

Analysis of Antibiotic Use with the ATC/DDD and DU 90% Methods at the Banjarbaru Selatan Health Center in 2023-2024

Analisis Penggunaan Antibiotik dengan Metode ATC/DDD dan DU90% di Puskesmas Banjarbaru Selatan Tahun 2023-2024

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Abstract

Antibiotic resistance is an escalating global health concern, with Indonesia increasingly reporting resistance across various bacterial species. This trend contributes to rising morbidity and mortality and influences patterns of antibiotic use, highlighting the need for systematic monitoring. The Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) methodology is a widely accepted standard for evaluating antibiotic consumption and serves as a key indicator of antimicrobial stewardship effectiveness. This study aimed to: (i) identify the most consumed antibiotics based on DDD/1000 outpatient visits, (ii) compare consumption between 2023 and 2024, and (iii) determine the DU90% segment of antibiotic use at Banjarbaru Selatan Health Center. A quantitative, descriptive, cross-sectional design was conducted from January to May 2025, involving adult outpatients prescribed antibiotics during 2023–2024. Data analysis included DDD/1000 outpatient visit calculations and year-to-year comparisons using the Wilcoxon test. Amoxicillin consistently showed the highest consumption, with 272.94 DDD/1000 outpatient visits in 2023 and 274.26 in 2024. Statistical analysis revealed no significant difference in overall antibiotic use between the two years ($p = 0.063$). DU90% analysis identified Amoxicillin as the dominant antibiotic in 2023, while Amoxicillin and Cefadroxil led in 2024. Antibiotic consumption at Banjarbaru Selatan Health Center remained stable over the two years, with Amoxicillin as the predominant agent. These findings underscore the importance of routine monitoring using ATC/DDD and DU90% methodologies to inform targeted interventions and enhance antimicrobial resistance control strategies.

Abstrak

Resistensi antibiotik merupakan masalah kesehatan global yang semakin meningkat, dengan Indonesia terus melaporkan kasus resistensi pada berbagai spesies bakteri. Fenomena ini tidak hanya berkontribusi terhadap peningkatan angka morbiditas dan mortalitas, tetapi juga memengaruhi pola penggunaan antibiotik, sehingga diperlukan pemantauan yang sistematis. Metodologi *Anatomical Therapeutic Chemical/Defined Daily Dose* (ATC/DDD) diakui secara luas sebagai pendekatan standar dalam mengevaluasi konsumsi antibiotik dan menjadi indikator utama efektivitas program pengendalian resistensi antimikroba. Penelitian ini bertujuan untuk: (i) mengidentifikasi antibiotik dengan tingkat konsumsi tertinggi berdasarkan DDD/1000 kunjungan rawat jalan, (ii) membandingkan nilai konsumsi antara tahun 2023 dan 2024, serta (iii) menentukan segmen DU90% penggunaan antibiotik di Puskesmas Banjarbaru Selatan. Desain penelitian yang digunakan adalah kuantitatif, deskriptif, dan potong lintang, dilaksanakan pada Januari hingga Mei 2025, melibatkan pasien dewasa rawat jalan yang menerima resep antibiotik selama tahun 2023–2024. Analisis data mencakup perhitungan DDD/1000 kunjungan rawat jalan dan perbandingan antar tahun menggunakan uji Wilcoxon. Amoksisilin secara konsisten menunjukkan tingkat konsumsi tertinggi, yaitu 272,94 DDD/1000 kunjungan rawat jalan pada tahun 2023 dan 274,26 pada tahun 2024. Analisis statistik menunjukkan tidak terdapat perbedaan signifikan dalam konsumsi antibiotik secara keseluruhan antara kedua tahun ($p = 0,063$). Analisis DU90% mengidentifikasi Amoksisilin sebagai komponen dominan pada tahun 2023, sementara Amoksisilin dan Sefadrokasil mendominasi pada tahun 2024. Konsumsi antibiotik di Puskesmas Banjarbaru Selatan tetap stabil selama dua tahun, dengan Amoksisilin sebagai agen utama. Temuan ini menegaskan pentingnya

INTRODUCTION

Antibiotic resistance is a growing global crisis, responsible for an estimated 1.27 million global deaths (GLASS report) and 133,800 deaths in Indonesia (Indonesian Health Survey).¹⁻⁴ Beyond its impact on mortality, antibiotic resistance modifies antibiotic utilization patterns and elevates healthcare costs.⁵ Research conducted in Indonesia indicates substantial levels of antibiotic resistance among various bacteria, including coagulase-negative *Staphylococcus* resistant to Cefepime (78.19%), Meropenem (79.50%), and Ceftriaxone (97.75%), as well as *Escherichia coli* exhibiting high resistance to Ampicillin-sulbactam (90.27%).⁶

In this context, local epidemiological data further underscore the challenge. According to a report from the data.banjarbarukota.go.id website regarding the incidence of infectious disease cases in Banjarbaru City, it has been observed that Banjarbaru Selatan District experienced an increase in infectious disease cases, rising from 2,639 in 2023 to 3,773 in 2024. The infectious diseases reported include syphilis (among pregnant women), diarrhea, upper respiratory tract infections (URTI)/pneumonia, and tuberculosis.⁷ As these illnesses are primarily due to bacterial infections, the elevated number of cases implies a potential increase in the prescription of antibiotics. It contributes to the development of antibiotic resistance.

Antibiotic resistance is the ability of bacteria to survive in the presence of antibiotics intended to inhibit or eliminate them.^{3,8} Several factors contribute to antibiotic resistance, including the overuse of antibiotics.^{9,10} The increased antibiotics use poses a critical concern, as higher prescribing rates contribute to the acceleration of antibiotic resistance.^{1,11} Notably, a correlation has been observed between the use of cephalosporins and extended-spectrum beta-lactamase (ESBL) rates.¹¹ This condition highlights the critical importance of assessing antibiotic utilization as part of control antibiotic resistance.

In this regard, the evaluation of antibiotic consumption represents a critical quality indicator in antibiotic resistance control programs.^{12,13} According to the Global Antimicrobial Resistance and Use Surveillance System (GLASS), antibiotic consumption in developed and developing nations varies between 12.3 and 31.2 Defined Daily Doses (DDD) per 1000 population per day. These figures highlight substantial variation in antibiotic usage between these countries.¹ The countries exhibiting the highest incidence of antibiotic resistance are those with elevated antibiotic consumption.¹⁴ A systematic review study documented an increase in antibiotic consumption among inpatients in Indonesia from 2016 to 2021, compared to the period from 2000 to 2015.¹⁵

To address these variations and standardize measurement, the World Health Organization (WHO) endorses the use of the ATC/DDD method for the quantitative evaluation of antibiotic consumption.^{8,12,16} The Anatomical Therapeutic Chemical (ATC) classification system categorizes antibiotics as pharmacologically active substances based on the organ or system they target, as well as their therapeutic, pharmacological, and chemical properties. DDD is defined as the average daily maintenance dose of an antibiotic prescribed for its main indication in adults.^{8,12,17} A lower DDD value signifies more selective consumption of antibiotics. The Drug Utilization (DU) 90% method denotes the categorization of drugs within the 90% usage segment, often employed in conjunction with the DDD methodology for analyzing drug consumption. Investigating the specific drugs encompassed within the 90% segment is imperative for drug evaluation and regulation.¹²

Research conducted in various community health centers throughout Indonesia indicates that Amoxicillin exhibits the highest Defined Daily Dose (DDD) value, ranging from 39.39 to 2,077 DDD per 1000 outpatient visits. The 90% Drug Utilization (DU) segment comprises several antibiotics, including Amoxicillin, Ciprofloxacin, Cotrimoxazole, and Tetracycline.¹⁸⁻²¹ This suggests that each region consistently uses the same type of antibiotic, as indicated by the highest consumption according to DDD metrics. However, the DDD

values of the antibiotics most frequently consumed differ, and the composition of the DU90% segment also demonstrates variability. Consequently, it is essential to research DDD values and DU90% of specific antibiotics in regions that have not yet conducted similar studies, with the intention of employing the findings as evaluative data for antibiotic consumption.

High antibiotic consumption increases the risk of resistance, making its evaluation essential. Using the DDD method allows one to compare antibiotic use.²² There are no previous data on DDD-based antibiotic consumption at Banjarbaru Selatan Community Health Center, South Kalimantan. This study uses the 2025 ATC/DDD guidelines, which distinguishes it from past studies. Evaluating consumption helps to reduce resistance.¹⁷ This study aims to calculate the highest amount of antibiotic consumption based on the DDD/1000 outpatient visits values, compare the DDD/1000 outpatient visits values between 2023 and 2024, and identify the segment of DU90% in antibiotic use at the Banjarbaru Selatan Health Center.

RESEARCH METHOD

This research employs a quantitative, descriptive, cross-sectional design, conducted from January to May 2025 at the Banjarbaru Selatan Community Health Center in Banjarbaru City, South Kalimantan. Data collection was done retrospectively using patient registration and prescription records from 2023 to 2024, provided by the Center's Pharmacy Department. Antibiotic use was assessed using ATC/DDD methodology. Ethical clearance was granted by Muhammadiyah University Banjarmasin, reference number 188/UMB/KE/IV/2025. The variables examined include: 1) antibiotic usage profile (class and name); 2) antibiotic consumption as DDD/1000 outpatient visits; and 3) segment of drug utilization (DU) of 90%.

Study Population

The study participants were adult outpatients who received antibiotics at the Banjarbaru Selatan Community Health Center in 2023 and 2024. This study employed a total sampling method. In this study, all members of the population who met the research criteria were sampled. The inclusion criteria covered patients under 18 years of age and those with complete outpatient registration and prescription records. Patients receiving non-systemic antibiotics or those using antibiotics without defined standard DDD values were excluded.

Research Procedures

Research methodology involves designing a data collection form. This form includes the patient's ID, age, gender, diagnosis, and medication details, including name, strength, class, form, dosage, and quantity, as well as the ATC code and DDD value. The Banjarbaru City Government Health Office approved the study, and an application for ethical clearance was submitted to Muhammadiyah University Banjarmasin prior to the research commencing. Data derived from registration records and prescriptions were filtered according to research criteria, leading to the finalization of the data form.

Evaluation of the quantity of antibiotic use

The evaluation of antibiotic use was evaluated using the DDD/1000 outpatient visits or *Kunjungan Pasien Rawat Jalan (KPRJ)* method. The ATC/DDD guidelines and the website https://atcddd.fhi.no/atc_ddd_index/ for the year 2025 served as references to establish the standard DDD value for antibiotics.

Data Analysis

The profile of antibiotic use, including nomenclature, class, dosage form, and disease diagnosis, was determined as a percentage and systematically presented in tabular form. The DDD/1000 outpatient visits value is calculated quantitatively, and the results are numerically characterized. The DU90% segment quantifies the percentage utilization of each antibiotic. The methodology for calculating the DDD/1000 outpatient visits value is delineated as follows:^{23,24}

- a. Calculating the total dose of antibiotics

Total dose of a specific antibiotic = quantity used x strength of preparation

- b. Calculating the total DDD of antibiotics

Total DDD of a specific antibiotic = $\frac{\text{specific antibiotic dose (grams)}}{\text{DDD values for specific antibiotics (WHO)}}$

- c. Calculate the DDD/1000 outpatient visits value

DDD/1000 outpatient visits value for certain antibiotics = $\frac{\text{total DDD of a specific antibiotic}}{\text{total outpatient visit}} \times 1000$

A comparison of DDD/1000 outpatient visit values between 2023 and 2024 was conducted using the Wilcoxon test (significance level $p < 0.05$), following a normality test that indicated the data were not normally distributed. Statistical analyses were performed with SPSS version 25.

RESULT AND DISCUSSION

A total of 4,182 patients were included in this study, comprising 1,558 in 2023 and 2,624 in 2024. Of these, 3298 patients (1,344 in 2023 and 1,954 in 2024) were included in the final analysis after excluding 874 patients receiving non-systemic antibiotics and 10 patients receiving antibiotics without a DDD value. During 2023 and 2024, there were 35,334 outpatient visits to the South Banjarbaru Health Center.

The Antibiotic Use Profile

A total of 3,312 antibiotics were prescribed for 3,298 adult outpatients, comprising 1,348 in 2023 and 1,964 in 2024. During the period 2023-2024, the number of antibiotic prescriptions issued at the Banjarbaru Selatan Community Health Center increased from 1,348 to 1,964 (**Table 1**). This trend in antibiotic prescription data corresponds to the increase in infectious diseases within the Banjarbaru Selatan Subdistrict from 2023 to 2024.⁷ The spectrum of antibiotic classes prescribed in 2023-2024 remained consistent, with penicillin being the predominant class. Similarly, the variety of antibiotics prescribed did not exhibit significant changes, with Amoxicillin being the antibiotic prescribed the most frequently between 2023 and 2024. This study identified acute pharyngitis as the predominant diagnosis that prompted antibiotic prescriptions during 2023-2024 (**Figs. 1 & 2**). These results align with previous studies, reinforcing that the Penicillin class and Amoxicillin are the antibiotics prescribed the most frequently in Community Health Centers.²⁵⁻²⁷ In particular, Amoxicillin is included in the Indonesian National Formulary, thus ensuring provision of appropriate, effective, high-quality, safe, and affordable medications to patients.²⁸

Table 1. Classes and Names of Antibiotics Prescribed at the South Banjarbaru Community Health Center

Classes	Antibiotics	Number of prescriptions		% Antibiotics	
		2023	2024	2023	2024
Penicillin	Amoxicillin	1,164	1,365	86.35	69.50
	Cefadroxil	74	149	5.49	7.59
Cephalosporin	Cefixime	3	0	0.22	0
	Ciprofloxacin	52	81	3.86	4.12
Amphenicol	Thiamphenicol	33	344	2.45	17.52
Nitroimidazole	Metronidazole	22	25	1.63	1.27
Total		1,348	1,964	100	100

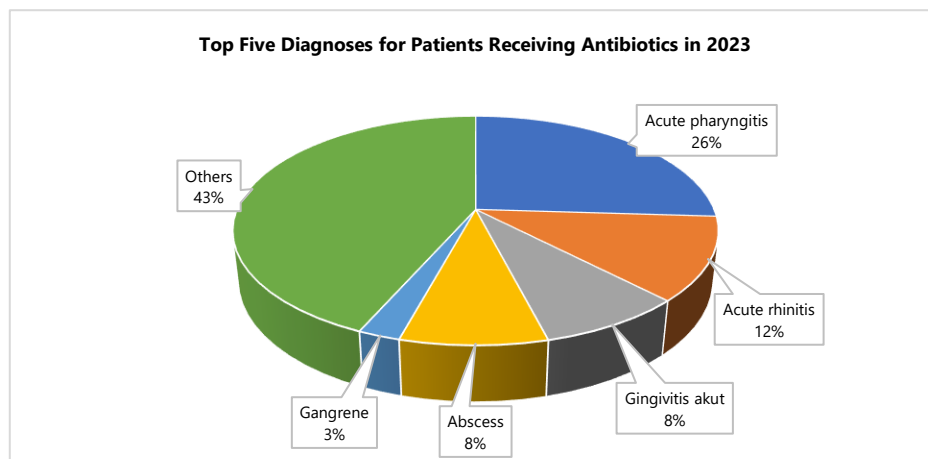


Figure 1. Top Five Diagnoses for Patients Receiving Antibiotics in 2023

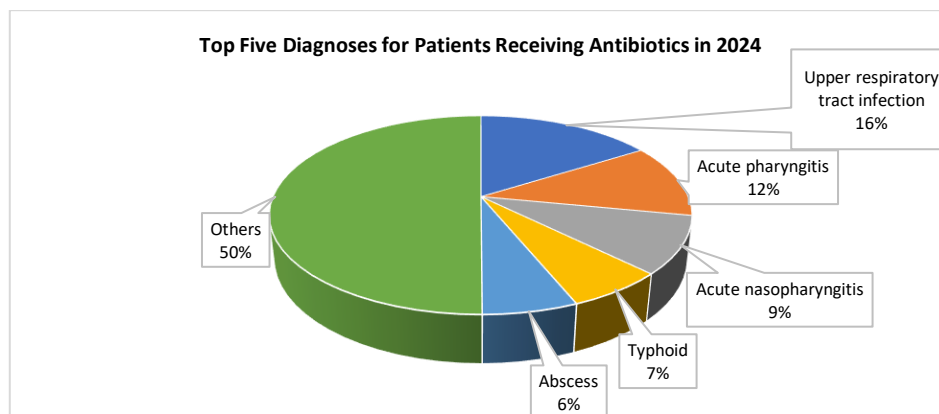


Figure 2. Top Five Diagnoses for Patients Receiving Antibiotics in 2024

The Quantity of Antibiotic Use

Based on the DDD method, total antibiotic consumption at the Banjarbaru Selatan Community Health Center increased from 315.57 DDD/1000 outpatient visits in 2023 to 377.38 DDD/1000 outpatient visits in 2024 (**Table 2**). Despite this increase, statistical analysis did not show significant differences in the DDD/1000 values between 2023 and 2024 ($p = 0.063$). This observation suggests that, despite an observed increase in antibiotic consumption at the Banjarbaru Selatan Health Center over the two years, the increase did not reach statistical significance. The rise in antibiotic consumption is correlated with various factors, including a high frequency of medication intake and a prolonged duration of medication use that exceeds the recommended guidelines for appropriate antibiotic use.²⁹ The total value of DDD/1000 outpatient visits is affected by the volume of outpatient visits.^{23,24} In this study, the increase in the total DDD value per 1000 outpatient visits from 2023 to 2024 was concomitant with the rise in outpatient visits, increasing from 16,109 patients in 2023 to 19,225 in 2024. This trend has implications for the prescribing practices of antibiotics for patients.

Table 2. Antibiotic Consumption at the South Banjarbaru Community Health Center Based on the DDD Method

Antibiotics	ATC Code	Number of Doses (Gram)		Number of DDDs in 1 year		DDD value/1000 outpatient visits		p-value
		2023	2024	2023	2024	2023	2024	
Amoxicillin	J01CA04	6,595.25	7,909	4,396.83	5,272.67	272.94	274.26	0.063
Ciprofloxacin	J01MA02	260	405	260	405	16.14	21.07	
Cefadroxil	J01DB05	385	1,720	192.5	860	11.95	44.73	
Thiamphenicol	J01BA02	227.5	975	151.67	650	9.42	33.81	
Metronidazole	P01AB01	135	135	67.5	67.5	4.19	3.51	
Cefixime	J01DD08	6	0	15	0	0.93	0	
Total						315.57	377.38	

Total outpatient visits in 2023 = 16109; Total outpatient visits in 2024 = 19225

The p-value represents the comparison of the DDD/1000 outpatient visits values between 2023 and 2024 using the Wilcoxon test.

The antibiotics used most frequently in the years 2023 and 2024 were Amoxicillin (**Table 2**). In 2023, Amoxicillin had a DDD value of 272.94 DDD per 1,000 outpatient visits, indicating that 273 out of 1,000 outpatient visits involved the administration of 1.5 grams of Amoxicillin.²³ In 2024, the DDD value increased slightly to 274.26 DDD per 1,000 outpatient visits, indicating that 274 out of 1,000 outpatient visits resulted in the administration of 1.5 grams of Amoxicillin. The DDD per 1,000 outpatient visits for Amoxicillin increased consistently throughout 2023 and 2024, suggesting a heightened clinical need for antibiotics that cover a variety of bacterial pathogens, especially those linked to respiratory infections. Consequently, health centers might consider broader-spectrum penicillin for empiric therapy.

Previous studies have supported these findings, with Amoxicillin reported as the most frequently used antibiotic in community health centers, according to DDD values.^{18–21,30,31} However, current research has found that the DDD value for Amoxicillin was lower than that reported in multiple earlier studies.^{19,20,30,31} This difference may be due to variants in patient diagnoses related to antibiotic usage, the geographical location where the study was conducted, and the period during which this research was conducted.

Amoxicillin is classified within the penicillin group of antibiotics and exhibits bactericidal activity against both Gram-positive and Gram-negative microorganisms. It is prescribed for conditions such as respiratory tract infections, otitis media, pneumonia, upper urinary tract infections, and skin infections.^{28,32} The benefits of administering Amoxicillin include its broad-spectrum efficacy, suitability for oral administration, and favorable tolerability profile.^{32,33} At the Banjarbaru Selatan Community Health Center, the predominant diagnosis among patients is pharyngitis. Empirical evidence suggests that individuals diagnosed with pharyngitis at this facility are more frequently prescribed Amoxicillin therapy.^{34,35} Pharyngitis is identified as an infectious condition characterized by pharyngeal inflammation, often presenting with dysphagia and a sore throat. *Streptococcus* spp. is the primary bacterial pathogen responsible for pharyngitis.³⁶ Amoxicillin is designated as the first-line therapeutic agent for pharyngitis in the antibiotic guidelines of Indonesia, contributing to its widespread use.^{34,36}

In this study, additional antibiotics recognized include Ciprofloxacin, Cefadroxil, and Thiamphenicol. The DDD/1000 outpatient visits for Ciprofloxacin and Cefadroxil observed in this research exceeded those recorded in the study by Perdana et al.²¹ Ciprofloxacin is classified as a fluoroquinolone antibiotic, which works by inhibiting the enzyme DNA gyrase. This enzyme is essential for bacterial replication and division.³⁷ Inhibition of DNA gyrase adversely affects DNA supercoiling and damages the double-stranded DNA structure, ultimately halting bacterial proliferation.³⁸ Ciprofloxacin is prescribed for various infections, including diabetic foot infections, respiratory tract infections, and urinary tract infections.³⁹ Research conducted at the Banjarbaru Selatan Community Health Center reveals that ciprofloxacin is the most commonly prescribed antibiotic, particularly among patients with urinary tract infections (UTIs).

Cefadroxil belongs to the cephalosporin class of antibiotics, which functions by inhibiting protein synthesis necessary for bacterial cell wall construction, thereby inducing damage and bacterial cell death, ultimately leading to the resolution of the infection. This antibiotic is effective only against bacterial infections and shows no efficacy against viral infections.⁴⁰ Cefadroxil is indicated for the treatment of uncomplicated urinary tract infections, respiratory tract infections, otitis media, and infections of the skin and soft tissues.³⁹ At the Banjarbaru Selatan Health Center in 2024, Cefadroxil was primarily administered to adults with skin infections, including abscesses, furuncles, and carbuncles, as well as acute pharyngitis and acute nasopharyngitis.

Thiamphenicol is classified as an Amphenicol antibiotic, functioning to inhibit bacterial protein synthesis by obstructing amino acid binding by tRNA.^{41,42} This antibiotic is effective against *Salmonella typhi* bacteria, making it a common prescription for individuals suffering from typhoid fever.⁴² At the Banjarbaru Selatan Community Health Center, the administration of thiamphenicol antibiotics was most prevalent among adult patients diagnosed with typhoid fever.

This investigation identified Cefixime as the antibiotic with the lowest consumption in 2023, while in 2024, Metronidazole was reported to have the lowest consumption. The results of this study differ from earlier research, which identified Erythromycin as the antibiotic with the least usage at the Jambi City Health Center.¹⁸ Metronidazole is used in clinical practice and is the preferred drug for treating anaerobic infections due to its narrow antibacterial spectrum.^{43,44} It is listed among the medications available at community health centers.⁴⁴ Metronidazole is used in the treatment of ulcerative gingivitis and acute oral infections.³⁹ According to the findings of a study conducted at the South Banjarbaru Community Health Center, Metronidazole is the most commonly prescribed antibiotic for patients diagnosed with periapical abscesses without sinus involvement, cellulitis, and oral abscesses. Cefixime, classified as a cephalosporin antibiotic analogous to Cefadroxil, shares a similar mechanism of action. The therapeutic indications for Cefixime include the treatment of uncomplicated urinary tract infections (caused by *Escherichia coli* and *Proteus mirabilis*), otitis media (caused by *Haemophilus influenzae* and *Streptococcus pneumoniae*), pharyngitis, and tonsillitis (caused by *Streptococcus pyogenes*). Cefixime is an antibiotic that should be available in advanced medical facilities such as hospitals. Its use is justified in particular high-risk resistance scenarios, necessitating careful monitoring of its application. This antibiotic can only be prescribed by specialist doctors or dentists and requires a pharmacist's review.⁴⁶

This study found that DDD/1000 outpatient visits values differed when compared to earlier studies.^{18,20,21,31} The variation in DDD/1000 outpatient visits values reflect differences in antibiotic use that may result from variations in disease prevalence, healthcare policies, or physicians' prescribing behaviors. This indicator is therefore essential for monitoring antibiotic consumption to control drug use and for organizing health services.⁴⁶ Furthermore, the varying DDD/1000 outpatient visit figures seen among health centers reflect the diverse rates of antibiotic use within these facilities.⁴⁷

Antibiotic consumption data are crucial for assessing the effectiveness of antibiotic management programs implemented in healthcare settings.⁴⁸ The implementation of the ATC/ DDD system within these services offers reliable data for evaluating antibiotic consumption and functions as a global standard method.⁸ The Defined Daily Dose (DDD) value represents the quantity of an antibiotic that is distributed. The decrease in DDD indicates that antibiotic prescriptions are being made more wisely, adhering to the principle of appropriate pharmacological use. On the other hand, high DDD can indicate improper or overuse of antibiotics. To improve the accuracy of DDD measurements, it is essential to include all antibiotic consumption within healthcare facilities.⁴⁹ This study demonstrates a decrease in the DDD value of metronidazole and cefixime use, which may be associated with changes in prescribing practices influenced by prescriber education and updated treatment guidelines.^{50,51} By employing the ATC/DDD system, researchers can gain an understanding of changing trends in drug use and make well-informed choices about antibiotic prescriptions, thereby helping to combat the growing challenge of antimicrobial resistance.¹⁷

The Segment of Drug Utilization 90%

The composition of the DU90% segment exhibits variation over the two years. In 2023, Amoxicillin solely constitutes the composition of the DU90% segment. Conversely, in 2024, the segment comprises both Amoxicillin and Cefadroxil (**Fig. 3 & Table 3**). This finding aligns with a study conducted at the Kebun Handil Community Health Center, which reported a change in the DU90% segment. In 2018, Amoxicillin was part of the DU90% segment, while in 2019, both Amoxicillin and ciprofloxacin were included in this category.⁵²

Antibiotics within the DU90% segment represent those most frequently prescribed in practice, whereas those in the DU10% segment are prescribed less often.⁵³ This study demonstrated a change in prescribing patterns, with Amoxicillin maintaining its position and Cefadroxil emerging as a frequently used alternative. The findings of this study on antibiotic utilization can contribute to the development of essential drug lists for planning purposes. Furthermore, information regarding antibiotic usage in the DU 90% segment is utilized in the preparation of formularies. Pharmaceuticals included in the DU 90% segment are essential for inclusion in health service formularies such as those used by Community Health Center.⁵⁴

The DU90% method emphasizes that frequently used antibiotics require careful management to prevent resistance.⁵⁵ Antibiotics within this segment carry a higher risk of resistance, emphasizing the need for cost-effective and efficient use.⁵⁶ High consumption and diversity of antibiotics further increase the risk of resistance, necessitating control measures such as limiting use and rotating antibiotic classes to maintain effectiveness.⁴⁶ The finding that Amoxicillin is included in the DU90% segment indicates that its frequent use may contribute to resistance if not adequately controlled. This highlights the need for rational prescribing, stronger pharmacist involvement in monitoring, and increased public awareness to prevent overuse.

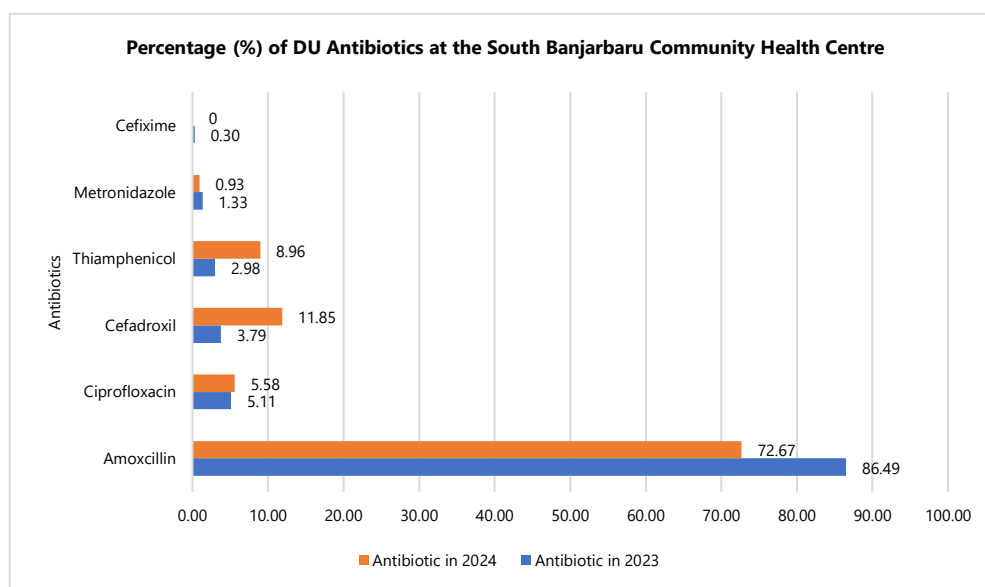


Figure 3. Percentage (%) of DU Antibiotics at the South Banjarbaru Community Health Center

Table 3. Compilation of the DU90% Antibiotic Segment at the South Banjarbaru Community Health Center Based on the DDD method

Year	Antibiotic	% DU	% DU Cumulative	DU Segment
2023	Amoxicillin	86.49	86.49	90% segment
	Ciprofloxacin	5.11	91.61	10% segment
	Cefadroxil	3.79	95.39	
	Thiamphenicol	2.98	98.38	
	Metronidazole	1.33	99.71	
	Cefixime	0.30	100	
2024	Amoxicillin	72.67	72.67	90% segment
	Cefadroxil	11.85	84.53	
	Thiamphenicol	8.96	93.49	10% segment
	Ciprofloxacin	5.58	99.07	
	Metronidazole	0.93	100	

Despite its contributions, this study has several limitations. The study utilized retrospective data from registration records and prescriptions, including only complete records to minimize bias. Furthermore, the Defined Daily Dose (DDD) method offers a standardized approach for comparing antibiotic use; however, it does not capture actual patient doses or the appropriateness of prescribing. Therefore, future research should integrate DDD analysis with patient-level and clinical data, complemented by qualitative assessments such as the Gyssens method, to provide a more comprehensive understanding of antibiotic utilization and its implications for resistance.

CONCLUSION

The relatively stable consumption of antibiotics, particularly the consistent predominance of Amoxicillin in the DU90% segment, reflects a prescribing pattern that, if not carefully managed, could accelerate antimicrobial resistance. This highlights the urgent need for rational prescribing, stronger pharmacist involvement, and public education on the responsible use of antibiotics. These findings offer actionable insights for strengthening antimicrobial stewardship and guiding policy interventions to preserve antibiotic efficacy.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

REFERENCES

1. WHO. *Global Antimicrobial Resistance and Use Surveillance System (GLASS) Report 2022*. World Health Organization; 2022.
2. Antimicrobial resistance. Accessed August 15, 2025. <https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance>
3. Lambraki IA, Cousins M, Graells T, et al. Governing Antimicrobial Resistance (AMR) in a Changing Climate: A Participatory Scenario Planning Approach Applied to Sweden in 2050. *Front Public Health*. 2022;10. doi:10.3389/FPUH.2022.831097
4. Kemenkes RI. *Survei Kesehatan Indonesia (SKI) Tahun 2023*. Kementerian Kesehatan Republik Indonesia; 2023.
5. Hodos V, Marius Daina C, Carmen Zaha D, et al. medicina Pattern of Antibiotic Use in the Perinatal Period in a Public University Hospital in Romania. Published online 2022. doi:10.3390/medicina58060772
6. Sukertiasih NK, Megawati F, Meriyani H, Sanjaya DA. Studi Retrospektif Gambaran Resistensi Bakteri terhadap Antibiotik. *Jurnal Ilmiah Medicamento*. 2021;7(2):108-111. doi:10.36733/MEDICAMENTO.V7I2.2177
7. Satu Data Kota Banjarbaru. Accessed April 20, 2025. <https://data.banjarbarukota.go.id/data/236/jumlah-kasus-penyakit-menular-berdasarkan-kecamatan-di-kota-banjarbaru>
8. Andarsari MR, Khosyyatillah I, Sholichah A, Shinta DW, Wibisono C, Khotib J. Application of ATC/DDD methodology to analyse antibiotic consumption in internal medicine department: A review. *Pharmacy Education*. 2023;23(4):251-258. doi:10.46542/PE.2023.234.251258
9. Siahaan S, Herman MJ, Fitri N. Antimicrobial Resistance Situation in Indonesia: A Challenge of Multisector and Global Coordination. *J Trop Med*. 2022;2022. doi:10.1155/2022/2783300
10. Klein EY, Impalli I, Poleon S, et al. Global trends in antibiotic consumption during 2016–2023 and future projections through 2030. *Proc Natl Acad Sci U S A*. 2024;121(49):e2411919121. doi:10.1073/PNAS.2411919121
11. Lisa Arulappen A, Hayat Khan A, Shahzad Hasan S, et al. The correlation between antibiotic usage and antibiotic resistance: a 3-year retrospective study. *Front Cell Infect Microbiol*. 2025;15:1608921. doi:10.3389/FCIMB.2025.1608921
12. Nasution ES, Tanjung HR, Putri I. Evaluation of antibiotics using ATC/DDD and DU 90% methods on ICU patients at Universitas Sumatera Utara Hospital. *Pharmacia*. 2023;70(4):1223-1229. doi:10.3897/pharmacia.70.e103566

13. Nunes PHC, Moreira JP de L, Thompson A de F, Machado TL da S, Cerbino-Neto J, Bozza FA. Antibiotic Consumption and Deviation of Prescribed Daily Dose From the Defined Daily Dose in Critical Care Patients: A Point-Prevalence Study. *Front Pharmacol*. 2022;13. doi:10.3389/fphar.2022.913568
14. Garedow AW, Tesfaye GT. Evaluation of Antibiotics Use and its Predictors at Pediatrics Ward of Jimma Medical Center: Hospital Based Prospective Cross-sectional Study. *Infect Drug Resist*. 2022;15:5365. doi:10.2147/IDR.S381999
15. Limato R, Lazarus G, Dernison P, et al. Optimizing antibiotic use in Indonesia: A systematic review and evidence synthesis to inform opportunities for intervention. *The Lancet Regional Health - Southeast Asia*. 2022;2:100013. doi:10.1016/J.LANSEA.2022.05.002
16. Amaha ND, Weldemariam DG, Berhe YH. Antibiotic consumption study in two hospitals in Asmara from 2014 to 2018 using WHO's defined daily dose (DDD) methodology. *PLoS One*. 2020;15(7). doi:10.1371/journal.pone.0233275
17. Nyamagoud SB, Swamy AHV, Varghese LE. Evaluation of antibiotic utilization and prescription patterns in inpatient hospital setting: A retrospective observational study. *BLDE University Journal of Health Sciences*. 2024;9(2):116-123. doi:10.4103/BJHS.BJHS_26_23
18. Andriani Y, Sahat Martua A, Program MA, Farmasi S, Harapan S, Jambi I. Evaluasi Penggunaan Antibiotik Dengan Metode ATC/DDD Dan DU 90% Di Puskesmas Aur Duri Kota Jambi Periode 2016-2018. *As-Syifaa Jurnal Farmasi*. 2020;12(2):91-98. doi:10.56711/JIFA.V12I2.628
19. Amini F, Hasanah NU, Alrosyidi AF. Analisis Penggunaan Antibiotik Menggunakan Metode DDD (Defined Daily Dose) Pada Pasien Rawat Jalan Di Puskesmas Proppo Kabupaten Pamekasan Periode Januari - Maret Tahun 2024. *Jurnal Ilmiah Kajian Multidisipliner*. 2024;8(8):2118-7302. Accessed April 20, 2025. <https://oaj.jurnalhst.com/index.php/jikm/article/view/3666>
20. Aleksander O, Andriani Y, Andriani M. Pola Penggunaan Antibiotik Dengan Metode ATC/DDD Dan DU 90% Di Puskesmas Paal V Kota Jambi Periode 2017-2019. *Journal of Healthcare Technology and Medicine*. 2020;6(1):259-275. Accessed April 29, 2025. <https://jurnal.uui.ac.id/index.php/JHTM/article/view/691>
21. Perdaka W, Sagita D, Pratama S. Studi Penggunaan Antibiotik Berdasarkan ATC/DDD Dan Du 90% Di Puskesmas X Kota Jambi Periode 2017-2018. *Journal of Healthcare Technology and Medicine*. 2020;6(1):26-32. Accessed April 29, 2025. <https://jurnal.uui.ac.id/index.php/JHTM/article/view/661>
22. Swarna Latha D, Giriraj Sekhar D, Surya Teja K V, et al. A Retrospective Study in DUE and ATC/DDD Evaluation of Antibiotics in Specif-ic Departments of a Tertiary Care Hospital. *Journal of Antibiotics Research*. 2023;6(1). www.annexpublishers.com
23. Siswidiarsari A, Wahab CS, Trisya R, Lansteiner Dam Selomangleng No F, Kediri K, Timur J. Evaluasi Kuantitas Penggunaan Obat Analgesik Di Puskesmas Pesantren Dengan Metode ACC/DDD Dan DU 90%. *Java Health Jounal*. 2021;8(3). doi:10.1210/JHJ.V8I3.416
24. Upa MSMP, Tjitda PJ, Blegur F, Indrawati MIM, Meni MZ. Profil Penggunaan Antibiotik dengan Metode ATC/DDD pada Pasien Rawat Jalan di Salah Satu Rumah Sakit di Kota Kupang. *Jurnal FarmasiKoe*. 2022;5(2):30-35.
25. Zairina E, Dhamanti I, Nurhaida I, Mutia DS, Natesan A. Analysing of drug patterns in primary healthcare centers in Indonesia based on WHO's prescribing indicators. *Clin Epidemiol Glob Health*. 2024;30:101815. doi:10.1016/J.CEGH.2024.101815
26. Wibowo YI, Firdhausi N, Rahmah N, Setianur N, Sunderland B, Setiadi AP. Antibiotic prescribing for children five years or younger in Indonesian primary care settings. *The Journal of Infection in Developing Countries*. 2025;19(03):409-417. doi:10.3855/jidc.19581
27. Karimi G, Kabir K, Farrokhi B, et al. Prescribing pattern of antibiotics by family physicians in primary health care. *J Pharm Policy Pract*. 2023;16(1). doi:10.1186/s40545-023-00515-6
28. Estiningsih D, Puspitasari I, Nuryastuti T, Lukitaningsih E. Antibiotic use and antibiotic resistance profile of bacteria isolated from outpatients of Pakem primary healthcare, Yogyakarta. *Pharmacy Education*. 2023;23(2):156-162. doi:10.46542/PE.2023.232.156162

29. Sukmawati IGAND, Adi Jaya MK, Swastini DA. Evaluasi Penggunaan Antibiotik pada Pasien Tifoid Rawat Inap di Salah Satu Rumah Sakit Pemerintah Provinsi Bali dengan Metode Gyssens dan ATC/DDD. *Jurnal Farmasi Udayana*. Published online June 26, 2020:37. doi:10.24843/JFU.2020.V09.I01.P06
30. Indiarito EN, Herawati F, Wardani SA. Profil Penggunaan Obat Rasional di Puskesmas Kabupaten Sidoarjo Provinsi Jawa Timur Tahun 2017. *CALYPTRA*. 2020;9(1). Accessed April 29, 2025. <https://journal.ubaya.ac.id/index.php/jimus/article/view/4686>
31. Fakhrunnisa F, Farmasi PS, Ilmu F, Universitas K, Slawi B. Evaluasi Penggunaan Antibiotik di Puskesmas Kabupaten Tegal di Jawa Tengah Dengan Metode ATC/ DDD. *KUNIR: JURNAL FARMASI INDONESIA*. 2024;2(1):66-73. doi:10.36308/KJFI.V2I1.670
32. Carvalho HEF, Schneider G, dos Santos Junior AG, et al. Prescription of Antimicrobials in Primary Health Care: Scoping Review. *Open Nurs J*. 2021;15(1):343-350. doi:10.2174/1874434602115010343
33. Al Mujaini SM, Almayahi ZK, Abouammoh NA, Al Amri S. Antibiotic prescription pattern among Primary Healthcare General Practitioners in the South Batinah Governorate of Oman, 2019. *BMC Primary Care*. 2024;25(1):1-10. doi:10.1186/S12875-024-02488-0/TABLES/4
34. Yuziani Y, Sofia R, Siregar FSI. Evaluation of the use of Antibiotics Quantitatively and Qualitatively in Pharyngitis Patients at Banda Sakti Public Health Center Lhokseumawe. *Media Farmasi: Jurnal Ilmu Farmasi*. 2023;20(2):72-77. doi:10.12928/MF.V20I2.26122
35. Pitasari NWN, Imba F, Risna R, Litaay GW. Evaluation of Antibiotic use with the ATC/DDD Method and DU 90% on Respiratory Tract Infection Patients. *Indonesian Journal of Global Health Research*. 2025;7(1):1023-1030. doi:10.37287/IJGHR.V7I1.5513
36. WHO. *WHO Antibiotics Book AWaRe (Access, Watch, Reserve)*. World Health Organization; 2023.
37. Rame A, Dewangga VS. Uji Resistensi Bakteri Pada Urin Penderita Isk Terhadap Antibiotik Levofloxacin Dan Ciprofloxacin Di Laboratorium Klinik Prodia Makassar. *Pharmacon*. 2022;11(3):1591-1596. doi:10.35799/PHA.11.2022.40986
38. Selifiana N, Irwanti D, Lisni I. Evaluasi Penggunaan Antibiotik pada Pasien Infeksi Saluran Kemih di Salah Satu Rumah Sakit Kota Bandung. *Jurnal Ners*. 2023;7(1):284-292. doi:10.31004/JN.V7I1.13209
39. BNF. *British National Formulary*. 85th ed. BMJ Publishing Group; 2023.
40. Handayani W, Aristyawan AD, Safitri OE. Uji In Vitro Interaksi Cefadroxil dengan Pisang dan Susu terhadap Bakteri Staphylococcus aureus dengan Metode Difusi Cakram. *Journal of Pharmacy and Science*. 2020;5(2).
41. Sari WK, Yustisia DA, Elisa N. Pola Peresepan Antibiotik Untuk Pengobatan Infeksi Saluran Pernafasan Atas (Ispa) Di Klinik X Kota Semarang. *Cendekia Journal of Pharmacy*. 2024;8(1):17-27. doi:10.31596/CJP.V8I1.275
42. Puspasari H, Suryaningrat D, Rizky M. Analisis Biaya Pengobatan Pasien Diagnosa Demam Tifoid di Instalasi Rawat Inap RSUD Dr Soedarso Pontianak Tahun 2018. *Jurnal Farmasi Dan Ilmu Kefarmasian Indonesia*. 2020;7(1):1-6. doi:10.20473/JFIKI.V7I12020.1-6
43. Li FF, Zhang PL, Tangadanchu VKR, Li S, Zhou CH. Novel metronidazole-derived three-component hybrids as promising broad-spectrum agents to combat oppressive bacterial resistance. *Bioorg Chem*. 2022;122:105718. doi:10.1016/J.BIOORG.2022.105718
44. Shah S, Adams K, Clarke L, et al. Clinical outcomes of a twice-daily metronidazole dosing strategy for Bacteroides spp. bloodstream infections. *Int J Antimicrob Agents*. 2025;65(3):107403. doi:10.1016/J.IJANTIMICAG.2024.107403
45. Wolters Kluwer. *Drug Information Handbook With International Trade Names Index 25th Edition*. 27th ed. American Pharmacist Association; 2018.
46. Arbaini NH, Irawan Y, Makani M. Evaluasi Penggunaan Antibiotik dengan Metode ATC/DDD dan DU 90% pada Pasien Anak Rawat Jalan di RSUD Sultan Imanuddin Pangkalan Bun. *INNOVATIVE: Journal Of Social Science Research*. 2024;4(6).
47. Juni Trisia F, Sagita D, Pratama S. Evaluasi Penggunaan Antibiotik Dengan Metode ATC/DDD Dan DU 90% Di Dua Puskesmas Kota Jambi Periode 2017-2018. *Journal of Healthcare Technology and Medicine*. 2020;6(1):125-138. Accessed May 28, 2025. <https://jurnal.uui.ac.id/index.php/JHTM/article/view/678>

48. Labi AK, Kartey BS, Hedidor GK, et al. Antibiotic consumption trends in Ghana: analysis of six-years pharmacy issue data from a secondary healthcare facility. *JAC Antimicrob Resist.* 2023;5(2). doi:10.1093/JACAMR/DLAD025
49. Heroweti J, Suswanto S, Johari AM. Evaluation Of Antibiotic Use With Quantitative Methods at Sultan Agung Semarang Hospital. *Jurnal Mandala Pharmacon Indonesia.* 2024;10(2):471-479. doi:10.35311/jmpi.v10i2.524
50. Devine P, O'kane M, Bucholc M. Trends, variation, and factors influencing antibiotic prescribing: A longitudinal study in primary care using a multilevel modelling approach. *Antibiotics.* 2022;11(1):17. doi:10.3390/ANTIBIOTICS11010017/S1
51. Ndefo UA, Norman R, Henry A. Academic Detailing Has a Positive Effect on Prescribing and Decreasing Prescription Drug Costs: A Health Plan's Perspective. *Am Health Drug Benefits.* 2017;10(3):129. Accessed August 16, 2025. <https://pmc.ncbi.nlm.nih.gov/articles/PMC5470238/>
52. Andriani Y, Meirista I, Aprio Y. Evaluasi Penggunaan Antibiotik Dengan Metode ATC/DDD Dan DU 90% di Puskesmas Kebun Handil Kota Jambi Periode 2018 dan 2019. *Journal of Healthcare Technology and Medicine.* 2020;6(2):700-707. doi:10.33143/JHTM.V6I2.976
53. Azyenela L, Tobat SR, Selvia L. Evaluasi Penggunaan Antibiotik di Instalasi Rawat Inap Bedah RSUD M. Natsir Kota Solok Tahun 2020. *Jurnal Mandala Pharmacon Indonesia.* 2022;8(1):1-10. doi:10.35311/JMPI.V8I1.123
54. Oktavina IN, Sunarti, Samodra G. Analysis of Antidiabetic Drug Utilization at Cilacap Regional General Hospital in 2022 Using ATC/DDD and DU90% Methods. *Viva Medika: Jurnal Kesehatan, Kebidanan dan Keperawatan.* 2024;17(1):83-88. doi:10.35960/VM.V17I1.1349
55. Rachmah AR, Khoirin, Shaum S, Suprayetno, Audia FS. Studi Penggunaan Antibiotik Pasien Pneumonia Dengan Metode Defined Daily Dose Dan Drug Utilization (DU 90%). *Jurnal 'Aisyiyah Medika.* 2024;9(1). doi:10.36729/JAM.V9I1.1169
56. Puspitadewi N, Halimah E. Evaluasi Penggunaan Antibiotik Pasien Rawat Inap Non-Bedah Rumah Sakit X Di Bandung Periode Januari-Desember 2022 Menggunakan Metode ATC/DDD. *Farmaka.* 2023;21(3):322-328. doi:10.24198/FARMAKA.V21I3.47213