Global Antimicrobial Resistance Surveillance System (GLASS) Report

Early implementation

2017-2018

World Health Organization

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SUMMARY

The global emergence of antimicrobial resistance (AMR) is posing a threat to human health. Putting resources into the containment of AMR – including surveillance – is one of the highest-yield investments a country can make to mitigate its impact. In 2015, WHO launched the Global Antimicrobial Resistance Surveillance System (GLASS), the first global collaborative effort to foster AMR surveillance in bacteria causing acute infections. As of December 2018, 71 countries are enrolled in GLASS. The aim of this report is to document participation efforts and outcomes across these countries, and highlight differences and constraints identified to date. This report follows on from the first GLASS Report – Early implementation 2016-17, published in January 2018, and drawing on data from GLASS first data call in 2017.

GLASS provides a standardised approach to the collection, analysis, and sharing of AMR data by countries, and seeks to monitor the status of existing or newly developed national AMR surveillance systems. GLASS works at all three levels of WHO – headquarter, regional, and country offices – and, supported by the network of WHO Collaborating Centres, involves strong commitment from participating countries and close collaborations with AMR regional networks such as CAESAR (Central Asian and Eastern European Surveillance of Antimicrobial Resistance), EARS-Net (European Antimicrobial Resistance Surveillance Network), and ReLAVRA (Latin American Network for Antimicrobial Resistance Surveillance).

In its early implementation phase (2015-2019), GLASS aims to combine data on the status of enrolled countries' AMR surveillance systems with AMR data for selected priority bacteria that cause infections in humans: *Acinetobacter* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Neisseria gonorrhoeae*, *Salmonella* spp., *Shigella* spp., *Staphylococcus aureus*, and *Streptococcus pneumoniae*. AMR data are collected through a case-finding surveillance system, which collates results of priority specimens from blood, urine, and stool, as well as cervical and urethral specimens, that have been sent routinely to laboratories for clinical purposes. Population data are also collected, including the overall number of patients tested per specific specimen, and variables such as age, gender, and infection origin. Data on infection origin is used as a proxy to define where the infection has been contracted (hospital versus community).

By the end of the second data call on 31 July 2018, 69 countries were enrolled in GLASS. Sixty-eight of these countries (10 low-income countries (LICs), 16 lower middle-income countries (LMICs), 15 upper middle-income countries (UMICs), and 27 high-income countries (HICs)) provided data. Specifically, 67 countries reported information on their national AMR surveillance systems, of which 48 also provided 2017 AMR rates. In addition, one country provided AMR data only, resulting in a total of 49 countries reporting AMR rates.

Compared to the first data call on April-July 2017, GLASS has seen a 64% increase in country enrolment and more than twice the number of countries submitting AMR data in 2018. The rapid increase in country enrolment and active participation in a global system to monitor AMR reflects a collective understanding and engagement to support the global effort to control AMR, particularly for countries that had never shared AMR data with international systems before. Moreover, 13 of the countries that last year only provided information on the status of their national AMR surveillance system have managed this year to also report AMR data, evidence that countries' commitment and the GLASS methodological approach can foster development of national AMR surveillance. Fourteen countries, compared to five in the preceding year, also submitted data on the total sampled population, enabling the frequency of occurrence of resistance within tested populations to be calculated and, for six countries, stratified for gender, age, and infection origin.

Still, due to the limitations highlighted in previous GLASS documents with regards to data quality and representativeness, no attempt was made to compare AMR status between countries and regions. However, it was possible to monitor the progress made by countries in the development and strengthening of their AMR national surveillance systems. Based on the information on implementation submitted though the data call, most countries have put in place the three surveillance core components suggested by GLASS (a National Coordination Centre, a National Reference Laboratory, and National surveillance sites). 97% of reporting laboratories are performing antimicrobial susceptibility testing (AST) according to internationally recognised standards – either European Committee on Antimicrobial Susceptibility Testing (EUCAST), the Clinical and Laboratory Standards Institute (CLSI), or other reorganised protocols. Finally, compared to the 2017 results, almost all countries have shown an increase in the number of surveillance sites reporting to GLASS.

Additionally, GLASS is working towards the integration of surveillance initiatives related to AMR in bacterial pathogens of relevance for human health. In this report we highlight a series of modules being developed to facilitate this integration. These include modules on antimicrobial consumption (AMC), the enhanced

Gonococcal Antimicrobial Surveillance Programme, and AMR in the food chain. These surveillance modules will be progressively added to the GLASS IT platform to allow for the collection, analysis, and reporting of diverse cross-sectoral AMR data into a single repository, with GLASS Emerging Antimicrobial Resistance Reporting (GLASS-EAR) also launched in 2018. In addition, this report summarises GLASS developments during the last year and the progress and activities by WHO Regional Offices to enhance AMR surveillance.

Despite the limitations of the current phase, GLASS has already collected an unprecedented level of information relating to AMR at a global level, and continues to foster further development of national AMR surveillance systems. The support given by WHO Regional Offices, WHO Collaborating Centers, and international partners to participating countries, has been fundamental to the achievements to date.

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ABBREVIATIONS

AFR	WHO African Region
AGISAR	WHO Technical Advisory Group on Integrated Surveillance of Antimicrobial Resistance
AMC	Antimicrobial consumption
AMR	Antimicrobial resistance
AMRO	WHO Region of the Americas
AST	Antimicrobial susceptibility testing
BI	Bacterial isolation
CAESAR	Central Asian and Eastern European Surveillance of Antimicrobial Resistance
CI	Confidence interval
CLSI	Clinical and Laboratory Standards Institute
EARS-Net	European Antimicrobial Resistance Surveillance Network
ECDC	European Centre for Disease Prevention and Control
EDL	Essential Diagnostics List
EMR	WHO Eastern Mediterranean Region
EQA	External quality assessment
ESAC-Net	ECDC European Surveillance of Antimicrobial Consumption Network
ESBL	Extended spectrum beta-lactamase
EUCAST	European Committee on Antimicrobial Susceptibility Testing
EUR	WHO European Region
FAO	Food and Agriculture Organization of the United Nations
GAP-AMR	Global Action Plan on Antimicrobial Resistance
GASP	Gonococcal Antimicrobial Surveillance Programme
GLASS	Global Antimicrobial Resistance Surveillance System
GLASS-EAR	GLASS Emerging Antimicrobial Resistance Reporting
HCF	Health-care facilities
HICs	High-income countries
HIV/AIDS	Human immunodeficiency virus/acquired immune deficiency syndrome
IACG	Interagency Coordination Group on Antimicrobial Resistance
IHR	International Health Regulations
KOICA	Korea International Cooperation Agency
LICs	Low-income countries
LMCs	Lower middle-income countries
LQMs	Laboratory quality management systems
MIC	Minimum inhibitory concentration
MRSA	Methicillin-resistant *Staphylococcus aureus*
NCC	National coordinating centre
NFP	National focal point
NRL	National reference laboratory
OIE	World Organisation for Animal Health
PPS	Point Prevalence Survey
ReLAVRA	Latin American Network for Antimicrobial Resistance Surveillance (Latinoamericana de Vigilancia de la Resistencia Antimicrobiana)
RIS	Resistant, intermediate, susceptible
RO	WHO Regional Office
SEAR	WHO South-East Asia Region
UMCs	Upper middle-income countries
WAAW	World Antibiotic Awareness Week
WPR	WHO Western Pacific Region

WHO Regional offices

AFRO	WHO Regional Office for Africa
AMRO/PAHO	WHO Regional Office for the Americas/Pan American Health Organization
EMRO	WHO Regional Office for the Eastern Mediterranean
EURO	WHO Regional Office for Europe
SEARO	WHO Regional Office for South-East Asia
WPRO	WHO Regional Office for the Western Pacific


SECTION
01

Introduction

1.1 The response of WHO to the emergence of AMR

Antimicrobial resistance (AMR) emergence is a natural phenomenon accelerated by the misuse and overuse of antimicrobials (1). Because bacteria are found in a number of ecosystems – human, animal, and environment – and can exchange AMR genes between them, understanding AMR dynamics is paramount in mitigating its impact on human health and controlling its spread (2). To start addressing the problem, almost 20 years ago WHO initiated a range of AMR related activities, culminating in the approval of the Global Action Plan on Antimicrobial Resistance (GAP-AMR) by the 68th World Health Assembly in May 2015 (3).

With the understanding that AMR was negatively affecting all sectors of society, in September 2016 the Political Declaration of the UN High-level Meeting on Antimicrobial Resistance (Resolution A/RES/71/3) called for the establishment of the Interagency Coordination Group on Antimicrobial Resistance (IACG) (4, 5) . The IACG's mandate is to provide practical guidance on approaches needed to ensure sustained effective global action to address AMR, and to report back to the UN Secretary General in 2019.

To reaffirm the importance of AMR in the WHO health agenda, an official side event "Addressing Antimicrobial Resistance: A Threat to Global Health and the Achievement of Universal Health Coverage" was co-hosted during the 71st World Health Assembly in May 2018 by the Republic of Korea and Sweden (6). Emphasis was put on the key role of AMR surveillance in guiding policy and rational use of antimicrobial drugs. Participants also highlighted difficulties in low-income countries (LICs) to developing their own surveillance and monitoring systems, which WHO is seeking to address.

1.2 GLASS and the role of surveillance in tackling AMR

Surveillance is the cornerstone to assessing the spread of AMR and informing and monitoring the impact of local, national, and global strategies. Global surveillance systems for HIV, influenza, malaria, and tuberculosis have monitored resistance in specific pathogens for many years (7-10) . Large regional AMR surveillance networks have been established in Europe and Central Asia - the European Centre for Disease Prevention and Control's (ECDC) European Antimicrobial Resistance Surveillance Network (EARS-Net) and the WHO's Central Asian and Eastern European Surveillance of Antimicrobial Resistance (CAESAR) (11, 12) - and for the last two decades in Latin America through the Latin American Network for Antimicrobial Resistance Surveillance (ReLavra) (13).

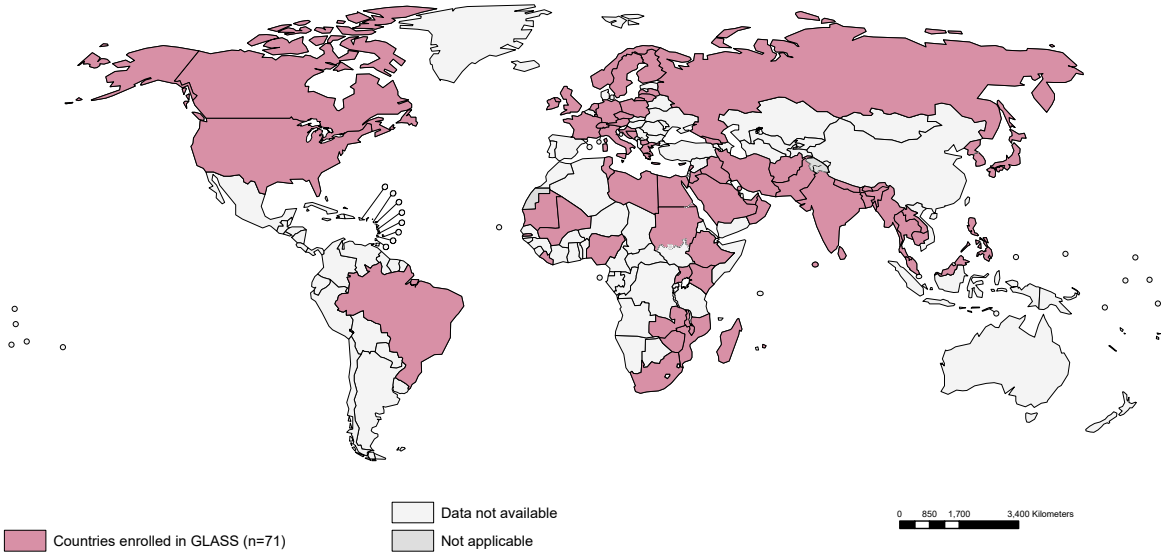
In order to support the second objective of the GAP-AMR initiative to "strengthen knowledge through surveillance and research", WHO launched GLASS in October 2015 (14). GLASS provides a standardised approach to the collection, analysis, and sharing of AMR data by countries, and seeks to document the status of existing or newly developed national AMR surveillance systems. Furthermore, GLASS promotes a shift from surveillance approaches based solely on laboratory data to a system that includes epidemiological, clinical, and population-level data. GLASS collaborates with regional and national AMR surveillance networks to produce timely and comprehensive data. The system is built upon the experience gained by long-standing WHO AMR surveillance programmes, and receives strong support of reporting countries, WHO Regional Offices, WHO Country Offices, and WHO Collaborating Centres. Specifically, GLASS is working closely with the European networks CAESAR and EARS-Net to facilitate data sharing and avoid "double reporting".

In alignment with the work of the GAP-AMR, GLASS also promotes integration with other surveillance programmes in public health and the animal and environment sectors. GLASS facilitates the surveillance of resistance in eight priority bacterial human pathogens, some with links to the food chain, and it will also monitor – starting in 2019 – antimicrobials consumption by humans. Collaboration with the UN Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (OIE) – which together with WHO form the Tripartite Collaboration – is ongoing to improve a comprehensive understanding of AMR across sectors and to promote the One Health Approach to AMR control (15).

Furthermore, in 2018, GLASS has entered a 5-year partnership with the Korean International Cooperation Agency (KOICA). To support global and country-level AMR surveillance, KOICA has funded the WHO project "Strengthening global and national surveillance systems through strengthening national laboratory capacities and the workforce for surveillance of AMR". In addition to the further development of

GLASS, this collaboration supports AMR surveillance development in four countries, namely, Jordan, Peru, Mali, and Lao People's Democratic Republic.

As of December 2018, 71 countries have enrolled in GLASS.



1.3 GLASS Early implementation phase (2015-2019)

GLASS is now in its early implementation phase (2015-2019). The key objectives of this phase have been to launch the global surveillance system and provide guidance to countries around the development of an effective AMR surveillance system (16).

At this stage, GLASS recommends the establishment of three core components to set up a well-functioning national AMR surveillance system: 1) A National Coordinating Centre (NCC); 2) A National Reference Laboratory (NRL); and 3) Sentinel surveillance sites where both diagnostic results and epidemiological data are collected. Countries may enrol and participate in GLASS before any of these components are put in place (17).

GLASS requires, if available, the submission of information on the implementation of national AMR surveillance systems and AMR data for eight priority human bacterial pathogens isolated from clinical specimens (blood, urine, stool, and urethral and cervical swabs) sent routinely to laboratories (16): *Acinetobacter* spp., *Escherichia coli, Klebsiella pneumoniae, Neisseria gonorrhoeae, Salmonella* spp., *Shigella* spp., *Staphylococcus aureus, and Streptococcus pneumoniae.* These pathogens cause worldwide common hospital-acquired and community-acquired infections, against which treatment is becoming increasingly difficult due to high rates of AMR. Moreover, some of the selected bacteria included in GLASS are also present in animals and the food chain. For each pathogen, a number of antibiotic combinations are identified (ANNEX I). The antimicrobial drugs chosen to be monitored were selected because either they are commonly recommended first-line treatments, or resistance in the pathogen–antibiotic combination is of particular clinical and public health concern.

GLASS first data call was open in April – July 2017 (18). Out of 42 countries enrolled, 40 countries provided information on their AMR surveillance systems, and 22 also provided AMR data. The GLASS Report – Early Implementation 2016-2017 was published in January 2018, and it summarised information of the implementation of National AMR surveillance systems in 2017 and 2016 AMR rates (18). The report includes data not only by countries with previously existing and fully operational surveillance systems, but also from brand new systems shaped following GLASS guidelines. The results gathered during this first GLASS data call showed that more and more countries were working towards achieving a status that will enable them to report AMR data in a more complete and systematic manner. Moreover, even if frequently AMR surveillance systems report only on the proportion of resistance among tested isolates, countries acknowledged the value of reporting data that combines both microbiological and core epidemiological information and data provided included variables such as gender, age group and infection origin, in addition to microbiological results. Five countries were able to provide population data allowing for the calculation of AMR frequency in the tested population. The calculation of AMR frequency by age groups and infections types is key to inform and direct mitigation strategies and interventions to control AMR in the most affected groups. The AMR surveillance standards established by GLASS proved to be a valuable and feasible methodology and represented a major achievement for both participating countries and GLASS.


SECTION
02

Reader's guide to results

2.1 Information on status of national AMR surveillance system

GLASS collects information on the status of national AMR surveillance systems through a short questionnaire completed by AMR national focal points (NFPs) in each country. The questionnaire covers three main areas: 1) overall coordination; 2) surveillance system; and 3) quality control (19). Each area consists of a set of indicators developed to measure development and strengthening of national AMR surveillance (ANNEX II). Surveillance implementation indicators for each country are summarised in the results section (Section 3.2) by WHO region: African Region (AFR), Region of the Americas (AMR/PAHO), Eastern Mediterranean Region (EMR), European Region (EUR), South-East Asia Region (SEAR), and Western Pacific Region (WPR). Individual country implementation results are further presented as infographics in country profiles. The indicators are monitored on a yearly basis to assess countries' progress.

2.2 Antibiotic resistance

AMR data are collected through a case-finding surveillance system, which collates results from sensitivity testing of specimens from blood, urine, stool, as well as cervical and urethral specimens, that have been sent routinely to laboratories for clinical purposes (16). Currently, GLASS collects information on numbers of patients with suspected infection from whom a pathogen was isolated, and antimicrobial susceptibility testing (AST) performed (16). After removal of duplicates, and assuming that routine microbiological testing is applied systematically, the number of isolates with laboratory AST results can be used as a proxy for the number of patients infected with the targeted bacteria. GLASS uses this information to generate, for each specimen type, pathogen, and antibiotic under surveillance, the proportions of infected patients with growth of non-susceptible strains. Countries are also asked to report epidemiological variables such as age, gender, and origin of infection in tested patients. The origin of infection is used as a proxy to define where the infection has been contracted (hospital versus community) (16).

In addition, population data are also collected (16): for all samples taken for microbiological testing, GLASS collects data on both the number of patients with positive samples for a specific specimen type (including both isolates of the target pathogens and other bacteria, as well as antibiotic susceptibility of positive isolates), and the number of patients with negative samples (no microbial growth). With this information GLASS can generate, for each specimen type, pathogen, and antibiotic under surveillance, two additional metrics: the frequency of infection, and the frequency of infection due to non-susceptible strains, in the population of tested patients.

Aside for country direct submission of AMR rates to GLASS, GLASS also accepts data from established official AMR surveillance networks, namely, WHO CAESAR and ECDC EARS-Net. Both networks collect information on AMR rates in blood specimens for *Acinetobacter* spp., *K. pneumoniae*, *E. coli*, *S. aureus* and *S. pneumoniae*. In order to avoid duplication of data submission, countries participating in these networks and also enrolled in GLASS may authorize the respective organization (i.e. ECDC for EARS-Net, or EURO for CAESAR) to transfer the data to WHO to be included in GLASS. These countries can also send additional data not collected by EARS-Net or CAESAR directly to GLASS.

GLASS accepts both submissions of AST results for single antibiotics and antimicrobial classes. This year, results reported by countries to EARS-Net were submitted to GLASS only in antimicrobial class aggregated format. According to the methodology applied by ECDC to AMR data preparation and analysis, if AST results are reported for the same patient for more than one antibiotic belonging to the same antimicrobial class (or group), AST results for only one of those antibiotics are considered (20). The class susceptibility status is calculated according to the final interpretations of each antibiotic AST results (20): if the pathogen AST result for at least one antibiotic is reported resistant, the pathogen is considered resistant to the whole class; if the pathogen AST result for at least one antibiotic is reported of intermediate sensitivity, and no resistant AST results are reported for any of the other antibiotics, the pathogen is considered having intermediate sensitivity to the whole class; if the pathogen AST results for all antibiotic are reported susceptible, the pathogen is considered susceptible to the whole class.

2.3 GLASS country profiles structure

The profiles contain country information on AMR surveillance implementation and a description of reported AMR data (18). In the first part of the country profile, an infographic summarises reported surveillance indicators for the three core components of the national AMR surveillance system. A short narrative describes countries' engagement with AMR surveillance. The population estimates shown are generated by the Population Division of the United Nations Department of Economic and Social Affairs and reflect the year of the AMR data collection (2017)(21).

Following, if AMR data are submitted, a dashboard shows – through a colour-coded system – the proportion of the data submission, and a second table gives an overview of the data reported. Patients AST results, for single antibiotic or antimicrobial class, are presented in a set of bar charts (referred to as a Pathogen non-susceptibility overview). For countries that have also submitted population data, two more sets of graphics are presented. The first set presents the frequency of infection in different anatomical sites caused by priority pathogens, and frequency of infection caused by the pathogens with resistance to specific antibiotics in the tested population. Where data are available, the second set describes specific resistance to carbapenems, stratified by age and gender. In the graphs, non-suceptibility results 95% confidence intervals are represented by black lines overlapping the bars.

GLASS applies a set of rules to its data analysis to ensure reliability of generated results. Results are not shown for pathogen-specimen combination reported for less than 10 patients, and for pathogen-antibiotic combinations with less than 10 AST results. Furthermore, in order to highlight the presence of possible antibiotic selective testing behaviours, different graphical representation of the results applies for patient with equal or more than 30% unknown AST results for a specific pathogen-antibiotic combination (22, 23). In the pathogen non-susceptibility overview graphs for outcomes with equal or more than 30% unknown AST results the bar filling is transparent while the others outcomes are presented with colour-filled bars. In the non-susceptible pathogen – antimicrobial combination frequency graphs, for antimicrobials with equal or more than 30% unknown AST results only the antibiotic name is reported, without any graphical representation. Finally, for the non-susceptible pathogen-imipenem combination stratified frequency no outcome is show for result with equal or more than 30% unknown AST results.

2.4 Limitations in interpretation of results

While the methods currently applied in GLASS have been internationally approved, surveillance is a complex activity (24). Limitations of any research or surveillance system are those characteristics linked with the design or methodology that impact or influence the interpretation of the findings from the data collected. They are a by-product of the ways in which surveillance systems are initially designed, and a direct consequence of all the constraints involved in health data collection (country policies and agendas, challenging logistics, lack of resources, sampling bias, poor diagnostic capacity, measurement errors, issues with data management, etc.). While interpreting GLASS results, it is paramount to identify limitations of the methodology used in generating those results. This is essential to assess the extent to which the outcomes are a true reflection of the status of surveillance systems reported by enrolled countries, and of their AMR epidemiological profiles, and the extent to which the results can be used to inform future development.

As this was the second year of GLASS data collection, great variability was expected in the completeness and quality of AMR data submitted. Such differences were addressed in order to promote a harmonised representation of the results, and to highlight country efforts. For this reason, and in order to avoid misrepresentations of the epidemiological status of global resistance, neither interpretation of the AMR data, nor the comparison of AMR results between countries or regions was attempted. The following limitations have also been identified:

- Many different healthcare and public health professionals are involved in the different steps of the data generation process, requiring commitment and training at different levels to ensure high-quality data. The diversity in countries' levels of capability and resources, and other limiting conditions outside the direct control of the national AMR surveillance system, affect data collection and validity. However, GLASS is fostering the development and the strengthening of national systems so in the future countries will be able to shorten these gaps.
- Data aggregation is a major limitation. No statistical analysis can be performed to test for associations among infection types and the proportion of resistance for a specific pathogen, or to identify risk factors linked with age, gender, or the source of infection origin. Furthermore, it is also not possible to group antibiotics in classes to identify patterns, because AST results are not line-listed, and merging outcomes from different antibiotics would have resulted in overestimation of resistance.

Aggregation of data also considerably limits options for epidemiological characterisation –for example, making the detection and subsequent validation of data from countries with unusual antimicrobial patterns impossible. The inclusion of aggregated data at a national level was suggested by country representatives at the 1st High Level Technical Meeting on Surveillance of Antimicrobial Resistance for Local and Global Action in Stockholm in 2014 (24). Although not perfect, aggregated data still offer a valuable set of information regarding the proportion and frequency of AMR within a given population, and once limitations are understood, data can be used to obtain meaningful insight into the development of resistance in enrolled countries.

- A small set of progress indicators (ANNEX II) was used to evaluate the implementation of surveillance systems in each participating country. In addition, information produced by countries is primarily through self-assessment, as the NFP fills in the implementation questionnaire, and a methodology to define the magnitude and validity of reported data based on the functionality of those systems is still not in place. However, the information collected in this round allowed for a first overview of country activities, and provided the baseline knowledge for further development.
- Because the different regions have different numbers of countries submitting information on the implementation of national surveillance systems, it was not possible to compare results by region. Also, it was not possible to compare 2017-2018 proportion data, or monitor progress within regions, as the number of countries submitting data differed across the 2 years.
- The number of surveillance sites in each country can vary depending on the existing national surveillance system structure, and both financial and technical capability. In addition, the extension of the country territory and its geographical boundaries has an impact on the set up of the sites. However, the data are presented together and are not weighted, in order to provide an overview of the current status of national surveillance systems, and to identify gaps for future implementation.
- Lack of a sampling strategy generates selection bias that may affect the representativeness and interpretation of results, and does not impact on country representativeness.
- Case-finding is done only on the population of patients that seeks medical care and are tested. For this reason, frequency can only be calculated for this population at risk.
- Most information is still generated at the laboratory level, and lacks epidemiological insight.
- Some of the isolates identified may possibly represent cases of contamination or colonisation. However, as the data are aggregated, it was considered the responsibility of each country to assess the clinical significance of positive cultures. Therefore, positive cultures reported are considered a proxy of infection. Moreover, the distinction between infection, contamination, and colonisation is relevant for estimating disease incidence, but it is less relevant for estimating proportion of resistance. While there are some cases where 'invasive' and 'non-invasive' strains may have different characteristics, in other cases, they probably have similar resistance characteristics.
- Although the CLSI recommendation is to only show results when a minimum of 30 isolates are reported, a cut point of 10 patients was chosen to fairly present data from countries with limited resources or very young surveillance systems (25).
- It is important to note that that the frequency of infection in tested patients can actually be the estimate of the frequency of positive cultures, in low- and medium-resource settings because of low culturing rates, and in all settings for clinical scenarios with high rates of empiric treatment or when diagnosis is by molecular methods, not by culture. This could result in a significant underestimate of frequency of infection.
- There are discrepancies in reporting negative results and "not tested" antibiotics. Although countries have the options to select "no AST" or "unknown breakpoints" for unknown AST results, if certain pathogen-antimicrobial combinations were not reported in the resistant, intermediate, susceptible (RIS) file, it was not always possible to know whether there were no isolates of the organism identified, or whether some isolates were indeed identified but not tested for antimicrobial susceptibility. In addition, where the data show high percentage of unknown AST results for specific antibiotics, the level of uncertainty on the AMR rates generated could be very high. Therefore, a 30% unknown AST results cut-off value was chosen to graphically represent different outcomes (22). This value was selected as giving a reasonable balance in terms of results inclusion and proportion of isolates with data available (23). To avoid this limitation going forward, countries should always report negative AST results of the isolates for which AST was not done.
- In countries where minimum inhibitory concentration (MIC) data with no interpretation are collected at a central level, the lack of information on patient diagnoses can hinder the NCC interpretation of AST results for certain organisms. In the case of *S. pneumoniae* MIC data, the GLASS protocol has suggested that NCCs use non-meningitis breakpoints to interpret reported AST results. However, it is

important to note that good for surveillance practices would involve the tabulation of results using both meningitis and non-meningitis breakpoints for all, irrespective of the individual patient diagnoses.

- Data completeness, particularly for population variables – age, gender, and infection origin – could not be assured for all reporting countries. Yet, the effort countries made to send the most complete and reliable data was taken into consideration, and data analysis was adapted to create a set of results that could be harmonised between different data submissions.

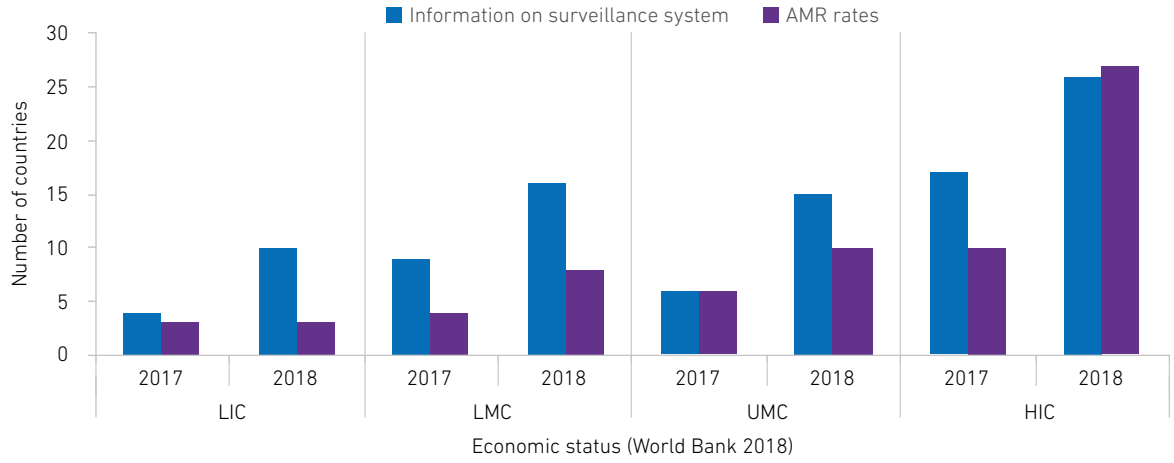

SECTION
03

Results

3.1 Participation

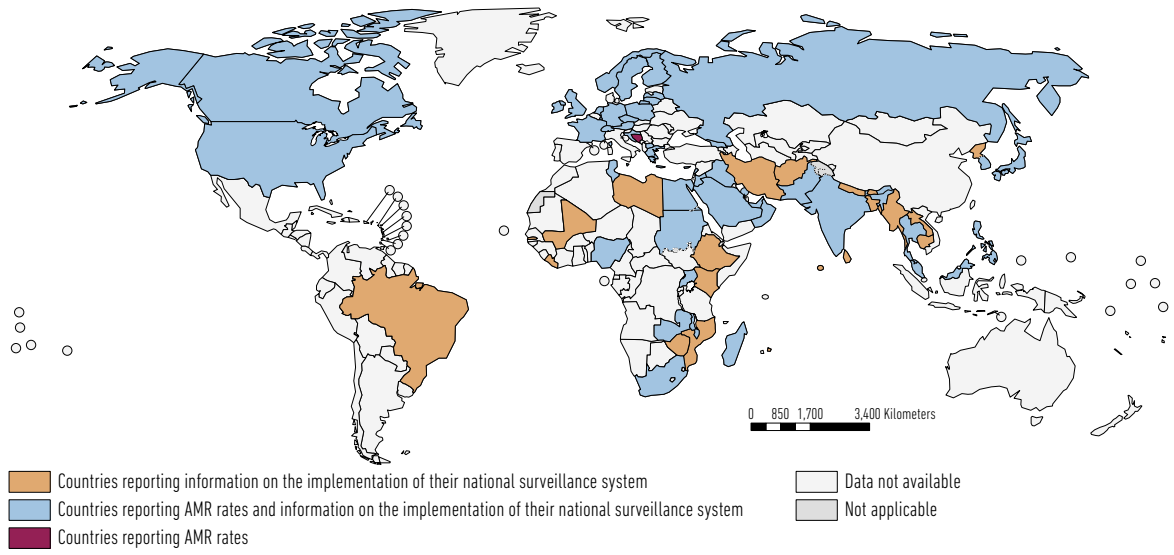
By the end of the second data call on 31 July 2018, 69 countries were enrolled and 68 reporting to GLASS, a 64% increase compared to GLASS first data call in 2017. These include a mix of countries in different stages of economic development (10 LICs, 16 lower middle-income countries [LMICs], 15 upper middle-income countries [UMICs], and 27 high-income countries [HICs]) from across all WHO regions (Fig. 3.1). Sixty-seven countries provided information on their national AMR surveillance systems, of which 47 countries also provided AMR data for 2017. In addition, one country provided AMR data only, for a total of 48 countries providing 2017 AMR rates (ANNEX III).

Fig. 3.1 Number of countries reporting to GLASS by economic status in 2017 and 2018



Of the 48 countries reporting AMR data, five of the CAESAR countries enrolled in GLASS submitted data on AMR in pathogens from blood via the WHO Regional Office for Europe, and 18 EARS-Net countries submitted their data through the ECDC.

Fig. 3.2 Map with countries providing implementation data only / Implementation data + AMR data



3.2 Information on status of national AMR surveillance system

The total number of countries per WHO region, and number of countries reporting to GLASS in this second data call is shown in Table 3.1. As described in Section 2.1 the indicators are summarised and compared between regions for the three areas of implementation (coordination, surveillance systems, and quality assurance and standards), and shown in Figure 3.3-3.13.

Table 3.1 WHO member countries per region enrolled in GLASS and reporting information on the implementation of national surveillance systems in the second data call

Region	Number of countries in the region	Number of countries enrolled to GLASS*	Number of countries reporting implementation to GLASS
AFR	47	15	14
AMR/PAHO	35	3	3
EMR	21	14	14
EUR	53	24	22
SEAR	11	9	8
WPR	27	6	6

*As per December 2018.

3.2.1 Coordination

Coordination elements for AMR surveillance are in place in almost all enrolled countries. Most countries have developed and implemented an AMR national surveillance plans (Fig. 3.3), and compared to data generated from the first data round in 2017, more have also approved a budget for it. Two of the core components for effective surveillance suggested by GLASS are present in the majority of the countries in all regions: the National Coordination Centre (NCC) (Fig. 3.4) with a designated National Focal Point (NFP) (Fig. 3.5), and the National Reference Laboratory (NRL) to support national AMR surveillance (Fig. 3.6). Compared to last year report data, more countries have established or are in the process of establishing NCCs and have designated the NRL (18). These core components secure the correct flow of information to GLASS, and facilitate data preparation and submission.

Fig. 3.3 Existence of functioning national AMR surveillance plan per country by region

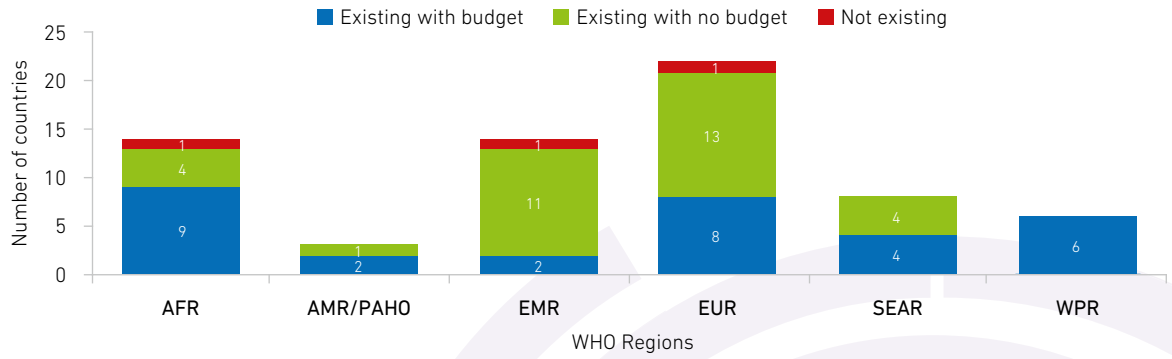


Fig. 3.4 Establishment of National Coordination Centre (NCC) per country by region

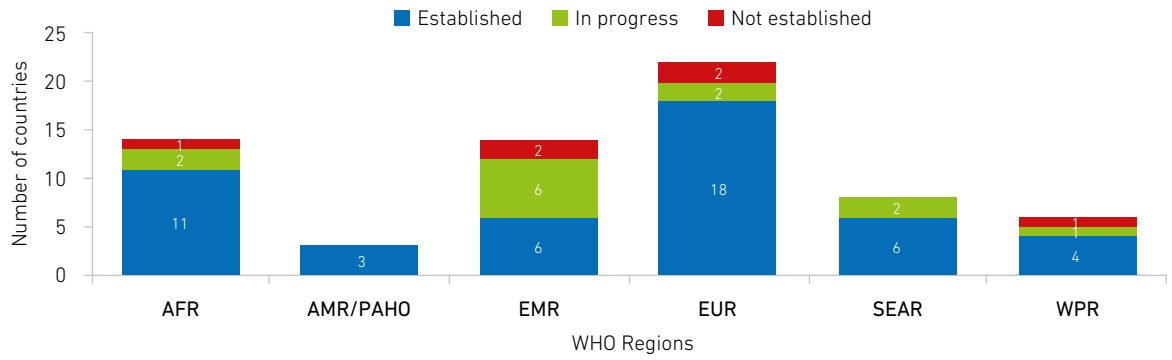


Fig. 3.5 Nomination of National Focal Point (NFP) per country by region

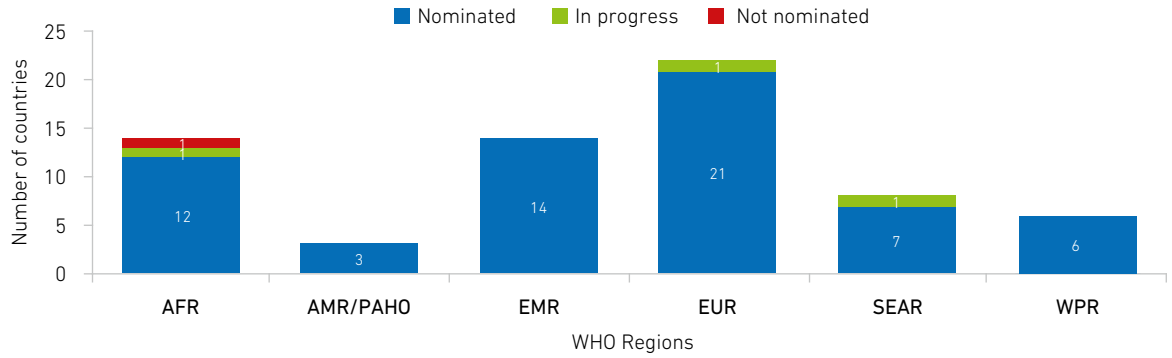
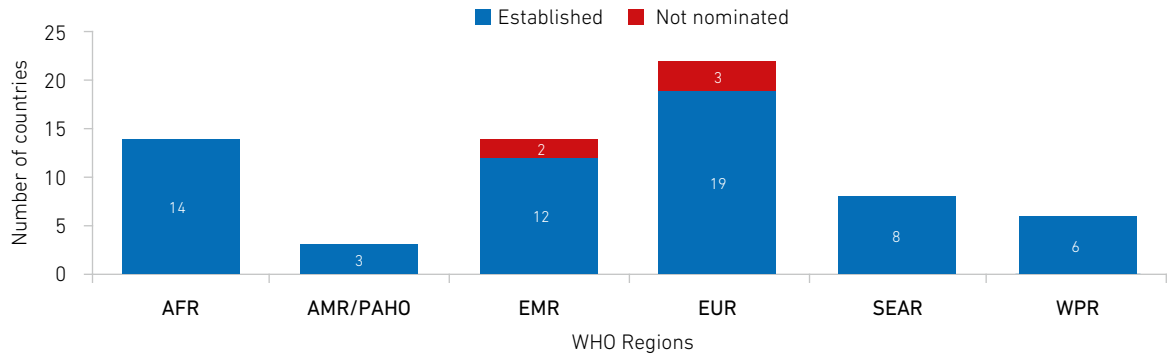


Fig. 3.6 Establishment of national reference laboratory (NRL) per country by region



3.2.2 Surveillance systems

Surveillance sites are the major source of AMR data for national surveillance systems in all regions and the number within the individual countries varies considerably. This is expected during the initial steps of establishing a functional system, and may be linked to a number of factors, such as country surface area and geographical features, the structure of the national health care system, the characteristic of the sites, or logistic and economic constraints. Hospital surveillance sites remain prominent providers as compared to outpatient healthcare category sites (Fig. 3.7). Patients infected with resistant infections require more intensive and expensive care and are more likely to be admitted to hospital, so that historically this has been the preferred facility type of AMR surveillance. However, it is paramount for countries to also monitor AMR in out-patients health care facility, in order to better capture community acquired AMR infections.

The number al local laboratories performing AST supporting the national surveillances systems also varied among countries, but within countries it seems matching the number of in-patients and out-patients health care facilities providing AMR data, suggesting harmonization and direct collaboration among health care and diagnostic providers (Fig. 3.8).

Overall, most countries reporting for the second year in a row showed an increase in the number of surveillance sites reporting to GLASS.

Fig. 3.7 Number of national surveillance sites providing data to the national AMR surveillance system per country by region: hospital category (In-pat) and outpatient health-care facility category (Out-pat). *(Number of countries per region that did not provide information of the number of surveillance sites: AFRO=2, AMR/PAHO=0, EMR=4, EUR=8, SEAR=2, WPR=1)*

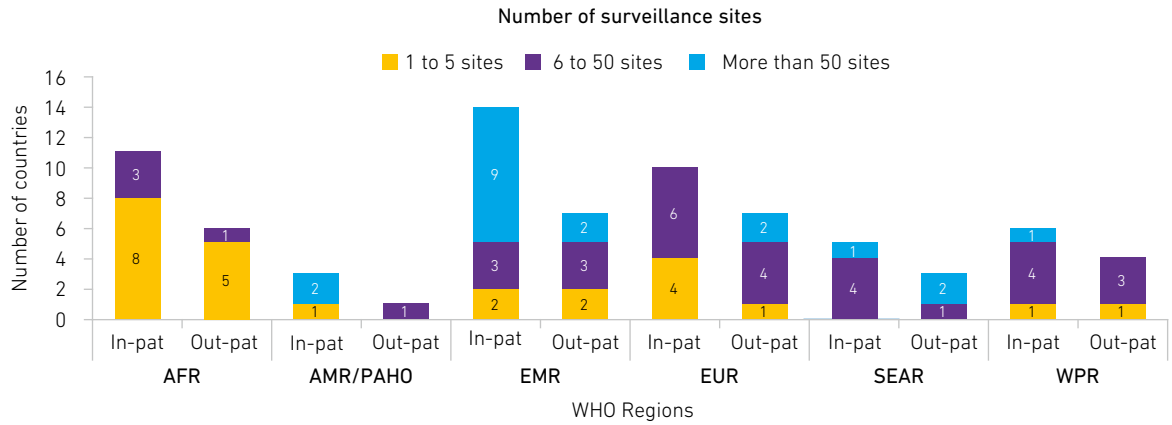
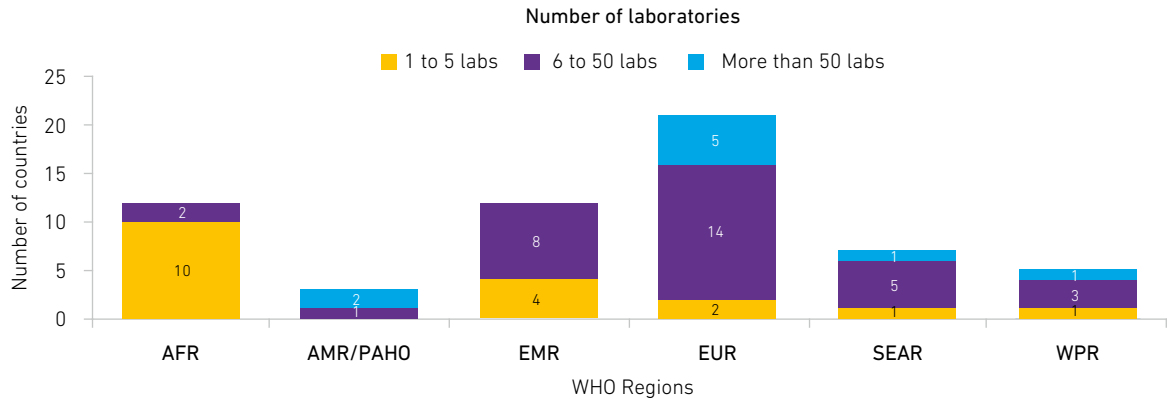


Fig. 3.8 Number of local clinical laboratories performing AST that support national AMR surveillance sites per country by region. (*(Number of countries per region that did not provide information of the number of laboratories: AFRO=2, AMR/PAHO=0 , EMR=2, EUR=1, SEAR=1, WPR=1)*



3.2.3 Quality assurance and standards

Although almost all NRLs participate in an External Quality Assessment (EQA) scheme (Fig. 3.9) EQA is still not provided to all local clinical laboratories serving the national AMR surveillance programme (Fig. 3.10). When provided, it covers both bacterial identification and AST (Fig. 3.11) for all or at least some GLASS pathogens (Fig. 3.12). In most countries reporting laboratories are performing antimicrobial susceptibility testing (AST) according to internationally recognised standards – either European Committee on Antimicrobial Susceptibility Testing (EUCAST) or the Clinical and Laboratory Standards Institute (CLSI) (Fig. 3.13).

Fig. 3.9 EQA provided to NRLs per country by region

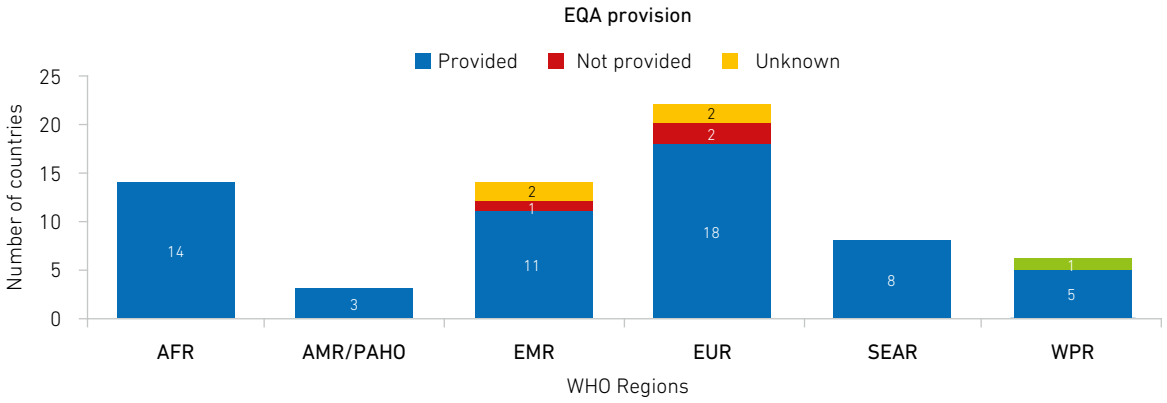


Fig. 3.10 EQA provided to local laboratories participating in national AMR surveillance system per country by region

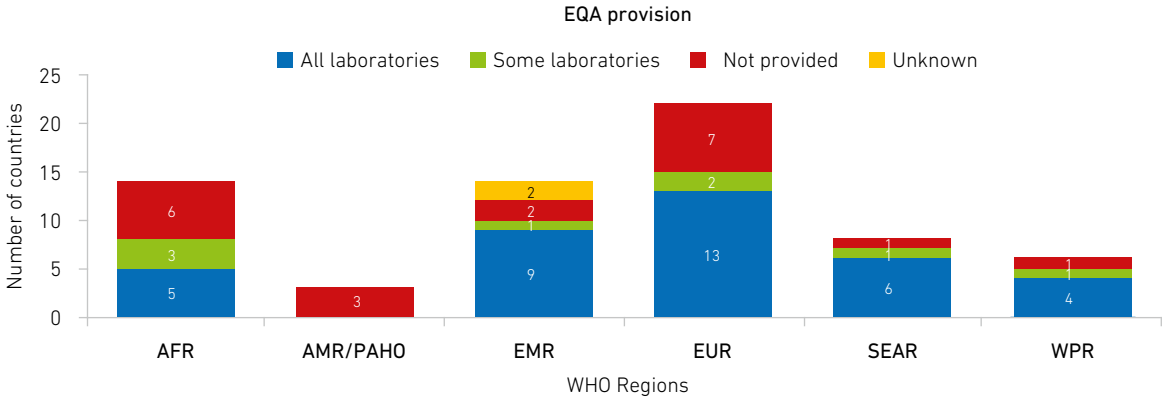


Fig. 3.11 EQA provided to local laboratories participating in the national AMR surveillance system for AST and bacterial identification (BI), per country by region

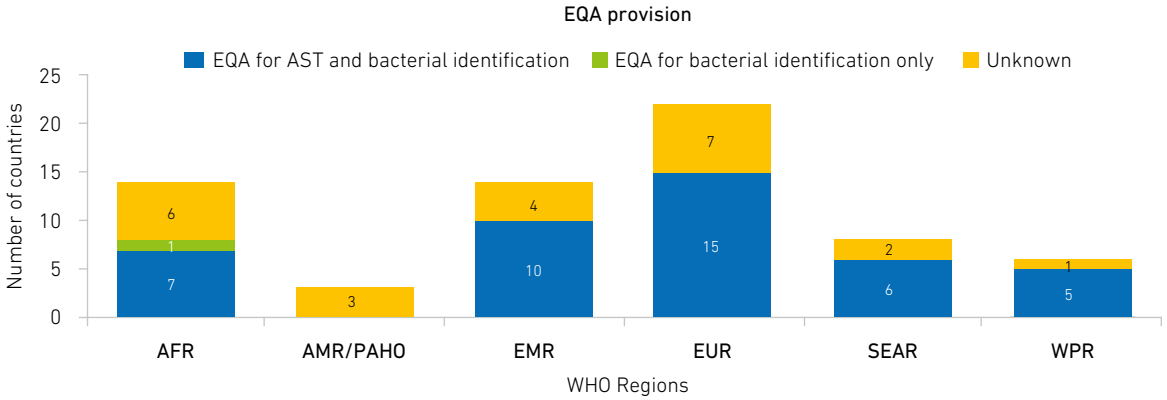


Fig. 3.12 GLASS pathogens diagnostic covered by EQA per country by region

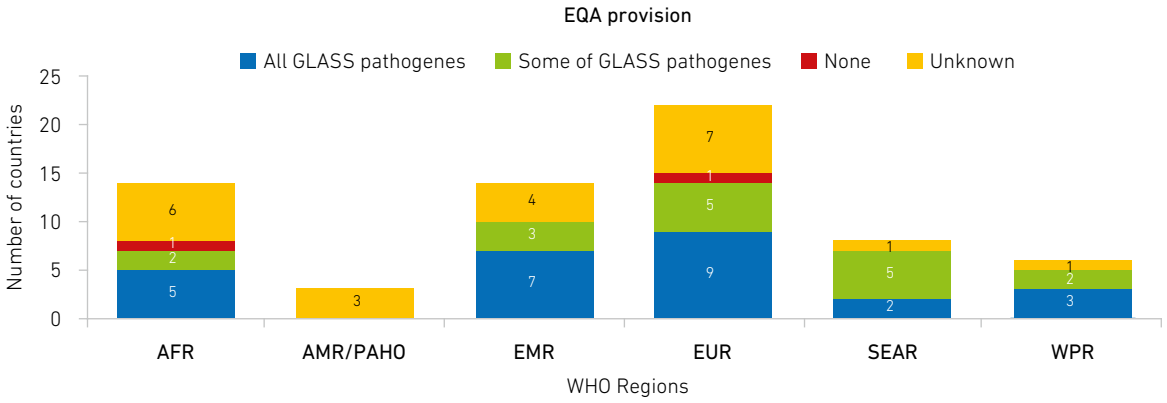
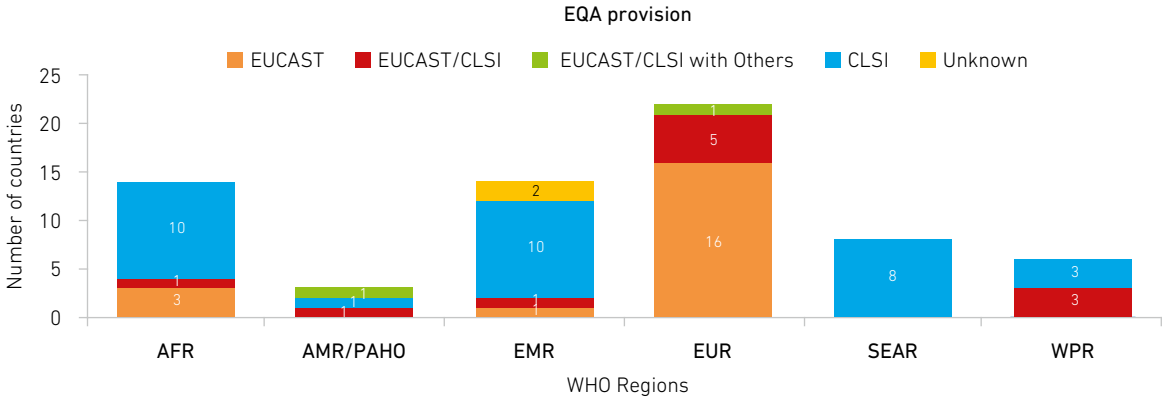


Fig. 3.13 Types of AST international standards used per country by region



Section 3

3.3 Reported AMR rates

Overall, 3097 hospitals and 2358 outpatient's clinics reported AMR data to GLASS. GLASS also received data from 560 laboratories from 26 countries that have not yet identified the surveillance sites from where the laboratory results originate. EQA provided for bacterial identification and AST to laboratories reporting to GLASS varied among regions.

45 (94%) countries submitted results from blood specimens, 24 (50%) from urine specimens, 21 (44%) from stool specimens, and 20 (42%) from cervical and urethral specimens. The most frequently reported pathogens were in order *E. coli, K. pneumoniae, Salmonella* spp., *Acinetobacter* spp., *S aureus, S pneumoniae, N gonorrhoea,* and *Shigella* spp. (ANNEX V).

The total number of patient with suspected infection from whom a pathogen was isolated varied considerably, from a minimum of 18 patients to a maximum of 859.002 patients per country. Overall, countries reported information for a combined total of 1,706,578 patients. Antimicrobial susceptibility testing varied greatly among countries and specimen-pathogen-antibiotic combination.

Enterobacteriaceae (*E. coli, K. pneumoniae, Salmonella* spp., and *Shigella* spp.) were mainly tested for resistance to ciprofloxacin and imipenem, *Acinetobacter* spp. to imipenem, *S. pneumoniae* to penicillin and co-trimoxazole, and *N. gonorrhoea to* ceftriaxone. For *S. aureus,* GLASS collects only data on cefoxitin resistance, and, when not available, oxacillin resistance.

Country profiles

Afghanistan

Population 35.53 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

1 surveillance site
1 hospital

1 laboratory performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
Not reported
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No 2016 AMR data reported to GLASS by the end of the data call

Austria

Population 8.73 million

The AMR surveillance in Austria is coordinated by the Federal Ministry of Health with the annual Austrian report on AMR (AURES) published annually. Austria is implementing the National Action Plan on AMR published in 2014. The country participates in the EARS-NET and has been enrolled in GLASS since June 2016.

Current status of the national AMR surveillance system

144 surveillance sites
144 hospitals

40 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Number of surveillance sites providing data to GLASS not reported

Data submission*

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

*Austria makes no warranties, express or implied, regarding the content, presentation, appearance, completeness or accuracy of the data in the web-based internet GLASS platform

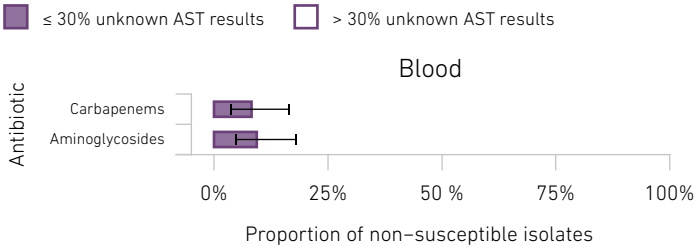
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	75
				E. coli	-	-	5367
				K. pneumoniae	-	-	1147
				Salmonella spp.	-	-	-
				S. aureus	-	-	3158
				S. pneumoniae	-	-	463
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

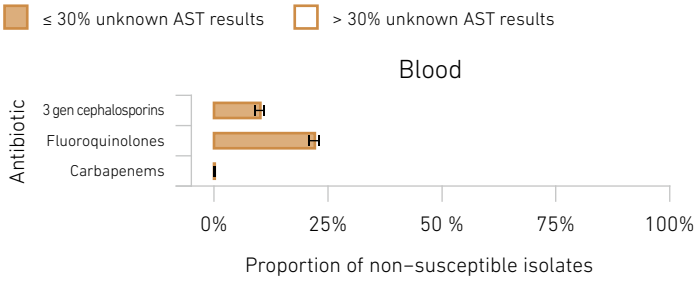
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

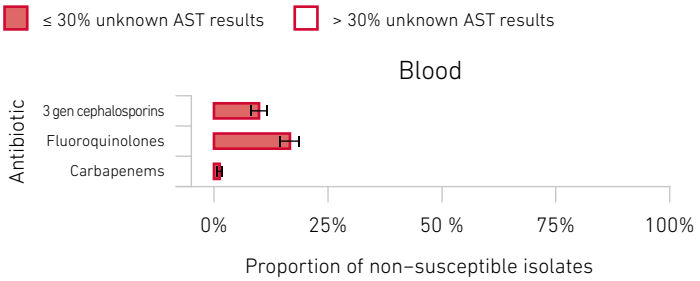


Escherichia coli

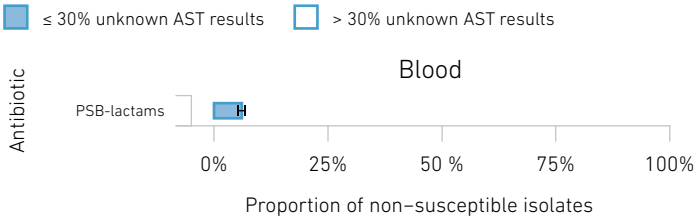


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

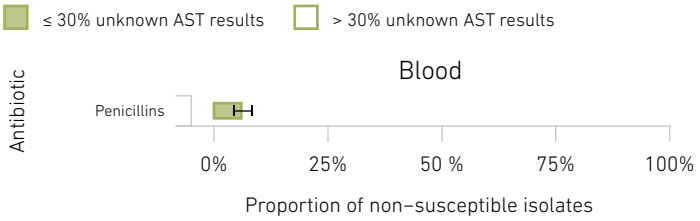
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Bahrain

Population 1.50 million

Bahrain has a National Action Plan on AMR that was approved in 2016. The functioning national AMR surveillance system produces regular reports and covers about 80% of the population. Bahrain has been enrolled in GLASS since October 2016.

Current status of the national AMR surveillance system

33 surveillance sites
5 hospitals
28 outpatient facilities

1 laboratory performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
33 surveillance sites providing data to GLASS
(5 hospitals)
(28 outpatient facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

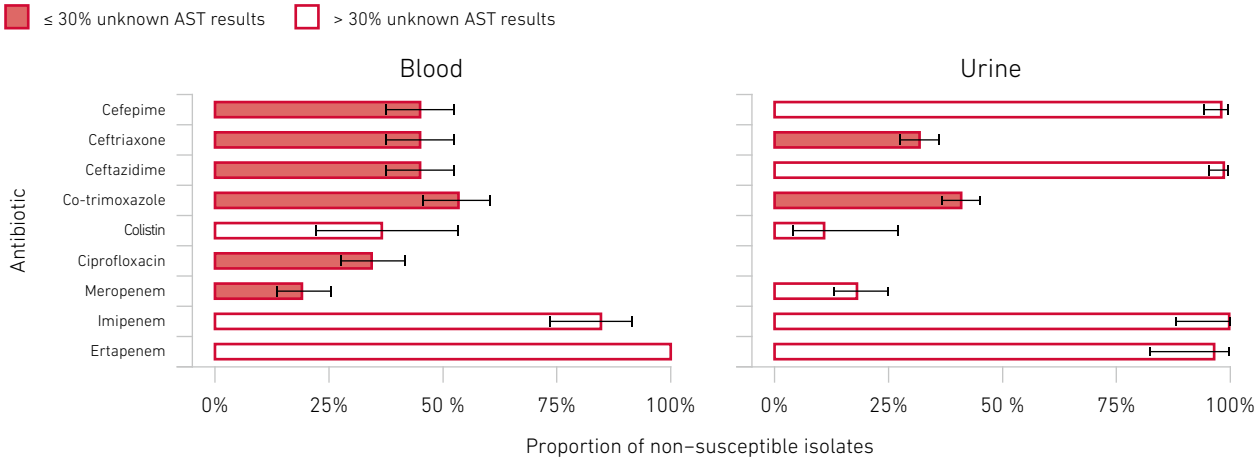
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	-
				K. pneumoniae	-	-	172
				Salmonella spp.	-	-	-
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	477
STOOL	-	-	-	*Salmonella* spp.	-	-	95
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	15

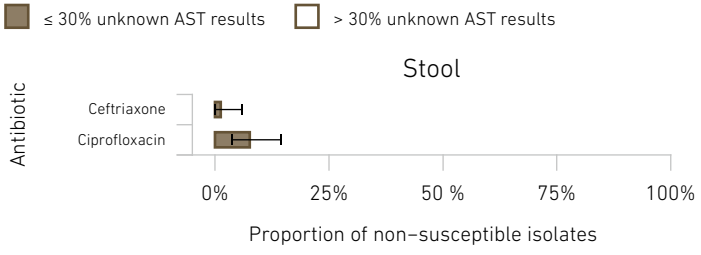
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Klebsiella pneumoniae

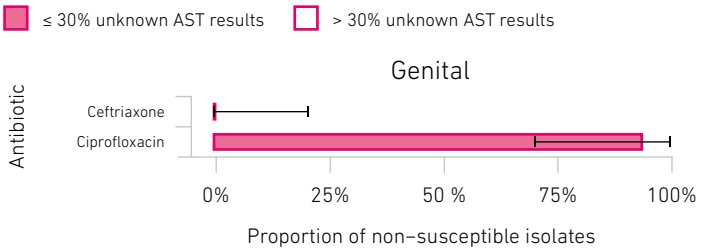


Salmonella **spp.**



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Neisseria gonorrhoeae



Bangladesh

Population 164.67 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

16 surveillance sites
8 hospitals
8 outpatient facilities

8 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Bhutan

Population 0.80 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

6 surveillance sites
3 hospitals
3 outpatient facilities

3 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Bosnia and Herzegovina

Population 3.51 million

AMR surveillance activities are conducted by two networks; one in the Federation of Bosnia and Herzegovina and one in Republika Srpska. AMR surveillance covers about two thirds of the population of the Federation of Bosnia and Herzegovina and at least 75% of the population of Republika Srpska. The country participates in CAESAR and has been enrolled in GLASS since September 2016.

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

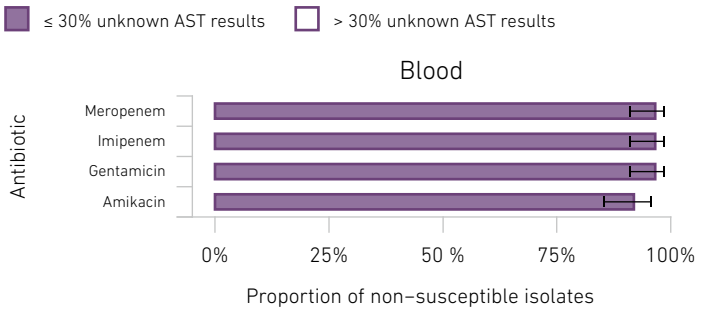
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	112
				E. coli	-	-	193
				K. pneumoniae	-	-	149
				Salmonella spp.	-	-	6
				S. aureus	-	-	155
				S. pneumoniae	-	-	19
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

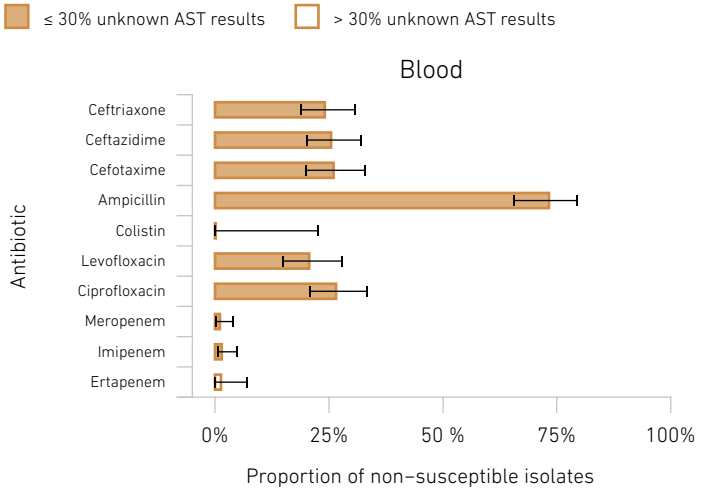
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

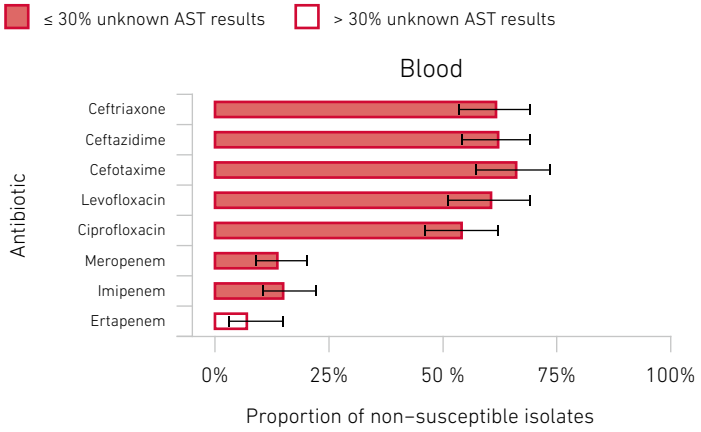
Acinetobacter **spp.**



Escherichia coli

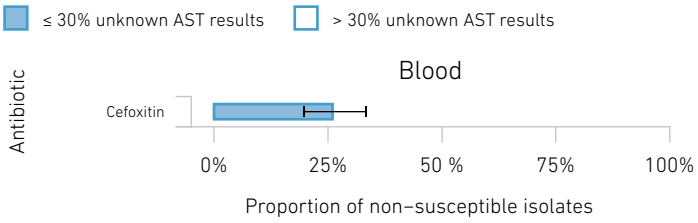


Klebsiella pneumoniae

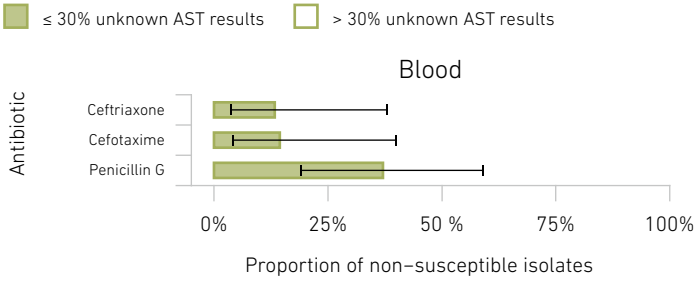


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.Klebsiella pneumoniae

Staphylococcus aureus



Streptococcus pneumoniae



Brazil

Population 209.29 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

18 surveillance sites
11 hospitals
7 outpatient facilities

7 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Cambodia

Population 16 million

Cambodia has approved its National Action Plan on AMR and is building its national AMR surveillance system. The country has enrolled in GLASS in April 2016.

Current status of the national AMR surveillance system

8 surveillance sites
8 hospitals

8 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

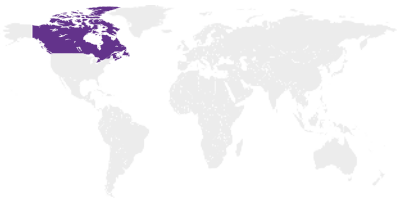
National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call



Canada

Population 36.62 million

The Canadian Antimicrobial Resistance Surveillance System (CARSS) is a national system for surveillance of AMR and antimicrobial use, producing annual reports. It integrates surveillance data from nine surveillance systems and laboratory reference services operated by the Public Health Agency of Canada. Federal Action Plan on Antimicrobial Resistance and Use in Canada has been published in 2015. Canada has enrolled in GLASS in November 2016.

Current status of the national AMR surveillance system

66 surveillance sites
65 hospitals

77 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, O
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

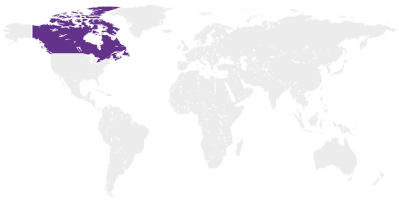
in 2018 data call
Number of surveillance site providing data to GLASS not reported*

*The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set-up of the National surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected



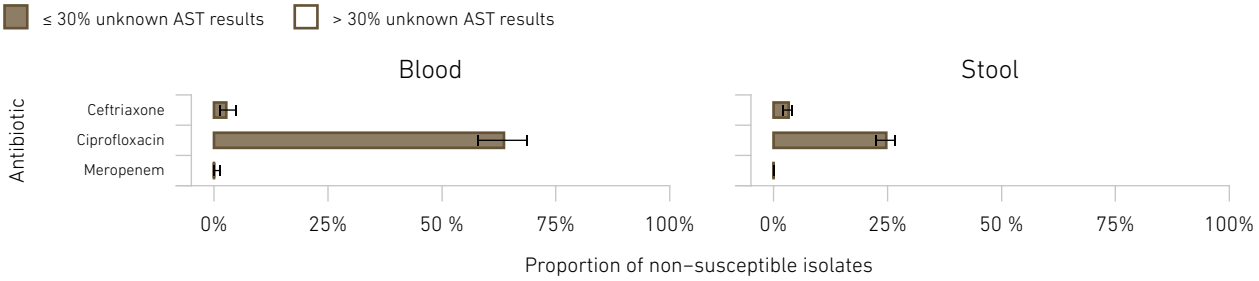
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	285
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	1746
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Salmonella **spp.**



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Croatia

Population 4.19 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

19 surveillance sites
19 hospitals

19 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Number of surveillance sites providing data to GLASS not reported

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

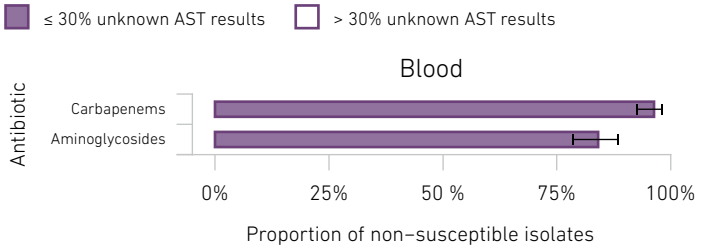
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	208
				E. coli	-	-	1156
				K. pneumoniae	-	-	313
				Salmonella spp.	-	-	-
				S. aureus	-	-	520
				S. pneumoniae	-	-	129
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

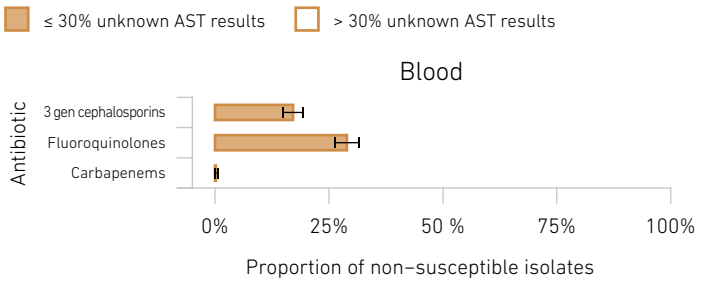
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

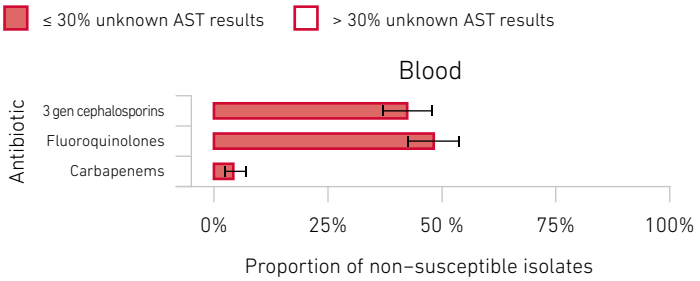


Escherichia coli

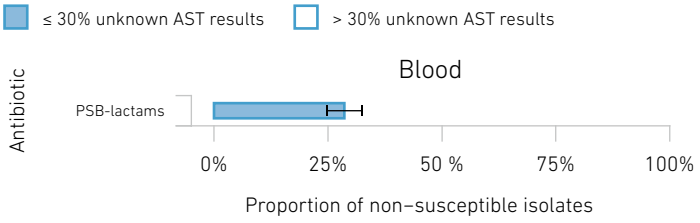


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

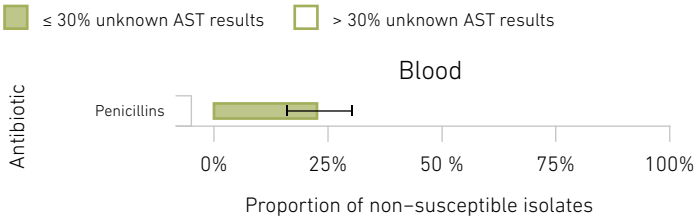
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Cyprus

Population 0.84 million

The National strategy of Cyprus against microbial resistance to antibiotics was published in 2012.
The country participates in the EARS-NET and is enrolled in GLASS since September 2016.

Current status of the national AMR surveillance system

54 surveillance sites
5 hospitals
49 outpatient facilities

5 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
10 surveillance sites providing data to GLASS
(5 hospitals)
(5 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

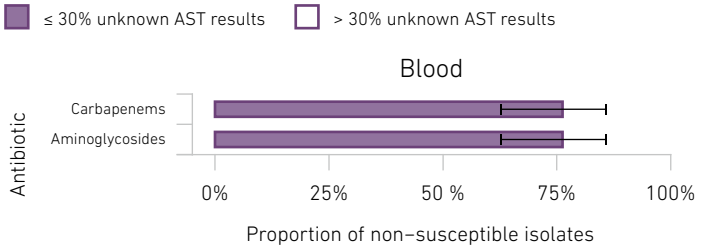
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	50
				E. coli	-	-	156
				K. pneumoniae	-	-	71
				Salmonella spp.	-	-	-
				S. aureus	-	-	125
				S. pneumoniae	-	-	11
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

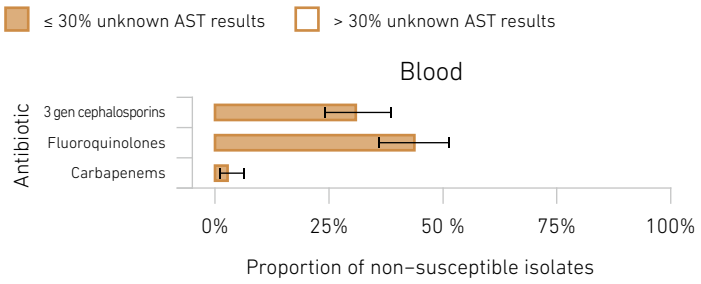
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

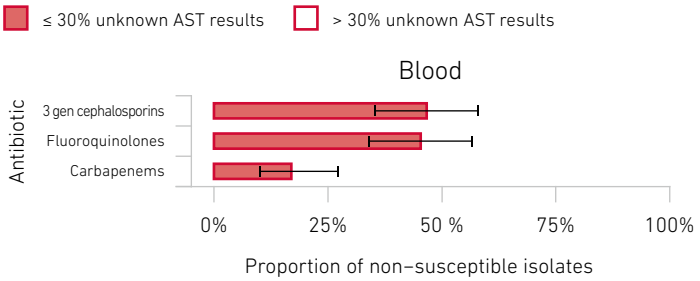


Escherichia coli

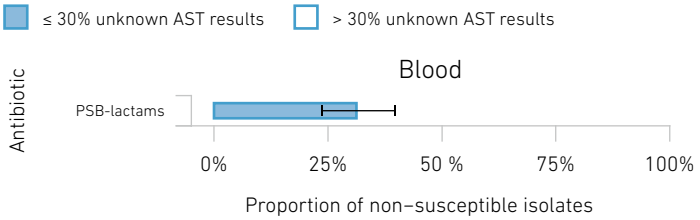


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

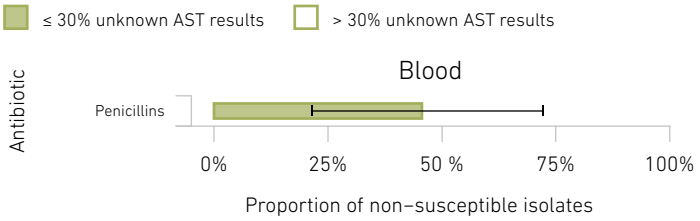
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Czech Republic

Population 10.62 million

The Czech Republic participates in the EARS-NET and the national AMR surveillance network (CZ-EARS-Net) covers almost 80% of the Czech population. The country works on development of a new National Action Plan on AMR.
The country has been enrolled in GLASS since December 2016.

Current status of the national AMR surveillance system

77 surveillance sites
77 hospitals

56 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
77 surveillance sites providing data to GLASS
(77 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

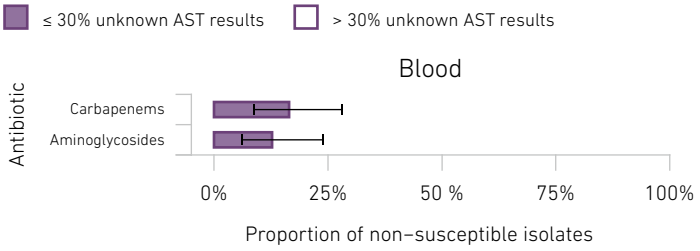
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	55
				E. coli	-	-	3199
				K. pneumoniae	-	-	1329
				Salmonella spp.	-	-	-
				S. aureus	-	-	1944
				S. pneumoniae	-	-	366
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

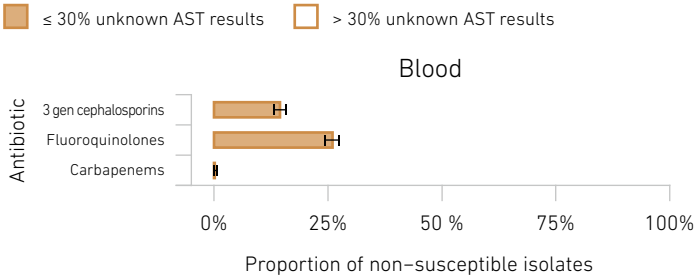
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

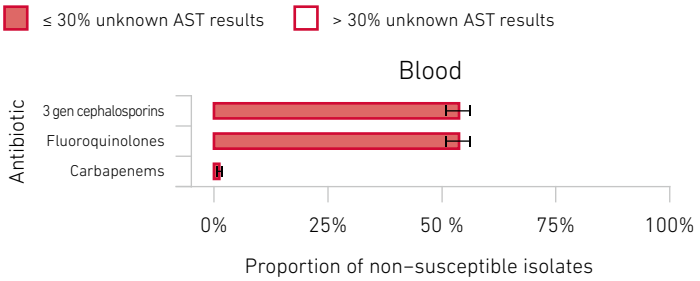


Escherichia coli

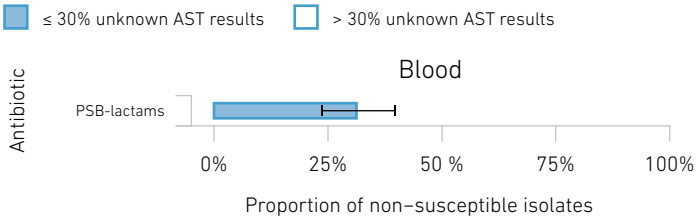


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

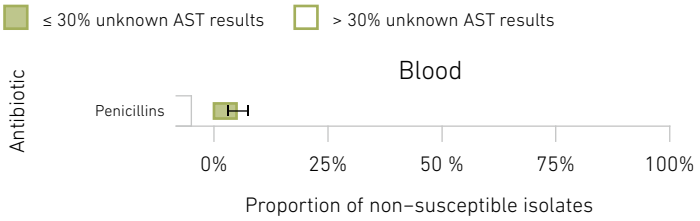
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Egypt

Population 97.55 million

Egypt is building its national AMR surveillance system. Phase one of the national AMR action plan (2017–2020) was drafted in 2017. Egypt has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

39 surveillance sites
39 hospitals

39 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
9 surveillance sites providing data to GLASS
(9 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

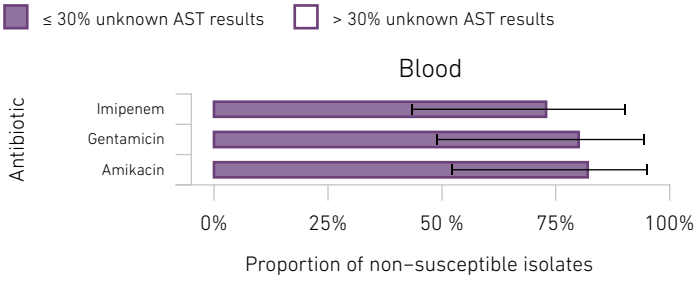
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	249	358	-	*Acinetobacter* spp.	2	10	-
				E. coli	4	2	-
				K. pneumoniae	15	54	-
				Salmonella spp.	-	-	-
				S. aureus	9	6	-
				S. pneumoniae	-	-	-
URINE	47	129	-	*E. coli*	5	9	-
				K. pneumoniae	-	5	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

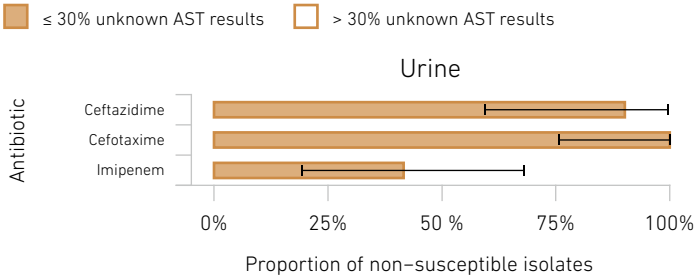
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

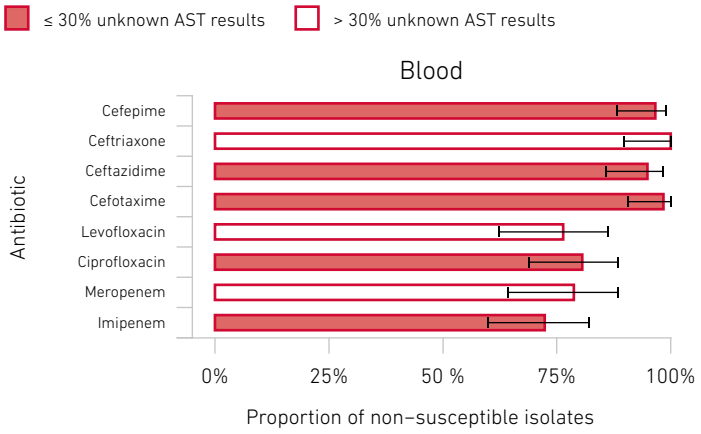


Escherichia coli



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

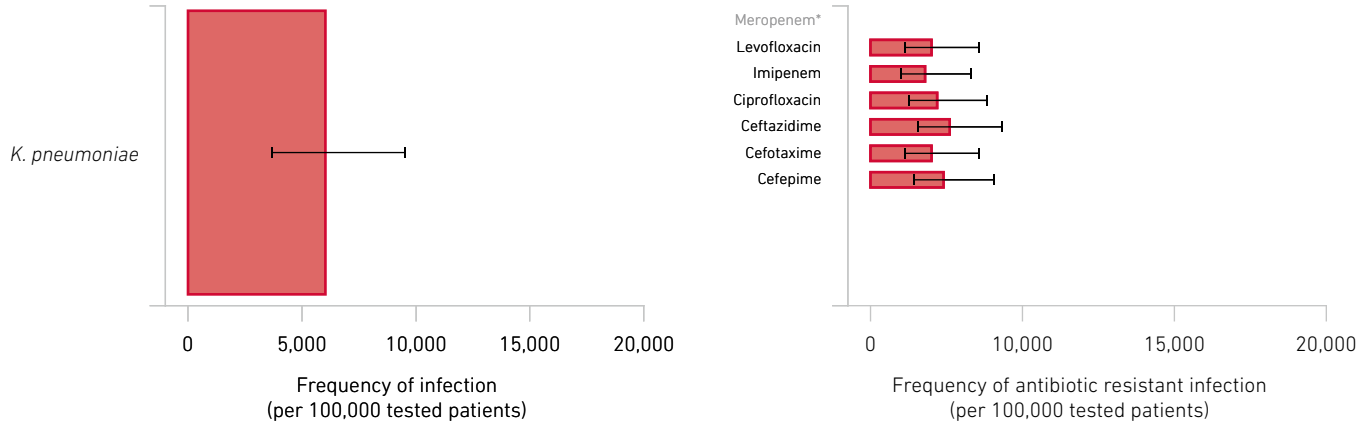
Klebsiella pneumoniae



Non-susceptible pathogen-antimicrobial combination frequency

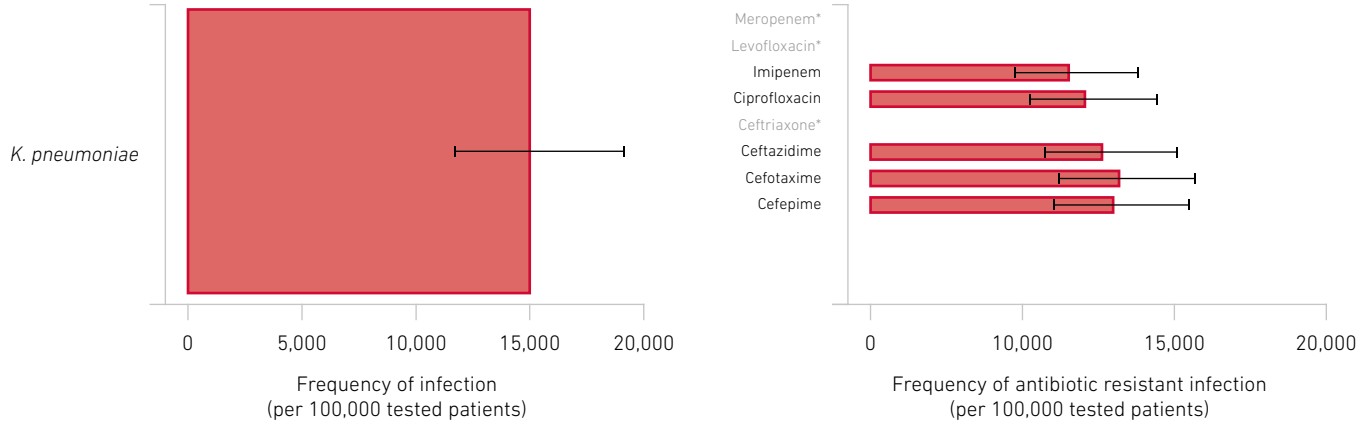
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Community origin (n tested = 249)



***Antibiotic with >30% unknown AST results**: AMR rates not shown

BLOOD- Hospital origin (n tested = 358)



*Antibiotic with >30% unknown AST results: AMR rates not shown

Ethiopia

Population 104.96 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

4 surveillance sites
2 hospitals
2 outpatient facilities

4 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS

in 2018 data call
No AMR data reported to GLASS by the end of the data call

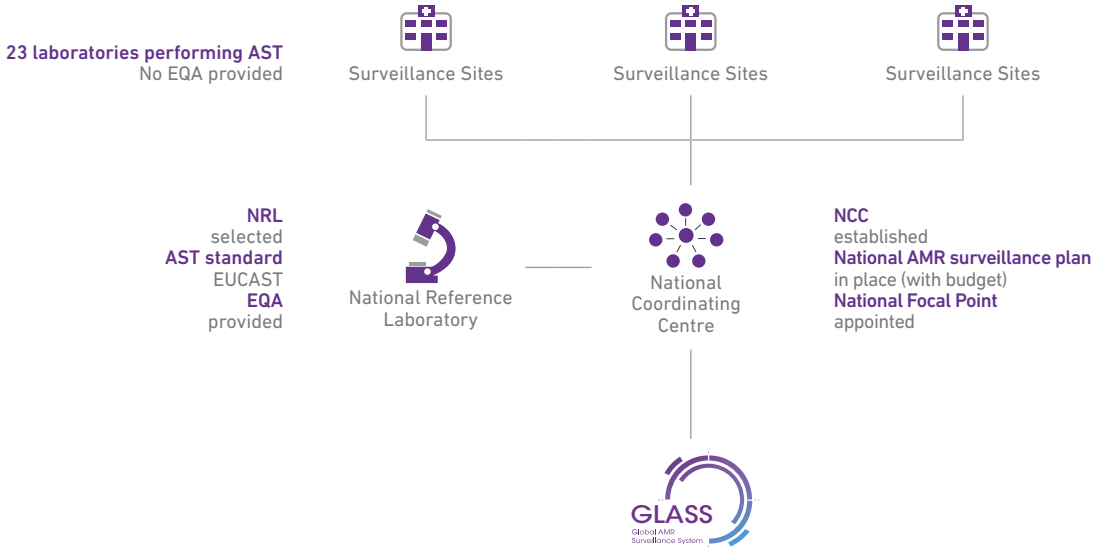
Finland

Population 5.52 million

Finland has several surveillance systems monitoring AMR which include, in particular, Finnish research group studying antimicrobial resistance (FiRe) and Hospital infection programme (SIRO). FiRe, founded in 1991, collects data on AMR in 15 clinically important bacteria and produces an annual FINRES report. SIRO collects data on AMR in pathogens that cause major healthcare associated infections. The National Action Plan on AMR covers the period from 2017 to 2021. Finland participates in the EARS-NET and has been enrolled in GLASS since October 2016.

Current status of the national AMR surveillance system

23 participating laboratories*



in 2018 data call
Participating Laboratories provinding data to GLASS
(23 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

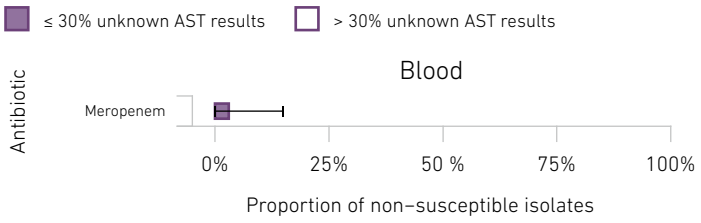
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	34
				E. coli	-	-	5311
				K. pneumoniae	-	-	756
				Salmonella spp.	-	-	55
				S. aureus	-	-	2432
				S. pneumoniae	-	-	834
URINE	-	-	-	*E. coli*	-	-	144257
				K. pneumoniae	-	-	137472
STOOL	-	-	-	*Salmonella* spp.	-	-	1 181
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	342

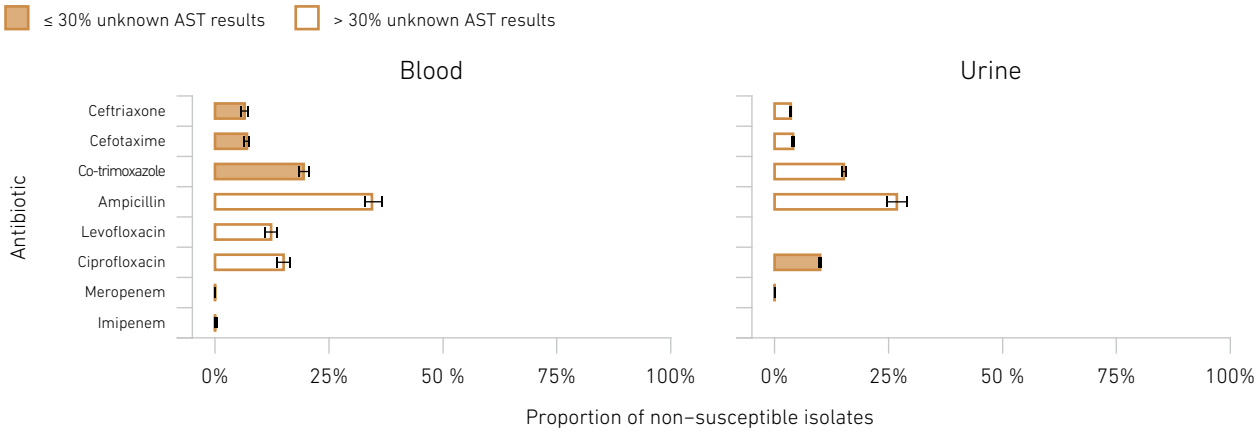
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

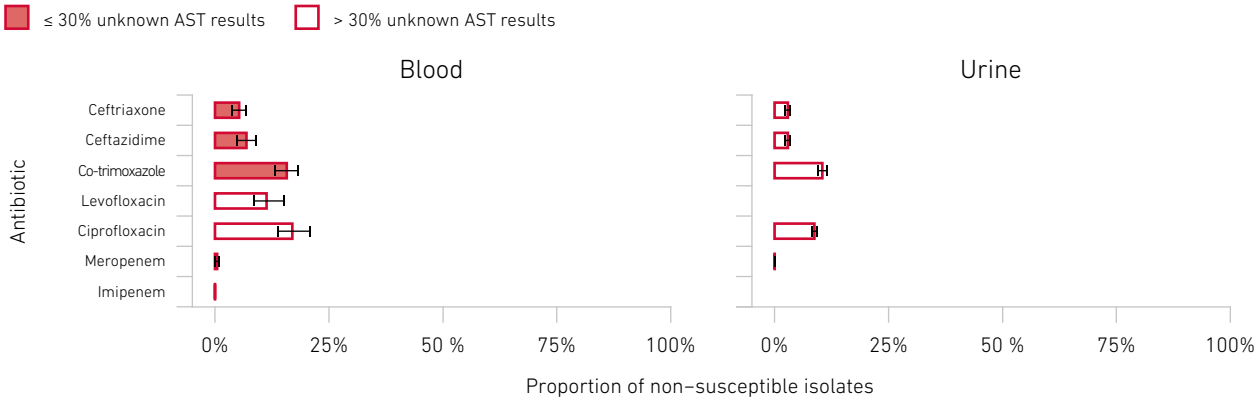
Acinetobacter **spp.**



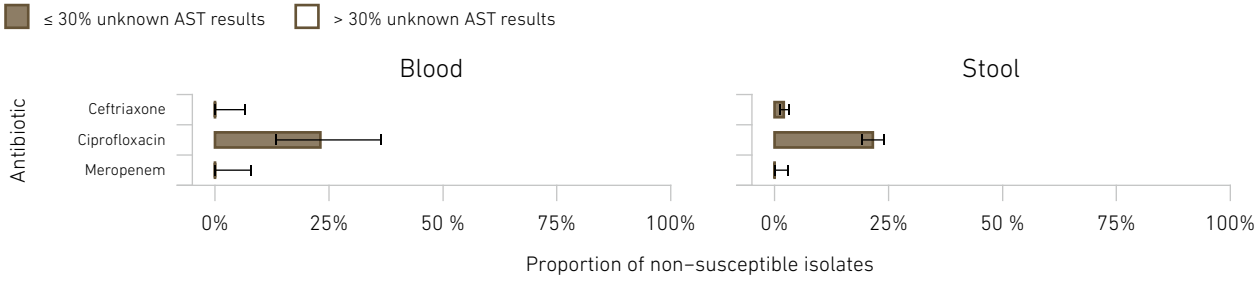
Escherichia coli



Klebsiella pneumoniae

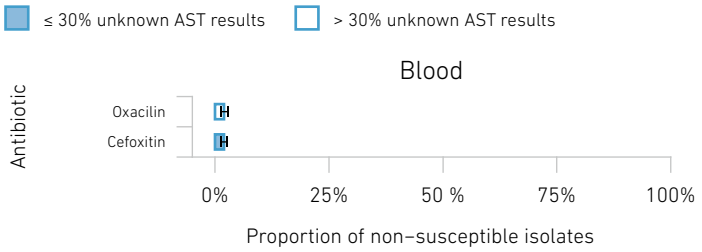


Salmonella **spp.**

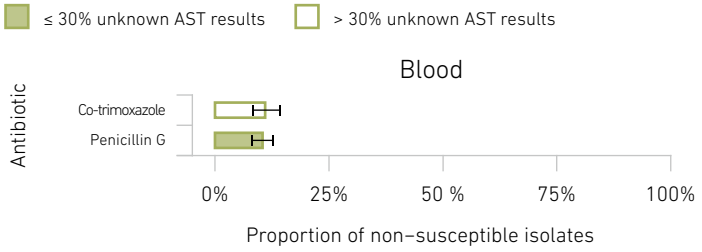


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

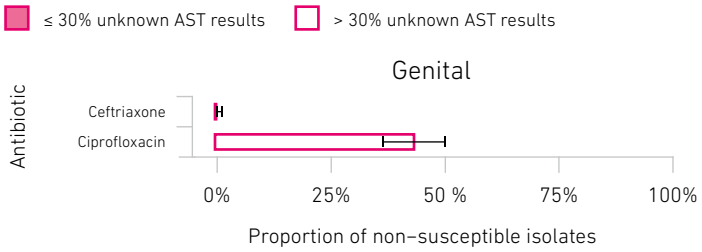
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



France

Population 64.98 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Participating laboratories:
169 for S. pneumoniae and 54 for the other EARS-net pathogens

Number of laboratories performing AST:169 for S. pneumoniae and 54 for the other EARS-net pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL selected
AST standard EUCAST, 0
EQA provided

National Reference Laboratory — National Coordinating Centre

NCC established
National AMR surveillance plan in place (with budget)
National Focal Point appointed

GLASS Global AMR Surveillance System

in 2018 data call
Number of laboratories providing data to GLASS:
169 for S. pneumoniae and 54 for the other EARS-net pathogens

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

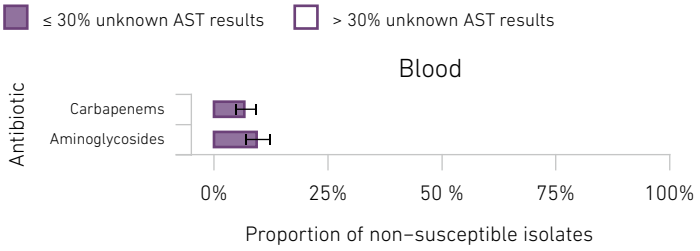
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	474
				E. coli	-	-	13357
				K. pneumoniae	-	-	2894
				Salmonella spp.	-	-	-
				S. aureus	-	-	6472
				S. pneumoniae	-	-	614
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

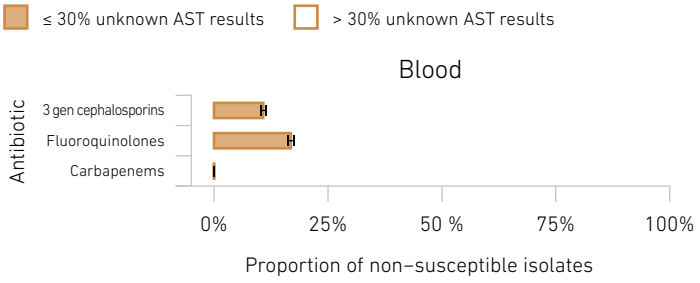
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

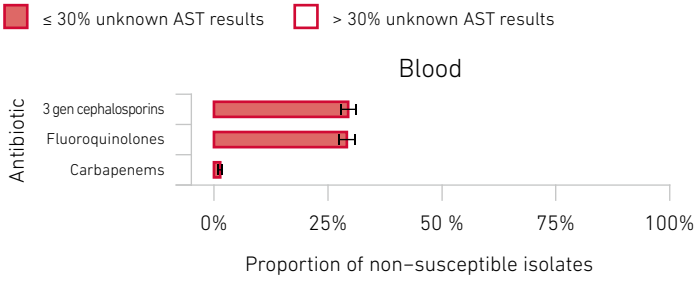
Acinetobacter **spp.**



Escherichia coli

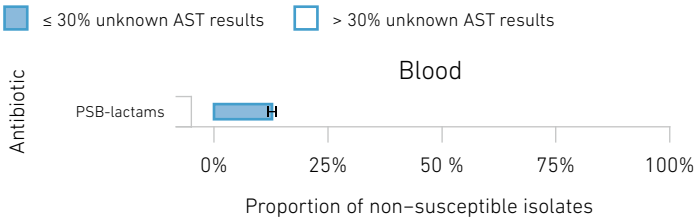


Klebsiella pneumoniae

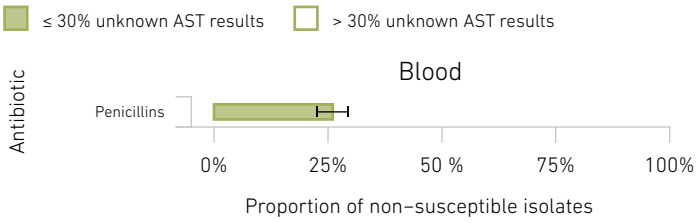


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Staphylococcus aureus



Streptococcus pneumoniae

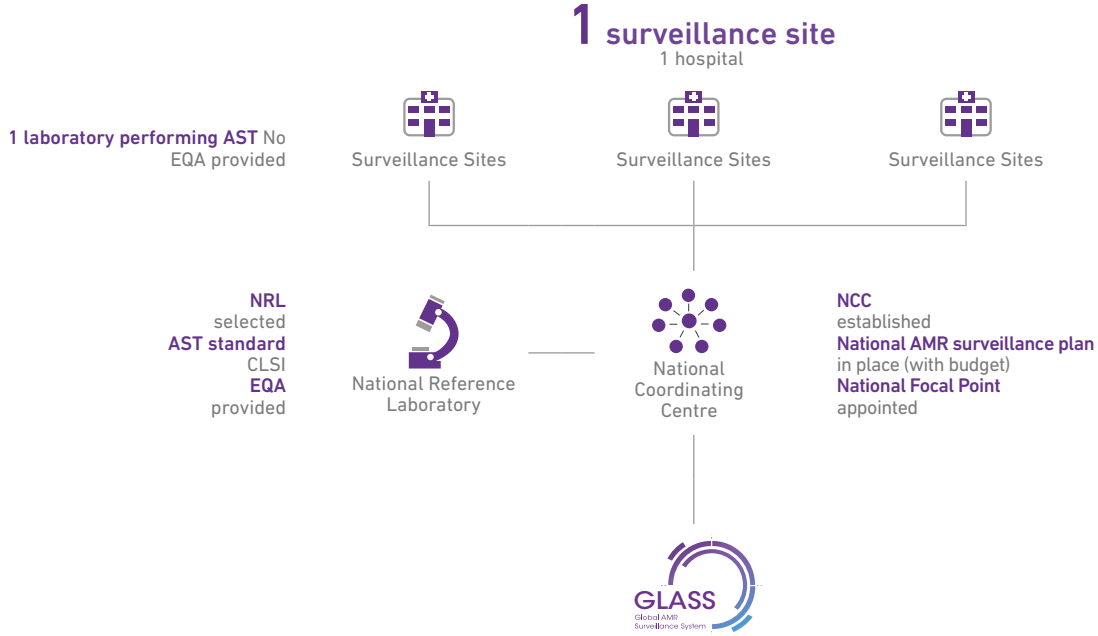


Gambia

Population 2.1 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system



in 2018 data call

No AMR data reported to GLASS by the end of the data call

Georgia

Population 3.91 million

The AMR National Strategy was approved in January 2017. AMR surveillance is included in the NAP. Georgia is building its national AMR surveillance system and participates in CAESAR. It has been enrolled in GLASS since April 2016.

Current status of the national AMR surveillance system

152 surveillance sites
150 hospitals
2 outpatient facilities

20 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
4 surveillance sites providing data to GLASS
(4 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

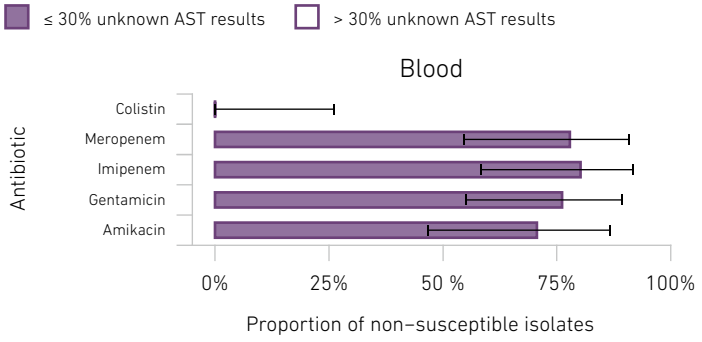
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	22
				E. coli	-	-	17
				K. pneumoniae	-	-	38
				Salmonella spp.	-	-	-
				S. aureus	-	-	27
				S. pneumoniae	-	-	1
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

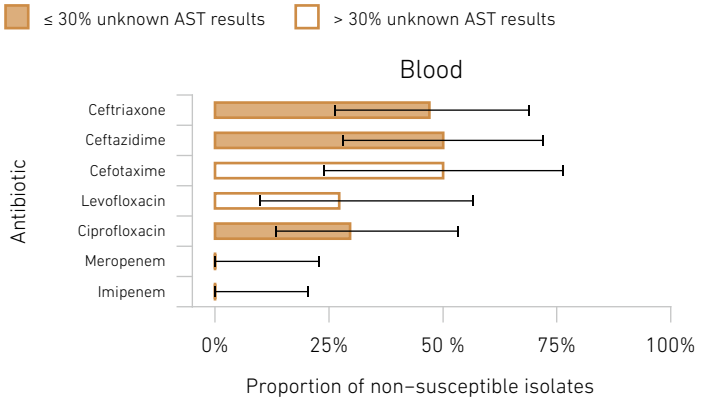
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

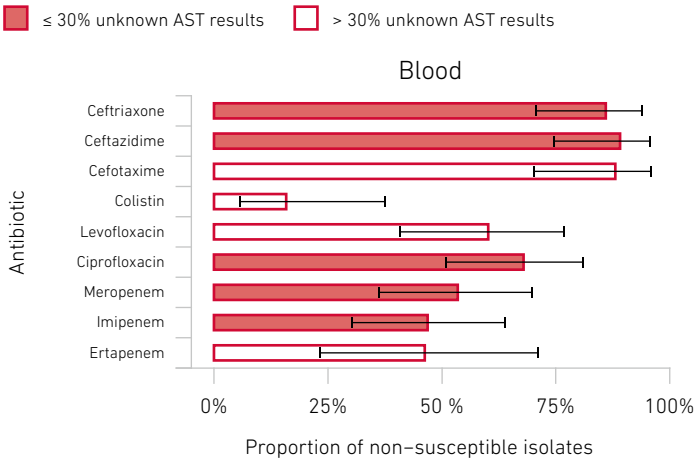


Escherichia coli

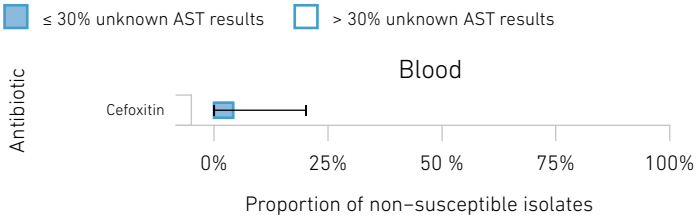


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Klebsiella pneumoniae



Staphylococcus aureus



Germany

Population 82.11 million

The national surveillance of AMR is coordinated by the Robert Koch Institute, offering a publically accessible interactive database for data of the AMR surveillance system (Antibiotika Resistenz Surveillance – ARS). The National action plan on prevention of AMR (DART 2020) was published in 2015. Germany participates in the EARS-NET and has been enrolled in GLASS since September 2016.

Current status of the national AMR surveillance system

18752 surveillance sites
623 hospitals
18129 outpatient facilities

53 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (not defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
479 surveillance sites providing data to GLASS
(479 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

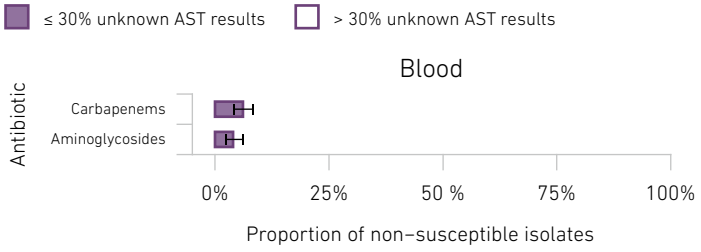
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	502
				E. coli	-	-	21081
				K. pneumoniae	-	-	3 549
				Salmonella spp.	-	-	168
				S. aureus	-	-	12021
				S. pneumoniae	-	-	1823
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

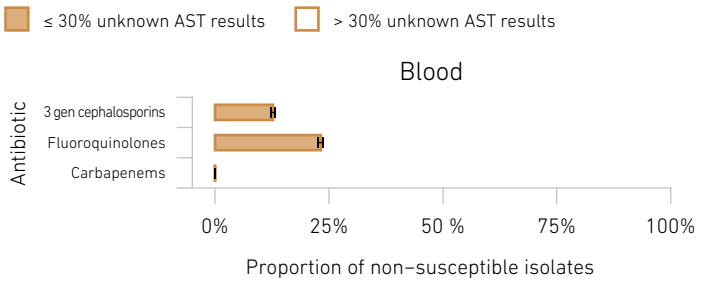
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

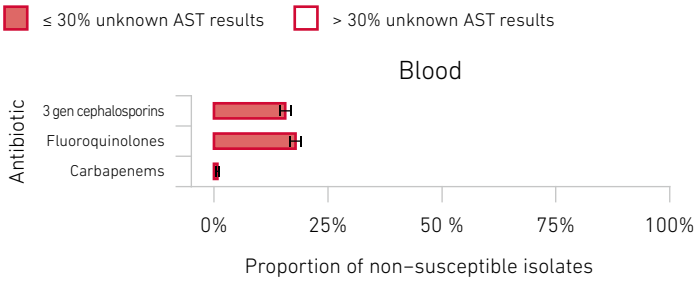


Escherichia coli

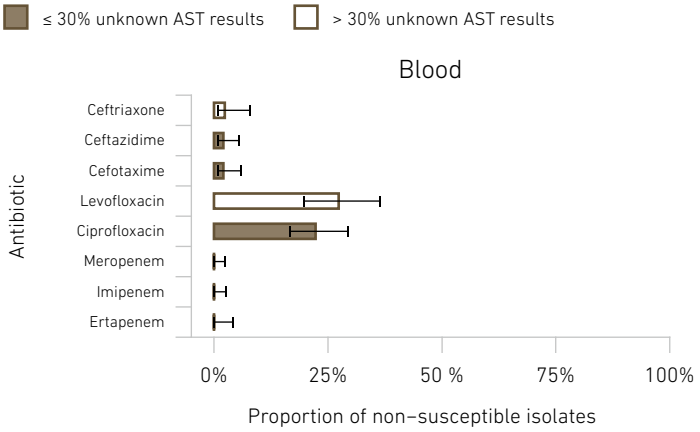


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

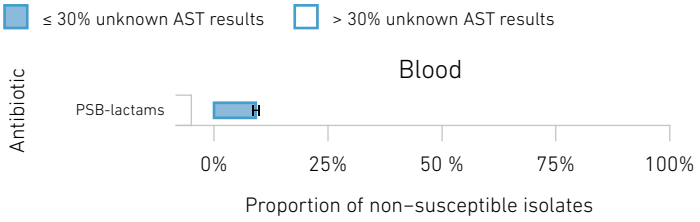
Klebsiella pneumoniae



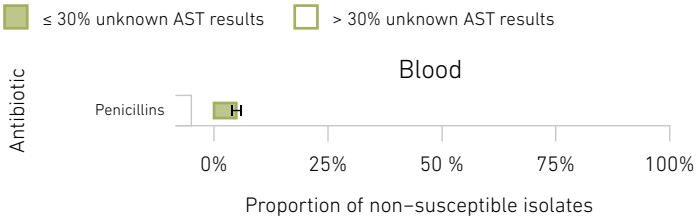
Salmonella **spp.**



Staphylococcus aureus



Streptococcus pneumoniae



Greece

Population 11.16 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

55 surveillance sites
55 hospitals

55 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (not defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
34 surveillance sites providing data to GLASS
(34 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

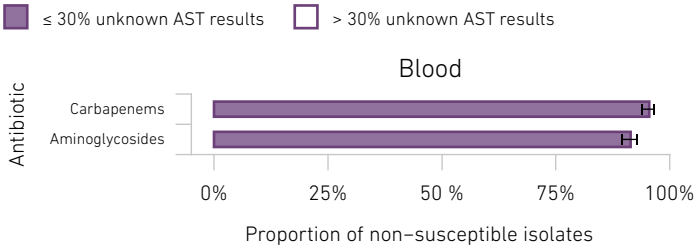
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	1095
				E. coli	-	-	1470
				K. pneumoniae	-	-	1363
				Salmonella spp.	-	-	-
				S. aureus	-	-	822
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

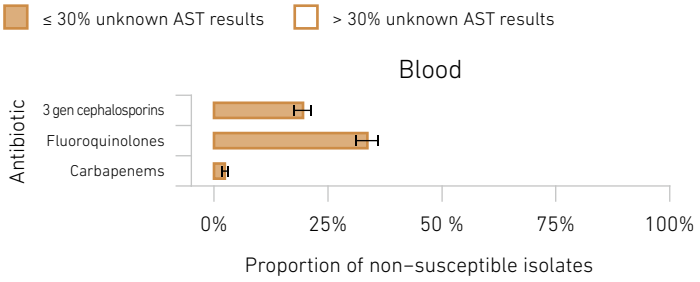
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

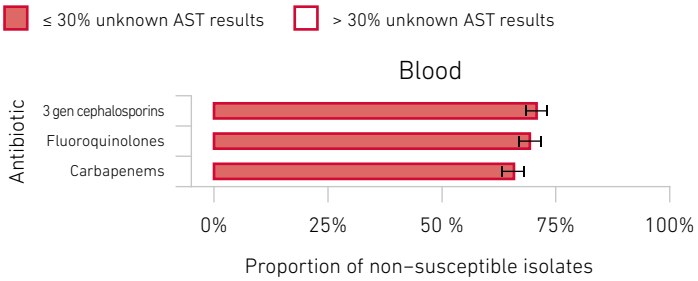


Escherichia coli

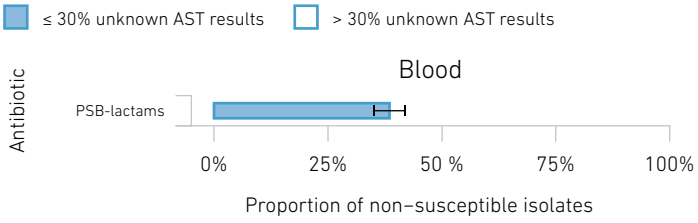


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Klebsiella pneumoniae



Staphylococcus aureus



India

Population 1.34 billion

The country is enrolled in GLASS since 2017.

Current status of the national AMR surveillance system

55 surveillance sites
55 hospitals

21 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
21 surveillance sites providing data to GLASS
(21 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood[1]	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine[1]	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Blood[2]	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine[2]	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

1. Data from the NCDC hospital surveillance network; 2. Laboratories from part of ICMR network; 3. One regional reference lab part of the NCDC hospital surveillance network

Data overview

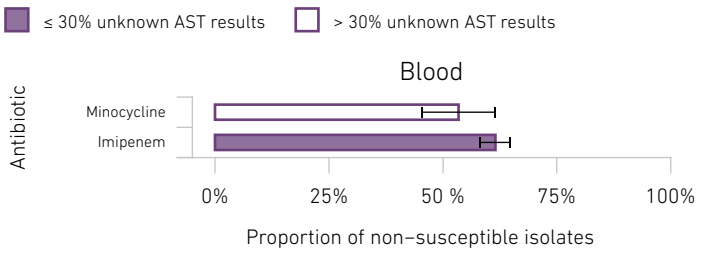
SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD[1]	-	-	-	*Acinetobacter* spp.	67	48	908
				E. coli	24	26	454
				K. pneumoniae	35	38	933
				Salmonella spp.	-	-	-
				S. aureus	155	62	2135
				S. pneumoniae	-	-	-
URINE[1]	5182	341	8523	*E. coli*	2947	182	4039
				K. pneumoniae	608	73	1665
BLOOD[2]	-	-	-	*Acinetobacter* spp.	131	167	38
				E. coli	625	292	101
				K. pneumoniae	314	352	127
				Salmonella spp.	-	-	-
				S. aureus	388	214	81
				S. pneumoniae	-	-	-
URINE[2]	-	-	-	*E. coli*	335	56	2
				K. pneumoniae	102	24	1
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL[3]	-	-	1794	*N. gonorrhoeae*	-	-	165

1. Data from the NCDC hospital surveillance network; 2. Laboratoires part of ICMR network; 3. One regional reference lab part of the NCDC hospital surveillance network

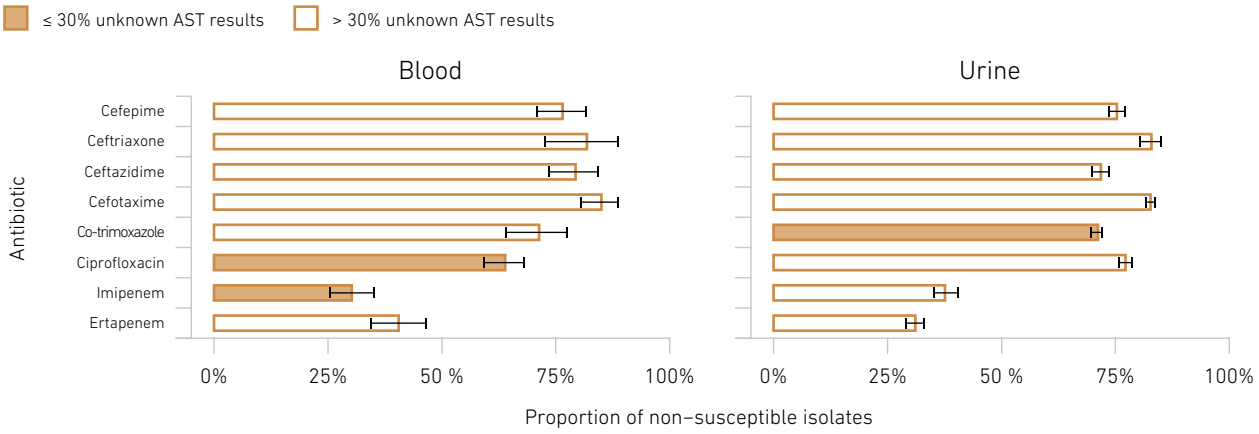
1 - NCDC hospital surveillance network
Pathogens non-susceptibility overview

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

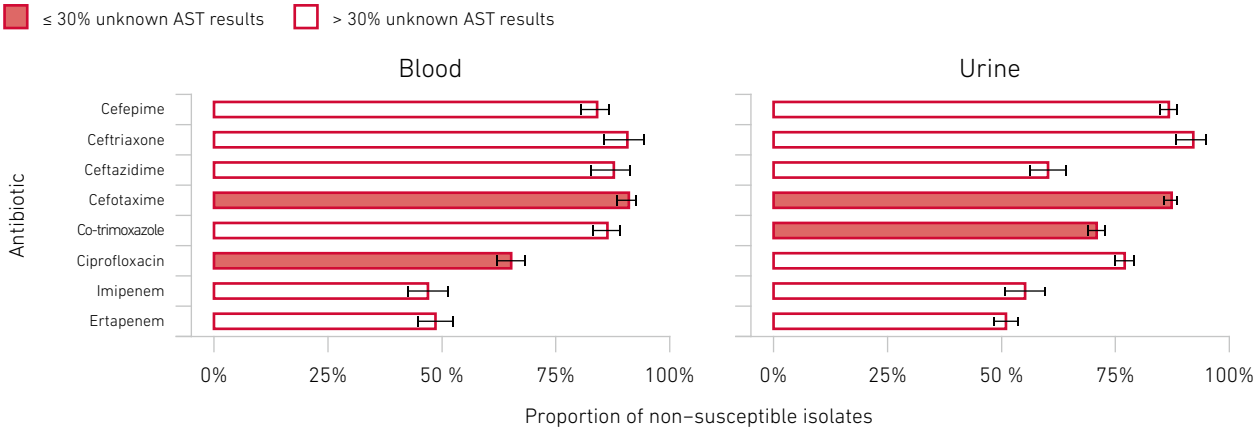
Acinetobacter **spp.**



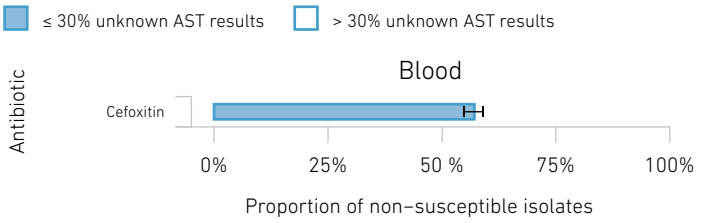
Escherichia coli



Klebsiella pneumoniae

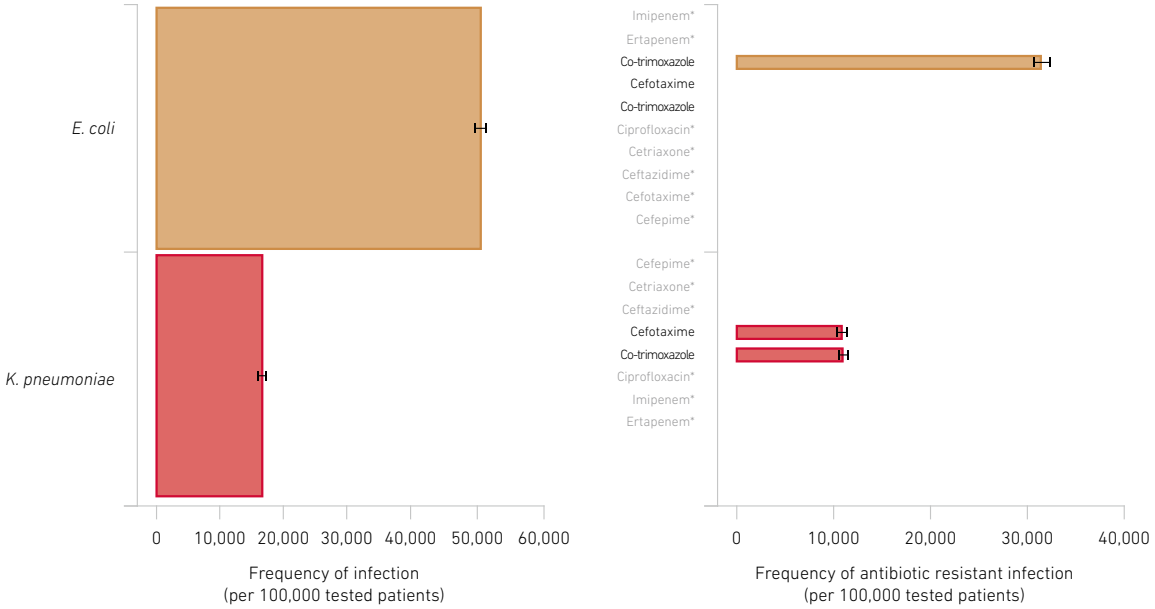


Staphylococcus aureus



Non-susceptible pathogen-antimicrobial combination frequency

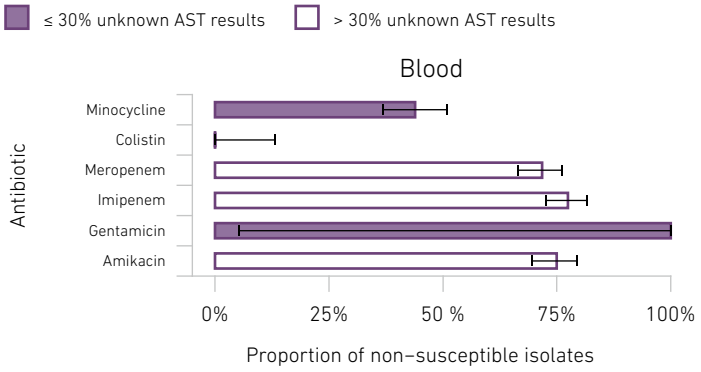
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection.



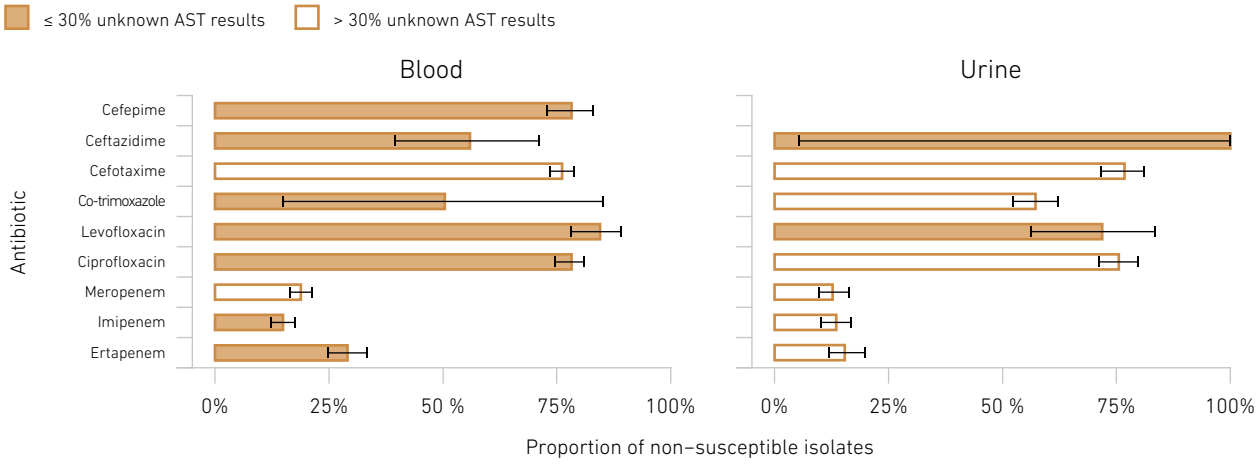
2. Laboratoires from part of ICMR network INC Pathogens non-susceptibility overview

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

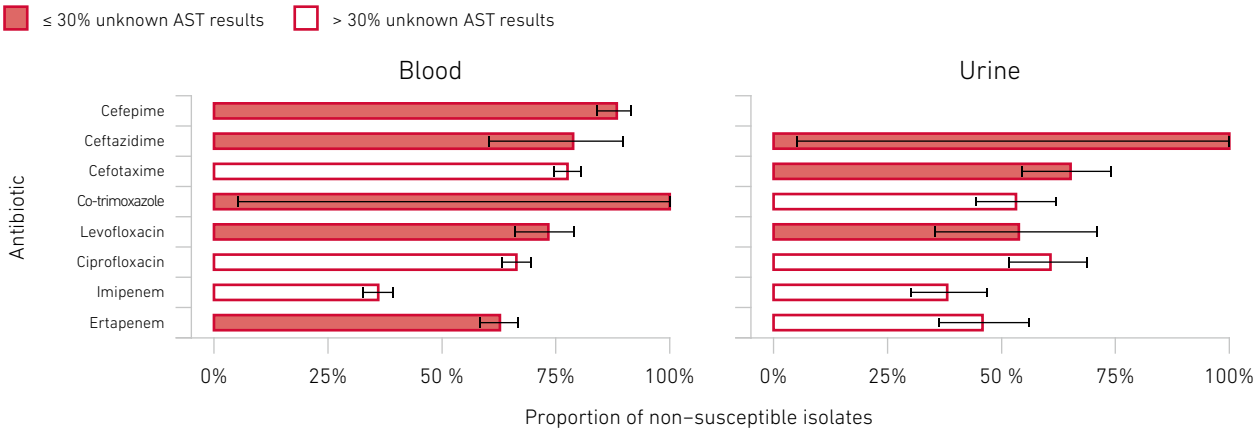
Acinetobacter **spp.**



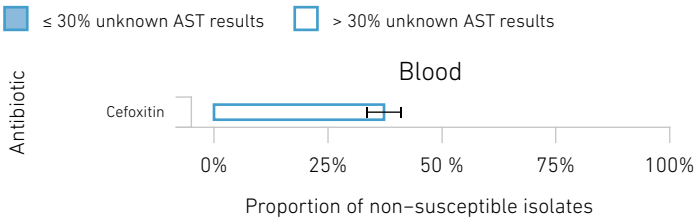
Escherichia coli



Klebsiella pneumoniae



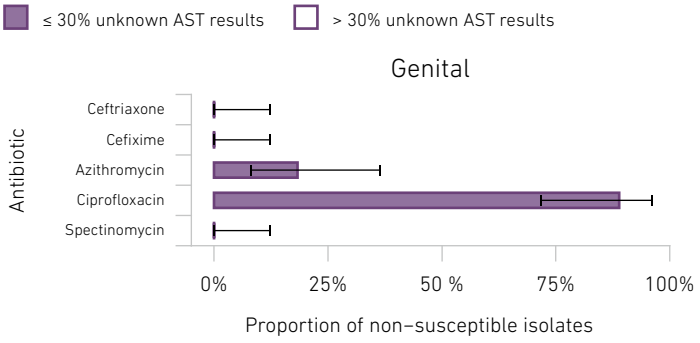
Staphylococcus aureus



3. Gonococcus network INC
Pathogens non-susceptibility overview

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Neisseria gonorrhoeae



Iran (Islamic Republic of)

Population 81.16 million

Iran has developed its National Action Plan on AMR with promotion and development of AMR surveillance included in the NAP.
Iran has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

12 surveillance sites
6 hospitals
6 outpatient facilities

6 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI,
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (not defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
6 surveillance sites providing data to GLASS
(6 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

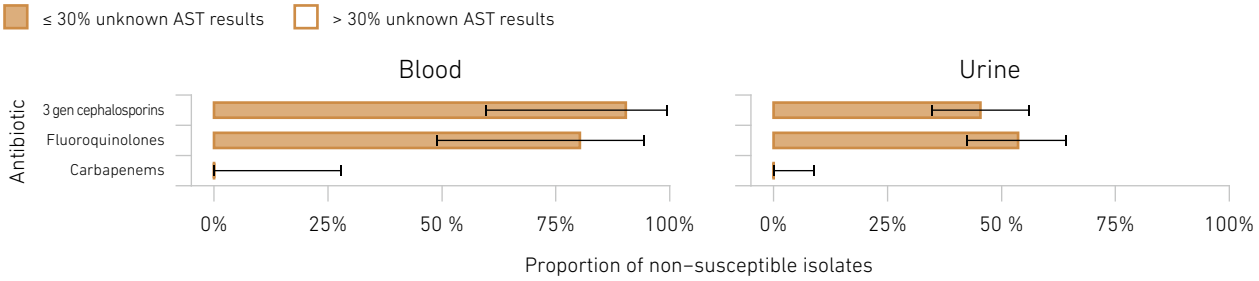
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	8
				E. coli	-	-	10
				K. pneumoniae	-	-	12
				Salmonella spp.	-	-	-
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	97
				K. pneumoniae	-	-	52
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

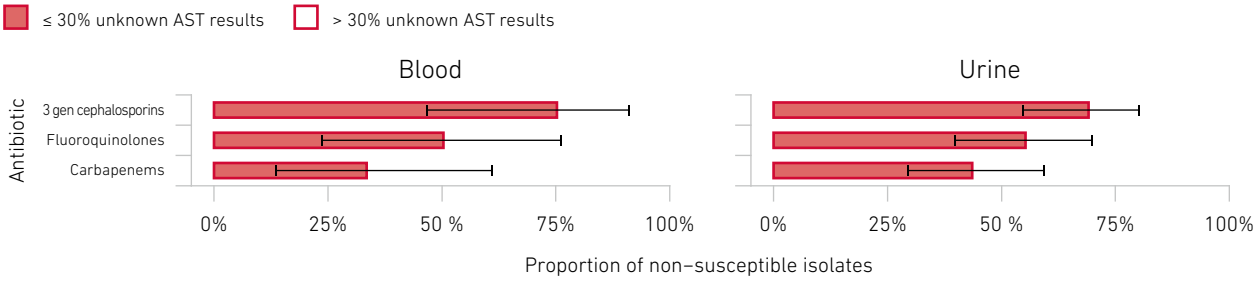
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli



Klebsiella pneumoniae



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Iraq

Population 38.27 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Participating surveillance sites not reported

Number of laboratories performing AST not reported

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL selected
AST standard CLSI,
EQA provided

National Reference Laboratory

National Coordinating Centre

NCC established
National AMR surveillance plan in place (not defined budget)
National Focal Point appointed

GLASS Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing data to GLASS
(1 laboratory)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	7	-
				E. coli	-	5	-
				K. pneumoniae	-	4	-
				Salmonella spp.	-	-	-
				S. aureus	-	3	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

Ireland

Population 4.76 million

The national AMR surveillance in Ireland is coordinated by the Health Protection Surveillance Centre (HPSC). Ireland has developed its National Action Plan on Antimicrobial Resistance for the period of 2017-2020. The country participates in the EARS-NET and has been enrolled in GLASS since July 2016.

Current status of the national AMR surveillance system

60 surveillance sites
60 hospitals

39 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (not defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
60 surveillance sites providing data to GLASS
(60 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

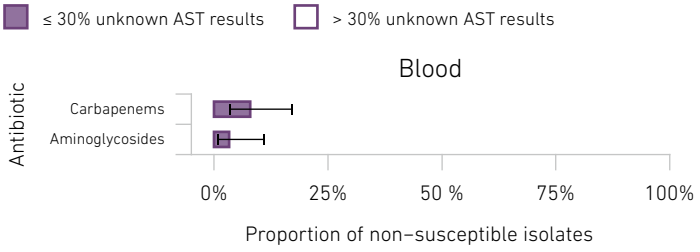
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	66
				E. coli	-	-	3124
				K. pneumoniae	-	-	479
				Salmonella spp.	-	-	-
				S. aureus	-	-	1140
				S. pneumoniae	-	-	412
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

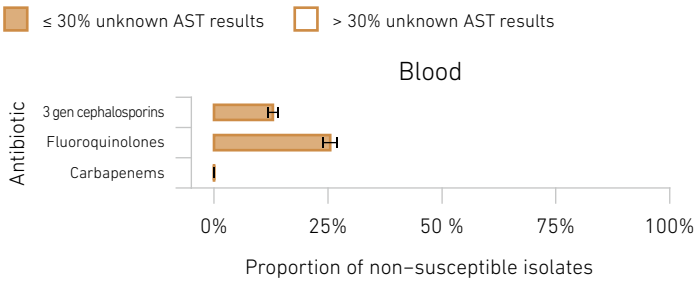
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

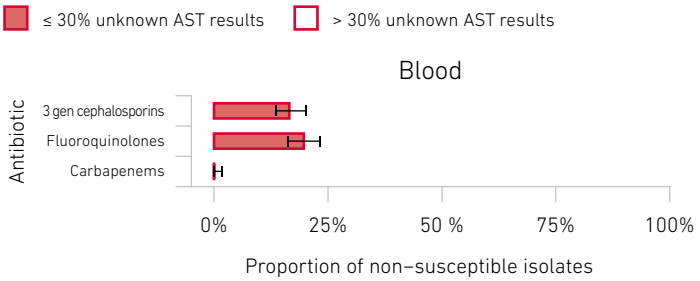


Escherichia coli

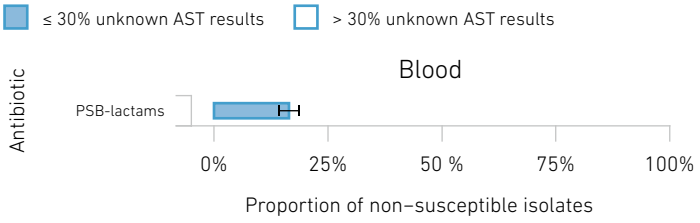


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

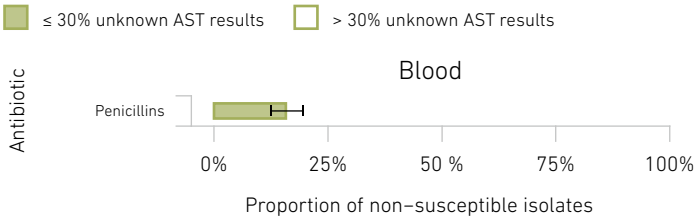
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Japan

Population 127.48 million

Japan Nosocomial Infections Surveillance (JANIS) is a national surveillance program launched in 2000. It collects surveillance data online from more than 1,000 hospitals across Japan and produces regular surveillance reports for participating hospitals and for the public. Japan implements the National Action Plan on Antimicrobial Resistance (2016-2020). The country has been enrolled in GLASS since November 2016.

Current status of the national AMR surveillance system

2000 surveillance sites
(2000 in-patients and out-patients facilites)

2000 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
2000 surveillance sites providing data to GLASS
(2000 in-patients and out-patients facilites)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

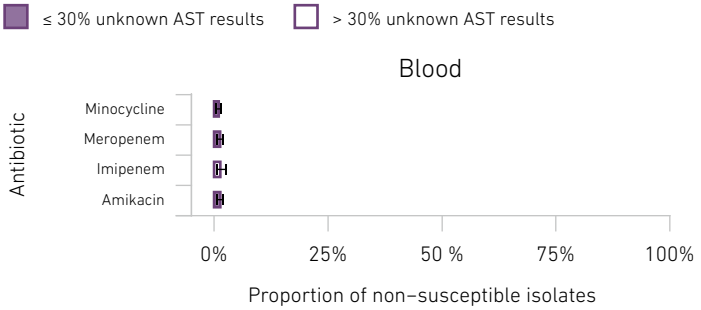
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	376805	511970	-	*Acinetobacter* spp.	212	1174	-
				E. coli	48010	46279	-
				K. pneumoniae	13843	17832	-
				Salmonella spp.	354	310	-
				S. aureus	9268	26027	-
				S. pneumoniae	3101	1735	-
URINE	646610	357060	-	*E. coli*	208744	168281	-
				K. pneumoniae	35441	39900	-
STOOL	-	-	-	*Salmonella* spp.	-	-	336
				Shigella spp.	82	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	982

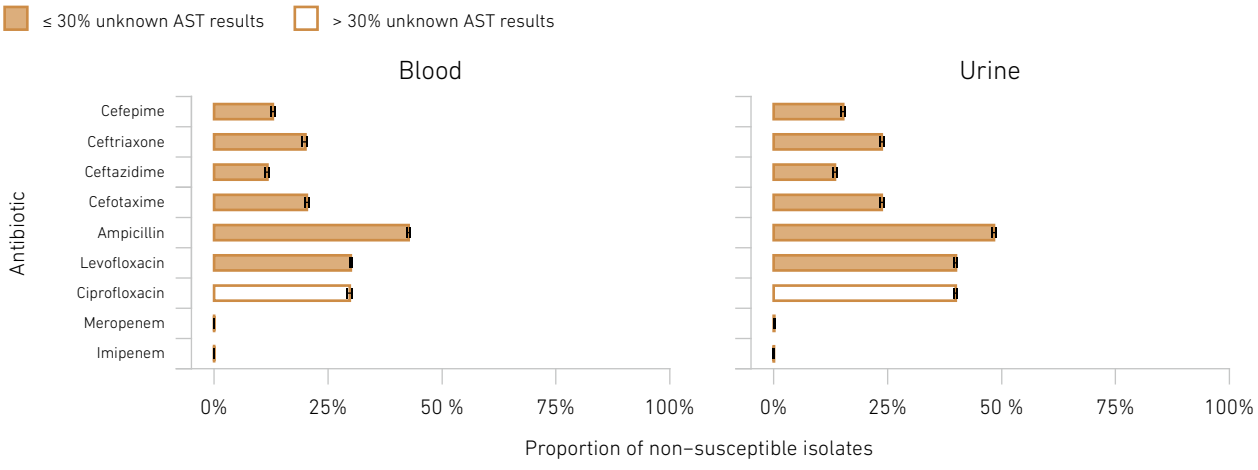
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

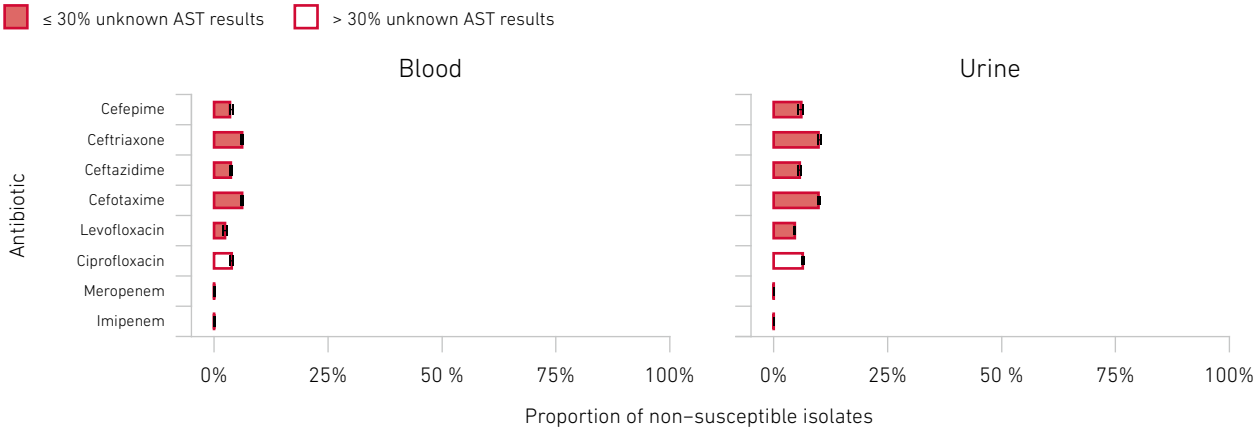


Escherichia coli

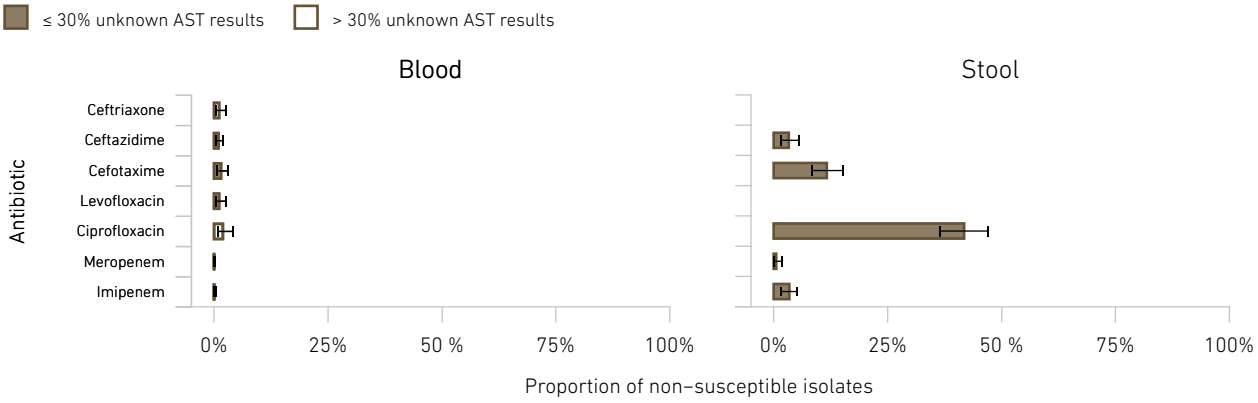


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

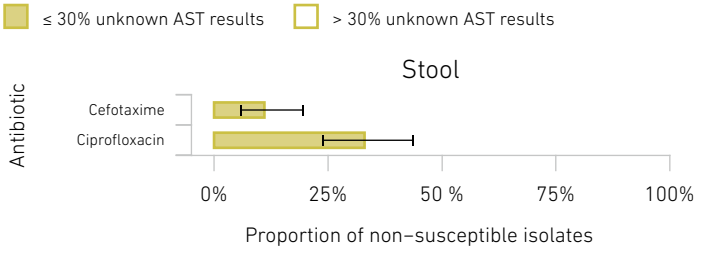
Klebsiella pneumoniae



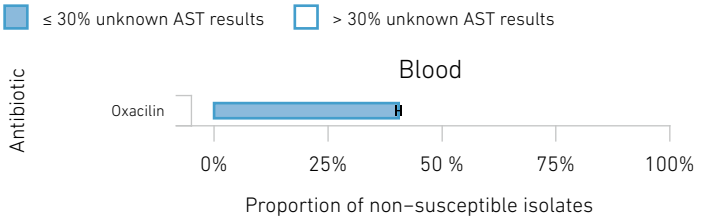
Salmonella **spp.**



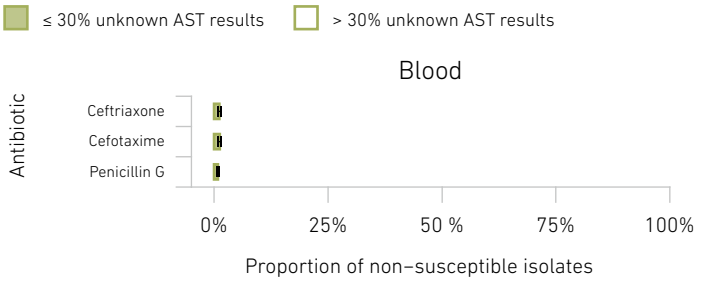
Shigella **spp.**



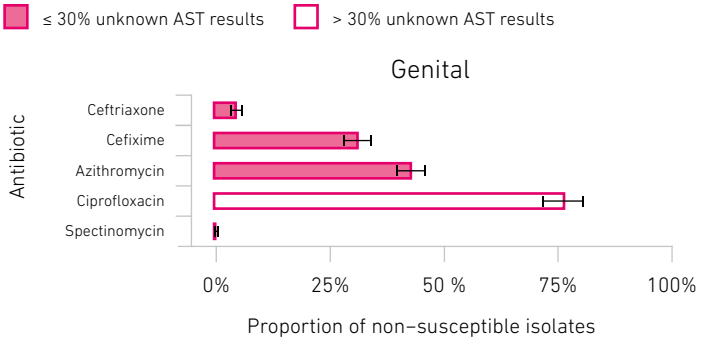
Staphylococcus aureus



Streptococcus pneumoniae



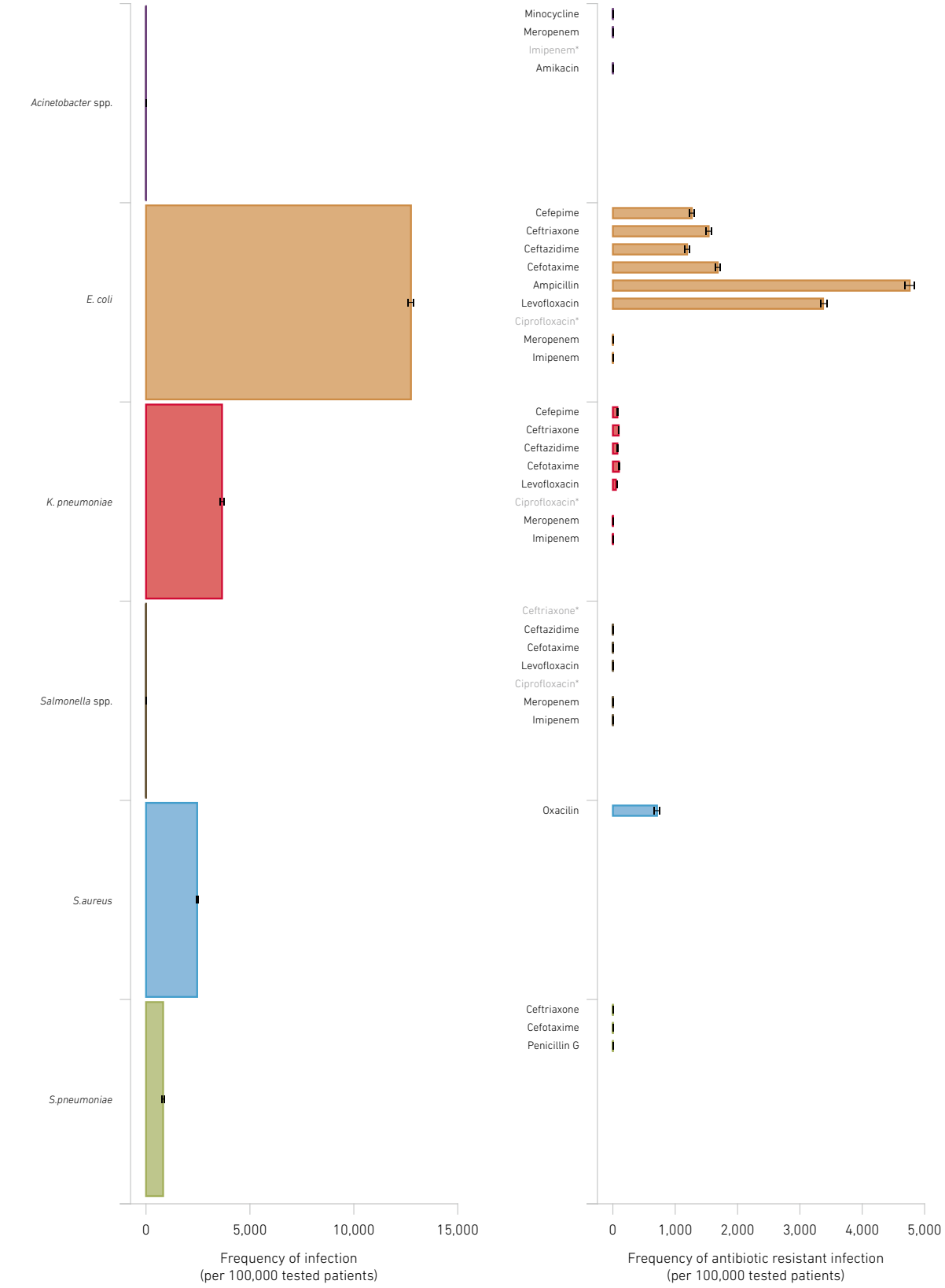
Neisseria gonorrhoeae



Non-susceptible pathogen-antimicrobial combination frequency

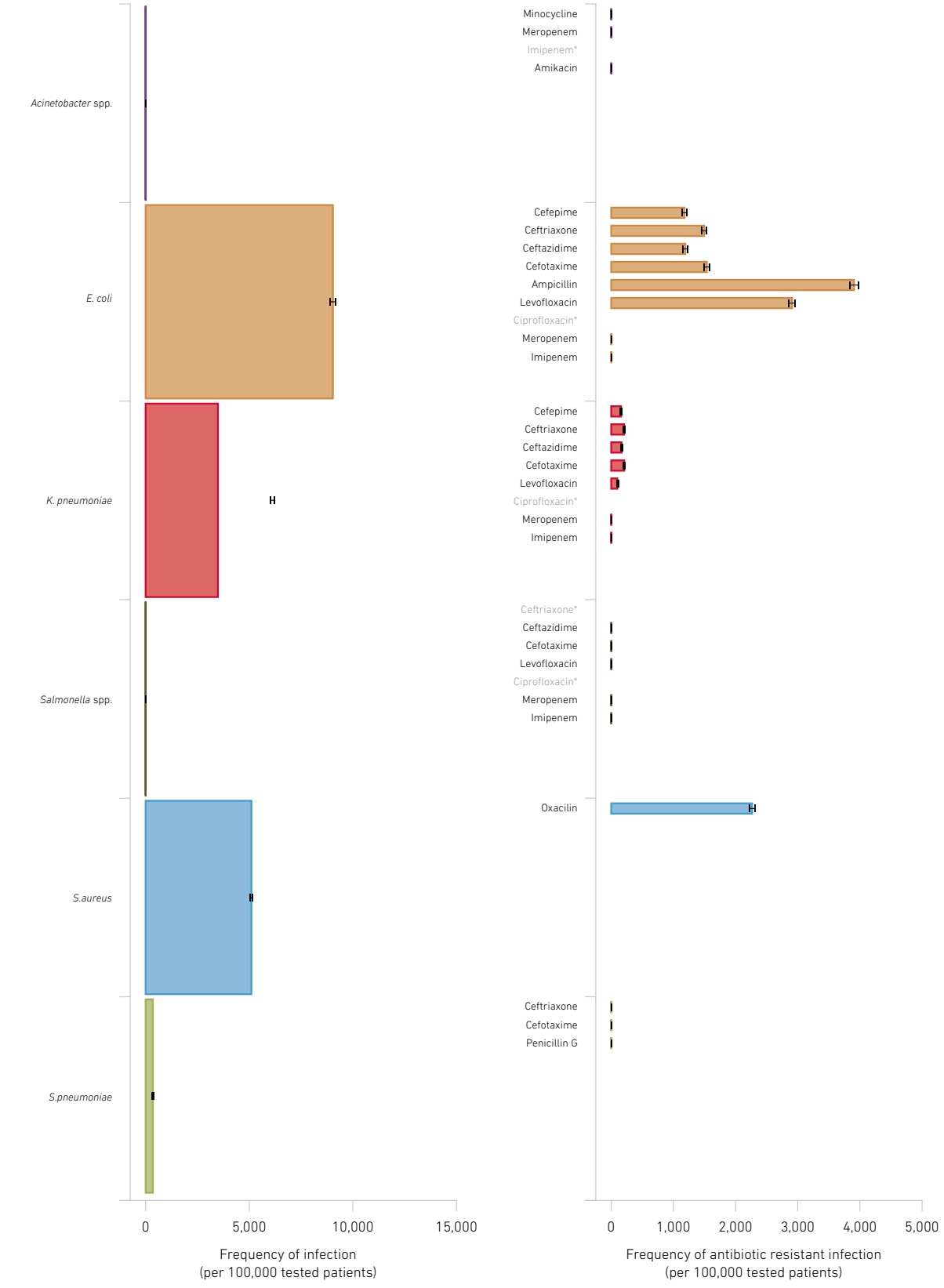
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Community origin (n tested = 376805)



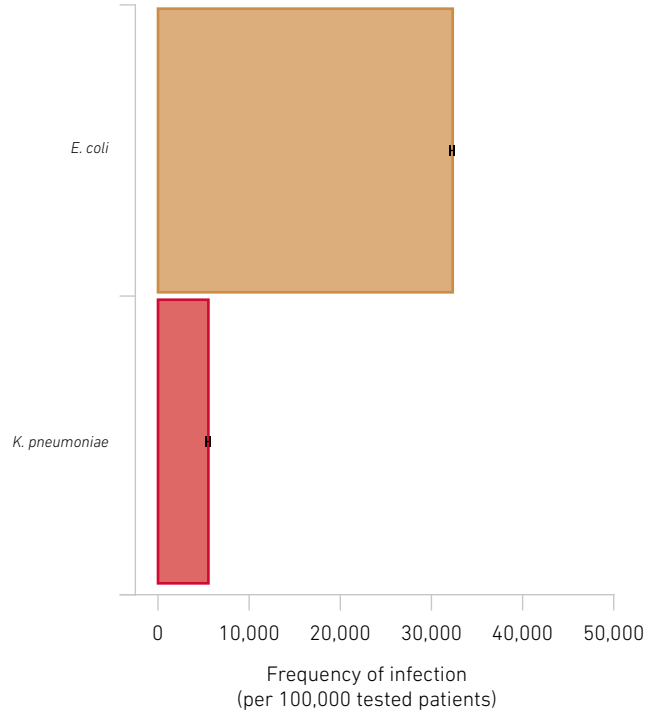
*Antibiotic with >30% unknown AST results: AMR rates not shown

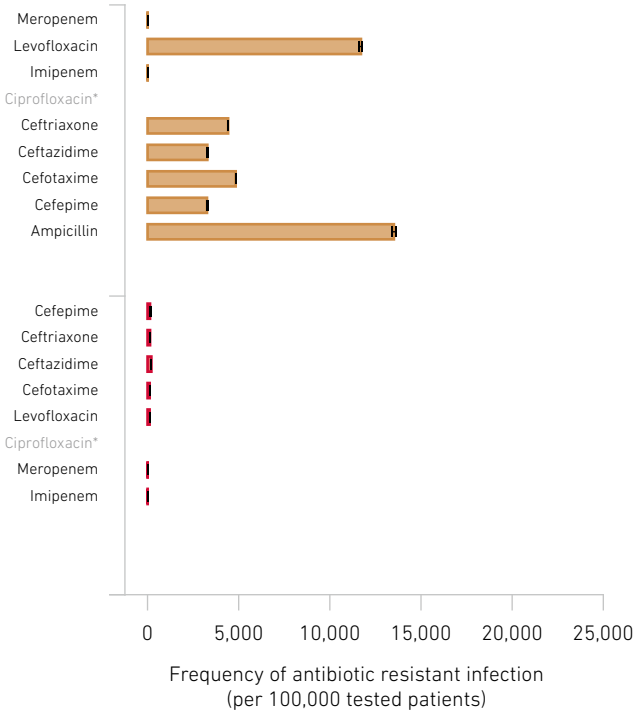
BLOOD- Hospital origin (n tested = 511970)



*Antibiotic with >30% unknown AST results: AMR rates not shown

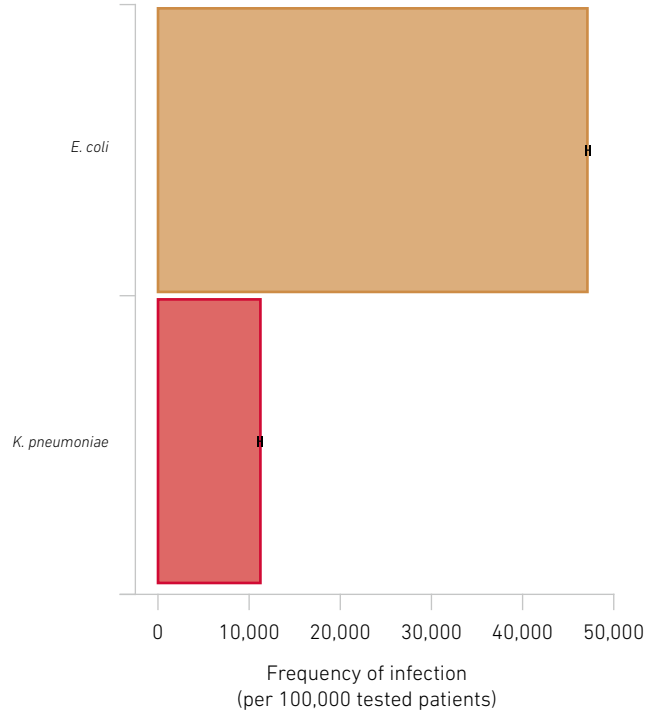
URINE- Community origin (n tested = 646610)

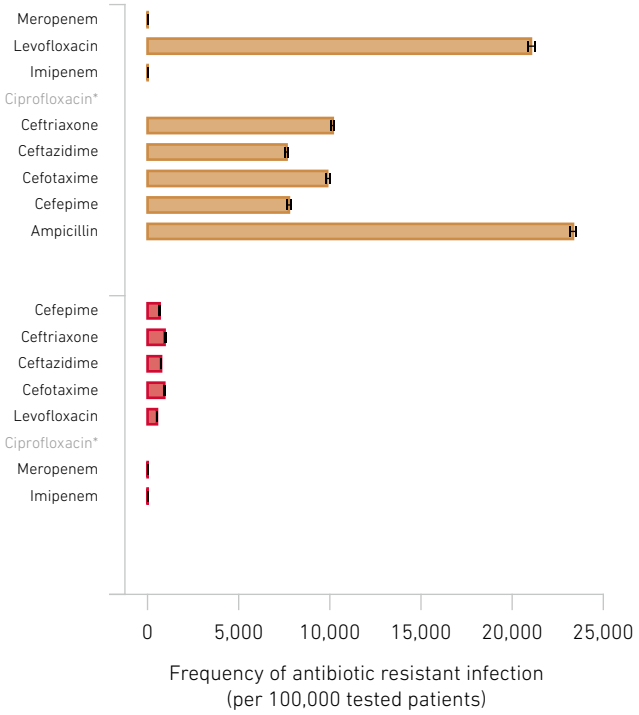




*Antibiotic with >30% unknown AST results: AMR rates not shown

URINE- Hospital origin (n tested = 357060)



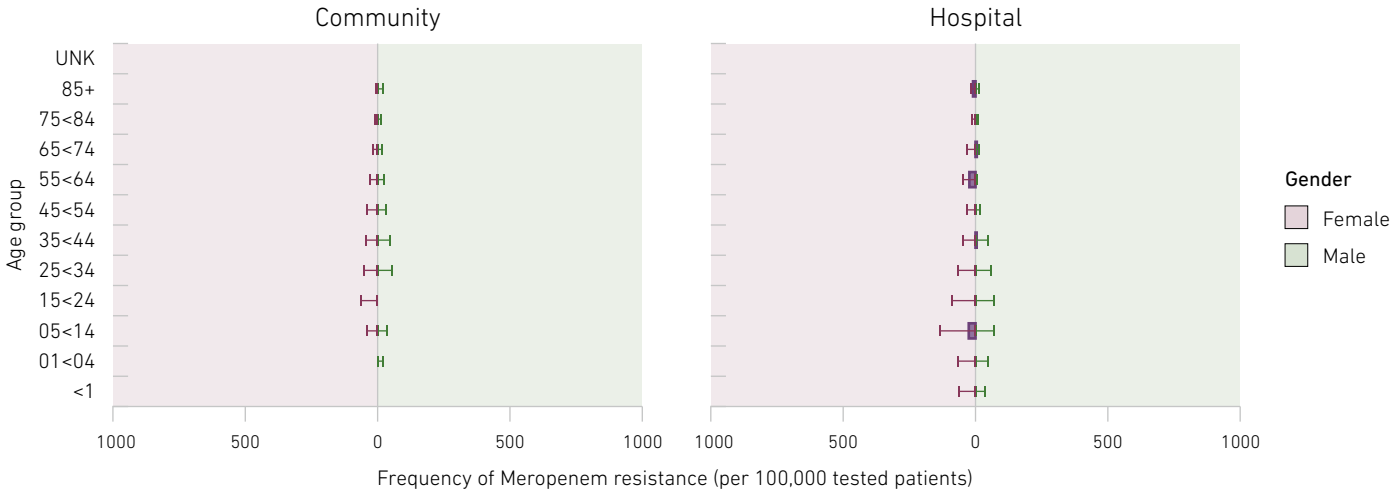


*Antibiotic with >30% unknown AST results: AMR rates not shown

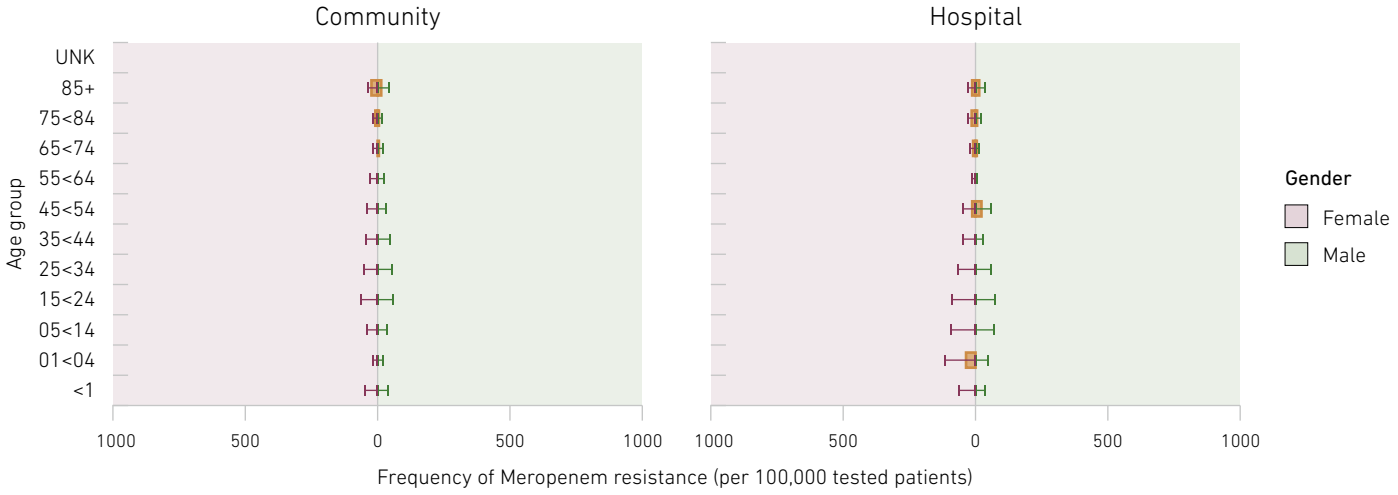
Non-susceptible pathogen-meropenem combination stratified frequency[2]

Frequency of infection caused by pathogens non-susceptible to meropenem per specimen and infection origin (right), stratified by age and gender.

BLOOD - *Acinetobacter* **spp.**

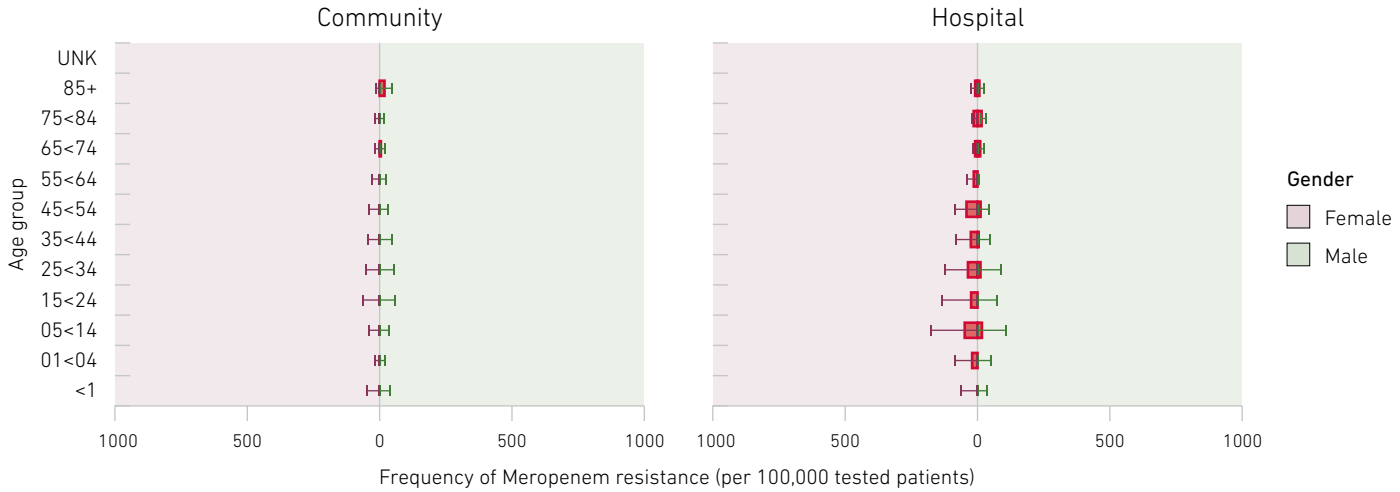


BLOOD - Escerichia Coli

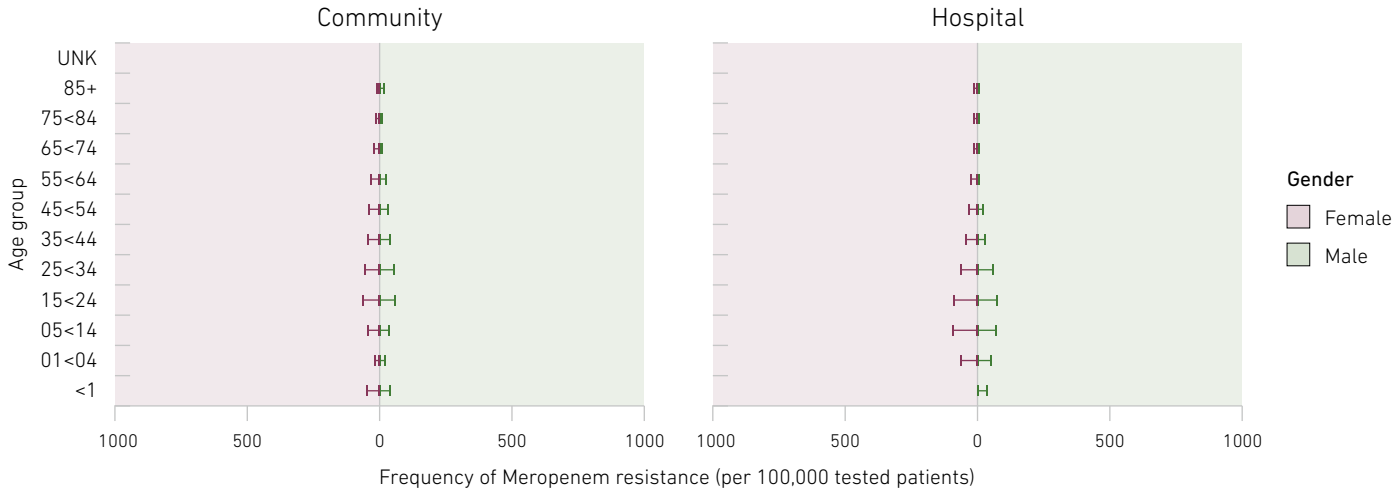


[2] Results for isolates with >30% unknown AST results are not shown. Grouping of carbapenem antibiotics was not possible due to results bias generation linked with data aggregation.

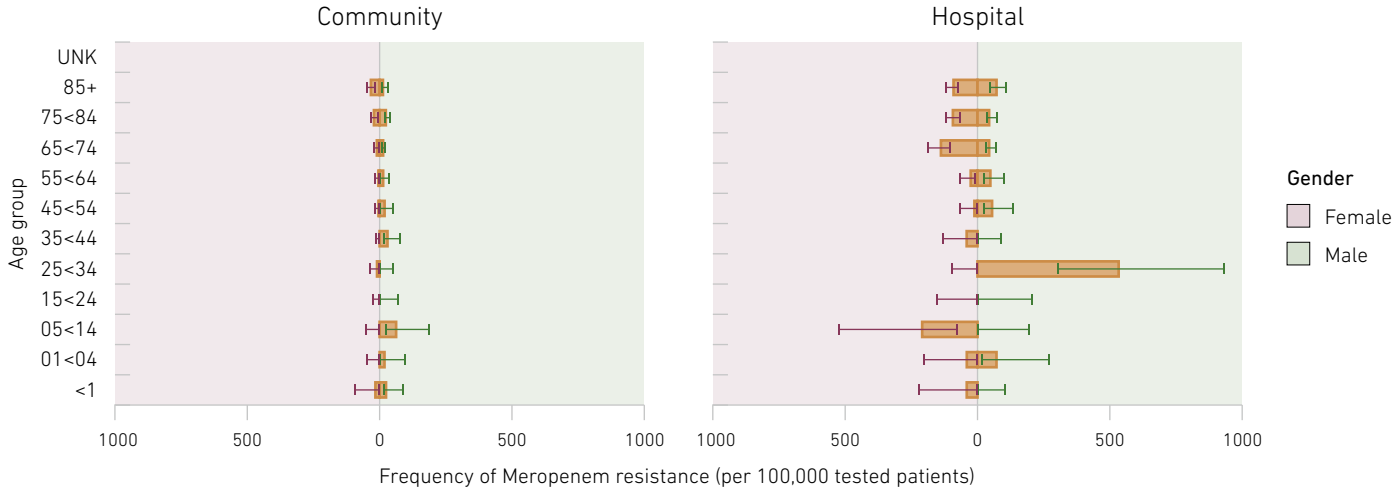
BLOOD - *Klebsiella pneumoniae*



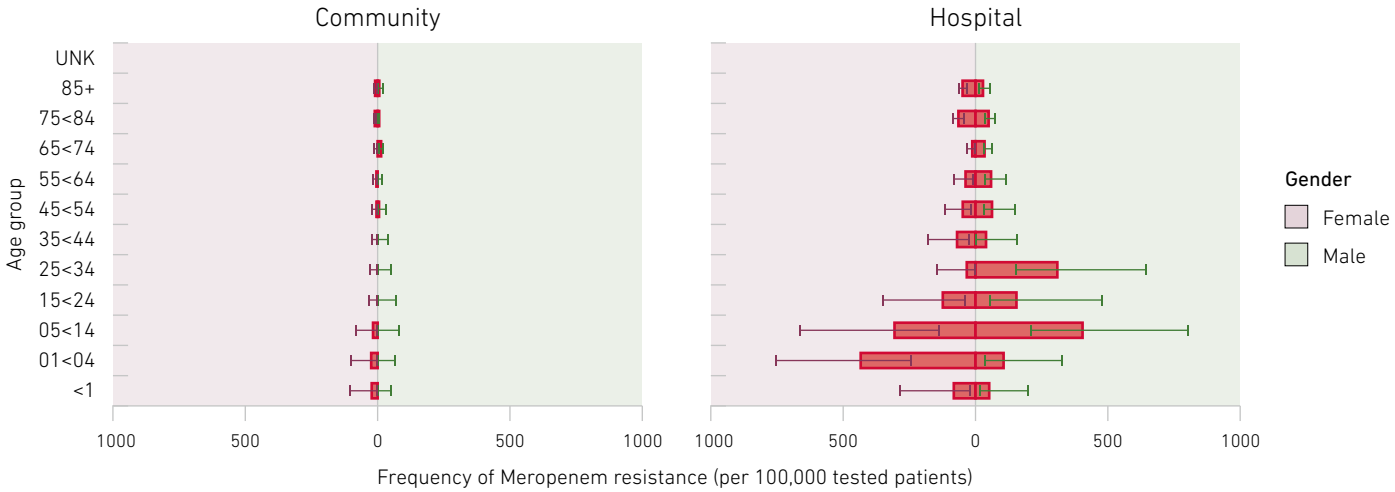
BLOOD - *Salmonella* **spp.**



URINE - *Escerichia coli*



URINE - *Klebsiella pneumoniae*



Jordan

Population 9.7 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

8 surveillance sites
8 hospitals

8 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
1 surveillance site providing data to GLASS
(1 hospital)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

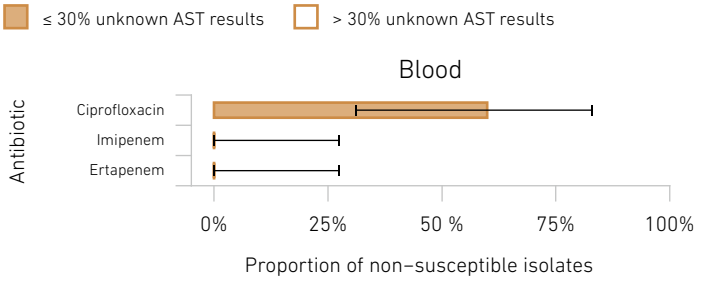
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	10
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	-
				S. aureus	-	-	8
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Kenya

Population 49.7 million

Kenya has developed the National Policy and Action Plan on AMR and is building its national AMR surveillance system. Kenya has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

4 surveillance sites
2 hospitals
2 outpatient facilities

2 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Lao People's Democratic Republic

Population 6.86 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Surveillance sites not established

0 laboratories performing AST

Surveillance Sites

Surveillance Sites

Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Latvia

Population 1.95 million

The country participates in the EARS-NET and has been enrolled in GLASS since December 2016.

Current status of the national AMR surveillance system

11 participating laboratories*

11 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS

in 2018 data call
2 surveillance sites providing data to GLASS
(1 hospital)
(1 outpatients facility)

*The identification of the total number of surveillance sites submitting specimens to participating laboratories wasnot possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

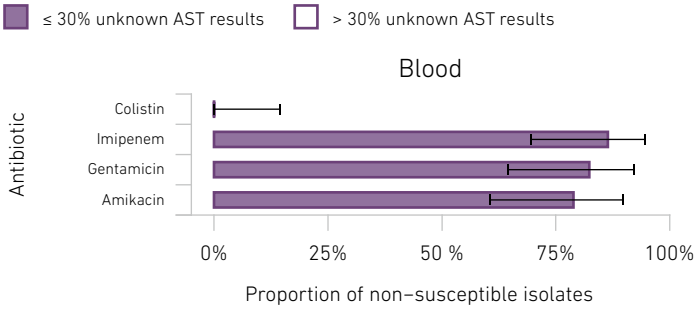
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	374	339	5	*Acinetobacter* spp.	5	24	-
				E. coli	83	28	-
				K. pneumoniae	34	25	1
				Salmonella spp.	-	-	-
				S. aureus	68	58	1
				S. pneumoniae	18	2	1
URINE	874	536	6	*E. coli*	574	254	6
				K. pneumoniae	77	78	-
STOOL	1	11	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	73	2	1	*N. gonorrhoeae*	-	-	-

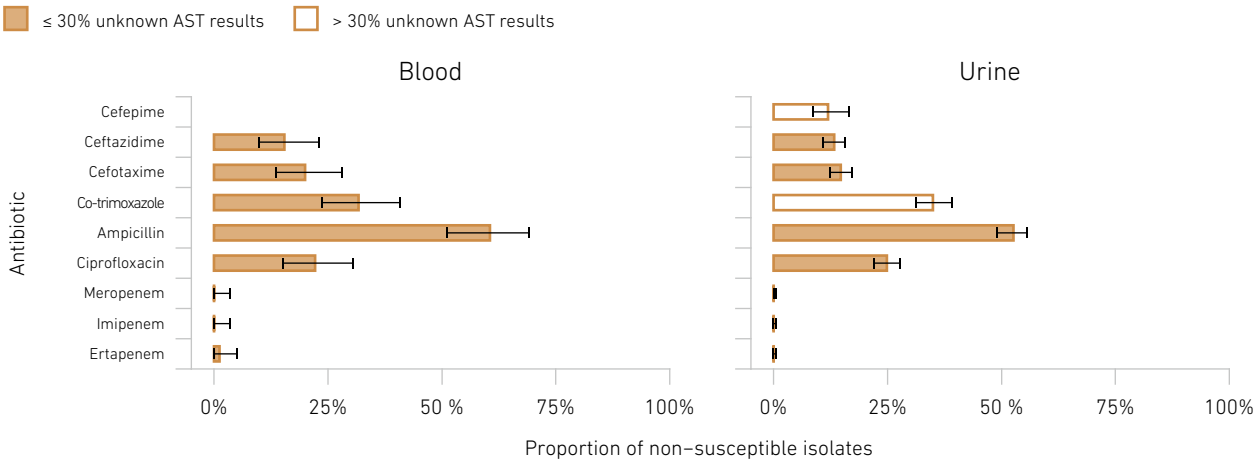
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

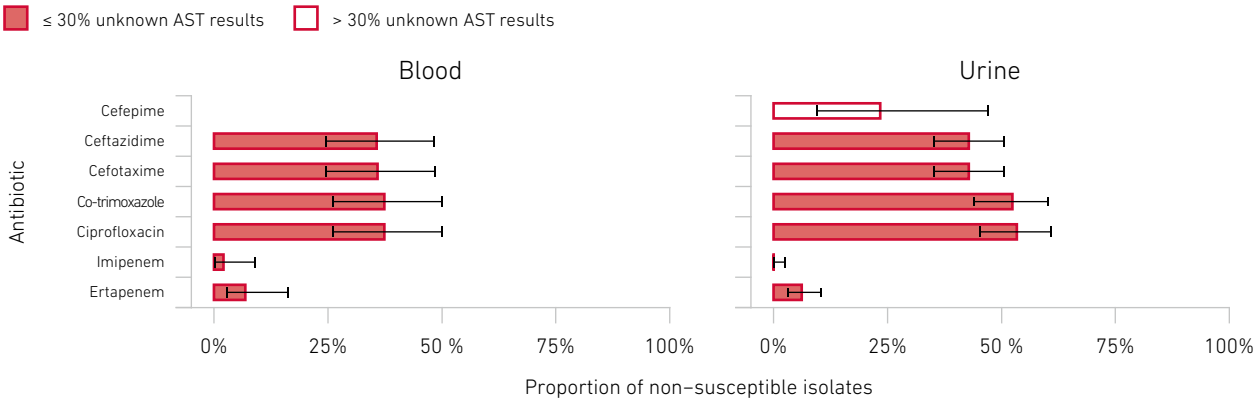


Escherichia coli

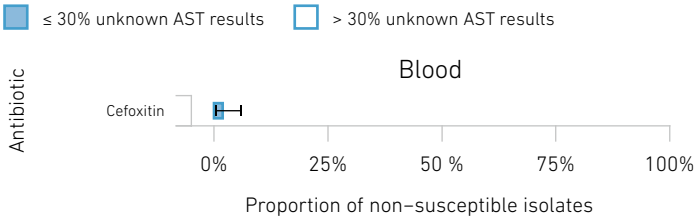


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

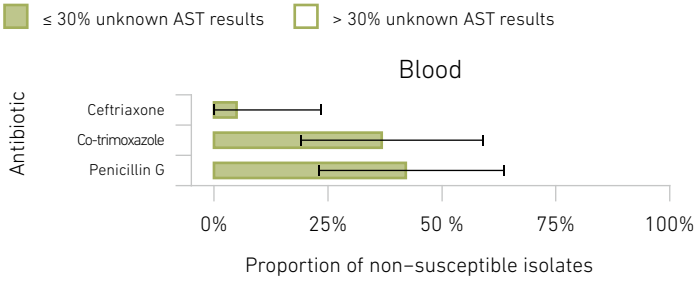
Klebsiella pneumoniae



Staphylococcus aureus



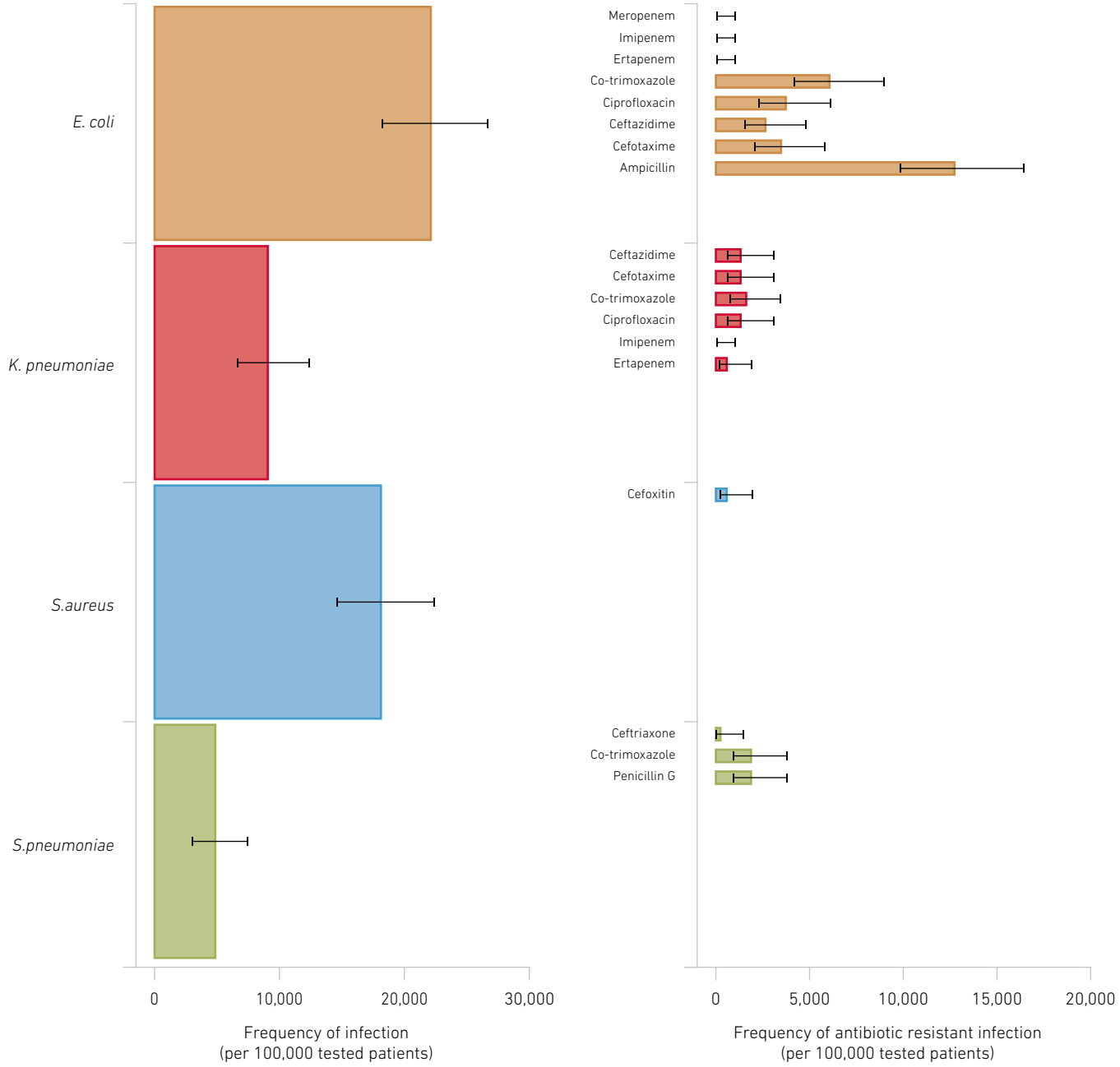
Streptococcus pneumoniae



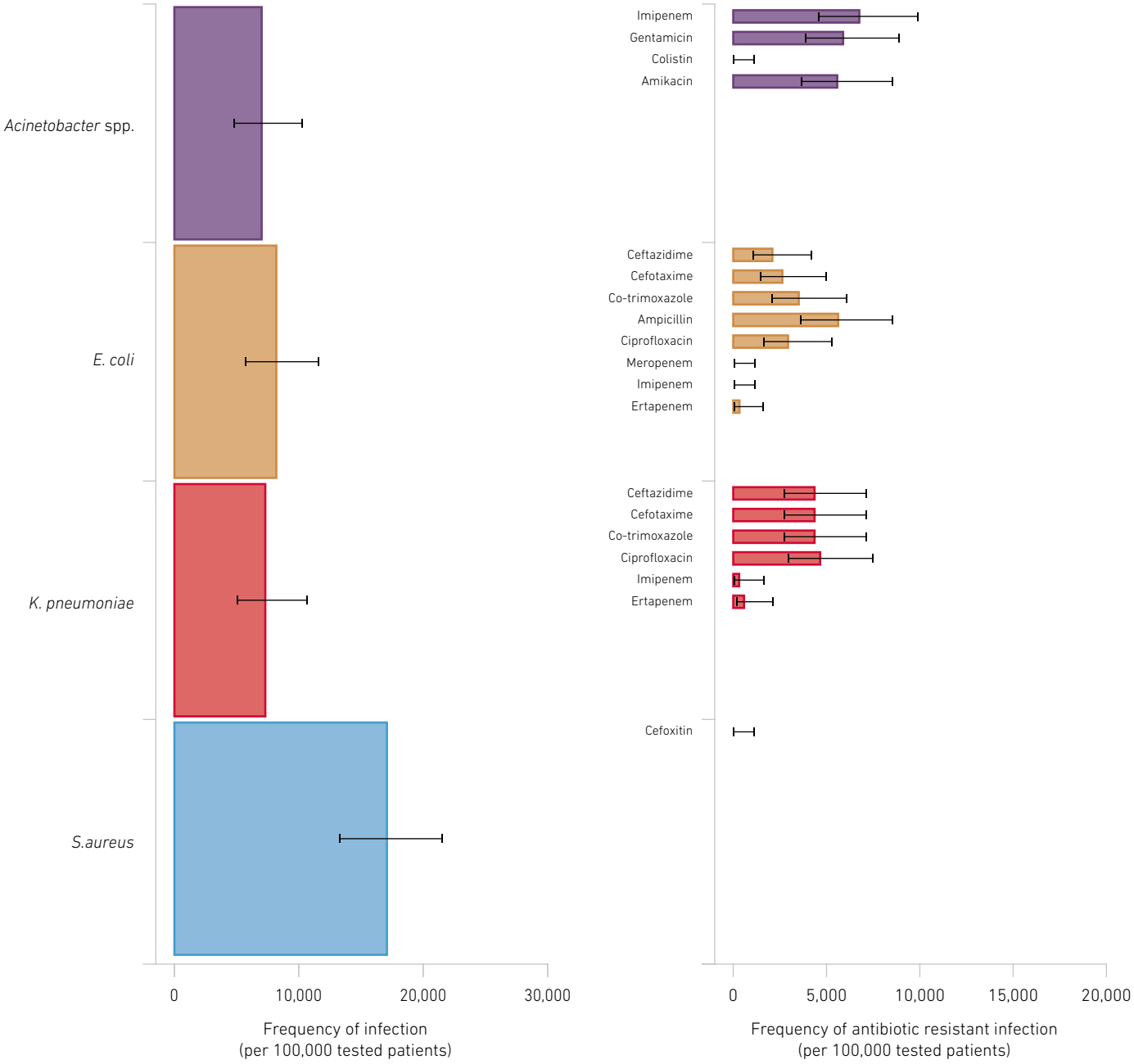
Non-susceptible pathogen-antimicrobial combination frequency

Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

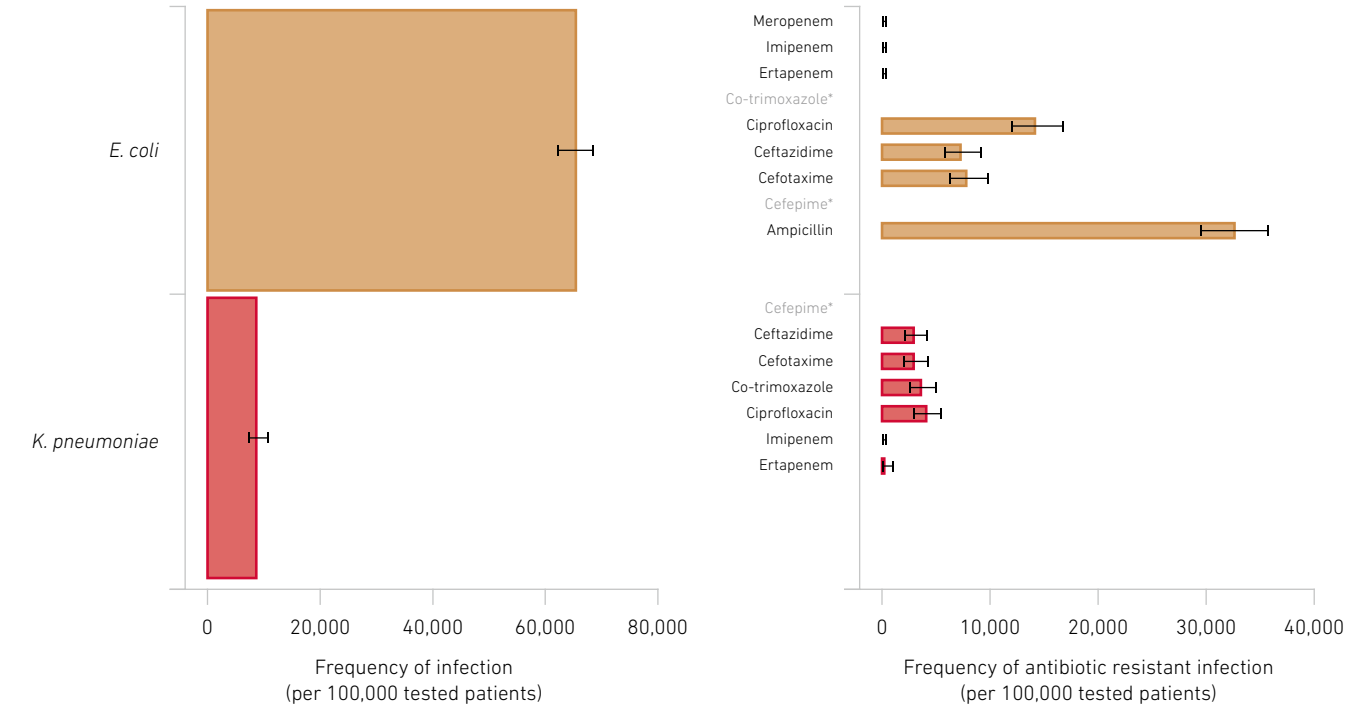
BLOOD- Community origin (n tested = 374)



BLOOD- Hospital origin (n tested = 339)

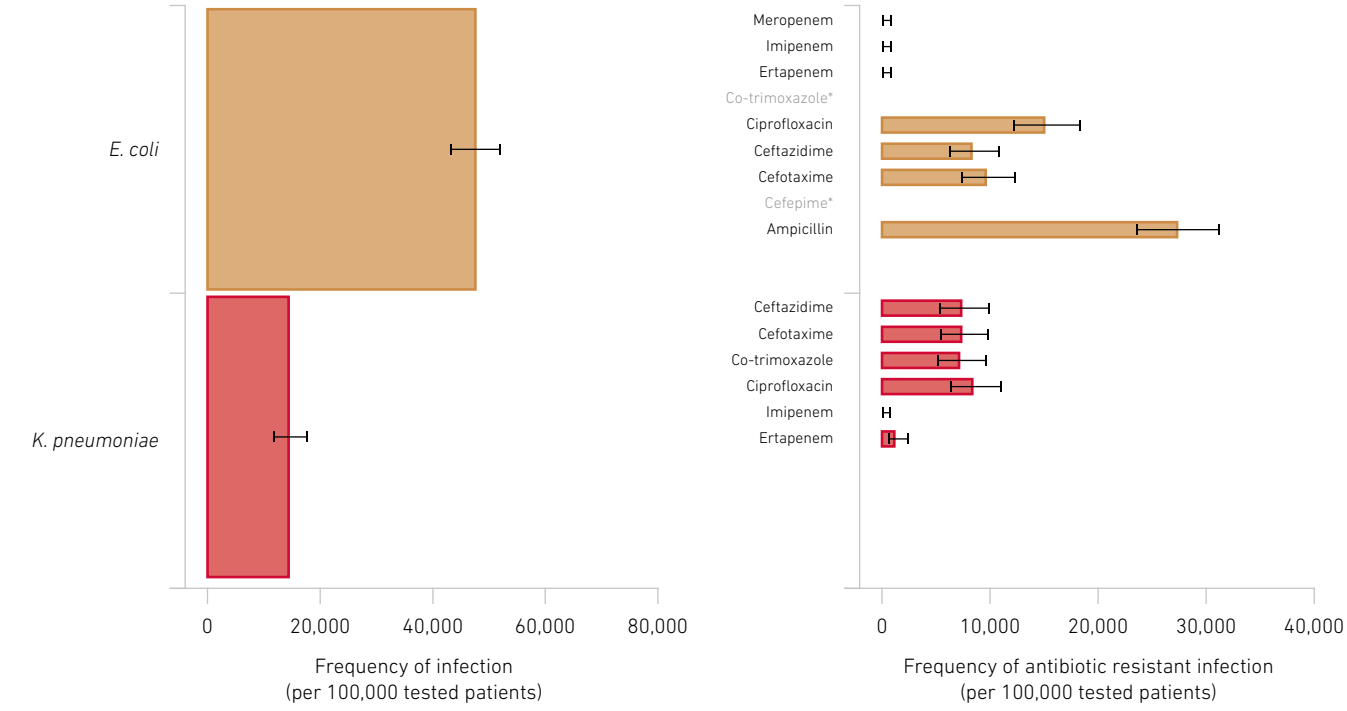


URINE- Community origin (n tested = 874)



*Antibiotic with >30% unknown AST results: AMR rates not shown

URINE- Hospital origin (n tested = 536)

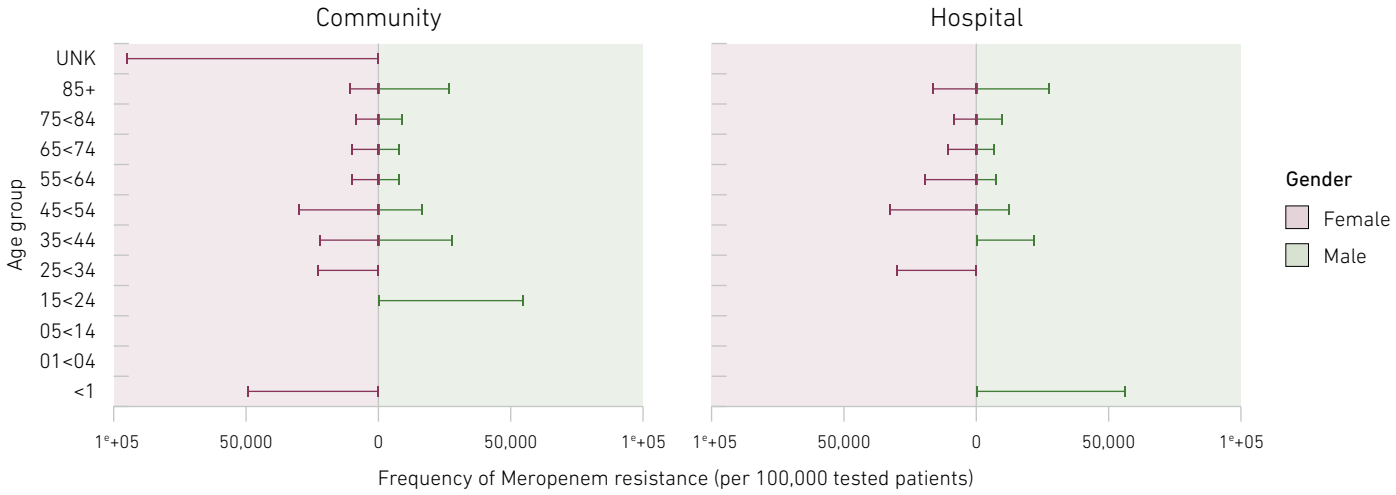


*Antibiotic with >30% unknown AST results: AMR rates not shown

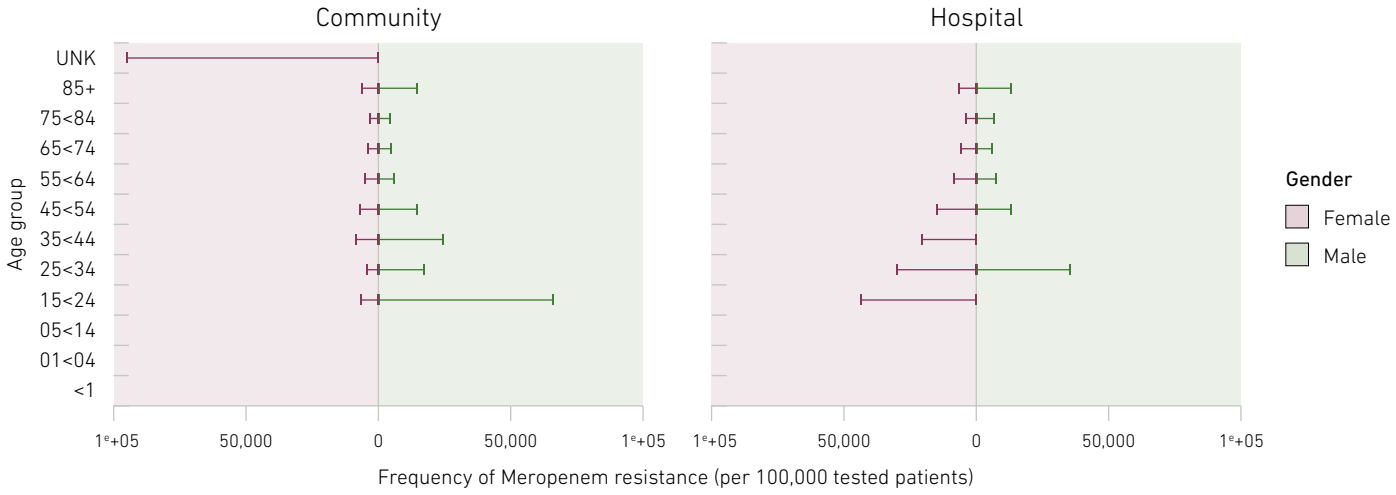
Non-susceptible pathogen-meropenem combination stratified frequency[2]

Frequency of infection caused by pathogens non-susceptible to meropenem per specimen and infection origin, stratified by age and gender.

BLOOD - *Escherichia coli*



URINE - *Escherichia coli*



[2] Results for isolates with >30% unknown AST results are not shown. Grouping of carbapenem antibiotics was not possible dueto results bias generation linked with data aggregation.

Lebanon

Population 6.08 million

Lebanon is developing a National Action Plan on AMR. The country has been enrolled in GLASS since April 2017.

Current status of the national AMR surveillance system

4 surveillance sites
4 hospitals

4 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
4 surveillance sites providing data to GLASS
(4 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

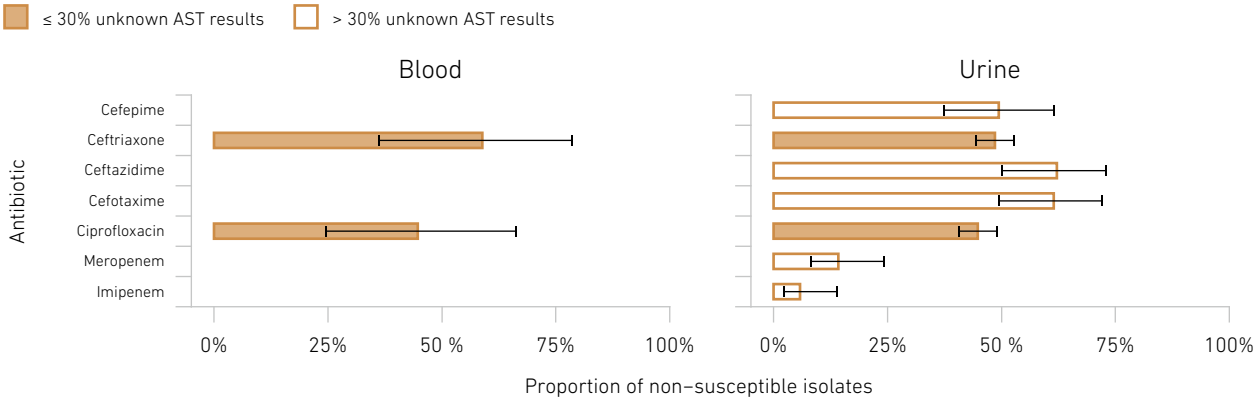
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	3220	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	20
				K. pneumoniae	-	-	7
				Salmonella spp.	-	-	2
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	6191	*E. coli*	-	-	680
				K. pneumoniae	-	-	60
STOOL	-	-	1874	*Salmonella* spp.	-	-	1
				Shigella spp.	-	-	-
GENITAL	-	-	111	*N. gonorrhoeae*	-	-	-

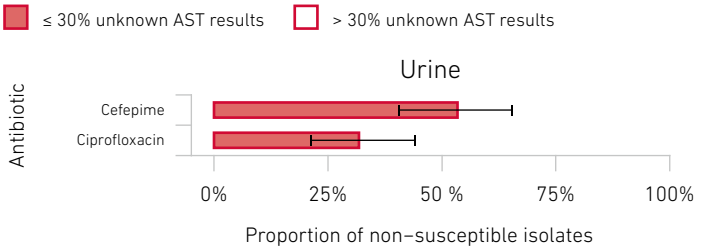
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli



Klebsiella pneumoniae

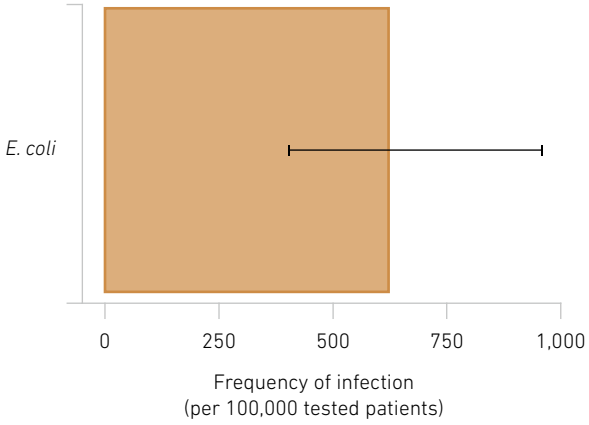


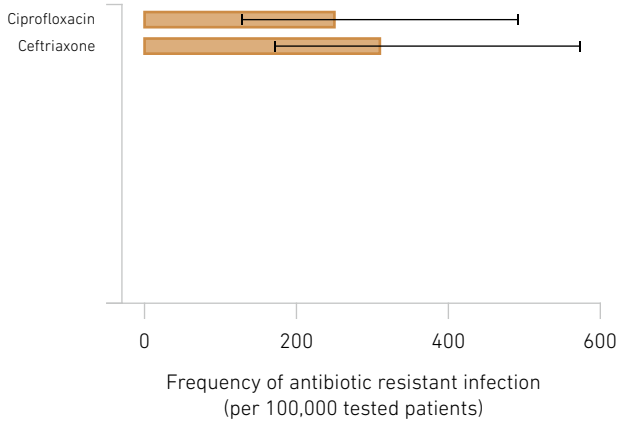
[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Non-susceptible pathogen-antimicrobial combination frequency

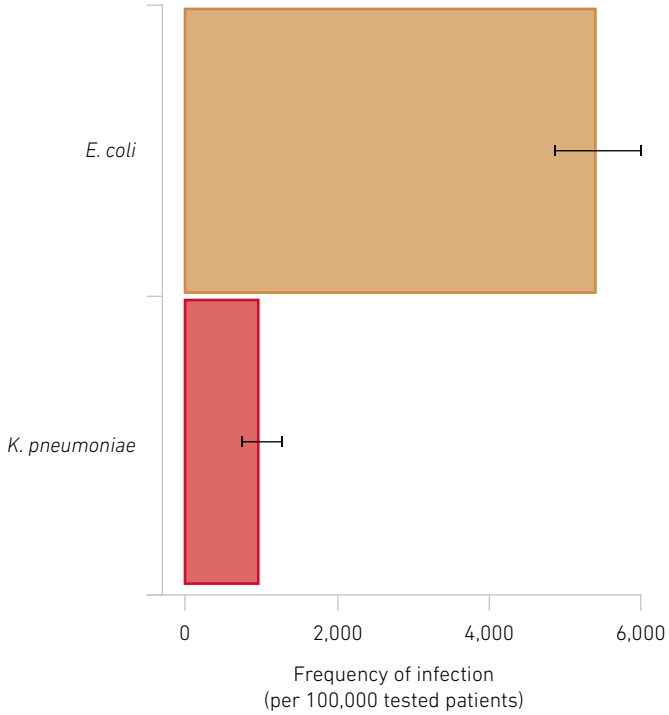
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by path

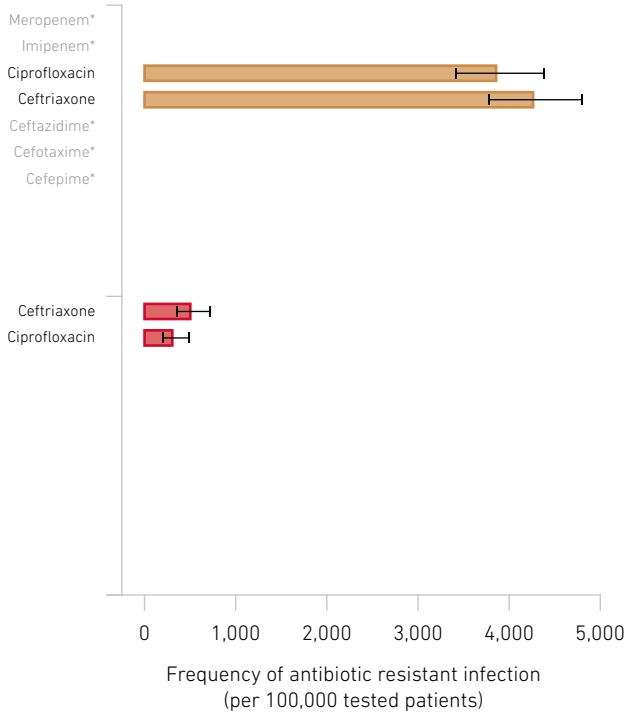
BLOOD- Unknown origin (n tested = 3220)





URINE- Unknown origin (n tested = 6191)





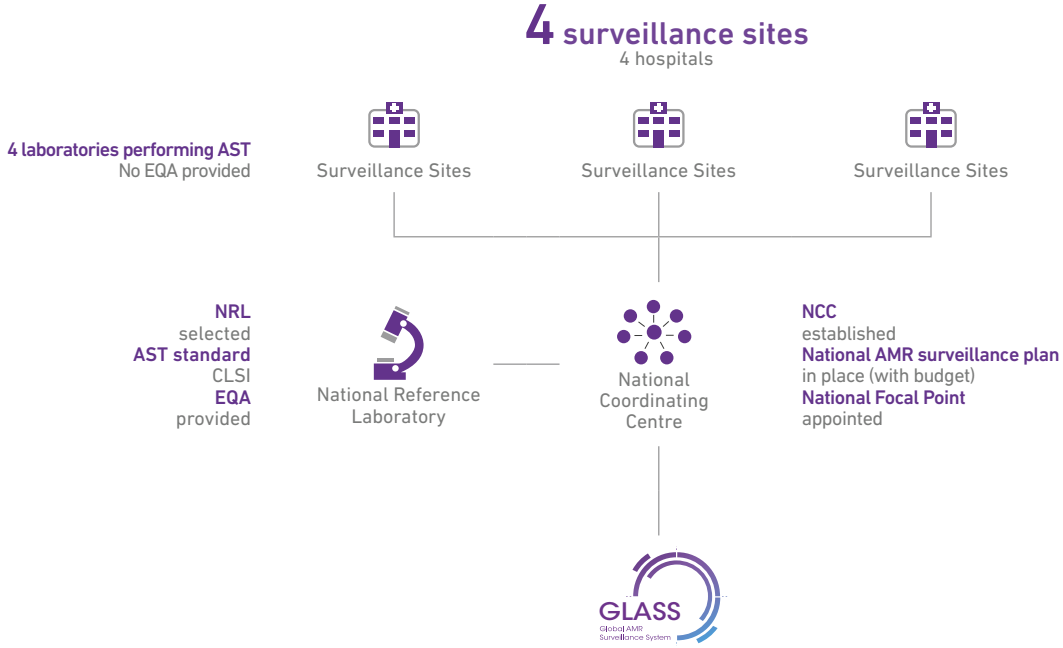
*Antibiotic with >30% unknown AST results: AMR rates not shown

Liberia

Population 4.73 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system



in 2018 data call

No AMR data reported to GLASS by the end of the data call

Libya

Population 6.37 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Participating surveillance sites not reported

Number of laboratories performing AST not reported

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
Not reported
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
not reported
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Lithuania

Population 2.89 million

The country is enrolled in GLASS since 2017.

Current status of the national AMR surveillance system

73 surveillance sites
43 hospitals
30 outpatient facilities

18 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointment in progress

GLASS
Global AMR Surveillance System

in 2018 data call
73 surveillance sites providing data to GLASS
(43 hospitals)
(30 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

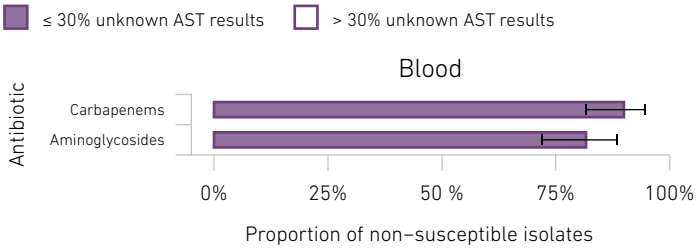
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	87
				E. coli	-	-	852
				K. pneumoniae	-	-	326
				Salmonella spp.	-	-	-
				S. aureus	-	-	514
				S. pneumoniae	-	-	109
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

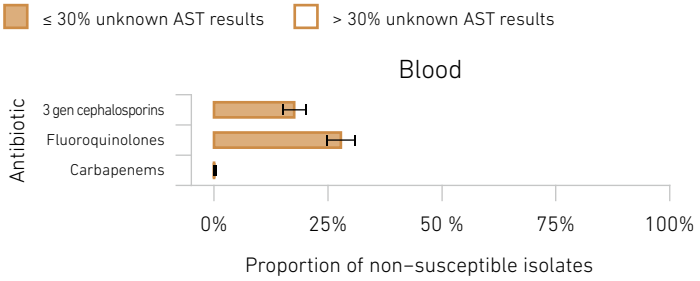
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

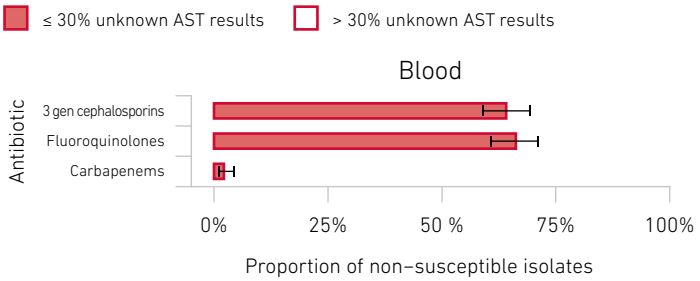


Escherichia coli

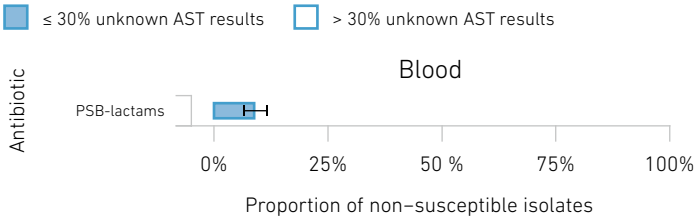


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

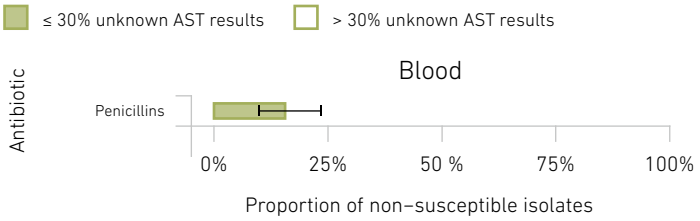
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Luxembourg

Population 0.56 million

The country participates in the EARS-NET and has been enrolled in GLASS since June 2016.

Current status of the national AMR surveillance system

8 surveillance sites
4 hospitals
4 outpatient facilities

8 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
not established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
4 surveillance sites providing data to GLASS
(4 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

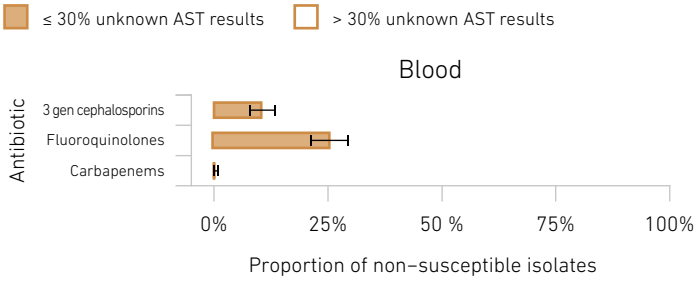
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	8
				E. coli	-	-	433
				K. pneumoniae	-	-	99
				S. aureus	-	-	200
				S. pneumoniae	-	-	45
				Salmonella spp.	-	-	-
URINE	-	-	-	*K. pneumoniae*	-	-	-
				E. coli	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

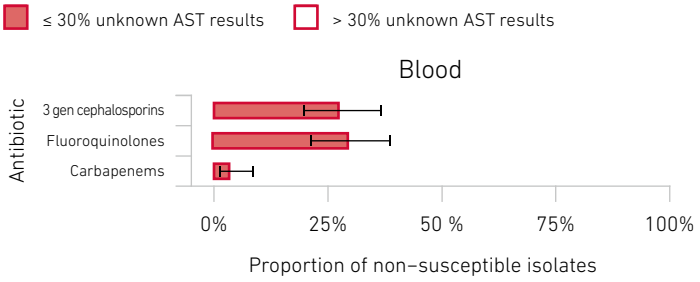
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli

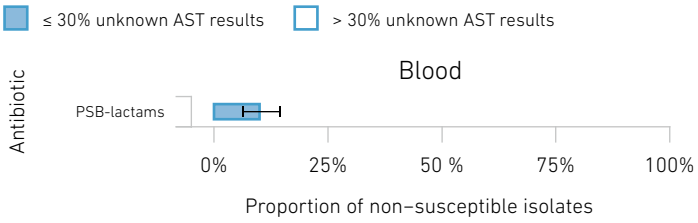


Klebsiella pneumoniae

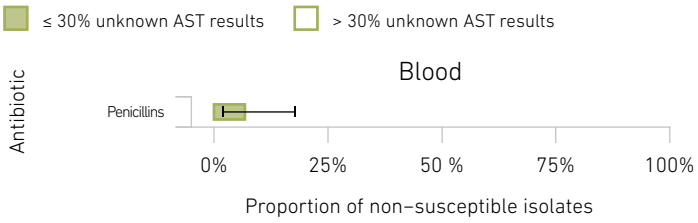


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Staphylococcus aureus



Streptococcus pneumoniae



Madagascar

Population 25.57 million

Madagascar is developing its National Action Plan on AMR and is building a national AMR surveillance system. The country has been enrolled in GLASS since July 2016.

Current status of the national AMR surveillance system

9 surveillance sites
8 hospitals
1 outpatient facility

8 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
not reported
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
1 surveillance site providing data to GLASS
(1 outpatient facility)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

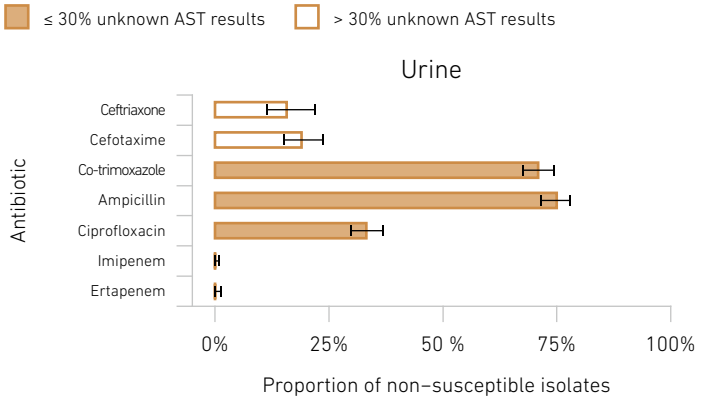
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	6
				E. coli	-	-	5
				K. pneumoniae	-	-	10
				Salmonella spp.	-	-	2
				S. aureus	-	-	10
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	694
				K. pneumoniae	-	-	113
STOOL	-	-	-	*Salmonella* spp.	-	-	1
				Shigella spp.	-	-	3
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	46

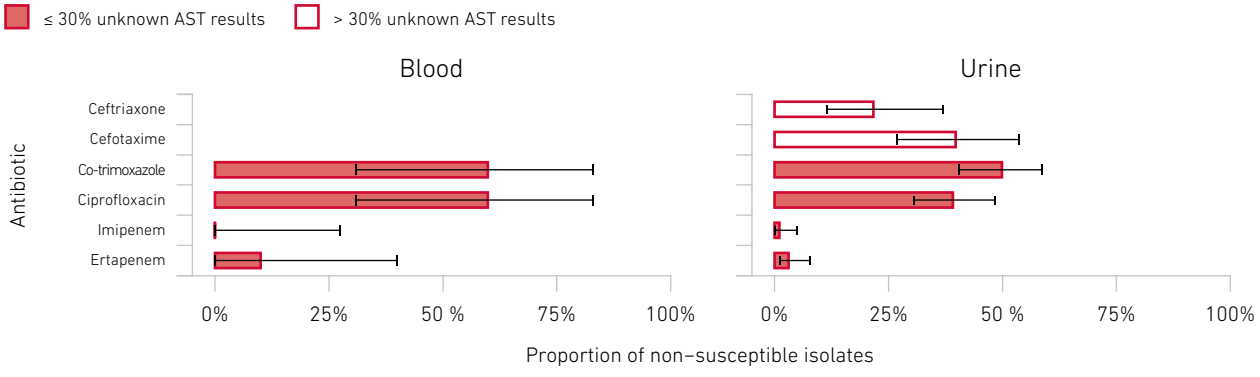
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli

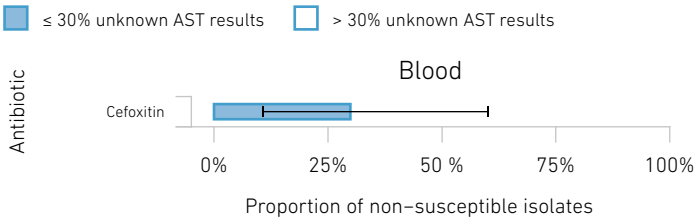


Klebsiella pneumoniae

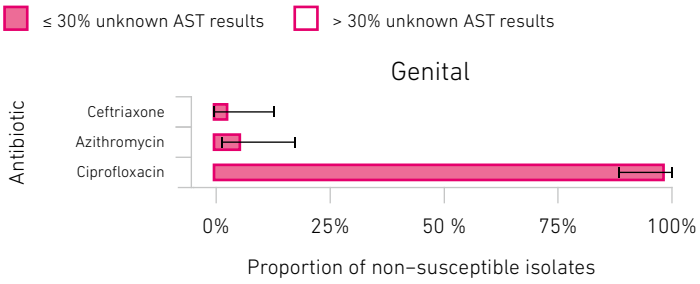


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Staphylococcus aureus



Neisseria gonorrhoeae



Malawi

Population 18.62 million

Malawi is developing its National Action Plan on AMR and is building a national AMR surveillance system. Malawi has been enrolled in GLASS since May 2017.

Current status of the national AMR surveillance system

4 surveillance sites
4 hospitals

2 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
not appointed

GLASS
Global AMR Surveillance System

in 2018 data call
2 surveillance sites providing data to GLASS
(2 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

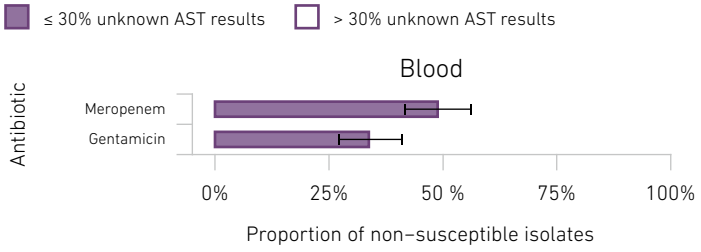
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	178
				E. coli	-	-	964
				K. pneumoniae	-	-	401
				Salmonella spp.	-	-	326
				S. aureus	-	-	509
				S. pneumoniae	-	-	448
URINE	-	-	-	*E. coli*	-	-	694
				K. pneumoniae	-	-	518
STOOL	-	-	-	*Salmonella* spp.	-	-	259
				Shigella spp.	-	-	169
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	938

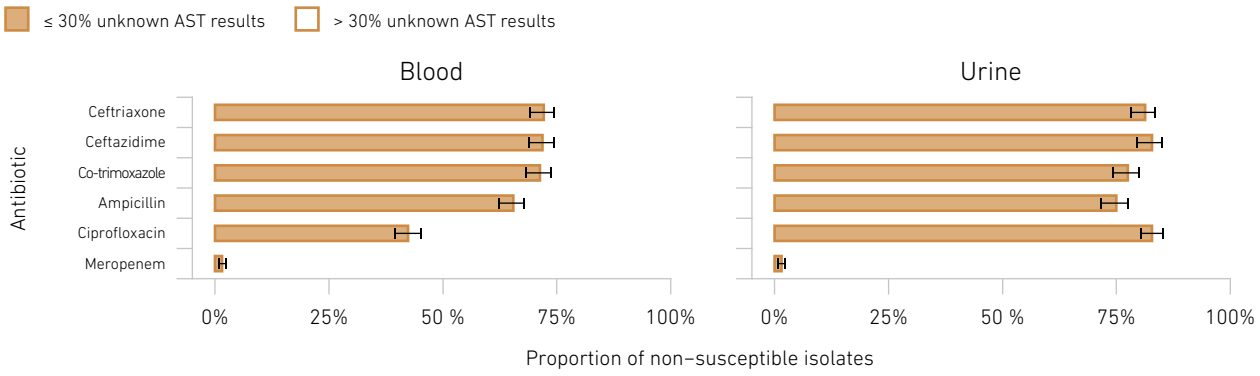
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

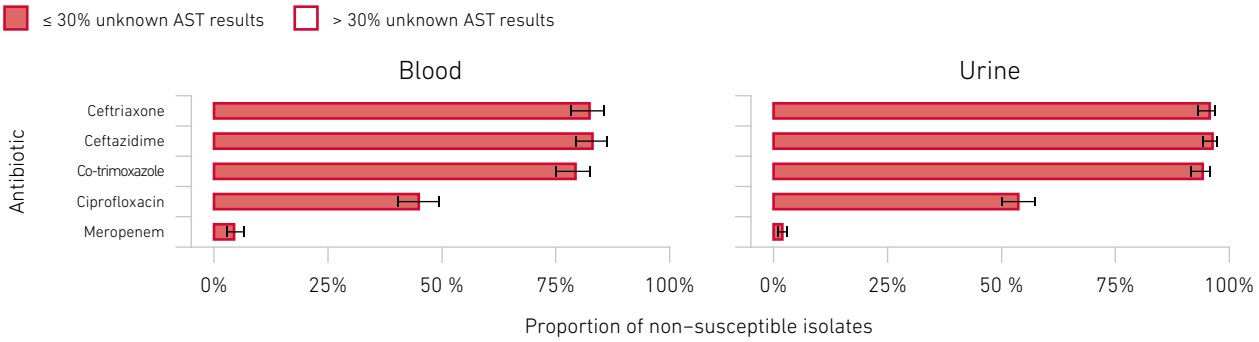


Escherichia coli

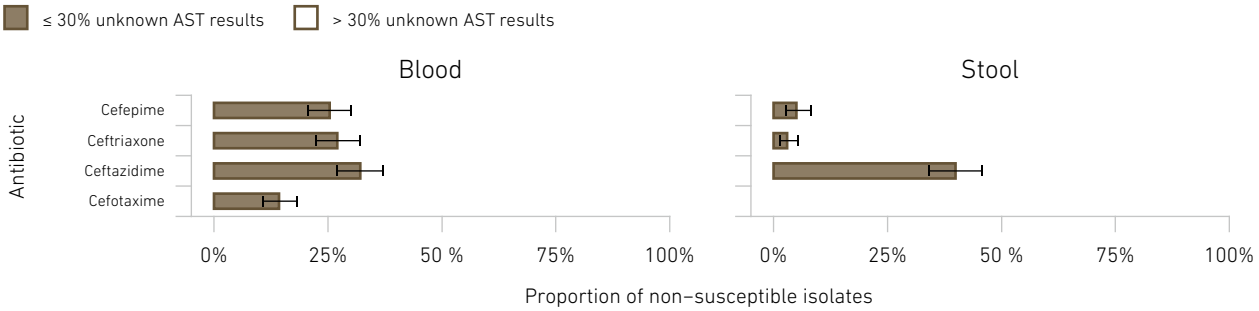


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

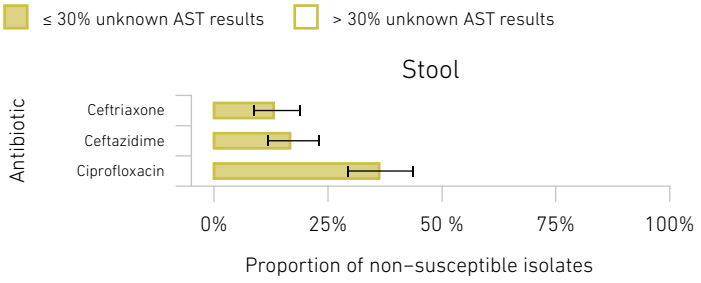
Klebsiella pneumoniae



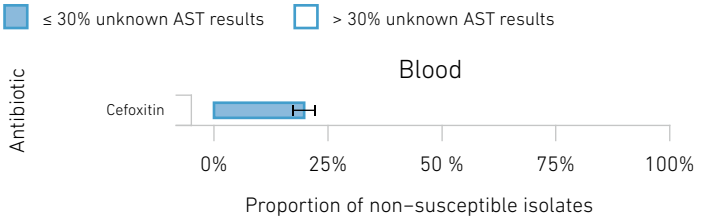
Salmonella **spp.**



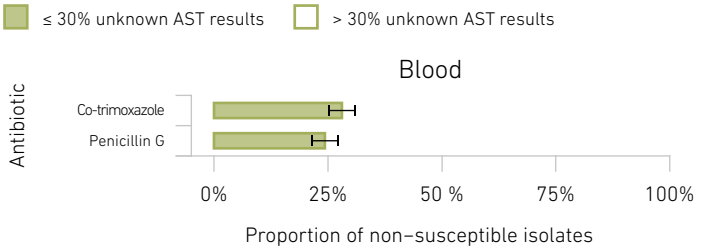
Shigella **spp.**



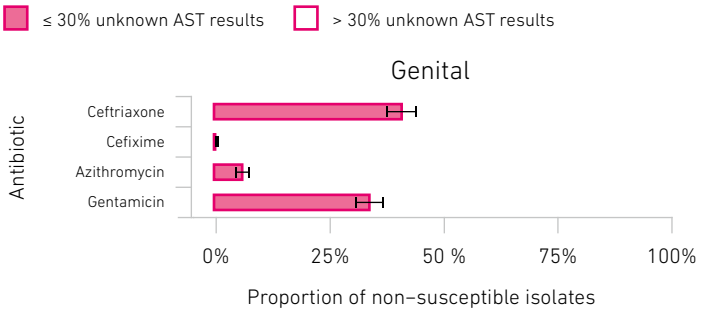
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



Malaysia

Population 31.62 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

110 surveillance sites
42 hospitals
68 outpatient facilities

43 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
110 surveillance sites providing data to GLASS
(42 hospitals)
(68 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

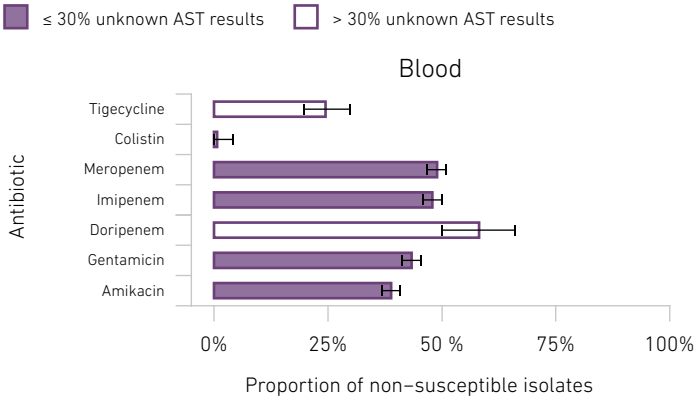
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	11146	-	62585	*Acinetobacter* spp.	182	-	2097
				E. coli	1472	-	5078
				K. pneumoniae	1062	-	4987
				Salmonella spp.	182	-	810
				S. aureus	1443	-	7570
				S. pneumoniae	251	-	511
URINE	11309	33	40713	*E. coli*	4083	4	9808
				K. pneumoniae	1207	3	4181
STOOL	1416	9	6205	*Salmonella* spp.	244	6	1661
				Shigella spp.	2	-	9
GENITAL	14809	-	37643	*N. gonorrhoeae*	126	-	91

Pathogen non-susceptibility overview[1]

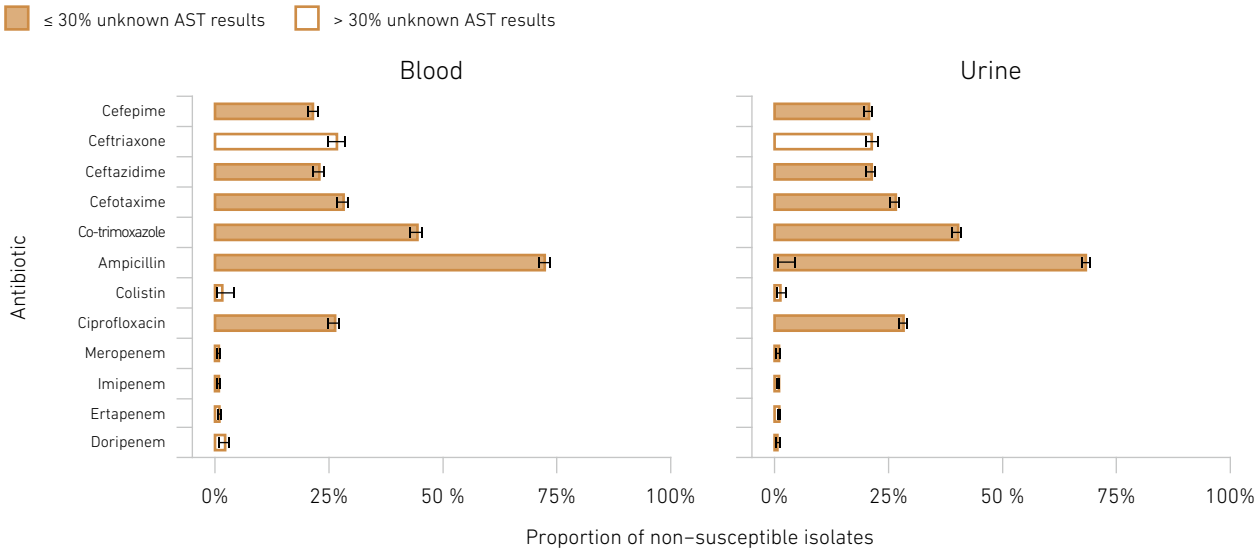
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

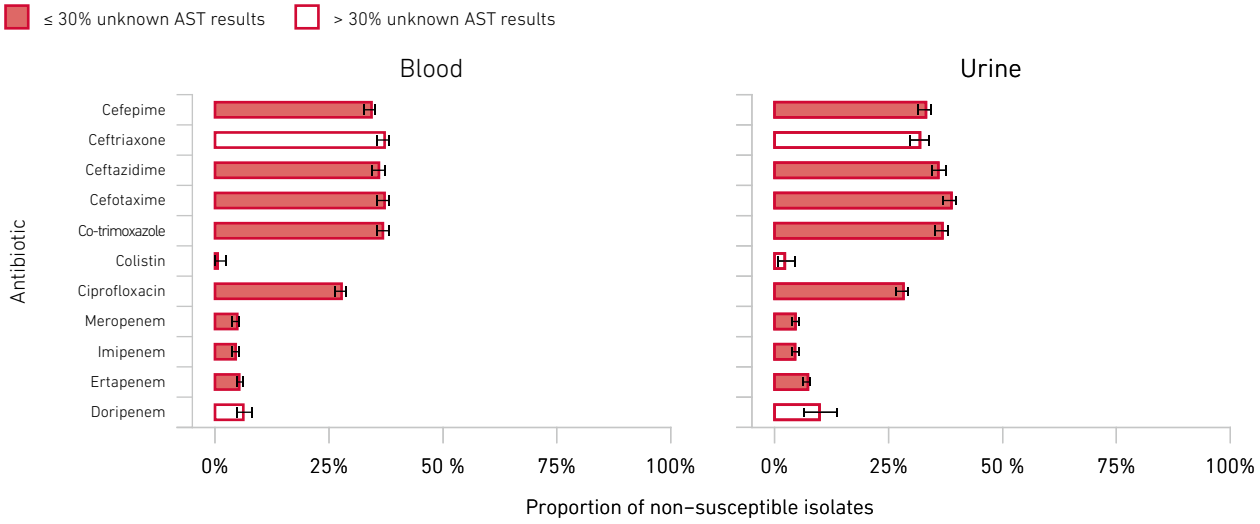


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

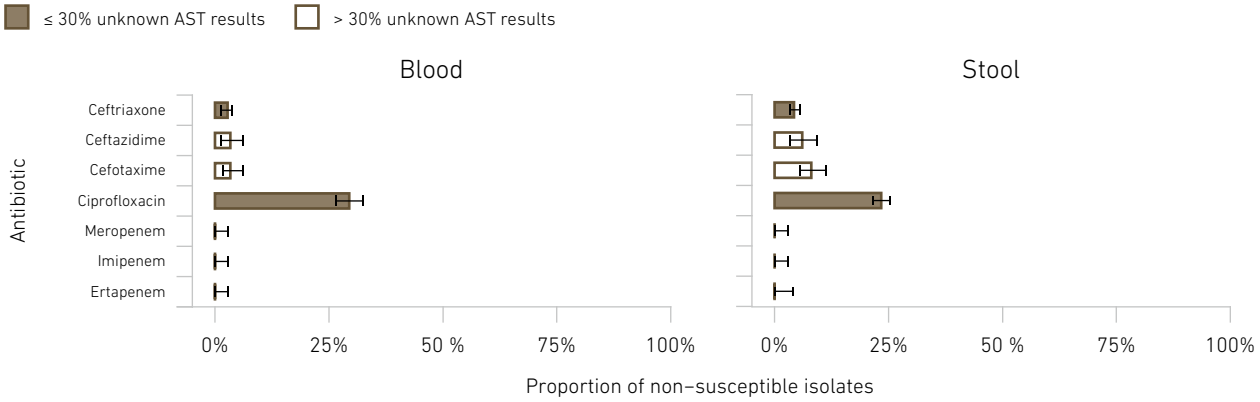
Escherichia coli



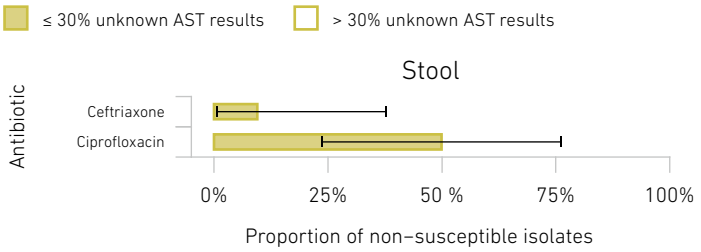
Klebsiella pneumoniae



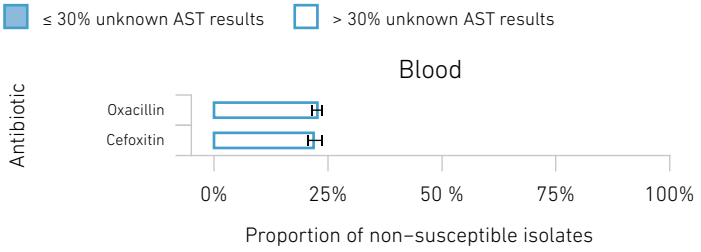
Salmonella **spp.**



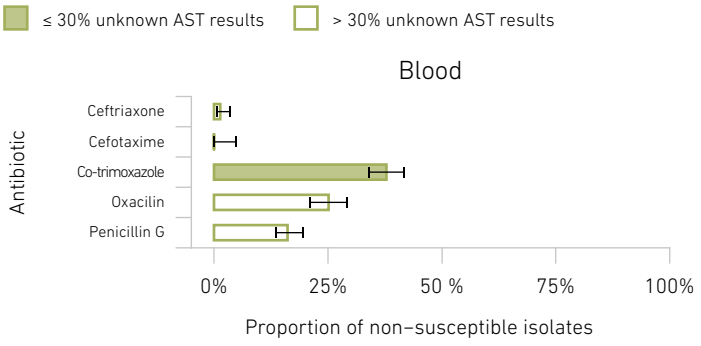
Shigella **spp.**



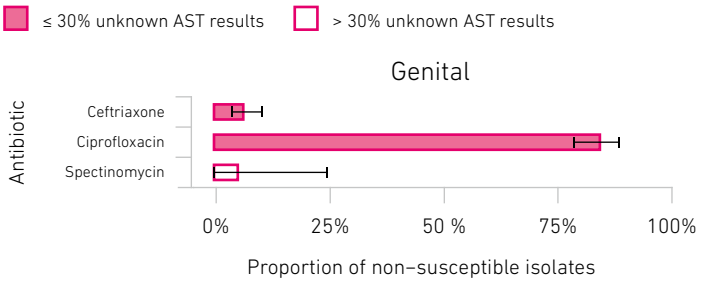
Staphylococcus aureus



Streptococcus pneumoniae



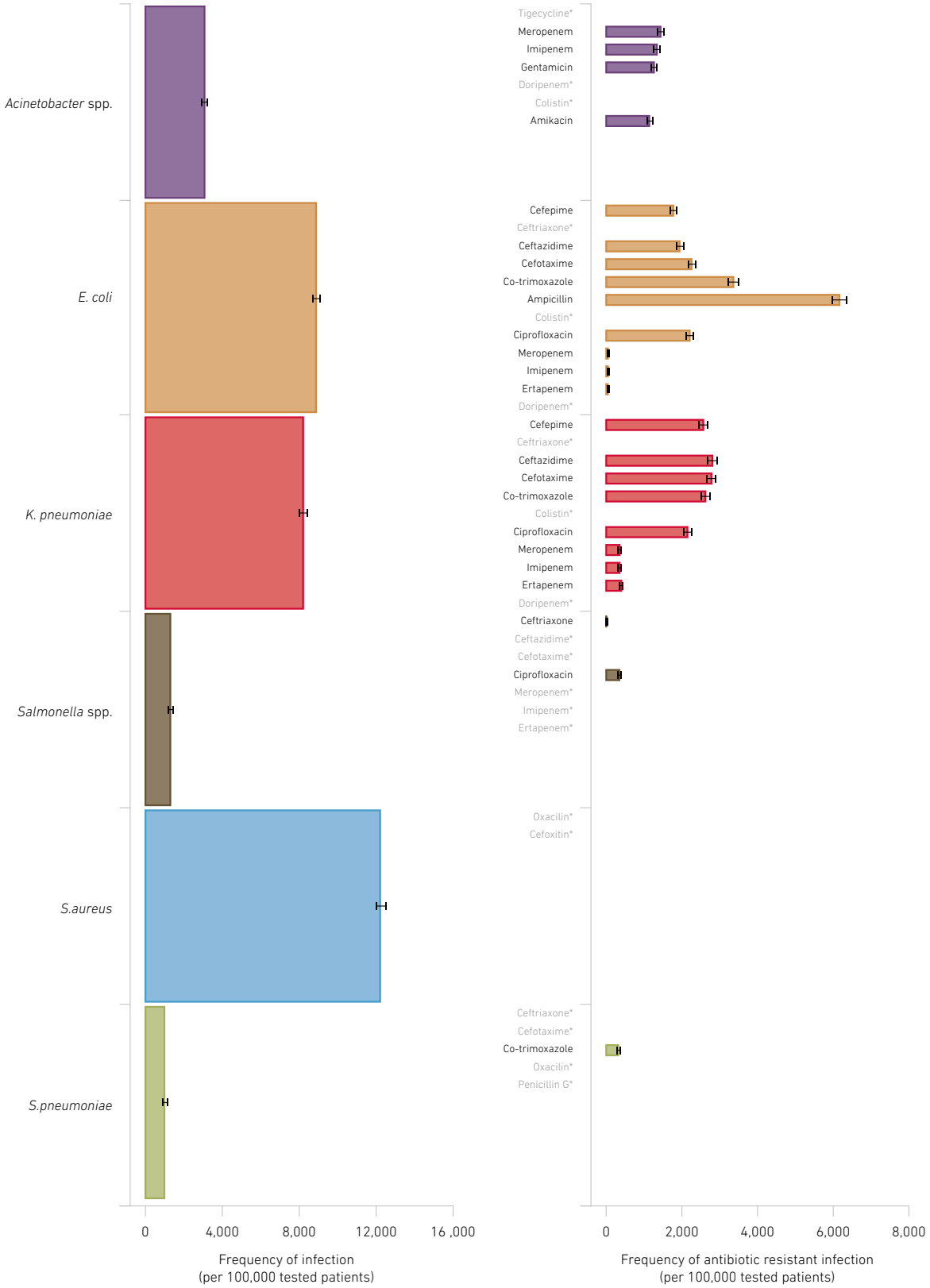
Neisseria gonorrhoeae



Non-susceptible pathogen-antimicrobial combination frequency

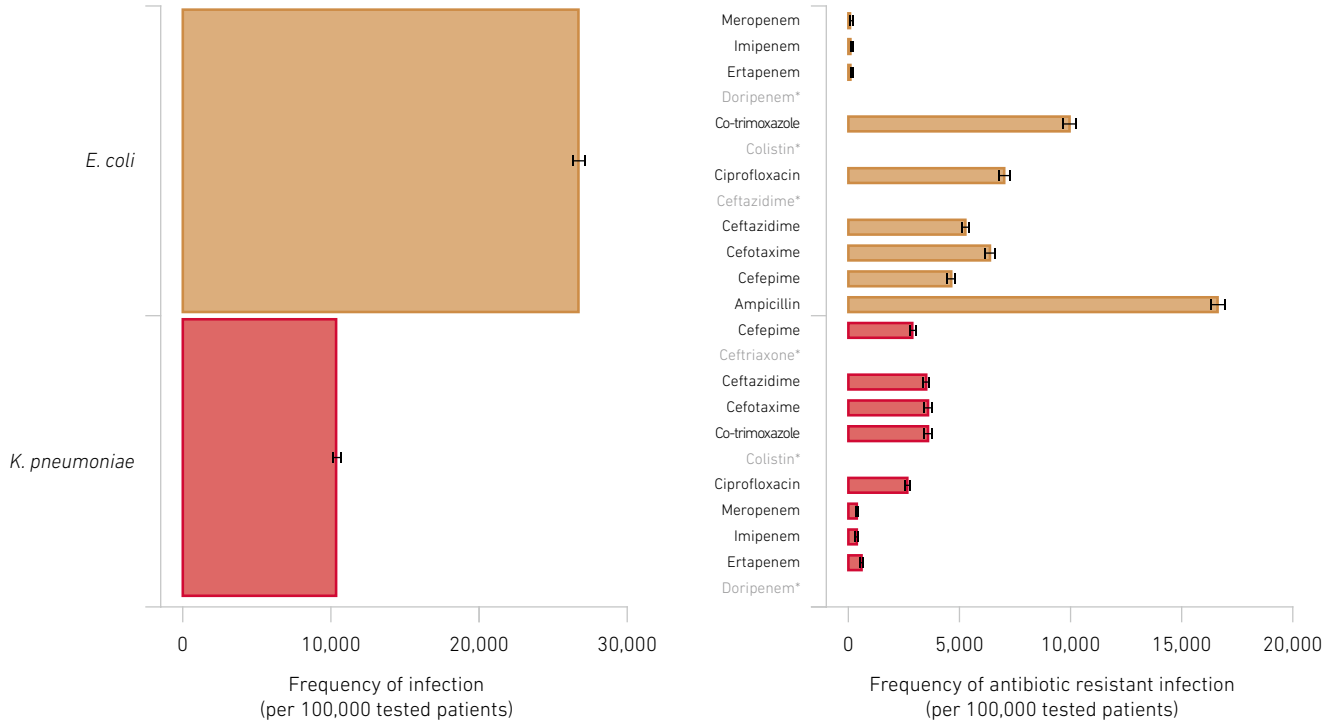
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Unknown origin (n tested = 73731)



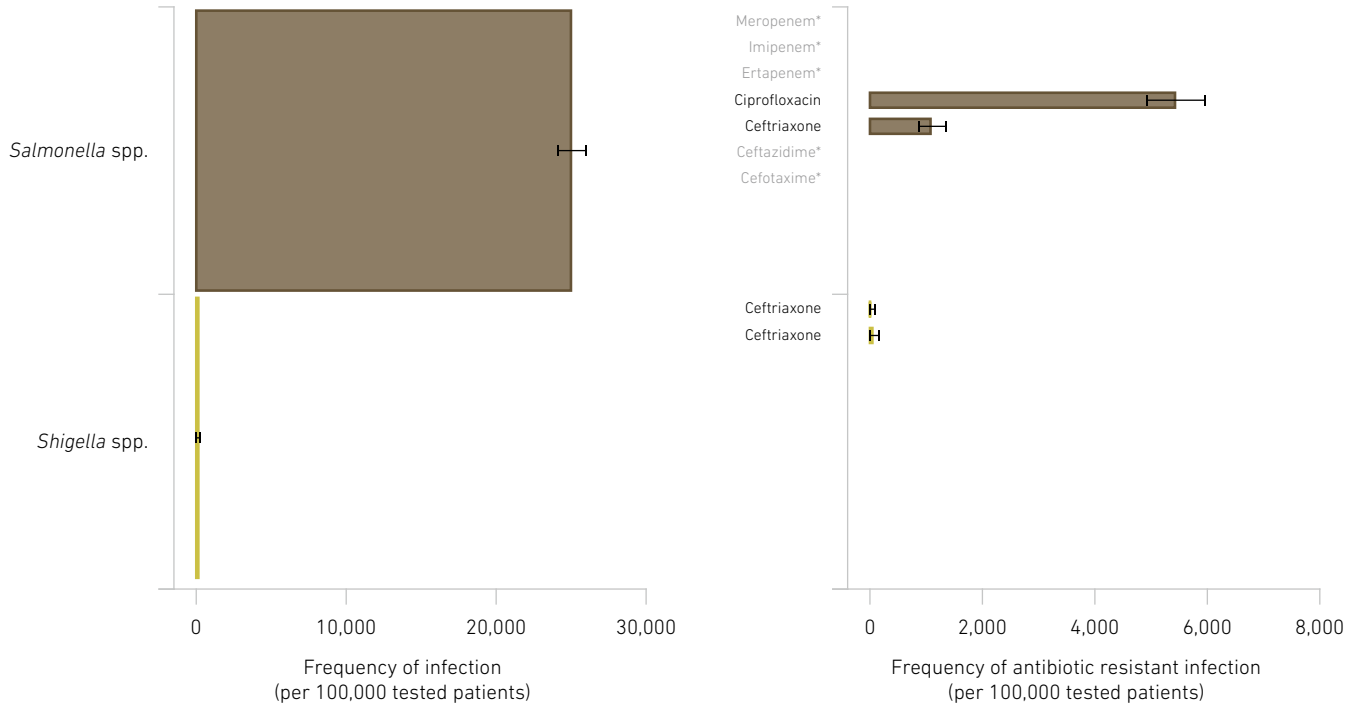
*Antibiotic with >30% unknown AST results: AMR rates not shown

URINE- Unknown origin (n tested = 52055)



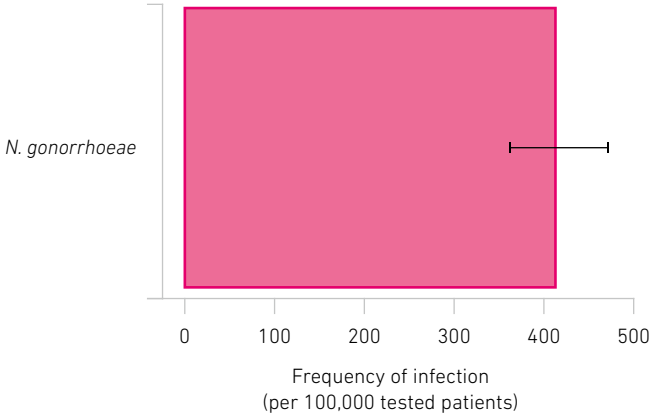
*Antibiotic with >30% unknown AST results: AMR rates not shown

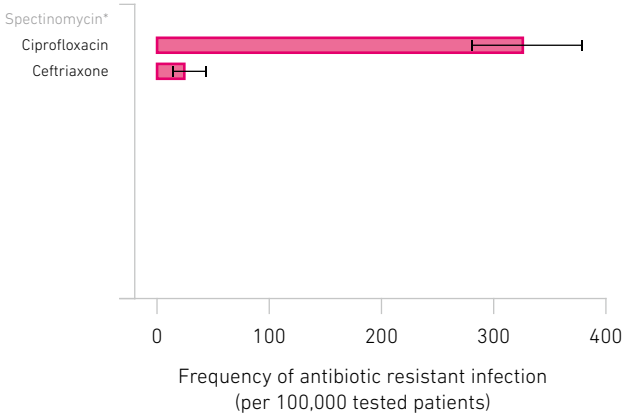
STOOL- Unknown origin (n tested = 7630)



*Antibiotic with >30% unknown AST results: AMR rates not shown

GENITAL- Unknown origin (n tested = 52452)





*Antibiotic with >30% unknown AST results: AMR rates not shown

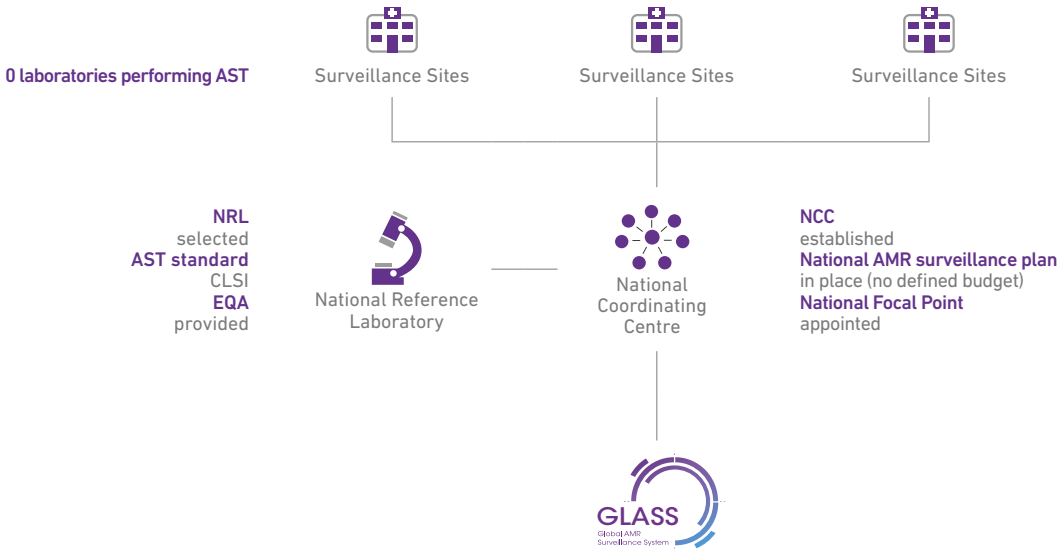
Maldives

Population 0.44 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Surveillance sites not established



in 2018 data call

No AMR data reported to GLASS by the end of the data call

Mali

Population 18.54 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

Surveillance sites not established

0 laboratories performing AST

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Malta

Population 0.43 million

There is no national AMR surveillance in Malta but data from Mater Dei Hospital covers around 95% of patients with bacteraemia in the country. The country has been a participant in EARS-NET (and previously EARSS) since 1999 and has been enrolled in GLASS since July 2017. Malta has just completed a comprehensive National AMR Strategy and Action Plan which will imminently be going out to final consultation before implementation in early 2019.

Current status of the national AMR surveillance system

1 surveillance site
1 hospital

1 laboratory performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
notselected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
not established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
1 surveillance site providing data to GLASS
(1 hospital)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

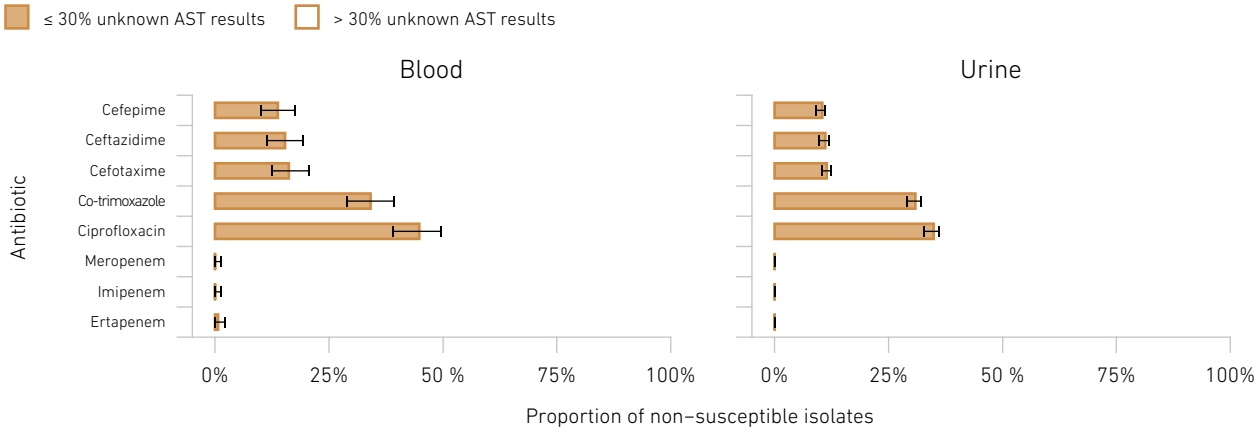
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	7328	*Acinetobacter* spp.	-	-	9
				E. coli	-	-	321
				K. pneumoniae	-	-	122
				Salmonella spp.	-	-	6
				S. aureus	-	-	97
				S. pneumoniae	-	-	19
URINE	-	-	23369	*E. coli*	-	-	3596
				K. pneumoniae	-	-	836
STOOL	-	-	5993	*Salmonella* spp.	-	-	97
				Shigella spp.	-	-	2
GENITAL	-	-	2890	*N. gonorrhoeae*	-	-	14

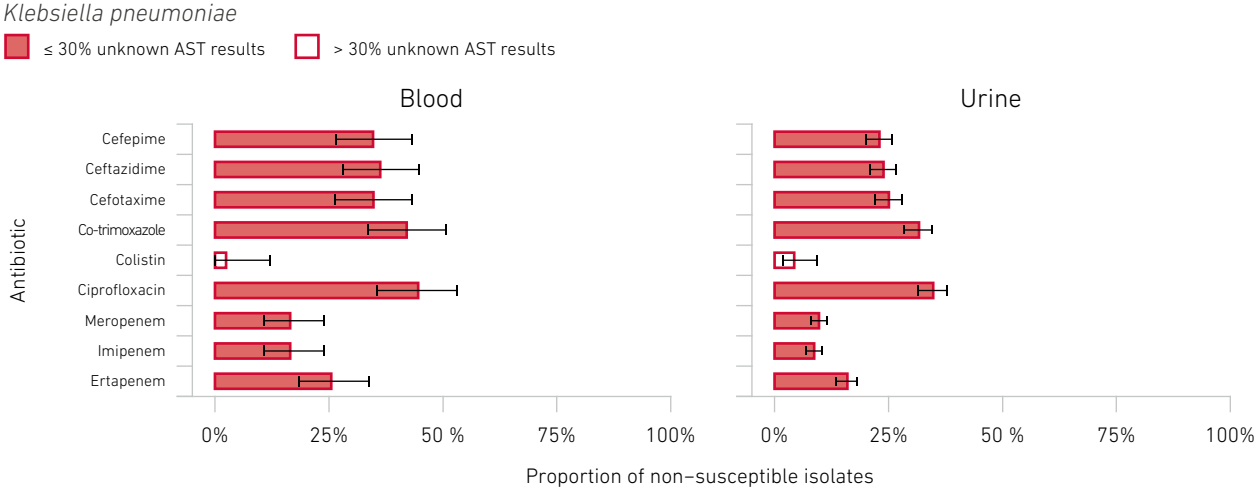
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli

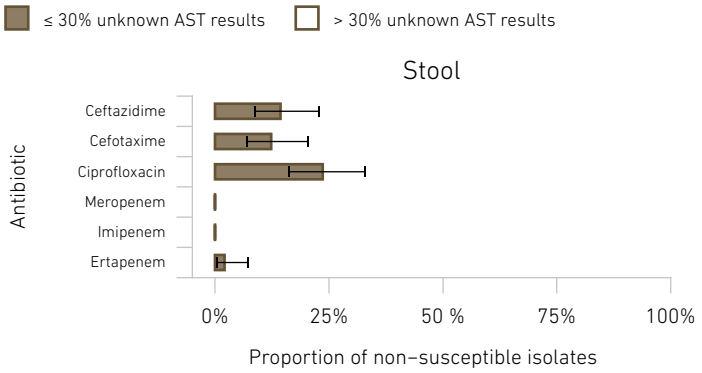


Klebsiella pneumoniae

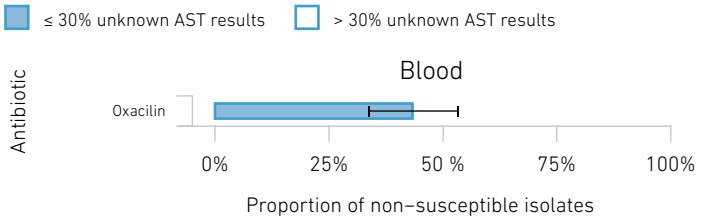


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

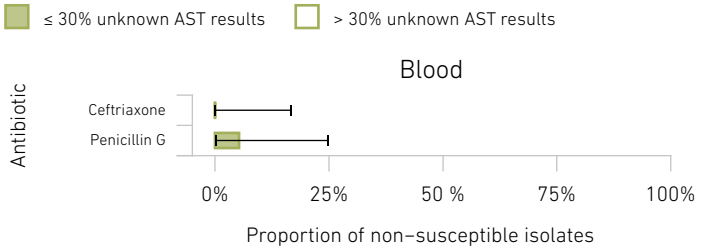
Salmonella **spp.**



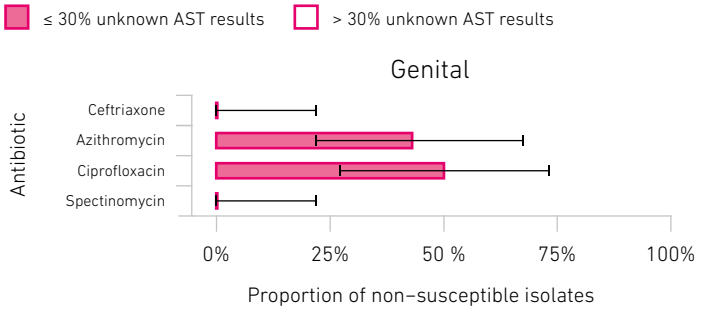
Staphylococcus aureus



Streptococcus pneumoniae



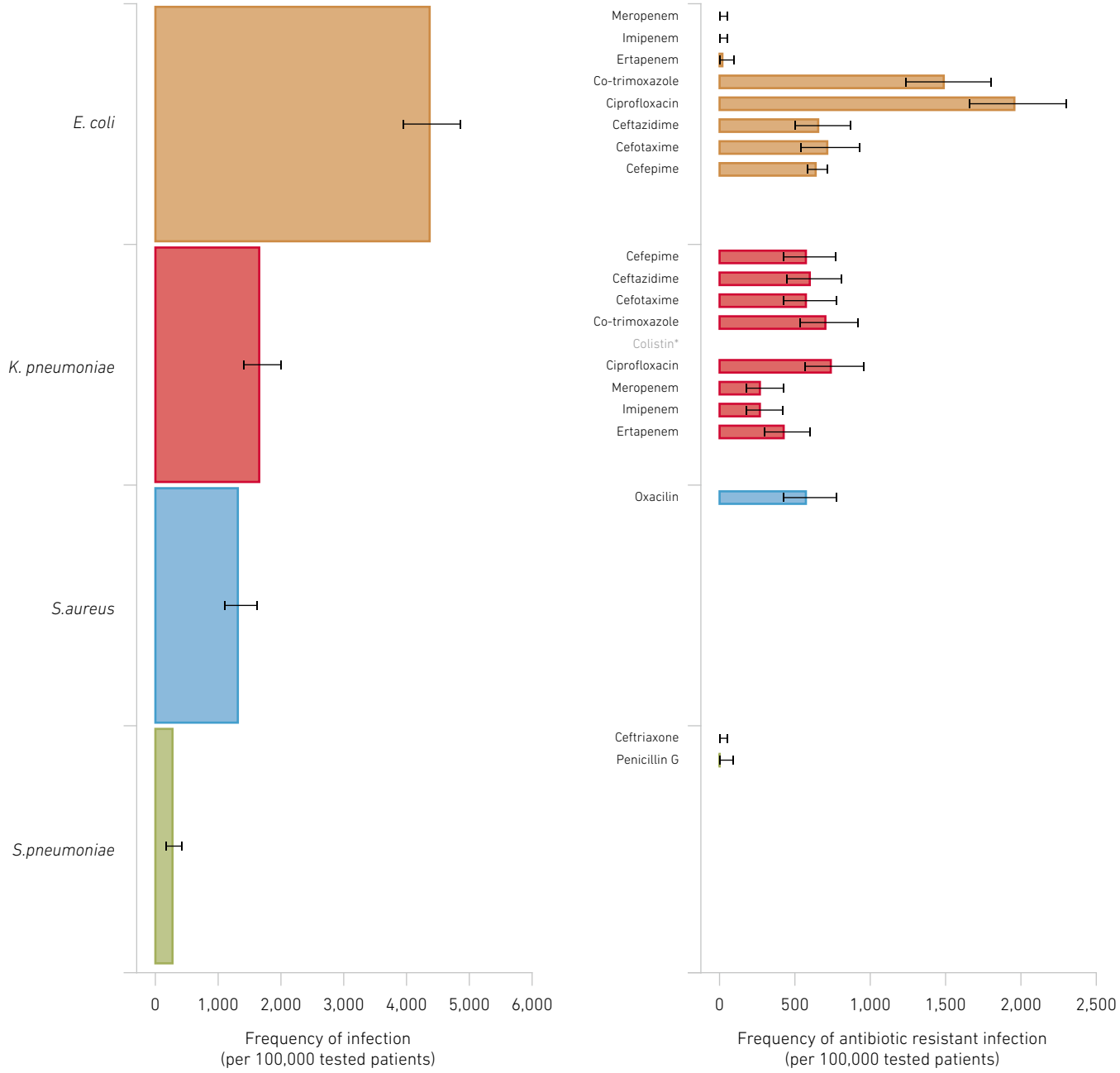
Neisseria gonorrhoeae



Non-susceptible pathogen-antimicrobial combination frequency

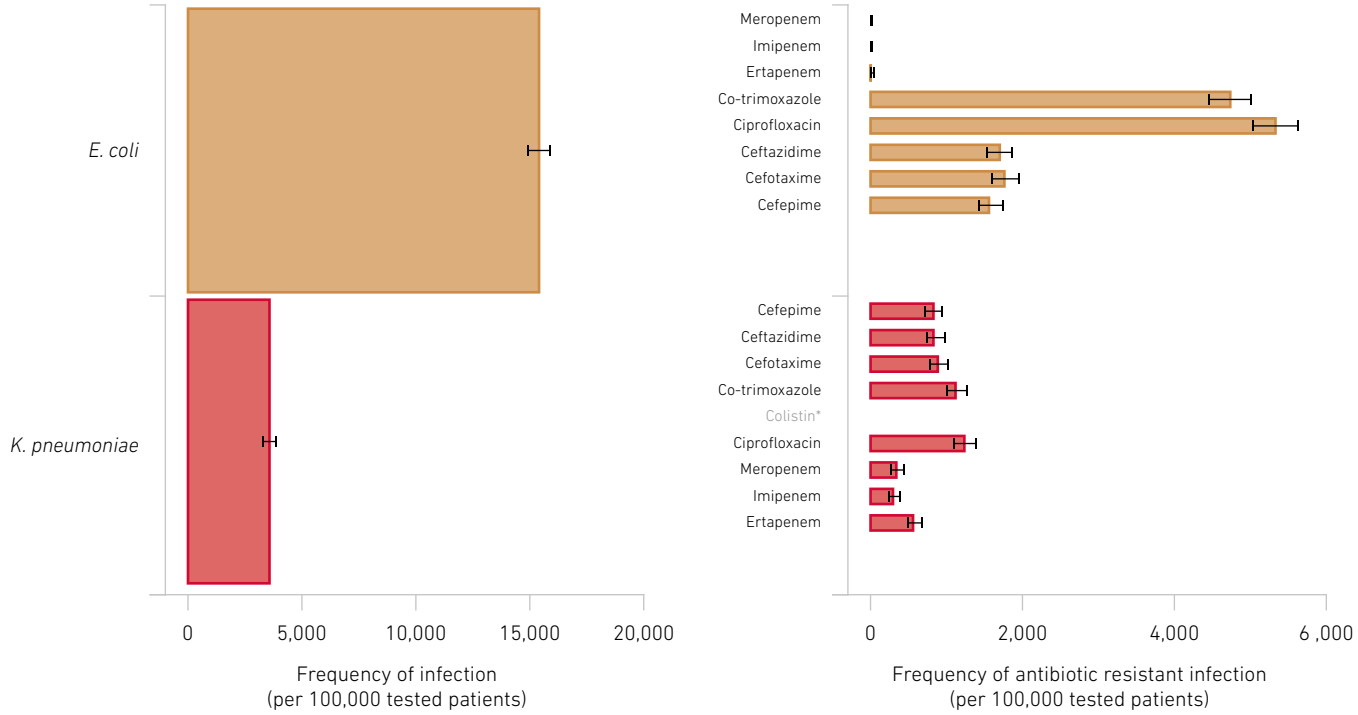
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Unknown origin (n tested = 7328)



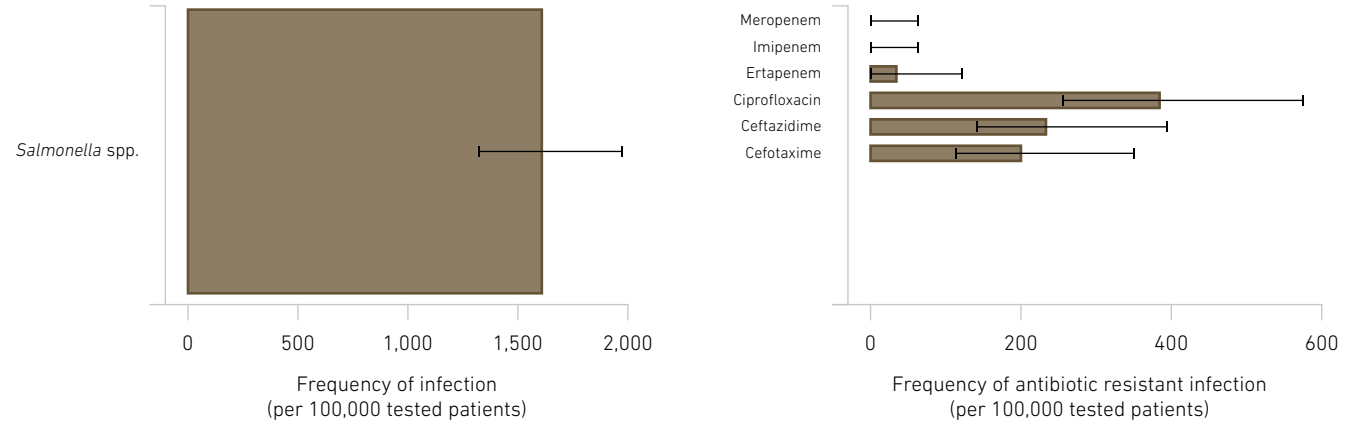
*Antibiotic with >30% unknown AST results: AMR rates not shown

URINE- Unknown origin (n tested = 23369)

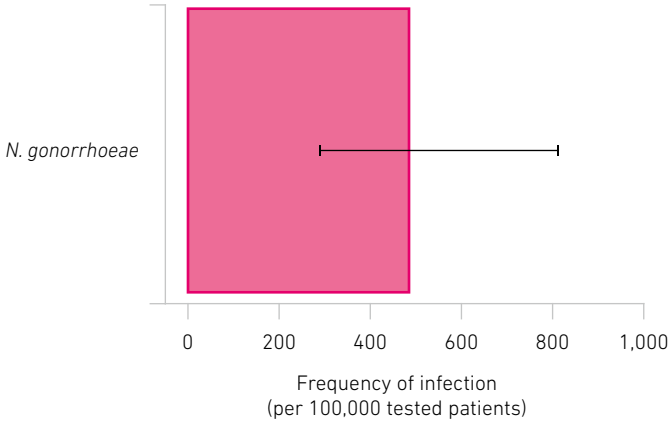


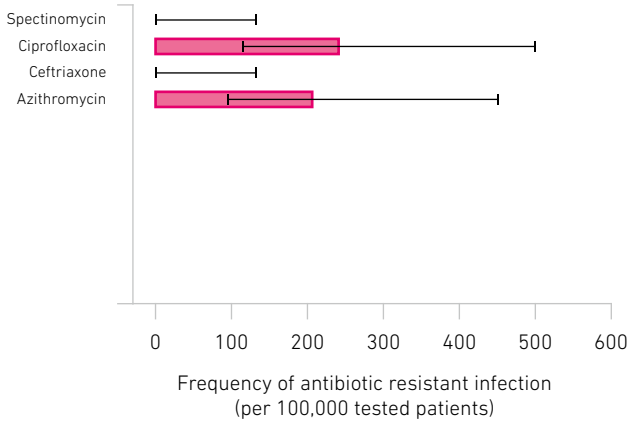
*Antibiotic with >30% unknown AST results: AMR rates not shown

STOOL- Unknown origin (n tested = 5993)



GENITAL- Unknown origin (n tested = 2890)



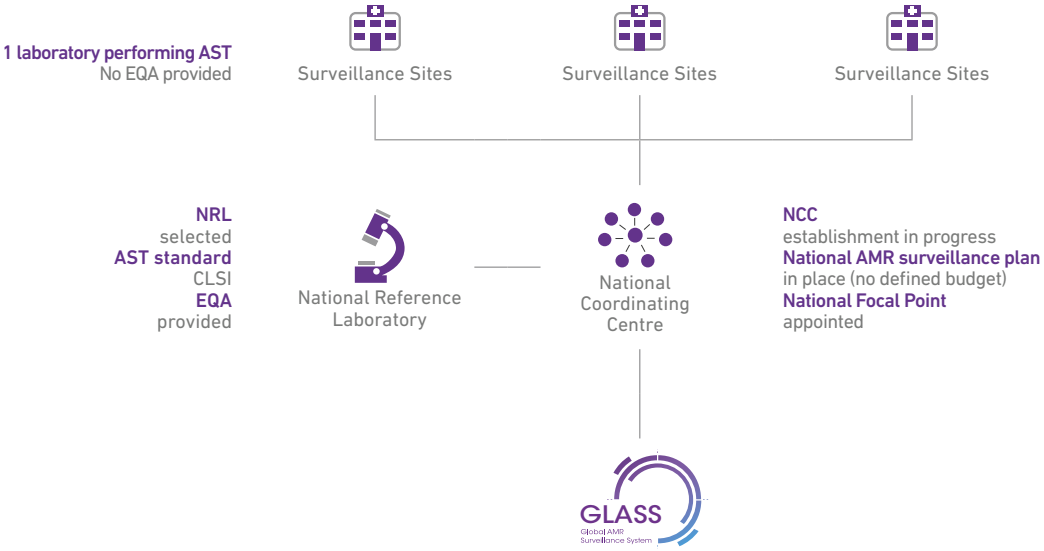


Mauritius

Population 1.26 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system



in 2018 data call

No AMR data reported to GLASS by the end of the data call

Mozambique

Population 29.67 million

Mozambique is developing its National Action Plan on AMR and is building a national AMR surveillance system. Mozambique has been enrolled in GLASS since July 2017.

Current status of the national AMR surveillance system

1 surveillance site
1 hospital

2 laboratories performing AST
No EQA provided

Surveillance Sites

Surveillance Sites

Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Myanmar

Population 53.37 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

in 2018 data call

No AMR data reported to GLASS by the end of the data call

Nepal

Population 29.3 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

42 surveillance sites
21 hospitals
21 outpatient facilities

21 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointment in progress

GLASS

in 2018 data call
Participating Laboratories providing data to GLASS
(15 laboratories)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

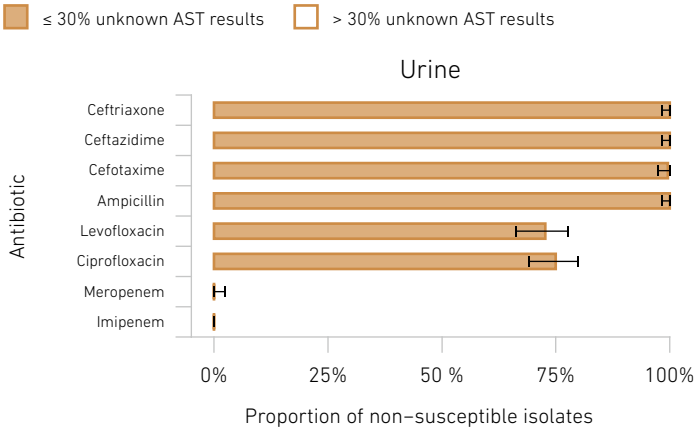
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	2	-
				E. coli	-	8	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	91	-
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	239	-
				K. pneumoniae	-	54	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

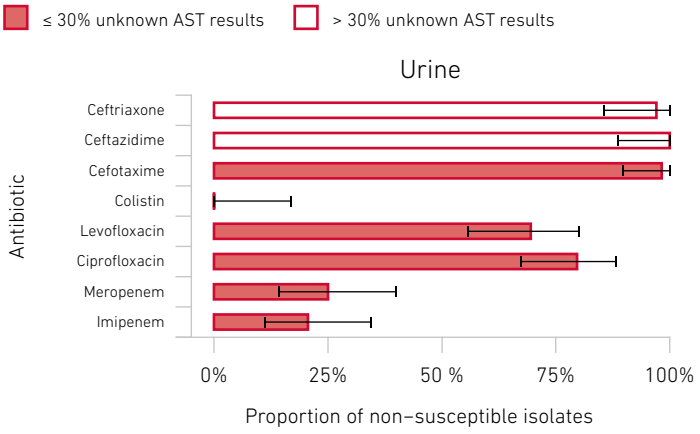
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli

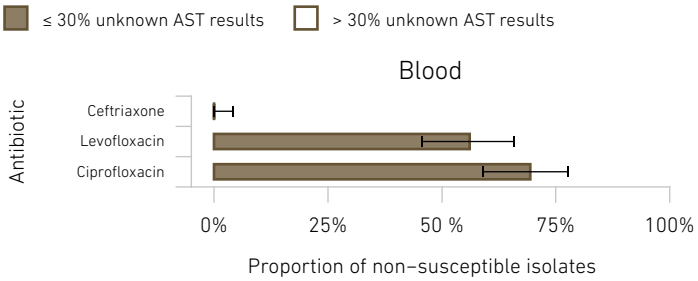


Klebsiella pneumoniae



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Salmonella **spp.**



Netherlands

Population 17.04 million

The country is enrolled in GLASS since 2017.

Current status of the national AMR surveillance system

42 participating laboratories*

42 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
not provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing data to GLASS
(42 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

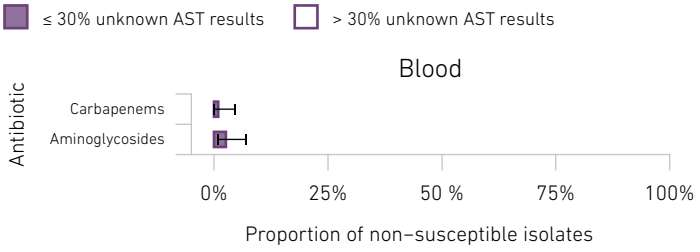
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	121
				E. coli	-	-	6686
				K. pneumoniae	-	-	1190
				Salmonella spp.	-	-	-
				S. aureus	-	-	2694
				S. pneumoniae	-	-	1401
URINE	-	-	-	*K. pneumoniae*	-	-	-
				E. coli	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

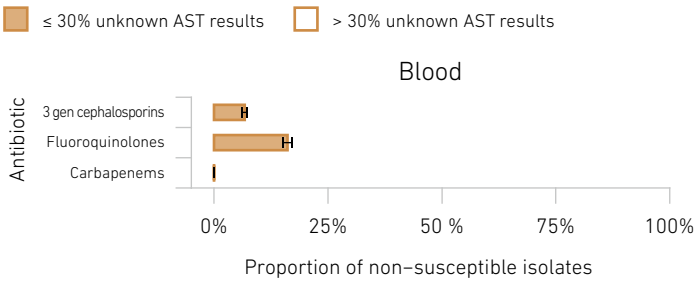
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

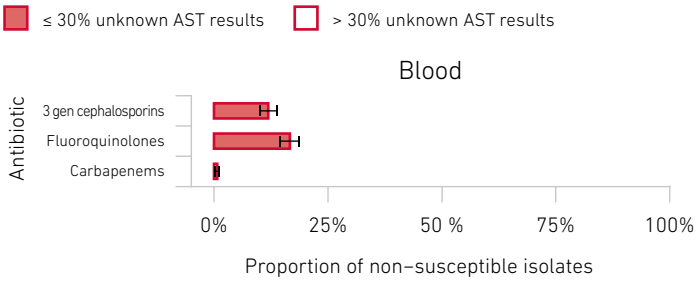


Escherichia coli

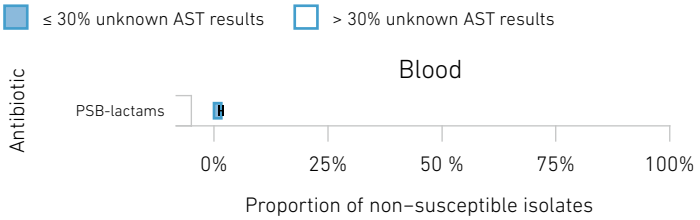


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

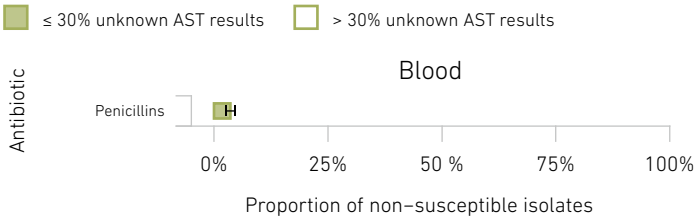
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Nigeria

Population 190.88 million

Nigeria is completing development of the National Action Plan on AMR and building its national AMR surveillance system coordinated by the Nigeria Centre for Disease Control. Nigeria has been enrolled in GLASS since April 2017.

Current status of the national AMR surveillance system

3 participating laboratories*

3 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing data to GLASS
(3 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	100%	*Acinetobacter* spp.	100%	99-70%	100%	<70%
		E. coli	100%	99-70%	99-70%	<70%
		K. pneumoniae	100%	99-70%	100%	<70%
		Salmonella spp.	100%	99-70%	100%	<70%
		S. aureus	100%	99-70%	100%	<70%
		S. pneumoniae	100%	100%	100%	<70%
Urine	<70%	*E. coli*	<70%	<70%	<70%	<70%
		K. pneumoniae	<70%	<70%	<70%	<70%
Stool	<70%	*Salmonella* spp.	<70%	<70%	<70%	<70%
		Shigella spp.	<70%	<70%	<70%	<70%
Genital	<70%	*N. gonorrhoeae*	<70%	<70%	<70%	<70%

100% data collected | 99-70% data collected | <70% data collected

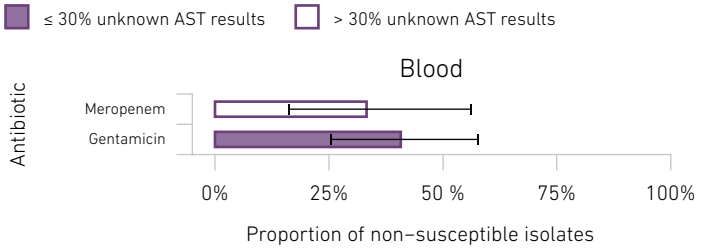
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	3638	*Acinetobacter* spp.	-	-	36
				E. coli	-	-	60
				K. pneumoniae	-	-	97
				Salmonella spp.	-	-	28
				S. aureus	-	-	256
				S. pneumoniae	-	-	2
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

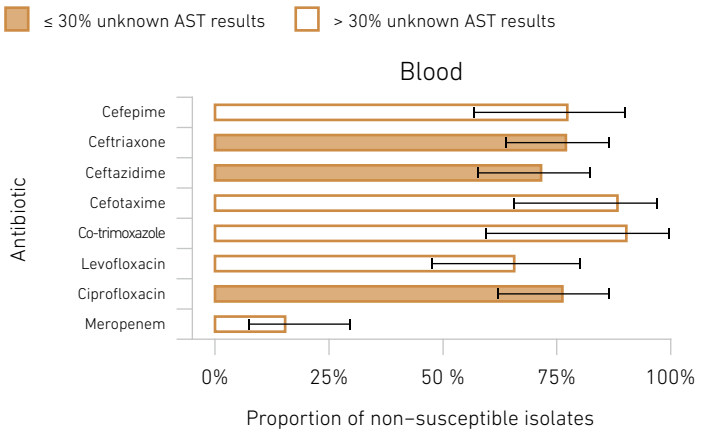
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

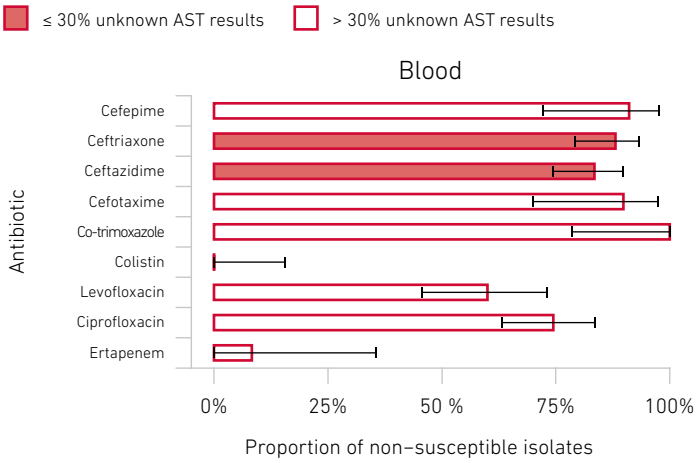


Escherichia coli

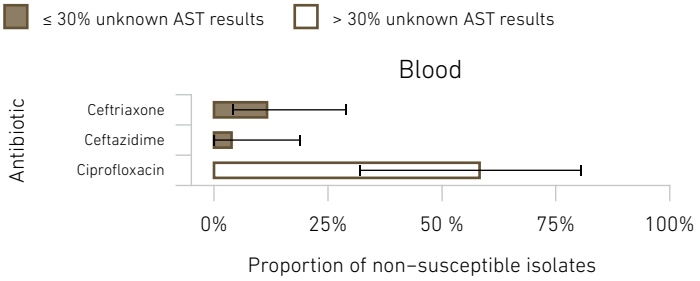


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

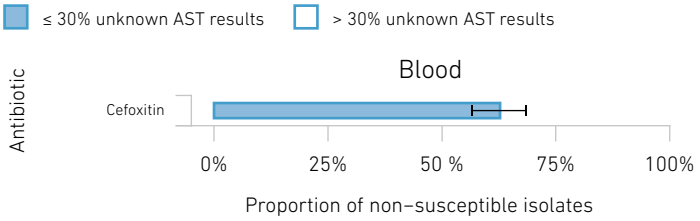
Klebsiella pneumoniae



Salmonella **spp.**



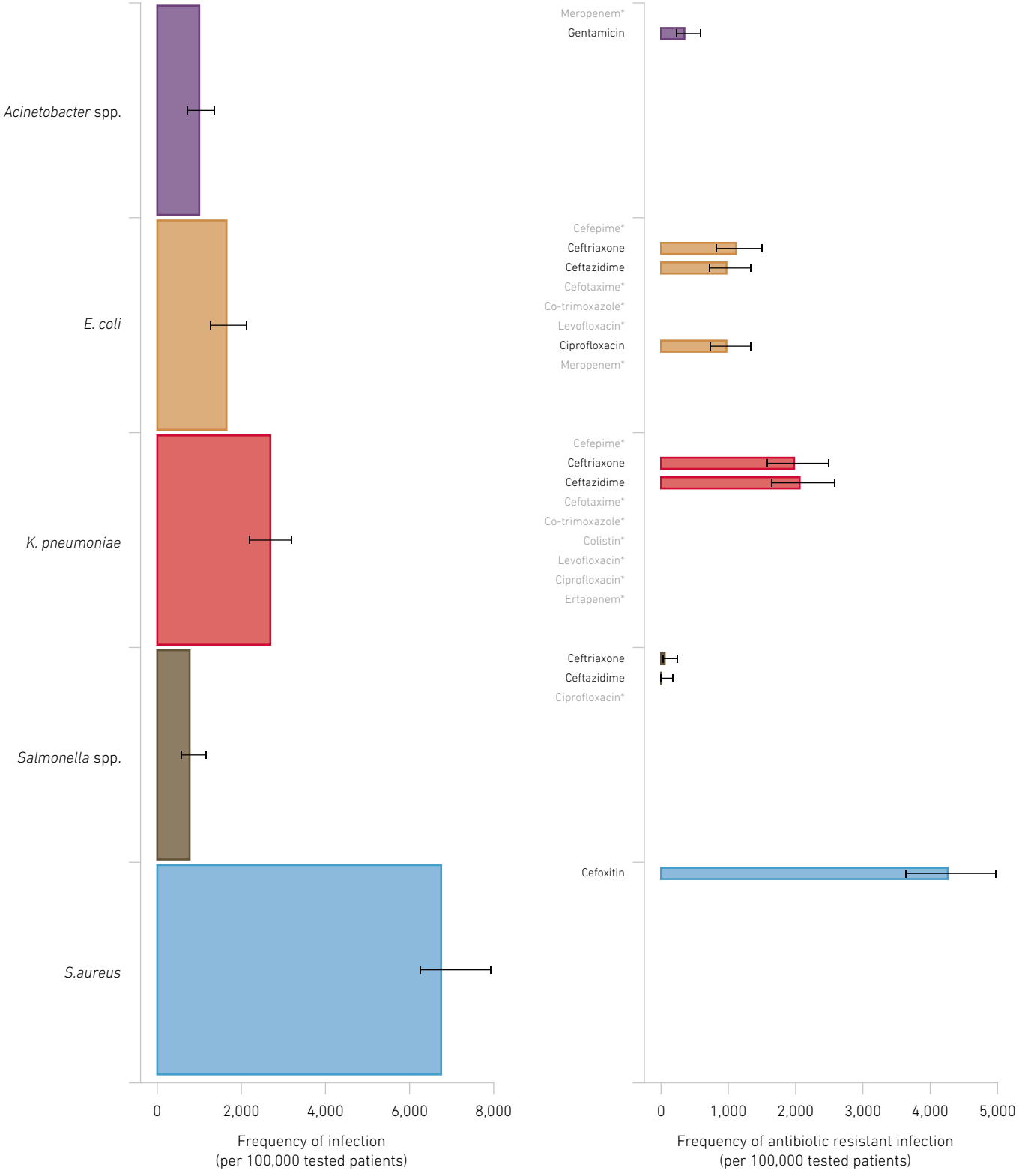
Staphylococcus aureus



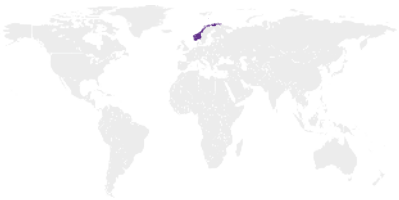
Non-susceptible pathogen-antimicrobial combination frequency

Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Unknown origin (n tested = 3638)



*Antibiotic with >30% unknown AST results: AMR rates not shown



Norway

Population 5.3 million

The Norwegian Surveillance System for Antimicrobial Drug Resistance (NORM) was established in 2000. In 2015 Norway adopted the National Strategy Against Antibiotic Resistance 2015-2020. The country participates in the EARS-NET and has been enrolled in GLASS since September 2016.

Current status of the national AMR surveillance system

22 participating laboratories*

22 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

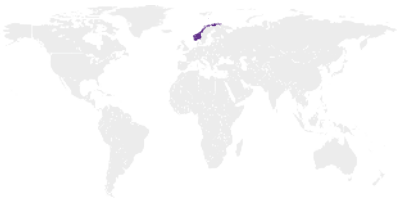
in 2018 data call
Participating Laboratories providing data to GLASS
(22 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected



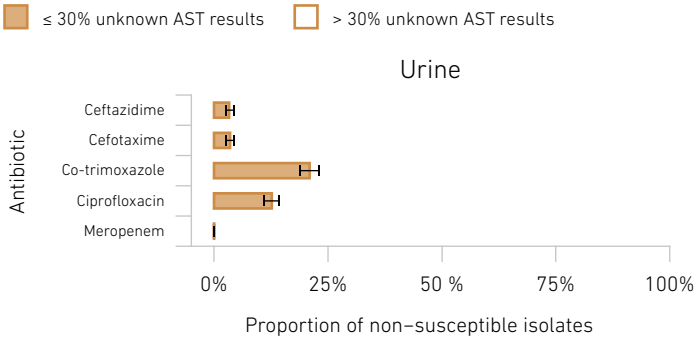
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	61
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	1510
				K. pneumoniae	-	-	742
STOOL	-	-	-	*Salmonella* spp.	-	-	782
				Shigella spp.	-	-	113
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	374

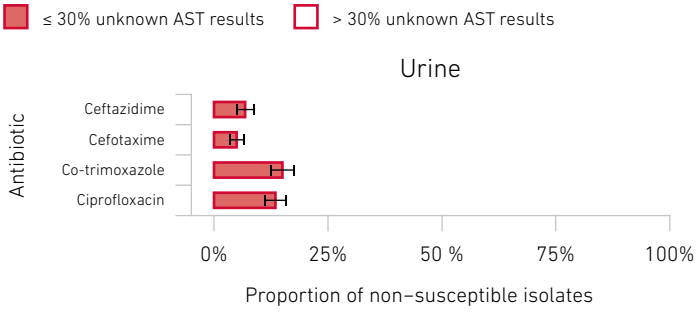
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

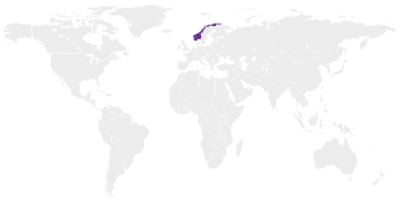
Escherichia coli



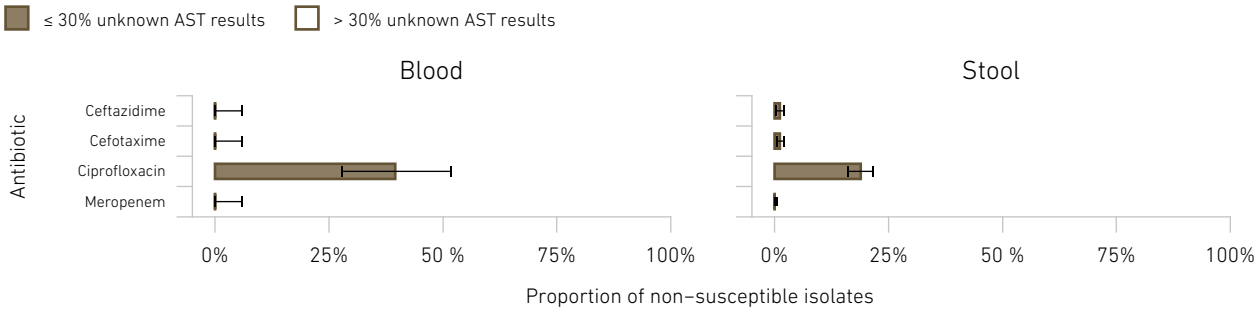
Klebsiella pneumoniae



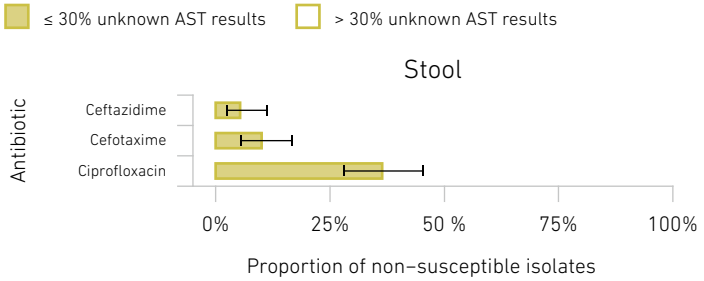
[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.



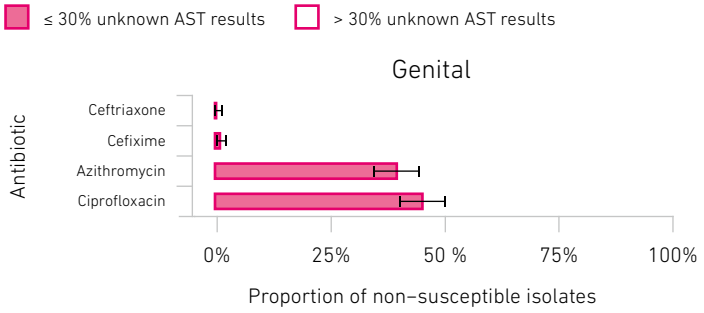
Salmonella **spp.**



Shigella **spp.**



Neisseria gonorrhoeae



Oman

Population 4.64 million

Oman has approved its National Policy and Action Plan on AMR and has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

6 participating laboratories

6 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
not established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing data to GLASS
(6 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

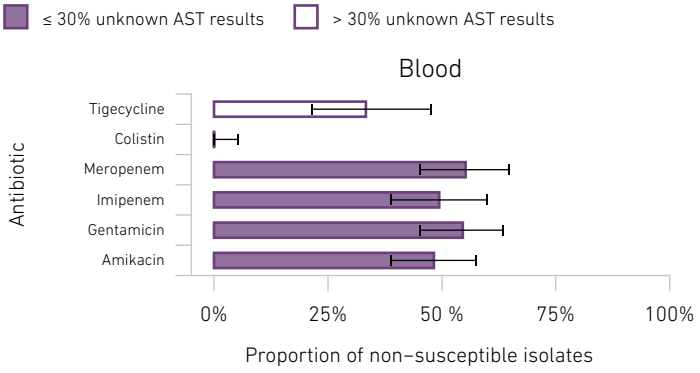
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	115
				E. coli	-	-	291
				K. pneumoniae	-	-	256
				Salmonella spp.	-	-	29
				S. aureus	-	-	286
				S. pneumoniae	-	-	66
URINE	-	-	-	*E. coli*	-	-	3604
				K. pneumoniae	-	-	773
STOOL	-	-	-	*Salmonella* spp.	-	-	309
				Shigella spp.	-	-	25
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	25

Pathogen non-susceptibility overview[1]

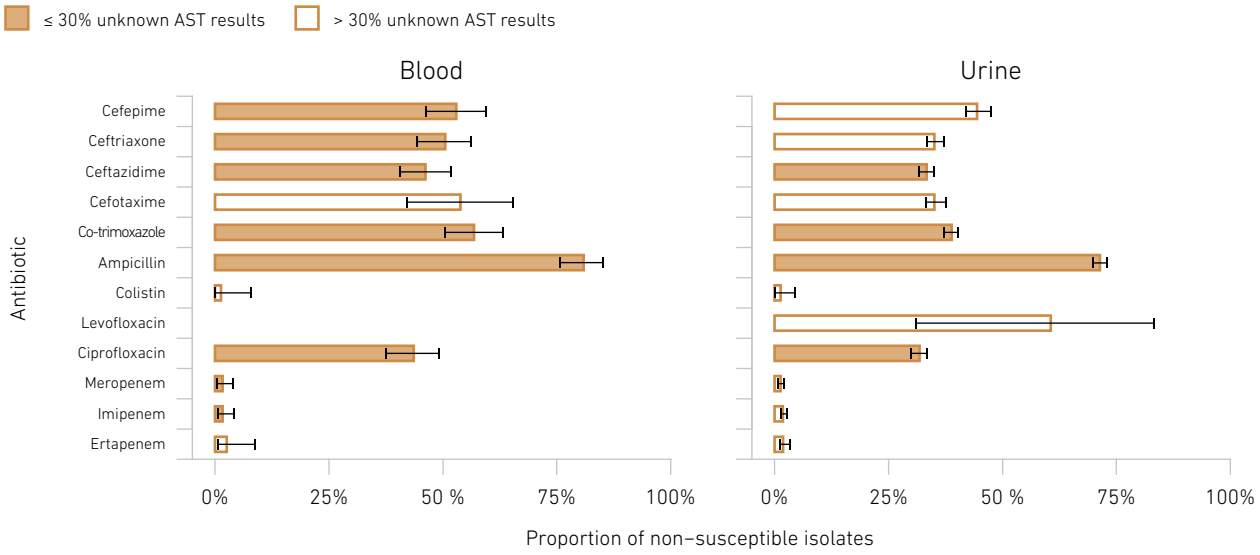
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

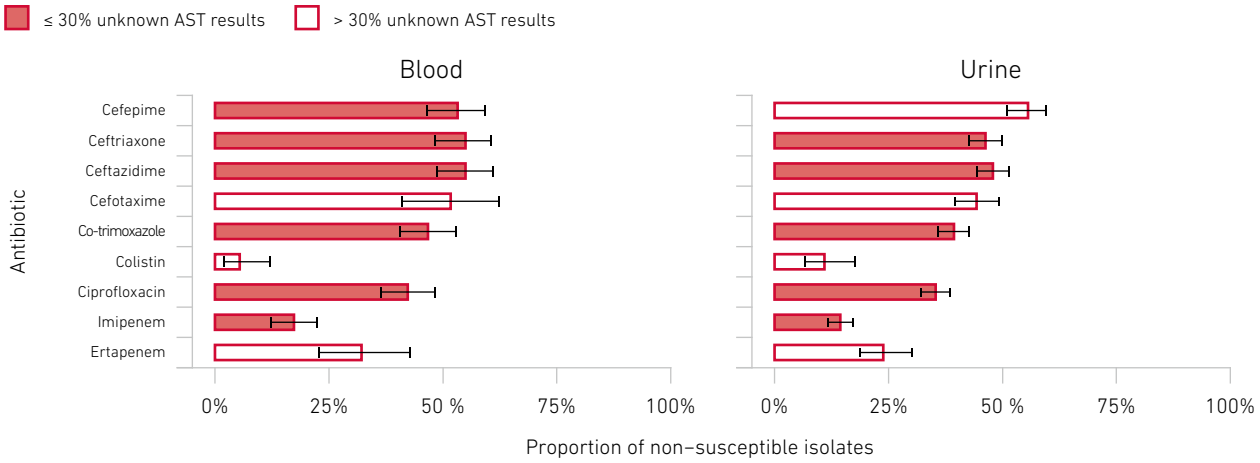


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

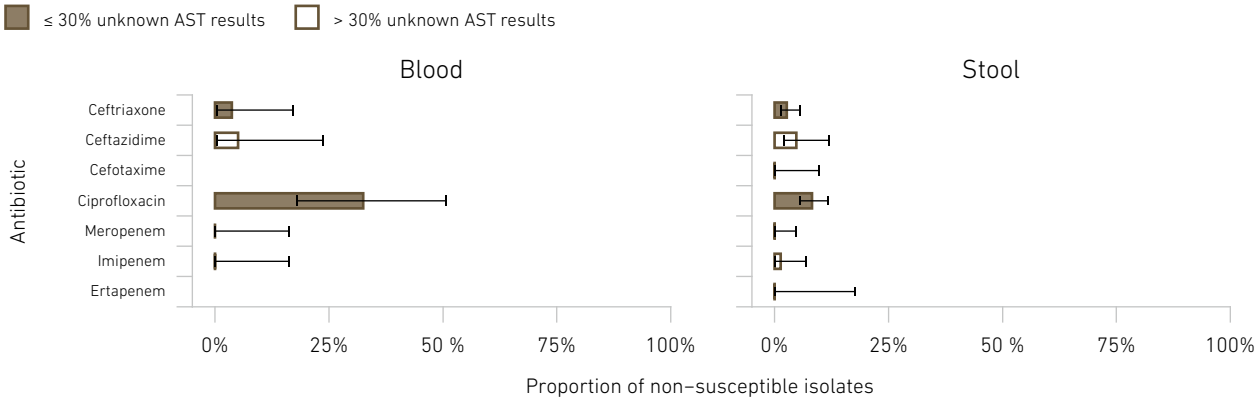
Escherichia coli



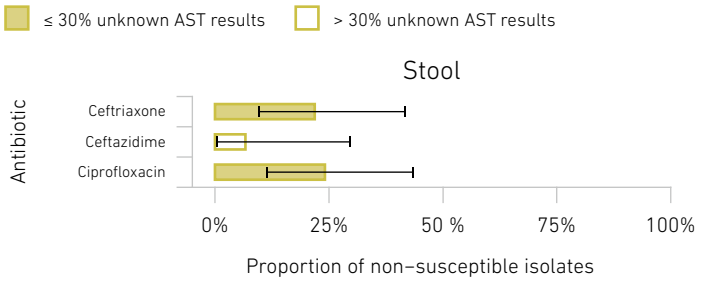
Klebsiella pneumoniae



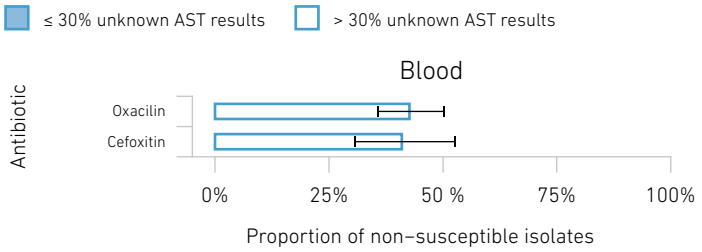
Salmonella **spp.**



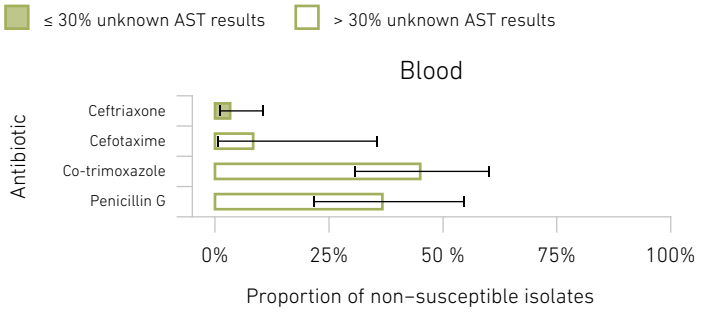
Shigella **spp.**



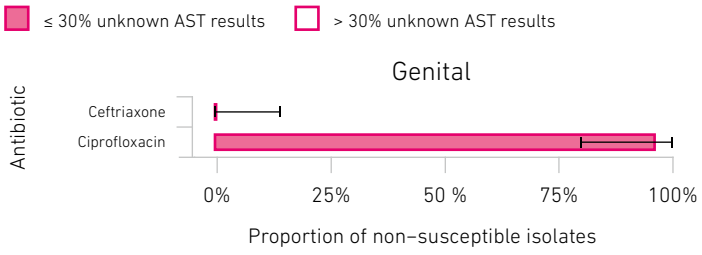
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



Pakistan

Population 197.01 million

Pakistan has enrolled in GLASS in 2018.

Current status of the national AMR surveillance system

9 surveillance sites
7 hospitals
2 outpatient facilities

9 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
6 surveillance sites providing data to GLASS
(4 hospitals)
(2 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

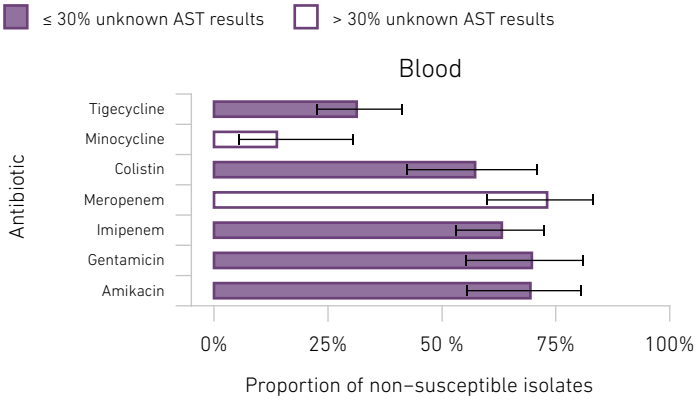
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	12	-	95
				E. coli	182	-	716
				K. pneumoniae	48	-	182
				Salmonella spp.	351	-	326
				S. aureus	100	-	96
				S. pneumoniae	27	-	12
URINE	-	-	-	*E. coli*	3814	-	3241
				K. pneumoniae	660	-	473
STOOL	-	-	-	*Salmonella* spp.	1	-	9
				Shigella spp.	12	-	28
GENITAL	-	-	-	*N. gonorrhoeae*	31	-	1

Pathogen non-susceptibility overview[1]

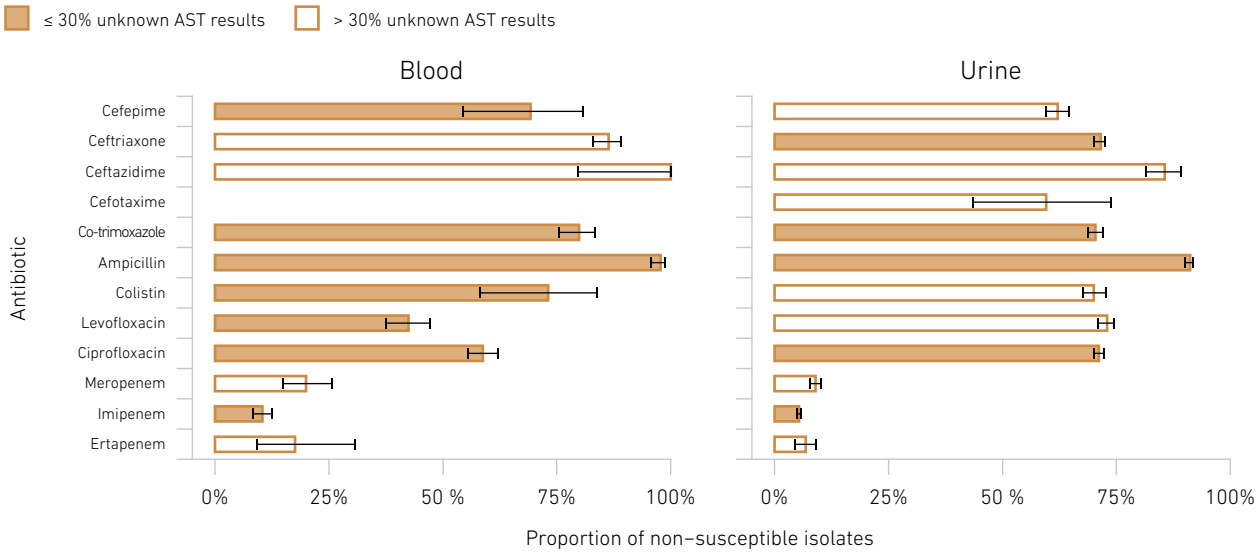
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

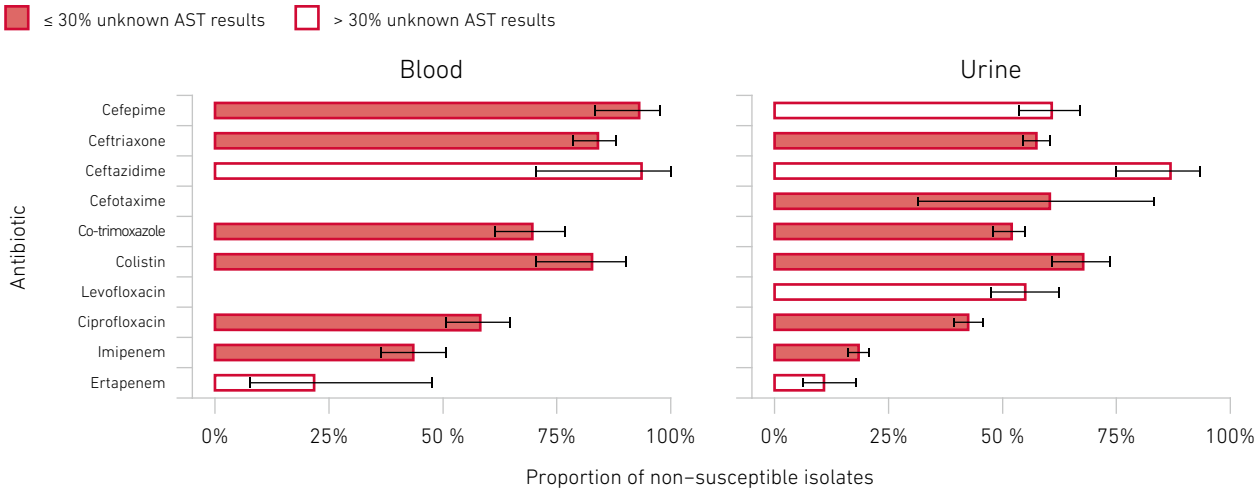


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

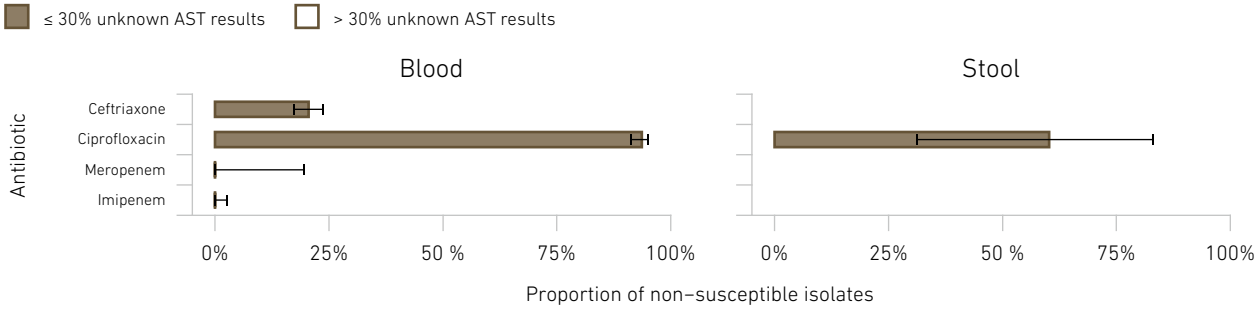
Escherichia coli



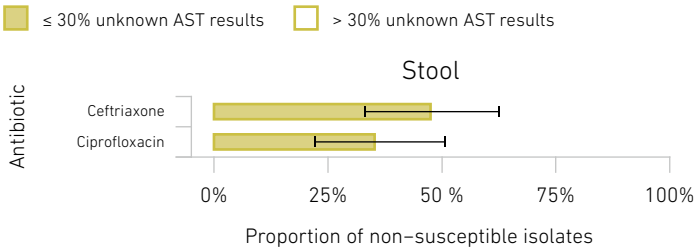
Klebsiella pneumoniae



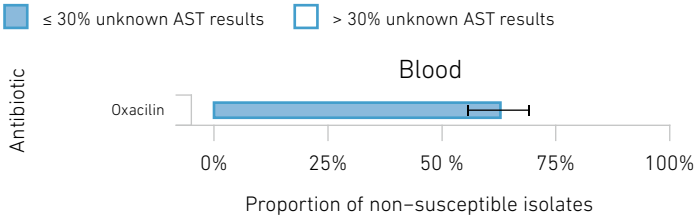
Salmonella **spp.**



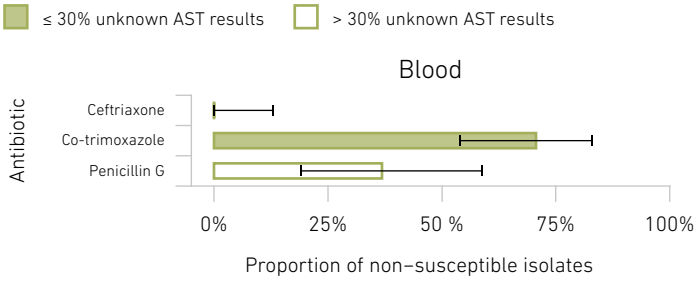
Shigella **spp.**



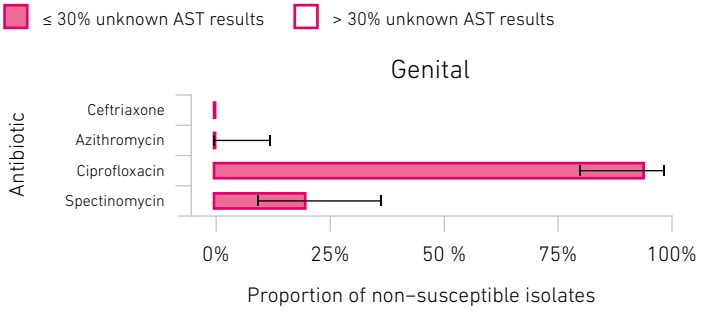
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



Philippines

Population 104.92 million

The National Action Plan to Combat Antimicrobial Resistance: One Health Approach has been launched in 2015 and describes the country's strategies to control emergence of AMR for the next 5 years. The Philippine Antimicrobial Resistance Surveillance Program produces annual reports on AMR surveillance since 1988. Philippines has been enrolled in GLASS since June 2016.

Current status of the national AMR surveillance system

26 surveillance sites
26 hospitals

26 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
26 surveillance sites providing data to GLASS
(26 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

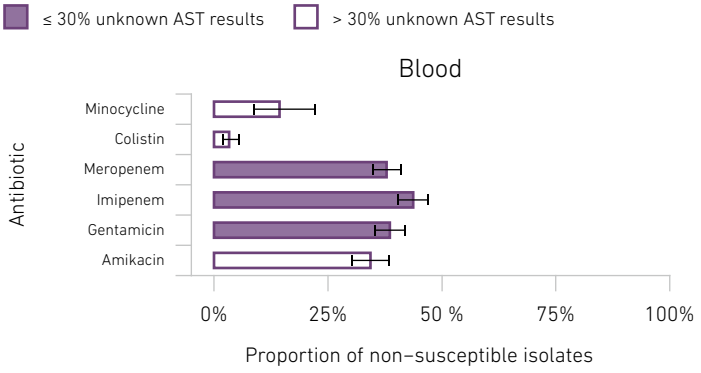
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	40881	13017	12277	*Acinetobacter* spp.	358	301	398
				E. coli	553	167	339
				K. pneumoniae	423	426	374
				Salmonella spp.	171	56	33
				S. aureus	677	246	334
				S. pneumoniae	68	60	11
URINE	11716	4950	5282	*E. coli*	2664	807	1213
				K. pneumoniae	849	416	740
STOOL	990	502	549	*Salmonella* spp.	18	15	7
				Shigella spp.	14	6	2
GENITAL	1584	68	271	*N. gonorrhoeae*	117	-	2

Pathogen non-susceptibility overview[1]

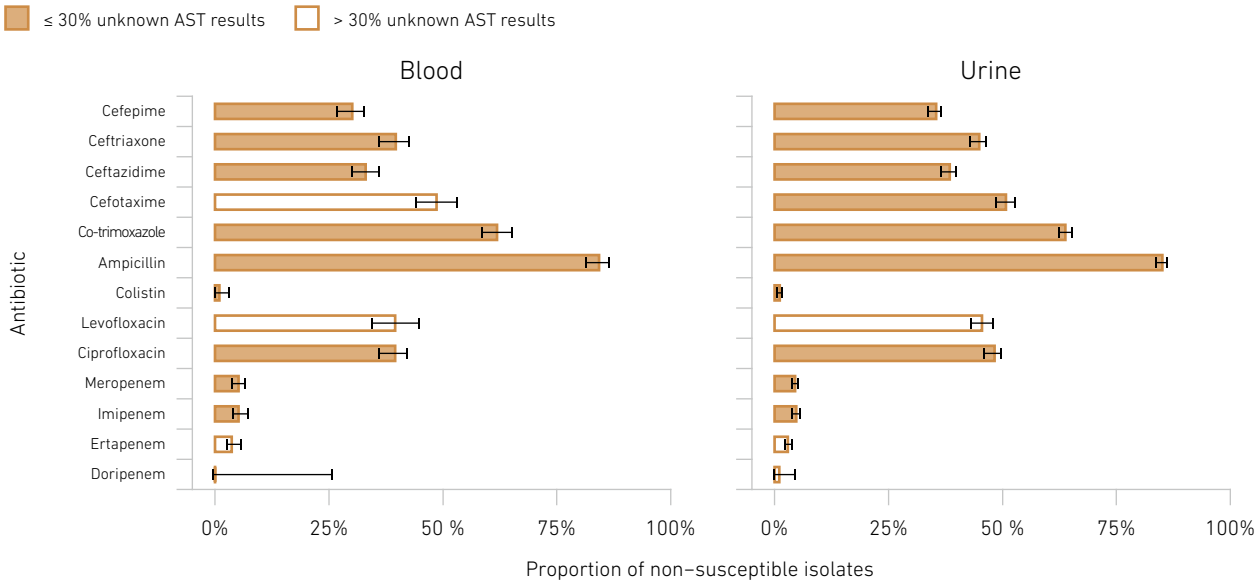
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

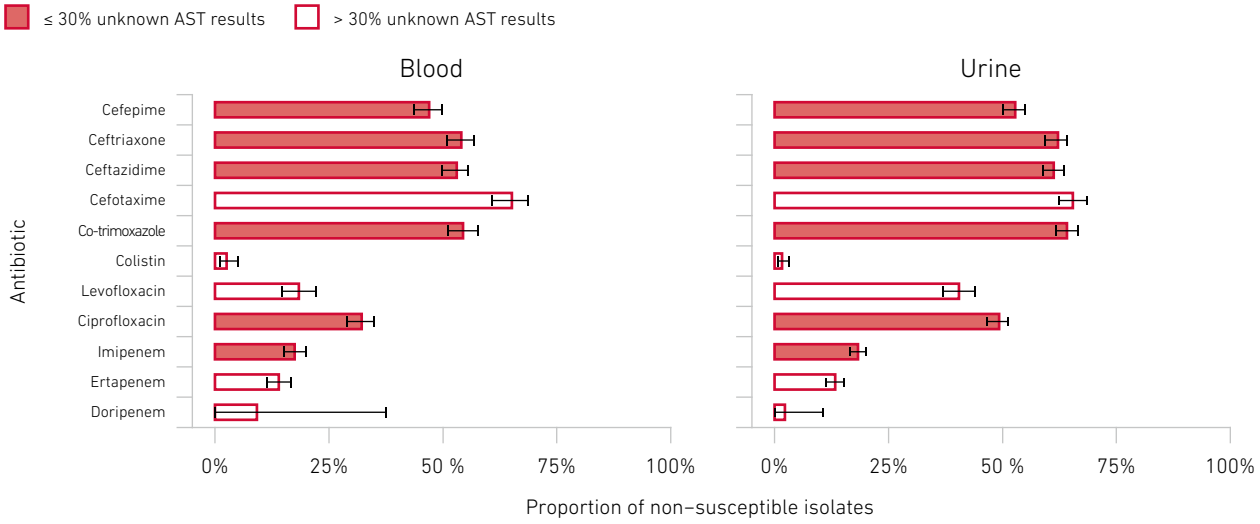


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Escherichia coli

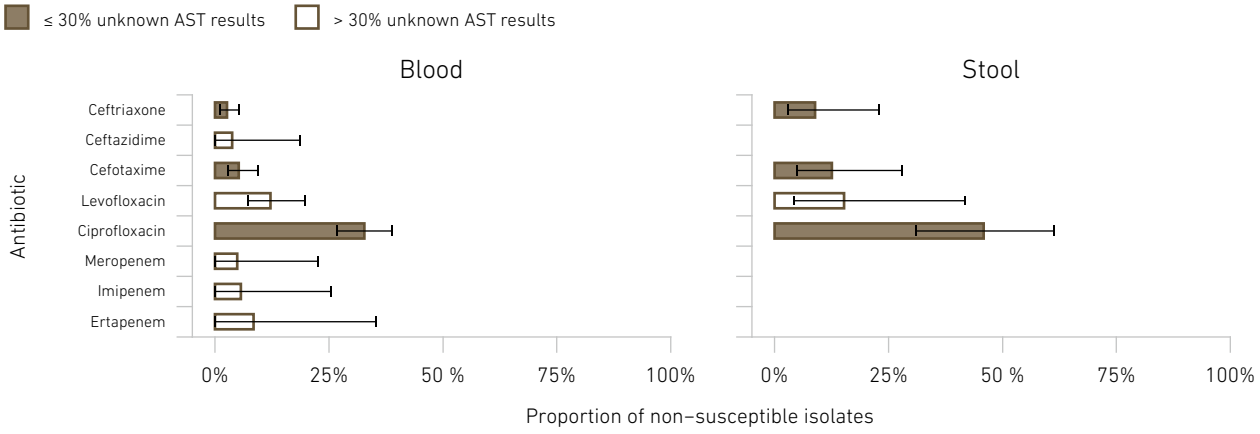


Klebsiella pneumoniae

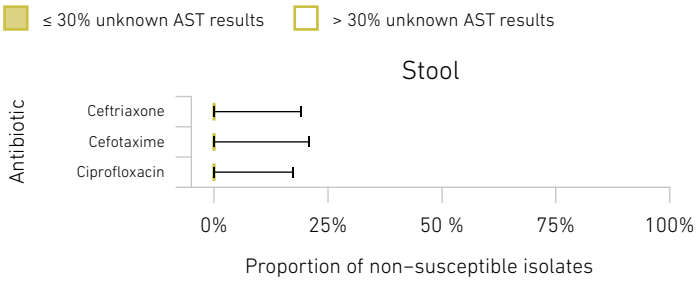


Klebsiella pneumoniae

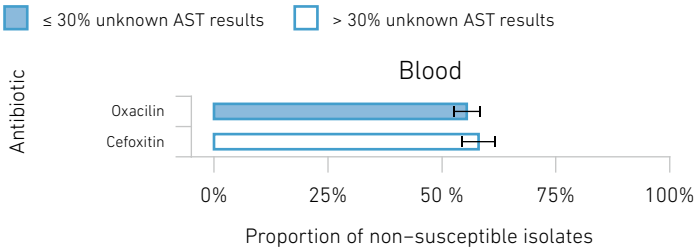
Salmonella **spp.**



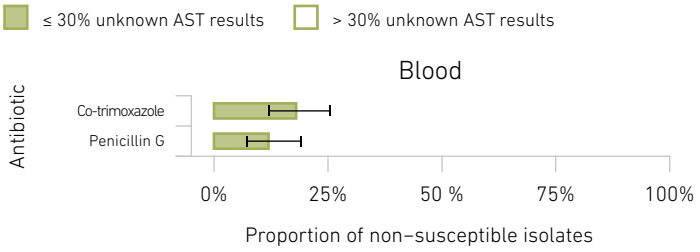
Shigella **spp.**



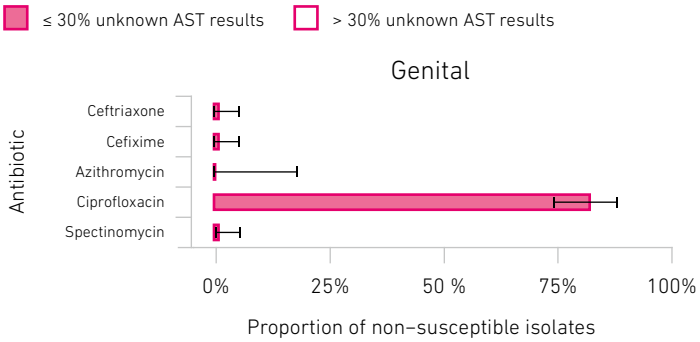
Staphylococcus aureus



Streptococcus pneumoniae



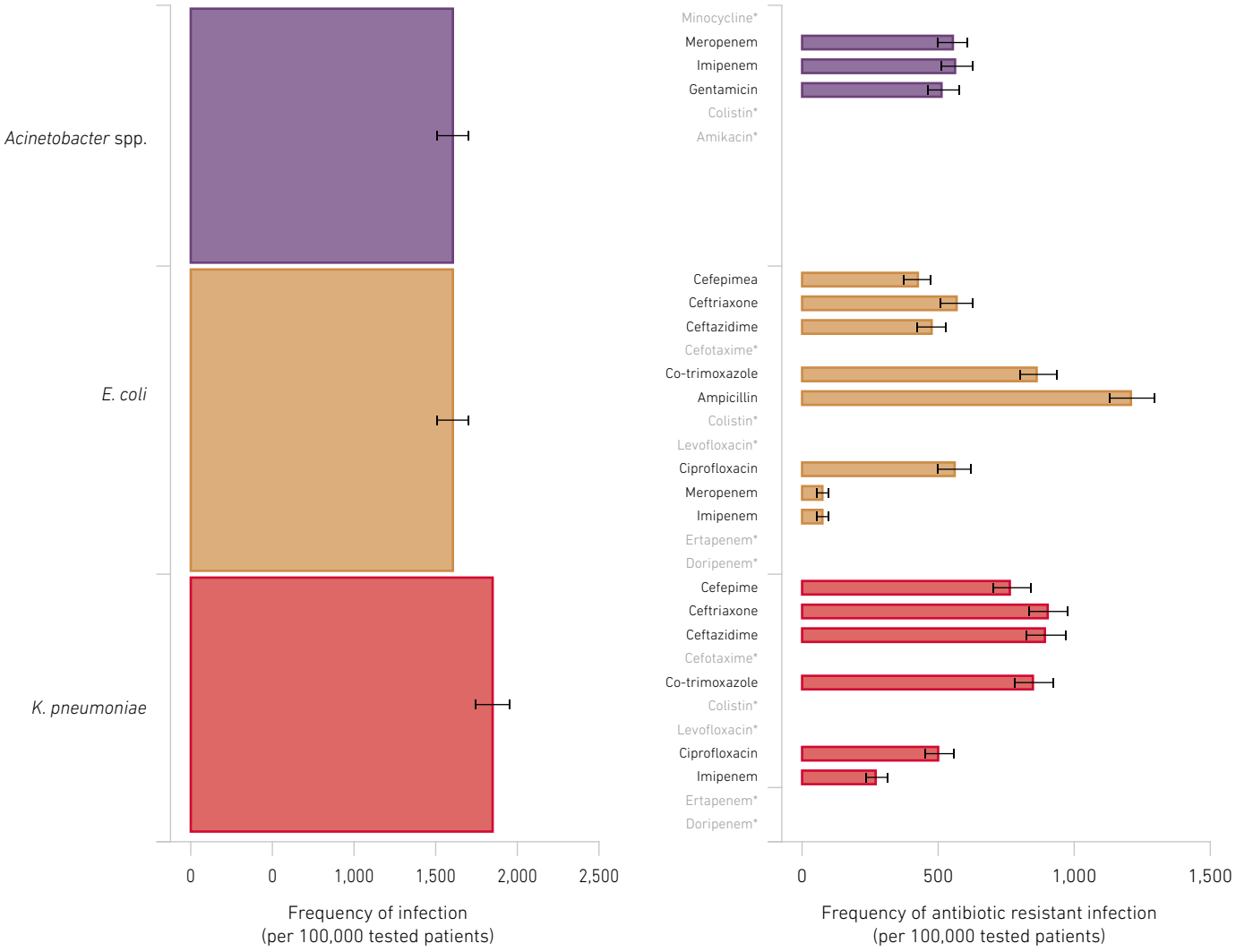
Neisseria gonorrhoeae



Non-susceptible pathogen-antimicrobial combination frequency

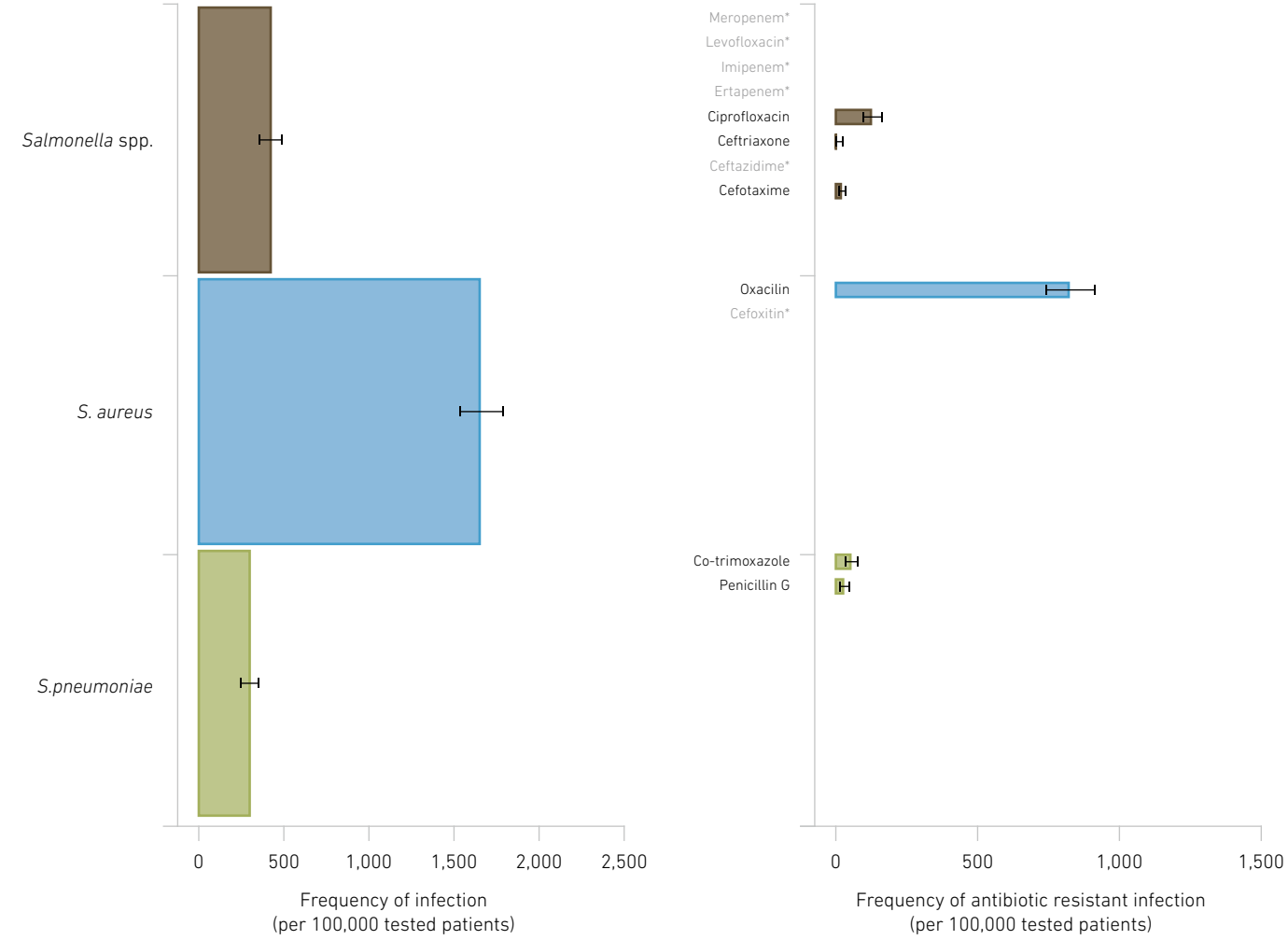
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Unknown origin (n tested = 66175)



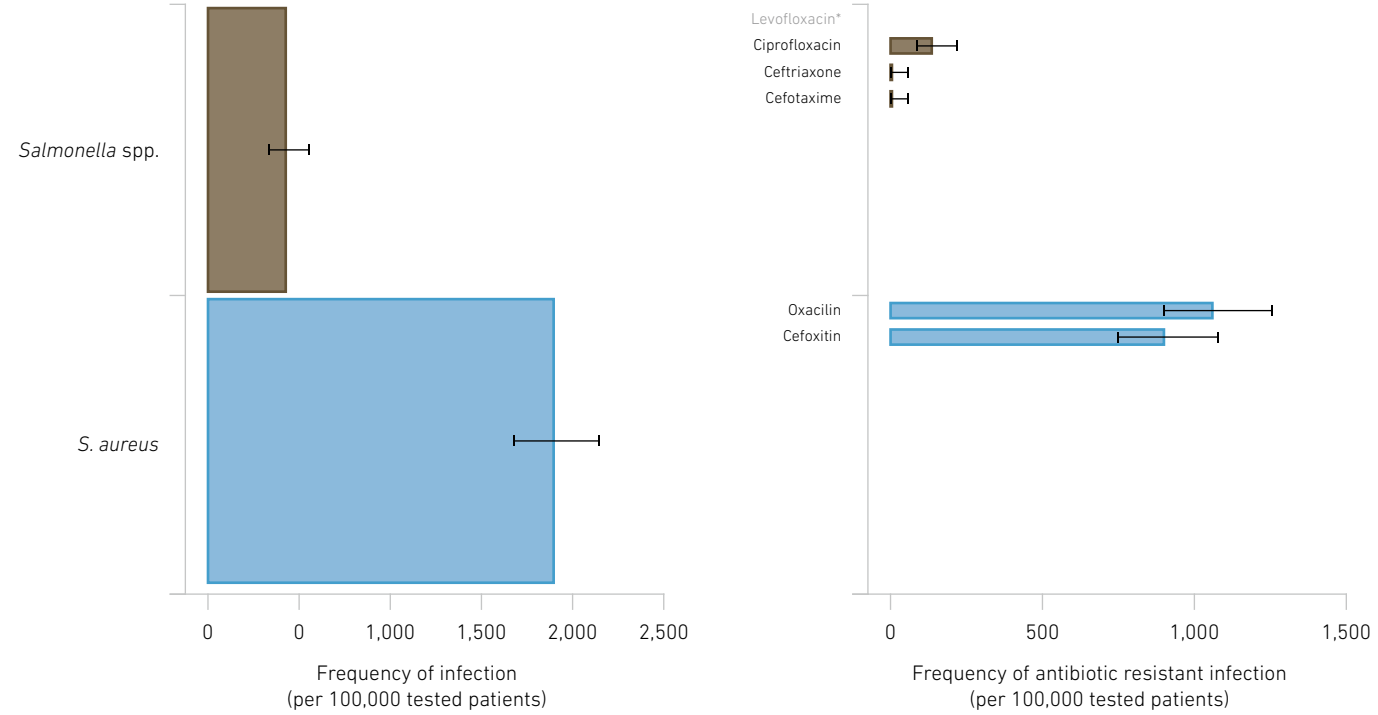
*Antibiotic with >30% unknown AST results: AMR rates not shown

BLOOD- Community origin (n tested = 40881)



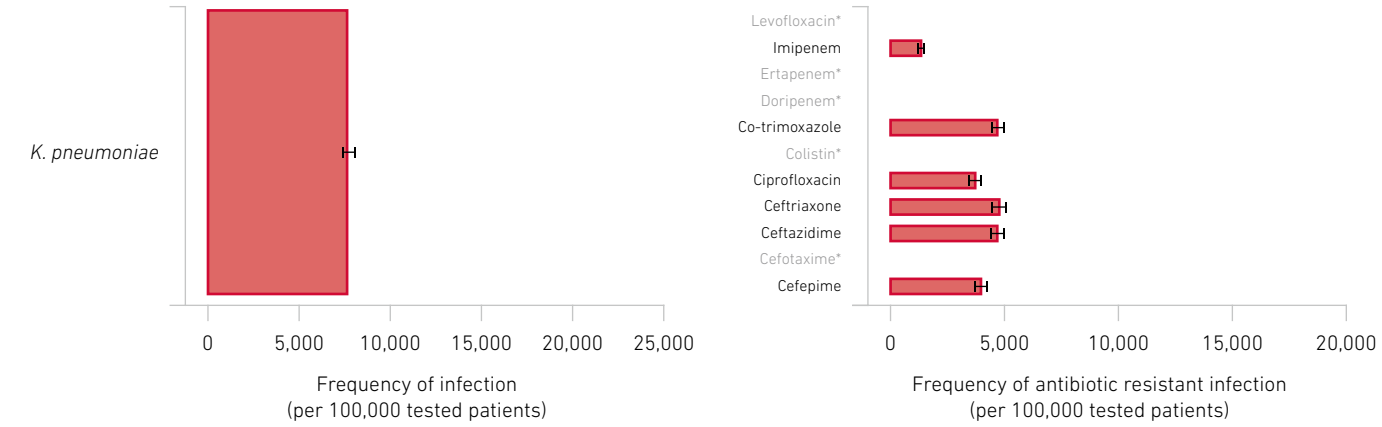
*Antibiotic with >30% unknown AST results: AMR rates not shown

BLOOD- Hospital origin (n tested = 13017)



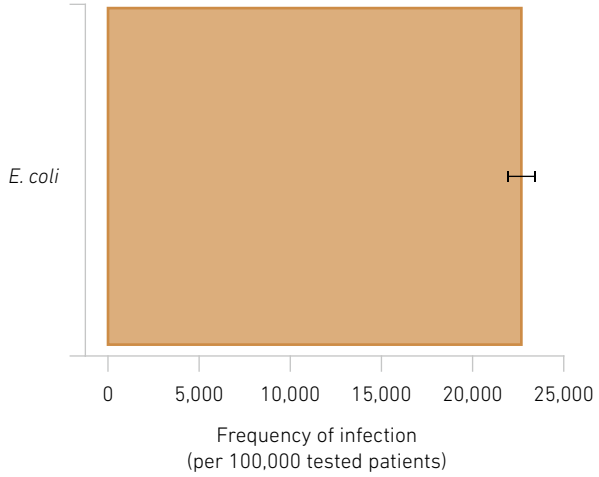
*Antibiotic with >30% unknown AST results: AMR rates not shown

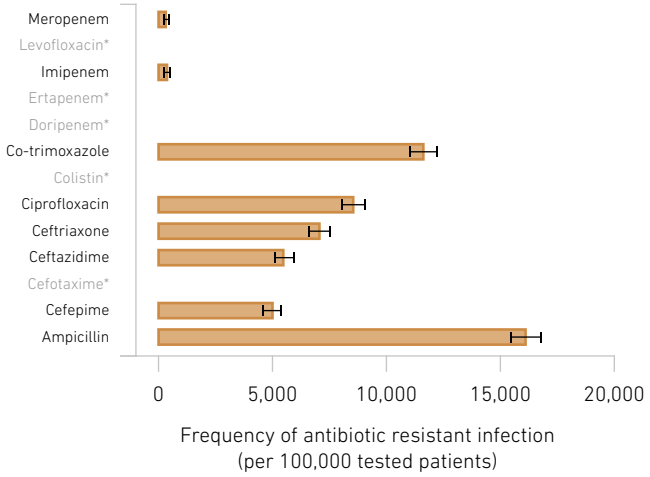
URINE- Unknown origin (n tested = 21948)



*Antibiotic with >30% unknown AST results: AMR rates not shown

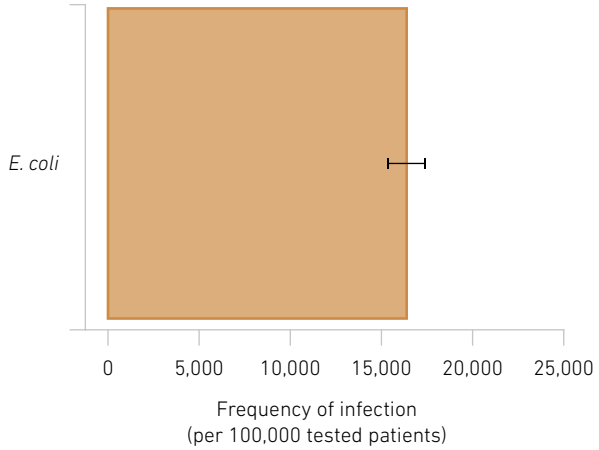
URINE- Community origin (n tested = 11716)

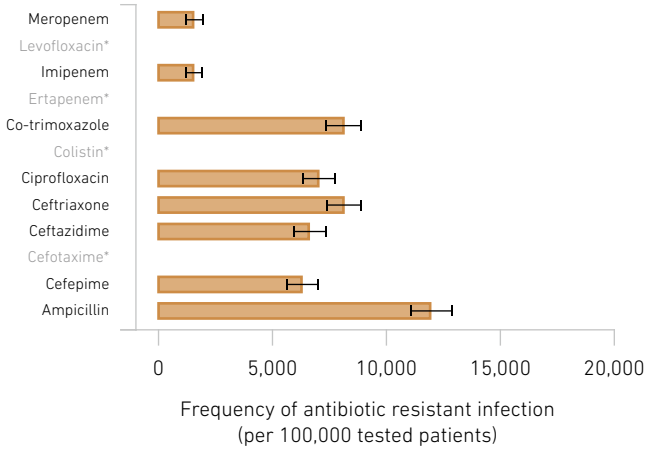




*Antibiotic with >30% unknown AST results: AMR rates not shown

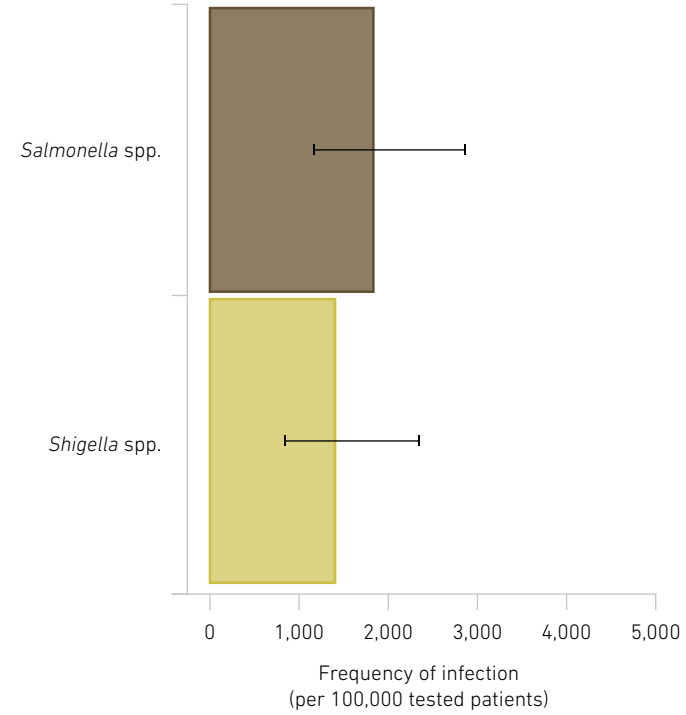
URINE- Hospital origin (n tested = 4950)

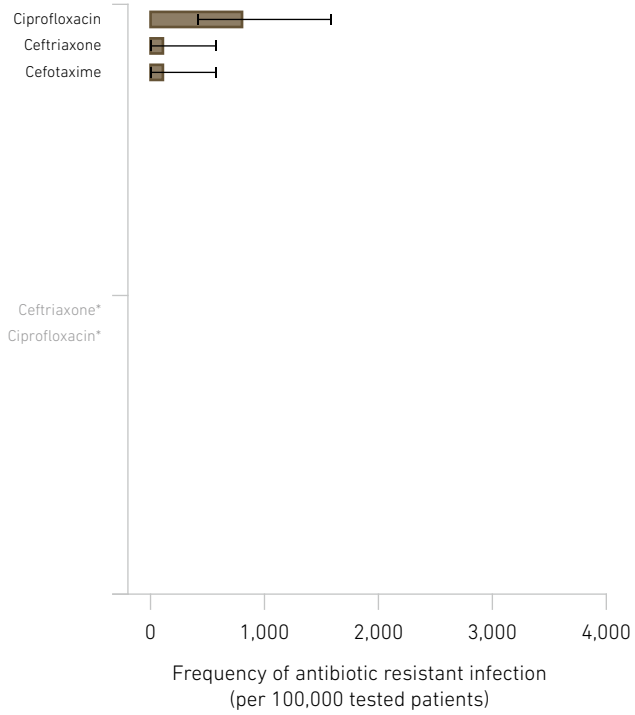




*Antibiotic with >30% unknown AST results: AMR rates not shown

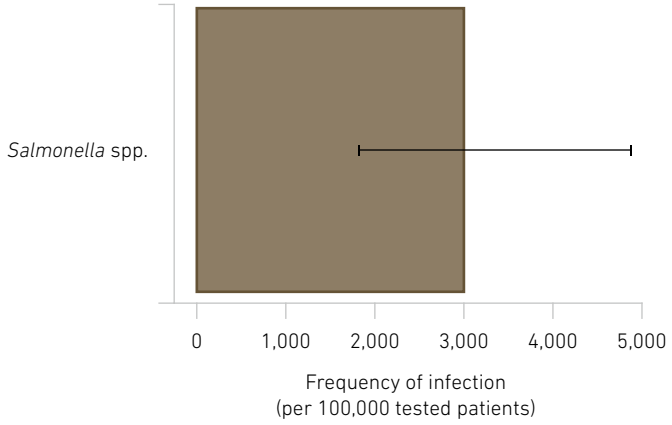
STOOL- Community origin (n tested = 990)

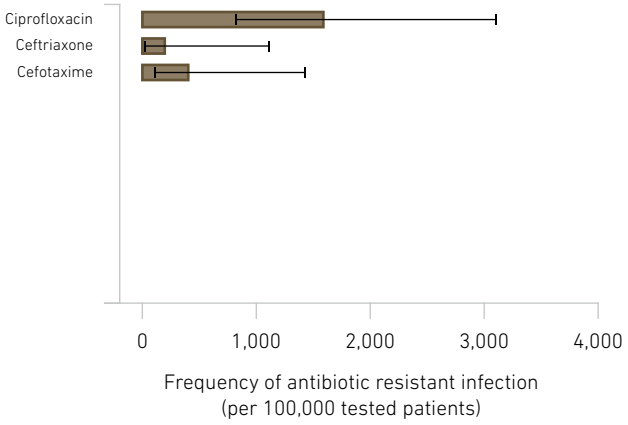




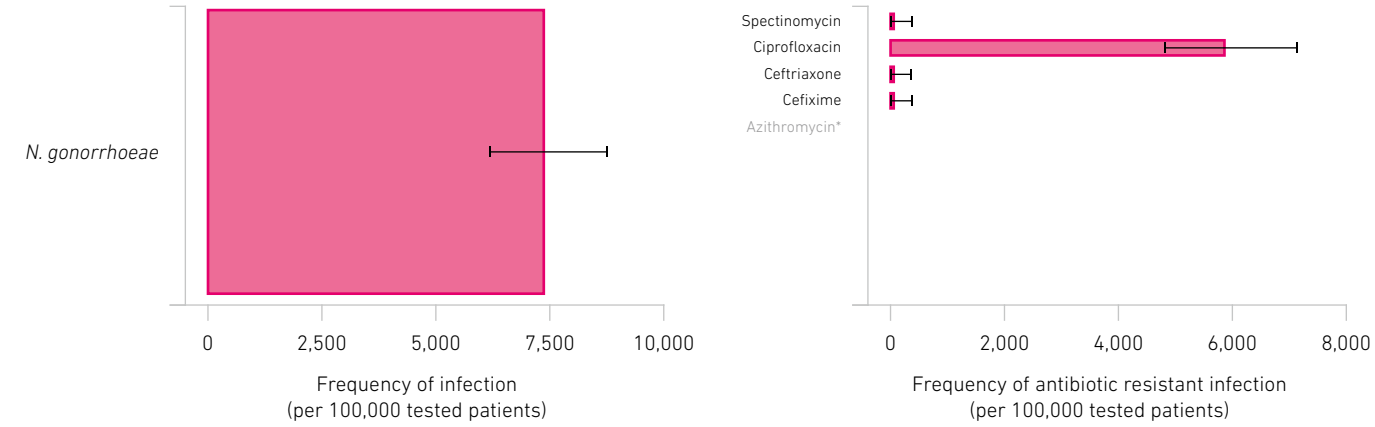
*Antibiotic with >30% unknown AST results: AMR rates not shown

STOOL- Hospital origin (n tested = 502)





GENITAL- Community origin (n tested = 1584)

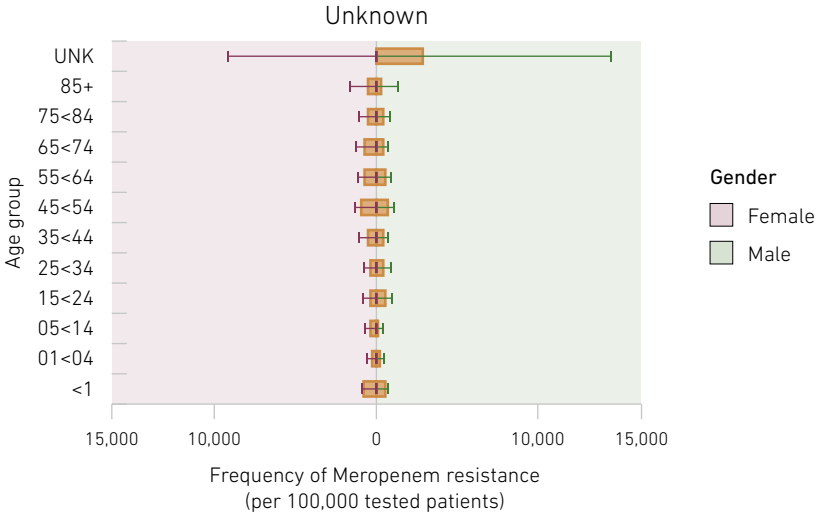


*Antibiotic with >30% unknown AST results: AMR rates not shown

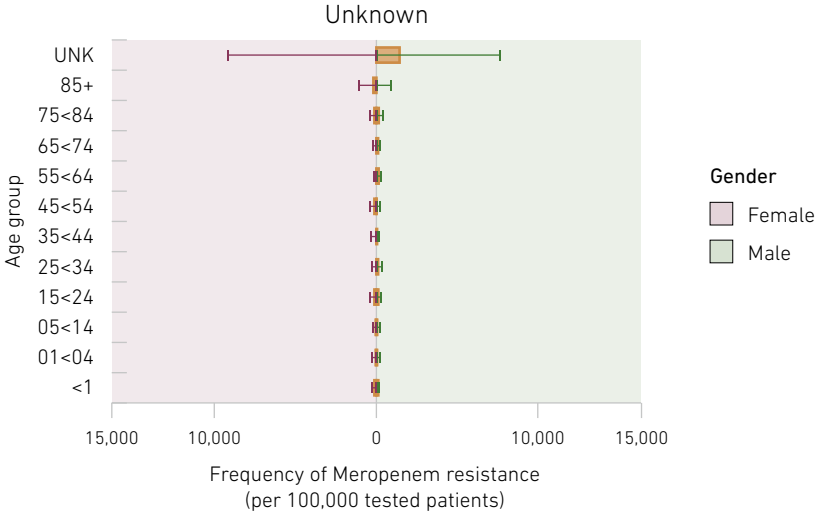
Non-susceptible pathogen-meropenem combination stratified frequency

Frequency of infection caused by pathogens non-susceptible to meropenem per specimen and infection origin, stratified by age and gender.

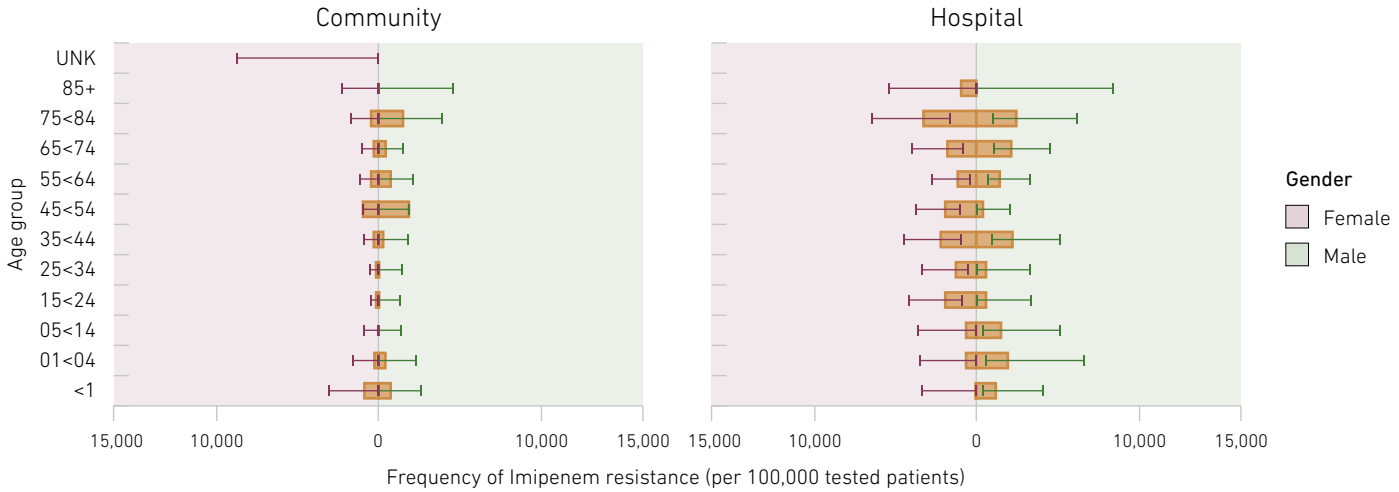
BLOOD - *Acinetobacter* **spp.**



BLOOD - *Escerichia coli*



URINE - *Escerichia coli*



Poland

Population 38.17 million

The country participates in the EARS-NET and has been enrolled in GLASS since August 2016.

Current status of the national AMR surveillance system

70 surveillance sites
70 hospitals

65 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
not reported
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
70 surveillance sites providing data to GLASS
(70 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

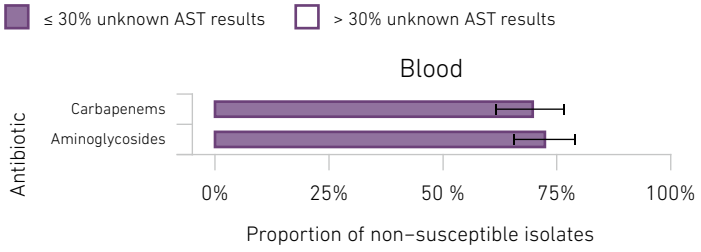
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	351
				E. coli	-	-	2867
				K. pneumoniae	-	-	1203
				Salmonella spp.	11	1	59
				S. aureus	-	-	1805
				S. pneumoniae	-	-	290
URINE	-	-	-	*K. pneumoniae*	-	-	-
				E. coli	-	-	-
STOOL	-	-	-	*Salmonella* spp.	68	16	447
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

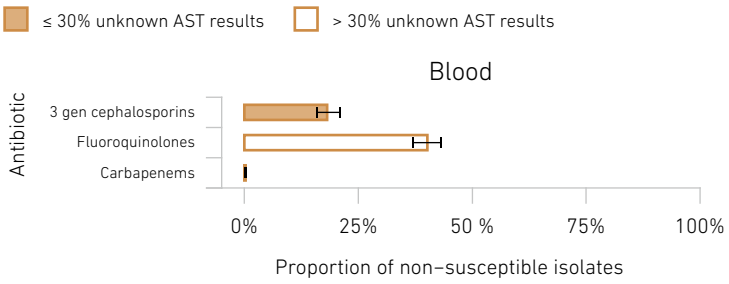
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

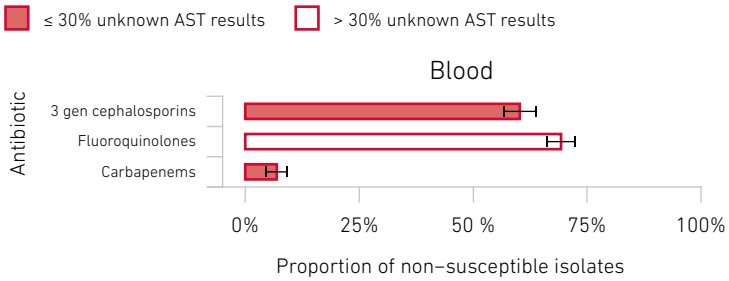


Escherichia coli

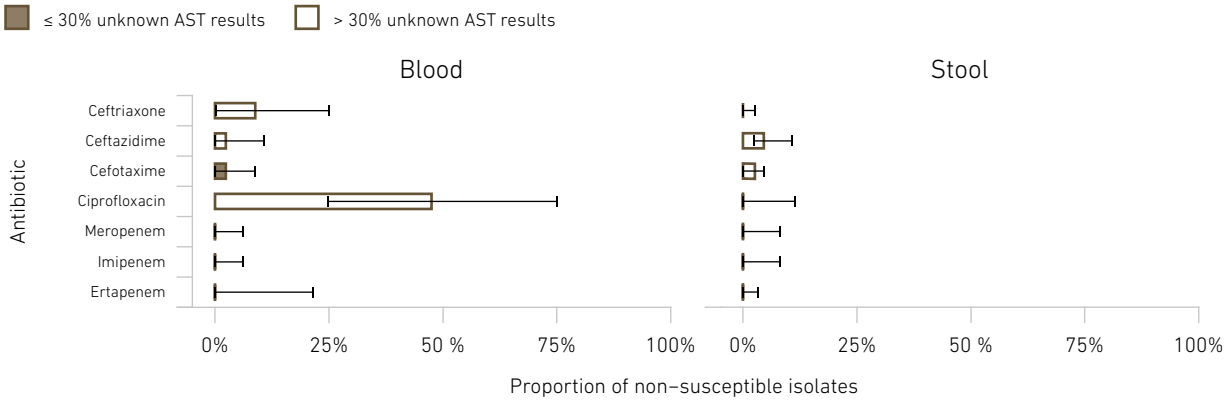


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

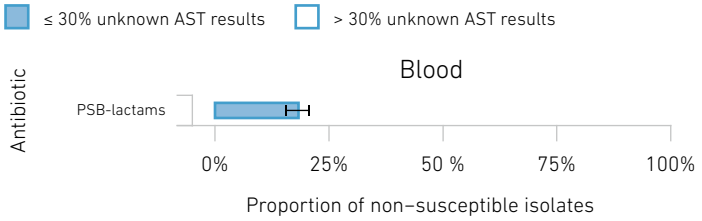
Klebsiella pneumoniae



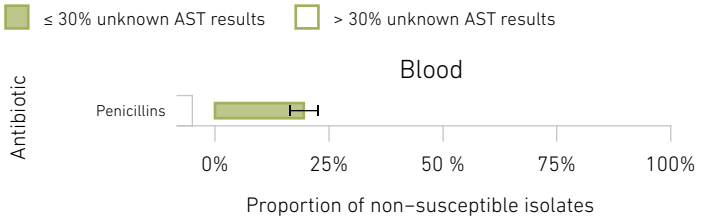
Salmonella **spp.**



Staphylococcus aureus



Streptococcus pneumoniae



Republic of Korea

Population 50.98 million

The Republic of Korea has been conducting surveillance of AMR since 2002 when the first nationwide AMR surveillance system (Korean Antimicrobial Resistance Monitoring System, KARMS) was launched. After adopting the National Action Plan on AMR in 2016, the national system was reorganized and named Kor-GLASS. The Republic of Korea has been enrolled in GLASS since July 2016.

Current status of the national AMR surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

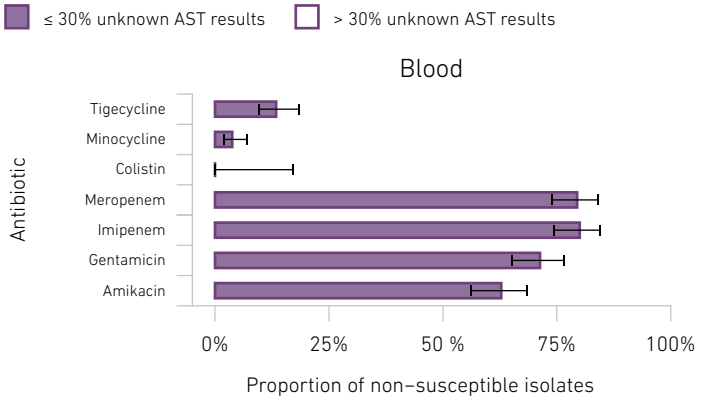
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	69898	11278	-	*Acinetobacter* spp.	28	207	-
				E. coli	1426	346	-
				K. pneumoniae	490	203	-
				Salmonella spp.	51	5	-
				S. aureus	358	350	-
				S. pneumoniae	48	6	-
URINE	64832	11793	-	*E. coli*	6584	1290	-
				K. pneumoniae	814	442	-
STOOL	9021	6436	-	*Salmonella* spp.	163	9	-
				Shigella spp.	1	-	-
GENITAL	4834	331	-	*N. gonorrhoeae*	1	-	-

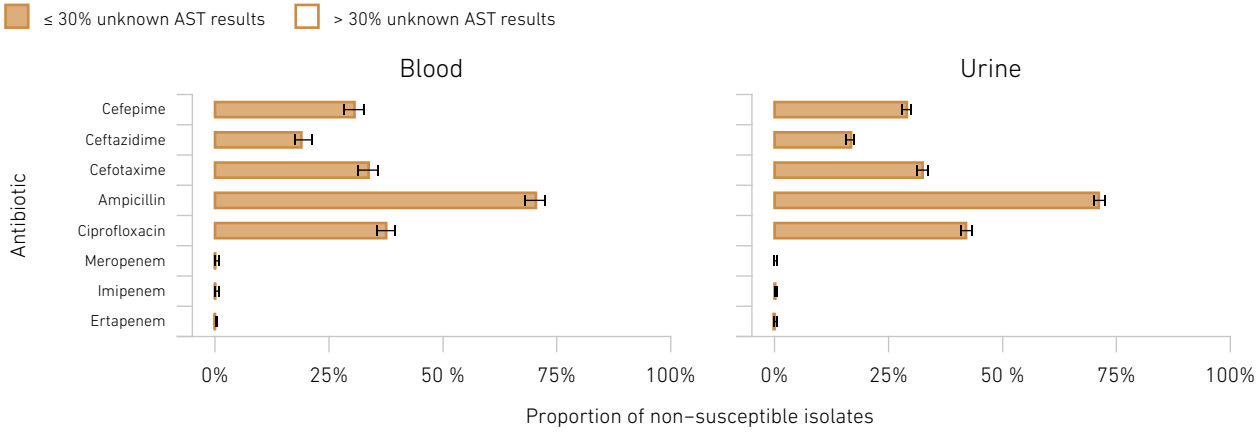
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

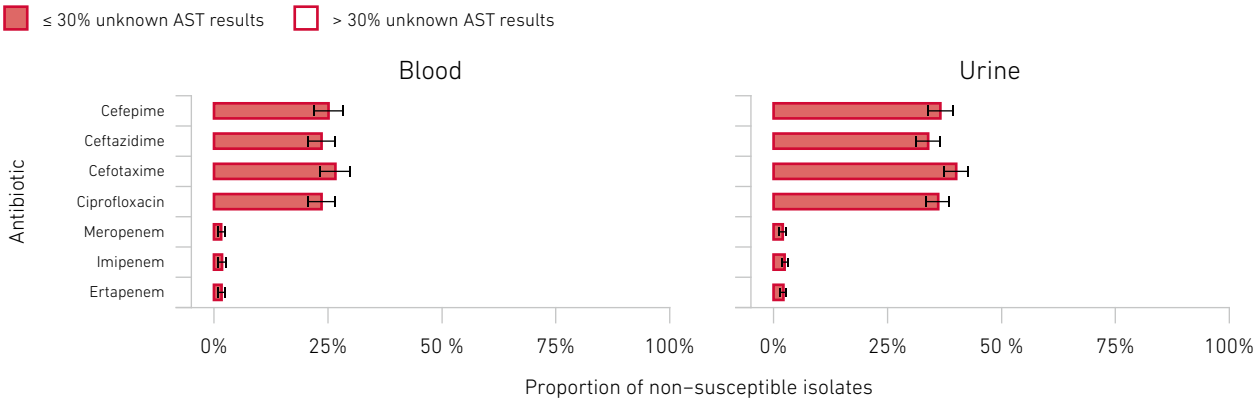


Escherichia coli

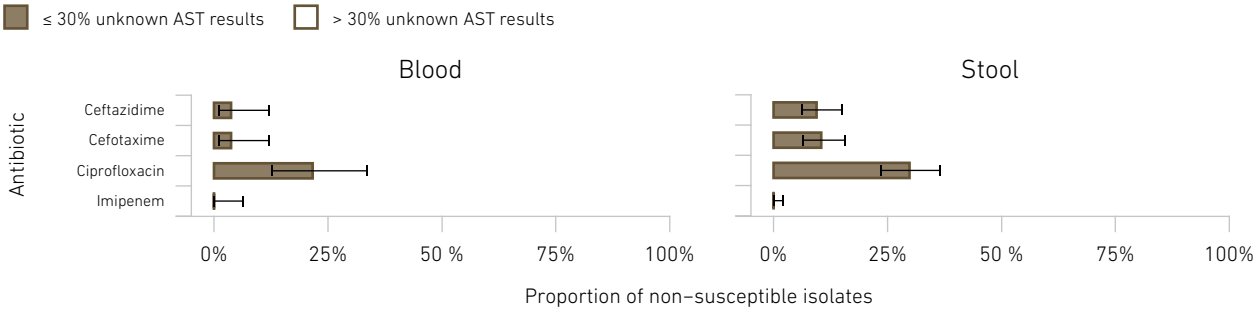


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

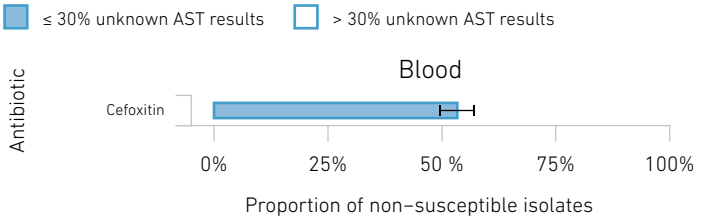
Klebsiella pneumoniae



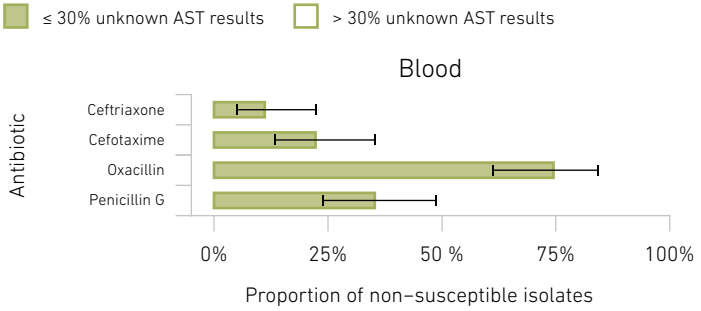
Salmonella **spp.**



Staphylococcus aureus



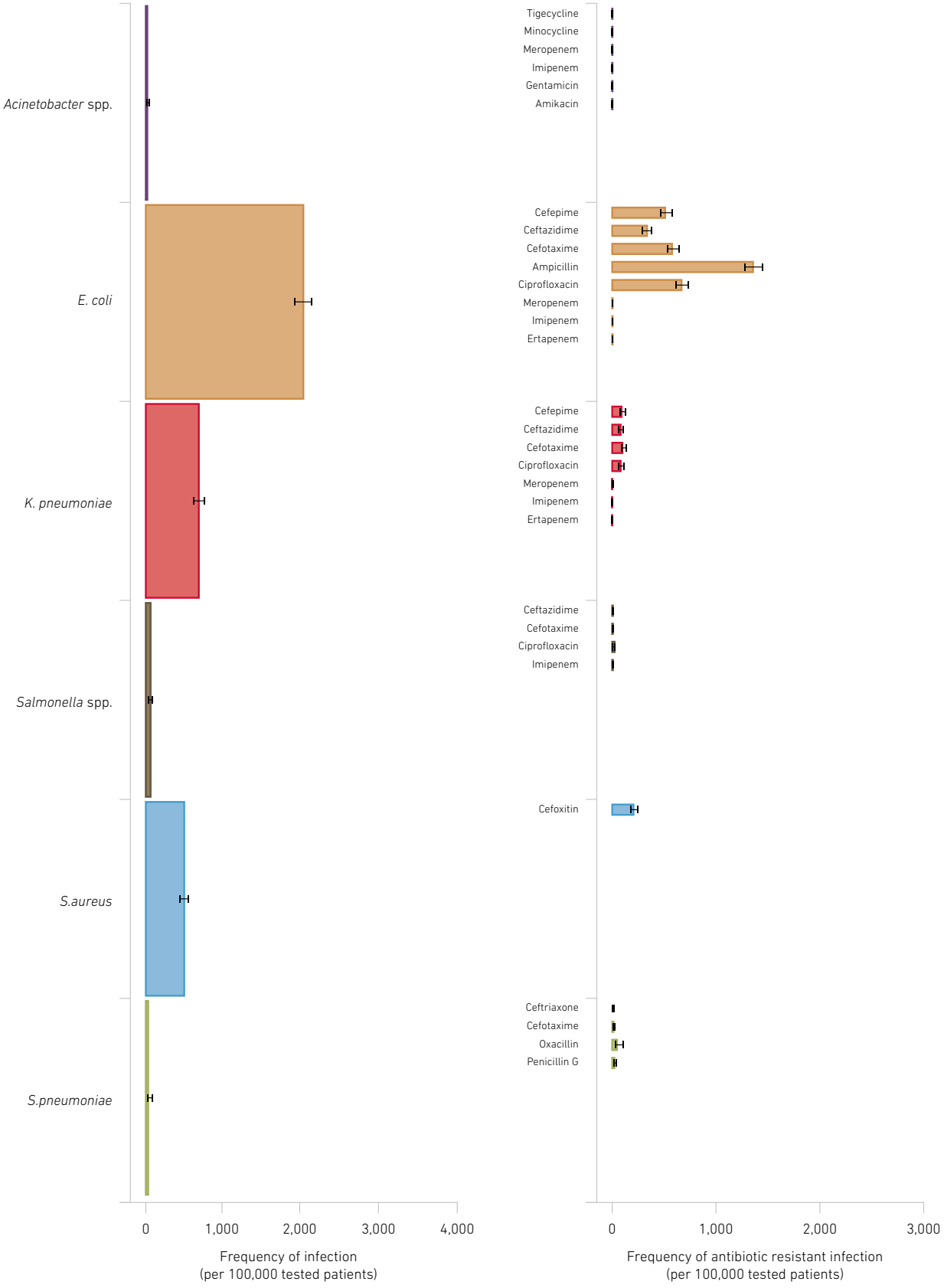
Streptococcus pneumoniae



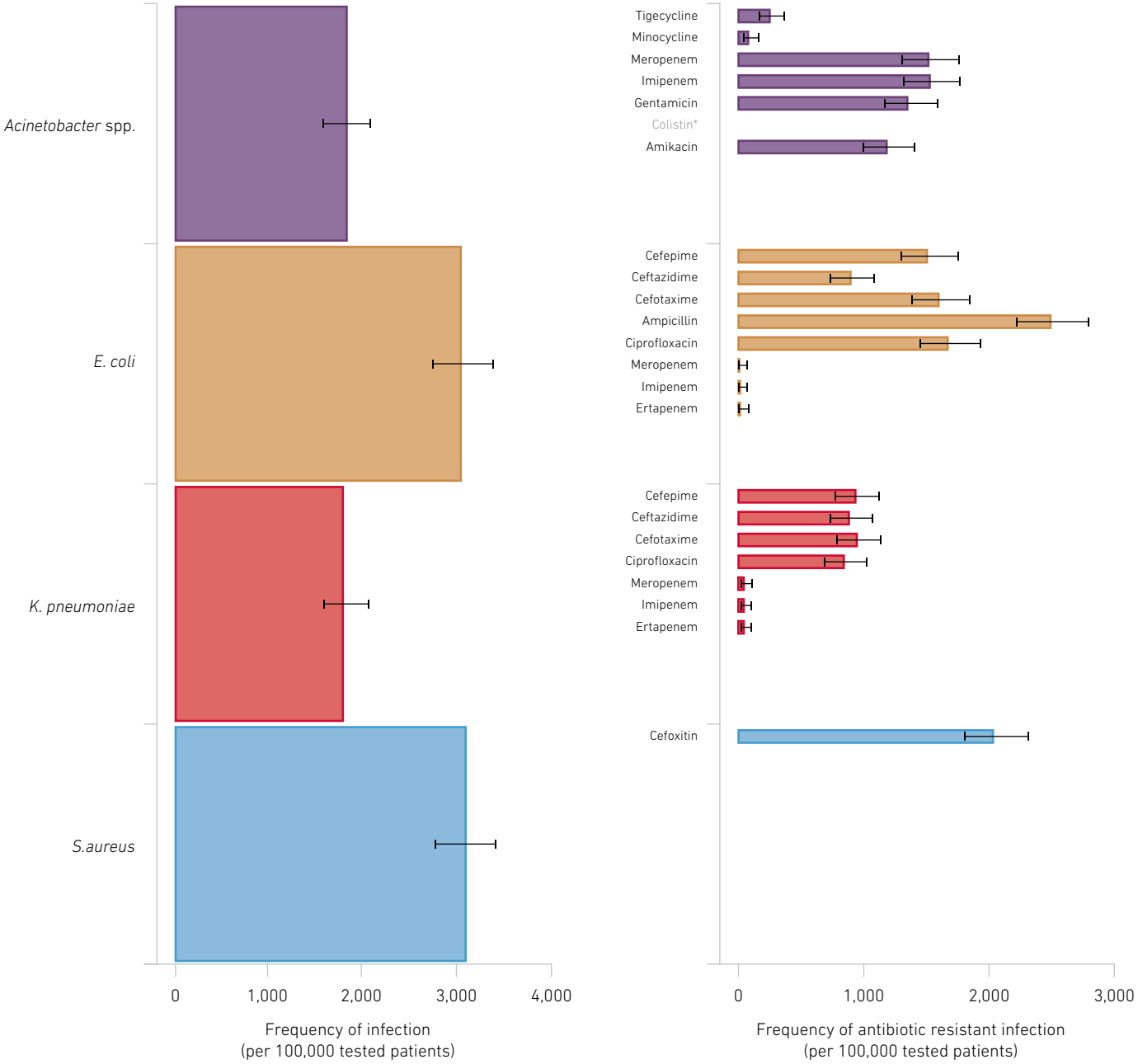
Non-susceptible pathogen-antimicrobial combination frequency

Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Community origin (n tested = 69898)

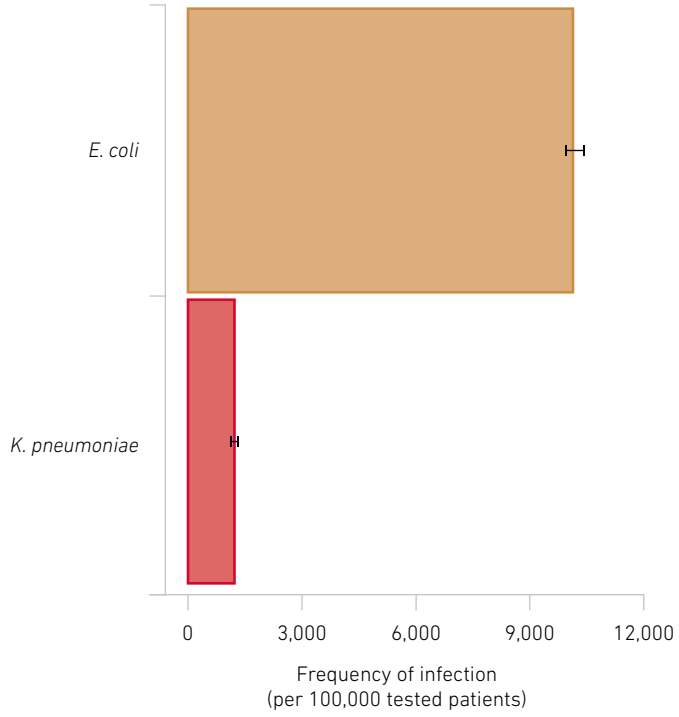


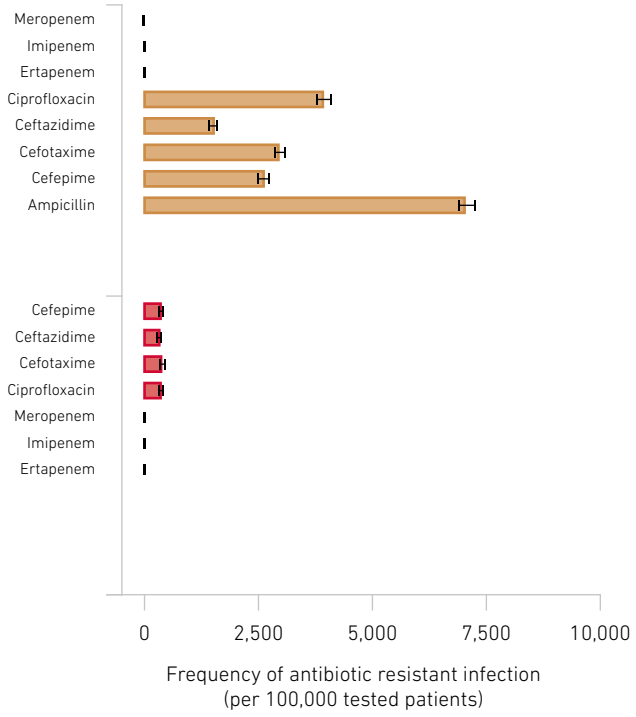
BLOOD- Hospital origin (n tested = 11278)



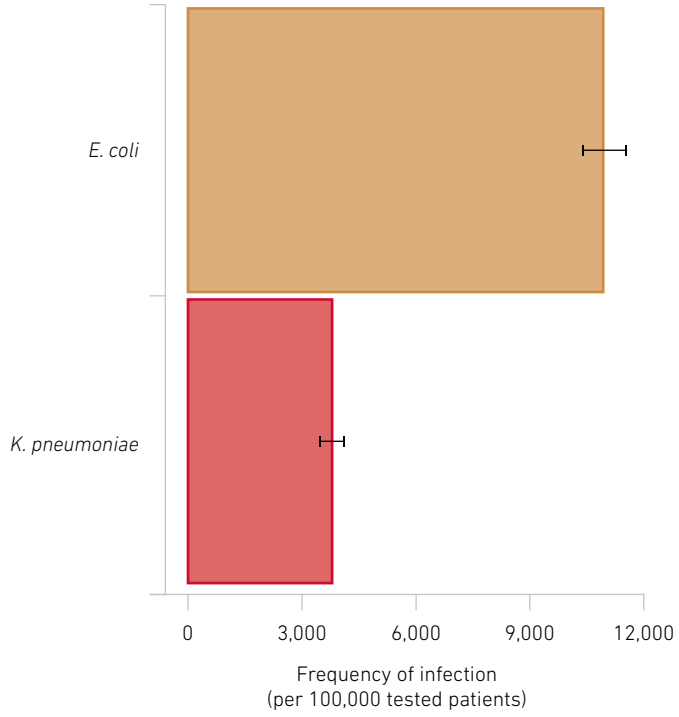
*Antibiotic with >30% unknown AST results: AMR rates not shown

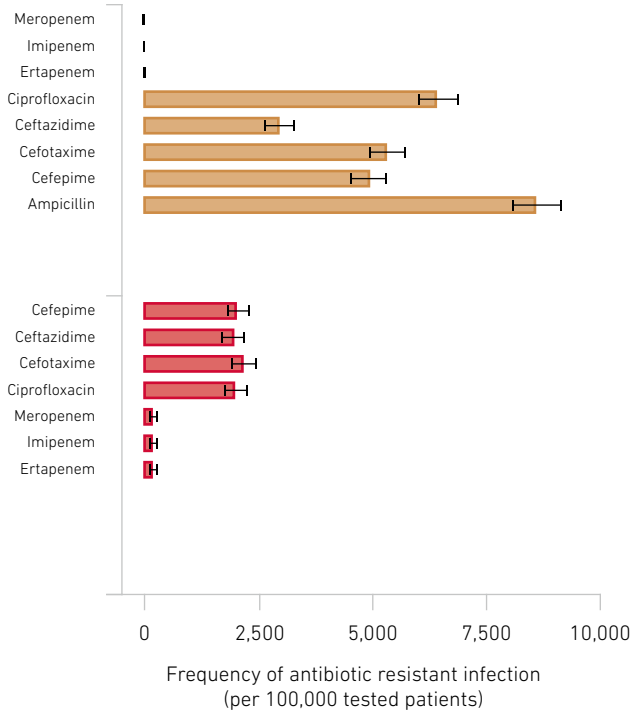
URINE- Community origin (n tested = 64832)



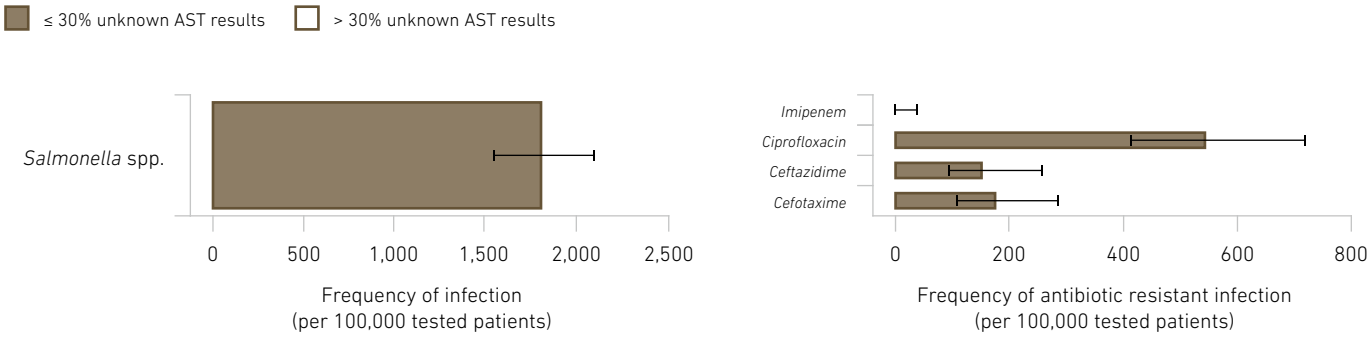


URINE- Hospital origin (n tested = 11793)





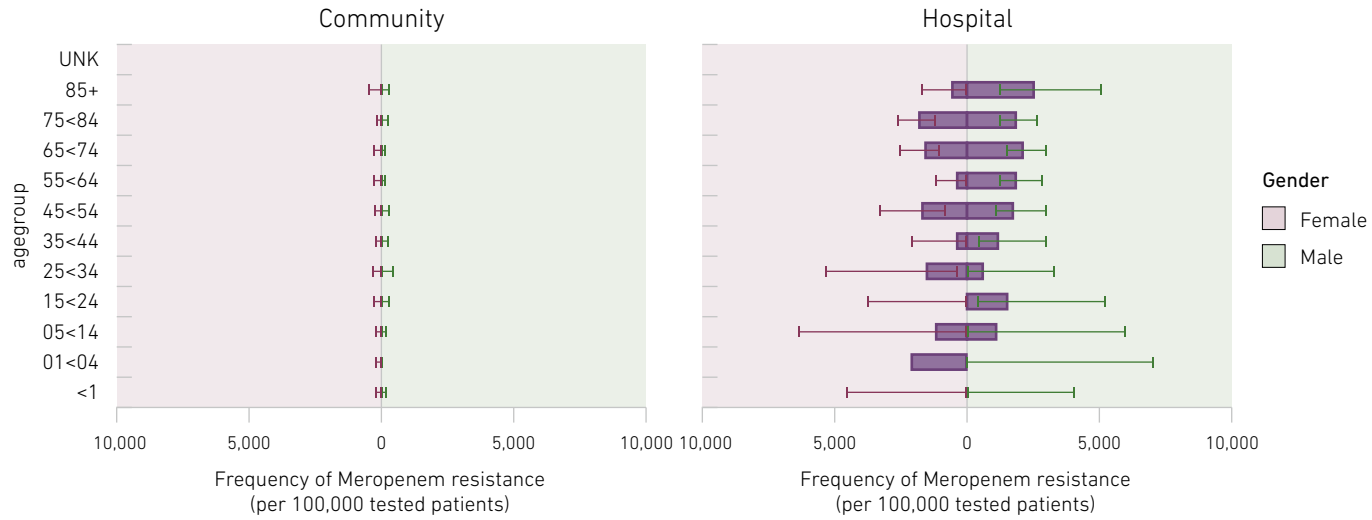
STOOL- Community origin (n tested = 9021)



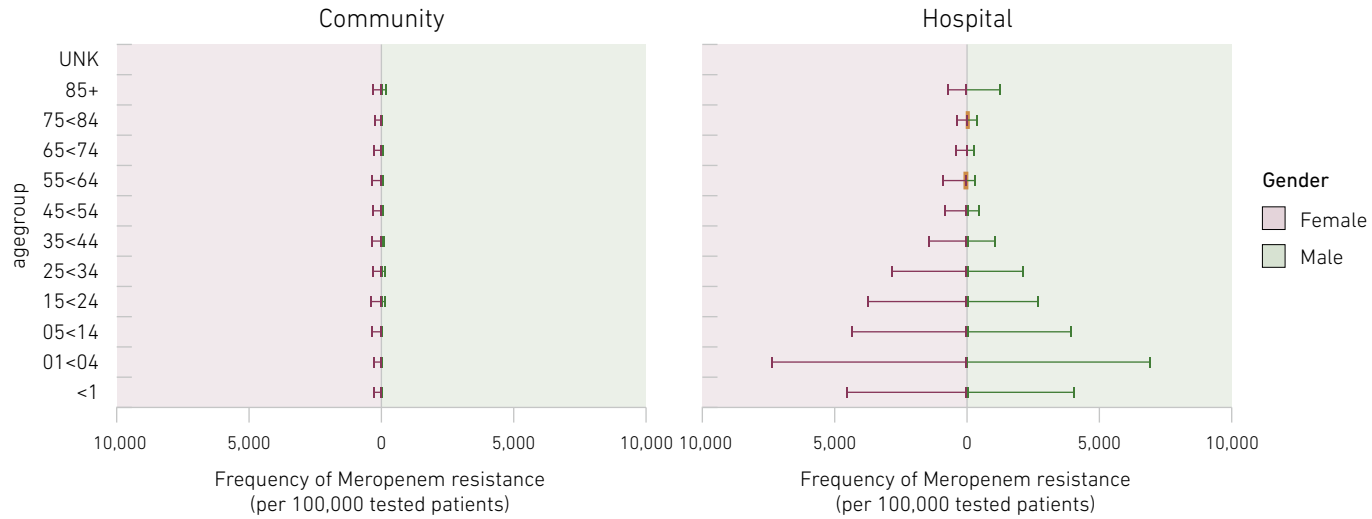
Non-susceptible pathogen-meropenem combination stratified frequency[2]

Frequency of infection caused by pathogens non-susceptible to meropenem per specimen and infection origin, stratified by age and gender.

BLOOD - *Acinetobacter* **spp.**

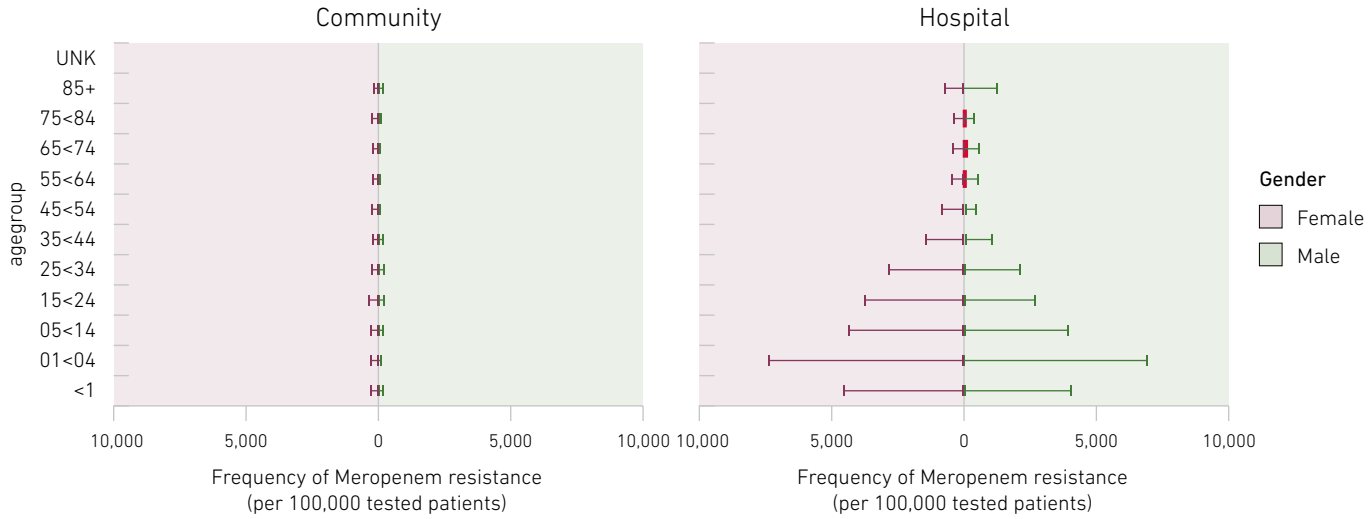


BLOOD - Escerichia Coli

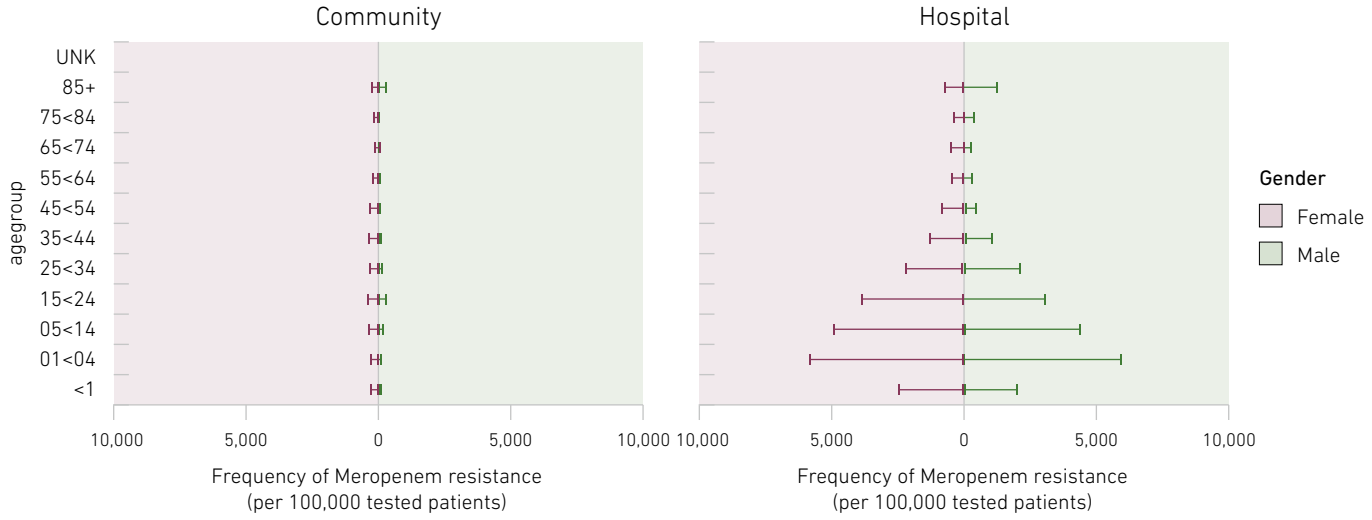


[2] Results for isolates with >30% unknown AST results are not shown. Grouping of carbapenem antibiotics was not possible due to results bias generation linked with data aggregation.

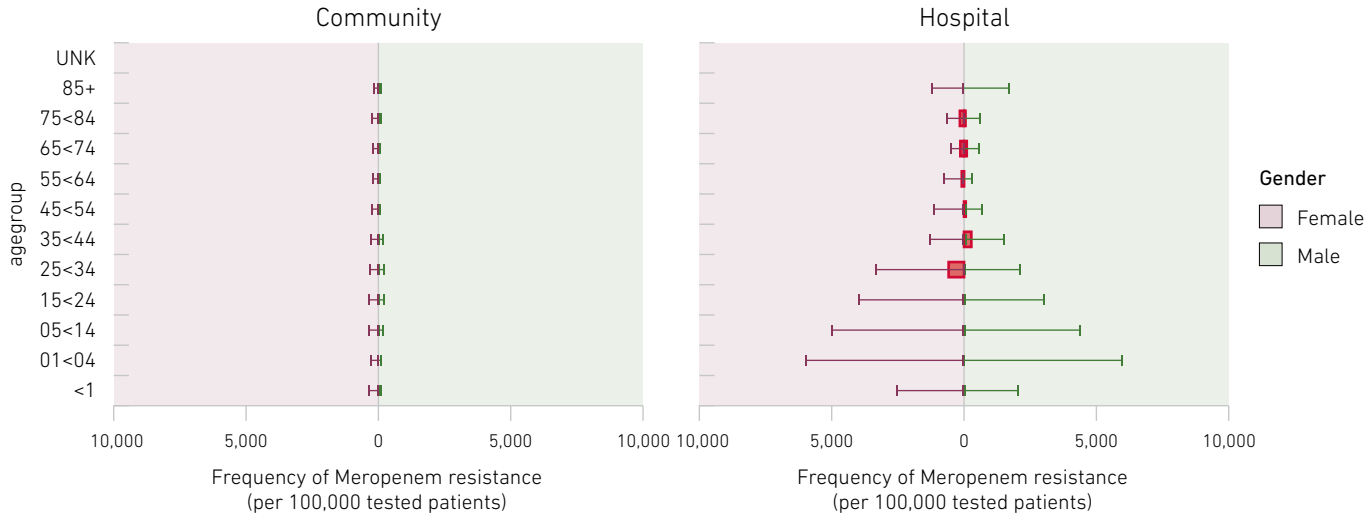
BLOOD - *Klebsiella pneumoniae*



URINE - *Escerichia coli*



URINE - *Klebsiella pneumoniae*



Republic of North Macedonia

Population 2.08 million

The former Yugoslav republic of Macedonia is developing its national surveillance system with a network of laboratories covering about 79% of hospitals (2015). The country participates in CAESAR and has been enrolled in GLASS since May 2017.

Current status of the national AMR surveillance system

30 participating laboratories*

30 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
not provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
37 surveillance sites providing data to GLASS
(37 hospitals)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

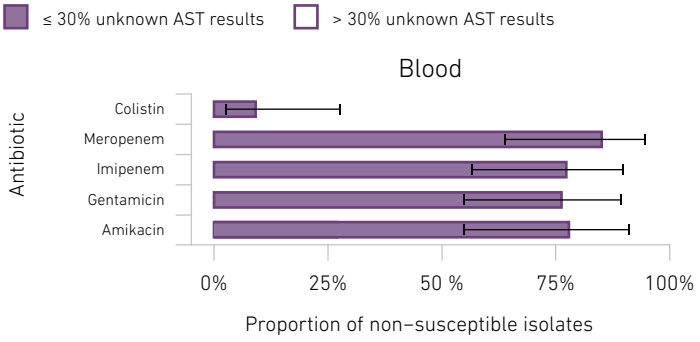
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	23
				E. coli	-	-	77
				K. pneumoniae	-	-	23
				Salmonella spp.	-	-	-
				S. aureus	-	-	50
				S. pneumoniae	-	-	2
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

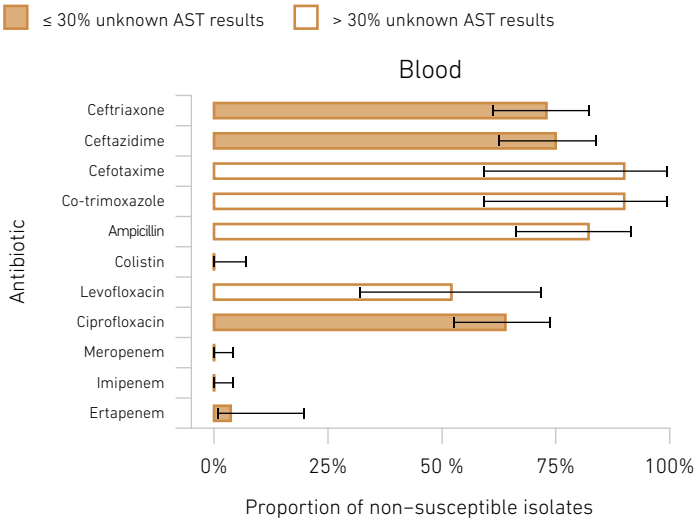
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

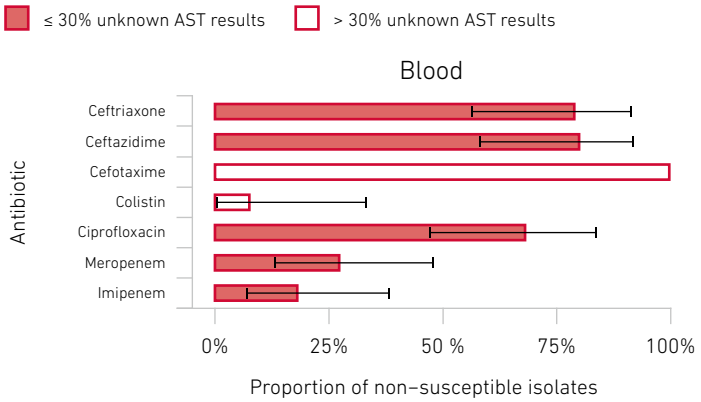


Escherichia coli

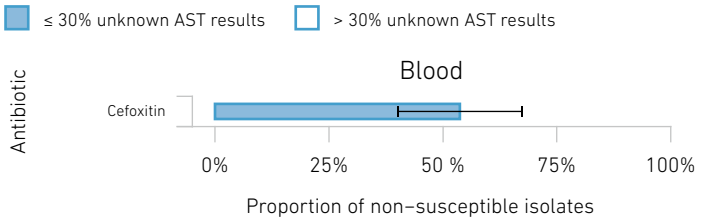


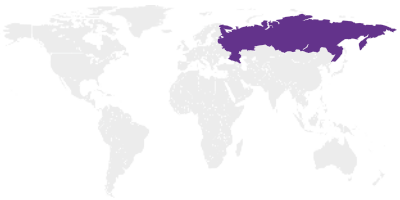
[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Klebsiella pneumoniae



Staphylococcus aureus





Russian Federation

Population 143.99 million

Current status of the national AMR surveillance system

71 surveillance sites
50 hospitals
21 outpatient facilities

45 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

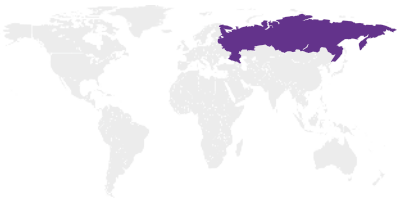
GLASS
Global AMR Surveillance System

Number of surveillance sites providing data to GLASS not reported

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected



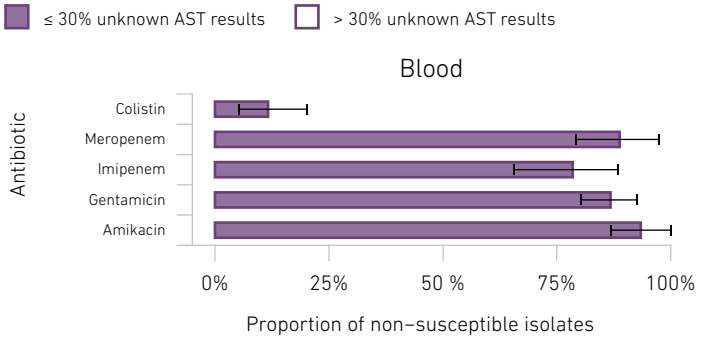
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	51
				E. coli	-	-	52
				K. pneumoniae	-	-	125
				Salmonella spp.	-	-	-
				S. aureus	-	-	85
				S. pneumoniae	-	-	8
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

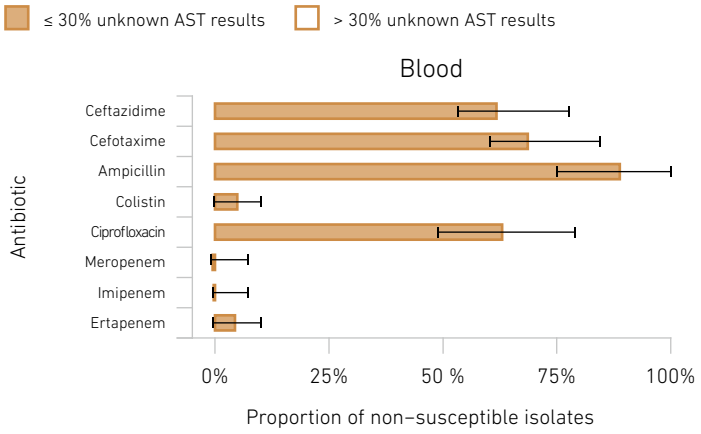
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

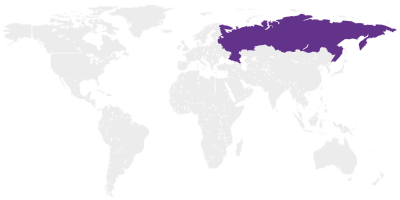
Acinetobacter **spp.**



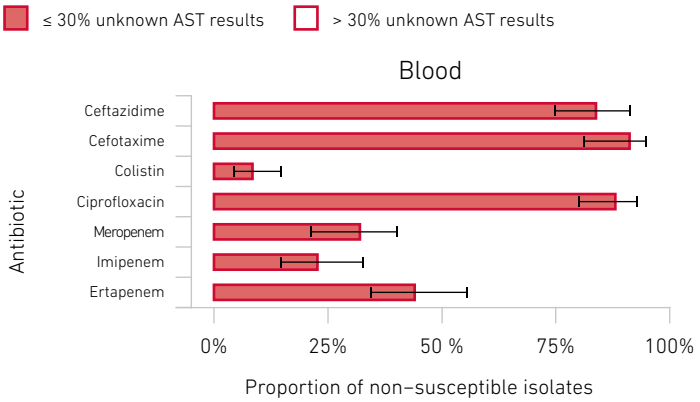
Escherichia coli



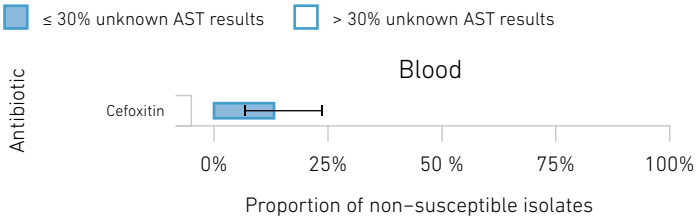
[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.



Klebsiella pneumoniae



Staphylococcus aureus



Saudi Arabia

Population 32.94 million

Saudi Arabia has been enrolled in GLASS since May 2017.

Current status of the national AMR surveillance system

39 surveillance sites
39 hospitals

39 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS

in 2018 data call
39 surveillance sites providing data to GLASS
(39 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

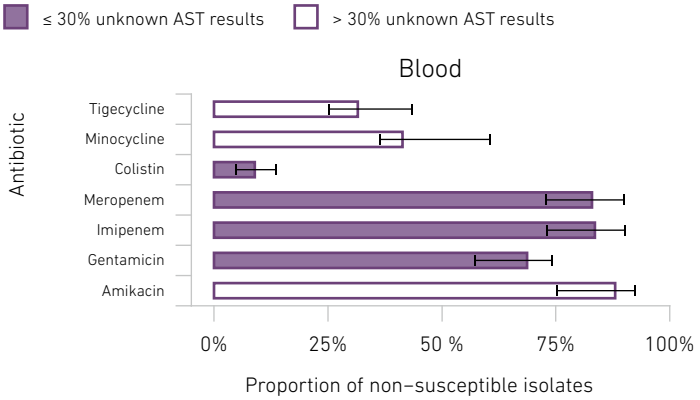
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	13	2	173
				E. coli	21	5	329
				K. pneumoniae	31	13	464
				Salmonella spp.	1	1	38
				S. aureus	32	2	326
				S. pneumoniae	3	-	37
URINE	-	-	-	*E. coli*	598	2	2162
				K. pneumoniae	181	1	916
STOOL	-	-	-	*Salmonella* spp.	28	2	186
				Shigella spp.	-	-	9
GENITAL	-	-	-	*N. gonorrhoeae*	6	-	69

Pathogen non-susceptibility overview[1]

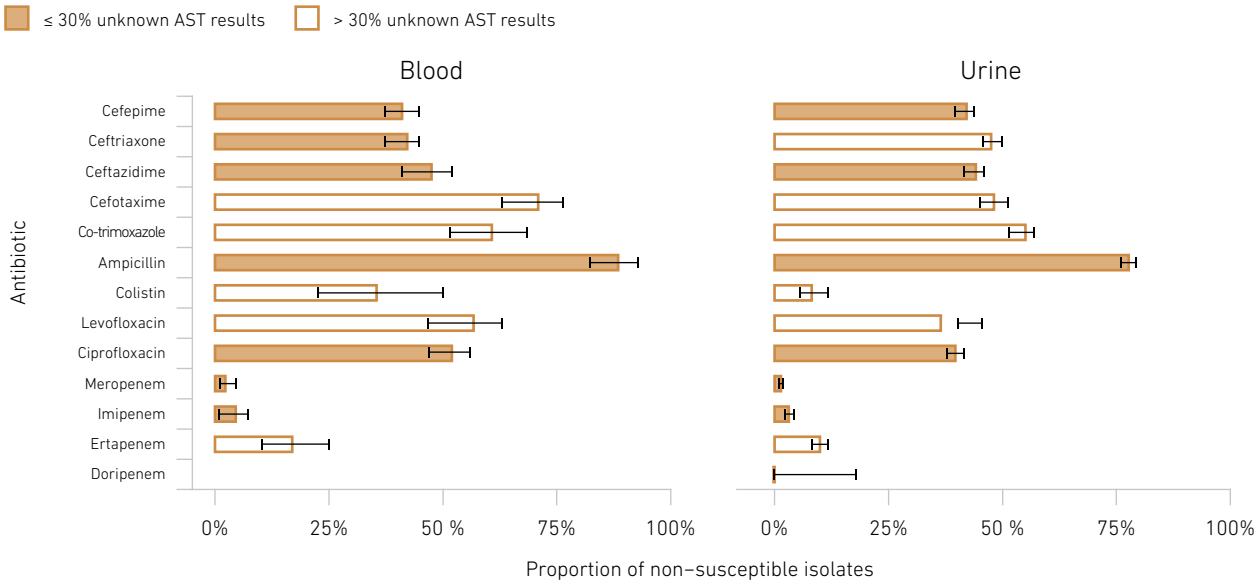
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

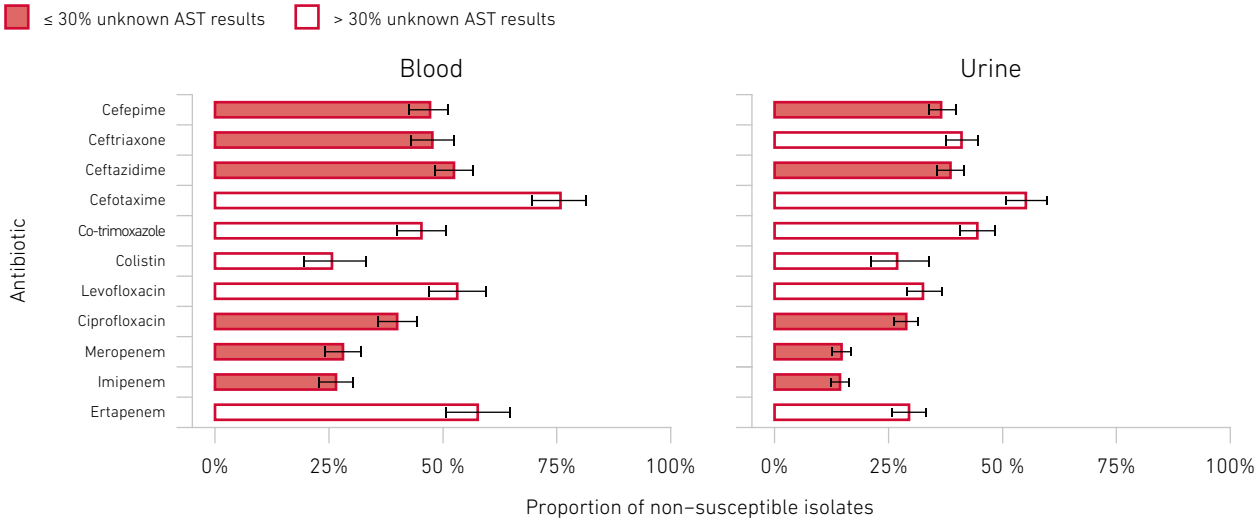


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

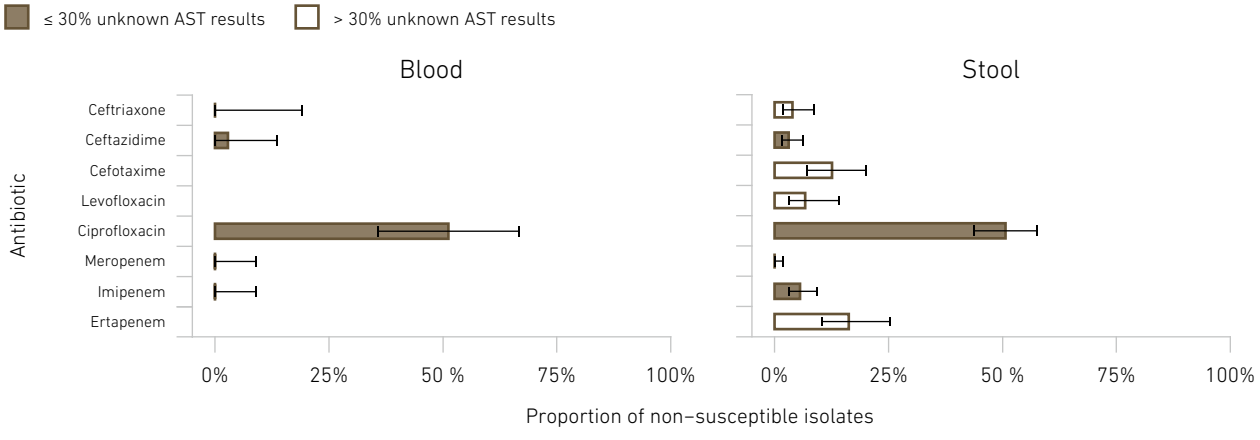
Escherichia coli



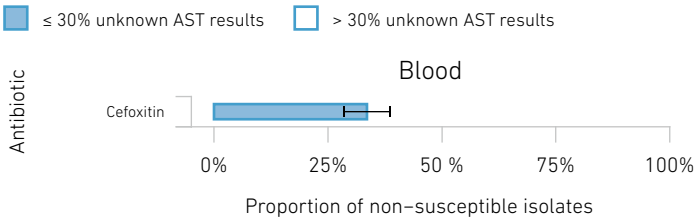
Klebsiella pneumoniae



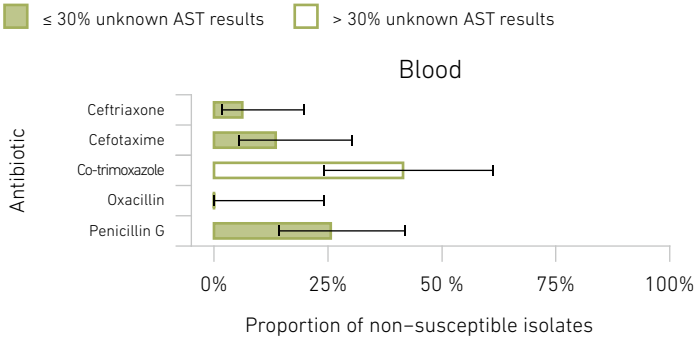
Salmonella **spp.**



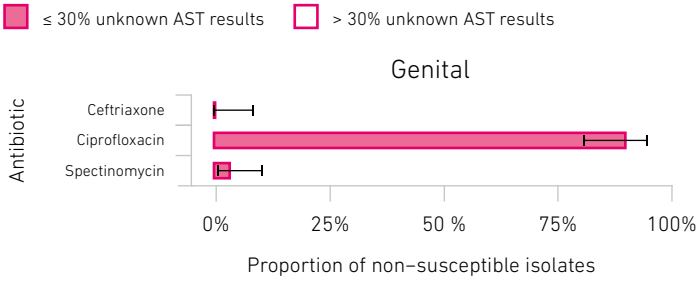
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



South Africa

Population 56.72 million

South Africa has been enrolled in GLASS since June 2016.

Current status of the national AMR surveillance system

31 surveillance sites
27 hospitals
4 outpatients facilities

50 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST, CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
31 surveillance sites providing data to GLASS
(27 hospitals)
(4 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

Data overview

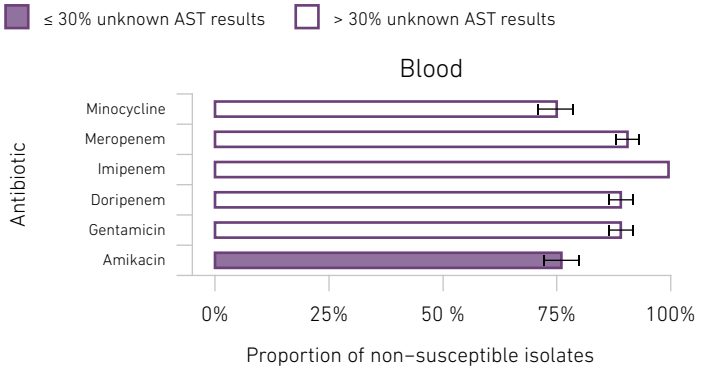
SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD*	537	67	107608	*Acinetobacter* spp.	-	-	1307
				E. coli	-	-	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	-
				S. aureus	380	577	14
				S. pneumoniae	537	67	49
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	646
				Shigella spp.	-	-	692
GENITAL	-	-	-	*N. gonorrhoeae*	572	-	-

* Number of tested patients available for *S. pneumoniae* only

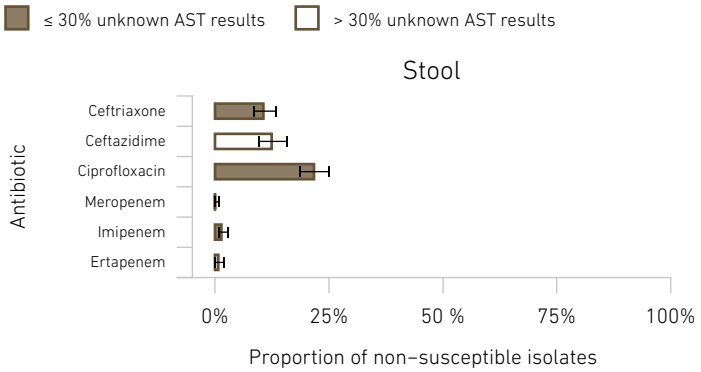
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

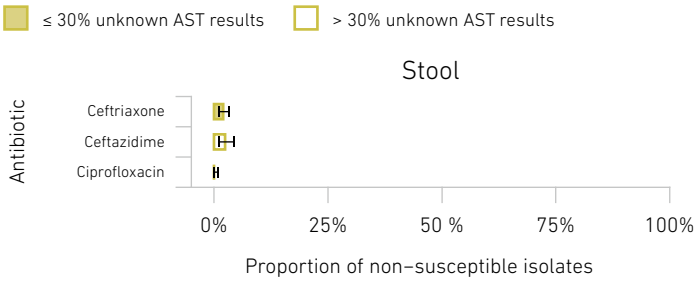


Salmonella **spp.**

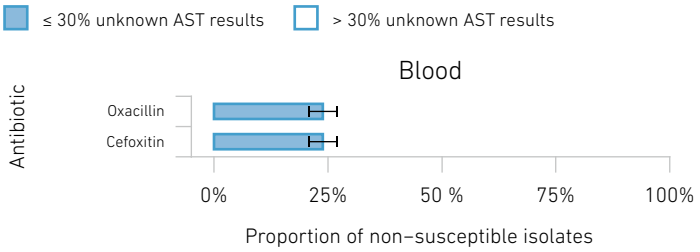


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

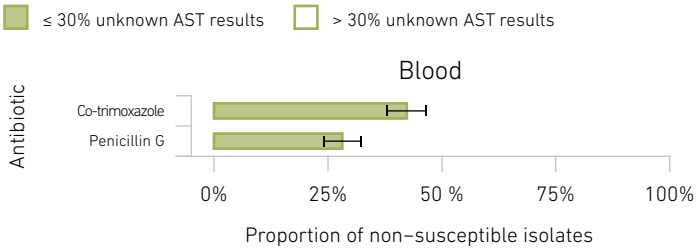
Shigella **spp.**



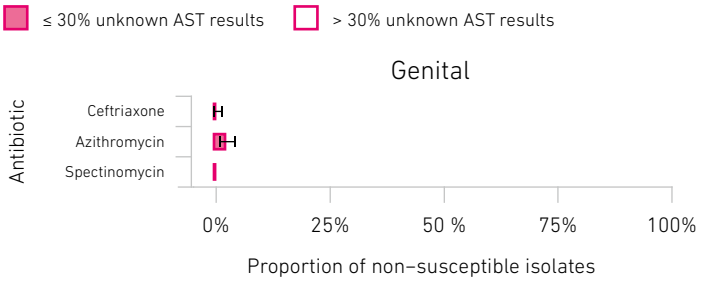
Staphylococcus aureus



Streptococcus pneumoniae



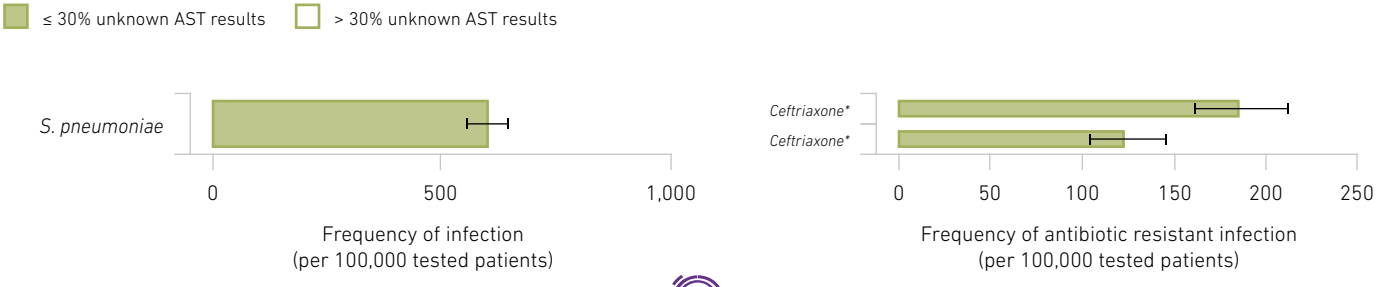
Neisseria gonorrhoeae



Non-susceptible pathogen-antimicrobial combination frequency

Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD - Unknown origin (n tested = 108212)



Sri Lanka

Population 20.88 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

25 surveillance sites
25 hospitals

25 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
No AMR data reported to GLASS by the end of the data call

Sudan

Population 40.53 million

The country is enrolled in GLASS since 2018.

Current status of the national AMR surveillance system

17 surveillance sites
2 hospitals
15 outpatient facilities

2 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Number of surveillance sites providing data to GLASS not reported

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

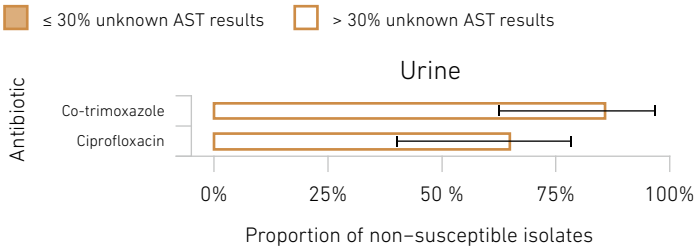
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	-
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	2	30
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Sweden

Population 9.91 million

Sweden has been conducting surveillance of AMR since mid-1990s. The Public Health Agency of Sweden is coordinating four different systems: Res-Net, EARS-Net, SMI-Net and Svebar. The Public Health Agency of Sweden and the National Veterinary Institute analyse and compile national data on antibiotic sales and resistance in an annual report, SWEDRES/SVARM (published in English). National strategies on antimicrobial resistance were released in 2000, 2006 and 2016. In 2017 a new revised AMR national action plan will be developed. Sweden has been enrolled in GLASS since 2016.

Current status of the national AMR surveillance system

26 participating laboratories*

26 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing to GLASS
(11 laboratories)

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

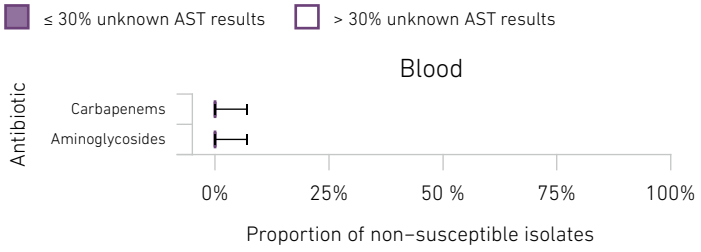
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	54
				E. coli	-	-	5791
				K. pneumoniae	-	-	1034
				Salmonella spp.	-	-	-
				S. aureus	-	-	3787
				S. pneumoniae	-	-	750
URINE	-	-	-	*E. coli*	-	-	127992
				K. pneumoniae	-	-	12614
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

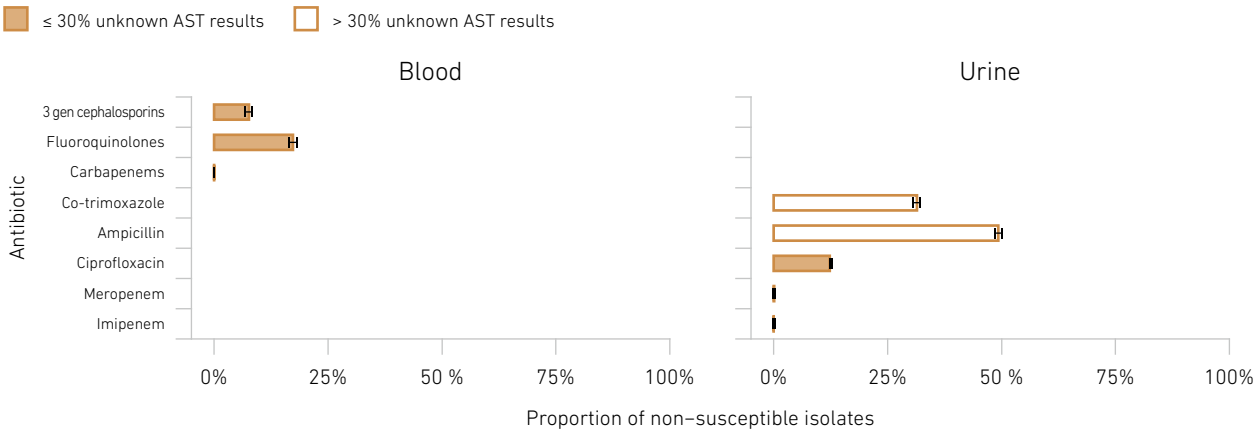
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

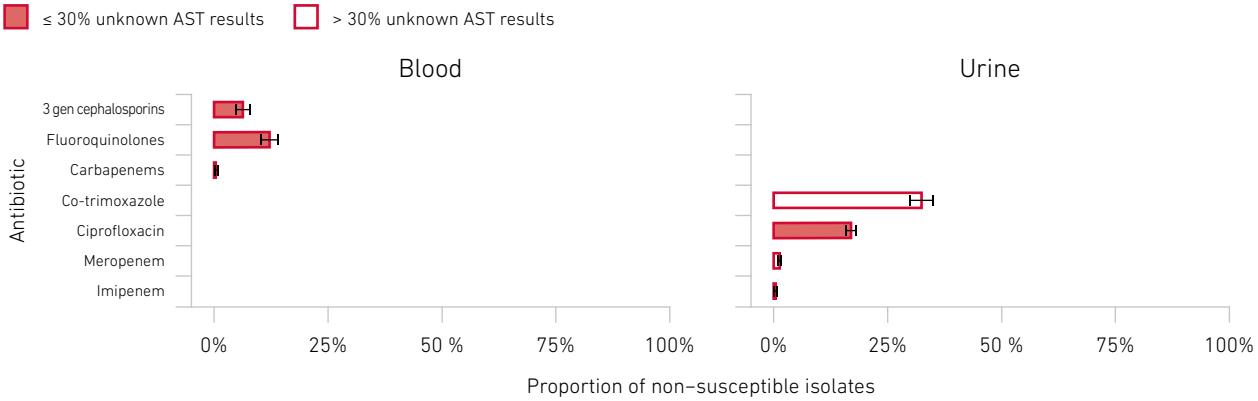


Escherichia coli

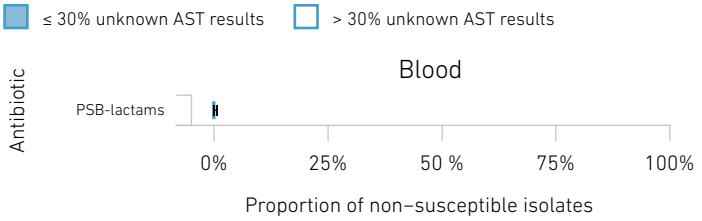


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

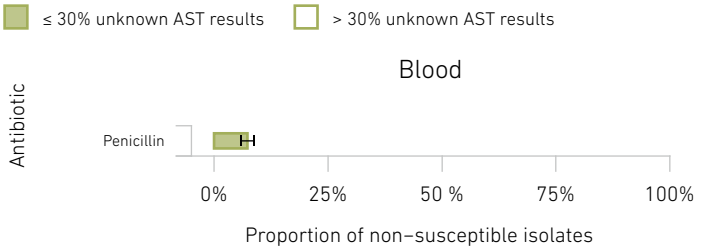
Klebsiella pneumoniae



Staphylococcus aureus



Streptococcus pneumoniae



Switzerland

Population 8.48 million

Switzerland developed anresis.ch which is a national surveillance system for antibiotic resistance and consumption. It collects and analyses antibiotic resistance data provided by a selection of Swiss clinical microbiology laboratories. The collected data represent at least 60% of annual hospitalisation days and at least 30% of Swiss practitioners. The Swiss Antibiotic Resistance Strategy (StAR) was adopted in 2015. The country participates in CAESAR and has been enrolled in GLASS since April 2017.

Current status of the national AMR surveillance system

249 surveillance sites
140 hospitals
109 outpatient facilities

25 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI, EUCAST
EQA
not reported

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
241 surveillance sites providing data to GLASS
(132 hospitals)
(109 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

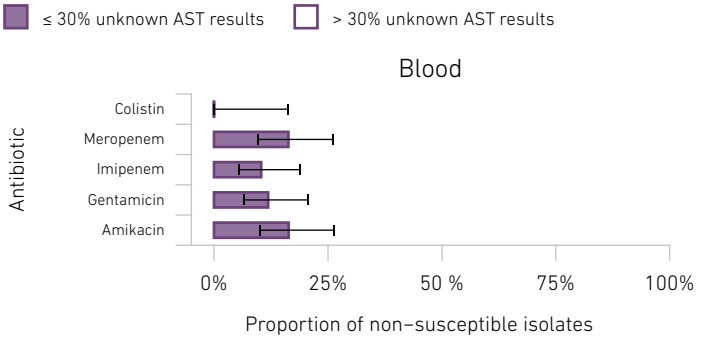
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	88
				E. coli	-	-	5397
				K. pneumoniae	-	-	961
				Salmonella spp.	-	-	88
				S. aureus	-	-	2000
				S. pneumoniae	-	-	725
URINE	-	-	-	*E. coli*	-	-	85404
				K. pneumoniae	-	-	12246
STOOL	-	-	-	*Salmonella* spp.	-	-	504
				Shigella spp.	-	-	87
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	94

Pathogen non-susceptibility overview[1]

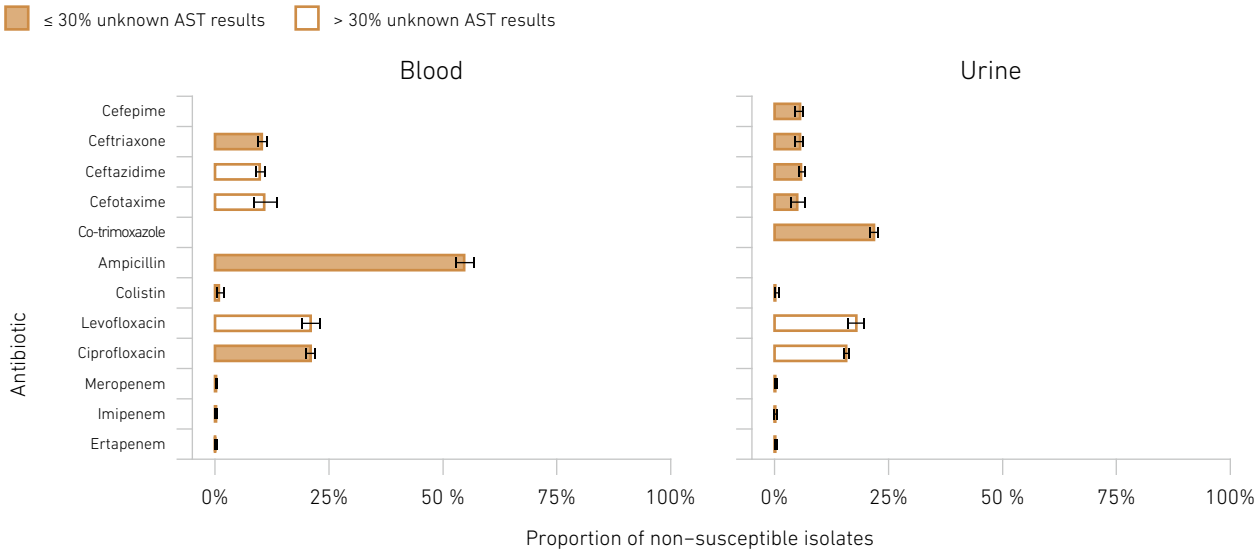
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

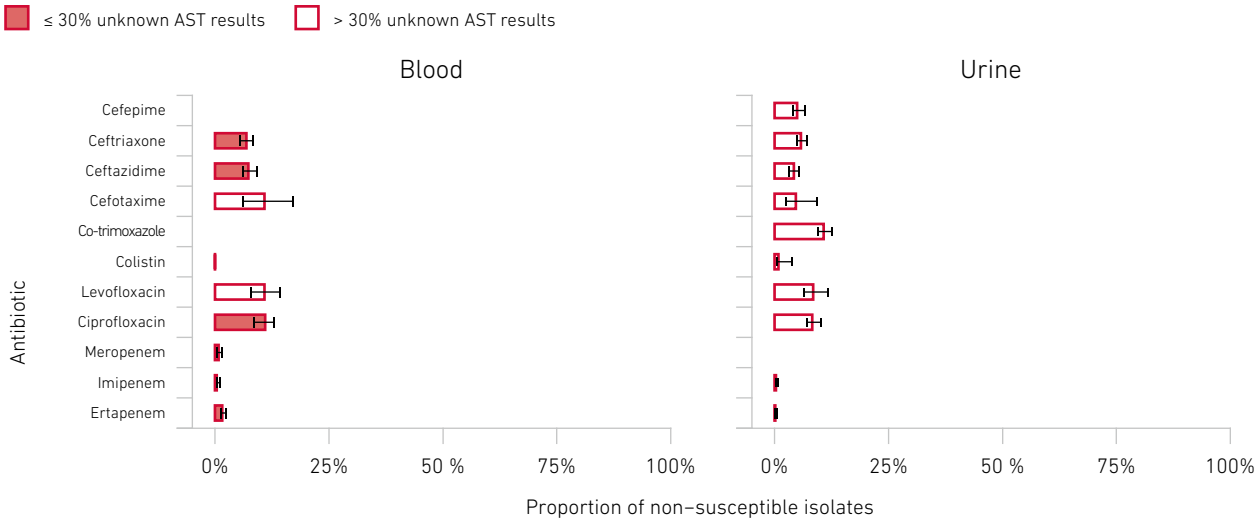


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

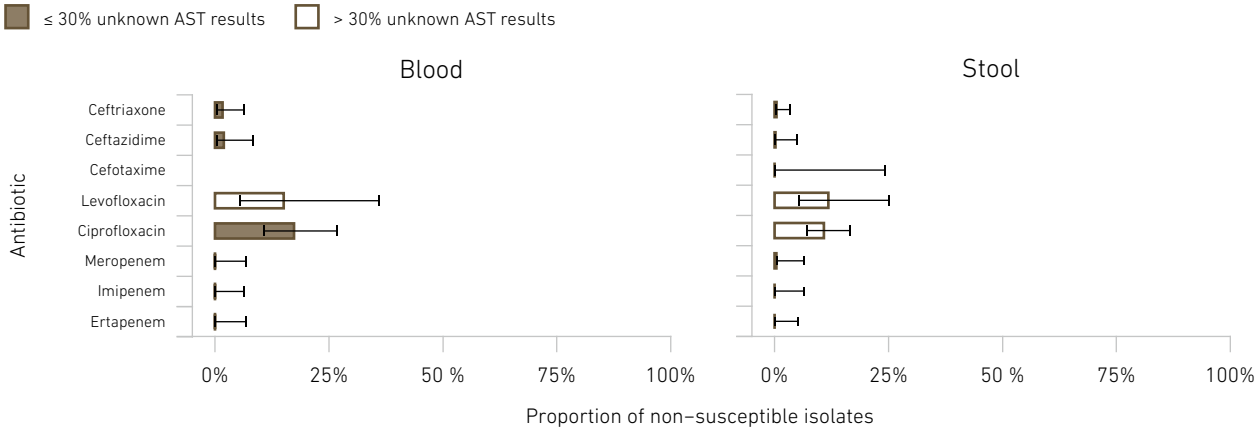
Escherichia coli



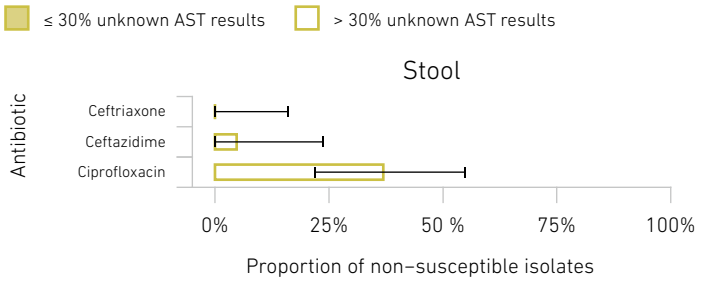
Klebsiella pneumoniae



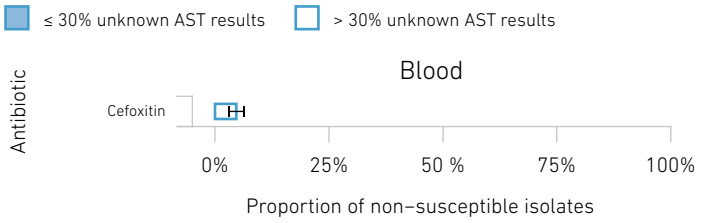
Salmonella **spp.**



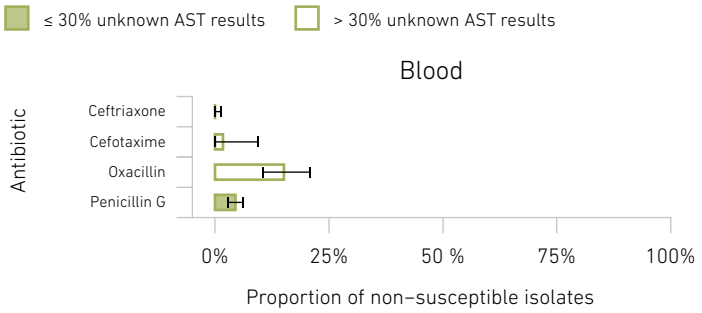
Shigella **spp.**



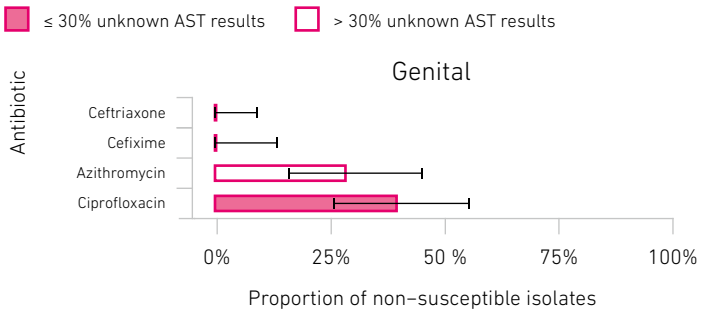
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



Thailand

Population 69.04 million

In August 2016, the Thai government endorsed a national strategic plan on antimicrobial resistance 2017-2021. Thailand has been enrolled in GLASS since February 2017.

Current status of the national AMR surveillance system

74 surveillance sites
74 hospitals

74 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for some GLASS pathogen

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

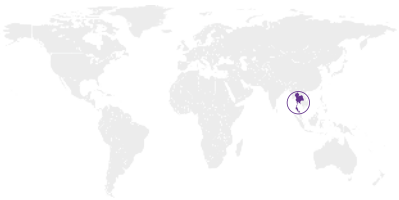
GLASS
Global AMR Surveillance System

in 2018 data call
4 surveillance sites providing data to GLASS
(3 hospitals)
(1 outpatients facility)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected



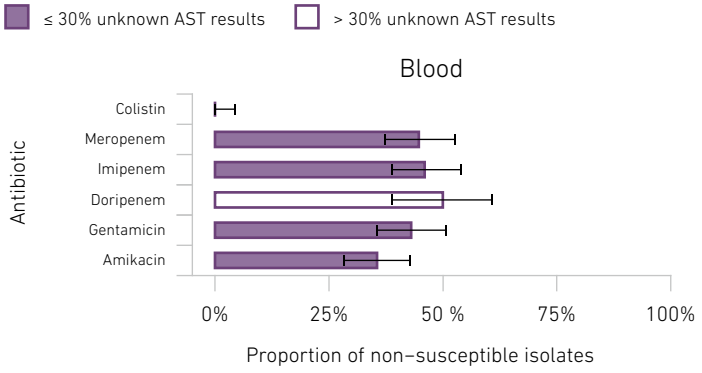
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	12238	4005	75	*Acinetobacter* spp.	57	109	1
				E. coli	487	119	4
				K. pneumoniae	151	120	3
				Salmonella spp.	38	5	-
				S. aureus	132	83	3
				S. pneumoniae	31	6	-
URINE	6129	3157	79	*E. coli*	1229	462	45
				K. pneumoniae	299	210	5
STOOL	1728	927	20	*Salmonella* spp.	194	51	2
				Shigella spp.	-	-	-
GENITAL	2939	-	-	*N. gonorrhoeae*	183	-	-

Pathogen non-susceptibility overview[1]

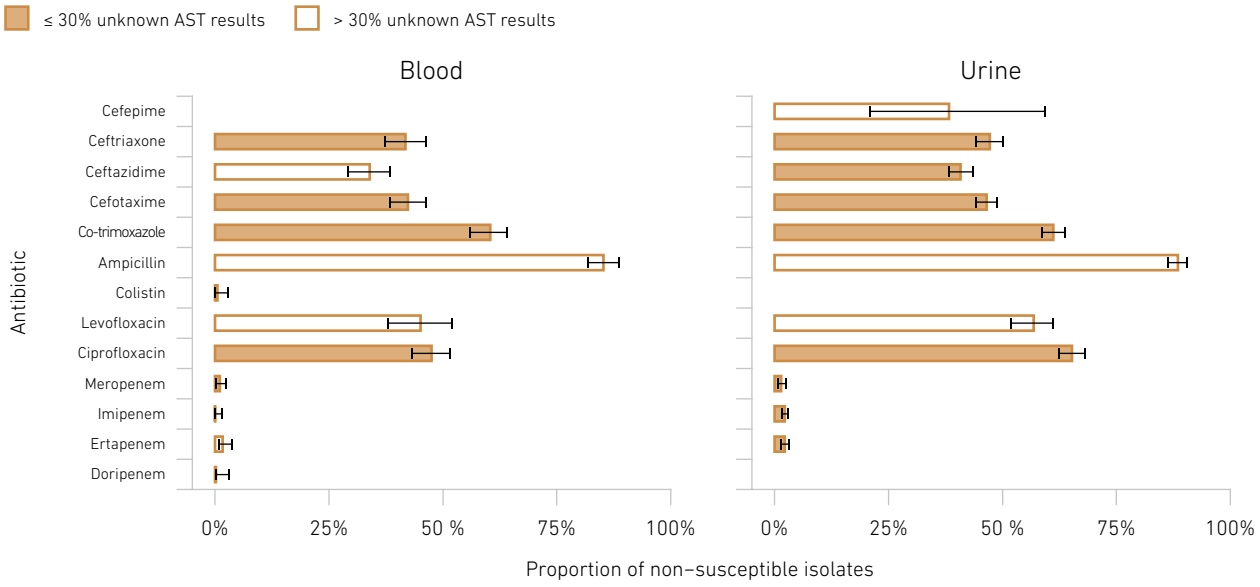
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

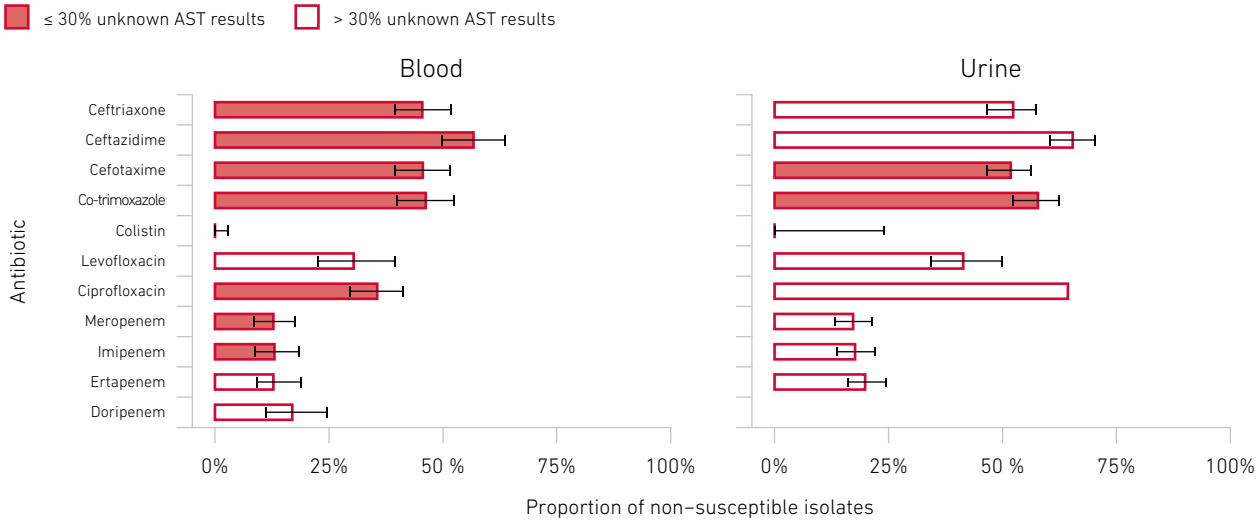


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

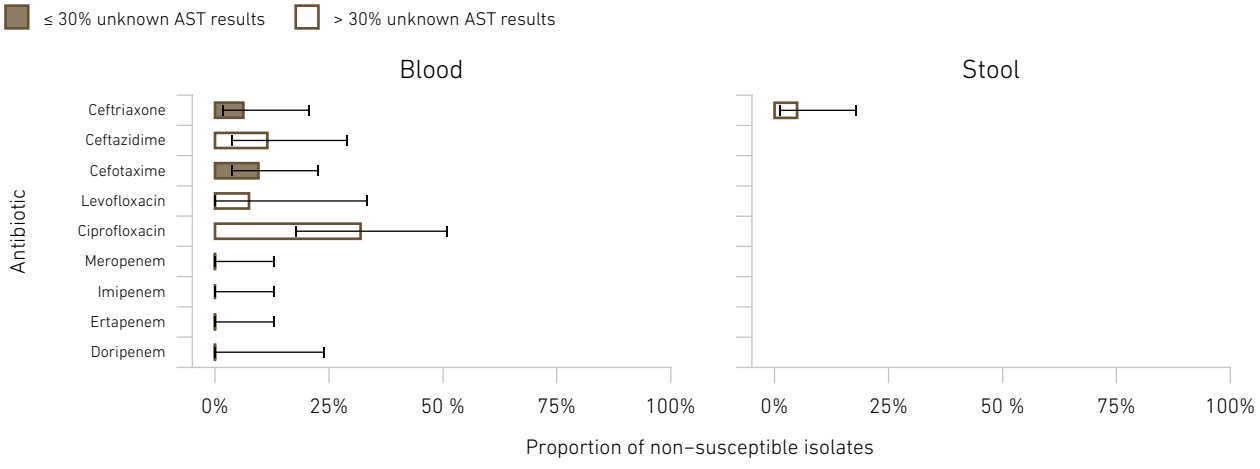
Escherichia coli

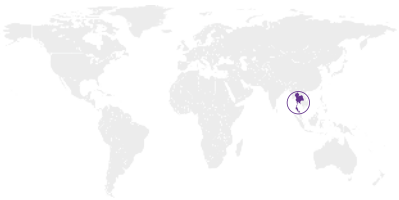


Klebsiella pneumoniae

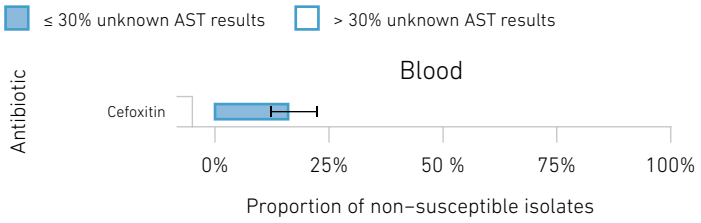


Salmonella **spp.**

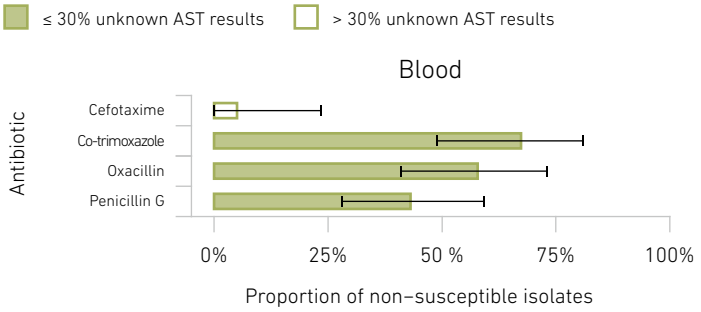




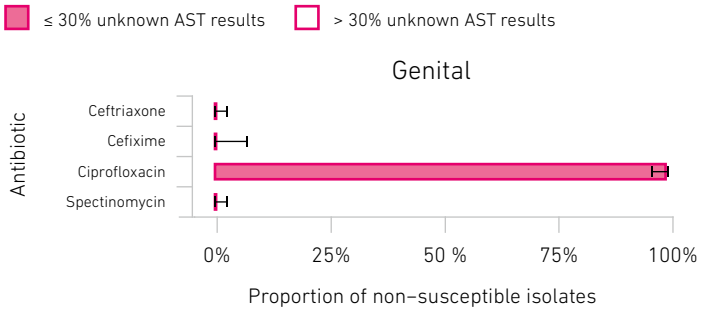
Staphylococcus aureus

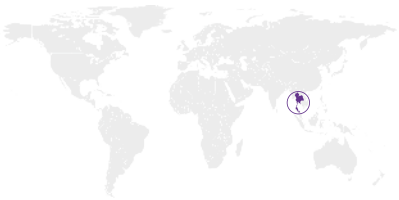


Streptococcus pneumoniae



Neisseria gonorrhoeae

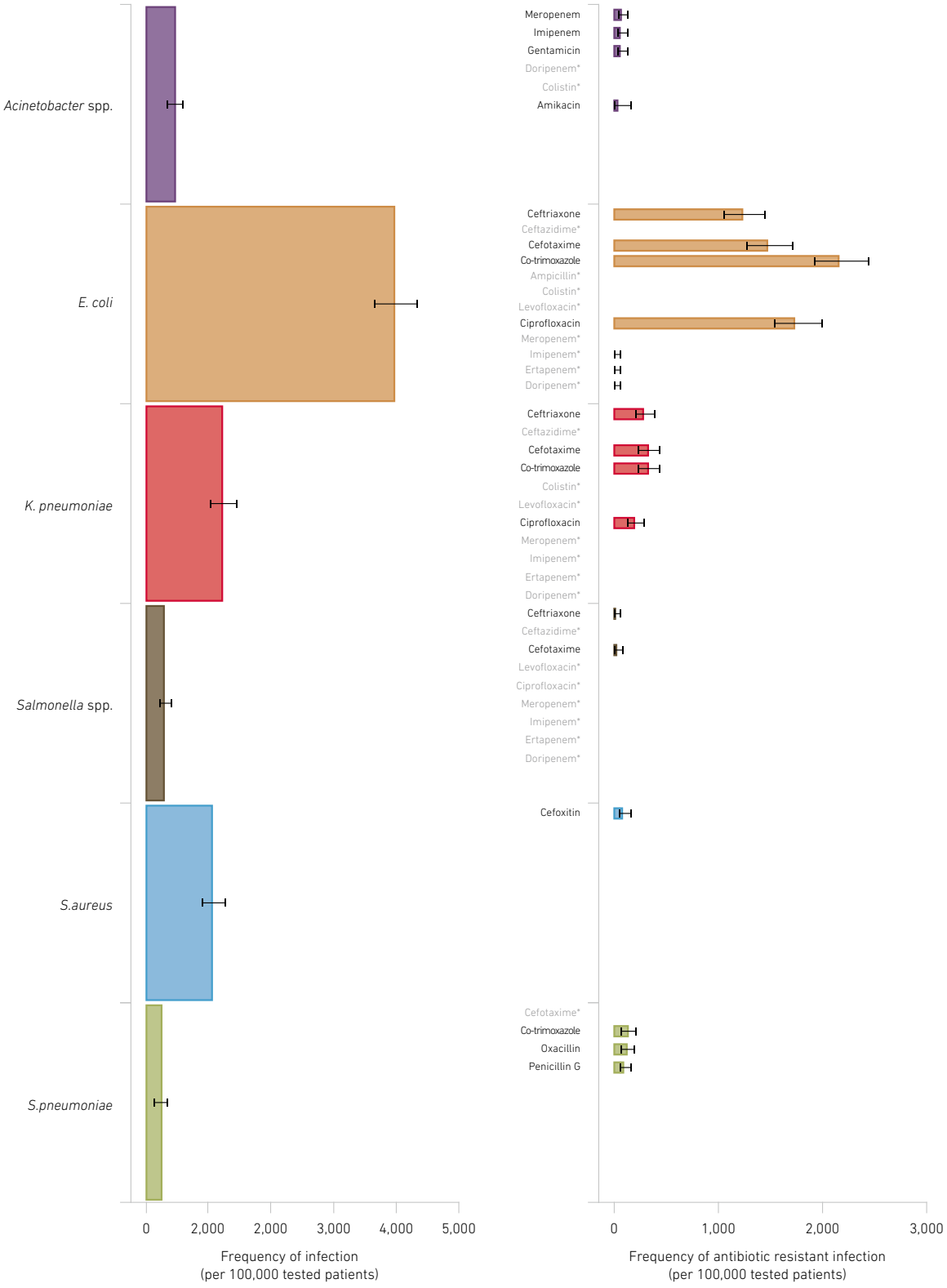




Non-susceptible pathogen-antimicrobial combination frequency

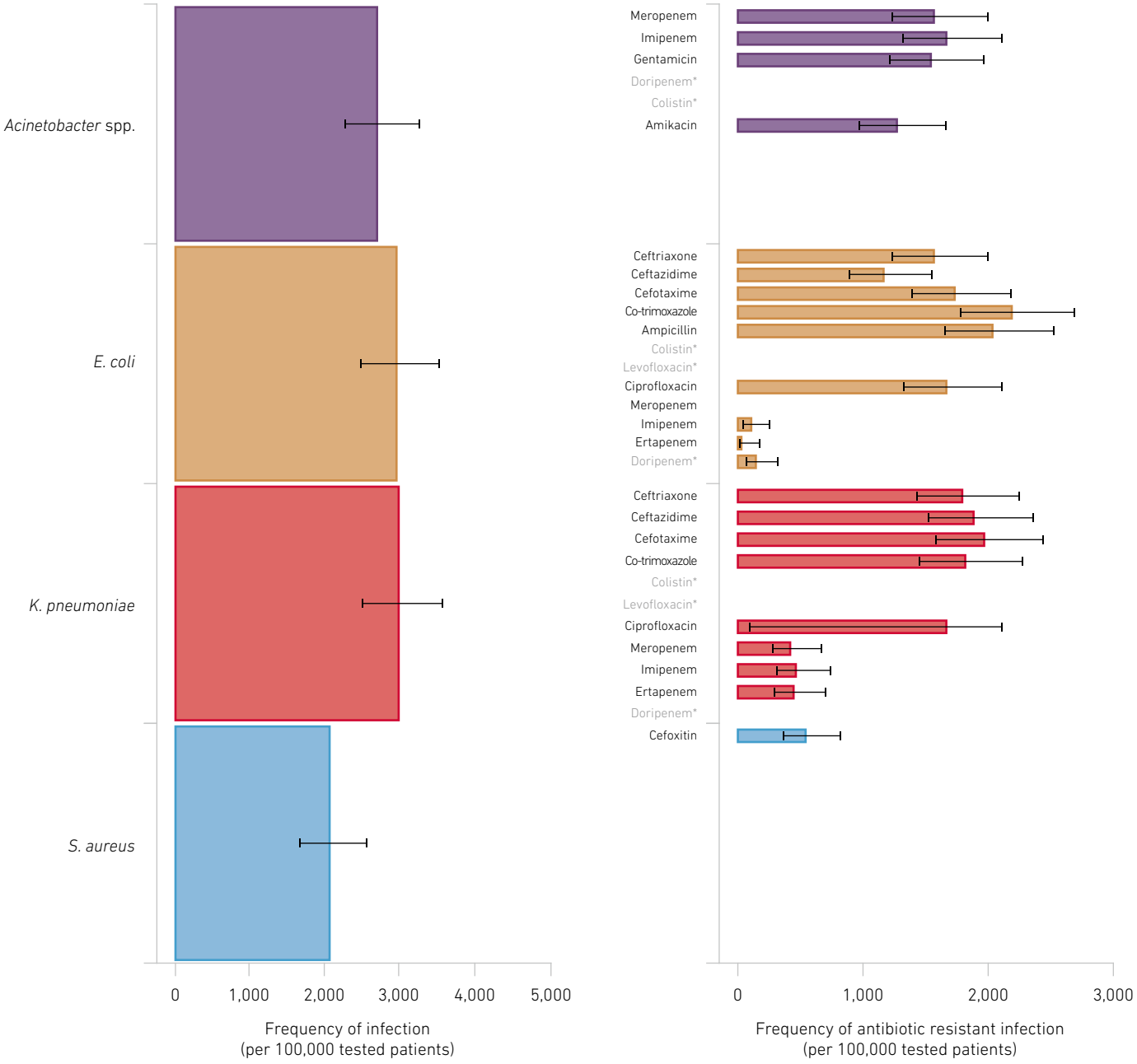
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Community origin (n tested = 5733)



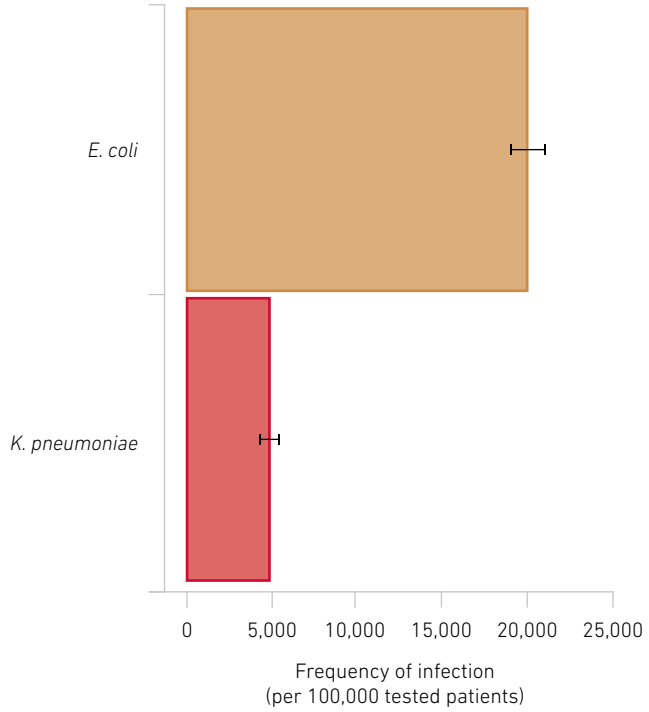
*Antibiotic with >30% unknown AST results: AMR rates not shown

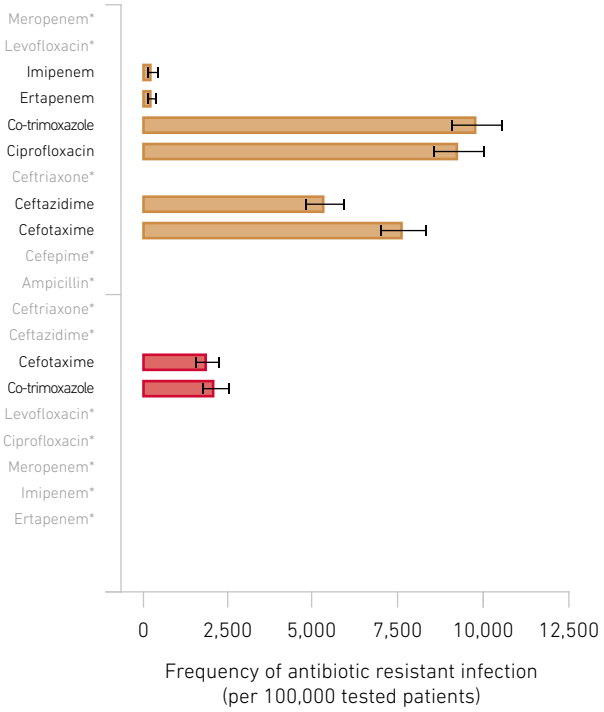
BLOOD- Hospital origin (n tested = 1567)



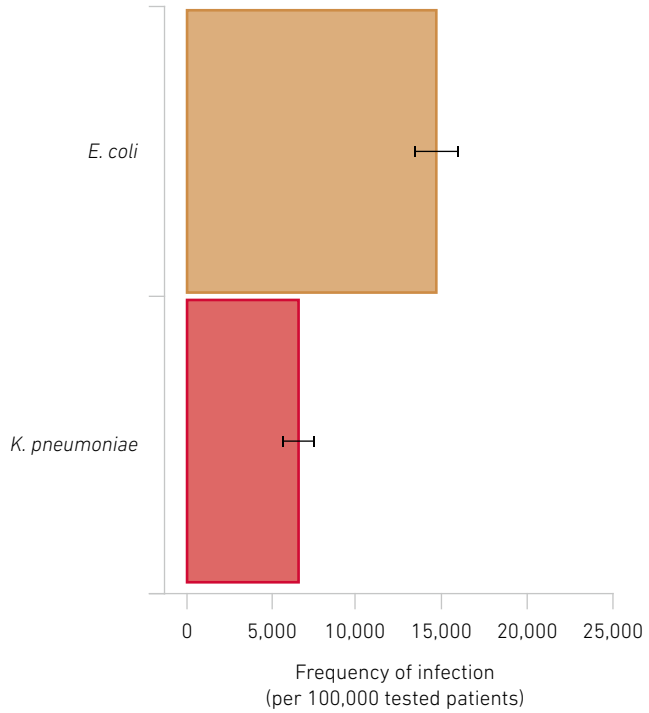
*Antibiotic with >30% unknown AST results: AMR rates not shown

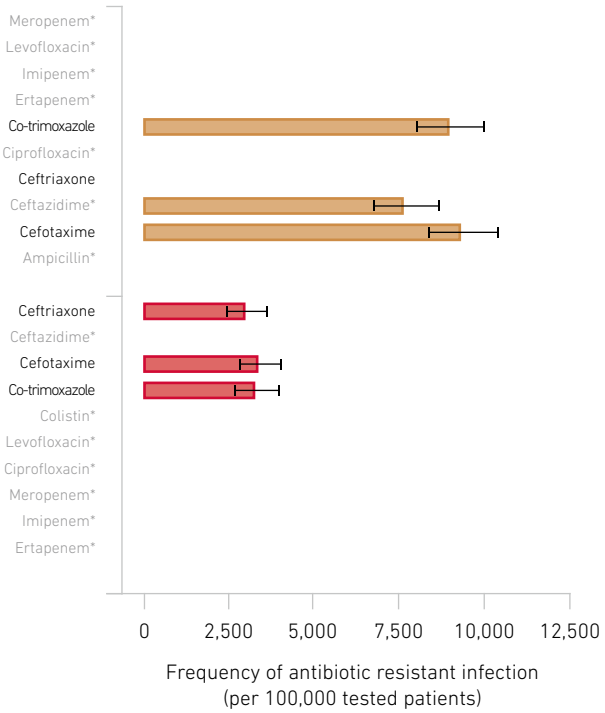
URINE- Community origin (n tested = 1880)



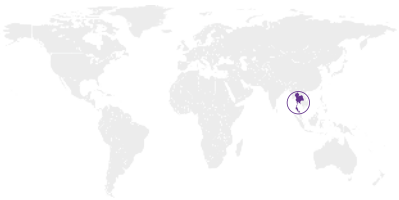


URINE- Hospital origin (n tested = 842)

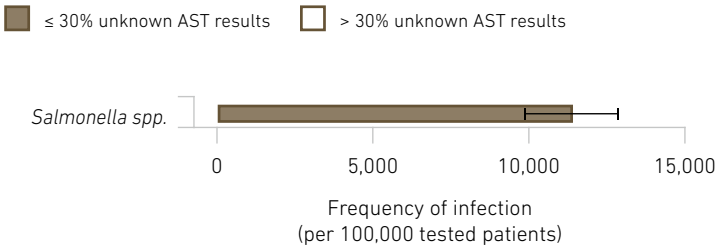


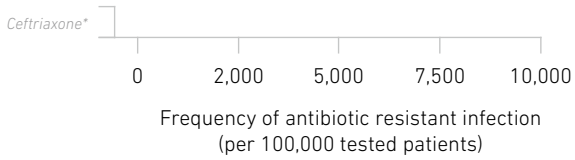


*Antibiotic with >30% unknown AST results: AMR rates not shown

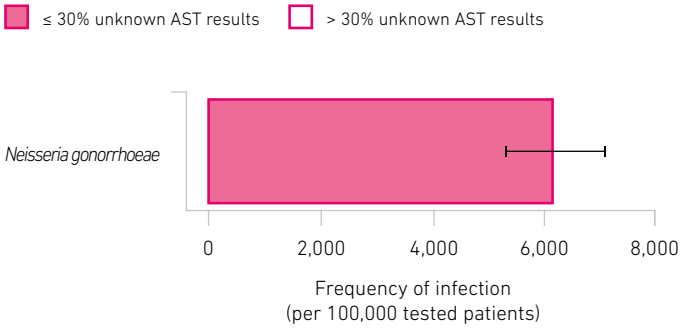


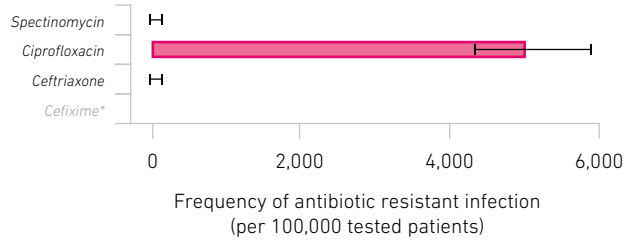
STOOL- Community origin (n tested = 677)





GENITAL- Unknown origin (n tested = 1794)



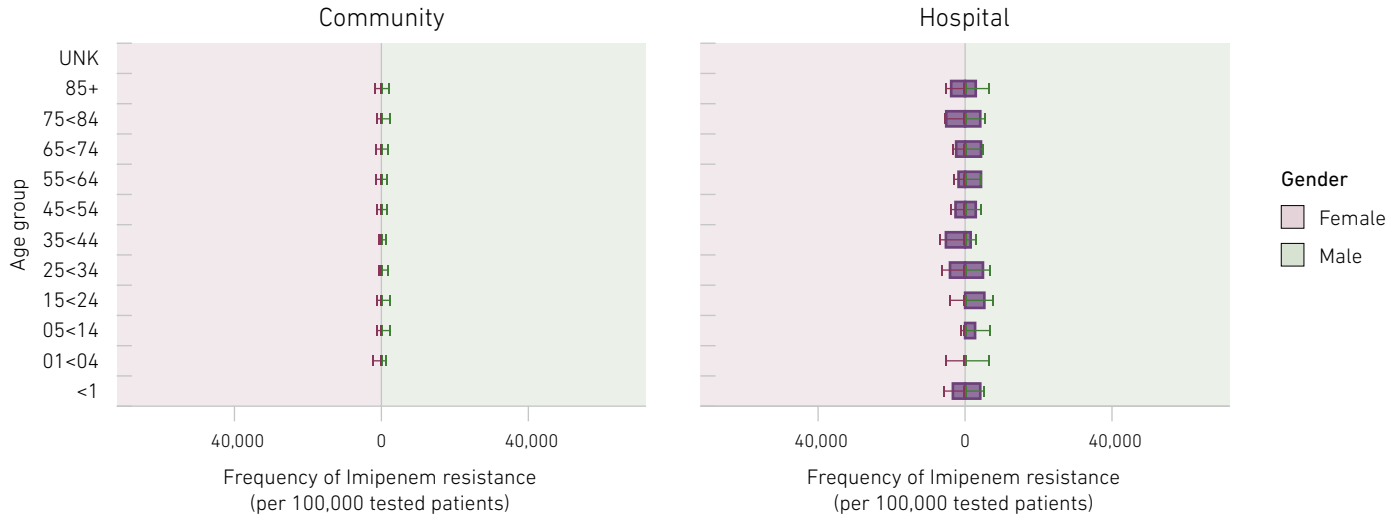


*Antibiotic with >30% unknown AST results: AMR rates not shown

Non-susceptible pathogen-meropenem combination stratified frequency[2]

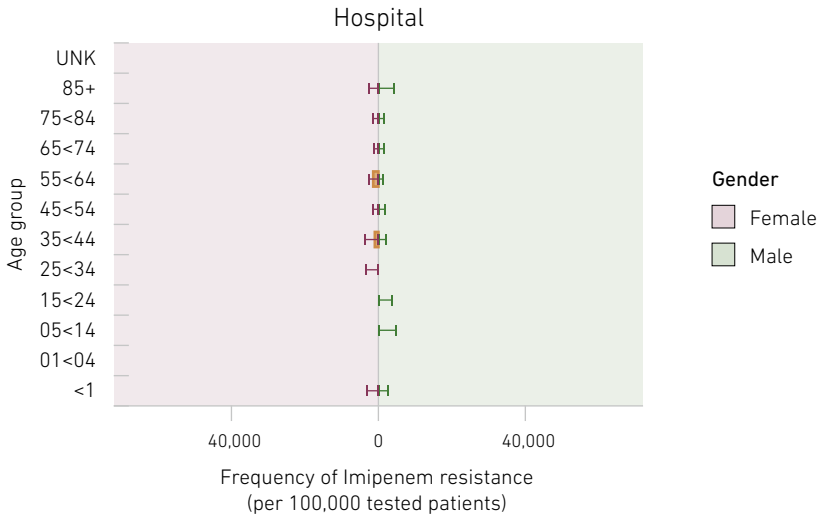
Frequency of infection caused by pathogens non-susceptible to imipenem per specimen and infection origin, stratified by age and gender.

BLOOD- *Acinetobacter* spp

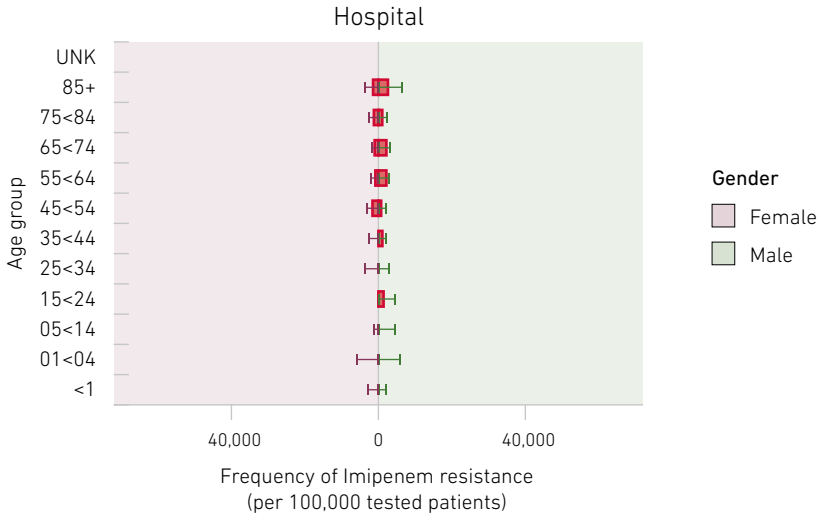


[2] Results for isolates with >30% unknown AST results are not shown. Grouping of carbapenem antibiotics was not possible due to results bias generation linked with data aggregation.

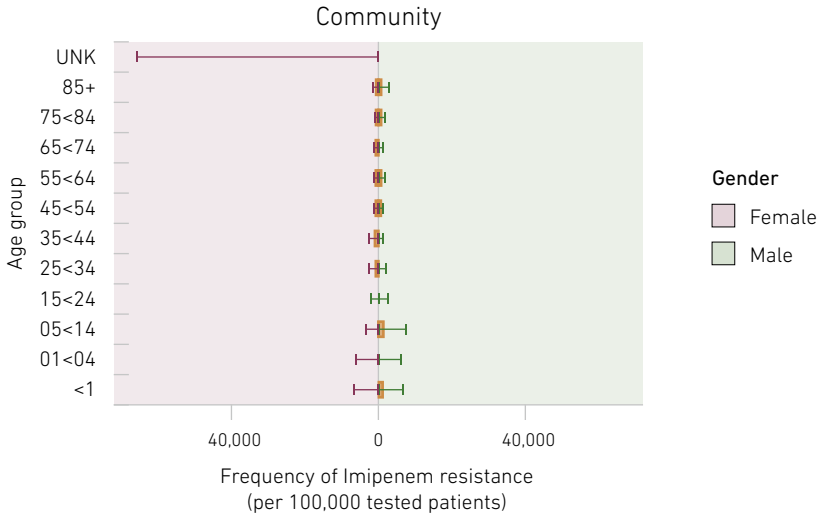
BLOOD - *Escerichia coli*



BLOOD - *Klebsiella pneumoniae*



URINE - *Escerichia coli*



Tunisia

Population 11.53 million

Tunisia is developing its National Action Plan on AMR and is building a national AMR surveillance system. The country has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

12 surveillance sites
12 hospitals

11 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
not selected
AST standard
EUCAST
EQA
not reported

National Reference Laboratory

National Coordinating Centre

NCC
not established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
12 surveillance sites providing data to GLASS
(12 hospitals)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

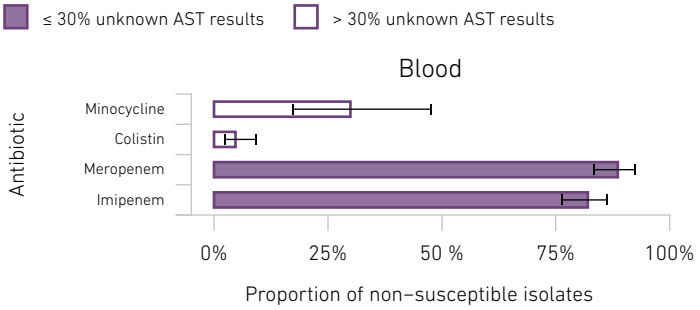
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	4	-	241
				E. coli	-	-	78
				K. pneumoniae	-	-	214
				Salmonella spp.	2	-	1
				S. aureus	18	-	260
				S. pneumoniae	6	-	11
URINE	-	-	-	*E. coli*	578	-	1773
				K. pneumoniae	385	-	787
STOOL	-	-	-	*Salmonella* spp.	10	-	17
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	7	-	2

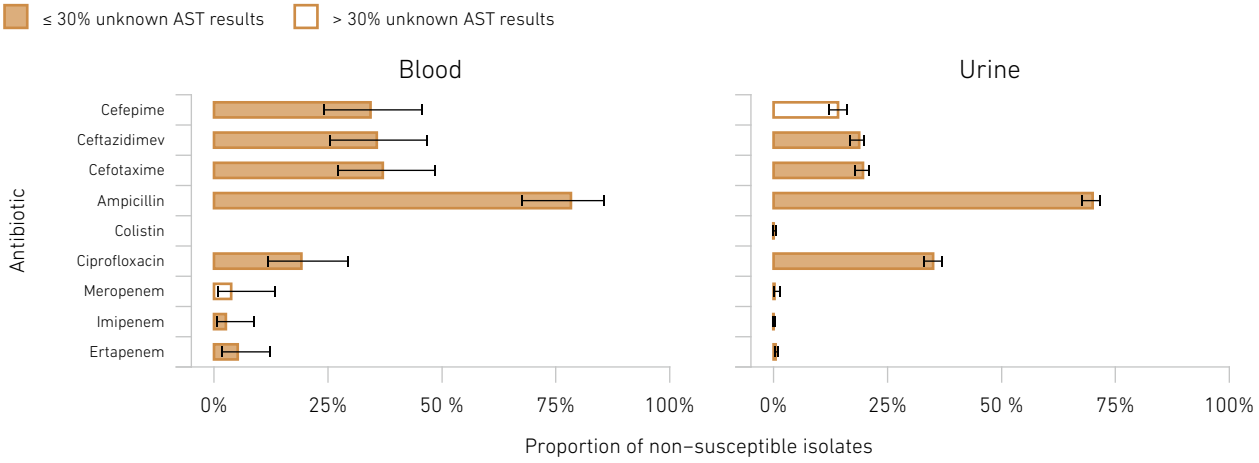
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

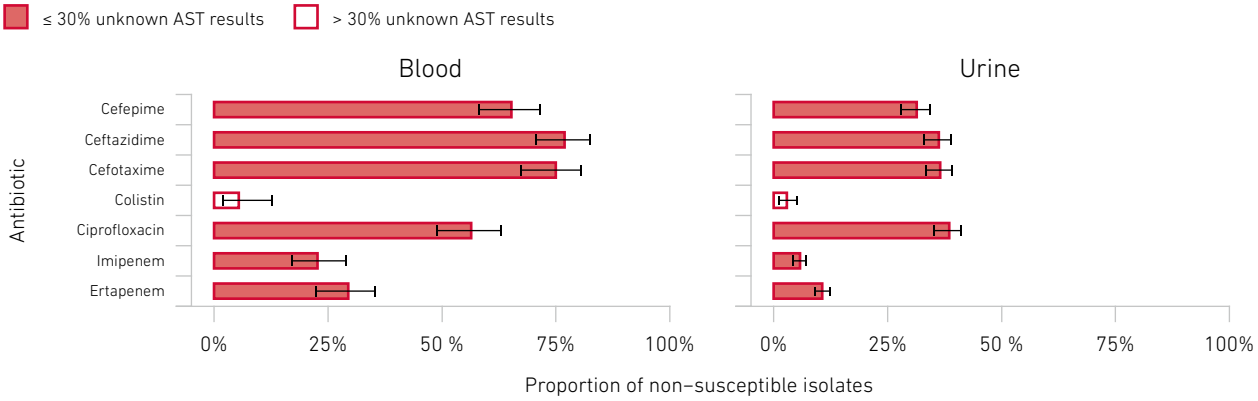


Escherichia coli

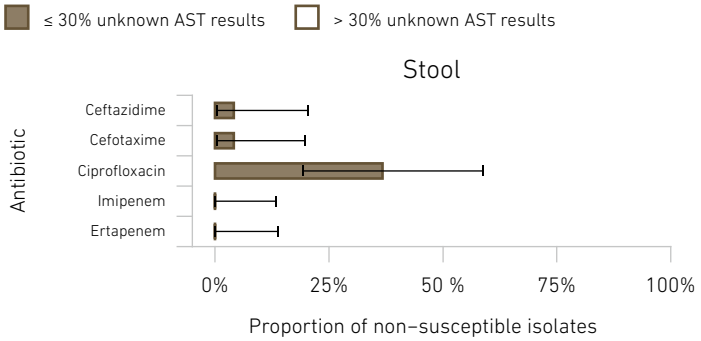


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

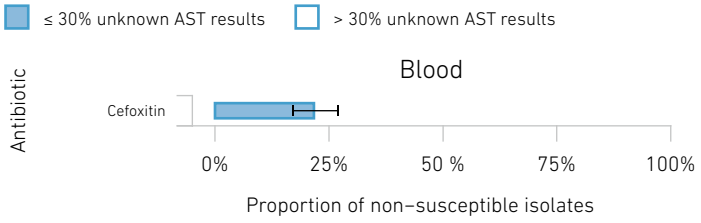
Klebsiella pneumoniae



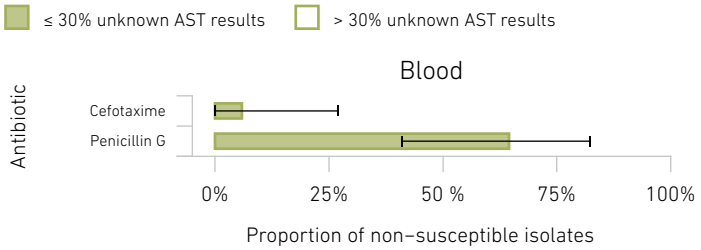
Salmonella **spp.**



Staphylococcus aureus



Streptococcus pneumoniae



Uganda

Population 42.86 million

Uganda has been enrolled in GLASS since July 2016.

Current status of the national AMR surveillance system

22 surveillance sites
6 hospitals
16 outpatient facilities

2 laboratories performing AST
EQA provided to some labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS

in 2018 data call
Participating Laboratories providing data to GLASS
(2 laboratories)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	100%	*Acinetobacter* spp.	100%	100%	100%	<70%
		E. coli	100%	100%	100%	<70%
		K. pneumoniae	100%	99-70%	100%	<70%
		Salmonella spp.	100%	100%	100%	<70%
		S. aureus	100%	100%	100%	<70%
		S. pneumoniae	100%	100%	100%	<70%
Urine	<70%	*E. coli*	<70%	<70%	<70%	<70%
		K. pneumoniae	<70%	<70%	<70%	<70%
Stool	<70%	*Salmonella* spp.	<70%	<70%	<70%	<70%
		Shigella spp.	<70%	<70%	<70%	<70%
Genital	100%	*N. gonorrhoeae*	100%	99-70%	100%	<70%

100% data collected | 99-70% data collected | <70% data collected

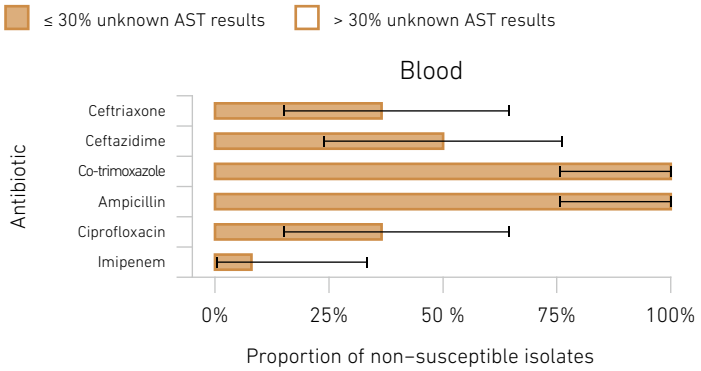
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	2024	*Acinetobacter* spp.	-	-	5
				E. coli	-	-	14
				K. pneumoniae	-	-	11
				Salmonella spp.	-	-	50
				S. aureus	-	-	26
				S. pneumoniae	-	-	6
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
GENITAL	-	-	557	*N. gonorrhoeae*	-	-	355

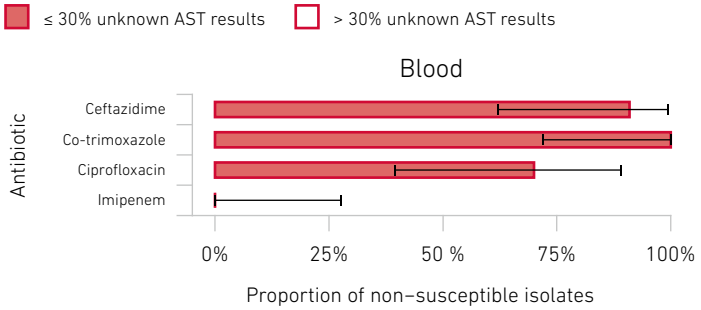
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Escherichia coli

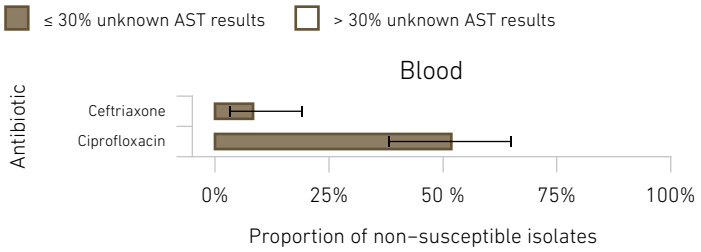


Klebsiella pneumoniae

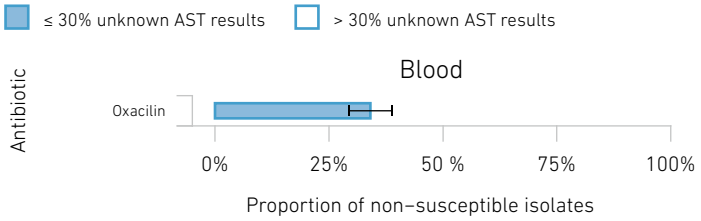


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

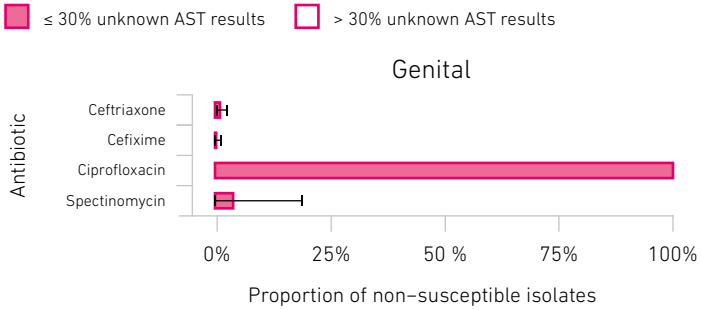
Salmonella **spp.**



Staphylococcus aureus



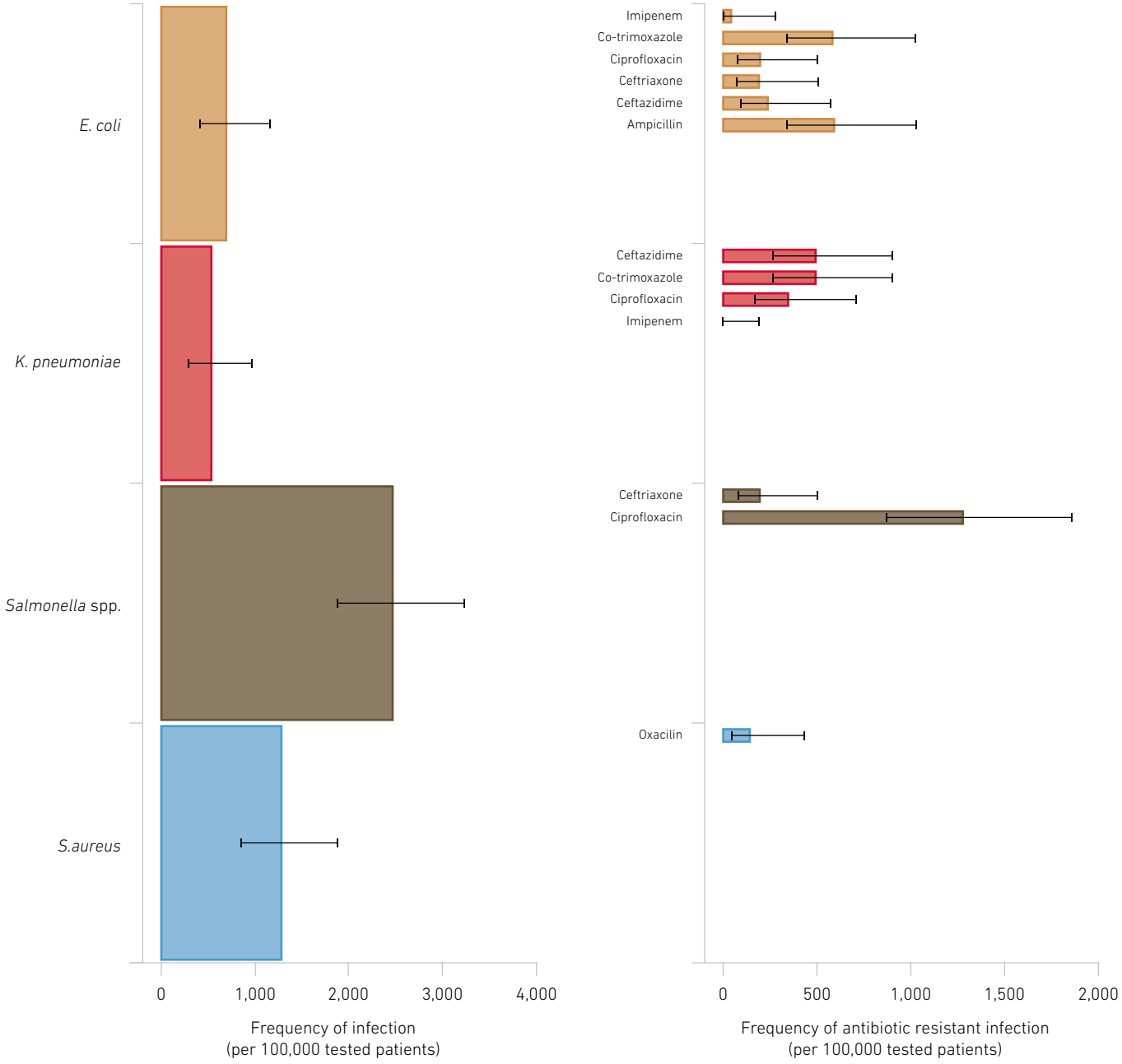
Neisseria gonorrhoeae



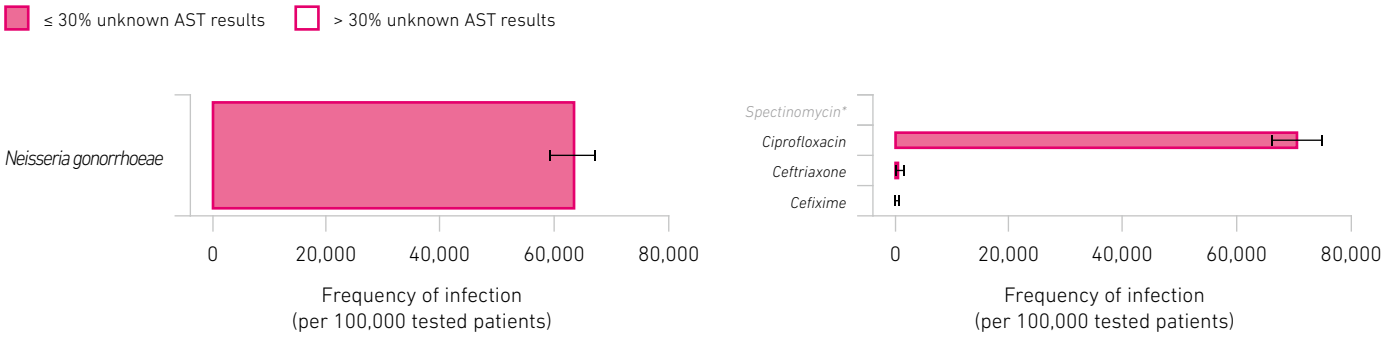
Non-susceptible pathogen-antimicrobial combination frequency

Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right).

BLOOD- Unknown origin (n tested = 2024)



GENITAL- Unknown origin (n tested = 557)



*Antibiotic with >30% unknown AST results: AMR rates not shown

Non-susceptible pathogen-imipenem combination stratified frequency[2]

Frequency of infection caused by pathogens non-susceptible to imipenem per specimen and infection origin, stratified by age and gender.

BLOOD - *Escerichia coli*

*Data on Imipenem presented because no testing was done for Meropenem

[2] Results for isolates with >30% unknown AST results are not shown. Grouping of carbapenem antibiotics was not possible due to results bias generation linked with data aggregation.

United Arab Emirates

Population 9.4 million

The UAE has been conducting surveillance of AMR since 2011 when the Abu Dhabi – Antimicrobial Resistance Surveillance Program (AD ARS) was introduced; in 2015 it was expanded nationwide. The National Action Plan on AMR is under development. UAE has enrolled in GLASS in April 2017.

Current status of the national AMR surveillance system

170 surveillance sites
48 hospitals
122 outpatient facilities

26 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
not selected
AST standard
CLSI
EQA
not provided

National Reference Laboratory

National Coordinating Centre

NCC
establishment in progress
National AMR surveillance plan
in place (no defined budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
117 surveillance sites providing data to GLASS
(28 hospitals)
(89 outpatients facilities)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

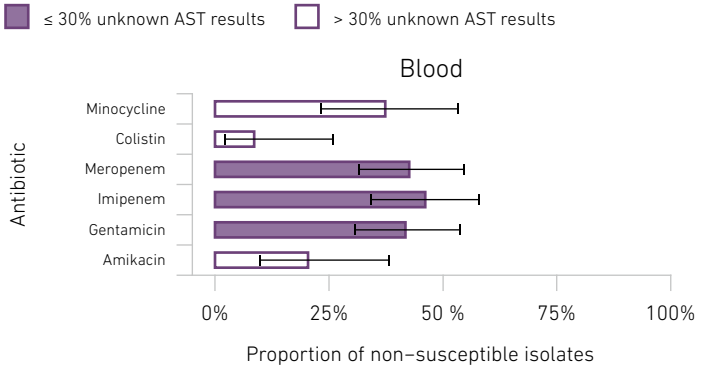
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	15	55	5
				E. coli	287	432	7
				K. pneumoniae	103	445	7
				Salmonella spp.	62	29	-
				S. aureus	154	254	11
				S. pneumoniae	59	53	4
URINE	-	-	-	*E. coli*	7994	2234	217
				K. pneumoniae	2028	1016	69
STOOL	-	-	-	*Salmonella* spp.	386	195	4
				Shigella spp.	48	20	-
GENITAL	-	-	-	*N. gonorrhoeae*	66	-	20

Pathogen non-susceptibility overview[1]

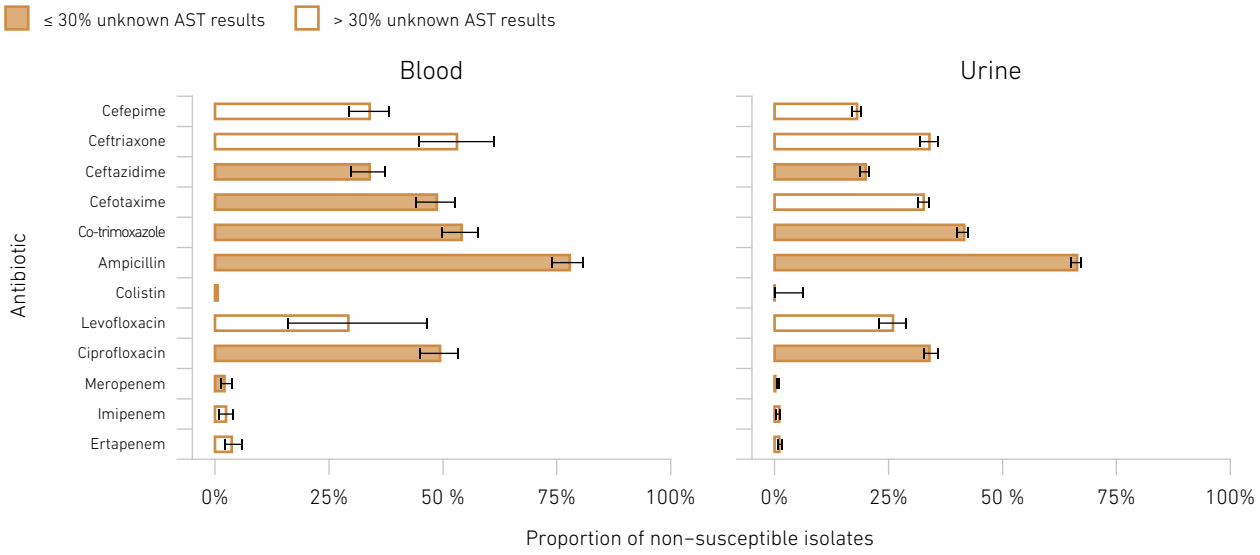
Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

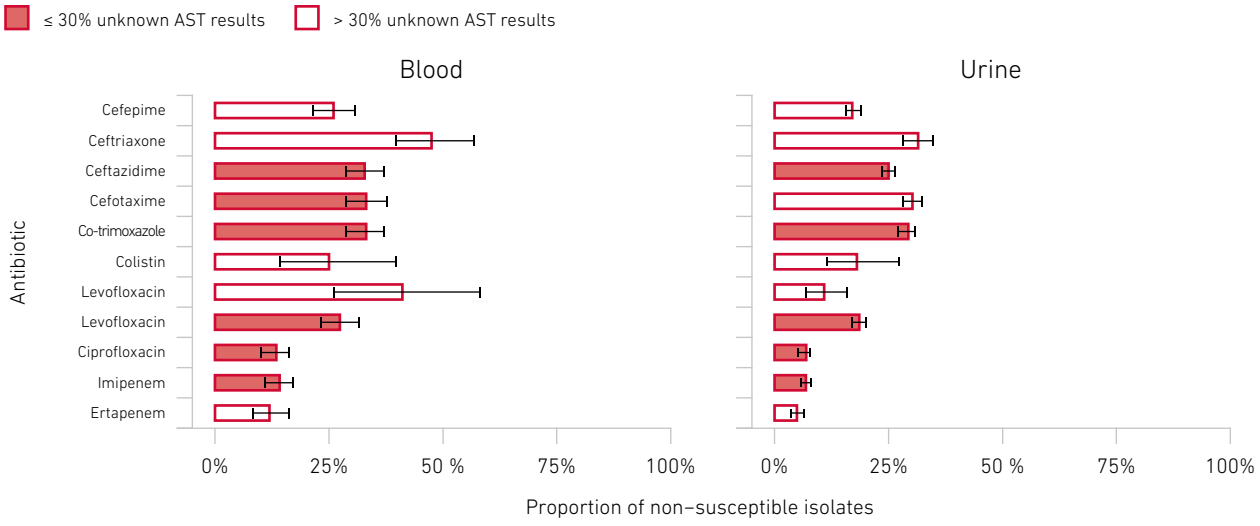


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

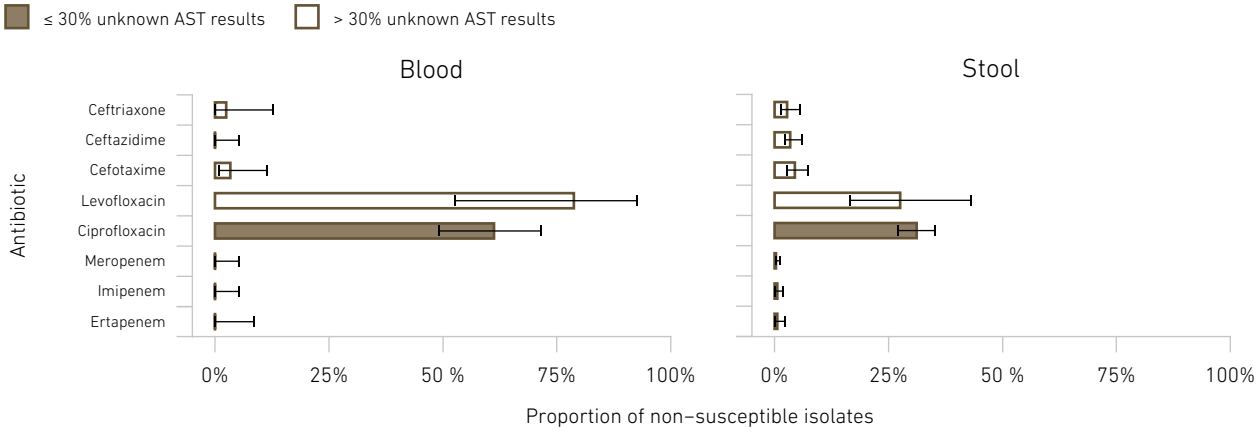
Escherichia coli



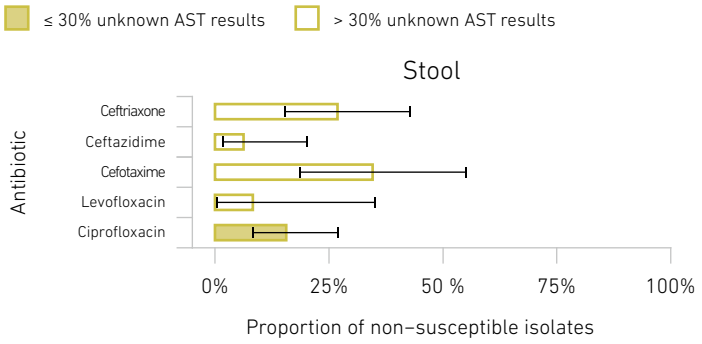
Klebsiella pneumoniae



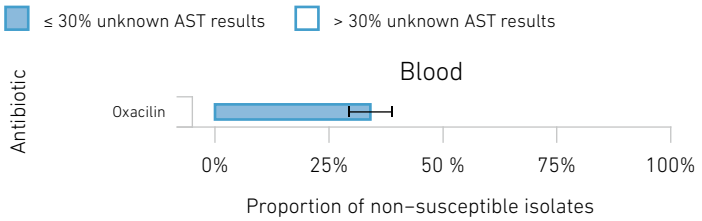
Salmonella **spp.**



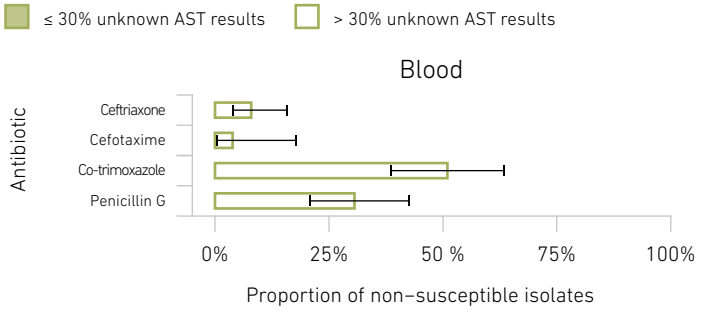
Shigella **spp.**



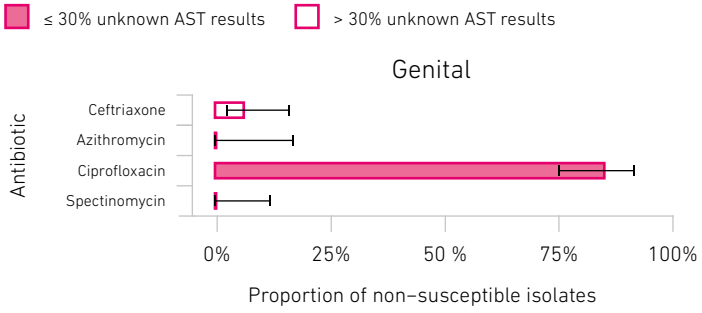
Staphylococcus aureus



Streptococcus pneumoniae



Neisseria gonorrhoeae



United Kingdom of Great Britain and Northern Ireland

Population 66.18 million

AMR surveillance in the UK is coordinated by Public Health England, Public Health Agency Northern Ireland, Health Protection Scotland and Public Health Wales. The UK has a Five Year AMR Strategy (2013 to 2018) which is currently undergoing a refresh. The UK participates in EARS-Net, Euro-GASP and FWD-Net and has been enrolled in GLASS since July 2017.

Current status of the national AMR surveillance system

160 participating laboratories*

160 laboratories performing AST
EQA provided to all labs for bacterial identification and AST for all GLASS pathogens

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
not selected
AST standard
CLSI, EUCAST
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
Participating Laboratories providing data to GLASS
EARS-Net/blood specimens: 108 laboratories
Urine specimens: 151 laboratories

* The identification of the total number of surveillance sites submitting specimens to participating laboratories was not possible due to the set-up of the national surveillance system

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

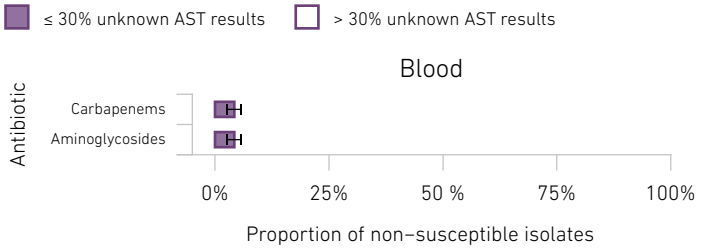
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	794
				E. coli	-	-	30218
				K. pneumoniae	-	-	5303
				Salmonella spp.	-	-	-
				S. aureus	-	-	8883
				S. pneumoniae	-	-	3963
URINE	-	-	-	*E. coli*	-	-	767064
				K. pneumoniae	-	-	43787
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

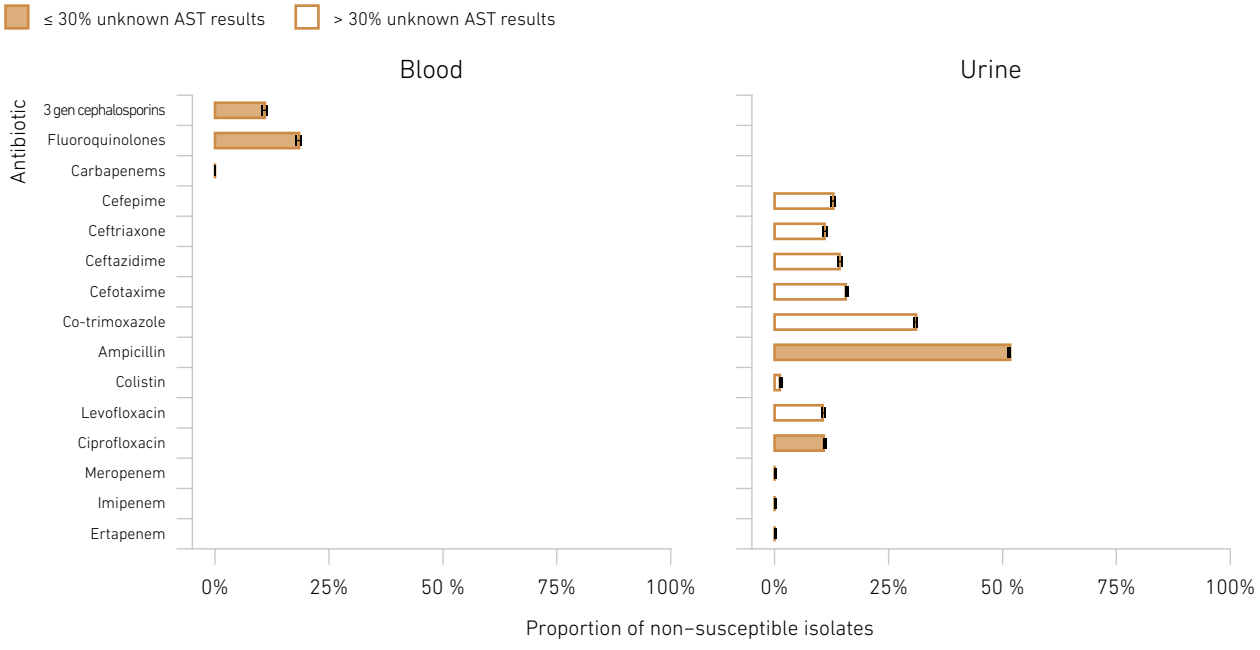
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

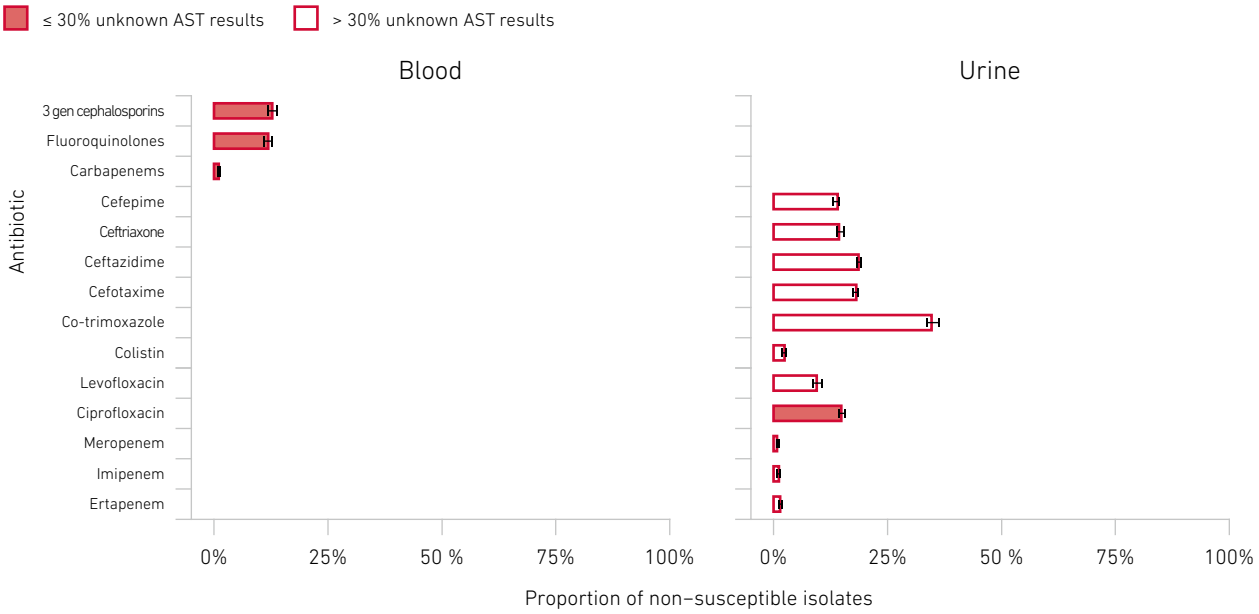


Escherichia coli

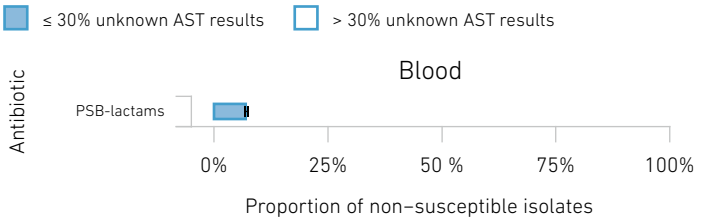


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

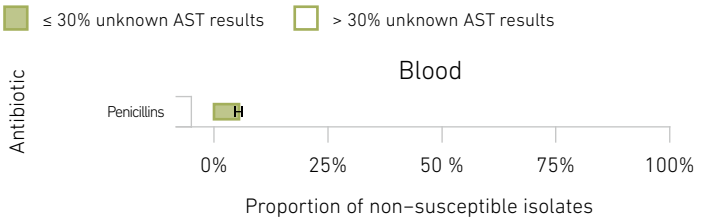
Klebsiella pneumoniae

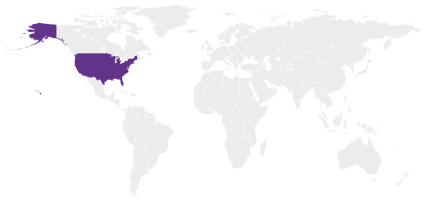


Staphylococcus aureus



Streptococcus pneumoniae





United States of America

Population 324.46 million

USA has been enrolled in GLASS since December 2016.

Current status of the national AMR surveillance system

3949 surveillance sites
3949 hospitals

3949 laboratories performing AST
No EQA provided

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

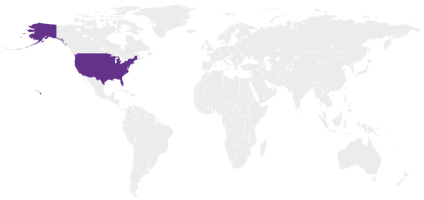
GLASS
Global AMR Surveillance System

in 2018 data call
Number of surveillance sites providing data to GLASS not reported

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected



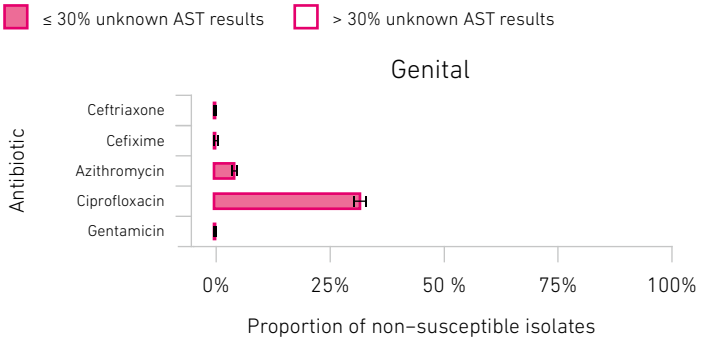
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	-	*Acinetobacter* spp.	-	-	-
				E. coli	-	-	-
				K. pneumoniae	-	-	-
				Salmonella spp.	-	-	-
				S. aureus	-	-	-
				S. pneumoniae	-	-	-
URINE	-	-	-	*E. coli*	-	-	-
				K. pneumoniae	-	-	-
STOOL	-	-	-	*Salmonella* spp.	-	-	-
				Shigella spp.	-	-	-
GENITAL	-	-	-	*N. gonorrhoeae*	5061	-	-

Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Neisseria gonorrhoeae



[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Zambia

Population 17.09 million

Zambia has completed development of the National Action Plan on AMR and is building its national AMR surveillance system. Zambia has been enrolled in GLASS since May 2016.

Current status of the national AMR surveillance system

1 surveillance site

1 laboratories performing AST

Surveillance Sites | Surveillance Sites | Surveillance Sites

NRL
selected
AST standard
CLSI
EQA
provided

National Reference Laboratory

National Coordinating Centre

NCC
established
National AMR surveillance plan
in place (with budget)
National Focal Point
appointed

GLASS
Global AMR Surveillance System

in 2018 data call
1 surveillance site providing data to GLASS
(1 hospital)

Data submission

Specimen type	Data on number of tested patient	Pathogen	AST results	Age	Gender	Infection origin
Blood	●	*Acinetobacter* spp.	●	●	●	●
		E. coli	●	●	●	●
		K. pneumoniae	●	●	●	●
		Salmonella spp.	●	●	●	●
		S. aureus	●	●	●	●
		S. pneumoniae	●	●	●	●
Urine	●	*E. coli*	●	●	●	●
		K. pneumoniae	●	●	●	●
Stool	●	*Salmonella* spp.	●	●	●	●
		Shigella spp.	●	●	●	●
Genital	●	*N. gonorrhoeae*	●	●	●	●

● 100% data collected ● 99-70% data collected ● <70% data collected

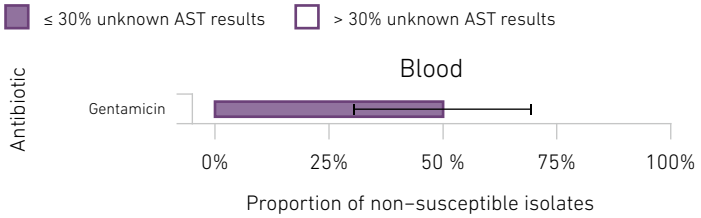
Data overview

SPECIMEN TYPE	NUMBER OF TESTED PATIENTS			PATHOGENS	NUMBER OF PATIENTS WITH POSITIVE SAMPLES		
	COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN		COMMUNITY ORIGIN	HOSPITAL ORIGIN	UNKNOWN ORIGIN
BLOOD	-	-	2924	*Acinetobacter* spp.	-	-	26
				E. coli	-	-	41
				K. pneumoniae	-	-	147
				Salmonella spp.	-	-	30
				S. aureus	-	-	106
				S. pneumoniae	-	-	-
URINE	-	-	1693	*E. coli*	-	-	488
				K. pneumoniae	-	-	319
STOOL	-	-	3653	*Salmonella* spp.	-	-	22
				Shigella spp.	-	-	29
GENITAL	-	-	-	*N. gonorrhoeae*	-	-	-

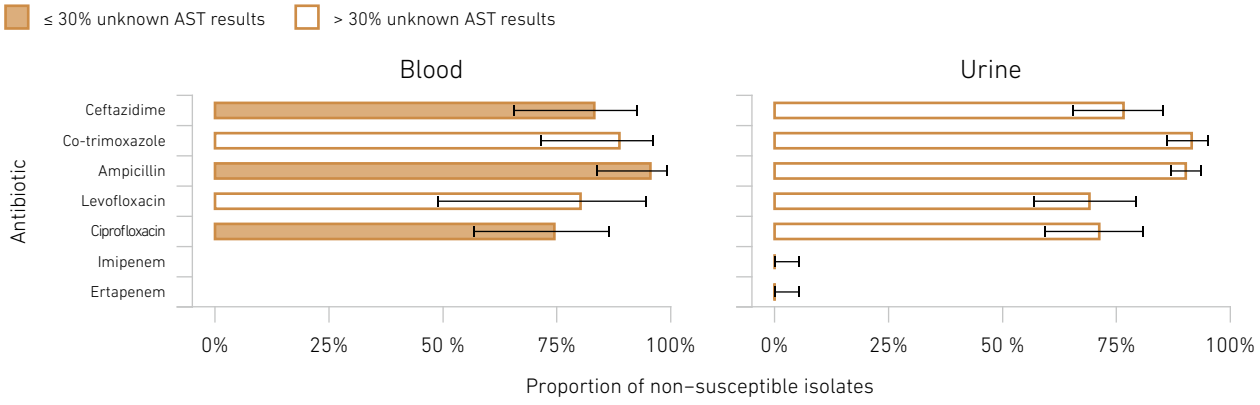
Pathogen non-susceptibility overview[1]

Proportion of samples with non-suceptibility results for bacteria species and antibiotic under surveillance.

Acinetobacter **spp.**

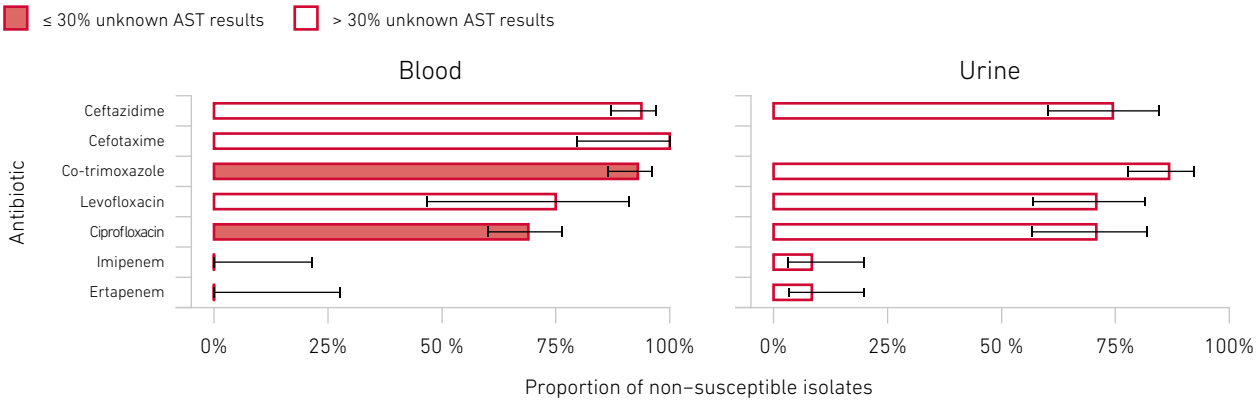


Escherichia coli

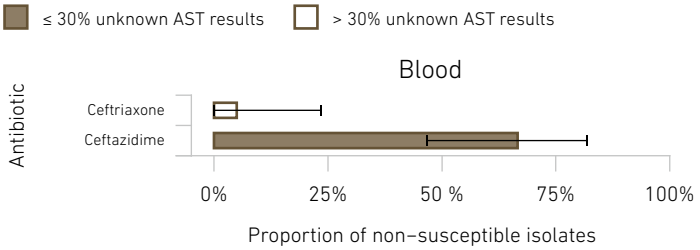


[1] AMR rates are not shown for pathogen-antibiotic combination with less than 10 AST result and/or 100% unknown AST results.

Klebsiella pneumoniae



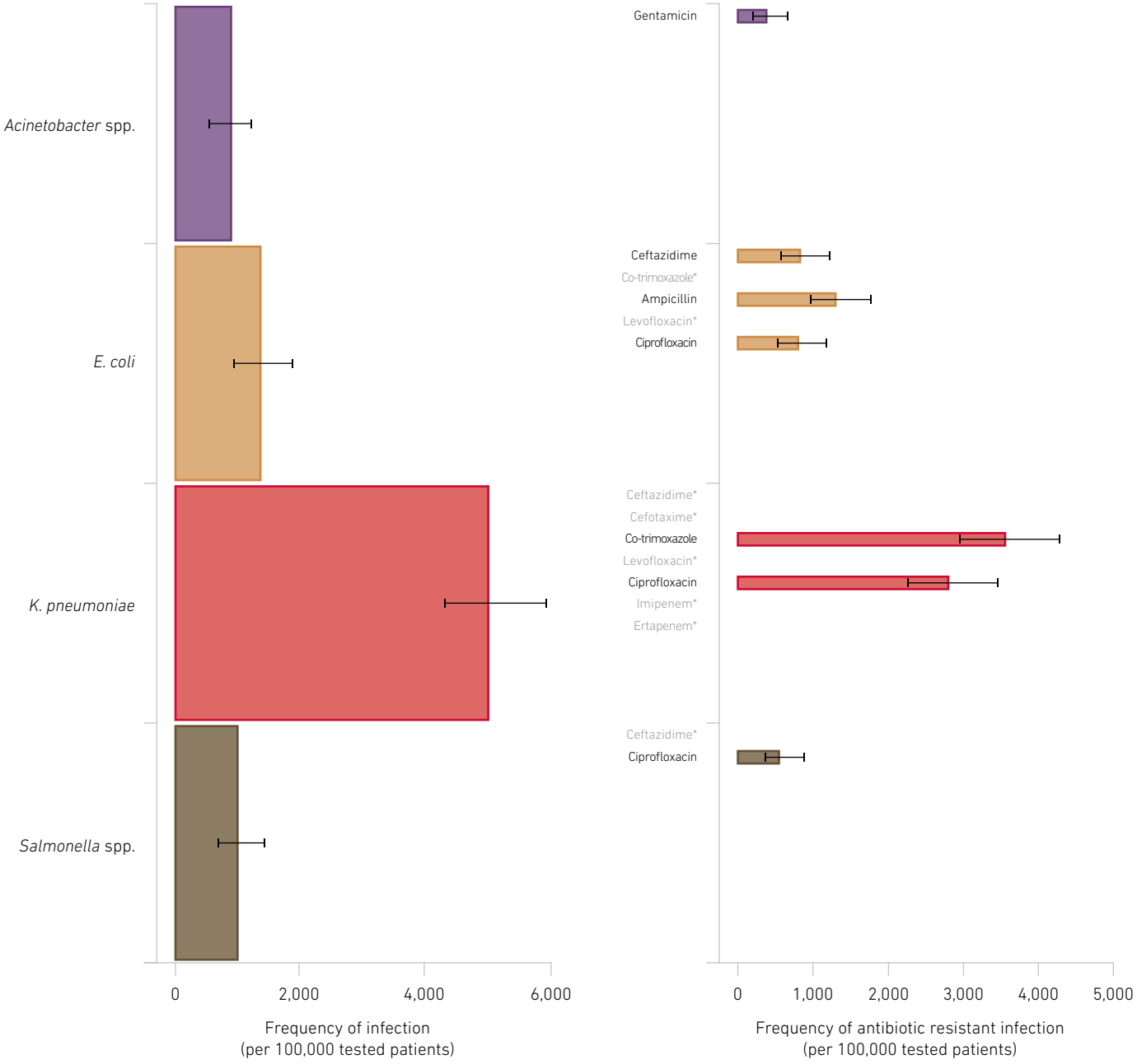
Salmonella **spp.**



Non-susceptible pathogen-antimicrobial combination frequency

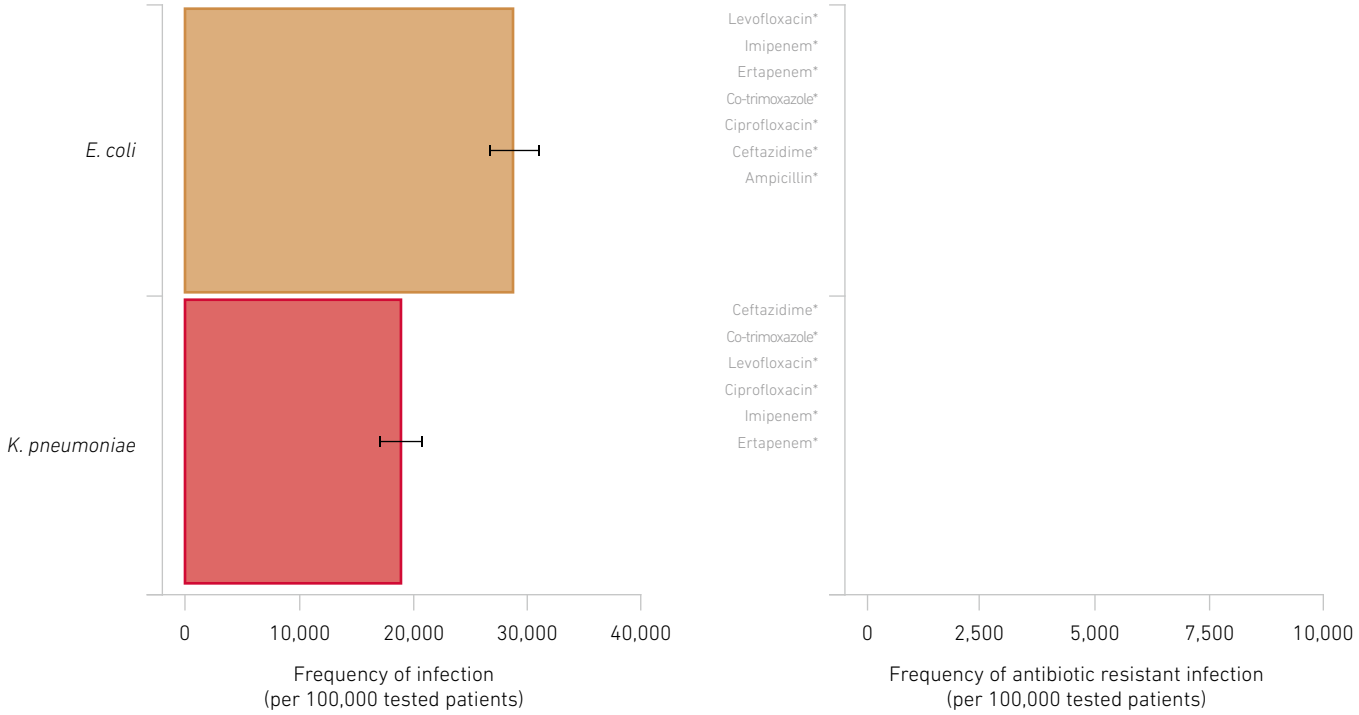
Frequency of infection caused by pathogens under surveillance per specimen and infection origin (left). Frequency of infection caused by pathogens non-susceptible to defined antibiotics under surveillance, per specimen and infection origin (right)

BLOOD- Unknown origin (n tested = 2924)



*Antibiotic with >30% unknown AST results: AMR rates not shown

URINE- Unknown origin (n tested = 1693)



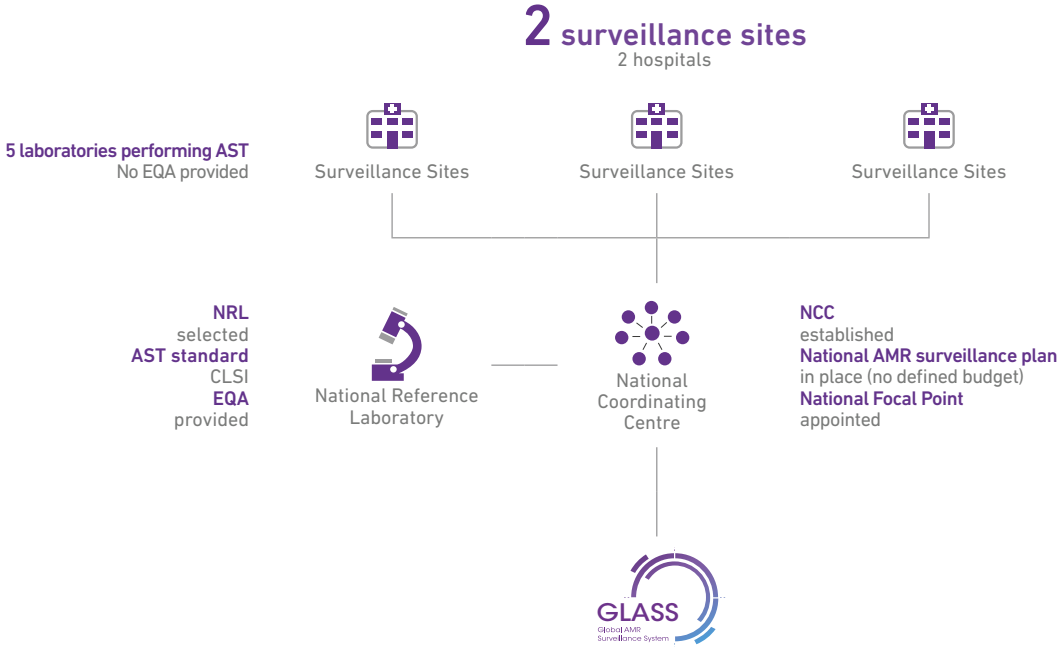
*Antibiotic with >30% unknown AST results: AMR rates not shown

Zimbabwe

Population 16.53 million

Zimbabwe has been enrolled in GLASS since November 2016.

Current status of the national AMR surveillance system



in 2018 data call

No AMR data reported to GLASS by the end of the data call


SECTION
04

GLASS development

GLASS continues its development by incorporating new modules and potentiating tools for country support and data analysis. Modules and tools currently under development are as follows and described in detail in the subsequent sections of this chapter:

- GLASS Emerging Antimicrobial Resistance Reporting (GLASS-EAR)
- Monitoring of antimicrobial consumption and use
- Special project on AMR for gonorrhoea (Enhanced GASP or EGASP)
- AMR surveillance in the food chain and environment
- GLASS web tools to improve reporting and data validation and analysis

4.1 GLASS Emerging Antimicrobial Resistance Reporting (GLASS-EAR)

The Emerging Antimicrobial Resistance Reporting (EAR) component within Global Antimicrobial Resistance Surveillance System (GLASS) was developed at the request of Member States to support detection, early warning and risk assessment capacities of national antimicrobial resistance (AMR) surveillance programmes.

The GLASS-EAR community is constituted by all Member States regardless of their GLASS enrolment status, WHO Collaborating Centres, AMR surveillance networks and research institutions that might discover new types of AMR in bacteria and fungi with potential relevance to public health. The GLASS-EAR component of GLASS implements a workflow process for notifying a diverse range of stakeholders on a timely basis, and in compliance with International Health Regulations (IHR) (26).

After a successful simulation exercise in November 2017 which brought together a geographically diverse group of stakeholders and provided feedback necessary for finalization of the framework, the GLASS-EAR module was launched in March 2018 (27).The module is embedded in the GLASS IT platform and provides a space where the GLASS-EAR members can share information regarding emerging AMR events (as defined in the GLASS-EAR framework (28)) to assess their importance, facilitate early information sharing, and stimulate epidemiological and microbiological discussion for coordinated actions.

GLASS-EAR provides a tool for a standardized, transparent, timely and secure reporting and reactive information sharing through:

1. Defined criteria (see the GLASS-EAR framework) to report select emerging AMR in bacteria or fungi event to be reported to GLASS-EAR;
2. Standardized collection for good information quality;
3. Defined roles for GLASS-EAR members and workflow for information sharing;
4. GLASS-EAR IT module, a web-based communication platform supporting the rapid and reactive exchange of technical information related to emerging AMR events according to the workflow and GLASS-EAR members' roles (29);
5. Ensured data security: WHO has a formal and comprehensive policy for securely managing all databases and information sources hosted by the Organization. This policy includes information security, technical and physical data security, data access and retention procedures, and confidentiality agreements.

Since the GLASS-EAR module was launched in March 2018, the GLASS team processed 7 emerging AMR events, including 4 reported by the GLASS NFPs and 3 via IHR channels (Table 4.1).

Table 4.1 Summary of emerging AMR events: Mar-Nov 2018

EAR event	Source
Unusual increase in critical resistance (ceftriaxone-resistant *Salmonella enterica* serotype Typhi	National GLASS focal point
2 events related to emergence of resistance to ceftazidime-avibactam in carbapenem-resistant Enterobacteriaceae	ECDC, National GLASS focal point
First case report of pan-resistant *Candida auris* infection in a country	National GLASS focal point
2 events related to multi-drug resistant strain of *N. gonorrhoeae*	IHR
Outbreak of typhoid fever caused by XDR *Salmonella* enterica serotype Typhi	IHR

4.2 Monitoring of antimicrobial consumption and use

4.2.1 WHO global antimicrobial consumption monitoring

The use of antimicrobials is one of the main drivers of antimicrobial resistance in both humans and animals. Antibiotics inactivate or kill susceptible bacteria, but allow antibiotic-resistant bacteria to proliferate. Broad spectrum antibiotics increase the selective pressure on bacteria, and stimulate the emergence of multi-resistant pathogens (30). In 2016, WHO developed a methodology for monitoring antimicrobial consumption (AMC) at the national level (31). AMC data are estimates derived from aggregated data sources (macro-level data – for example, import or distribution), as opposed to AMC data that refers to estimates derived from patient-level data (micro-level data – for example, prescription data). Consumption indicates which antimicrobials are used, and how much, whereas use data indicates how these medicines are used. These indicators are complementary, and together provide a comprehensive and better understanding of how antimicrobials are used.

Since 2016, WHO has been implementing a global surveillance system for monitoring the consumption of antimicrobials. This includes two main components, first developing central tools for managing the global surveillance system, and second, supporting countries in establishing corresponding national surveillance systems. Existing and similar international monitoring systems were used as references, for example ESAC-Net (The European Surveillance of Antimicrobial Consumption Network, managed by the ECDC), which has been in place since 2001 (32). Additionally, the WHO Regional Office for Europe established the WHO AMC Network in 2011 to assist countries in the region setting up or strengthening national AMC surveillance, and to contribute to region-wide AMC surveillance (33).

At a central level, WHO is integrating the monitoring of AMC in GLASS by developing the new module. This integration will reinforce GLASS, and provide synergies in surveillance of both AMR and AMC data. At the country level, WHO has provided training to 57 countries in collecting AMC data, and informed an additional 23 countries about the WHO methodology for surveillance of antimicrobial consumption (34). In the future, WHO plans to consolidate the global monitoring of AMC by developing or improving tools to capture consumption data, and continuing in-country support.

4.2.2 Measuring antibiotic use

In parallel to monitoring AMC, WHO is additionally developing tools to capture data on antibiotic use at a patient level. WHO is currently focused on developing tools adapted to hospital settings, and expects to release a protocol to survey antibiotic use in hospitals by the end of 2018. For these surveys, WHO is developing a web tool to capture and report data on the use of antibiotics through the GLASS platform. This web tool will facilitate data entry and reporting for countries, and will allow the building of a global database on antibiotic usage in hospitals. Since 2017, WHO has piloted the WHO Protocol for Point Prevalence Survey (PPS) on Antibiotic Use in hospitals in several countries, which has been adapted from the existing point prevalence protocols from the European Centre for Disease Prevention and Control, and from the Global PPS. A regional project has been initiated to collect data on prescribing and use of antibiotics from hospitals in Sub-Saharan Africa. In the future, WHO will develop similar tools to measure antibiotic use in community or primary-care settings.

4.3 Special project on AMR for Gonorrhoea (Enhanced GASP)

Initiatives to control and mitigate the impact of resistance in *N. gonorrhoeae* are being implemented following the GAP-AMR framework, and approaches are now being developed to monitor gonococcal AMR within GLASS. The Special Project on AMR for Gonorrhoea (Enhanced GASP or EGASP) was created to monitor trends in antimicrobial susceptibilities in *N. gonorrhoeae* using standardised sampling and laboratory protocols. EGASP ensures that epidemiological data (which is more extensive) is linked to laboratory results, and antimicrobial susceptibility testing uses the E-test. In addition, the capacity of the identified laboratories to perform gonorrhoea culture and AST is being strengthened through training and the implementation of adequate internal and external laboratory quality assurance systems. The protocol is being implemented in sentinel countries: It is the third year of implementation in Thailand, and the programme has been initiated in the Philippines and soon in Cambodia. Based on the experience generated, EGASP protocols and standard operating procedures (laboratory, data collection, and management) are being finalised to be used by other countries. Through the Enhanced GASP, a treatment failure mechanism is being established. The new GLASS EGASP module is currently under development.

4.4 AMR surveillance in the food chain and environment 2017-2018

4.4.1 Capacity building on Integrated Surveillance on AMR through research country pilot projects

A new round of pilot projects were opened in 2016, with the selection process supported and revised by members of the WHO Technical Advisory Group on Integrated Surveillance of Antimicrobial Resistance (AGISAR), and 15 pilot project proposals were granted funding (Table 4.2)(35). Country projects are focused on pathogens in the food chain, involve at least two sectors, and also include data on the use and consumption of antimicrobials in-country. These projects have 2-year duration, and all projects are supporting the establishment or improvement of the Integrated Surveillance on AMR based on National Action Plans (NAPs) on AMR.

Table 4.2 AGISAR projects funded between 2017 and 2018

AGISAR project type (N=number of countries)	Countries selected
Country project (n=4)	Ecuador, South Africa, Zambia, and Zimbabwe
Focused project (n=11)	Tanzania, Ethiopia, Chad, Suriname, Argentina, Palestine, Albania, Bhutan, Thailand, Japan, and The Philippines

4.4.2 WHO Integrated Global Survey on Extended Spectrum Beta-Lactamae (ESBL) *E.coli*, the Tricycle Project, using a One Health Approach and GLASS

The WHO Integrated Global Survey protocol has been developed, with the support of AGISAR members and experts from WHO Collaborating Centres, to support the establishment and implementation of multisectoral integrated surveillance in a simple and doable way. This One Health approach in the Member States is based on one indicator, ESBL producing *E. coli*, that will be detected in the three main sectors: human, food chain, and environment (35). The first draft version of the protocol is being piloted in six countries in four WHO Regions, including Ghana (AFR), Senegal (AFR), and Madagascar (AFR), Pakistan (EMR), Indonesia (SEAR), and Malaysia (WPR). The results of this pilot phase will be analysed in an AGISAR expert meeting to finalise the protocol and launch it in 2019 to be used for all Member States.

The new GLASS module for One Health integrated surveillance on ESBL-producing *E. coli* is currently under development.

4.5 GLASS web tools

The GLASS IT Platform (available at https://extranet.who.int/glass/portal/) is a web-based platform for global data sharing related to AMR hosted by the WHO. Launched in 2016, it serves as a common environment for sharing data generated within the framework of several WHO AMR surveillance activities.

Currently, the platform hosts three modules:

1. Antibacterial resistance in humans from countries participating in GLASS (AMR in humans)
2. Emerging AMR reporting (GLASS EAR)
3. Antimicrobial Consumption (AMC)

Since the first GLASS report publication, the platform has been further developed with new analytical and data visualisation tools, and export functionalities for its AMR in human's module. Notably, countries can now automatically generate and export reports to check the validity of the data reported over a number of selected indicators and produce reports for their own purposes. The module is also generating the GLASS country profiles that are being used for the GLASS annual reports. The module will be further developed to automatize as much as possible GLASS enrolment, data submission, and validation, and to increase the analytical and data visualisation outputs.

The module also offers a tool for individual (line-listed) data reporting. Launched in 2018, this tool is open to GLASS national focal points from CAESAR countries, and to WHO European Regional Officers. The module allows for individual (line-listed) data uploading, validation, and analysis according to the CAESAR protocol, and it automatically aggregates data for GLASS reporting (36).

By consolidating different national AMR surveillance outputs in one environment, the GLASS-IT platform supports the implementation of One Health AMR surveillance at national levels, and facilitates future integrated analysis between AMC and AMR data at national, regional, and global levels. Aside for the EGASP and the One Health integrated surveillance on ESBL-producing *E. coli* modules, the development of a module for surveillance of antifungal resistance is planned for the near future.


SECTION
05

Updates from WHO Regional Offices on AMR surveillance activities

5.1 African region (AFR)

5.1.1 Regional surveillance initiatives

The WHO African Regional Office (AFRO) continues to support member states to develop/implement their National Action Plans (NAPs) using the One Health approach, and to strengthen partnerships for a more coordinated and efficient implementation of AMR surveillance in the Region. 15 countries have had their NAP approved by national authorities, while eight are waiting for approval or heading towards finalisation.

Technical assistance is currently planned for countries to develop national laboratory AMR capacities. Since December 2017, Mali is being supported through the KOICA project aiming to strengthen global and national surveillance systems through strengthening national laboratory capacities and the workforce for surveillance of AMR. In February 2018, AFRO has organised training in Nairobi, Kenya, convening laboratory technicians from eight countries from human and agricultural/veterinary sectors. The aim was to strengthen their capacities in laboratory surveillance and control of major foodborne diseases, and contribute to the global effort and initiatives of AMR containment in foodborne pathogens. Chad, Ethiopia, and Tanzania are being provided technical support to implement AGISAR funded focused research projects on integrated surveillance of AMR in foodborne bacteria, whilst South Africa, Zambia, and Zimbabwe are receiving support in the implementation of 2-year country projects on integrated surveillance including antimicrobial usage. The ESBL-producing *E. coli* "Tricycle project" is being piloted in Ghana, Madagascar, and Senegal.

5.1.2 Link between AFR activities and GLASS

AFRO is sensitising countries to enrol in GLASS as part of the implementation of AMR activities. This is done through the technical support provided to develop/review AMR NAPs, and attendance at regional workshops/meetings. In 2018, with support from WHO, tools and guidance were provided to four new countries: Ethiopia, Liberia, Mali, and Mauritius. In Mali, AMR research will be conducted, among others, through post graduate scholarships granted by KOICA. In total, since the official launch of GLASS in March 2016, 15 AFRO countries out of 47 completed the process. AFR staff followed up with Tanzania, Algeria, and Burkina Faso to determine the feasibility of submitting data to GLASS in 2018 for Ministries of Health and associated reference laboratories. Remote technical support was also provided to Zambia towards the development of their AMR national surveillance strategy.

5.2 Region of the Americas (AMR/PAHO)

5.2.1 Regional surveillance initiatives

In 1996, the WHO Regional Office for the Americas/ Pan American Health Organization (AMRO/PAHO) established the Latin American Network for Antimicrobial Resistance Surveillance (ReLAVRA) (13). ReLAVRA was directed towards improving AMR laboratory surveillance in the Americas through the strengthening of laboratory capacity for pathogen identification and AST. Since then, AMRO/PAHO has expanded programmes for AMR surveillance, prevention, and control, forging collaborations with different partners and stakeholders.

Today ReLAVRA has 20 designated NRLs in 20 Latin American countries, reporting AST data on a broad range of pathogens (11 community-acquired pathogens, and 10 nosocomial-acquired pathogens), including the GLASS pathogens. In addition to collecting AST data on 21 human pathogens, the network laboratories alert on isolates with unusual types of AMR (called here "event-driven surveillance") (13).

AMRO/PAHO has also launched several initiatives aimed at building or enhancing antimicrobial surveillance capacities in the Caribbean sub-region, supporting the creation of an AMR surveillance network in the Caribbean. During the multi-country Workshop to Strengthen Antimicrobial Resistance Surveillance in The Caribbean (25 – 29 June, 2018 Bridgetown, Barbados), representatives from 21 countries and territories agreed on the need to form a network for AMR surveillance to facilitate and standardise their collaborative outcomes (13).

5.2.2 Link between AMR/PAHO activities and GLASS

Through these established regional networks, the AMRO/PAHO Office has been working with the countries in the region to foster their participation in GLASS, and avoid double reporting and discrepancies in reported national AMR data. To further support alignment of the ReLAVRA methodology with GLASS, the AMRO/PAHO office has invited countries to participate in a pilot to capture additional variables, in line with GLASS methodology. The AMRO/PAHO office is also supporting the Caribbean network to standardise their methodology following the GLASS model.

Within the AMRO region, Brazil, Canada, and the United States are already enrolled, and have reported data to GLASS. Recently, Haiti has also enrolled. However, substantial capacity building is needed to strengthen the foundation for AMR surveillance activities, as very few laboratories have the resources to identify pathogens and their susceptibility to antibiotics.

Although the GLASS early implementation phase focuses on bacterial infections in humans, it is recognised that the information gap in other types of AMR such as in invasive fungal infections must also be addressed. Therefore, in August of 2018, an expert consultation meeting was organised by PAHO to establish the operational framework for the creation of a surveillance network for antifungal resistance in the region, following the GLASS meeting on global surveillance of antimicrobial resistant invasive candida infections on the 24 April, 2018, Madrid, Spain. During the consultation, experts and representatives from Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Guatemala, Mexico, Peru, the United States, and Venezuela discussed the minimal requirements and methodology for a surveillance protocol for antifungal resistance in candidaemia in the region, and the first steps towards implementation.

5.3 Eastern Mediterranean Region (EMR)

The WHO Eastern Mediterranean Regional Office (EMRO) is continuing to deliver detailed interventions and activities to establish/improve national AMR surveillance systems. As result, three countries (Sudan, Iran, and Libya) have recently endorsed and submitted their AMR NAPs to WHO. Five countries (Bahrain, Egypt, Iraq, Qatar, and Tunisia) have completed their NAPs, and are awaiting official endorsement by relevant authorities. Pakistan is currently implementing the first phase of the plan.

Mapping of existing laboratory capacities within countries to support AMR detection has been conducted with support from the Public Health Laboratories. On-site technical assessment of AMR NRLs was undertaken in Jordan, Pakistan, Sudan, and Tunisia. Technical support was provided to set up internal laboratory quality control systems according to CLSI standards by arranging shipment of quality control strains for AMR pathogens for three countries (Sudan, Jordan, and Iraq).

Tripartite/tricycle integrated AMR surveillance of ESBL-producing *E .coli* in humans, animals, and the environment is being conducted in Pakistan. The project is an example of tripartite collaboration on integrated AMR surveillance between WHO, FAO, and OIE. Plans are in place to expand this study to Egypt, Iran, Jordan, Morocco, and Sudan by the end of 2018.

5.3.1 Link between EMR activities and GLASS

14 countries in the region are currently enrolled in GLASS. This represents more than half of the countries in the region. During the last GLASS data call for 2018, EMRO supported 12 (85%) of these countries in the submission of their AMR data. Moreover, a sub-regional training workshop on the WHONET software and principles/methods of GLASS was conducted for national teams from five countries in the region in September 2017. A second round of this training is planned in January 2019 for teams from GLASS-enrolled countries. In addition, a laboratory training workshop on the implementation of laboratory quality management systems (LQMs) will be provided to AMR NRLs in GLASS enrolled countries in February 2019 to enhance the quality and comparability of AMR data reported by the countries.

The "Strengthening global and national surveillance systems through strengthening national laboratory capacities and the workforce for surveillance of AMR" project, funded by KOICA and coordinated by GLASS, has been launched in Jordan (37). Two back-to-back laboratory workshops will be hosted with AMR NRLs and sentinel sites in October 2018. IT support is also being provided to facilitate AMR reporting from sentinel sites to NCCs through the integration of existing surveillance systems. Jordan is the first country in the

region to build upon existing surveillance programs for national AMR reporting.

5.4 European Region (EUR)

In countries of the European Union and the European Economic Area (EU/EEA), antibiotic resistance surveillance has been on-going for almost two decades. This has been coordinated and driven by the ECDC through the European Antimicrobial Resistance Surveillance Network (EARS-Net)(38). For European countries outside of the EU/EEA, the WHO Regional Office for Europe (EURO) and partners have been coordinating surveillance through the Central Asian and Eastern European Surveillance of Antimicrobial Resistance (CAESAR) network since 2012 (11).

The CAESAR network supports the building of surveillance capacity, which is tailored to the development and specific needs of the surveillance system in each county. Although building surveillance capacity is a time and effort consuming process, the network has steadily made progress since its initiation in 2012. This progress has been reported annually in CAESAR reports since 2015 (36). In close collaboration with the ECDC, and using methodology compatible to EARS-Net, CAESAR expands surveillance conducted in the EU/EEA to obtain a pan-European overview of the trends and sources of AMR. CAESAR assesses the data that are being provided following clear criteria, and assigns different levels of evidence or quality. This reminds the reader to be cautious when interpreting certain data, and lowers the threshold for sharing data and provides motivation to improve the system, guided by the criteria used to assess data quality. Currently, 10 countries of the CAESAR network are providing data whereas the remaining countries are continuing to develop their systems.

To initiate surveillance in countries where the foundation and structure for surveillance is absent, WHO EURO and partners developed the so-called Proof of Principle (PoP) projects (39). PoP projects are designed to stimulate blood sampling of patients with suspected bloodstream infections to support treatment decisions of clinicians, as well as to start assessing the antibiotic susceptibility of the main pathogens causing community-acquired and hospital-acquired bloodstream infections. The first PoP project was performed in Georgia, and completed in December 2016. Armenia is currently performing a PoP project, and preparations are taking place to initiate similar projects in Tajikistan and Uzbekistan.

5.4.1 Link between EUR activities and GLASS

The regional AMR surveillance networks of EURO and ECDC are working closely with the GLASS secretariat to support countries participating in the networks and enrolled in GLASS to avoid additional reporting burden, as well as discrepancies in reported national data. Data from EARS-Net and CAESAR from countries enrolled in GLASS are transfered to the GLASS IT platform. A special module for CAESAR countries has been developed within the GLASS IT platform to capture the CAESAR data format (individual line-list data) and facilitate the uploading to GLASS. A workshop with CAESAR countries to discuss the IT solutions to reporting individual data is planned for the first quarter of 2019. Data not captured by EARS-Net are directly uploaded by countries. Currently, five countries from the European region provide data directly to the GLASS IT Platform.

5.5 South-East Asia Region (SEAR)

Since 2016, a series of baseline knowledge and capacity gaps assessments were conducted by the WHO Regional Office for South East Asia (SEARO). SEARO also supported the undertaking of a situation analysis for the national AMR control programme, and the establishment of baseline data collection in 10 of 11 Member States of the region (40). SEARO's roadmap was also developed in 2016 to assist Member States in strengthening their national AMR prevention and containment programmes, leading to the development of AMR National Action Plans (NAP) for all 11 countries in the Region (40). In 2017, SEARO also assisted the Democratic People's Republic of Korea in developing a NAP, and the Maldives in developing their national policy for AMR.

In 2017, coordination mechanisms between different departments in SEARO and the FAO–OIE–WHO tripartite were advanced. A regional tripartite One Health/AMR Secretariat based in the FAO Regional Office for Asia and the Pacific (RAP) in Bangkok was established to be a strong advocate, and leverage traction of multiple sectors in promoting inter-sectorial coordination at the national level in SEAR countries. The Secretariat also aims to coordinate bi-regional (SEARO and WPRO) activities related to AMR containment.

Within the framework of NAPs, and based on baseline risk assessment, priority intervention areas were identified and pilots were initiated. Key projects included the pilot of the ESBL *E. coli* Tricycle project that contributes to integrated surveillance (initiated in Indonesia, India, and Nepal); Sri Lanka, Bangladesh, India, Thailand, Nepal have agreed in principle to participate beginning in 2018. Integrated surveillance is further proposed to be strengthened through use of IT systems for centralisation of AMR surveillance data in partnership with WHONET and JANIS (Japan Nosocomial Infection Surveillance). Awareness was also identified as a priority, and a template for creating targeted communications strategies for AMR in SEAR is being developed.

All 11 member countries from SEAR are participating in AMR self-assessment for Global Monitoring of Country Progress on AMR.

5.5.1 Link between SEAR activities and GLASS

Compared to only two countries (India and Thailand) last year, seven more countries have enrolled in GLASS: Bangladesh, Bhutan, the Democratic People's Republic of Korea, the Maldives, Myanmar, Nepal, and Sri Lanka, which account for the 82% of the region. SEARO will continue and strengthen its support to countries to secure the participation of all the regional members in GLASS.

5.6 Western Pacific Region (WPR)

To date, 15 Member States/areas have developed their national AMR action plans including Australia, Cambodia, China, the Cook Islands, Fiji, Hong Kong SAR (China), Japan, Malaysia, Mongolia, New Zealand, Papua New Guinea, the Philippines, the Republic of Korea, Singapore, and Viet Nam. The Federated States of Micronesia (FSM), the Marshall Islands, Lao People's Democratic Republic, and Palau are in the process of finalising and endorsing their plans.

In the region, surveillance, ACM, stewardship programmes, and infection prevention and control are prioritised. In 2018, two additional countries were supported – Lao People's Democratic Republic and Cambodia. A substantial number of countries in the Region including Australia, Japan, Malaysia, the Philippines, South Korea, Singapore, and New Zealand have established surveillance systems. Seven countries, including Australia, Brunei, Malaysia, Mongolia, the Philippines, Singapore, and Viet Nam have established antimicrobial stewardship programmes, and a module for training multidisciplinary teams and tools to monitor implementation and impact have been developed. WPRO has also developed a 5-year plan for advocacy, and a campaign for behavioural change, targeting human, health and animal sectors. The plan is implemented through the annual World Antibiotic Awareness Week (WAAW). In 2017, it added a web-based approach to the campaign with its Race to a Million Pledges against AMR.

Finally, the Gonococcal Antimicrobial Surveillance Programme (GASP) is in place, and 11 countries in this region are participating. Enhanced GASP, which incorporates molecular technology for antimicrobial susceptibility of *N. gonorrhoeae*, has started in the Philippines, and is planned for Cambodia.

5.6.1 Link between WPR activities and GLASS

The WHO Regional Office for WPRO works with countries to ensure that the information generated through national surveillance systems can contribute to the global monitoring of AMR. The GLASS approach can help countries to progressively strengthen their AMR surveillance systems. To date, only Japan, the Philippines and the Republic of Korea are reporting AMR data to GLASS, however in 2018, Lao People's Democratic Republic and Cambodia were supported to set-up their national AMR surveillance systems, and provided related information to GLASS.

Countries continue to meet challenges in determining the approach to AMR surveillance based on their contexts, level of capacity, and needs, as well as in ensuring that the surveillance systems can be sustained and will evolve as part of the broader public health surveillance systems. In order to address this need, the WPRO technical working group is collaborating with the AMR surveillance team in WHO headquarters to draft a guidance document for countries. An informal consultation on strengthening AMR surveillance in the region will be undertaken in April 2019.


SECTION
06

Conclusion

6.1 Progress in GLASS

A global system such as GLASS can succeed only through continued data sharing, as well as global collaboration, harmonisation, and coordination between all partners involved in the implementation of AMR surveillance. The results from the second GLASS data call summarized in this report have shown that by working together with countries and partners, GLASS can motivate national systems to share AMR data from surveillance and control systems. Although some countries still face major challenges in building their national surveillance systems, and improvements are still urgently needed, participation in GLASS and the amount of information generated by the system has grown substantially.

For this data call, the enhanced coordination with AMR regional networks, specifically CAESAR and EARS-Net, guaranteed a broader inclusion of national AMR data. Five CAESAR countries and 18 EARS-Net countries submitted data on AMR in pathogens from blood to GLASS, with the support of the WHO Collaborating Centre at the Dutch National Institute for Public Health and the Environment.

GLASS is continuously evolving. The lessons learned from the first data call (2017) informed and improved support to countries for data management and sharing with GLASS. New enhanced IT tools for data analysis and validation were designed for GLASS. These tools facilitated the data collection process, and enabled enrolled countries to better monitor and secure the quality of their data submission thought-out the process prior to publication and produce separate reports for the respective country summary. WHONET, a free Windows-based database software developed by a WHO Collaborating Centre (Brigham & Women's Hospital and Harvard Medical School) for the management and analysis of microbiology laboratory data, has proved a key enabler for data preparation, particularly in countries with less developed IT systems.

For the current report, twice as many countries provided data on AMR samples compared with the first GLASS data call in 2017(18). This rapid increase in country participation demonstrates countries' confidence in the system, improved understanding of the importance of sharing valid and accurate AMR data, commitment to sharing data internationally, and the applicability of the GLASS approach among countries with different levels of development. This year, aside from 26 HICs, GLASS received AMR data from three LICs, eight LMICs, and 10 UMICs.

Finally, GLASS promotes a shift from surveillance approaches based solely on laboratory data (isolate-based data) to a system that includes epidemiological, clinical, and population-level data, which has been well accepted by countries. The Resistant-Intermediate-Suscpeptible (RIS) AMR dataset provided by countries already conveys information on pathogens specific sites of infection, and tested patients age and gender, and infection origin. This additional information was required for data stratification into variables of epidemiological importance. In addition, GLASS also seeks information on total number of patients sampled to calculate AMR frequency rates in the tested population, as the calculation on these rates by age groups and infection types is key to inform and direct mitigation strategies and intervention to control AMR in the most affected groups. Compared to four countries last year, 14 countries have submitted denominator data to calculate the frequency of occurrence of resistance within tested populations. For six countries, it was also possible to stratify the frequency by age, gender, and infection origin, which enables a clearer identification of AMR patterns within population levels.

6.2 Challenges and steps forward

While the achievements of GLASS so far are clear, it is also important to identify and critically assess the limitations and gaps of the early implementation phase. Detailed technical limitations are summarised in Section 2.4, and extensively discussed in the first GLASS Report – Early Implementation 2016-2017 (18).

There is large variability in terms of data submission, not only with respect to the types of data submitted, but also their completeness. However, although priorities and resources for AMR surveillance will vary between countries, the flexibility built into GLASS has allowed a systematic data collection from countries at different stages of surveillance system development.

Data quality is also associated with varied capabilities of different countries to structure and run surveillance systems, and is linked to a large number of factors, including access to and use of laboratory diagnostics, personnel training, availability of resources, and infrastructure. Tools targeting particularly limited

resource countries are being developed to help with their implementation and strengthening processes.

The GLASS data call timeframe has proven to be a challenge for several countries, including those with existing functional AMR surveillance systems. However, the effort put into GLASS IT development this year is targeted at the creation of a fully automated system that will allow in the future for an almost continuous flow of information gathering and real-time analysis of the data. This will be particularly important to monitor AMR trends, and will allow better synergy with existing surveillance systems.

Data aggregation at national levels it is still a large challenge for data analysis and results interpretation. Ideally, GLASS would welcome anonymised individual line-list data to permit proper analysis of the AMR epidemiology globally. Aside from allowing for better data validation and management of issues associated with data computability, the huge benefit associated with individual data is their analytical potential. It will enable the identification of associations among infection types, the proportion of resistance for specific pathogens, and the identification of risk factors linked with age, gender, infection origin, and prescription behaviours, which will offer essential guidance to health-care practices. Estimates generated using individual data will also inform models for more reliable forecasting, and allow the progress of targeted and more effective control strategies to be monitored.

On the other end, to comply with the request made by representatives from countries participating at the 1st Member State consultation on global AMR surveillance[1], currently the AMR module in the GLASS IT platform collects data aggregated at national level. Countries participating in GLASS are familiar with the GLASS platform, and data preparation and uploading in the aggregated format. The newly developed individual data module being used by CAESAR countries will become available to all countries that will want to explore the benefits of submitting individual, line-listed anonymised AMR data.

Another important limitation of GLASS is the lack, in most countries, of a sampling strategy to produce representative AMR data. For this reason, GLASS has been asked to provide a methodological approach that would guarantee more representative AMR data. In addition to promoting diagnostic stewardship to secure a more robust identification of AMR cases, GLASS will be developing protocols for data collection that will help countries to achieve national representativeness of AMR rates.

WHO headquarters, Regional Offices and Country Offices – together with the AMR Surveillance Collaborating Centres Network and international partners – are supporting countries to build national laboratory capacity, and providing technical support for microbiology laboratories in countries through a range of activities. Technical assistance is prioritised in LICs and LMICs for the development and operation of NRLs, EQA, and quality management. Technical guidance is also being developed for the detection and reporting of colistin resistance, and the use of molecular methods to support AMR surveillance. Materials for AMR diagnostic testing are being included in the WHO catalogue to enable efficient ordering of pre-qualified material by countries, and will also be included in the next WHO Essential Diagnostics List (EDL).

GLASS is facilitating synergies between WHO surveillance initiatives related to AMR in common bacterial pathogens such as AMR in foodborne pathogens, in *N. gonorrhoeae*, and antimicrobial consumption monitoring, and new modules within the GLASS IT platform are being built to facilitate further integration of analysis and reporting. GLASS has also started the development of a framework for AMR surveillance in invasive fungal disease.

Advocacy and communication to engage and support countries on this journey are paramount, as is collaboration with other partners that work on the implementation of AMR surveillance and capacity building. GLASS has benefitted from the expertise of the GLASS AMR Collaborative Platform, which comprises WHO Collaborating Centres and partner technical institutions (41). These groups will continue to work together to further develop the AMR surveillance system. GLASS will also continue to collaborate closely with international and regional AMR surveillance networks.

The GLASS early implementation phase (2015-2019) is proving to be an essential step for GLASS revision in 2020. GLASS will be using the knowledge generated during this phase to identify necessary methodological steps to secure better quality, robustness, and representativeness of the collected data and generated results. This will permit comparison of AMR patterns over time, and generate reliable estimates of the magnitude of the problem. A central feature of GLASS is countries full ownership of data and the active participation they have to scope future GLASS development to meet national public health needs. GLASS has become an essential system for the monitoring of global AMR trends and the identification of AMR drivers, which will inform effective and sustainable control strategies.

[1] https://www.who.int/antimicrobial-resistance/events/SwedenMeeting/en/

Annexes

ANNEX I: Pathogen-antimicrobial combinations under GLASS surveillance

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

[a] The listed substances are priorities for surveillance of resistance in each pathogen, although they may not be first-line options for treatment. One or more of the drugs listed may be tested.
[b] One or more of the drugs listed may be tested in countries. R, I ,S and nominator and denominator data for each shall be reported separately.
[c] Imipenem or meropenem is preferred to represent the group when available.
[d] Cefoxitin is a surrogate for testing susceptibility to oxacillin (methicillin, nafcillin); the AST report to clinicians should state susceptibility or resistance to oxacillin.
[e] Oxacillin is a surrogate for testing reduced susceptibility or resistance to penicillin; the AST report to clinicians should state reduced susceptibility or resistance to penicillin.

ANNEX II: GLASS country surveillance implementation indicators

AREA	INDICATOR	OUTCOMES
Coordination	National Coordination Centre (NCC) has been set up	Yes/No/Not known
	National focal point (NFP) appointed	Yes/No/Not known
	National AMR surveillance plan developed	Yes with budget/Yes without budget/No/Not known
	National reference laboratory (NRL) designated	Yes/No/Not known
Surveillance system	Total number of AMR surveillance sites contributing to the national surveillance system	Numerical
	Number of local clinical laboratories performing AST that support the national AMR surveillance sites	Numerical
Quality Assessment (QA)	External Quality Assessment (EQA) is provided for NRL	Yes/No/Not known
	EQA provided to local laboratories participating national AMR surveillance system	Yes/No/Not known
	EQA provided to local laboratories participating in the national AMR surveillance system for AST and bacterial isolation	Yes/No/Not known
	Pathogens included in GLASS are covered by EQA	Yes/Some/None/Not Known
	Type of AST standards followed by countries	CLSI/EUCAST/Other

ANNEX III: Economic status of countries reporting to GLASS

GLASS report 2017-18	Economic status			
	LIC	LMIC	UMIC	HIC
Information on implementation only	Afghanistan	Bangladesh	Brazil	The United States of America
	Ethiopia	Bhutan	Islamic Republic of Iran	
	Gambia	Cambodia	Libya	
	Liberia	Kenya	Maldives	
	Mali	Lao People's Democratic Republic	Mauritius	
	Nepal	Mozambique		
	Zimbabwe	Myanmar		
		Sri Lanka		
AMR data and information on implementation	Madagascar	Egypt	Bosnia and Herzegovina*	Austria
	Malawi	India	Georgia	Bahrain
	Uganda	Nigeria	Iraq	Canada
		Pakistan	Jordan	Croatia
		Philippines	Lebanon	Cyprus
		Sudan	Malaysia	Czech Republic
		Tunisia	Republic of North Macedonia	Finland
		Zambia	Russian Federation	France
			South Africa	Germany
			Thailand	Greece
				Ireland
				Japan
				Latvia
				Lithuania
				Luxembourg
				Malta
				Netherlands
				Norway
				Oman
				Poland
				Republic of Korea
				Saudi Arabia
				Sweden
				Switzerland
				United Arab Emirates
				United Kingdom of Great Britain and Northern Ireland

*AMR data only.

ANNEX IV: AMR data analysis and interpretation

Reported Data

GLASS requests submission of two types of AMR data files generated from the same source database which are outlined as follows (42):

1. **The resistant, intermediate, susceptible "RIS" file with susceptibility testing results.** These are data (aggregated from all participating national surveillance sites submissions) on the number of patients with positive cultures per specimen type, and AST results for each GLASS pathogen–antibiotic combination, interpreted according to EUCAST, CLSI, or other national definitions (43, 44). Data includes numbers of patients with susceptible, non-susceptible, intermediate, and resistant isolates, as well as numbers of isolates with unknown susceptibility. Two different types of unknown results are recorded: "Unknown_no_AST" representing the number of isolates with AST results not reported (or not performed) for a specific antibiotic, and "Unknown_no_breakpoints" representing the number of isolates with AST performed but no interpretation of results available for a specific antibiotic. The AST data is stratified according to core patient variables (16):
   - Age: age-groups defined as per the WHO Global Health Observatory (less than 1 year, 1-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, over 85 years), or as unknown.
   - Gender: female, male, unknown.
   - Infection origin: hospital, community, unknown. Countries were advised to use the following definition: "Hospital" origin is selected for patients admitted for >2 calendar days when the specimen was taken, or admitted to the health care facility for ≤2 calendar days but transferred from another health-care facility where he or she was admitted for ≥2 calendar days. "Community" origin is selected for patients cared for at outpatient clinics, or patients in hospital for ≤2 calendar days when the specimen was taken. Countries using a different classification method were nevertheless invited to report infection origin data in the GLASS format.
2. **SAMPLE file with the numbers of patients seeking care at surveillance sites from which specimens for bacterial isolation were taken over a defined period, stratified by the same variables as in the RIS file.**

Data preparation

GLASS requires input data to be de-duplicated, so that one isolate will represent one patient. This also minimises bias associated with reporting of repeated cultures. Thus, when several cultures are collected from one patient, repeat isolates of a given species from the same patient are excluded. Only the first isolate per patient, per pathogen, per reporting period, and per stratification level is included. Note that for national and local surveillance, it is important to collect consecutive isolates of the same pathogen in order to monitor clinical episode characteristics. De-duplication and data quality assurance should be performed either at surveillance sites before submission to the NCC, or by the NCC. If de-duplication is done locally, the NCC should also conduct new checks for duplicates and data quality. Finally, it is the task of the designated NFP to upload the datasets, including aggregated data at national level, onto the GLASS IT platform (GLASS guide to uploading aggregated AMR data [21]). The GLASS data management team offers direct support to countries both for de-duplication and aggregation of the data, and quality checks are run during the data validation process.

GLASS requires countries to include a dataset batch identification number – for example, "Data set 1", "Data set 2" – in order to distinguish subsets of national aggregated data. This approach is used when countries are not able to aggregate national data in a single data set, or when dividing the national data set has an important added value, for example by regions (42).

AMR data validation and analysis

Countries are responsible for ensuring the validity, consistency, and completeness of AMR data submitted to GLASS. A second validation step is performed during the AMR uploading process thanks to a series of automatic checks built in to the GLASS platform, which identify issues related to the integrity of the dataset (e.g. variables, codes), and the consistency of the data provided (for example, specimen-pathogen-antibiotic combinations, and validity of the AST results provided). Summary tables are also generated allowing the NFP to verify that the uploaded data reflect what was prepared. Data uploading can be finalised only after all the validation steps are completed. Once uploaded, the last validation step is performed by the GLASS team. Data are exported into STATA 14 (StataCorp LP, Texas, USA) and summarised to identify unexpected distribution of age, gender, infection origin, and AST results for each specimen-pathogen-antibacterial combination. Communication with countries is maintained during this stage in order to resolve possible data issues or clarify existing gaps in data submission. In case of errors, countries are asked to correct and resubmit their data. Validated data are then analysed using STATA 14 and R Software.

For each country, a dashboard is produced and included in the country profile (Section 3.4) to indicate range of completeness of data submitted for each variable: specimens, priority pathogens, gender, age, and infection origin. An overview table is created with the overall RIS and SAMPLE data file submissions, showing numbers of tested patients per specimen type, and numbers of patients with growth of GLASS pathogens, stratified by infection origin.

AMR data are summarised by country, and main results are represented graphically and compiled into tables (Section 3.4 and the report electronic supplementary material). AST results are categorised as follows: susceptible, non-susceptible (non-susceptible + intermediate + resistant), and unknown (unknown_no_AST + unkown_no_breakpoints).

Data are described by the following approaches

1. **Pathogen non-susceptibility overview**: For each specimen type, pathogen, and antibiotic under surveillance, the proportions of patients with growth of non-susceptible strains are calculated using the following formula and described graphically:

$$\frac{\textit{Number of patients with growth of non-susceptible strains of bacteria species under surveillance (per specimen type pathogen and antibiotic)}}{\textit{Total number of patients with growth of bacteria species under surveillance (per specimen type and pathogen)}}$$

Overall AST results, proportion of samples with unknown AST, and stratified AST results by specimen type, age, gender, and infection origin are provided in the electronic supplementary material).

Further analysis was performed for countries that submitted sample-based data. Because countries are asked to provide only clinically significant results, positive cultures reported were considered as a proxy of infection. In addition, data deduplication only allows new cases to be reported. Therefore, frequency of infection with pathogens under surveillance and frequency of infection with pathogens non-susceptible to specific antibiotics are calculated for the population at risk, defined as the total number of symptomatic patients that sought medical care and from which samples of different specimen types where taken.

2. **Non-susceptible pathogen – antimicrobial combination frequency:** for each specimen type, infection origin, and pathogen, frequency of patients with infections are calculated per 100,000 tested patients using the following formula, and presented graphically:

$$\frac{\textit{Cases of infection in the population tested during reporting period (per specimen type, pathogen, and infection origin)}}{\textit{Population tested during the reporting period (per specimen type and infection origin)}}$$

Subsequently, for each specimen type, infection origin, pathogen, and antibiotic under surveillance, frequency of patients with growth of non-susceptible strains was calculated per 100,000 tested patients using the following formula, and presented graphically:

$$\frac{\textit{Cases of AMR in the population tested during reporting period (per specimen type, pathogen, infection origin, and antibiotic)}}{\textit{Population tested during the reporting period (per specimen type and infection origin)}}$$

The two charts are presented aligned to show the relationship between the magnitude of each pathogen contribution to infection in a specific anatomical site, and the frequency of infections caused by pathogens resistant to specific antibiotics. AMR frequencies are also provided in the report electronic supplementary material).

3. Meropenem was chosen to illustrate resistance to carbapenems. As indicated by EUCAST, meropenem offers the best compromise between sensitivity and specificity in terms of detecting carbapenemase-producers. Carbapenem resistance is one of the most concerning types of resistance recognised worldwide, with several carbapenem-resistant pathogens included as critical priorities in the WHO global Priority Pathogens List (45). When meropenem is not tested, it is substituted with imipenem.

   For each specimen type, pathogen, and infection origin, frequency of carbapenem non-susceptible strains are calculated per 100,000 tested patients, stratified by gender and age using the following formula, and presented graphically:

$$\frac{\textit{Cases of AMR due to carbapenem non-susceptible strains in the tested population during reporting period (per specimen type, pathogen, infection origin, age, and gender)}}{\textit{Tested population during the reporting period (per specimen type, age group and infection origin)}}$$

   Results stratified by age, gender, and infection origin, for all reported antibiotics are provided in the report electronic supplementary material).

Pathogens isolated in specimens from fewer than 10 patients are excluded from the analysis. AMR proportions/frequencies are not shown for pathogen-antibiotic combinations that are: a) not reported; b) have fewer than 10 AST results; c) have 100% unknown AST results.

If the unknown AST results are more than 30%, in the pathogen non-susceptibility overview graphs the bars are not coloured and in the non-susceptible pathogen – antimicrobial combination frequency graphs only the antibiotics names are shown, without any graphical representation of the outcomes. If the proportion of provided information on infection origin and or gender is below 70%, results are not stratified.

Confidence intervals (CIs) are calculated using the Wilson method to address limitations due to small sample sizes or zero values (46).

ANNEX V: Number of countries per region reporting data on specific pathogens (by specimen)

WHO Region and specimen	PATHOGEN							
(n=number of countries per region reporting data)	*Acinetobacter* **spp.**	*E. coli*	*K. pneumoniae*	*N. gonorrhoea*	*Salmonella* **spp.**	*Shigella* **spp.**	*S. aureus*	*S. pneumoniae*
AFR (n=14)	x	x	x	x	x	x	x	x
Blood	5	4	4	x	4	x	5	3
Genital	x	x	x	3	x	x	x	x
Stool	x	x	x	x	3	3	x	x
Urine	x	2	2	x	x	x	x	x
AMR/PAHO (n=3)	x	x	x	x	x	x	x	x
Blood	x	x	x	x	1	x	x	x
Genital	x	x	x	1	x	x	x	x
Stool	x	x	x	x	1	x	x	x
Urine	x	x	x	x	x	x	x	x
EMR (n=14)	x	x	x	x	x	x	x	x
Blood	9	10	10	x	6	x	8	6
Genital	x	x	x	6	x	x	x	x
Stool	x	x	x	x	7	4	x	x
Urine	x	9	9	x	x	x	x	x
EUR (n=23)	x	x	x	x	x	x	x	x
Blood	23	23	23	x	7	x	23	22
Genital	x	x	x	4	x	x	x	x
Stool	x	x	x	x	5	3	x	x
Urine	x	7	7	x	x	x	x	x
SEAR (n=8)	x	x	x	x	x	x	x	x
Blood	2	2	2	x	2	x	2	x
Genital	x	x	x	2	x	x	x	x
Stool	x	x	x	x	1	x	x	x
Urine	x	2	2	x	x	x	x	x
WPR (n=6)	x	x	x	x	x	x	x	x
Blood	3	3	3	x	3	x	3	3
Genital	x	x	x	4	x	x	x	x
Stool	x	x	x	x	3	4	x	x
Urine	x	3	3	x	x	x	x	x
TOTAL	45	65	65	20	43	14	41	34

[x] = non reported

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