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Effectiveness of Audio-Visual Media on Whatsapp for Antibiotic Resistance Education

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Abstract

The escalating threat of antibiotic resistance, driven by misuse and overuse of antibiotics, poses a severe public health crisis that requires immediate and innovative solutions. Education on proper antibiotic use is crucial in combating this issue, particularly among community health cadres who play a pivotal role in disseminating health information. This study evaluates the influence of an educational intervention delivered via audio-visual media through WhatsApp on enhancing the knowledge and attitudes of Integrated Health Pos (Posyandu) and Family Welfare Movement (PKK) cadres about antibiotic resistance. A pretest-posttest design was adopted, involving 100 participants from rural areas in Kebak Kramat Subdistrict, Karanganyar Regency, Central Java. Questionnaires assessed participants' knowledge and attitudes both before and after the intervention, which consisted of educational audio-visual content shared through WhatsApp. The findings revealed a significant improvement in knowledge, as evidenced by a Mann-Whitney U test Z-value of -2.044 ($p=0.041$) when comparing Posyandu and PKK cadres. However, no significant change was observed in attitudes, with a Z-value of -0.944 ($p=0.345$). These results indicate that while the intervention effectively increased knowledge about antibiotic resistance, it had limited impact on altering attitudes. The study underscores WhatsApp's potential as a practical and accessible platform for delivering health education in rural settings. Nevertheless, it also highlights the necessity for complementary approaches to foster meaningful attitude changes and encourage sustained behavioral adaptations in antibiotic use. Future interventions should explore integrating interactive and participatory methods to address these challenges more effectively.

Keywords: audio-visual education, whatsapp intervention, community health, health cadres

Introduction

Antibiotic resistance (RA) has become one of the biggest challenges in global public health (Aslam et al., 2018). Bacteria that develop resistance to antibiotics not only lead to infections that are more difficult to treat, but also have the potential to increase mortality, prolong the duration of treatment, and increase the cost of treatment (Kaur et al., 2024; Okeke et al., 2024). According to a World Health Organization (WHO, 2020), more than 700,000 people die each year from infections caused by resistant bacteria. This number is expected to continue to rise, with a projected 10 million deaths per year by 2050 if there is no stronger effort in addressing this issue. WHO mentions that RA risks thwarting many achievements in modern medicine, including cancer treatment, organ transplants, and major surgical procedures that require the use of antibiotics to prevent post-operative infections (Murray et al., 2022; WHO, 2023). This fact signifies the importance of controlling antibiotic use and increasing public education about the impact of antibiotic misuse.

Antibiotic resistance is a growing global issue, and Indonesia is no exception. The irrational use of antibiotics is still prevalent, both in households and healthcare facilities. Suminar (2022) found that irrational antibiotic use is common, with 81.4% in public hospitals and 86.2% in private hospitals. This misuse significantly contributes to antibiotic resistance, highlighting the need for better prescription practices and improved patient adherence to treatment protocols. Moreover, Ramdhani *et al.* (2021) points out that antibiotic resistance is a significant problem in Indonesia, with high resistance rates, such as 38.0% for cefixime and 92.86% for tetracycline. This issue is exacerbated by improper antibiotic use and premature discontinuation of treatment. These actions not only increase the risk of recurrent infections but also accelerate the development of resistant bacteria.

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On the other hand, a survey conducted in 10 hospitals across Indonesia in 2020 revealed that the resistance rate of *Escherichia coli* to the antibiotic ceftriaxone reached 60%, while resistance to ciprofloxacin was 55% (Handayani et al., 2017). These high resistance rates indicate that treating infections with certain antibiotics is becoming increasingly ineffective, thus limiting treatment options for patients. This situation is further exacerbated by the easy access to antibiotics without strict regulations, especially in pharmacies and traditional medicine stores. The irrational use of antibiotics in Indonesia, including 40% of individuals using them without a prescription and nearly 50% stopping treatment prematurely, significantly contributes to antibiotic resistance, increasing the risk of recurrent infections and accelerating the development of resistant bacteria (Siahaan et al., 2022).

The primary cause of antibiotic resistance is the improper use of antibiotics. One form of misuse is consuming antibiotics without a prescription or discontinuing treatment prematurely. A survey conducted in 2024 highlights that self-medication and premature cessation of antibiotics significantly contribute to antimicrobial resistance (AMR). Public awareness and education are essential in addressing this information gap and promoting responsible antibiotic use, ultimately reducing the spread of resistant microorganisms (Ahmed et al., 2024). Furthermore, another survey revealed that 45% of respondents stopped their antibiotic treatment early, mainly because they felt better, and 51% expressed an intention to use leftover antibiotics, emphasizing a significant gap in understanding proper antibiotic use, contributing to the potential for antibiotic resistance (Shah et al., 2024).

Several factors contribute to worsening the situation, including the low level of public health education and the lack of access to accurate and easily understood information regarding the proper use of antibiotics (Septiani et al., 2023). Research has shown that 50% of antibiotic use worldwide is not in accordance with medical guidelines, whether in terms of dosage, frequency, or the type of antibiotics used. This leads to an increase in the population of antibiotic-resistant bacteria, making infections more difficult to treat and potentially causing larger outbreaks of infections (Kanan et al., 2023; Salam et al., 2023).

Social and cultural factors also play a role in inappropriate antibiotic use patterns. In many countries, including Indonesia, antibiotics are often available without a doctor's prescription, making it easier for individuals to access these drugs even when they do not need them. This myth demonstrates a significant information gap in society, which needs to be addressed through effective and sustained education (Kassa et al., 2022; Mukherjee et al., 2024).

Further research highlights that improper use of antibiotics, particularly reserve antibiotics, leads to increased antibiotic resistance and adverse drug reactions. This underscores the need for antimicrobial stewardship programs to optimize antibiotic use and raise awareness about drug safety and resistance. Additionally, the lack of public participation in reporting adverse drug reactions in developing countries is a significant barrier (Deori et al., 2024; Garg, 2024).

Excessive and inappropriate use of antibiotics contributes significantly to antibiotic resistance. Horizontal gene transfer among pathogens further exacerbates this issue. Therefore, public awareness and guidance from health authorities are crucial to reducing the misuse of antibiotics that contributes to the development of antibiotic resistance (Malhi & Bao, 2023).

The scarcity of new antibiotics also worsens the problem of improper antibiotic use. Dependence on older antibiotics, which are more frequently misused, increases antibiotic resistance due to the lack of safe and effective alternatives. Greater public awareness campaigns and ongoing education are necessary to promote responsible antibiotic use (Joshi, 2023).

Raising public awareness about antibiotic resistance is crucial in managing this global health threat (Alhur et al., 2024; Kim et al., 2023). Social media and digital platforms offer a powerful means to disseminate information and educate the public on the importance of proper antibiotic use (Gilham et al., 2024). With over 4.7 billion internet users worldwide, these platforms can effectively reach diverse audiences. The use of engaging content, especially audio-visual formats, can improve understanding and retention of information compared to traditional text-based methods (Atallah et al., 2023).

Several previous studies indicate that social media platforms, including YouTube, Instagram, and Facebook, have been utilized for various health purposes, ranging from disease prevention campaigns to promoting healthy lifestyles (Agoulmam & Chakor, 2024; Raja, 2024). Farrokhi *et al.* (2023) found that educational videos disseminated through social media significantly

enhanced audience understanding of health topics compared to relying solely on traditional media or text. In the context of antibiotic resistance, educational videos on social media can effectively convey key messages about controlling antibiotic use and explain the potential negative impacts of antibiotic misuse in a way that is easier for audiences to comprehend.

However, although social media has been widely used for health campaigns, there is still limited research specifically examining the impact of audio-visual content on social media on public understanding of antibiotic resistance. Most existing studies focus on other diseases or more general health issues, while the topic of antibiotic resistance has not received sufficient attention in the social media literature. Therefore, it is crucial to conduct more in-depth research on the effectiveness of audio-visual media on social platforms as a tool to enhance public awareness and understanding of antibiotic resistance.

This research is grounded in two relevant communication theories: Social Learning Theory and the Elaboration Likelihood Model (ELM). Social Learning Theory, first introduced by Albert Bandura, emphasizes the importance of observation and imitation in the learning process (Firmansyah & Saepuloh, 2022). In relation to this theory, social media serves as a platform where audiences can observe and learn desired behaviors, such as the prudent use of antibiotics (Raja, 2024). Audio-visual content, such as educational videos and animations, can present information in a more engaging and easily comprehensible manner, enabling audiences to learn from concrete examples presented in the videos (Kim et al., 2023).

Meanwhile, the Elaboration Likelihood Model (ELM), developed by Richard E. Petty and John Cacioppo, explains two pathways in information processing: the central route and the peripheral route. The central route involves deep and analytical information processing, while the peripheral route emphasizes elements that capture the audience's attention, such as visuals and emotions (Hidayat & Solihah, 2021). In this context, audio-visual content on social media operates through the peripheral route, where audiences are more influenced by engaging visual elements, such as animations or emotionally driven narratives (Lam et al., 2022). These features can motivate audiences to pay attention to the message conveyed, even without engaging in deep cognitive process (Niu et al., 2020).

There is a clear research gap regarding how the use of audio-visual content on social media can contribute to educating the public about the importance of prudent antibiotic use and the impacts of antibiotic resistance. In-depth studies on this subject are urgently needed, as social media, one of the most widely used communication platforms today, holds significant potential to reach a broader and more diverse audience. Therefore, this study aims to address this gap by examining the influence of audio-visual content on social media in raising awareness about antibiotic resistance.

The urgency of this research is high, particularly given the threat posed by antimicrobial resistance (AMR) in Indonesia. Data and information regarding the role of antibiotic misuse in contributing to AMR are still limited. A national basic health survey in Indonesia revealed that approximately 10% of the population stores antibiotics at home, and 86.1% obtain these antibiotics without a doctor's prescription. This highlights the critical need for public education on the responsible use of antibiotics to mitigate the growing risks associated with AMR (Gach et al., 2024; Siahaan et al., 2022).

The study expected to find evidence showing that social media, particularly through audio-visual content, can be an effective tool to educate the public about antibiotic resistance. Due to the large role social media plays in daily life, the results of this study have the potential to make a significant contribution to more effective health communication strategies. The results of this study can be used to design more engaging and impactful educational campaigns, which can help reduce antibiotic resistance rates and increase public understanding of the importance of wise antibiotic use. This study aimed to assess the effectiveness of using audio-visual media in increasing understanding and awareness of antibiotic resistance.

Method

This study utilized a quasi-experimental design with a two-group pretest-posttest approach to evaluate the effectiveness of an educational video intervention on antibiotic resistance in influencing changes in public knowledge and attitudes. The design was selected to compare two groups involved in the research: *Posyandu* health volunteers and members of the Family Welfare

Empowerment (PKK) group in Karanganyar Regency, Central Java Province, involving 100 participants from both groups. The choice of this design took into account the fact that the study was conducted within a community with an existing social structure, which made full randomization challenging (Shadish et al., 2002).

The research paradigm applied was post-positivist, employing a quantitative approach to measure changes in respondents' knowledge and attitudes after being exposed to the educational video intervention. The instrument used in this study was a questionnaire comprising two sections: a knowledge questionnaire and an attitude questionnaire. The knowledge questionnaire initially consisted of 15 questions, which were filtered down to 10 valid questions after validity testing. The attitude questionnaire included 10 statements measured using a five-point Likert scale (Table 1). Reliability testing of the questionnaire showed satisfactory results, with a Cronbach's Alpha of 0.773 for the knowledge questionnaire and 0.731 for the attitude questionnaire, indicating that both instruments were reliable for data collection (Hair et al., 2010).

Figure 1. Sample Video Used for Education from Social Media
Source: Medion Indonesia (2024), *Ini Kata Dokter* (2022)

The research process began with respondents completing a pretest to measure their initial knowledge and attitudes toward antibiotic resistance. Following the pretest, respondents received an intervention in the form of educational videos sourced from social media. These videos were delivered gradually according to a schedule set by the research team through WhatsApp groups. The videos had a duration of 2 to 5 minutes, making them easily accessible and understandable for participants. The video content covered information about proper antibiotic use, the mechanisms of antibiotic resistance, and the consequences of antibiotic misuse. The WhatsApp groups were also utilized to facilitate discussions about the video materials and to provide respondents with the opportunity to ask questions directly to the research team, ensuring that the information was well received and understood by the participants (Ghozali et al., 2023; Siregar et al., 2023). At the end of the intervention period, respondents were asked to complete the same questionnaire again to assess changes in their knowledge and attitudes. The collected data were then analyzed to determine whether there were significant changes between the pretest and posttest results.

Data analysis utilized non-parametric statistical methods. The Wilcoxon signed-rank test was employed to evaluate changes in knowledge and attitudes within the same group (pretest-posttest), as this test does not require the assumption of normality. Meanwhile, to compare differences between two groups (Posyandu cadres and PKK members), the Mann-Whitney U test was used (Bagdonavičius et al., 2013; Denis, 2018).

Results and Discussion

The rise of social media usage has had significant implications for various aspects of society, including communication, information dissemination, and social engagement. As a powerful tool for connecting individuals, social media platforms also serve as channels for the exchange of knowledge, especially among groups engaged in community development and public health. In this context, the study aimed to explore the demographic characteristics and social media behaviors of cadres involved in community-based programs such as Posyandu and PKK, shedding light on their educational backgrounds, occupations, and social media usage patterns (Table 1). The sample consisted of two primary groups Posyandu Cadres and PKK Cadres. Among them, Posyandu Cadres represented the larger group, comprising 56.0% of the

total respondents, while PKK Cadres accounted for 44.0%. This demonstrates a higher participation rate from the Posyandu Cadres in the study.

In terms of educational attainment, the most common level of education among the participants was high school, with 52.0% of respondents falling into this category. On the other hand, the least represented educational level was elementary school, with only 6.0% of participants in this group.

Tabel 1. Sociodemographic Characteristics and Media Usage

Category	F	%
Group		
Posyandu Cadres	56	56.0
PKK Cadres	44	44.0
Education		
Elementary School	6	6.0
Middle School	18	18.0
High School	52	52.0
Higher Education	24	24.0
Occupation		
Housewife	63	63.0
Employee	32	32.0
Civil Servant	5	5.0
Social Media Usage Frequency		
< 1 hour	34	34.0
1-2 hours	49	49.0
2-4 hours	6	6.0
> 4 hours	11	11.0
Social Media Type		
Facebook	16	16.0
TikTok	31	31.0
YouTube	34	34.0
Others	19	19.0
Content Type		
Video	76	76.0
Image	12	12.0
Text	12	12.0

(Source: Research Results, 2024)

Occupationally, housewives made up the largest portion, with 63.0% of respondents, while civil servants represented the smallest group, accounting for just 5.0%. This shows a significant majority of participants are housewives, reflecting the demographics of the sample.

Regarding social media usage, the majority of participants (49.0%) spent between 1-2 hours on social media each day. In contrast, the least common usage was over 4 hours, which was only reported by 11.0% of the respondents. This suggests a tendency for moderate social media usage among the participants.

When considering the types of social media platforms used, YouTube was the most popular platform, with 34.0% of participants favoring it, while Facebook was the least used platform, at just 16.0%. This indicates a clear preference for video-based platforms among the respondents. Finally, in terms of content type, video content was overwhelmingly the preferred choice, with 76.0% of respondents selecting it. On the other hand, image and text-based content each accounted for only 12.0%, reflecting the strong dominance of video in participants' content preferences.

The research findings indicate certain tendencies regarding the frequency of social media use, the types of platforms chosen, and preferences for the types of content consumed. In this context, video has emerged as the dominant content type, reflecting a global trend

increasingly oriented toward visualization as a more engaging and easily comprehensible form of communication (Juanna et al., 2024).

With the advancement of technology and social media, video has become the primary choice for many users. This aligns with previous research findings showing that video content is more effective in capturing audience attention, particularly among users seeking quick and concise information (Liu, 2023). Platforms such as YouTube, widely used for video viewing, are becoming increasingly dominant due to their ability to offer diverse content, ranging from entertainment to education, in a more interactive and easily accessible manner (Ziyada & Shamoi, 2024). These findings are consistent with (Fan et al., 2022), who found that video usage has significantly increased across various demographics, including among older dan women social media users.

Meanwhile, the findings of this study show that the majority of respondents spend between one to two hours per day on social media. This is relatively moderate use of social media aligns with other studies suggesting that although social media has become an integral part of daily life, many users prefer to spend their time in a more controlled manner. Research by Schwamm & Silva (2023) also found that while many users access social media, they tend to avoid excessive time on these platforms, opting instead to use them with more focused purposes, such as for entertainment or obtaining information.

On the other hand, the lower usage of Facebook compared to platforms such as YouTube or TikTok in this study reflects a shift in social media user preferences, particularly among younger age groups (Timmi et al., 2024). Research by Kirkpatrick & Lawrie (2024) indicates that Facebook is losing its appeal among younger users, while platforms like TikTok and YouTube are gaining popularity due to their more dynamic and interactive formats. This demonstrates that social media consumption is increasingly influenced by the ease of access and engagement offered by these platforms.

In terms of content types, the dominance of video highlights the importance of visualization in delivering effective messages. This reflects a trend in digital communication increasingly favoring visual media as a more efficient tool for capturing audience attention. Various previous studies have also shown that visual content, particularly videos, is more appealing than text or static images (Jain & Arakkal, 2022). According to Karataş & Karakoç (2024) videos have higher engagement rates and are more effective in conveying messages, especially in the context of social media.

Analysis of Changes in Knowledge and Attitudes

The Wilcoxon Signed Ranks test was used in this study because the data did not follow a normal distribution, thus failing to meet the assumptions of parametric tests. This test is appropriate for assessing differences between two paired conditions, namely before and after the intervention. Table 2. presents the results of the Wilcoxon test for knowledge and attitude variables.

The results of the Wilcoxon Signed Ranks Test show significant differences in both variables analyzed, namely knowledge and attitudes. For the knowledge variable, the Z-value was -8.445 with a p-value of 0.000, indicating a very significant change in the respondents' knowledge after the intervention. This result suggests that the intervention had a substantial impact on the improvement of the cadres' knowledge, both Posyandu and PKK cadres.

Further analysis by group reveals that Posyandu cadres had a Z-value of -6.477 with a p-value of 0.000, also showing a significant change in their knowledge after the intervention. Meanwhile, PKK cadres had a Z-value of -5.458 with a p-value of 0.000, confirming that the intervention positively impacted the improvement of PKK cadres' knowledge.

In addition to knowledge, the respondents' attitudes also showed significant changes. For the attitude variable, the Z-value was -7.702 with a p-value of 0.000, indicating a significant change in the respondents' attitudes after the intervention. This improvement in attitude is crucial as it demonstrates that the intervention affected not only the knowledge but also the attitudes of the cadres toward the topic being addressed. At the group level, Posyandu cadres had a Z-value of -5.855 and a p-value of 0.000, indicating a significant change in attitude.

Similarly, PKK cadres showed a Z-value of -5.050 with a p-value of 0.000, supporting the findings that the intervention had an effect on their attitudes.

Table 2. Wilcoxon Signed Ranks Test Results

Test Variables	Z-Value	p-value
Knowledge	-8.445	0.000*
Posyandu	-6.477	0.000*
PKK	-5.458	0.000*
Attitude	-7.702	0.000*
Posyandu	-5.855	0.000*
PKK	-5.050	0.000*

(Source: Research Results, 2024)

The use of educational interventions through audio-visual media via WhatsApp has proven to be an effective method for enhancing both knowledge and attitudes among participants. This approach leverages the widespread availability and accessibility of mobile technology, making it a practical solution for reaching diverse populations, particularly in areas where traditional educational resources might be limited. By delivering content in audio-visual formats, participants are able to engage with the material in a more dynamic and accessible way, which can lead to better understanding and retention of information.

In the context of this study, the intervention utilized WhatsApp, a widely used messaging application, to distribute educational content in the form of videos, images, and voice messages. This method is particularly advantageous as it allows for real-time communication, fostering a more interactive and engaging learning environment. Participants could ask questions, receive immediate responses, and share feedback, which enhanced the learning experience.

Comparing this approach to other research, similar studies have shown that educational interventions using mobile platforms can significantly improve health knowledge and attitudes. For instance, research by Hicks et al. (2023) demonstrated that mobile-based interventions via WhatsApp led to significant improvements in health knowledge and behavior among participants. Additionally, studies like those of Ferret et al. (2021) found that audio-visual content, when paired with interactive features such as messaging and feedback, was particularly effective in influencing attitudes and encouraging behavior change.

The Effectiveness of Intervention in Improving Knowledge and Attitudes

The data presented in Table 4 illustrates the results of the Mann-Whitney U test, which was used to compare the knowledge and attitudes of Posyandu and PKK cadres. This test was chosen due to the non-normal distribution of the data. The following analysis highlights the key findings related to the differences between the two groups in terms of knowledge and attitude after the intervention.

Table 3. Mann-Whitney U Test Results for Knowledge and Attitude

Group	N	Mean Rank	Z-Value	p-value
Knowledge				
Posyandu	56	55.65	-2.044	0.041*
PKK	44	43.94		
Attitude				
Posyandu	56	52.92	-0.944	0.345
PKK	44	47.42		

(Source: Research Results, 2024)

The Mann-Whitney U test was conducted to assess the differences in knowledge and attitudes between Posyandu cadres and PKK cadres. For the knowledge variable, Posyandu cadres had a mean rank of 55.65, while PKK cadres had a mean rank of 43.94. The Z-value for this comparison was -2.044, with a p-value of 0.041, indicating a statistically significant difference in knowledge between the two groups. This suggests that Posyandu cadres had a higher level of knowledge compared to PKK cadres after the intervention.

In contrast, for the attitude variable, the mean rank for Posyandu cadres was 52.92, while PKK cadres had a mean rank of 47.42. The Z-value for the attitude comparison was -0.944, with a p-value of 0.345. This result suggests that there was no statistically significant difference in attitudes between the two groups, as the p-value is greater than the significance threshold of 0.05.

The results of the Mann-Whitney U test show a significant difference in knowledge between Posyandu and PKK cadres after the intervention. Posyandu cadres had a higher mean rank in knowledge compared to PKK cadres, indicating that the intervention was more effective in improving the knowledge of Posyandu cadres. However, in terms of attitude, no significant difference was found between the two groups, suggesting that while knowledge improved, the cadres' attitudes were not significantly influenced by the intervention.

Similar research investigating the effectiveness of interventions using audio-visual media via WhatsApp also showed varied results. Alsaad & AlDossary, (2024) revealed that the use of WhatsApp media, supplemented with audio-visual materials, significantly improved participants' knowledge, similar to the findings of this study regarding knowledge enhancement. However, this study also found that although knowledge increased, changes in participants' attitudes toward the taught topic were not as pronounced, similar to the findings in this study concerning the attitudes of Posyandu and PKK cadres (Arif P & Wardaningsih, 2023).

While the audio-visual based intervention through WhatsApp proved effective in enhancing knowledge, changing attitudes requires a more in-depth approach, which could involve additional aspects beyond just providing information through media. Further research may need to explore how this medium can be more effectively used to influence participants' attitudes, taking into account other factors that may affect behavioral change.

Relevance of Social Learning Theory

The results of this study, which indicate an increase in knowledge but limited changes in attitudes after an intervention using audio-visual media via WhatsApp, can be explained through the Social Learning Theory proposed by Albert Bandura. This theory emphasizes how individuals learn by observing others' behaviors within a social context and how these behaviors are reinforced or diminished based on their consequences (Bandura, 1977). In the context of this study, the intervention provided to Posyandu and PKK cadres can be viewed as a form of teaching through observation of the audio-visual materials presented.

According to Bandura, the processes of observation and imitation are key to social learning, meaning that changes in knowledge are likely to occur when individuals are exposed to relevant and easily understandable information delivered through their preferred media. Audio-visual media can facilitate this learning process by providing clear models through materials that can be seen and heard, making it easier for participants to assimilate information (Ferret et al., 2021; Manik et al., 2022). This is consistent with the findings of this study, where the knowledge of Posyandu and PKK cadres increased after receiving materials via WhatsApp. In this case, the audio-visual media intervention acted as an informational model that participants could follow and comprehend.

However, while knowledge increased, more complex and enduring changes in attitudes require more than mere exposure to information. Bandura highlights the importance of reinforcement in behavioral change. This reinforcement could take the form of positive feedback or consequences that support attitude changes (Manik et al., 2022). In this study, although audio-visual materials were delivered, the lack of contextual reinforcement or social interaction in the learning process reduced the impact on attitude changes. This aligns with the findings that while knowledge improved, changes in the cadres' attitudes were not as significant as changes in their knowledge.

Furthermore, the social environment surrounding individuals also plays a critical role in behavioral change, as explained in Social Learning Theory. Beyond the materials received through WhatsApp, factors such as direct interaction with fellow cadres or an environment that supports or does not support new attitudes influence the extent to which those attitudes can change. Therefore, interventions that rely solely on audio-visual media without supportive

social environments may be insufficient to bring about desired attitude changes (Akuiyibo et al., 2022).

Bandura also underscores the importance of self-efficacy in adopting and maintaining new behaviors. In the context of this intervention, if cadres feel confident that the new knowledge they have acquired can be effectively applied, they are more likely to change their attitudes (Lawrent, 2022; McMahon, 2023). Limited attitude changes may be linked to a low sense of self-efficacy among cadres in applying this knowledge in their daily lives.

In line with these findings, Ferret *et al*. (2021) which also used WhatsApp as a medium for interventions aimed at improving knowledge and attitudes, found that while participants' knowledge increased, changes in attitudes were more limited. This research confirms that social reinforcement and direct interaction are critical factors that may not be adequately substituted by audio-visual materials alone.

Relevance of the Elaboration Likelihood Model (ELM)

The findings of this study, which show significant changes in knowledge but less pronounced changes in attitude after the intervention using audio-visual media via WhatsApp, can also be explained through the Elaboration Likelihood Model (ELM) proposed by Richard E. Petty and John Cacioppo (1986). The ELM is a dual-process theory that explains how individuals process persuasive messages, and it posits two primary routes of persuasion: the central route and the peripheral route. These routes differ in the amount of cognitive effort exerted by the individual when processing the information (Petty & Turnes, 2020).

In this study, the audio-visual materials delivered through WhatsApp can be seen as persuasive messages aimed at changing both knowledge and attitudes of Posyandu and PKK cadres. The way these messages are processed—either through the central route or the peripheral route—could help explain the differences observed in knowledge and attitude changes (Glover. et al., 2019).

a. Central Route to Persuasion

According to the central route, individuals process messages carefully and thoughtfully, focusing on the quality of the arguments presented. This route leads to lasting attitude change because the individual is actively engaged in processing the information. The fact that significant changes in knowledge were observed in this study suggests that the participants were able to engage with the content of the audio-visual materials meaningfully, reflecting a more thoughtful processing of the information. When the messages presented through WhatsApp were perceived as relevant and clear, participants likely engaged in deeper cognitive processing, which resulted in improved knowledge retention (Manca. et al., 2020).

However, attitude change was less pronounced, which suggests that the intervention may not have been as effective in engaging the participants through the central route for attitude change. This could be because the audio-visual materials alone may not have provided sufficient cognitive engagement for attitude change, which requires more than just information processing—it often involves emotional engagement, persuasive appeals, and motivation to act (Zvetomira, 2023). As such, while knowledge improvement may be attributed to the central route's cognitive processing, attitude change often requires deeper involvement and motivation, which might not have been fully addressed by the intervention.

b. Peripheral Route to Persuasion

On the other hand, the peripheral route involves less cognitive effort and relies on external cues or superficial characteristics of the message, such as the source's credibility, attractiveness, or the emotional appeal of the message. In this study, the fact that there was no significant change in attitude, despite improvements in knowledge, suggests that participants may have processed the message through the peripheral route. Audio-visual media, while useful for delivering clear and engaging content, may not have included enough persuasive cues that could trigger deeper emotional engagement or motivation for attitude change (Manca & Fornara, 2019). The medium's focus on providing information through WhatsApp, while easily accessible, may have been processed by participants with limited cognitive effort, focusing on

surface-level elements of the message rather than the underlying content that could lead to a shift in attitudes

Additionally, the credibility of the source (i.e., the sender of the WhatsApp messages) and the relevance of the content may have influenced how participants processed the messages. If the messages were perceived as credible and trustworthy, they could have been processed through the central route for knowledge change, but without sufficient persuasive cues to encourage attitude change, the effect may have been limited (Petty & Turnes, 2020).

Implications of ELM for Future Interventions

This study's findings suggest that interventions using audio-visual media via WhatsApp may be effective in changing knowledge but may not necessarily lead to significant attitude changes unless more strategies are employed to encourage deeper cognitive engagement or trigger the peripheral cues that influence attitudes. Future interventions may benefit from incorporating interactive elements, personalized messages, or feedback mechanisms that could enhance both the central route (for knowledge retention) and the peripheral route (for attitude change). Petty et al. (1983) supports this notion, suggesting that the central route requires more personal involvement and cognitive elaboration, while the peripheral route relies more on emotional appeals or cues from the environment. Combining both approaches could be more effective in achieving both knowledge and attitude changes.

Conclusion

This study assessed the effectiveness of an audio-visual intervention delivered via WhatsApp in improving the knowledge and attitudes of Posyandu and PKK cadres regarding antibiotic resistance. The results indicated a significant improvement in knowledge, particularly among Posyandu cadres. However, the intervention did not result in meaningful changes in attitudes. These findings suggest that audio-visual media can effectively enhance knowledge but may be less impactful in influencing attitudes. This underscores the need for more comprehensive strategies to complement digital approaches.

Based on these findings, it is essential to develop more interactive strategies to support digital media-based interventions. For instance, incorporating group discussions or case-based training can help cadres better understand the practical implications of the information provided, thereby influencing their attitudes more profoundly. Additionally, designing personalized content, such as stories relevant to the cadres' experiences, could enhance its impact on attitude changes.

Future research is recommended to evaluate the long-term effects of using digital media in health education, including testing more innovative methods such as gamification or providing direct feedback. Moreover, combining digital media with face-to-face approaches or intensive mentoring could be a viable solution to increase effectiveness in creating significant attitude changes.

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