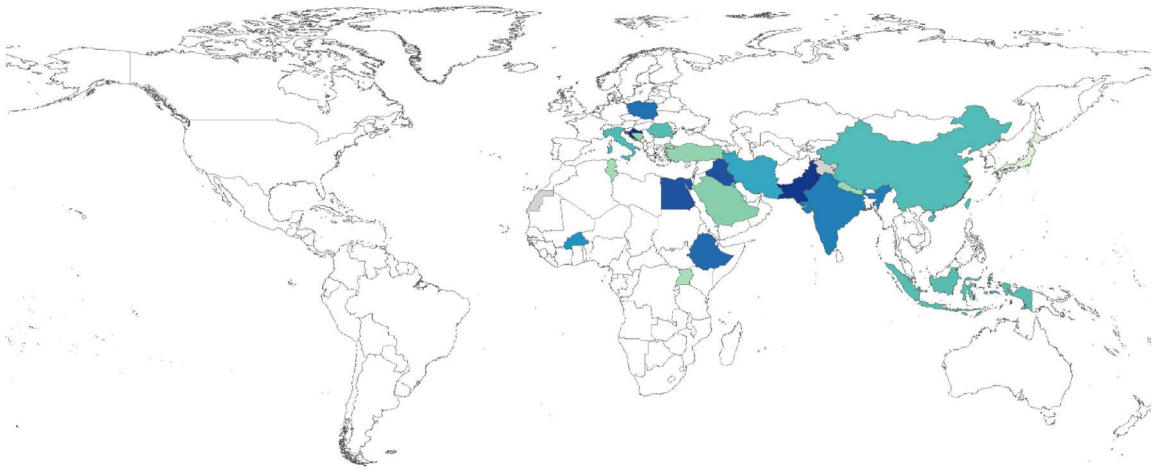
in GLASS. Resistance to carbapenems remained contained, the highest being imipenem at 4.4% (2.3, 7.0) compared to 2.6% (2.0, 3.5) in GLASS.

For *K. pneumoniae*, resistance to co-trimoxazole reached 52.4% (43.5, 61.3) in the systematic review, compared to 46.4% (41.5, 51.4) in GLASS. Resistance to third-generation cephalosporins was similarly elevated, with ceftriaxone at 51.0% (39.6, 62.4) compared to 47.3% (41.0, 53.7) in GLASS. Ciprofloxacin resistance was 50.9% (43.7, 58.1), higher than in GLASS at 39.1% (33.9, 44.6). As in GLASS data, resistance to carbapenems was higher in *K. pneumoniae* than in *E. coli*, with imipenem at 14.8% (8.7, 22.2) compared to 10.9% (8.7, 13.6) in GLASS.

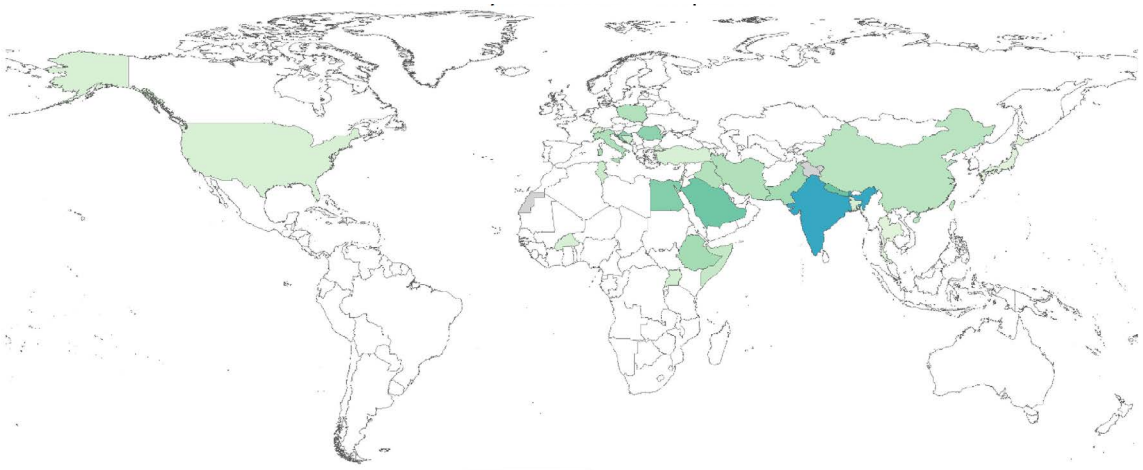
Figure 4.5. Percentage resistance to selected antibiotics in urinary tract infections in the systematic review

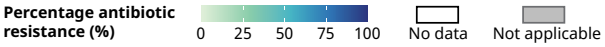


***K. pneumoniae* - Cefotaxime**



***K. pneumoniae* - Imipenem**





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Annex 1.

Methods for statistical analysis of AMR surveillance data

Surveillance coverage over time

Bayesian hierarchical regression models with negative binomial likelihood were used to assess progress in national surveillance coverage of confirmed bacterial infections with AST results for 2016–2023. Surveillance coverage was defined as the number of episodes of infection with AST results per million population. Models were first fitted to the total number of infections per million for each of the four infections separately. They were then fitted to disaggregated data by infection type and pathogen–antibiotic class combinations reported to GLASS. The latter provided insights into the pathogen and resistance profiles responsible for the observed changes in reporting trends for the four infection types.

$$y_i \sim \text{Negative Binomial}\ (\mu_i, \phi)$$

$$\log(\mu_i) = \log(\text{pop}_i) + \beta_0 + \beta_t . \text{Year}_t + u_i + u_{t(i)}$$

The models accounted for overdispersion (ϕ) and included an offset term for population size (Pop) in country *i* and year *t* to adjust for national differences in population size and were hence fitted to reporting rates. The models included country-specific baseline levels of infection episodes with AST per million and temporal trends by including normally distributed random intercepts and random slopes for time. The time variable (year) was centred to improve model convergence.

Model fitting

Models were implemented in the *brms* package in R version 4.1.1 with 2000 posterior draws after a burn-in period of 2000 iterations and four chains. Weakly informative priors were used for all parameters (see published model code). The R^ statistic (< 1.01) and visual inspection of MCMC trace plots were used to assess convergence, and the absence of divergent transitions post-burn-in was checked. Comparative model fit was evaluated for both linear and nonlinear temporal trends and with additional regional-level random effects in an improvement to model fit. Model performance was assessed by "leave-one-out" (LOO) cross-validation. The best-fitting model was selected according to differences in the LOO information criterion (looic). Model improvement was determined against a threshold of looicdiff > 4. The model code is available at https://github.com/GlobalAMR/GLASS-2025.

Estimation of annual relative progress in surveillance coverage, 2016–2023

Regional and global trends in surveillance coverage between 2016 and 2023 were presented as annual percentage changes in the number of infections with AST per million population for all infection types and for 18 commonly tested infection type–pathogen–antibiotic class combinations. The global fixed effect estimates of the temporal slope and the corresponding country-level random slopes were extracted from the posterior distributions of the linear trend terms in the best-fitting Bayesian models. These were combined to generate country-specific trends in surveillance coverage over time. To obtain regional and global estimates, the country-level slopes were combined with a population-weighted median and weights proportional to each country's population in the corresponding year. This approach ensured that countries with larger populations contributed more to the aggregated estimates. Models were fitted to data from all countries, but estimates of national annual percentage change in each region were based on extracted country-level slopes for countries for which infections with AST results had been reported for at least 3 years.

The final regional and global trends were summarized as posterior medians with associated 95% and 80% CrI. Estimates were reported as representative for regions when there were data from at least five countries and globally when there were data from 10 or more countries according to the actual number of countries that had reported at least 3 years of data between 2016 and 2023.

Data completeness: scoring and definition of variables

We assessed the completeness of national data reported to GLASS for 2023 in four domains: first, implementation of the national AMR surveillance system; second, surveillance coverage; third, AMR data by infection type; and fourth, linkage of laboratory data to epidemiological, demographic and clinical variables.

A structured scoring system was applied to each domain with predefined rules for data completeness. Scoring was done in a traffic light system: green (2) = complete data available; orange (1) = partial data available; red (0) = no data. An overall score for completeness was calculated for each country and categorized into: high (> 80%), medium–high (>50–80%), medium–low (>20–50%) and low (≤ 20%). Further information is provided in Box 2.1 in section 2.3 of the main text. For the AMR surveillance coverage domain, data were considered missing if they did not pass pre-defined quality criteria (Table A1.1).

Estimation of national and regional percentage resistance by infection type, pathogen and antibiotic combinations in 2023 and over time

Bayesian hierarchical regression models with a binomial likelihood were fitted to reported confirmed bacterial infections with AST results (from here onwards referred to as infections) to estimate the percentage resistance in 2023 and over time at country level. For each infection type, pathogen and antibiotic combination, the percentage resistance was defined as the number of infections with a resistant or non-susceptible AST result (R) of the total number of infections with interpretable AST results (including intermediate results). Data were stratified by age, sex, year and country, and models were fitted separately for all infection type–pathogen–antibiotic combinations. Data reported in the first 2 years of GLASS (2016 and 2017) were excluded, as enrolment was only beginning, and the data were sparse. All reported infections from location-years in which there were more than 10 isolates per infection type–pathogen–antibiotic combination were included in the analyses.

Model specification

The statistical models were used to estimate country-specific resistance in percentages for 2023 and temporal trends for 2018–2023. The models included random intercepts and slopes to account for country-level heterogeneity in

Table A1.1. Surveillance coverage domain: quality criteria

National health infrastructure and service utilization			
Total health facilities	a	Total health facilities	a > b & count of a > 10
	b	Health facilities with inpatient beds	b < a
Inpatient services utilization per calendar year	c	Inpatient admissions	c > b & count of c > 1% of country population
	d	Inpatient days of care	d > c
Outpatient services utilization per calendar year	e	Outpatient consultations	e ≥ 2x c
Health infrastructure and utilization in facilities reporting to GLASS			
Total health facilities	f	Total health facilities	f ≤ a
	g	Health facilities with inpatient beds	g ≤ b & 7 ≤ f
Inpatient services utilization per calendar year	h	Inpatient admissions	h > g & h ≤ c
	i	Inpatient days of care	i > h & i ≤ d
Outpatient services utilization per calendar year	j	Outpatient consultations	j ≤ e

baseline resistance and linear time trends and also included random effects for age groups, assuming normally distributed variation. The time variable (year) was centred to improve model convergence. Biological sex was modelled as a fixed effect, with no consideration of interactions between sex and country. Given the relatively short time for which data were available and after visual inspection, a linear trend over time was considered appropriate. To account for potential bias arising from differences in surveillance coverage among countries, the age- and sex-standardized number of infections with AST per million population was included as a quadratic term to the linear predictor. This adjustment was motivated by the hypothesis that low testing coverage may reflect overrepresentation of samples taken after treatment failure (that is, of severe cases that had probably been exposed to antibiotics previously), leading to overestimation of resistance prevalence *(1).*

$$y_i \sim \text{Binomial}\ (n_i, p_i)$$
$$\text{logit}\ (pi) = \beta_0 + \beta_t\ .\ Year_t + \beta_a .\ Age_a + \beta_g .\ Sex_g + \beta_{ag} .$$
$$(\text{Age}_a\ .\ \text{Sex}_g) + \beta_1\ .\ \text{testcov}_i + \beta_2\ .$$
$$\text{testcov}_i^2 + u_i + u_{t(i)} + u_{a(i)}$$

For countries in which age- and sex-standardized surveillance coverage was below the empirical threshold identified for each infection type–pathogen–antibiotic class combination (see Accounting for surveillance coverage bias, below), where the threshold represented the minimum level of coverage above which resistance estimates are considered less prone to surveillance bias, posterior resistance estimates were adjusted by predicting values under a scenario in which standardized surveillance coverage met the threshold level for that infection type–pathogen–antibiotic class. The aims of this adjustment were to mitigate bias associated with selective testing in low-coverage settings *(1)* and to improve comparability among countries by harmonizing coverage levels to a minimum standard (see Accounting for surveillance coverage bias, below). For countries with surveillance coverage above the surveillance coverage limit, age- and sex-standardized surveillance coverage was maintained at the reported value.

Model fitting

All Bayesian models were implemented in the *brms* package in R version 4.4.1 with 4000 posterior draws after a burn-in period of 2000 iterations and four chains. Weakly informative priors were used for all parameters. The R^ statistic (< 1.01) and MCMC rank histogram plots were used to assess convergence, and the absence of divergent transitions post-burn-in was checked. For each infection type–pathogen–antibiotic combination, model fit was compared between model specifications that included or excluded age, sex and their interaction (i.e. four models with different covariate combinations were fitted per infection type–pathogen–antibiotic combination). Addition of a random effect to account for clustering of resistance percentages at WHO regional level was evaluated but did not improve model fit.

Prior and posterior predictive checks were performed with data on *E. coli* and ceftriaxone to evaluate model specification and the informativeness of the data. Prior predictive checks involved simulating outcomes from the model with prior distributions alone to assess their plausibility, while posterior predictive checks involved simulating data from the posterior distribution to assess model fit and the extent to which the observed data updated assumed priors when they were weakly informative. Model performance was assessed by LOO cross-validation. The best-fitting model was selected according to differences in the LOO information criterion (looic). Model support was determined with a threshold of $\text{looic}_{\text{diff}} > 4$.

Estimation of resistance by country

Estimation of age- and sex-weighted resistance percentages for each country and year were calculated by aggregating posterior predicted resistance values across demographic strata, weighted by the proportion of the national population in each age and sex group. This approach ensured that national estimates of the prevalence of resistance reflected underlying population structures and enabled demographically standardized comparisons. It should be noted that use of national age–sex population weights to standardize resistance

estimates may not reflect the true distribution of infection in the population structure. For example, if a pathogen disproportionately affects older women in country X but this group makes up a small proportion of the country's general population, the weighted national estimate of resistance may be an underestimate of the true burden of resistance in the infected population. Infection-specific demographic weights could not be applied at this stage because of limited data on the age and sex distribution of infected individuals in some countries. This could be explored in future iterations.

National estimates are presented for 16 priority infection type–pathogen–antibiotic combinations for countries that reported data for 2023. Final estimates are reported as the median and 95% CrI of the posterior predictions.

Estimation of resistance regionally and globally, 2018–2023

Regional and global estimates for 2023 and absolute changes in percentage resistance between 2018 and 2023 were calculated by applying inverse-variance weighting to logit-transformed age- and sex-weighted estimates of national resistance. This meta-analytical approach accounted for uncertainty in each country's resistance estimate and heterogeneity between countries, with the between-country variance component (τ^2) estimated with Cochran's Q statistic. Yearly regional estimates were calculated only for countries that had reported data for at least 3 years and/or reported data in 2023. The resulting regional estimates represent posterior medians with 95% CrI, giving greater weight to countries with higher surveillance coverage and more precise estimates. Estimates for regions were considered representative when there 10 or more infections with AST from at least five countries, and global estimates were considered representative when data were available from 10 or more countries. Regional and global AMR trends for 2018–2023 were based on the number of countries that had reported at least 3 years of data. Sensitivity analyses with population-based weighting yielded comparable results, supporting the robustness of the findings.

Estimation of annual relative change in resistance, 2018–2023

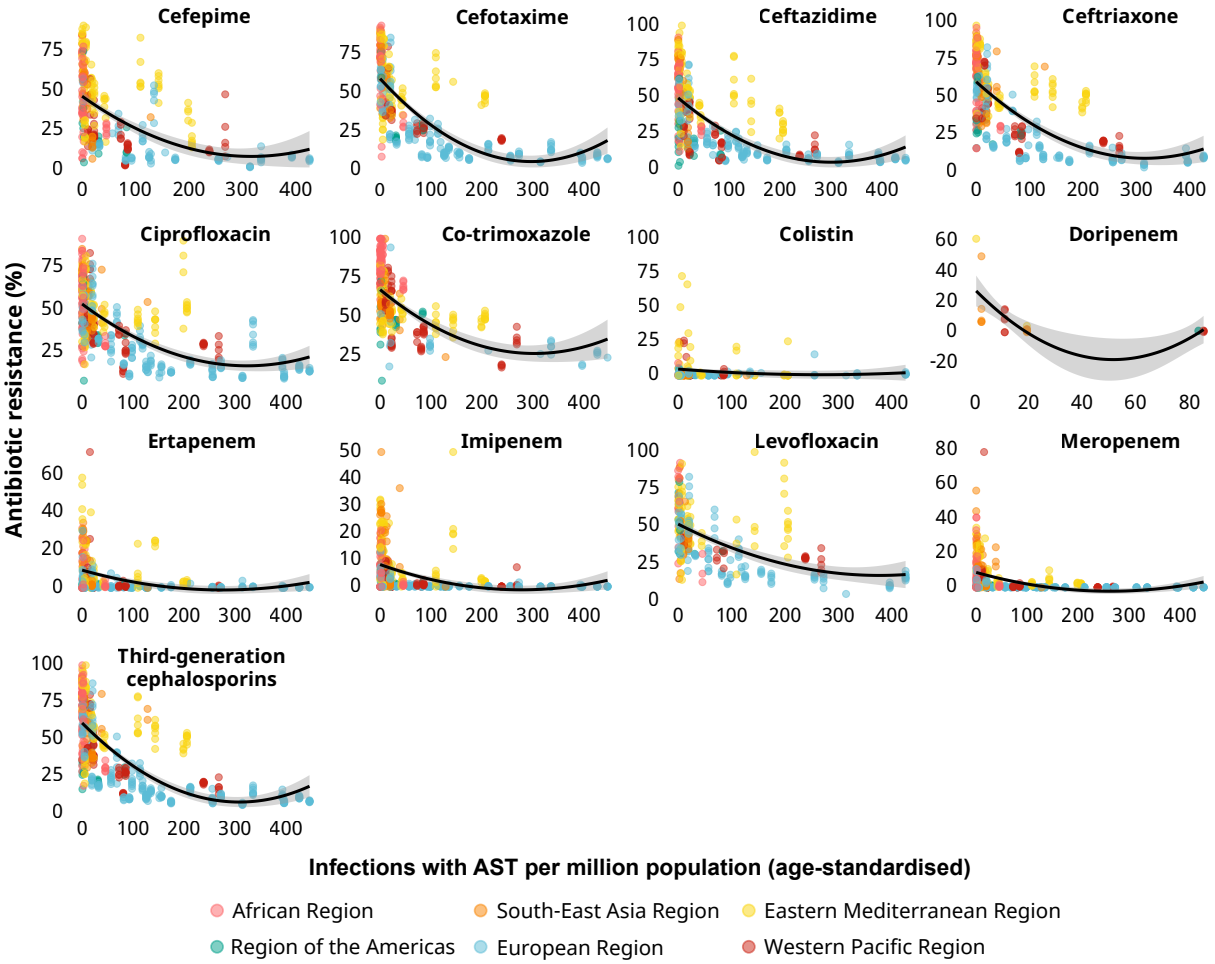
Regional and global trends in resistance between 2018 and 2023 are presented as annual relative changes in percentage resistance for 16 priority infection type–pathogen–antibiotic–infection combinations. Country-level temporal slopes were extracted from the posterior distributions of linear trend terms in the best-fitting Bayesian models to quantify annual percentage changes in resistance. To obtain regional and global estimates, country-level slopes were combined in a population-weighted median, with weights proportional to each country's population in the corresponding year. This approach ensured that countries with larger populations contributed more to the aggregated estimates. Final regional and global trends were summarized as posterior distribution medians, with associated 95% CrI. Regional trends were based on countries for which data were available for at least 3 years.

Accounting for surveillance coverage bias

To address potential biases arising from differences in surveillance coverage among countries, the relation between the number of reported age-standardized infections per million and percentage resistance was assessed. Surveillance coverage was age standardized to account for variation in surveillance coverage between countries due to demographic differences. Antibiotics were grouped into clinically relevant classes (e.g. third-generation cephalosporins, carbapenems, fluoroquinolones) according to the types of pathogen and infection. Age-specific isolate counts for each of these combinations were merged with United Nations population estimates *(2)* and standardized by the direct method, applying a global reference age distribution to facilitate cross-country comparisons. Several inclusion criteria were assessed to define age groups that resulted in a minimum level of data completeness per age stratum, including thresholds for the number of isolates per age group (e.g. ≥ 10) and the proportion of missing data on age (e.g. < 15%). See published model code at https://github.com/GlobalAMR/GLASS-2025 . Fig. A1.1 shows the results for *E. coli.*

Frequentist binomial regression models (fitted with the *glm* package in R) assuming a quadratic relation were then fitted to evaluate

Figure A1.1. Relations between reported numbers of age-standardized *E. coli* bloodstream infections per million population and percentage AMR



the association between age-standardized testing rates and percentage resistance. Model residuals were inspected to identify empirical thresholds above which residual variance stabilized, as a marker of lower limit surveillance coverage. These thresholds were subsequently used to adjust resistance estimates for countries with surveillance coverage below the identified lower limit. It should be noted that this approach assumes that variation in surveillance coverage primarily reflects differences in testing practices and reporting rather than true differences in infection incidence. Countries with fewer infections per million generally reported higher crude levels of resistance, which we interpreted to be due primarily to surveillance bias, as limited testing may disproportionately capture more severe cases or those with previous exposure to antibiotics. It is acknowledged, however, that, in some settings, the higher estimates may reflect genuinely elevated AMR levels. While our adjustment method with empirically derived coverage thresholds helped to mitigate surveillance-related bias, it may also have attenuated some true variation in AMR. In future iterations, we could further explore methods to distinguish true differences in AMR between low- and high testing settings from bias introduced by limited sampling.

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Annex 2.

Methods for systematic review of percentage AMR from peer-reviewed literature

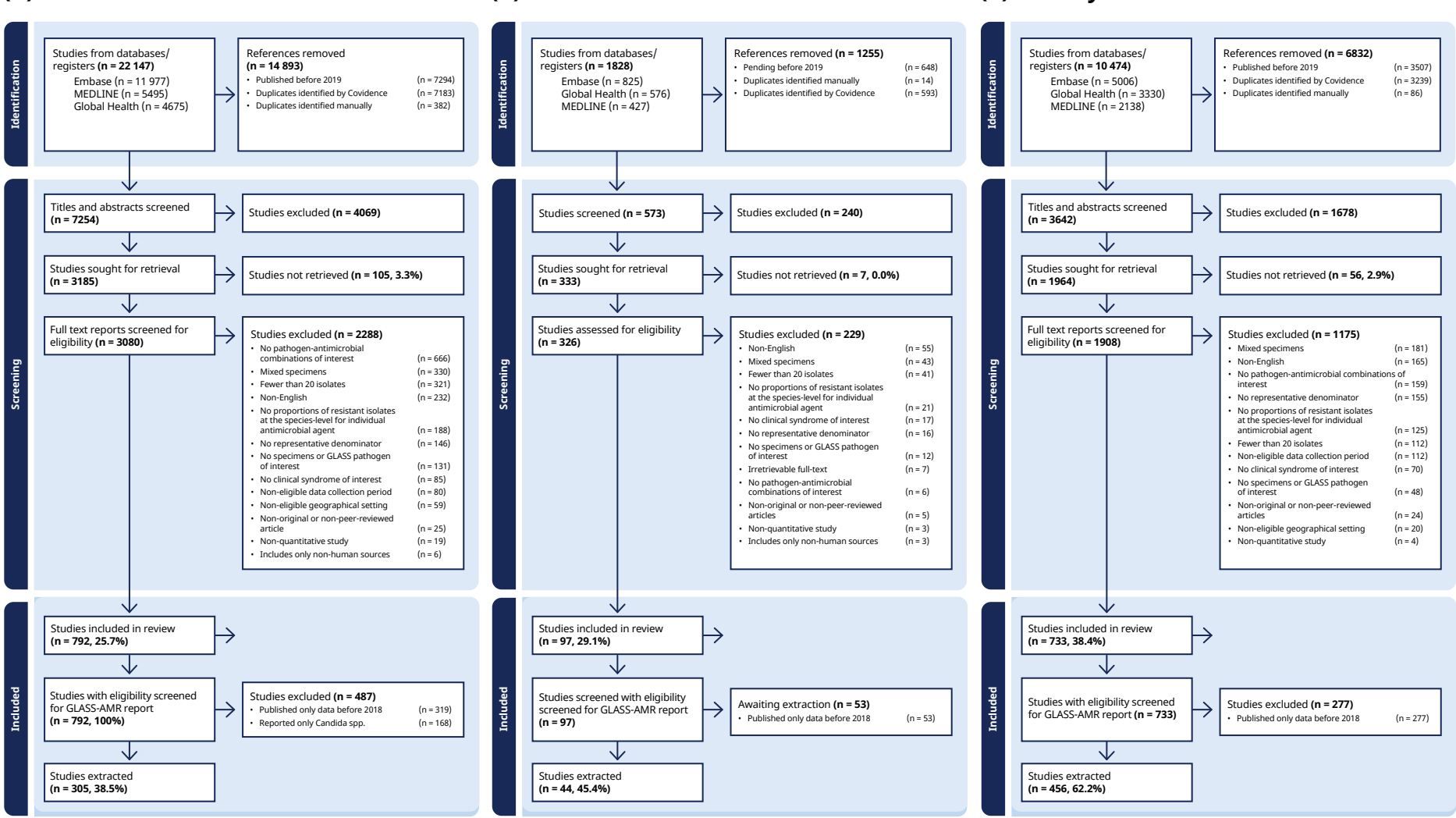
The systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) 2020 guidelines (Fig A2.1). The protocol was registered in PROSPERO (CRD42024549753) *(1).*

Search strategy and selection criteria

Three international bibliographic databases were searched (MEDLINE, Embase and Global Health Database) for eligible articles published between 1 January 2010 and 1 May 2024.
A restricted analysis of isolates collected between 2018 and 2023 is presented in this report to correspond to the years of GLASS data used to estimate percentage resistance. The search was restricted to original, peer-reviewed articles in English. Reports were included (Table A2.1) if they included AST data on at least 20 clinically relevant bacterial isolates from people seeking care at health-care facilities for a bacteriologically confirmed infection in the bloodstream, urinary tract, gastrointestinal, tract central nervous system or lower respiratory tract caused by any of the GLASS priority bacterial pathogens from human specimens and reported at least one of the GLASS bacterial pathogen–antibiotic combination *(2).* Reports were excluded if they were written as systematic or narrative reviews, abstracts or conference proceedings, oral presentations, individual case reports, government reports, unpublished full study reports, preprints, dissertations or theses, editorials, letters to the editor, opinions or commentaries, book chapters or other grey literature.

Safe, Clean, Green, and Climate-Resilient Healthcare Facilities Initiative in Lao People's Democratic Republic. Once the needle is safely destroyed, the syringe is disposed of in a clinical waste bin, adhering to strict safety and infection control protocols. This ensures proper disposal and helps maintain a safe, hygienic and sterile environment.

Figure A2.1. PRISMA flow diagrams for selection and inclusion of articles



Article screening and selection

Two independent reviewers screened the titles and abstracts of all articles, and duplicate articles were removed with the automated tool in Covidence (Veritas Health Innovation, Melbourne, Australia) and manually where necessary. Full-text articles were judged independently for relevance and quality by at least two reviewers. Any disagreement was resolved by a senior researcher. All screening was done with Covidence software.

Risk of bias and quality assessment

As the studies included were neither randomized controlled trials nor comparative studies, traditional methods for assessment of risk of bias were not applicable. Instead, we excluded studies that did not include an essential set of five core items from the MICRO checklist *(3)*: specimen type (item #1), sampling period (#2), geographical setting (#5), denominators (#16) and proportions for single agent and class resistance (#18).

Data extraction and synthesis

Data were extracted by a single reviewer onto a predefined Covidence extraction form and then verified by a second reviewer for data accuracy. We collected information on health-care level (primary, secondary or tertiary as defined in the GLASS manual *(2)*), country and WHO region, year of isolate collection and author-reported summary estimates (not individual-level data) of the AST results for relevant pathogen–antibiotic combinations. When isolates were collected from several health-care facilities providing different levels of care, we selected the highest-level hospital category to represent the report.

Ascertainment of AMR

As most of the studies did not report minimum inhibitory concentrations for antibiotics, we used author-reported AST interpretations to categorize them into susceptible, intermediate or resistant. Intermediate susceptibility, when reported, was considered resistant. Resistance proportions were calculated as the inverse of susceptibility, when applicable. Duplicate or sequential isolates from the same individual and disease episode, when reported, were removed from the analysis.

Statistical analysis

We performed a three-level random-effects meta-analysis to estimate the pooled percentage of AMR separately for each pathogen–antibiotic combination when at least five studies were available, both globally and for each WHO region, in a single time-aggregated estimate. Models included individual countries as a random effect to account for clustering of data within countries and to mitigate the predominant influence of any single country in the regional and global analyses. Models were fitted by the restricted maximum likelihood method with inverse variance weighting, arcsine transformation and the Hartung-Knapp adjustment, and 95% confidence intervals were calculated by the Clopper-Pearson exact method. All analyses were conducted in R version 4.3.2.

Table A2.1. Inclusion and exclusion criteria for the systematic review

Inclusion criteria
Article published between 1 January 2019 and 1 May 2024
Original research article published in a peer-reviewed journal
• Exclusions are non-peer-reviewed or grey literature and non-original articles such as systematic or narrative reviews, abstracts and conference proceedings, oral presentations, individual case reports, government reports, unpublished full study reports, preprints, dissertations and theses, editorials, letters to the editor, opinions and commentary papers, book chapters and other grey literature.

Quantitative study with a descriptive observational, analytical observational or experimental design and with human participants

- Eligible study designs included descriptive observational studies (i.e. case series), analytical observational studies (i.e. case–control, cohort, cross-sectional, the quantitative component of mixed-method studies) and experimental studies (non-randomized and randomized intervention trials and studies). Qualitative studies and case reports are excluded.

Includes individuals or populations seeking care in health-care facilities for at least one of the infection types of interest (i.e. bloodstream, urinary, gastrointestinal)

- Clinical case definitions are limited to the infection type name, synonym or short description, if applicable, and do not include a prescriptive set of specific signs or symptoms for each infection type.
- Includes health-care facilities that deliver short-term treatment for a severe injury or episode of illness, an urgent medical condition or recovery from surgery. Acute care may be delivered in hospitals or outpatient clinics not linked to hospitals. Health-care facilities are categorized according to the level of care they provide into primary, secondary or tertiary *(2)*. The review excludes population-based surveys in communities or in health-care facilities delivering long-term care (nursing homes, rehabilitation centres or psychiatric centres).

Includes bacterial isolates from target specimens from patients with diseases caused by any of 11 specified GLASS target pathogens, stratified by infection type (i.e. bloodstream, urinary, gastrointestinal).

- [MICRO item #1: Specimen types] Describes the types of specimen included (e.g. blood cultures). Specimens and isolates should be stratified by infection type.

Includes AST data for one or more of the pathogen–antibiotic combinations of interest.

- See GLASS pathogen–antibiotic combinations in GLASS manual 2023.

Exclusion criteria

The study report does not describe isolate denominators in each analysis.

- [MICRO item #16: Denominators] Isolate denominators should be used appropriately to ensure that correct numbers are included in each analysis. Of particular importance is reporting of resistance if different AST panels were used (i.e. not all isolates of a particular species were tested against all agents).
- When only a subset of isolates of a species was tested, reporting of a percentage without the numbers of isolates tested or resistant may be misleading, and the subset should not be considered eligible (e.g. reporting of AST data only in MRSA or ESBL isolates).

The study report does not describe the proportions of resistant isolates at species level as the number of isolates susceptible or resistant to an individual antibiotic of the actual number of isolates tested for susceptibility to that antibiotic.

- [MICRO item #18: Reporting resistance proportions for single agents and class resistance]
- AST data should be reported at species level and be specific to an individual antibiotic. Study reports that report on AST only for a group of pathogen species or a group of antibiotic classes are excluded.

AST results are reported for fewer than 20 clinically relevant isolates of at least one target pathogen in at least one infection type in a country since 2018.

- If a study report does not include ≥ 20 clinically relevant isolates of any of the target pathogens for any of the infection types from a single country collected since 2018, the study is excluded.
- If a study report includes ≥ 20 clinically relevant isolates of one or more of the target pathogens for any of the infection types, the study is included, but data are extracted only for those target pathogens of which the study included ≥ 20 clinically relevant isolates from a single country collected since 2018.

- Study reports of clinically relevant isolates in several countries are included provided that there are ≥ 20 clinically relevant isolates from a given country. Only data from countries that reported ≥ 20 clinically relevant isolates are extracted.

Geographical setting not specified, at least country of origin

- [MICRO item #5: Geographical setting] Describe the geographical distribution of specimens or patients from which isolates were obtained, at least at country level.
- Multi-country studies are eligible if the data can be separated by country.

The data or sample collection period is either not specified or completed before 2018, or the midpoint or upper-midpoint of the data collection period was before 2018 for reports in which data were not stratified by year.

- [MICRO item #2: Sampling period] State the collection timeframe for specimens yielding isolates for which data are reported, e.g. from MM/YY to MM/YY.
- From study reports of data from a data or sample collection period of 2 years (with data not stratified by year), select the year with the most days covered in the study. From study reports of data from a data or sampling collection period of several years (with data not stratified by year), select the (upper-) mid-point year representing the period. If the (upper-) mid-point year of data sample collection period is before 2018, the paper should be excluded.

Includes only samples from non-human sources

No identifiable author(s), journal or publisher or year of publication

Cannot be obtained in full text

Target specimens tested for AST are mixed with non-relevant specimen types.

- If a study reports both GLASS target specimen types and non-relevant specimen types but the AST results are reported separately, the study will be included, and only the AST data for the GLASS target specimen types will be extracted. Otherwise, the study report will be excluded.

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Annex 3.

Table A3.1. Trends in AMR surveillance coverage in 2016–2023 and national coverage in 2023, by WHO region and pathogen–antibiotic class combination

Infection type	Bacterial pathogen	Antibiotic class	National coverage, 2023. Median annual change, 2016–2023	Global		African Region		Region of the Americas		South-East Asia Region		European Region		Eastern Mediterranean Region		Western Pacific Region	
				Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]
Bloodstream	*Acinetobacter* spp.	Carbapenems	2023	8.0 (7.0, 9.1)	86	6.3 (4.5, 9.8)	16	6.5 (4.7, 9.9)	4	4.6 (3.4, 6.7)	9	17.4 (14.6, 21.5)	31	5.6 (4.6, 7.1)	17	917.1 (13.5, 22.9)	9
			Annual change (%)	29.6 (22.2, 37.8)*		22.3 (11.0, 35.0)*		24.5 (5.5, 46.6)		40.0 (23.4, 59.2)*		17.3 (7.6, 27.9)*		39.8 (28.1, 52.2)*		7.5 (-0.1, 15.3)	9
	E. coli	3rd-gen. cephalosporins	2023	56.4 (49.2, 66.9)	88	6.1 (4.6, 8.9)	16	40.5 (27.5, 66.6)	5	5.0 (3.9, 6.7)	9	209.2 (182.6, 244.8)	31	10.0 (8.6, 12.0)	18	9274.3 (201.7, 399.9)	9
			Annual change (%)	23.3 (16.6, 30.3)*		20.0 (10.3, 30.7)*		26.7 (11.1, 44.7)		27.5 (12.4, 43.9)*		13.0 (5.4, 21.1)*		36.1 (26.3, 47.0)*		4.5 (-2.4, 11.6)	9
		Carbapenems	2023	59.1 (50.9, 70.8)	88	6.1 (4.4, 9.0)	16	41.6 (27.9, 70.1)	5	5.9 (4.4, 8.1)	9	221.6 (190.5, 263.4)	31	10.3 (8.6, 12.7)	18	9283.1 (202.1, 427.5)	9
			Annual change (%)	24.6 (17.3, 32.1)*		18.8 (8.9, 30.2)*		23.2 (8.0, 41.3)		34.7 (18.6, 52.9)*		14.3 (5.3, 23.7)*		26.9 (17.6, 36.9)*		5.0 (-2.3, 12.9)	9
	K. pneumoniae	3rd-gen. cephalosporins	2023	23.8 (21.1, 27.5)	87	9.3 (7.0, 13.3)	17	31.2 (21.4, 50.6)	5	4.4 (3.4, 6.1)	9	66.1 (57.7, 77.4)	31	8.4 (7.3, 9.9)	16	9105.8 (80.5, 148.8)	9
			Annual change (%)	19.8 (13.4, 26.7)*		13.8 (5.3, 23.1)*		23.9 (8.8, 41.1)		23.5 (9.7, 38.9)*		15.6 (8.1, 23.4)*		28.3 (19.3, 38.3)*		5.9 (-0.9, 13.0)	9
		Carbapenems	2023	24.8 (21.9, 28.8)	88	9.2 (6.7, 13.5)	17	31.5 (21.3, 52.2)	5	5.2 (3.9, 7.4)	9	69.7 (60.6, 82.3)	31	8.3 (7.1, 9.9)	17	9109.7 (82.1, 154.9)	9
			Annual change (%)	24.6 (17.6, 31.8)*		19.8 (9.9, 31.1)*		23.5 (8.1, 41.4)		32.6 (17.3, 49.8)*		17.6 (8.9, 26.7)*		25.9 (16.1, 36.3)*		7.3 (0.2, 14.9)	9
	Salmonella spp.	Fluoroquinolones	2023	2.0 (1.7, 2.3)	74	1.5 (1.1, 2.2)	14	3.2 (2.3, 4.7)	6	0.9 (0.7, 1.4)	9	2.0 (1.6, 2.7)	23	2.3 (1.6, 3.8)	13	95.4 (4.1, 7.5)	9
			Annual change (%)	2.5 (-4.9, 10.4)		-2.6 (-13.9, 10.8)		4.9 (-9.5, 22.9)		9.5 (-5.7, 27.2)		2.7 (-8.4, 15.7)		-16.0 (-27.3, -3.5)*		-2.7 (-9.9, 5.3)	9

Infection type	Bacterial pathogen	Antibiotic class	National coverage, 2023. Median annual change, 2016–2023	Global		African Region		Region of the Americas		South-East Asia Region		European Region		Eastern Mediterranean Region		Western Pacific Region	
				Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]
	S. aureus	Methicillin resistance[b]	2023	24.7 (20.6, 31.1)	89	9.7 (6.3, 17.9)	17	25.6 (15.6, 53.2)	5	5.0 (3.2, 9.6)	9	76.4 (61.5, 100.4)	31	5.1 (4.0, 6.7)	18	9102.2 (68.9, 173.9)	9
			Annual change (%)	19.1 (9.3, 29.5)*		13.3 (-0.8, 28.5)		18.8 (-2.5, 43.8)		24.3 (3.0, 50.0)*		5.0 (-5.7, 16.2)		35.6 (20.4, 52.9)*		4.3 (-5.8, 15.9)	9
	S. pneumoniae	Penicillins	2023	4.0 (3.5, 4.6)	66	0.5 (0.4, 0.7)	7	6.9 (4.2, 12.9)	4	0.1 (0.1, 0.2)	4	18.2 (16.1, 21.0)	29	0.9 (0.8, 1.1)	13	97.5 (5.7, 10.4)	9
			Annual change (%)	17.4 (11.3, 24.0)*		-2.9 (-14.1, 8.6)		46.2 (21.8, 77.4)		29.1 (10.6, 50.8)		12.5 (4.7, 20.9)*		31.0 (16.8, 46.9)*		-7.6 (-13.5, -1.3)*	9
Gastrointestinal	*Salmonella* spp.	Fluoroquinolones	2023	7.0 (6.1, 8.3)	62	1.6 (1.1, 2.5)	10	10.0 (7.3, 15.0)	6	0.5 (0.4, 0.7)	6	33.2 (27.1, 43.8)	18	3.8 (3.1, 4.9)	15	718.0 (13.4, 26.3)	7
			Annual change (%)	9.1 (1.2, 17.8)*		6.9 (-5.1, 20.6)		4.0 (-10.8, 21.2)		11.0 (-3.5, 28.5)		14.2 (1.8, 27.5)*		15.8 (4.8, 28.5)*		-1.8 (-8.6, 5.6)	7
	Shigella spp.	3rd-gen. cephalosporins	2023	1.0 (0.8, 1.3)	46	1.5 (1.0, 2.7)	9	2.1 (1.5, 3.2)	5	0.1 (0.0, 0.3)	4	4.8 (3.4, 7.9)	8	0.7 (0.6, 0.9)	13	70.7 (0.5, 1.1)	7
			Annual change (%)	6.5 (-1.5, 15.4)		6.1 (-8.4, 24.8)		-0.6 (-14.6, 16.7)		11.1 (-7.9, 33.5)		14.2 (-4.5, 38.6)		19.8 (6.4, 35.4)*		-6.6 (-16.2, 4.3)	7
Urinary tract	*E. coli*	3rd-gen. cephalosporins	2023	464.8 (386.8, 574.9)	62	73.6 (43.7, 155.2)	12	564.4 (364.8, 1036.2)	6	30.7 (23.1, 44.4)	8	5170.8 (3907.8, 7123.8)	10	155.0 (128.2, 196.1)	19	71 466.9 (1038.8, 2219.1)	7
			Annual change (%)	23.9 (15.2, 32.9)*		21.6 (9.6, 35.0)*		11.0 (-2.5, 26.5)		26.8 (10.7, 44.6)*		7.0 (-6.3, 22.1)		38.9 (27.5, 50.8)*		5.2 (-3.1, 13.7)	7
		Fluoroquinolones	2023	651.7 (537.8, 817.5)	62	72.1 (43.2, 153.5)	12	602.4 (398.4, 1056.9)	6	34.5 (25.4, 51.0)	8	9142.7 (6984.5, 12 556.9)	10	157.1 (129.5, 199.4)	19	71 473.5 (1024.2, 2291.9)	7
			Annual change (%)	29.1 (19.8, 39.4)*		22.4 (9.7, 36.4)*		11.7 (-2.0, 27.8)		37.5 (19.4, 59.2)*		5.4 (-8.3, 21.2)		39.9 (28.9, 51.9)*		5.5 (-3.0, 14.7)	7
		TMP-Sulfa	2023	480.1 (387.4, 627.5)	60	74.6 (43.9, 154.5)	12	567.6 (385.1, 949.8)	5	33.4 (24.7, 48.8)	7	5784.6 (4364.1, 8002.5)	10	147.8 (122.6, 185.7)	19	71 251.8 (735.0, 2567.3)	7
			Annual change (%)	28.4 (19.5, 38.2)*		22.0 (9.0, 36.2)*		8.3 (-5.3, 24.3)		33.5 (16.9, 53.0)*		9.8 (-4.4, 25.4)		47.5 (34.7, 60.7)*		6.2 (-6.5, 20.3)	7
	K. pneumoniae	3rd-gen. cephalosporins	2023	88.9 (74.4, 109.6)	59	19.3 (12.3, 39.3)	12	98.2 (62.8, 173.6)	5	8.4 (6.3, 11.9)	8	808.9 (610.9, 1128.6)	10	43.2 (36.0, 54.0)	17	7320.7 (228.3, 494.4)	7
			Annual change (%)	23.5 (14.9, 32.8)*		21.5 (9.5, 35.3)*		18.7 (4.0, 36.2)		26.5 (11.5, 43.9)*		9.1 (-3.8, 23.5)		31.8 (20.4, 43.7)*		7.5 (-0.5, 16.3)	7

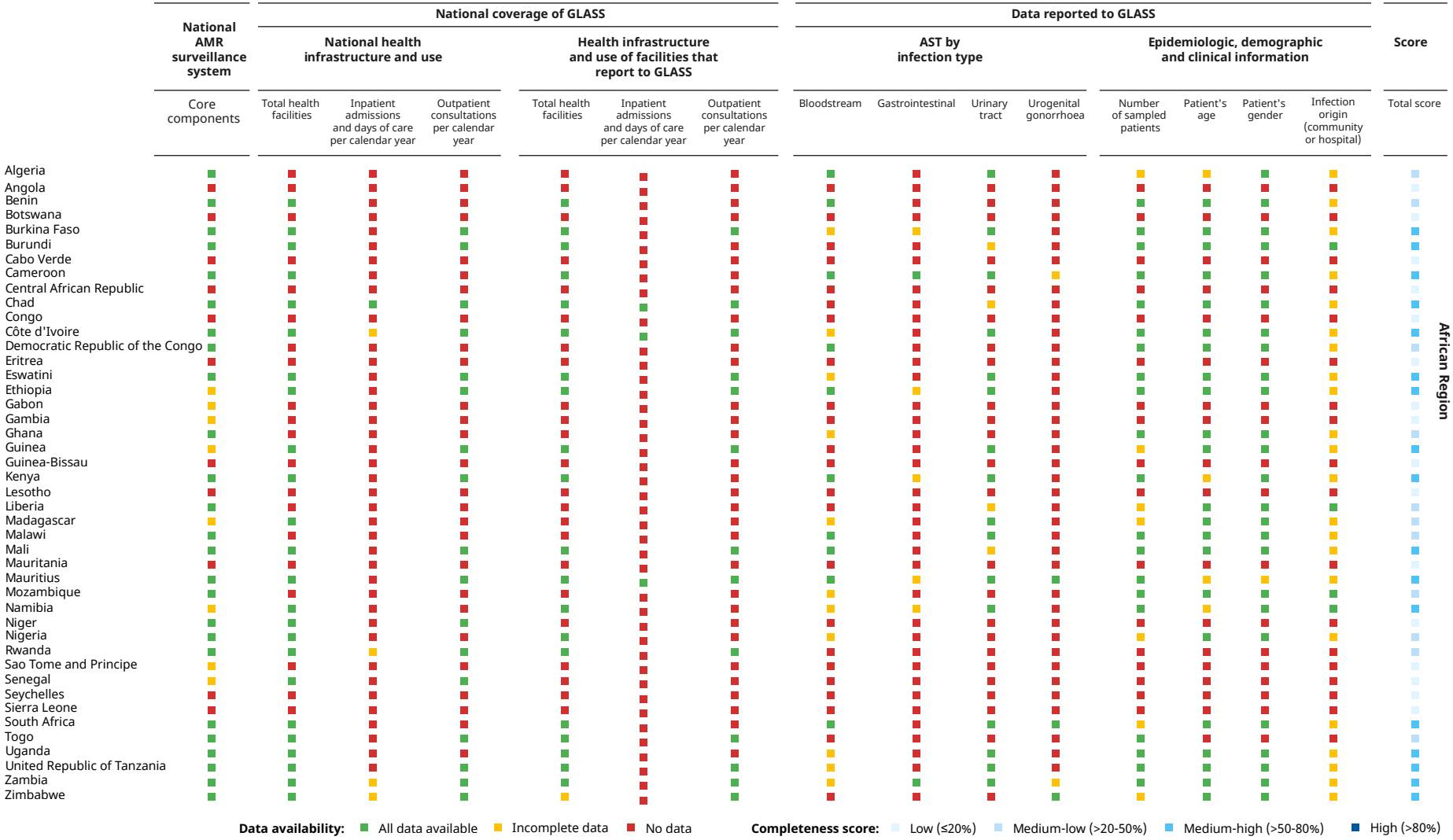
Infection type	Bacterial pathogen	Antibiotic class	National coverage, 2023. Median annual change, 2016–2023	Global		African Region		Region of the Americas		South-East Asia Region		European Region		Eastern Mediterranean Region		Western Pacific Region	
				Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]	Estimate (95% CrI)	n[a]
		Fluoroquinolones	2023	105.7 (88.1, 131.4)	59	19.2 (11.9, 39.8)	12	100.6 (63.6, 185.7)	5	9.5 (7.0, 14.4)	8	1146.3 (872.6, 1571.5)	10	42.8 (34.9, 55.2)	17	7326.1 (229.2, 522.7)	7
			Annual change (%)	28.6 (18.8, 39.8)*		21.5 (9.2, 35.5)*		20.3 (3.7, 39.9)		35.1 (17.4, 57.0)*		10.7 (-3.1, 26.0)		35.4 (22.9, 48.8)*		8.6 (-0.1, 18.0)	7
		TMP-Sulfa	2023	88.2 (71.1, 117.5)	57	18.7 (11.7, 38.0)	12	93.1 (60.5, 168.5)	4	9.0 (6.6, 13.6)	7	878.1 (654.0, 1252.1)	10	42.7 (35.0, 54.7)	17	7276.2 (164.7, 559.4)	7
			Annual change (%)	26.8 (17.0, 37.4)*		19.8 (7.1, 34.2)*		16.8 (0.3, 36.7)		32.3 (14.9, 53.0)*		14.0 (0.0, 30.3)		34.6 (21.4, 48.4)*		9.5 (-3.2, 23.4)	7
Urogenital	*N. gonorrhoeae*	Macrolides	2023	5.6 (4.0, 9.4)	38	3.2 (1.6, 11.4)	3	15.9 (8.6, 37.0)	4	0.1 (0.1, 0.3)	3	8.6 (5.8, 15.7)	17	0.7 (0.4, 1.9)	7	418.0 (10.1, 40.9)	7
			Annual change (%)	-1.4 (-16.2, 16.0)		-1.7 (-14.4, 13.0)		-2.9 (-17.7, 12.2)		-0.6 (-24.8, 33.1)		-2.7 (-14.7, 8.6)		-0.7 (-17.2, 20.4)		-2.0 (-14.4, 11.5)	7
		3rd-gen. cephalosporins	2023	4.8 (3.9, 6.4)	47	2.3 (1.6, 3.9)	5	10.4 (6.8, 17.6)	5	0.1 (0.1, 0.2)	3	9.2 (7.4, 12.3)	18	1.1 (0.9, 1.6)	10	618.9 (12.9, 31.5)	4
			Annual change (%)	-5.1 (-17.7, 9.4)		-3.1 (-14.1, 9.9)		-7.0 (-20.9, 8.4)		-9.4 (-32.7, 21.3)		3.5 (-6.5, 14.9)		9.5 (-5.2, 26.3)		-8.8 (-17.2, 1.0)	6

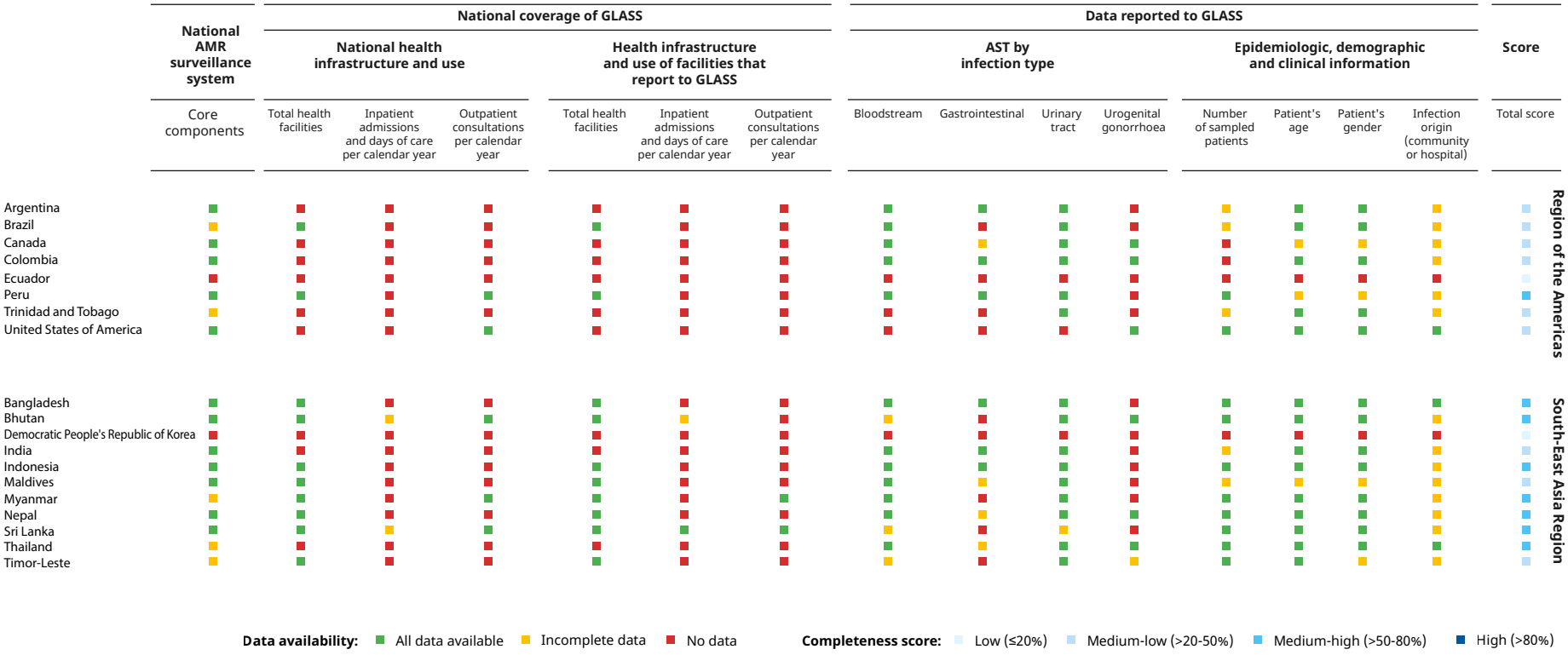
Surveillance coverage in 2023 is summarized as median population-weighted national coverage values derived from Bayesian regression models. Trends in AMR testing are summarized as the population-weighted median national yearly percentage change in the number of infections with AST per million population. An asterisk (*) indicates a statistically meaningful trend. A trend is considered statistically meaningful if ≥ 5 countries reported ≥ 10 infections with AST in ≥ 3 years between 2016 and 2023, and if the 95% CrI for the annual percentage change does not overlap with zero, with the lower bound ≥ 1% or the upper bound ≤ –1%. For methodological details, see Annex 1.

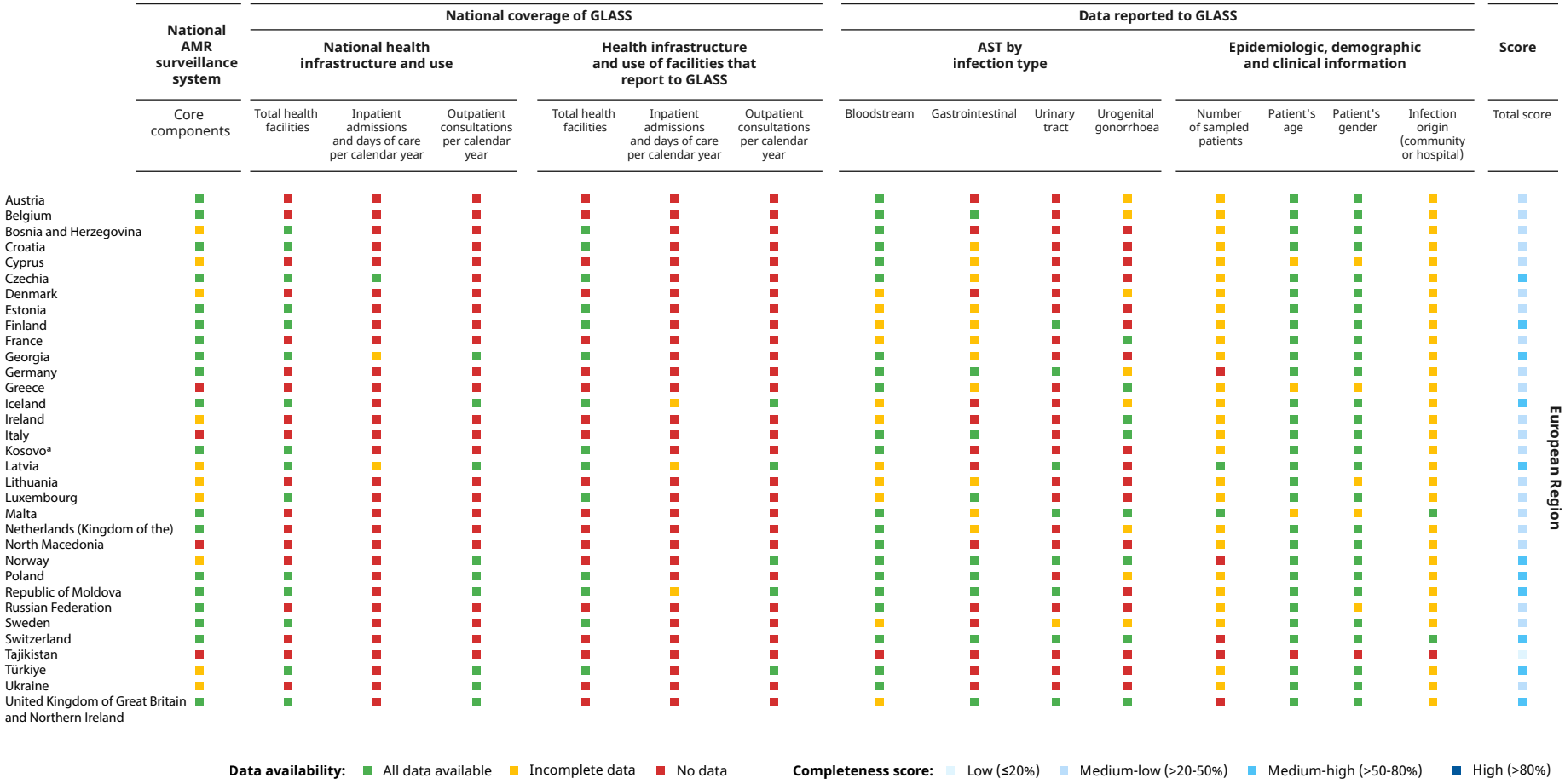
[a] Number of countries. Includes three territories and areas.

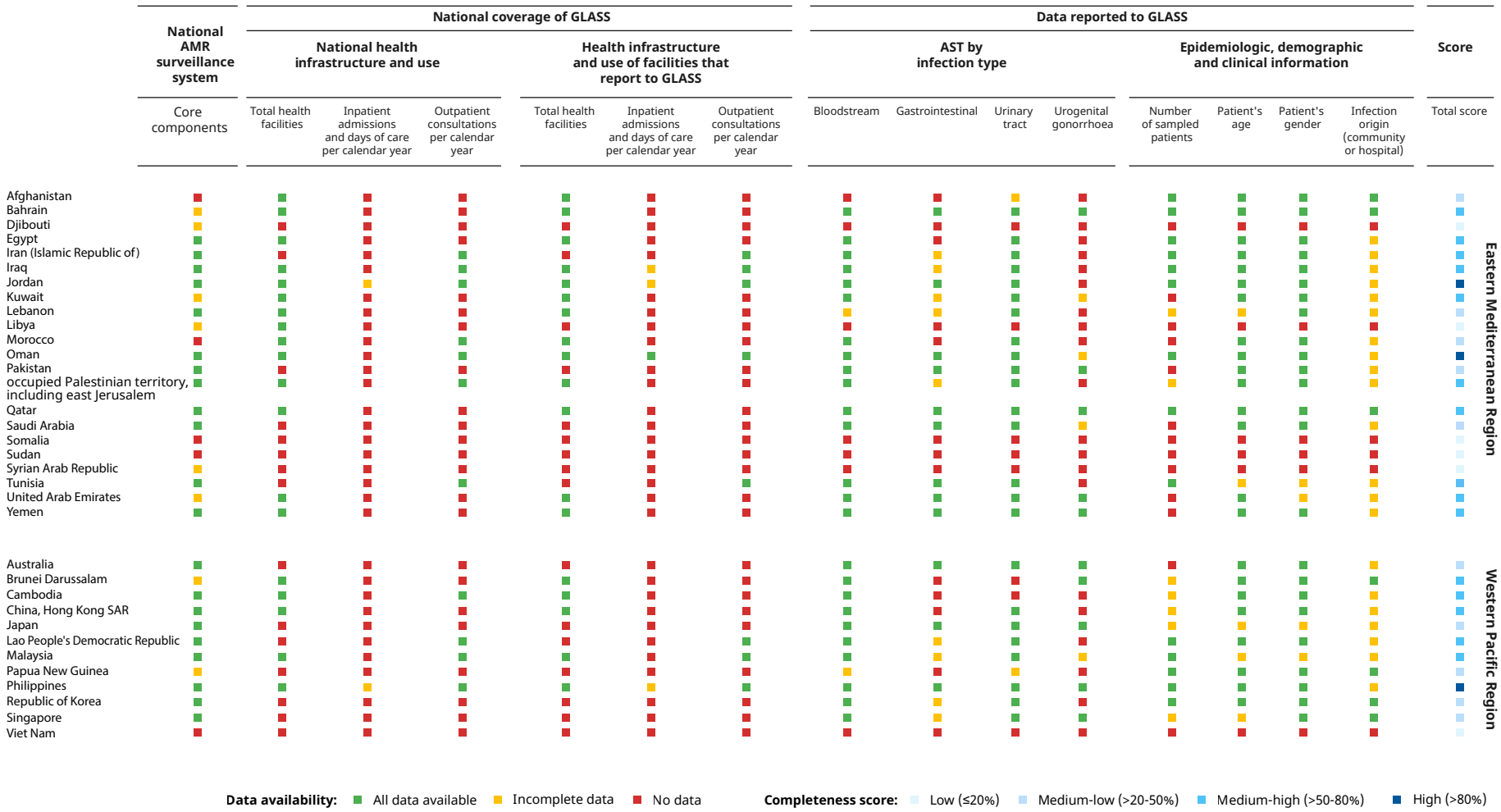
[b] Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

Annex 4. Table A4.1. Scores for availability and completeness of national AMR surveillance data, 2023




National AMR surveillance system
National coverage of GLASS
National health infrastructure and use
Health infrastructure and use of facilities that report to GLASS
Data reported to GLASS
AST by infection type
Epidemiologic, demographic and clinical information
Score
Core components
Total health facilities
Inpatient admissions and days of care per calendar year
Outpatient consultations per calendar year
Total health facilities
Inpatient admissions and days of care per calendar year
Outpatient consultations per calendar year
Bloodstream
Gastrointestinal
Urinary tract
Urogenital gonorrhoea
Number of sampled patients
Patient's age
Patient's gender
Infection origin (community or hospital)
Total score
Region of the Americas
Argentina
Brazil
Canada
Colombia
Ecuador
Peru
Trinidad and Tobago
United States of America
South-East Asia Region
Bangladesh
Bhutan
Democratic People's Republic of Korea
India
Indonesia
Maldives
Myanmar
Nepal
Sri Lanka
Thailand
Timor-Leste
Data availability: All data available Incomplete data No data
Completeness score: Low (≤20%) Medium-low (>20-50%) Medium-high (>50-80%) High (>80%)


National AMR surveillance system
National coverage of GLASS
National health infrastructure and use
Health infrastructure and use of facilities that report to GLASS
Data reported to GLASS
AST by infection type
Epidemiologic, demographic and clinical information
Score
Core components
Total health facilities
Inpatient admissions and days of care per calendar year
Outpatient consultations per calendar year
Total health facilities
Inpatient admissions and days of care per calendar year
Outpatient consultations per calendar year
Bloodstream
Gastrointestinal
Urinary tract
Urogenital gonorrhoea
Number of sampled patients
Patient's age
Patient's gender
Infection origin (community or hospital)
Total score
Austria
Belgium
Bosnia and Herzegovina
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Iceland
Ireland
Italy
Kosovo[a]
Latvia
Lithuania
Luxembourg
Malta
Netherlands (Kingdom of the)
North Macedonia
Norway
Poland
Republic of Moldova
Russian Federation
Sweden
Switzerland
Tajikistan
Türkiye
Ukraine
United Kingdom of Great Britain and Northern Ireland
European Region
Data availability: All data available Incomplete data No data
Completeness score: Low (≤20%) Medium-low (>20-50%) Medium-high (>50-80%) High (>80%)



The table summarizes the completeness of 2023 AMR surveillance data reported to GLASS by 130 countries enrolled in global AMR surveillance in the six WHO regions. It includes countries that submitted AMR data in 2023 (n = 104) as well as those that provided information in other domains. A traffic light system is used to indicate whether data are complete, partial or missing in four domains. The colour-coded format highlights surveillance gaps and areas that require improvement.

[a] In accordance with Security Council resolution 1244 (1999).

Annex 5.

Table A5.1. Global and regional AMR estimates, 2023

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
Bloodstream	*Acinetobacter* spp.	Aminoglycosides	Amikacin	39.0 (34.3, 43.9) 76 (42 497)	29.5 (23.4, 36.4) 15 (4205)	31.2 (13.4, 57.0) 4 (2234)	48.9 (41.8, 56.1) 8 (14 519)	44.4 (33.0, 56.5) 25 (9761)	55.7 (49.0, 62.2) 14 (5089)	18.8 (12.5, 27.1) 10 (6689)
			Gentamicin	44.6 (40.2, 49.1) 80 (43 050)	57.6 (53.7, 61.3) 16 (7305)	45.8 (23.2, 70.4) 4 (2172)	54.1 (50.7, 57.5) 9 (12 241)	35.0 (24.4, 47.4) 26 (9604)	56.2 (49.1, 63.1) 15 (4784)	24.8 (17.7, 33.5) 10 (6944)
		Carbapenems	Doripenem	40.9 (28.4, 54.7) 4 (994)	–	13.2 (7.7, 21.8) 1 (54)	58.9 (55.4, 62.4) 2 (880)	–	–	35.4 (26.4, 45.6) 1 (60)
			Imipenem	54.3 (49.3, 59.2) 71 (42 318)	55.8 (48.7, 62.6) 11 (6619)	54.0 (30.0, 76.3) 4 (1911)	62.0 (57.2, 66.6) 8 (13 254)	49.8 (35.6, 64.0) 25 (8926)	66.5 (58.1, 73.9) 15 (5025)	32.4 (22.7, 43.8) 8 (6583)
			Meropenem	49.6 (44.7, 54.5) 76 (42 321)	53.5 (47.2, 59.6) 12 (7026)	54.0 (27.2, 78.6) 4 (2348)	60.6 (55.9, 65.1) 9 (12 253)	38.6 (26.6, 52.2) 26 (8354)	66.7 (59.2, 73.5) 15 (5074)	29.3 (20.3, 40.3) 10 (7266)
		Polymyxins	Colistin	4.7 (3.4, 6.6) 45 (15 514)	0.9 (0.0, 69.8) 2 (312)	3.4 (1.8, 6.4) 3 (449)	2.8 (1.0, 7.9) 4 (7927)	5.9 (3.7, 9.2) 18 (3985)	6.7 (4.4, 10.2) 12 (1870)	3.4 (1.5, 7.4) 6 (971)
		Tetracyclines	Minocycline	13.5 (9.3, 19.1) 13 (12 864)	73.7 (58.2, 84.9) 1 (22)	12.4 (6.3, 23.0) 2 (616)	26.5 (25.3, 27.8) 1 (7839)	–	21.6 (12.0, 35.8) 5 (1555)	1.7 (0.7, 4.1) 4 (2832)
			Tigecycline	13.0 (7.5, 21.7) 12 (2839)	2.2 (1.7, 3.0) 0 (0)	1.2 (0.6, 2.2) 1 (567)	11.1 (9.5, 12.8) 1 (1306)	–	24.1 (11.8, 42.8) 7 (316)	7.1 (4.6, 10.9) 3 (650)
	E. coli	Carbapenems	Doripenem	3.5 (1.7, 7.0) 3 (2215)	–	0.9 (0.3, 2.5) 1 (86)	3.6 (1.6, 7.8) 2 (2129)	–	–	10.2 (3.7, 25.0) 0 (0)
			Ertapenem	3.5 (2.5, 5.0) 65 (111 015)	9.3 (5.5, 15.3) 10 (4998)	2.1 (1.9, 2.4) 3 (16 771)	12.2 (6.7, 21.3) 5 (10 867)	1.3 (0.7, 2.3) 25 (53 147)	11.6 (7.3, 18.0) 13 (5178)	2.3 (0.8, 6.5) 9 (20 054)
			Imipenem	2.4 (1.8, 3.3) 79 (206 018)	6.9 (3.7, 12.4) 14 (5662)	2.2 (1.5, 3.2) 4 (15 016)	17.5 (12.4, 24.2) 9 (15 155)	0.4 (0.2, 0.8) 28 (60 260)	9.2 (6.2, 13.3) 15 (8733)	1.2 (0.4, 3.2) 9 (101 192)
			Meropenem	1.9 (1.4, 2.7) 86 (259 837)	7.8 (4.2, 13.9) 15 (5914)	1.6 (1.1, 2.3) 5 (18 397)	17.5 (11.8, 25.3) 10 (16 281)	0.3 (0.1, 0.5) 31 (87 601)	9.1 (6.0, 13.7) 15 (8265)	0.9 (0.3, 3.3) 10 (123 379)
		3rd– gen. cephalosporins	Cefotaxime	39.0 (33.5, 44.8) 72 (154 958)	62.7 (53.8, 70.9) 15 (6072)	34.2 (25.0, 44.7) 3 (3042)	67.3 (54.4, 78.0) 7 (10 654)	17.7 (14.4, 21.5) 27 (46 778)	60.6 (51.5, 69.0) 14 (3886)	31.5 (26.1, 37.5) 6 (84 526)
			Ceftazidime	31.8 (26.8, 37.3) 81 (243 723)	57.8 (49.0, 66.1) 15 (6014)	21.0 (14.0, 30.2) 5 (17 623)	59.8 (41.9, 75.5) 6 (11 566)	15.7 (12.3, 19.9) 30 (81 315)	53.9 (44.8, 62.7) 15 (6983)	17.4 (12.3, 24.1) 10 (120 222)
			Ceftriaxone	43.5 (37.6, 49.6) 75 (147 397)	68.9 (58.0, 78.0) 17 (1743)	34.9 (27.7, 42.8) 4 (12 450)	62.6 (50.5, 73.3) 9 (11 781)	19.1 (13.5, 26.2) 21 (27 303)	62.7 (53.4, 71.3) 14 (7932)	30.5 (24.2, 37.7) 10 (86 188)

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
		4th– gen. cephalosporins	Cefepime	31.5 (26.5, 36.9) 66 (204 414)	55.3 (45.8, 64.5) 15 (5423)	23.4 (15.9, 32.9) 4 (18 036)	51.0 (37.9, 63.9) 7 (11 377)	11.0 (8.4, 14.2) 16 (44 946)	49.6 (40.4, 58.9) 15 (5808)	16.9 (13.4, 21.0) 9 (118 824)
		Fluoroquinolones	Ciprofloxacin	40.7 (36.5, 45.1) 91 (257 378)	59.7 (52.3, 66.6) 19 (6598)	41.0 (35.9, 46.3) 5 (18 639)	59.5 (50.3, 68.1) 10 (17 168)	22.3 (18.9, 26.0) 31 (126 403)	54.5 (47.2, 61.6) 15 (8953)	34.9 (29.4, 40.8) 11 (79 617)
			Levofloxacin	38.5 (34.5, 42.7) 48 (131 218)	57.8 (27.0, 83.5) 4 (184)	31.3 (29.3, 33.2) 2 (3855)	54.7 (45.4, 63.6) 4 (3287)	25.4 (20.5, 31.0) 19 (17 835)	54.3 (46.5, 61.9) 14 (3614)	29.4 (26.9, 32.2) 5 (102 443)
		Polymyxins	Colistin	1.7 (1.1, 2.8) 44 (23 220)	7.6 (0.0, 100.0) 3 (579)	1.1 (0.6, 1.7) 3 (3303)	1.6 (0.4, 6.3) 5 (8490)	1.5 (0.9, 2.4) 16 (6218)	2.3 (0.9, 5.8) 12 (916)	1.3 (0.2, 7.4) 5 (3714)
		TMP– sulfa	Co–trimoxazole	61.2 (57.1, 65.2) 60 (65 921)	82.1 (78.8, 85.0) 18 (6319)	52.7 (47.9, 57.5) 4 (9808)	55.2 (51.8, 58.5) 9 (11 481)	37.4 (32.6, 42.4) 5 (7463)	56.6 (50.2, 62.9) 14 (8402)	44.8 (36.6, 53.4) 10 (22 448)
	K. pneumoniae	Carbapenems	Meropenem	15.1 (12.6, 18.1) 86 (126 273)	22.3 (18.9, 26.1) 16 (8986)	29.3 (23.3, 36.1) 5 (13 387)	40.3 (28.4, 53.4) 9 (14 076)	8.0 (5.4, 11.5) 31 (33 810)	35.3 (28.0, 43.3) 15 (7285)	3.7 (1.8, 7.3) 10 (48 729)
			Imipenem	16.7 (13.9, 19.9) 77 (106 396)	15.9 (13.2, 19.1) 14 (8257)	32.0 (26.2, 38.5) 4 (11 322)	41.2 (30.3, 53.1) 9 (12 983)	11.2 (7.7, 16.1) 25 (26 004)	33.1 (25.8, 41.2) 16 (7060)	3.8 (2.0, 6.9) 9 (40 770)
			Ertapenem	20.4 (16.6, 24.8) 63 (65 839)	29.4 (24.6, 34.6) 9 (7355)	36.4 (26.7, 47.3) 3 (12 081)	32.9 (18.2, 51.9) 5 (8332)	15.0 (9.4, 23.0) 23 (21 402)	38.7 (29.4, 48.8) 14 (4023)	5.8 (3.5, 9.4) 9 (12 646)
			Doripenem	23.2 (14.9, 34.2) 5 (1468)	–	13.1 (9.5, 17.9) 1 (68)	23.1 (15.1, 33.6) 2 (1337)	–	82.8 (65.7, 92.3) 1 (46)	12.3 (6.5, 22.0) 1 (17)
		3rd– gen. cephalosporins	Cefotaxime	55.2 (48.5, 61.7) 69 (78 283)	77.8 (73.1, 81.9) 14 (8754)	55.4 (44.3, 66.1) 3 (2510)	71.5 (60.2, 80.6) 6 (8803)	38.9 (29.4, 49.3) 26 (20 035)	70.7 (62.1, 78.1) 14 (3666)	25.9 (15.7, 39.7) 6 (34 515)
			Ceftazidime	53.0 (47.2, 58.7) 82 (117 403)	73.4 (69.3, 77.1) 17 (9213)	49.6 (38.2, 61.1) 5 (12 891)	73.4 (61.0, 83.0) 6 (9335)	41.1 (31.4, 51.6) 29 (32 666)	67.8 (59.5, 75.1) 15 (5894)	20.0 (12.4, 30.8) 10 (47 404)
			Ceftriaxone	60.4 (54.0, 66.5) 76 (72 678)	82.2 (77.8, 85.8) 17 (2474)	52.1 (41.2, 62.7) 4 (8306)	72.7 (63.3, 80.5) 9 (9927)	47.3 (33.7, 61.4) 22 (12 875)	69.1 (60.6, 76.5) 15 (6989)	23.7 (14.1, 36.9) 9 (32 107)
		4th– gen. cephalosporins	Cefepime	46.4 (40.9, 52.1) 68 (104 786)	67.4 (61.9, 72.4) 16 (8317)	52.1 (41.1, 62.9) 4 (13 127)	66.2 (54.2, 76.5) 7 (10 566)	25.5 (18.2, 34.5) 16 (20 539)	62.4 (53.2, 70.7) 16 (4952)	17.8 (11.4, 26.6) 9 (47 285)
		Fluoroquinolones	Ciprofloxacin	48.3 (43.4, 53.2) 92 (125 742)	63.5 (58.9, 67.8) 20 (9908)	52.7 (43.7, 61.4) 5 (13 626)	66.4 (58.3, 73.6) 10 (14 293)	36.1 (28.3, 44.8) 31 (46 484)	59.5 (52.2, 66.3) 16 (8325)	24.7 (14.9, 38.0) 10 (33 106)
			Levofloxacin	42.8 (34.8, 51.3) 47 (53 899)	46.7 (20.5, 74.9) 5 (302)	43.9 (29.4, 59.5) 2 (3052)	52.9 (40.5, 64.9) 3 (2544)	40.2 (28.5, 53.2) 17 (7827)	55.0 (48.5, 61.3) 15 (3561)	13.8 (6.3, 27.5) 5 (36 613)
		Polymyxins	Colistin	7.9 (5.9, 10.5) 47 (21 243)	19.6 (3.6, 61.3) 3 (568)	5.9 (2.9, 11.5) 3 (2536)	5.1 (3.0, 8.4) 5 (7815)	8.7 (5.7, 13.2) 18 (7309)	12.9 (9.2, 17.8) 13 (1300)	2.1 (0.6, 7.6) 5 (1715)
		TMP– sulfa	Co–trimoxazole	59.0 (54.4, 63.5) 61 (47 974)	79.2 (75.7, 82.2) 19 (9434)	49.3 (38.5, 60.1) 4 (7244)	59.7 (53.0, 66.1) 9 (9874)	41.5 (26.6, 58.1) 5 (2077)	58.0 (49.3, 66.2) 15 (6227)	29.8 (23.0, 37.7) 9 (13 118)
	Salmonella spp.	Carbapenems	Doripenem	0.2 (0.0, 4.1) 1 (24)	–	–	0.2 (0.0, 4.1) 1 (24)	–	–	–

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
			Ertapenem	0.3 (0.2, 0.5) 19 (2953)	0.4 (0.2, 0.9) 4 (952)	0.5 (0.2, 1.0) 1 (834)	0.2 (0.0, 0.6) 2 (460)	0.1 (0.0, 0.6) 5 (401)	0.2 (0.0, 0.8) 4 (163)	0.3 (0.0, 1.6) 3 (143)
			Imipenem	0.4 (0.2, 0.9) 26 (4021)	0.5 (0.1, 2.4) 5 (1232)	0.1 (0.0, 0.5) 1 (610)	1.0 (0.2, 4.3) 4 (492)	0.3 (0.0, 99.9) 4 (421)	0.4 (0.0, 20.7) 7 (285)	0.3 (0.1, 0.7) 5 (981)
			Meropenem	0.1 (0.0, 0.3) 37 (5876)	1.0 (0.1, 7.8) 3 (916)	0.1 (0.0, 4.9) 4 (1412)	0.4 (0.1, 1.6) 4 (642)	0.0 (0.0, 0.1) 13 (1386)	0.2 (0.1, 0.5) 7 (326)	0.2 (0.1, 0.4) 6 (1194)
		3rd– gen. cephalosporins	Cefotaxime	4.6 (2.4, 8.7) 38 (4364)	4.1 (0.7, 20.2) 8 (1603)	7.5 (2.7, 19.0) 2 (164)	11.3 (7.0, 17.5) 4 (447)	1.6 (0.9, 2.8) 12 (1009)	19.0 (6.3, 45.2) 7 (259)	5.8 (2.4, 13.2) 5 (882)
			Ceftazidime	3.1 (1.7, 5.6) 28 (3352)	2.7 (1.5, 5.0) 4 (568)	0.4 (0.1, 1.6) 0 (0)	7.1 (4.4, 11.2) 1 (248)	1.7 (0.9, 3.1) 12 (1097)	11.8 (3.4, 33.5) 7 (277)	2.1 (1.2, 3.6) 4 (1162)
			Ceftriaxone	5.3 (3.0, 9.2) 38 (5771)	9.0 (2.1, 30.9) 7 (737)	6.9 (3.9, 12.0) 4 (1193)	4.7 (2.9, 7.5) 5 (683)	1.8 (0.8, 4.2) 6 (817)	15.6 (7.2, 30.5) 8 (476)	3.1 (1.8, 5.3) 8 (1865)
		Fluoroquinolones	Ciprofloxacin	18.0 (13.9, 22.9) 52 (8169)	11.2 (3.8, 28.5) 10 (1378)	12.6 (6.3, 23.5) 5 (2134)	23.2 (12.1, 39.8) 6 (735)	36.2 (29.0, 44.2) 13 (1708)	22.7 (14.9, 32.9) 10 (500)	4.9 (2.0, 11.5) 8 (1714)
			Levofloxacin	11.8 (6.9, 19.5) 14 (1713)	–	16.9 (12.6, 22.4) 1 (243)	8.0 (3.5, 17.3) 3 (348)	15.4 (6.9, 30.7) 3 (156)	18.5 (9.6, 32.8) 5 (104)	5.6 (0.5, 42.7) 2 (862)
	S.pneumoniae	3rd– gen. cephalosporins	Cefotaxime	0.8 (0.5, 1.3) 40 (10 933)	0.3 (0.0, 3.8) 2 (32)	2.9 (1.6, 5.3) 2 (726)	3.1 (1.4, 6.7) 3 (233)	0.4 (0.2, 0.8) 21 (7541)	2.4 (0.9, 6.5) 7 (348)	1.4 (0.4, 4.6) 5 (2053)
			Ceftriaxone	0.7 (0.4, 1.1) 47 (13 504)	0.4 (0.1, 0.9) 3 (402)	0.4 (0.1, 1.6) 3 (4095)	2.3 (1.2, 4.6) 2 (188)	0.4 (0.2, 0.9) 21 (5140)	1.1 (0.3, 3.5) 9 (892)	1.2 (0.4, 3.2) 9 (2787)
		Penicillins	Oxacillin	17.8 (12.0, 25.5) 30 (3661)	46.4 (29.7, 64.1) 1 (39)	20.8 (14.7, 28.7) 0 (0)	18.5 (10.4, 30.7) 3 (86)	9.6 (5.9, 15.2) 15 (3158)	33.7 (17.2, 55.6) 5 (90)	40.3 (19.5, 65.4) 6 (288)
			Penicillin G	5.2 (3.6, 7.6) 57 (21 208)	38.6 (29.2, 48.9) 3 (414)	2.5 (0.5, 10.8) 3 (4277)	8.9 (6.7, 11.8) 3 (323)	3.0 (2.1, 4.2) 28 (12 185)	20.3 (11.9, 32.5) 10 (765)	4.2 (1.7, 10.2) 10 (3244)
		TMP– sulfa	Co–trimoxazole	35.1 (28.6, 42.2) 28 (7393)	60.1 (43.9, 74.3) 4 (511)	19.5 (14.9, 25.1) 3 (4463)	51.7 (35.3, 67.8) 3 (294)	8.2 (3.4, 18.1) 2 (581)	41.8 (28.7, 56.3) 9 (659)	29.5 (21.7, 38.7) 7 (885)
SDG (Bloodstream)	*E. coli*	3rd– gen. cephalosporins		44.8 (39.3, 50.4) 91 (176 429)	70.7 (62.3, 78.0) 19 (6055)	35.0 (26.8, 44.2) 5 (3964)	68.8 (57.2, 78.4) 10 (12 648)	19.9 (15.9, 24.7) 31 (52 309)	66.9 (57.8, 74.9) 15 (7205)	32.8 (26.5, 39.8) 11 (94 248)
	S. aureus	Methicillin resistance[b]		27.1 (23.5, 31.0) 91 (107 078)	44.7 (33.4, 56.5) 20 (9696)	34.2 (27.3, 41.8) 5 (9791)	39.6 (31.7, 48.0) 10 (12 233)	9.7 (7.0, 13.2) 29 (28 015)	50.3 (39.8, 60.8) 16 (4325)	30.4 (26.2, 34.9) 11 (43 018)
Gastrointestinal	*Salmonella* spp.	Carbapenems	Doripenem	1.6 (0.2, 13.3) 2 (51)	–	–	2.7 (0.3, 22.8) 1 (15)	0.6 (0.0, 17.1) 1 (36)	–	–
			Ertapenem	0.5 (0.3, 1.1) 20 (6001)	1.3 (0.3, 5.4) 1 (14)	0.4 (0.2, 0.9) 1 (952)	1.4 (0.2, 10.2) 3 (248)	0.2 (0.0, 80.1) 5 (1980)	0.9 (0.3, 2.5) 8 (1537)	0.2 (0.1, 0.5) 2 (1270)
			Imipenem	0.4 (0.2, 0.9) 26 (5091)	3.2 (0.2, 36.2) 2 (52)	0.4 (0.1, 1.3) 1 (324)	0.9 (0.0, 23.8) 3 (265)	0.1 (0.0, 0.4) 5 (2289)	0.7 (0.4, 1.1) 10 (1712)	0.2 (0.0, 0.7) 5 (449)

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
			Meropenem	0.1 (0.0, 0.5) 41 (19 813)	1.6 (0.2, 13.8) 2 (44)	0.1 (0.0, 0.5) 3 (5754)	0.4 (0.0, 98.9) 3 (277)	0.0 (0.0, 0.5) 18 (9455)	0.2 (0.1, 0.4) 9 (1777)	0.1 (0.0, 0.3) 6 (2506)
		3rd– gen. cephalosporins	Ceftriaxone	6.0 (4.0, 8.7) 35 (16 851)	9.3 (5.6, 15.0) 5 (122)	11.4 (3.0, 35.2) 3 (5553)	11.5 (4.8, 25.1) 5 (442)	1.1 (0.7, 1.7) 6 (2781)	7.3 (4.7, 11.3) 11 (2932)	5.4 (2.5, 10.9) 5 (5021)
			Ceftazidime	2.9 (1.8, 4.7) 34 (13 741)	10.2 (3.5, 26.6) 3 (44)	1.1 (0.4, 3.4) 0 (0)	52.5 (36.6, 68.0) 1 (47)	1.2 (0.9, 1.6) 17 (10 296)	6.6 (2.6, 15.8) 9 (1119)	3.9 (1.2, 11.8) 4 (2235)
			Cefotaxime	3.5 (2.4, 5.2) 38 (12 145)	5.3 (2.3, 11.4) 3 (126)	11.6 (3.9, 29.5) 2 (262)	22.9 (9.1, 46.9) 2 (553)	1.5 (1.1, 1.9) 17 (9392)	6.0 (3.3, 10.7) 8 (1010)	7.1 (3.3, 14.7) 6 (802)
		Fluoroquinolones	Ciprofloxacin	16.3 (13.8, 19.1) 55 (31 571)	9.3 (6.5, 13.2) 5 (166)	14.9 (10.1, 21.6) 4 (6501)	19.7 (9.5, 36.4) 6 (1538)	23.9 (20.0, 28.2) 20 (15 154)	15.8 (11.3, 21.6) 13 (2906)	5.9 (3.3, 10.4) 7 (5306)
			Levofloxacin	15.7 (13.1, 18.8) 15 (2097)	15.9 (6.0, 35.9) 1 (16)	22.1 (17.4, 27.6) 1 (195)	18.6 (9.2, 34.0) 2 (203)	10.2 (6.9, 14.7) 3 (1041)	17.0 (13.5, 21.2) 8 (642)	25.4 (10.1, 50.5) 0 (0)
	Shigella spp.	3rd– gen. cephalosporins	Cefotaxime	27.5 (18.6, 38.6) 20 (1692)	3.6 (1.2, 10.5) 2 (59)	5.0 (3.3, 7.6) 3 (555)	36.4 (17.1, 61.3) 1 (16)	39.9 (34.2, 45.9) 6 (824)	63.9 (46.0, 78.6) 5 (169)	23.6 (10.5, 44.9) 3 (69)
			Ceftazidime	6.5 (3.2, 12.9) 16 (1353)	0.3 (0.1, 0.9) 1 (30)	0.2 (0.0, 0.9) 0 (0)	10.4 (2.5, 33.9) 1 (16)	7.4 (2.5, 19.7) 7 (929)	18.8 (8.4, 36.8) 6 (193)	7.6 (4.8, 11.6) 1 (185)
			Ceftriaxone	27.8 (19.1, 38.5) 20 (2445)	2.0 (0.7, 5.4) 2 (50)	4.6 (1.4, 14.0) 2 (468)	40.9 (21.6, 63.3) 3 (103)	49.8 (41.4, 58.1) 4 (1209)	56.9 (47.3, 65.9) 7 (373)	19.7 (11.7, 31.3) 2 (242)
		Fluoroquinolones	Ciprofloxacin	29.7 (22.9, 37.5) 33 (6318)	3.8 (1.1, 12.4) 4 (129)	14.4 (9.4, 21.5) 3 (2771)	75.5 (58.1, 87.3) 4 (232)	48.8 (39.4, 58.4) 8 (2370)	30.0 (21.8, 39.7) 11 (520)	21.6 (13.3, 32.9) 3 (296)
			Levofloxacin	32.7 (20.5, 47.7) 8 (263)	–	19.4 (12.4, 29.1) 1 (99)		43.5 (35.1, 52.3) 3 (93)	22.7 (6.1, 56.9) 4 (71)	
		Macrolides	Azithromycin	25.6 (14.2, 41.5) 10 (2738)	19.7 (10.4, 33.9) 1 (40)	4.7 (1.8, 11.9) 1 (1838)	45.3 (22.3, 70.4) 3 (157)	40.1 (34.6, 45.8) 3 (513)	1.2 (0.2, 6.2) 1 (66)	44.6 (36.3, 53.3) 1 (124)
Urinary tract	*E. coli*	Carbapenems	Doripenem	5.0 (1.9, 12.7) 11 (7520)	17.2 (4.3, 49.2) 0 (0)	0.4 (0.2, 1.0) 1 (497)	3.7 (3.1, 4.4) 3 (6038)	2.0 (0.8, 5.1) 1 (191)	12.2 (3.5, 34.8) 5 (783)	2.1 (0.2, 18.4) 1 (11)
			Ertapenem	2.8 (1.8, 4.5) 49 (1 461 392)	4.9 (2.1, 11.1) 13 (38 915)	2.4 (1.4, 3.8) 3 (203 741)	12.6 (8.9, 17.4) 5 (54 413)	0.3 (0.2, 0.5) 7 (99 9430)	4.7 (3.1, 6.9) 15 (112 828)	0.9 (0.3, 2.3) 6 (52 065)
			Imipenem	2.6 (2.0, 3.5) 61 (1 099 667)	4.3 (1.9, 9.7) 16 (43 449)	1.3 (0.9, 2.0) 5 (102 744)	16.3 (13.1, 20.2) 9 (89 608)	0.1 (0.1, 0.2) 8 (29 1984)	5.1 (3.3, 8.0) 17 (139 849)	0.5 (0.1, 2.2) 6 (432 033)
			Meropenem	2.0 (1.4, 2.8) 66 (2 267 193)	4.5 (1.9, 10.1) 15 (41 435)	0.9 (0.6, 1.3) 6 (235 391)	12.0 (9.5, 15.1) 10 (85 984)	0.1 (0.0, 0.1) 9 (114 9421)	4.6 (3.0, 7.0) 17 (141 641)	0.5 (0.1, 2.3) 9 (613 321)
		3rd– gen. cephalosporins	Cefotaxime	39.8 (33.9, 46.0) 62 (1 525 634)	47.4 (39.4, 55.6) 19 (45 966)	25.2 (19.6, 31.7) 4 (50 403)	60.4 (51.8, 68.4) 7 (72 335)	14.4 (11.1, 18.4) 8 (912 410)	51.2 (43.0, 59.3) 17 (82 694)	23.9 (20.9, 27.1) 7 (361 826)
			Ceftazidime	31.2 (26.4, 36.4) 65 (2 163 692)	42.5 (33.7, 51.8) 17 (44 012)	14.0 (9.0, 21.0) 6 (230 622)	49.6 (38.6, 60.7) 7 (53 532)	8.6 (6.8, 10.8) 9 (113 5040)	49.3 (41.0, 57.5) 17 (123 421)	13.8 (11.0, 17.2) 9 (577 065)

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
			Ceftriaxone	41.0 (34.7, 47.5) 62 (1 461 230)	50.4 (41.2, 59.6) 18 (44 529)	21.6 (17.7, 26.1) 5 (199 090)	52.4 (44.2, 60.5) 9 (62 573)	11.3 (8.4, 15.0) 5 (521 874)	50.9 (43.2, 58.5) 17 (148 315)	26.4 (21.7, 31.8) 8 (484 849)
		4th– gen. cephalosporins	Cefepime	30.8 (25.8, 36.3) 58 (1 448 174)	38.1 (28.7, 48.5) 16 (40 365)	25.7 (17.8, 35.7) 5 (241 497)	44.8 (38.6, 51.3) 7 (71 545)	9.2 (6.6, 12.7) 6 (435 537)	42.2 (34.4, 50.3) 17 (98 017)	13.4 (11.3, 15.7) 7 (561 213)
		Fluoroquinolones	Ciprofloxacin	39.4 (35.1, 43.8) 70 (2 931 838)	50.5 (43.9, 57.0) 20 (50 050)	37.3 (33.8, 41.1) 6 (265 746)	58.4 (53.2, 63.5) 9 (107 849)	13.4 (12.0, 15.1) 9 (1 950 418)	42.7 (36.2, 49.5) 17 (178 192)	32.6 (27.3, 38.2) 9 (379 583)
			Levofloxacin	40.0 (35.8, 44.4) 42 (893 017)	44.8 (35.2, 54.7) 11 (1581)	34.3 (31.9, 36.8) 2 (66 643)	54.0 (44.2, 63.4) 5 (14 923)	14.9 (13.4, 16.5) 4 (265 953)	44.1 (37.4, 51.1) 16 (53 032)	32.3 (30.8, 33.8) 4 (490 885)
		Polymyxins	Colistin	3.4 (2.1, 5.3) 32 (93 325)	12.9 (0.8, 72.0) 4 (4972)	1.0 (0.5, 2.1) 3 (34 491)	2.2 (0.5, 9.4) 5 (40 348)	3.4 (0.3, 30.5) 2 (579)	4.9 (2.7, 8.8) 14 (10 013)	1.2 (0.3, 4.4) 4 (2922)
		TMP– sulfa	Co–trimoxazole	53.2 (49.1, 57.2) 65 (1 608 229)	76.9 (73.5, 79.9) 19 (49 235)	44.3 (39.8, 49.0) 5 (248 692)	55.0 (51.7, 58.3) 9 (92 879)	23.4 (21.2, 25.7) 8 (924 316)	52.1 (45.8, 58.4) 16 (152 737)	41.0 (34.0, 48.3) 8 (140 370)
	K. pneumoniae	Carbapenems	Doripenem	19.4 (12.6, 28.7) 9 (2394)	–	4.4 (2.9, 6.5) 1 (218)	22.8 (19.2, 26.9) 3 (1993)	7.4 (2.2, 22.0) 1 (28)	43.0 (17.7, 72.5) 4 (155)	9.1 (4.2, 18.4) 0 (0)
			Ertapenem	12.5 (9.2, 16.8) 46 (258 475)	13.4 (10.3, 17.3) 11 (9426)	26.4 (16.7, 39.0) 3 (37 414)	33.4 (26.4, 41.2) 5 (17 316)	3.9 (1.7, 8.6) 7 (148 472)	16.5 (12.1, 22.0) 14 (29 013)	6.5 (3.7, 11.3) 6 (16 834)
			Imipenem	10.9 (8.7, 13.6) 56 (258 279)	11.2 (8.8, 14.0) 13 (10 801)	22.7 (16.1, 30.9) 5 (21 915)	31.1 (27.0, 35.6) 8 (26 546)	3.2 (1.3, 7.9) 8 (53 770)	15.5 (10.9, 21.5) 16 (38 915)	2.7 (1.0, 7.3) 6 (106 332)
			Meropenem	8.9 (6.8, 11.5) 62 (449 060)	12.5 (9.1, 17.0) 14 (10 647)	19.1 (12.1, 28.8) 6 (45 596)	27.9 (23.4, 32.9) 10 (26 545)	1.3 (0.6, 3.0) 9 (177 154)	15.5 (11.1, 21.1) 15 (42 762)	2.1 (0.7, 6.4) 8 (146 356)
		3rd– gen. cephalosporins	Cefotaxime	45.5 (38.6, 52.5) 55 (291 061)	57.8 (52.1, 63.2) 15 (11 413)	43.9 (28.0, 61.2) 3 (9917)	60.1 (54.9, 65.0) 7 (19 723)	22.0 (16.6, 28.4) 8 (140 655)	51.6 (44.2, 58.9) 15 (22 422)	26.2 (18.2, 36.2) 7 (86 931)
			Ceftazidime	42.5 (36.8, 48.5) 60 (422 211)	54.5 (49.1, 59.9) 15 (11 243)	34.4 (24.0, 46.6) 6 (43 581)	62.5 (57.8, 67.1) 7 (17 239)	17.8 (13.7, 22.6) 9 (178 101)	53.9 (46.7, 61.0) 15 (34 201)	21.3 (12.9, 33.1) 8 (137 846)
			Ceftriaxone	47.3 (41.0, 53.7) 57 (307 530)	62.0 (56.1, 67.6) 14 (11 238)	38.2 (30.7, 46.3) 5 (36 533)	56.9 (52.4, 61.3) 9 (19 396)	19.1 (12.7, 27.7) 5 (90 192)	53.4 (47.4, 59.3) 16 (40 545)	27.8 (18.1, 40.1) 8 (109 626)
		4th– gen. cephalosporins	Cefepime	39.4 (33.6, 45.6) 54 (308 514)	46.8 (40.4, 53.4) 13 (10 021)	48.7 (35.5, 62.0) 5 (45 288)	54.6 (51.7, 57.5) 7 (20 782)	20.4 (13.6, 29.5) 6 (70 709)	45.5 (37.5, 53.7) 16 (27 725)	16.5 (10.2, 25.5) 7 (133 989)
		Fluoroquinolones	Ciprofloxacin	39.1 (33.9, 44.6) 66 (481 218)	46.7 (40.9, 52.6) 17 (12 717)	42.1 (34.6, 50.0) 6 (48 629)	60.7 (57.0, 64.4) 9 (30 274)	18.9 (15.1, 23.3) 9 (251 576)	42.7 (37.0, 48.5) 16 (48 174)	24.7 (13.7, 40.5) 9 (89 848)
			Levofloxacin	32.8 (26.2, 40.3) 37 (193 423)	31.1 (20.8, 43.7) 8 (469)	40.8 (29.9, 52.7) 2 (11 973)	56.5 (50.9, 62.1) 5 (4833)	18.7 (13.5, 25.4) 4 (45 926)	36.5 (30.4, 43.0) 14 (13 023)	15.7 (8.3, 27.8) 4 (117 199)
		Polymyxins	Colistin	8.9 (6.6, 11.8) 31 (27 322)	25.6 (1.6, 88.2) 4 (1415)	7.0 (4.6, 10.4) 3 (6314)	7.5 (3.5, 15.4) 5 (14 633)	6.8 (2.8, 15.5) 3 (399)	11.4 (8.7, 14.9) 12 (3738)	4.7 (1.6, 12.9) 4 (823)
		TMP– sulfa	Co–trimoxazole	46.4 (41.5, 51.4) 62 (315 457)	65.5 (60.6, 70.0) 17 (12 369)	36.7 (28.3, 45.9) 5 (43 887)	52.9 (50.0, 55.9) 9 (25 409)	24.6 (18.9, 31.3) 8 (159 582)	47.2 (40.8, 53.7) 15 (40 977)	35.6 (25.5, 47.1) 8 (33 233)

				% Resistance (95% CrI), 2023 No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South–East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
Urogenital	*N. gonorrhoeae*	Aminoglycosides	Gentamicin	0.9 (0.3, 2.9) 5 (7492)	0.2 (0.0, 2.4) 1 (341)	3.7 (0.7, 17.1) 1 (3502)	2.3 (0.9, 5.4) 1 (170)	–	–	0.0 (0.0, 0.2) 2 (3479)
			Spectinomycin	0.0 (0.0, 0.1) 16 (12 877)	0.0 (0.0, 0.5) 1 (89)	0.0 (0.0, 0.1) 1 (1594)	0.0 (0.0, 0.6) 1 (171)	0.1 (0.0, 0.2) 8 (4072)	0.0 (0.0, 3.5) 0 (0)	0.0 (0.0, 0.1) 5 (6951)
		3rd– gen. cephalosporins	Cefixime	0.8 (0.4, 1.6) 28 (12 434)	0.5 (0.0, 19.3) 3 (448)	0.6 (0.2, 1.5) 2 (5240)	1.0 (0.1, 9.4) 3 (212)	0.4 (0.2, 1.0) 15 (5239)	10.7 (5.0, 21.4) 3 (286)	4.2 (1.1, 15.0) 2 (1009)
			Ceftriaxone	0.3 (0.1, 0.6) 38 (20 088)	0.3 (0.0, 10.2) 3 (448)	0.1 (0.0, 0.5) 3 (5517)	0.6 (0.2, 2.2) 3 (261)	0.1 (0.0, 0.2) 16 (5433)	2.5 (0.8, 7.7) 7 (597)	1.0 (0.5, 2.0) 6 (7832)
		Fluoroquinolones	Ciprofloxacin	75.0 (70.9, 78.8) 40 (20 562)	86.2 (64.2, 95.6) 3 (117)	70.6 (55.5, 82.3) 3 (5516)	87.8 (79.3, 93.2) 4 (307)	66.1 (62.1, 69.9) 16 (6420)	82.2 (77.6, 86.1) 8 (566)	77.3 (68.8, 84.0) 6 (7636)
		Macrolides	Azithromycin	12.6 (8.8, 17.7) 22 (17 766)	2.5 (1.3, 4.6) 2 (359)	9.3 (6.2, 13.5) 3 (5516)	6.6 (1.5, 24.9) 3 (224)	25.8 (17.0, 37.2) 4 (3798)	7.4 (2.3, 21.5) 5 (401)	3.5 (2.4, 5.1) 5 (7468)

Numbers of infections with AST and numbers of countries (including three territories and areas) refer to those included in the analysis. This analysis considered countries that reported infections with AST either in 2023 or for at least three years between 2018 and 2023. Location–time points with fewer than 10 infections with AST were excluded.

[a] Includes three territories and areas

[b] Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

Annex 6.

Table A6.1. National AMR estimates, 2023

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
African Region	Algeria	86.3 (80.2, 91.2) 211 (211)	39.5 (31.2, 48.4) 196 (196)	3 (1, 7.2) 197 (197)	48.3 (38.3, 58.4) 56 (56)	79.8 (74.0, 85.0) 301 (301)	18.8 (13.6, 25.3) 282 (282)	3.1 (0.2, 15.8) 17 (17)	43.9 (37.6, 50.6) 439 (439)	–	–	–	19.7 (17.8, 21.7) 3133 (3133)	0.8 (0.4, 1.3) 2577 (2577)	50.8 (46.1, 55.5) 823 (823)	7.4 (5.0, 10.5) 685 (685)	–
	Benin	33.4 (26.9, 40.3) 166 (313)	76.1 (71.1, 80.8) 173 (330)	2.8 (1.1, 5.6) 139 (260)	77.3 (72.2, 81.8) 173 (329)	87.5 (84.2, 90.4) 317 (654)	8.3 (5.6, 12) 268 (572)	10.3 (1.6, 35.1) 13 (13)	60.5 (54.8, 66.2) 261 (495)	–	–	–	–	–	–	–	–
	Burkina Faso	56.5 (33.4, 78.6) 16 (16)	–	15.6 (7.7, 27.2) 20 (88)	86.6 (78.6, 92.4) 26 (75)	–	14.2 (6.5, 26.6) 21 (124)	–	24 (16.5, 33.5) 59 (180)	–	7.7 (2.7, 17.7) 13 (105)	6.7 (1.0, 22.1) 13 (25)	54.0 (47.8, 60.1) 210 (413)	8.6 (6.5, 11.2) 589 (3112)	49.9 (35.5, 64.8) 46 (46)	19.6 (14.6, 25.5) 189 (787)	–
	Burundi	–	–	–	–	–	–	–	–	–	–	–	53.3 (31.0, 74.5) 17 (17)	–	–	–	–
	Cameroon	28.1 (15.4, 43.9) 20 (38)	71.8 (60.9, 80.9) 46 (76)	9.4 (4.6, 17.2) 65 (114)	86.1 (78.1, 92.1) 60 (87)	79.7 (67.9, 88.4) 62 (93)	15.8 (8.8, 25.6) 71 (116)	27.2 (12.0, 47.7) 21 (21)	62.5 (49.6, 74.0) 24 (60)	–	26.9 (9.9, 51.4) 13 (13)	–	56.3 (51.9, 60.8) 435 (796)	8.2 (6.1, 11.0) 537 (1111)	62.0 (54.8, 68.7) 169 (296)	9.0 (5.5, 13.8) 186 (369)	–
	Chad	–	–	–	–	–	–	–	–	–	–	–	57.1 (44.1, 69.4) 75 (75)	20.5 (11.6, 32.7) 84 (84)	–	–	–
	Côte d'Ivoire	–	71.5 (44.8, 89.6) 12 (12)	1 (0.0, 11.6) 12 (12)	72.4 (46.8, 90.1) 12 (12)	81.8 (62.4, 93.5) 16 (30)	10.7 (2.9, 27.8) 16 (34)	–	92.2 (84.8, 96.6) 57 (194)	–	–	–	56.5 (50.3, 62.6) 343 (485)	2.9 (1.4, 5.4) 342 (508)	55.4 (45.7, 64.5) 149 (201)	3.5 (1.5, 7.7) 149 (211)	–
	Democratic Republic of the Congo	66.9 (45.9, 84.4) 21 (21)	73.4 (66.9, 79.2) 156 (207)	18.1 (10.7, 28.0) 77 (101)	73.4 (67.2, 79.0) 156 (265)	88 (82.2, 92.5) 164 (223)	11.8 (6.7, 18.7) 89 (149)	69.7 (61.5, 77.1) 378 (782)	89.3 (82.0, 94.1) 94 (143)	–	–	–	–	–	–	–	–
	Eswatini	–	–	–	–	74.6 (56.9, 87.8) 27 (27)	–	–	29.7 (18.0, 44.4) 23 (34)	–	–	,	39.1 (24.0, 56.1) 19 (33)	–	–	–	–

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	Ethiopia	67.7 (53.2, 79.1) 28 (79)	84.1 (76.3, 90.2) 38 (109)	13.5 (6.8, 23.4) 47 (86)	89.5 (85.1, 92.9) 38 (153)	91.3 (84.5, 95.4) 94 (346)	25.9 (15.9, 38.4) 120 (303)	23.9 (9.5, 46.0) 27 (27)	56.4 (47.4, 65.0) 92 (415)	–	–	6.6 (1.1, 21.2) 19 (19)	79.3 (74.7, 83.3) 141 (739)	10.3 (7.0, 14.6) 238 (557)	88.5 (82.7, 93.1) 31 (237)	27.7 (18.4, 38.8) 57 (147)	–
	Ghana	–	74.5 (66.7, 81.1) 32 (170)	–	88.2 (82.9, 92.3) 32 (152)	–	–	–	55.6 (48.0, 62.7) 143 (590)	–	–	–	–	–	–	–	–
	Guinea	–	–	–	–	–	–	–	–	–	–	–	39.7 (30.4, 49.5) 130 (130)	2.5 (0.8, 6.3) 150 (150)	50.2 (36.1, 64.4) 53 (53)	3.2 (0.7, 9.2) 61 (61)	–
	Kenya	–	65.5 (51.3, 76.7) 183 (224)	–	76.0 (67.0, 83.7) 215 (280)	80.6 (65.3, 90.9) 312 (392)	–	6.9 (1.9, 17.6) 32 (44)	41.1 (29.5, 54.3) 63 (111)	–	8.7 (1.7, 29.1) 17 (17)	–	50.6 (44.4, 56.9) 676 (831)	–	59.7 (44.6, 73.1) 255 (308)	–	–
	Liberia	–	–	–	–	–	–	–	–	–	–	–	53.4 (36.5, 69.4) 21 (45)	9.0 (2.2, 23.8) 22 (56)	–	–	–
	Madagascar	–	–	0.6 (0.0, 6.0) 11 (69)	45.6 (31.6, 60.9) 11 (76)	–	1.3 (0.1, 7.9) 15 (106)	–	31.7 (14.9, 53.1) 14 (70)	–	–	–	–	0.9 (0.1, 4) 52 (551)	–	2.1 (0.2, 10.4) 18 (137)	–
	Malawi	–	79.9 (60.0, 92.8) 19 (19)	–	73.8 (62.7, 83.4) 19 (742)	–	–	14.5 (4.9, 31.4) 20 (82)	42.6 (30.7, 54.9) 12 (887)	–	–	–	65.1 (55.1, 76.0) 114 (114)	0.7 (0.0, 6.7) 24 (24)	76.9 (57.2, 90.9) 19 (19)	–	–
	Mali	52.4 (22.1, 78.4) 20 (46)	56 (45.6, 66.3) 72 (361)	–	61.7 (49.3, 73.2) 72 (441)	59.0 (37.8, 77.2) 27 (107)	–	5.4 (1.3, 19.4) 63 (669)	13.5 (5.8, 29) 50 (278)	47.4 (32.1, 63.8) 39 (245)	–	–	66.0 (58.5, 73.2) 56 (550)	–	69.5 (56.0, 81.1) 11 (72)	–	–
	Mauritius	77.4 (47.5, 92.8) 213 (969)	51.7 (33.2, 69.0) 432 (1443)	3.7 (1.2, 10.7) 430 (1439)	55.7 (35.5, 75.2) 430 (1440)	73.4 (49.3, 88.5) 298 (1343)	33.1 (10.3, 66.1) 298 (1343)	2.8 (0.2, 17.2) 13 (13)	33.0 (18.1, 51.6) 582 (1765)	1.6 (0.1, 16.4) 12 (12)	4.5 (0.7, 24.4) 55 (280)	–	43.8 (22.2, 68.2) 3293 (11 753)	10.2 (1.9, 40.7) 2088 (6738)	60.3 (30.7, 84) 818 (3652)	32.1 (11.8, 60.2) 573 (2417)	0.1 (0.0, 3.2) 89 (163)
	Mozambique	–	–	–	–	–	10.5 (3.2, 29) 17 (88)	–	13.7 (6.0, 27.7) 12 (115)	–	–	–	–	–	–	–	–
	Namibia	–	14.7 (7.9, 23.8) 23 (76)	15.5 (8.1, 25.7) 33 (88)	23.0 (14.3, 33.7) 16 (71)	28.7 (18.4, 40.9) 14 (74)	10.4 (4.3, 20.2) 19 (79)	–	9.9 (4.2, 19.0) 23 (68)	–	–	1.1 (0.1, 4.6) 39 (89)	5.5 (3.8, 7.6) 309 (785)	4.3 (2.6, 6.6) 544 (1062)	20.5 (14.4, 27.9) 59 (181)	5.6 (2.8, 10.3) 113 (242)	–
	Nigeria	–	–	–	81.9 (72.1, 89.3) 33 (72)	–	–	–	64.8 (56.6, 72.4) 93 (500)	–	–	–	–	–	–	–	–

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	South Africa	67.1 (65.9, 68.3) 5873 (25 971)	34.2 (32.7, 35.7) 4525 (16 800)	1.6 (1.3, 2.0) 4533 (24 696)	32.7 (31.6, 34.0) 4525 (24 705)	67.3 (65.9, 68.6) 6951 (26 695)	26.8 (25.7, 27.9) 6920 (38 955)	4.1 (3.1, 5.4) 794 (4434)	12.9 (12.3, 13.5) 6874 (36 494)	38.1 (33.6, 42.7) 363 (2063)	–	–	19.5 (19.0, 20.1) 35 934 (35 934)	0.3 (0.2, 0.4) 35 578 (72 275)	43.4 (42.1, 44.8) 8662 (8662)	10.4 (9.7, 11.2) 8571 (16 832)	0.0 (0.0, 0.2) 341 (1923)
	Uganda	–	–	9.8 (3.0, 22.9) 16 (47)	80.0 (69.2, 88.3) 16 (72)	–	–	–	–	–	–	–	65.2 (57.8, 72.4) 68 (641)	3.1 (1.3, 6.4) 117 (845)	58.5 (45.3, 71.4) 15 (115)	7.3 (2.4, 17.3) 22 (151)	–
	United Republic of Tanzania	43.7 (27.3, 61.7) 31 (43)	67.3 (60.5, 73.5) 134 (228)	18.3 (10.5, 28.7) 43 (94)	78.2 (73.9, 82.0) 134 (607)	79.2 (70.0, 86.4) 105 (211)	25.5 (14.1, 40.2) 46 (100)	–	63.8 (60.3, 67.3) 674 (2382)	–	–	–	56.8 (52.9, 60.6) 639 (1022)	24.6 (19.5, 30.3) 261 (528)	57.4 (50.6, 64.0) 185 (296)	30.5 (21.5, 41.3) 67 (141)	–
	Zambia	17.7 (7.9, 32.7) 20 (46)	75.5 (65.3, 84.1) 31 (115)	7.7 (3.6, 14.6) 39 (158)	87.1 (81.2, 91.7) 31 (232)	87 (78.1, 92.9) 66 (154)	9.9 (5.8, 15.9) 75 (254)	–	57.7 (49.6, 65.8) 107 (255)	–	11.1 (5.9, 18.9) 68 (121)	13.9 (7.6, 22.5) 58 (136)	52.0 (47.9, 56.2) 353 (1118)	3.6 (2.1, 5.8) 246 (842)	71.8 (66.2, 77.0) 118 (403)	6.0 (3.2, 10.2) 110 (343)	–
	Zimbabwe	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1 (0.0, 4.2) 18 (18)
Region of the Americas[b]	Argentina	72.6 (69.5, 75.6) 560 (3120)	21.5 (20.0, 23.1) 1743 (8566)	1.3 (0.9, 1.7) 2384 (12 235)	22.9 (21.3, 24.4) 1743 (9903)	55.8 (53.4, 58.1) 1452 (6248)	35.2 (33.4, 37.1) 2113 (10 762)	0.9 (0.4, 1.9) 784 (2643)	35.9 (34.3, 37.6) 2257 (10 906)	–	2.1 (1.4, 3.1) 883 (3499)	9.3 (7, 12) 2249 (12 343)	22.5 (21.9, 23.1) 11 649 (85 650)	0.5 (0.5, 0.6) 20 227 (124 215)	54.1 (52.8, 55.5) 3133 (17 018)	27.7 (26.6, 28.8) 4880 (24 535)	–
	Brazil	52.8 (46.0, 59.8) 113 (528)	–	2.6 (0.8, 6.5) 49 (347)	34.6 (31.2, 38.2) 765 (1427)	–	41.1 (33.2, 49.4) 97 (584)	14.2 (3.0, 37.6) 13 (13)	25.8 (22.8, 29.1) 1095 (2140)	7.9 (3.8, 14.6) 84 (101)	–	–	19.2 (12.2, 28.2) 83 (161)	2.5 (1.3, 4.2) 562 (1776)	–	23.3 (19.2, 27.9) 214 (1568)	–
	Colombia	23.1 (20.9, 25.4) 1227 (3368)	26.8 (24.6, 29.1) 1269 (4287)	2.0 (1.7, 2.3) 12 560 (30 925)	25.7 (24.3, 27.2) 1269 (4287)	38.6 (35.6, 41.7) 1018 (3952)	24 (23, 25.1) 9066 (24 434)	26.8 (23.7, 30.0) 843 (2246)	49.6 (48.2, 50.9) 6171 (14 633)	1.1 (0.7, 1.7) 1345 (2213)	30.0 (27, 33.1) 971 (2082)	19.1 (15.4, 23.0) 442 (1062)	18.3 (17.9, 18.7) 33 899 (140 494)	0.6 (0.6, 0.7) 81 757 (210 548)	25.6 (24.5, 26.6) 6228 (24 813)	13.5 (12.9, 14.2) 16 760 (40 766)	0.0 (0, 0.4) 277 (537)
	Peru	68.9 (57.9, 78.3) 11 (732)	62.0 (54.3, 69.2) 30 (303)	5.8 (3.2, 9.6) 23 (689)	70.8 (64.9, 76.3) 175 (384)	74.4 (66.1, 81.6) 40 (360)	31.5 (23.5, 40.1) 46 (775)	15.0 (6.4, 29.4) 27 (78)	37.3 (28.6, 46.1) 31 (291)	,	17.6 (9.3, 29.6) 69 (200)	11.6 (5.2, 21.9) 80 (377)	42.0 (40.3, 43.7) 4772 (8250)	4.6 (3.1, 6.8) 181 (11 102)	54.4 (49.5, 59.3) 556 (1058)	33.9 (26.6, 42.4) 47 (1775)	–
	Trinidad and Tobago	–	–	–	–	–	–	–	–	–	–	–	–	2.3 (0.4, 7.9) 17 (116)	–	17.8 (8.1, 32.8) 14 (74)	–
	United States of America	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.1 (0.0, 0.2) 3502 (17 826)

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
South, East Asia Region	Bangladesh	96.6 (85.1, 99.7) 30 (30)	79.9 (66.4, 89.4) 18 (45)	23.2 (10.4, 41.7) 15 (66)	88.1 (81.4, 93.1) 50 (139)	87.0 (71.7, 95.7) 26 (26)	51.1 (31.5, 70.2) 19 (33)	16.4 (10.0, 24.5) 65 (351)	79.0 (68.9, 87) 59 (85)	–	17.4 (5.2, 39.2) 13 (25)	89.1 (71.7, 97.7) 18 (18)	64.7 (59.3, 69.8) 248 (341)	27.4 (22.1, 33.3) 249 (1171)	53.2 (43.7, 62.4) 96 (116)	29.7 (19.3, 42.0) 56 (269)	–
	Bhutan	–	–	–	65 (55.4, 74.0) 36 (243)	–	–	–	8.6 (3.2, 19.0) 20 (181)	–	–	–	–	–	–	–	0.1 (0.0, 3.5) 28 (28)
	India	71.2 (70.4, 72.0) 9946 (30 983)	78.5 (77.7, 79.3) 6564 (25 744)	32.3 (31.4, 33.2) 8962 (30 295)	79.4 (78.5, 80.2) 6564 (17 527)	79.6 (78.7, 80.6) 6132 (24 864)	61.2 (60.2, 62.3) 9065 (32 301)	–	50.9 (49.9, 51.8) 8373 (37 592)	–	28.9 (24.6, 33.4) 340 (1084)	82.1 (75.4, 87.7) 186 (186)	73.5 (73.2, 73.8) 51 874 (174 593)	19.2 (18.9, 19.5) 64 488 (206 402)	69.9 (69.3, 70.6) 13 440 (44 535)	40.3 (39.6, 41.0) 18 739 (59 460)	–
	Indonesia	61.1 (57.8, 64.5) 848 (1647)	71.7 (69.4, 74.0) 1197 (2584)	12.9 (10.8, 15.4) 786 (1617)	73.6 (71.4, 75.6) 1197 (3616)	73.7 (71.1, 76.0) 1361 (3239)	31.2 (28.4, 34.4) 1037 (2275)	22.6 (16.3, 30) 110 (433)	36.0 (33.7, 38.3) 1362 (3621)	6.1 (1.7, 15.6) 31 (56)	48.7 (32.5, 65.6) 31 (31)	33.2 (13.1, 59.1) 13 (13)	65.3 (64.0, 66.6) 5167 (10 627)	14.1 (12.9, 15.4) 3786 (7080)	66.2 (64.1, 68.3) 1919 (4309)	25.2 (22.8, 27.6) 1493 (2984)	,
	Maldives	26.6 (5.5, 67.0) 12 (12)	–	0.6 (0.0, 6.3) 33 (33)	64.6 (45.5, 80.3) 27 (54)	–	58.2 (22.1, 86.2) 34 (34)	–	28.6 (12.0, 52.1) 30 (30)	–	24.4 (5.4, 61.5) 12 (12)	–	–	2.1 (0.3, 12.7) 737 (737)	–	16.5 (5.2, 41.1) 291 (291)	–
	Myanmar	38.2 (21.9, 57.7) 12 (226)	79.0 (68.3, 87.2) 16 (89)	27.7 (18.6, 38.0) 53 (596)	78.5 (71.1, 84.8) 16 (90)	–	50.9 (36.0, 66.4) 29 (264)	–	51.8 (38.6, 64.7) 25 (793)	–	–	–	77.8 (73.6, 81.5) 396 (1427)	35.9 (31.9, 40.0) 547 (3099)	71.4 (63.0, 78.8) 125 (176)	39.3 32.8, 46.5) 168 (833)	–
	Nepal	58.6 (53.8, 63.3) 273 (1192)	61.9 (53.2, 69.5) 89 (297)	20.6 (16.6, 25.1) 281 (837)	79.2 (75.0, 83.1) 186 (518)	77.8 (67.1, 86.2) 73 (324)	54.6 (49.4, 59.8) 292 (1208)	48.6 (40.6, 56.5) 34 (1229)	75.3 (70.9, 79.2) 569 (820)	11.8 (3.8, 26.0) 28 (58)	13.3 (4.8, 27.8) 17 (120)	81.9 (64.3, 93.0) 15 (85)	53.6 (52.1, 55.0) 5125 (10 424)	9.0 (8.3, 9.7) 5326 (15 847)	52.6 (49.2, 55.7) 927 (1648)	32.9 (30.5, 35.3) 1194 (3639)	–
	Sri Lanka	61.6 (52.5, 70.0) 55 (479)	58.8 (55.6, 61.9) 719 (2169)	32.1 (27.4, 36.9) 305 (1394)	63.4 (59.9, 66.8) 719 (2928)	68.8 (64.0, 73.1) 284 (1166)	57.9 (51.3, 64.2) 99 (891)	13 (5.5, 24.7) 36 (84)	47.8 (44.4, 51.3) 691 (1983)	–	–	–	40.6 (38.7, 42.5) 2168 (7827)	34.9 (30.5, 39.6) 282 (3738)	47.5 (44.3, 50.8) 734 (2706)	–	–
	Thailand	60.5 (58.5, 62.6) 2078 (5889)	37.3 (35.3, 39.3) 2051 (10 552)	3.2 (2.7, 3.9) 4690 (14 905)	39.0 (37.4, 40.7) 3807 (12 308)	42.1 (39.2, 45.1) 927 (4892)	18.5 (16.8, 20.4) 2371 (7475)	4.6 (3.1, 6.5) 475 (1263)	7.8 (6.4, 9.3) 1054 (3578)	9.0 (6.5, 11.9) 264 (823)	5.8 (4.6, 7.3) 1125 (3466)	–	43.2 (42.0, 44.4) 7357 (30 620)	4.7 (4.3, 5.1) 14 158 (38 848)	58.6 (56.6, 60.6) 2482 (10061)	24.7 (23.2, 26.3) 4591 (12 948)	0.5 (0.1, 1.9) 215 (555)
	Timor Leste	–	–	19.6 (10.2, 32.7) 30 (75)	41.2 (31.5, 51.5) 46 (96)	–	2.3 (0.3, 8.2) 37 (101)	–	22.2 (14.2, 32.3) 50 (101)	–	–	–	–	10.2 (4.6, 19.6) 35 (213)	–	5.6 (1.4, 15.7) 14 (68)	4.6 (0.2, 31.2) 18 (18)

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
European Region	Austria	9.3 (4.9, 16.2) 34 (235)	8.0 (7.3, 8.8) 3070 (24 336)	0.3 (0.1, 0.6) 1507 (13 092)	9.1 (8.2, 10.1) 440 (27 378)	14.8 (12.4, 17.5) 742 (5443)	2.1 (1.2, 3.6) 447 (3043)	–	4.4 (3.7, 5.2) 1522 (13 175)	1.3 (0.6, 2.4) 503 (2064)	–	–	–	–	–	–	0.0 (0.0, 0.7) 303 (1050)
	Belgium	4.8 (1.8, 10.3) 30 (176)	9.2 (8.1, 10.5) 1352 (10 361)	0.1 (0.0, 0.3) 329 (2239)	11.7 (10.4, 13.1) 2941 (11 950)	19.3 (15.7, 23.5) 274 (2184)	1.3 (0.3, 4.1) 54 (380)	45.7 (36.6, 54.7) 74 (301)	5.9 (4.6, 7.6) 1114 (4611)	2.1 (1.6, 2.8) 1654 (4812)	26.7 (23.5, 30.2) 394 (2648)	36.2 (32.0, 40.6) 428 (873)	–	–	–	–	0.1 (0, 0.8) 174 (470)
	Bosnia and Herzegovina	98.1 (96.8, 98.9) 217 (1974)	25.0 (21.6, 28.7) 332 (1526)	0.4 (0.1, 1.1) 338 (1526)	26.1 (22.5, 30.0) 332 (1526)	84.3 (81.1, 87.1) 377 (1509)	45.6 (40.8, 50.5) 378 (1569)	–	22.5 (17.9, 27.9) 116 (847)	35.9 (23.6, 50.3) 37 (147)	–	–	–	–	–	–	–
	Croatia	97.2 (94.7, 98.7) 97 (1163)	–	0.2 (0.1, 0.6) 445 (3998)	17.8 (15.8, 20.0) 827 (4899)	,	26.8 (21.5, 32.9) 194 (1480)	24.5 (7.1, 51.3) 12 (12)	23.8 (20.8, 27.0) 606 (1483)	0.4 (0.0, 3.2) 26 (269)	34.7 (30.8, 38.8) 554 (1432)	–	–	–	–	–	–
	Cyprus	85.2 (79.3, 90.0) 94 (657)	25.5 (20.1, 31.6) 138 (633)	0.9 (0.3, 2.0) 252 (975)	41.1 (34.4, 48.2) 106 (605)	55.5 (46.7, 64.1) 96 (500)	33.8 (26.9, 41.3) 163 (709)	–	50.6 (43.0, 58.1) 83 (785)	16.0 (6.6, 31.1) 28 (53)	27.1 (20.0, 34.8) 122 (384)	–	–	–	–	–	–
	Czechia	41.7 (32.9, 51.1) 43 (427)	13.2 (11.9, 14.6) 1559 (14 602)	0.4 (0.1, 1.1) 172 (1157)	14.1 (13.0, 15.4) 2332 (19 016)	45.4 (42.5, 48.4) 615 (6906)	–	–	6.2 (5.4, 7.2) 172 (10 893)	0.8 (0.2, 2.6) 115 (1274)	25.8 (19.3, 33.2) 171 (171)	–	–	–	–	–	–
	Denmark	–	–	–	9.0 (7.9, 10.3) 574 (8160)	–	–	–	1.7 (1.2, 2.3) 1860 (10 407)	0.8 (0.2, 2.1) 226 (1123)	–	–	–	–	–	–	0.0 (0.0, 0.7) 162 (362)
	Estonia	22.4 (7.0, 46.8) 13 (13)	10.5 (8.7, 12.6) 701 (2633)	0.1 (0.0, 0.7) 220 (699)	12.3 (10.2, 14.8) 383 (2315)	13.9 (10.1, 18.8) 192 (660)	1.9 (0.4, 5.6) 68 (186)	–	3.0 (1.7, 5.1) 203 (726)	0.5 (0.1, 2.3) 104 (280)	23.8 (18.3, 29.9) 173 (435)	–	–	–	–	–	–
	Finland	–	6.6 (4.7, 9.4) 46 (1147)	0.2 (0.0, 0.9) 110 (1331)	7.4 (6.5, 8.3) 46 (18 214)	–	3.9 (0.9, 12.1) 11 (152)	28.6 (12.7, 49.2) 19 (19)	1.6 (1.1, 2.4) 253 (8101)	1.0 (0.4, 2.0) 411 (1961)	12.3 (7.8, 18.3) 94 (1422)	–	–	0.1 (0.0, 0.7) 146 (1348)	–	19.9 (10.8, 32.3) 55 (223)	–
	France	–	–	–	–	–	–	33.0 (22.8, 45.0) 56 (294)	–	2.7 (1.9, 3.6) 863 (5062)	25.6 (23.4, 27.9) 1191 (4332)	–	–	–	–	–	0.2 (0.0, 1.7) 174 (601)
	Georgia	82.6 (76.3, 87.8) 75 (640)	42.4 (36.5, 48.3) 128 (615)	3.6 (1.8, 6.4) 178 (684)	45.3 (39.7, 50.9) 195 (695)	84.1 (79.1, 88.3) 102 (815)	72 (65.6, 77.6) 134 (922)	–	28.2 (22.9, 33.9) 165 (653)	–	2 (0.4, 6.4) 30 (134)	–	–	–	–	–	–

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		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	Germany	4.0 (2.7, 5.8) 335 (2545)	9.4 (8.9, 9.9) 13990 (120 638)	0.1 (0.1, 0.2) 16 747 (124 327)	9.7 (9.3, 10.2) 7158 (12 2646)	11.3 (10.3, 12.5) 3111 (25 943)	2.1 (1.6, 2.7) 3812 (27026)	33.5 (29.0, 38.3) 319 (1116)	3.9 (3.6, 4.3) 1109 (54 115)	2.3 (1.8, 2.8) 3358 (10 125)	15.1 (14.1, 16.2) 2364 (14 052)	43.4 (36.7, 50.4) 210 (449)	7.2 (7.1, 7.3) 539 525 (2 152 209)	0.1 (0.1, 0.1) 11 9371 (750 761)	9.8 (9.5, 10.0) 93 278 (367 289)	1.7 (1.5, 2.0) 23 983 (143 945)	0.0 (0.0, 0.3) 164 (1392)
	Greece	93.7 (91.9, 95.3) 1388 (5735)	19.6 (17.0, 22.5) 1352 (4854)	2.1 (1.3, 3.2) 1580 (5581)	21.5 (18.8, 24.5) 1352 (5429)	78.6 (75.8, 81.1) 1499 (5562)	71.8 (68.7, 74.7) 1984 (7027)	41.8 (22.0, 63.3) 23 (48)	37.6 (33.7, 41.4) 922 (4410)	3.6 (1.0, 10.0) 58 (88)	39.1 (33.8, 45.0) 390 (757)	–	–	–	–	–	0.0 (0.0, 0.9) 72 (333)
	Iceland	–	11.6 (8.6, 15.3) 258 (493)	–	11.9 (8.8, 15.8) 258 (493)	8.3 (3.2– 17.5) 44 (76)	–	–	4.4 (2.3, 7.7) 128 (272)	1.3 (0.1, 6.4) 35 (69)	–	–	–	–	–	–	0.1 (0.0, 1.3) 99 (148)
	Ireland	2.7 (0.4, 10.4) 12 (55)	8.7 (7.6, 9.9) 1423 (10 147)	0.2 (0.0, 0.8) 63 (1695)	9.6 (8.5, 10.8) 1012 (11 818)	13.5 (10.5, 17.1) 273 (1792)	–	–	9.0 (7.7, 10.6) 947 (4584)	1.9 (1.0, 3.3) 339 (1277)	–	–	–	–	–	–	0.0 (0.0, 0.7) 108 (399)
	Italy	80.1 (78.0, 82.0) 1368 (7299)	20.9 (20.3, 21.5) 13795 (83 414)	0.5 (0.4, 0.7) 11 426 (55 630)	22.9 (22.0, 23.8) 1264 (26 556)	51.2 (50.0, 52.4) 6590 (36 030)	28.2 (27.0, 29.3) 6241 (28 425)	40.9 (32.8, 49.2) 123 (283)	24.1 (23.3, 25.0) 1412 (38 634)	4.9 (3.8, 6.2) 1132 (3944)	19.1 (17.1, 21.3) 1473 (3710)	65.7 (40.8, 85.8) 13 (13)	–	–	–	–	0.0 (0.0, 0.9) 75 (332)
	Latvia	61.3 (51.0, 71.1) 55 (341)	20.5 (17.3, 23.9) 327 (1768)	0.2 (0.0, 0.6) 327 (2041)	22.3 (18.9, 26.1) 327 (1304)	36.5 (30.3, 42.9) 143 (833)	8.1 (4.5, 13.7) 143 (1027)	–	3.7 (2.5, 5.5) 234 (1486)	8.2 (3.2, 17.2) 44 (238)	–	–	14.7 (13.1, 16.5) 1575 (5912)	0.1 (0.0, 0.3) 1334 (5402)	42.1 (37.0, 47.3) 488 (1408)	5.3 (3.2, 8.6) 444 (1546)	–
	Lithuania	91.3 (85.8, 95.2) 55 (700)	14.7 (12.5, 17.1) 524 (3848)	0.3 (0.1, 0.7) 631 (4433)	16.8 (14.6, 19.2) 669 (4243)	33.5 (28.3, 39.0) 164 (1364)	3.3 (1.8, 5.6) 206 (1724)	–	6.6 (5.4, 8.1) 810 (4435)	1.2 (0.4, 2.9) 177 (673)	19 (15.0, 23.5) 313 (723)	–	–	–	–	–	–
	Luxembourg	–	–	0.5 (0.1, 1.9) 129 (380)	12.1 (9.8, 14.9) 461 (1836)	–	–	–	–	2.2 (0.6, 6.1) 62 (189)	23.0 (17.2, 29.5) 153 (472)	30.1 (17.7, 45.3) 40 (40)	–	–	–	–	–
	Malta	5.6 (1.6, 14.7) 22 (66)	10.5 (8.4, 12.9) 497 (2165)	0.1 (0.0, 0.5) 497 (2165)	10.7 (8.6, 13.2) 497 (2165)	23.5 (18.5, 29.2) 168 (857)	6.3 (3.8, 10.0) 168 (858)	–	14.0 (10.2, 19) 133 (633)	5.4 (1.4, 14.6) 28 (121)	15.5 (11.2, 20.7) 114 (690)	–	8.1 (7.4, 8.8) 4324 (14 983)	0.0 (0.0, 0.1) 4324 (14 983)	16.6 (14.6, 18.8) 1282 (4299)	2.3 (1.7, 3.3) 1282 (4305)	0.7 (0.0, 8.3) 29 (117)
	Netherlands (Kingdom of the)	1.1 (0.3, 2.8) 69 (536)	8.4 (7.6, 9.4) 2701 (28 564)	0.1 (0.0, 0.2) 3864 (32 120)	9.9 (9.0, 10.9) 3440 (33 816)	12.6 (10.3, 15.1) 551 (5437)	0.6 (0.3, 1.3) 737 (6168)	36.9 (29.7, 44.6) 152 (310)	2.8 (2.2, 3.6) 1576 (12 376)	1.7 (1.0, 2.8) 644 (4185)	24.5 (22.3, 26.9) 1211 (2825)	–	–	–	–	–	0.0 (0.0, 0.8) 72 (535)
	North Macedonia	97.5 (93.4, 99.3) 31 (202)	71.8 (59.0, 82.3) 14 (86)	1.7 (0.5, 4.4) 52 (346)	65.2 (56.5, 73.0) 34 (239)	85.3 (73.1, 93.0) 61 (353)	30.9 (20.7, 42.7) 95 (513)	–	45.8 (37.6, 54.5) 82 (338)	–	–	–	–	–	–	–	–

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		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	Norway	–	6.4 (5.4, 7.7) 1496 (11 999)	0.1 (0.0, 0.4) 173 (2148)	7.1 (6.0, 8.3) 1496 (15 878)	8.7 (6.1, 12.1) 296 (2400)	0.6 (0.1, 3.0) 29 (421)	27.1 (19.8, 35.4) 86 (314)	2.9 (1.8, 4.5) 382 (4886)	0.3 (0.1, 1.0) 376 (1383)	14.2 (11.5, 17.3) 341 (1446)	64.4 (56.7, 71.5) 114 (332)	4.4 (3.6, 5.5) 1478 (9565)	–	6.2 (4.7, 8.1) 775 (4310)	–	0.2 (0.0, 0.7) 815 (2397)
	Poland	76.8 (73.3, 80.0) 425 (2322)	17.1 (15.2, 19.1) 412 (8422)	0.2 (0.1, 0.4) 2544 (10 999)	20.1 (18.5, 21.8) 2384 (11 224)	63.8 (60.1, 67.5) 138 (4071)	22.3 (19.9, 24.9) 1356 (5909)	49.6 (38.7, 60.1) 78 (237)	14.2 (12.6, 16.0) 144 (7183)	8.6 (5.8, 12.3) 310 (1370)	47.7 (43.5, 51.8) 822 (1415)	–	–	–	–	–	0.1 (0.0, 2.5) 26 (110)
	Republic of Moldova	83.2 (74.1, 90.2) 61 (221)	62.5 (53.1, 71.4) 66 (125)	4.5 (1.6, 10.1) 67 (130)	65.1 (56.1, 73.7) 64 (129)	94.7 (91.8, 96.8) 188 (478)	59.2 (51.7, 66.3) 190 (480)	–	19.3 (12.2, 28.1) 35 (87)	–	63.3 (41.9, 81.8) 18 (80)	74.3 (48.9, 91.0) 12 (12)	26.5 (24.5, 28.5) 1901 (4510)	1.0 (0.6, 1.5) 2028 (4631)	59.2 (55.2, 63.2) 745 (1190)	22.6 (19.6, 26.1) 742 (1560)	–
	Russian Federation	84.9 (82.5, 87.0) 1302 (2747)	65.0 (61.5, 68.4) 1230 (2294)	5.1 (3.4, 7.5) 540 (1357)	69.8 (66.5, 72.9) 1230 (2125)	92.1 (90.7, 93.3) 3102 (5197)	72.1 (68.8, 75.1) 1202 (3149)	–	7.2 (6.0, 8.5) 1710 (3083)	6.4 (3.4, 10.8) 161 (291)	–	–	–	–	–	–	–
	Sweden	3.4 (1.7, 6.1) 125 (628)	–	0.1 (0.0, 0.2) 7115 (42 080)	9.6 (9.0, 10.3) 10717 (66 418)	–	1.1 (0.5, 2.1) 1399 (8034)	–	3.1 (2.7, 3.5) 7915 (46 913)	1.8 (0.8, 3.6) 267 (3359)	–	–	4.8 (4.6, 5.0) 36 782 (395 316)	0.2 (0.1, 0.2) 18 855 (135 741)	6.2 (5.5, 6.9) 4034 (40 502)	1.5 (1.1, 2.1) 3225 (19 913)	0.0 (0.0, 0.7) 93 (527)
	Switzerland	11.6 (7.6, 16.7) 107 (577)	9.7 (8.0, 11.6) 659 (3943)	0.1 (0.0, 0.2) 6139 (38 893)	11.4 (10.6, 12.4) 5634 (34 131)	8.8 (5.4, 13.4) 144 (860)	1.7 (1.0, 2.6) 1499 (8245)	22.5 (16.0, 30.1) 102 (549)	4.3 (3.6, 5.2) 2527 (8152)	2.7 (1.9, 3.8) 906 (4543)	17.0 (14.1, 20.2) 613 (1873)	34.2 (27.6, 41.3) 163 (472)	7.4 (6.7, 8.1) 6611 (28 055)	0.0 (0.0, 0.0) 106 658 (351 178)	7.2 (5.6, 9.3) 1203 (4929)	0.5 (0.3, 0.7) 19 611 (56 483)	0.1 (0.0, 0.7) 228 (646)
	Türkiye	86.4 (84.7, 87.9) 2726 (8200)	53.8 (49.7, 58.0) 293 (1464)	4.6 (3.9, 5.5) 4652 (10 316)	58.9 (56.8, 61.0) 5992 (7163)	71.5 (67.7, 75.1) 509 (1868)	47.1 (45.1, 48.9) 4981 (10 569)	23.2 (14.8, 33.7) 65 (209)	35.9 (33.5, 38.2) 1234 (6855)	15.4 (11.3, 20.6) 237 (634)	–	–	–	–	–	–	–
	Ukraine	82.6 (77.9, 86.7) 213 (545)	48.5 (42.6, 54.5) 157 (323)	9.7 (6.2, 14.2) 139 (318)	57.9 (51.5, 64.2) 102 (219)	87.5 (84.9, 89.9) 546 (1109)	73.3 (69.4, 77.1) 450 (1111)	–	14.9 (12.2, 17.9) 587 (1122)	7.2 (1.9, 18.2) 30 (42)	–	–	–	–	–	–	–
	United Kingdom of Great Britain and Northern Ireland[c]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.0 (0.0, 0.2) 2839 (5720)
	Kosovo[d]	95.0 (88.3, 98.1) 29 (321)	44.7 (31.6, 58.1) 24 (66)	0.5 (0.0, 4.6) 24 (66)	46.8 (33.4, 60.6) 24 (66)	93.6 (82.7, 98.0) 63 (461)	2.7 (0.3, 13.5) 63 (461)	–	54.8 (42.4, 67.2) 34 (145)	–	–	–	–	–	–	–	–

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
Eastern Mediteranean Region	Afghanistan	–	–	–	–	–	–	–	–	–	–	–	85.6 (79.2, 90.5) 123 (169)	3.2 (0.6, 10.7) 39 (58)	–	–	–
	Bahrain	76.2 (69.0, 82.5) 101 (599)	54.4 (30.5, 77.3) 14 (14)	24.5 (17.2, 33.0) 132 (272)	60.6 (54.7, 66.4) 14 (693)	53.6 (34.7, 71.4) 15 (27)	48.7 (39.8, 57.8) 172 (580)	7.6 (2.5, 18.7) 22 (138)	44.4 (37.8, 51.3) 15 (710)	5.3 (0.6, 22.0) 13 (42)	5.6 (3.7, 8.3) 263 (1183)	13.0 (6.3, 22) 60 (151)	43.0 (38.4, 47.7) 362 (731)	8.6 (7.6, 9.8) 3173 (5320)	42.3 (34.7, 50.4) 100 (219)	13.1 (10.9, 15.5) 904 (1806)	0.7 (0.1, 3.6) 50 (268)
	Egypt	68.8 (57.7, 78.6) 80 (306)	87.4 (81.7, 91.8) 85 (269)	37.3 (26.3, 49.3) 72 (299)	93.3 (89.2, 96.1) 85 (245)	89.9 (83.5, 94.0) 154 (1072)	64.6 (55.4, 72.9) 102 (1106)	–	76.3 (68.6, 82.7) 18 (240)	–	–	–	78.9 (74.5, 82.8) 564 (1007)	23.7 (18.1, 29.6) 459 (834)	86.0 (77.5, 92.0) 86 (237)	52.5 (38.2, 66.7) 51 (173)	–
	Iran (Islamic Republic of)	89.7 (87.6, 91.6) 511 (2224)	71.1 (68.1, 74.0) 660 (2288)	21.0 (18.1, 24.1) 555 (2576)	73.8 (70.9, 76.4) 660 (2779)	76.5 (72.7, 79.9) 427 (1444)	65.1 (61.0, 69.1) 401 (1685)	30.4 (11.4, 55.1) 12 (31)	34.6 (31.2, 38.0) 669 (2581)	77.1 (58.5, 90.4) 23 (57)	12.7 (3.2, 32.3) 14 (26)	60.7 (39.8, 78.7) 11 (25)	69.9 (68.6, 71.3) 4024 (14 879)	20.4 (19.0, 21.9) 2697 (15 086)	65.2 (62.6, 67.8) 1266 (3678)	49.2 (46.1, 52.2) 962 (3581)	–
	Iraq	73.5 (68.7, 77.9) 457 (1219)	85.1 (80.5, 89.1) 139 (350)	26.3 (22.0, 30.9) 393 (893)	91.0 (87.9, 93.5) 139 (457)	85.8 (78.5, 91.4) 95 (171)	60.6 (54.7, 66.3) 319 (593)	18.9 (12.2, 27.4) 66 (373)	88.9 (84.5, 92.4) 300 (508)	–	–	15.9 (5.6, 33.5) 16 (28)	71.9 (70.6, 73.3) 3051 (7510)	26.1 (24.8, 27.3) 4518 (11 645)	66.7 (62.3, 71.0) 344 (763)	30.6 (27.8, 33.5) 906 (2084)	–
	Jordan	75.7 (70.8, 79.9) 308 (869)	62.6 (57.3, 67.5) 261 (606)	12.2 (9.4, 15.5) 498 (1342)	68.6 (64.2, 72.8) 261 (790)	68.7 (62.4, 74.4) 188 (454)	42.0 (36.6, 47.6) 366 (1039)	–	74.7 (71.0, 78.2) 910 (1436)	35.5 (22.1, 51.4) 38 (73)	24.6 (14.0, 38.1) 36 (59)	14.0 (4.4, 30.4) 26 (26)	47.6 (46.5, 48.6) 7501 (20 789)	4.8 (4.5, 5.2) 15 296 (37 550)	46.4 (44.0, 48.7) 1443 (3906)	12.2 (11.0, 13.4) 3097 (7499)	–
	Kuwait	60.6 (51.3, 69.0) 100 (366)	48.0 (43.5, 52.6) 338 (869)	4.3 (2.8, 6.3) 531 (1102)	52.7 (48.1, 57.1) 338 (843)	62.6 (57.2, 68.0) 307 (828)	26.9 (22.3, 31.6) 427 (1052)	34.5 (19.7, 52.1) 23 (67)	49.8 (42.7, 57.2) 67 (195)	17.4 (10.5, 26.5) 73 (154)	22.4 (17.6, 27.9) 231 (530)	–	42.9 (41.7, 44.1) 6272 (14 851)	2.0 (1.7, 2.3) 10 322 (17 957)	49.5 (47.1, 52.1) 1338 (3657)	12.0 (10.6, 13.5) 2665 (4800)	0.1 (0.0, 3.7) 31 (31)
	Lebanon	–	–	–	–	–	21.3 (11.1, 35.7) 23 (280)	–	53.9 (40.6, 66.7) 12 (179)	–	16.4 (9.1, 26.4) 15 (276)	–	44.0 (41.2, 46.9) 236 (5018)	23.0 (20.6, 25.8) 571 (12 166)	–	12.7 (8.7, 17.8) 45 (1536)	–
	Morocco	89.1 (85.6, 92.1) 268 (529)	48 (40.6, 55.4) 114 (203)	4.9 (2.9, 7.7) 247 (488)	48.6 (42.7, 54.4) 114 (295)	70.5 (64.6, 76.0) 324 (536)	26.2 (22.4, 30.2) 581 (1042)	–	23.5 (19.4, 27.9) 365 (585)	10.8 (3.2, 25.9) 20 (42)	–	–	16.7 (15.2, 18.4) 2204 (4169)	1.5 (1.1, 1.9) 4197 (7756)	40.0 (36.5, 43.7) 803 (1421)	15.4 (13.4, 17.5) 1621 (2816)	–

WHO region	Country[a]	% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)															
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
		Acinetobacter spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	occupied Palestinian territory, including east Jerusalem	54.1 (42.3, 65.5) 76 (136)	44.3 (39.3, 49.4) 295 (1113)	2.9 (1.2, 6.1) 159 (565)	49.4 (44.2, 54.4) 295 (1191)	67.1 (58.5, 74.8) 114 (471)	12.3 (6.5, 21.7) 83 (261)	–	25.5 (20.2, 31.5) 35 (1262)	9.7 (2.9, 22.4) 30 (92)	8.0 (1.9, 23.3) 14 (49)	–	38.5 (37.1, 39.9) 4495 (17 844)	0.8 (0.5, 1.2) 2563 (8563)	64.7 (61.6, 67.8) 893 (3581)	5.6 (3.9, 7.7) 580 (2041)	–
	Oman	63.4 (56.4, 69.8) 128 (447)	65.4 (60.4, 70.3) 273 (900)	6.4 (4.1, 9.6) 408 (1053)	71.4 (67.3, 75.1) 273 (1227)	65.0 (59.9, 69.9) 293 (1022)	31.0 (26.5, 35.5) 378 (1101)	2.6 (0.9, 5.9) 89 (249)	38.0 (27.7, 49.5) 11 (140)	30.6 (21.7, 40.9) 79 (168)	8.1 (6.4, 10.2) 885 (2190)	26.1 (17.6, 35.8) 87 (318)	54.3 (52.4, 56.2) 2324 (7688)	2.0 (1.5, 2.6) 3015 (7774)	50.5 (47.4, 53.7) 960 (2913)	25.0 (22.4, 27.7) 1188 (3285)	0.1 (0.0, 1.2) 38 (191)
	Pakistan	60.3 (58.4, 62.3) 2456 (8083)	82.3 (79.8, 84.7) 627 (2182)	31.5 (30, 33.1) 3186 (11 591)	85.4 (83.9, 86.8) 3007 (9085)	81.2 (77.0, 84.9) 459 (1506)	53.0 (51, 55) 2113 (7170)	55.0 (51.9, 58.3) 101 (13 406)	70.7 (68.3, 72.9) 354 (3291)	35.5 (30.2, 41.1) 258 (676)	36.7 (27.3, 47.1) 42 (245)	27.2 (21.3, 33.8) 109 (497)	69.2 (68.5, 69.9) 17 604 (49 518)	14.1 (13.7, 14.6) 30 423 (107 957)	60.5 (59.0, 62.1) 5038 (12 132)	24.4 (23.3, 25.4) 7406 (23 233)	0.0 (0.0, 0.9) 63 (174)
	Qatar	4.2 (1.4, 10.2) 39 (96)	43.3 (23.9, 64.2) 19 (19)	3.8 (2.5, 5.5) 586 (1595)	46.7 (43.1, 50.5) 595 (1813)	–	5.4 (3.3, 8.3) 270 (850)	19.5 (10.6, 32.0) 41 (197)	37.6 (31.4, 44.3) 169 (634)	–	25.9 (18.9, 34.1) 106 (587)	40.2 (28.2, 52.5) 56 (142)	40.1 (37.9, 42.4) 1668 (4849)	1.6 (1.3, 1.9) 8704 (27 746)	33.1 (29.2, 37.2) 483 (1456)	3.9 (3.2, 4.8) 2896 (8929)	0.0 (0.0, 0.6) 101 (371)
	Saudi Arabia	74.4 (69.0, 79.2) 155 (1644)	–	3.8 (2.4, 5.7) 395 (2575)	57.7 (53.4, 61.9) 308 (2283)	60.9 (56.7, 65.1) 335 (2621)	41.5 (38, 45) 496 (3927)	30.0 (18.7, 43.6) 37 (186)	50.0 (45.8, 54.1) 301 (2820)	20.0 (10.8, 32.8) 26 (120)	19.7 (14.5, 25.9) 129 (703)	35.7 (12.8, 62.5) 11 (22)	40.4 (39.0, 41.7) 3526 (14 995)	1.5 (1.2, 1.7) 6595 (22 731)	42.4 (40.4, 44.5) 1696 (6830)	16.7 (15.5, 18.1) 3016 (10 291)	–
	Tunisia	82.7 (77.4, 86.9) 158 (801)	26.6 (21.8, 31.6) 184 (843)	0.6 (0.1, 1.7) 179 (843)	28.2 (23.3, 33.3) 184 (850)	60.7 (55.9, 65.3) 410 (1409)	31.7 (27.3, 36.4) 403 (1600)	32.8 (16.0, 55.2) 19 (68)	14.8 (11.8, 18.2) 399 (1252)	–	32.1 (16.6, 51.1) 26 (95)	66.3 (52.3, 78.0) 64 (78)	11.5 (10.8, 12.3) 5834 (26 846)	0.4 (0.2, 0.6) 5828 (26 538)	35.9 (33.4, 38.4) 1644 (5784)	10.0 (8.6, 11.6) 1656 (6826)	–
	United Arab Emirates	24.6 (19.5, 30.4) 135 (767)	49.4 (46.5, 52.2) 804 (4337)	2.7 (2.0, 3.7) 1329 (6057)	55.3 (52.4, 58.2) 844 (3623)	31.1 (27.7, 34.7) 511 (3003)	17.1 (14.9, 19.6) 893 (4535)	22.9 (17.4, 29.0) 90 (684)	39.9 (36.7, 43.3) 514 (2931)	2.7 (1.6, 4.4) 205 (673)	8.9 (7.6, 10.5) 1053 (4735)	28.5 (21.1, 36.9) 63 (361)	35.0 (34.5, 35.6) 18 486 (104 810)	1.3 (1.1, 1.4) 39 253 (155 250)	27.5 (26.5, 28.5) 6055 (32 908)	4.2 (3.8, 4.5) 11693 (46 875)	9.5 (6.8, 13.2) 303 (1125)
	Yemen	54.8 (44.6, 65.0) 53 (95)	86.4 (79.5, 91.6) 73 (123)	16.4 (10.2, 24.0) 63 (131)	94.4 (90.0, 97.3) 88 (171)	93.7 (86.0, 98.0) 34 (60)	15.7 (8.2, 26.5) 33 (57)	–	86.6 (81.6, 90.7) 186 (293)	–	9.2 (4.9, 15.4) 92 (120)	12.4 (3.0, 31.7) 17 (17)	67.9 (66.2, 69.5) 4420 (5693)	3.8 (3.0, 4.8) 2196 (3543)	73.4 (67.5, 78.5) 273 (418)	6.1 (3.7, 9.5) 229 (364)	51.1 (23.3, 78.8) 11 (11)
Western Pacific Region	Australia	1.1 (0.1, 5.6) 13 (69)	–	0.4 (0.2, 1.0) 530 (3005)	13.7 (12.9, 14.6) 5402 (25 327)	–	0.3 (0, 1.2) 137 (708)	17.2 (12.6, 22.7) 133 (552)	15.6 (14.5, 16.7) 3319 (15 337)	1.2 (0.6, 2.2) 609 (1895)	6.4 (5.4, 7.5) 2271 (9452)	25.4 (20.5, 30.4) 246 (678)	16.5 (15.8, 17.2) 11 230 (40 412)	–	12.0 (10.4, 13.9) 1581 (5364)	–	0.5 (0.3, 0.8) 6002 (33 455)
	Brunei Darussalam	70.9 (63.0, 77.8) 158 (295)	–	1.7 (0.7, 3.6) 263 (855)	20.7 (17.0, 25.1) 263 (890)	–	1.6 (0.6, 3.3) 203 (623)	1.5 (0.2, 7.7) 31 (141)	12.2 (8.0, 17.8) 38 (1100)	–	–	–	–	–	–	–	0.1 (0.0, 3.2) 38 (38)

% Resistance (95% CrI), 2023 No. of infections with AST, 2023 (no. of infections with AST, 2018–2023)																	
		Bloodstream									Gastrointestinal		Urinary tract				Urogenital
WHO region	Country[a]	*Acinetobacter* spp.	*E. coli*			*K. pneumoniae*		*Salmonella* spp.	*S. aureus*	*S. pneumoniae*	*Salmonella* spp.	*Shigella spp.*	*E. coli*		*K. pneumoniae*		*N. gonorrhoeae*
		Imipenem	Cefotaxime	Imipenem	3rd– gen. cephalosporins	Cefotaxime	Imipenem	Ciprofloxacin	Methicillin[e]	Penicillin G	Ciprofloxacin	Ciprofloxacin	Cefotaxime	Imipenem	Cefotaxime	Imipenem	Ceftriaxone
	Cambodia	36.3 (26.8, 46.6) 82 (158)	–	13.4 (10.4, 16.9) 486 (1708)	73.2 (69.8, 76.4) 529 (1652)	–	13.8 (9.6, 19.4) 200 (621)	9.3 (3.1, 21) 11 (76)	50.9 (40.8, 61.3) 72 (176)	46.1 (23.4, 70.7) 14 (73)	–	–	–	–	–	–	–
	China, Hong Kong SAR	47.0 (40, 54.6) 223 (444)	27.3 (25.5, 29.2) 5571 (10 448)	1.3 (0.9, 2.0) 3145 (5942)	29.2 (27.2, 31.3) 3325 (6334)	17.9 (15.4, 20.6) 1810 (3555)	1.6 (0.9, 2.9) 960 (1927)	–	31.0 (28.3, 33.9) 1906 (3876)	0.5 (0.0, 3.0) 68 (92)	–	–	21.2 (20.2, 22.1) 18 080 (33 819)	1.8 (1.3, 2.5) 4381 (8338)	19.5 (17.3, 21.9) 3709 (6708)	4.8 (3.0, 7.5) 1066 (2055)	–
	Japan	0.9 (0.6, 1.4) 1560 (8136)	17.9 (17.5, 18.3) 67 259 (376 492)	0.1 (0.1, 0.1) 85 186 (460 468)	18.4 (18.0, 18.8) 72415 (361 800)	10.3 (9.7, 1.0) 23 641 (126 722)	0.7 (0.5, 0.9) 29 454 (153 487)	0.5 (0.2, 1.2) 509 (2118)	26.0 (25.6, 26.5) 30 226 (160 954)	0.3 (0.2, 0.6) 2033 (13 051)	0.9 (0.2, 2.3) 149 (968)	25.3 (7.9, 56.7) 32 (367)	17.6 (17.5, 17.8) 306 577 (1 715 749)	0.0 (0.0, 0.0) 401 717 (2 131 493)	14.1 (13.7, 14.5) 71 592 (367 875)	0.2 (0.1, 0.2) 94 378 (462 024)	1.2 (0.1, 11.3) 1134 (5797)
	Lao People's Democratic Republic	–	–	0.2 (0.0, 1.3) 132 (338)	56.2 (51.3, 61.0) 252 (985)	–	2.6 (0.6, 7.7) 47 (142)	–	49.9 (40.7, 59.5) 45 (348)	5.0 (0.6, 19.6) 16 (16)	23.8 (12.1, 40.0) 26 (95)	–	–	0.9 (0.2– 2.5) 166 (555)	–	2.4 (0.6, 7.2) 45 (113)	–
	Malaysia	50.4 (48.4, 52.4) 2657 (11 058)	27.0 (25.7, 28.4) 6841 (28 880)	1.9 (1.5, 2.4) 7140 (29 527)	27.9 (26.5, 29.4) 6841 (29 631)	37.0 (35.5, 38.5) 6442 (26 677)	9.8 (8.8, 10.9) 6658 (27 055)	1.3 (0.7, 2.2) 798 (4101)	15.4 (14.2, 16.6) 3862 (19 329)	5.9 (4.2, 8.2) 368 (1726)	4.7 (3.8, 5.9) 2399 (9493)	–	21.8 (21.1, 22.5) 17 263 (63 233)	1.3 (1.1, 1.5) 16 992 (62 528)	32.5 (31.2, 33.9) 7306 (26 544)	6.6 (5.9, 7.4) 7264 (26 677)	1.5 (0.6, 3.7) 361 (886)
	Papua New Guinea	–	–	–	36.6 (15.8, 60.9) 14 (14)	–	–	–	67.5 (56.0, 77.9) 47 (76)	8.9 (1.8, 26.2) 15 (15)	–	–	–	–	–	–	–
	Philippines	39.0 (36.9, 41.1) 1496 (6494)	39.6 (36.5, 42.6) 608 (3463)	12.3 (10.7, 14.1) 1466 (6559)	41.7 (39.2, 44.2) 1454 (5308)	48.3 (45.1, 51.6) 691 (4210)	24.8 (22.8, 26.9) 1867 (8173)	10.9 (6.6, 16.7) 97 (915)	41.2 (39.2, 43.3) 2248 (8679)	5.7 (2.8, 10.3) 71 (461)	3.5 (1.0, 9.5) 33 (238)	1.9 (0.2, 8.9) 18 (83)	44.6 (43, 46.1) 2842 (15 113)	10.9 (10.1, 11.7) 6964 (28 625)	56.6 (54.2, 59.0) 1192 (6257)	24.2 (22.7, 25.7) 3229 (12 677)	3.2 (0.7, 10.4) 26 (300)
	Republic of Korea	72.1 (67.7, 76.2) 394 (1736)	35.1 (33.1, 37.0) 2844 (13 162)	0.2 (0.1, 0.4) 2844 (13 162)	35.2 (33.2, 37.1) 2844 (13162)	31.5 (28.6, 34.7) 1244 (5491)	8.4 (6.5, 10.7) 1244 (5491)	3.2 (0.9, 8.4) 75 (308)	37.9 (34.9, 41.0) 832 (4499)	13.8 (6.2, 25.7) 27 (187)	1.6 (0.7, 3.2) 194 (926)	–	32.0 (30.9, 33.1) 1813 (39 997)	0.0 (0.0, 0.1) 1813 (39 997)	36.1 (33.2, 39) 350 (7288)	4.6 (3.2, 6.6) 350 (7288)	–
	Singapore	–	24.9 (22.0, 27.8) 1403 (4190)	–	26.4 (23.6, 29.5) 909 (3761)	22.3 (18.8, 26.3) 687 (2098)	–	22.3 (12.2, 35.5) 60 (206)	23.4 (19.6, 27.5) 423 (1311)	3.8 (0.5, 15.5) 23 (36)	23.7 (18.7, 29.4) 234 (866)	–	20.2 (19.0, 21.4) 4021 (20 581)	–	26.9 (24.4, 29.6) 1201 (6193)	–	1.1 (0.1, 14.0) 271 (1157)

National AMR estimates for 2023 are based on AMR data from all years between 2018 and 2023 in which at least 10 infections with AST were reported.

[a] Includes three territories and areas.
[b] National resistance estimates for Canada in 2023 are not published in this report; unadjusted data are available on the GLASS dashboard.
[c] National estimates of resistance for the United Kingdom of Great Britain and Northern Ireland in 2023 (except for urogenital gonorrhoea) are not published in this report; unadjusted data are available on the GLASS dashboard.
[d] In accordance with Security Council resolution 1244 (1999).
[e] Methicillin resistance in *S. aureus* was assessed was assessed by oxacillin or cefoxitin susceptibility testing.

Annex 7.

Table A7.1. Numbers of countries and episodes of infection with AST included in Bayesian models for analysis of trends in AMR, 2018–2023

			No. of countries[a] (no. of infections with AST), 2018–2023						
Infection type	**Bacterial pathogen**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
Bloodstream	*Acinetobacter* spp.	Imipenem	64 (163 301)	5 (27 111)	4 (7748)	6 (40 416)	26 (41 688)	15 (18 316)	8 (28 022)
	E. coli	Cefotaxime	64 (1 048 389)	7 (19 226)	3 (13 156)	6 (41 435)	30 (532 335)	12 (15 906)	6 (426 331)
		Imipenem	74 (1 109 199)	8 (26 677)	4 (44 196)	8 (49 785)	30 (438 319)	15 (32 601)	9 (517 621)
	K. pneumoniae	Cefotaxime	60 (407 510)	6 (28 856)	3 (10 560)	5 (34 485)	30 (154 410)	11 (14 001)	5 (165 198)
		Imipenem	73 (486 636)	10 (41 477)	4 (36 555)	7 (44 515)	28 (139 906)	15 (26 821)	9 (197 362)
	Salmonella spp.	Ciprofloxacin	41 (50 772)	4 (5273)	5 (8023)	6 (10 078)	9 (3613)	9 (15 368)	8 (8417)
	S. pneumoniae	Penicillin G	44 (85 534)	2 (2308)	2 (3701)	1 (823)	25 (59 251)	9 (2131)	5 (17 320)
SDG (Bloodstream)	*E. coli*	3rd– gen. cephalosporins	83 (1 144 388)	15 (29 370)	4 (16 001)	9 (37 465)	31 (591 906)	15 (27 130)	9 (442 516)
	S. aureus	Methicillin resistance[b]	84 (653 476)	15 (44 245)	5 (30 806)	8 (48 669)	31 (298 988)	16 (19 035)	9 (211 733)
Gastrointestinal	*Salmonella* spp.	Ciprofloxacin	46 (101 629)	4 (3306)	5 (22 272)	3 (4670)	17 (38 750)	10 (10 593)	7 (22 038)
	Shigella spp.	Ciprofloxacin	19 (22 740)	2 (3045)	4 (14 887)	1 (85)	4 (2126)	5 (1469)	3 (1128)
Urinary tract	*E. coli*	Cefotaxime	53 (6 618 107)	9 (17 863)	3 (234 394)	6 (235 518)	10 (3 933 167)	19 (302 080)	6 (1 895 085)
		Imipenem	55 (4 861 089)	9 (14 800)	6 (368 925)	8 (276 398)	8 (1 453 122)	18 (469 462)	6 (2 278 382)
	K. pneumoniae	Cefotaxime	45 (1 199 143)	7 (5071)	3 (42 889)	6 (63 435)	9 (589 669)	14 (78 558)	6 (419 521)
		Imipenem	51 (1 047 587)	8 (4492)	5 (68 718)	8 (80 819)	8 (254 299)	16 (125 968)	6 (513 291)
Urogenital	*N. gonorrhoeae*	Ceftriaxone	38 (91 795)	3 (3165)	5 (28 475)	2 (664)	17 (15 587)	6 (2309)	5 (41 595)

Trends are based on countries that reported infections with AST in at least 3 years between 2018 and 2023, excluding location–time points with fewer than 10 infections with AST.
SDG: Sustainable Development Goal indicators for AMR.

[a] Includes three territories and areas
[b] Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

Annex 8.

Table A8.1. National distribution of bloodstream bacterial pathogens, 2023

	No. of bloodstream infections reported in 2023 (% of total)						
WHO region and country[a]	Total	*Acinetobacter* spp.	*E. coli*	*K. pneumoniae*	*Salmonella* spp.	*S. aureus*	*S. pneumoniae*
Global	715 008	53 291 (7.5)	312 077 (43.7)	149 512 (20.9)	9970 (1.5)	165 679 (23.2)	24 479 (3.5)
African Region	38 953	7854 (20.2)	7125 (18.3)	10 666 (27.4)	1790 (4.6)	10 793 (27.7)	725 (1.9)
Benin*	971	172 (17.7)	177 (18.2)	320 (33.0)	16 (1.6)	265 (27.3)	21 (2.2)
Burkina Faso	273	25 (9.2)	69 (25.3)	74 (27.1)	5 (1.8)	100 (36.6)	0 (0.0)
Côte d'Ivoire*	113	13 (11.5)	13 (11.5)	29 (25.7)	0 (0.0)	58 (51.3)	0 (0.0)
Cameroon	339	28 (8.3)	85 (25.1)	96 (28.3)	23 (6.8)	105 (31.0)	2 (0.6)
Democratic Republic of the Congo	1147	35 (3.1)	162 (14.1)	173 (15.1)	584 (50.9)	96 (8.4)	97 (8.5)
Algeria*	1601	280 (17.5)	284 (17.7)	468 (29.2)	28 (1.7)	526 (32.9)	15 (0.9)
Ethiopia	1761	462 (26.2)	278 (15.8)	707 (40.1)	41 (2.3)	265 (15.0)	8 (0.5)
Ghana	537	45 (8.4)	102 (19.0)	76 (14.2)	8 (1.5)	296 (55.1)	10 (1.9)
Guinea*	11	1 (9.1)	4 (36.4)	2 (18.2)	0 (0.0)	4 (36.4)	0 (0.0)
Kenya	992	98 (9.9)	233 (23.5)	378 (38.1)	36 (3.6)	243 (24.5)	4 (0.4)
Liberia	9	1 (11.1)	0 (0.0)	3 (33.3)	0 (0.0)	5 (55.6)	0 (0.0)
Madagascar	46	1 (2.2)	11 (23.9)	16 (34.8)	1 (2.2)	16 (34.8)	1 (2.2)
Mali	275	23 (8.4)	72 (26.2)	27 (9.8)	63 (22.9)	51 (18.5)	39 (14.2)
Mozambique	51	11 (21.6)	11 (21.6)	17 (33.3)	0 (0.0)	12 (23.5)	0 (0.0)
Mauritius	1551	213 (13.7)	432 (27.9)	298 (19.2)	13 (0.8)	583 (37.6)	12 (0.8)
Malawi	368	61 (16.6)	76 (20.7)	68 (18.5)	22 (6.0)	135 (36.7)	6 (1.6)
Namibia*	126	9 (7.1)	48 (38.1)	23 (18.3)	4 (3.2)	35 (27.8)	7 (5.6)
Nigeria	302	51 (16.9)	42 (13.9)	76 (25.2)	5 (1.7)	128 (42.4)	0 (0.0)
Eswatini*	87	11 (12.6)	6 (6.9)	34 (39.1)	2 (2.3)	34 (39.1)	0 (0.0)
United Republic of Tanzania	1810	248 (13.7)	278 (15.4)	525 (29.0)	10 (0.6)	744 (41.1)	5 (0.3)
Uganda	47	3 (6.4)	21 (44.7)	5 (10.6)	5 (10.6)	13 (27.7)	0 (0.0)
South Africa	26 026	6007 (23.1)	4622 (17.8)	7069 (27.2)	903 (3.5)	6931 (26.6)	494 (1.9)

	No. of bloodstream infections reported in 2023 (% of total)						
WHO region and country[a]	**Total**	***Acinetobacter* spp.**	***E. coli***	***K. pneumoniae***	***Salmonella* spp.**	***S. aureus***	***S. pneumoniae***
Zambia	510	56 (11.0)	99 (19.4)	182 (35.7)	21 (4.1)	148 (29.0)	4 (0.8)
Region of the Americas[b]	58 861	2753 (5.0)	19 168 (32.6)	14 084 (23.9)	2241 (3.8)	15 979 (27.1)	4636 (9.4)
Argentina	9290	587 (6.3)	2580 (27.8)	2224 (23.9)	839 (9.0)	3060 (32.9)	0 (0.0)
Brazil	3041	242 (8.0)	789 (25.9)	775 (25.5)	15 (0.5)	1122 (36.9)	98 (3.2)
Colombia	40 859	1621 (4.0)	15 112 (37.0)	10 436 (25.5)	869 (2.1)	11 149 (27.3)	1672 (4.1)
Peru	1623	303 (18.7)	422 (26.0)	418 (25.8)	51 (3.1)	411 (25.3)	18 (1.1)
Trinidad and Tobago	3	0 (0.0)	1 (33.3)	2 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)
South-East Asia Region	72 090	16 843 (23.4)	19 672 (27.3)	16 953 (23.5)	1010 (1.4)	16 995 (23.6)	617 (0.9)
Bangladesh	298	77 (25.8)	50 (16.8)	41 (13.8)	65 (21.8)	62 (20.8)	3 (1.0)
Bhutan	102	18 (17.6)	37 (36.3)	14 (13.7)	8 (7.8)	20 (19.6)	5 (4.9)
Indonesia	9180	1929 (21.0)	2264 (24.7)	2457 (26.8)	265 (2.9)	2206 (24.0)	59 (0.6)
India	41 375	11 310 (27.3)	9866 (23.8)	10 040 (24.3)	15 (0.0)	10 083 (24.4)	61 (0.1)
Sri Lanka	3208	92 (2.9)	1115 (34.8)	340 (10.6)	44 (1.4)	1499 (46.7)	118 (3.7)
Maldives*	148	13 (8.8)	42 (28.4)	42 (28.4)	8 (5.4)	36 (24.3)	7 (4.7)
Myanmar	130	12 (9.2)	53 (40.8)	30 (23.1)	3 (2.3)	32 (24.6)	0 (0.0)
Nepal	2740	666 (24.3)	483 (17.6)	512 (18.7)	34 (1.2)	1011 (36.9)	34 (1.2)
Thailand	14 722	2709 (18.4)	5716 (38.8)	3415 (23.2)	561 (3.8)	1995 (13.6)	326 (2.2)
Timor-Leste	187	17 (9.1)	46 (24.6)	62 (33.2)	7 (3.7)	51 (27.3)	4 (2.1)
European Region[b]	267 743	11 823 (4.4)	128 796 (48.3)	48 280 (18.1)	1899 (0.9)	63 114 (23.7)	13 831 (5.2)
Austria	7874	74 (0.9)	4639 (58.9)	1136 (14.4)	0 (0.0)	1522 (19.3)	503 (6.4)
Belgium	8542	162 (1.9)	4619 (54.1)	919 (10.8)	74 (0.9)	1114 (13.0)	1654 (19.4)
Bosnia and Herzegovina	1271	217 (17.1)	339 (26.7)	379 (29.8)	2 (0.2)	297 (23.4)	37 (2.9)
Switzerland	12 511	118 (0.9)	6878 (55.0)	1688 (13.5)	113 (0.9)	2774 (22.2)	940 (7.5)
Cyprus	784	122 (15.6)	290 (37.0)	195 (24.9)	3 (0.4)	146 (18.6)	28 (3.6)
Czechia	7983	55 (0.7)	3888 (48.7)	1666 (20.9)	4 (0.1)	1957 (24.5)	413 (5.2)
Germany	54 645	529 (1.0)	28 894 (52.9)	6353 (11.6)	333 (0.6)	15 178 (27.8)	3358 (6.1)
Denmark	9514	89 (0.9)	5822 (61.2)	1396 (14.7)	0 (0.0)	1860 (19.6)	347 (3.6)
Estonia	1702	13 (0.8)	1054 (61.9)	296 (17.4)	5 (0.3)	230 (13.5)	104 (6.1)
Finland	5584	31 (0.6)	4155 (74.4)	715 (12.8)	19 (0.3)	253 (4.5)	411 (7.4)

	No. of bloodstream infections reported in 2023 (% of total)						
WHO region and country[a]	**Total**	***Acinetobacter* spp.**	***E. coli***	***K. pneumoniae***	***Salmonella* spp.**	***S. aureus***	***S. pneumoniae***
France	919	0 (0.0)	0 (0.0)	0 (0.0)	56 (6.1)	0 (0.0)	863 (93.9)
Georgia	898	101 (11.2)	225 (25.1)	183 (20.4)	2 (0.2)	355 (39.5)	32 (3.6)
Greece	6464	1523 (23.6)	1837 (28.4)	2093 (32.4)	23 (0.4)	922 (14.3)	66 (1.0)
Croatia	2826	258 (9.1)	1299 (46.0)	562 (19.9)	13 (0.5)	606 (21.4)	88 (3.1)
Ireland	4946	56 (1.1)	3049 (61.6)	555 (11.2)	0 (0.0)	947 (19.1)	339 (6.9)
Iceland*	466	1 (0.2)	258 (55.4)	44 (9.4)	0 (0.0)	128 (27.5)	35 (7.5)
Italy	53 987	2651 (4.9)	24 841 (46.0)	11 836 (21.9)	123 (0.2)	13 404 (24.8)	1132 (2.1)
Lithuania	3099	120 (3.9)	454 (46.9)	532 (17.2)	6 (0.2)	810 (26.1)	177 (5.7)
Luxembourg	621	7 (1.1)	461 (74.2)	83 (13.4)	3 (0.5)	5 (0.8)	62 (10.0)
Latvia	807	55 (6.8)	329 (40.8)	143 (17.7)	1 (0.1)	235 (29.1)	44 (5.5)
Republic of Moldova	406	62 (15.3)	68 (16.7)	190 (46.8)	3 (0.7)	79 (19.5)	4 (1.0)
North Macedonia	283	32 (11.3)	52 (18.4)	95 (33.6)	0 (0.0)	99 (35.0)	5 (1.8)
Malta	859	24 (2.8)	498 (58.0)	168 (19.6)	7 (0.8)	134 (15.6)	28 (3.3)
Netherlands (Kingdom of the)	11 748	139 (1.2)	7255 (61.8)	1387 (11.8)	152 (1.3)	2034 (17.3)	781 (6.6)
Norway	6015	33 (0.5)	3949 (65.7)	779 (13.0)	86 (1.4)	792 (13.2)	376 (6.3)
Poland	7277	425 (5.8)	3031 (41.7)	1562 (21.5)	96 (1.3)	1796 (24.7)	367 (5.0)
Russian Federation	9671	1443 (14.9)	1627 (16.8)	3980 (41.2)	57 (0.6)	2378 (24.6)	186 (1.9)
Sweden	21 978	125 (0.6)	10 717 (48.8)	2165 (9.9)	0 (0.0)	7915 (36.0)	1056 (4.8)
Türkiye	19 875	3048 (15.3)	6 000 (30.2)	6218 (31.3)	99 (0.5)	4256 (21.4)	254 (1.3)
Ukraine	1897	271 (14.3)	212 (11.2)	711 (37.5)	11 (0.6)	618 (32.6)	74 (3.9)
Kosovo[c]	164	29 (17.7)	24 (14.6)	63 (38.4)	2 (1.2)	36 (22.0)	10 (6.1)
Eastern Mediterranean Region	39 836	6362 (16.0)	11 266 (28.3)	9701 (24.4)	693 (1.8)	10 620 (26.7)	1194 (3.1)
Afghanistan	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
United Arab Emirates	3959	167 (4.2)	1499 (37.9)	1000 (25.3)	124 (3.1)	908 (22.9)	261 (6.6)
Bahrain	964	106 (11.0)	267 (27.7)	249 (25.8)	25 (2.6)	294 (30.5)	23 (2.4)
Egypt	919	115 (12.5)	187 (20.3)	327 (35.6)	1 (0.1)	289 (31.4)	0 (0.0)
Iran (Islamic Republic of)	2925	688 (23.5)	826 (28.2)	621 (21.2)	14 (0.5)	723 (24.7)	53 (1.8)
Iraq	2164	565 (26.1)	492 (22.7)	366 (16.9)	113 (5.2)	606 (28.0)	22 (1.0)
Jordan	3 297	391 (11.9)	659 (20.0)	482 (14.6)	17 (0.5)	1675 (50.8)	73 (2.2)

	No. of bloodstream infections reported in 2023 (% of total)						
WHO region and country[a]	**Total**	***Acinetobacter* spp.**	***E. coli***	***K. pneumoniae***	***Salmonella* spp.**	***S. aureus***	***S. pneumoniae***
Kuwait	1 731	111 (6.4)	586 (33.9)	463 (26.7)	25 (1.4)	430 (24.8)	116 (6.7)
Lebanon	54	9 (16.7)	10 (18.5)	23 (42.6)	0 (0.0)	12 (22.2)	0 (0.0)
Morocco	1569	271 (17.3)	254 (16.2)	582 (37.1)	10 (0.6)	427 (27.2)	25 (1.6)
Oman	2586	252 (9.7)	765 (29.6)	667 (25.8)	92 (3.6)	695 (26.9)	115 (4.4)
Pakistan	13 338	3032 (22.7)	3843 (28.8)	3364 (25.2)	137 (1.0)	2669 (20.0)	293 (2.2)
occupied Palestinian territory, including east Jerusalem	1066	140 (13.1)	418 (39.2)	176 (16.5)	11 (1.0)	275 (25.8)	46 (4.3)
Qatar	1274	43 (3.4)	598 (46.9)	275 (21.6)	43 (3.4)	210 (16.5)	105 (8.2)
Saudi Arabia	1927	176 (9.1)	485 (25.2)	600 (31.1)	50 (2.6)	571 (29.6)	45 (2.3)
Tunisia	1332	193 (14.5)	212 (15.9)	469 (35.2)	31 (2.3)	413 (31.0)	14 (1.1)
Yemen	729	103 (14.1)	165 (22.6)	37 (5.1)	0 (0.0)	421 (57.8)	3 (0.4)
Western Pacific Region	237 525	7656 (3.2)	12 6050 (53.1)	49 828 (21.0)	2337 (1.0)	48 178 (20.3)	3476 (1.5)
Australia	11 075	143 (1.3)	5455 (49.3)	1364 (12.3)	139 (1.3)	3319 (30.0)	655 (5.9)
Brunei Darussalam	703	159 (22.6)	264 (37.6)	205 (29.2)	31 (4.4)	38 (5.4)	6 (0.9)
China, Hong Kong SAR*	10 749	227 (2.1)	6425 (59.8)	2119 (19.7)	0 (0.0)	1910 (17.8)	68 (0.6)
Japan	169 604	1756 (1.0)	99 783 (58.8)	34 895 (20.6)	898 (0.5)	30 226 (17.8)	2046 (1.2)
Cambodia	1186	329 (27.7)	529 (44.6)	220 (18.5)	11 (0.9)	72 (6.1)	25 (2.1)
Republic of Korea	5416	394 (7.3)	2844 (52.5)	1244 (23.0)	75 (1.4)	832 (15.4)	27 (0.5)
Lao People's Democratic Republic	605	58 (9.6)	252 (41.7)	94 (15.5)	21 (3.5)	163 (26.9)	17 (2.8)
Malaysia	27 407	2818 (10.3)	7431 (27.1)	7005 (25.6)	954 (3.5)	8719 (31.8)	480 (1.8)
Philippines	7705	1716 (22.3)	1531 (19.9)	1914 (24.8)	145 (1.9)	2292 (29.7)	107 (1.4)
Papua New Guinea*	108	7 (6.5)	21 (19.4)	11 (10.2)	3 (2.8)	51 (47.2)	15 (13.9)
Singapore	2967	49 (1.7)	1515 (51.1)	757 (25.5)	60 (2.0)	556 (18.7)	30 (1.0)

Countries for which there were fewer than 3 years of data are marked with an asterisk. These were excluded from the global and regional distributions shown in Fig. 3.5.

[a] Includes three territories and areas.
[b] Unadjusted national data on bloodstream infections from Canada and the United Kingdom of Great Britain and Northern Ireland for 2023 are not published in this report; unadjusted data are available on the GLASS dashboard.
[c] In accordance with United Nations Security Council resolution 1244 (1999)

Annex 9.

Table A9.1. Estimated percentage of AMR from the systematic review, 2018–2023

				% Resistance (95% CI) No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
Bloodstream	*Acinetobacter* spp.	Aminoglycosides	Amikacin	65.4 (54.4, 75.6) 66 (8966)	42.2 (11.0, 77.4) 6 (2257)	63.7 (4.3, 100.0) 2 (176)	61.3 (41.7, 79.1) 21 (1030)	88.1 (75.8, 96.4) 13 (2296)	69.9 (36.6, 94.3) 9 (546)	42.4 (29.0, 56.4) 15 (2661)
			Gentamicin	67.3 (55.2, 78.3) 66.0 (9723)	60.8 (28.7, 88.4) 7 (2275)	38.9 (0.0, 97.8) 5 (1009)	45.5 (8.0, 86.4) 20 (990)	90.0 (80.3, 96.6) 15 (2324)	76.6 (49.3, 95.3) 8 (446)	56.7 (40.5, 72.2) 11 (2679)
		Carbapenems	Doripenem	76.6 (49.8, 95.1) 7 (620)	75.9 (0.0, 100.0) 2 (143)	100.0 (97.6, 100.0) 1 (39)	–	–	67.4 (0.0, 100.0) 2 (211)	52.4 (14.3, 88.9) 2 (227)
			Imipenem	71.0 (57.1, 83.1) 65 (9127)	49.3 (0.0, 100.0) 4 (1905)	83.3 (2.3, 100.0) 3 (476)	47.3 (8.1, 88.7) 18 (793)	83.6 (63.5, 96.6) 14 (1901)	76.0 (66.7, 84.2) 8 (443)	69.1 (56.4, 80.6) 18 (3609)
			Meropenem	71.8 (61.3, 81.2) 70 (10 039)	62.7 (21.7, 94.9) 6 (2282)	45.9 (0.2, 98.5) 5 (962)	57.9 (26.0, 86.5) 18 (755)	87.5 (72.7, 97.0) 18 (2593)	79.6 (66.4, 90.2) 9 (546)	62.0 (39.3, 82.3) 14 (2901)
		Polymyxins	Colistin	13.8 (4.1, 28.1) 42 (6754)	4.5 (0.0, 96.2) 2 (2129)	100.0 (97.6, 100.0) 1 (39)	8.3 (0.0, 34.6) 9 (619)	7.6 (0.6, 21.3) 17 (2118)	40.8 (0.0, 100.0) 3 (80)	6.9 (0.0, 32.7) 10 (1769)
		Tetracyclines	Minocycline	26.5 (8.1, 50.7) 19 (5109)	48.4 (0.0, 100.0) 2 (2129)	7.8 (2.1, 16.7) 1 (51)	30.1 (9.5, 56.3) 4 (235)	83.6 (48.8, 99.9) 2 (640)	0.0 (0.0, 0.6) 1 (156)	24.0 (5.5, 50.2) 9 (1898)
			Tigecycline	23.3 (10.5, 39.4) 28 (2826)	–	7.8 (2.1, 16.7) 1 (51)	30.9 (0.0, 96.3) 6 (161)	32.9 (10.2, 61.1) 8 (1059)	10.8 (0.0, 100.0) 2 (176)	12.1 (6.1, 19.7) 11 (1379)
	E. coli	3rd– gen. cephalosporins	Cefotaxime	44.7 (32.6, 57.1) 47 (15 289)	76.7 (65.6, 86.2) 6 (298)	45.2 (0.0, 100.0) 2 (972)	70.5 (50.9, 86.8) 10 (520)	20.6 (11.8, 31.1) 15 (6155)	50.6 (0.4, 99.7) 4 (184)	48.1 (28.5, 68.1) 10 (7160)
			Ceftazidime	41.6 (32.9, 50.6) 79 (47 660)	70.5 (56.2, 82.9) 7 (326)	28.7 (9.4, 53.3) 9 (6956)	70.8 (49.7, 88.0) 11 (425)	27.0 (16.3, 39.3) 15 (2709)	66.8 (44.3, 85.9) 8 (455)	22.9 (15.5, 31.2) 29 (36 789)
			Ceftriaxone	53.6 (43.8, 63.3) 66 (57 536)	60.5 (35.5, 82.8) 8 (502)	32.7 (9.2, 62.3) 7 (3015)	66.8 (46.5, 84.3) 8 (445)	40.1 (22.5, 59.1) 8 (1022)	79.9 (67.4, 89.9) 10 (682)	37.8 (21.2, 56.1) 25 (51 870)
		4th– gen. cephalosporins	Cefepime	41.6 (30.7, 53.0) 69 (48 411)	59.8 (6.6, 99.6) 4 (184)	28.2 (9.3, 52.4) 10 (9289)	62.9 (43.6, 80.2) 9 (575)	30.9 (15.6, 48.8) 13 (1739)	77.8 (52.1, 95.4) 8 (508)	19.2 (12.2, 27.3) 25 (36 116)
		Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	5.5 (1.6, 11.6) 41 (22 556)	32.4 (0.6, 82.3) 3 (182)	2.1 (0.0, 22.8) 4 (651)	57.3 (0.0, 100.0) 4 (220)	2.7 (0.9, 5.3) 14 (13 026)	4.3 (0.0, 19.7) 3 (290)	0.7 (0.1, 1.8) 13 (8187)
			Imipenem	4.8 (1.8, 9.0) 73 (27 300)	7.4 (0.0, 60.6) 3 (127)	0.5 (0.0, 2.9) 5 (5708)	29.9 (10.7, 53.9) 12 (599)	1.1 (0.3, 2.5) 15 (2525)	12.7 (2.2, 29.9) 10 (685)	2.0 (0.1, 6.2) 28 (17 656)

				% Resistance (95% CI) No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
			Meropenem	3.2 (1.3, 5.9) 89 (52 000)	7.4 (0.8, 19.8) 8 (519)	0.5 (0.0, 1.7) 11 (9144)	22.9 (7.8, 43.0) 12 (582)	0.8 (0.1, 2.0) 22 (4389)	8.2 (0.0, 29.4) 9 (624)	1.3 (0.2, 3.2) 27 (36 742)
		Fluoroquinolones	Ciprofloxacin	47.6 (41.1, 54.2) 97 (51 813)	60.0 (45.3, 73.9) 9 (561)	50.1 (31.1, 69.2) 10 (8153)	68.8 (49.2, 85.4) 14 (775)	33.6 (23.6, 44.5) 24 (5356)	54.2 (36.6, 71.3) 11 (780)	44.9 (29.7, 60.5) 29 (36 188)
			Levofloxacin	46.6 (37.7, 55.5) 45 (33 373)	65.3 (51.6, 77.9) 1 (49)	40.2 (17.2, 65.7) 5 (3076)	76.1 (6.1, 100.0) 4 (132)	31.4 (14.4, 51.5) 5 (835)	50.8 (29.6, 71.8) 6 (455)	47.1 (40.1, 54.2) 24 (28 826)
		Polymyxins	Colistin	4.1 (0.2, 12.6) 24 (9280)	–	–	8.4 (0.0, 71.3) 5 (244)	1.7 (0.0, 6.1) 12 (2038)	2.9 (0.0, 33.1) 2 (100)	16.2 (0.0, 89.3) 5 (6898)
		TMP– sulfa	Co-trimoxazole	51.3 (44.4, 58.3) 77 (72 485)	83.9 (61.4, 97.6) 8 (484)	41.7 (25.9, 58.4) 9 (19 439)	61.3 (46.4, 75.2) 14 (777)	39.8 (30.9, 49.2) 15 (15 396)	42.9 (14.6, 74.0) 7 (485)	48.7 (36.7, 60.9) 24 (35 904)
	K. pneumoniae	Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	31.6 (20.3, 44.1) 42 (7940)	31.3 (15.0, 50.5) 3 (191)	31.7 (0.0, 87.9) 6 (789)	76.7 (42.6, 97.9) 6 (319)	35.2 (19.8, 52.3) 9 (1274)	34.0 (8.0, 66.9) 4 (437)	16.6 (6.4, 30.4) 14 (4930)
			Imipenem	25.8 (18.6, 33.9) 70 (14 706)	7.6 (0.0, 36.2) 4 (212)	14.3 (0.8, 40.4) 7 (2656)	40.6 (21.9, 60.9) 16 (1101)	27.0 (11.4, 46.3) 11 (1509)	38.1 (19.4, 58.8) 8 (647)	23.5 (14.7, 33.6) 24 (8581)
			Meropenem	21.1 (13.7, 29.6) 90 (21 639)	10.1 (1.6, 24.6) 11 (776)	13.7 (0.8, 38.7) 10 (4321)	37.7 (19.7, 57.6) 17 (1307)	18.9 (4.1, 41.2) 17 (211)	64.0 (34.3, 88.7) 9 (691)	10.4 (2.0, 24.1) 26 (12 133)
		3rd– gen. cephalosporins	Cefotaxime	68.1 (55.1, 79.7) 52 (8163)	93.4 (87.7, 97.5) 8 (607)	75.8 (52.5, 93.0) 3 (603)	77.7 (63.3, 89.3) 16 (1323)	39.1 (15.2, 66.2) 10 (836)	89.6 (33.0, 100.0) 5 (445)	44.8 (26.0, 64.4) 10 (3349)
			Ceftazidime	60.2 (48.9, 70.9) 82 (20 909)	80.6 (64.6, 92.7) 11 (638)	32.8 (12.9, 56.7) 9 (3415)	82.6 (68.7, 93.0) 16 (1180)	53.3 (28.8, 77.0) 10 (1628)	92.6 (70.5, 100.0) 8 (591)	29.5 (17.0, 43.9) 28 (13 457)
			Ceftriaxone	69.2 (57.8, 79.6) 56 (12 707)	84.7 (75.0, 92.3) 11 (628)	48.9 (21.2, 77.0) 7 (1667)	77.6 (69.9, 84.4) 6 (398)	75.3 (54.2, 91.5) 5 (572)	91.7 (76.7, 99.3) 7 (440)	29.6 (14.1, 48.0) 20 (9002)
		4th– gen. cephalosporins	Cefepime	54.1 (40.8, 67.2) 67 (20 284)	68.8 (14.8, 100.0) 6 (287)	27.2 (8.5, 51.5) 10 (4853)	65.3 (51.1, 78.2) 8 (553)	59.8 (42.1, 76.3) 11 (1707)	89.6 (58.9, 100.0) 7 (447)	22.8 (9.0, 40.6) 25 (12 437)
		Fluoroquinolones	Ciprofloxacin	49.9 (42.5, 57.4) 92 (21 764)	66.6 (52.2, 79.5) 13 (879)	40.1 (15.1, 68.3) 8 (3868)	58.7 (44.6, 72.1) 17 (1359)	49.7 (34.7, 64.8) 16 (2073)	61.2 (38.8, 81.4) 10 (705)	32.9 (19.2, 48.3) 28 (12 880)
			Levofloxacin	40.9 (27.7, 54.8) 42 (6749)	22.2 (0.0, 100.0) 2 (97)	13.3 (5.1, 24.8) 4 (1030)	59.2 (0.0, 100.0) 4 (271)	49.7 (9.1, 90.6) 3 (421)	55.6 (27.3, 82.0) 6 (528)	39.2 (28.9, 50.0) 23 (4402)
		Polymyxins	Colistin	15.5 (6.0, 28.5) 33 (6032)	–	100.0 (97.0, 100.0) 1 (32)	4.2 (0.0, 35.5) 8 (623)	16.6 (8.4, 27.1) 14 (1826)	9.2 (0.0, 93.2) 2 (169)	16.1 (0.0, 54.7) 8 (3382)
		TMP– sulfa	Co-trimoxazole	59.8 (49.8, 69.3) 71 (18 330)	83.5 (58.7, 98.1) 12 (776)	53.3 (28.2, 77.5) 6 (1973)	66.8 (47.8, 83.2) 11 (864)	45.9 (28.3, 63.9) 12 (2234)	77.3 (49.8, 95.8) 9 (692)	34.4 (21.6, 48.5) 21 (11 791)

				% Resistance (95% CI) No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
	Salmonella spp.	Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	–	–	–	–	–	–	–
			Imipenem	–	–	–	–	–	–	–
		3rd– gen. cephalosporins	Cefotaxime	4.5 (0.2, 13.5) 12 (1438)	–	1.2 (0.0, 4.5) 1 (86)	1.0 (0.0, 6.6) 6 (294)	–	26.2 (0.0, 100.0) 2 (450)	3.6 (0.0, 36.1) 3 (608)
			Ceftazidime	7.9 (0.5, 22.8) 13 (2252)	–	0.7 (0.0, 2.8) 1 (138)	10.2 (0.0, 56.8) 7 (865)	–	33.0 (28.6, 37.6) 1 (415)	3.9 (0.0, 28.8) 4 (834)
			Ceftriaxone	6.5 (0.1, 21.5) 47 (23 121)	10.4 (0.0, 82.4) 4 (359)	–	1.3 (0.3, 3.2) 22 (9553)	–	21.1 (0.0, 94.3) 20 (12 958)	0.0 (0.0, 0.4) 1 (251)
		Fluoroquinolones	Ciprofloxacin	38.1 (19.0, 59.4) 56 (27 089)	14.8 (1.5, 38.1) 8 (1078)	16.3 (0.0, 99.1) 2 (208)	77.3 (61.7, 89.8) 20 (9642)	–	58.0 (2.2, 100.0) 21 (15 211)	29.5 (0.0, 98.2) 5 (950)
			Levofloxacin	59.7 (21.6, 92.0) 6 (640)	–	–	67.4 (0.0, 100.0) 2 (88)	–	78.6 (20.5, 100.0) 2 (127)	17.1 (0.0, 100.0) 2 (425)
	S. aureus	Methicillin resistance[a]		47.1 (38.8, 55.5) 69 (36 027)	52.1 (28.5, 75.2) 9 (413)	44.1 (29.5, 59.4) 14 (13 356)	51.5 (40.1, 62.8) 15 (2758)	29.9 (5.7, 63.1) 9 (3591)	71.1 (49.0, 88.9) 8 (632)	42.2 (28.3, 56.8) 14 (15 277)
	S. pneumoniae	3rd– gen. cephalosporins	Cefotaxime	11.5 (2.4, 26.0) 6 (305)	–	23.4 (0.0, 100.0) 2 (125)	5.0 (0.0, 18.5) 1 (20)	–	0.0 (0.0, 28.7) 1 (3)	7.1 (0.0, 99.8) 2 (157)
			Ceftriaxone	–	–	–	–	–	–	–
		Penicillins	Oxacillin	–	–	–	–	–	–	–
			Penicillin G	12.0 (4.0, 23.3) 12 (1177)	–	32.7 (26.2, 39.7) 2 (113)	13.8 (0.0, 59.4) 3 (104)	7.0 (0.0, 100.0) 2 (386)	0.0 (0.0, 28.7) 1 (3)	6.3 (0.0, 26.1) 4 (571)
		TMP– sulfa	Co-trimoxazole	58.0 (25.6, 87.0) 6 (320)	–	60.4 (50.9, 69.4) 1 (106)	46.3 (0.0, 100.0) 2 (54)	–	100.0 (71.3, 100.0) 1 (3)	50.9 (0.0, 100.0) 2 (157)
Gastrointestinal	*Salmonella* spp.	Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	–	–	–	–	–	–	–
			Imipenem	2.7 (0.0, 18.5) 11 (778)	–	–	40.9 (21.7, 61.6) 1 (22)	–	0.5 (0.0, 70.1) 2 (98)	0.1 (0.0, 0.8) 8 (658)
			Meropenem	4.9 (0.0, 37.5) 9 (445)	0.0 (0.0, 4.3) 1 (22)	–	50.0 (29.7, 70.3) 1 (22)	–	–	0.9 (0.0, 3.1) 7 (401)

				% Resistance (95% CI) No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
		3rd– gen. cephalosporins	Cefotaxime	24.8 (0.5, 68.0) 12 (1370)	–	–	–	–	67.3 (0.0, 100.0) 3 (542)	9.6 (2.5, 20.8) 9 (828)
			Ceftazidime	21.6 (3.7, 48.7) 8 (656)	–	–	–	–	37.5 (24.5, 51.5) 1 (48)	15.0 (6.1, 27.0) 7 (608)
			Ceftriaxone	14.3 (2.2, 34.2) 12 (939)	5.1 (0.0, 100.0) 2 (72)	–	36.0 (0.0, 100.0) 2 (119)	–	7.1 (3.5, 12.0) 1 (140)	14.8 (6.4, 25.9) 7 (608)
		Fluoroquinolones	Ciprofloxacin	25.2 (10.4, 43.8) 21 (1951)	17.1 (0.0, 78.5) 4 (292)	–	46.5 (0.0, 100.0) 2 (119)	–	10.2 (0.0, 72.7) 4 (682)	29.5 (3.1, 68.2) 11 (858)
			Levofloxacin	–	–	–	–	–	–	–
	Shigella spp.	3rd– gen. cephalosporins	Cefotaxime	48.4 (13.4, 84.4) 9 (1164)	–	–	53.2 (39.0, 67.1) 1 (47)	–	43.0 (0.1, 96.9) 8 (1117)	–
			Ceftazidime	17.9 (0.1, 56.0) 7 (1021)	–	0.4 (0.0, 1.2) 1 (471)	–	–	32.3 (15.2, 52.2) 6 (550)	–
			Ceftriaxone	30.9 (11.7, 54.5) 15 (1814)	–	8.7 (0.0, 100.0) 2 (642)	51.5 (0.0, 100.0) 3 (264)	8.1 (0.0, 100.0) 2 (107)	36.0 (4.2, 77.7) 8 (801)	–
		Fluoroquinolones	Ciprofloxacin	36.9 (18.6, 57.3) 24 (2922)	35.5 (16.6, 57.1) 4 (147)	45.5 (0.0, 100.0) 2 (642)	82.3 (64.1, 95.0) 4 (413)	15.4 (0.0, 100.0) 2 (107)	22.1 (8.9, 39.2) 12 (1613)	–
			Levofloxacin	–	–	–	–	–	–	–
		Macrolides	Azithromycin	33.3 (19.7, 48.6) 14 (1185)	22.1 (0.0, 89.2) 3 (98)	51.5 (44.0, 58.9) 1 (171)	41.9 (11.1, 76.9) 2 (303)	55.0 (44.1, 65.7) 1 (80)	13.1 (0.0, 86.2) 7 (533)	–
Urinary tract	*E. coli*	Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	3.1 (1.0, 6.3) 73 (56 022)	0.7 (0.0, 21.7) 3 (1338)	0.9 (0.0, 6.1) 9 (18 486)	9.0 (0.0, 36.9) 16 (4782)	2.4 (0.0, 10.7) 20 (22 048)	4.3 (0.4, 12.0) 18 (5232)	1.5 (0.1, 4.4) 7 (4136)
			Imipenem	4.4 (2.3, 7.0) 224 (89 023)	3.8 (0.2, 11.5) 18 (2542)	0.8 (0.0, 4.3) 7 (18 451)	9.2 (1.2, 23.3) 53 (12 342)	1.1 (0.0, 4.3) 33 (30 388)	9.7 (5.8, 14.6) 101 (19 108)	1.0 (0.2, 2.6) 12 (6192)
			Meropenem	2.7 (1.2, 4.7) 228 (126 783)	3.5 (1.2, 6.9) 18 (16 649)	0.3 (0.0, 1.9) 11 (17 719)	7.8 (1.1, 19.9) 57 (11 646)	0.3 (0.0, 1.8) 45 (28 827)	8.1 (3.3, 14.7) 84 (24 454)	0.5 (0.0, 1.7) 13 (27 488)
		3rd– gen. cephalosporins	Cefotaxime	41.5 (32.5, 50.7) 161 (50 719)	36.1 (23.0, 50.4) 19 (3661)	–	54.4 (37.9, 70.4) 32 (6624)	17.2 (7.4, 30.1) 20 (8433)	59.2 (40.3, 76.9) 82 (12 327)	30.0 (10.3, 54.9) 8 (19 674)
			Ceftazidime	39.8 (32.6, 47.2) 211 (90 346)	44.2 (34.5, 54.0) 26 (19 426)	20.0 (3.9, 44.3) 9 (17 765)	49.2 (36.1, 62.4) 46 (8662)	18.9 (9.0, 31.3) 32 (24 819)	59.8 (47.4, 71.6) 85 (13 345)	29.7 (20.9, 39.3) 13 (6329)
			Ceftriaxone	39.8 (32.2, 47.6) 223 (168 967)	39.6 (28.5, 51.2) 24 (20 697)	17.0 (2.3, 41.2) 13 (32 770)	52.7 (38.5, 66.8) 62 (12 872)	22.0 (12.7, 33.0) 20 (53 478)	60.5 (48.7, 71.8) 92 (25 769)	21.0 (5.5, 43.0) 12 (23 381)

				% Resistance (95% CI) No. of countries (no. of infections with AST)						
Infection type	**Bacterial pathogen**	**Antibiotic class**	**Antibiotic**	**Global**	**African Region**	**Region of the Americas**	**South-East Asia Region**	**European Region**	**Eastern Mediterranean Region**	**Western Pacific Region**
		4th– gen. cephalosporins	Cefepime	38.1 (29.7, 47.0) 134 (153 083)	62.7 (35.6, 86.0) 6 (447)	24.7 (2.9, 58.3) 7 (22 275)	46.0 (29.3, 63.2) 36 (7642)	21.4 (7.8, 39.5) 19 (106 913)	54.1 (41.7, 66.1) 54 (9624)	24.4 (14.2, 36.2) 12 (6182)
		Fluoroquinolones	Ciprofloxacin	39.8 (34.7, 45.0) 315 (387 210)	40.2 (31.2, 49.6) 38 (20 427)	34.1 (13.4, 58.8) 14 (29 436)	59.6 (48.9, 69.8) 64 (13 388)	21.8 (17.6, 26.4) 51 (283 197)	51.3 (43.1, 59.5) 135 (34 694)	38.7 (27.0, 51.1) 13 (6068)
			Levofloxacin	39.0 (32.6, 45.5) 140 (65 860)	49.0 (3.4, 95.7) 3 (88)	22.5 (8.7, 40.4) 5 (18 281)	55.4 (34.8, 75.1) 36 (5595)	26.4 (21.6, 31.5) 31 (16 249)	46.1 (37.0, 55.3) 52 (19 603)	41.2 (22.8, 61.1) 13 (6044)
		Polymyxins	Colistin	2.8 (0.9, 5.9) 64 (27 125)	15.7 (0.0, 99.0) 4 (208)	0.3 (0.0, 2.1) 3 (512)	1.1 (0.2, 2.9) 26 (7050)	3.4 (0.0, 14.5) 9 (4770)	4.4 (0.6, 11.4) 22 (14 585)	–
		TMP– sulfa	Co-trimoxazole	49.1 (43.3, 54.8) 299 (601 468)	70.3 (58.6, 80.7) 31 (4843)	34.5 (22.3, 47.7) 16 (206 946)	60.8 (55.7, 65.7) 75 (15 593)	29.1 (25.7, 32.6) 58 (333 285)	60.7 (52.4, 68.8) 104 (34 522)	37.0 (18.9, 57.3) 15 (6279)
	K. pneumoniae	Carbapenems	Doripenem	–	–	–	–	–	–	–
			Ertapenem	15.9 (6.8, 28.0) 31 (11 964)	1.5 (0.4, 3.4) 1 (259)	0.6 (0.0, 63.7) 2 (5988)	38.5 (0.0, 100.0) 4 (491)	17.2 (4.5, 35.7) 7 (2737)	22.8 (4.6, 49.5) 10 (972)	5.7 (0.0, 24.8) 7 (1517)
			Imipenem	14.8 (8.7, 22.2) 81 (16 270)	8.3 (0.0, 31.2) 4 (316)	2.1 (1.7, 2.5) 1 (5577)	26.1 (2.1, 64.0) 17 (1534)	9.9 (2.9, 20.6) 11 (3896)	17.0 (10.0, 25.3) 37 (3025)	5.7 (0.0, 20.2) 11 (1922)
			Meropenem	14.7 (8.8, 21.9) 76 (13 176)	23.4 (7.8, 44.1) 5 (161)	0.4 (0.0, 7.8) 3 (4236)	31.6 (16.3, 49.3) 18 (1526)	11.5 (4.3, 21.6) 12 (3165)	21.7 (12.1, 33.1) 27 (2364)	2.8 (0.0, 11.8) 11 (1724)
		3rd– gen. cephalosporins	Cefotaxime	55.9 (40.9, 70.4) 57 (5484)	63.9 (13.5, 99.1) 5 (322)		49.1 (12.8, 85.9) 9 (1010)	51.8 (23.9, 79.1) 9 (1452)	66.5 (42.4, 86.7) 31 (2525)	12.8 (0.0, 100.0) 3 (175)
			Ceftazidime	58.8 (48.3, 68.9) 71 (14 975)	69.7 (20.1, 99.7) 4 (290)	11.6 (3.2, 24.5) 2 (5792)	69.0 (50.2, 85.0) 13 (1319)	54.8 (22.2, 85.3) 10 (3209)	71.9 (60.2, 82.3) 31 (2517)	35.6 (23.3, 48.9) 11 (1848)
			Ceftriaxone	51.0 (39.6, 62.4) 84 (18 509)	49.7 (5.4, 94.4) 6 (596)	10.8 (2.5, 23.9) 3 (8995)	60.2 (39.5, 79.2) 18 (1835)	54.6 (25.1, 82.4) 10 (2462)	62.6 (45.5, 78.2) 35 (2678)	29.8 (8.2, 57.8) 12 (1943)
		4th– gen. cephalosporins	Cefepime	49.0 (35.4, 62.7) 61 (14 140)	97.3 (89.7, 100.0) 1 (37)	9.7 (0.0, 40.7) 2 (7516)	54.8 (35.5, 73.3) 12 (1305)	49.8 (21.6, 78.0) 8 (1543)	63.4 (39.9, 83.9) 27 (2119)	17.3 (4.5, 36.1) 11 (1620)
		Fluoroquinolones	Ciprofloxacin	50.9 (43.7, 58.1) 99 (33 944)	49.6 (22.4, 76.9) 9 (425)	25.7 (0.0, 90.6) 3 (8986)	61.7 (45.3, 76.9) 17 (1725)	49.0 (28.2, 70.1) 15 (17 535)	52.9 (42.8, 63.0) 45 (3595)	43.3 (14.3, 75.2) 10 (1678)
			Levofloxacin	44.2 (31.6, 57.3) 45 (10 955)	–	9.7 (9.0, 10.5) 1 (5890)	61.8 (38.4, 82.6) 10 (1131)	38.2 (0.0, 100.0) 4 (430)	53.6 (39.3, 67.7) 17 (1468)	27.0 (4.6, 59.1) 13 (2036)
		Polymyxins	Colistin	11.1 (2.5, 24.8) 24 (2203)	–	2.0 (0.2, 5.6) 1 (100)	2.4 (0.0, 22.9) 10 (976)	12.5 (0.0, 72.8) 4 (113)	20.6 (1.3, 54.3) 8 (692)	0.9 (0.2, 2.3) 1 (322)
		TMP– sulfa	Co-trimoxazole	52.4 (43.5, 61.3) 90 (37 804)	73.2 (41.4, 95.3) 7 (423)	25.4 (2.2, 62.2) 4 (12 918)	60.6 (49.7, 71.1) 21 (2029)	41.3 (30.1, 53.0) 15 (17 715)	65.5 (50.4, 79.1) 33 (3107)	36.3 (15.7, 59.9) 10 (1612)

[a] Methicillin resistance in *S. aureus* was assessed by oxacillin or cefoxitin susceptibility testing.

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