सत्यमेव जयते

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 2022

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

In India, National Centre for Disease Control (NCDC) serves as the Nodal agency for the National Programme on AMR Containment. 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 2022. The findings revealed significant variations in antibiotic use across 30 tertiary care institutions. Notably, there was high consumption of "Watch" antibiotics, which are linked to a greater risk of resistance, and low usage of "Access" antibiotics, which are recommended as first-line treatments. The use of "Access" antibiotics ranged from 21% to 72%, with only one site reporting >60% antibiotic consumption from "Access" category. There were also concerns about the use of "Reserve" antibiotics, intended for last-resort situations, including colistin, linezolid, and aztreonam. These accounted for 0-9 % of total consumption. Additionally, the use of non-recommended antibiotics (7%) raised alarms.

The top antibiotics consumed, varied by institution, with azithromycin, amoxicillin and clavulanic acid, and ceftriaxone being most common.

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

Background

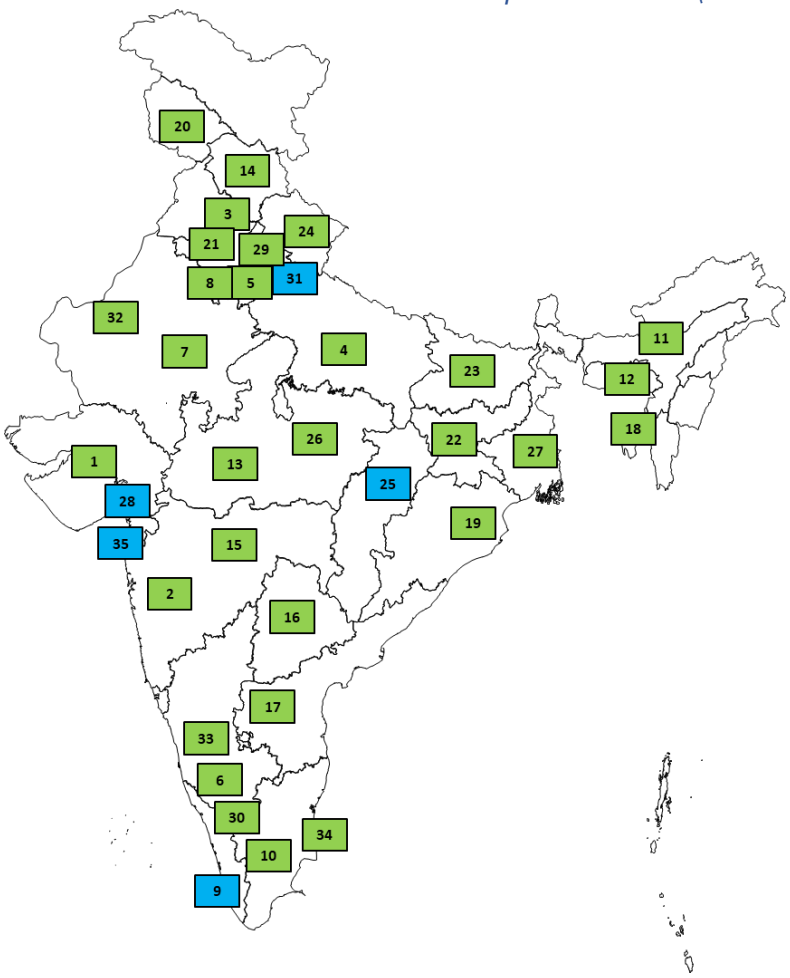
The growing threat of antibiotic resistance (AMR) poses a significant challenge to global public health. As bacteria evolve, antibiotics become less effective, making infections more difficult to treat. In 2019, an estimated 4.95 million deaths were linked to bacterial AMR, with 1.27 million deaths directly attributed to antibiotic resistance (1). South Asian region is projected to have one of the highest all-age AMR mortality rates in 2050 (2). A key factor driving AMR is the overuse of antibiotics in humans, with studies highlighting the inappropriate use of antibiotics, particularly in hospital settings (3-5).

The National Centre for Disease Control (NCDC) in New Delhi serves as the nodal agency for the National Programme on AMR Containment, which promotes rational antibiotic use. A key focus of this program is conducting surveillance on antibiotic use in healthcare settings across India. As part of the AMR initiative, the National Antibiotic Consumption Network (NAC-NET) was established across 24 states and 3 union territories (UTs) in a phased approach, involving government tertiary healthcare facilities (Fig. 1).

The 2015 global surveillance report, covering 65 countries, did not include data on antibiotic consumption in India. Limited research has been conducted on antibiotic consumption in India using the WHO's AWaRe (Access, Watch, and Reserve) classification and Defined Daily Doses (DDD) system (6). This report aims to address that gap by presenting a detailed analysis of antibiotic consumption data gathered from 30 NAC-NET sites in 2022. The analysis follows the WHO’s Anatomical Therapeutic Chemical (ATC) classification and the DDD system. Antibiotic consumption data can be used to (7):

- Identify and detect changes in antibiotic use and exposure;
- Develop interventions to address identified issues;
- Monitor the effectiveness of these interventions;
- Ensure adherence to appropriate prescribing guidelines; and
- Raise awareness about the harmful effects of improper antibiotic use.

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



	Phase I sites		Phase II sites		Phase III sites
1	BJMC, Ahmedabad	9	GMC, Trivandrum	15	GMC, Aurangabad
2	BJMC, Pune	10	KAPVGMC, Trichy	16	OMC, Hyderabad
3	GMC, Chandigarh	11	GMC, Guwahati	17	GMC, Guntur
4	GMC, Kanpur	12	NEIGRIHMS, Shillong	18	GMC, Agartala
5	LHMC, Delhi	13	MHMMC, Indore	19	SCBMC&H, Cuttack
6	MMC & RI, Mysore	14	IGMC, Shimla	20	GMC& H, Jammu
7	SMSMC, Jaipur				
8	VMMC, Delhi				

	Phase IV sites		Phase V sites		Phase VI sites
21	PGIMS, Rohtak	26	GMC, Bhopal	30	CMCH, Coimbatore
22	RIMS, Ranchi	27	CSTM, Kolkata	31	MAMC, Delhi
23	IGIMS, Patna	28	GMERSMC&H, Valsad	32	SPMC, Bikaner
24	GMC, Haldwani	29	LLRMMC, Meerut	33	KIMS, Hubballi
25	JLNMMC, Raipur			34	IGMC&RI, Puducherry
				35	NAMOMERI, Silvassa

** Antibiotic consumption data from thirty 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 2022. A total of 30 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

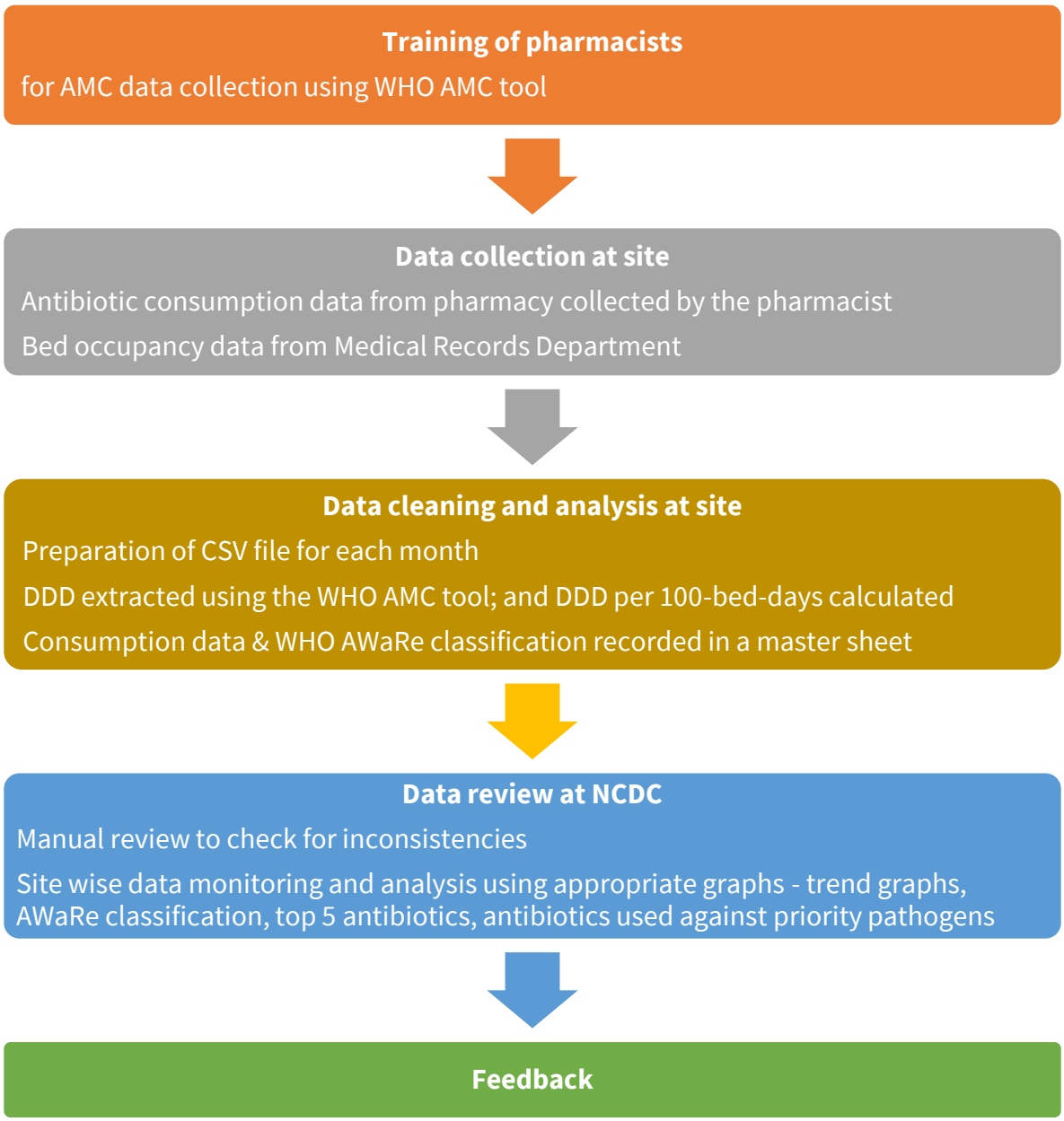
Exclusion criteria

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

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 – Bed occupancy rate / Bed days = Occupied beds / 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 30 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 30 NAC-NET sites for the year 2022. 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	97%	1200
2	Site 2	61%	2300
3	Site 3	71%	2080
4	Site 4	97%	750
5	Site 5	55%	605
6	Site 6	61%	782
7	Site 7	100%	2496
8	Site 8	100%	1055
9	Site 9	55.8%	877
10	Site 10	100%	1167
11	Site 11	100%	1267
12	Site 12	100%	1513
13	Site 13	90%	800
14	Site 14	100%	2304
15	Site 15	64%	1665
16	Site 16	100%	2405
17	Site 17	70%	2171
18	Site 18	40%	695
19	Site 19	19%	2461
20	Site 20	82%	3677
21	Site 21	130%	733
22	Site 22	97%	1603
23	Site 23	80%	925
24	Site 24	69.4%	1000
25	Site 25	83%	1196
26	Site 26	100%	162
27	Site 27	61%	1050
28	Site 28	100%	2518
29	Site 29	64%	3200
30	Site 30	76%	2316
Total Beds			**46973**

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

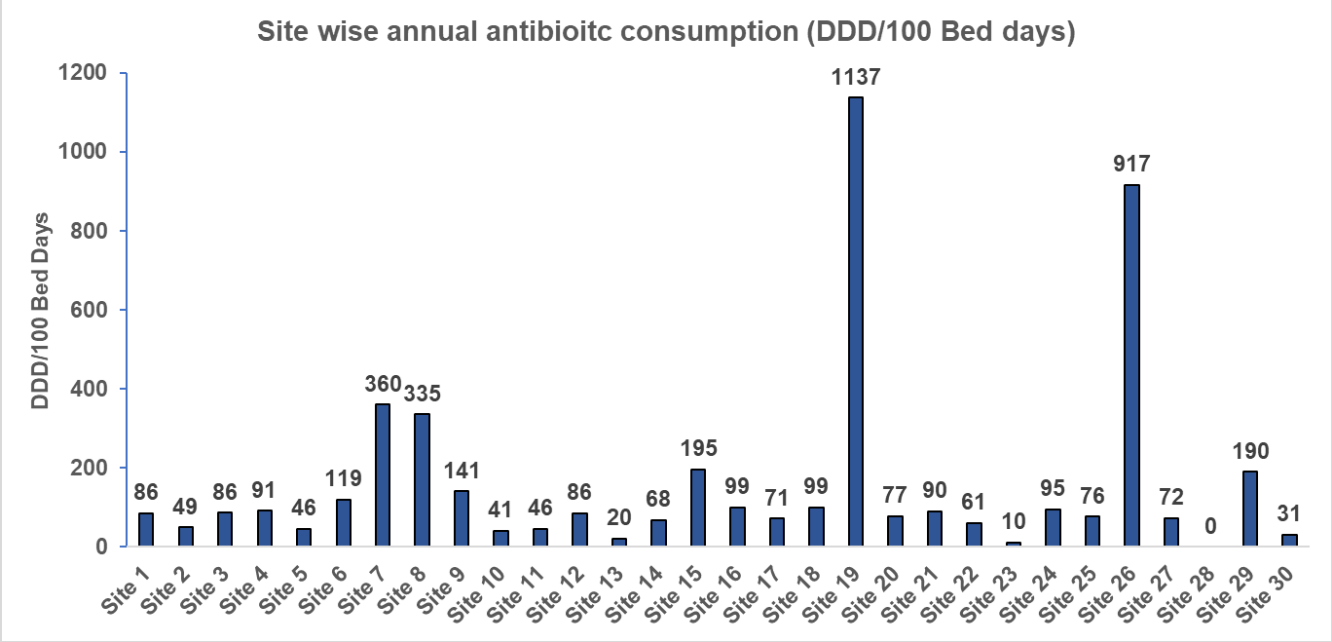
Bed strength of the sites ranged from 162 to 3667 and bed occupancy ranged from 55.8% to 130%. For operational reasons, maximum bed occupancy has been taken as 100%.

Site-wise antibiotic consumption of NACNET sites

Annual antibiotic consumption

Annual antibiotic consumption of NACNET sites ranged from 10 DDD/100 Bed days to 1137 DDD/100 Bed days. Majority of the sites have reported antibiotic consumption below 500 DDD/100 Bed days with twenty-three sites reporting consumption below 100 DDD/100 Bed days.

Figure 3: Annual antibiotic consumption of NACNET sites



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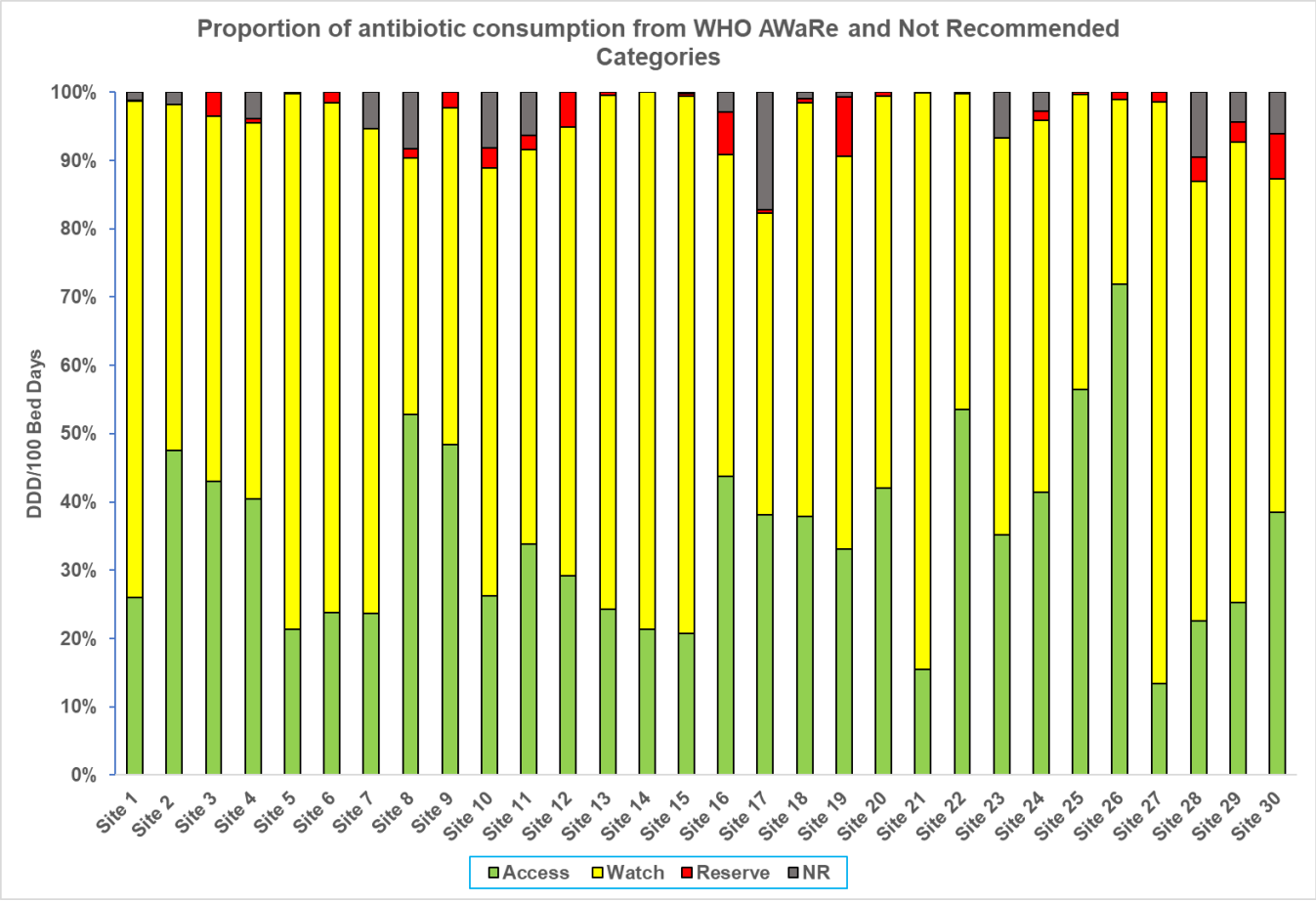
AWaRe category-wise antibiotic consumption

Only four sites (site 26:71%, site 25: 56%, site 22: 54% site 8: 53%) have reported majority of antibiotic consumption from **Access** category rest all sites have reported maximum antibiotic consumption from **Watch** category with three sites reporting >80% consumption from this category. Three sites have reported >5% antibiotic consumption from **Reserve** category of antibiotics. Four sites have reported >5% antibiotic consumption from WHO **Not Recommended** (NR) category of antibiotic of which one site has reported 17% antibiotic consumption from NR category.

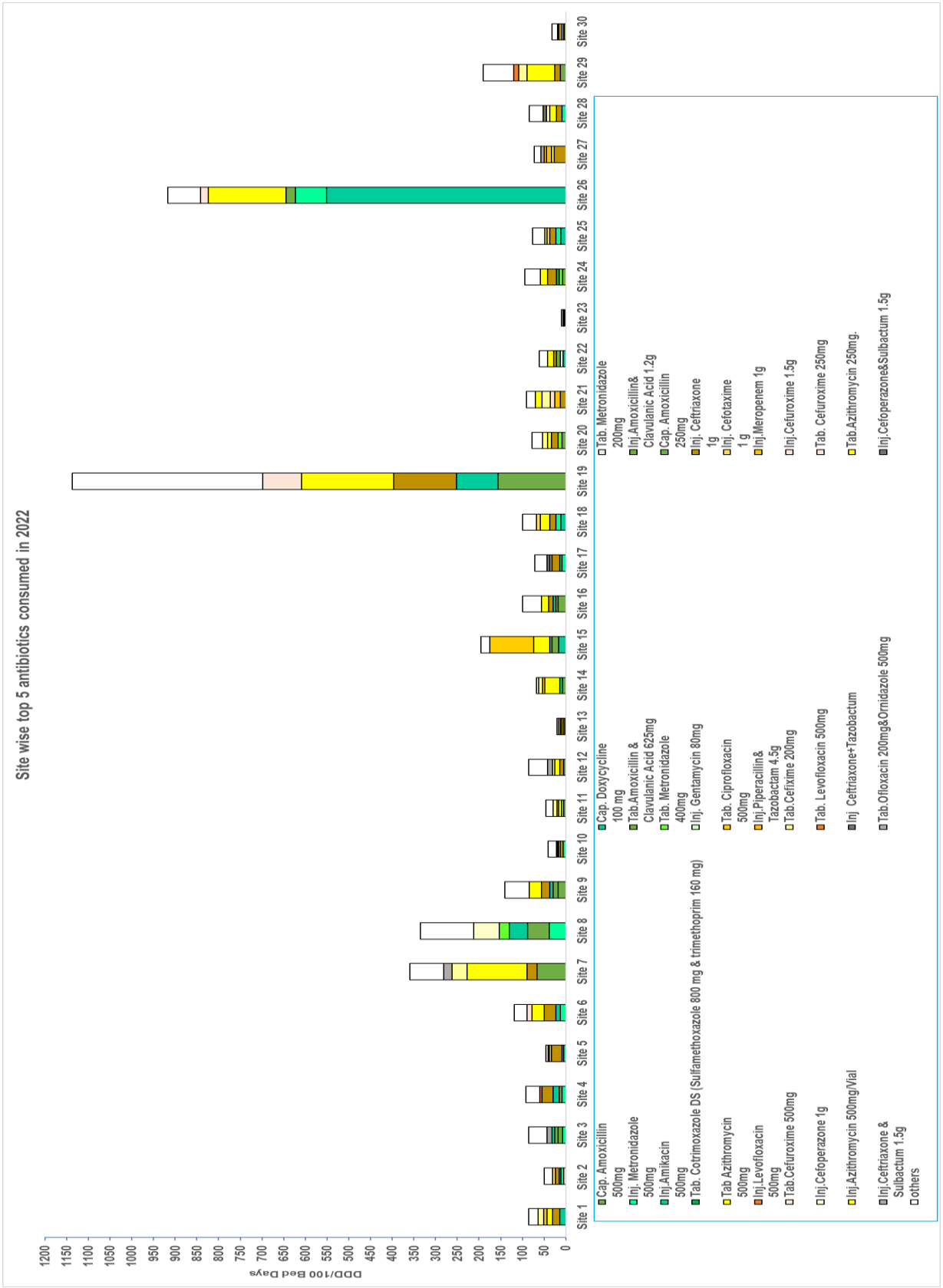
Figure 4: WHO AWaRe category wise antibiotic consumption of NACNET sites



Top five antibiotics consumed

Tablet Azithromycin 500mg **(Watch)**, Capsule Doxycycline 100mg **(Access)**, Injection Ceftriaxone 1g **(Watch)**, Tablet Amoxycillin and Clavulanic Acid 625mg **(Access)** and Injection Amikacin 500mg **(Access)** were most commonly consumed antibiotics. Six sites have reported consumption of Injection Cefoperazone & Sulbactum 1.5g **(NR)**, Tablet Ofloxacin 200mg & Ornidazole 500mg **(NR)**, Injection Ceftriaxone & Tazobactam 1.125g **(NR)** and Injection Ceftriaxone & Sulbactum 1.5g **(NR)** amongst top five antibiotics consumed at the site.

Figure 5: Top five antibiotics consumed at NACNET sites



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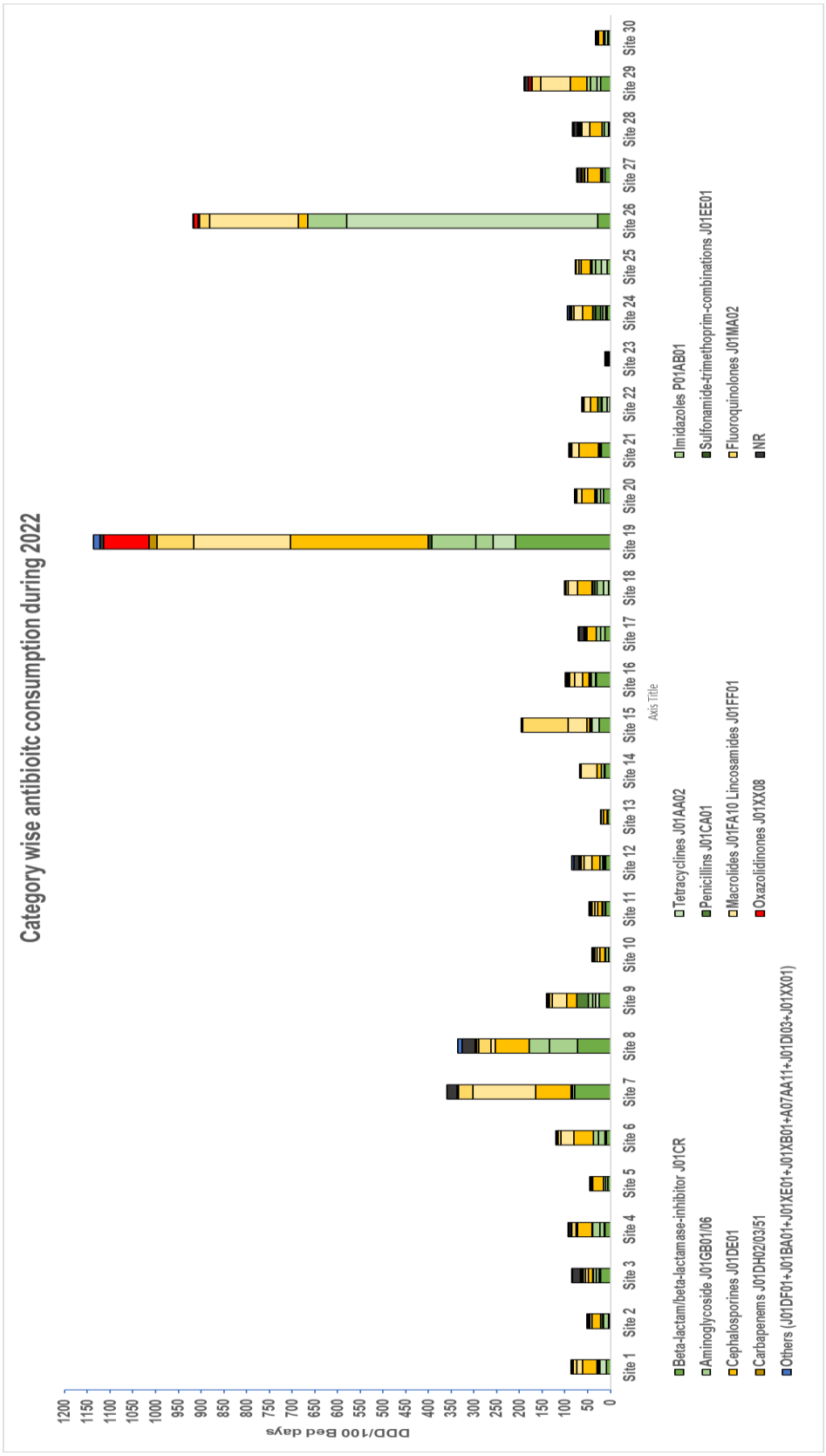
Category wise antibiotic consumption

Cephalosporins (**Watch**), Macrolides/Lincosamides (**Watch**), followed by Tetracyclines (**Access**) and Beta lactam/ beta lactamase inhibitors (**Access**) and Fluoroquinolones (**Watch**) are the most commonly consumed group of antibiotics. Four sites have shown noticeable consumption from Oxazolidinones (**Reserve**) and fourteen sites have shown significant consumption from WHO **Not Recommended** group of antibiotics with four sites having >10% antibiotic consumption from NR group.

Figure 6: Category-wise antibiotic consumption at NACNET sites



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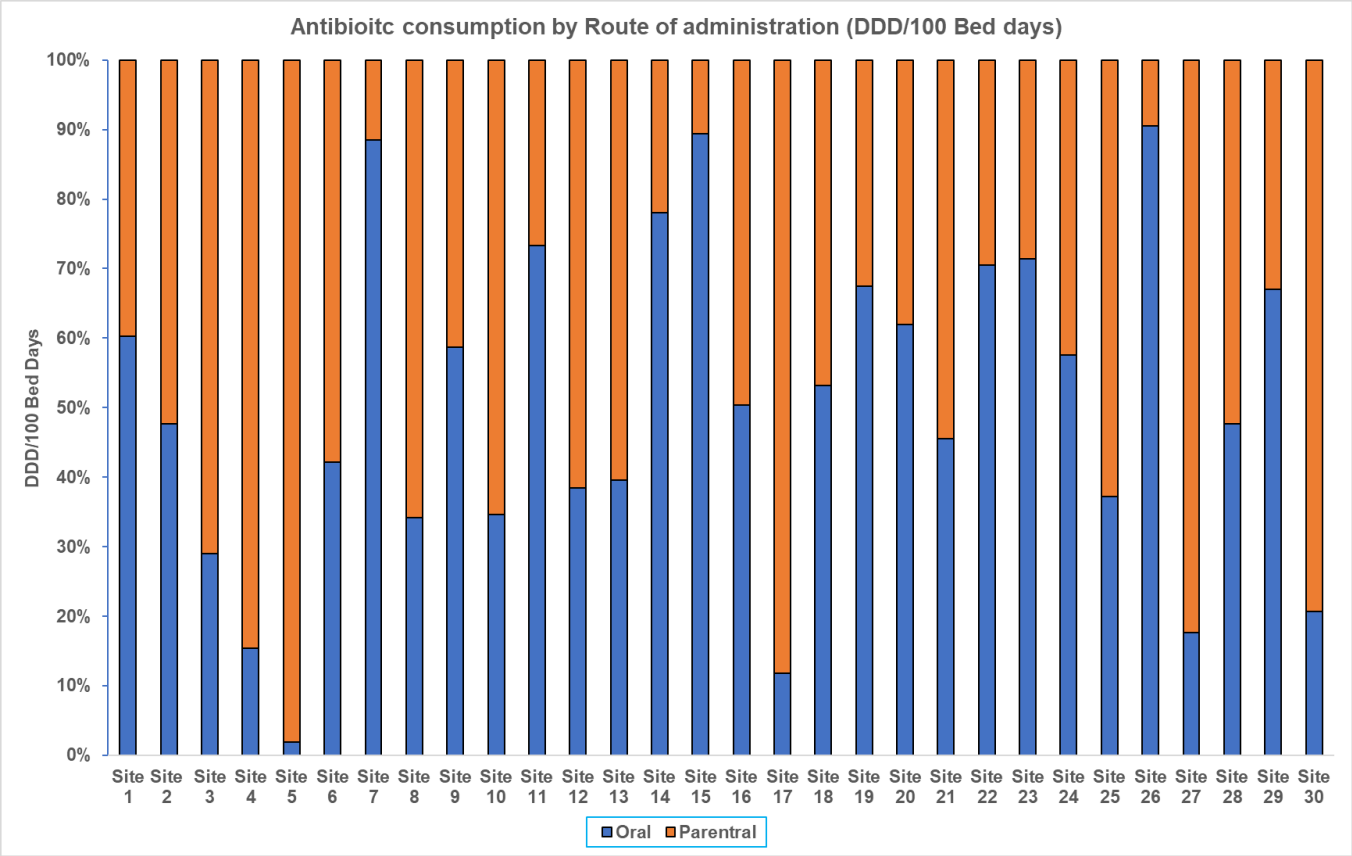
Antibiotic consumption by Route of administration

Antibiotic consumption is higher by oral route as compared to parenteral in fifteen sites. Five sites reported >80% consumption by parenteral route with one site reporting just 1.8% consumption by oral route.

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



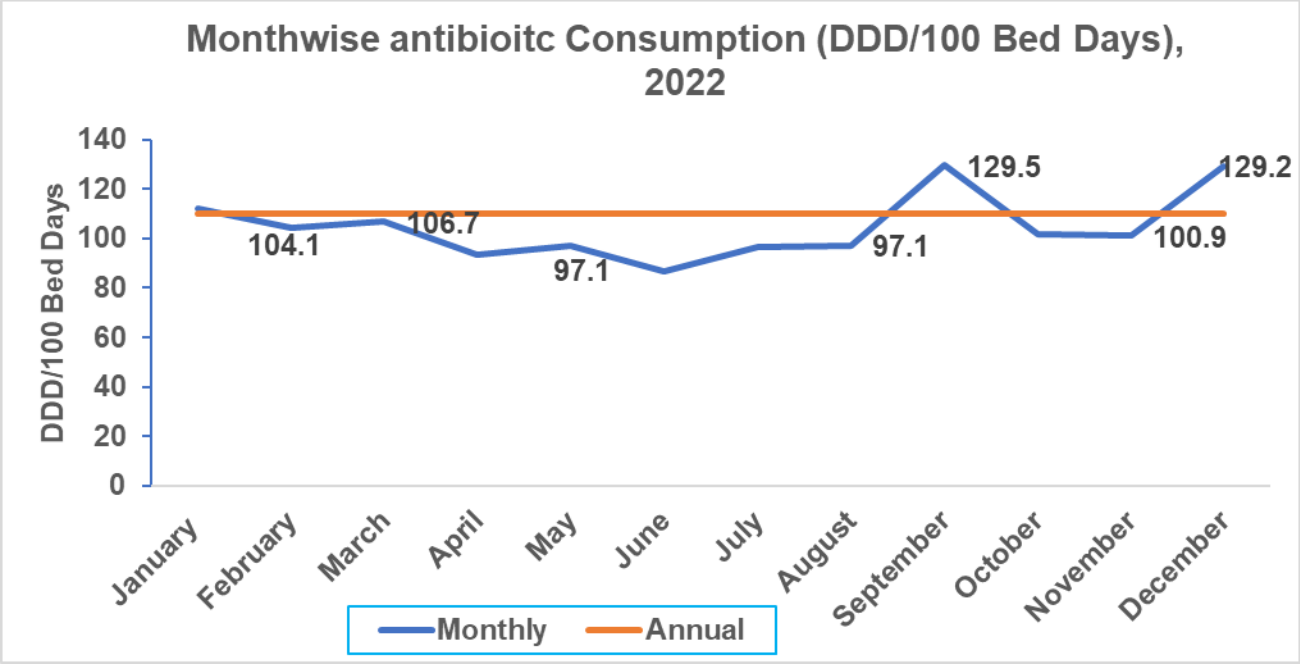
Consolidated antibiotic consumption

Consolidated antibiotic consumption of NACNET sites during 2022 is 110 DDD/100 Bed days. Antibiotic consumption from oral route is 66 DDD/100 Bed days and from parenteral route is 44 DDD/100 Bed days.

Month-wise antibiotic consumption

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

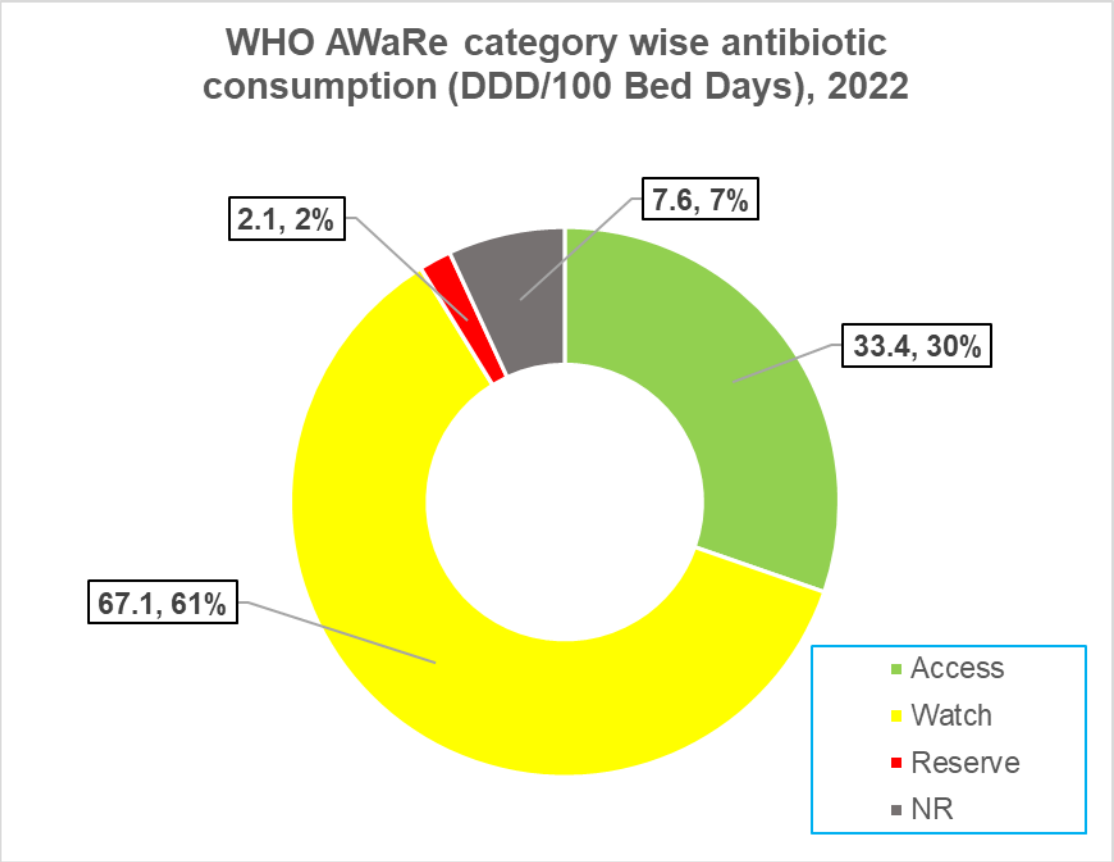
Figure 8: Month wise antibiotic consumption during 2022



AWaRe category-wise antibiotic consumption

Access category consumption has been recorded to be just 33% as against WHO's recommendation of 60% or above at country-level. Noticeable consumption has been observed from **Reserve** (2%) and **Not Recommended** (7%) category of antibiotics.

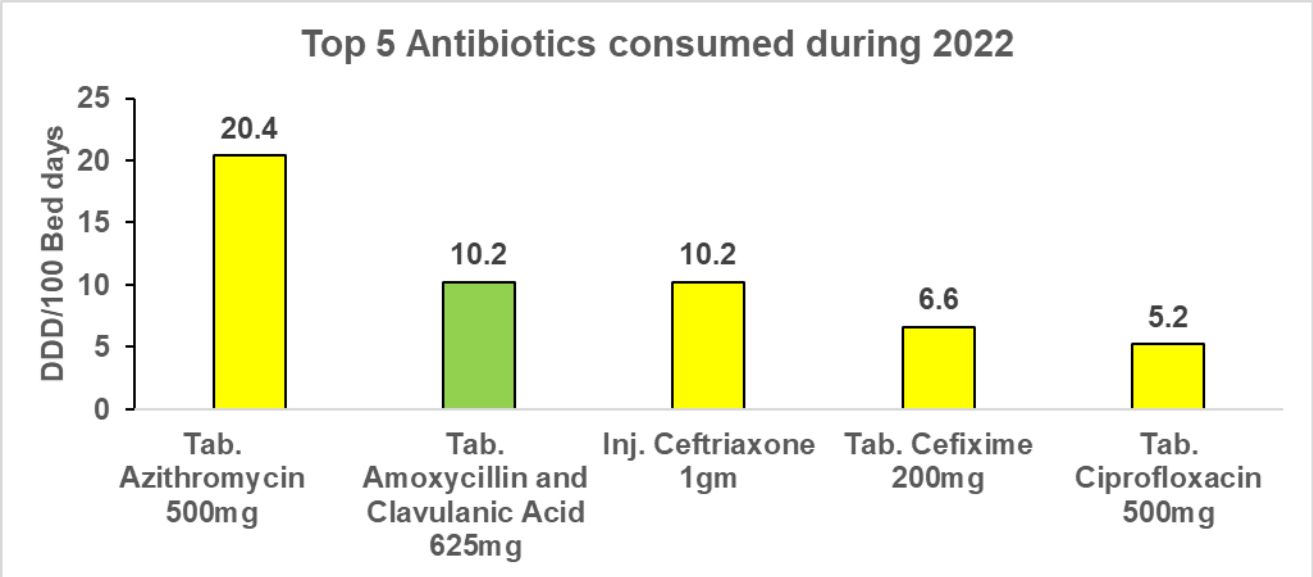
Figure 9: WHO AWaRe category- wise antibiotic consumption during 2022



Top five antibiotics consumed

Tablet Azithromycin 500mg **(Watch)**, Tablet Amoxycillin and Clavulanic Acid 625mg **(Access)**, Injection Ceftriaxone 1g **(Watch)**, Tablet Cefixime 200mg **(Watch)** and Tablet Ciprofloxacin 500mg **(Watch)** were most commonly consumed antibiotics.

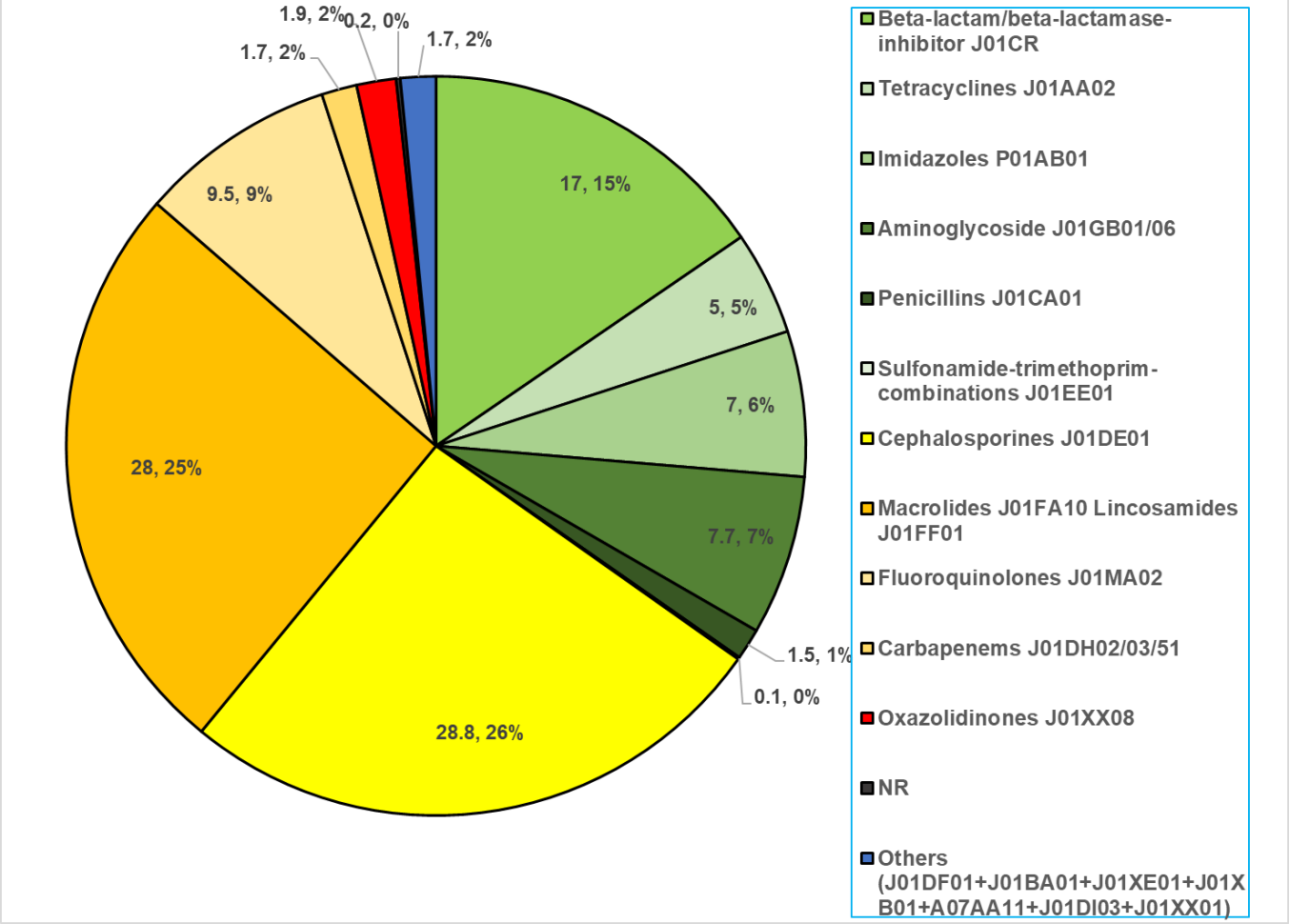
Figure 10: Top five antibiotics consumed during 2022



Category wise antibiotic consumption

Cephalosporins (**Watch**, 26%), Macrolides/Lincosamides (**Watch**, 25%) followed by Beta lactam/ beta lactamase inhibitors (**Access**, 15%) 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 0.2%.

Figure 11: Category-wise antibiotic consumption during 2022



Discussion

The 2022 surveillance conducted under the National Antimicrobial Consumption Network (NAC-NET) highlighted considerable variations in antibiotic usage across 30 participating tertiary care institutions, with some institutions reporting particularly high consumption rates. An analysis based on the WHO's AWaRe classification identified several concerns. The "Access" category, which includes first-line treatments, showed significant variation in usage, with overall consumption only reaching 30%, ranging from 21% to 72%. In contrast, the "Watch" category accounted for the majority of consumption in many institutions. The over-reliance on "Watch" antibiotics, which are linked to a higher risk of resistance, emphasizes the need for improved antimicrobial stewardship. This pattern does not align with the WHO's recommendation that at least 60% of total antimicrobial consumption should come from the Access category.

The use of Reserve group antimicrobials, intended for "last resort" situations, also raised concerns. The consumption of Reserve antimicrobials ranged from 0-9 % of total usage, indicating a need to strengthen local antimicrobial stewardship practices. Since Reserve antimicrobials are meant to be used sparingly, their consumption should be minimized. It's important to note that the data on consumption was sourced from hospital pharmacies and did not account for antibiotics purchased out-of-pocket by patients. The use of "non-recommended" antibiotics (7%), which ranged from 0-17%, also raises concern.

The top five most commonly used antibiotics varied across institutions, with azithromycin, amoxicillin and clavulanic acid, and ceftriaxone frequently appearing on the list. Some institutions also reported bed occupancy rates exceeding 100%. For operational purposes, bed occupancy was recorded as 100%, which may have contributed to increased antibiotic consumption due to higher patient loads. Consumption by route of administration is variable across the sites.

Overall, the findings reveal significant gaps in the rational use of antibiotics. The overuse of "Watch" antibiotics and the variability in practices across sites suggest inconsistent

implementation of antimicrobial stewardship programs (ASPs) and limited adherence to Standard Treatment Guidelines. These challenges highlight the urgent need for targeted interventions to optimize antibiotic use across 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

The analysis of antimicrobial consumption across the sites provides valuable insights into usage patterns and overall trends. By linking consumption data with antimicrobial resistance, we can gain a deeper understanding of AMR issues within these facilities. Ongoing monitoring of the use of "Watch" and "Reserve" category antimicrobials will be crucial in supporting effective antimicrobial stewardship practices. Surveillance of antimicrobial consumption at the hospital level is an essential tool in the ongoing battle against antimicrobial resistance.

Recommendations

- Strengthen Stewardship Programs:
    - Expand antimicrobial stewardship training at all NAC-NET sites, emphasizing the responsible use of antibiotics and adherence to standard treatment guidelines.
- Data-Driven Interventions:
    - Utilize site-specific consumption data to identify and address inappropriate prescribing patterns.
- Promote "Access" Category Antibiotics:
    - Increase the use of "Access" antibiotics by enhancing awareness and availability, while reducing reliance on "Watch" and "Reserve" categories.
- Monitor and Evaluate:
    - Link antimicrobial consumption data with antimicrobial resistance trends to inform and guide stewardship efforts
    - Implement continuous monitoring mechanisms to assess the impact of interventions on antibiotic use and resistance patterns.
- Policy Support:
    - Strengthen national policies to enforce adherence to antimicrobial stewardship programs (ASPs) and encourage hospitals to meet established benchmarks.

By implementing these strategies, NAC-NET sites can optimize antibiotic usage, minimize resistance development, and contribute to the national effort to contain antimicrobial resistance in India. These measures will improve patient outcomes and help preserve the effectiveness of antibiotics for future generations.

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List of Contributors

Dr. Arti Bahl, Addl. Director & HOD DPD Division
Dr. Suneet Kaur, Joint Director Epidemiology Division
Mr. Baheed Ahmad, Pharmacist
Ms. Iram Naaz, Assistant

Acknowledgments

NCDC warmly thank all the Nodal Officers and Pharmacists at NACNET sites for collecting and sharing their data on antimicrobial consumption.

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