Kerala Antimicrobial Resistance Surveillance Network

(KARS-Net)

Annual Report 2025

(Data from January to December 2024)

HANDLE ANTIMICROBIALS WITH CARE

Smt VEENA GEORGE
Hon'ble Minister for Health & Family Welfare
Govt. of Kerala

FOREWARD

Antimicrobial Resistance (AMR) is a serious global public health threat which can be tackled only by a "One Health" approach. Kerala became the first state in India to draft and implement an AMR strategic action plan , KARSAP (Kerala Antimicrobial Resistance Strategic Action Plan) which was launched on 25 October 2018. *KARSAP is the flagship project of the state in its fight against the growing threat of AMR.* Lord Inorder to understand the magnitude of AMR in the State, Kerala Antimicrobial Resistance Surveillance Network (KARS-NET) was established in 2019. *In 2022 , Kerala became the first State in India to release its own antibiogram.* KARSNET antibiograms of 2021 , 2022 and 2023 for State of Kerala showed that the resistance trends among priority pathogens varied from centre to centre. KARSNET data is reflective of susceptibility trends in tertiary care institutions only. Hence with the aim of capturing the susceptibility trends among priority pathogens at all tiers of health care system, for the first time in India, hub and spoke model of AMR surveillance was initiated in all districts in Kerala . First District antibiogram in India was compiled and released by Ernakulam last year. Such stratified antibiograms at district level help in planning customized interventions at various levels of healthcare.

KARSNET over the years has expanded from 21 labs in 9 districts to 59 labs across14 districts in a phased manner. This annual report reflects the dedication and hardwork of the nodal officers from the different KARSNET surveillance centres .I wholeheartedly congratulate the nodal officers and the entire KARSAP team for their exemplary work and wish them all the success in their unending fight against AMR.

Smt Veena George
Hon'ble Minister for Health &Family Welfare
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Dr. Rajan N Khobragade IAS
Additional Chief Secretary
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FOREWARD

Antimicrobial resistance (AMR) has emerged as one of the most pressing public health challenges of our time, threatening the effectiveness of life-saving treatments and complicating routine clinical care. AMR is a serious plobal public health threat which can be tackled only by a “One Health” approach. Kerala became the first state in India to draft and implement an AMR strategic action plan , KARSAP (Kerala Antimicrobial Resistance Strategic Action Plan) which was launched on 25 October 2018. KARSAP is the flagship project of the state in its fight against the growing threat of AMR. Systematic AMR surveillance is essential to guide rational antibiotic use, monitor evolving resistance trends, and support evidence-based policy and stewardship interventions. For this purpose, I erala Antimicrobial Resistance Surveillance Network (KARS-NET) was established in 2019. in 2022 , Kerala became the first State in India to release its own antibiogram. KARSNET antibiograms used to reflect the AMR trends in tertiary care institutes only and hence with the aim of capturing the susceptibility trends among priority pathogens at all tiers of health care system, for the first time in India, hub and spoke model of AMR surveillance was initiated in all districts in Kerala . First District antibiogram in India was compiled and released by Ernakulam last year. Such stratified antibiograms at district level help in planning customized interventions at various levels of healthcare. ifiéRSNET over the years has expanded from 21 labs in 9 districts to 59 labs and around 185 spokes across all 14 districts in a phased manner. KARSNET annual report of 2025 depicts the annual report AMR data from 1 January to 31 December 2024. Atotal of 47 surveillance laboratories from 13 districts submitted their data during this period. Data from 55,640 unique patient isolates were analysed and included in this report. This annual report reflects the dedication and hardwork of the nodal officers from the different KARSNET surveillance centres. I wholeheartedly congratulate the nodal officers and the entire KARSAP team for their exemplary work and wish themall the success in their unending fight against AMR. This report provides valuable insights into local resistance patterns, serving as a cornerstone for optimizing empirical therapy, strengthening infection control programs, and fostering a culture of responsible antimicrobial use.

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Dr.Viswanathan.K.V
Director of Medical Education
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FOREWORD

Antimicrobial resistance (AMR) is now widely recognized as one of the most critical global health challenges of our era. Often called the “silent tsunami,” AMR, if unchecked, is projected to claim nearly 10 million lives annually by 2050 and inflict a staggering $100 trillion loss on the global economy. It makes common infections increasingly difficult to treat, resulting in longer hospital stays, higher healthcare costs, and greater risk of complications and death. In Kerala, too, the situation is concerning, with rising reports of infections caused by extensively drug-resistant (XDR) and pan-drug-resistant (PDR) organisms in tertiary care hospitals.

In response, Kerala has launched KARSAP—a comprehensive action plan to combat AMR effectively. Central to this initiative is KARS-NET, the state’s antimicrobial resistance surveillance network established in 2019 to monitor resistance trends in key human pathogens. KARS-NET antibiograms provide critical data that guide clinicians in selecting effective treatments and support public health authorities in shaping targeted policies. Surveillance plays a vital role in evaluating the impact of infection control and stewardship measures, and it aids the formulation of evidence-based treatment guidelines. The 2024 KARS-NET Annual Report underscores the need for collective action, robust surveillance, and stewardship to protect the health of our community.

Dr.Viswanathan.K.V
Director of Medical Education
Govt. of Kerala

Dr. Reena K.J
Director of Health Services
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MESSAGE

Antimicrobial resistance (AMR) is one of the most urgent public health challenges we face today. It threatens our ability to treat common infections, making routine procedures such as surgeries, chemotherapy, and transplants increasingly hazardous. Infections caused by resistant pathogens lead to prolonged hospital stays, increased healthcare costs, and higher mortality. The progress we have made in modern medicine is at serious risk of being reversed. As the Director of Health Services, I emphasize the critical importance of addressing AMR with urgency and commitment. The erosion of antibiotic efficacy is not limited to one region, it is a global crisis that affects every one, demanding a united and proactive response.

A robust surveillance system is central to tackling AMR. By continuously monitoring resistance patterns. we can better guide clinical decisions and public health strategies. I commend the entire KARSAP team for their commendable achievement in expanding the KARSNET surveillance network to nearly every district in Kerala. Their innovative hub-and- spoke model has enabled the creation of district-level antibiograms, greatly enhancing our data- driven response to AMR. Let us continue to strengthen surveillance, advocate for the prudent use of antimicrobials, and foster collaboration across all sectors to safeguard public health for future generations.

Dr Reena K J
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FOREWARD

Antimicrobial resistance (AMR) is a global public health emergency, impacting not only human health but also food security and economic stability. It leads to more intensive and prolonged treatments, extended hospital stays, and higher healthcare costs for patients with resistant infections. In severe cases, infections can become untreatable, tragically resulting in fatalities. AMR also jeopardizes the success of routine medical procedures like surgeries and chemotherapy by significantly increasing the risk of untreatable infections. Addressing this complex challenge is crucial for safeguarding global health and well-being.

Effective surveillance systems are fundamental to combating AMR. These systems systematically collect, analyze, and interpret data on antimicrobial resistance, allowing public health officials to monitor the prevalence and spread of resistant microorganisms. This crucial information helps identify emerging threats and enables timely interventions. KARSNET, for instance, is a vital surveillance system established in Kerala to standardize and expand AMR surveillance. It regularly analyzes and reports data to the State Government and NCDC, contributing significantly to understanding and monitoring the extent and burden of AMR within the state.

The antibiograms generated through KARSNET are instrumental in pinpointing high-AMR areas, guiding the development of targeted prevention and control measures, and evaluating the effectiveness of interventions. KARSNET has impressively grown to include 59 nodal AMR surveillance centers across 14 districts in Kerala, making it the largest state-level AMR surveillance network in India. This collaborative effort has led to a substantial increase in antimicrobial susceptibility testing (AST) data, with 55,640 priority pathogen isolates now available. The initiation of a hub-and-spoke model for AMR surveillance in Kerala promises to further enhance data collection, allowing for the development of stratified, tier-specific antibiograms from 2024 onwards. The success of this initiative is a testament to the strong cooperation among KARSNET nodal centers, NCDC, and WHO.

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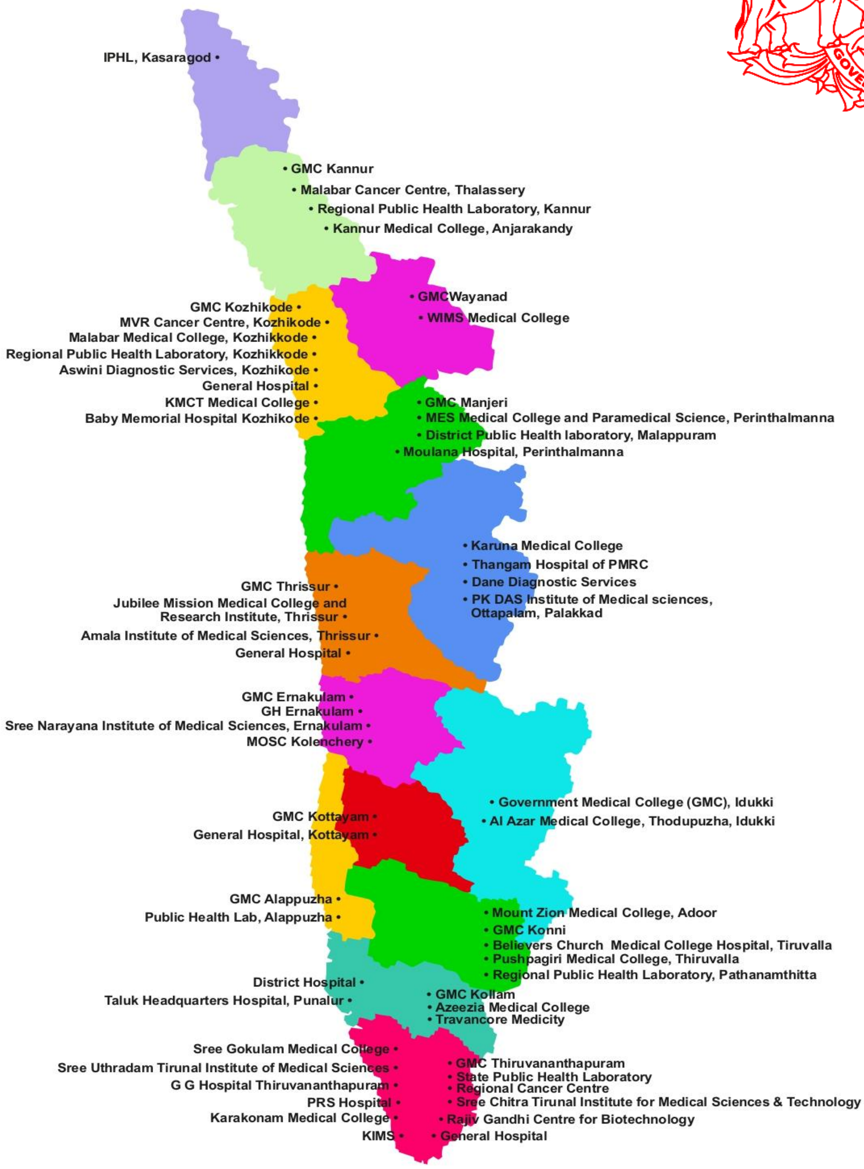
IPHL, Kasaragod
GMC Kannur
Malabar Cancer Centre, Thalassery
Regional Public Health Laboratory, Kannur
Kannur Medical College, Anjarakandy
GMCWayanad
WIMS Medical College
GMC Kozhikode
MVR Cancer Centre, Kozhikode
Malabar Medical College, Kozhikkode
Regional Public Health Laboratory, Kozhikkode
Aswini Diagnostic Services, Kozhikode
General Hospital
KMCT Medical College
Baby Memorial Hospital Kozhikode
GMC Manjeri
MES Medical College and Paramedical Science, Perinthalmanna
District Public Health laboratory, Malappuram
Moulana Hospital, Perinthalmanna
Karuna Medical College
Thangam Hospital of PMRC
Dane Diagnostic Services
PK DAS Institute of Medical sciences, Ottapalam, Palakkad
GMC Thrissur
Jubilee Mission Medical College and Research Institute, Thrissur
Amala Institute of Medical Sciences, Thrissur
General Hospital
GMC Ernakulam
GH Ernakulam
Sree Narayana Institute of Medical Sciences, Ernakulam
MOSC Kolenchery
Government Medical College (GMC), Idukki
Al Azar Medical College, Thodupuzha, Idukki
GMC Kottayam
General Hospital, Kottayam
GMC Alappuzha
Public Health Lab, Alappuzha
Mount Zion Medical College, Adoor
GMC Konni
Believers Church Medical College Hospital, Tiruvalla
Pushpagiri Medical College, Thiruvalla
Regional Public Health Laboratory, Pathanamthitta
District Hospital
Taluk Headquarters Hospital, Punalur
GMC Kollam
Azeezia Medical College
Travancore Medicity
Sree Gokulam Medical College
Sree Uthradam Tirunal Institute of Medical Sciences
G G Hospital Thiruvananthapuram
PRS Hospital
Karakonam Medical College
KIMS
GMC Thiruvananthapuram
State Public Health Laboratory
Regional Cancer Centre
Sree Chitra Tirunal Institute for Medical Sciences & Technology
Rajiv Gandhi Centre for Biotechnology
General Hospital

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Abbreviations

AMR	Antimicrobial resistance
AST	Antimicrobial susceptibility testing
BMD	Broth microdilution
CLSI	Clinical and Laboratory Standards Institute
CRE	Carbapenem resistant Enterobacteriaceae
EQAS	External quality assessment scheme
ESBL	Extended spectrum beta-lactamase
GLASS	Global Antimicrobial Resistance Surveillance System
ICU	Intensive care unit
ID	Identification
IPD	In-patient
IQC	Internal quality control
KARSAP	Kerala Antimicrobial Resistance Strategic Action Plan
KARS-Net	Kerala Antimicrobial Resistance Surveillance Network
LIMS	Laboratory information management system
MRSA	Methicillin resistant *Staphylococcus aureus*
NCDC	National Centre for Disease Control
NFGNB	Non-fermenting Gram-negative bacilli
OPD	Outpatient
OSBF	Other sterile body fluids
PA	Pus aspirate
R I S	Resistant Intermediate Sensitive
SDGs	Sustainable Development Goals
SOP	Standard operating procedure
TMP-SMX	Trimethoprim sulfamethoxazole
VRE	Vancomycin Resistant *Enterococci*
WHO	World Health Organization

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I. Executive Summary

The Government of Kerala in collaboration with Ministry of Health and Family Welfare and WHO Country Office for India officially launched the Kerala Antimicrobial Resistance Strategic Action Plan (KARSAP) on 25 October 2018. Antimicrobial resistance (AMR) has emerged as a significant public health threat that requires urgent attention. In order to strengthen and expand the AMR surveillance network in Kerala, Kerala Antimicrobial Resistance Surveillance Network (KARS-Net) was established in 2019. The objectives of the network were to foster standardization, to strengthen and expand AMR surveillance in Kerala, to analyze and report KARS-Net data to State Government and NCDC on regular basis, to contribute towards the estimation of extent, burden and monitoring of AMR in Kerala and to detect emerging resistance and it's spread in Kerala. The network of laboratories over the years has expanded from 21 labs in 9 districts to 59 labs across 14 districts in a phased manner (Figure 1). Priority pathogens under surveillance currently include nine commonly isolated pathogens from identified specimens. The WHONET software is used for the collection and analysis of antimicrobial susceptibility data.

This annual report covers the AMR data from 1 January to 31 December 2024. A total of 47 surveillance laboratories from 13 districts submitted their data during this period. Antimicrobial susceptibility (AST) data of 62,087 priority pathogens, along with the demographic information of the patients from whom these pathogens were isolated, were reported under KARS-Net during 2024. After data deduplication, data from 55,640 unique patient isolates were analysed; 45% (25,176) of reported isolates were from males; 55% (30,441) were from females. Gender data was not available for a small number of isolates.

Urine was the most commonly reported specimen 56.3% (31,339), followed by pus aspirate 32.6% (18,113), blood 8.3% (4,603), other sterile body fluids 2.7% (1528) and stool 0.1% (57). The most frequently reported priority pathogen from all specimens was *E. coli* (40.4%), followed by *Klebsiella species* (22.7%), *S. aureus* (12.5%), *Pseudomonas species* (11.4%), *Enterococcus species* (8.3%), *Acinetobacter species* (4.4%), *Salmonella enterica* serotype Typhi and Paratyphi A & B (0.2%), *Shigella species* (0.1%) and *Vibrio cholerae* (0.01%) Among the reported *Staphylococcus aureus* isolates from blood, 32% were Methicillin resistant *Staphylococcus aureus* (MRSA). Among the Enterococcus isolates from blood, Vancomycin resistance was 3% and Linezolid resistance was 1%. Extended spectrum beta-lactamase (ESBL) was observed in 71% of *E. coli* and 68% of *Klebsiella spp*. isolated from blood. With respect to carbapenem resistant Enterobacterales (CRE) in blood, 9% resistance was observed in *E. coli* and 43% in *Klebsiella spp*.

Resistance to carbapenem was observed in 47% blood isolates of *Acinetobacter spp*. and 17% of *Pseudomonas spp*. Despite the relatively high resistance levels amongst Gram-negatives isolates in general, the overall resistance to colistin in gram negative isolates was only 0.2%.

II. Kerala Antimicrobial Resistance Surveillance Network (KARS-Net)

Antimicrobial resistance (AMR) is a growing threat to public health which needs urgent attention. Government of India has already taken a series of initiatives to combat this burgeoning problem. One such initiative is the National Programme on Antimicrobial Resistance Containment, launched in 2013, during the Twelfth Five-Year Plan (2012-2017). This programme coordinated by National Centre for Disease Control (NCDC), New Delhi, aims to capture quality AMR surveillance data from sentinel surveillance sites to generate evidence of AMR prevalence in the country to guide the National Action Plan on AMR.

Kerala Antimicrobial Resistance Strategic Action Plan (KARSAP) was the first subnational State action plan on AMR conceptualised in India. It was launched by the Honourable Chief Minister of Kerala Sri Pinarayi Vijayan on 25 October 2018. Kerala Antimicrobial Resistance Surveillance Network (KARS-Net) was established in 2018 to estimate the extent, burden and monitoring of AMR in Kerala with the Department of Microbiology, Government Medical College, Thiruvananthapuram as the state nodal centre. The network had 10 laboratories in the beginning. From 2019, with the technical support from World Health Organization (WHO) and National Centre for Disease Control (NCDC), the network has now expanded to 59 laboratories from both public and private sectors. The data generated by KARS-Net is shared with NCDC for submission to WHO's Global Antimicrobial Resistance Surveillance System (GLASS) from 2021 onwards.

The KARSAP identified AMR surveillance as a strategic priority in line with national and global AMR action plans. The WHO Country Office for India collaborated with KARS-Net, with oversight of the State Government and NCDC. The network utilizes WHONET to collate, analyse and share AMR data on a monthly basis. KARS-Net currently includes surveillance of AMR in nine key priority pathogens responsible for high antibiotic resistance rates among bacteria that commonly cause human infections.

The nine priority pathogens monitored by KARS-NET are:

1. *Staphylococcus aureus*
2. *Enterococcus species*
3. *Klebsiella species*
4. *Escherichia coli*
5. *Acinetobacter species*
6. *Pseudomonas species*
7. *Salmonella enterica* serovar Typhi and Paratyphi
8. *Shigella species*
9. *Vibrio cholerae*

KARS-NET includes 12 government medical college hospitals and 14 government hospitals/laboratories under Directorate of Health Services, 5 semi-autonomous institutions, 20 private medical colleges, 8 private hospitals/laboratories. Of these 59 sites, AMR surveillance data was received for the period of one year from 1 January to 31 December 2024 from 47 network centres from 13 districts in Kerala (Figure 1- Sites marked in black have contributed data for the said period). More centres became part of KARS-Net after the above period of data collection.

The clinical specimens currently included under KARS-Net are:

- Blood
- Urine
- Pus aspirate (PA)
- Other sterile body fluids (OSBF)
- Stool (only for *Salmonella* Typhi and Paratyphi, *Shigella* spp and *Vibrio cholerae*)

Table 1: Pathogens and specimens included under surveillance

	Staph. aureus	*Enterococcus spp.*	*Klebsiella spp.*	*E. coli*	*Acinetobacter spp.*	*Pseudomonas spp.*	*Salmonella Typhi/ Paratyphi*	*Shigella spp*	*Vibrio cholerae*
Blood	✓	✓	✓	✓	✓	✓	✓	X	X
Urine	X	✓	✓	✓	✓	✓	X	X	X
PA	✓	✓	✓	✓	✓	✓	X	X	X
OSBF	✓	✓	✓	✓	✓	✓	X	X	X
Stool	X	X	X	X	X	X	✓	✓	✓

X: specimen not relevant

All the participating network sites report the monthly AMR data of the nine priority pathogens from the above-mentioned specimen types to the Department of Microbiology, Government Medical College, Thiruvananthapuram. The feedback regarding the quality and completeness of AMR data is being provided to the network sites on monthly basis. The network sites are mandated to implement internal quality control as an essential component of quality assurance in antimicrobial susceptibility testing and also participate in the External Quality Assessment Scheme (EQAS). Continuous support is provided to the programme sites to improve specimen collection, bacterial culture, identification of pathogens and their antimicrobial susceptibility testing (AST) which includes provision of continuous virtual and/or hands-on trainings. Onsite support visits and onsite trainings are also conducted for handholding the sites to strengthen bacteriology laboratory capacity by improving the quality of culture and AST practices. In addition, trainings and workshops on WHONET software to streamline AMR surveillance data flow from network sites are regularly organised.

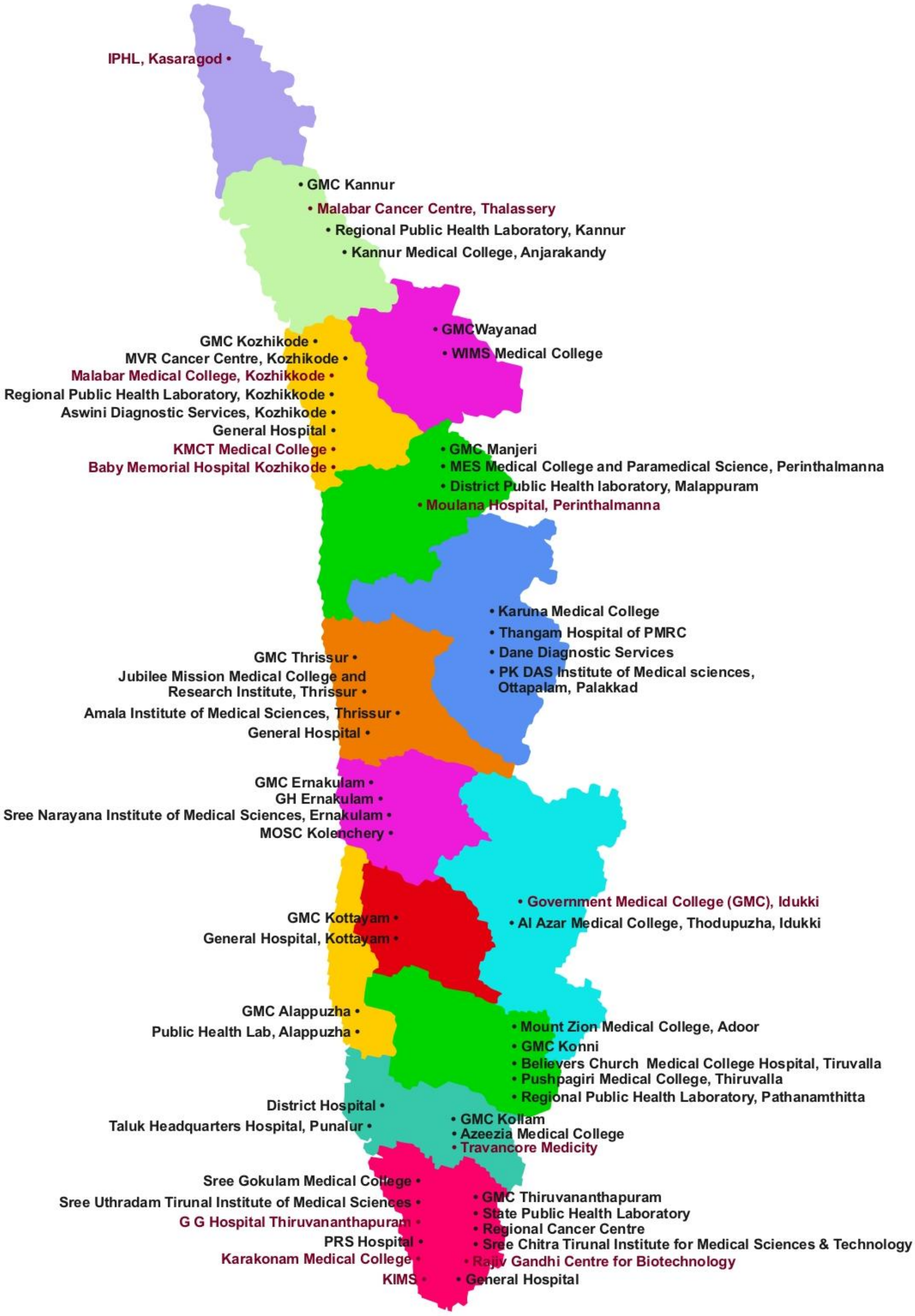

Figure 1: Institutions in the Kerala AMR Surveillance Network (KARS-Net)

The laboratories enrolled in KARS-Net follow a standardised approach for AMR data collection, analysis, and reporting using WHONET software. Trainings are provided on using WHONET for AMR data management. Online capacity building sessions were also held during 2019 for standardisation of techniques for clinical specimen collection, bacterial culture, identification of pathogens & their AST, including frequent trouble shooting sessions for WHONET data management. Onsite support visits were also conducted in 2021 and 2022 for streamlining AMR surveillance data management and to assess the training needs. Hands on training on antimicrobial susceptibility testing with emphasis on broth micro dilution (BMD) method and WHONET training was conducted at Government Medical College, Thiruvananthapuram for the new member sites in December 2023. Feedback for the data submitted every month is provided using a standardised feedback tool to improve the completeness and quality of AMR data. Under KARS-Net, Standard operating procedures (SOP) and guidance documents were adopted from NARS-Net for strengthening the network sites on routine AST techniques and for improving internal quality control for AST testing in laboratories, which are reviewed on a regular basis.

III. Data Collection

The WHONET software is used for the collection, collation and analysis of the antimicrobial susceptibility (AST) data generated by the manual testing methods and the automated systems at the programme sites. WHONET is a free open-source Windows application for management of microbiology laboratory data on antimicrobial susceptibility testing, developed by WHO Collaborating Centre for Surveillance of AMR at the Brigham and Women's Hospital at Harvard University. WHONET is used for local, national, regional and global surveillance efforts worldwide.

The classification of the isolates as susceptible, intermediate or resistant is based on the Clinical & Laboratory Standards Institute (CLSI) guidelines. During 2024, AST data of 62,087 priority pathogens, along with the demographic information of the patients from whom these pathogens were isolated, was reported from 47 sites in 13 districts.
All sentinel sites submitted the data monthly after validation by the AMR nodal officer at the sites. The monthly data submitted by the sites were screened and analysed and the detailed feedback was provided to them for each month. Based on feedback the corrected WHONET files were received.

IV. Data Analysis

The analysis of cumulative data for the year 2024 has been performed by the Department of Microbiology, Government Medical College Thiruvananthapuram, based on which this annual report was prepared. The AST data includes data of conventional disk diffusion method, Broth-micro dilution (BMD) method and data generated through the automated antimicrobial susceptibility testing systems.

a. Data deduplication

As a first step for data analysis, a single file was created by collating all the cumulative AMR data files. During this step, duplicate isolates (from the same patients) have been excluded from the database files. Before starting the de-duplication process, variables containing information about the patient was checked and variables were generated if required, e.g., patient ID number, age, sex, location, department, AST in values (mm or µg/ml) etc. For analysis, only one result was considered for each patient per specimen type and per pathogen. For example, if two blood cultures from the same patient yielded growth of *E. coli*, only the first has been included in the data; if the growth of E. coli was detected in one culture and of *K. pneumoniae* in the other, both results have been considered. If there is the growth of *E. coli* in one blood culture and in one urinary culture from the same patient, both specimen types have been included. From each patient, only the first isolate of a given species recovered during the investigated time interval was included, regardless of its susceptibility profile. The total number of isolates from unique patients (after de-duplication) was 55,640 (Figure 2).

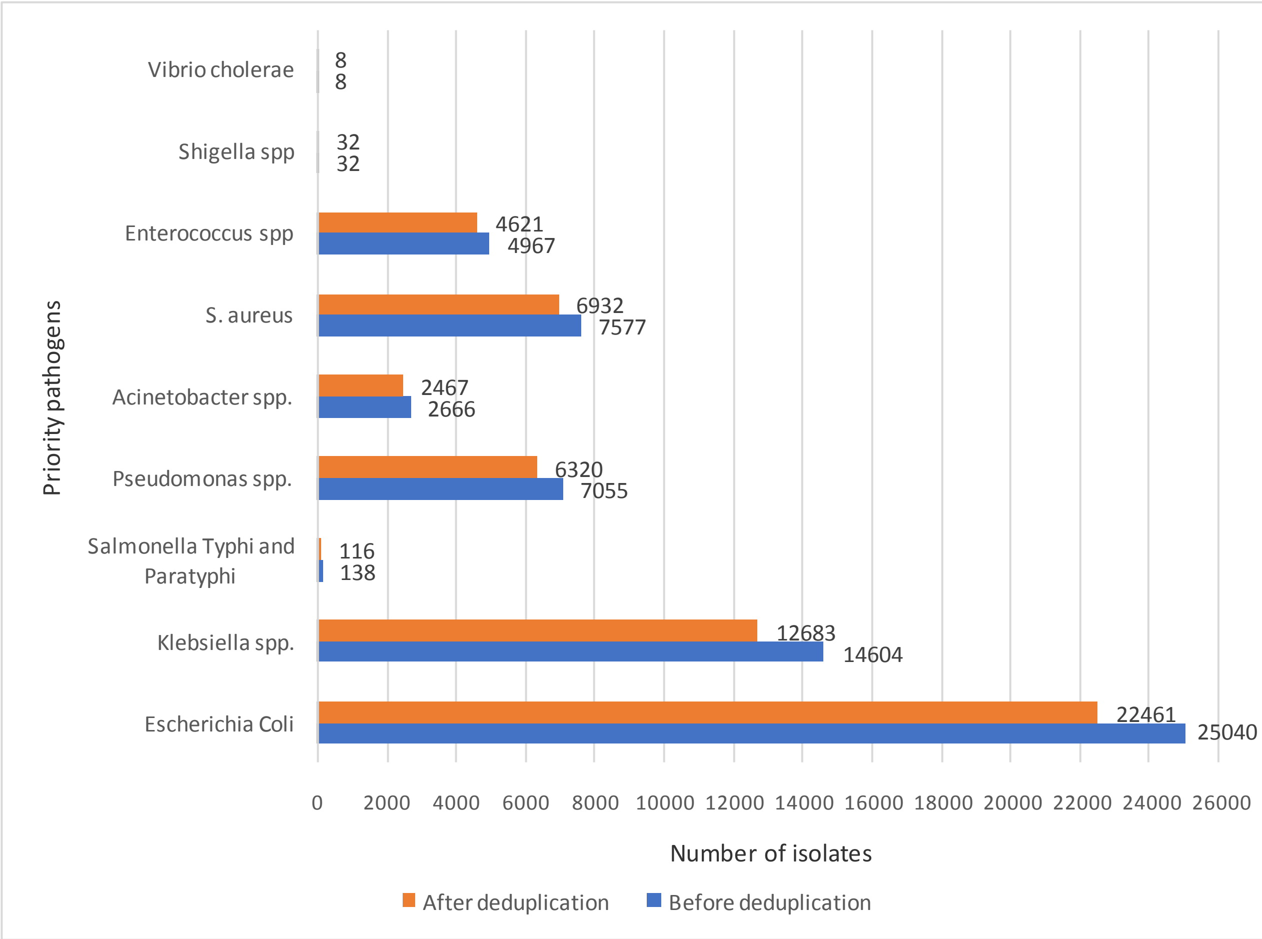

Figure 2: Priority pathogens before and after de-duplication

b. Demography and distribution of priority pathogens

Among the total of 55,640 unique patients, 45% pathogens were from males as compared to females (55%). Age data was available for 100% of unique patient isolates. The highest proportion of unique patients contributing to the AST data belong to mature working age group that is 55-64 years (22.3%) whereas the lowest number of pathogens (2.4%) were reported from age group of 1-4 years (Figure 3).

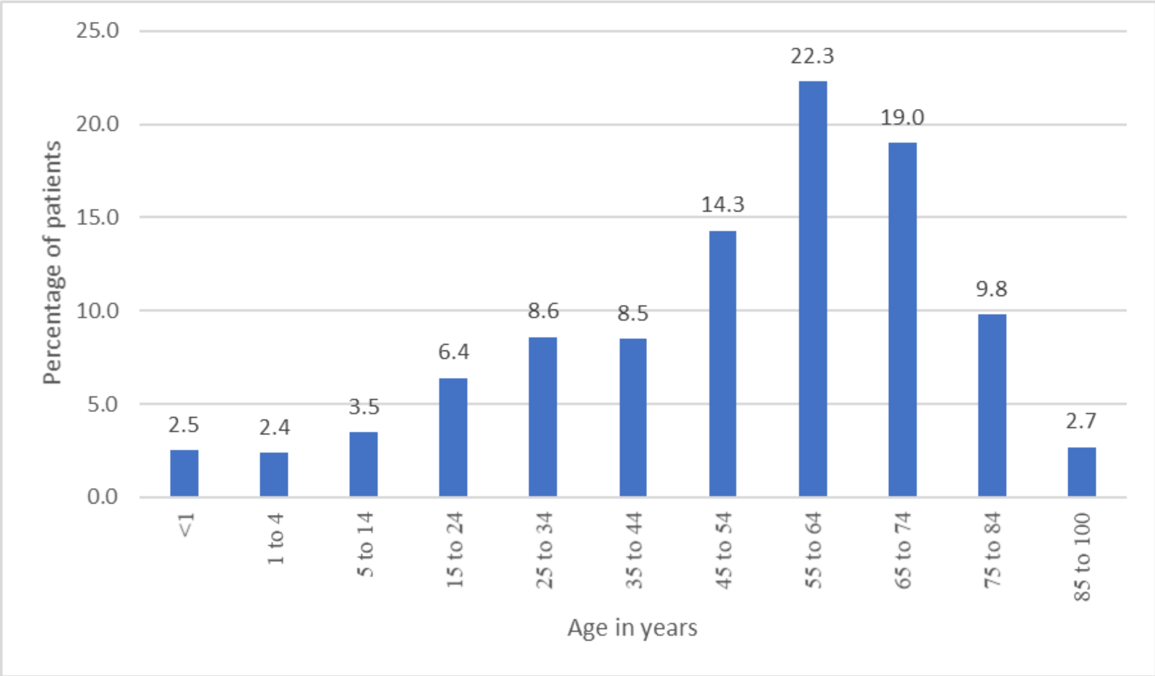

Figure 3: Distribution of isolates based on age

Of the total unique isolates (after de-duplication; 55,640) the following was the specimen distribution:

- Urine – 31,339 (56.3%)
- Blood – 4,603 (8.3%)
- Pus aspirate (PA) – 18,113 (32.6%)
- Other sterile body fluids (OSBF) – 1,528 (2.7%)
- Stool – 57 (0.1%)

The total number of isolates reported in the year 2024 has increased over those reported last year, probably due to the increase in reporting sites. In 2024 AMR surveillance data, the most commonly isolated priority pathogen was *E. coli* (40.4%), followed by *Klebsiella species* (22.7%), *S. aureus* (12.5%), *Pseudomonas species* (11.4%), *Enterococcus species* (8.3%), *Acinetobacter species* (4.4%), *Salmonella enterica* serovar Typhi and Paratyphi A & B (0.2%), *Shigella* spp (0.1%) and *Vibrio cholerae* (0.01%) (Figure 4).

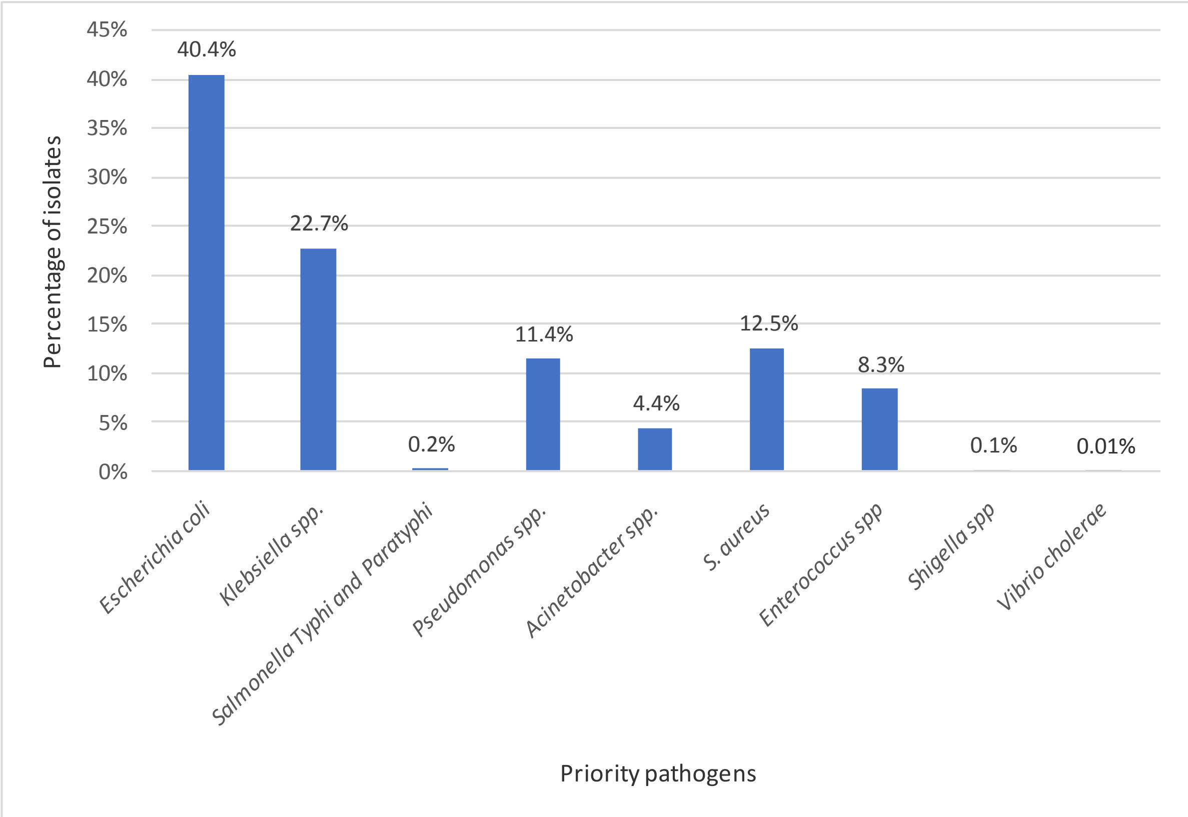

Figure 4: Distribution of AMR surveillance priority pathogens

From urine specimens, *E. coli* (58%) was the most commonly isolated pathogen, from blood specimens the most common priority pathogen isolated were *E. coli & Klebsiella spp* (24% each); among pus aspirates was *Staphylococcus aureus* (32%). *Shigella spp* (56%) was the most commonly isolated pathogen from stool. *Klebsiella spp* (30%) was the most commonly isolated pathogen from other sterile body fluids (OSBF).

Table 2: Specimen-wise isolation of priority pathogens

Priority pathogens	Blood (%)	PA (%)	OSBF (%)	Urine (%)	Stool (%)
Escherichia coli	1103 (24%)	3026 (17%)	304 (20%)	18028 (58%)	
Klebsiella spp.	1107 (24%)	3303 (18%)	456 (30%)	7817 (25%)	
Salmonella Typhi and Paratyphi	99 (2%)				17 (30%)
Shigella					32 (56%)
Pseudomonas spp.	380 (8%)	3445 (19%)	322 (21%)	2173 (7%)	
Acinetobacter spp.	691 (15%)	1038 (6%)	135 (9%)	603 (2%)	
S. aureus	892 (20%)	5865 (32%)	175 (11%)		
Enterococcus spp	331 (7%)	1436 (8%)	136 (9%)	2718 (8%)	
Vibrio cholerae					8 (14%)
Total	**4603**	**18113**	**1528**	**31339**	**57**

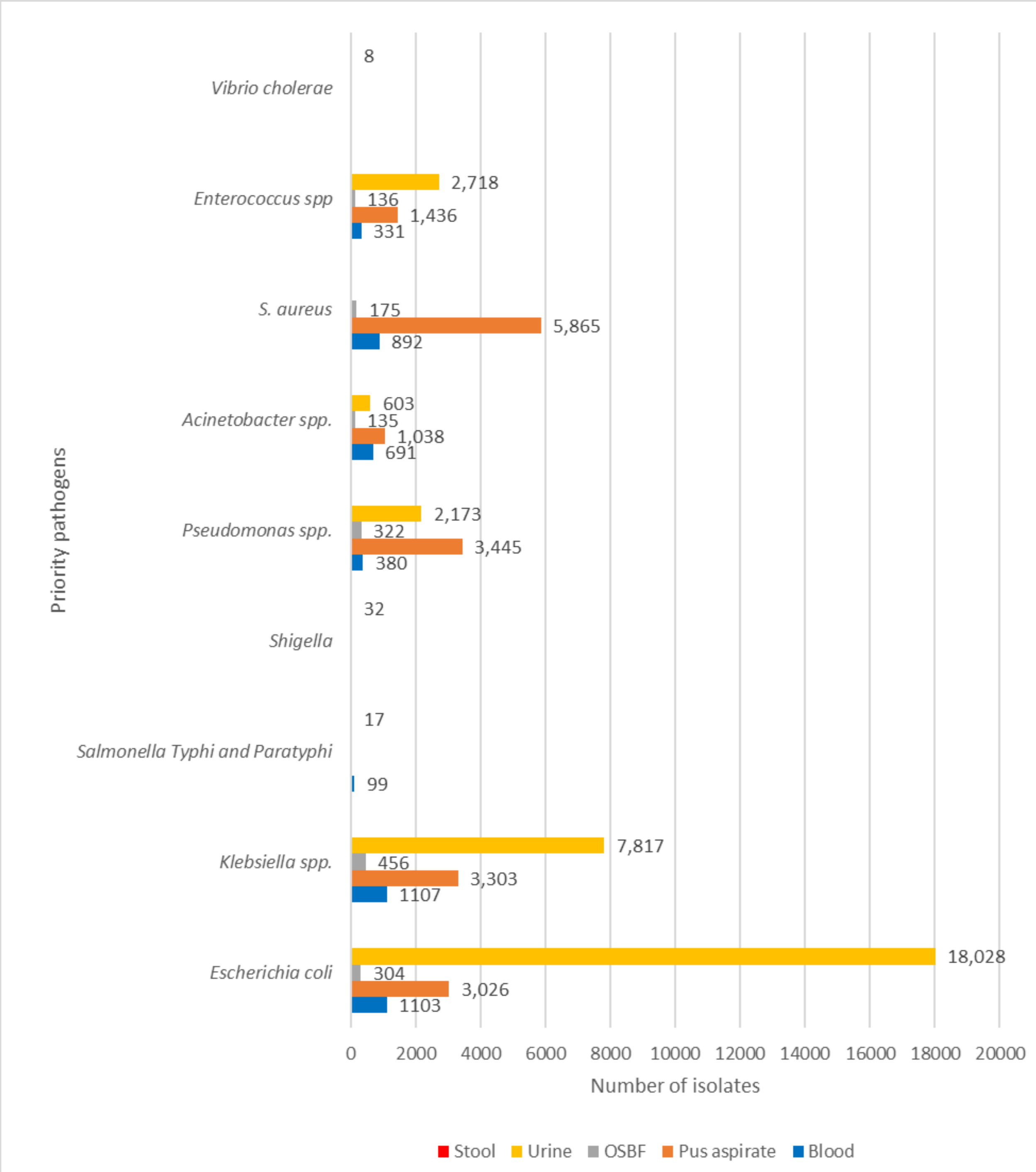

Figure 5: Specimen wise distribution of AMR surveillance priority pathogens

Out of the 55,640 isolates, 45% were from in-patients (IPD), 45% from out-patients (OPD) and 10% from patients in Intensive care units (ICU); (Figure 6). The most common pathogen isolated from IPD and OPD was *E. coli*. In IPD patients, maximum isolates were *E. coli* (36%) followed by *Klebsiella* spp. (23%), *Pseudomonas* spp. (13%), *S. aureus* (13%), *Enterococcus* spp. (10%) and *Acinetobacter* spp. (5%). Among OPD patients, the most common pathogen was *E. coli* (47%) followed by *Klebsiella* spp. (22%). In ICU facilities, *E. coli* (31%) and *Klebsiella* spp. (27%) were the most common pathogens isolated, followed by *Pseudomonas* spp *(11%)* and *Enterococcus* spp. (11%) (Table 3, Figure 6)

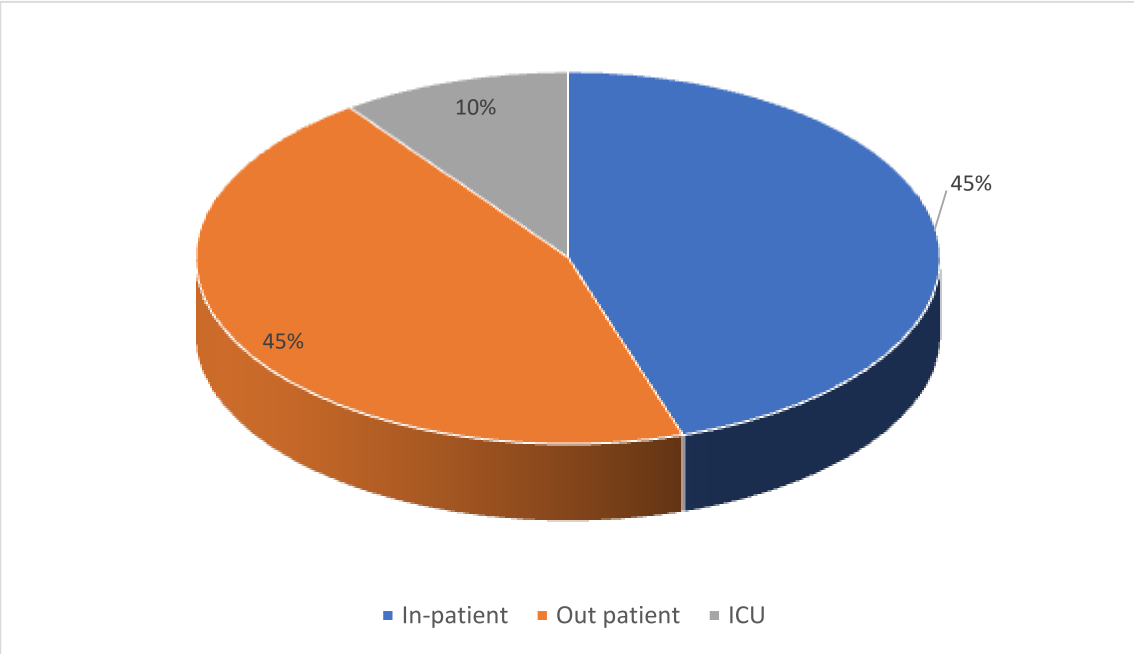

Figure 6: Location-wise distribution of isolates

Table 3: Location-wise distribution of priority pathogens

Priority Pathogens	**ICU (%)**	**IPD (%)**	**OPD (%)**
Escherichia coli	1697 (31%)	8923 (36%)	11841 (47%)
Klebsiella spp.	1480 (27%)	5863 (23%)	5340 (22%)
Salmonella Typhi and Para typhi	7 (0.1%)	85 (0.3%)	24 (0.1)
Pseudomonas spp.	638 (11%)	3344 (13%)	2338 (9.4%)
Acinetobacter spp.	535 (10%)	1285 (5%)	647 (3%)
S. aureus	543 (10%)	3190 (13%)	3199 (13%)
Enterococcus spp.	642 (11%)	2381 (10%)	1598 (6%)
Shigella spp.	2 (0.03%)	16 (0.06%)	14 (0.06%)
Vibrio cholerae	3 (0.05%)	2 (0.007%)	3 (0.01%)
Total	**5,547**	**25,089**	**25,004**

V. AMR profile of priority pathogens

The data collected under KARS-Net is for selected antibiotics only as per NCDC's AMR surveillance data management SOP. This AMR surveillance data is from patients visiting the OPD, IPD and ICU of the hospitals/laboratories.

a. Gram positive cocci

AMR surveillance under KARS-Net covers 2 important globally prevalent gram-positive bacterial pathogens i.e., *Staphylococcus aureus* and *Enterococcus species*. The AST data of 12,544 Gram positive cocci have been submitted by KARS-Net sites, of which 11,553 isolates are from unique patients.

Staphylococcus aureus

Staphylococcus aureus constituted 12.5% of all the isolates (Figure 4). Data of a total of 7,577 *S. aureus* isolates were submitted by the KARS-Net sites of which 6,932 isolates were from unique patients. Of the 6,932 isolates, 12.5% were from blood, 85% from PA and 2.5% from OSBF. Methicillin resistance was reported as 27.5% overall. Methicillin resistance was 32% in blood isolates, 27% in PA and 20% in OSBF (Table 4). Distribution of *S. aureus* isolates reported under the programme in 2024 is from 8% of ICU patients, 46% of IPD patients and 46% of OPD patients. Resistance profile of *S. aureus* isolated from blood from different location types is depicted in Figure 7.

Table 4: Resistance profile of *Staphylococcus aureus*

Antibiotic tested	**Blood** (N = 892)			**PA** (N = 5865)			**OSBF** (N = 175)		
	Number tested	Number Resistant	Resistance (%)	Number tested	Number Resistant	Resistance (%)	Number tested	Number Resistant	Resistance (%)
Cefoxitin	739	234	32	4903	1327	27	162	33	20
Gentamicin	778	95	12	4990	596	12	129	8	6
Ciprofloxacin	552	220	40	4579	2249	49	121	68	56
Trimethoprim/ Sulfamethoxazole	851	144	17	5589	564	10	170	22	13
Clindamycin	859	260	30	5727	945	17	171	25	15
Erythromycin	821	513	62	5679	2889	51	169	74	44
Linezolid	752	0	0	5273	0	0	158	0	0
Teicoplanin	181	0	0	1417	13	1	18*	0	-
Doxycycline	354	9	3	2971	71	2	28*	2	-
Vancomycin	278	0	0	2333	0	0	27*	0	-

*Due to number tested being < 30, percentages were not computed

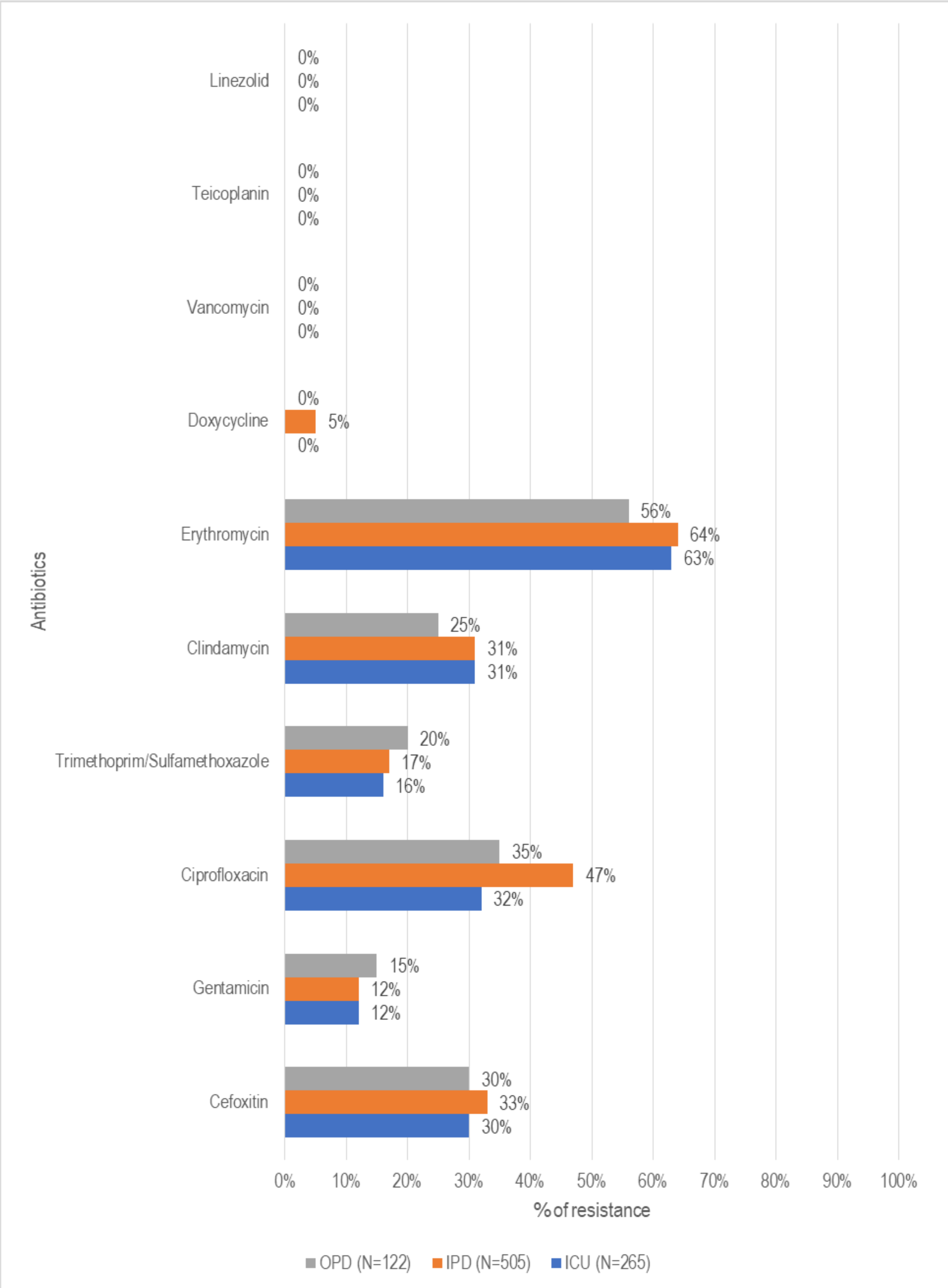

Figure 7: Resistance profile of S. aureus isolated from blood from different location types

Enterococcus species

Enterococcus species constituted 8.3% of all isolates (Figure 4). The data of 4,967 isolates of *Enterococcus* species were submitted by the KARS-Net sites during 2024 of which 4,621 isolates were from unique patients. Reported *Enterococcus species* represent 7% of blood culture isolates, 9% of OSBF isolates, 8% of PA isolates and 8% of urine isolates (Table 2).
Vancomycin resistance among urinary isolates was 2%, blood isolates was 3% and pus aspirates was 2%. No VRE was reported from OSBF. 0.4% of overall isolates showed linezolid resistance. An overall 1.8% vancomycin resistance was observed. Resistance profile of *Enterococcus* species is given in Table 5.

Table 5: Resistance profile of *Enterococcus* species

Antibiotic tested	**Blood** (N=331)			**PA** (N=1436)			**OSBF**(N=136)			**Urine** (N=2718)		
	Number tested	No. Resistant	Resistance %	Number tested	No. Resistant	Resistance %	Number tested	No. Resistant	Resistance %	Number tested	No. Resistant	Resistance %
Ampicillin	262	130	50	1286	241	19	124	40	32	2257	864	38
Gentamicin-High	258	106	41	1244	287	23	103	24	23	2196	709	32
Ciprofloxacin										2150	1297	60
Erythromycin	247	173	70	1208	780	65	103	75	73			
Linezolid	286	3	1	1283	4	0.3	114	1	1	2410	10	0.4
Vancomycin	316	9	3	1309	20	2	119	0	0	2374	44	2
Teicoplanin	191	20	10	640	34	5	64	1	2	1330	66	5
Doxycycline	89	39	44	441	93	21	35	7	20			
Fosfomycin										1304	367	28
Tetracycline										1225	965	79
Nitrofurantoin										2416	629	26

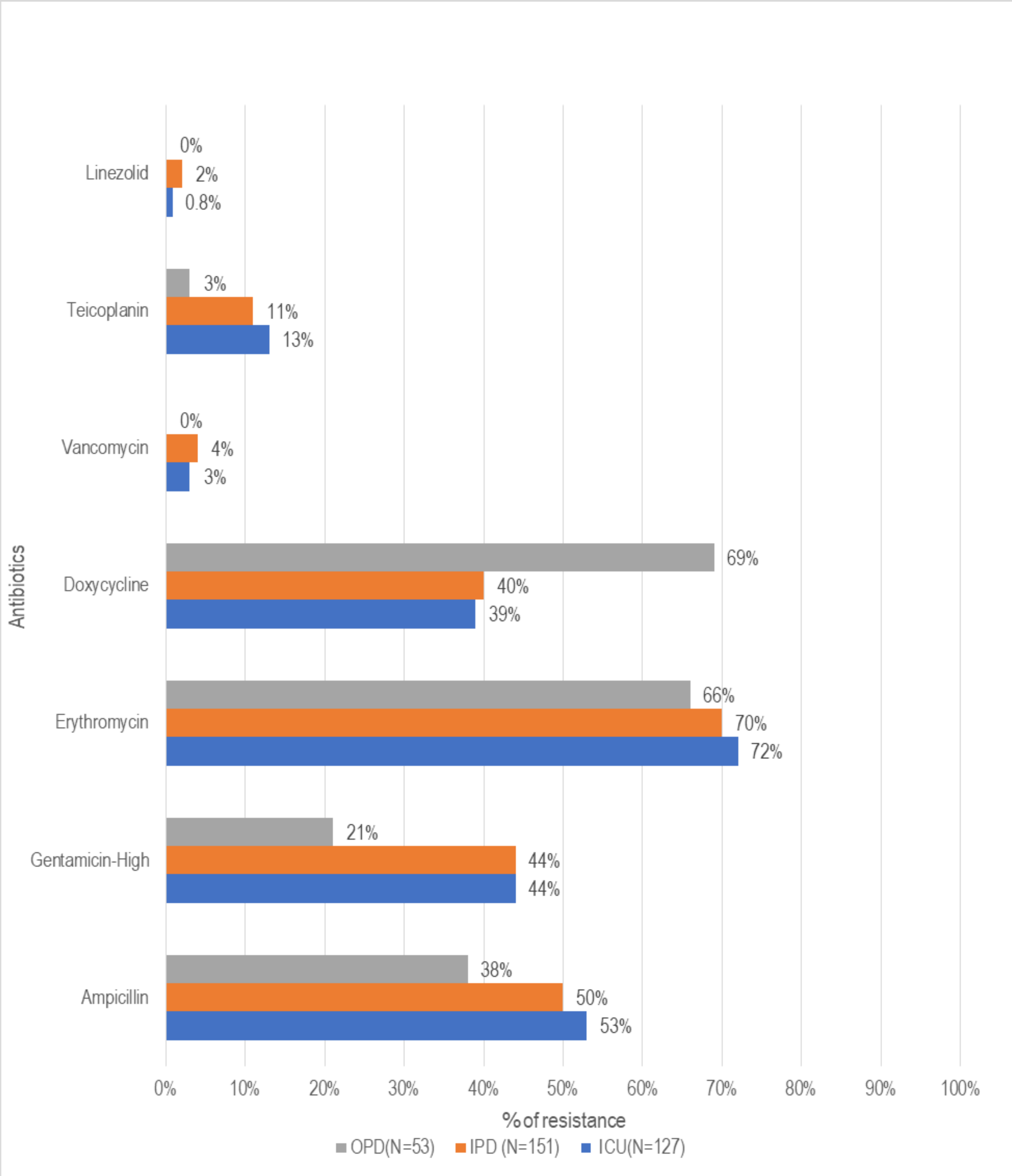

Figure 8: Resistance profile of Enterococcus species isolated from blood from different location types

b. Gram negative bacilli

Under KARS-Net, seven commonly isolated gram-negative bacilli of public health importance are included for AMR surveillance. These are *E. coli*, *Klebsiella species, Pseudomonas species*, *Acinetobacter species*, *Salmonella enterica* serovar Typhi and Paratyphi, *Shigella* spp and *Vibrio cholerae*. AST data of 49,543 isolates of Gram-negative bacilli have been reported from 44,087 unique patients during the reporting period.

i. Enterobacteriaceae

E. coli, *Klebsiella species*, *Salmonella enterica* serovar Typhi, Paratyphi and *Shigella* spp AST data submitted by network sites accounted for 39,814 (64%) isolates from 35,292 (63%) unique patients. Thus, in concordance to previous annual report, this year also maximum isolates belonged to the Enterobacteriaceae family.

Escherichia coli

A total of 25,040 *E. coli* isolates were reported from 22,461 unique patients. *E. coli* constituted 40.4% of data reported from unique patients for the year 2024. The highest number of *E. coli* was reported from urine samples, followed by PA, blood & OSBF (Table 2). Ampicillin resistance in *E. coli* was observed to be more than 85% in all specimen types. Ceftriaxone resistance was observed in >60% of *E. coli* isolated from all specimen types. Among blood isolates of *E. coli*, 71% were ESBL producers. Carbapenem resistance observed in *E. coli* isolates from blood was 9%. For non-beta-lactam antibiotics from blood isolates, 66% resistance was observed to Ciprofloxacin and 51% to Trimethoprim-sulfamethoxazole (TMP/SMX). Twenty-three per cent blood isolates showed resistance to Piperacillin tazobactam. Around 11% resistance to Nitrofurantoin was seen in urinary isolates (Table 6). The Colistin susceptibility testing was done using either broth microdilution method or agar dilution method as per NARS-Net SOP for AMR Surveillance 2023. Only three *E.coli* isolates (2 from urine and 1 from blood) were resistant to Colistin (Table 6).

Table 6: Resistance profile of *Escherichia coli*

Antibiotic tested	**Blood** (N=1,103)			**PA** (N=3,026)			**OSBF** (N=304)			**Urine** (N=18,028)		
	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %
Ampicillin	791	721	91	2515	2274	90	265	244	92	15678	13453	86
Amoxicillin/ Clavulanic acid	703	231	33	2270	805	35	181	73	40	13467	3729	28
Piperacillin/ Tazobactam	1085	248	23	2914	585	20	293	71	24	16135	2537	16
Cefuroxime	805	601	75	2114	1412	67	191	127	66	12628	7967	63
Ceftriaxone	879	625	71	2516	1594	63	239	148	62	13510	8191	61
Cefotaxime	571	414	73	1868	1217	65	206	127	62	10746	6628	62
Cefepime	749	400	53	2002	936	47	181	71	39	9120	4074	45
Ertapenem	581	71	12	1379	155	11	120	23	19	8017	504	6
Imipenem	984	95	10	2476	295	12	220	37	17	12330	840	7
Meropenem	1065	100	9	2625	214	8	254	33	13	13764	757	5
Amikacin	1065	144	14	2838	505	18	297	42	14	16336	2118	13
Gentamicin	1073	262	24	2897	723	25	292	70	24	16691	3568	21
Ciprofloxacin	1059	699	66	2917	1707	59	291	179	62	15903	8343	52
Trimethoprim/ Sulfamethoxazole	1050	532	51	2728	1200	44	278	115	41	17049	6818	40
Colistin	730	1	0	1339	0	0	139	0	0	4334	2	0.05
Doxycycline				710	182	26	37	8	22			
Fosfomycin										7687	167	2
Nitrofurantoin										16876	1875	11

zs

Figure 9: Resistance profile of Escherichia coli isolated from blood from different location types

Klebsiella species

High level of resistance was observed in *Klebsiella* spp. isolated from all specimen types and for all antibiotics except Colistin. Total of 7,817 *Klebsiella species* were isolated from urine specimens. Ceftriaxone resistance in the blood isolates was 68% followed by 65% in OSBF isolates, 59% in PA isolates, and 53% in urinary isolates. Highest resistance to carbapenem was observed in isolates of *Klebsiella* spp. from blood i.e., 43% compared to the other specimen types (Table 7). Colistin resistance of *Klebsiella* spp from blood was 0.8%.

Table 7: Resistance profile of *Klebsiella species*

Antibiotic tested	**Blood** (N=1,107)			**PA** (N=3,303)			**OSBF** (N=456)			**Urine** (N=7,817)		
	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %
Amoxicillin/ Clavulanic acid	622	308	50	2600	1241	48	257	119	46	5964	2179	37
Piperacillin/ Tazobactam	1078	582	54	3216	1385	43	448	221	49	7206	2289	32
Cefuroxime	777	554	71	2562	1568	61	331	231	70	6023	3342	55
Ceftriaxone	870	589	68	2824	1678	59	395	256	65	6186	3277	53
Cefotaxime	656	477	73	2248	1379	61	352	238	68	5138	2763	54
Cefepime	717	436	61	2371	1195	50	272	148	54	4097	1799	44
Ertapenem	586	255	44	1833	611	33	184	75	41	4110	995	24
Imipenem	935	390	42	2863	904	32	375	160	43	5919	1344	23
Meropenem	1064	455	43	2968	888	30	406	143	35	6500	1384	21
Amikacin	1079	480	44	3154	1235	39	435	172	40	7210	1906	26
Gentamicin	1073	469	44	3211	1240	39	434	163	38	7362	2040	28
Ciprofloxacin	1067	697	65	3200	1792	56	445	277	62	6973	3389	49
Trimethoprim/ Sulfamethoxazole	1028	553	54	3072	1429	47	415	186	45	7409	2814	38
Colistin	731	6	0.8	1765	9	0.5	271	1	0.4	2488	10	0.4
Doxycycline				675	256	38	38	12	32			
Nitrofurantoin										7190	3424	48

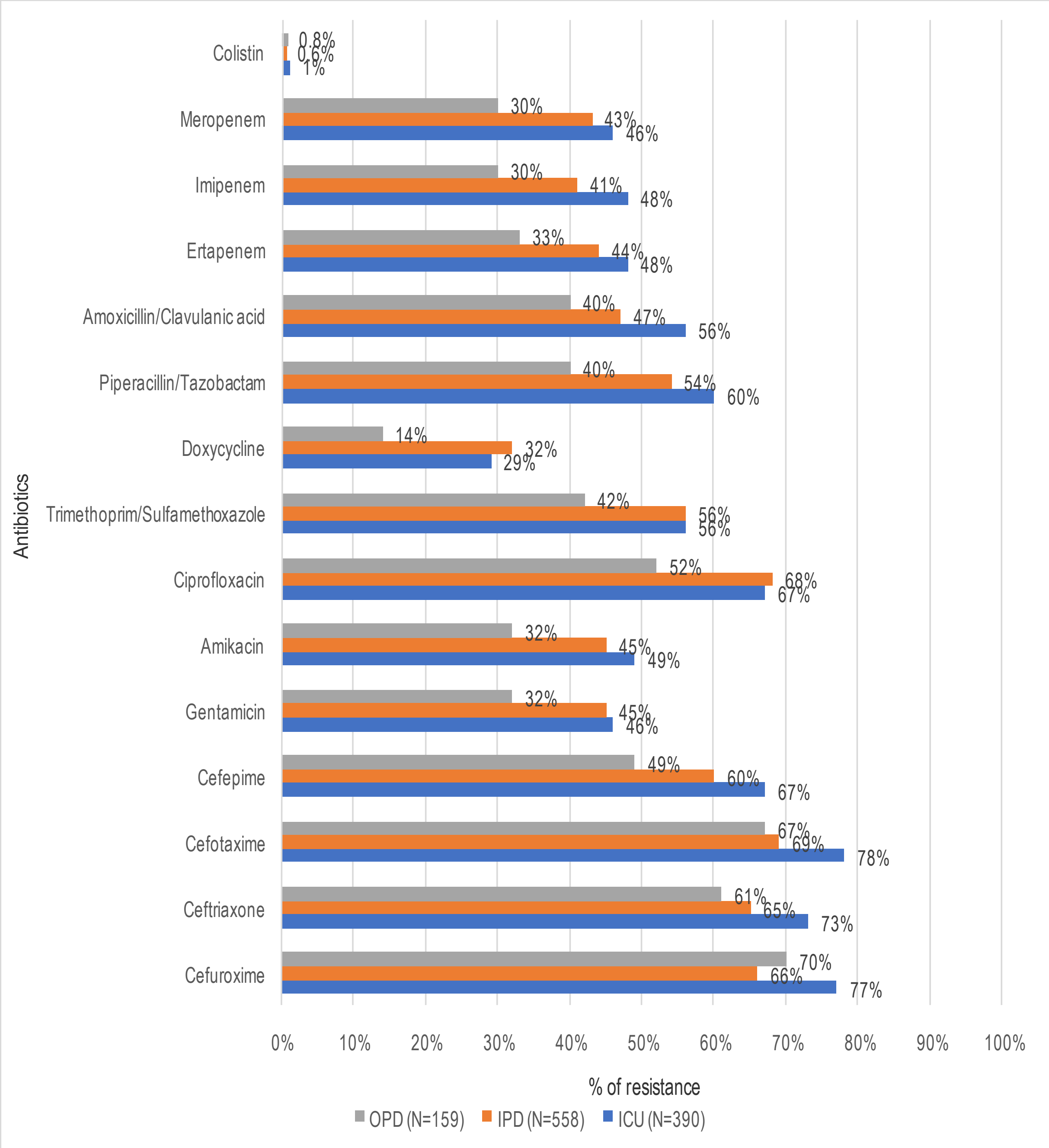

Figure 10: Resistance profile of Klebsiella species isolated from blood from different location types

Salmonella enterica serovar Typhi and Paratyphi

AMR surveillance data of 138 *Salmonella* enterica serovar Typhi and Paratyphi isolates were submitted this year of which 116 isolates were from unique patients. Low resistance to first-line antibiotics (3% for ampicillin) was observed compared to ciprofloxacin (58%) in *S. Typhi*. A single isolate of *S. Typhi* was resistant to Ceftriaxone.

Table 8: Resistance profile of *Salmonella enterica* serovar Typhi and Paratyphi

Antibiotic tested	***S. Typhi*** (N=79)			***S. Paratyphi*** (N=37)		
	Number tested	Number Resistant	% Resistant	Number tested	Number Resistant	% Resistant
Ampicillin	67	2	3	32	2	6
Ceftriaxone	68	1	2	34	0	0
Imipenem	46	0	0	18*	0	-
Ciprofloxacin	77	45	58	36	23	64
Azithromycin	41	0	0	11*	0	-
Chloramphenicol	39	1	3	18*	0	-
Trimethoprim/Sulfamethoxazole	76	4	5	35	1	3
Cefixime	13*	0	-	15*	0	-

*Due to number tested being <30, percentages were not computed

Shigella species

The resistance profile of a total of 32 *Shigella* isolates (from 32 unique patients) were obtained during the time period. The rate of resistance to Ciprofloxacin was 84% and 5 isolates were resistant to Ceftriaxone.

Table 9: Resistance profile of *Shigella* spp

Antibiotic tested	***Shigella* spp** (N=32)		
	Number tested	Number Resistant	% Resistant
Ampicillin	27*	10	-
Ceftriaxone	28*	5	-
Ciprofloxacin	31	26	84
Azithromycin	21*	4	-
Chloramphenicol	21*	2	-
Trimethoprim/Sulfamethoxazole	28*	14	-

*Due to number tested being < 30, percentages were not computed

ii. *Vibrio cholerae*

The resistance profile of a total of 8 *Vibrio cholerae* isolates (from 8 unique patients) were obtained during the time period. Six isolates were resistant to Trimethoprim/Sulfamethoxazole. No Tetracycline/ Doxycycline resistance was observed.

Table 10: Resistance profile of *Vibrio cholera*

Antibiotic tested	**Vibrio cholerae** (N=8)		
	Number tested	Number Resistant	% Resistant*
Ampicillin	6*	5	-
Azithromycin	6*	0	-
Chloramphenicol	6*	0	-
Trimethoprim/Sulfamethoxazole	6*	6	-
Tetracycline	8*	0	-
Doxycycline	6*	0	-

*Due to number tested being < 30, percentages were not computed

iii. Non-fermenting Gram-negative bacilli

Among the non-fermenting Gram-negative bacilli (NFGNB) collected during Jan-Dec 2024 across all KARS-Net sites, *Pseudomonas species* (6,320) was the most common pathogen isolated followed by *Acinetobacter species* (2,467).

Pseudomonas species

Pseudomonas species isolated from blood showed 17% resistance to Meropenem and 23% to Piperacillin tazobactam. Isolates from blood in ICU, IPD and OPD patient facilities showed high resistance to Ceftazidime i.e., 38%, 32% and 37%, respectively. Carbapenem-resistance was observed in 25% of *Pseudomonas spp*. isolated from urine. (Table 11, Figure 11).

Table 11: Resistance profile of *Pseudomonas species*

Antibiotic tested	**Blood** (N=380)			**PA** (N=3,445)			**OSBF** (N=322)			**Urine** (N=2,173)		
	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %
Piperacillin / Tazobactam	370	86	23	3328	631	19	317	97	31	2095	536	26
Ceftazidime	368	128	35	3376	1107	33	315	117	37	2096	809	39
Aztreonam	174	38	22	2051	321	16	87	16	18	1104	277	25
Imipenem	279	67	24	2747	387	14	178	54	30	1638	496	30
Meropenem	368	61	17	3179	383	12	303	60	20	1996	490	25
Amikacin	292	55	19	2379	447	19	211	43	20	1911	495	26
Gentamicin	266	70	26	2411	594	25	206	49	24	1196	312	26
Ciprofloxacin	365	85	23	3282	952	29	311	88	28	1871	619	33
Colistin	156	2	1.3	1317	2	0.2	64	0	0	663	0	0
Netilmicin	76	14	18	1230	283	23	72	17	24	624	181	29

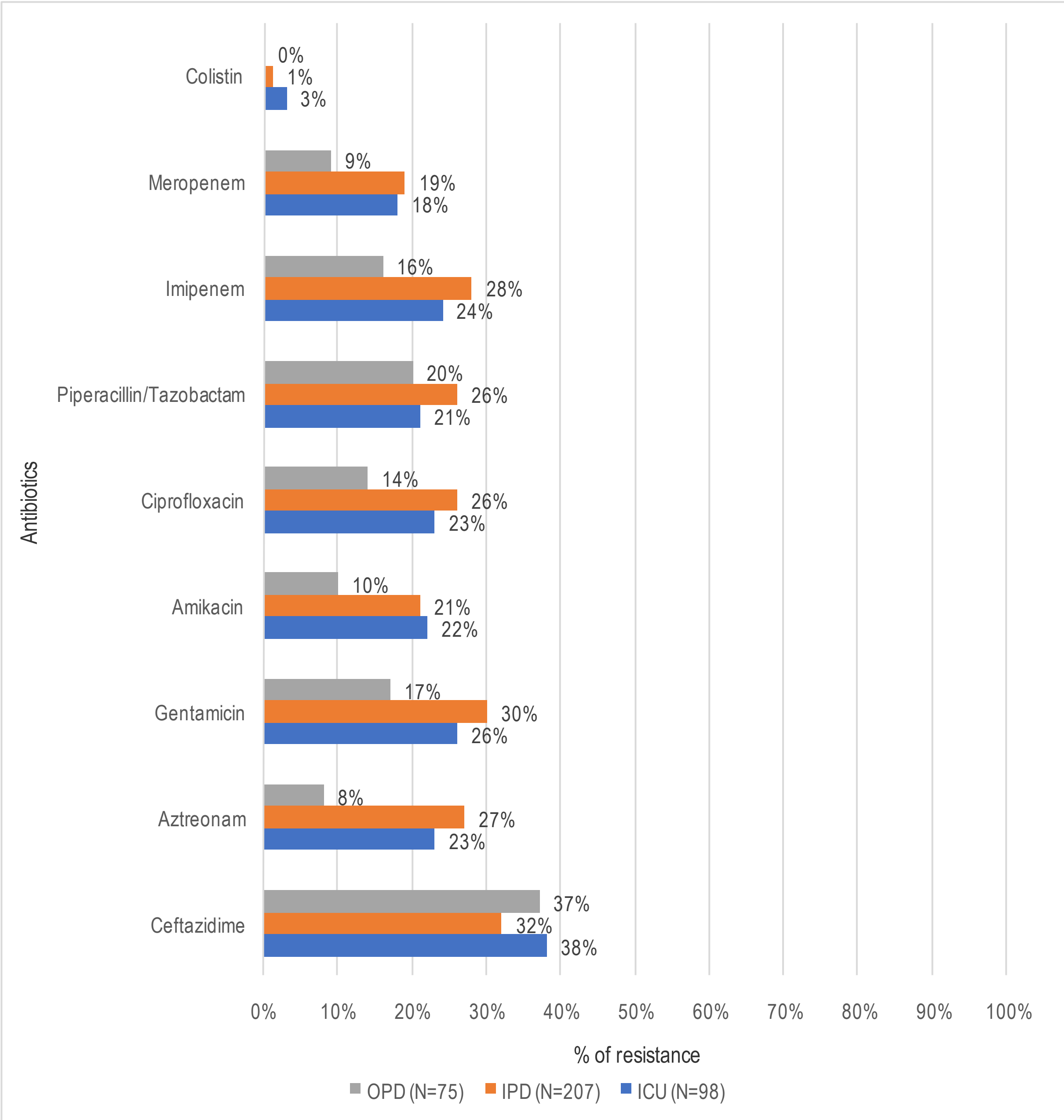

Figure 11: Resistance profile of Pseudomonas species isolated from blood from different location types

Acinetobacter species

Data from a total of 2,666 *Acinetobacter species* isolates was submitted by network sites, of which 2,467 were from unique patients. Majority of *Acinetobacter spp*. reported under KARS-Net were from pus aspirate (42%) similar to previous year. Forty-seven per cent resistance to Meropenem was observed in blood isolates. *Acinetobacter spp*. isolated from all specimen types showed highest resistance to Ceftazidime (Table 12).

Table 12: Resistance profile of *Acinetobacter species*

Antibiotic tested	**Blood** (N=691)			**PA** (N=1038)			**OSBF** (N= 135)			**Urine** (N=603)		
	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %	Number tested	Number resistant	Resistance %
Ampicillin/ Sulbactam	275	114	41	476	239	50	63	25	40	102	21	21
Piperacillin/ Tazobactam	657	327	50	969	622	64	134	80	60	554	173	31
Ceftazidime	493	326	66	803	584	73	72	46	64	507	231	57
Imipenem	489	271	55	904	541	60	114	73	64	487	145	30
Meropenem	625	294	47	888	490	55	115	64	56	503	126	25
Amikacin	678	288	42	983	567	58	125	67	54	561	119	21
Gentamicin	667	303	45	989	597	60	128	77	60	556	149	27
Ciprofloxacin	645	317	49	899	611	68	122	69	57	486	190	39
Trimethoprim/ Sulfamethoxazole	625	257	41	910	562	62	120	72	60	451	112	25
Colistin	350	0	0	552	0	0	84	0	0	214	0	0
Minocycline	328	62	19	579	147	25	71	17	24	251	18	7
Tetracycline										252	49	19

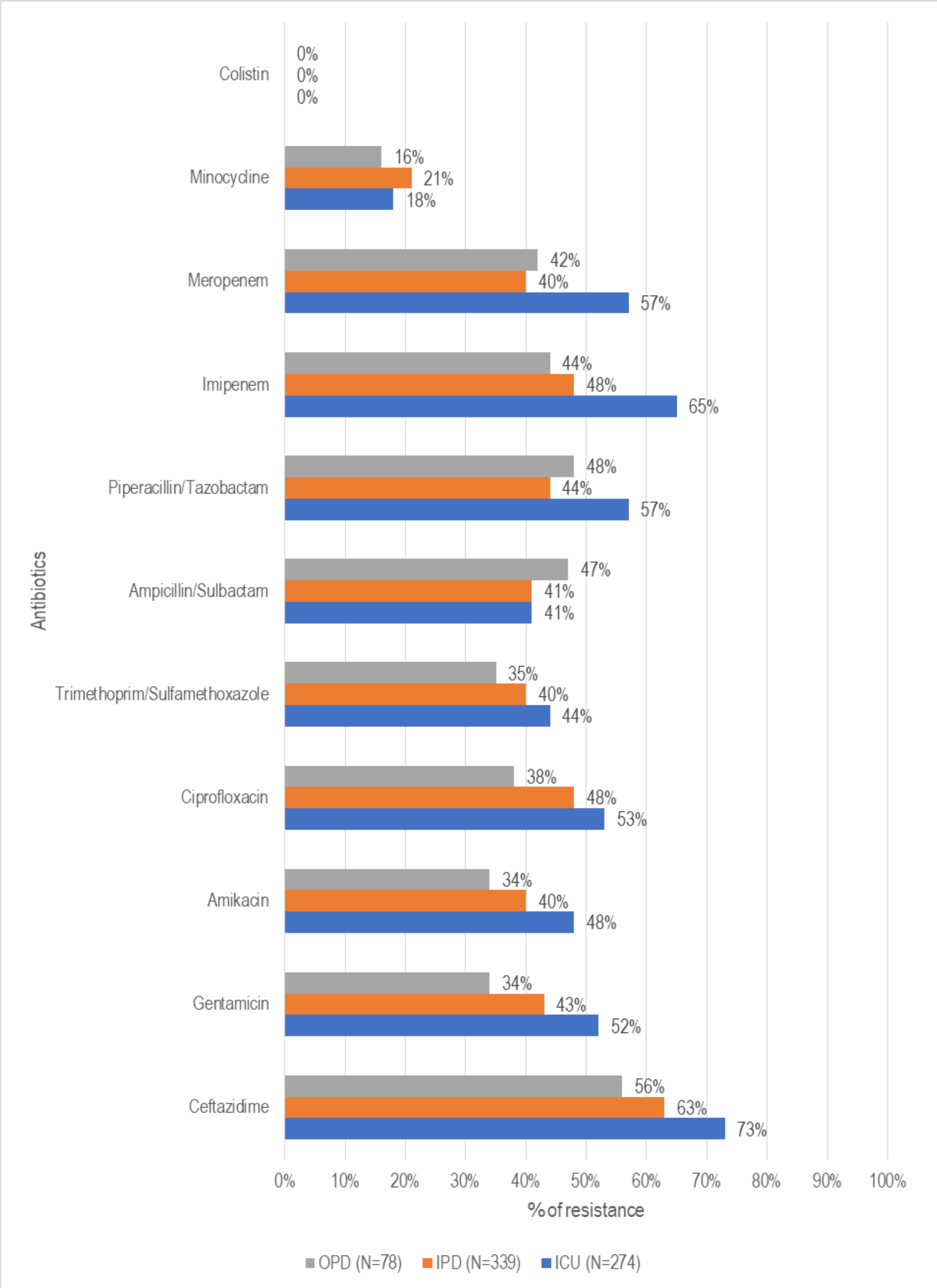

Figure 12: Resistance profile of Acinetobacter species isolated from blood from different location types

VI. Trends of AMR in Kerala over 6 years

The trends of AMR in Kerala over six years (2018, 2019, 2021, 2022, 2023 and 2024) were analysed from the KARS-NET data. The data for 2020 was not included as most of the centres were unable to test and report AMR due to the COVID pandemic. It was observed that ESBL production as well as carbapenem resistance has generally shown a slight decrease last year (Figures 13 & 14). The apparent decrease in MRSA in 2021 may be attributed to the non-uniformity in data from some centres in the initial months of 2021 owing to the subsequent waves of pandemic in the state and majority of centres being COVID care centres. Slight decrease in MRSA rate was observed during 2024, but the VRE rate showed a similar trend compared to previous year report (Figure 15 & 16).

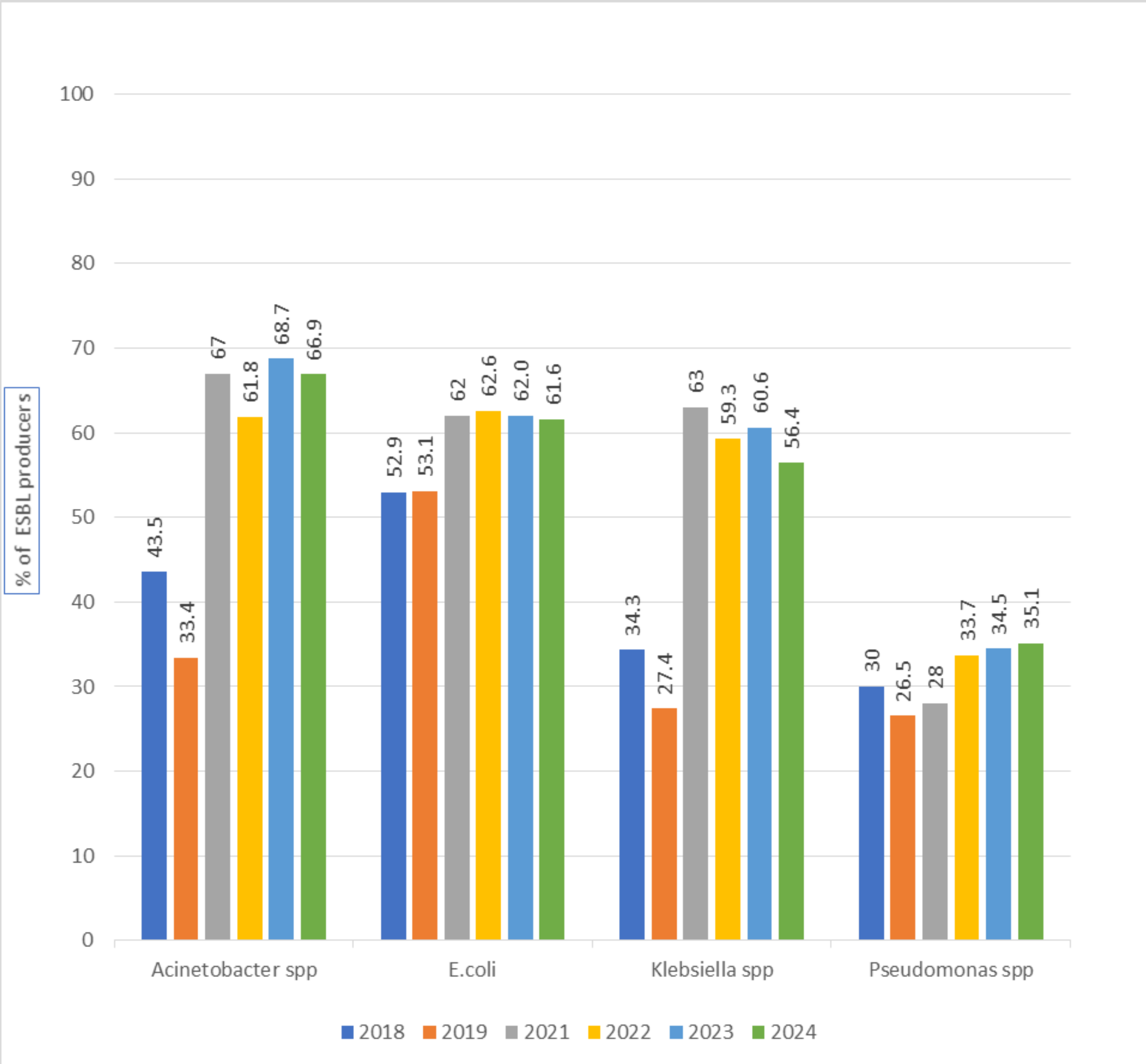

Figure 13: Trends of ESBL – evidence from KARS-Net over 6 years

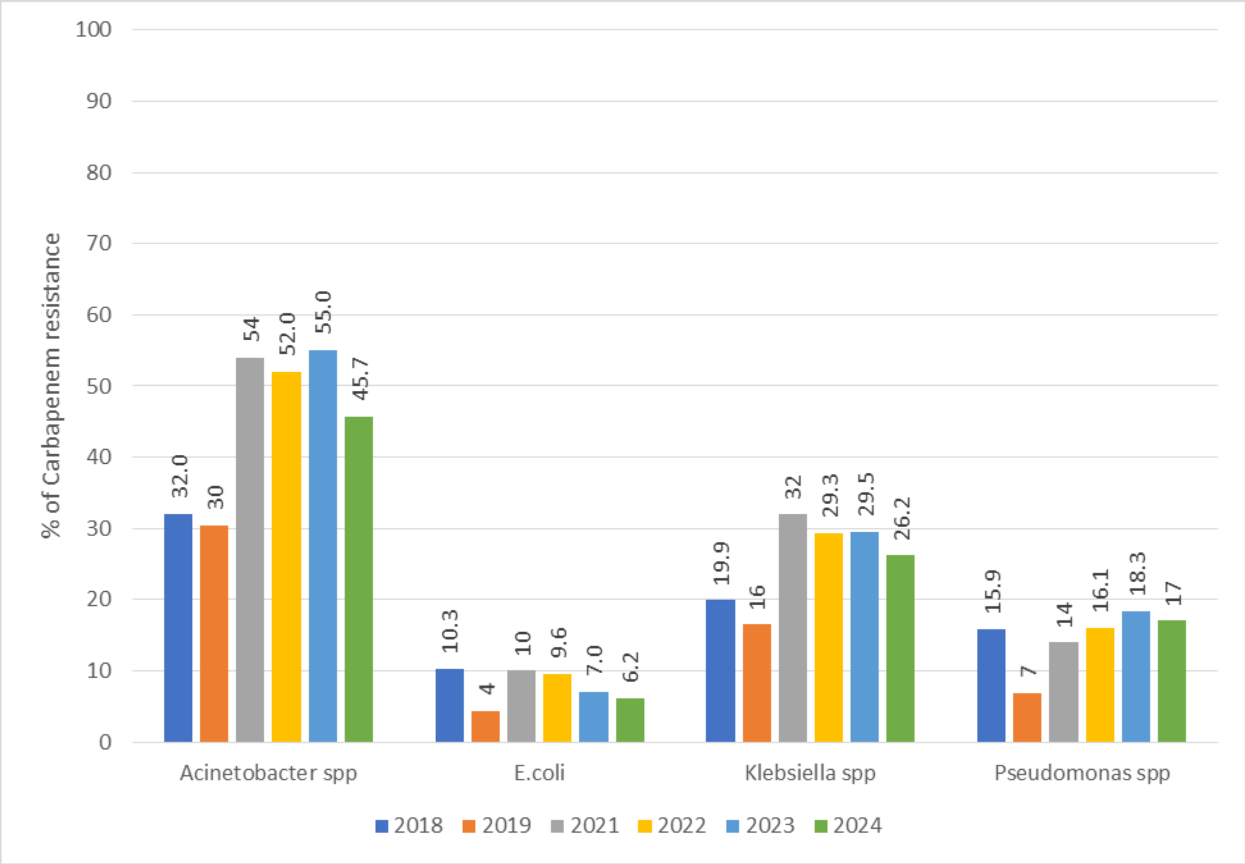

Figure 14: Trends of Carbapenem resistance – evidence from KARS-Net over 6 years

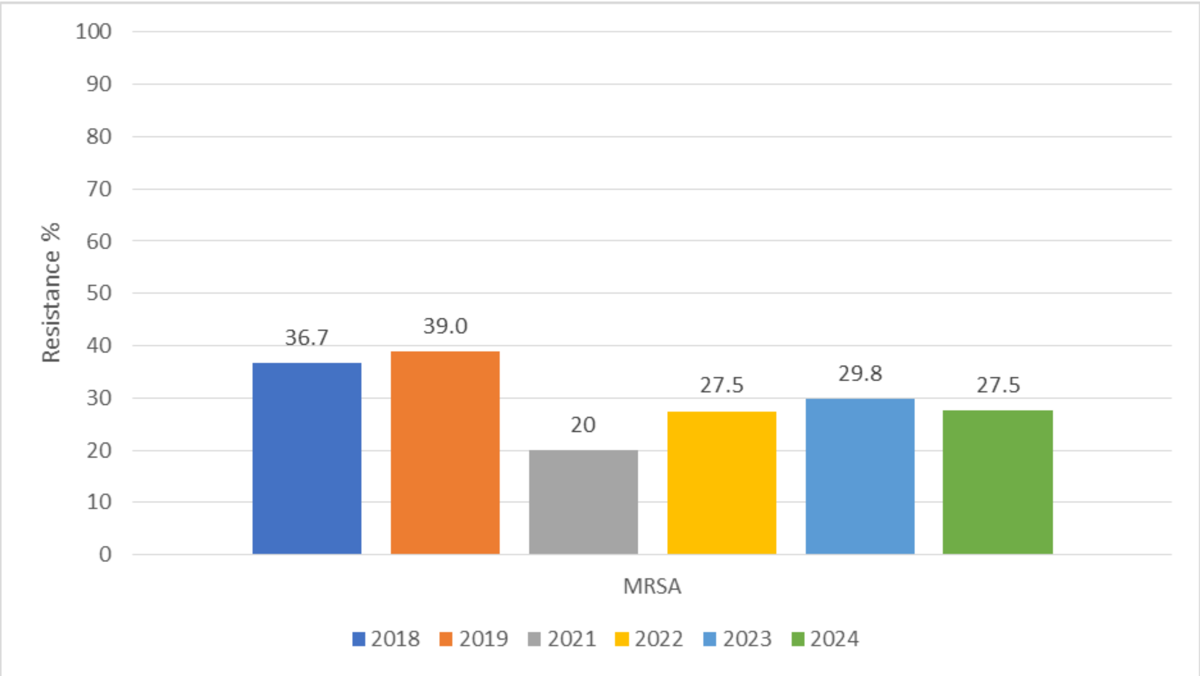

Figure 85: Trends of MRSA – evidence from KARS-Net over 6 years

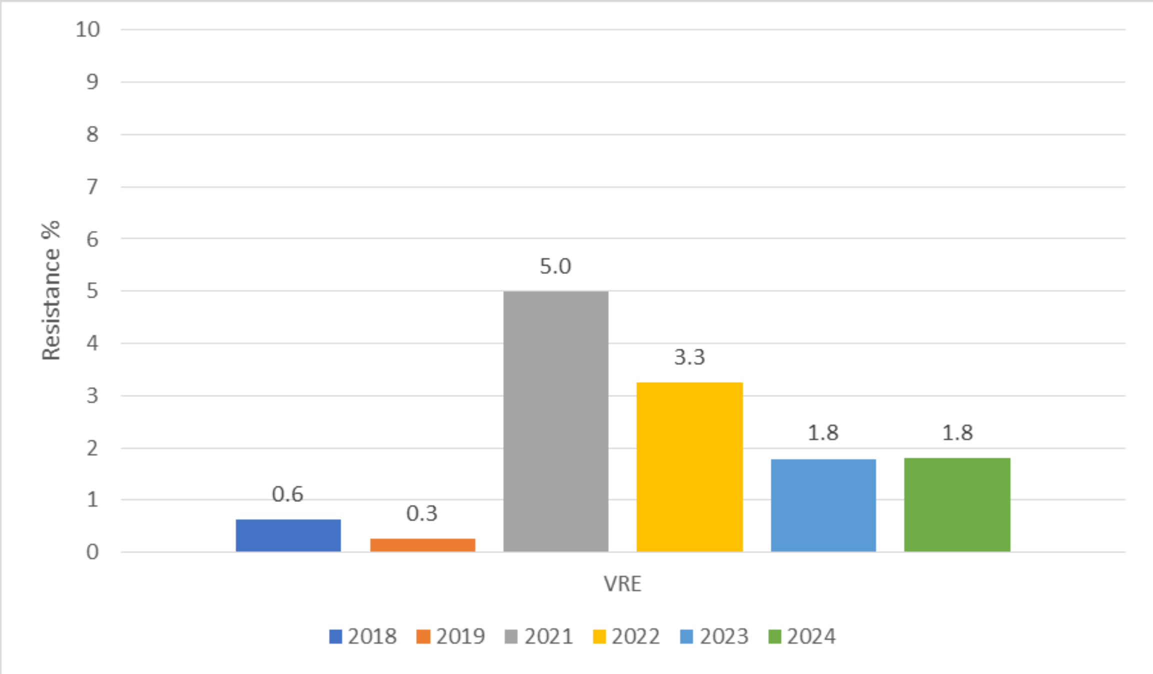

Figure 16: Trends of VRE – evidence from KARS-Net over 6 years

VII. Discussion

Strengthening global, national and local AMR surveillance is critical for AMR containment as it is the basis for designing and implementing evidence-based strategies, monitoring the effectiveness of public health interventions and detecting new trends and threats. AMR poses a significant global health challenge threatening the attainment of Sustainable Development Goals (SDGs) related to health. WHO declared AMR as one of the ten global public health threats in 2019 and an emerging health challenge for the decade in 2020.
KARS-Net compiles the State AMR surveillance report annually. The activities under KARS-Net include capacity building of a network of government and private medical colleges and laboratories for AMR surveillance. KARS-Net has been expanded in a phased manner to all 14 districts across the state. AMR surveillance under KARS-Net includes standardised collection, collation, analysis and compilation of AMR data from all the network sites. The compiled data is used to generate the annual State AMR surveillance report which is shared with all the network sites under KARS-Net and to the stakeholders at the State level. This network data is also submitted annually to NCDC for submission to WHO's Global AMR Surveillance System (GLASS).

The report for the year 2025 presents data (1 January to 31 December 2024) analysed from 47 network sites located in 13 districts of Kerala. Compared to the previous years' Kerala AMR surveillance report which included 2021 data from 18 network sites, 2022 data from 23 network sites and 2023 data from 34 network sites, the number of sites submitting the AMR data during 2024 has increased to 47 network sites. Quality of AMR surveillance data submitted by the sites has been ensured by continuous support in the form of trainings based on standard operating procedures for data management, antimicrobial susceptibility testing, internal quality control (IQC) and other technical guidelines developed by NCDC. The number of centres performing colistin BMD has increased compared to the previous years. The monthly feedback on AMR data provided to the network laboratories have played an essential role in improving the patient demographic & AST data compliance. Most sites have adopted stringent internal quality control of antibiotic susceptibility testing as per recommendations under the programme.

E. coli was the most common pathogen isolated (40.4%) in the AMR surveillance data of 2024 which is similar to the previous year report. Amongst urinary isolates, *E. coli* was the most common pathogen isolated (58%) while *E. coli (24%) and Klebsiella spp.* (24%) were the most common pathogens isolated from blood. These findings corroborate with the previous year's report. *Klebsiella spp*. was the predominant pathogen isolated from OSBF (30%), while *Staphylococcus aureus* was the predominant pathogen isolated from PA (32%). In terms of location type, *E coli* was the most common priority pathogen isolated from OPD (47%), IPD (36%) and ICU (31%) settings. Similar pathogen burden in respective location types were seen in the previous year report also. Similar rates of MRSA among the *S. aureus* isolates from blood was noted this year (32%), compared to the previous year (33%). *Enterococcus spp.* isolated from blood cultures showed 3% resistance to Vancomycin similar to the previous year. About 9% of *E. coli* and 43% of *Klebsiella spp.* isolated from blood were found to be CREs.

AMR surveillance through the KARS-Net plays a pivotal role in determining the burden and trends of AMR in Kerala, providing valuable information for evidence-based policy making and implementation for containment of AMR. The establishment and expansion of KARS-Net surveillance network can be a good example for other Indian States and Union Territories to follow.

Annexure

Members of KARS-Net AMR surveillance network

1. Government Medical College (GMC), Thiruvananthapuram
2. Government Medical College (GMC), Kozhikode
3. Government Medical College (GMC), Thrissur
4. Government Medical College (GMC), Kottayam
5. Government T.D Medical College (GMC), Alappuzha
6. Government Medical College (GMC), Manjeri
7. Government Medical College (GMC), Ernakulam
8. Government Medical College (GMC), Kollam
9. General Hospital (GH), Ernakulam
10. State Public Health Laboratory, Thiruvananthapuram
11. Believers Church Medical College Hospital, Tiruvalla
12. Aswini Diagnostic Services, Kozhikode
13. Dane Diagnostic Services, Palakkad
14. Karuna Medical College, Palakkad
15. Pushpagiri Medical College Hospital, Tiruvalla
16. Regional Cancer Centre, Thiruvananthapuram
17. Sree Chitra Tirunal Institute for Medical Sciences &Technology, Thiruvananthapuram
18. MVR Cancer Centre, Kozhikode
19. Thangam Hospital of PMRC, Palakkad
20. Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram
21. General Hospital, Thiruvananthapuram
22. General Hospital, Kottayam
23. Government Medical College (GMC), Kannur
24. Jubilee Mission Medical College and Research Institute, Thrissur
25. Amala Institute of Medical Sciences, Thrissur
26. MES Medical College, Perinthalmanna
27. Malabar Cancer Centre, Thalassery
28. Sree Uthradom Thirunal Institute of Medical Sciences, Thiruvananthapuram
29. Regional Public Health Laboratory, Kannur
30. Regional Public Health Laboratory, Pathanamthitta
31. District Public Health Laboratory, Malappuram
32. Government Medical College (GMC), Konni
33. Dr Somervell Memorial CSI Medical College, Karakonam
34. Mount Zion Medical College, Adoor
35. KMCT Medical College, Mukkam
36. MOSC Medical College, Kolenchery
37. Sree Gokulam Medical College and Research Foundation, Venjarammoodu
38. PRS Hospital, Thiruvananthapuram
39. KIMS HEALTH Hospital, Thiruvananthapuram
40. Government Medical College (GMC), Wayanad
41. Azeezia Medical College, Kollam
42. District Hospital, Kollam
43. Taluk Head Quarters Hospital, Punalur
44. Public Health Lab, Alappuzha
45. General Hospital, Thrissur
46. General Hospital, Kozhikode

47. Travancore Medical College Hospital, Kollam
48. Kannur Medical College, Anjarakkandy
49. Dr Moopen's Medical College, Wayanad
50. PK Das Institute of Medical Science, Palakkad
51. Sree Narayana Institute of Medical Science, Ernakulam
52. Al Azhar Medical College, Thodupuzha
53. Regional Public Health Lab, Kozhikode
54. Government Medical College (GMC), Idukki
55. IPHL, Kasaragod
56. Malabar Medical College, Kozhikode
57. Moulana Hospital, Perinthalmanna
58. GG Hospital, Thiruvananthapuram
59. Baby Memorial Hospital, Kozhikode