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ORIGINAL RESEARCH

# Impact Assessment of an Educational Intervention Toward Rational Antibiotic Use Among Community Pharmacists in Nepal

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**Introduction:** Educating community pharmacists (CPs) is an important step in promoting rational use of antibiotics. In this study, authors assessed the impact of an educational intervention on knowledge, attitude, and practice (KAP) related to rational antibiotic use among selected CPs in Kathmandu valley, Nepal and also obtained qualitative feedback.

**Methods:** An educational intervention was conducted among 162 CPs. Antimicrobial resistance (AMR) and its causes, strategies to contain resistance and the role of community pharmacists in reducing AMR were discussed followed by problem solving exercises. Their KAP were assessed before (baseline), posttest (immediately after the intervention), and retention (2 weeks after the intervention) using a pre-validated tool. The quantitative data were analyzed using appropriate tests ($p < 0.05$). Semi-structured qualitative interviews were conducted after the follow-up, among six CPs to obtain their perspectives on the intervention and their role in combating AMR.

**Results:** The majority (n = 118; 72.84%) had a "Diploma in Pharmacy" qualification. The median (IQR) knowledge scores were 9 (1), 9 (2), and 10 (0) during the pretest, post-test, and retention, respectively (maximum score 10), $p < 0.001$. The attitude score improved from 25 (5.25) pretest to 27 (5.25) posttest (maximum score 35), $p < 0.001$. The intervention also increased practice scores [25 (6)] pretest to [27 (6)] posttest, (maximum score 30) $p < 0.001$. Sixty-one CPs (37.6%) mentioned that patients had no time and budget to visit physicians, and 42 (25.92%) mentioned that CPs were competent to treat common infections. Total KAP scores improved significantly among different subgroups of respondents after the intervention. This was retained during follow-up. Participants perceived the intervention program to be useful. Heavy competition, the presence of many community pharmacies, and pharmacy shopping by patients were mentioned as challenges by CPs.

**Conclusion:** A positive outcome on the KAP scores and positive feedback suggests the potential benefits of a future larger-scale educational intervention.

**Keywords:** antimicrobials, antibiotics, educational intervention, Kathmandu Valley, Nepal, resistance

## Introduction

Antimicrobial resistance (AMR) is a global concern that substantially impacts morbidity and mortality. Overuse of antimicrobials has significantly contributed to AMR, which is a burning issue in Nepal, a developing country in South Asia with multiple medicine use problems like any other developing country. Previously, the government of Nepal had taken measures to contain AMR and promote rational use of antimicrobials. AMR has been mentioned in the National Health Policy 2019, Section 6, point number 24 as

> Antimicrobial resistance shall be reduced, one door health policy shall be developed and expanded for the control and management of communicable diseases, environmental pollution such as air pollution, sound pollution, and water pollution, shall be scientifically regulated and controlled.[1]

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The National Action Plan for Antimicrobial Resistance (NAP-AMR) was formulated to address the problem of AMR and reduce its associated problems such as morbidity, mortality as well as economic impact.[2]

One of the major causes of antibiotic resistance is the widespread use of antibiotics in the population.[3] Easy availability of antibiotics as over-the-counter drugs also contributes to antibiotic resistance.[4] In developing countries antibiotics are easily available without a prescription.[5–7] Treatment failure, increase in mortality, and also an increase in healthcare costs can arise because of AMR.[8,9] All these factors have a negative impact on antimicrobial resistance. It will make infections difficult to treat and increase the economic burden to the patients. Antibiotics are available easily without a prescription in Nepal and community pharmacists (CPs) often treat patients by dispensing antibiotics on their own judgement. In a study conducted in Nepal, 76.9% of the CPs mentioned that antibiotics are sold without prescription. This has also contributed to AMR.[10] Several studies conducted in various parts of Nepal have found that antibiotics are dispensed without prescription by the community pharmacies for the treatment of self-limiting diseases.[11–13] Like in most developing countries, CPs are generally approached first by the public for minor ailments and in Nepal, CPs often are the first-line health providers for many people.

Therefore, CPs can play an important role in promoting the rational use of antibiotics in the community. Thus, educating CPs regarding antibiotic use and resistance is an important step to address the problem of antibiotic misuse and antibiotic resistance. A study conducted in Jordan showed that educating CPs on antimicrobial stewardship had shown positive results. In this study, CPs were given virtual cases to first decide if an antimicrobial is required and then select appropriate antimicrobials. There was a significant improvement ($p < 0.05$) in selecting the proper antimicrobial by the CPs in this study.[14] Similar results were seen in other studies.[15,16] An educational intervention in Pakistan regarding rational use of antibiotics among the healthcare workers was effective in improving the knowledge, attitude and practice (KAP) of healthcare workers.[17] Another study conducted in Egypt showed an improvement in KAP of healthcare providers in antimicrobial stewardship.[18] It is likely that the knowledge of many CPs about AMR may be low. Further, there are no educational programs for them to update their knowledge. Thus, delivering an educational module for CPs can be valuable to educate them on the rational use of antibiotics. Therefore, the current study was conducted to design and assess the impact of an educational intervention on knowledge, attitude and practice (KAP) outcomes related to rational antibiotic use among the CPs, to qualitatively assess the usefulness of the intervention, and to obtain CPs' perspectives on their role in reducing AMR and associated challenges.

# Methods

## Research Method

This study used quantitative and qualitative methodology to study the effect of an educational intervention on CPs knowledge, attitude, and practices towards AMR.

## Research Design

Pre, post, and follow-up tests were done using a tool from a previous study on antibiotic use and antibiotic resistance among the participants.[19] Participants' perception was also studied using semi-structured interviews.

## Ethical Approval

Ethical approval was obtained from the Nepal Health Research Council (Reference number: 110/202, dated 26th May 2023).

## Informed Consent

Written informed consent was obtained from each participant prior to enrolling in the study and separately before the start of the interview. For the questionnaire study, this included permission to publish the aggregated responses and for the qualitative study to publish anonymized direct respondent quotes. All the ethical principles laid down by the ethical approving body were followed strictly.

## Study Setting

The study was conducted in the three municipalities (Kathmandu, Lalitpur and Bhaktapur municipality) of Kathmandu Valley.

## Study Population

All CPs listed in the directory of the Department of Drug Administration (DDA), the national drug regulatory authority of Nepal and working in various retail community pharmacies of the Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur municipalities) were included in the study.[20]

Nepal Chemists and Druggists Association, the association of community pharmacists, was approached who in turn disseminated the information to the members, allowing the members to join the workshop and the study on a voluntary basis.

## Sample Size

### Quantitative Assessment

A total number of 3881 (2828 in Kathmandu, 646 in Lalitpur, and 407 in Bhaktapur) retail community pharmacies were found in the DDA list. The lowest sample size for our research using the published reference that 33.3% of the public had adequate awareness towards the use and resistance of antibiotics in Kathmandu,[10] 5% margin of error, 95% confidence interval was obtained as 342. After adding a 10% non-response rate, the lowest sample size for our research would be 342 + 10% of 342 = 376.2 nearly equal to 377.

### Qualitative Study

A semi-structured interview was conducted among six CPs (2 CPs each from three municipalities). The interviews were conducted by the study team at the respective pharmacies of the CPs. We selected two community pharmacists from Kathmandu district, two from Lalitpur district and two from Bhaktapur district based on convenience.

## Sampling Method

The CPs were recruited using convenience sampling based on the availability of their time and ability to attend the educational intervention.

## Inclusion and Exclusion Criteria

All registered CPs working in the retail pharmacies in the Kathmandu Valley who provided informed consent to participate in the study were included. CPs unable to dedicate time for attending the educational intervention were excluded. We included partial responses in the data to be analyzed. We used the linear interpolation method to handle the missing data.[21]

## Study Questionnaire

A pre-validated questionnaire was used in the study.

### Questionnaire Development

The questionnaire was prepared based on a previously published study.[19] Few modifications were made in the questionnaire according to the study objectives.

### Questionnaire Validation

The content validity of the questionnaire was confirmed by the principal and coinvestigators of this research. The face validity of the questionnaire was performed by obtaining the opinion of ten CPs who were not involved in the study.

### Final Version of the Questionnaire

The questionnaire was divided into five sections. The *first* part of the questionnaire was regarding the demographic features of the respondents. The *second, third* and *fourth* part were about the knowledge, attitude and practice of the CPs

regarding antibiotic use and antibiotic resistance respectively. There were a total of 10 knowledge questions, seven attitude questions and six practice questions. The *fifth* part was about the reasons for dispensing antibiotics without prescription.

## Data Collection Technique

This study had three phases: *Phase I* (baseline assessment of CPs' knowledge, attitude and practice towards antimicrobials use and resistance), *Phase II* (educational intervention) and *Phase III* (quantitative and qualitative post interventional assessment). The study flow is presented in Figure 1.

### Phase I: Preintervention Assessment

The data were collected before the intervention using the pre-validated questionnaire.

### Phase II: Educational Intervention

Educational intervention was conducted in three different places of Kathmandu, Lalitpur and Bhaktapur districts. Quantitative data was collected, and educational intervention carried out by members of the research team. The learning

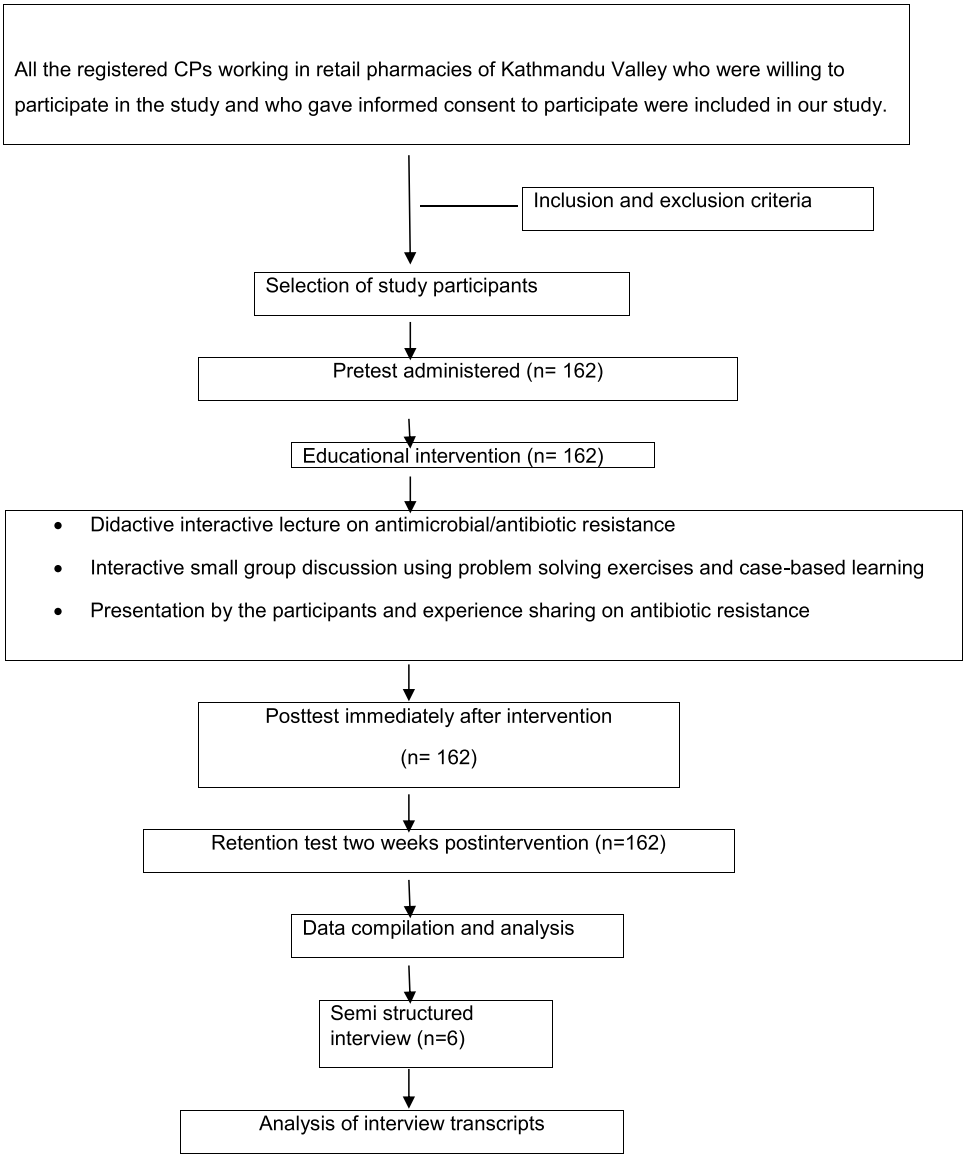


**Figure 1** Study flow depicting the participant recruitment, intervention delivery and impact assessment of the intervention.

outcomes were explaining the significance of AMR, explaining the causes of AMR, enumerating strategies to contain resistance and the role of community pharmacists to prevent/reduce AMR.

*Step I*: The principal investigator *(SK)* delivered an interactive lecture to CPs on antibiotic/antimicrobial resistance. The lecture included basic information on "What is antimicrobial resistance?", "Why resistance is a concern?", "Causes of antimicrobial resistance", "Strategies to contain resistance", and the "Role of CPs in combating antimicrobial resistance".

*Step II*: This was followed by interactive small group activities using problem-solving exercises and case-based learning, encouraging the participants to present, analyze and discuss concepts. The case scenarios provided were (a) A patient comes to your pharmacy with a demand for antibiotics for common cough and cold condition. How will you move ahead? (b) A patient comes to your pharmacy without any prescription. How will you react and move ahead? (c), A patient comes to your pharmacy with a demand for antibiotics for diarrhoea in the past 2 days. How will you move ahead? (d) A patient comes to you with a history of his family member who is in ICU with a history of antibiotic resistance due to rampant use of antibiotics. What should be your advice?

*Step III*: After the group discussion, CPs came forward and presented their understanding of, and experience related to antibiotic/antimicrobial resistance.

### Phase III: Impact Assessment

*(a) Quantitative assessment*: The knowledge, attitude and practice were assessed immediately after the educational intervention and two weeks post-intervention by the study team.

*(b) Qualitative assessment: A* qualitative study was carried out among six selected CPs who met the study criteria and were willing to participate. A separate informed consent was taken from the participants. This was followed by a semi-structured interview using an interview guide [Appendix 1]. The interviews were done by the study team. Each interview lasted for about ten minutes and were audio recorded. The "usefulness of the intervention" and the "role of the CPs in preventing antibiotic resistance and challenges in doing so" were explored.

## Data Analysis

*Quantitative assessment*: Each knowledge question was given a maximum score "1" for the correct responses, and 0 for an incorrect response, attitude questions were scored strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2 and strongly disagree = 1. For the practice questions the scoring was, never = 1, rarely = 2, sometimes = 3, often = 4 and always = 5. Thus, the maximum possible score for knowledge, attitude and practice were 10, 35 and 30, respectively. The quantitative data was entered into IBM SPSS 28 software. The data were analyzed using descriptive and inferential statistics methods. The normality of the data was checked using Shapiro–Wilk test ($p < 0.05$). The data were analyzed using appropriate statistical tests. A p value of less than 0.05 was considered statistically significant. The total KAP score was also calculated by adding the total knowledge, attitude and practice scores. The normality of the data was checked using Shapiro–Wilk test ($p < 0.05$). We included partial responses in the data to be analyzed. We used the linear interpolation method to handle the missing data.

*Qualitative data*: Qualitative data was transcribed and translated by the study team. The results were analyzed according to the answers to the two questions. The analysis was done following each interview. No new insights were obtained after the fifth interview, but one more interview was done to confirm this finding. The data was analyzed using an inductive method of thematic analysis. Two researchers independently analyzed the data and compared their findings.

# Results

Table 1 shows the demographic characteristics of respondents. A total of 162 CPs participated in the study and among them 109 (67.3%) were male; 49 (67.9%) CPs were between the age of 30 to 39 years. Nearly three-fourth 118 (75.2%) CPs had completed diploma in pharmacy and 65 (39.6%) CPs had working experience of less than 5 years. Table 1 shows the demographic features of the participants. There were 46 CPs from Kathmandu, 35 CPs from Lalitpur and 81 CPs from Bhaktapur. The same participants were involved in all the three phases. Only 26 participants from Lalitpur responded to the retention study.

**Table 1** Demographic Characteristics of Respondents [n = 162]

| Characteristic | Number | Percentage |
|---|---|---|
| Gender | | |
| Male | 109 | 67.28 |
| Female | 53 | 32.72 |
| **Age** | | |
| <30 Years | 61 | 37.65 |
| 30–39 Years | 49 | 30.25 |
| >40 Years | 52 | 32.10 |
| **Educational Qualification** | | |
| Diploma in Pharmacy | 118 | 72.84 |
| Bachelors in Pharmacy | 26 | 16.05 |
| Masters in Pharmacy | 1 | 0.62 |
| Pharm D | 5 | 3.09 |
| Orientation | 7 | 4.32 |
| **Working Experience** | | |
| <5 Years | 65 | 40.12 |
| 5–10 Years | 39 | 24.07 |
| >10 Years | 57 | 35.19 |

**Note**: Not all respondents provided answers to each demographic characteristic.

Table 2 shows the median KAP scores before, immediately after and two-week post-intervention among all the participants and there was a significant increase in scores in many categories. The median (IQR) knowledge scores were 9 (1), 9 (2) and 10 (0) during pretest, post-test, and retention respectively. Similarly, the attitude score improved from pretest to posttest [25 (5.25) to 27 (5.25)] (maximum score 35), $p < 0.001$. The intervention also increased practice scores [25 (6)] pretest to [27 (6)] posttest, (maximum score 30) $p < 0.001$.

**Table 2** Total Median Knowledge, Attitude, and Practice Scores at Different Periods During the Study

| Assessment Period | Knowledge Median (IQR) | P-value | Attitude Median (IQR) | P-value | Practice Median (IQR) | P-value |
|---|---|---|---|---|---|---|
| Pretest | 9 (1) | **<0.001** | 25 (5.25) | **<0.001** | 25 (6) | **<0.001** |
| Post test | 9 (2) | | 27 (4.25) | | 27 (6) | |
| Pretest | 9 (1) | **<0.001** | 25 (5.25) | **<0.001** | 25 (6) | 0.386 |
| Retention | 10 (0) | | 26 (3) | | 26 (3) | |
| Post test | 9 (2) | **<0.001** | 27 (4.25) | **0.012** | 27 (6) | **0.031** |
| Retention | 10 (0) | | 26 (3) | | 26 (3) | |

**Note**: Bold values indicate statistical significance at alpha=0.05.

Table 3 represents the median scores of individual knowledge statements at different times. The scores of individual knowledge statements/questions also improved. One of the knowledge-related assessment statements was "If antibiotics are taken frequently, they may stop working in the future" (K2). For this statement, there was significant improvement during pretest-posttest as well as pretest-retention.

Table 4 shows the median scores of individual attitude statements at different times during the study. CPs had a major change towards the statement Antibiotic resistance has become a serious issue over the globe, which is attitude statement 1.

Table 5 shows the median scores of individual practice statements at different times during the study. The intervention also brought changes in the practice score.

Table 6 shows the median total KAP scores before, immediately after and follow-up (retention) among different subgroups of respondents. The total KAP score increased immediately after, and the increase was retained on follow-up in most subgroups.

The final part of the questionnaire was regarding the reasons for CPs dispensing antibiotics without a prescription. Among the 162 CPs who participated in our study, 61 (37.6%) mentioned that the patient had no time and budget to visit physicians, 42 (25.92%) mentioned that CPs were competent to treat common infections, 28 (17.28%) mentioned that patient requests antibiotics and 11 (6.79%) CPs mentioned that it was for the benefit of the pharmacy.

## Qualitative Findings

A total of six participants, two each from Kathmandu, Lalitpur and Bhaktapur district were included in the study.

## Usefulness of the Intervention

Participants believed the intervention program was useful.

> The sessions helped me to understand the basics of the AMR. The mechanisms for development of AMR were discussed, which helped me to understand further about the details for the proper use of antibiotics. Before this program, I used to dispense whatever antibiotics as per the patients demand and my knowledge. Now, I have learned that that practice was not good, and I have stopped doing that. This is a good change after attending that program. (CP1)

Another participant mentioned,

> These programs should be done frequently and should also involve doctors, pharmacists and the public. As the problem of AMR should be solved by a collaborative way. Pharmacists alone cannot solve the problem. Public should also be made aware about the problems due to AMR. (CP2)

A participant mentioned.

"The sessions and the discussions for the case scenarios given were the best part." (CP3)

CPs were asked questions like How can we tackle patients when they come asking for antibiotics without any indication. What is the major cause of AMR? Why AMR is increasing?

## CPs Perspectives on Their Role in Reducing AMR and Challenges in Doing so

A participant said,

> The program was nice and useful for us but practically it is difficult to do. So many pharmacies are here, even if I don't give antibiotics, he will go to other nearby pharmacies and take it. If you are able to take the program everywhere and do it practically then this program is nice. (CP4)

A participant mentioned,

"I don't prefer to give them insufficient doses. Instead, I try to counsel them." *But they are not convinced. Most patients come to take two tables, three tablets of antibiotics. Some of them also stop taking the antibiotics after their symptoms subside. Some of them come to return the remaining tablets of antibiotics and with the refund, they want to buy some other medicine. This is the common situation*." (CP5)

**Table 3** Median Scores of Individual Knowledge Statements at Different Periods During the Study

| Characteristic | Knowledge Statement 1 | Knowledge Statement 2 | Knowledge Statement 3 | Knowledge Statement 4 | Knowledge Statement 5 | Knowledge Statement 6 | Knowledge Statement 7 | Knowledge Statement 8 | Knowledge Statement 9 | Knowledge Statement 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Assessment Period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| **Median (IQR)** | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0.25) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| **P-value** | 0.065 | **0.002** | **0.001** | **0.012** | **<0.001** | 0.112 | 0.267 | 0.180 | 1.000 | 0.302 |
| **Time period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| **P value** | 0.549 | **<0.001** | **<0.001** | **0.021** | **<0.001** | **<0.001** | 0.804 | 0.093 | 0.688 | 0.049 |
| **Time period** | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0.25) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) | 1 (0) |
| **P value** | 0.508 | 0.267 | 0.118 | 1.000 | 0.055 | **<0.001** | 1.000 | 0.629 | 0.453 | 0.549 |

**Note**: Bold values indicate statistical significance at alpha=0.05. Knowledge statements: 1. Antibiotic is any medicament used to kill or inhibit the growth of bacteria. 2. If antibiotics are taken frequently, they may stop working in the future. 3. Did you come across the term antibiotic/antimicrobial resistance? 4. Antibiotic resistance is an important and serious public health problem in the world. 5. Acute diarrhea can be treated with antibiotics. 6. Patients can stop taking antibiotics when their symptoms improve before the full antibiotic course. 7. Common colds can be treated with antibiotics. 8. Antibiotics are used to reduce pain. 9. Antibiotics can cause side effects (allergies, diarrhea, vomiting). 10. Antibiotic resistance is the loss of sensitivity of a specific bacterium to antibiotic/s.


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**Table 4** Median Scores of Individual Attitude Statements at Different Periods During the Study

| Characteristic | Attitude Statement 1 | Attitude Statement 2 | Attitude Statement 3 | Attitude Statement 4 | Attitude Statement 5 | Attitude Statement 6 | Attitude Statement 7 |
|---|---|---|---|---|---|---|---|
| **Assessment period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| **Median (IQR)** | 4 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (3) | 3 (2) | 3 (2) |
| | 5 (1) | 5 (1) | 4 (2) | 4 (2) | 4 (1) | 4 (3) | 3 (2) |
| **P-value** | <0.001 | 0.005 | 1.000 | **0.010** | **0.002** | **<0.001** | 0.092 |
| **Time period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 4 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (3) | 3 (2) | 3 (2) |
| | 4.5 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (1) | 4 (1) | 4 (2) |
| **P value** | 0.272 | 0.678 | 0.013 | 0.017 | 1.000 | 0.008 | **<0.001** |
| **Time period** | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 5(1) | 5(1) | 4(2) | 4(2) | 4(1) | 4(3) | 3(2) |
| | 4.5(1) | 4(1) | 4(2) | 4(1) | 4(1) | 4(1) | 4(2) |
| **P value** | 0.023 | 0.028 | **0.010** | 1.000 | 0.006 | 0.164 | 0.009 |
| **Characteristic** | Attitude statement 1 | Attitude statement 2 | Attitude statement 3 | Attitude statement 4 | Attitude statement 5 | Attitude statement 6 | Attitude statement 7 |
| **Assessment period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| **Median (IQR)** | 4 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (3) | 3 (2) | 3 (2) |
| | 5 (1) | 5 (1) | 4 (2) | 4 (2) | 4 (1) | 4 (3) | 3 (2) |
| **P-value** | <0.001 | 0.005 | 1.000 | **0.010** | **0.002** | **<0.001** | 0.092 |
| **Time period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 4 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (3) | 3 (2) | 3 (2) |
| | 4.5 (1) | 4 (1) | 4 (2) | 4 (1) | 4 (1) | 4 (1) | 4 (2) |
| **P value** | 0.272 | 0.678 | 0.013 | 0.017 | 1.000 | 0.008 | **<0.001** |
| **Time period** | Post test | Post test | Post test | Post test | Post test | Post test | Post test |
| | Retention | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 5(1) | 5(1) | 4(2) | 4(2) | 4(1) | 4(3) | 3(2) |
| | 4.5(1) | 4(1) | 4(2) | 4(1) | 4(1) | 4(1) | 4(2) |
| **P value** | 0.023 | 0.028 | **0.010** | 1.000 | 0.006 | 0.164 | 0.009 |

**Note**: Bold values indicate statistical significance at alpha=0.05 **Attitude statements**: 1. Antibiotic resistance has become a serious issue over the globe. 2. It is the responsibility of pharmacists to educate the patient on the proper use of antibiotics. 3. New antibiotic development can solve antibiotic resistance issue. 4. Antibiotics can be dispensed without a prescription. 5. Patient should be requested to consult a physician before dispensing an antibiotic. 6. Patients with minor infections (pharyngitis, diarrhea etc.) need not consult a physician for an antibiotic, it can be dispensed without a prescription by a pharmacist. 7. Tackling antibiotic resistance is solely the responsibility of the physician.

**Table 5** Median Scores of Individual Practice Statements at Different Periods During the Study

| Characteristic | Practice Statement 1 | Practice Statement 2 | Practice Statement 3 | Practice Statement 4 | Practice Statement 5 | Practice Statement 6 |
|---|---|---|---|---|---|---|
| **Assessment period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Post test | Post test | Post test | Post test | Post test | Post test |
| **Median (IQR)** | 5 (1) | 5 (2) | 4 (2) | 5 () | 5 (1) | 5 (1) |
| | 5 (1) | 5 (1) | 5 (1) | 5 (1) | 5 (1) | 5 (1) |
| **P-value** | 0.671 | **<0.001** | **<0.001** | 0.077 | **<0.001** | 0.480 |
| **Time period** | Pretest | Pretest | Pretest | Pretest | Pretest | Pretest |
| | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 5 (1) | 5 (2) | 4 (2) | 5 (2) | 5 (1) | 5 (1) |
| | 5 (0) | 5 (1) | 5 (1) | 5 (1) | 5 (2) | 5 (1) |
| **P value** | 0.073 | **0.002** | 0.101 | **0.029** | 0.259 | 0.050 |
| **Time period** | Post test | Post test | Post test | Post test | Post test | Post test |
| | Retention | Retention | Retention | Retention | Retention | Retention |
| **Median (IQR)** | 5 (1) | 5 (1) | 5 (1) | 5 (1) | 5 (1) | 5 (1) |
| | 5 (0) | 5 (1) | 5 (1) | 5 (1) | 5 (2) | 5 (1) |
| **P value** | 0.131 | 0.160 | 0.141 | 0.828 | **<0.001** | **<0.001** |

**Note**: Bold values indicate statistical significance at alpha=0.05. **Practice statements** 1. I educate the patient on when and how to use the antibiotic. 2. I educate the patient on the minor side effects of antibiotics. 3. I dispense antibiotics without a prescription if the patient requests an antibiotic. 4. I dispense antibiotics to known patients without prescription. 5. I dispense antibiotics to treat minor ailments in patient without prescription. 6. I inform the patients that misuse of antibiotics can lead to antibiotic resistance.

Another CP stated,

> The problem of AMR is a big problem. Pharmacists cannot handle this alone. Others should also be engaged in this mission. The objective is to reduce the problem of AMR; hence, the approach should be collaborative. Practically, it is difficult for us to control the misuse of antibiotics. People go and buy antibiotics from anywhere, provided they have money. There is no regulation for this. Regulatory authority should be serious regarding this issue. (CP6)

Participants mentioned that their knowledge and attitude regarding AMR improved after attending the workshop. Heavy competition, the presence of many community pharmacies and pharmacy shopping by patients were mentioned as challenges in promoting rational use of antimicrobials and reducing AMR. They recommended others like regulators, other healthcare professionals and members of the public should be involved in future sessions.

## Discussion

Antimicrobials have been used inappropriately due to reasons such as patient demand, inappropriate identification of disease, financial conditions of the patients, and other reasons well reported in the literature.[22] Several educational and regulatory interventions have been implemented globally to tackle the challenges associated with the inappropriate use of antimicrobials with varying degrees of success.[23] Educating the health care providers involved in selecting and handling antimicrobials has been very successful in promoting their rational use.[24] The current study is one such initiative wherein CPs in Nepal were educated on antibiotic resistance and its consequences, and the impact of the intervention was assessed quantitatively and qualitatively. The research findings showed a significant improvement in knowledge, attitude, and practice scores among the participating CPs and yielded positive qualitative feedback. The study findings is discussed below.

**Table 6** Median Total KAP Scores Before, Immediately After and Follow up (Retention) Among Different Subgroups of Respondents

| Characteristic | Age <30 years | Age 30–39 years | Age >40 years | Gender Female | Gender Male | Education DPharm | Education BPharm | Education MPharm | Education PharmD | Work experience <5 years | Work Exp 5–10 years | Work exp >10 years |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PreKAP Median (IQR) | **57 (10.5)** | **57 (8.5)** | **60 (12)** | **57.5 (15.25)** | **58 (9.75)** | **58 (10)** | **59 (10.25)** | 62 (14) | 56 (11) | **58 (10)** | **58 (9)** | **57 (11.5)** |
| PostKAP Median (IQR) | **62 (8.5)** | **63 (8.5)** | **61 (12)** | **59.5 (13)** | **64 (6.75)** | **62 (9.5)** | **63 (10.25)** | 64 (4.5) | 59 (10.25) | **62 (7.75)** | **62 (9)** | **63 (11.75)** |
| P value | **<0.001** | **<0.001** | **0.008** | **0.021** | **<0.001** | **<0.001** | **0.003** | 0.343 | 0.292 | **<0.001** | **0.002** | **<0.001** |
| PreKAP Median (IQR) | **57 (10.5)** | **57 (8.5)** | **60 (12)** | **57.5 (15.25)** | **58 (9.75)** | **58 (10)** | **59 (10.25)** | 62 (14) | **56 (11)** | **58 (10)** | **58 (9)** | **57 (11.5)** |
| Retention KAP Median (IQR) | **65 (5)** | **64 (5.5)** | **64 (5)** | **64.5 (9.75)** | **64 (7)** | **64 (5)** | **63.5 (5.5)** | 64 (8.5) | **66.5 (3.25)** | **64 (6)** | **64 (5)** | **65 (4)** |
| P value | **<0.001** | **<0.001** | **<0.001** | **0.046** | **<0.001** | **<0.001** | **0.012** | 0.416 | **0.043** | **<0.001** | **0.001** | **<0.001** |
| Post KAP Median (IQR) | 62 (8.5) | 63 (8.5) | **61 (12)** | 59.5 (13) | 64 (6.75) | 62 (9.5) | 63 (10.25) | 64 (4.5) | **59 (10.25)** | 62 (7.75) | 62 (9) | 63 (11.75) |
| Retention KAP Median (IQR) | 65 (5) | 64 (5.5) | **64 (5)** | 64.5 (9.75) | 64 (7) | 64 (5) | 63.5 (5.5) | 64 (8.5) | **66.5 (3.25)** | 64 (6) | 64 (5) | 65 (4) |
| P value | 0.904 | 0.720 | **0.016** | 0.266 | 0.518 | 0.194 | 0.450 | 0.854 | **0.028** | 0.455 | 0.845 | 0.203 |

**Note**: Bold values indicate statistical significance at alpha=0.05.

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## Quantitative Assessment of the Knowledge, Attitude, and Practice Outcomes

There was a significant improvement in the CPs' knowledge after the intervention (pretest-post-test, pre-test-retention). Sustainable attitude and practice changes can be brought only with improvement in knowledge. In one study, poor knowledge negatively impacted CPs attitude and practice toward antibiotic dispensing.[25] Thus, a good knowledge among CPs is beneficial in knowing about the selection and use of antibiotics and the consequences of resistance, which were detailed during the educational intervention. The educational module used adult learning principles, and the KAP was assessed using the questionnaire. However, the present study did not assess the impact of knowledge improvement in terms of practice outcomes. One of the knowledge-related assessment statements was "If antibiotics are taken frequently, they may stop working in the future" (K2). For this statement, there was significant improvement during pretest-posttest as well as pretest-retention. This shows the usefulness of the intervention in enhancing CPs' knowledge of the concept of AMR. Previous studies in Nepal[11,26,27] and other countries[28–30] have documented a similar finding wherein CPs had low knowledge. The present study findings showed that even a simple educational intervention can bring changes in the knowledge levels of CPs. Another finding of this research is related to the statement 'Acute diarrhea can be treated with antibiotics' (K5). In Nepal, there is a common practice of using antibiotics for acute diarrhea[31] like in many other developing countries. Data often show acute diarrhea is viral, and hence the use of antibiotics can be irrational.[32] In addition, there is an unethical practice of dispensing antibiotics for acute diarrhea for the CPs to improve their sales volume as well as addressing demands from the patients. This practice can be harmful and needs urgent intervention. The outcome of the present intervention clearly demonstrated an improvement in CPs' knowledge of this aspect.

In this study, some CPs felt that patients can stop taking antibiotics when their symptoms improve before completing the full antibiotic course (K6). Often CPs' attitude can be a reason for resistance due to a particular way of thinking and understanding. Chan et al[33] have reported the importance of attitude and behavioral aspects of CPs in rational antimicrobial use. Multiple previous studies have reported a relatively poor attitude among CPs towards AMR.[13,34,35] Some of these are the patient's condition may worsen if antibiotics are not given early, and nothing harmful will result even if antibiotics are given for a viral condition. In the present study, the intervention emphasized attitude change of the CPs. The role-plays during the intervention delivered through small group learning emphasized largely on behavioral changes. After intervention, the attitude improved in five out of the seven statements.

Pharmacists' perceived responsibility is crucial in combating AMR. Often AMR is perceived as a problem initiated by physicians, but in many developing countries a large amount of antibiotics is dispensed by CPs without a valid prescription. Hence, it is crucial for the CPs to take responsibility for AMR. In the present study, following the intervention the CPs' attitude on "antibiotics can be dispensed without a prescription (A4)" changed and in addition, the CPs felt that educating patients on the proper use of antibiotics (A2) is their responsibility. Another striking finding of the present study is the CPs' attitude toward the importance of physician involvement in antibiotic dispensing. Post-intervention, the CP's attitude on consulting a physician before dispensing antibiotics (A5) and treating minor infections (diarrhea, pharyngitis, etc) by a pharmacist changed (A6). Thus, a closer look at the findings showed that in general CPs had a poor attitude towards AMR, which improved significantly during the study period. However, the sustainability of attitude change can be a major concern, and long-term studies may be helpful.

Previous studies in Nepal have reported poor practices related to antimicrobial use. It is common for CPs in Nepal to dispense antibiotics without a valid prescription.[12] The poor practice is linked to weak regulatory guidelines and monitoring, lack of competent pharmacists, poor remuneration, staff overload, poor information technology facilities and challenges with access to health facilities among others. A simulated patient study has shown that even antibiotics can be obtained without a valid prescription in Nepal.[10] Another recent study from Nepal showed that 34.9% of CPs dispensed antibiotics without prescription.[11] A study from the capital city of Kathmandu reported that 85.9% of pharmacies dispense antibiotics without a valid prescription. Paudel et al[36] in an article pointed out the growing AMR in the country and recommended urgent action to contain the current practice of dispensing antibiotics without a prescription. Undoubtedly, a practice change at the CP level can certainly improve antimicrobial usage patterns in the community, which can help minimize AMR.

In the present research, a detailed assessment was made by comparing the total KAP scores with CPs demographic parameters. Findings showed that respondents' age had a significant association with total KAP scores at pre-post, and pre-retention for all the age groups studied. Gender also influenced the total KAP scores with females showing more improvements in the total scores following the intervention. This suggests that the female gender is more receptive to change and willing to promote rational antimicrobial use in the community. Study findings also demonstrate that work experience has a strong influence on the KAP improvements with relatively more significant changes among the CPs with more than 10 years of experience, confirming the assumption that senior CPs have busy schedules in the pharmacies and utilize more effective training programs whenever they attend.

### Qualitative Assessment of the Usefulness of the Intervention and Role of CPs in Reducing AMR and Associated Challenges

A qualitative assessment of the session based on participants' feedback can be beneficial in assessing the usefulness and lacunae of the module. Qualitative feedback was obtained on two aspects, "usefulness of the intervention" and "role of CPs in reducing AMR and challenges in doing so". The CPs in general found the session to be useful in enhancing their understanding of the proper use of antibiotics and felt that their current practice is not good and requires change. One CP also mentioned the need for repeated programs in the future suggesting the potential for exploring digital tools to deliver training, while the CPs are at their worksite. CPs also emphasized the importance of collaboration among health professionals and patients. Interprofessional collaboration (IPC) is largely lacking in many developing countries.[37] Collaboration among CPs and physicians can help clarify errors/confusion in prescriptions and patients requesting antibiotics can be redirected to physicians and better patient counseling be provided by the pharmacists.

Another important finding of the qualitative research is that patients often visit another pharmacy and obtain antibiotics even if one pharmacy does not provide the same. This raises concern about patient safety and the requirement for educating patients on the safe and effective use of medicines, which is a concern not only in the case of antibiotics but even for other prescription medications. Another challenge is patients asking for incomplete dosages of antibiotics, which is a confirmed cause of AMR. The CPs would also explore all opportunities to sell more antibiotics to increase their sales volume. A study by Acharya et al in 2021 assessed the economic and social drivers of dispensing antibiotics without prescription by community pharmacies in Nepal, and the authors found no consistent relationship between the likelihood of dispensing antibiotics with revenue and profits rather the dispensing behavior was influenced by the pressure from the patient.[38]

On the contrary, another study[39] reported that antibiotics are among the top-selling medicines with a high number of promotional activities and the authors mentioned that the pharmaceutical companies directly promote their use for conditions like upper respiratory tract infections in the community pharmacies. Thus, more studies are needed to identify the reasons (including financial) behind the overuse of antibiotics at community pharmacies in Nepal.

## Limitations and Recommendations

The present study had a limitation in terms of its sample size. Though the target sample size was 377 the authors could enroll only 162 CPs due to financial and logistical constraints. Convenience sampling was also another limitation. The duration of the study was short (4 months) and this period is inadequate to assess the sustainability of the intervention. Also, we had interviewed only 6 CPs, which is another limitation.

Similar studies can be done in different parts of the country and recruiting a greater number of CPs. Digital technologies can be utilized in the future to provide education and training for CPs. Authors recommend the "National Action Plan Antimicrobial Resistance, Nepal, 2021–26" should be implemented quickly.[2]

## Conclusion

There are major challenges at the community pharmacy level to be addressed to improve antibiotic usage in the country. Both quantitative and qualitative findings demonstrated the usefulness of the educational intervention in influencing CPs' knowledge attitudes and practice toward AMR. As reported in previous studies in Nepal and other developing countries,

a targeted intervention at multiple levels such as pharmaceutical company promotion, physician prescribing, CP dispensing, and patient usage can improve the use of antibiotics and minimize AMR. CPs can be a potential target for interventions to promote the rational use of antibiotics.

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