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Determinants of non-prescription antibiotic use and knowledge gaps in Indonesia: findings from the Indonesian Health Survey 2023

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Abstract

Purpose: This study examines the key determinants influencing non-prescription antibiotic use and identifies knowledge gaps in Indonesia, based on the 2023 National Health Survey (SKI 2023). Using national data, the research examines education, healthcare access, gender, and age-related trends, comparing these trends across rural and urban populations. **Methods:** The study utilizes SKI 2023 national data to analyze antibiotic usage patterns and examine trends related to education, healthcare access, public awareness, gender, and age. A comparative analysis of urban and rural areas reveals disparities, with Pearson Chi-Square and Multinomial Logistic Regression tests applied at $p \leq 0.05$ for statistical significance. **Results:** The study shows that lower education levels are significantly associated with higher antibiotic misuse ($p<0.001$). Younger individuals and males also tend to misuse antibiotics more frequently and have lower knowledge levels ($p<0.001$). In urban areas, 58.4% of males and 54.3% of females report using antibiotics without a prescription. Limited access to healthcare is also significantly linked to increased self-medication ($p<0.001$). Additionally, 73.5% of respondents hold misconceptions about antimicrobial resistance (AMR), underscoring the urgent need for improved public awareness and education. **Conclusion:** According to the Indonesian Health Survey 2023, non-prescription antibiotic use is more prevalent among individuals with lower educational attainment, younger age, male gender, urban residence, and limited access to healthcare. To address this issue, public policies should prioritize health education, school-based awareness programs, improved access to healthcare, and stricter regulation of antibiotic sales.

Keywords: antibiotic misuse; antimicrobial resistance; healthcare accessibility; non-prescription antibiotics; public health interventions

INTRODUCTION

The unregulated practice of dispensing antibiotics without a prescription represents a significant global health challenge, as it fuels the alarming rise of antimicrobial resistance and undermines treatment effectiveness. This issue poses serious risks to sustainable health outcomes, increasing the financial burden on healthcare systems while diminishing the efficacy of critical medicines. Addressing this problem requires robust essential medicines policies, which aim to ensure safe, controlled access to antibiotics and align with the Sustainable Development Goal (SDG) target

3.8. This target emphasizes universal health coverage, including equitable access to safe, effective, and affordable medications [1].

Antimicrobial resistance (AMR) is a pressing global health challenge, and Indonesia is no exception to its growing threats. The misuse of antibiotics, particularly without medical supervision, is a major contributor to AMR [2]. Despite the establishment of the National Committee for Antimicrobial Resistance Control under the Ministry of Health, efforts to comprehensively address AMR remain insufficient, with gaps in enforcement, public awareness, and access to proper healthcare interventions. The Indonesian Health Survey (SKI) 2023 highlights the severity of the issue, revealing that 41.0% of respondents who used antibiotics in the past year obtained them without a prescription, and 61.3% sourced these antibiotics from licensed pharmacies or drug stores. These findings underscore systemic and behavioral drivers that perpetuate antibiotic misuse and jeopardize efforts to combat AMR. Additionally, AMR has already led to significant health and economic burdens in Indonesia, with an estimated 133,800 deaths in 2019 linked to resistant infections [3].

Given the widespread impact of AMR, research on antibiotic misuse is essential for developing targeted strategies to reduce inappropriate use, enhance antimicrobial stewardship, and protect public health. By analyzing SKI 2023 data, researchers examine the social, cultural, and psychological factors that drive misuse, particularly the common practice of obtaining antibiotics without a prescription and the role of pharmacies in facilitating access. They assess public knowledge of AMR and its risks, identifying gaps and misconceptions that require attention. This analysis informs evidence-based recommendations to strengthen AMR policy enforcement, improve healthcare accessibility, and regulate antibiotic distribution. Ultimately, it supports the development and implementation of interventions that educate the public and healthcare providers on responsible antibiotic use and the urgency of combating AMR [4-5].

Building on this, the study also examines the broader implications of antibiotic misuse by analyzing SKI 2023 data to identify the social, cultural, and psychological factors that drive inappropriate use. Researchers investigate the widespread practice of obtaining antibiotics without prescriptions and the role of pharmacies in enabling access, while also assessing public knowledge of AMR and associated risks. Identifying misconceptions and knowledge gaps informs targeted interventions to enhance antibiotic awareness, improve healthcare accessibility, and regulate the distribution of antibiotics. These insights contribute to evidence-based recommendations that reinforce AMR policy enforcement, advance public education, and support sustainable healthcare strategies that promote responsible antibiotic use.

METHODS

Observational analytical study with retrospective and population-based design using secondary data from the Indonesian Health Survey (SKI) in 2023. The total sample consisted of respondents aged 15 years or older, comprising a total of 146,985 individuals. The dataset was organized and coded via Microsoft Excel before being analyzed using SPSS (version 25) on Windows. Using the Pearson Chi-Square test and the Regression Logistic Multinomial. The study examined the relationship between health determinants, including characteristics, knowledge, access to healthcare services, and antibiotic use without a prescription, in both urban and rural environments.

The data used in this study comes from the SKI 2023. Household-level information is collected through the Household Questionnaire (RUTA), where residence type (urban or rural) is recorded in Blocks I-V, and demographic characteristics—such as age, gender, education level, and occupation—are captured in Block IV. Individual-level data on antibiotic use, specifically whether antibiotics are obtained with or without a doctor's prescription, are collected from the Individual Questionnaire Block F (Code F06b). Respondents' knowledge of appropriate antibiotic use is assessed through questions in the same block [3]. The research has received ethical review approval with ethics review number 049/KER/FK/08/2024 from the Research Ethics Commission of the Faculty of Medicine, Trisakti University.

RESULTS

Table 1 shows that the age distribution reveals that 48.28% of participants are aged 35–54, with females comprising 58.93% of the group. Education is evenly divided, with 49.84% of individuals completing nine years or fewer of education, and 50.16% completing more than nine years of education. Among participants, 64.23% are employed. Additionally, 71.2% exhibit good knowledge of antibiotic use, and 94.16% report having easy access to healthcare. Antibiotic use without a prescription is nearly the same in rural areas (22.56%) and urban areas (25.59%). Urban populations have higher non-prescription antibiotic use (Males: 58.4%, Females: 54.3%). Males are more likely than females to use antibiotics without a prescription (PR: 1.126 in rural areas, 1.076 in urban areas).

Table 1. Health determinant of health associated with non-prescription antibiotic-use (n= 146,985)

Variabels	Rural		p	PR (95% CI)	Urban		p	PR (95% CI)
	With prescription	Without prescription			With prescription	Without prescription		
	n (%)	n (%)			n (%)	n (%)		
Sex								
Male	17,973 (55,5)	14,408 (44.5)	0.000	1.126 (1.107-1.145)	11,638 (41.6)	16,341 (58.4)	0.000	1.076 (1.052-1.092)
Female	28,691 (60.5)	18,749 (39.5)			17,919 (45.7)	21,266 (54.3)		
Age group (years)								
15 - 34	14,944 (58.9)	10,408 (41.1)	0.000	-	9,615 (44.8)	11,863 (55.2)	0.000	-
35 - 54	21,616 (56.5)	16,665 (43.5)			14,040 (43.0)	18,643 (57.0)		
55 - 74	9,481 (62.0)	5,812 (38.0)			5,479 (45.2)	6,655 (54.8)		
> 75	623 (69.6)	272 (30.4)			423 (48.7)	446 (51.3)		
Education (years)								
≤ 9	16,706 (53.4)	14,560 (46.6)	0.000	1.126 (1.196-1.226)	17,442 (41.5)	24,546 (58.5)	0.000	1.127 (1.111-1.173)
> 9	29,958 (61.7)	18,597 (38.3)			12,115 (48.1)	13,061 (51.9)		
Employment								
None	17,793 (58.8)	12,475 (41.2)	0.147	0.987 (0.979-1.004)	9,992 (44.8)	12,318 (55.2)	0.004	0.979 (0.965-0.993)
Working	28,871 (58.3)	20,682 (41.7)			19,565 (43.6)	25,289 (56.4)		
Health access								
Tough	2,386 (1.6)	1,700 (1.2)	0.930	1.002 (0.965-1.040)	2,106 (1.4)	2,389 (1.6)	0.000	0.946 (0.919-0.973)
Convenient	44.278 (30.1)	31,457 (21.4)			27,451 (18.7)	35,218 (24.0)		
Antibiotics knowledge								
Good	7,520 (5.1)	12,142 (8.3)	0.000	1.768 (1.741-1.793)	6,175 (4.2)	16,488 (11.2)	0.000	1.533 (1.514-1.552)
Poor	39,144 (26.6)	21,015 (14.3)			23,382 (15.9)	21,119 (14.4)		

Note: *Chi-square test; PR (Prevalence Ratio); CI (Confidence Interval); p (p-value)

Younger individuals (15-34 years old) have higher non-prescription use (55.2% in urban areas, 41.1% in rural areas) compared to older age groups (>75 years old), who mostly rely on prescriptions (69.6% in rural areas, 48.7% in urban areas). Lower education (≤9 years) is linked to more non-prescription use (46.6% rural, 58.5% urban), while higher education (>9 years) improves adherence to prescription-based use (PR: 1.126–1.127, p = 0.000). Healthcare access has a greater impact on urban populations, with 24.0% of those with easy access using antibiotics without a prescription, compared to 1.6% with limited access (PR = 0.946). Poor antibiotic knowledge leads to higher misuse (PR: 1.768 in rural areas, 1.533 in urban areas).

We further explore the determinants of non-prescription antibiotic use in urban and rural communities through multinomial logistic regression analysis. Examining variations across education, healthcare access, public awareness, gender, and age-related trends to identify key influencing factors. Table 2 shows that the analysis reveals critical socio-demographic factors associated with non-prescription antibiotic use in both rural and urban contexts. Male respondents (p=0.000) and individuals aged 55–74 years (p=0.001) demonstrate significantly lower tendencies to self-medicate with antibiotics. In contrast, individuals with lower educational attainment (≤9 years) are more than twice as likely to engage in such behavior compared to those with higher education levels (p=0.000). Unemployment (p=0.000) is also associated with a reduced likelihood of nonprescription use. Furthermore, limited access to health-care services (p=0.000) markedly increases the probability of antibiotic use without professional guidance. These findings highlight the influence of education and healthcare accessibility in shaping antibiotic use behaviors across community settings.

Table 2. Analysis of determinants among rural-urban areas without prescription used

Variables	B	Std. Error	Wald	df	Sig*	ExpB
Intercept	-0.183	0.080	5.216	1	0.022	-
Gender-1	-0.127	0.017	53.833	1	0.000	0.881
Gender-2	**Ob**			-		
Age (years)						
15-34	0.085	0.079	1.152	1	0.283	1.089
35-54	-0.140	0.079	3.117	1	0.075	0.869
55-74	-0.272	0.080	11.642	1	0.001	0.762
>75	**Ob**	-	-	-	-	-
Education						
≤ 9	0.943	0.016	3394.974	1	0.000	**2.567**
> 9	**Ob**	-	-	-	-	-
Working						
None	-0.445	0.018	578.925	1	0.000	0.641
Yes	**Ob**	-	-	-	-	-
Health access						
Difficult	0.212	0.016	180.820	1	0.000	1.236
Easy	**Ob**	-	-	-	-	-

Note: * Regresi Logistik Multinominal, Ob=referensi category, Exp(B)= base on rural-urban without prescription, df=degreeof freedom, Sig=significant, ExpB=exponentiated value of parameter estimate.

Based on previous results, further analysis comparing antibiotic knowledge levels between urban and rural communities is conducted using the same analytical test. The results, presented in Table 3, reveal notable findings. The analysis in Table 3 identifies several socio-demographic determinants that influence antibiotic-related knowledge across rural and urban

populations. Individuals residing in urban areas exhibit significantly lower levels of antibiotic knowledge compared to their rural counterparts (p=0.000). Male respondents (p=0.000) are also less likely than females to possess adequate knowledge of antibiotics. Age emerges as a significant factor, with younger adults aged 15–34 and 35–54 showing higher odds of poor knowledge compared to older individuals (p=0.000).

Table 3. Analysis of determinants and antibiotic-related knowledge among the rural-urban population

Variables	B	Std. Error	Wald	df	Sig*	ExpB
Intercept	1.782	0.054	1103.181	1	0.000	-
Prescription Rural-Urban	-0.326	0.005	3914.779	1	0.000	0.722
Gender	-0.160	0.013	143.641	1	0.000	0.852
Age (years)						
15-34	0.268	0.052	26.629	1	0.000	1.307
35-54	0.295	0.051	33.041	1	0.000	1.343
55-74	0.204	0.052	15.191	1	0.000	1.226
>75	**Ob**	-	-	-	-	-
Education (years)						
≤ 9	-0.401	0.013	1019.663	1	0.000	0.670
> 9	**Ob**	-	-	-	-	-
Working						
None	-0.126	0.014	79.413	1	0.000	0.882
Yes	**Ob**	-	-	-	-	-
Health access						
Difficult	-0.049	0.025	3.966	1	0.046	0.952
Easy	**Ob**	-	-	-	-	-

Note: *Regresi logistik multinominal, Ob=referensi category, Exp(B)= base on good antibiotic knowledge, df=degree of freedom, Sig=significant, ExpB=exponentiated value of parameter estimate.

Table 4. Public knowledge regarding antibiotics (n=146,985)

Question items	Respondent responses			
	Correct		Not-correct	
	n	%	n	%
Question 1 / F07a "Should antibiotics be finished?"	103,551	70.5	43,343	29.5
Question 2 / F07b "Are antibiotics taken on schedule?"	107,908	73.4	39,077	26.6
Question 3 / F07c "Can antibiotics be purchased without a doctor's prescription?"	65,165	44.3	81,829	55.7
Question 4 / F07d "Can leftover antibiotics be reused for yourself or others?"	82,035	55.8	64,950	44.2
Question 5 / F07e "If antibiotics are not used according to the rules, will they become resistant ?"	38,904	26.5	108,081	73.5
Question 6 / F07f "Are antibiotics only used for bacterial infections?"	64,354	43.8	8,631	56.2

Lower educational attainment (≤9 years) is strongly associated with reduced knowledge (p=0.000), reinforcing the importance of education in public health awareness. Unemployment is similarly linked to poorer understanding (p=0.000). Finally, limited access to healthcare services is associated with slightly lower antibiotic knowledge (p=0.046), indicating that improved accessibility may enhance public awareness and understanding of appropriate antibiotic use.

Further analysis reveals the responses to six questions on antibiotic knowledge, presented in Table 4. Table 4 presents responses from 146,985 respondents regarding key aspects of antibiotic knowledge. The findings highlight variations in understanding, with certain misconceptions more prevalent than others.

Most correctly answered questions

Question 2 ("Are antibiotics taken on schedule?") received the highest percentage of correct responses (73.4%), indicating strong awareness of antibiotic scheduling. Question 1 ("Should antibiotics be finished?") was also well understood, with 70.5% answering correctly, reflecting good adherence to completing antibiotic courses.

Most incorrectly answered questions

Question 5 ("If antibiotics are not used correctly, will they become resistant?") received 73.5% incorrect responses, indicating a widespread misunderstanding about antimicrobial resistance (AMR). Question 6 ("Are antibiotics only used for bacterial infections?") had 56.2% incorrect responses, indicating confusion about the scope of antibiotic effectiveness. Question 3 ("Can antibiotics be purchased without a doctor's prescription?") had 55.7% incorrect responses, which may reflect uncertainty about regulations or access to antibiotics.

DISCUSSION

This study highlights that non-prescription antibiotic use is influenced by a complex interplay of biological, educational, occupational, and knowledge-related factors. Gender differences appear to influence health-seeking behaviors and antibiotic use patterns; women generally exhibit greater adherence to prescribed antibiotics, likely due to more frequent engagement with healthcare services [6–8]. Women have been found to receive approximately 25% more prescriptions than men, particularly for respiratory tract infections, with the most significant disparities reported among individuals aged 16–54. Similarly, it was observed that women in Indonesia were more likely to seek professional medical advice and adhere to treat-

ment protocols, supporting the view that health literacy and caregiving roles contribute to more responsible medication practices [9].

Age and residential context also play critical roles. Younger populations, especially in urban areas, reported higher levels of non-prescription antibiotic use, with usage rates reaching 55.2% in urban settings versus 41.1% in rural areas. This pattern is echoed in findings by Do Tu Anh et al. [10] who emphasized that increased access to drug outlets and informal networks in urban environments, combined with time constraints and convenience factors, drives self-medication among working-age adults. These findings underscore the importance of context-sensitive interventions that address demographic and behavioral dimensions of antibiotic misuse.

Educational disparities significantly contribute to irrational antibiotic use. In rural areas, individuals with lower education levels exhibit a higher prevalence of non-prescription antibiotic use (46.6%) compared to their more educated counterparts (38.3%). In urban settings, misuse is widespread, regardless of educational background, with rates of 58.5% among less-educated individuals and 51.9% among more educated individuals. This paradox may be attributed to the greater availability of antibiotics, lenient pharmacy oversight, and misconceptions surrounding the efficacy of antibiotics.

Nurmala & Gunawan (2020) underscored that limited health literacy—especially in rural Indonesian communities—amplifies the tendency to self-medicate, often guided by experience or community norms rather than professional consultation [11]. Similarly, Djawaria et al. (2018) highlighted the role of culturally rooted health behaviors in shaping antibiotic use, finding that educational interventions tailored to community contexts improved awareness and reduced misuse [12]. Ayana et al. (2021) further observed that even among literate populations, gaps in specific knowledge about antibiotic resistance and appropriate usage persist, suggesting that general education alone is insufficient without targeted public health messaging [13].

Occupational factors also strongly influence patterns of antibiotic use. Urban workers, driven by demanding work schedules and higher disposable incomes, often opt for self-medication to avoid time-consuming clinic visits. This behavior is exacerbated by limited awareness of the long-term consequences of inappropriate antibiotic use. As Ayana et al. (2021) noted, work-related stress and the prioritization of productivity frequently override caution, leading individuals to rely on over-the-counter antibiotics or informal advice. Weak regulatory enforcement in both retail and informal drug markets continues to facilitate this trend [13]. Addressing these occupational and educational factors requires a multifaceted strategy—combining more vigorous policy enforcement, community-based education, and employer-supported health initiatives—to reduce misuse and foster res- ponsible antibiotic practices.

Limited public knowledge remains a substantial driver of inappropriate antibiotic use. Many individuals lack a fundamental understanding that antibiotics are specifically designed to treat bacterial infections and should neither be reused nor obtained without professional medical guidance. Recent findings from Pratiwi et al. (2020) and the SKI (2023) survey underscore significant disparities in knowledge between urban and rural populations, highlighting the urgent need for sustained and comprehensive health education initiatives [14].

According to the Kebijakan Pembangunan Kemenkes (2023), strengthening health literacy is a strategic priority in Indonesia's public health agenda, with antibiotic stewardship identified as a key area for behavior change communication [3,14]. Despite regulatory provisions, only 44.3% of respondents accurately recognized that antibiotics must be prescribed, signaling inadequate dissemination of relevant regulations and lax enforcement in pharmaceutical retail settings. Yuswantina et al. (2019) emphasized that a lack of public understanding and minimal oversight of antibiotic sales continues to facilitate irrational consumption, especially in areas where over-the-counter access remains unchecked [15]. Moreover, global studies have echoed similar concerns.

Yin, Mu et al. (2021) observed that insufficient awareness of antibiotic resistance mechanisms contributes to persistent misuse, particularly where individuals rely on personal experience or non-professional recommendations [16]. Horumpende et al. (2018) reported that misconceptions regarding the efficacy of antibiotics for non-bacterial infections are still widespread and significantly undermine public health campaigns [17]. These knowledge gaps not only hinder responsible antibiotic use but also exacerbate antimicrobial resistance (AMR)—a growing global health threat. To address this, Godman et al. (2021) advocate for transparent, community-driven education efforts involving healthcare professionals, civil society, and local leaders [18]. Developing culturally tailored messages and ensuring the accessibility of accurate antibiotic information are critical to fostering trust, shaping health behaviors, and reinforcing regulatory frameworks. Ultimately, reducing irrational antibiotic use requires a coordinated strategy that combines edu-

cational empowerment, community engagement, and consistent enforcement of policies.

National survey data from SKI reveal alarmingly low levels of public awareness regarding antibiotic resistance, with 73.5% of respondents unaware that improper use could lead to antimicrobial resistance (AMR) [19–20]. This widespread knowledge gap is consistently echoed in global literature, where insufficient understanding of AMR correlates with higher rates of antibiotic misuse. Maidin et al. (2021) emphasized that a lack of antibiotic literacy, especially in community settings, significantly contributes to unsupervised self-medication and the purchase of over-the-counter medications [19]. Mazzoleni et al. (2023) further argued that public misconceptions—particularly the belief that antibiotics are universally effective—persist even among populations with access to healthcare services, suggesting that awareness initiatives must extend beyond access to encompass behavioral change [20].

Empirical prescribing practices, often based on symptoms rather than laboratory-confirmed diagnoses, exacerbate the issue by increasing the likelihood of incorrect antibiotic type, dose, or duration—factors that accelerate the development of resistance. Notably, 56.2% of respondents incorrectly believed that antibiotics could treat non-bacterial infections, underscoring the persistent misunderstanding of their function. Emphasized that antibiotics are effective only against bacterial pathogens and that their misuse for viral illnesses, such as influenza or the common cold, contributes directly to the evolution of resistance [21-22]. Clarifying the mechanism of antibiotic action—whether through inhibition of bacterial cell wall synthesis (e.g., β-lactams, glycopeptides), interference with protein translation (e.g., aminoglycosides, macrolides), or disruption of nucleic acid replication (e.g., quinolones, metronidazole)—is critical for guiding responsible use and optimizing clinical outcomes.

Healthcare access inequalities also shape patterns of misuse. In urban areas, respondents with easier access to healthcare paradoxically reported higher rates of non-prescription antibiotic use (24%) compared to only 1.6% among those with limited access. This suggests that the widespread availability of antibiotics, coupled with lax regulatory enforcement, facilitates their misuse. Interestingly, rural misuse patterns did not significantly correlate with healthcare access ($p = 0.930$), indicating that unique sociocultural factors—such as informal caregiving, peer advice, or local norms—may be more influential in shaping antibiotic behaviors.

As Mazzoleni et al. (2023) observed, community-level dynamics often override regulatory frameworks, highlighting the need for localized, culturally relevant health interventions [20]. Ultimately, public education campaigns must emphasize the dangers of antibiotic overuse and encourage individuals to consult healthcare professionals and rely on verified health information sources.

Indonesia has made progressive strides in controlling antimicrobial resistance (AMR) through national-level policy and surveillance initiatives. Since 2005, the Ministry of Health has implemented the Antibiotic Resistance Control Program (PPRA) in government and teaching hospitals to monitor antimicrobial usage and track resistance patterns. This program, supported by findings from the AMRIN study, has been instrumental in promoting rational antibiotic use within clinical settings [23-24]. Building on this foundation, the National Action Plan for Antimicrobial Resistance (RAN-PRA) 2020–2024 was introduced as a strategic framework aligning with Indonesia's broader health system reform goals. The plan emphasizes a One Health approach, integrating efforts across human, animal, and environmental sectors to mitigate the emergence and spread of AMR [25].

To further consolidate national efforts, the Ministry launched the National Strategy for Controlling AMR (Stranas AMR) 2025–2029, which incorporates WHO recommendations and focuses on early detection, community-based interventions, and the strengthening of laboratory capacity across primary and referral healthcare systems [26-27]. This forward-looking strategy aims to translate surveillance data into responsive public health action while fostering cross-sector collaboration.

In support of these frameworks, the Minister of Health Regulation No. 28 of 2021 mandates that antibiotics be dispensed only upon presentation of a physician's prescription and explicitly prohibits unauthorized sales in pharmacies and informal markets [28]. Nevertheless, enforcement remains inconsistent, particularly in urban areas where non-prescription antibiotic use is most prevalent [29]. These enforcement gaps underscore the need for comprehensive public education campaigns to raise awareness about AMR risks and promote the responsible use of antibiotics. Diagnostic-based prescribing protocols must also be emphasized at all levels of healthcare to reduce the use of empirical treatments that contribute to the development of resistance [30].

Equally important is enhancing healthcare accessibility in rural regions, where limited service availability often drives self-medication and reliance on informal providers. Addressing these disparities requires localized interventions that bridge the urban–rural divide and promote equitable access to safe and

effective antibiotic therapy. Collectively, these policy mechanisms and strategic frameworks represent meaningful progress in Indonesia's AMR response [31]. However, their long-term success depends on consistent implementation, cross-sector engagement, and strengthened public accountability.

To effectively curb antibiotic misuse and promote rational use, multifaceted interventions must prioritize public education, regulatory enforcement, equitable access to healthcare, and awareness campaigns about antimicrobial resistance (AMR). Strengthening health literacy—particularly through school curricula and digital outreach—can improve knowledge among high-risk groups such as adolescents and men, who consistently show higher levels of inappropriate use [19,21]. Enforcing tighter controls on over-the-counter antibiotic sales, especially in urban areas where self-medication is prevalent due to widespread availability and weak oversight, is critical to limiting irrational access [32]. Concurrently, investment in healthcare infrastructure in under-resourced regions will facilitate the use of prescription-based antibiotics and reduce dependence on informal providers [23-24].

Public awareness strategies must focus on dismantling persistent misconceptions—such as the belief that antibiotics can treat viral infections—and clarify the mechanisms by which misuse accelerates AMR. As noted in the SKI (2023) findings and global studies, significant proportions of the population remain unaware of resistance risks, highlighting the need for targeted, community-based education [18,25,33].

Moreover, campaigns should be inclusive, culturally relevant, and supported by transparent health communication in collaboration with community leaders, civil society, and healthcare providers. By combining these educational and policy-based interventions with real-time surveillance and behavior change communication, Indonesia can promote sustainable antibiotic stewardship. Addressing social, demographic, and systemic drivers of misuse will be essential to safeguarding antibiotic efficacy. These findings underscore the urgency of coordinated action across sectors to reduce misuse and strengthen community engagement, ensuring that antibiotics remain effective for future generations [29,3].

CONCLUSION

This study demonstrates that a combination of social, educational, and systemic factors contributes to antibiotic misuse in Indonesia. Key drivers include gender, age, education level, work pressure, and limited understanding of antibiotics—especially among urban and younger populations. Despite existing efforts, weak enforcement and widespread misconceptions continue to fuel irrational antibiotic use.

To address these challenges, Indonesia has introduced several key regulatory frameworks. The Antibiotic Resistance Control Program (PPRA), National Action Plan for AMR 2020–2024, Stranas AMR 2025–2029, and Minister of Health Regulation No. 28 of 2021 reflect the government's commitment to curbing antimicrobial resistance. However, the impact of these policies depends on consistent enforcement, improved public awareness, and stronger collaboration across sectors. By aligning regulatory action with targeted education and equitable access to healthcare, Indonesia can strengthen antibiotic stewardship and safeguard public health in the long term.

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