The Effectiveness of Using Telenursing in Supporting Patient Adherence to Antimalarial Medication

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Abstract: Malaria, which is still endemic in Papua Indonesia, especially Mimika Regency, has the classic issue of low adherence to antimalarial medication necessitates the use of a technological approach through telenursing, which includes reminders and self-reporting, allowing for optimal monitoring of adherence. To determine the effect of web application-based telenursing on adherence to antimalarial medication. This study used a quasi-experimental design with a pre-post test only approach. The instrument used was the Morisky Medication Adherence Scale-8 (MMAS). The sample consisted of 42 respondents per group. The analysis of medication adherence showed a significant difference between pre- and post-treatment in the intervention group, with a p-value of 0.000 (p-value < 0.05). Additionally, post-hoc pairwise comparisons showed that in the control group, a significant p-value of 0.000 was only found between day 15 and day 3, while in the intervention group, significant p-values of 0.000 were found at every time point. Web application-based telenursing has been proven to significantly affect adherence to antimalarial medication.

Keywords: Compliance; Drug adherence; Malaria; Telenursing; Web

Introduction

Malaria is a disease caused by a parasite transmitted through the bite of an infected female Anopheles mosquito carrying Plasmodium. There are five species of Plasmodium that cause malaria in humans, with the greatest threat coming from P. vivax and P. falciparum. In 2021, an estimated 247 million malaria infections occurred, resulting in 619,000 deaths. The latest malaria report from the World Health Organization (WHO, 2023) revealed 241 million cases, representing 5% of the population, with a 12% mortality rate (47,000 deaths in 2020). Globally, malaria is prevalent in tropical and subtropical regions, as well as low-income countries, as reported by the CDC (2023). Africa is the most affected region due to this combination. Similarly, in Indonesia, Papua has the highest malaria cases (Fadilah et al., 2022). The Ministry of Health reported five districts/cities in Papua with the highest positive malaria cases in 2022, including Mimika (123,031 cases), Jayapura (40,700 cases), Jayapura City (35,068 cases), Keerom (24,662 cases), and Yahukimo (15,492 cases).

In Mimika Regency, malaria cases increased from 119,167 in 2021 to 123,031 in 2022. The Pasar Sentral Health Center recorded the highest incidence in 2021 with 20,107 cases. In 2022, it dropped to second place with 11,681 cases but rose again to the top in 2023 with 4,810 cases, including 26 cases in infants (0-11 months), 445 cases in children (1-4 years), 652 cases in children (5-9 years), 536 cases in adolescents (10-14 years), 3,109 cases in adults (15-64 years), and 42 cases in seniors (over 64 years).

Research on the effectiveness of web application-based telenursing for improving adherence to antimalarial medication is crucial in enhancing the management and control of malaria. With the high prevalence of malaria in certain regions, especially in developing countries in tropical and subtropical areas, this research offers significant contributions to improving access to and monitoring of antimalarial treatment. Web-based telenursing can be an effective alternative for enhancing medication adherence by providing remote information, monitoring, and support to patients. This innovative and efficient approach could help prevent and control malaria and improve public health interventions globally.

Berwulo et al. (2020) found that early education on malaria treatment delivered in local dialects via telenursing during prescription proved beneficial, with patients showing better understanding compared to a control group that received no explanation or telenursing intervention. Non-compliance can lead to drug resistance, as shown in Kenangalem et al. (2019), who discovered antimalarial drug resistance levels in Papua. Drug resistance is a significant factor in the rising number of malaria cases (Azlin, 2016; Nursafingi et al., 2024; Rahmasari et al., 2023; Rocamora & Winzeler, 2020). Although resistance is not the only reason malaria has not been eliminated in Indonesia (Azlin, 2016), (Rahmasari et al., 2022) found that drug resistance in Papua reached 96.1%.

Non-medical strategies, particularly in disease prevention, are needed to curb antimalarial drug resistance. One effective measure is the use of antimalarial medication reminders, which have improved malaria recovery rates in Papua, especially in Timika. Although previous studies used SMS and phone calls, these methods served only as reminders and did not support data storage and processing, which can be accommodated through information technology, such as mobile health applications (Berwulo et al., 2020).

Examples of mobile applications improving medication adherence include studies on HIV/AIDS (Horvath et al., 2020), Tuberculosis, Hypertension, and Malaria (Periáñez et al., 2023). Nema et al. (2021) highlighted the comprehensiveness of digital health in malaria control and elimination, including data storage for easy evaluation. Periáñez et al. (2023) demonstrated the use of digital health for surveillance, prevention, diagnosis, and therapy, including adherence to medication to prevent drug resistance.

The Ministry of Health is transforming healthcare services with six pillars, one of which is health technology. The sixth pillar aims to digitize medical records, integrate healthcare providers, prescriptions, and mobile- and web-based applications to simplify access for Indonesia's 270 million people. Based on this, the researcher will develop a web application prototype to remind patients to take antimalarial medication.

Community nurses play a crucial role in preventing the rise of malaria cases. They also help detect and track the disease, providing holistic and comprehensive care to the community, both directly and indirectly. Based on the background explained above, the research question can be formulated as follows: "What is the effect of web application-based telenursing on adherence to antimalarial medication at the Pasar Sentral Health Center in Mimika Regency?" The research aims to identify the effect of web application-based telenursing on adherence to antimalarial medication at the Pasar Sentral Health Center, Mimika Regency.

Method

The research design employed is a quasi-experimental approach with a pre-post test and control group. This design allows the identification of intervention effectiveness by involving two subject groups: the experimental group and the control group (Siedlecki, 2020).

The intervention used in this study is a web application designed to improve adherence to antimalarial medication. This web application is an example of telenursing, developed by the researcher to monitor medication adherence. The web application was designed to track and monitor the antimalarial medication intake of the respondents.

The target population of the study consists of malaria patients at the Pasar Sentral Health Center in Mimika Regency. All respondents who visited the health center and met the inclusion criteria were consecutively selected as samples. The study continued until the required number of subjects was reached. In this sampling technique, the researcher selects respondents who meet the inclusion criteria until the desired sample size is achieved (Sastroasmoro & Ismael, 2017). The sample size was determined using G-Power estimation. G-Power version 3.19 was used to calculate the sample size, selecting a t-test with the statistical test "means: difference between two independent means (two groups)," a priori type, one-tailed, with a large effect size (0.8), an alpha level of 0.05, a confidence level of 0.95, and an OR of 1. This calculation recommended a sample size of 84, with 42 respondents in each group.

The research was conducted at the Pasar Sentral Health Center in Mimika Regency. The site was chosen due to its accessibility in terms of data collection from potential respondents, availability of resources, funding, and time efficiency. Additionally, the location consistently reported the highest malaria incidence. The study was carried out from August 22 to September 23, 2023, with the control group and the intervention group

filling out the questionnaires through the web application. The questionnaires used in this study included respondent characteristics and medication adherence, using the Morisky Medication Adherence Scale-8 (MMAS), a tool used to measure medication adherence in patients with chronic illnesses.

Bivariate analysis was conducted to test the research hypothesis by comparing two independent and dependent means. The bivariate analysis aimed to examine the difference in medication adherence before and after the intervention and monitoring, between the control and intervention groups. The bivariate tests used in this study were the Paired T-Test and the Independent T-Test. For multivariate analysis, a general linear model with repeated measures was employed to assess the effectiveness of education and monitoring (including reminders and photo uploads) on antimalarial medication adherence.

The data analysis in this study was conducted using SPSS and included univariate, bivariate, and multivariate analyses. The univariate analysis was used to assess the percentage distribution of respondent characteristics. Bivariate analysis was employed to examine the differences in medication adherence before and after the provision of education and monitoring of antimalarial medication adherence between the control and intervention groups. The bivariate tests used were the paired t-test and independent t-test. Meanwhile, multivariate analysis utilized the general linear model to evaluate the effectiveness of adherence changes over time within each group.

Results and Discussion

This chapter presents the findings of the study on the effect of web-based telenursing on adherence to antimalarial medication. The discussion includes the respondent characteristics, tests for normality and homogeneity, the effect of web-based telenursing on antimalarial medication adherence, and changes in adherence over time in both the control and intervention groups.

Respondent Characteristics
Univariate analysis was used to assess the distribution of frequency and percentage for each variable. The univariate analysis of respondent characteristics is summarized as follows:

Table 1. Respondent Characteristics in Both Groups

Variable		Frequency		Percent (%)	
		Control	Case	Control	Case
Gender	Male	25	25	59.5	59.5
	Female	17	17	40.5	40.5
Age	18-45	33	30	78.6	71.4
	46-59	9	12	21.4	28.6
Education	Junior	9	6	21.4	14.3
	Secondary School	21	23	50	54.8
History Of Malaria	No	12	11	28.6	26.2
	Yes	30	31	71.4	73.8
Hospitalization History Due to Malaria	No	27	32	64.3	76.2
	Yes	15	10	35.7	23.8

Table 1 shows that the gender distribution is similar between the control and intervention groups. The majority of participants are aged between 18 and 45 years; most have a secondary education; income is below the regional minimum wage of Mimika Regency; and most have a history of malaria and have previously received hospital treatment for malaria.

Table 2. Dependent T-Test (Paired)

Variable	Group		Mean ± SD		p-value
		Pre-Test	*Post-test*		
Medication Adherence	Control	2.862±0.700	2.852±0.704		0.570
	Case	4.767±0.848	6.319±0.541		0.000

Difference in Adherence to Antimalarial Medication Between Groups (Pre and Post Treatment)
Analysis of adherence to medication (Table 2) shows a p-value of 0.000 (p-*value* <0.05) for the intervention group, indicating a significant difference between pre-treatment and post-treatment adherence.

The average post-test score is 6.319, compared to an average pre-test score of 4.767. In contrast, the analysis of medication adherence for the control group shows no significant difference, with a p-value of 0.570. The average score on the pre-test was 2.862, while the average score on the post-test was 2.852.

Difference in Medication Adherence between Intervention and Control Groups

Based on the comparison of average medication adherence between the intervention and control groups (Table 3), the significance value is 0.000. This indicates that H0 is rejected and H1 is accepted, as the significance value (0.000) is less than the alpha level of 0.05. Therefore, it can be concluded that medication adherence is significantly different between the control and intervention groups. The average adherence score in the intervention group (6.319) is higher than that of the control group (2.852).

Table 3. Independent T-Test

	Group		p-value
	Control	Case	
Post-test	2.852	6.319	0.000

Changes in Antimalarial Medication Adherence Over Time

Changes in antimalarial medication adherence over time were analyzed using a General Linear Model, detailed as follows:

Changes in Antimalarial Medication Adherence Over Time in the Intervention Group

According to Table 6, the output of the Tests of Within-Subjects Effects shows a Greenhouse-Geisser significance value of 0.000 < 0.05. This indicates a significant difference in the average increase in medication adherence across different time points. To obtain information about the average increase in medication adherence for each time measurement (PostH3, PostH6, PostH9, PostH12, PostH15), refer to Table 4.

Table 4. General Linear Model (*Repeated measures annova*) Control Group

Test of Within- Subjects Effects		df	Sig.
Inter-time compliance	Greenhouse- Geisser	3.222	0.000

Table 5. Post Hoc Pairwise Comparisons Control Group

Time Parameter	Control	
	Δ Mean	Δ Mean
Day 3 – Day 6	0.405	0.405
Day 6 – Day 9	0.167	0.167
Day 9 – Day 12	0.310	0.310
Day 12- Day 15	0.095	0.095
Day 15- Day 3	0.976	0.976

Comparing PostH3 with PostH6, there was an increase in medication adherence of 0.405, which was not statistically significant, with a significance value of 0.079 > 0.05. In contrast, comparing PostH15 with PostH3, there was an increase in medication adherence

of 0.976, which was statistically significant, with a significance value of 0.000.

Changes in Adherence to Antimalarial Medication Over Time in the Intervention Group Based on the output from the Tests of Within-Subjects Effects in Table 8, the Greenhouse-Geisser significance value is 0.000, which is less than 0.05. This indicates that the null hypothesis (H0) is rejected and the alternative hypothesis (Ha) is accepted, meaning there is a significant difference in the average increase in medication adherence over time.

To obtain information on the average increase in medication adherence for each time measurement (PostH3, PostH6, PostH9, PostH12, PostH15), Table 9 shows the post hoc pairwise comparisons. Comparing PostH3 with PostH6, there is an increase in adherence of 1.571, and this difference is significant with a significance value (Sig.) of 0.000, which is less than 0.05.

Table 6. General Linear Model-Repeated Anova Test for Intervention Group

Test of Within- Subjects Effects		df	Sig.
Adherence Over Time	Greenhouse-Geisser	2.565	0.000

Table 7. Post Hoc Pairwise Comparisons Intervention Groups

Time Parameter	Intervention	
	Δ Mean	p-value
Day 3 – Day 6	1.571	0.000
Day 6 – Day 9	1.119	0.000
Day 9 – Day 12	0.667	0.000
Day 12- Day 15	0.548	0.000
Day 15 - Day 3	3.905	0.000

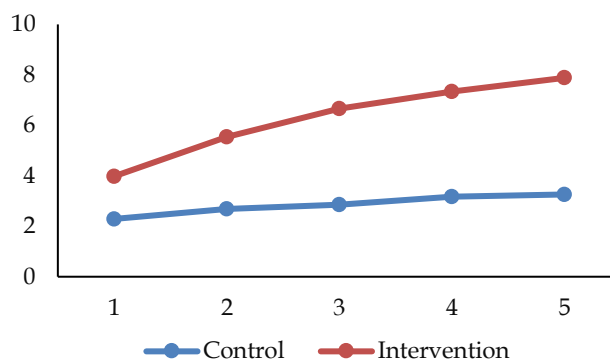*Average Increase in Adherence to Antimalarial Medication*

Figure 1. Comparison of medication adherence margin

Based on the graph in Figure 1, it is shown that adherence to medication has improved steadily day by day. Medication adherence in the intervention group was better than in the control group, with a higher average value. The difference between the control and

intervention groups lies in the timing of the increase: for the control group, the increase occurred on day 15 post-treatment, while for the intervention group, it occurred on day 6 post-treatment. However, the graph clearly shows a significant difference between the intervention and control groups.

Discussion
Malaria History

Most respondents in this study were found to have a history of malaria. Mimika is largely a mountainous area, and it also has several lakes and rivers. These environmental conditions provide a potential breeding ground for Anopheles mosquitoes, which influences the spread of malaria cases. Referring to Mbacham et al. (2019) regarding the geographic conditions in the Amazon and Africa, which have environmental factors supporting malaria transmission, Papua, specifically Mimika, has similar conditions. This has consistently placed Mimika among the regions with the highest malaria cases in Indonesia. Compared to patients who initially suffered from Plasmodium falciparum malaria, those with Plasmodium vivax are more prone to malaria relapses, which are associated with a higher risk of mortality (Dini et al., 2020). According to research by Lusiyana et al. (2022), the high prevalence of malaria in endemic areas generally stems from recurring malaria episodes, marked by the reappearance of malaria symptoms during examinations. Almost every resident is at risk of experiencing such relapses. After malaria treatment, an individual can either enter an aparasitemic state or revert to parasitemic status, undetected or confirmed due to noncompliance with malaria therapy. The possibility of malaria recurrence is influenced by noncompliance with preventive measures. Therefore, early malaria prevention efforts, such as the use of bed nets and spraying, are necessary to reduce malaria incidence.

Respondents without a history of hospital care for malaria were examined in a study by Shafira et al. (2020), which found that there was no significant correlation between a history of malaria and medication adherence behavior. According to the data, 50% of those with a prior history of malaria had low adherence levels, suggesting that a history of malaria does not impact medication adherence. Various factors such as patient characteristics, medications, healthcare providers, and the healthcare system may influence medication adherence. Healthcare system factors, such as the absence of health insurance, high treatment costs, and limited access to healthcare services, can lead to low treatment adherence. Furthermore, Ramdzan et al. (2020) identified a geographic connection, as two-thirds of reported malaria cases come from urban areas. This is expected, given that most clinics are located in urban

regions, where people generally have better healthcare-seeking behaviors.

The Impact of Web-Based Telenursing on Adherence to Antimalarial Medication

According to the study results, there is a significant difference between adherence before and after the intervention, suggesting that antimalarial medication adherence can be improved through telenursing. This is because telecommunication networks are readily available, and mobile devices are easy to carry anywhere (Helal et al., 2006). Additionally, telenursing helps meet excessive demands and overcomes difficulties caused by geographic distance and transportation issues (Souza-Junior et al., 2016). The antimalarial medication adherence web application is equipped with a medication reminder alarm, which is an advantage of the app. Ramadhani et al. (2021) found that alarms can be used as reminders to improve medication adherence. The reminder feature in this web application is part of this study. According to Lawrence Green's theory, predisposition factors influencing adherence include knowledge, beliefs, attitudes, values, traditions, and other internal and social environmental elements. Enabling factors that influence malaria patients' adherence to their treatment plans can also be applied through technology, such as web-based mobile apps. Reinforcing factors are elements that encourage or strengthen adherence, such as web-based telenursing.

The web application also allows patients to upload photos as proof of taking their medication, enabling researchers to evaluate whether respondents are adhering to their medication regimen. This also provides recommendations for nurses managing patients who forget to take their medication. Previous research has shown that telehealth technology enables nurses to extend services to anyone in need, regardless of location. Telenursing is a strategy that enhances nursing activities, allowing professionals to guide and monitor patients according to their needs. This increases the likelihood of better self-care, saves time and resources, and improves access (Souza-Junior et al., 2016). Therefore, it is important for nurses or healthcare professionals to provide education through telenursing methods because they are easy to use, effective, and keep pace with technological advancements.

The impact of web-based telenursing on adherence to antimalarial medication is significant, as evidenced by various studies that highlight its effectiveness in improving medication adherence across different health conditions. Telenursing serves as a crucial tool in enhancing patient engagement and medication adherence, particularly in challenging contexts such as pandemics or chronic diseases. Telenursing has been proven to effectively increase medication adherence in

patients with chronic conditions, such as tuberculosis, where adherence significantly improved post-intervention (from 1.45 to 2.74 on the MMAS scale) (Mahdani & Andriani, 2023). This research demonstrates that telehealth interventions, including telenursing, can enhance adherence to treatment guidelines, with a combined odds ratio of 2.78 for improved adherence (Dirjayanto et al., 2023).

Telenursing provides essential reminders and educational support, which are crucial for maintaining adherence, especially in remote settings (Elfiyunai et al., 2023). The use of mobile applications for reminders and education has been effective in improving medication adherence among patients with mental health disorders (Syarif et al., 2024). While telenursing shows promise in enhancing adherence, challenges remain in its implementation, as some studies report mixed results regarding its overall effectiveness in different populations (Cahaya & Skarayadi, 2022).

Web-Based Telenursing has emerged as a significant intervention for improving adherence to antimalarial medication. This approach leverages technology to provide reminders, education, and support, which are essential for ensuring patient compliance. Telenursing uses mobile reminders, which have been shown to significantly improve adherence to medication regimens, including antiretroviral therapy in HIV/AIDS patients (Kurnianingsih & Yona, 2024). It encourages better communication between healthcare providers and patients, boosting motivation and adherence through continuous support (Elfiyunai et al., 2023). For patients with mental health disorders, telenursing has proven effective in improving medication adherence by addressing barriers such as forgetfulness and lack of motivation (Setyorini et al., 2023).

Accessibility and Convenience of Telenursing Allow for Remote Support Telenursing provides remote access to healthcare, which is especially beneficial during crises like the COVID-19 pandemic, ensuring that patients continue their treatment without needing physical visits (Elfiyunai et al., 2023). The use of various communication platforms (e.g., WhatsApp, Telegram) allows for personalized reminders and education, catering to the needs of individual patients.

While telenursing shows promise in improving adherence to antimalarial medication, challenges such as digital literacy and access to technology may hinder its effectiveness in certain populations. Overcoming these barriers is crucial to maximizing the benefits of this innovative approach. The Impact of Web-Based Telenursing on Adherence to Antimalarial Medication Web-based telenursing has proven to be a significant and effective intervention in improving adherence to antimalarial medication. By utilizing mobile reminders,

continuous education, and personalized support, telenursing enhances communication between patients and healthcare providers, thereby increasing patient motivation and compliance. The accessibility and convenience of this approach allow for remote healthcare delivery, which is particularly valuable in challenging circumstances, such as during pandemics or in geographically remote areas. Despite its promise, telenursing faces challenges, particularly in populations with limited access to technology or lower digital literacy. Addressing these barriers is essential to fully realize the potential of telenursing in improving medication adherence, ensuring better health outcomes in the fight against malaria.

Differences in Medication Adherence Over Time Between the Intervention and Control Groups

The results of time-based tests in the intervention group showed an increase in adherence to antimalarial medication starting from day 6, compared to the control group, which showed improvement only by day 15. Consistent with Wong's research, the impact of telehealth interventions on medication adherence demonstrates that telehealth improves medication adherence and patients' quality of life. The most frequently used features include communication mechanisms, health monitoring, reminders, and alerts, along with providing information and education (Wong et al., 2020). Additionally, telenursing functions help improve patient medication adherence and support better health outcomes over time (Mason et al., 2022).

Based on the explanations and discussion above, the researcher believes this design can be considered a healthcare innovation and addresses the needs of the Mimika Central Market Community Health Center's service area in providing professional in-home nursing care to support malaria prevention, thereby reducing case numbers. Telenursing not only reminds individuals to take their medication but also educates them on the importance and benefits of regularly taking antimalarial medication.

Differences in adherence to malaria treatment can vary significantly over time and across different populations. Research indicates that adherence is influenced by various factors, including treatment settings, patient demographics, and healthcare practices. In a study of patients with rheumatoid arthritis and systemic lupus erythematosus, four different adherence patterns were identified, with 53.2% not consistently adhering within the first year (Hoque, 2023). Factors such as age, income, and type of illness significantly impacted adherence levels.

In Bangladesh, a high overall adherence rate of 92.7% for malaria treatment was reported, but non-adherence was noted among certain age groups and men

(Hossain et al., 2024). This suggests that while overall adherence is good, certain demographics may require targeted interventions. In Nigeria, adherence to seasonal malaria chemoprevention was initially high but declined due to forgetfulness and caregiver absenteeism. This highlights the need for improved education and caregiver support.

Another study revealed that adherence was significantly higher in inpatient settings (99.3%) compared to outpatient settings (82.7%), emphasizing the impact of healthcare environments on adherence (Twagirumukiza et al., 2010). While adherence to malaria treatment is generally high, there are variations based on patient demographics, treatment settings, and healthcare practices, indicating the need for tailored adherence strategies.

Differences in medication adherence over time between the intervention and control groups indicate that interventions can have a significant impact on improving adherence. Findings from various studies suggest that interventions such as telenursing or other reminder methods often result in higher adherence rates compared to control groups that do not receive such interventions. The intervention group tends to show more consistent and faster improvements in adherence compared to the control group. This highlights the effectiveness of intervention methods in helping patients adhere to their treatment plans more effectively over time. In contrast, the control group often experiences slower or less stable improvements in adherence, which may be due to a lack of support and reminders. Implementing interventions designed to improve medication adherence results in better and more stable outcomes compared to standard approaches. This underscores the importance of adopting effective intervention strategies to optimize medication adherence across various populations.

Malaria Issue Update

The World Health Organization (WHO) established the Global Malaria Programme to organize a global campaign to fight and eliminate malaria. This program includes the Global Technical Strategy for Malaria 2016–2030, which has four targets to be achieved by 2030 as part of the Sustainable Development Goals (SDGs): reducing malaria cases by at least 90%, eliminating malaria transmission in at least 35 countries, and preventing malaria resurgence in all malaria-free countries. To combat malaria as an endemic disease, WHO collaborates with the Indonesian government to implement the Global Malaria Programme (GMP). The National Action Plan for Accelerating Malaria Elimination 2020–2026 was created to help plan and implement malaria prevention and control strategies in Indonesia. To support the goal of eliminating malaria by 2030, the action plan includes strengthening integrated health systems in regions through cross-sectoral activities, community empowerment, appropriate technology, and cross-stakeholder collaboration to ensure that malaria elimination efforts are aligned. As of November 2023, 389 (or 76%) districts/cities have achieved malaria elimination status, surpassing the target of 405 districts/cities set by the National Medium-Term Development Plan (RPJMN) 2020–2024.

This shows that the national government's elimination program has been successful. However, challenges remain that have slowed the reduction of malaria cases in regions where malaria is highly prevalent, such as Papua, West Papua, and East Nusa Tenggara. This condition is primarily related to community behavior and perspectives on malaria. Therefore, to ensure the success of the malaria elimination program, innovations that encourage behavior changes aligned with local issues and community conditions are required.

The number of recorded malaria cases in 2023, based on data from the Ministry of Health, is 398,293. However, this data cannot yet be used as a reference to indicate that malaria cases have decreased in 2023, as some regions have not yet submitted their case reports. The Mimika District Health Office reported 144,220 malaria cases to date, but several healthcare facilities have not yet submitted their reports. Based on the preliminary data above, it can be concluded that malaria cases in Mimika district have increased compared to the previous year.

According to data from the Ministry of Health, in 2023, five provinces and nine districts/cities successfully eliminated malaria. These provinces are DKI Jakarta, West Java, Bali, Banten, and East Java, while the nine districts/cities are Manado City, South Bengkulu District, North Bengkulu District, Central Halmahera District, West Halmahera District, Central Tapanuli District, Tana Toraja District, Mahakam Ulu District, and Ogan Komering Ulu Selatan District.

Malaria remains a significant public health challenge in Indonesia, particularly in Eastern regions where the disease is endemic. Despite progress in reducing cases, environmental factors and socio-economic conditions continue to influence malaria transmission. In 2021, 95% of malaria cases were reported from Papua, West Papua, and Nusa Tenggara Timur (NTT) (Ayuandini et al., 2023). Annual Parasite Incidence (API) in endemic areas varies, with some villages reporting up to 4.1 cases per 1,000 residents (Kosasih et al., 2024).

Key determinants include poverty, with significant correlations found between malaria incidence and factors such as low education, unemployment, and agricultural work. Environmental conditions like

precipitation and land temperature also play critical roles in malaria transmission (Nursafingi et al., 2024). Local perceptions of malaria significantly affect health-seeking behaviours, often leading to delays in testing and treatment adherence. Public health interventions must address these perceptions to enhance the effectiveness of malaria control programs (Ayuandini et al., 2023). While efforts to combat malaria are ongoing, addressing socio-economic and environmental determinants is crucial for sustained progress in Indonesia.

Various Efforts in Malaria Treatment in Indonesia. Various efforts have been made in malaria treatment in Indonesia, involving both modern medical approaches and traditional practices. The Indonesian government aims to eliminate malaria by 2030; however, challenges remain due to diverse healthcare-seeking behaviors and the prevalence of traditional medicine use. Modern Treatment Dihydroartemisinin-piperaquine (DHP) has been the first-line treatment for uncomplicated malaria since 2008, demonstrating a 100% cure rate for Plasmodium vivax malaria (Arcelia et al., 2023). Studies show its continued efficacy against Plasmodium falciparum, although a slight increase in late treatment failure has been observed (Rahmasari et al., 2022). Traditional Medicine The Asmat tribe uses sambiloto, a local plant, for malaria treatment, highlighting the role of ethnopharmacology in community health (Awotauw & Panggabean, 2024). This research reveals a variety of healthcare-seeking behaviors, including self-medication and reliance on traditional medicine, which are influenced by factors such as education and access to healthcare facilities (Philothra et al., 2023).

Conclusion

The conclusion from this research on the effectiveness of web-based telenursing in improving adherence to antimalarial medication is that this intervention significantly benefits patients' medication adherence. Compared to the control group, which did not receive telenursing intervention, patients who received initial education about malaria treatment in the local Indonesian language via telenursing tended to better understand and adhere to their medication regimen. This suggests that this approach has potential as an effective method for improving patient adherence to malaria treatment through a web-based telenursing platform. According to our study, the most common respondent characteristics were males aged 18–45, with a high school education, income below the minimum wage, a history of malaria, and no prior hospital care due to malaria. Web-based telenursing proved to influence adherence to antimalarial medication, and the intervention group showed faster adherence within six days compared to the control group.

Author Contributions
This article was written by three authors, namely D. T. H., S. A., and S. B. All authors worked together in every stage of writing the article.

Conflicts of Interest
The authors declare no conflict of interest.

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