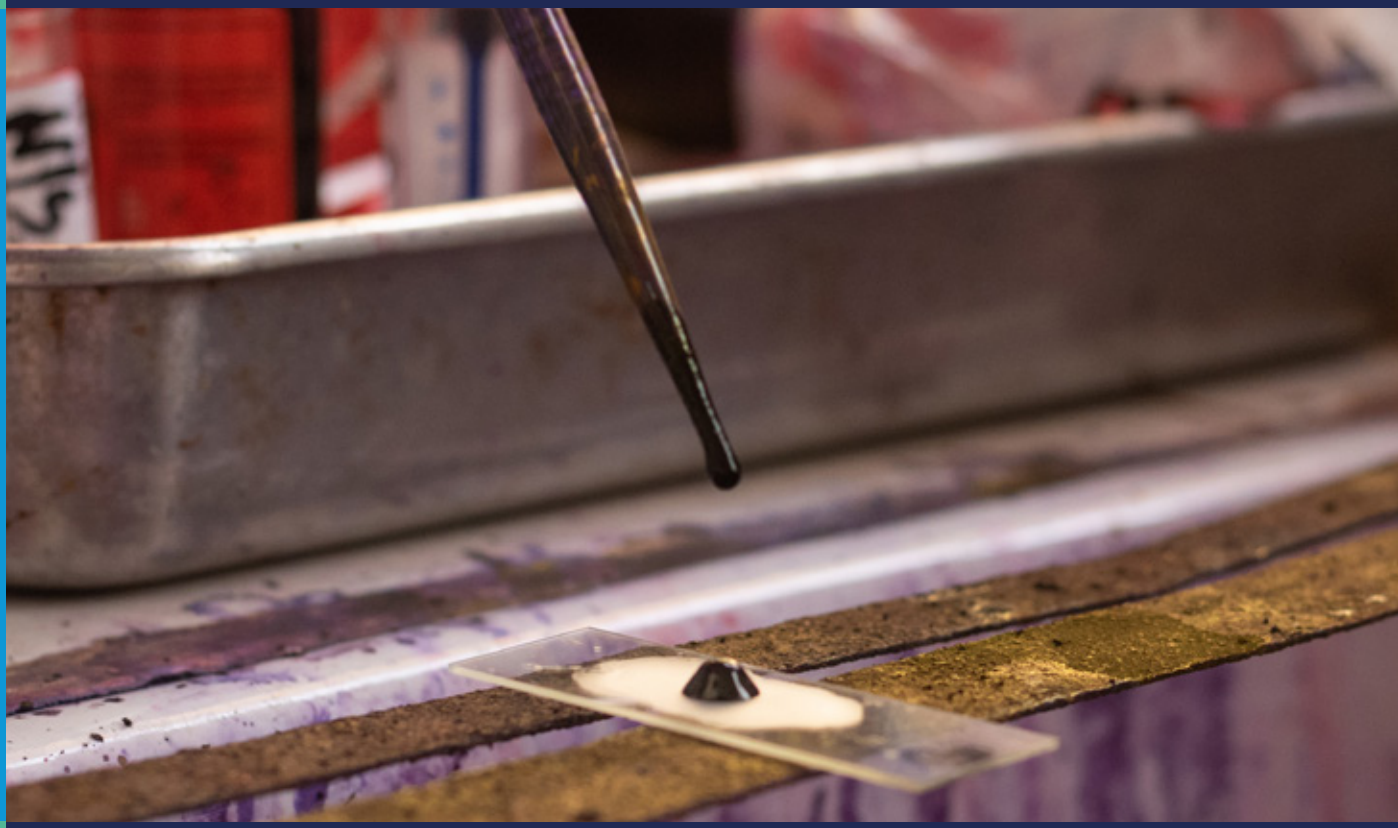
Analysis of antimicrobial resistance trends in the WHO African Region

Insights from GLASS data, 2024 report



World Health Organization
African Region

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Contents

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The following experts contributed to the development of the report through technical inputs, data analysis, drafting, and review: Dr Laetitia Gahimbare (Technical Officer – AMR Surveillance, Evidence and Laboratory Strengthening, WHO Regional Office for Africa) and Mr Yidnekachew Degefaw (Technical Officer – AMR National Action Plans, WHO Regional Office for Africa), under the direction of Dr Ali Ahmed Yahaya (AMR Team Lead, WHO Regional Office for Africa).

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Abbreviations

AMR	antimicrobial resistance
AMS	antimicrobial stewardship
AMU	antimicrobial use
AST	antimicrobial susceptibility testing
BCIs	bacteriologically confirmed infections
CTAs	countries, territories and areas
GDP	gross domestic product
GLASS	Global Antimicrobial Resistance and Use Surveillance System
LMICs	low- and middle-income countries
MRSA	methicillin-resistant *Staphylococcus aureus*
SDGs	Sustainable Development Goals
SSA	sub-Saharan Africa
UTIs	urinary tract infections

Executive summary

Antimicrobial resistance (AMR) remains a significant global health threat, driven by the misuse and overuse of antimicrobials in human health, animal health and agriculture, as well as anthropogenic activities that result in the contamination/pollution of the environment. Listed among the top ten public health threats facing humanity, AMR disproportionately affects sub-Saharan Africa (SSA). Without urgent and concrete action, AMR is expected to kill an estimated 10 million people annually by 2050.

The primary objective of this report is to support the implementation of global and regional AMR strategies by analysing trends in AMR data collected through a globally standardized approach. Specifically, the report aims to: (1) analyse AMR trends in the WHO African Region using data from the Global Antimicrobial Resistance and Use Surveillance System (GLASS) for the years 2020, 2021 and 2022; (2) assess the progress and challenges of AMR surveillance in the Region; and (3) provide recommendations to enhance AMR surveillance, prevention and control measures across the Region.

Data for this analysis were extracted from the GLASS dashboard[1] on 14 November 2024. The dashboard presents global antimicrobial use and resistance data from countries, territories and areas (CTAs) enrolled in GLASS by the end of 2023, using interactive visualizations. Data for 2023 were not yet available at the time of extraction. This report focuses exclusively on AMR data from the WHO African Region. Due to limited data, only blood and urine specimens were considered for analysis. AMR trends were examined for bloodstream infections (BSIs) caused by *Acinetobacter baumannii*, *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella* spp., and *Staphylococcus aureus*; and for urinary tract infections (UTIs) caused by *Klebsiella pneumoniae* and *Escherichia coli*. The report also highlights key findings on Sustainable Development Goal (SDG) indicators related to AMR, particularly SDG Indicator 3.d.2, which tracks the percentage of BSIs caused by selected antimicrobial-resistant organisms: *E. coli* resistance to third-generation cephalosporins and *methicillin-resistant Staphylococcus aureus (MRSA).*

The results show that the number of countries reporting BSI AMR data to GLASS increased from 15 in 2020 to 19 in 2022. Among these, 13 countries consistently reported AMR trends over the three-year period. Mauritius and South Africa contributed the largest amount of AMR data, sourced from a relatively larger number of health care facilities and in-country locations, making their data more representative of AMR patterns in their respective settings.

Acinetobacter baumannii exhibited high resistance levels, with up to 78% resistance to carbapenems. *Klebsiella pneumoniae* showed similarly elevated resistance rates, reaching 80% resistance to third- and fourth-generation cephalosporins in some countries. In contrast, *Salmonella spp*. demonstrated significantly lower resistance levels, with approximately 3% resistance to ceftazidime and ciprofloxacin in countries with robust testing systems, and less than 0.5% resistance to carbapenems. *E. coli* resistance to third-generation cephalosporins was reported at 64–78% across all reporting countries, while in Mauritius, levels ranged from 50% to 60%. *MRSA* showed resistance rates of 45–50% across reporting countries, with Mauritius reporting slightly lower rates between 40% and 43%.

The number of countries reporting AMR data for UTIs rose from 11 in 2020 to 14 in 2022, with nine countries consistently reporting data over the three-year period. *E. coli* in UTIs exhibited exceptionally high resistance to ampicillin, with a median resistance of 93% across all reporting countries. Between 2020 and 2022, both *E. coli* and *K. pneumoniae* showed high resistance rates: 78–84% to co-trimoxazole, 64–76% to cefotaxime, and 57–59% to ciprofloxacin.

These findings reflect a growing number of countries in the WHO African Region submitting AMR data to GLASS. They also reveal important variations between countries and highlight concerning increases in AMR trends for BSIs

1 GLASS Dashboard: https://worldhealthorg.shinyapps.io/glass-dashboard/_w_eb26d24a/#!/

and UTIs across the Region. However, the data remains limited in scope and does not fully represent the regional AMR landscape, as most reporting countries lack comprehensive national coverage. Despite these limitations, the results underscore the urgent need to strengthen AMR mitigation efforts, including raising awareness and enhancing education, improving infection prevention and control, promoting innovation through research, reinforcing antimicrobial stewardship (AMS) programmes, expanding microbiology services to improve testing and surveillance, building sustainable capacity for data collection, analysis, reporting and utilization in evidence-based decision-making, and mobilizing and supporting other countries to contribute data, ensuring a more comprehensive and representative picture of AMR across the Region.

1. Introduction

Antimicrobial resistance (AMR) remains a critical global health threat, primarily driven by the misuse and overuse of antimicrobials in human health, animal health and agriculture, as well as by anthropogenic activities that result in the contamination/pollution of the environment. In 2021, bacterial AMR was responsible for an estimated 4.71 million deaths worldwide, with 1.14 million deaths directly attributed to AMR. Sub-Saharan Africa (SSA) experienced the highest mortality rates. By 2050, projections suggest that AMR could lead to 1.91 million direct deaths and a total of 8.22 million deaths globally. The economic toll is also expected to be substantial, with annual health care costs projected to reach US$ 1 trillion by 2050 and global GDP losses ranging between US$ 1 trillion and 3.4 trillion by 2030[2].

Laboratory-based antimicrobial susceptibility testing (AST) of priority pathogens is crucial for guiding effective antimicrobial therapy, preventing the spread of resistant strains, and improving patient outcomes. AMR surveillance data play a key role in informing infection prevention and control strategies, supporting outbreak response in health care settings, and strengthening local, national and global AMR mitigation efforts. To address the need for standardized global AMR surveillance, the World Health Organization (WHO) launched the Global Antimicrobial Resistance and Use Surveillance System (GLASS) in 2015. As the first global collaborative effort to standardize AMR surveillance, GLASS was endorsed by the Sixty-eighth World Health Assembly (as resolution WHA68.7) to support the second objective of the Global action plan on AMR: "Strengthen knowledge through surveillance and research." GLASS aims to bridge knowledge gaps and inform evidence-based strategies at national, regional and global levels. It provides a harmonized framework for countries to collect, analyse and share AMR data, enabling them to document the status and progress of their AMR surveillance systems while supporting efforts to achieve the Sustainable Development Goals (SDGs). As of December 2024, a total of 44 Member States in the WHO African Region had joined GLASS.

In 2021, WHO AFRO published a regional AMR report (2016–2020)3, which was primarily based on a systematic review of available literature. The report provided an overview of country enrolment and reporting status in GLASS. In 2023, WHO AFRO introduced the Regional strategy for expediting the implementation and monitoring of national action plans on AMR (2023–2030)4. This strategy emphasizes the urgent need to strengthen AMR surveillance and laboratory diagnostic capacities across the African Region and encourages the use of GLASS data for evidence-based decision-making. In 2024, WHO released the updated bacterial priority pathogens list (WHO BPPL)5, an important tool in the global fight against antimicrobial resistance. Building on the 2017 edition, the 2024 WHO BPPL updates and refines the prioritization of antibiotic-resistant bacterial pathogens based on scientific and public health criteria: (1) public health impact (infection burden and mortality); (2) treatment challenges due to resistance to existing antibiotics; (3) ease of transmission in health care and community settings; (4) burden on health care systems, including prolonged hospital stays and higher medical costs; and (6) the urgent need for new antibiotics where effective treatment options are lacking.

2 GBD 2021 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet. 2024 Sep 28;404(10459):1199-1226. doi: 10.1016/S0140-6736(24)01867-1. Epub 2024 Sep 16. PMID: 39299261; PMCID: PMC11718157.

3 World Health Organization. Regional Office for Africa. (‟ 2021)‟ . Antimicrobial resistance in the WHO African Region: a systematic literature review. World Health Organization. Regional Office for Africa (https://iris.who.int/handle/10665/349223). Licence: CC BY-NC-SA 3.0 IGO

4 https://www.afro.who.int/sites/default/files/2023-08/AFR-RC73-6%20Regional%20strategy%20for%20expediting%20the%20implementation%20and%20monitoring%20of%20NAPs%20on%20AMR.pdf

5 WHO Bacterial Priority Pathogens List, 2024: bacterial pathogens of public health importance to guide research, development and strategies to prevent and control antimicrobial resistance. Geneva: World Health Organization; 2024. License: CC BY-NC-SA 3.0 IGO

The updated list categorizes bacterial pathogens into critical, high and medium priority groups to guide research and development (R&D) efforts and inform public health interventions. The description of groups is found in table 1 below.

Table 1: Updated list of bacterial pathogens by priority groups

Group	Description	Example
Critical priority group	It includes bacteria for which new antibiotics are urgently needed. These pathogens often exhibit resistance to last-resort antibiotics, cause severe infections such as pneumonia and bloodstream infections, and spread easily in health care settings.	*Acinetobacter baumannii and Pseudomonas aeruginosa* (resistant to carbapenems) and carbapenem-resistant or extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae
high priority group	This group comprises bacteria responsible for common but serious infections (such as bloodstream infections, food-borne diseases and sexually transmitted diseases) that are increasingly resistant to antibiotics.	*Enterococcus faecium (vancomycin-resistant); Staphylococcus aureus* (methicillin-resistant, vancomycin-intermediate, and vancomycin-resistant – MRSA, VRSA); *Helicobacter pylori* (clarithromycin-resistant); *Campylobacter spp.* (fluoroquinolone-resistant); *Salmonella spp.* (fluoroquinolone-resistant) and, *Neisseria gonorrhoeae* (cephalosporin- and fluoroquinolone-resistant).
Medium priority group	*The medium priority group consists of bacteria primarily associated with respiratory and diarrheal infections that require alternative treatment options due to growing resistance*	*Streptococcus pneumoniae* (penicillin-non-susceptible), *Haemophilus influenzae* (ampicillin-resistant). *and Shigella spp.* (fluoroquinolone-resistant).

In September 2024, during the Seventy-ninth session of the United Nations General Assembly, world leaders adopted a political declaration on AMR, committing to reduce global deaths associated with bacterial antimicrobial resistance by 10% by 2030, based on the 2019 baseline of 4.95 million deaths[6] .

This report, "AMR trends in the WHO African Region: insights from GLASS data" provides an in-depth analysis of recent AMR data trends extracted from GLASS. It offers critical insights into AMR surveillance and control measures across the Region.

6 United Nations (2024, September 26). *World leaders adopt political declaration on antimicrobial resistance at 2024 General Assembly High-Level Meeting.* United Nations. https://press.un.org/en/2024/ga12642.doc.htm

2. Objectives of the report

Overall objective

To support the implementation of global and regional strategies on AMR by analysing AMR data collected and assessed through a globally standardized approach.

Specific objectives

- Analyse AMR trends in the WHO African Region using data reported to the Global Antimicrobial Resistance and Use Surveillance System (GLASS) between 2020 and 2022.
- Assess progress and challenges in AMR surveillance across the Region.
- Provide actionable recommendations to enhance AMR surveillance, prevention and control measures across the Region.

3. Methodology

A detailed description of the GLASS methodology can be found in the respective editions of the GLASS reports[7] and Manual for early implementation8, which readers are encouraged to consult. The methodology outlined below draws on the above-mentioned references. WHO provided guidance and supported Member States in building capacity to use GLASS guidelines and tools, and countries enrolled in GLASS committed to applying these standards. However, WHO could not independently verify whether data collection and analysis processes were applied consistently within individual countries or uniformly across all participating countries submitting data to GLASS.

3.1 Surveillance methods used in GLASS

3.1.1 Case-finding based on routine clinical samples of priority specimen types

Cases were identified according to local clinical practices. Patient samples were analysed using each laboratory's standard protocols, including antibiotic susceptibility testing (AST) performed in accordance with internationally recognized standards such as EUCAST, CLSI. Data on targeted specimens, bacteria and antibiotics were collected and submitted to GLASS the following year. Basic demographic and epidemiological data were collected, along with information on the populations covered, to better understand their characteristics. AST results were linked to patient data from each request and correlated with population data from surveillance sites, allowing for a comprehensive analysis of AMR trends across the Region. The priority specimen types and pathogens for routine clinical AMR surveillance are presented in Table 1 below.

Table 2. Priority specimens and pathogens for AMR surveillance

Specimen	Laboratory case definition	Surveillance type and sampling setting	Priority pathogens for surveillance
Blood	Isolation from blood[a]	Selected sites or national coverage. Continuous Patients in hospital and the community	*E. coli; K. pneumoniae; A. baumannii; S. aureus; S. pneumoniae; Salmonella* spp.
Urine	Significant growth in urine specimen[b]		*E. coli; K. pneumoniae.*
Faeces	Isolation of *Salmonella spp*[c]. or *Shigella* spp. from stool		*Salmonella* spp.; *Shigella* spp.
Urethral and cervical swabs	Isolation of *N. gonorrhoeae*		*N. gonorrhoeae*

[a]Any pathogen isolated from a blood culture may be of local and national significant; only prioritized pathogens designated for global surveillance during the reference period are listed here.

[b]Pure culture according to local laboratory practices. Catheter samples were excluded when possible.

[c]Diarrheal surveillance focused on non-typhoidal Salmonella species. However, for local clinical purposes, typhoid and paratyphoid were included.

7 Global antimicrobial resistance and use surveillance system (GLASS) reports – all reports. GLASS Resource Centre (who.int)
8 https://www.who.int/publications/i/item/9789241549400

3.1.2 Population

GLASS surveillance focused on two target populations:

- All patients from whom prioritized specimens were collected, regardless of culture result (positive or negative)
- All patients with prioritized specimens that yielded growth of priority species (only positive samples).

To estimate the burden and prevalence of AMR in the population, data were collected on the populations served by surveillance sites. This included the catchment population size to help assess surveillance coverage and contextualize the AMR burden. Countries were requested to submit the following information:

1. Total national population.
2. Patient volumes at surveillance sites over a 12-month period, disaggregated by outpatient consultations and inpatient admissions.
3. Microbiological data, including the number of patients per specimen type with positive and negative cultures and pathogens categorized as susceptible and non-susceptible for each priority pathogen–antibiotic combination.

These data were further stratified by key patient characteristics:

- Age: the age groups reported followed the categorization used by the Global Health Observatory, WHO's main health statistics platform, which compiles and presents global health data across domains.
- Gender.
- Health care-associated infection (HAI): defined as an infection occurring 48 hours or more after admission, or within 30 days following health care exposure (for example, surgery). This includes infections acquired in outpatient settings, long-term care facilities and during home-based care following medical intervention.
- Community-acquired infection (CAI): defined as an infection acquired outside of a health care setting or identified within 48 hours of hospital admission in a patient without recent health care exposure.

All data must be aggregated at the national level before submission to GLASS. It was recommended that surveillance coordination centres maintain individual-level data to support error detection and quality control. To facilitate this process, the WHONET software has been adapted for use at surveillance sites. It enables data entry, transmission to national surveillance centres, and automatic aggregation and generation of reporting forms.

3.1.3 Removal of duplicates

When multiple cultures are collected during patient management, duplicate findings for the same patient should be excluded (de-duplication). For each 12-month surveillance period (GLASS-AMR), only one result per patient, per specimen type and per pathogen should be reported. For example, if two blood cultures from the same patient yield growth of E. coli, only the first should be included in the report. If E. coli is detected in one culture and K. pneumoniae in the other, both results should be reported. Similarly, if E. coli growth is found in one blood culture and also in a urine culture from the same patient, both specimen types should be reported. Where possible, repeated negative results for the same specimen type in the same patient should also be de-duplicated.

3.1.4 Period for national surveillance and reporting to WHO

Surveillance should be continuous and aggregated at the national level every 12 months. National coordination centres (NCCs) should report aggregated data to WHO annually. Outbreaks of resistant pathogens, newly identified resistance patterns or unexpected findings should be reported to the relevant national authorities as soon as they are confirmed by a reference laboratory, with notification also sent WHO. Additionally, the GLASS platform provides a dedicated mechanism for reporting emerging resistance.

3.2 Priority pathogen–antibacterial combinations for reporting to GLASS

Antimicrobial resistance (AMR) can be detected only by microbiological methods. Therefore, samples must be collected from patients for species identification and antimicrobial susceptibility testing (AST). At this stage of GLASS, only AST results are used as a marker of AMR. Other detection methods, such as genotypic testing, are not considered. For each antibacterial combination, AST results are classified according to the guidelines of the Clinical and Laboratory Standards Institute (CLSI) or the European Committee on Antimicrobial Susceptibility Testing (EUCAST) as: susceptible (S), intermediate (I), resistant (R), or not tested.

CLSI[9] classifies AST results into three categories: **Susceptible (S), Intermediate (I)**, and **Resistant (R)**. A "Susceptible" result indicates that the pathogen is likely to be inhibited by standard concentrations of the antimicrobial agent, suggesting that treatment is likely to be effective. The "Intermediate" category represents a buffer zone, where clinical efficacy may be uncertain but still possible with higher doses, drug concentration at the infection site, or combination therapy. A "Resistant" result implies that the pathogen is not inhibited by achievable drug concentrations, and that standard treatment is likely to fail.

EUCAST[10] also uses three categories but defines them slightly differently: **Susceptible – Standard dosing regimen (S), Susceptible – Increased exposure (I)**, and **Resistant (R)**. In the EUCAST system, the "S" category indicates a high probability of treatment success with a standard dosing regimen, while the "I" category denotes that clinical success is still achievable if antimicrobial exposure is increased, for example through higher doses or optimized delivery. This redefinition of "I" in 2019 shifted its interpretation from a borderline category to one that emphasizes actionable treatment adjustments. The "R" category indicates that the infection is unlikely to respond even with increased antimicrobial exposure. EUCAST also uses the term "**Non-Susceptible (NS)**" in specific situations, especially when only a susceptible breakpoint is defined and no clear "Resistant" breakpoint exists. For epidemiological purposes, WHO GLASS sometimes reports "non-susceptible" as a composite of I + R, particularly when compiling cross-country AMR data, though this is not a standard interpretive category under CLSI.

The priority pathogens and antibacterial combinations monitored by GLASS are detailed in table 2 below, with results classified as susceptible (S), intermediate (I), resistant (R), or not tested/not applicable.

9 Clinical and Laboratory Standards Institute (CLSI). Performance Standards for Antimicrobial Susceptibility Testing, 34th ed. CLSI supplement M100. Wayne, PA: CLSI; 2024.

10 European Committee on Antimicrobial Susceptibility Testing (EUCAST). Breakpoint tables for interpretation of MICs and zone diameters. Version 14.0, 2024 (https://www.eucast.org/clinical_breakpoints/).

Table 3. Priority pathogen–antibacterial combinations monitored by GLASS

Pathogen	Antibacterial class	Antibacterial agents that might be used for AST[a] [b]
Escherichia coli	Sulphonamides and trimethoprim	Co-trimoxazole
	Fluroquinolones	Ciprofloxacin or levofloxacin
	Third-generation cephalosporins	Ceftriaxone or cefotaxime and ceftazidime
	Fourth-generation cephalosporins	Cefepime
	Carbapenems[c]	Imipenem, meropenem, ertapenem or doripenem
	Polymyxins	Colistin
	Penicillins	Ampicillin
Klebsiella pneumoniae	Sulphonamides and trimethoprim	Co-trimoxazole
	Fluroquinolones	Ciprofloxacin or levofloxacin
	Third-generation cephalosporins	Ceftriaxone or cefotaxime and ceftazidime
	Fourth-generation cephalosporins	Cefepime
	Carbapenems[c]	Imipenem, meropenem, ertapenem or doripenem
	Polymyxins	Colistin
Acinetobacter baumannii	Tetracyclines	Tigecycline or minocycline
	Aminoglycosides	Gentamycin and amikacin
	Carbapenems[c]	Imipenem, meropenem or doripenem
	Polymyxins	Colistin
Staphylococcus aureus	Penicillinase-stable beta-lactams	Cefoxitin[d]
Streptococcus pneumoniae	Penicillins	Oxacillin[e], penicillin G
	Sulphonamides and trimethoprim	Co-trimoxazole
	Third-generation cephalosporins	Ceftriaxone or cefotaxime
Salmonella spp.	Fluroquinolones	Ciprofloxacin or levofloxacin
	Third-generation cephalosporins	Ceftriaxone or cefotaxime and ceftazidime
	Carbapenems[c]	Imipenem, meropenem, ertapenem or doripenem
Shigella spp.	Fluroquinolones	Ciprofloxacin or levofloxacin
	Third-generation cephalosporins	Ceftriaxone or cefotaxime and ceftazidime
	Macrolides	Azithromycin
Neisseria gonorrhoea	Third-generation cephalosporins	Cefixime, ceftriaxone
	Macrolides	Azithromycin
	Aminocyclitols	Spectinomycin
	Fluroquinolones	Ciprofloxacin
	Aminoglycosides	Gentamicin

[a] The listed substances were prioritized for resistance surveillance in each pathogen, although they may not be first-line treatment options. One or more of the listed drugs may be tested.

[b] One or more of the listed drugs may be tested in countries. For each antibacterial agent tested, S, I, R results, along with corresponding numerator and denominator data, should be reported separately.

[c] Imipenem or meropenem is preferred to represent the carbapenem class when available.

[d] Cefoxitin is used in testing to assess susceptibility to oxacillin (as well as methicillin and nafcillin); AST reports to clinicians should indicate susceptibility or resistance to oxacillin.

[e] Oxacillin is used in AST to detect reduced susceptibility or resistance to penicillin; reports to clinicians should indicate reduced susceptibility or resistance to penicillin

GLASS proposed the above list of antimicrobial agents for resistance testing because they are either commonly used as first-line treatments, serve as representative alternatives to evaluate resistance to frequently prescribed drugs, or involve pathogen–antimicrobial combinations of particular concern due to limited treatment options.

3.3 Priority specimen types assessed

Data on bacterial resistance in human infections submitted to GLASS were obtained from the following specimen types: blood, urine, faeces, urethral and cervical swabs. These represent infections in the bloodstream, urinary tract, gastrointestinal tract, and gonorrhoea, respectively. These infections are common and have shown alarming increases in resistance to last-resort drugs. Although uncomplicated urinary tract infections are not routinely tested, urine samples serve as likely indicators of emerging resistance in Gram-negative bacteria. Furthermore, blood and urinary pathogens are often identified using accurate, uncomplicated laboratory methods. Respiratory tract infections, though common, were excluded from the initial GLASS phase due to challenges in linking detected pathogens to infection. Inclusion of respiratory samples is planned for subsequent phases. Other significant infection sites and pathogens were also not covered in this initial phase. The limited specimen list was intended to simplify global data gathering and reporting during early GLASS implementation.

3.4 Data source

Data for this report were extracted from the GLASS dashboard[11] on 14 November 2024. The dashboard offers interactive visualizations of global antimicrobial use (AMU) and antimicrobial resistance (AMR) data for countries, territories and areas (CTAs) enrolled in GLASS by the end of 2023. It includes CTA-specific profiles for both AMR and AMU and is optimized for use with Google Chrome.

The global AMR data dashboard presents key information on the status, quality assurance and standards of national AMR surveillance systems as of 2022, tracks global GLASS-AMR coverage progress since 2016, and provides global antibiotic resistance estimates for 2022. Users can also filter data to access AMR estimates from previous years (2020–2021).

The primary data unit is bacteriologically confirmed infections (BCIs) with interpretable AST results, categorized by infectious syndrome, bacterial pathogen, and antimicrobial agent.

Key considerations for data inclusion:

- To reduce bias from small sample sizes and ensure the reliability and comparability of data used in GLASS global analyses12, only countries reporting at least 10 BCIs per pathogen-antibiotic combination were included.
- Testing coverage was measured as the median number of BCIs with AST results per million population per country.
- The 2024 GLASS report used mid-year population estimates from the United Nations World Population Prospects 2024 to calculate annual testing coverage per million population.
- Countries with "testing coverage above the 75th percentile" had sufficient volumes of BCIs with AST results to allow extrapolation to national population estimates, indicating better testing coverage.

The new *GLASS manual for antimicrobial resistance surveillance in common bacteria causing human infection* expands the list of pathogens under surveillance. However, the 2024 GLASS dashboard update does not yet reflect the extended methods outlined in GLASS Manual 2.0, as technical integration into the global platform is still underway.

11 Global Antimicrobial Resistance and Use Surveillance System (GLASS) dashboard (https://worldhealthorg.shinyapps.io/glass-dashboard).
12 Global Antimicrobial Resistance and Use Surveillance System (GLASS): Early Implementation Protocol for the Integration of Antimicrobial Resistance Surveillance in National Surveillance System

4. AMR trends in the WHO African Region (2020, 2021 and 2022)

The data presented in this report were extracted from the "Resistance to Antibiotics in Selected Calendar Year" chart on the GLASS dashboard, which categorizes AMR trends into the following infectious syndromes: bloodstream infections, gastrointestinal infections, gonorrhoea, and urinary tract infections. For each pathogen, antibiotic resistance is expressed as the median percentage. Due to limited data availability, trends for gastrointestinal and gonorrhoea infections are not included in this report.

Note: to simplify the presentation of key messages, resistance percentages have been rounded to the nearest whole number. Detailed tables with exact median percentages (including decimal values) are available in the appendices.

4.1 AMR trends in bloodstream infections

A. Reporting countries and pathogens assessed

Between 2020 and 2022, the number of countries that reported AMR data for bloodstream infections (BSIs) increased from 15 to 19, as shown below and visualized in Figure 1. Data on surveillance sites, bacteriologically confirmed infections (BCIs) and antimicrobial susceptibility tests (ASTs) per million population for 2022 are presented in Appendix Table 2. Data for previous years can be found on the GLASS dashboard under "Global maps of testing coverage by infectious syndrome".

- Countries reporting 2020 AMR data (n=15): Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mali, Mauritius, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, and Zambia.
- Countries reporting 2021 AMR data (n= 16): Burkina Faso, Cameroon, Democratic Republic of the Congo, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mali, Mauritius, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, and Zambia.
- Countries reporting 2022 AMR data (n= 19): Benin, Burkina Faso, Cameroon, Democratic Republic of the Congo, Eswatini, Ethiopia, Ghana, Kenya, Liberia, Mali, Mauritius, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Uganda, United Republic of Tanzania, and Zambia.

Fig. 1. Countries reporting AMR data on BSIs from 2020 to 2022

2020 2021 2022

The following 13 countries reported AMR data on BSIs consistently over the three-year period: Burkina Faso, Ethiopia, Ghana, Kenya, Liberia, Mali, Mauritius, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, and Zambia.

Six pathogens were assessed for BSIs: Acinetobacter baumannii, Escherichia coli, Klebsiella pneumoniae, Salmonella spp., Staphylococcus aureus, and Streptococcus pneumoniae. AMR trends for Staphylococcus aureus are presented in the following section on GLASS indicators for the United Nations Sustainable Development Goals (SDGs). Due to insufficient data, trends for Streptococcus pneumoniae are not included in this report. Among the countries that reported at least 10 BCIs with AST results, Mauritius and South Africa contributed the largest amount of AMR data across a broad range of health care facilities and locations, making their datasets more representative of national AMR patterns.

B. Antimicrobial resistant *Acinetobacter baumannii* in bloodstream infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed cases of *Acinetobacter baumannii* infections with AST results ranged from one to 11, depending on the antibiotics tested. The highest number of cases with AST results (6285) was reported for gentamicin in 2022. In Mauritius and South Africa, resistance rates were as high as 78% for imipenem and meropenem, 74% for gentamicin, and 68% for amikacin. However, when considering all reporting countries, resistance rates were comparatively lower: 60% for imipenem, 71% for meropenem, 62% for gentamycin, and 44% for amikacin. Detailed findings on resistance percentages for *Acinetobacter baumannii* bloodstream infections are available in Appendix Table 4.

C. Antimicrobial resistant *Escherichia coli* in bloodstream infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed *E. coli* infections with AST data varied from one to 15, depending on the antibiotics tested. In 2022, ciprofloxacin had the highest number of AST results (5605). However, only three countries reported results for ampicillin, and just one for colistin. Median resistance rates across reporting countries were notably high: 84% for co-trimoxazole and 63% for ciprofloxacin. Mauritius reported comparatively lower resistance levels: 50% for co-trimoxazole and 55% for ciprofloxacin. While resistance to carbapenems remains low, it showed an upward trend, rising from 1% in 2020 to 8% in 2022 across all reporting countries, and from 3% to 4% in Mauritius over the same period. Detailed findings on resistance percentages for *E. coli* bloodstream infections are provided in Appendix Table 5.

c. Antimicrobial resistant *Klebsiella pneumoniae* in bloodstream infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed *Klebsiella pneumoniae* infections with AST data varied from one to 16, depending on the antibiotics tested. In 2022, ciprofloxacin had the highest number of AST results (9157). Across reporting countries, *Klebsiella pneumoniae* isolates from bloodstream infections showed high levels of resistance to all antibiotics tested. In Mauritius and South Africa, median resistance rates were as high as 80% for cefotaxime (a third-generation cephalosporin), 69% for cefepime (a fourth-generation cephalosporin), 54% for ciprofloxacin (a quinolone), 35% for meropenem, and 28% for both ertapenem and imipenem (all carbapenems). Detailed findings on resistance percentages for *Klebsiella pneumoniae* bloodstream infections are available in Appendix Table 6.

A. Antimicrobial resistant *Salmonella spp.* in bloodstream infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed *Salmonella spp.* infections with AST data varied from one to eight, depending on the antibiotics tested. The highest count of BCIs with AST results was reported for ceftriaxone (1186), followed by ciprofloxacin (1172). Overall, low levels of antibiotic resistance were observed in all antibiotics tested. In countries with more representative data, median resistance rates for *Salmonella spp*. isolated from bloodstream infections reached up to 3% for ceftazidime and ciprofloxacin, while remaining below 0.5% for carbapenems. An exception was noted in the Democratic Republic of the Congo, which reported 62% resistance to levofloxacin in 2022, based on 13 isolates. Detailed findings are provided in Appendix Table 7.

Antimicrobial resistance is a growing crisis threatening public health. For example, Klebsiella pneumoniae shows alarming resistance levels, with rates as high as 80% for cefotaxime and 35% for meropenem. Such trends increase the risk of severe sepsis, septic shock, and multiorgan infections. Without urgent action, our treatment options will collapse. Policy-makers must act now. Strengthening surveillance, infection prevention and antibiotic stewardship is essential to avert a health care catastrophe.

4.2 AMR trends for GLASS SDG indicators

In 2020, two new AMR indicators were integrated into the SDGs under health target 3.d.2, which aims to "strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks". These indicators track the proportion of bloodstream infections caused by *Escherichia coli* resistant to third-generation cephalosporins and methicillin-resistant Staphylococcus aureus (MRSA).

A. Resistance of *Escherichia coli* to third-generation cephalosporins in bloodstream infections

Resistance to third-generation cephalosporins often signals the presence of extended-spectrum beta-lactamases (ESBLs), which confer resistance to a broad range of beta-lactam antibiotics, limiting treatment options. Between 2020 and 2022, the number of countries reporting at least 10 confirmed *E. coli* infections with AST data varied from 13 to 16. Across these countries, median resistance rates ranged from 64% to 78%. In Mauritius, median resistance ranged between 50% and 60%. Detailed findings are available in Appendix Table 8.

B. Methicillin resistant *Staphylococcus aureus* (MRSA) bloodstream infections

Resistance to methicillin or cefoxitin indicates oxacillin resistance and is used in AST to detect MRSA. Although they are not used therapeutically, methicillin and cefoxitin serve as markers for MRSA detection. MRSA strains are resistant to all beta-lactam antibiotics except ceftaroline, which is not widely available in most African countries. The identification of MRSA is particularly critical, as this phenotype is a leading cause of both hospital-acquired and community-associated infections. Between 2020 and 2022, the number of countries reporting at least 10 confirmed *S. aureus* infections with AST data varied from 13 to 16. Across these countries, the median percentage of MRSA ranged from 45% to 50%, with Mauritius reporting lower rates between 40% and 43%. Detailed findings are available in Appendix Table 9.

Antimicrobial resistance is a serious threat to public health and the achievement of the SDGs. From 2020 to 2022, a total of 64–78% of E. coli bloodstream infections in the African Region were resistant to third-generation cephalosporins. This makes common infections like sepsis, kidney infections and meningitis harder to treat, increasing the risk of death. Similarly, MRSA accounted for 45–50% of bloodstream infections, leading to severe conditions such as pneumonia, bone infections and life-threatening sepsis. Without urgent action to improve surveillance, infection prevention and antibiotic stewardship, we risk undermining global health security and delaying progress towards SDG targets. Policy-makers and all stakeholders must act now.

4.3 AMR trends in urinary tract infections

A. Reporting countries and pathogens assessed

Two pathogens were assessed for urinary tract infections: *Escherichia coli* and *Klebsiella pneumoniae.* Between 2020 and 2022, the number of countries that reported AMR data for urinary tract infections increased from 11 to 14, as indicated below and illustrated in Figure 2. Details about the number of BCIs and ASTs reported per million population by each country are available on the GLASS dashboard.

- Countries reporting 2020 AMR data (n=11): Burkina Faso, Côte d'Ivoire, Ethiopia, Kenya, Liberia, Malawi, Mali, Mauritius, Uganda, United Republic of Tanzania, and Zambia.
- Countries reporting 2021 AMR data (n= 11): Burkina Faso, Cameroon, Ethiopia, Kenya, Liberia, Malawi, Mali, Mauritius, Uganda, United Republic of Tanzania, and Zambia.
- Countries reporting 2022 AMR data (n= 14): Burkina Faso, Cameroon, Eswatini, Ethiopia, Kenya, Liberia, Mali, Mauritius, Namibia, Togo, South Africa, Uganda, United Republic of Tanzania, and Zambia.

Fig. 2. Countries reporting AMR data on UTIs from 2020 to 2022

Nine countries consistently reported AMR trends in urinary tract infections throughout the three-year period: Burkina Faso, Ethiopia, Kenya, Liberia, Mali, Mauritius, Uganda, United Republic of Tanzania, and Zambia.

B. Antimicrobial resistant *Escherichia coli* in urinary tract infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed *E. coli* infections with AST data ranged from one to 13, depending on the antibiotic tested. The highest number of AST results (44 659) was recorded for ciprofloxacin in 2022. However, only three countries reported results for ampicillin and colistin in the same year. The median resistance rate of *E. coli* to ampicillin was high at 93%, while resistance to imipenem and meropenem remained low, at or below 8% across all reporting countries. Median resistance was also high for co-trimoxazole (84%), cefotaxime (64%), and ciprofloxacin (59%).

Country-specific data from 2022 showed cefepime resistance at 12% in South Africa and cefotaxime resistance at 45% in Mauritius. Resistance to ceftriaxone was 74% in Mauritius and 17% in South Africa. Ciprofloxacin resistance stood at 55% in Mauritius and 25% in South Africa, while co-trimoxazole resistance was 44% in Mauritius and 58% in South Africa. Detailed findings are available in Appendix Table 10.

C. Antimicrobial resistant *Klebsiella pneumoniae* in urinary tract infections

Between 2020 and 2022, the number of countries reporting at least 10 confirmed *Klebsiella pneumoniae* infections with AST results ranged from one to 12, depending on the antibiotics tested. In 2022, the highest number of AST results was reported for ciprofloxacin (10 522), followed by co-trimoxazole (10 419). Across all reporting countries, *K. pneumoniae* showed the highest median resistance rates to selected antibiotics: 78% for co-trimoxazole, 76% for cefotaxime, 57% for ciprofloxacin, and 17% for meropenem.

Country-specific data from 2022 showed cefepime resistance at 34% in South Africa. Ceftriaxone resistance was 88% in Mauritius and 43% in South Africa, with ciprofloxacin resistance at 61% in Mauritius and 31% in South Africa. Co-trimoxazole resistance stood at 58% in Mauritius and 48% in South Africa, while resistance to imipenem was 35% in Mauritius and 9% in South Africa. Detailed findings are provided in Appendix Table 11.

Rising antimicrobial resistance in urinary tract infections (UTIs) caused by E. coli and Klebsiella pneumoniae is making treatment increasingly difficult, leading to higher risks of kidney infections, sepsis, increased patient costs and longer hospital stays. Data from 2020 to 2022 show alarmingly high resistance rates: 78–84% for co-trimoxazole, 64–76% for cefotaxime, and 57–59% for ciprofloxacin. Without urgent action, even routine UTIs could become untreatable. Policy-makers and other key stakeholders must act now by strengthening surveillance, enhancing infection prevention, and enforcing antimicrobial stewardship to protect public health.

5. Subregional and country variations

WHO continues to guide and support Member States in building capacity to use GLASS guidelines and tools. However, the development and maturity of surveillance systems vary across countries. Countries may participate in GLASS even without a fully established AMR surveillance system, using the platform as a framework to build national capacities. Data submitted to GLASS often originate from sentinel sites, and the number and selection of these sites is determined by each country. Consequently, the analysis is limited to the available data and may not fully reflect the national situation. Furthermore, WHO does not independently verify whether data collection and analysis procedures are applied consistently within or across countries. The status, quality assurance practices, and standards of national AMR surveillance systems are also not independently assessed, which may affect the comparability and reliability of the reported data.

As a result, despite global and regional efforts, significant gaps remain in understanding the true magnitude, distribution and trends of drug-resistant infections at national and subregional levels. It is important to note that not all countries registered with GLASS are submitting data, and that the data from most reporting countries is not yet nationally representative. Nevertheless, the observed levels of AMR remain concerning.

While this report does not specifically assess intercountry or subregional variations in AMR levels, socioeconomic status may influence testing coverage and AMR detection. For instance, Mauritius, classified as a high-income country, consistently demonstrated broader testing coverage and lower AMR rates compared to other reporting countries. The fifth GLASS report[13] (2022) similarly highlighted that AMR percentages vary significantly by country, territory, or area (CTA), depending largely on the extent of testing and reporting. Notably, higher testing and/or reporting coverage was often associated with lower AMR percentages across many pathogen-antimicrobial combinations.

These disparities underscore the challenges faced by low- and middle-income countries (LMICs) in developing and sustaining robust AMR surveillance systems. Effective systems require broad population coverage, access to quality-assured laboratory services, strong diagnostic stewardship, and reliable data reporting mechanisms. While many high-income countries have institutionalized these elements through systematic data collection in routine clinical practice, most LMICs continue to face structural limitations that hinder their ability to produce nationally representative AMR data capable of informing policy, tracking trends, or enabling meaningful cross-country comparisons.

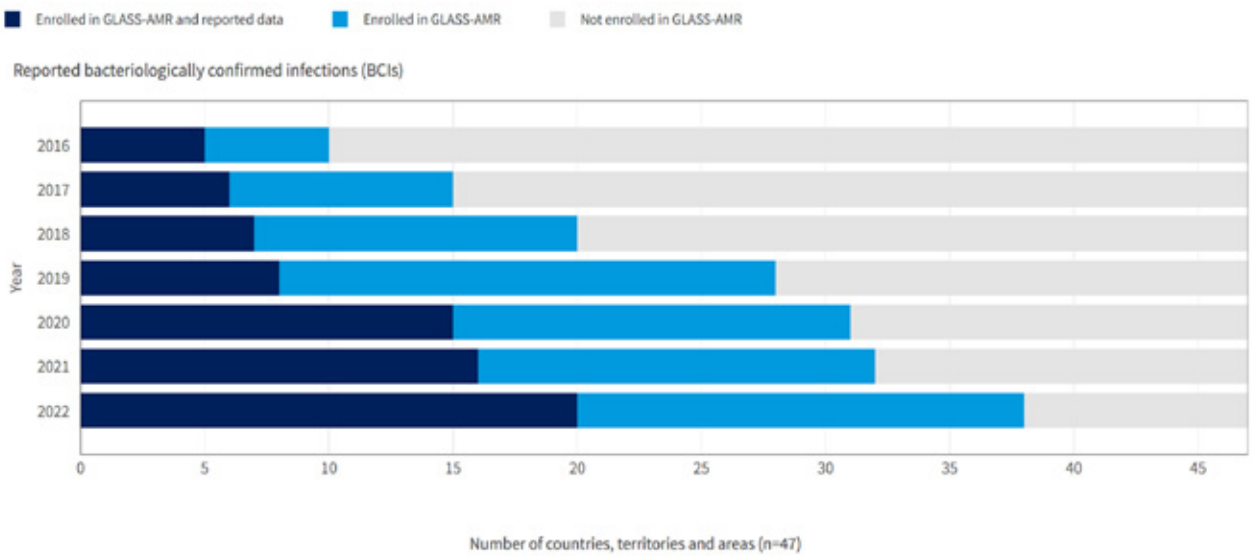
13 Global Antimicrobial Resistance and Use Surveillance System (GLASS) reports – all reports. GLASS Resource Centre (who.int)

6. Progress and challenges in AMR surveillance in the WHO African Region

6.1 Achievements in AMR surveillance

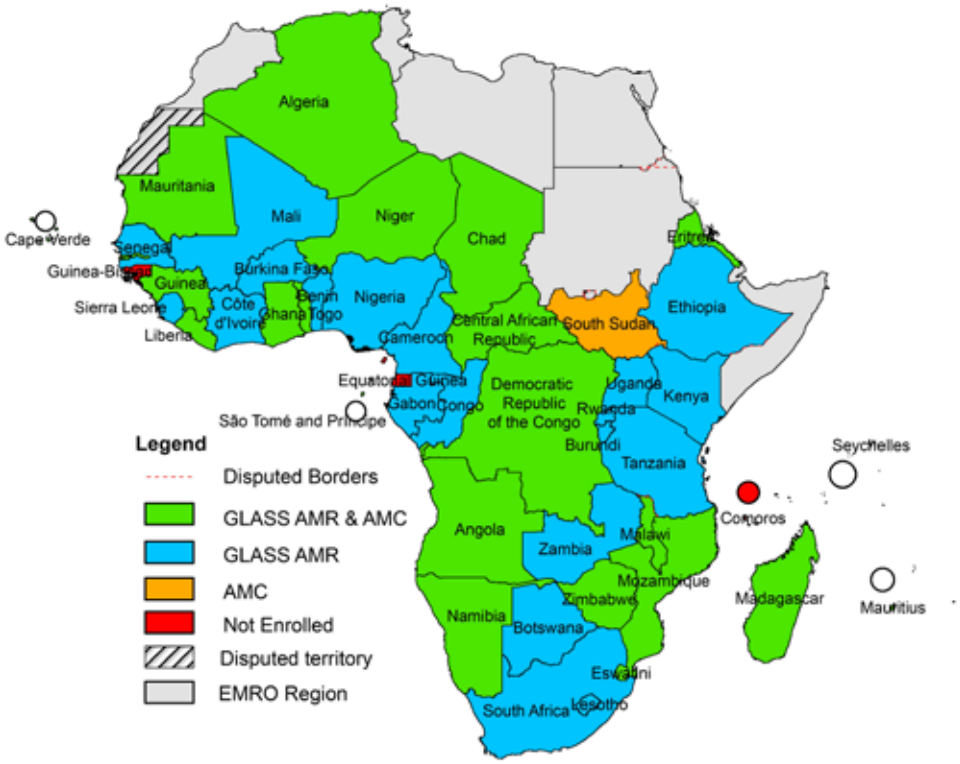
Since the inception of GLASS, and with the technical support of WHO (headquarters, regional and country offices), WHO collaborating centres and other partners, Member States in the African Region have made steady progress in establishing or enhancing their national surveillance systems. The number of countries registered with GLASS has risen from 10 (21%) in 2016 to 38 (81%) in 2022. Over the same period, the number of countries reporting AMR data has also increased from 5 to 20, representing 50–53% of registered countries. Figure 3 below illustrates this upward trend in both registration and reporting. As of December 2024, forty-four countries were enrolled in GLASS (Fig. 4). WHO has supported this progress through the provision of technical manuals, IT tools, webinars, in-country missions, training workshops, external quality assessments, and assistance in procuring essential supplies and consumables.

Fig.3. Number of countries reporting data to GLASS-AMR in the WHO African Region (2016–2022)



Source: GLASS dashboard

Fig 4. Countries enrolled in GLASS in the WHO African Region as of December 2024



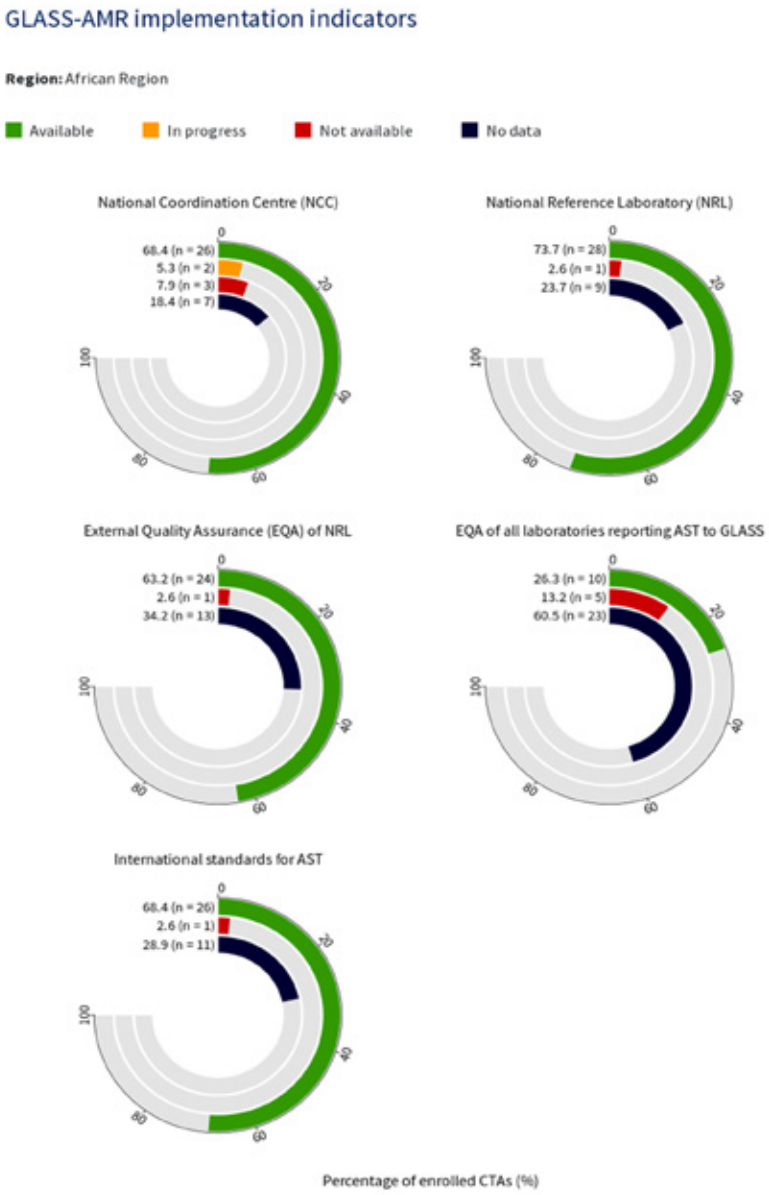
6.2 Key challenges faced by countries in AMR data collection and reporting

Many of the challenges faced by countries in collecting and reporting AMR data are tied to broader health systems issues, such as health infrastructure, access to care, diagnostic capabilities, the lack of integration of AMR surveillance into routine disease surveillance systems, high staff turnover, limited health care financing, and competing priorities that often divert policy-makers' attention to other pressing needs.

This report focuses exclusively on the indicators collected by GLASS and, therefore, does not reflect the specific contributions of the various factors mentioned above. However, the GLASS dashboard includes findings from a standard questionnaire on the implementation of GLASS , completed by reporting countries regardless of their readiness to submit AMR data. This questionnaire offers valuable insights into national surveillance capacities, enabling policy-makers and partners to identify areas in need of support. Key aspects assessed by the questionnaire include the presence of the following essential components of an effective national AMR surveillance system: a national coordination centre (NCC) for AMR, a national reference laboratory (NRL) for AMR, active AMR surveillance sites, participation in external quality assurance (EQA) schemes, and adoption of international AST standards, such as those established by the Clinical and Laboratory Standards Institute (CLSI) or the European Committee on Antimicrobial Susceptibility Testing (EUCAST).

Several critical gaps were highlighted in the 2022 data: some countries had only one designated AMR surveillance site (see Appendix - Table 3); only 55% of responding Member States in the Region reported having an NCC for AMR surveillance and using international AST standards; 22% lacked an NRL and 30% of laboratories did not participate in any EQA scheme (Fig. 5). As more countries continue to enrol in GLASS, it is essential to build capacity in countries to collect, report and utilize AMR data, establish and strengthen NRLs for AMR, and ensure that all microbiology laboratories comply with an external quality assurance (EQA) scheme. A coordinated network of public and private laboratories, operating under standardized protocols, can further enhance the capacity and quality of AMR data generated.

Fig 5. Implementation status, EQA participation, and AST standards of national surveillance systems in the African Region



7. Implications for health and policy

GLASS findings reveal rising levels of AMR in the WHO African Region, particularly in bloodstream and urinary tract infections caused by bacteria such as *Acinetobacter baumannii*, *Escherichia coli*, *Klebsiella pneumoniae* and *Staphylococcus aureus*. The negative impact of AMR on health care outcomes is known to be considerable. Recent forecasts and analyses further underscore that sub-Saharan Africa bears the highest burden of AMR, with some analyses describing it as the next pandemic or a silent pandemic in the making [14]. A study by Murray et al.[15] estimated that in 2019, bacterial AMR was associated with 1.05 million deaths in sub-Saharan Africa, of which 250 000 were directly attributable to resistant infections. The Region recoded the highest AMR-attributable mortality rate globally, with 24 deaths per 100 000 population directly caused by resistant infections, and 99 AMR-associated deaths per 100 000. Within the Region, lower respiratory infections accounted for the largest share of fatal AMR cases (119 000 deaths, or 48% of all estimated bacterial AMR deaths), followed by bloodstream infections (56 000 deaths) and intra-abdominal infections (26 000 deaths). Seven pathogens (*Streptococcus pneumoniae*, *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Mycobacterium tuberculosis) were* collectively responsible for 821 000 AMR-associated deaths in the Region. A 2021 study[16] estimates that from 2025 to 2050, the cumulative number of AMR-attributable deaths in the African Region will reach approximately 6.63 million. In western sub-Saharan Africa, 58.9% of AMR-attributable deaths in 2021 occurred in children under five, whereas 15.8% occurred in adults aged 70 years and older.

Findings from the Mapping Antimicrobial Resistance and Antimicrobial Use Partnership (MAAP) study[17], which analysed over 819 000 AMR records from 205 laboratories across 14 African countries between 2016 and 2019, revealed significant data gaps in AMR surveillance. Of the 50 000 medical laboratories in the participating countries, only 1.3% conducted bacteriology testing. Furthermore, just 20% of these laboratories were ISO-accredited, and 80% performed fewer than 1000 antimicrobial susceptibility tests annually, highlighting a limited capacity to effectively monitor and respond to AMR. The study also reported high resistance rates in WHO-priority pathogens. Notably, over 40% of *Staphylococcus aureus* isolates were methicillin-resistant (MRSA), and more than 30% of *Pseudomonas aeruginosa* isolates demonstrated resistance to carbapenems, critical last-resort antibiotics. A major concern identified was the disconnect between clinical and laboratory data: 88% of AMR test records lacked accompanying clinical information, such as patient diagnoses or prior antibiotic use. This gap hampers the development of effective treatment guidelines and limits insights into resistance patterns. The study also highlighted elevated Drug Resistance Index (DRI) scores, with all assessed countries exceeding twice the benchmark value of 25%, indicating a significant AMR burden. These high scores reflect constrained health care resources and underscore the urgent need for targeted, coordinated interventions.

The economic impact of AMR at the regional level is equally concerning, particularly for low-income African countries. Rising rates of drug-resistant infections are driving up health care costs due to increased hospital admissions and the necessity for more expensive treatments[18]. If left unaddressed, AMR could lead to GDP losses exceeding 5% in low-income African economies, undermining recent developmental gains. The impact on household vulnerability and poverty is similarly dire. According to World Bank estimates, up to 28 million additional people in developing regions,

14 Gautam A. Antimicrobial Resistance: The Next Probable Pandemic. JNMA J Nepal Med Assoc. 2022 Feb 15;60(246):225-228. doi: 10.31729/jnma.7174. PMID: 35210634; PMCID: PMC9200017.

15 Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis
Murray, Christopher J L et al.
The Lancet, Volume 399, Issue 10325, 629 - 655

16 GBD 2021 Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet. 2024 Sep 28;404(10459):1199-1226. doi: 10.1016/S0140-6736(24)01867-1. Epub 2024 Sep 16. PMID: 39299261; PMCID: PMC11718157.

17 Africa Centres for Disease Control and Prevention (Africa CDC), & African Society for Laboratory Medicine (ASLM). (2022). Mapping Antimicrobial Resistance and Antimicrobial Use Partnership (MAAP) Country Reports. Africa CDC (https://africacdc.org/download/mapping-antimicrobial-resistance-and-antimicrobial-use-partnership-maap-country-reports/).

18 Dadgostar, P. (2019). Antimicrobial Resistance: Implications and Costs. Infection and Drug Resistance, 12, 3903–3910 (https://doi.org/10.2147/IDR.S234610).

including many African countries, could be pushed into extreme poverty because of job losses, lowered agricultural yields, and the high cost of treating infections that no longer respond to available antimicrobials[19]. Moreover, by 2050, AMR could cause an estimated 11% decline in livestock production in sub-Saharan Africa, posing additional threats to food security and livelihoods.

The One Health approach is critical in addressing AMR, recognizing the interconnectedness of human, animal and environmental health. In regions like sub-Saharan Africa, where close contact between humans and animals is common, resistant pathogens can easily transfer across species and ecosystems. Coordinated surveillance, responsible antimicrobial use in both human medicine and animal husbandry, and strengthened environmental sanitation are essential components of One Health interventions. By fostering collaboration across sectors such as public health, veterinary services, agriculture and environmental management, the One Health framework enhances early detection and containment of resistance, thus reducing the health and economic burden of AMR[20, 21].

These trends highlight the need for comprehensive, multisectoral strategies to mitigate the broad health and economic impacts of AMR. Recommendations are addressed to various socioprofessional categories to mitigate this impact.

19 https://www.worldbank.org/en/news/press-release/2016/09/18/by-2050-drug-resistant-infections-could-cause-global-economic-damage-on-par-with-2008-financial-crisis

20 WHO. Global Action Plan on Antimicrobial Resistance. (2015). https://www.who.int/publications/i/item/9789241509763

21 FAO, OIE, WHO. Tripartite and UNEP support OHHLEP's definition of "One Health". (2021). https://www.who.int/news/item/01-12-2021-tripartite-and-unep-support-ohhlep-s-definition-of-one-health

8. Recommendations

Despite high levels of country registration, few Member States in the African Region regularly report data to GLASS, even as resistance to last-resort antibiotics in common BSI and UTI pathogens remains high. Given the importance of GLASS data in tracking progress towards SDG indicators and the 2024 UN High-Level Meeting target of reducing AMR-related deaths by 10% by 2030, urgent, coordinated action is required to strengthen surveillance and improve the representativeness and quality of AMR data. The following tailored recommendations are directed to policy-makers, health care providers, surveillance and research institutions, and communities.

For governments

Enable action through systems strengthening and regulation

- Prioritize AMR and invest strategically: acknowledge AMR as a critical health and development issue. Mobilize domestic and external resources to fund national AMR programmes, integrating them into broader health agendas such as global health security, primary health care (PHC) and universal health coverage (UHC) .
- Enhance regulatory frameworks: enforce prescription-only antibiotic sales, regulate antimicrobial use in human and animal health, and implement proper disposal mechanisms for unused or expired antibiotics.
- Strengthen infection prevention measures: expand water, sanitation and hygiene (WASH) infrastructure, promote vaccination, and enforce hand hygiene compliance in health care settings and communities to reduce the incidence of infections.
- Enhance antimicrobial stewardship (AMS): establish and support functional AMS committees at all levels of health care, and promote evidence-based prescribing practices to ensure responsible use of antimicrobials.
- Strengthen prevention and stewardship systems: expand WASH infrastructure, promote vaccination, enforce hand hygiene compliance in health care settings and communities to prevent infections and enhance antimicrobial stewardship (AMS) at all levels of care. Support the formation of functional AMS committees and promote evidence-based prescribing.
- Support integrated, interoperable surveillance: build laboratory capacity for pathogen identification and AST, and ensure secure, timely and cross-sectoral data sharing to inform policy.
- Advance One Health approaches: develop coordinated strategies across human, animal and environmental health sectors to promote responsible antimicrobial use and integrated AMR surveillance.
- Foster public awareness: launch nationwide campaigns to promote responsible antimicrobial use and preventive health behaviours.

For health care providers

Promote stewardship and quality of care

- Support laboratory and surveillance systems: advocate for functional microbiology labs with reliable supply access to reagents and consumables; establish laboratory networks and participate in external quality assessment (EQA) schemes to improve diagnostic accuracy.
- Embed AMS into clinical practice: establish AMS committees, implement standardized treatment guidelines informed by surveillance data, and actively monitor and report on antimicrobial resistance and antimicrobial use.
- Promote infection prevention: ensure strict hand hygiene, promote WASH and vaccination in clinical settings,

and integrate IPC practices into routine care.

- Educate patients: counsel patients on the correct use of antimicrobials, emphasizing adherence to prescribed treatments and the risks of misuse.

For surveillance and research institutions

Build evidence and innovation

- Standardize laboratory systems: implement laboratory quality management systems to ensure consistent, high-quality AMR data.
- Integrate and expand surveillance: align AMR monitoring with existing surveillance platforms such as the Integrated Disease Surveillance and Response (IDSR) system, conduct nationally representative AMR surveys in line with the latest GLASS guidelines of 2023, and utilize advanced digital tools, including AI-driven analytics, for the surveillance and analysis of antimicrobial resistance patterns.
- Advance research and innovation: localize the Human Health Priority Research Agenda on AMR and the Quadripartite One Health AMR Research Agenda; invest in context-specific studies, diagnostics and therapeutics; and foster partnerships with pharmaceutical companies and academic institutions to drive innovation in Africa.

For community engagement, including civil society organizations

Drive sustainable behaviour change

- Raise awareness broadly and strategically: leverage mass media and social media to educate the public about AMR and the importance of responsible antibiotic use.
- Engage local actors: empower youth, civil society, and community leaders to lead grassroots awareness and prevention efforts.
- Co-create solutions with communities: involve communities in the design and implementation of AMR interventions to ensure cultural relevance, ownership, and long-term sustainability.

9. Conclusion

Governments have a critical responsibility to address AMR as a national public health priority. Early detection of AMR enables health care providers to select appropriate antibiotic therapy, improving patient outcomes and supporting infection control measures that help prevent the spread of resistant strains. These actions are essential to reduce health care-associated infections and mitigate the broader threat of AMR. Fulfilling this responsibility requires adequate and sustained funding, the integration of AMR surveillance into routine health systems, and expanded access to quality-assured microbiology services. While progress has been made in GLASS reporting , most Member States in the WHO African Region continue to face significant gaps in surveillance coverage and representativity. Strengthening national capacities for systematic data collection, analysis and use is essential to guide effective, evidence-based interventions. A coordinated, well-funded and multisectoral approach is urgently needed to curb the spread of AMR and preserve the effectiveness of existing treatments across human, animal and environmental health.

10. Annexes

Annex 1. Number of surveillance sites reporting AMR data from bloodstream infections and testing coverage in 2022

Country	Number of surveillance sites reporting to GLASS-AMR	Total BCIs per million population	Absolute number of BCIs	Total BCIs with AST per million population	Absolute number of BCIs with AST	% of BCIs with AST
Benin	1	66.4	913	65.9	907	99.3
Burkina Faso	15	6.6	148	5.9	133	89.9
Cameroon	6	8	221	6.3	174	78.7
Democratic Republic of the Congo	5	5.7	581	5.5	565	97.2
Eswatini	9	84.5	103	41.8	51	49.5
Ethiopia	14	10.9	1371	6.5	819	59.7
Ghana	10	36.7	1218	21.3	705	57.9
Kenya	17	2.7	148	1.5	83	56.1
Liberia	5	3.2	17	2.2	12	70.6
Mali	_	12.4	286	12.4	286	100
Mauritius	41	1022.6	1305	1021.1	1303	99.8
Mozambique	1	2.4	80	2.4	80	100
Namibia	2	72	208	69.9	202	97.1
Nigeria	5	0.8	187	0.6	132	70.6
Rwanda	3	7.4	101	7.2	98	97
South Africa	3593	395.3	24 658	384.8	24 004	97.3
Uganda	26	0.7	35	0.5	26	74.3
United Republic of Tanzania	135	32	2072	29.5	1910	92.2
Zambia	7	12.1	244	9.8	198	81.1

Annex 2. Tables of GLASS AMR trends in bloodstream infections

Annex 2.1 Antimicrobial resistant *Acinetobacter baumannii* in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs With AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Amikacin	4	6	11	2969	2811	3573	43.81	21.11	28.57	2	2	2	2897	2648	3033	57.96	68.29	63.67
Colistin	1	1	1	288	256	211	8.33	2.34	0.47	1	1	1	288	256	211	8.33	2.34	0.47
Gentamicin	6	10	11	5253	5446	6285	62.35	51.94	47.06	2	2	2	4833	5129	5704	67.32	74.47	74.30
Imipenem	4	7	7	4772	5211	5913	48.72	50.00	60.00	2	2	2	4740	5138	5666	70.14	77.84	76.25
Meropenem	4	8	9	5195	5339	6196	70.69	57.00	38.24	2	2	2	4790	5135	5672	70.15	78.22	77.10
Minocycline	1		2	55		69	58.18		35.63	NA		NA	NA		NA	NA		NA
Tigecycline	1	1	1	3166	3659	4190	2.31	2.87	1.79	1	1	1	3166	3659	4190	2.31	2.87	1.79

Annex 2.2 Antimicrobial resistant *Escherichia coli* in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Ampicillin	9	11	3	550	4408	264	92.86	94.23	90.00	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cefepime	7	6	11	4765	4257	4991	36.36	43.93	58.93	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cefotaxime	9	8	10	4908	4493	883	64.29	64.85	65.21	1	NA	NA	368	NA	NA	49.46	NA	NA
Ceftazidime	10	6	12	5147	4510	5318	53.23	61.40	63.28	1	NA	NA	366	NA	NA	44.54	NA	NA
Ceftriaxone	9	13	14	921	4775	5474	59.70	73.33	70.63	1	1	1	367	314	325	49.59	50.96	60.31
Ciprofloxacin	12	13	15	5293	4852	5605	50.66	53.85	63.27	1	NA	1	368	NA	326	46.47	NA	54.91
Co-trimoxazole	12	12	14	5297	4727	5471	81.02	85.71	83.86	2	2	1	4701	4288	326	56.36	59.22	50.31
Colistin	2	1	1	380	315	325	0.00	0.95	0.62	1	1	1	367	315	325	0.00	0.95	0.62
Ertapenem	3	6	8	4336	4039	4572	11.54	1.44	15.04	NA	NA	NA	NA	NA	NA	NA	NA	NA
Imipenem	8	8	11	4724	4470	5006	1.48	4.63	8.16	1	1	1	367	317	325	2.72	3.15	4.31
Levofloxacin	1	2	6	22	110	217	18.18	56.81	68.33	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meropenem	8	7	12	5117	4514	5312	3.74	2.68	4.94	1	NA	NA	367	NA	NA	2.72	NA	NA

Annex 2.3 Antimicrobial resistant *Klebsiella pneumoniae* in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Cefepime	8	8	12	7530	7187	8031	67.95	53.86	77.87	1	1	1	7149	6652	6860	69.23	57.56	58.82
Cefotaxime	10	7	11	7847	7277	1221	82.05	81.82	87.18	2	2	1	7663	7023	301	72.16	70.40	79.73
Ceftazidime	9	7	11	7806	7442	8606	73.68	71.68	74.42	2	1	2	7569	380	7196	69.66	70.00	71.89
Ceftriaxone	11	11	14	860	7733	8756	80.00	87.74	89.46	1	2	2	364	7022	7280	71.70	70.37	76.10
Ciprofloxacin	13	14	16	8243	7923	9157	52.17	50.71	63.21	2	1	2	7665	380	7306	51.16	52.11	54.44
Co-trimoxazole	14	13	14	8413	7802	8797	85.35	86.05	81.30	2	2	2	7654	7100	7322	67.09	67.04	68.16
Colistin	3	1	1	395	379	301	10.44	6.33	7.97	1	1	1	364	379	301	10.44	6.33	7.97
Ertapenem	5	5	8	6889	6668	7233	13.24	22.48	16.31	1	1	1	6797	6467	6703	13.24	22.48	27.67
Imipenem	10	9	12	7767	7448	7876	5.18	18.09	12.25	2	2	2	7573	7120	7281	24.10	25.62	28.45
Levofloxacin	3	3	7	161	227	378	60.00	24.78	33.33	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meropenem	7	9	13	7971	7613	8520	17.76	25.19	16.00	2	1	2	7533	380	7143	25.60	34.47	29.17

Annex 2.4 Antimicrobial resistant *Salmonella spp.* in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Cefotaxime	5	1	3	968	924	454	3.04	2.27	8.33	2	1	NA	833	924	NA	1.52	2.27	NA
Ceftazidime	4	3	5	617	619	427	6.80	3.08	1.62	2	1	1	566	584	370	1.80	3.08	1.62
Ceftriaxone	5	4	5	175	1325	1186	8.33	13.03	8.33	1	1	1	10	924	716	0.00	2.27	1.82
Ciprofloxacin	6	8	6	961	1073	1172	0.00	0.98	9.86	2	1	1	804	922	655	1.26	1.95	3.05
Ertapenem	3	4	2	922	1011	768	0.00	0.00	0.00	1	1	1	804	908	704	0.00	0.44	0.00
Imipenem	3	4	3	837	1125	735	0.00	0.00	0.00	2	1	1	824	923	710	0.06	0.33	0.00
Levofloxacin		1	1		15	13		0.00	61.54		NA	NA		NA	NA		NA	NA
Meropenem	3	2	4	851	936	740	0.25	4.12	0.00	2	1	1	820	923	700	0.12	0.54	0.00

Annex 3. Tables of GLASS AMR trends for SDG indicators

Annex 3.1 SDG indicator – Resistance of *Escherichia coli* to third-generation cephalosporins in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Third-generation cephalosporins	13	13	16	5326	4737	5478	63.64	77.78	70.63	1	1	1	367	317	326	49.59	52.68	60.43

Annex 3.2 SDG indicator – Methicillin-resistant *Staphylococcus aureus* in bloodstream infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Methicillin	13	15	16	7514	7689	8400	50.21	45.45	45.96	1	1	1	313	433	437	39.62	42.96	39.36

Annex 4. Tables of GLASS AMR trends in urinary tract infections

Annex 4.1 Antimicrobial resistant *Escherichia coli* in urinary tract infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Ampicillin	9	8	3	1626	1981	1274	90.91	93.26	91.91	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cefepime	9	8	11	858	1555	39 597	55.26	52.20	50.08	NA	NA	1	NA	NA	36 159	NA	NA	12.22
Cefotaxime	9	7	11	4135	3205	4921	64.08	64.29	59.57	1	1	1	3303	2366	2791	40.18	40.07	44.86
Ceftazidime	11	9	13	3337	2752	41 863	60.47	54.17	51.58	1	1	1	1795	1220	1619	48.69	54.43	43.24
Ceftriaxone	11	10	12	3831	3646	42451	62.08	61.51	60.03	1	1	1	1799	1227	1625	70.98	72.45	74.46
Ciprofloxacin	11	10	12	5756	4930	44 659	57.84	59.27	57.13	1	1	1	3304	2368	2791	50.27	52.11	54.82
Co-trimoxazole	10	10	13	5347	4334	44 328	79.77	84.11	81.13	1	1	1	3255	2369	2791	42.21	41.45	43.75
Colistin	3	3	3	2049	1320	1782	4.62	16.67	0.43	1	1	1	1800	1225	1624	0.44	0.49	0.43
Doripenem	2		1	71		35	37.10		11.43	NA		NA	NA		NA	NA		NA
Ertapenem	5	6	9	415	460	36 065	31.91	9.52	4.99	NA	NA	NA	NA	NA	NA	NA	NA	NA
Imipenem	10	8	11	3074	2812	41 506	3.90	6.48	5.74	1	1	2	1799	1227	38 321	3.95	7.74	3.82
Levofloxacin	6	6	7	230	369	881	48.04	61.83	57.77	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meropenem	8	7	10	3075	2734	39 659	3.99	7.58	4.45	1	1	1	1800	1227	1625	4.06	7.99	7.75

Annex 4.2 Antimicrobial resistant *Klebsiella pneumoniae* in urinary tract infections

Antibiotic tested	All countries with at least 10 BCIs with AST results									Countries with good testing coverage								
	Number of countries			Total BCIs with AST			Resistance (Median %)			Number of countries			Total BCIs with AST			Resistance (Median %)		
Cefepime	6	8	10	195	440	9087	51.10	64.17	53.65	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cefotaxime	8	6	8	1360	1245	1293	71.02	76.00	65.84	1	1	1	1152	951	731	56.60	56.57	67.31
Ceftazidime	9	7	12	1509	1005	9887	76.47	62.96	50.09	1	1	1	726	594	527	78.10	80.81	75.52
Ceftriaxone	8	8	10	1594	1236	9707	79.76	63.57	67.20	1	1	1	725	595	529	85.24	85.38	87.71
Ciprofloxacin	11	11	11	2214	1637	10 522	57.14	51.10	46.63	1	1	1	1151	951	731	49.52	51.10	61.01
Co-trimoxazole	10	11	12	2106	1541	10 419	75.87	77.78	68.77	1	1	1	1152	951	731	54.60	52.47	57.73
Colistin	3	2	3	793	608	553	4.42	11.64	0.00	1	1	1	724	595	529	4.42	7.90	11.53
Doripenem	1			16			6.25			NA			NA			NA		
Ertapenem	3	5	7	82	106	8187	1.92	16.67	18.75	NA	NA	NA	NA	NA	NA	NA	NA	NA
Imipenem	8	8	11	1069	987	9606	4.24	6.27	7.75	1	1	1	720	595	529	29.31	36.81	35.35
Levofloxacin	2	2	3	28	46	201	51.79	25.14	44.00	NA	NA	NA	NA	NA	NA	NA	NA	NA
Meropenem	8	7	10	1430	1054	9408	15.07	16.67	9.80	1	1	1	725	596	529	30.62	37.75	37.05

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World Health Organization
Regional Office for Africa

Cité du Djoué
PO Box 6, Brazzaville
Congo
Telephone: +(47 241) 39402
Fax: +(47 241) 39503
Email: WHOAfricaNews@who.int
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