ORIGINAL ARTICLE

Investigating the Variability among Indicators for Quantifying Antimicrobial Use in the Intensive Care Units: Analysis of Real-world Evidence

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Abstract

This study investigated variability among four indicators for quantifying antimicrobial use in intensive care units (ICUs): defined daily doses (DDD), prescribed daily doses (PDD), duration of therapy (DOT), and length of therapy (LOT) and recommended the most clinically relevant approach. Retrospective data from patients who had received at least one antimicrobial was analyzed. Patients whose records were incomplete or expired were excluded. Duration of therapy (24433/1000 PDs) and LOTs (12832/1000 PDs) underestimated the overall consumption of antimicrobials compared with DDD of 28391/1000 PDs. Whereas PDD (46699/1000 PDs) overestimated it. Comparison analysis detected % differences of 13.94, 23.92, and 54.80% between DDD and DOT, DDD and PDD, and DDD and LOT, indicators respectively. Linear regression revealed stronger (r^2 = 0.86), moderate (r^2 = 0.50), and moderate (r^2 =0.60) correlation between DDD and DOT, DDD and PDD and DDD and LOT indicators respectively. According to findings, combining DOT and DDD is a more practical method to quantify antimicrobial consumption in hospital ICUs.

Keywords: Antimicrobial use, Days of therapy, Defined daily dose, Length of therapy, Prescribed daily dose, Real-world evidence.

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Highlights

- This article used real-world data available from a cohort of hospitalized patients and brought together all four commonly used quantifying indicators of antimicrobial use [defined daily doses (DDD), prescribed daily doses (PDD), duration of therapy (DOT), length of therapy (LOT)], on a centralized platform to investigate the variability between them.
- Higher correlation strengths were observed between DDD and DOT in comparison to correlations between DDD and PDD and DDD and LOT. The summary of subgroup analysis also provides the source of heterogeneity in the methodologies of these four indicators.
- This study recommends the combination of DDD and DOT as a more appropriate approach for precise quantification of antimicrobial consumption in the intensive care units (ICUs) of the hospital.

Introduction

Ensuring the proper utilization of antimicrobial agents is paramount for patient care, especially given the rising challenges of drug resistance and the decreasing number of new antibiotics in drug research and development pipelines.[1] Further, antimicrobial use is progressively being identified as a significant selective pressure driving the drug resistance.[2–4] Therefore, antimicrobial stewardship necessitates tracking the quantity of antimicrobials used in hospitals. The first step in control and improvement of antibiotic use is to quantify the amount of antibiotics being used.[5] Metrics of quantity may indicate the number of antibiotics used, and standardizing the quantification of antibiotics is the only way to compare antibiotic consumption accurately.[6]

The World Health Organization (WHO) Collaborating Center for Drug Statistics and Methodology advocates for employing the metric of DDD per 1,000 patient days as the standard method for measuring antibiotic usage, which is widely accepted for quantifying antimicrobial consumption. The DDD represents a standardized unit of measurement equivalent to the average adult maintenance dose per day.[7] The metric of DDD per 1,000 patient days provides insight into the rate of prescriptions per 1,000 patients and serves as a valuable benchmark for comparing antibiotic utilization across different countries or regions.[8]

The other approaches, other than the DDD are PDD, DOT, and LOT. The only exception to LOT, all three can be used to compare individual-level consumption of antimicrobials.[9]

The average dose prescribed based on a representative sample of prescriptions is illustrated by quantification in the prescribed daily dose. Prescription, medical, or pharmacy records can be used to determine the PDD, and it is essential to link it to the drug's diagnosis.[10] Conversely, a DOT unit is defined as one day during which a patient receives a drug, irrespective of the dose. Additionally, DOT measurements offer a value that is comparable to adult

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antibiotic use, more applicable across various populations, and less influenced by dosing variations.[5,10] The DDDs have been reported to have a tenuous relationship with the treatment that patients actually receive, whereas it is missing with the metric DOTs.[11]

Length of therapy represents the total number of days a patient receives any antimicrobial agent, regardless of the number of different antibiotics used. Duration of therapy or LOT serves as a crucial metric for disease-specific therapy because it considers longer dosing intervals. Length of therapy are inversely related to antimicrobial-free days, which addresses a spectrum of therapy, monotherapy vs duo therapy, and whether patients are receiving antimicrobials or not.[10,11]

The "best" method among the quantity metrics for quantifying antibiotic use is still a question that has not yet been answered. This study is an attempt to answer this question, how do four metrics, DDD, PDD, DOT, and LOT vary from each other for the purpose of quantification of antimicrobial consumption? Additionally, an attempt is made not only to determine the variation that exists among these indicators but also what is the extent of this variation. In light of this, this study aimed to investigate the variability among metrics, DDD, PDD, DOT, and LOT for quantifying the antimicrobial use in the ICUs of a private tertiary care hospital and recommend the best approach for quantification of antimicrobial use.

Materials and Methods

Study Design

A retrospective study was conducted using the real-world data in the ICUs of a private tertiary care hospital.

Setting

Five ICUs of the hospital were included in the study: Cardiac care unit (CCU), surgical pulmonary intensive care unit-1 (SPICU-1), surgical pulmonary intensive care unit-2 (SPICU-2), surgical intensive care unit (SICU), and medical intensive care unit (MICU). The ICUs collectively comprised a total of 190 beds.

Study Participants

The data of inpatients, admitted to the five selected ICUs of either gender and aged over 18 years who received at least one antimicrobial was included in the study. Patients with incomplete medical records, who were not followed up to discharge or expired during the course of treatment were excluded from this study.

Data Source and Type

Retrospective data obtained from a tertiary care hospital was used for this study. Patient information was recorded on a predesigned data collection form. The data recorded for the study included demographic information, disease, co-morbidities, duration of therapy, prescribed medication, date of admission and discharge, length of stay, immunocompromised, and surgical notes. All the collected data were completely anonymized and no unique identifiers were recorded. Antimicrobials were categorized according to the World Health Organization's Anatomical Therapeutic Chemical (WHO-ATC) classification system.[12]

Primary Analysis

A total of five measures were used for the estimation of the use of antimicrobial agents. These five measures were percentage consumption, DDD, PDD, DOT, and LOT. Except for percentage consumption, all were normalized by 1,000 patient days (PDs) to express the use of antimicrobials in aggregated form.

$$\text{DDD per 1,000 patient days} = (\text{Total DDD}/\text{Total Patient Days}) \times 1{,}000$$

The total sum was divided by a denominator and the total number of patient days. Patient days were computed by tallying the number of patients present for any portion of each day, encompassing admission, and discharge days, within a calendar month in a particular ICU.

Secondary Analysis

Comparison between the metrics of quantification of antimicrobials was performed using the following secondary outcomes: 1. Between DDD and PDD: (a) The ratio of total PDD and DDD (sum PDD/sum DDD), (b) Percentage difference [(PDD-DDD)/PDDx100]; 2. Between DDD and DOT: (a) Ratio of total DDD and DOT (sum DDD/sum DOT), (b) Percentage difference [(DDD-DOT)/DDDx100]; 3. Between DDD and LOT: (a) Ratio of total DOT and LOT (sum DOT/sum LOT), (b) Percentage difference [(DDD-LOT)/DDDx100].

Additionally, in conducting a comparative analysis between DDD and DOT per 1000 PDs, the extent of variability was categorized into three groups: "significant" (exceeding a 25% difference), "moderate" (between a 5% and 25% difference), and "minor" (less than a 5% difference).[13]

Statistical Analysis

Descriptive analysis was performed for primary and secondary outcomes and represented by the percentage, mean with standard error mean, median, and interquartile range (IQR). In subgroup analysis, demographic variables and methods of antimicrobial consumption estimation were compared using Student's t-test and one-way ANOVA. The association between metrics used for estimating antimicrobial consumption was determined by performing linear regression. Additionally, the correlations were categorized as follows: "weak" for r^2-values less than 0.30, "moderate" for r^2-values between 0.30 and 0.70, and "strong" for r^2-values greater than 0.70. A significance threshold of $p < 0.05$ was employed to determine statistical significance. Statistical analyses were conducted using SPSS version 28.0 (IBM Corp, Armonk, NY) for all computations.

Results

The retrospective data of a total of 2,377 patients from the ICUs of a private tertiary care hospital were used for this study. Only 2,352 patients met the inclusion and exclusion criteria; and the data of the remaining 25 patients were excluded. Therefore, the results of this study are based on the data of 2,352 patients.

Baseline Characteristics

Out of the total, 960 individuals (40.8%) were male, and 1,392 (59.2%) were female. The average age of all patients was 43.01 ± 0.39 years. Moreover, there was no statistically significant distinction observed between the mean ages of males (43.20 ± 0.21 years) and females (42.34 ± 0.36 years). The mean duration of hospitalization was 5.21 ± 2.01 days. The baseline characteristics of the population are represented in the following Table 1.

Table 1: Baseline characteristics of population

#	*Parameter*	*Values*	*%*
1	Total (*N*)	2,352	100
2	Age (Mean)	43.01 ± 0.391	
	Male mean age	43.20 ± 0.21	
	Female mean age	42.34 ± 0.36	
3	Gender, *N* (%)		
	Male	960	40.81
	Female	1,392	59.22
4	Age distribution, *N* (%)		
	<30 years	863	36.7
	≥30–59 years	897	38.2
	≥ 60 years	592	25.1
5	Number of drugs prescribed, Mean	13 ± 0.25	
6	Number of AMD prescribed, Mean	3 ± 0.21	
7	Length of hospital stay, mean	5 ± 0.001	
8	Comorbidity, *N* (%)		
	Present	1,652	70.24
	Absent	686	29.17
	HTN	243	10.33
	DM	265	11.27
	Renal impairment	381	16.20
	Hypothyroidism	377	16.03
	Asthma/COPD	385	16.37
	Parkinson	413	17.56
	Epilepsy	411	17.47
	Hyperlipidemia/Dyslipidemia	413	17.56
	BPH	404	17.18
	CAD	404	17.18
	CVA	410	17.43
	Others	396	16.84
9	Multiple co-morbidities		
	One	708	30.10
	Two	649	27.59
	Three	254	10.80
	Four	53	2.25
	Five	18	0.77
10	Surgery		
	Yes	1,201	51.06
	No	1,152	48.98
11	Number of patient admitted to ICU		
	CCU	711	30.23
	MICU	715	30.40
	SICU	427	18.15
	SPICU-1	353	15.01
	SPICU-2	147	6.25
12	Specialty		
	Gastroenterology	153	6.51
	Cardiology	807	34.31
	CVTS	243	10.33
	General surgery	333	14.16
	Gynecology	38	1.62
	Nephrology	83	3.53
	Neurology	15	0.64
	Oncology	76	3.23
	Orthopedic	153	6.51
	Pulmonology	167	7.10
	Urology	112	4.76
	Endocrinology	64	2.72
	Others	10	0.43
	Internal medicine	99	4.21
13	Immunocompromised		
	No	744	31.63
	Yes	1,609	68.41

Table 2: Antimicrobial consumption expressed in (a) defined daily dose (DDD), (b) days of therapy (DOT), (c) prescribed daily dose (PDD) and (d) length of therapy (LOT) per 1000 patient days

Average consumption			
#	*Outcomes*	*Value (Average ± SEM)*	*t-value*
1	Grams per day	4.37 ± 0.08	7.61 ($p < 0.001$)
2	Defined daily dose	12.30 ± 0.27	23.18 ($p < 0.001$)
3	Prescribed daily dose	20.00 ± 0.66	10.97 ($p < 0.001$)
4	Days of therapy	12.00 ± 0.24	5.65 ($p < 0.001$)
5	Length of therapy	5.00 ± 0.07	4.32 ($p = 0.16$)
Total sum consumption			
#	*Outcomes*	*Value*	
1	Defined daily dose	28,391 DDD/1,000 patient days	
2	Prescribed daily dose	46699 PDD/1,000 patient days	
3	Days of therapy	24433 DOT/1,000 patient days	
4	Length of therapy	1283 LOT/1,000 patient days	

Average and Sum Consumption

The overall estimated average consumption of 7,731 antimicrobials in the population of 2,352 patients was 4.37 ± 0.08 gm/day. When expressed in the DDD, PDD, DOT, and LOT, it was found to be 12.30 ± 0.27, 20.00 ± 0.6, 12 ± 0.24, and 5 ± 0.07, respectively.

On the evaluation of total sum consumption, it was observed that DOT (24,433 DOT/1,000 patient days) and LOT (1,283/1,000 patient days) underestimated the total consumption in comparison to DDD (28,391 DDD/1,000 patient days) as illustrated in Table 2. In contrast, the PDD method (46,699 PDD/1,000 patient days) overestimated the total consumption of antimicrobials. The brief sum consumption is represented in the Supplementary file S1.

Subgroup Analysis

The patients in the study were sub-grouped based on the population, clinical, and antimicrobial characteristics. For 11 subgroups, average consumption, and sum consumption were

calculated and evaluated for their significance in the variation of consumption of antimicrobials between the categories of subgroups. Out of 11, two subgroups were based on the population characteristics: age, gender (Fig. 1); five subgroups were based on the clinical characteristics: based on surgery, the patient admitted to the type of ICU, the status of comorbidity, the specialty of disease or disorder diagnosed to the patient and if the patient was immunocompromised or not (Fig. 2); the remaining four subgroups were based on the antimicrobial characteristics, class of antimicrobials prescribed, AWaRe classification, the route of administration and the use of antimicrobials as combinations (Fig. 3).

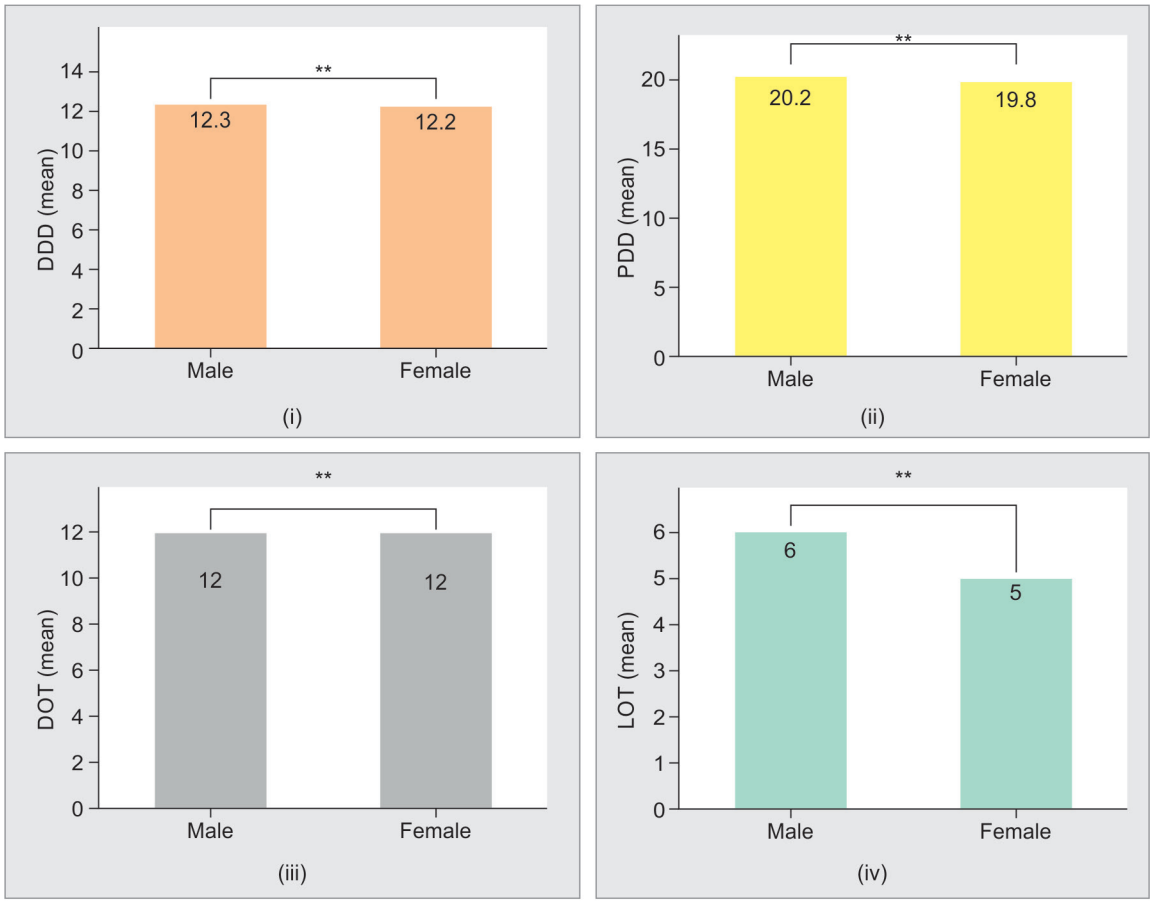
Comparison Analysis

Between the Defined Daily Dose and Days of Therapy

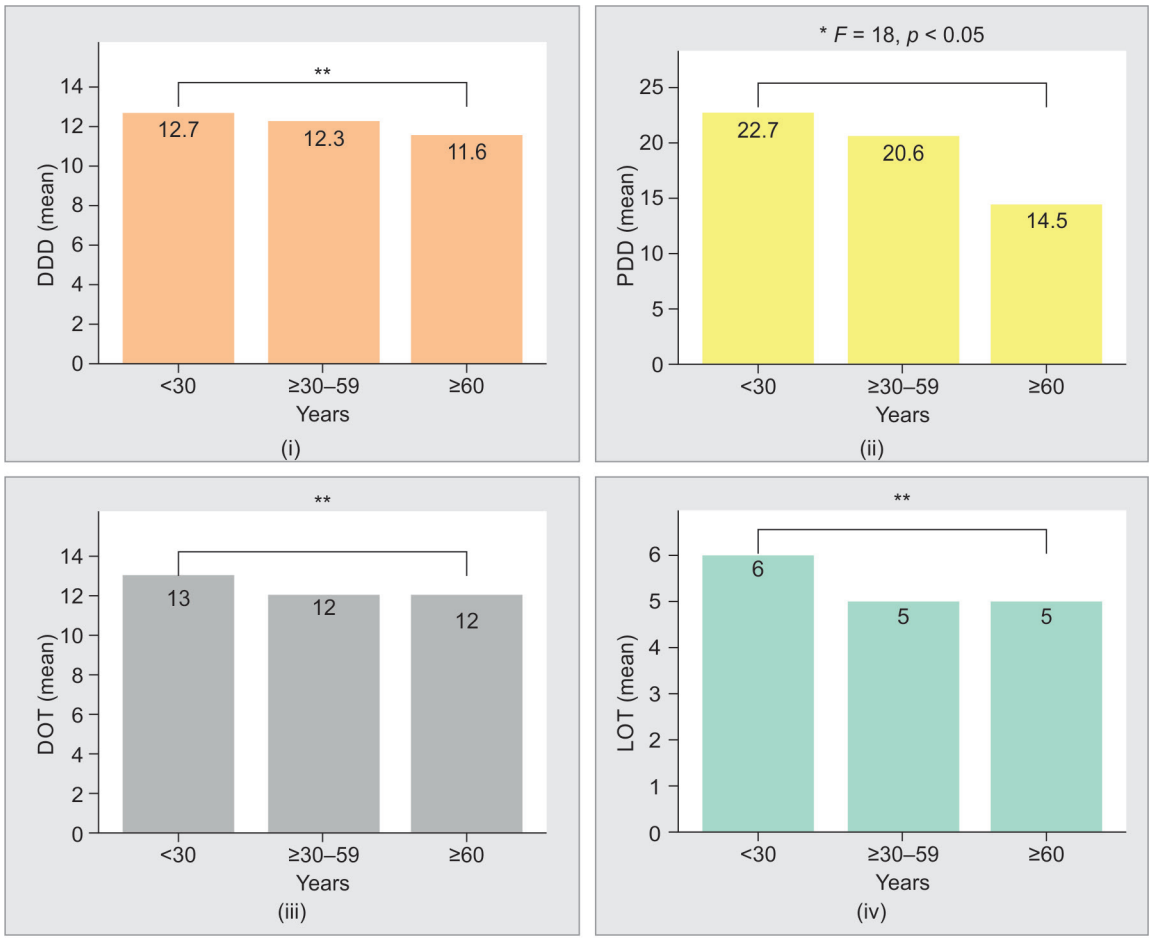
Overall, the percentage difference between the DDD and DOT was determined to be moderate (13.94%). Consequently, the total number of DOTs was 0.86 times the DDDs (Table 3).

Among the class of antimicrobials, the range of the ratio of sum DDDs/1000 PDs to DOTs/1000 PDs was from 0.68–1.30, which indicated a variation among the classes from under-estimation (ratio <1.0), equivalent estimation (ratio = 1.0) to overestimation (ratio >1.0) by DOT relative to the DDD. It was observed in classes, penicillin (ratio = 0.94), cephalosporins first generation, (ratio = 0.74) second generation (ratio = 0.68) and fourth generation (ratio = 0.94), macrolides (ratio = 0.84), fluoroquinolones (ratio = 0.75), glycopeptides (ratio = 0.95), nitroimidazoles (ratio = 0.77) and other (ratio = 0.87), the results revealed that DOT underestimated the consumption on comparison to DDD indicator. While the classes, cephalosporins 4th generation and aminoglycosides represented the equivalent estimation by both indicators as the ratio equals one. In contrast to the above classes, DOT overestimated the consumption in Penems (ratio = 1.22) and polymyxins classes (ratio = 1.33) of antimicrobials.

The estimation of consumption by these two indicators, DOT and DDD, differed by a moderate percentage difference in most of



(A) Gender



(B) Age

Figs 1A and B: Average antimicrobial estimation through four indicators; (i) Defined daily dose (DDD); (ii) Prescribed daily dose (PDD); (iii) Days of therapy (DOT); (iv) Length of therapy (LOT), in the two subgroups based on the population characteristics: (A) Gender (male and female), (B) Age (<30 years, ≥30–59 years, ≥60 years). *Indicates significant difference between sub-groups; **Indicates insignificant difference between sub-groups

the classes. An exception to it involved the classes of antimicrobial drug: first (25.5%) and second-generation (31.7%) cephalosporins which represented a major percentage difference, whereas the third-generation cephalosporins (0.26%) and antifungals (4.7%) represented minor percentage difference.

Between the Defined Daily Dose and the Prescribed Daily Dose

The overall estimation of antimicrobial by the indicator, PDD was 1.64 times the estimated by the DDD, and a percentage difference of 39.20% was observed in estimation through these two indicators (Table 3).

The ratio of PDDs/1,000PD to DDDs/1,000PDs varied among antimicrobial classes, extending from 1.08 to 1.79, with the percentage difference ranging from 1.97 to 44.29%. When the percentage difference was categorized further, it was observed that most of the antimicrobial classes demonstrated a percentage difference ≥25%, exception was found in macrolides (1.9%), Penems (16.6%), antifungal (23.4%), polymyxins (19.9%), and nitroimidazoles (7.4%).

Between Defined Daily Dose and Length of Therapy

The length of therapy (12,832 LOT/1,000 PDs) underestimated the overall antimicrobial consumption in comparison to the DDD (28391 DDDs/1000 PDs). The overall percentage difference in estimating the antimicrobial consumption between these two indicators was 54.8% (Table 3).

The variation in percentage difference was observed in aged patients, who had aged ≥60 years (53%), reported it lower than the patients who had aged either <30 years (56.2%) or ≥30–59 years (56.5%), however, patients belonged to latter age categories, reported equivalent magnitude of percentage difference (Fig. 4).

Correlation Analysis

Correlation between Defined Daily Dose and a Prescribed Daily Dose

Overall, a moderate association was observed between DDD per 1,000 PDs and PDD per 1,000 PDs, $r^2 = 0.50$, F (1,2351) = 2,408.2, $p < 0.05$.

Variation was observed in the association among the classes of antimicrobials from the overall association values. Almost all the classes demonstrated a weak association (r^2 ranged from 0.16 to 0.28) between DDD per 1000 PDs and PDD per 1000 PDs, the exception was observed in classes: Fluoroquinolones (r^2 = 0.85), cephalosporins of fourth generation (r^2 = 0.90) and Penems (r^2 = 0.77) which reported a strong association. On the other hand, cephalosporins of second generation (r^2 = 0.70) and cephalosporins of third generation (r^2 = 0.59) reported a moderate association. Access (r^2 = 0.59) and reserve (r^2 = 0.34) consumed antibiotics revealed a moderate correlation than watch antibiotics (r^2 = 0.10). Correlations between indicators in different sub-groups are presented in Supplementary file S2.

Correlation between Defined Daily Dose and Days of Therapy

Correlation analysis revealed a strong association overall between DDD per 1,000 PDs and DOT per 1,000 PDs, r^2 = 0.86, F (1,2351) = 15275.9, $p < 0.05$.

However, a clear disparity was observed when the correlation was further analyzed for different sub-groups. In contrast to the overall correlation, most of the classes demonstrated a moderate level correlation, with few anomalies like cephalosporin second-generation class which reported a strong association (r^2 = 0.73) and antifungals reported a weak association (r^2 = 0.24). Access and watch-consumed antibiotics demonstrated a little higher correlation than reserve antibiotics (r^2 = 0.64 and 0.60 vs 0.53). Correlations between indicators in different sub-groups are presented in Supplementary file S3.

Correlation between Defined Daily Dose and Length of Therapy

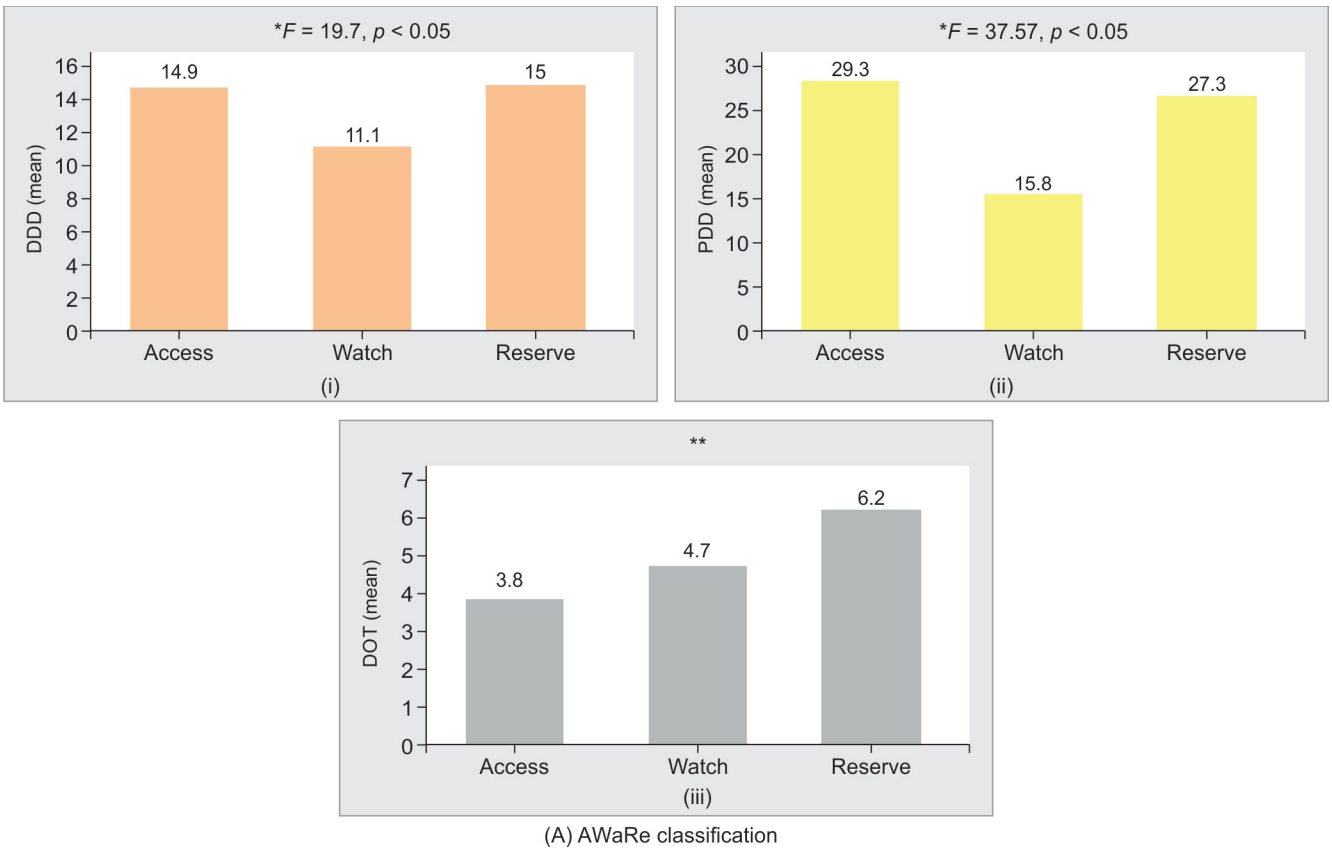
Correlation analysis between DDD per 1,000 patient days and LOT per 1000 patient days revealed a moderate level association r^2 = 0.60, F(1,2351) =3,574.2, $p < 0.05$.

In female patients, the correlation magnitude was found slightly higher than in male patients. (r^2 = 0.62 vs 0.58). The patients whose age ≥60 years (r^2 = 0.48), reported it lower in magnitude than the patients whose age was either <30 years (r^2 = 0.61) category or ≥30–59 years category (r^2 = 0.67). Correlations between indicators in different sub-groups are presented in the Supplementary file S4.

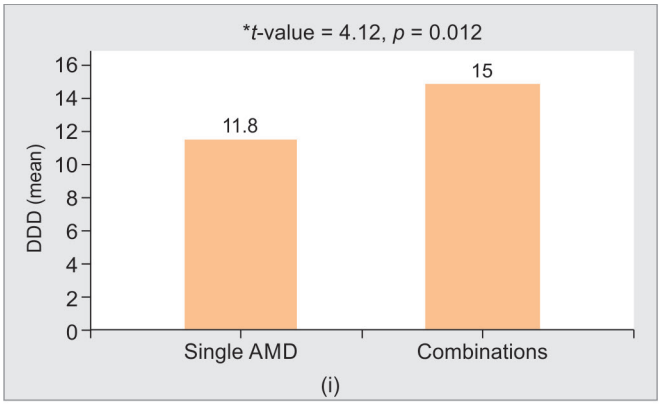
Discussion

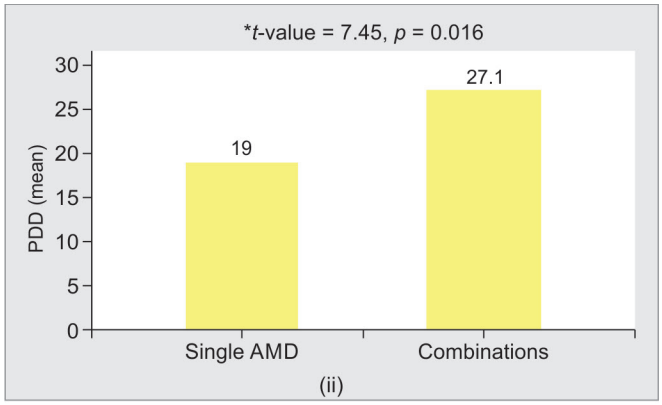
To the best of the knowledge of the co-authors, this is the first study reporting the variations between four different indicators (DDD, PDD, LOT, and DOT) of antimicrobial consumption using comparison and correlation analysis; additionally, we have also performed subgroup analysis for better understanding of this variation.

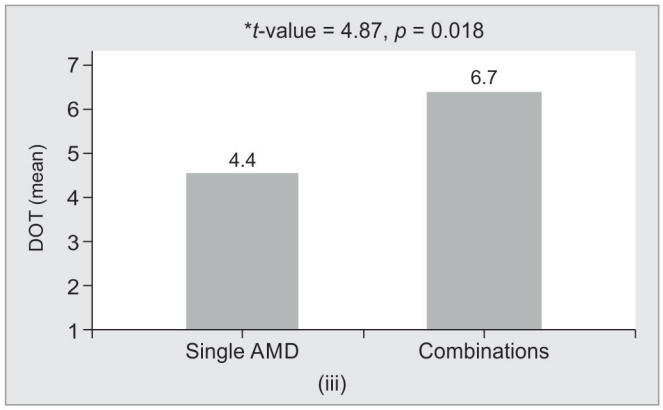
Earlier, a few studies have reported the DDD method to be misleading when measuring antimicrobial utilization for which the definition of the DDD does not reflect the average daily dose administered to an average adult patient.[8,13–17] In the results from other hospitals,[18–20] the PDD method overestimated the



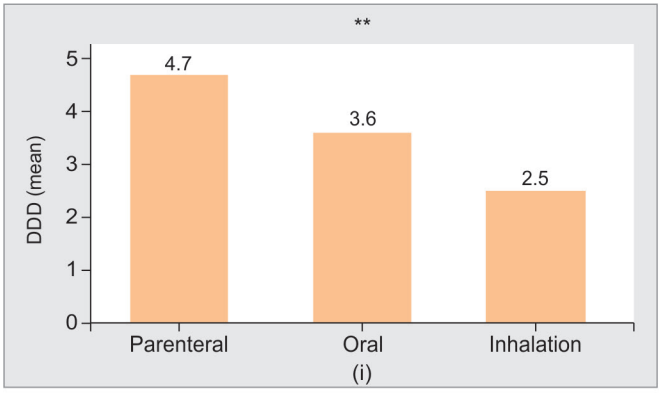
(A) AWaRe classification

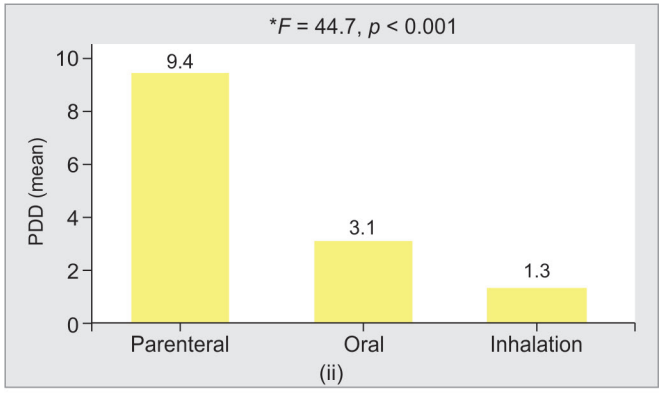


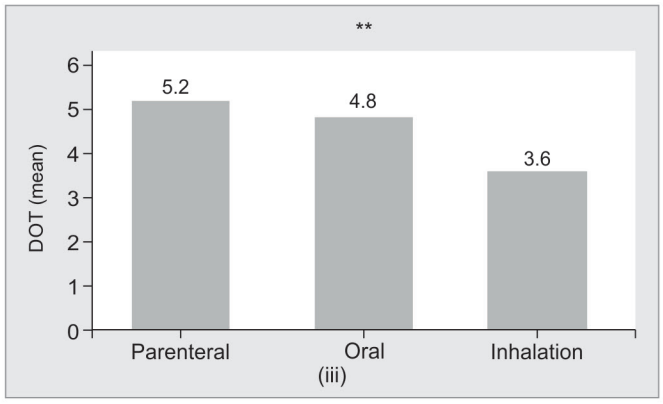




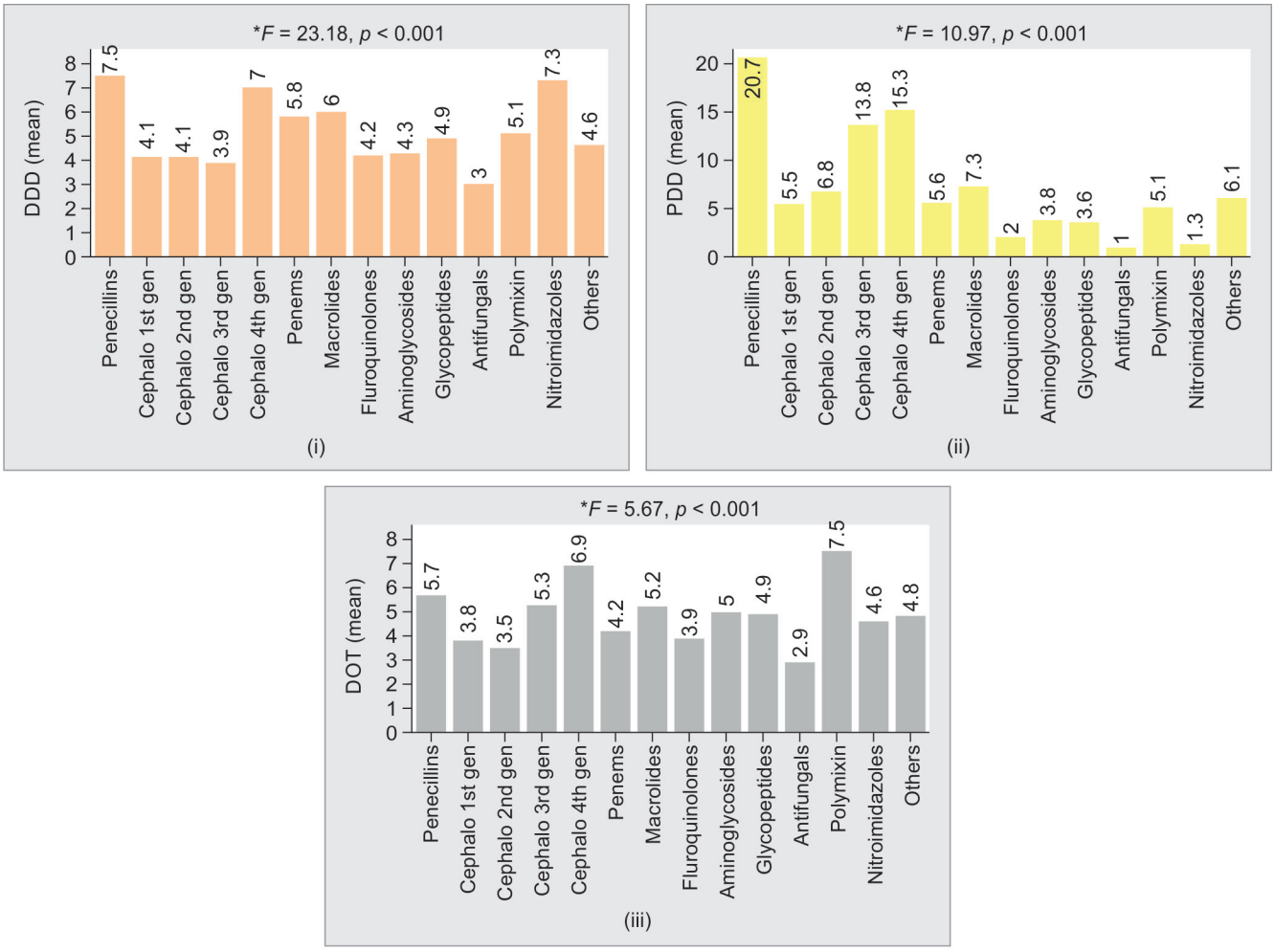
(B) Use of antimicrobials as combinations







(C) Route of administration of antimicrobials



(D) Class of antimicrobials prescribed

Figs 2A to D: Average antimicrobial estimation through three indicators; (i) Defined daily dose (DDD); (ii) Prescribed daily dose (PDD); (iii) Days of therapy (DOT), in the four sub-groups based on antimicrobial characteristics; (A) AWaRe classification (Access, Watch and reserve antimicrobials); (B) Use of antimicrobials as combinations (single vs fixed-dose combinations); (C) Route of administration of antimicrobials (parenteral, oral, and inhaled antimicrobials); (D) Class of antimicrobials prescribed. *Indicates significant difference between sub-groups; **Indicates insignificant difference between sub-groups

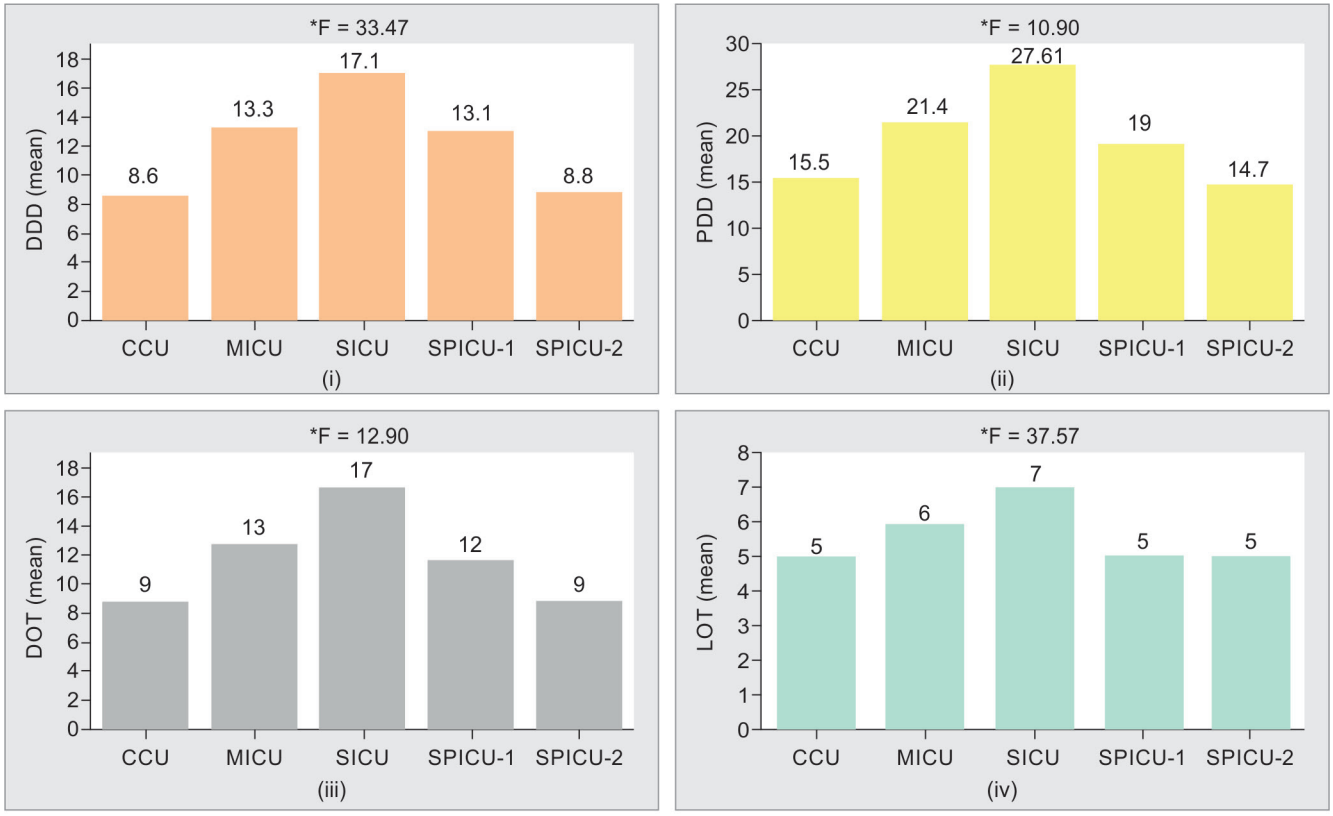
consumption of antimicrobials in comparison to the DDD method which is in agreement with our results in this study. Först et al.[18] reported an overall percentage deviation (30%), lower than this study (39.2%). Gagliotti et al.[21] reported ratio of PDD and DDD ranged from 0.8 to 2.6, whereas it ranged from 1.07 to 1.79 in this study.

Other than DDD and PDD, the alternative method for the estimation of antimicrobial consumption is the DOT methodology. The DOT method's key advantages are that it is not influenced by the change in recommended DDD and also by any discrepancies between DDD and PDD.[13] In spite of these advantages, the most significant restriction of DOT methodology is the difficulty of measurement when computerized pharmacy records are not available. Results of this study are also in concordance with results from a Spanish study, with a closely matching sample size, that reported a 46.6% percentage deviation with a correlation value of 0.79 between DDD and DOT per 100 patient days. Vallès et al.[22] and Momattin et al.[23] have reported the DOT method to underestimate the consumption of antimicrobials in comparison to the DDD method.

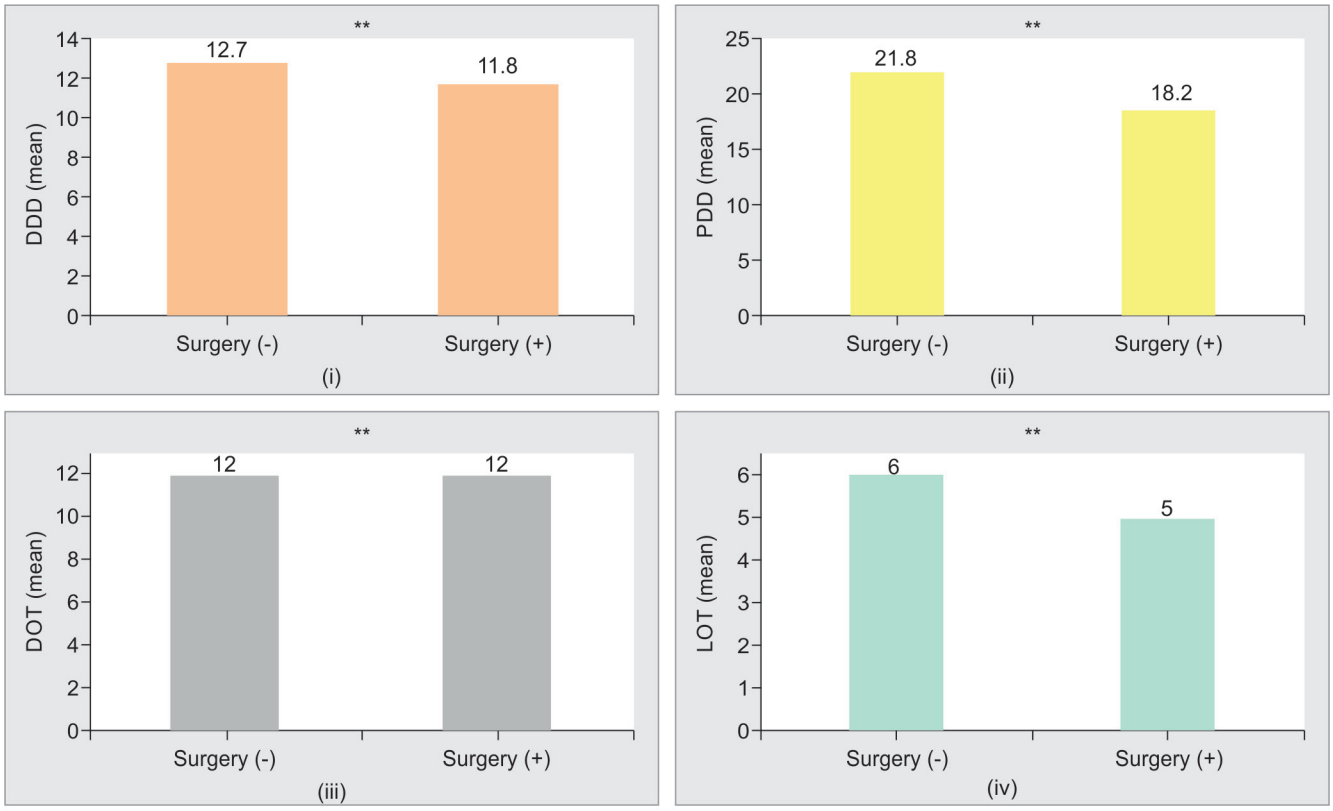
Moreover, while DOTs accurately reflect the duration of drug administration for medications such as ceftriaxone, which do not necessitate dosage adjustments for organ dysfunction, they may not fully capture patients' actual exposure to agents like levofloxacin, which may be administered every other day, or for aminoglycosides or vancomycin, which might be dosed even less frequently (every 3–4 days) based on drug levels. Hence, relying solely on the calculation of DOTs based on the number of days of drug administration may not provide an accurate representation of patients' real exposure.[5]

The values for LOT should ideally be equal to or lower than the values for DOT since each antibiotic has its specific DOT. LOT cannot be effectively utilized for comparing individual antimicrobial usage. The ratio of DOT to LOT served as a helpful indicator for distinguishing between combination and monotherapy. A ratio of 1 indicates monotherapy, while a ratio greater than 1 indicates combination therapy.[9]

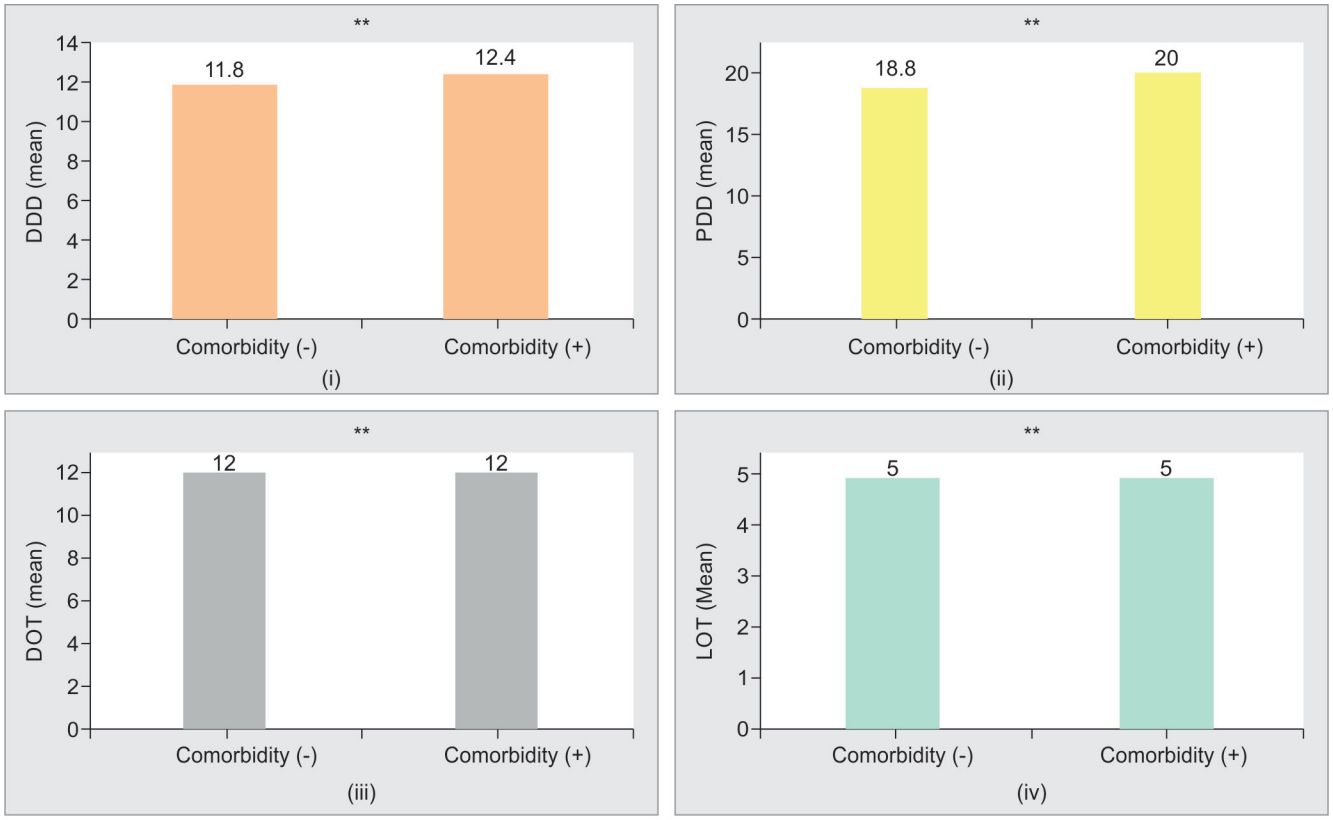
To support the comparison analysis, the correlation was evaluated among these metrics. The overall correlation coefficient value between DDD and PDD, DDD and DOT, and DDD and LOT



(A) Based on the patient admitted to the ICU



(B) Based on surgery



(C) Based on the status of comorbidity

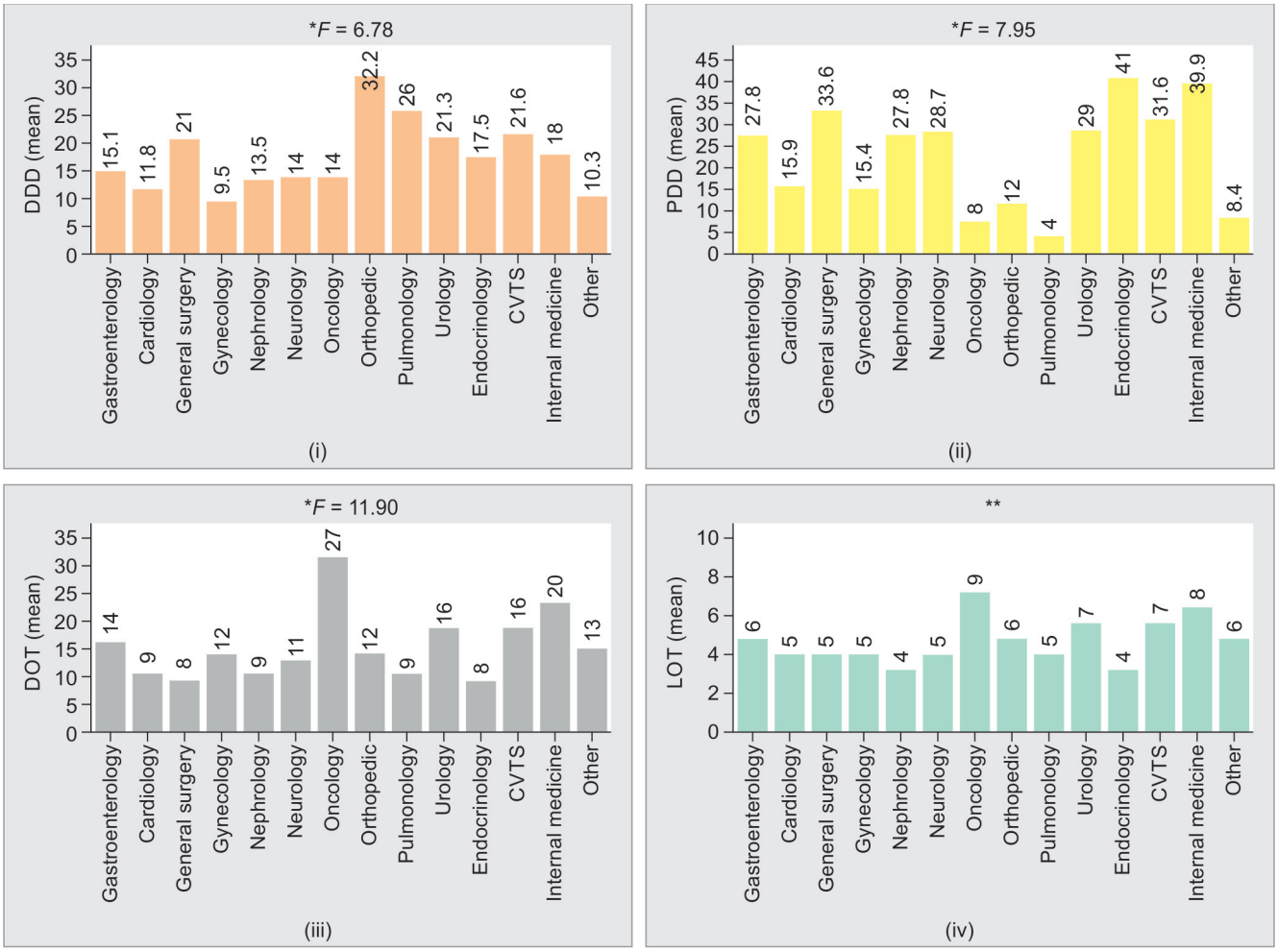
was found to be 0.86, 0.50, and 0.60, respectively. Different levels of consumption of antimicrobials among sub-groups could be the reason for demonstrating a variation in the correlation magnitude in sub-groups. The largest amount of variability is not explained by regression analysis; however, it could be explained by the methodological differences in the calculation of the four indicators as metrics (DDD, PDD, DOT, and LOT).

Although the Infectious Diseases Society of America (IDSA) issued a guideline recommending the use of DDDs for benchmarking, numerous other quantitative metrics of antimicrobial consumption, such as DOT, PDD, and LOT, are prevalent in published literature, complicating valid data comparisons within and between institutions.[24–28] Factors like discrepancies between administered daily dose and the WHO-assigned DDD, dose reduction in administered daily dose (renal/hepatic-impairment), and the quantity metric which is relevant in only adult population, have the potential to cause variation in the estimation of antimicrobial use by the DDD method.[5] Therefore, using solely DDDs for estimation does not necessarily provide a precise idea of actual antimicrobial consumption in practice. In this context, several studies have suggested that indicators, such as PDDs, DOT, LOT, and the number of exposed patients, used as numerators, may provide a more accurate assessment of antibiotic exposure compared with DDDs alone, allowing for more meaningful comparisons.[9,29]

This study's limitation stems from the use of retrospective data set and the lack of comprehensive information on patient transfers, which might have created bias in the results. Another limitation is the measurement of antimicrobial consumption without taking into account the dose fluctuation due to different organ dysfunctions or insertion of the device. Both of these factors are potential confounders that could not be adjusted for the estimation of antimicrobial consumption in this study.

Conclusion

The findings of this study concluded that the evaluation of antibiotic consumption using the DDD, PDD, DOT, and LOT per 1000 PDs demonstrated high discrepancies. Therefore, as a result of correlation analysis the use of a combination of DOT and DDD



(D) Based on the specialty of disease or disorder diagnosed to the patient

approach should be recommended for the actual quantification of antimicrobial consumption in the ICUs of hospitals.

Acknowledgment

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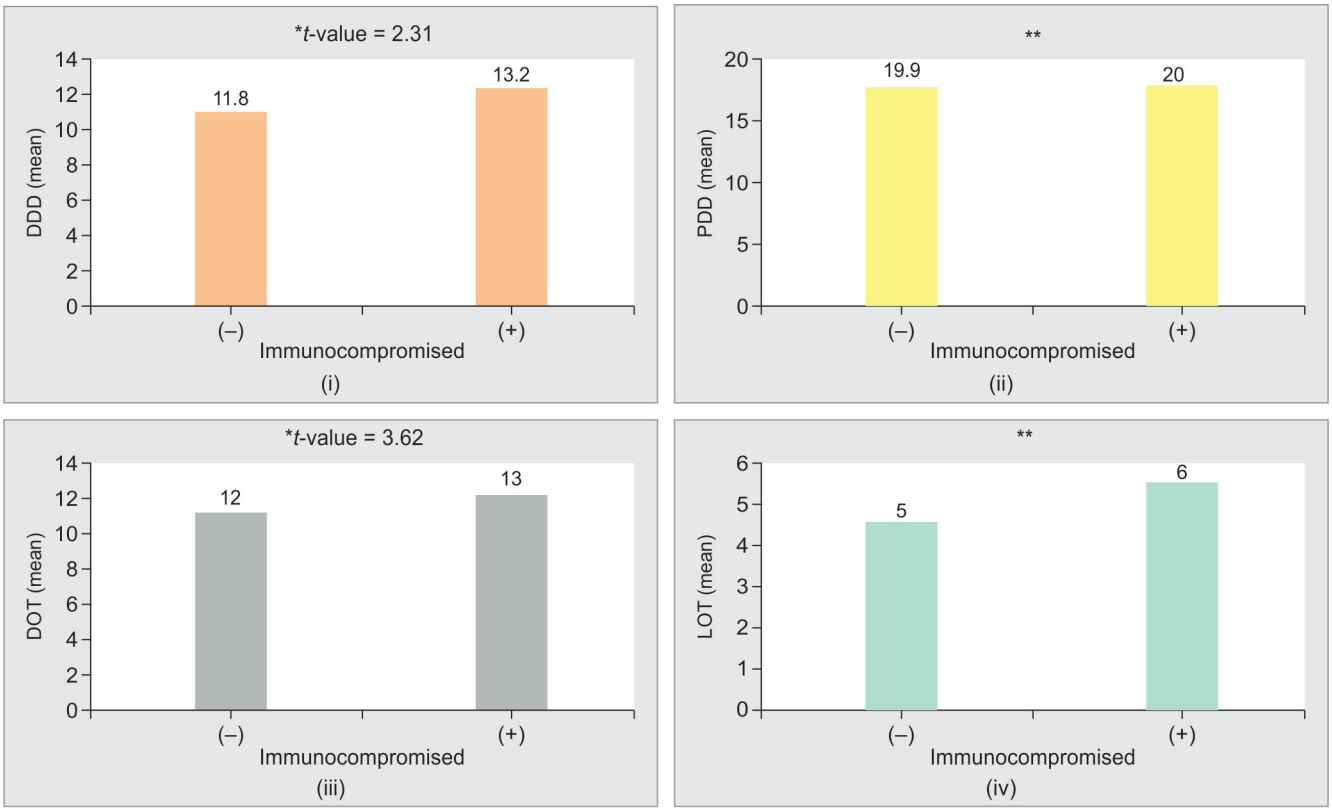
Ethical Approval

This study was approved by the Human Ethics Committee, National Institute of Pharmaceutical Education and Research, Mohali, India. (IEC/54/2021).

Supplementary Materials

All the supplementary materials are available online on the website of www.IJCCM.org.



(E) Based on the status of immunocompromisation

Figs 3A to E: Average antimicrobial estimation through four indicators. (i) Defined daily dose (DDD); (ii) Prescribed daily dose (PDD); (iii) Days of therapy (DOT); (iv) Length of therapy (LOT), in the five sub-groups based on clinical characteristics: (A) Based on the patient admitted to the ICU (MICU, CCU, SICU, SPICU-1, and SPICU-2); (B) Based on surgery (Surgical and non-surgical patients); (C) Based on the status of comorbidity (absent vs present); (D) Based on the specialty of disease or disorder diagnosed to the patient; (E) Based on the status of immunocompromisation (immunocompromised vs non-immunocompromised). *Indicates significant difference between sub-groups; **Indicates insignificant difference between sub-groups

Table 3: Comparison analysis between the estimation of antimicrobial consumption by defined daily dose (DDD) and (a) days of therapy (DOT), (b) prescribed daily dose, (PDD) (c) length of therapy (LOT) per 1,000 patient days

				Comparison between DDD and PDD		*Comparison between DDD and DOT*	*Comparison between DDD and LOT*	
Criteria	*Groups/Sub-groups*	*Parameters*	*N (%)*	*PDD/DDD*	*(PDD-DDD)/PDD*100*	*(DDD-DOT)/DDD*100*	*(DDD-LOT)/DDD*100*	*DOT/LOT*
		Overall	2,352	1.64	39.20	13.94	54.80	1.90
AMD class								
	1	Penicillins	1,121 (14.5%)	1.79	44.29	6.39	NA	NA
	2.1	Cephalo 1st gen	1,056 (13.7%)	1.49	32.81	25.55	NA	NA
	2.2	Cephalo 2nd gen	871 (11.3%)	1.69	40.77	31.76	NA	NA
	2.3	Cephalo 3rd gen	461 (6.0%)	1.59	37.04	–0.26	NA	NA
	2.4	Cephalo 4th gen	148 (1.9%)	1.50	33.53	8.59	NA	NA
	3	Penems	287 (3.7%)	1.20	16.66	–21.57	NA	NA
	4	Macrolides	109 (1.4%)	1.02	1.97	16.47	NA	NA
	5	Fluoroquinolones	1,521 (19.7%)	1.87	46.64	24.98	NA	NA
	6	Aminoglycosides	896 (11.6%)	1.76	43.20	0.39	NA	NA
	7	Glycopeptides	436 (5.6%)	1.45	31.08	5.35	NA	NA

(Contd...)

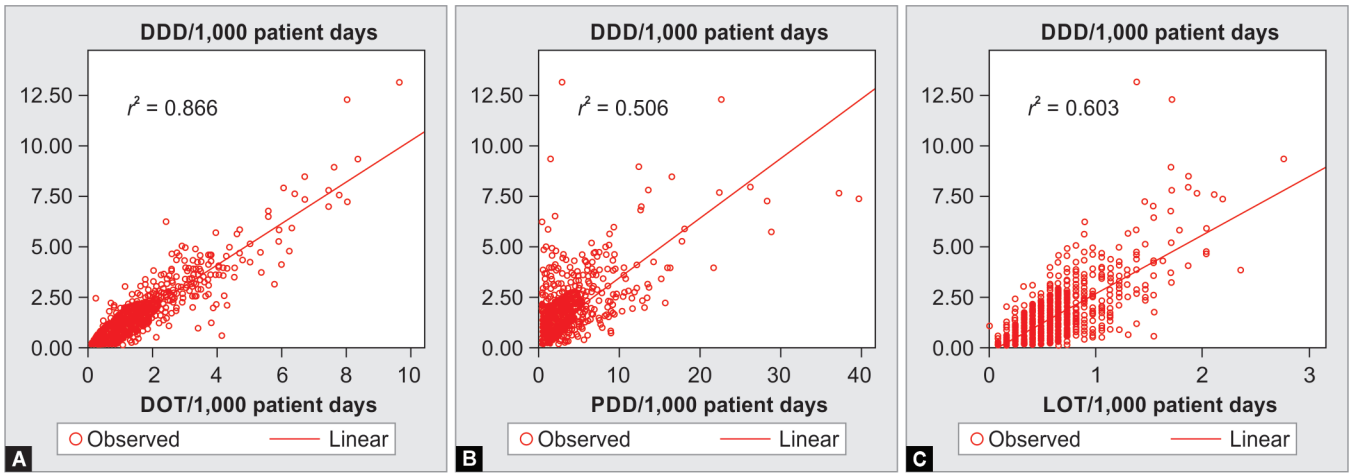
Table 3: *(Contd...)*

Criteria	Groups/Sub-groups	Parameters	N (%)	Comparison between DDD and PDD		Comparison between DDD and DOT	Comparison between DDD and LOT	
				PDD/DDD	(PDD-DDD)/PDD*100	(DDD-DOT)/DDD*100	(DDD-LOT)/DDD*100	DOT/LOT
	8	Antifungals	65 (0.8%)	1.31	23.42	–4.74	NA	NA
	9	Polymyxins	58 (0.7%)	1.25	19.90	–30.19	NA	NA
	10	Nitroimidazoles	88 (1.1%)	1.08	7.41	23.41	NA	NA
	11	Others	613 (7.9%)	1.55	35.67	12.67	NA	NA
ICUs								
	1	CCU	710 (30.19%)	1.81	44.64	7.17	46.75	1.74
	2	MICU	718 (30.53%)	1.61	37.74	18.21	56.09	1.86
	3	SICU	426 (18.11%)	1.60	37.67	14.53	61.01	2.19
	4	SPICU-1	352 (14.97%)	1.45	31.06	22.62	62.61	2.07
	5	SPICU-2	146 (6.21%)	1.68	40.31	16.18	39.35	1.38
Based on the status of surgery								
	1	Surgery (–)	1,152 (48.98%)	1.71	41.69	17.61	55.86	1.87
	2	Surgery (+)	1,200 (51.02%)	1.54	34.87	13.44	55.43	1.94
Gender								
	1	Male	960 (40.82%)	1.65	39.36	15.55	55.01	1.88
	2	Female	1,392 (59.18%)	1.61	37.91	15.56	56.09	1.92
Age								
	1	<30 years	769 (32.70%)	1.78	43.92	15.74	56.24	1.93
	2	≥ 30–59 years	1,002 (42.60%)	1.67	40.21	15.94	56.56	1.93
	3	≥60 years	581 (24.70%)	1.24	19.37	13.99	53.07	1.83
Based on the status of comorbidity								
	1	Comorbidity (–)	689 (29.29%)	1.59	37.16	15.42	54.96	1.88
	2	Comorbidity (+)	1,663 (70.71%)	1.63	38.58	15.72	55.83	1.91
Based on the specialty of diagnosed disease								
	1	Gastroenterology	156 (6.63%)	1.79	44.20	21.06	60.12	1.98
	2	Cardiology	806 (34.27%)	1.71	41.48	4.86	44.43	1.71
	3	General surgery	332 (14.12%)	1.47	31.95	22.82	63.41	2.11
	4	Gynecology	37 (1.57%)	1.34	25.30	25.14	66.80	2.25
	5	Nephrology	40 (1.70%)	1.13	11.45	13.51	50.29	1.74
	6	Neurology	30 (1.28%)	1.35	25.79	24.17	68.52	2.41
	7	Oncology	75 (3.19%)	1.90	47.43	21.48	55.77	1.78
	8	Orthopedic	152 (6.46%)	1.62	38.36	16.25	39.46	1.38
	9	Pulmonology	166 (7.06%)	1.56	35.99	21.64	60.55	1.99
	10	Urology	111 (4.72%)	1.65	39.30	3.49	38.72	1.57
	11	Endocrinology	63 (2.68%)	1.71	41.37	17.04	59.50	2.05
	12	CVTS	242 (10.29%)	1.61	37.99	16.48	63.74	2.30
	13	Internal medicine	112 (4.76%)	1.63	38.55	15.62	57.76	2.00
	14	Other	30 (1.28%)	1.27	21.42	10.89	34.71	1.36
Based on the status of immunocompromisation								
	1	Immunocompromised (–)	1,609 (68.41%)	1.69	40.75	15.65	54.70	1.86
	2	Immunocompromised (+)	743 (31.59%)	1.51	33.65	15.37	57.49	1.99

(Contd...)

Table 3: *(Contd...)*

Criteria	Groups/Sub-groups	Parameters	N (%)	Comparison between DDD and PDD		Comparison between DDD and DOT	Comparison between DDD and LOT	
				PDD/DDD	(PDD-DDD)/PDD*100	(DDD-DOT)/DDD*100	(DDD-LOT)/DDD*100	DOT/LOT
AWaRe classification								
	1	Access AMD	2,402 (31.07)	1.56	36.07	11.79	NA	NA
	2	Watch AMD	5,029 (65.05)	1.71	41.62	16.10	NA	NA
	3	Reserve AMD	300 (3.88)	1.17	14.75	–4.56	NA	NA
Based on the use of AMD as combinations								
	1	Single AMD	6,562 (84.88)	1.60	37.54	7.80	NA	NA
	2	Combinations	1,168 (15.11)	1.80	44.48	35.82	NA	NA
Route								
	1	Parenteral	5,526 (71.5)	1.91	47.69	6.40	NA	NA
	2	Oral	2,176 (28.1)	1.01	0.74	30.97	NA	NA
	3	Inhalation	29 (0.4)	1.02	1.98	62.35	NA	NA



Figs 4A to C: Correlation analysis between estimation of antimicrobial consumption by defined daily dose (DDD) and (A) Days of therapy (DOT), (B) Prescribed daily dose (PDD), (C) Length of therapy (LOT) per 1,000 patient days

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