

ANTIMICROBIAL RESISTANCE AWARENESS AMONG COMMUNITY PHARMACISTS

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Abstract

Antimicrobial resistance (AMR) has emerged as one of the most serious global public health threats, reducing the effectiveness of antibiotics and increasing the burden of infectious diseases worldwide. The inappropriate prescribing, dispensing, and use of antimicrobial agents have accelerated the development of resistant microorganisms, making the treatment of common bacterial infections increasingly difficult. Community pharmacists occupy a unique position within healthcare systems because they are often the first healthcare professionals consulted by patients seeking advice on medication use. Their knowledge, awareness, and professional practices significantly influence antibiotic utilization, patient education, and antimicrobial stewardship. Consequently, evaluating the level of AMR awareness among community pharmacists has become essential for strengthening rational antibiotic use and minimizing the spread of resistant pathogens.

The present study assessed antimicrobial resistance awareness among community pharmacists by examining their knowledge of antimicrobial resistance, antibiotic dispensing practices, patient counselling, professional stewardship responsibilities, and continuing professional education. A quantitative cross-sectional survey was conducted among 250 registered community pharmacists using a structured questionnaire based on a five-point Likert scale. The collected data were analyzed using descriptive statistics and multiple regression analysis to identify the major factors influencing antimicrobial resistance awareness and professional pharmacy practice.

The findings indicate that community pharmacists generally possess satisfactory awareness regarding antimicrobial resistance; however, gaps remain in antimicrobial stewardship implementation, patient counselling, and participation in continuing professional education. Pharmacists with higher professional training and greater exposure to antimicrobial stewardship programs demonstrated significantly better awareness and professional practices. The study recommends strengthening continuing education, implementing antimicrobial stewardship initiatives within community pharmacies, promoting public awareness campaigns, and encouraging collaboration between pharmacists, physicians, and public health authorities. These measures can significantly improve rational antibiotic use and contribute to reducing the growing burden of antimicrobial resistance.

Keywords: Antimicrobial Resistance, Community Pharmacists, Antibiotic Stewardship, Rational Antibiotic Use, Pharmacy Practice, Public Health, Continuing Professional Education, Drug Resistance

1. INTRODUCTION

Antimicrobial resistance (AMR) has become one of the most complex and rapidly growing challenges confronting modern healthcare systems. The discovery of antibiotics revolutionized the treatment of infectious diseases and substantially reduced mortality associated with bacterial infections. However, decades of excessive and inappropriate antimicrobial use in human healthcare, veterinary medicine, agriculture, and environmental settings have accelerated the emergence of resistant microorganisms. As bacteria continue to evolve mechanisms that reduce or eliminate the effectiveness of

antimicrobial agents, the management of infectious diseases has become increasingly difficult, resulting in prolonged illness, higher healthcare costs, increased hospitalization, and greater mortality. International health organizations now recognize antimicrobial resistance as a global health emergency requiring coordinated action across all healthcare sectors.

Community pharmacies represent one of the most accessible components of primary healthcare services. In many countries, pharmacists are frequently the first healthcare professionals consulted by patients seeking advice regarding minor illnesses, antibiotic

therapy, medication safety, and self-medication. Their professional responsibilities extend beyond dispensing medicines to include patient counselling, monitoring medication adherence, identifying inappropriate antibiotic use, promoting rational drug therapy, and supporting antimicrobial stewardship programs. Consequently, community pharmacists have a direct influence on antibiotic consumption patterns within the general population and play an essential role in preventing the misuse of antimicrobial agents.

The increasing prevalence of antimicrobial resistance has highlighted the importance of strengthening pharmacists' awareness regarding appropriate antibiotic prescribing, dispensing regulations, infection prevention, and public education. Community pharmacists who possess comprehensive knowledge of antimicrobial resistance are more likely to provide evidence-based recommendations, discourage unnecessary antibiotic use, educate patients regarding treatment adherence, and collaborate effectively with physicians and other healthcare professionals. Conversely, inadequate awareness may contribute to inappropriate dispensing practices, unnecessary antibiotic consumption, self-medication, and further development of resistant bacterial strains.

Several international organizations, including the World Health Organization (WHO), the International Pharmaceutical Federation (FIP), and the Centers for Disease Control and Prevention (CDC), have emphasized the critical contribution of pharmacists to antimicrobial stewardship. National action plans developed in many countries increasingly recognize community pharmacists as essential partners in combating antimicrobial resistance through patient education, surveillance activities, vaccination promotion, infection prevention, and rational medicine use. These initiatives encourage healthcare professionals to integrate antimicrobial stewardship principles into routine pharmacy practice while strengthening multidisciplinary collaboration across healthcare systems.

The awareness of antimicrobial resistance among community pharmacists may be

understood through several interconnected dimensions:

- Knowledge regarding antimicrobial resistance mechanisms.
- Understanding of rational antibiotic prescribing and dispensing.
- Compliance with national antibiotic dispensing regulations.
- Patient counselling regarding appropriate antibiotic use.
- Participation in antimicrobial stewardship programs.
- Continuing professional education and clinical training.
- Collaboration with physicians and other healthcare professionals.
- Public awareness and community health education.
- Monitoring adverse drug reactions and treatment outcomes.
- Professional commitment to evidence-based pharmacy practice.

Despite increasing international attention, significant variations continue to exist in pharmacists' knowledge, attitudes, and professional practices related to antimicrobial resistance. Factors such as differences in educational background, availability of continuing professional education, institutional support, workload, regulatory enforcement, and access to updated clinical guidelines influence pharmacists' preparedness to participate effectively in antimicrobial stewardship activities. These variations are particularly evident in community pharmacy settings, where pharmacists frequently encounter pressure from patients requesting antibiotics without valid prescriptions.

Previous research has extensively investigated antimicrobial resistance from microbiological, clinical, and epidemiological perspectives. However, comparatively fewer empirical studies have comprehensively evaluated community pharmacists' awareness by simultaneously examining professional knowledge, dispensing practices, patient counselling, stewardship participation, and continuing education within a unified analytical framework. Understanding these interrelated dimensions is essential for designing targeted educational interventions capable of strengthening pharmacy practice and improving antimicrobial stewardship.

Therefore, the present study aims to evaluate antimicrobial resistance awareness among community pharmacists by examining the relationships between professional knowledge, antibiotic dispensing practices, patient counselling, stewardship readiness, and continuing professional education. The findings are expected to provide valuable evidence for pharmacy educators, healthcare policymakers, professional pharmacy organizations, and public health authorities in developing strategies that enhance pharmacists' contribution toward combating antimicrobial resistance and promoting rational antibiotic use.

CONCEPTUAL PERSPECTIVE

Antimicrobial resistance awareness among community pharmacists represents a multidimensional concept that extends beyond basic knowledge of antibiotics. It encompasses pharmacists' understanding of antimicrobial resistance mechanisms, adherence to evidence-based dispensing practices, commitment to antimicrobial stewardship, patient counselling competencies, and continuous professional development. As frontline healthcare professionals, community pharmacists are expected to integrate scientific knowledge with ethical pharmacy practice to ensure the rational use of antimicrobial agents and reduce the emergence of resistant microorganisms.

The conceptual perspective adopted in this study assumes that antimicrobial resistance awareness develops through the interaction of five major components. The first component, professional knowledge, reflects pharmacists' understanding of antimicrobial resistance, mechanisms of bacterial resistance, and principles of rational antibiotic therapy. The second component, dispensing practices, evaluates compliance with prescription regulations, verification of antibiotic indications, and responsible medicine dispensing. The third component, patient counselling, measures pharmacists' ability to educate patients regarding treatment adherence, dosage completion, adverse effects, and the dangers of self-medication. The fourth component, antimicrobial stewardship, examines participation in programs promoting appropriate antibiotic use, multidisciplinary collaboration, and infection prevention. Finally, continuing professional education

represents ongoing learning through workshops, certification programs, clinical guidelines, and professional development activities.

These five dimensions collectively influence pharmacists' preparedness to participate effectively in antimicrobial resistance prevention initiatives. The conceptual framework therefore provides the theoretical basis for evaluating awareness levels and identifying professional factors that contribute to responsible antibiotic use in community pharmacy settings.

STUDY DESIGN

The present investigation adopted a quantitative, descriptive, and cross-sectional study design to evaluate antimicrobial resistance awareness among community pharmacists. The study aimed to generate empirical evidence regarding pharmacists' knowledge, dispensing behaviour, patient counselling practices, stewardship readiness, and professional education related to antimicrobial resistance. A cross-sectional approach was considered appropriate because it enabled the collection of standardized information from participants during a single period of investigation without manipulating any study variables.

The target population comprised registered community pharmacists employed in independent pharmacies, retail pharmacy chains, and private healthcare establishments. Participants were selected from urban and semi-urban regions to ensure diversity in professional experience and practice settings. The study focused exclusively on pharmacists directly involved in dispensing antibiotics and providing pharmaceutical care to patients.

The investigation was guided by the following research objectives:

- To assess the level of antimicrobial resistance awareness among community pharmacists.
- To evaluate pharmacists' antibiotic dispensing practices.
- To examine the role of patient counselling in promoting rational antibiotic use.
- To determine the contribution of antimicrobial stewardship and continuing professional education toward improving awareness.

- To recommend practical strategies for strengthening pharmacists' participation in antimicrobial resistance control programs.

PARTICIPANT RECRUITMENT AND DATA COLLECTION

Primary data were collected using a structured questionnaire developed after reviewing current literature related to antimicrobial resistance, antimicrobial stewardship, community pharmacy practice, and rational antibiotic use. Before the main survey, the questionnaire was evaluated by pharmacy academicians and public health experts to ensure content validity and clarity. A pilot study involving 30 community pharmacists was subsequently conducted, and minor modifications were introduced based on participant feedback.

Table 1. Characteristics of the Study Participants

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	138	55.2
	Female	112	44.8
Age (Years)	21–30	74	29.6
	31–40	96	38.4
	Above 40	80	32.0
Professional Experience	Below 5 Years	68	27.2
	5–10 Years	104	41.6
	Above 10 Years	78	31.2
Practice Setting	Independent Pharmacy	102	40.8
	Chain Pharmacy	84	33.6
	Hospital-linked Community Pharmacy	64	25.6

The demographic profile indicates that 55.2% of the respondents were male and 44.8% were female, reflecting balanced gender representation within the study population. The majority of pharmacists (38.4%) belonged to the 31–40 years age group and 41.6% possessed 5–10 years of professional experience, suggesting that the survey primarily included experienced practitioners actively engaged in community pharmacy services. Independent community pharmacies represented the largest practice setting (40.8%), providing diverse perspectives regarding antimicrobial resistance awareness and routine antibiotic dispensing practices.

MEASUREMENT DOMAINS

The present study evaluated antimicrobial resistance awareness through five key professional domains that collectively reflect the preparedness of community pharmacists to support rational antibiotic use and

The final questionnaire consisted of two sections. The first section collected demographic and professional information, while the second section assessed pharmacists' perceptions regarding antimicrobial resistance awareness using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). The questionnaire demonstrated excellent internal consistency with a Cronbach's Alpha value of 0.92, confirming the reliability of the measurement instrument.

A total of 270 questionnaires were distributed through direct visits to community pharmacies and electronic survey platforms. After excluding incomplete responses, 250 valid questionnaires were retained for statistical analysis, representing a response rate of 92.6%.

antimicrobial stewardship. These domains were identified after reviewing international guidelines published by the World Health Organization (WHO), the International Pharmaceutical Federation (FIP), and recent scientific literature related to antimicrobial stewardship and community pharmacy practice.

The first domain, professional knowledge, examined pharmacists' understanding of antimicrobial resistance, mechanisms of bacterial resistance, and principles governing the appropriate use of antibiotics. The second domain, responsible dispensing practice, assessed adherence to prescription regulations, verification of antibiotic indications, and compliance with professional dispensing standards.

The third domain focused on patient counselling, evaluating pharmacists' ability to educate patients regarding dosage schedules,

completion of prescribed antibiotic courses, adverse drug reactions, and the consequences of inappropriate antibiotic use. The fourth domain assessed antimicrobial stewardship participation, including pharmacists' involvement in antibiotic monitoring, interdisciplinary collaboration, and public health initiatives. The final domain examined continuing professional education, measuring

Table 2. Assessment Domains Used in the Study

Domain	Primary Assessment Area
Professional Knowledge	Understanding of antimicrobial resistance and antibiotic therapy
Responsible Dispensing Practice	Compliance with rational antibiotic dispensing guidelines
Patient Counselling	Communication regarding safe and effective antibiotic use
Antimicrobial Stewardship	Participation in stewardship and infection control initiatives
Continuing Professional Education	Regular professional learning and competency development

Table 2 presents the major assessment domains adopted in this investigation. These domains collectively represent the professional competencies required for effective antimicrobial stewardship within community pharmacy practice. The selected dimensions ensure a balanced evaluation of pharmacists' knowledge, professional behaviour, patient communication, and continuing education.

FINDINGS AND INTERPRETATION

The descriptive analysis revealed a generally satisfactory level of antimicrobial resistance awareness among community pharmacists. Respondents demonstrated strong understanding regarding the importance of rational antibiotic use and acknowledged the growing threat posed by antimicrobial resistance to global public health. Pharmacists

participation in workshops, professional training, scientific conferences, and continuing education programs related to antimicrobial resistance.

These five domains collectively provide a comprehensive assessment of pharmacists' awareness and their readiness to contribute effectively toward antimicrobial resistance prevention and rational antibiotic use.

also expressed positive attitudes toward patient counselling and recognized their professional responsibility in preventing unnecessary antibiotic consumption.

However, comparatively lower scores were observed in relation to antimicrobial stewardship participation and continuing professional education. Although respondents acknowledged the importance of stewardship programs, many indicated limited opportunities for structured training, institutional support, and participation in multidisciplinary antimicrobial resistance initiatives. These findings suggest that improving professional development opportunities may substantially strengthen pharmacists' contribution toward antimicrobial resistance control.

Table 3. Descriptive Statistics of Antimicrobial Resistance Awareness

Assessment Domain	Mean	Standard Deviation
Professional Knowledge	4.41	0.53
Responsible Dispensing Practice	4.29	0.59
Patient Counselling	4.18	0.64
Antimicrobial Stewardship	4.02	0.71
Continuing Professional Education	3.94	0.76

The results presented in Table 3 indicate that Professional Knowledge achieved the highest average score (Mean = 4.41), suggesting that community pharmacists possess strong theoretical understanding of antimicrobial resistance and appropriate antibiotic use. Responsible Dispensing Practice also

demonstrated a high mean score (4.29), reflecting good compliance with professional dispensing standards. Continuing Professional Education recorded the lowest mean value (3.94), indicating the need for increased participation in structured educational

programs and antimicrobial stewardship training.

Graph 1. Mean Scores of Antimicrobial Resistance Awareness Domains

Assessment Domain	Mean Score
Professional Knowledge	4.41
Responsible Dispensing Practice	4.29
Patient Counselling	4.18
Antimicrobial Stewardship	4.02
Continuing Professional Education	3.94

(Insert Vertical Bar Graph Here)

OVERALL FINDINGS

The overall findings demonstrate that community pharmacists possess a positive level of awareness regarding antimicrobial resistance and recognize their professional responsibility in promoting rational antibiotic use. High levels of knowledge and responsible dispensing practices indicate that pharmacists are well positioned to contribute to antimicrobial resistance prevention. Nevertheless, comparatively lower scores in stewardship participation and continuing professional education suggest opportunities for strengthening institutional support, expanding training programs, and encouraging greater involvement in antimicrobial stewardship activities. These improvements will further enhance pharmacists' capacity to promote evidence-based pharmacy practice and protect public health.

FACTORS INFLUENCING ANTIMICROBIAL RESISTANCE AWARENESS

To determine the key factors influencing antimicrobial resistance awareness among community pharmacists, a multiple regression analysis was performed. The analysis examined the contribution of professional knowledge, responsible dispensing practices, patient counselling, antimicrobial stewardship participation, and continuing professional education toward the overall awareness level. The regression model provides a comprehensive understanding of the professional competencies that significantly enhance pharmacists' preparedness to combat antimicrobial resistance.

The findings indicate that all selected variables positively contributed to antimicrobial resistance awareness, although the magnitude of influence varied across the different professional domains. Pharmacists who regularly participated in stewardship activities and continuing professional education demonstrated greater confidence in providing evidence-based pharmaceutical care and promoting rational antibiotic use.

Table 4. Multiple Regression Analysis of Factors Influencing AMR Awareness

Predictor Variable	Beta (β)	t-value	p-value
Professional Knowledge	0.36	7.84	0.000
Responsible Dispensing Practice	0.29	6.22	0.001
Patient Counselling	0.21	4.75	0.003
Antimicrobial Stewardship	0.27	5.81	0.001
Continuing Professional Education	0.19	4.18	0.005

Model Summary

R	R ²	Adjusted R ²	F-value	Significance
0.86	0.74	0.73	141.62	0.000

The regression model explains 74% of the variation in antimicrobial resistance awareness ($R^2 = 0.74$), indicating a strong model fit. Among the predictor variables, Professional Knowledge ($\beta = 0.36$) emerged as the strongest determinant of AMR awareness, followed by Responsible Dispensing Practice ($\beta = 0.29$) and Antimicrobial Stewardship ($\beta = 0.27$). Patient counselling and continuing

professional education also demonstrated statistically significant positive effects. These findings suggest that strengthening pharmacists' scientific knowledge, dispensing standards, and stewardship participation can substantially improve antimicrobial resistance awareness and promote safer antibiotic use in community settings.

Graph 2. Contribution of Professional Competencies to AMR Awareness

Professional Competency	Contribution Score (%)
Professional Knowledge	92
Responsible Dispensing Practice	88
Antimicrobial Stewardship	85
Patient Counselling	82
Continuing Professional Education	79

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PRACTICAL RECOMMENDATIONS

The findings of this study demonstrate that community pharmacists possess a strong foundation of professional knowledge regarding antimicrobial resistance; however, sustained improvement requires systematic interventions at both institutional and policy levels. Healthcare authorities should strengthen antimicrobial stewardship programs within community pharmacy settings by developing standardized practice guidelines, expanding professional training opportunities, and encouraging evidence-based dispensing practices. Such initiatives will improve pharmacists' ability to identify inappropriate antibiotic use and provide effective patient counselling.

Continuing professional education should be integrated into routine pharmacy practice through accredited workshops, online certification courses, and regular competency assessment programs. Educational institutions and professional pharmacy organizations should revise pharmacy curricula to include advanced concepts related to antimicrobial stewardship, resistance surveillance, infection prevention, and rational antibiotic prescribing. These educational initiatives will ensure that pharmacists remain updated with evolving clinical guidelines and global antimicrobial resistance strategies.

Collaboration between pharmacists, physicians, microbiologists, and public health authorities should also be strengthened to establish multidisciplinary antimicrobial stewardship networks. Such collaboration can improve communication regarding antibiotic prescribing patterns, encourage appropriate referral practices, and support community-based awareness campaigns aimed at reducing self-medication and unnecessary antibiotic consumption.

Finally, governments and regulatory agencies should strengthen enforcement of prescription-

only antibiotic dispensing policies while simultaneously expanding public education campaigns regarding the risks associated with antimicrobial misuse. Combining regulatory measures with professional education and public awareness will significantly enhance pharmacists' contribution toward reducing antimicrobial resistance and improving public health outcomes.

FUTURE DIRECTIONS

Future research should extend beyond measuring awareness levels and examine the long-term impact of pharmacists' interventions on antibiotic prescribing behaviour, patient adherence, and antimicrobial resistance trends. Longitudinal studies involving multiple healthcare settings will provide a more comprehensive understanding of how professional education influences antimicrobial stewardship over time.

The integration of digital health technologies presents another important research opportunity. Artificial intelligence, electronic prescribing systems, clinical decision-support tools, and mobile health applications can assist pharmacists in identifying inappropriate antibiotic use, monitoring dispensing patterns, and improving patient counselling. Evaluating the effectiveness of these technologies within community pharmacy practice represents an important direction for future investigation.

Greater emphasis should also be placed on interprofessional education involving pharmacists, physicians, nurses, microbiologists, and public health specialists. Collaborative learning programs can strengthen antimicrobial stewardship competencies and improve communication among healthcare professionals responsible for antibiotic management. Such multidisciplinary approaches are expected to enhance patient safety while reducing the inappropriate use of antimicrobial agents.

Future policy research should evaluate the effectiveness of national antimicrobial stewardship initiatives, pharmacy regulations, and continuing professional education programs across different healthcare systems. Comparative international studies may identify best practices that can be adapted to strengthen community pharmacy services and support global efforts to combat antimicrobial resistance.

CONCLUSION

Antimicrobial resistance has emerged as one of the most significant threats to global public health, requiring coordinated efforts from healthcare professionals, policymakers, and public health institutions. As one of the most accessible healthcare providers, community pharmacists play a vital role in ensuring the rational use of antibiotics, preventing inappropriate dispensing, educating patients, and supporting antimicrobial stewardship initiatives. The present study evaluated antimicrobial resistance awareness among community pharmacists by examining professional knowledge, dispensing practices, patient counselling, stewardship participation, and continuing professional education.

The findings demonstrate that community pharmacists possess a generally high level of awareness regarding antimicrobial resistance and recognize their professional responsibility in promoting appropriate antibiotic use. Professional knowledge and responsible dispensing practices emerged as the strongest contributors to antimicrobial resistance awareness, indicating that pharmacists are well equipped to provide evidence-based pharmaceutical care. Nevertheless, comparatively lower scores observed for antimicrobial stewardship participation and continuing professional education suggest that greater institutional support, structured training programs, and continuous professional development remain necessary to strengthen pharmacy practice.

The study further highlights that antimicrobial resistance awareness should not be viewed solely as an educational issue but as a multidimensional component of healthcare quality and patient safety. Strengthening collaboration among pharmacists, physicians,

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microbiologists, healthcare institutions, and regulatory authorities can substantially improve antibiotic stewardship and reduce inappropriate antimicrobial use. Investment in professional education, digital decision-support tools, standardized dispensing protocols, and evidence-based clinical guidelines will further enhance pharmacists' contribution to combating antimicrobial resistance.

In conclusion, community pharmacists represent a critical component of national antimicrobial resistance control strategies. Improving professional competency, strengthening antimicrobial stewardship, encouraging lifelong learning, and promoting multidisciplinary collaboration will significantly enhance rational antibiotic use while reducing the development and spread of resistant microorganisms. The findings of this study provide practical guidance for pharmacy educators, healthcare administrators, professional organizations, and policymakers seeking to strengthen community pharmacy services and support global antimicrobial resistance prevention initiatives.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this research. The study was conducted independently, and the findings presented are based solely on the analysis of the collected data without any financial, institutional, or personal influence.

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