

BRIDGING THE GAP IN RATIONAL ANTIBIOTIC USE: KNOWLEDGE–BEHAVIOR DYNAMICS AND THE EFFICACY OF BOOKLET-BASED DAGUSIBU EDUCATION IN RURAL INDONESIA

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ABSTRACT

Antibiotic resistance is a major public health concern associated with inappropriate antibiotic use, while limited community knowledge may contribute to irrational antibiotic practices. This study aimed to examine community knowledge regarding DAGUSIBU antibiotics and its relationship with antibiotic use behavior in Tempang II Village, North Langowan District as one of rural area in Indonesia, while assessing the contribution of booklet-based education to improving knowledge. The study comprised two complementary research approaches. The first used a descriptive cross-sectional design involving 158 respondents selected from an adult population through total sampling after inclusion and exclusion criteria were applied, to examine the relationship between knowledge and antibiotic use behavior. The second used a quantitative pre-experimental one-group pretest–posttest design involving 34 participants selected through purposive sampling to evaluate the effectiveness of booklet-based DAGUSIBU education. The first study demonstrated a moderate positive relationship between knowledge and antibiotic use behavior ($r = 0.463$; $p < 0.001$). The second study showed that low knowledge decreased from 68.6% before the intervention to 11.4% after the intervention, while good knowledge increased to 88.6%, with a significant difference ($p < 0.001$). These findings highlight the importance of strengthening community knowledge through appropriate education as part of efforts to support rational antibiotic use.

KEYWORDS: DAGUSIBU; Antibiotics; Knowledge; Antibiotic Use Behavior

INTRODUCTION

Antibiotic resistance is a global issue that continues to pose a major challenge to the appropriate use of antibiotics worldwide. The increasing incidence of bacterial infectious diseases has contributed to the growing use of antibiotics. Inadequate restrictions on the purchase of antibiotics without a prescription may reduce control over their use at the community level. Inappropriate antibiotic use can lead to antibiotic resistance, which may reduce treatment effectiveness and increase healthcare costs. This condition occurs when microorganisms develop the ability to reduce or withstand the activity of antimicrobial agents, making bacterial growth increasingly difficult to control effectively with the antibiotics administered (Putri et al., 2023)

The World Health Organization (WHO) reported that antibiotic resistance contributed to approximately 1.27 million deaths globally in 2019. Furthermore, the World Bank estimated that the impact of antimicrobial resistance could increase healthcare expenditure by up to US\$1 trillion by 2050 (WHO, 2022a). More than 60% of *Neisseria gonorrhoeae* isolates, a sexually transmitted infection-causing bacterium, have demonstrated resistance to ciprofloxacin, one of the antibiotics commonly used to treat the infection. WHO has also reported that antibiotic resistance among various bacteria responsible for common infections continues to increase in many countries, making treatment more difficult and increasing the risks of disease transmission, severe infection, and mortality (WHO, 2022b).

Indonesia also faces a serious antibiotic resistance problem. It is estimated that more than 400,000 people die from sepsis, with approximately 34,000 deaths associated with antimicrobial resistance. Data from the Indonesian Ministry of Health indicate that 25% of sepsis-related deaths in 2023 occurred among hospitalized patients. In addition, sentinel hospital surveillance reported that the prevalence of Extended-Spectrum Beta-Lactamase (ESBL) increased from 68% across 20 referral hospitals in 2022 to 70.75% across 24 referral hospitals in 2023, exceeding the 2024 target of 52%. These conditions indicate that antibiotic resistance remains an important health problem requiring serious attention (Kementerian Kesehatan Republik Indonesia, 2024).

North Sulawesi is also among the regions requiring attention regarding antibiotic use. According to the World Health Organization, antibiotics are classified into the AWARe categories, namely Access, Watch, and Reserve. Data indicate that the proportion of antibiotics classified as Access in North Sulawesi increased from 56.82% in

2021 to 70% in 2022. Although this increase indicates progress toward more appropriate antibiotic use, efforts to promote rational antibiotic use through community education and monitoring remain necessary (Widya et al., 2025). The Food and Drug Authority (BPOM) in Manado explained that antibiotic resistance can prolong the recovery process from infection and increase treatment costs. In addition, bacteria that have developed resistance to antibiotics may undergo further genetic changes and be transmitted to other individuals, increasing the risk of disease spread. This condition also represents a major challenge to global health because of the high mortality associated with antimicrobial resistance. Therefore, antibiotics need to be used responsibly, according to medical recommendations and the principles of rational drug use (BPOM, 2023).

Limited public understanding of antibiotics remains one of the factors contributing to inappropriate antibiotic use. Knowledge regarding indications, proper administration, and the risks of antibiotic resistance can influence how individuals use antibiotics (Meinitasari et al., 2021). However, several studies have indicated that community knowledge regarding antibiotics remains inadequate. A study conducted in Bolaang Mongondow Regency found that approximately 54% of respondents had a low level of knowledge regarding appropriate antibiotic use (Melaniawati et al., 2021). Another study also reported that most community members had insufficient understanding of the functions and proper use of antibiotics (Rahmat et al., 2021). These findings indicate the need for continuous and accessible educational interventions to strengthen community knowledge regarding appropriate antibiotic use.

Preliminary interviews with five community members in Tempang II Village indicated that knowledge and practices related to antibiotic use were not fully consistent with the principles of DAGUSIBU. One respondent reported not completing an antibiotic course because of concerns that it could worsen kidney problems. Three respondents reported disposing of unused or expired antibiotics in household waste together with their packaging. Two respondents obtained antibiotics from shops rather than pharmacies, and one respondent reported not completing the prescribed antibiotic course. These findings indicate that inappropriate antibiotic use practices remain present in the community and may contribute to the development of antibiotic resistance. Therefore, continuous education regarding appropriate antibiotic use based on the DAGUSIBU principles is needed.

Interviews with nurses at Walantakan Community Health Center, North Langowan District, also revealed that education regarding medication use, particularly antibiotics, had not been routinely provided to the community. Education was generally delivered when medicines were dispensed, with information mainly limited to the dosage, timing of administration, and the recommendation to complete the prescribed course. Nurses also reported that medication education was sometimes provided to patients but had not been systematically structured according to the DAGUSIBU concept. In addition, nurses indicated that some patients continued to have inadequate understanding of appropriate antibiotic use. This condition highlights the need for structured and accessible educational media that can support the delivery of comprehensive information regarding antibiotic management.

A review of 15 previous studies conducted by the researchers showed that the use of booklets as an educational medium remains limited. Most previous studies used leaflets, PowerPoint presentations, videos, or direct health education, while only one study used an e-book. Compared with these media, booklets can provide information in a more comprehensive and systematic format and allow readers to review the material repeatedly. Thus, the use of booklets represents a potential educational approach for improving community knowledge regarding antibiotic use based on DAGUSIBU principles. In addition to knowledge, previous research has also indicated that knowledge is associated with antibiotic use behavior, suggesting that adequate understanding may play an important role in supporting appropriate antibiotic practices.

Despite previous studies examining antibiotic education and community knowledge, research specifically evaluating booklet-based DAGUSIBU education remains limited. Furthermore, studies examining the relationship between knowledge and antibiotic use behavior provide a complementary perspective on the importance of community understanding in promoting appropriate antibiotic practices. However, these aspects have rarely been presented together within the context of the same community. Therefore, the scientific contribution of this study lies in presenting complementary evidence regarding antibiotic use in Tempang II Village, namely the effectiveness of booklet-based DAGUSIBU education in improving community knowledge and the relationship between knowledge and antibiotic use behavior. This approach provides a broader understanding of community antibiotic use without assuming a causal relationship between the educational intervention and behavioral outcomes.

Based on these considerations, this study aims to assess community knowledge and antibiotic-use behavior and to analyze the relationship between knowledge and antibiotic-use behavior among residents of Tempang II Village, North Langowan District as one of rural area in Indonesia.

METHOD

This study employed two complementary quantitative approaches conducted in Tempang II Village, North Langowan District, Minahasa Regency, North Sulawesi, Indonesia. The first study used an analytical correlational cross-sectional design to examine the relationship between knowledge and antibiotic-use behavior. The study was conducted from March to May 2026 and involved 158 adults aged 21–59 years who had previously used antibiotics. The second study used a pre-experimental one-group pre-test and post-test design to evaluate changes in community knowledge following DAGUSIBU antibiotic education using a booklet. The study was conducted from March to July 2026 and involved 34 adults aged 21–59 years selected through purposive sampling. Participants met the

inclusion criteria of residing in Tempang II Village, having used or currently using antibiotics, and obtaining an initial knowledge score of ≤ 5 .

Both studies used the Antibiotic DAGUSIBU Knowledge Questionnaire developed by Lestari, (2020), consisting of 10 items with dichotomous scoring, where correct answers received 1 point and incorrect answers received 0 points. Scores were categorized as good (76–100%), moderate (56–75%), and poor ($<55\%$). The questionnaire had been tested on 30 respondents outside the study sample, with all items declared valid and a Cronbach's Alpha coefficient of 0.902. In the first study, the same knowledge questionnaire was used together with a nine-item antibiotic-use behavior questionnaire adapted from Hani Kurniawati Laili, (2019) which had a Cronbach's Alpha coefficient of 0.748. In the second study, the knowledge questionnaire was administered before and after the booklet-based educational intervention.

Data collection in the first study consisted of informed consent followed by completion of the knowledge and antibiotic-use behavior questionnaires. In the second study, data collection consisted of participant screening, informed consent, pre-test, booklet-based DAGUSIBU education, and post-test. Data were analyzed descriptively and inferentially according to the research objectives. The first study used the Spearman's rho test to examine the relationship between knowledge and antibiotic-use behavior, while the second study used the Wilcoxon Signed-Rank Test to compare knowledge before and after the intervention, with a significance level of $\alpha = 0.05$. Ethical principles, including voluntary participation, informed consent, confidentiality, and the right to withdraw, were applied throughout the research.

RESULTS AND DISCUSSION

Table 1 presents the characteristics of the respondents based on age, sex, education level, occupation, and history of antibiotic use. Based on the characteristics of the respondents ($N = 158$), the majority were aged 51–59 years, with 50 respondents (31.6%), followed by those aged 41–50 years with 49 respondents (31.0%), aged 31–40 years with 34 respondents (21.5%), and aged 21–30 years with 25 respondents (15.8%). In terms of sex, the majority of respondents were female, with 80 respondents (50.6%), while 78 respondents (49.4%) were male. Regarding education level, most respondents had completed senior high school, with 85 respondents (53.8%), followed by higher education with 35 respondents (22.2%), junior high school with 28 respondents (17.7%), and elementary school with 10 respondents (6.3%).

Based on occupation, the largest proportion of respondents were housewives, with 54 respondents (34.2%), followed by farmers with 49 respondents (31.0%). Other occupations included private-sector employees with 20 respondents (12.7%), civil servants with 14 respondents (8.9%), unemployed respondents with 8 respondents (5.1%), students and honorary employees with 5 respondents each (3.2%), and other occupations with 3 respondents (1.9%). In addition, all respondents (100%) had a history of antibiotic use. The predominance of female respondents was consistent with the findings of Septiana et al., (2025), which also reported a higher proportion of female participants. This may be related to the important role of women in family health management and healthcare decision-making. The predominance of respondents aged 51–59 years was also consistent with Sitepu et al., (2024), who reported a similar age distribution. However, age does not necessarily determine antibiotic knowledge, as Yunita et al., (2022) found no significant relationship between age and knowledge regarding antibiotics. The predominance of respondents with senior high school education was consistent with Elsaputri et al., (2025), who reported that respondents with secondary education constituted the largest group.

Table 1. Frequency Distribution of Respondent Characteristics

Characteristics	Frequency (f)	Percentage (%)
Age		
21-30 years	27	14.06
31-40 years	38	19,79
41-50 years	62	32,29
51-59 years	64	33,85
Gender		
Men	89	46.35
Women	103	53.65

Education

Elementary School	16	3.33
Junior High School	35	18,23
Senior High School	103	53.65
Higher Education	38	19,79
Occupation		
Unemployed	9	5.28
Student	6	3.51
Housewife	72	42.11
Farmer	57	33.33
Civil Servant	57	

Private-sector employee	17	9.94
Honorary employee	6	3.51
Private Employee	21	10.94
Others	4	2.34
History of Antibiotic Use	192	100
Ever used antibiotics	0	0
Never used antibiotic		
Total	192	100

Table 2. Distribution of Respondents' Knowledge and Antibiotic-Use Behavior

Variabel	n	Presentase (%)
Knowledge		
Good	19	12,
Moderate	38	24,1
Poor	101	63,9
Behavior		
Good	10	6,3
Moderate	56	35,4
poor	96	58,2
Total	158	100

Table 2 shows the distribution of respondents' knowledge and antibiotic-use behavior. Regarding knowledge level, the highest proportion of respondents was classified as having poor knowledge, with 101 respondents (63.9%), while the lowest proportion was classified as having good knowledge, with 19 respondents (12.0%). These findings are consistent with previous studies indicating that inadequate knowledge regarding appropriate antibiotic use remains common in the community. Nursyafni et al., (2024) reported that most respondents had low knowledge of antibiotic use, which was associated with limited access to reliable health information and inadequate health education. Similarly, Suwena et al., (2025) found that a substantial proportion of community members still had limited understanding of appropriate antibiotic use. These findings indicate that insufficient health information and education may contribute to low levels of knowledge regarding rational antibiotic use.

In terms of antibiotic-use behavior, the largest proportion of respondents was classified as having poor behavior, with 96 respondents (58.2%), followed by moderate behavior, with 56 respondents (35.4%), and good behavior, with 10 respondents (6.3%). This finding is in line with Syahida et al., (2023) who reported that inappropriate antibiotic-use practices remained common, particularly the use of antibiotics without clear indications and non-adherence to recommended instructions. Similarly, Nursyafni et al., (2024) found that antibiotic use without a prescription and poor adherence to health workers' recommendations were still frequently observed among community members.

Table 3. Distribution of Knowledge Before and After DAGUSIBU Antibiotic Education

Knowledge Level	Pre-test n (%)	Post-test n (%)
Good	-	30 (88.2%)
Moderate	-	4 (11.8%)
Poor	34 (100%)	-

Table 3 shows the distribution of respondents' knowledge before and after DAGUSIBU antibiotic education using a booklet. Before the intervention, all respondents (34; 100.0%) were classified as having poor knowledge. The highest number of correct answers was found in Question 1 regarding the appropriate place to obtain medicines, while Question 10 concerning the disposal of solid medicines had the highest number of incorrect answers. This indicates that respondents had basic knowledge of obtaining medicines but limited understanding of proper medicine disposal. These findings are consistent with Maulina et al., (2023) who reported that community knowledge regarding appropriate medicine use and management remained low. Similar findings were reported by Febriani et al., (2024), Nabila et al., (2021) and Dwiaini (2022), who emphasized the need for education to improve community understanding of DAGUSIBU and rational antibiotic use.

After the intervention, 30 respondents (88.2%) had good knowledge and 4 respondents (11.8%) had moderate knowledge, with no respondents remaining in the poor category. During the intervention, respondents appeared more attentive and actively engaged with the material. However, Question 7 regarding the use of household

teaspoons or tablespoons for liquid medicines remained one of the items with incorrect answers. This may have occurred because the education did not include direct demonstrations using appropriate medicine-measuring devices. Mutmainah et al., (2021) explained that knowledge is influenced by the information and educational media received. The improvement in knowledge is consistent with Nabila et al., (2021) and Mutia et al. (2024), who found that health education significantly improved understanding of rational medicine use. These findings are also consistent with Lawrence W. Green's PRECEDE-PROCEED model, in which knowledge functions as a predisposing factor that can be strengthened through health education.

Table 4. Relationship Between Knowledge Level and Antibiotic-Use Behavior

Variabel	Spearman's rank correlation	p-value
Knowledge Behavior	0,511	<0,001

Based on Table 4, the Spearman's rho test showed a significant relationship between knowledge and antibiotic-use behavior, with a p-value of <0.001 and a correlation coefficient of 0.511, indicating a moderate positive correlation. This means that higher knowledge tends to be associated with better antibiotic-use behavior. Therefore, H_0 was rejected and H_1 was accepted, confirming a significant relationship between knowledge and antibiotic-use behavior among the community in Tempang II Village, Langowan Utara District. This finding is consistent with Meinitasari et al., (2021) and Hamdani et al., (2021), who reported that adequate understanding of antibiotic indications, dosage, and the risk of resistance contributes to appropriate antibiotic-use behavior.

In this study, antibiotic-use behavior was predominantly classified as poor, with 96 respondents, followed by moderate behavior with 56 respondents and good behavior with 10 respondents. Respondents with better behavior were likely to understand the consequences of inappropriate antibiotic use and follow healthcare providers' instructions. In contrast, poor behavior was associated with practices such as purchasing antibiotics without a prescription and self-medication. This finding is consistent with Syahida et al., (2023), who explained that antibiotic-use behavior includes decisions regarding self-medication, adherence to prescribed dosage and duration, proper storage and disposal, and avoiding antibiotic use for conditions that do not require antibiotics. Thus, knowledge plays an important role in shaping responsible antibiotic-use behavior and supporting rational antibiotic use in the community.

Table 5. Effect of DAGUSIBU Antibiotic Education on Knowledge

Variabel	n	Mean Rank	Sum of ranks	P-Value
Positive Ranks	34	17,50	595,00	<0,001
Negative Ranks	0	0,00	0,00	
Ties	-	-	-	
Total	34			

Based on Table 5, the Wilcoxon Signed-Rank Test showed a significant improvement in respondents' knowledge after DAGUSIBU education using a booklet. All 34 respondents experienced an increase in knowledge, with no respondents showing stagnation or a decrease in scores. The statistical analysis produced a p-value of <0.001, which was lower than $\alpha = 0.05$, indicating a significant difference in knowledge before and after the intervention. Therefore, H_0 was rejected and H_1 was accepted, confirming that booklet-based DAGUSIBU education significantly improved respondents' knowledge regarding appropriate antibiotic management.

This finding is consistent with Febriani et al., (2024), who reported that DAGUSIBU education improved community understanding of antibiotics. Madania et al., (2022) also found that DAGUSIBU education helped communities understand appropriate medicine management. Furthermore, Azzahra et al., (2022) showed that health education using learning media could improve community knowledge, while Suryaningsih, (2022) reported that booklets were effective because the information was easy to understand and could be reviewed independently. Anggralisa et al., (2025) similarly explained that booklets can facilitate health education by combining clear text and illustrations. These findings support the present result that the structured and communicative booklet helped respondents understand antibiotic acquisition, use, storage, and disposal according to DAGUSIBU principles.

The improvement in knowledge can also be explained by Lawrence Green's PRECEDE-PROCEED model, which identifies knowledge as a predisposing factor in health behavior and recognizes health education as an important intervention for strengthening this factor (Nelwan, 2022). The researcher assumes that the effectiveness of the intervention was supported by the use of a booklet containing concise information and visual elements, which helped respondents receive, understand, and recall the material. Thus, booklet-based DAGUSIBU education can be considered an effective approach to improving community knowledge of rational, appropriate, and safe antibiotic management.

CONCLUSIONS AND SUGGESTIONS

The findings indicate that DAGUSIBU antibiotic education using a booklet can effectively improve community knowledge regarding the appropriate acquisition, use, storage, and disposal of antibiotics. In addition, knowledge is significantly associated with antibiotic-use behavior, indicating that better knowledge tends to be accompanied by better antibiotic-use practices. These findings highlight the importance of continuous community education as part of efforts to promote rational antibiotic use and prevent inappropriate antibiotic practices. Health education using structured and accessible media such as booklets can be considered as one approach to strengthen community understanding of responsible antibiotic use.

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