International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s, 2025
https://www.theaspd.com/ijes.php

Effectiveness of a Training Intervention on Antimicrobial Resistance and Antibiotic Dispensing Patterns among Community Pharmacists

Rosy Raju,[1] Srikanth Malavalli Siddalingegowda[1*], Teggina Math Pramod Kumar,[2] Gabriella Edina Veronica E,[3] Ravindra Pukharaj Choudhary[1]
[1*]Department of Pharmacy Practice, JSS College of Pharmacy, Mysuru, Karnataka, India
[2] Department of Pharmaceutics, JSS College of Pharmacy, Mysuru, Karnataka, India
[3] Independent Researcher, Mysuru, Karnataka, India
***Corresponding Author**: Srikanth Malavalli Siddalingegowda
*Department of Pharmacy Practice, JSS College of Pharmacy, Mysuru, Karnataka, India

Abstract
Antimicrobial resistance (AMR) poses a significant public health threat globally, with India among the worst affected. Community pharmacists (CPs), as accessible healthcare providers, often dispense antibiotics without prescriptions, contributing to misuse and resistance. Despite their crucial role in antimicrobial stewardship (AMS), few targeted educational initiatives exist in India. This study aimed to assess the impact of a structured educational intervention on the knowledge, attitude, and practice (KAP) of CPs, regarding antibiotic use and AMR. A prospective educational intervention study was conducted over six months involving 87 CPs. A validated KAP questionnaire, developed using WHO and FIP guidelines, was administered pre- and post-intervention. A two-day Continuing Professional Development (CPD) workshop covering AMR, the WHO AWaRe classification, and AMS was conducted. Data were analyzed using SPSS v20.0, applying paired t-tests with $p < 0.05$ considered statistically significant. A total of 87 CPs participated, predominantly male (59.8%) and aged 21–30 years (51.7%), with most holding a diploma in pharmacy (83.9%) and working in independent pharmacies (65.5%). Pre-intervention, 60.9% of CPs dispensed antibiotics without a prescription, mainly for respiratory infections. Azithromycin and amoxicillin were the most commonly dispensed antibiotics. Post-intervention, knowledge, attitude, and practice scores significantly improved. Recognition of AMR as a public threat rose (27.6% to 42.5%), and awareness of prescription-only antibiotic dispensing improved (35.6% to 89.8%). Attitude and practice also improved, including medical history checks (13.8% to 75.9%) and counselling (13.8% to 65.5%). Structured CPD-based training significantly improved the KAP of CPs. Sustainable AMS in India requires regular training, supportive policy frameworks, and public engagement to empower pharmacists as key stakeholders in combating AMR

Keywords: *Antimicrobial resistance, antibiotic dispensing, Community pharmacists, continuing professional development*

INTRODUCTION

Antimicrobial resistance (AMR) has emerged as one of the gravest threats to global health. The 2019 Global Research on Antimicrobial Resistance (GRAM) study estimated 1.27 million deaths were directly attributable to bacterial AMR and 4.95 million were associated with it worldwide, placing AMR ahead of HIV and malaria as a cause of mortality. Without effective control, annual deaths could approach ten million by 2050, risking modern medicine and global development targets.[1]

The burden of AMR is disproportionately borne by India. Resistant infections already claim more than 58,000 neonatal lives each year, and projections warn the national death toll could rise steeply if current trends continue. Community settings are responsible for the majority of antibiotic consumption. According to previous studies, approximately 80% of all antibiotics are administered outside of hospitals, with 20–50% of these antibiotics considered inappropriate[3]. A variety of thoroughly documented factors contribute to the AMR crisis in India. These include easy access to antibiotics without prescriptions, prevalent self-medication practices, inconsistent quality in prescribing, issues related to sanitation, fragmented enforcement of regulations, and a lack of diagnostic capabilities. Collectively, these factors provide a situation beneficial to the growth of resistant pathogens[4].

Within this landscape, Community Pharmacists (CPs) are gatekeepers of the antibiotic supply. Observational studies across Indian cities continue to show more than half of antibiotics dispensed without a valid prescription, highlighting critical gaps in stewardship at the retail level[5]. Yet, pharmacists can also serve as powerful allies against AMR by screening prescriptions, counselling patients, promoting narrow-spectrum choices, and tracking consumption. Systematic reviews from low- and middle-income countries (LMICs) emphasise this unrealised potential but point to deficiencies in AMR knowledge, limited stewardship training, and weak policy support[6].

Contrastingly, high-income nations have embedded community pharmacy within formal antimicrobial-stewardship (AMS) frameworks. In the United Kingdom, initiatives such as the TARGET toolkit, Pharmacy Quality Scheme incentives, Antibiotic Guardian pledges, and dedicated e-learning modules have normalised AMS activities and reward pharmacies that document checklist use and patient education[7]. The United States applies the CDC Core Elements of Outpatient Antibiotic Stewardship, which positions pharmacists as key actors in policy, tracking, and education across retail chains[8]. These structured programmes, bolstered by electronic prescribing, real-time surveillance, and mandatory continuing education, contrast sharply with the ad-hoc, under-resourced environment that characterises many developing settings.

The consequences of inadequate pharmacist preparedness in India are far-reaching inappropriate regimen selection, sub-therapeutic dosing, truncated courses, and failure to reinforce adherence all fuel resistance, erode public trust, and squander scarce healthcare resources[9]. Addressing these deficits through evidence-based training and policy reform is therefore integral to the National Action Plan on AMR.

Many studies conducted globally have demonstrated the effectiveness of structured educational interventions in improving the knowledge, attitude, and behaviour of healthcare workers with respect to antibiotic use and AMR [10-15]. However, very few structured training studies in India have examined the impact of such training in real-world settings in secondary and tertiary care settings[16-18]. Moreover, integrated AMR capacity-building interventions that engage both public health and pharmacy stakeholders remain limited. Therefore, this prospective interventional study was designed to evaluate the impact of a structured educational intervention on antibiotic utilisation practices among CPs.

MATERIALS AND METHODS

Study Design and Settings

This prospective educational intervention study was conducted over a period of six months from October 2022 to March 2025 in selected community pharmacy settings of Mysuru City, Karnataka, South India.

Ethics Committee Approval

The study protocol was reviewed and approved by the Institutional Ethics Committee of JSS College of Pharmacy, Mysuru, JSS Academy of Higher Education & Research. (IEC No- JSSMC/IEC/110523/ 16 NCT /2023-24).

Study Participants

The study participants are registered pharmacists who are practising in the community pharmacy of Mysuru city and were enrolled in the study.

Study Criteria

Inclusion criteria:

- Pharmacist must practice as a full-time or part-time community pharmacist in Mysuru City

Exclusion criteria:

- Other pharmacy workers or owners who have not graduated with a pharmacy degree.
- Pharmacists employed in government hospitals.
- Pharmacists' not unwilling to participate in the study.

Sampling strategy

Convenience sampling was adopted due to time and resource constraints, allowing easy access to practising CPs available during site visits. This method enabled rapid recruitment from busy pharmacy settings without disrupting workflow. It was practical and feasible given the urban context and study timeline.

Study tool

A structured KAP questionnaire was designed using the WHO competency framework for antimicrobial resistance among health workers, the International Pharmaceutical Federation (FIP) guidelines, and previously validated instruments tailored to Indian context[19-22]. This tool, developed specifically for CPs, underwent content validation. The validation panel comprised fifteen subject matter experts, including CPs, academic professionals, and pharmacy practice research scholars. The purpose and procedures of the validation process were communicated to the panel before distributing the questionnaire. Experts were asked to assess each item for relevance, clarity, simplicity, and ambiguity using a four-point rating scale. The scale-level content validity index (S-CVI) was determined based on the expert evaluations. Additionally, the internal consistency of the questionnaire was measured using Cronbach's alpha, with a value of 0.8 or higher in each domain and overall scale indicating acceptable reliability.

Development of Structured Training Materials

Training manuals for CPs and ASHAs were developed using national AMR/AMS guidelines, and relevant literature [23-25]. The CPs manual included AMR definitions, causes, consequences, India's national action plans, and the pharmacist's role in AMS. Training material included a booklet and role-play script focusing on antibiotics, AMR, WHO AWaRe classification, AMS, and the pharmacist's role. All materials were reviewed by senior pharmacy and public health experts to ensure accuracy and cultural relevance.

Conduct of Continuing Professional Development (CPD) Program

A two-day CPD workshop on AMR and AMS was conducted for 87 CPs. Sessions covered AMR concepts, antibiotic use, WHO AWaRe classification, AMS, and the pharmacist's role, using interactive lectures and gamified modules.

Evaluation of Training Impact

Validated pre- and post-intervention KAP questionnaires were administered four weeks apart to assess changes in knowledge, attitude, and practices. Qualitataive componen6 was included in post training to capture participants experiences and identify barriers and facilitators in applying training content to daily professional practice

Statistical analysis

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 20.0. Descriptive statistics were used to present the findings, including the KAP scores of CPs before and after the educational intervention. To assess differences between pre- and post-intervention scores, the paired t-test and Kolmogorov-Smirnov test were applied. A p-value less than 0.05 was considered indicative of statistical significance.

RESULTS

Demographic details of CP

A total of 87 community pharmacists (CPs) participated, with a majority being male (59.8%), aged between 21–30 years (51.7%), and holding a diploma in pharmacy (83.9%). Most were employees (73.6%) working in independent pharmacies (65.5%), with 32.1% having 6–10 years of experience. The demographic details of the CPs enrolled in the study are presented in Table 1.

Table 1: Demographic details of Community Pharmacists

Characteristics	Frequency (n=87)	Percentage (%)
Gender		
Male	52	59.8
Female	35	40.2
Age in Years		
21 - 30	45	51.7
31 - 40	13	14.9
41 - 50	22	25.3
51 - 60	7	8.1
Level of education		
D. Pharm	73	83.9
B. Pharm	13	14.9
Pharm. D	1	1.2
M. Pharm	0	0
Ph. D	0	0
Position in pharmacy		
Owner	23	26.4
Employee	64	73.6
Number of years of experience		
1 – 5	10	11.5
6 – 10	28	32.1
11 – 15	19	21.9
16 – 20	23	26.4

20 – 25	7	8.1
Type of pharmacy		
Independent	57	65.5
Chain	12	13.8
Hospital Attached	18	20.7

Antibiotic dispensing pattern of CPs

Of the 87 CPs, 21.8% received 20–30 prescriptions daily, while 41.0% dispensed 20–25 antibiotics per day. Notably, 60.9% reported dispensing antibiotics without a prescription. Detailed patterns are shown in Table 2.

Table 2: Frequency of Antibiotics Dispensed and Non-Prescription Practices Among CPs

Characteristics	Before training		After training	
	Frequency N=87	Percentage %	Frequency N=87	Percentage %
Average no. of antibiotics dispensed per day				
1 – 5	0	0	0	0
6 – 10	11	12.6	15	17.2
11 – 15	9	10.3	25	28.7
16 – 20	22	25.3	31	35.6
20 – 25	35	40.3	9	10.4
25 – 30	10	11.5	7	8.1
>30	0	0	0	0
Pharmacists dispensing antibiotics without a prescription				
Yes	53	60.9	46	52.9
No	34	39.1	41	47.1

Figure 1 shows that the most common indications for non-prescription antibiotic dispensing were acute sore throat, cold, and cough (94.3%).

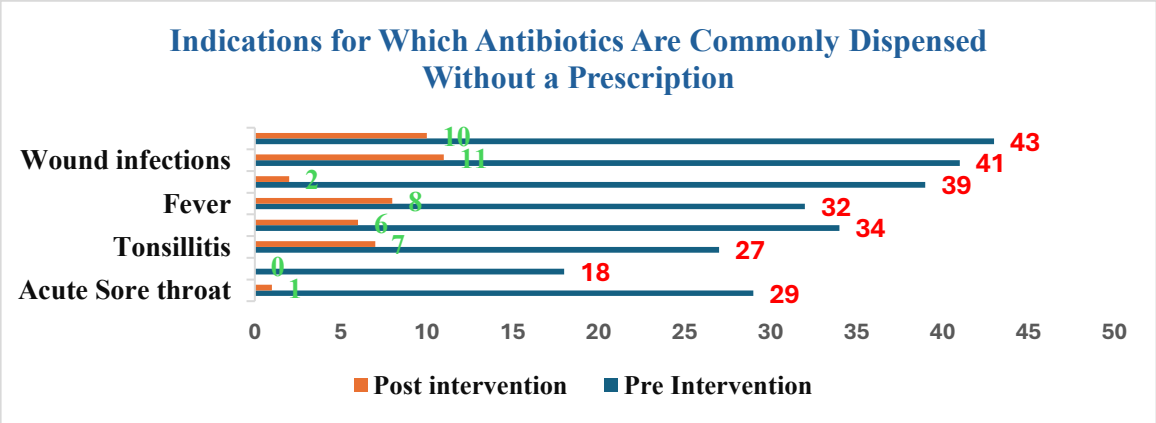

Figure 1: Indications for Which Antibiotics Are Commonly Dispensed Without a Prescription

Figure 2. highlights that azithromycin and amoxicillin were the most frequently dispensed antibiotics without prescription

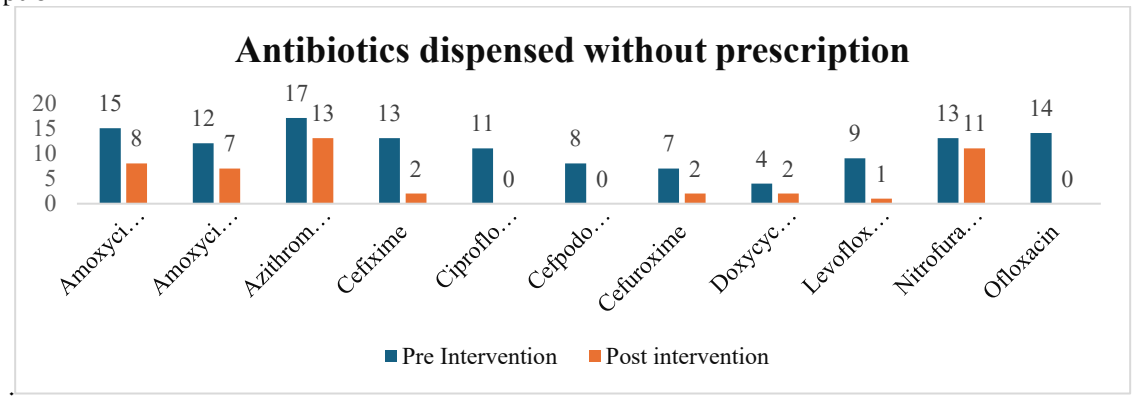

Figure 2: Distribution of Non-Prescription Antibiotic Dispensing Among Study Participants

CP's knowledge, attitude, and practice before and after educational intervention

Evaluation of knowledge of CP towards antibiotic use and AMR before and after educational intervention

Post-training, knowledge scores improved notably. Recognition that antibiotics should not be stopped early increased from 33.3% to 56.3%, and concern about dispensing without prescription improved from 35.6% to 89.8% ($p = 0.04$). Awareness of AMR as a public health threat and relevant regulations also improved. The detailed response distributions are shown in Table 3.

Table 3: CPs' knowledge towards antibiotic use and AMR before and after educational intervention

Question		Before training	After training	p-value
		n (%)	n (%)	
K1: Patients can stop taking antibiotics if they feel better after taking one or two tablets	Strongly agree	14(16.1)	1(1.1)	0.139
	Agree	13(14.9)	9(10.3)	
	Neutral	8(9.3)	0(0)	
	Disagree	23(26.4)	28(32.3)	
	Strongly disagree	29(33.3)	49(56.3)	
K2: Dispensing antibiotics without a prescription is a serious health concern	Strongly agree	14(16.1)	37(42.6)	**0.04**
	Agree	17(19.5)	41(47.2)	
	Neutral	11(12.6)	3(3.4)	
	Disagree	24(27.6)	3(3.4)	
	Strongly disagree	21(24.2)	3(3.4)	
K3: Antibiotic resistance occurs when bacteria change in response to antibiotics	Strongly agree	28(32.2)	31(35.6)	0.435
	Agree	35(40.3)	53(61)	
	Neutral	11(12.6)	0(0)	
	Disagree	10(11.5)	3(3.4)	
	Strongly disagree	3(3.4)	0(0)	
K4: Antibiotic resistance is a threat to public health	Strongly agree	24(27.6)	37(42.5)	**0.02**
	Agree	48(55.2)	47(54.1)	
	Neutral	0(0)	0(0)	
	Disagree	9(10.3)	0(0)	
	Strongly disagree	6(6.9)	3(3.4)	
K5: Skipping one or two doses of an antibiotic do not cause to the development of antibiotic resistance	Strongly agree	11(12.6)	2(2.2)	0.09
	Agree	7(8.1)	9(10.4)	
	Neutral	16(18.4)	16(18.4)	
	Disagree	36(41.4)	40(46.0)	
	Strongly disagree	17(19.5)	20(23.0)	
K6: CPs have a responsibility to take an effective role in reducing antibiotic resistance	Strongly agree	17(19.5)	32(36.8)	0.389
	Agree	39(44.9)	54(62.1)	
	Neutral	10(11.5)	1(1.1)	
	Disagree	10(11.5)	0(0)	
	Strongly disagree	11(12.6)	0(0)	
K7: CPs have clear understanding of the rules and regulations regarding antibiotic dispensing practices in India	Strongly agree	18(20.7)	29(33.3)	0.23
	Agree	34(39.1)	45(51.7)	
	Neutral	13(14.9)	12(13.9)	
	Disagree	13(14.9)	1(1.1)	
	Strongly disagree	9(10.4)	0(0)	
K8: Dispensing antibiotics without a prescription can increase the risk of antibiotic resistance	Strongly agree	29(33.3)	42(48.3)	0.358
	Agree	46(52.9)	45(51.7)	
	Neutral	4(4.7)	0(0)	
	Disagree	5(5.7)	0(0)	
	Strongly disagree	3(3.4)	0(0)	

* The p-value is <0.05, which is statistically significant

Attitude of CPs towards antibiotic use and AMR before and after educational intervention

Post-intervention, there was a significant improvement in the Attitude of CPs. Agreement with the statement that refusing to dispense antibiotics without prescription would affect business decreased from 78.1% to 13.8%,

and willingness to dispense in the absence of physician access dropped from 65.5% to 18.4% ($p < 0.05$). The detailed response distributions are shown in Table 4.

Table 4: CP's attitude towards use and AMR before and after educational intervention

Question		Before training	After training	p-value
A1: Refusing to dispense antibiotics Without a prescription will affect my business	Strongly agree	27(31.1)	0(0)	**<0.05**
	Agree	41(47.1)	12(13.8)	
	Neutral	12(13.8)	19(21.8)	
	Disagree	6(6.9)	44(50.6)	
	Strongly disagree	1(1.1)	12(13.8)	
A2: Antibiotics are sometimes dispensed without a prescription if the patient is known to have difficulty obtaining a medical consultation	Strongly agree	14(16.1)	0(0)	**<0.05**
	Agree	43(49.4)	15(17.3)	
	Neutral	24(27.6)	1(1.1)	
	Disagree	6(6.9)	63(72.4)	
	Strongly disagree	0(0)	8(9.2)	
A3: CPs have adequate expertise and knowledge regarding antibiotic use, allowing them to dispense antibiotics for the treatment of infection without a prescription	Strongly agree	0(0.0)	9(10.3)	**<0.05**
	Agree	7(8.1)	24(27.6)	
	Neutral	23(26.4)	11(12.6)	
	Disagree	42(48.3)	41(47.2)	
	Strongly disagree	15(17.2)	2(2.3)	

Practice of CPs towards antibiotic use and AMR before and after educational intervention

Positive behavioural changes were observed post-training. Always inquiring about medical history improved from 13.8% to 75.9%, asking history of any allergy for medications increased from 12.6% to 73.6%, and patient counselling from 13.8% to 65.5%. Awareness campaign participation also improved from 5.7% to 29.9%. The detailed response distributions are shown in Table 5.

Table 5: CP's practice towards use and AMR before and after educational intervention

Question		Before training	After training	p-value
P1: Before dispensing antibiotics, do you ask about the patient's medical and medication history and current symptoms?	Never	40(46.0)	0(0)	**<0.05**
	Sometimes	35(40.2)	21(24.1)	
	Always	12(13.8)	66(75.9)	
P2: Do you ask patients about allergies to antibiotics before dispensing them?	Never	54(62.1)	1(1.1)	**<0.05**
	Sometimes	22(25.3)	22(25.3)	
	Always	11(12.6)	64(73.6)	
P3: Do you dispense antibiotics without a prescription if the patient is your family member or someone you know closely?	Never	26(29.9)	34(39.1)	**0.04**
	Sometimes	44(50.6)	39(44.8)	
	Always	17(19.5)	14(16.1)	
P4: Do you counsel patients on the appropriate use of antibiotics?	Never	42(48.3)	0(0)	**0.03**
	Sometimes	33(37.9)	30(34.5)	
	Always	12(13.8)	57(65.5)	
P5: Do you educate patients about the importance of completing the full course of antibiotics?	Never	49(56.3)	1(1.1)	**0.026**
	Sometimes	25(28.8)	28(32.2)	
	Always	13(14.9)	58(66.7)	
P6: Do you educate patients on antibiotic resistance-related issues?	Never	11(12.6)	1(1.1)	**<0.05**
	Sometimes	47(54.1)	37(42.6)	
	Always	29(33.3)	49(56.3)	
P7: Do you follow up with patients whom you dispensed antibiotics?	Never	51(58.6)	4(4.6)	**<0.05**
	Sometimes	30(34.5)	61(70.1)	
	Always	6(6.9)	22(25.3)	
P8: Do you take part in antibiotics awareness campaigns to promote the optimal use of antibiotics?	Never	47(54.1)	6(6.9)	**<0.05**
	Sometimes	35(40.2)	55(63.2)	
	Always	5(5.7)	26(29.9)	

Implementation of Training by Community Pharmacists: Thematic analysis

Out of 87 CPs, 41 reported implementing training into their daily professional practice. Thematic analysis revealed key changes including patient-centred counselling (n=39), ethical dispensing (n=6), and behavioural

shifts (n=8), which are represented in Table 6. Implementation was supported by personal motivation, supervisor support, and training materials (see Table 7).

Table 6: Thematic Analysis of Areas of Training Implementation (n = 41)

Theme	Practice Reported	Frequency	Quotes
1. Patient-centred counselling	Patient counselling on appropriate antibiotic use	39	"Now I make sure to explain to patients how to use antibiotics properly."
2. Ethical dispensing practices	Refusal to dispense without a valid prescription	6	"I have stopped giving antibiotics unless they have a doctor's prescription."
3. Professional collaboration	Collaborating with doctors for rational antibiotic use	2	"We sometimes call nearby doctors to confirm treatment if needed."
4. Behavioural change	Conscious changes in daily dispensing practices	8	"I've become more cautious while dispensing antibiotics now."

Thematic analysis of community pharmacists' responses on what supported their implementation of training revealed five key themes. These themes reflect a combination of individual motivation, institutional support, and practical enablers that facilitated the application of antimicrobial stewardship practices in pharmacy settings. The findings are presented in Table 7.

Table 7: Thematic Analysis of Factors Supporting Implementation (n = 41)

Theme	Factor	Frequency
1. Personal motivation	Personal commitment to responsible antibiotic use	38
2. Institutional support	Support from supervisors/management	23
3. Training-driven motivation	Motivation due to training content	19
4. Patient-related facilitators	Patient acceptance and cooperation	9
5. Practical tools and materials	Availability of printed materials (infographics, etc.)	5

Non-Implementation of Training by Community Pharmacists: Thematic Analysis

Among 46 CPs who did not implement training, barriers identified included patient pressure, lack of regulatory enforcement, professional limitations, and contextual factors. These are presented in Figure 3.

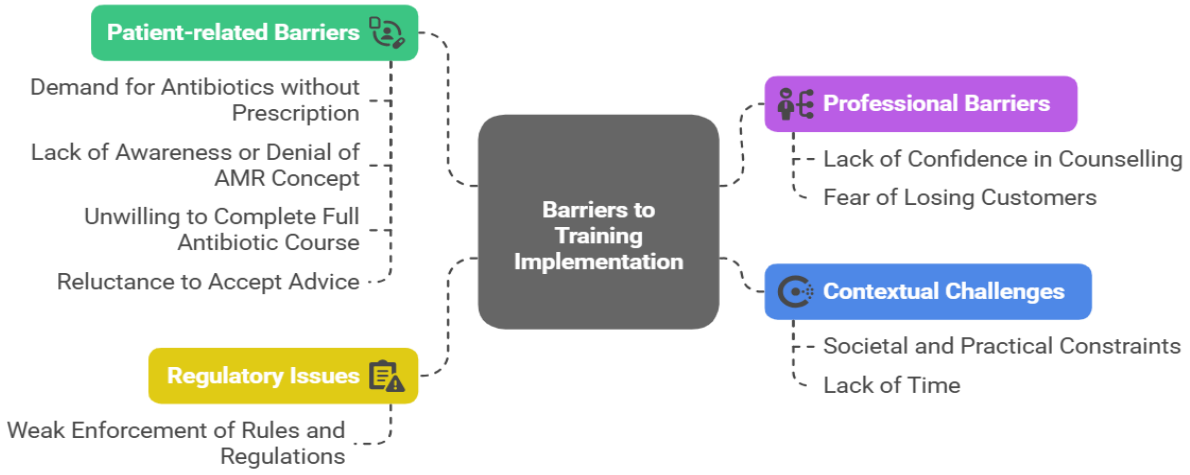

Figure 3: Barriers Faced by Community Pharmacists in Implementing Training into Practice

DISCUSSION

This study evaluated the effect of educational interventions on the KAP concerning antibiotic use and AMR among community pharmacists in Mysuru, India. The results highlight the need to reinforce antimicrobial stewardship (AMS) initiatives at the community level, with a particular focus on tailored capacity-building efforts. The majority of participating CPs were young males (aged 21–30 years) with a diploma in pharmacy, consistent with workforce demographics in India, where the D. Pharm qualification remains a primary credential for community practice (Basak et al, 2009)[26]. Most pharmacists were employed rather than owning pharmacies, with

significant representation from independent setups, indicating a diverse working environment, similar to other Indian studies[27.]

Before the intervention, 60.9% of people were using antibiotics without a prescription, mostly for viral upper respiratory tract infections, including cold and sore throat. This is similar to what Kotwani et al. (2012) and others (2018) observed in their studies[28,29]. This shows that applying Schedule H1 rules in India is a big challenge. The training program only slightly lowered the number of non-prescription practices (to 52.9%), which suggests respondents were not very open to changing their behaviour. However, the qualitative results showed that pharmacists were more likely to think about ethics after training, such as refusing to give out antibiotics without a prescription[30].

There were statistically significant improvements in knowledge measures related to AMR as a public health hazard ($p=0.02$) and the seriousness of distributing without prescriptions ($p=0.04$). More people agreed that CPs can help fight AMR, going from 64.3% to 98.9%. Post-training attitudes also improved significantly. Notably, the percentage of respondents who thought that refusing to dispense could harm business decreased from 78.1% to 13.8%, highlighting increased professional accountability. In the same way, practices like counselling on appropriate use (from 13.8% to 65.5%) and taking part in awareness efforts (from 5.7% to 29.9%) improved significantly ($p<0.05$). These behavioural improvements reflect the effectiveness of structured CPD training modules, consistent with findings from similar interventions studies conducted by Saleh D et al. (2021) and Mudenda S et al. (2025)[31,32].

Most of the CPs who participated in the program reported they now "always explain" why people need to finish a full course of antibiotics. Brief AMS workshops in LMIC community pharmacies have been shown to offer similar benefits for counselling, such as better communication, self-efficacy and fewer incorrect sales[33]. The transition to ethical, prescription-only dispensing, even if it only occurred with six pharmacists, is similar to the small changes in behaviour seen in other Indian and African research. It also shows the business risk that pharmacists observe in not giving antibiotics to walk-in consumers[34,35].

Self-determination theory suggests that intrinsic personal motivation is the most potent motivator of long-term professional behaviour change. The fact that intrinsic personal motivation is so prevalent encourages this concept. Institutional support, notably owner endorsement and protected time, has been shown repeatedly and again to be essential for AMS to be used in community settings.[36] The most common patient-related barriers were a significant need for antibiotics, a lack of belief in AMR, and not following the full course of treatment. These are all variables that have been widely reported in qualitative studies in South Asia.[37] Fear of losing clients and a lack of trust in counselling are professional barriers that are similar to what Indian reports state regarding AMS efforts being blocked by a lack of sales and poor communication training.[35] Contextual restrictions (workload, time pressure) are similar to operational problems faced by other LMIC pharmacies, where large client volumes contribute to it being difficult to give long-term counselling.[38]

CONCLUSION

Structured educational intervention significantly improved the knowledge, attitude, and practices of CPs toward antibiotic use and AMR. Pharmacists showed increased awareness, ethical dispensing, and better patient counselling after the training. However, barriers such as patient pressure and weak enforcement remain challenges. Continued capacity building, supportive policies, and public engagement are essential to sustain improvements. CPs must be empowered as key stakeholders in national AMR containment efforts.

Acknowledgement

All authors sincerely thank the community pharmacists for their participation. We also extend our gratitude to the Department of Pharmacy Practice, JSS College of Pharmacy, Mysuru and the JSS Academy of Higher Education & Research, Mysuru for institutional support.

CONFLICT OF INTEREST:

NIL

Funding Sources

NIL

Data availability statement:

The data supporting the findings of this study are available from the corresponding author upon reasonable request

informed consent statement

Written informed consent was obtained from all participating community pharmacists prior to data collection.

authors contributions

Rosy Raju: Writing – Original Draft, Conceptualisation & Visualisation.
Ganbriella Edina Veronica: Data Analysis, Writing –Review & Editing;
Ravindra Pukharaj Choudhary: Review & Editing
Teggina Math Pramod Kumar: Reviewing & Editing, Resources, Supervision
Srikanth Malavalli Siddalingegowda: Reviewing & Editing, Supervision.

REFERENCES

1. Murray CJ, Ikuta KS, Sharara F, Swetschinski L, Aguilar GR, Gray A, Han C, Bisignano C, Rao P, Wool E, Johnson SC. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The lancet. 2022;399(10325):629-55.
2. Chakrabarti A, Balaji V, Bansal N, Gopalakrishnan R, Gupta P, Jain A, Kale P, Kapil A, Prasad KN, Ray P, Rodrigues C. NAMS task force report on antimicrobial resistance. Annals of the National Academy of Medical Sciences (India):1-40.
3. Kotwani A, Holloway K. Trends in antibiotic use among outpatients in New Delhi, India. BMC infectious diseases. 2011; 11:1-9.
4. Al Masud A, Walpola RL, Sarker M, Asaduzzaman M, Islam MS, Mostafa AT, Akhtar Z, Kabir A, Seale H. Antibiotic dispensing practices in community pharmacies: Implications for antimicrobial stewardship in resource-constrained settings. Exploratory Research in Clinical and Social Pharmacy. 2025 ;19:100606.
5. Kotwani A, Bhanot A, Singal GL, Gandra S. Marketing and distribution system foster misuse of antibiotics in the community: insights from drugs wholesalers in India. Antibiotics. 2022;11(1):95.
6. Raju R, Srinivas SC, Siddalingegowda SM, Vaidya R, Gharat M, Kumar TP. CP as antimicrobial resistance stewards: a narrative review on their contributions and challenges in low-and middle-income countries. Journal of Pharmacy & Pharmaceutical Sciences. 2024; 27:12721.
7. UK Health Security Agency (UKHSA). (2023). English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) Report 2023 to 2024. https://assets.publishing.service.gov.uk/media/6734e208b613efc3f1823095/ESPAUR-report-2023-2024.pdf . Accessed on 09 May 2025.
8. Sanchez GV. Core elements of outpatient antibiotic stewardship. MMWR. Recommendations and Reports. 2016;65.
9. Apte A, Bright HR, Kadam S, Sundarsanam TD, Chandy SJ. Facilitators, Barriers, and Potential Impacts of Implementation of e-Pharmacy in India and its Potential Impact on Cost, Quality, and Access to Medicines: Scoping Review. Online Journal of Public Health Informatics. 2024;16:e51080.
10. Orok E, Ikpe F, Williams T, Ekada I. Impact of educational intervention on knowledge of antimicrobial resistance and antibiotic use patterns among healthcare students: a pre-and post-intervention study. BMC Medical Education. 2025;25(1):283.
11. Price L, Gozdzielewska L, Young M, Smith F, MacDonald J, McParland J, Williams L, Langdridge D, Davis M, Flowers P. Effectiveness of interventions to improve the public's antimicrobial resistance awareness and behaviours associated with prudent use of antimicrobials: a systematic review. Journal of Antimicrobial Chemotherapy. 2018;73(6):1464-78.
12. Parveen S, Garzon-Orjuela N, Amin D, McHugh P, Vellinga A. Public health interventions to improve antimicrobial resistance awareness and behavioural change associated with antimicrobial use: a systematic review exploring the use of social media. Antibiotics. 2022 ;11(5):669.
13. Afzal S, Khan FU, Aqeel MT, Ullah M, Bajwa M, Akhtar M, Majid M. Impact of a pharmacist-led educational intervention on knowledge, attitude, and practice toward the rational use of antibiotics among healthcare workers in a secondary care hospital in Punjab, Pakistan. Frontiers in Pharmacology. 2024; 14:1327576.
14. Otieku E, Fenny AP, Labi AK, Owusu-Ofori AK, Kurtzhals J, Enemark U. Knowledge, attitudes and practices regarding antimicrobial use and resistance among healthcare seekers in two tertiary hospitals in Ghana: a quasi-experimental study. BMJ open. 2023;13(2):e065233.
15. Kafle S, Jha N, Shankar PR, Bhandary S, Palaian S. Impact Assessment of an Educational Intervention Toward Rational Antibiotic Use Among Community Pharmacists in Nepal. Risk Management and Healthcare Policy. 2025:1181-95.
16. Mittal N, Deswal H, Mittal R, Sharma S, Kaushik P. An educational program on antimicrobial resistance and stewardship for staff nurses in a public tertiary care hospital in India. Infection, Disease & Health. 2023;28(3):202-10.
17. Ramanarayanan V, Prabhu AS, Sundareswaran A, Boban D. Effectiveness of a training program on the knowledge and awareness of antimicrobial resistance and stewardship among dental house-surgeons. Public Health Toxicology. 2024 ;4(2):1-7.
18. Rassi N, Sudha MJ, Viveka S, Sharafudeen S. The impact of educational intervention on knowledge and attitude regarding antibiotic resistance among medical doctors in a tertiary care hospital. Biomedical and Pharmacology Journal. 2021;14(1):351-61.
19. Abdelrahman Hussain M, Osman Mohamed A, Sandel Abkar A, Siddig Mohamed F, Khider Elzubair H. Knowledge, attitude and practice of community pharmacists in relation to dispensing antibiotics without prescription in Sudan: a cross-sectional study. Integrated Pharmacy Research and Practice. 2022 Jan 1:107-16. nal journal of environmental research and public health. 2021 ;18(3):1320.
20. Khan MU, Hassali MA, Ahmad A, Elkalmi RM, Zaidi ST, Dhingra S. Perceptions and practices of community pharmacists towards antimicrobial stewardship in the state of Selangor, Malaysia. PloS one. 2016;11(2):e0149623.
21. Belachew SA, Hall L, Selvey LA. Community drug retail outlet staff's knowledge, attitudes and practices towards non-prescription antibiotics use and antibiotic resistance in the Amhara region, Ethiopia with a focus on non-urban towns. Antimicrobial Resistance & Infection Control. 2022;11(1):64.
22. Poyongo BP, Sangeda RZ. Pharmacists' knowledge attitude and practice regarding the dispensing of antibiotics without prescription in Tanzania: an explorative cross-sectional study. public health. 2019; 3:4.
23. World Health Organization. (2019). Antimicrobial Stewardship Programmes in Health-Care Facilities in Low- and Middle-Income Countries: A WHO Practical Toolkit [Report]. https://iris.who.int/bitstream/handle/10665/329404/9789241515481-eng.pdf. Accessed on 02 June 2025.

24. Commonwealth Pharmacists Association. (2020). Commonwealth Partnership for Antimicrobial Stewardship (CWPAMS) toolkit.
25. Tahoon MA, Khalil MM, Hammad E, Morad WS, awad SM, Ezzat S. The effect of educational intervention on healthcare providers' knowledge, attitude, & practice towards antimicrobial stewardship program at, National Liver Institute, Egypt. Egyptian Liver Journal. 2020 ;10(1):5.
26. Basak SC, Sathyanarayana D. Community pharmacy practice in India: past, present and future. Southern Med Review. 2009;2(1):11.
27. Kalita A, Bose B, Woskie L, Haakenstad A, Cooper JE, Yip W. Private pharmacies as healthcare providers in Odisha, India: analysis and implications for universal health coverage. BMJ Global Health. 2023;8(Suppl 5): e008903.
28. Kotwani A, Wattal C, Joshi PC, Holloway K. Irrational use of antibiotics and role of the pharmacist: an insight from a qualitative study in New Delhi, India. Journal of clinical pharmacy and therapeutics. 2012;37(3):308-12.
29. Bhanwra S. A study of non-prescription usage of antibiotics in the upper respiratory tract infections in the urban population. Journal of Pharmacology and Pharmacotherapeutics. 2013;4(1):62-4.
30. Chetty S, Swe-Han KS, Mahabeer Y, Pillay A, Essack SY. Interprofessional education in antimicrobial stewardship, a collaborative effort. JAC-Antimicrobial Resistance. 2024;6(2): dlae054.
31. Saleh D, Abu Farha R, Alefishat E. Impact of educational intervention to promote Jordanian community pharmacists' knowledge and perception towards antimicrobial stewardship: pre-post interventional study. Infection and Drug Resistance. 2021:3019-27.
32. Mudenda S, Daka V, Kamayani M, Mohamed S, Kasanga M, Mufwambi W. The Effect of Educational Intervention on Healthcare Workers' Awareness and Knowledge of Antimicrobial Resistance, Stewardship, and Surveillance: Opportunities for Antimicrobial and Diagnostic Stewardship. Pharmacology & Pharmacy. 2025;16(5):125-49.
33. Raju R, Srinivas SC, Siddalingegowda SM, Vaidya R, Gharat M, Kumar TP. Community pharmacists as antimicrobial resistance stewards: a narrative review on their contributions and challenges in low-and middle-income countries. Journal of Pharmacy & Pharmaceutical Sciences. 2024 ;27:12721.
34. Al Masud A, Walpola RL, Sarker M, Asaduzzaman M, Islam MS, Mostafa AT, Akhtar Z, Kabir A, Seale H. Antibiotic dispensing practices in community pharmacies: Implications for antimicrobial stewardship in resource-constrained settings. Exploratory Research in Clinical and Social Pharmacy. 2025;19:100606.
35. Kumar KS, Saranya S, Rani NV. Community pharmacists' knowledge, attitude, and nonprescription dispensing practices of antibiotics: An explorative study in a selected city of South India. Journal of Research in Pharmacy Practice. 2022 Apr 1;11(2):51-8.
36. Murray JL, Leung DT, Hanson OR, Ahmed SM, Pavia AT, Khan AI, Szymczak JE, Vaughn VM, Patel PK, Biswas D, Watt MH. Drivers of inappropriate use of antimicrobials in South Asia: A systematic review of qualitative literature. PLOS Global Public Health. 2024 ;4(4):e0002507.
37. Kotwani A, Joshi J, Lamkang AS. Over-the-counter sale of antibiotics in India: A qualitative study of providers' perspectives across two states. Antibiotics. 2021;10(9):1123.
38. Prabakaran S, Santhoshkumar SG, Deepika SU, Vishnu T, Mohanta GP. Patient safety at risk: non-compliance with drug regulations among community pharmacies in Chennai, Tamil Nadu. Int J Community Med Public Health 2025; 12:887-91.