

Evaluation of Antibiotics Utilization Pattern Among Outpatients with Acute Respiratory Infection (ARI) at Taraman Public Health Center, East Ogan Komering Ulu in 2025 Using the ATC/DDD and DU 90% Methods

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Abstract

Background: Acute respiratory infections (ARIs) are among the most common conditions managed in primary healthcare and contribute substantially to antibiotic prescribing. Monitoring antibiotic utilization is important to identify prescribing patterns and support antimicrobial stewardship efforts. The Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) and Drug Utilization 90% (DU90%) methodologies provide standardized approaches for evaluating medicine utilization. **Objectives:** This study aimed to evaluate the pattern of antibiotic utilization among outpatients with ARIs at Taraman Public Health Center, East OKU Regency, Indonesia, using the ATC/DDD and DU90% methods. **Methods:** A retrospective cross-sectional study was conducted using medical records of 77 ARI outpatients who received antibiotics at Taraman Public Health Center from January to December 2025. Antibiotic use was classified using the ATC system and quantified by DDD. The DU90% segment was determined based on DDD contribution. Associations between patient characteristics and antibiotic type were analyzed using the Fisher–Freeman–Halton exact test in IBM SPSS Statistics version 27. **Result:** Among the 77 patients included, amoxicillin was the most frequently utilized antibiotic, with a utilization value of 661.54 DDD/ [appropriate denominator]. Amoxicillin, cefadroxil, and cefixime accounted for the DU90% segment. No significant association was observed between antibiotic type and sex ($p = 0.531$) or age group ($p = 0.282$). **Conclusion:** Antibiotic use in ARI outpatients at Taraman Public Health Center was dominated by amoxicillin. Amoxicillin, cefadroxil, and cefixime accounted for the DU90% segment. These findings support antibiotic monitoring and antimicrobial stewardship in primary healthcare.

Keywords: Acute Respiratory Infection; Antibiotic Utilization; ATC/DDD; DU90%; Primary Health Care

1. INTRODUCTION

Acute respiratory tract infection (ARI) is defined as an infectious condition of the respiratory system caused by viral or bacterial pathogens, characterized by symptoms such as fever, sore throat, odynophagia, rhinorrhea, and dry or productive cough. [1]. Three risk factors are associated with ARI, namely individual, behavioral, and environmental factors[2]. According to the World Health Organization (WHO), ARI is a leading cause of healthcare visits, underscoring the need for effective strategies to reduce its incidence and impact [3].

Acute respiratory tract infection (ARI) remains a major health concern in Indonesia, with 12,159,831 cases reported in 2025, the highest number recorded [4]. South Sumatra Province recorded 331,064 ARI cases, while East OKU Regency recorded 24,301 cases [5]. A similar trend was observed at Taraman Public Health Center, where ARI rose from the fourth most prevalent disease in 2024 to the leading health problem in 2025, with 325 cases. The high burden of ARI in primary healthcare settings may increase antibiotic use, highlighting the importance of evaluating prescribing patterns to promote rational antibiotic use and prevent antimicrobial resistance [6].

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As primary healthcare facilities, public health centers play a key role in the outpatient management of ARI, including antibiotic prescribing decisions [7]. Therefore, antibiotic prescribing patterns in public health centers serve as indicators of healthcare quality and rational drug use [8], [9]. Patient characteristics, including age and sex, may influence ARI incidence and treatment decisions due to differences in physiological and immune responses. Children are at higher risk of ARI because of their immature immune systems, while clinical variations among adults may also influence antibiotic selection [10], [11], [12]. In addition to patient characteristics, variations in antibiotic prescribing warrant evaluation as they reflect considerations of antimicrobial spectrum, efficacy, and healthcare policies [13].

World Health Organization (WHO) recommends the Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) methodology as an international standard for evaluating drug utilization, including antibiotics, while the Drug Utilization 90% (DU90%) method identifies the most frequently used antibiotics [12], [14]. Combining these methods provides a more comprehensive assessment of antibiotic utilization patterns and supports the evaluation of prescribing rationality.

Several studies have reported variations in antibiotic utilization patterns among ARI patients across healthcare settings. A study in a hospital in Kupang identified cefadroxil as the most frequently prescribed antibiotic, whereas a study of pediatric ARI patients reported amoxicillin as having the highest utilization based on the ATC/DDD method [12], [15]. These differences indicate that antibiotic utilization patterns are influenced by patient characteristics, antibiotic availability, and healthcare policies across facilities. However, studies specifically evaluating antibiotic utilization among outpatients with ARI at Taraman Public Health Center, East OKU Regency, remain limited. Therefore, this study aimed to evaluate antibiotic utilization patterns among outpatients with ARI at Taraman Public Health Center in 2025 using the ATC/DDD and DU90% methods. The findings are expected to provide scientific evidence on antibiotic utilization in primary healthcare settings and support efforts to promote rational antibiotic use.

2. METHODS

Materials

The study used secondary data from the medical records of outpatients primarily diagnosed with acute respiratory tract infection (ARI) at Taraman Public Health Center, East OKU Regency, from January to December 2025. Of 325 medical records, 77 records met the inclusion criteria, comprising patients aged 18–55 years who received at least one antibiotic and had complete medical records [16].

Equipment

The study instruments included an observation sheet for recording patient characteristics and antibiotic prescribing details from medical records, the World Health Organization (WHO) Anatomical Therapeutic Chemical/Defined Daily Dose (ATC/DDD) Index for standardized drug classification, Microsoft Excel for data processing, DDD/1,000 outpatient visits calculations, and DU90% analysis, and IBM SPSS Statistics version 27 for assessing associations between variables [17].

Procedures

The study commenced after obtaining ethical approval from the relevant institutional ethics committee, with ethical clearance No. KEPK/UMP/108/VI/2026. Secondary data were retrospectively collected from March to June 2026 using medical records of patients with acute respiratory infections (ARIs) treated at Taraman Public Health Center during January–December 2025. Medical records were selected using purposive sampling according to the predefined inclusion criteria, resulting in 77 eligible records. Patient characteristics, including age, sex, diagnosis, and comorbidities, as well as antibiotic utilization variables, including drug name, dose, route of administration, quantity, and duration of therapy, were extracted using a standardized observation sheet. The procedures for reporting the study setting, participants, variables, data sources, and statistical methods were aligned with recommendations for observational studies.

Antibiotics were classified according to the Anatomical Therapeutic Chemical (ATC) classification system and quantified using the Defined Daily Dose (DDD) methodology. Microsoft Excel was used for data processing, calculation of antibiotic utilization, and determination of the DU90% segment based on cumulative DDD percentages. The ATC/DDD methodology is recommended by the World Health Organization (WHO) as a standardized approach for drug-utilization monitoring and research, facilitating the comparison of medicine utilization across populations and settings (World Health Organization [WHO], 2024). The DU90% method was used to identify the antibiotics accounting for 90% of total utilization, consistent with the WHO-recommended application of the indicator. Statistical analysis was performed using IBM SPSS Statistics version 27. The Fisher–Freeman–Halton exact test was used to assess associations between patient characteristics (age and sex) and antibiotic utilization patterns, with statistical significance defined as $p < 0.05$ [17], [18].

3. RESULT

This study analyzed antibiotic utilization patterns among outpatients with ARI at Taraman Public Health Center, East OKU Regency, from January to December 2025 using the ATC/DDD and DU90% methods. A total of 77 patients met the study criteria and were included in the analysis. The evaluation covered patient characteristics, antibiotic utilization based on DDD/1,000 outpatient visits, antibiotic distribution within the DU90% segment, and the association between patient characteristics and antibiotic utilization.

Patient characteristics included age and sex to describe the demographic profile of outpatients with ARI receiving antibiotic therapy. Their distribution is presented in **Table 1**.

Table 1. Patient Characteristics by Sex and Age Group

Characteristic	N	%
Sex		
Male	31	40,26
Female	46	59,74
Total	77	100
Age Group		
Late Adolescence (18-20 years)	4	5,20
Early Adulthood (21-40 years)	35	45,45
Late Adulthood (41-55 years)	38	49,35
Total	77	100

As shown in **Table 1**, female patients predominated among outpatients with ARI receiving antibiotic therapy, accounting for 46 patients (59.74%), compared with 31 males (40.26%). By age group, late adulthood was the most represented category (38 patients, 49.35%), followed by early adulthood (35 patients, 45.45%) and late adolescence (4 patients, 5.20%). Antibiotic utilization was also evaluated to characterize prescribing patterns among outpatients with ARI. The distribution of antibiotics by utilization and DDD/1,000 outpatient visits is presented in **Table 2**.

Table 2. Antibiotic Utilization Patterns Based on the ATC/DDD Method

Antibiotic	ATC Code	Total Utilization (g)	WHO-Defined DDD (g)	Total DDD	DDD/1000 Outpatient Visit
Amoxicillin	J01CA04	322,5	1,5	215,00	661,54
Cefadroxil	J01DB05	120	2	60,00	184,62
Cefixime	J01DD08	7	1	17,50	53,85
Ciprofloxacin	J01MA02	15	0,4	15,00	46,15

As shown in **Table 2**, amoxicillin had the highest utilization, with a total of 322.5 g, equivalent to 216.00 DDD and 661.54 DDD/1,000 outpatient visits. This was followed by cefadroxil at 184.62 DDD/1,000 outpatient visits (60.00 DDD), cefixime at 53.85 DDD/1,000 outpatient visits (17.50 DDD), and ciprofloxacin at 46.15

DDD/1,000 outpatient visits (15.00 DDD). DU90% analysis was performed to identify antibiotics accounting for 90% of total utilization based on DDD/1,000 outpatient visits. The results are presented in **Table 3**.

Table 3. DU90% Profile

Antibiotic	Total DDD	Percentage (%)	Cumulative Percentage	DU90% Segment
Amoxicillin	215	69,92	69,92	Yes
Cefadroxil	60	19,51	89,43	Yes
Cefixime	17,5	5,69	95,12	Yes
Ciprofloxacin	15	4,88	100,00	No

As shown in **Table 3**, amoxicillin, cefadroxil, and cefixime comprised the DU90% segment, with a cumulative utilization of 95.12%. Ciprofloxacin was excluded from the DU90% segment, accounting for only 4.88% of total antibiotic utilization. This indicates that antibiotic use was concentrated among a limited number of agents, particularly amoxicillin.

Table 4. Association Between Sex and Antibiotic Utilization

Sex	Amoxicillin		Cefadroxil		Cefixime		Ciprofloxacin		Total		p-value
	f	%	f	%	f	%	f	%	f	%	
Male	18	41,9	11	45,8	1	14,3	1	33,3	31	40,3	0,531
Female	25	58,1	13	54,2	6	85,7	2	66,7	36	46,7	
Total	43	100	24	100	7	100	3	100	77	100	

As shown in **Table 4**, amoxicillin was the most frequently used antibiotic among both male and female patients, accounting for 18 (41.9%) and 25 (58.1%) patients, respectively. The distribution of other antibiotics was relatively similar between the two groups. The Fisher–Freeman–Halton exact test showed no significant association between sex and antibiotic utilization ($p = 0.531$).

The association between age group and antibiotic utilization was also analyzed to assess prescribing patterns across different age groups. The results are presented in **Table 5**.

Table 5. Association Between Age Group and Antibiotic Utilization

Age Group	Amoxicillin		Cefadroxil		Cefixime		Ciprofloxacin		Total		p-value
	f	%	f	%	f	%	f	%	f	%	
Late Adolescence	3	7	0	0	1	14,3	0	0	4	5,2	0,282
Early Adulthood	18	41,9	14	58,3	3	42,9	0	0	35	45,5	
Late Adulthood	22	51,1	10	41,7	3	42,9	3	100	38	49,3	
Total	43	100	24	100	7	100	3	100	77	100	

As shown in **Table 5**, amoxicillin was the most frequently used antibiotic across all age groups, particularly among late-adult (51.1%) and early-adult (41.9%) patients. A similar pattern was observed for cefadroxil and cefixime, whereas ciprofloxacin was used only among late-adult patients. The Fisher–Freeman–Halton exact test showed no significant association between age group and antibiotic utilization ($p = 0.282$).

4. DISCUSSION

The predominance of female patients in this study is consistent with Ali et al. (2024), who reported a higher proportion of female than male ARI patients at Telaga Biru Public Health Center [1]. This difference may be related to health-seeking behavior, with women tending to utilize healthcare services more frequently than men [19].

The high proportion of late-adult patients may be associated with greater activity levels, environmental exposure, and age-related changes in immune response [20]. However, demographic characteristics do not directly determine antibiotic utilization, as ARI treatment decisions are primarily influenced by clinical condition and infection etiology. Thus, the patient characteristics provide an epidemiological profile of ARI subgroups receiving antibiotics at Taraman Public Health Center, East OKU Regency, and serve as a descriptive basis for further evaluation of antibiotic utilization using the ATC/DDD and DU90% methods.

The DDD/1,000 outpatient visits value estimates antibiotic consumption based on the standard daily dose per 1,000 outpatient visits and does not indicate the number of patients receiving antibiotics or the appropriateness of individual therapy. This value is influenced by the amount of antibiotic used, formulation strength, dose, and treatment duration. In this study, all antibiotics were administered for five days, resulting in cumulative antibiotic use throughout the treatment period and consequently affecting the calculated DDD values [21].

The high DDD value of amoxicillin indicates its major contribution to antibiotic utilization among ARI patients at Taraman Public Health Center. Its predominance may be attributed to its role as a first-line antibiotic for suspected bacterial respiratory infections, along with its efficacy, favorable safety profile, affordability, and availability in primary healthcare [22]. In addition, treatment guidelines for adult ARI generally recommend antibiotic courses of 3–7 days, depending on the clinical condition and patient response [23].

Differences in DDD values across antibiotics reflect variations in utilization patterns at Taraman Public Health Center. The predominance of amoxicillin and cefadroxil over cefixime and ciprofloxacin suggests that first-line antibiotics remain the primary choices in primary healthcare. The relatively low use of broad-spectrum antibiotics is consistent with antimicrobial stewardship principles aimed at reducing selective pressure for bacterial resistance. Nevertheless, periodic evaluation of antibiotic utilization remains necessary to ensure alignment between antibiotic consumption, clinical indications, and treatment guidelines.

Amoxicillin contributed the largest proportion of the DU90% segment, accounting for 69.92%. Its predominant use is consistent with the ATC/DDD analysis, which showed the highest utilization compared with other antibiotics. The high utilization of amoxicillin may be attributed to its role as a first-line antibiotic for respiratory infections suspected to be bacterial, its favorable safety profile, adequate efficacy, and availability in primary healthcare [12], [24].

In addition to amoxicillin, cefadroxil and cefixime were also included in the DU90% segment. Cefadroxil may be used as an alternative cephalosporin therapy for mild to moderate infections, whereas cefixime warrants attention because it is a broader-spectrum antibiotic that should be used based on appropriate clinical indications [25], [26]. According to the WHO AWaRe classification, amoxicillin belongs to the *Access* group, whereas cefixime and ciprofloxacin belong to the *Watch* group, which carries a higher risk of resistance and therefore requires careful monitoring [27].

The antibiotic utilization pattern in this study is consistent with previous studies showing that amoxicillin is often the predominant antibiotic in the DU90% segment among ARI patients in primary healthcare settings, followed by cephalosporins such as cefadroxil and cefixime [12], [24], [28]. Although the predominance of amoxicillin suggests a preference for first-line antibiotics, evaluating the rationality of antibiotic use remains necessary by assessing indications, dosage, treatment duration, and adherence to clinical guidelines.

In addition to clinical considerations, demographic analysis showed no significant association between sex and antibiotic utilization. This finding indicates that antibiotic utilization patterns among ARI patients at Taraman Public Health Center were not influenced by sex. Antibiotic selection for ARI is generally based on clinical considerations, including diagnosis, suspected etiology, disease severity, and adherence to treatment guidelines, rather than patient demographics. Furthermore, the antibiotics used in this study generally have no sex-specific dosing recommendations, resulting in similar utilization patterns between male and female patients.

These findings are consistent with Melinda (2025), who reported no significant association between sex and antibiotic utilization patterns among ARI patients. This finding suggests that antibiotic prescribing practices in primary healthcare settings are more strongly influenced by patients' clinical characteristics than by demographic characteristics [29]. Similar to sex, age was not significantly associated with antibiotic utilization patterns. This finding may be influenced by the uneven sample distribution, with only four patients in the late-adolescent group, while most participants were in the early- and late-adult groups. In addition, all participants were aged 18–55 years, resulting in relatively limited physiological variation across age groups and similar

antibiotic selection in accordance with treatment guidelines.

In adults with ARI, antibiotic selection is generally driven by clinical diagnosis, suspected etiology, disease severity, and patient condition rather than age. This finding is consistent with Runtu et al. (2020), who reported no association between age and antibiotic selection in adult patients, as treatment was primarily guided by clinical considerations [30]. The absence of an association between age group and antibiotic utilization suggests that antibiotic selection for ARI patients at Taraman Public Health Center is influenced more by clinical considerations and treatment standards than by demographic factors [31,32].

5. CONCLUSION

Antibiotic utilization among outpatients with acute respiratory infections at Taraman Public Health Center was predominantly characterized by amoxicillin use, with amoxicillin, cefadroxil, and cefixime comprising the DU90% segment. No significant association was observed between antibiotic type and patients' sex or age group. These findings provide baseline evidence to support antibiotic utilization monitoring and strengthen antimicrobial stewardship practices in primary healthcare settings

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