CASE STUDY

Assessment of knowledge, attitude, and practice of pharmacy students on antibiotic use and its resistance: A cross-sectional study

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Abstract

Antibiotic resistance is one of the most serious issues confronting the globe as a result of antibiotic overuse and misuse. Understanding antibiotic knowledge, attitudes, and practices (KAP) is critical in combating antibiotic resistance. In this present survey, we have determined the level of KAP about antibiotic use and resistance among undergraduate pharmacy students at the Government Pharmacy College, Sajong, Sikkim. A cross-sectional questionnaire-based study was done at Government Pharmacy College Sajong, Rumtek, among undergraduate pharmacy students from 1st year to final years. The survey was conducted from 8th May 2023 to 5th July 2023, employing close-ended face-to-face questionnaire-based survey approach. The data were collected in spreadsheet and analyzed using descriptive statistics. The survey was completed with 149 respondents and the average KAP scores for all the undergraduate students who responded were determined to be 2.72 ± 0.952, 3.18 ± 0.980, and 3.18 ± 0.078, respectively. Based on the mean score, it can be deduced that the students had a moderate KAP regarding the use of antibiotics and their resistance. As far as KAP is concerned, there is a significant need for improvements among pharmacy students. The study implies that future studies should take an integrative approach to improve pharmacy students' knowledge of antibiotic use and resistance. Despite having a moderate KAP, students should be encouraged to take part in training sessions on antibiotic use and resistance.

Key words: Antibiotics, antimicrobial, attitude, knowledge, pharmacy students, practice

INTRODUCTION

Bacterial infections are a primary cause of morbidity and mortality worldwide, and as a result, antibiotic use is skyrocketing. Antibiotics have been incredibly successful in enhancing health outcomes. As a result, the mortality rate for children under 5 years has decreased globally from 216/1000 live births in 1950 to 39/1000 live births in 2017, and male life expectancy has increased from 48 to 71 years over the same time period.[1,2] The wide use and abuse of antibiotics could make antimicrobial resistance (AMR) an increasingly serious issue that threatens global health.[3] The World Health Organization (WHO) defines AMR as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism. The WHO has even declared AMR as one of the top 10 global public health threats.[4] Over more than 700,000 deaths are caused by bacterial resistance and 10 million death is expected by 2050.[5] Every year, an estimated 56,524 newborns die in India from sepsis caused

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by bacteria resistant to first-line antibiotics.[6,7] Antibiotic resistance is considered to be one of the biggest threats to global health, food security, and development.[8] One of the main contributors to the emergence of antibiotic resistance is the easy availability of antibiotics without a prescription in the developing countries.[9]

Global AMR and Use Surveillance System was launched by the WHO in 2015 to promote worldwide AMR and antimicrobial consumption and use surveillance to inform AMR containment strategies.[10]

In April 2017, national action plan (NAP) for containing AMR was published by the Indian Ministry of Health and Family Welfare, which was submitted to the 70th World Health Assembly in Geneva in May 2017. The goals and execution plans for reducing AMR in India were outlined in this 5-year NAP on AMR (2017–2021).[11]

The promiscuous and irrational use of antibiotics which is driven by a lack of knowledge and casual attitude adopted by the pharmacist needs to be addressed immediately.[12,13] It has been estimated that more than 50% of all oral antibiotics taken worldwide are thought to be administered without a prescription.[14] Misuse of antibiotics not only leads to antibiotic resistance but also to treatment failure, prolonged hospitalization, and a financial burden.[15] Pharmacists can make a huge difference in either increasing or decreasing the antibiotic resistance because they are the most accessible healthcare practitioners and frequently serve as the initial point of contact. They can even have a strong influence on patients' decisions making over the purchase of antibiotics. Many studies have highlighted that pharmacist had a poor practice toward dispensing broad-spectrum antibiotics when they are not necessary and there is no sign of a bacterial infection. Therefore, to change such behavior among pharmacists, it is important to assess the pharmacy students' knowledge, attitudes, and practice (KAP) toward antibiotics usage and its resistance.[16,17] Pharmacist education and training have the potential to influence healthcare behaviors. Infectious disease education, management, and AMR should be prioritized in the pharmacy curriculum. Furthermore, trained pharmacists can help address the world problem of AMR by empowering patients to make the best use of antimicrobial medicines.[18]

It was strongly urged in previous studies that sufficient training should be provided for allied health science students including pharmacy on correct antibiotic prescribing, distribution, and use to improve rational use of antibiotic. Therefore, it is essential to evaluate undergraduate pharmacy students' baseline antimicrobial knowledge.[19] Therefore, this study was designed to investigate the understanding of pharmacy students from different year of Government Pharmacy College Sajong (GPCS), about the antibiotic use and its resistance.

MATERIALS AND METHODS

Survey Design and Data Collection

A descriptive cross-sectional study was conducted among pharmacy students at GPCS, Rumtek to evaluate their KAPs regarding the use of antibiotics and its resistance. The survey was conducted from 8th May to 5th July 2023, employing close-ended face-to-face questionnaire-based survey approach.

Survey Sample

The study included undergraduate pharmacy students from GPCS, Rumtek, who were in their 1st, 2nd, 3rd, and 4th years of study. The participants were above 18 years of age. The minimum recommended sample size for this study was determined to be 149 participants which was calculated using online sample size calculator Rao soft (https://www.raosoft.com/samplesize.html). The calculation considered a population size of 242 students, a margin error of 5%, a confidence level of 95%, and a response distribution of 50%. A total of 149 participants were randomly selected from the different years. Specifically, 50 students were approached from the 4th year, 33 students from the 3rd year, 33 students from the 2nd year, and 33 students from the 1st year. The random selection aimed to ensure representative participation from each year group.

Survey Questionnaire

A pre-validated structured questionnaire about KAP on antibiotic use and its resistance was developed and collected from the previous published related studies through the literature survey.[19-22] The validated questionnaire was further modified to meet the objective of the research by two pharmacist experts from the Department of Pharmaceutics. The entire questionnaire selected was close ended. In this study, data were gathered using four parts of questions, each with five questions to analyze the KAP of participants. The sociodemographic characteristics including age, gender, section, residence, antibiotics used in the past 6 months, and reason for use, were gathered initially.

The first part of the questionnaire examines student's knowledge on understanding and familiarity with antibiotic use and was assessed by a 5 items' with "Yes" or "No" option. The student's knowledge and understanding of antibiotic resistance were examined in the second part of the questionnaire and were assessed by a 5 items' scale using a Likert scale of 3–1 (3: Unsure, 2: Disagree, and 1: Agree). Furthermore, in the third part, students' attitudes toward the use of antibiotics were assessed by 5 items' scale using a Likert scale of 4 to 1 (4: Strongly disagree, 3: Disagree, 2: Agree, and 1: Strongly agree). The final part of questionnaires was used to examine how the students' practices on the use of antibiotics and was

assessed by a 5 items' scale using a Likert scale of 4–1 (4: Most of the time, 3: Often, 2: Occasionally, and 1: Never).

Score Measurement

The responses were recoded for score generation and comparison, those answering "strongly agree" and "agree" being considered as "agree," those who answered "strongly disagree" and "disagree" were considered as "disagree," similarly, "most of the time" considered as "often" and "occasionally" as never. One point was given for each correct answer whereas no deduction was done for wrong. Scores of 4–5, 2–3, 0–1 were considered as good, moderate, and poor, respectively, while assessing KAP of students.[23]

Sample Analysis

The data were collected initially using Microsoft Excel, furthered cleaned, and coded using IBM Statistical Packages for the Social Sciences Statistics version 29.0.1.0. Frequency and percentage were calculated to assess the KAP of pharmacy students toward the use and resistance of antibiotics.

RESULTS

Sociodemographic Results

The sociodemographic data of the participants [Table 1] indicated that out of 149 participants, n = 75 male, 50.3% and n = 74 female, 49.7% with age ranging 18–25 were involved. From the total participants, 50 were from 4th year and 33 each from 1st year, 2nd year, and 3rd year. Furthermore, about n = 97, 65.1% of the participants were previously using antibiotics and about 90 (60.4%) of participants were using antibiotics for fever followed by n = 42, 28.2 of them for sore throat. Only about n = 26, 17.45% of the participants were receiving antibiotics from the doctor and almost n = 78, 52.35% from friends, the detailed response is mentioned in Figure 1.

KAP toward the use of antibiotics and its resistance, Table 2, indicates the frequency and % of participants who answered yes/no for each question related to knowledge of participants toward antibiotics use. For the question "AB and anti-inflammatory drugs are the same drugs?," n = 141, 94.6% respondents gave the correct response (n = 143, 96.0%) and (n = 104, 69.8%) respondents were correct about the question "Inappropriate use of antibiotic can lead to ineffective treatment?" and "Antibiotics are safe drugs; hence, they can be commonly used?." Furthermore, n = 99, 66.4% and n = 126, 84.6% respondents gave correct answer for the questions "Antibiotics should only be obtained with a doctor's prescription?" and "The more expensive the antibiotic, the more effective it will be?," majority of the respondent had good knowledge on antibiotics and are familiar using it.

Table 1: Sociodemographic characteristics of participants

Variable	Category	*n*	*n*%
Age	18	6	4.0
	19	26	17.4
	20	26	17.4
	21	33	22.1
	22	26	17.4
	23	23	15.4
	24	7	4.7
	25	2	1.3
Gender	Male	75	50.3
	Female	74	49.7
Section	1st year	33	22.1
	2nd year	33	22.1
	3rd year	33	22.1
	4th year	50	33.6
Residence	Rural	124	83.2
	Urban	25	16.8
Antibiotics used in last 6 months	No	52	34.9
	Yes	97	65.1
Reasons for taking antibiotics	Fever	90	60.4
	Sore throat	42	28.2
	UTI	6	4.0
	Skin problem	0	0.0
	Headache	0	0.0
	Other	11	7.4

UTI: Urinary tract infection

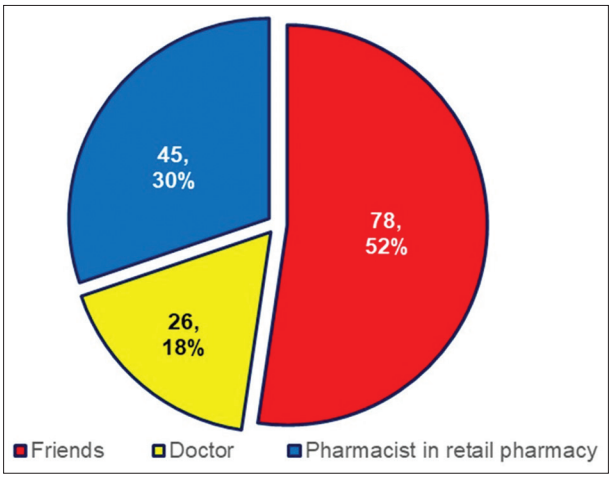

Figure 1: Source of antibiotic received by pharmacy students

Five questions were further used to assess the student's knowledge and understanding of antibiotic resistance which is detailed in Table 3, the questionnaire was designed to understand the general knowledge of the respondents regarding antibiotic resistance. Unexpectedly, most of the participants (n = 65,

Table 2: Knowledge on understanding and familiarity with antibiotics use

Question	Category	*n*	*n*%
AB and anti-inflammatory drugs are the same drugs?	No	141	94.6
	Yes	8	5.4
Inappropriate use of antibiotic can lead to ineffective treatment?	No	6	4.0
	Yes	143	96.0
Antibiotics should be withdrawn as soon as the symptoms disappear?	No	104	69.8
	Yes	45	30.2
Antibiotics should only be obtained with a doctor's prescription?	No	50	33.6
	Yes	99	66.4
The more expensive the antibiotic, the more effective it will be?	No	126	84.6
	Yes	23	15.4

Table 3: Knowledge and understanding of antibiotic resistance

Question	Category	*n*	*n*%
Antibiotics treat the majority of diseases?	Agree	65	43.6
	Disagree	44	29.5
	Unsure	40	26.8
Antibiotics treat viral infections?	Agree	73	49.0
	Disagree	50	33.6
	Unsure	26	17.4
Antibiotic kills bacteria?	Agree	118	79.2
	Disagree	9	6.0
	Unsure	22	14.8
Antibiotics have side effects?	Agree	131	87.9
	Disagree	7	4.7
	Unsure	11	7.4
Animal products can contain antibiotic residue, which may increase antimicrobial resistance when entering the human body?	Agree	131	87.9
	Disagree	7	4.7
	Unsure	11	7.4

43.6%) responded incorrectly agreed to question "Antibiotics treat the majority of diseases?," they even had a great confusion for the question "Antibiotics treat viral infections?" were (*n* = 73, 49.0%) incorrectly agreed to the statement, 26, 17.4% were unsure, and only *n* = 50, 33.6% correctly disagreed. For the question "Antibiotic kills bacteria?" and "Antibiotics have side effects?," majority of participants (*n* = 118, 79.2%) and (*n* = 131, 87.9%), respectively, give the correct response. Similarly, the participants (*n* = 131, 87.9%) agreed correctly for the question "Animal products can contain antibiotic residue, which may increase AMR when entering the human body?." Similarly, the 5-point KAP survey questionnaire were designed to understand the pharmacy students' attitude toward the antibiotic resistance.

The participants (*n* = 100, 67.1%) and (*n* = 56, 37.6%) were less likely to correctly answer the question, "When I get fever, antibiotics help me to get better more quickly?," and "Antibiotics are safe drugs; hence, they can be commonly used?" respectively. They gave correct response for the question "Whenever I take an antibiotic, it contributes to the development of antibiotic resistance?" and "Skipping one or two doses does not contribute to the development of antibiotic resistance?" (*n* = 105, 70.5%) and (*n* = 86, 57.7%), respectively. However, the attitude of pharmacy students can be improved in the aspect of antibiotic resistance as most of them incorrectly responded to the question "When antibiotics utilized properly for the right indication and right duration, will also result in bacterial resistance?" (*n* = 107, 71.8%). The detailed responses are mentioned in Table 4.

The results of Table 5 revealed that only (*n* = 15, 10%) of participants most of the time practice of taking antibiotics by consulting doctor. Beside that most of the time, participants checked the expiry date before taking AB (*n* = 69, 46.3%) and often the participants were practicing of completing the full course of antibiotics (*n* = 57, 44.3%). Majority of participants (*n* = 57, 38.3%) never store antibiotics at home in case of future need. However, (*n* = 92, 61.7%) participants never discarded leftover medication which is again a serious concern apart from antibiotic resistance.

KAP Score

Based on the assigned scores, the mean KAP score of all respondent pharmacy students was calculated as 2.72 ± 0.952, 3.18 ± 0.980, and 3.18 ± 1.078, respectively [Table 6]. Apart from the mean score, the percentage KAP score was also generated and out of total respondents (*n* = 29, 19.5%), *n* = 54, 36.2% and *n* = 60, 40.3% had good KAP, respectively [Table 7].

DISCUSSION

It has been observed that most of the time in developing countries illness is treated by self-medication. Consuming antibiotics without the advice of a medical practitioner is an act of self-medication that leads to increase adverse events and resistance to antibiotics.[24] Self-decision was the major reason which persuaded pharmacy students to self-antibiotic use most of the time.[25-28] This gap in the execution of knowledge could be bridged by effective interventions and promoting rational antibiotic use.[29] In developing county, more than 50% of antibiotics worldwide are sold without a prescription.[30] This pattern is anticipated to persist unless appropriate use of antibiotics is actively encouraged, needless usage is avoided, and the issue of antibiotic resistance is addressed.[31] Antibiotic usage practices among pharmacists could be potentially improved by the implementation of antimicrobial stewardship.[32-35]

Table 4: The pharmacy students' attitude toward the use of antibiotic

Question	Category	*n*	*n*%
When I get fever, antibiotics help me to get better more quickly?	Strongly agree	100	67.1
	Agree	10	6.7
	Disagree	32	21.5
	Strongly disagree	7	4.7
Whenever I take an antibiotic, it contributes to the development of antibiotic resistance?	Strongly agree	105	70.5
	Agree	17	11.4
	Disagree	26	17.4
	Strongly disagree	1	0.7
Antibiotics are safe drugs; hence, they can be commonly used?	Strongly agree	56	37.6
	Agree	8	5.4
	Disagree	69	46.3
	Strongly disagree	16	10.7
Skipping one or two doses does not contribute to the development of antibiotic resistance?	Strongly agree	47	31.5
	Agree	4	2.7
	Disagree	86	57.7
	Strongly disagree	12	8.1
When antibiotics are utilized properly for the right indication and right duration, will also result in bacterial resistance?	Strongly agree	107	71.8
	Agree	13	8.7
	Disagree	24	16.1
	Strongly disagree	5	3.4

Table 5: The pharmacy students practice toward use of antibiotics

Question	Category	*n*	*n*%
Do you consult a doctor before starting antibiotics?	Never	27	18.1
	Occasionally	81	54.4
	Often	26	17.4
	Most of the time	15	10.1
Do you check the expiry date before taking antibiotics?	Never	3	2.0
	Occasionally	11	7.4
	Often	66	44.3
	Most of the time	69	46.3
Do you complete the full course of antibiotics?	Never	18	12.1
	Occasionally	22	14.8
	Often	57	38.3
	Most of the time	52	34.9
Do you store antibiotics at home in case of future need?	Never	57	38.3
	Occasionally	18	12.1
	Often	50	33.6
	Most of the time	24	16.1
If you have stopped taking remaining dose of antibiotics, do you discard remaining leftover medication?	Never	92	61.7
	Occasionally	21	14.1
	Often	24	16.1
	Most of the time	12	8.1

Table 6: KAP of students

Criteria	*n*	Minimum	Maximum	Mean	Standard Deviation
Knowledge	149	1	5	2.72	0.952
Attitude	149	1	5	3.18	0.980
Practice	149	1	5	3.18	1.078

KAP: Knowledge, attitudes, and practices

Table 7: Percentage KAP of students

Criteria	Good (*n*%)	Moderate (*n*%)	Poor (*n*%)
Knowledge	29 (19.5)	105 (70.5)	15 (10.1)
Attitude	54 (36.2)	86 (57.7)	9 (6.0)
Practice	60 (40.3)	77 (51.7)	12 (8.1)

KAP: Knowledge, attitudes, and practices

The current study reflects different levels of the KAP of the pharmacy students. The findings of the present study showed moderate KAP of participants toward antibiotic use and its resistance. Most of the participant (n = 90, 60.4%) revealed that reasons for taking antibiotics were for fever and such wrong practice is even observed in many other similar studies which were conducted earlier.[36,37] Some of the key important findings are highlighted further from the section KAP. As far as knowledge of use of antibiotics is concerned overall, most of the participants (n = 104, 69.8) responded that antibiotics should not be withdrawn as soon as the symptoms disappear which is similar response recorded in other study where 236 (57.0%) preferred for full completion of treatment of course. Majority of the pharmacy students (n = 99, 66.4%) responded that antibiotics should only be obtained with a doctor's prescription that shows a good knowledge of students toward the use of antibiotics. Unexpectedly, most of the participants (n = 73, 49%) recommended that antibiotics treat viral infection, such confusion has previously been observed in other similar studies done within the medical students and those type of wrong decisions can ultimately lead to abuse of antibiotics.[38] However, the participants (n = 131, 87.9%) agreed that animal products can contain antibiotic residue, which may increase AMR when entering the human body. The response observed from the pharmacy students was comparatively better than the general public of Romania was only 40.57% of them agreed with the statement.

Interestingly in the attitude section, most of the pharmacy students (n = 107, 71.8%) strongly agreed with the statement antibiotics when utilized properly for the right indication and right duration will also result in bacterial resistance, this finding was similar to that of the previous study. Similarly, inappropriate attitude was also observed when majority (n = 100, 67.1%) agreed that antibiotics help to get rid of fever quickly, similar pattern of response was previously observed in the study from Jordanian pharmacy students.

Most of the participants (n = 80, 54.4%) occasionally consulted a doctor before starting antibiotics, this response was not in line with other studies where even most of general public consulted the doctor before taking antibiotics.[39] Almost most of the participants (n = 92, 61.7%) never properly discarded remaining leftover medication, such inappropriate practice on disposal of unused and expired antibiotics is of great importance because of the impending environmental hazards and public health risk and recently, many studies are highlighting the importance of such practice that may help reduce AMR in significant manner.[40,41] The findings of this study would be helpful as the baseline for the future development of more effective pharmacy curriculum to improve KAP of pharmacy students.

There are some limitations to this study, as it was designed to be conducted only at GPCS, opting for a convenience sampling technique, which may cause selection bias and the results are thus unable to offer generalizability. Nevertheless, this is an exploratory investigational descriptive cross-sectional study that provides the overall KAP of pharmacy students about antibiotic use and its resistance.

CONCLUSION

Our study aimed to investigate the KAP of pharmacy students from GPCS, Rumtek, toward the antibiotic use and its resistance. From the study findings, students at GPCS had moderate KAP toward antibiotic resistance. The pharmacy students will play a key part in the administration of medications, including antibiotics, if they are properly groomed and made aware of the importance of rational antibiotic handling, this issue may be reduced to a greater extent. However, it is also recommended that more studies can be planned with interventional design to improve KAP of students on antibiotic use and its resistance. Furthermore, there is also a need for an in-depth analysis of pharmacists' role in antibiotic resistance. Despite having moderate KAP, the pharmacy students should additionally be encouraged to participate in educational training sessions regarding antimicrobial use and antibiotic resistance. Henceforth, with the help of continuous educational training programs and improved curriculum, pharmacy students can be presented as a behavioral model for citizens and patients. Therefore, it is very essential to raise awareness on this topic during the pharmacy degree courses.

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AUTHOR'S CONTRIBUTION

AP: RSM: BT: Responsible for selection of the research work and major data collection by trial and error methods. AP: BS: SB: Responsible for the guidance of the research work till the end. KS: SD: SB: Contributed for drafting, designing, formatting, and referencing of this research article and communicating with scientific esteemed journal having good reputation in the scientific fields. All authors have read and approved the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Data and materials are available upon request.

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