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Improving Antibiotic Stewardship and Antimicrobial Resistance Awareness Through Community and Digital Health Interventions

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Abstract

Background: Antimicrobial resistance (AMR) is a major global health threat driven largely by inappropriate antibiotic use in community settings.

Objective: To assess antibiotic stewardship practices, AMR awareness, and the impact of community-based and digital health interventions among mothers and caregivers.

Methodology: A community-based mixed-methods study was conducted in Lahore (January–June 2025) among 425 mothers and caregivers recruited from healthcare facilities and through digital platforms. Data were collected using a pretested questionnaire, interviews, and focus group discussions to assess antibiotic use, AMR awareness, and exposure to community and digital interventions. Quantitative data were analyzed using SPSS version 26 with descriptive statistics, chi-square test, and multivariate logistic regression, while qualitative data were analyzed thematically.

Results: Among 425 participants, self-medication was reported by 41.41% (n = 176), non-prescription antibiotic purchase by 37.18% (n = 158), and leftover antibiotic use by 28.00% (n = 119), while only 53.88% (n = 229) completed full antibiotic courses. Overall, 53.65% (n = 228) of participants demonstrated awareness of AMR. Community education exposure was significantly associated with better stewardship (68.87%, n = 146 vs 48.36%, n = 103; $p < 0.001$), and digital health exposure was significantly associated with higher AMR awareness (61.32%, n = 176 vs 37.68%, n = 52; $p < 0.001$). Key predictors of inappropriate antibiotic use included low education (AOR = 2.68), poor AMR awareness (AOR = 3.12), and lack of digital health exposure (AOR = 2.21).

Conclusion: Antibiotic misuse and limited AMR awareness remain common, while community and digital health interventions significantly improve stewardship behaviors.

Introduction

Antimicrobial resistance (AMR) is known to be one of the most significant public health challenges of the twenty first century, hampering the ability of regular treatment to combat infections and resulting in increasing costs, morbidity and mortality due to AMR infections [1,2]. The World Health Organization (WHO) states that inappropriate use of antibiotics in community and health care settings is a major

contributor to antimicrobial resistance, especially in LMICs where regulatory oversight and public understanding of the issue are minimal [3].

AMR is largely driven by the overuse and misuse of antibiotics, including self-medication, accessing antibiotics without prescription, incorrect indications, and early antibiotic discontinuation, which has led to the emergence of resistant bacterial strains of high concern [4]. Lack of awareness, misconceptions regarding antibiotics and taking advice from non-formal sources play a role in these behaviors [5]. Household decision makers, especially mothers and household caregivers, are a key priority group to reach for antimicrobial stewardship (AMS) interventions in this context, as they are directly responsible for the decisions on whether or not to use antibiotics for their own and their children's health [6].

Evidence suggests a strong association between irrational antibiotic use and low health literacy, poor knowledge of the concept of AMR and socio-cultural beliefs on how to treat diseases [7,8]. In many developing countries, antibiotics are also often seen as a universal treatment for febrile diseases, such as viral diseases, and thus are routinely overused [9].

Community-based health education and digital health communication strategies have become important tools to help overcome knowledge gaps and change health-seeking behavior in the recent years [10]. Rational antibiotic use has been demonstrated to be enhanced by community engagement by healthcare professionals, pharmacists and primary care workers, which helps reinforce correct practices and correct misconceptions [11]. At the same time, digital platforms like mobile health apps, social media and educational platforms have made health education more accessible and allowed for continuous and scalable dissemination of AMR related information [12].

Antibiotics use is widely prevalent in Pakistan especially in urban areas like Lahore and is frequently used without prescription, which is poorly monitored and there are few organised public awareness initiatives. In the context of local studies, it has been shown that there are significant knowledge gaps and inappropriate antibiotic-use among mothers, indicating the need for context specific educational strategies to promote good AMS at the community level.

Research Objectives

To assess the current knowledge, attitudes, and practices regarding antibiotic use and AMR among mothers and caregivers.

To identify factors associated with inappropriate antibiotic use, self-medication, and poor adherence to antibiotic therapy.

To explore the role of community-based educational programs and healthcare professionals in promoting responsible antibiotic use.

To evaluate the potential of digital health interventions, such as mobile health education and online information resources, in improving AMR awareness and antibiotic stewardship.

To develop recommendations for public health and community pharmacy initiatives aimed at optimizing antibiotic use.

Methodology

Study Design

An explanatory sequential mixed-methods design was used, incorporating both quantitative and qualitative components to comprehensively assess antibiotic use behaviors, antimicrobial resistance (AMR) awareness, and access to community-based and digital health information among mothers and caregivers. This design enabled an in-depth analysis of quantitative patterns as well as the behavioral and perceptual factors influencing antibiotic use.

Study Setting and Duration
The study was performed in the densely populated urban and peri-urban areas of Lahore, Punjab, Pakistan, where there are varied types of socio-economic groups and access to healthcare services. The data collection period lasted for six months from January 2025 to June 2025.

Study Population
The study population included mothers and caregivers aged 18 years and above, who were in charge of healthcare-related decision making in their households, in the context of childhood illnesses, medication use, and treatment-seeking behaviors in Lahore, Pakistan.

Sample Size
The sample size was computed with the single population proportion formula at a 95% confidence level and a margin of error of 5%, based on the assumption that there is no previous knowledge of the local prevalence of adequate knowledge of antibiotic use and AMR awareness, and thus the prevalence was assumed to be 50%. The calculated sample size was 384 participants. After adding a 10% non-response allowance, the required sample size became 422 participants. To ensure adequate representation, the final sample size was set at 425 participants.

Sampling Technique
A multi-source convenience sampling was conducted among participants that were recruited from primary healthcare centres, community pharmacies, maternal and child health clinics and community outreach programmes. Beyond this, digital recruitment was also implemented via social media and online community groups to capture individuals who were exposed to digital health information and/or online health education content about antibiotics.

Data Collection Procedure
Data were collected using quantitative methods **such as structured questionnaires developed by the researchers and some sections adapted from previously validated questionnaires to evaluate antibiotic use practice (AUP) and AMR awareness in the community. The instrument was content validated by an expert panel of community medicine practitioners and infectious disease and public health experts to ensure relevance, clarity and appropriateness for the targeted population.** The questionnaire was pre-tested among a small group of participants to assess clarity, comprehensiveness, internal consistency, and contextual appropriateness. Before final data collection, necessary refinements were made to improve reliability and reduce ambiguity. **The final questionnaire contained questions on social demographic factors, knowledge of antibiotic use and AMR, attitudes towards antibiotic use, self-reported antibiotic use practices, exposure to community health education programs, and exposure to digital health interventions (such as mobile health apps, social media, and health information on the internet). Purposive sampling was used to collect qualitative data by conducting semi-structured interviews and focus group discussions with selected participants. They were designed to gain insight into participant perceptions of the use of antibiotics, motivation to use them non-rationally, obstacles to rational use and the impact of interventions based on educational programs and digital health communication on the antibiotic-related decision making processes.**

Study Variables
The outcome variables evaluated in the study were knowledge related to antibiotic use, attitude towards AMR and antibiotic-use practices related to stewardship behaviors. Independent variables included age, educational attainment, socio-economic status, household size, number of children, access to health care, access to community based education activities, and access to digital health information sources.

Data Analysis
Data collected with SPSS version 26 were used for quantitative data analysis. Participant characteristics and study variables were summarized using descriptive statistics: frequencies, percentages, means and standard deviations. Chi-square test was used to evaluate association between categorical variables and multivariate logistic regression analysis was used to identify independent variables associated with inappropriate antibiotic use and poor AMR awareness. The criterion for the significance of the p value was set at < 0.05. Thematic content analysis was carried out to analyze qualitative data. This involved transcribing the interviews, systematic coding, classification of responses and generating key themes around antibiotic use, awareness of AMR and impact of community and digital health interventions.

Ethical Considerations
Ethical approval was obtained from the relevant institutional review committee prior to data collection. Written informed consent was obtained from all participants before enrollment. Confidentiality, anonymity, and voluntary participation were strictly maintained throughout the study in accordance with ethical research guidelines.

Results Tables
A total of 425 participants were included in the study (table 1). Most participants were aged 26–35 years (n = 198, 46.59%), followed by 18–25 years (n = 102, 24.00%), 36–45 years (n = 88, 20.71%), and >45 years (n = 37, 8.71%). Regarding education, secondary education was most common (n = 147, 34.59%), followed by primary (n = 118, 27.76%), higher education (n = 96, 22.59%), and illiteracy (n = 64, 15.06%). Most participants belonged to middle (n = 189, 44.47%) and low socioeconomic status (n = 176, 41.41%). Household size was mainly 5–7 members (n = 203, 47.76%), while n = 121 (28.47%) had ≤4 members and n = 101 (23.76%) had >7 members. Most participants had 3–4 children (n = 179, 42.12%), followed by 1–2 children (n = 165, 38.82%) and ≥5 children (n = 81, 19.06%). More than half reported easy healthcare access (n = 248, 58.35%), while n = 119 (28.00%) and n = 58 (13.65%) reported moderate and difficult access, respectively.

Table 1. Socio-Demographic Characteristics of Participants (n = 425)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–25	102	24.00
	26–35	198	46.59
	36–45	88	20.71
	>45	37	8.71
Education	Illiterate	64	15.06
	Primary	118	27.76
	Secondary	147	34.59
	Higher	96	22.59
Socioeconomic Status	Low	176	41.41
	Middle	189	44.47
	High	60	14.12

Household Size	≤4 members	121	28.47
	5–7 members	203	47.76
	>7 members	101	23.76
Number of Children	1–2	165	38.82
	3–4	179	42.12
	≥5	81	19.06
Healthcare Access	Easy	248	58.35
	Moderate	119	28.00
	Difficult	58	13.65

Correct identification that antibiotics are effective against bacterial infections was reported by 56.0% (n = 238), while 45.65% (n = 194) correctly knew that antibiotics are not effective against viral infections (figure 1). Awareness that incomplete antibiotic courses contribute to AMR was (n = 219, 51.53%), and (n = 244, 57.41%) recognized self-medication increases resistance risk. Overall, 53.65% (n = 228) reported awareness of AMR, while (n = 267, 62.82%) correctly stated antibiotics should only be used on professional advice.

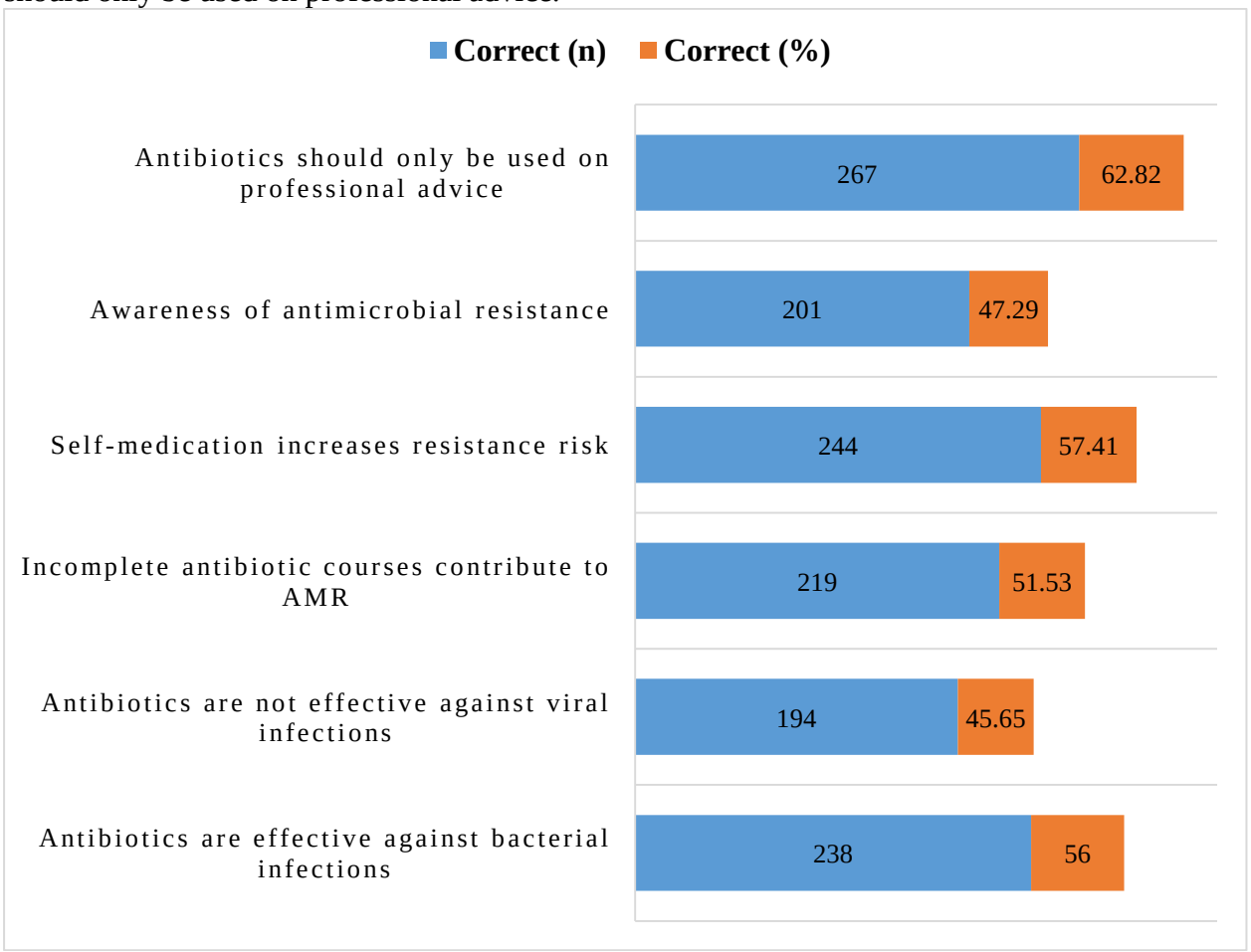

Figure 1. Knowledge Regarding Antibiotic Use and AMR (n = 425)

Participants showed generally positive attitudes toward antibiotic stewardship (table 2). A majority agreed that antibiotics should only be used when prescribed (n = 281, 66.12%) and that AMR is a serious public health concern (n = 276, 64.94%). Additionally, (n = 309, 72.71%) believed educational campaigns improve antibiotic use, and (n = 337, 79.29%) supported healthcare professional counseling. Digital health interventions were positively viewed by (n = 292, 68.71%) participants.

Table 2. Attitudes Toward Antibiotic Use and AMR (n = 425)

Statement	Agree n (%)	Disagree n (%)
Antibiotics should only be used when prescribed	281 (66.12)	144 (33.88)
AMR is a serious public health concern	276 (64.94)	149 (35.06)
Educational campaigns improve antibiotic use	309 (72.71)	116 (27.29)
Healthcare professionals should provide counseling	337 (79.29)	88 (20.71)
Digital health can improve AMR awareness	292 (68.71)	133 (31.29)

Self-medication was reported by 41.41% (n = 176), and 37.18% (n = 158) purchased antibiotics without prescription (table 3). Leftover antibiotic use was reported by (n = 119, 28.00%), and (n = 102, 24.00%) shared antibiotics with others. Slightly more than half (n = 229, 53.88%) completed full antibiotic courses, while (n = 248, 58.35%) followed healthcare provider instructions.

Table 3. Antibiotic Use Practices and Stewardship Behaviors (n = 425)

Practice Variable	Yes n (%)	No n (%)
Self-medication with antibiotics	176 (41.41)	249 (58.59)
Purchased antibiotics without prescription	158 (37.18)	267 (62.82)
Used leftover antibiotics	119 (28.00)	306 (72.00)
Shared antibiotics with others	102 (24.00)	323 (76.00)
Completed full antibiotic course	229 (53.88)	196 (46.12)
Followed healthcare provider instructions	248 (58.35)	177 (41.65)

Exposure to community-based interventions was highest for physician counseling (n = 289, 68.00%) and pharmacist counseling (n = 241, 56.71%), shown in figure 2. Other exposures included community awareness sessions (n = 212, 49.88%), health worker visits (n = 183, 43.06%), and public health campaigns (n = 156, 36.71%). For digital interventions, messaging applications were most common (n = 214, 50.35%), followed by social media health content (n = 196, 46.12%), online health websites (n = 173, 40.71%), mobile health applications (n = 144, 33.88%), and educational videos/webinars (n = 128, 30.12%).

Figure 2. Exposure to Community-Based and Digital Health Educational Interventions (n = 425)

Community education exposure was significantly associated with appropriate antibiotic stewardship, with (n = 146, 68.87%) in the exposed group compared to (n = 103, 48.36%) in the non-exposed group ($\chi^2 = 16.82$, $p < 0.001$), shown in table 4. Digital health exposure was also significantly associated with good AMR awareness, with (n = 176, 61.32%) in the exposed group versus (n = 52, 37.68%) in non-exposed participants ($\chi^2 = 18.47$, $p < 0.001$).

Table 4. Association of Community-Based and Digital Health Exposure with Antibiotic Stewardship Practices and AMR Awareness (n = 425)

Exposure Type	**Exposure Status**	**Outcome Category**	**n (%)**	**χ^2**	**p-value**
Community Education Exposure	Exposed (n = 212)	Appropriate stewardship	146 (68.87)	16.82	<0.001
		Inappropriate stewardship	66 (31.13)		
	Not exposed (n = 213)	Appropriate stewardship	103 (48.36)		
		Inappropriate stewardship	110 (51.64)		
Digital Health Exposure	Exposed (n = 287)	Good AMR awareness	176 (61.32)	18.47	<0.001
		Poor AMR awareness	111 (38.68)		
	Not exposed (n = 138)	Good AMR awareness	52 (37.68)		
		Poor AMR awareness	86 (62.32)		

Low education, low socioeconomic status, poor AMR awareness, lack of community and digital health exposure, and difficult healthcare access were significant predictors of inappropriate antibiotic use (table 5). Similarly, poor AMR awareness was significantly associated with low education (AOR = 2.91), self-medication (AOR =

2.27), low socioeconomic status, and lack of both community and digital health exposure, all with statistically significant associations ($p < 0.05$).

Table 5. Multivariate Logistic Regression Analysis of Factors Associated with Inappropriate Antibiotic Use and Poor AMR Awareness (n = 425)

Outcome	Variable	Adjusted OR	95% CI	p-value
Inappropriate Antibiotic Use	Low education level	2.68	1.61–4.45	<0.001
	Low socioeconomic status	1.94	1.18–3.20	0.009
	Poor AMR awareness	3.12	1.97–4.95	<0.001
	Lack of community education exposure	1.83	1.14–2.95	0.012
	Lack of digital health exposure	2.21	1.35–3.62	0.002
	Difficult healthcare access	1.76	1.03–3.01	0.039
Poor AMR Awareness	Low education level	2.91	1.75–4.85	<0.001
	Low socioeconomic status	1.87	1.12–3.12	0.016
	Lack of digital health exposure	2.38	1.46–3.89	<0.001
	Lack of community education exposure	1.94	1.19–3.15	0.008
	Difficult healthcare access	1.69	1.01–2.84	0.045
	Self-medication practice	2.27	1.39–3.70	0.001

Qualitative analysis identified six major themes influencing antibiotic use behavior (table 6). Participants commonly reported misconceptions that antibiotics are effective for all infections, including viral illnesses. Self-medication was driven by previous positive experiences. Barriers to adherence included symptom improvement, medication cost, and inadequate counseling. Healthcare professionals were viewed as trusted sources, while digital platforms were helpful but sometimes misleading. Participants emphasized the need for stronger community education programs to improve antibiotic stewardship and AMR awareness.

Table 6. Major Themes Identified from Qualitative Interviews and Focus Group Discussions

Theme	Representative Findings
Misconceptions about antibiotics	Many participants believed antibiotics were effective against all infections, including viral illnesses.
Self-medication behavior	Previous successful experiences frequently influenced antibiotic self-medication.
Barriers to adherence	Symptom improvement, medication costs, and inadequate counseling contributed to premature discontinuation of therapy.
Role of healthcare professionals	Physicians and pharmacists were viewed as trusted sources of antibiotic-related information.
Influence of digital health resources	Social media and online resources increased awareness but occasionally provided inaccurate information.
Need for community	Participants highlighted the importance of regular

education	educational campaigns to improve antibiotic stewardship and AMR awareness.

Discussion

In the current study, suboptimal level of AMR awareness (47.29%, n = 201) and only moderate correct knowledge about antibiotics (56.00%, n = 238) that it is effective against bacterial infection and 45.65%, (n = 194) that it is not effective against viral infection were noticed. The results suggest there are ongoing gaps in the understanding of communities, especially caregivers. Importantly, this knowledge–behaviour gap is not due to lack of information, but is a key implementation shortcoming of AMR awareness strategies. In Pakistan, AMR knowledge is also still low among community despite the awareness campaign raised around the world, some similar deficiency has been reported [13]. Similar trends have been seen in other South Asian populations, indicating that factors other than just knowledge sharing, such as structural and behavioral factors, play a more important part in shaping antibiotic use practices [14].

Attitudes towards antibiotic use were relatively positive: 66.12% (n = 281) agreed that Antibiotics should only be used when prescribed by a healthcare professional and 64.94% (n = 276) agreed using antibiotics to combat AMR was a serious issue in health. In addition, 79.29% (n = 337) supported health professional counseling. But, in spite of these positive attitudes, behavior compliance was still low. This gap is attributable to the much described attitude–behaviour gap in AMS, which is the gap between what people know and what they do. This is consistent with earlier research, suggesting that sustained reinforcement in addition to cognitive knowledge is necessary for a behavior change [15].

The present study showed high rate of inappropriate antibiotic use including self-medication, non-prescription purchase, and leftover antibiotic use (41.41%, n = 176; 37.18%, n = 158; and 28.00%, n = 119, respectively), and only 53.88% (n = 229) finished their prescribed courses. These results are indicative of a continuing public health problem in LMICs where antibiotic use is largely uncontrolled, and often purchased without a prescription. Weak regulatory enforcement, informal health services, and reliance on self-treatment for health are strong correlates of such misuse patterns. Similar problematic patterns of use have been described in low income countries where use of antibiotics is often linked to convenience and previous experience, rather than clinical advice [16,17].

Moderate coverage was achieved with physician counseling (68.00% (n = 289)) and pharmacist counseling (56.71% (n = 241)) and with digital exposure via messaging applications (50.35% (n = 214)). Importantly, there was a significant improvement in exposure through community education for stewardship behavior (68.87% among exposed participants vs 48.36% among non-exposed participants, $p < 0.001$) and exposure through digital for AMR awareness (61.32% cE vs 37.68% noncE, $p < 0.001$). The results support the idea that multi-channel interventions that involve the community with digital health tools are more effective than single modality awareness strategies. The same intervention-based improvements have been reported with structured education significantly decreasing the use of inappropriate antibiotics [18].

Low education (AOR = 2.68), poor AMR awareness (AOR = 3.12), low socioeconomic status (AOR = 1.94), lack of community exposure (AOR = 1.83) and lack of digital exposure (AOR = 2.21) were found to be significant predictors of inappropriate antibiotic use. The results indicate that socioeconomic and informational inequalities are major factors in driving irrational antibiotic use, not awareness. These similar factors have been described across the world and highlight the importance of education, information about health services, and structural barriers, not just deficiencies in knowledge, in explaining why antibiotics are misused [19].

The results of the qualitative analysis reinforced the quantitative results, highlighting misconceptions about antibiotics, previous experience, and poor counselling as the main behavioral factors contributing to the misuse. Participants also identified positive and negative experiences relating to digital health resources, noting that digital platforms offer a way to access information, but also carry the risk of disseminating misinformation. The double nature of digital media highlights the importance of evidence-based and regulated digital health communication strategies in AMS programs.

Strength and Limitations

The main advantage of this study was the large sample size of 425 participants and the mixed methods design, which enabled the full assessment of antibiotic stewardship behaviors and awareness of AMR using both quantitative and qualitative methods. The inclusion of community-based and digital health exposure variables with multivariate regression analysis reinforced the ability to identify independent predictors of the use of inappropriate antibiotic and poor AMR awareness. Furthermore, data was gathered from various community sources, such as health centers, pharmacies, outreach initiatives, and online platforms, enhancing the variability and representativeness of participants. But there are drawbacks to the study. Convenience sampling could cause selection bias and give limited generalizability to the population. Reporting of antibiotic use may also be susceptible to social desirability and recall bias, given that it is based on the self-reported behaviour. Furthermore, this study is cross-sectional, which does not allow for causal relationships to be drawn from the exposure to interventions and outcomes. Even so, these findings have the potential to shed light on community antibiotic use behaviors and the effectiveness of interventions.

Conclusion

The results of this study suggest that AMR knowledge and attitudes regarding antibiotic stewardship among mothers and caregivers are sub-optimal, with high rates of inappropriate antibiotic use despite moderate levels of knowledge and positive attitudes in general. Community-based educational programs and digital health interventions were found to have a significant relationship with improved antibiotic stewardship behaviors and significantly higher AMR awareness, which shows their role in reducing irrational antibiotic use at the community level as important. The results of this study indicate that knowledge is not enough if there is no structured education exposure and there is no platform or medium for expressing health information. Ongoing involvement in the community by healthcare professionals at both primary care and pharmacy levels should be encouraged as a way of enhancing AMS in the future. AMR education should continue to be incorporated into regular maternal and child health care and prescription-only antibiotic policies must be strictly enforced to curb self-medication. Further expansion of digital health interventions such as mobile applications, social media campaigns, and SMS-based awareness building is also key in enhancing outreach among caregivers. Further, specific health literacy interventions for low-education and low-income populations and a robust surveillance framework with continuous public health education initiatives are necessary to ensure continued improvements in reducing inappropriate antibiotic use and AMR.

Questionnaire

Title: Antibiotic Stewardship and Antimicrobial Resistance Awareness Among Mothers and Caregivers

Participant ID: _____

Date: ___ / ___ / _____

Instructions: Please tick (✓) the most appropriate answer. All information will remain confidential and used only for research purposes.

Section A: Socio-Demographic Information

Age:

- ☐ 18–25 years
- ☐ 26–35 years
- ☐ 36–45 years
- ☐ >45 years

Education Level:

- ☐ Illiterate
- ☐ Primary
- ☐ Secondary
- ☐ Higher Education

Socioeconomic Status:

- ☐ Low
- ☐ Middle
- ☐ High

Household Size:

- ☐ ≤4 members
- ☐ 5–7 members
- ☐ >7 members

Number of Children:

- ☐ 1–2
- ☐ 3–4
- ☐ ≥5

Access to Healthcare Services:

- ☐ Easy
- ☐ Moderate
- ☐ Difficult

Section B: Knowledge Regarding Antibiotic Use and Antimicrobial Resistance

Please indicate whether the following statements are True, False, or Don't Know.

Statement	True	False	Don't Know
1. Antibiotics are effective against bacterial infections.	☐	☐	☐
2. Antibiotics can cure viral infections such as the common cold.	☐	☐	☐
3. Not completing the full antibiotic course can contribute to antimicrobial resistance.	☐	☐	☐
4. Self-medication with antibiotics can increase antibiotic resistance.	☐	☐	☐
5. Antibiotics should only be taken under professional medical advice.	☐	☐	☐
6. Antimicrobial resistance means antibiotics become less effective against bacteria.	☐	☐	☐

Section C: Attitudes Toward Antibiotic Use and AMR

Please indicate your level of agreement.

Statement	Agree	Neutral	Disagree
1. Antibiotics should only be used when prescribed by a healthcare professional.	☐	☐	☐
2. Antimicrobial resistance is a serious public health problem.	☐	☐	☐
3. Educational campaigns can improve antibiotic use practices.	☐	☐	☐
4. Healthcare professionals should provide antibiotic counseling.	☐	☐	☐
5. Digital health tools can improve awareness about AMR.	☐	☐	☐
6. Antibiotics are often overused in the community.	☐	☐	☐

Section D: Antibiotic Use Practices

Have you ever taken antibiotics without consulting a doctor?

☐ Yes

☐ No

Have you purchased antibiotics without a prescription?

☐ Yes

☐ No

Have you ever used leftover antibiotics from a previous illness?

☐ Yes

☐ No

Have you ever shared antibiotics with family members or friends?

☐ Yes

☐ No

Do you usually complete the full course of antibiotics as prescribed?

☐ Yes

☐ No

Do you follow the instructions given by healthcare professionals regarding antibiotic use?

☐ Yes

☐ No

What is your main reason for using antibiotics without prescription? (Choose one)

☐ Previous successful experience

☐ Cost of healthcare visit

☐ Easy pharmacy access

☐ Time-saving

☐ Advice from relatives/friends

☐ Other: _____

Section E: Exposure to Community-Based Educational Interventions

Have you received information about proper antibiotic use from any of the following?

Source	Yes	No
Physician counseling	☐	☐
Pharmacist counseling	☐	☐
Community awareness sessions	☐	☐
Health worker educational visits	☐	☐
Public health campaigns	☐	☐

Section F: Exposure to Digital Health Interventions

Have you received information regarding antibiotics or AMR through:

Source	Yes	No
Mobile health applications	☐	☐
Social media health content	☐	☐
Online health websites	☐	☐
Educational videos/webinars	☐	☐
Messaging applications (WhatsApp, SMS, etc.)	☐	☐

Section G: Awareness of Antimicrobial Resistance (AMR)

Have you heard of antimicrobial resistance (AMR)?

- ☐ Yes
- ☐ No

If yes, where did you learn about AMR?

- ☐ Healthcare professional
- ☐ Social media
- ☐ Internet websites
- ☐ Television/Radio
- ☐ Family/Friends
- ☐ Other _____

Do you believe AMR can affect your family's health?

- ☐ Yes
- ☐ No
- ☐ Not sure

Section H: Open-Ended Questions (Qualitative Component)

What do you think antibiotics are used for?

Why do people in your community sometimes use antibiotics without consulting a doctor?

What challenges prevent people from completing the full antibiotic course?

How helpful are healthcare professionals in guiding proper antibiotic use?

How has social media or the internet influenced your understanding of antibiotics?

What recommendations do you have for improving awareness about antimicrobial resistance?

Scoring Guide

Knowledge Score

Correct answer = 1 point
Incorrect/Don't Know = 0 points
Total score: 0–6

Classification

Good Knowledge: ≥4

Poor Knowledge: <4

Attitude Score

Agree with positive statement = 2
Neutral = 1
Disagree = 0

Classification

Positive Attitude: ≥70% score
Negative Attitude: <70% score

Practice Score

Appropriate practice = 1 point:

No self-medication
No non-prescription purchase
No leftover use
No sharing antibiotics
Completes course
Follows instructions

Total score: 0–6

Appropriate Stewardship: ≥4 points
Inappropriate Stewardship: <4 points

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