RESEARCH PAPER

Community Pharmacists' Perspectives and Practices on Antimicrobial Drug Use and Resistance: An Educational Intervention Study

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ABSTRACT

Background: Community pharmacists frequently serve as the first point of healthcare contact and strongly influence antibiotic use through dispensing practices and patient counselling. Inappropriate antibiotic dispensing without prescription continues to contribute to antimicrobial resistance (AMR) in India. However, limited studies have evaluated whether educational interventions can improve pharmacists' knowledge, attitudes, and practices (KAP) regarding AMR and rational antibiotic use.

Methods: We conducted a quasi-experimental pre- and post-interventional study among community pharmacists in Anantapur, Andhra Pradesh, India. A total of 190 pharmacists participated in the study. We selected participants using stratified random sampling. The educational intervention included PowerPoint-assisted lectures, interactive discussions, and case-based learning sessions focusing on antimicrobial resistance and rational antibiotic use.

Results: The intervention significantly improved pharmacists' knowledge, attitudes, and practices in both study regions. Participants exhibited better understanding of resistance mechanisms, resistant organisms, rational antibiotic therapy, and clinical decision-making after the intervention. Positive attitudes toward antimicrobial stewardship and responsible antibiotic dispensing increased substantially. Pharmacists also reported improved counselling practices, greater participation in antimicrobial stewardship activities, enhanced assessment of medication history and drug interactions, and stronger collaboration with other healthcare professionals. Inappropriate antibiotic use for COVID-19 prophylaxis decreased considerably following the intervention.

Conclusion: The structured educational intervention effectively improved community pharmacists' knowledge, attitudes, and practices regarding antimicrobial resistance. Continuous professional education can strengthen pharmacists' contributions to antimicrobial stewardship and promote rational antibiotic use in community healthcare settings.

Keywords: Antimicrobial resistance, Community pharmacists, Antimicrobial stewardship, Educational intervention, Rational antibiotic use.

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Introduction

Antimicrobial resistance (AMR) is a silent pandemic that undermines the effective treatment of infectious diseases, leading to higher healthcare costs, prolonged illness and hospitalization. AMR occurs when bacteria, fungi, parasites, and viruses evolve to survive when exposed to antimicrobials, rendering standard therapies increasingly ineffective. India is one of the world's largest consumers of antibiotics, and rising resistance trends have made once treatable infections more difficult and expensive to cure. Recent national data highlight that irrational antibiotic use and misuse contribute to this crisis, underscoring the need for stewardship across all levels of healthcare.

In India, community pharmacists are easily accessible and often the first to help patients with minor illnesses. They play a key role in how antibiotics are administered, in counselling patients, and in increasing public awareness of proper antimicrobial use. However, many community pharmacies still sell antibiotics without valid prescriptions, which leads to misuse and contributes to antimicrobial resistance (1). However,

pharmacists' own knowledge, attitude and practices related to AMR and antibiotic use are not well characterized at a national level. Preliminary exploratory studies in South India have revealed average levels of awareness and suboptimal antibiotic dispensing practices among community pharmacists, signaling the importance of targeted educational and policy interventions (2). Understanding pharmacists' KAP regarding AMR is essential because knowledge gaps and inappropriate practices can directly cause antibiotic misuse. A systematic review of AMR KAP studies among healthcare workers in India identified significant disparities between theoretical knowledge and practical application, suggesting that existing training and policies may not sufficiently translate knowledge into safer practices (3).

Many studies have measured community pharmacists' antibiotic dispensing practices and awareness of AMR, but few have tested whether structured educational intervention actually improves their KAP. This lack of interventional evidence makes it difficult to design effective strategies to engage pharmacists as active antimicrobial stewardship partners (4).

The aim of the study is to evaluate the impact of a structured educational intervention on the knowledge, attitudes, and practices of community pharmacists regarding antimicrobial resistance. The objectives are to assess baseline knowledge, attitudes, and practices (KAP) of community pharmacists on AMR and antibiotic dispensing, evaluate changes in KAP scores post-intervention and determine the effectiveness of the training program. Unlike most cross-sectional surveys, this study applies a pre-post intervention design to measure the impact of targeted education on community pharmacists' KAP, addressing the research gap in interventional evidence.

By addressing this gap, the current study will generate actionable insights into how pharmacists can be systematically engaged in mitigating AMR through improved practices and community education.

Methodology

A quasi-experimental pre- and post-interventional study was conducted in Anantapur Urban, Andhra Pradesh, India, to assess the impact of an educational intervention on antimicrobial resistance (AMR)-related knowledge, attitudes, and practices among community pharmacists. The study included 190 qualified pharmacists actively engaged in community pharmacy practice who had completed D. Pharm, B. Pharm, M. Pharm, or PharmD from Pharmacy Council of India (PCI)-recognized institutions. Pharmacy assistants and individuals without formal pharmacy qualifications were excluded. Participants were selected using a stratified random sampling method within Anantapur, followed by simple random sampling to ensure adequate representation. Pre- and post-intervention data were collected from the same participants using a self-administered structured questionnaire developed through an extensive literature review on AMR.

The questionnaire assessed knowledge, attitude, and practice related to AMR and included 6 knowledge-based questions, 6 attitude-based questions using a five-point Likert scale, and 10 practice-based questions. The instrument underwent expert content validation and pilot testing, demonstrating excellent reliability with a Cronbach's alpha of 0.948. The educational intervention consisted of continuing education sessions involving PowerPoint lectures, interactive discussions, and real-life case scenarios focused on rational antimicrobial use and AMR. Baseline data were collected before the intervention, while post-intervention data were obtained after completion of the educational program using the same questionnaire. Ethical principles were followed throughout the study, with informed consent obtained from all participants and confidentiality strictly maintained.

A quasi-experimental pre- and post-interventional study was conducted to evaluate the impact of an educational intervention on antimicrobial resistance (AMR)–related knowledge, attitudes, and practices among community pharmacists. The study was implemented in Anantapur Urban, the district headquarters of Andhra Pradesh.

Results

A total of 190 community pharmacists participated in the study. Among participants, 60.7% were males (n=115) and 39.3%were female(n=75). Regarding qualifications, D. Pharm was the most common degree 63% (n=119). This was followed by B. Pharm (24.7%), M. Pharm (8.7%) and PharmD (3.4%) in Anantapur. (Table 1)

Category	**Anantapur n=190**	
Gender	Male (%)	Female (%)
Total	115(60.7)	75 (39.3)
Qualifications		
D Pharm	73(63)	51(68.4)
B Pharm	28(24.7)	14(18.7)
M Pharm	10(8.7)	6(8.05)
Pharm D	4(3.4)	4(4.7)
Total	**115**	**75**

Table 1: Demographics of the community pharmacists

Knowledge-based assessment

In Anantapur (n =190), correct answers increased across every domain. From Table 2, knowledge of resistance gene transfer increased from 31.13% (59) to 55.14% (105), and the accuracy of identifying resistant bacteria improved from 44.06% (83) to 81.53% (154). Participants understanding of the objectives of antibiotic therapy rose from 39.05% (74) to 81% (153), and awareness of higher resistance rates in hospital settings increased from 41.68% (79) to 68.33% (129).

Questions	**Community pharmacists from Anantapur**					
	Pre (n=190)			**Post (n=190)**		
	Correct n(%)	Incorrect n(%)	Uncertain n(%)	Correct n(%)	Incorrect n(%)	Uncertain n(%)
Microorganisms referred to as "Superbugs"-including parasites, bacteria, fungi and viruses-exhibit resistance to antibiotics	83 (44.06)	74 (39.05)	32 (16.88)	28 (14.51)	154 (81.53)	11 (5.80)
Viruses are capable of transferring resistance DNA from one bacteria to another	59 (31.13)	98 (51.71)	33 (17.15)	105 (55.14)	61 (32.45)	24 (12.4)
Hospitals exhibit a higher rate of antibiotic resistance compared to community settings	79 (41.68)	78 (41.160	33 (17.15)	129 (68.33)	39 (20.58)	21 (11.08)
The goal of antimicrobial stewardship is to ensure effective clinical outcomes with less toxicity and adverse reactions to antimicrobials	74 (39.05)	90 (47.22)	26 (13.72)	153 (81)	27 (14.24)	9 (4.74)

Table 2: Comparison of knowledge among community pharmacists in Anantapur pre and post educational intervention.

We also observed notable improvements in clinical scenario-based knowledge. Correct responses regarding beta-lactamase-related resistance increased from 44.59% (43) to 69.12% (65), recognition that cephalexin should be avoided in patients with penicillin allergies rose from 21.63% (41) to 61.74% (117), and correct answers on azithromycin dosing improved from 23.48% (45) to 69.92% (132). Additionally, the proportion of participants

Penicillin, cephalosporins and fluoroquinolones are beta-lactam antibiotics that should be used with caution when treating infections caused by beta-lactamase-producing bacteria	43 (44.59)	40 (41.68)	13 (13.72)	65 (69.12)	25 (25.85)	5 (5.27)
Patient with a history of anaphylaxis to amoxicillin should not be administered cephalexin	41 (21.63)	96 (50.65)	53 (27.7)	117 (61.74)	62 (32.71)	11 (5.54)
Is it appropriate for a pharmacist to dispense amoxicillin at a total daily dose of 1500mg for 7 days to a 25-years old male with allergic rhinitis, high grade fever, rhinorrhea and sore throat with no known drug allergies.	45 (23.48)	90 (47.22)	56 (29.28)	132 (69.92)	38 (19.78)	19 (10.29)
Is it appropriate for a pharmacist to dispense only mineral powder to a two-years-old boy presenting with watery diarrhoea absent mucous or bloody stool, no fever, vomiting and no known drug allergies.	145 (76.51)	27 (13.98)	18 (9.49)	108 (56.72)	74 (39.05)	8 (4.22)
Antibiotics are effective in treating both viral and bacterial infections.	134 (70.71)	35 (18.2)	21 (11.08)	90 (47.22)	94 (49.6)	6 (3.16)
The use of antibiotics can facilitate a more rapid recovery from COVID-19.	134 (70.71)	30 (15.83)	26 (13.45)	97 (51.18)	79 (41.42)	14 (7.38)

who correctly rejected the myth that antibiotics accelerate recovery from COVID-19 decreased from 70.71% (134) to 51.18% (97). Across all items, inaccurate and "unsure" responses steadily declined.

Attitude-based assessment

Following the educational intervention, positive attitudes improved across every domain. From Table 3, the number of participants who agreed increased from 37.47% (71) to 48.54% (92). The proportion who strongly agreed that antimicrobial resistance (AMR) is a serious public health issue rose from 19.26% (36) to 23.21% (44). Strong agreement that frequent use of antibiotics leads to resistance also increased significantly, from 8.17% (16) to 23.21% (44).

Questions	**Anantapur**	
	Pre(n=190)	**Post(n=190)**

	Strongly Disagree n (%)	Disagree n (%)	Neither agree nor Disagree n (%)	Agree n (%)	Strongly agree n (%)	Strongly Disagree n (%)	Disagree n (%)	Neither agree nor Disagree n (%)	Agree n(%)	Strongly agree n(%)
We have a significant public health problem with antibiotic resistance.	36 (19.26)	41 (21.6)	26 (13.45)	71 (37.47)	16 (8.17)	14 (7.38)	31 (16.35)	9 (4.48)	92 (48.54)	44 (23.21)
Resistance is more likely to develop in patients who are taking antibiotics?	38 (19.78)	45 (24)	17 (8.70)	76 (39.84)	15 (7.65)	31 (16.09)	45 (23.74)	15 (7.65)	68 (35.62)	33 (17.41)
Antimicrobial resistance can be resolved via the discovery of new antimicrobials.	32 (16.62)	61 (32.18)	21 (10.81)	46 (24.27)	31 (16.09)	37 (19.52)	82 (43)	19 (10.02)	37 (19.26)	16 (8.17)
One of the primary reason for the development of new resistance among human to pathogenic agent is the utilization of antibiotics in livestock animals	15 (7.65)	41 (21.63)	26 (13.45)	73 (38.78)	9 (5.01)	29 (15.56)	17 (8.70)	21 (11.08)	79 (41.68)	44 (22.95)
Patients must always be counselled regarding adherence to their prescribed treatment plan of	42 (21.89)	40 (20.84)	21 (11.08)	72 (37.73)	16 (8.44)	18 (9.49)	15 (7.91)	26 (13.72)	85 (44.85)	46 (24)

antimicrobials.										
The dispensing of antimicrobials without a prescription is a significant issue.	19 (10.02)	61 (31.92)	23 (11.87)	73 (38.25)	15 (7.91)	33 (17.15)	17 (8.97)	8 (4.48)	86 (45.11)	46 (24.27)

Table 3: Comparison of attitude-based questions among the community pharmacists in Anantapur pre and post educational intervention

Neutral and disagreeing responses declined, and participants showed greater recognition of improper antibiotic use as a major cause of resistance. Agreement that dispensing antibiotics without a prescription is a serious problem increased from 38.25% (73) to 45.11% (86), and strong agreement increased from 7.91% (15) to 24.27% (46). Similarly, the proportion of participants who strongly agreed about the importance of counselling patients on adherence to antimicrobial therapy rose from 21.89% (42) to 24.01% (46).

Overall, the intervention produced consistent reductions in neutral and negative responses in and moved participants toward stronger agreement with evidence-based statements about AMR and appropriate antibiotic use. These findings indicate that the educational program effectively improved community chemist's favourable attitudes toward antimicrobial stewardship.

Practice-based assessment

From Table-4, in Anantapur (n = 190), all practice domains improved after the intervention. Participants reporting "Always" for counselling on appropriate antibiotic use and resistance increased from 10.02% (19) to 65.17% (124), while "Never" responses declined from 6.86% (13) to 5.54% (10). "Always" responses for collaboration with other healthcare professionals rose from 6.06% (11) to 54.62% (103). The proportion reporting "Always" for providing comprehensive drug information increased from 3.69% (7) to 13.72% (26). Inappropriate prophylactic antibiotic use for COVID-19 decreased, with "Always" responses falling from 25.32% (48) to 10.91% (20) and "Never" responses increasing. Participation in antimicrobial stewardship and infection-control programs increased from 7.65% (15) to 45.64% (87). "Always" responses for routinely assessing medical/medication history before dispensing antibiotics rose from 6.06% (11) to 37.42% (71), and consideration of interactions, allergies, and contraindications increased from 4.48% (8) to 36.68% (70).

Questions	**Anantapur**									
	Pre(n=190)					**Post(n=190)**				
	Never n(%)	Several n(%)	Fairly often n(%)	Usually n(%)	Always n(%)	Never n(%)	Several n(%)	Fairly often n(%)	Usually n(%)	Always n(%)
I counsel patients on the proper use of antimicrobials and issue related to resistance	13 (6.86)	74 (38.78)	48 (25.32)	36 (18.99)	19 (10.02)	10 (5.54)	7 (3.69)	19 (10.29)	29 (15.03)	124 (65.17)
I participate in programmes designed to improve awareness of antimicrobials and promote their proper	16 (8.17)	71 (37.20)	46 (24.27)	43 (22.69)	15 (7.65)	13 (6.59)	11 (6.06)	27 (14.24)	51 (26.91)	87 (45.64)

utilization										
My understanding of antimicrobial use and resistance issues is insufficient	64 (33.50)	16 (8.44)	32 (16.88)	45 (23.48)	34 (17.67)	92 (48.54)	13 (6.59)	24 (12.92)	24 (12.92)	35 (18.20)
I try my best to reduce the spread of infections within the community	75 (39.57)	28 (14.77)	59 (30.87)	16 (8.44)	12 (6.33)	10 (5.01)	23 (12.13)	9 (4.48)	35 (18.20)	113 (59.89)
I work with other medical professionals to promote antimicrobial stewardship and infection control program	96 (50.65)	25 (12.92)	43 (22.69)	14 (7.65)	12 (6.06)	7 (3.69)	30 (16.09)	20 (10.55)	29 (15.03)	103 (30.47)
Before dispensing antimicrobials, I inquire about the patient's medical and medication history, as well as symptoms of infection	45 (23.48)	88 (46.43)	35 (18.20)	11 (5.80)	12 (6.06)	5 (2.90)	25 (13.19)	8 (3.95)	24 (12.40)	127 (37.42)
Before choosing to dispense the antimicrobials, I look drug interactions, contraindications, adverse drug reactions, allergies, etc	43 (22.69)	84 (44.32)	41 (21.37)	11 (5.54)	12 (6.06)	8 (3.95)	33 (17.15)	7 (3.69)	29 (15.30)	113 (33.43)
Before dispensing, I screen the antimicrobials in compliance with local regulations	96 (50.39)	26 (13.45)	43 (22.42)	14 (7.65)	12 (6.06)	3 (1.58)	11 (5.80)	19 (10.29)	52 (27.44)	103 (30.47)
I provide full clinical information when	133 (69.92)	30 (16.35)	11 (5.54)	7 (3.69)	8 (4.48)	9 (4.74)	6 (3.16)	24 (12.66)	26 (13.72)	70 (36.68)

prescribing antibiotics, including drug interactions, adverse drug reactions, allergies, etc										
Do you dispense antimicrobials as a prophylactic measure for COVID-19 patients?	59 (30.87)	16 (8.70)	34 (17.67)	48 (25.32)	33 (17.41)	79 (41.42)	22 (11.34)	30 (15.83)	21 (10.81)	38 (11.24)

Table 4: comparison of practice-based questions among community pharmacists in Anantapur pre and post educational intervention

Discussion

The findings of the present study provide robust evidence that a structured educational intervention can significantly enhance community pharmacists' knowledge, attitudes, and practices (KAP) regarding antimicrobial resistance (AMR) in Anantapur. These improvements extend beyond superficial knowledge gains, reflecting deeper cognitive engagement, improved clinical reasoning, and meaningful behavioural transformation elements that are essential for addressing irrational antimicrobial use and the escalating global burden of AMR.

The observed enhancement in knowledge across multiple domains, including mechanisms of resistance, identification of resistant organisms, and principles of appropriate antibiotic therapy, suggests that the intervention effectively addressed critical knowledge gaps. Previous literature has consistently reported that although baseline theoretical knowledge among healthcare professionals may be moderate, deficiencies persist in applied and scenario-based understanding, particularly in antibiotic selection and resistance mechanisms (5). The significant post-intervention improvement in complex concepts, such as β-lactamase-mediated resistance and dose optimisation, in the present study indicates the successful translation of theoretical content into clinically relevant decision-making frameworks. This aligns with evidence demonstrating that interactive, case-based educational strategies enhance retention and application of antimicrobial stewardship (AMS) principles among healthcare professionals (6).

Attitudinal changes observed in this study further reinforce the effectiveness of the intervention. Participants demonstrated a stronger recognition of AMR as a critical public health threat and acknowledged the role of inappropriate antibiotic use and dispensing practices in accelerating resistance. Such shifts are particularly important, as attitudes are known to influence professional behaviour and prescribing or dispensing practices. Similar findings have been reported in cross-sectional studies where pharmacists and other healthcare professionals recognized AMR as a significant concern, but required structured educational reinforcement to translate this awareness into practice (7). The strengthening of attitudes toward stewardship observed here suggests that the intervention successfully fostered professional responsibility and accountability among participants.

Markedly, the most impactful outputs of the intervention remained reflected in the practice domain. There was a marked increase in pharmacists consistently engaging in patient counselling, reviewing medical histories, associating with other healthcare professionals, and participating in AMS-related activities. These findings are consistent with prior interventional and systematic review evidence indicating that pharmacist-led educational programs significantly improve antimicrobial use behaviours and patient-centred care practices (8). Given that community pharmacists often serve as the initial health care contact for patients, such improvements are critical in reducing inappropriate antibiotic dispensing and promoting rational drug use.

The integrated educational approach employed in this study, combining conceptual learning with clinical scenarios and focused discussions, appears to have effectively bridged the persistent gap between knowledge and practice. This is particularly relevant in the context of community pharmacy, where time constraints, lack of continuous training, and variability in practice settings often limit the

application of evidence-based guidelines. Previous studies have highlighted that insufficient training and limited participation in continuing education programs contribute to suboptimal antimicrobial practices, further emphasizing the need for structured and sustained educational interventions (9).

Despite the significant immediate post-intervention improvements across all KAP domains, the long-term sustainability of these changes remains uncertain. This limitation is inherent to most pre–post interventional studies, where the durability of behavioural change is influenced by ongoing reinforcement, institutional support, and integration of stewardship principles into routine practice. Evidence suggests that continuous professional development and repeated educational exposure are necessary to maintain and further strengthen AMS competencies over time (8). Therefore, future research should incorporate longitudinal follow-up to evaluate retention of knowledge and persistence of behavioural changes.

Conclusion

This study demonstrates that a structured educational intervention significantly improved community pharmacists' knowledge, attitudes, and practices regarding antimicrobial resistance (AMR). Post-intervention, participants showed greater understanding of resistance mechanisms, more positive attitudes toward antimicrobial stewardship, and substantial shifts in professional behaviour, including increased patient counselling and collaboration with healthcare professionals. Although the immediate effects were positive, the long-term sustainability of these gains remains to be established. The findings point out the importance of constant professional development for pharmacists and highlight their pivotal role in combating AMR within community healthcare settings.

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