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Original Research Article

An interventional study to assess improvement in knowledge attitude and practice on antimicrobial use and resistance among rural community in Tamil Nadu, India

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Abstract

Background: In rural Indian communities, misuse of antibiotics contributes significantly to rising antimicrobial resistance (AMR). A village in South India was chosen as it represents a typical setting where patterns of antibiotic use remain suboptimal due to low awareness and improper access.

Aim and Objective: To evaluate the knowledge, attitude and practice related to antibiotic use and resistance, effectiveness of a structured community-based educational intervention on improving the community knowledge and to measure changes between pre- and post-intervention phases.

Materials and Methods: A quasi-experimental pre-post study was conducted from August 2024 to January 2025 in Kalaiyur village which was taken as the intervention group and another village nearby with the same characteristics was chosen to be control group. Baseline KAP data were collected using a validated questionnaire covering awareness of antibiotics, proper indications, consequences of misuse, adherence, and resistance. An intervention package comprising pamphlets, lecture, placards, and street plays in Tamil, was delivered over four weeks. The same questionnaire was administered six weeks post-intervention. Data were analysed using paired t-tests and McNemar's test; significance was set at $p < 0.05$.

Results: Before intervention, both the groups had approximately the similar knowledge, attitude and practices, the intervention group showed an improvement in all the three domains after the multicomponent interventions was applied. The DiD analysis showed a spike of 4.0, 2.2 & 2.7 in knowledge, attitude and practices scores respectively after the intervention was applied.

Conclusion: A targeted, culturally-tailored educational intervention significantly improved knowledge, attitudes, and practices significantly about AMR in Kalaiyur village. These results underline the potential of community-level programs to combat antibiotic misuse. Scaling such initiatives across rural India could be a cost-effective step toward AMR containment.

Keywords: Antimicrobial Resistance; Self-medication practice; Over the counter medicines; Superbugs; Antibiotic misuse and overuse.

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1. Introduction

Antibiotic resistance also known as the AMR is a crucial and enhancing health threat which has led to significant changes in the antibiotic assignment for infectious disease patients and the overall misuse and overuse of antibiotics. The World Health Organization (WHO) have made stringent policies for scrubbing AMR which has been placed in the top ten global health threats affecting mankind.[1] The development of resistant pathogens due to the misuse and overuse of antibiotics in both humans and animals has waved the path and evolved to be the main bearers of AMR. Effective management of antibiotic prescription and restricted availability can help in reducing life threatening conditions.[2]

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Low- and Middle-Income Countries (LMICs), such as India have a higher burden of antimicrobial resistance mainly due to sloughing practice of use of unprescribed antibiotics, unlimited availability, poor law regulations and health infrastructure in rural areas and mainly lack of knowledge regarding antibiotics.[3] The Indian Council of Medical research has released in their reports that India has alarming rates of antibiotic consumption and higher evidence of resistance towards commonly used antibiotics.[4] Rampant misconceptions about the use of antibiotics especially in rural areas where the healthcare practices are lower than urban areas serve as the point of contact for the raising AMR concerns. As per the evidences from many studies conducted in India practices like leftover antibiotic usage, incomplete antibiotic course and taking antibiotics for viral infections are alarmingly increasing in rural populations.[5,6] These instances prove to be the main key factors for the spread of resistant organisms among the community. Educational programmes to raise awareness about antibiotics targeted for rural community helps in improving the knowledge, practices and attitude of people towards antimicrobial resistance.[7,8]

Kalaiyur, a rural village in the district of Cuddalore of Tamil Nadu, reflects a microcosm of the broader challenges faced in India's rural healthcare landscape. Despite the presence of primary healthcare services, there exists a noticeable gap in awareness and understanding of antibiotic use and antimicrobial resistance. Informal discussions with local healthcare workers and residents highlight that antibiotics are often perceived as a cure-all remedy, and practices like sharing medications or self-prescribing are common.

This study aims to bridge this knowledge gap by evaluating the effectiveness of a structured community-based educational intervention focused on improving the knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance in Kalaiyur. Utilizing a pre- and post-intervention design, the study assesses baseline community perceptions, implements a multi-modal awareness campaign, and measures the post-intervention changes in KAP. The outcomes of this study are expected to provide valuable evidence for designing scalable, community-led antimicrobial stewardship strategies, contributing meaningfully to the national action plan on AMR and the global agenda for sustainable antibiotic use.

2. Materials and Methods

2.1. Study design and setting

A quasi-experimental design was used to conduct this study with a pre and post intervention modules. Kalaiyur village in Cuddalore district of Tamil Nadu located in India was selected as the intervention group because of its limited healthcare access, diverse rural settlement, and entangled antibiotic practices. A non-overlapping and demographically identical village nearby Kalaiyur was selected to be the control group for the study. The identity of the control group has been masked as requested by the village authorities.

2.2. Study period

The study was implemented in three phases during the time frame of 6 months from August 2024 to January 2025.

1. Baseline KAP survey (Pre-intervention)
2. Implementation of the health education intervention
3. Follow-up KAP survey (Post-intervention)

2.3. Study population and sampling

The participants were selected on the conditions of age above 18 years, resident of the study village for at least six months and consented to participate in the study. Participants who were not available for any one of the phases and individuals with psychological impairment were excluded.

The sample size was calculated based on the previous studies KAP surveys which showed a baseline KAP proportion of 50%, and a 20% increase was anticipated in the present study after the intervention. The sample size was estimated to be 195 participants per group with an 80% power at two sided $\alpha = 0.05$. An additional 10% was added to compensate the non-respondents or loss during the follow up, thus the final sample size was estimated to be 215 participants in each group therefore accounting to 430 participants (intervention and control group). Participants were selected using simple random sampling method.

1. Intervention group: 215 participants from Kalaiyur (exposed to intervention)
2. Control group: 215 participants from a matched village (no intervention)

2.4. Data collection tool

A structured questionnaire was developed in English and translated to Tamil. The Tamil translated version was back translated to ensure consistency. The questionnaire was then validated by internal and external experts for maintain the integrity. The questionnaire was based on the Antimicrobial Resistance Knowledge Attitude and Practice studies done in community based areas.[9-11] The questionnaire was sectioned into four comprising of the sociodemographic details, knowledge on antibiotics and its resistance, attitude towards antibiotic usage and practices followed in the community. A pilot study was conducted in the field practice community areas to confirm the reliability of the questionnaire which yielded a Cornbach's $\alpha = 0.83$ which proved the reliability of the tool used in the study.

2.5. Baseline survey

The data was collected from the participants using direct face to face interview by trained public health specialists who are fluent in Tamil. The pre-intervention data collection interview lasted for 15 to 20 minutes and was conducted in a private setting within the participant's home.

2.6. Intervention strategy

The community based interventions were planned and executed in the Kalaiyur village (intervention group), a way its easily understandable and coincide with the WHO guidelines on AMR education.[12,13] The interventions planned in this study includes pamphlets designed to raise awareness on antibiotic resistance and the do's & don't regarding antibiotic usage, street plays illustrating the seriousness and consequences of misuse and overuse of antibiotics, placards displaying the over-the-counter prescription and self-medication of antibiotics and a general lecture session on antibiotic awareness. It was specifically framed to be engaging, free of cost and culturally adapting. The community sessions were conducted during the weekends in four batches with each batch being exposed to the intervention for 3 hours in the panchayat community hall to ensure maximum participation. No intervention activities were conducted in the control group till the conclusion of the assessment to maintain the study's internal validity.

2.7. Post-intervention assessment

The same questionnaire was administered again one month after the multicomponent intervention programmes to the same participants who participated in the pre assessment to analyse the effect of the intervention programmes. The practice component was assessed using the questionnaire by asking specific questions related to the behavioural actions, frequency and perceived barriers before and after the intervention was applied using Likert scale. The scoring system for different components are mentioned below:

Component	Score Range	Interpretation
Knowledge (out of 10)	0–4	Poor
	5–7	Moderate
	8–10	Good
Attitude (out of 8)	0–3	Negative Attitude
	4–6	Neutral Attitude
	7–8	Positive Attitude
Practice (out of 10)	0–4	Poor
	5–7	Moderate
	8–10	Good

2.8. Data analysis

Data analysis was carried out using SPSS version 25.0. Descriptive statistics were used to summarize the demographic and baseline KAP data. Within-group comparisons (pre- vs post-intervention) were made using paired t-tests for continuous variables and McNemar's test for categorical variables. Between-group comparisons (intervention vs control post-intervention) used independent t-tests or chi-square tests as appropriate. A difference-in-differences (DiD) analysis was also conducted to estimate the net effect of the intervention by comparing changes in outcomes between the two groups. A p-value <0.05 was considered statistically significant.

3. Results

3.1. Participant characteristics

Out of the total 430 participants who participated in the study, 215 belonged to the intervention group and 215 were in the control group who received no intervention. The overall response rate was noted to be 96.4%. There were no significant differences in baseline sociodemographic characteristics (p>0.05) between the two groups, indicating group comparability. (**Table 1**)

Table 1: Sociodemographic characteristics of participants

Variable	Intervention (n=215)	Control (n=215)	p-value
Mean Age (years)	38.6 ± 11.3	37.8 ± 9.9	0.23
Female (%)	61.4%	62.1%	0.59
Education ≥ Secondary (%)	41.8%	43.1%	0.65
Occupation - Agriculture (%)	38.2%	37.4%	0.82
Monthly Income < ₹10,000 (%)	66.5%	67.3%	0.69

No significant differences found between groups at baseline.

3.2. Changes in knowledge, attitudes, and practices (KAP)

3.2.1. Knowledge

Before intervention, both the groups had approximately similar knowledge (Mean ± SD: Intervention = 4.9 ± 1.9; Control = 5.1 ± 2.1; p = 0.43). After the educational intervention programme, the intervention group showed an improvement in knowledge which was statistically significant (Mean ± SD: 8.9 ± 2.1; p < 0.001), whereas the control group's knowledge has not shown any massive improvement by time. (Mean = 5.5 ± 1.8). (**Table 2**)

3.2.2. Attitude

The intervention group showed positive trend when compared with the control group in attitudes toward antibiotic use (Pre Intervention: 3.7 ± 1.7, Post Intervention: 5.9 ± 1.1; p < 0.001), particularly in their belief that antibiotics should only be taken with a prescription. The control group exhibited no significant attitude changes (**Table 2**).

3.2.3. Practices

Antibiotic usage and self-medication practices among the intervention group has significantly increased (Pre Intervention: 3.2 ± 2.3, Post Intervention: 5.9 ± 1.6; p < 0.001) (**Table 2**), including:

1. A 50% decrease in self-medication
2. A 40% increase in completion of antibiotic courses
3. A 60% rise in consultation with qualified health providers before taking antibiotics

These changes were statistically significant (p < 0.001). The control group exhibited minimal negative change.

Table 2: Comparison of KAP scores before and after intervention

KAP Component	Time Point	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value (between groups)
Knowledge	Pre-Intervention	4.9 ± 1.9	5.1 ± 2.1	0.43
	Post-Intervention	8.9 ± 2.1	5.5 ± 1.8	<0.001
Attitude	Pre-Intervention	3.7 ± 1.7	3.9 ± 1.4	0.33
	Post-Intervention	5.9 ± 1.1	4.1 ± 1.6	<0.001
Practice	Pre-Intervention	3.2 ± 2.3	3.7 ± 1.1	0.60
	Post-Intervention	5.9 ± 1.6	3.7 ± 1.3	<0.001

Significant improvements observed in the intervention group across all domains.

Table 3: Difference-in-differences (DiD) Analysis of KAP scores

KAP Component	Intervention Δ (Post - Pre)	Control Δ (Post - Pre)	DiD Estimate (Net Effect)	p-value
Knowledge	8.9 – 4.9 = +4.0	5.5 – 5.1 = +0.4	+3.6	<0.001
Attitude	5.9 – 3.7 = +2.2	4.1 – 3.9 = +0.2	+2.0	<0.001
Practice	5.9 – 3.2 = +2.7	3.7 – 3.7 = +0.0	+2.7	<0.001

Interpretation:

1. The DiD analysis proved that the educational intervention programmes significantly improved the knowledge, attitude, and practices of the community people.
2. All the changes noted were statistically significant (p < 0.001), demonstrating the effectiveness of the multicomponent education intervention programmes. (**Table 3**)

4. Discussion

The study revealed that the impact created by the multicomponent educational intervention programme in the community had considerable extend in knowledge, attitude, and practices of the people regarding antibiotic usage and resistance. The intervention group had noticeable changes during the post intervention period which helped in developing the knowledge about the misconceptions of antibiotics usage and resistance.

The knowledge of the intervention group raised up to 8.9 from 4.9, (**Table 2**) indicating increased awareness about the overuse and misuse of the antibiotics. Similar higher trends were noticed with the attitude and practice of the community people. The DiD analysis casted a practice domain. (**Table 3**).

The current study findings align with the study conducted by Shukla *et al*. where educational intervention had significant impact in all the three domains of knowledge, attitude, and practice.[14] Our study also goes on par in with other international studies such as in rural China, a multifaceted campaign (including speakerphone messages, posters, and training) led to significant knowledge and attitude improvements among villagers, though changes in animal antibiotic use were limited[15] and similarly, in Cyprus, a multifaceted intervention targeting parents and pediatricians decreased antibiotic consumption for pediatric URTIs.[16]

The intervention's effectiveness in Kalaiyur act like a stem from its layered approach—combining health-provider talks, community meetings, and mass-media messages. This resembles the "One Health" initiatives effective. Regression models in Tanzania have shown that knowledge and attitudes are significant predictors of antibiotic-use behavior supporting the rationale that educational interventions produce downstream effects on practice.[17] Despite overall gains, some misconceptions persist—for instance, misbeliefs about antibiotic utility for viral infections—mirroring findings among students in Nigeria and healthcare trainees in Ecuador.[10] This underscores the need for future interventions to explicitly address biological mechanisms, such as bacterial adaptation and antibiotic spectrum.

Unlike previous studies that focused solely on knowledge or conducted single-session campaigns, our multi-touchpoint, behavioural change communication (BCC) approach sustained engagement and likely contributed to the observed improvements. The strengths of the study are controlled design using a comparison group enhanced internal validity, pre-validated questionnaire with good reliability (Cronbach's α = 0.83) ensured robust data collection and multimodal intervention (pamphlets, lecture, placards, and street plays) enhanced message retention and cultural appropriateness.

The limitations of the study are the short follow-up period may not fully capture long-term behavioural change and reporting bias.

5. Conclusion

The educational program effectively addressed misconceptions, promoted responsible antibiotic use, and reduced risky behaviors such as self-medication. The Difference-in-Differences (DiD) analysis further confirmed that the observed changes were attributable to the intervention rather than external factors.

These findings highlight the importance of targeted health education campaigns as a cost-effective and scalable approach to combat antimicrobial resistance (AMR) at the community level. Expanding such interventions to other rural areas could contribute meaningfully to national and global efforts in preserving antibiotic effectiveness.

The use of multimodal tools— pamphlets, lecture, placards, and street plays proved particularly impactful in addressing misconceptions and promoting responsible antibiotic behaviors. These findings highlight the critical role of community engagement and behavioral change communication in combating the growing threat of antimicrobial resistance (AMR), especially in underserved settings. Thus scaling up the community education programs, involving local health care workers, use of multimedia and periodic reinforcement will help to attain the necessary awareness among all the communities around the world.

Given the global urgency of addressing AMR, incorporating such interventions into primary healthcare and national AMR strategies can be a cost-effective, scalable solution. Long-term follow-up and broader implementation across diverse settings are recommended to reinforce sustained behavioural change and improve public health outcomes.

6. Ethical Considerations

Institutional Research Committee has given clearance (SAHS/IRC/2024/53) for this study and written informed consent was obtained from all participants before administering the pre assessment. The study adhered to the ethical principles outlined in the Declaration of Helsinki.

7. Source of Funding

The authors declare that no funds or grants or external support were received during the study.

8. Conflict of Interest

The authors confirms that there is no relevant financial or non-financial information to disclose.

9. Author Contribution

Sujin Padmanabhan: Conceptualization, Project administration, Writing – original draft, Valarmathi Balakrishnan: Conceptualization, Formal analysis, Savitha Govindarajan: Investigation, Project administration, Resources, Sendilkumar Balasundaram: Supervision, Gayathri Kumar: Methodology, Saranya Loganathan Kumaresan: Project administration, Resources.

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