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A Study on the Rational Use of Antimalarial Medicines at Puskesmas Asologaima, Jayawijaya, Papua Pegunungan

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ABSTRACT

Malaria remains a significant public health challenge in Papua Province, Indonesia, which consistently reports among the highest incidence rates nationwide. Environmental factors and community behaviors continue to impede effective prevention and treatment efforts. This study aimed to evaluate the rationality of antimalarial drug prescriptions at primary health centers (Puskesmas) in Jayawijaya, Papua Pegunungan Province. A retrospective, descriptive-analytical study was conducted using 135 prescription records from 2023 to 2024. Data were analyzed using the Chi-square test via SPSS software. The findings revealed that most prescriptions met rational drug use criteria regarding patient eligibility, drug selection, timing, and route of administration. However, a significant gap was identified in dosage accuracy, particularly in *Plasmodium falciparum* cases, where only 8.3% of prescriptions conformed to recommended dosing guidelines ($p \leq 0.05$). These results underscore the urgent need for targeted interventions and prescriber training to improve the quality of antimalarial drug use in high-endemic areas.

KEYWORDS: Malaria, Rational Use, Antimalarial Medicines, Papua

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I. INTRODUCTION

Malaria is a life-threatening disease that remains endemic in many tropical and subtropical regions, imposing a significant burden on public health systems and socio-economic development. Despite advancements in prevention and treatment strategies, delayed diagnosis and inappropriate therapy can rapidly progress uncomplicated malaria into severe illness, potentially resulting in fatal outcomes without timely and adequate medical intervention [1].

Malaria is transmitted through the bite of infected female *Anopheles* mosquitoes, which serve as vectors for *Plasmodium* parasites. The disease's geographic distribution is closely linked to the availability of suitable mosquito breeding sites. The most common *Plasmodium* species infecting humans are *P. vivax, P. falciparum, P. malariae* and *P. ovale* [2].

In Indonesia, malaria remains a persistent health concern, especially in the eastern regions. Fifteen provinces report malaria incidence rates above the national average, with the highest rates recorded in Papua (9.8% incidence, 28.6% prevalence), East Nusa Tenggara, West Papua, Central Sulawesi and Maluku. Vulnerable populations-such as Children aged 1-9 and pregnant women-are disproportionately affected [3].

Rational prescribing, as defined by the World Health Organization (WHO), refers to the evidence-based use of medications, ensuring that patients receive the correct drug, in the appropriate dose, for the appropriate duration and at the lowest possible cost. This approach emphasizes personalized treatment plans that are consistent with clinical guidelines, minimizes unnecessary polypharmacy and promotes the use of fixed-dose combinations when clinically justified. Adhering to high-quality prescribing practices is essential for optimizing therapeutic outcomes, minimizing drug-related complications and ensuring the delivery of cost-effective healthcare [4].

A study conducted at Mimika District Hospital demonstrated generally accurate antimalarial prescribing patterns, with particularly appropriate use of primaquine in cases of *Plasmodium vivax* infection. However, regional variations in prescribing practices, drug availability and the

emergence of resistance patterns highlight the need for further context-specific investigations to guide localized treatment strategies [5].

Papua continues to face distinct challenges in malaria control, particularly with the rising resistance to chloroquine. Adverse environmental conditions, behavioral patterns and limited healthcare infrastructure further exacerbate transmission and complicate treatment efforts [6]. These challenges underscore the critical need for ongoing monitoring of antimalarial drug use within healthcare settings to optimize treatment strategies and mitigate resistance.

While previous studies have primarily focused on hospital-based settings, a notable gap exists in the literature regarding rational drug use at the primary healthcare level, especially in remote, high-burden areas such as Asologaima in Jayawijaya. Asologaima Primary Health Center (Puskesmas) serves as a frontline facility for malaria treatment but lacks published evaluations of its prescribing practices. This gap highlights the need for research to assess the rationality of antimalarial drug use in primary healthcare settings, which are crucial in malaria control efforts.

Therefore, this study aims to evaluate the rational use of antimalarial medications at Puskesmas Asologaima, Papua Pegunungan. The findings are expected to provide valuable insights for healthcare providers in optimizing therapeutic strategies and contribute to the development of more effective regional malaria control interventions.

METHODS

Study Design and Participants

This study employed a descriptive-retrospective approach by reviewing malaria treatment records from January to December in the year 2023 and 2024. The data were collected from existing medical records and subsequently analyzed to evaluate the treatment patterns administered to malaria patients.

The study design involved the collection of prescription data using standardized data collection sheets. Only prescriptions related to malaria treatment were included for analysis. The sample consisted of malaria related prescriptions obtained from Puskesmas Asologaima during the years 2023 and 2024.

To determine the sample size, the Slovin's formula was applied, with a margin of error was set at 5%. Using the formula:

$$n = \frac{N}{1 + N \cdot e^2}$$

Where:

N = 204 (total population)

e = 0.05 (margin of error)

The sample size was calculated to be approximately 135 using Slovin's formula.

The sample consisted of 135 malaria-related prescriptions, which were randomly selected from the total populations of 204. To ensure the relevance and accuracy of the data, inclusion and exclusion criteria were applied as follows:

Inclusion Criteria:

- Laboratory-confirmed diagnosis of malaria, with a specified *Plasmodium* species (*P. falciparum*, *P. vivax*, *P. ovale*, *P. malariae*, or mixed infection).
- Complete prescription information, including the patient's name, gender, age, body weight, address, prescribed medication, quantity, dosage instructions, prescribing physician's name and drug strength or dosage.

Exclusion Criteria:

- Patients with a negative laboratory diagnosis for malaria.
- Incomplete prescription information, including missing details such as the patient's name, gender, age, body weight, address, prescribed, medications, quantity, dosage instructions, prescribing physician's name and drug strength or dosage.

Data Analysis

The collected data from the Data Collection Sheets were categorized into independent and dependent variables. Independent variables included age, gender, body mass index (BMI) and type of malaria. The dependent variable was treatment accuracy indicator, evaluated in relation to the type of malaria and the prescribed medication.

Descriptive and inferential analyses were conducted using SPSS version 24. Descriptive analysis presented frequencies and percentage of each variable. Inferential analysis was performed using the Chi-square test to determine the association between categorial variables. The Chi-square test, a non-parametric comparative method, was applied when both variables were measured on a nominal scale or when at least one of them was nominal. This test is widely used to assess the correlation between two categorial variables [7].

II. RESULTS AND DISCUSSION

A. Distribution of Patient Characteristics Based on Prescription Rationality

In the Asologaima district, there are 12 villages served by Puskesmas Asologaima. To provide a comprehensive overview of malaria patient profiles in this area, data on patient characteristics were collected and analyzed. The variables included age, gender, ethnicity, place of origin, and the identified *Plasmodium* species, as presented in Table 1.

Table 1. Patient Characteristics by Prescription Rationality

No	Patient Characteristics	N = 135 (%)	Rational (n=80), 59.3%	Irrational (n=55), 40.7%	*P value*
1	Age (mean ±	27.04±14.	26,35±1	8.05±13.76	0.37

	SD)		12	4.41		
2	Sex	Male	82 (60.7)	50 (62.5)	32 (58.2)	0.37
		Female	53 (39.3)	30 (37.5)	23 (41.8)	
3	Malaria type	*P. falciparum*	60 (44.4)	5 (6.2)	55 (100)	**0.00***
		P. vivax	67 (49.6)	67 (83.8)	0 (0.0)	
		Mixed infection	8 (6.0)	8 (10.0)	0 (0.0)	
4	Ethnicity	Papuan	104 (77.0)	59 (73.8)	45 (81.8)	0.18
		Non-Papuan	31 (23.0)	21 (26.2)	10 (18.2)	
5	Patient Origin	Local Patients	38 (28.1)	18 (22.5)	20 (36.4)	0.05
		Patients from Other Areas	97 (71.9)	62 (77.5	35 (63.5)	

As shown in Table 1, the average age of outpatients at Puskesmas Asologaima was 27.04 ± 14.12 years. When stratified by treatment rationality, the mean age in the rational prescribing group was 26.35 ± 14.41 years, while that in the irrational prescribing group was slightly higher at 28.05 ± 13.76 years. However, the difference was not statistically significant, as indicated by the Chi-square test (p = 0.37). These findings suggest that patient age does not have a significant association with the rationality of antimalarial drug prescribing in this setting.

These findings are consistent with previous research, including a study conducted at Puskesmas Pancoran Mas in Depok, which similarly reported no significant association between patient age and prescription rationality [8]. Instead, variables such as educational background and occupational status were found to have a greater influence. This suggests that age alone does not directly affect the rationality of malaria treatment. More critical determinants may include the prescribing physician's clinical knowledge, patient adherence to treatment protocols and the availability of essential antimalarial drugs. These factors should be prioritized in future interventions aimed at improving rational prescribing practices.

With regard to gender distribution, the majority of patients were male (60.7%). However, Chi-square analysis revealed no statistically significant association between gender and the rationality of antimalarial prescribing (p = 0.37). This finding aligns with previous research by Sari et al. (2020) in Bandar Lampung, which also concluded that gender is not a determining factor in rational drug use. Similar results have been reported in studies examining adherence to antimalarial therapy, where no significant relationship was observed between gender and treatment compliance [9]. These findings suggest that other factors—such as healthcare access, patient education and provider–patient communication—may exert a greater influence on prescribing behavior and treatment outcomes.

In contrast, a statistically significant association was observed between the type of *Plasmodium* infection and the rationality of treatment (p < 0.001). All cases classified as irrational prescribing were associated with *Plasmodium falciparum* infections, whereas patients diagnosed with *P. vivax* or mixed infections were predominantly managed with rational therapy. This finding highlights a critical gap in the application or understanding of appropriate treatment protocols for *P. falciparum*, suggesting the need for targeted interventions—such as clinician training and guideline reinforcement—to improve prescribing practices in these cases.

These findings suggest a potential deficiency in knowledge or compliance with standardized treatment protocols, particularly concerning Artemisinin-based Combination Therapy (ACT), which is recommended by the World Health Organization (WHO) as the first-line treatment for *Plasmodium falciparum* infections. Several contributing factors may underlie this issue, including limited drug availability, insufficient training, and lack of regular supervision at the primary healthcare level [10]. Similar patterns have been documented in other resource-constrained settings, where *P. falciparum* cases were disproportionately associated with irrational prescribing practices [11]. This underscores the urgent need for strengthened capacity building among healthcare providers, regular refresher training on national malaria treatment guidelines, and systematic monitoring to ensure protocol adherence [12].

In terms of ethnicity, the majority of patients were indigenous Papuans (77%). However, statistical analysis revealed no significant association between ethnicity and the rationality of antimalarial prescribing (p = 0.188). Similarly, no statistically significant relationship was found between patients' place of origin and prescribing rationality (p = 0.05), although a trend was observed wherein patients from outside the region were more likely to receive rational treatment. This pattern may reflect underlying disparities in access to healthcare information and services. It is possible that non-local patients are more often treated in better-resourced facilities staffed by more adequately trained personnel [13], highlighting the importance of equitable distribution of healthcare resources and personnel training across all regions.

Setiawan et al. (2021) emphasized that key determinants of rational prescribing include healthcare provider competence, consistent drug availability, and adherence to

established clinical guidelines, rather than patient ethnicity [14]. Similarly, Suryadi and Wahyuni (2020) reported that patients from urban areas or regions outside the locality tend to receive treatment that aligns more closely with national guidelines compared to those residing in remote settings, such as Asologaima in the highlands of Papua. This disparity is likely attributable to limitations in healthcare infrastructure, shortages of trained pharmaceutical personnel, and various sociocultural and logistical barriers that impede the consistent implementation of rational prescribing practices [15].

Overall, the analysis indicates that the type of *Plasmodium* infection is the most influential factor associated with the rationality of malaria treatment, while variables such as age, gender, ethnicity and place of origin do not show statistically significant associations. Accordingly, efforts to improve rational prescribing practices should prioritize strengthening healthcare providers' knowledge and clinical competencies, ensuring the consistent availability of antimalarial drugs, and reinforcing adherence to standardized treatment protocols—particularly for *P. falciparum* cases. Such interventions are essential to reduce the risk of treatment failure, curb the emergence of drug resistance and enhance malaria control outcomes in endemic regions.

B. Evaluation of Antimalarial Prescription Rationality

The evaluation of prescription rationality was based on five criteria: patient selection, drug choice, dosage, duration and route of administration. The analysis covered three types of malaria infections: *P. falciparum*, *P. vivax* and mixed infections. The findings are summarized in Table 2.

Table 2. Evaluation of Antimalarial Prescription Rationality Based on Five Criteria

No	Rational Criteria	Rational Prescription			Irrational Prescription		
		P. falciparum	*P. vivax*	Mixed	*P. falciparum*	*P. vivax*	Mixed
1	Patient	60	67	8	0	0	0
2	Drug	60	67	8	0	0	0
3	Dosage	5	67	8	55	0	0
4	Duration	60	67	8	0	0	0
5	Route of Administration	60	67	8	0	0	0

All prescriptions for the three types of malaria were deemed rational with respect to patient selection. This suggests that antimalarial therapy was administered only to patients with appropriate clinical indications and confirmed diagnoses, in accordance with the clinical guidelines set forth by the Indonesian Ministry of Health (2022). These findings are consistent with the study by Rahmawati et al. (2021), which highlighted that accurate patient indication is a fundamental component of rational drug use, particularly in primary healthcare settings. Ensuring proper patient identification not only enhances treatment effectiveness but also plays a vital role in preventing the development of antimalarial drug resistance [16].

The analysis also demonstrated that all prescriptions for the three types of malaria adhered to national and international treatment guidelines. For *Plasmodium falciparum*, artemisinin-based combination therapy (ACT) was consistently prescribed, in accordance with the World Health Organization (WHO) recommendations (2021). For *P. vivax* and mixed infections, primaquine was appropriately administered to prevent relapse and ensure clearance of liver-stage parasites. These findings are consistent with those of Putri et al. (2021) and Yusuf and Sari (2022), who emphasized the critical importance of selecting the appropriate drug to minimize treatment failure and mitigate the risk of drug resistance [17-18].

A significant issue was identified regarding dosage accuracy, particularly in the treatment of *Plasmodium falciparum*. Only 5 out of 60 prescriptions were deemed rational in terms of dosage, while the remaining 55 prescriptions exhibited dosage inaccuracies. In contrast, prescriptions for *P. vivax* and mixed infections fully adhered to the recommended dosage guidelines. These inaccuracies are likely the result of miscalculations in weight-based dosing or failure to comply with established treatment protocols. Incorrect dosing can lead to therapeutic failure and contribute to the development of resistant parasite strains. Similar findings were reported by Handayani et al. (2022), who observed that inconsistent ACT dosing for *P. falciparum* was significantly associated with treatment recurrence and the emergence of resistance [19]. Prasetyo and Indah (2021) attributed these errors to insufficient provider training and lack of supervision at primary healthcare centers, particularly in cases involving patients with significant weight variability [20].

All prescriptions were deemed rational with respect to treatment durations, indicating that the prescribed therapy lengths and dosing intervals were in accordance with established malaria treatment guidelines. For *Plasmodium falciparum* cases, the recommended three-day consecutive dosing regimen for artemisinin-based combination therapy (ACT) was strictly followed, ensuring optimal pharmacodynamic outcomes and minimizing the risk of residual parasitemia. Similarly, primaquine was administered for the appropriate duration to ensure complete eradication of liver-stage parasites in *P. vivax* and mixed infections. Sutrisno et al. (2022) demonstrated that adherence to recommended treatment durations significantly reduced the incidence of therapeutic failure, while Anwar and Rahma (2021) highlighted that shortened therapy was

associated with an increased risk of relapse in *P. vivax* cases [21-22].

The route of administration was appropriate for all prescriptions and infection types, reflecting full compliance with established therapeutic standards. Oral administration was predominantly used for uncomplicated cases, consistent with both national guidelines and the World Health Organization (WHO) recommendations (2021). The proper selection of the administration route plays a crucial role in drug absorption and overall treatment efficacy. Nurhayati et al. (2022) demonstrated that aligning the route of ACT administration with the patient's clinical status improved therapeutic outcomes by up to 90% in *P. falciparum* cases [23]. Similarly, Rahmat and Putri (2021) found that oral therapy significantly enhanced patient adherence in non-severe malaria cases [24].

Among the five rationality criteria, dosage for *Plasmodium falciparum* emerged as the only parameter with a notably high rate of irrationality. This highlights the critical need for targeted interventions at Puskesmas Asologaima, particularly focusing on improving healthcare provider training and supervision in weight-based dosage calculations. Ensuring accurate dosing is crucial not only for achieving therapeutic efficacy but also for preventing the development of drug-resistant malaria strains.

III. CONCLUSION

The findings of this study suggest that, overall, the rational use of antimalarial drugs at Puskesmas Asologaima is adequate in terms of patient selection, drug choice, timing, and route of administration. However, a significant issue was identified concerning dosage for *Plasmodium falciparum* cases. Among the 60 prescriptions reviewed, only 5 met the criteria for rational dosing, while the remaining 55 were classified as inappropriate. This dosage inaccuracy presents a potential risk for drug resistance and treatment failure, highlighting the need for enhanced prescribing oversight and targeted educational interventions. Future studies should investigate the underlying factors contributing to dosing discrepancies and assess the effectiveness of clinical training programs aimed at improving prescription accuracy in malaria-endemic regions.

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