



Ministry of Health and Family Welfare
Government of India

Surveillance of Antimicrobial Consumption under National Antimicrobial Consumption Network (NAC-NET)

Report of NACNET sites for 2023



National Programme on AMR Containment

National Centre for Disease Control (NCDC), Directorate General of Health Services



Antimicrobial Resistance Stewardship – Our Role, Our Responsibility
Judicious Use of Antimicrobials – Key to Contain AMR

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Abbreviations

AMR	Antimicrobial Resistance
ASP's	Antimicrobial Stewardship Programs
ATC	Anatomical Therapeutic Chemical
AWaRe	Access, Watch, Reserve
Cap.	Capsule
DDD	Defined Daily Dose
g	Gram
GMC	Government Medical College
Inj.	Injection
mg	Milligram
NAC-NET	National Antibiotic Consumption-Network
NCDC	National Centre for Disease Control
NR	Not Recommended
SUs	Standard units
Tab.	Tablet
UTs	Union Territories
WHO	World Health Organisation

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Executive Summary

National Centre for Disease Control (NCDC) serves as the Nodal agency for the National Programme on AMR Containment in India. Monitoring antibiotic usage is one of the critical components of this program. To support this initiative, NCDC established the National Antibiotic Consumption Network (NAC-NET). Under this network, participating sites collect data on antibiotic consumption within their health facilities and report it to the NCDC.

This report presents findings of compiled and analysed antibiotic consumption data from thirty NAC-NET sites for the year 2023. The findings revealed considerable variability in antibiotic usage across 29 tertiary care institutions. Notably, there was excessive use of "Watch" antibiotics, which are associated with a higher risk of resistance, and insufficient use of "Access" antibiotics, which are recommended as first-line treatments. The use of "Access" antibiotics ranged from 20% to 82% with only one institution exceeding 60% of consumption from the "Access" category. Use of "Reserve" antibiotics, such as colistin, linezolid, and aztreonam, which are intended for last-resort situations, accounting for 0-4% of total consumption is also concerning. One of the sites reported consumption of Linezolid amongst top 5 antibiotics consumed at the site. Additionally, 4% of antibiotics used were not recommended, which raised further concerns.

The most frequently used antibiotics varied across institutions, with azithromycin, amoxicillin and clavulanic acid and ceftriaxone being the most common.

Overall, the findings highlight the inconsistent implementation of antimicrobial stewardship programs and adherence to treatment guidelines, emphasizing the need for targeted interventions to optimize antibiotic use at NAC-NET sites.

Background

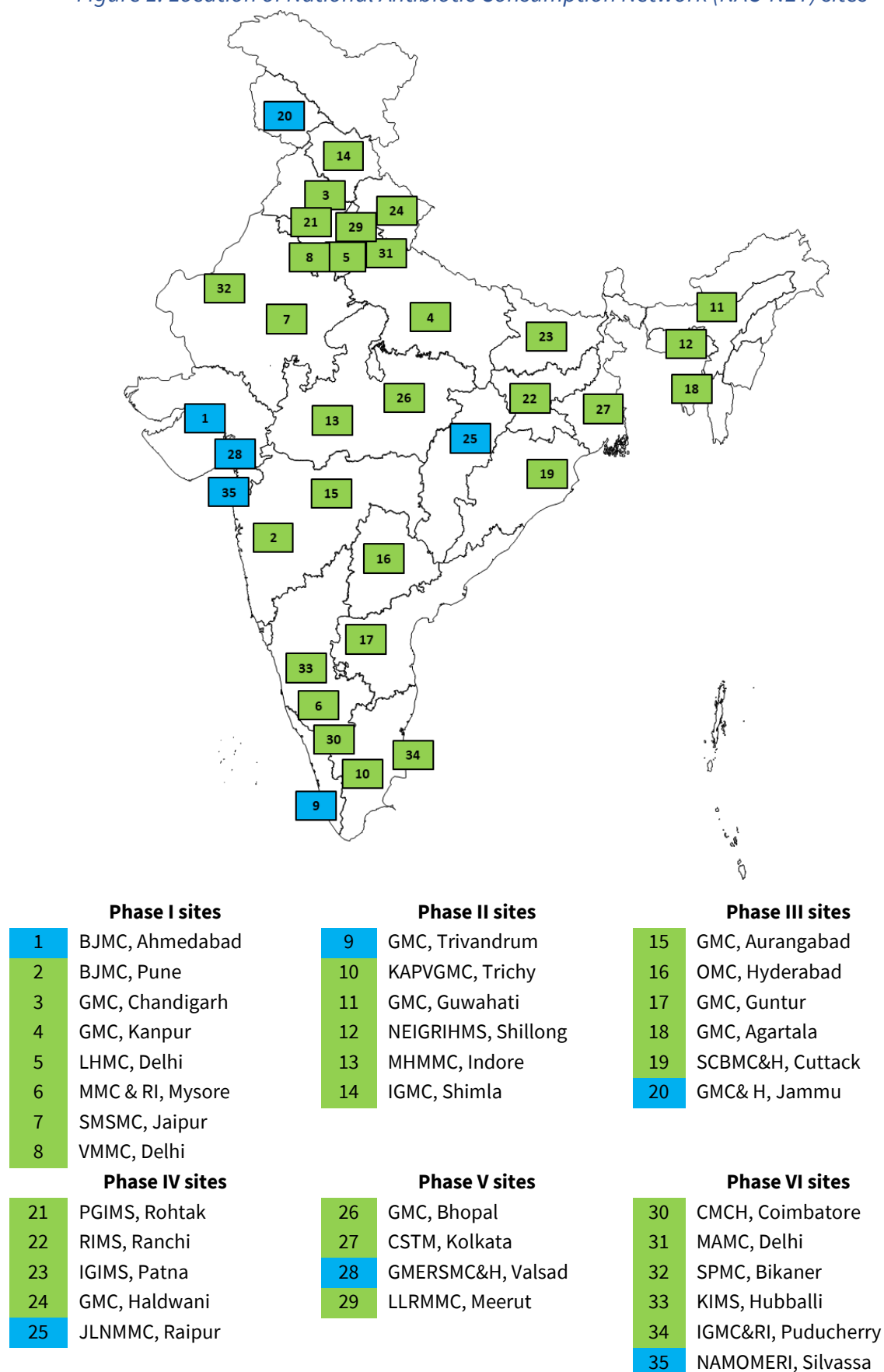
The increasing threat of antibiotic resistance (AMR) is a critical issue for global public health. As bacteria evolve, antibiotics lose their effectiveness, making infections harder to treat. In 2019 alone, approximately 4.95 million deaths were linked to bacterial AMR, with 1.27 million of those deaths being directly caused by antibiotic resistance (1). Projections indicate that by 2050, AMR will be responsible for 10 million deaths annually, surpassing cancer as the leading cause of death worldwide (2). A major driver of AMR is the overuse of antibiotics in humans, with studies showing that a significant proportion of antibiotics are used inappropriately, especially in hospital settings (3–5).

National Centre for Disease Control, New Delhi is the nodal agency for the National Programme on AMR Containment, which encourages rational antibiotic use (6). One of the priorities of this programme is to carry out surveillance of antibiotic usage in healthcare settings across India. Under the AMR programme, National Antibiotic Consumption-Network (NAC-NET) comprising of Government tertiary health care facilities was established across 24 States and 3 Union territories (UTs) in a phased manner (Fig. 1).

The global surveillance report for 2015 from 65 countries, does not include antibiotic consumption data from India. Limited research has been done to assess antibiotic consumption in India using the WHO's AwaRe (Access, Watch, and Reserve) classification system and Defined Daily Doses (DDD) (6). This report is an effort to fill this gap by presenting a comprehensive analysis of antibiotic consumption data collected from twenty-nine NAC-NET sites during 2023. This analysis follows the WHO Anatomical Therapeutic Chemical (ATC) methodology and the Defined Daily Doses (DDD) system, which is widely used for assessing antibiotic use and comparing consumption patterns. Antibiotic consumption data can be used to (7):

- recognize and detect changes in antibiotic exposure and use;
- develop interventions to address the identified problems;
- monitor the impact of interventions;
- ensure prescribing practices adhere to appropriate guidelines; and
- promote awareness of the adverse effects of inappropriate antibiotic use.

Figure 1: Location of National Antibiotic Consumption Network (NAC-NET) sites*



* Antibiotic consumption data from twenty-nine NAC-NET sites (marked in green) is included in this report.

Methodology

The antibiotic consumption data collection, compilation and report preparation was done as follows:

Selection of sites

The sites included in this report were the ones which had compiled the antibiotic consumption data for the year 2023. A total of 29 NAC-NET sites had submitted their antibiotic consumption data. The site list is provided in Fig. 1

Training

The pharmacists recruited under the programme undergo induction and refresher trainings. The trainings cover:

- Collection of antibiotic consumption data from the central stores/ pharmacy;
- Collection of bed occupancy data from the medical records department;
- Compilation of the data in the excel template provided by NCDC;
- Calculation of DDD and DDD/100-bed-days using the WHO AMC tool 2019 as per the WHO ATC-DDD methodology; and
- Analysis of the compiled data using trend graphs, AWaRe classification and top 5 antibiotics.

Inclusion criteria

- Antibiotics consumed at the inpatient facilities of NAC-NET sites
- Antibiotics prescribed through oral and parenteral routes

Exclusion criteria

- Antibiotics prescribed in any other route ex. topical preparations, eye/ear drops, gel, and suppositories
- Other antibiotics like antifungal, antiviral, antitubercular, antiprotozoals

Antibiotics were classified in J01 and P01 groups under the WHO Anatomical Therapeutic Chemical (ATC) classification system. We reported consumption estimates in standard units (SUs) defined as the smallest dose of formulation like one tablet or capsule for oral solids, and one vial or ampoule for injectable antibiotics.

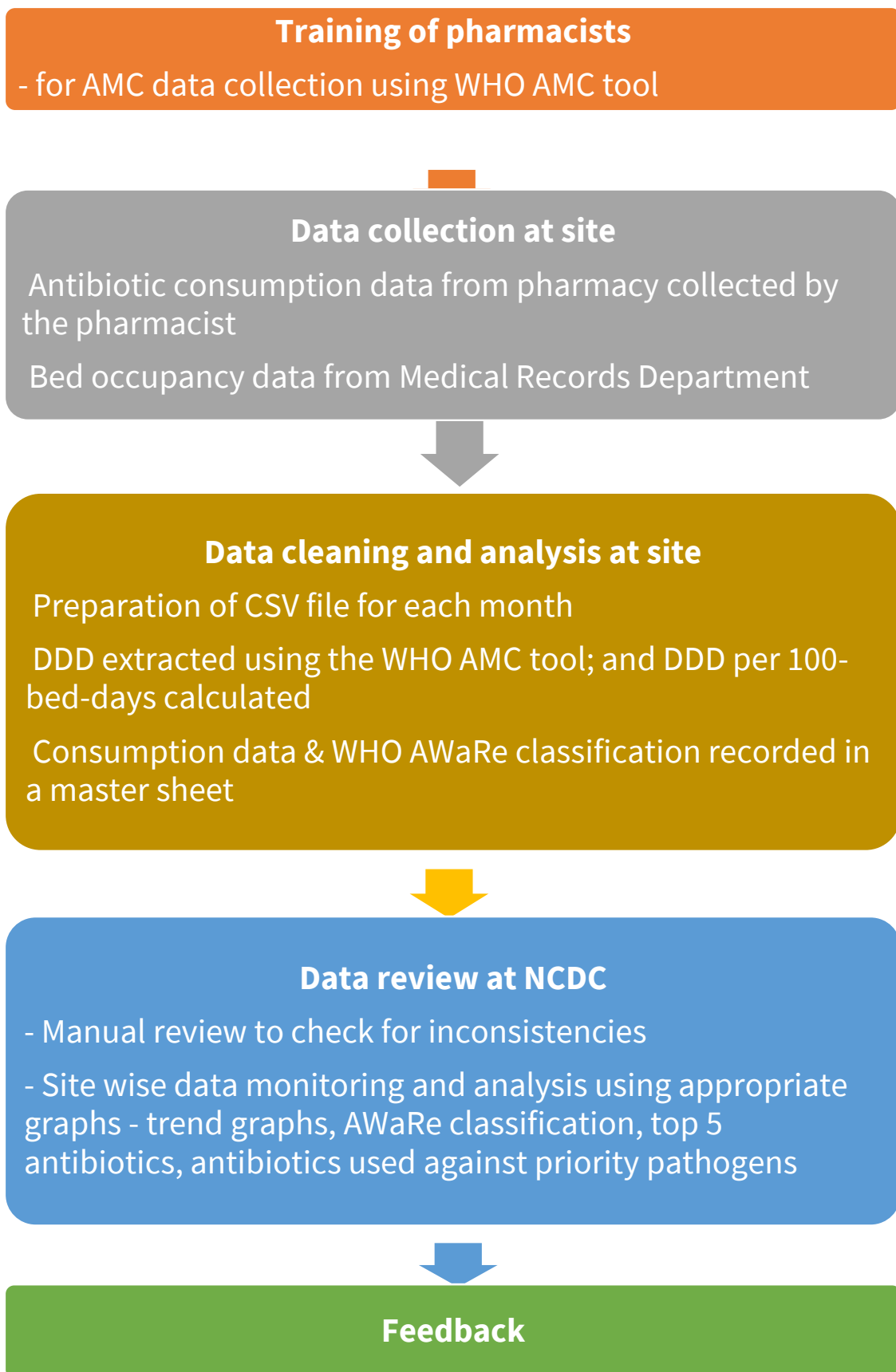


Figure 2: Mechanism of data collection and feedback to sites

Measures of antibiotic consumption

Antibiotic consumption was measured in Defined Daily Doses.

- **Defined Daily Dose:** The assumed average maintenance dose per day for a drug used for its main indication in adults (5). WHO AMC Tool 2019 v.1.9.0 was used to calculate DDDs of each volume of antibiotics.
- **Bed occupancy:** Bed occupancy rate for each month was calculated using the formula – $\text{Bed occupancy rate} / \text{Bed days} = \text{Occupied beds} / \text{Available beds}$,
- **DDD/100-bed-days:** This was calculated using the total number of beds for all sites and using the bed occupancy rate as 100%.

Data collection and analysis

At the site level, data collection is done by the pharmacist. The steps include:

- Consumption data is collected from the central drug store of the health facility.
- Bed occupancy data is sourced from the Medical Records Department.
- Consumption data is recorded in a master sheet along with their WHO AWaRe (Access-Watch-Reserve) classification.
- A CSV file is created using the following variables:
 - Name of the antibiotic
 - Pack size
 - Strength of the drug
 - ATC code
 - Route of administration
- After data entry, data was imported in WHO AMC Tool 2019 v.1.9.0, to calculate the DDD of each antibiotic.
- DDD/100-bed-days calculated for each antibiotic and consolidated.

Overview at NCDC:

- Manual review of antibiotic consumption was done to check for inconsistencies.
- The sites were consulted for confirmation.
- Analysis of the data done using trend graphs based on AWaRe classification, antibiotics used against priority pathogens.
- Monthly data for 29 sites compiled and consolidated using MS-Excel.
- A new CSV file was prepared for the consolidated consumption.
- After data entry, data was imported into WHO AMC Tool 2019 v.1.9.0, to calculate DDD of each antibiotic.
- DDD/100-bed-days was calculated for each antibiotic and consolidated.
- Consolidated data was then analysed for the indicators mentioned below.

Indicators monitored

Antibiotic consumption is organized using the following key indicators:

- Annual consumption in terms of DDD/100-bed-days
- AWaRe classification of antibiotics
- List of top-5 antibiotics used
- Group wise antibiotic consumption
- Route of administration of antibiotics

Results

This report presents antibiotic consumption of 29 NACNET sites for the year 2023. Total bed strength and bed occupancy of the sites is given in Table 1.

Table 1: NAC-NET sites with Bed strength and Bed Occupancy Rates

S. No.	NAC-NET site	Bed Occupancy Rate	Bed Strength
1	Site 1	52%	2400
2	Site 2	59%	2300
3	Site 3	77%	2080
4	Site 4	83%	950
5	Site 5	57%	591
6	Site 6	71%	782
7	Site 7	100%	2496
8	Site 8	100%	1055
9	Site 9	55.8%	877
10	Site 10	55%	1167
11	Site 11	126.9%	1267
12	Site 12	100%	1513
13	Site 13	90%	861
14	Site 14	83%	2776
15	Site 15	62%	1665
16	Site 16	100%	2873
17	Site 17	69%	2191
18	Site 18	70%	710
19	Site 19	19%	2461
20	Site 20	82%	3667
21	Site 21	100%	733
22	Site 22	85%	1756
23	Site 23	78%	2000
24	Site 24	80%	1014
25	Site 25	86%	1296
26	Site 26	100%	162
27	Site 27	68%	888
28	Site 28	100%	2518
29	Site 29	57%	1383
Total Beds			46432

Note: The sites have been assigned numbers randomly and not as per Figure 1

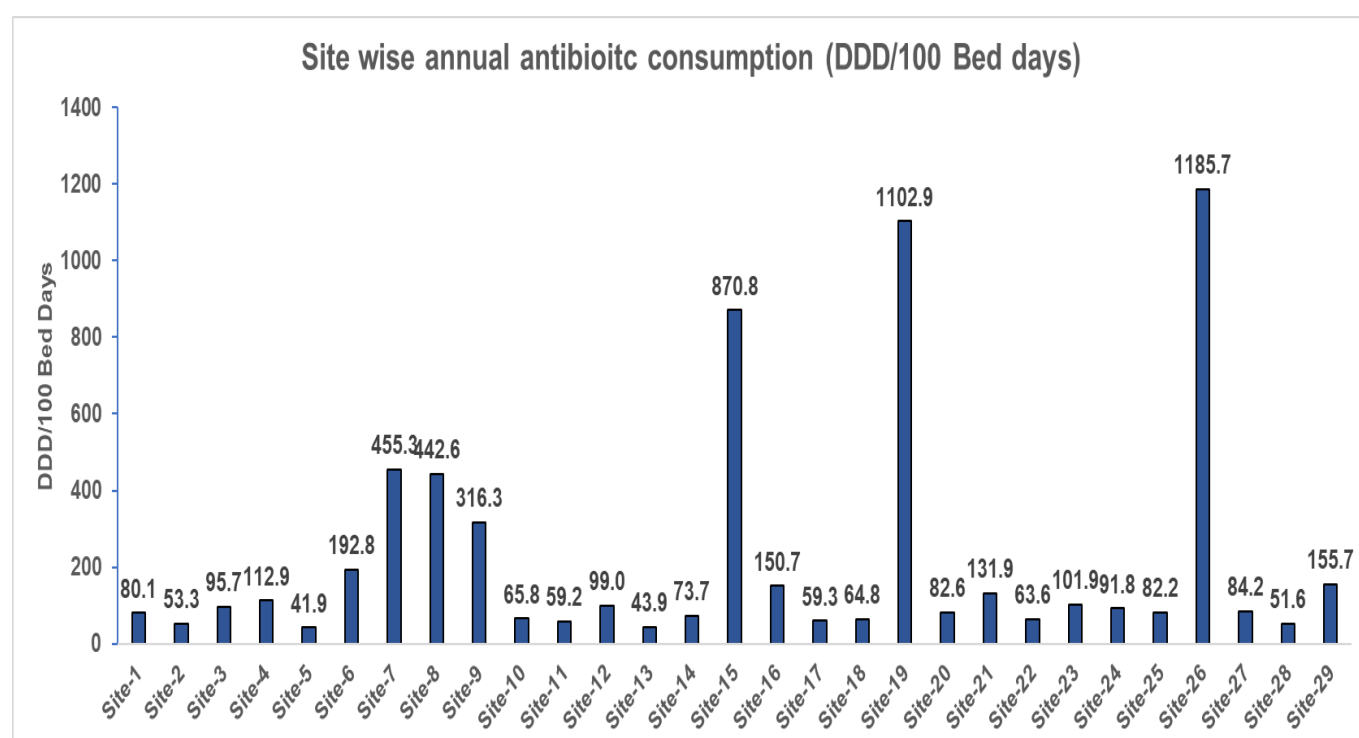
Bed strength of the sites ranged from 162 to 3667 and bed occupancy ranged from 52% to 126.9%. For operational reasons, maximum bed occupancy has been taken as 100%.

Site-wise antibiotic consumption of NACNET sites

Annual antibiotic consumption

Annual antibiotic consumption of NACNET sites ranged from 41.9 DDD/100 Bed days to 1185.7 DDD/100 Bed days. Majority of the sites have reported antibiotic consumption below 500 DDD/100 Bed days.

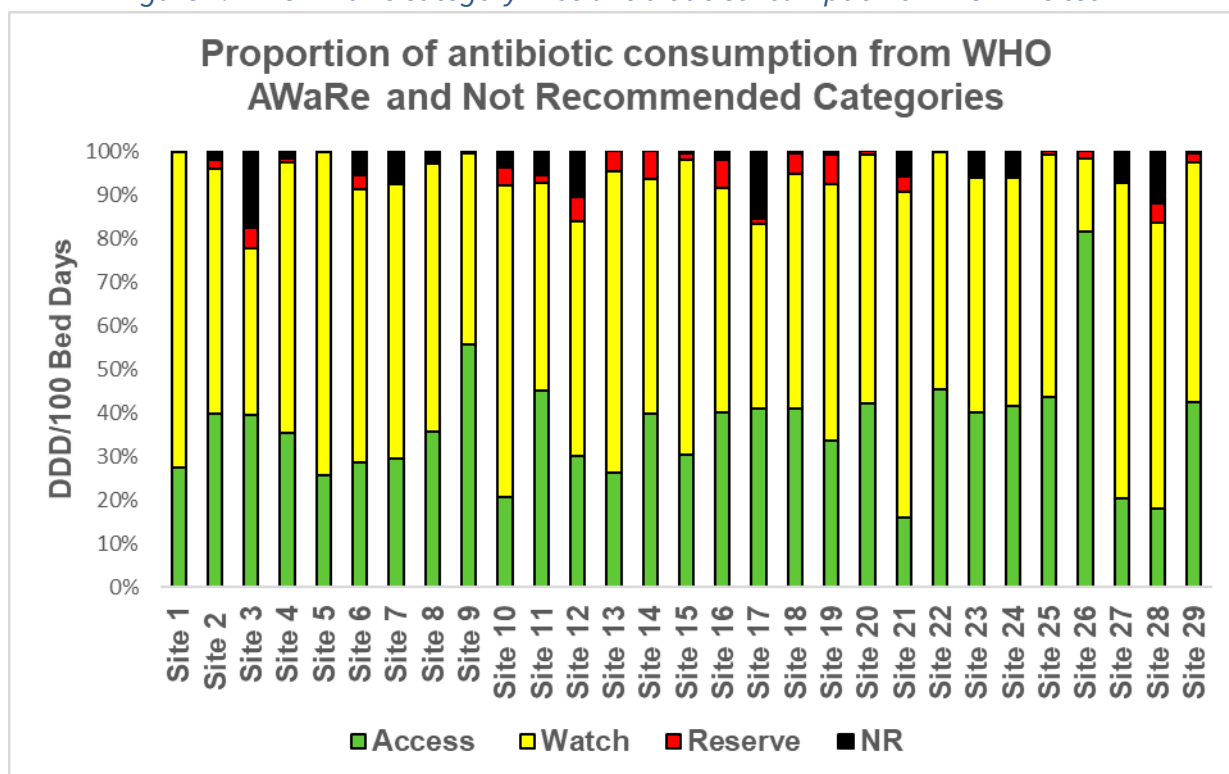
Figure 3: Annual antibiotic consumption of NACNET sites



AWaRe category-wise antibiotic consumption

Only two sites (one site has recorded 82% and another recorded 56%) have reported majority of antibiotic consumption from **Access** category rest all sites have reported maximum antibiotic consumption from **Watch** category. Five sites have reported >5% antibiotic consumption from **Reserve** category of antibiotics. Eight sites have reported >5% antibiotic consumption from WHO **Not Recommended** (NR) category of antibiotic of which four sites have reported more that 10% antibiotic consumption from NR category.

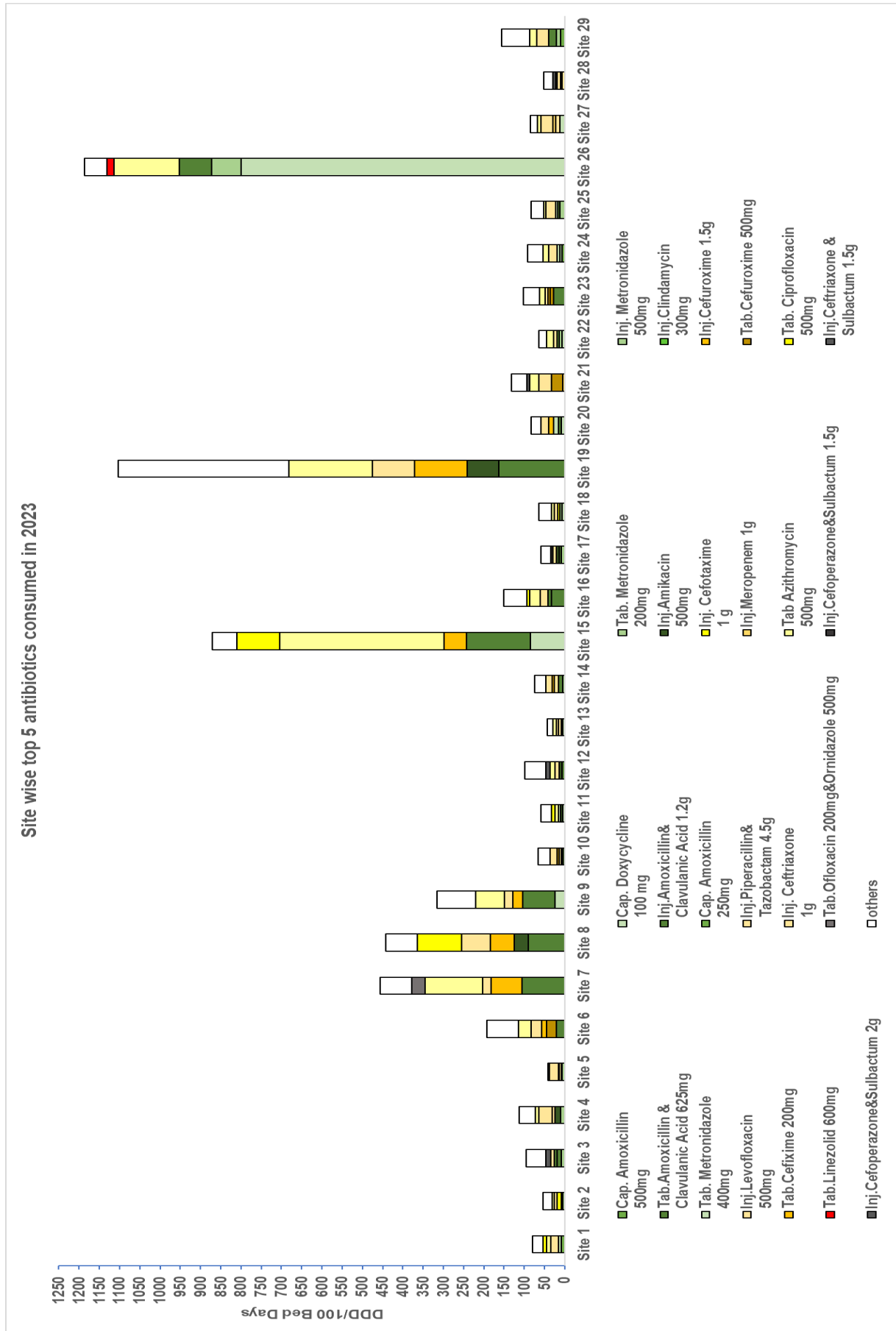
Figure 4: WHO AWaRe category wise antibiotic consumption of NACNET sites



Top five antibiotics consumed

Tablet Azithromycin 500mg (**Watch**), Capsule Doxycycline 100mg (**Access**), Tablet Amoxycillin and Clavulanic Acid 625mg (**Access**), Injection Ceftriaxone 1000mg (**Watch**), Tablet Cefixime 200mg (**Watch**) and Tablet Ciprofloxacin 500mg (**Watch**) were most commonly consumed antibiotics. One of the NACNET site has reported Tablet Linezolid (**Reserve**) among top five antibiotics consumed in the site. Six sites have reported consumption of Injection Cefoperazone & Sulbactam 2g (**NR**), Tablet Ofloxacin 200mg & Ornidazole 500mg (**NR**) and Injection Ceftriaxone & Sulbactam 1.5g (**NR**) amongst top five antibiotics consumed at the site.

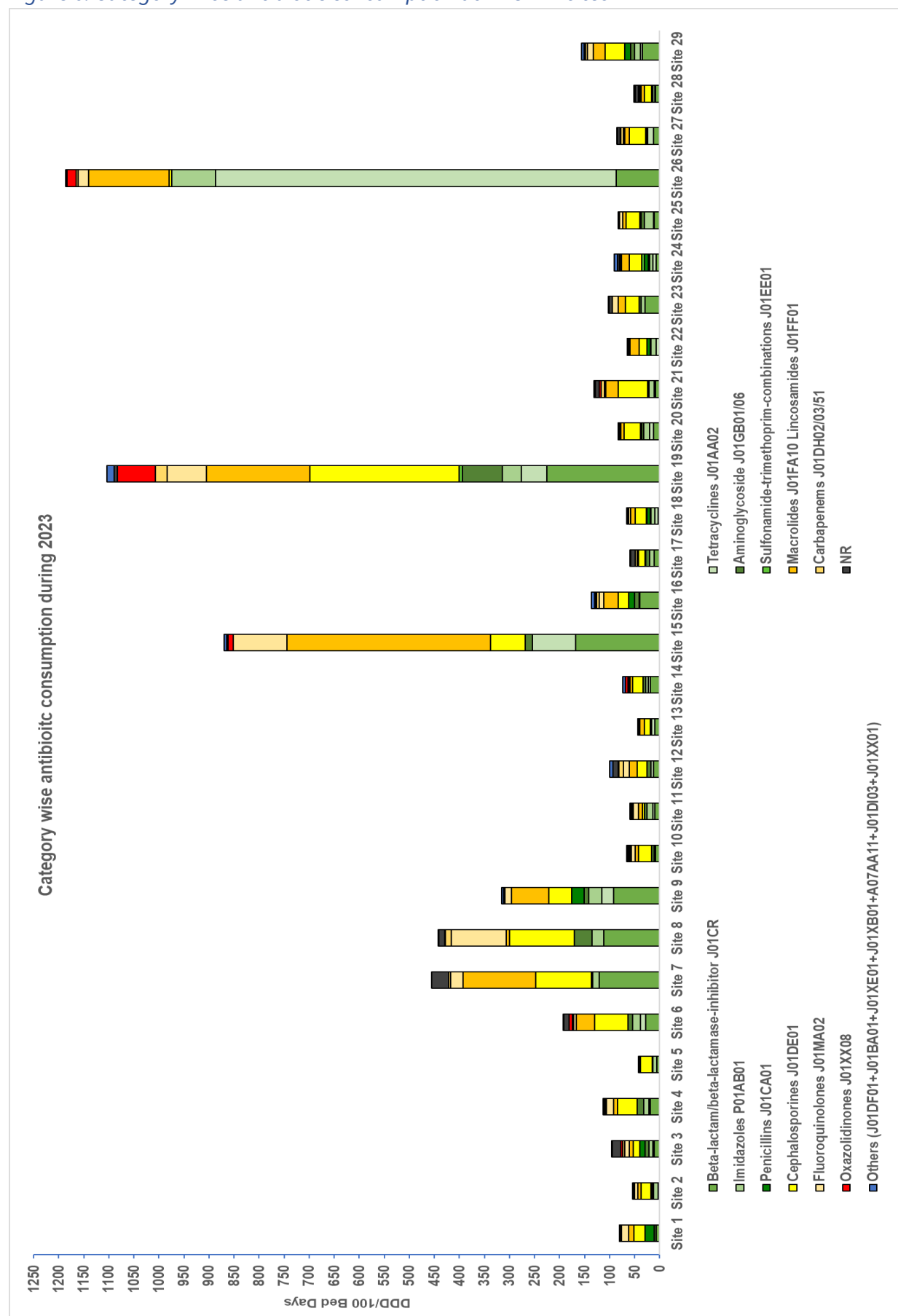
Figure 5: Top five antibiotics consumed at NACNET sites



Category wise antibiotic consumption

Macrolides/Lincosamides (**Watch**), Cephalosporins (**Watch**), followed by Beta lactam/ beta lactamase inhibitors (**Access**), Tetracyclines (**Access**) and Fluoroquinolones (**Watch**) are the most commonly consumed group of antibiotics. Three sites have shown noticeable consumption from Oxazolidinones (**Reserve**) and five sites have shown significant consumption from WHO **Not Recommended** group of antibiotics.

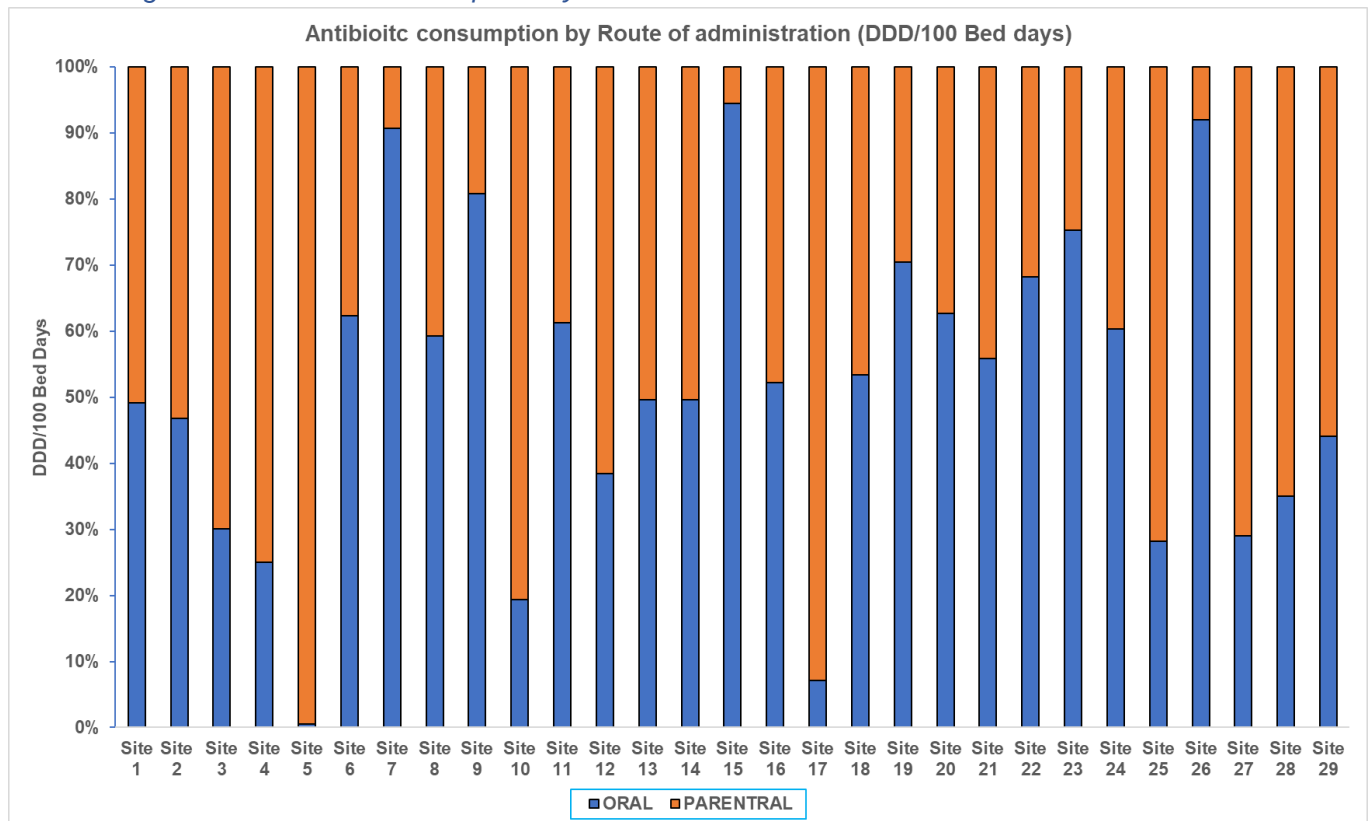
Figure 6: Category-wise antibiotic consumption at NACNET sites



Antibiotic consumption by Route of administration

Antibiotic consumption is higher by oral route as compared to parenteral in fifteen sites. Three sites reported >80% consumption by parenteral route with one site reporting just 0.5 % consumption by oral route.

Figure 7: Antibiotic consumption by route of administration at NACNET sites



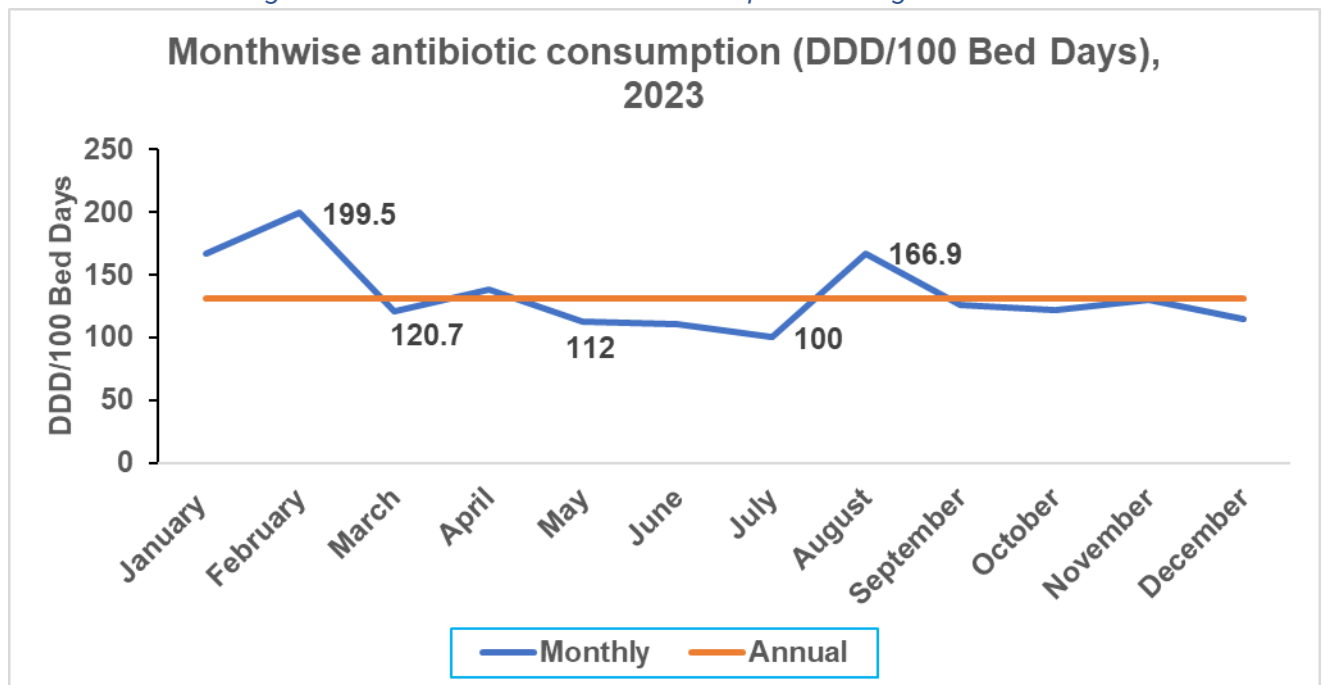
Consolidated antibiotic consumption

Consolidated antibiotic consumption of NACNET sites during 2023 is 131.3 DDD/100 Bed days. Antibiotic consumption from oral route is 89 DDD/100 Bed days and from parenteral route is 42.3 DDD/100 Bed days.

Month-wise antibiotic consumption

The trend shows that antibiotic consumption peaked during February and September months.

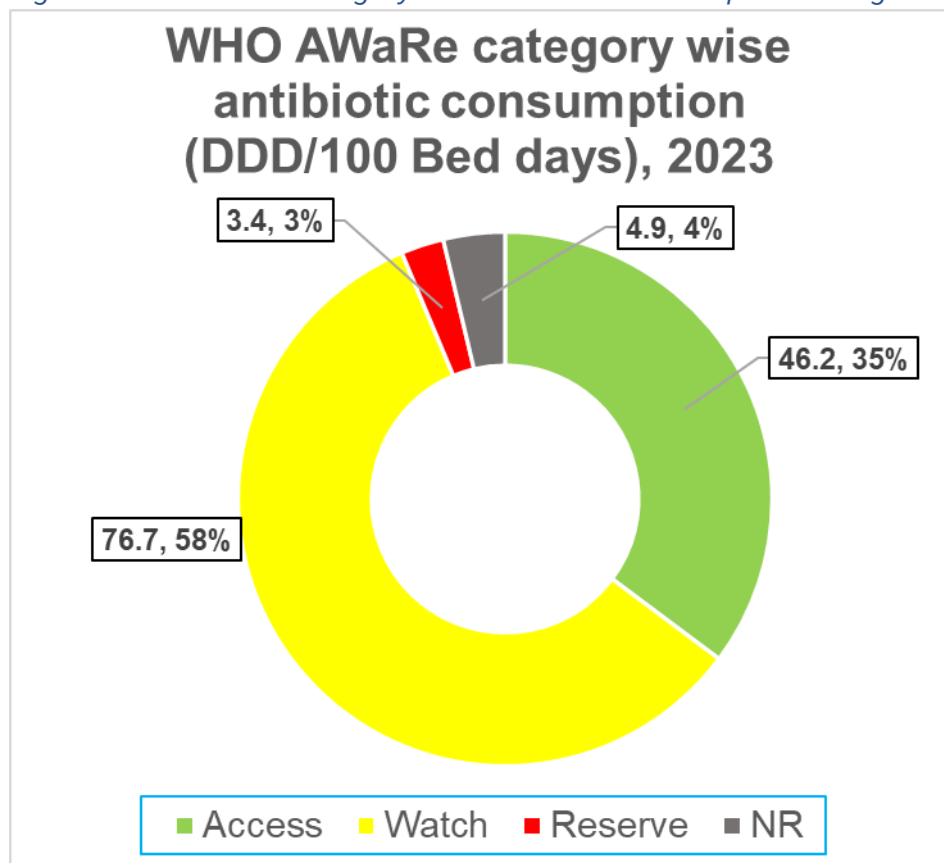
Figure 8: Month wise antibiotic consumption during 2023



AWaRe category-wise antibiotic consumption

Access category consumption has been recorded to be just 35% as against WHO's recommendation of 60% or above. Significant consumption has been observed from **Reserve** (3%) and **Not Recommended** (4%) category of antibiotics.

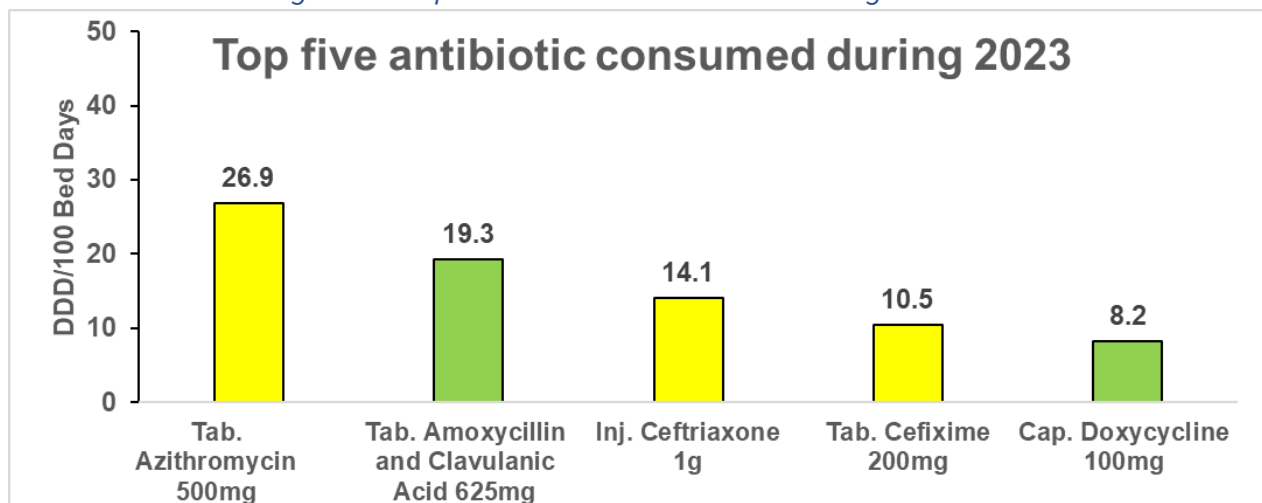
Figure 9: WHO AWaRe category- wise antibiotic consumption during 2023



Top five antibiotics consumed

Tablet Azithromycin 500mg (**Watch**), Tablet Amoxycillin and Clavulanic Acid 625mg (**Access**), Injection Ceftriaxone 1000mg (**Watch**), Tablet Cefixime 200mg (**Watch**) and Capsule Doxycycline 100mg (**Access**) were most commonly consumed antibiotics.

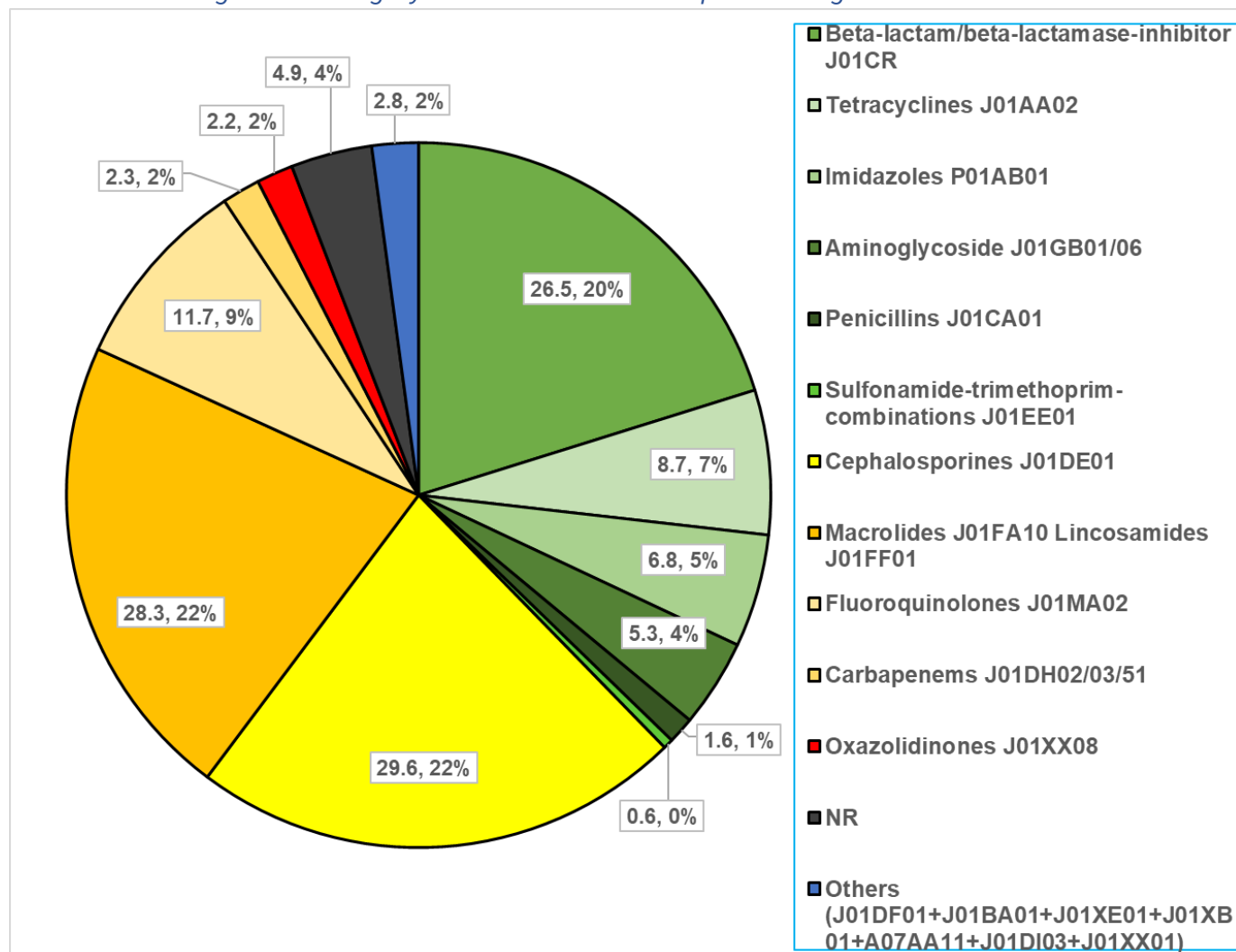
Figure 10: Top five antibiotics consumed during 2023



Category wise antibiotic consumption

Cephalosporins (**Watch**, 22%), Macrolides/Lincosamides (**Watch**, 22%) followed by Beta lactam/ beta lactamase inhibitors (**Access**, 20%) and Fluoroquinolones (**Watch**, 9%) are the most commonly consumed group of antibiotics. Oxazolidinones (**Reserve**) account for 2% consumption whereas consumption from WHO **Not Recommended** group of antibiotics is 4%.

Figure 11: Category-wise antibiotic consumption during 2023



Discussion

The surveillance conducted under the National Antimicrobial Consumption Network (NAC-NET) in 2023 revealed significant variations in antibiotic usage across the 29 participating tertiary care institutions with some institutions reporting exceptionally high usage rates.

An analysis based on the WHO's AWaRe classification raised several concerns. The "Access" category, which generally includes first-line treatments, displayed a wide range of usage, with consolidated consumption of only 35% ranging from 20% to 82% while the "Watch" category accounted for the majority of consumption in many institutions. The excessive reliance on "Watch" antibiotics, which are associated with a higher risk of resistance, highlights the need for improved antimicrobial stewardship. This doesn't fall in line with the WHO's recommendation of a country-level target of at least 60% of total antimicrobial consumption to be from the Access group of antimicrobials (8).

Reserve group antimicrobials should be treated as "last resort" options, however, the use of colistin, linezolid, and aztreonam in these sites is a matter of concern. One site has reported Linezolid among top 5 antibiotics consumed at the site. Use of last resort antimicrobials (Reserve group) such as colistin, linezolid and aztreonam was between 0-7% of overall consumption which raises concerns and hence requires strengthening of local antimicrobial stewardship practices in these sites. As the use of Reserve category antimicrobials is a last resort and hence it is imperative to keep the consumption of this group of antimicrobials to a minimum. It is also relevant to note that consumption data has been sourced from the pharmacy of the hospital and did not include any out-of-pocket purchase of antimicrobials by the patients. The use of "non-recommended (NR)" antibiotics (4%) ranged from 0-18% which is again a matter of concern. It is also relevant to note that consumption data has been sourced from the pharmacy of the hospital and did not include any out-of-pocket purchase of antimicrobials by the patients.

The top five antibiotics varied by institution, with azithromycin, amoxicillin and clavulanic acid and ceftriaxone being among the most commonly used. Additionally, some institutions reported bed occupancy rates exceeding 100%. However, for operational purposes, bed occupancy was considered as 100%, which may have contributed to increased antibiotic

consumption due to the higher patient load. Consumption by route of administration is variable across the sites.

Overall, the findings point to significant gaps in the rational use of antibiotics. The overuse of "Watch" antibiotics and the variability across sites suggest inconsistent implementation of antimicrobial stewardship programs (ASPs) and limited adherence to Standard Treatment guidelines. These challenges underline the urgent need for targeted interventions to optimize antibiotic use at all NAC-NET sites.

Limitation

The consumption data compiled in this report is from the hospital pharmacy which only caters to in-patients of the hospital. Any antimicrobials prescribed to the patients that were purchased from other sources is not included, including antimicrobials prescribed to outpatients.

Conclusion

Analysis of antimicrobial consumption across the the sites presents an interesting picture of the pattern and overall usage of antimicrobials. Linking consumption data with antimicrobial resistance will lead to a better understanding of the AMR issues in these facilities. Continued monitoring of the usage of Watch and Reserve category antimicrobials will support antimicrobial stewardship practices. Surveillance of antimicrobial consumption and use at the hospital level is an important tool in our fight against antimicrobial resistance.

Recommendations

- Strengthen Stewardship Programs:
 - Expand antimicrobial stewardship training at all NAC-NET sites, focusing on the judicious use of antibiotics and adherence to standard treatment guidelines.
- Data-Driven Interventions:
 - Use site-specific consumption data to identify and address inappropriate prescribing patterns.
- Promote "Access" Category Antibiotics:
 - Increase the use of "Access" antibiotics by improving awareness and availability, while reducing dependence on "Watch" and "Reserve" categories.
- Monitor and Evaluate:
 - Linking antimicrobial consumption with antimicrobial resistance data to guide antimicrobial stewardship activities.
 - Establish continuous monitoring mechanisms to evaluate the impact of interventions on antibiotic consumption and resistance trends.
- Policy Support:
 - Strengthen national policies to enforce compliance with ASPs and encourage hospitals to meet established benchmarks.

By implementing these measures, NAC-NET sites can optimize antibiotic use, reduce the emergence of resistance, and contribute to the broader goal of containing antimicrobial resistance in India. These actions will not only improve patient outcomes but also protect the effectiveness of antibiotics for future generations.

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