

# Knowledge, Attitudes and Practices of Antibiotic Use and Antimicrobial Resistance among Medical Students in a Private University in Dominica, West Indies

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## Abstract

Antibiotics are indispensable to maintaining human health, however, their overuse has resulted in resistant organisms which present a significantly higher burden to the low to middle income countries, due to the high incidence of communicable diseases. Insufficient antimicrobial-related training for physicians during their undergraduate education could have a negative impact on their prescribing. This study assessed the knowledge, attitudes and practices of antibiotic use and antimicrobial resistance among medical students in a private university in Dominica, a resource-limited country, in order to facilitate more effective education of these future prescribers. A cross-sectional study was undertaken with the medical students from February 2021 to April 2021 using a 36-item questionnaire. Data analysis was achieved using descriptive statistics. A total of 85 students participated in the study, majority (70%) were female, African, aged  $23.8 \pm 4.6$  years and single. Between 64 and 99% of the respondents reported no risk factors for communicable diseases and demonstrated a low to moderate (10% - 40%) negative response to knowledge-related questions. The majority (70%) of the respondents who had used antibiotics in the past 12 months reported efficacy and limited side-effects, but confirmed lack of knowledge about the classes of antibiotics prescribed to them. Almost half of the medical students (48%) reported having abused antibiotics, while about a third (35%) of the respondents reported sharing antibiotics with friends or loved ones in the past. There was no significant association between age, gender, and the medical students' knowledge of antibiotic resistance ( $p > 0.05$ ). However, they reported that they would like more education on antimicrobial use and resistance. The medical students in this study showed knowledge of antimicrobial

resistance, but lacked comprehension of components of antimicrobial stewardship, including prevention of inappropriate use and classes of antibiotics. Therefore, steps need to be taken to prepare medical students for antimicrobial resistance and stewardship initiatives effectively.

## Keywords

Dominica, African, Medical Students, Antibiotics Use, Antimicrobial Resistance

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## 1. Introduction

Antibiotics are indispensable to maintaining human health, however, their overuse has resulted in resistant organisms. Antimicrobial Resistance (AMR) is a significant threat to national, regional, and global public health systems [1] [2]. An infection with AMR organism leads to serious illnesses and prolonged hospital admissions, increases in healthcare costs, higher costs of second-line drugs, and treatment failures [1] [3] [4]. The majority of the burden of AMR falls on low to middle income countries (LMICs) [5], due to the high burden of communicable diseases driven by complex factors including lack of access to clean water, sub-optimal sewage systems, poor sanitation, poorer healthcare infection control practices, excessive and inappropriate consumption of antimicrobials in humans, availability and distribution of poor-quality (counterfeit) medicines and lack of regulation on antimicrobial use in farming, and pharmaceutical industry pollution, and exacerbation by the ongoing COVID-19 pandemic [6].

Although, antimicrobial stewardship programs that promote and focus on the appropriate use of antimicrobials and strategies to improve patient outcomes, and reduce antimicrobial resistance have been shown to be successful in many academic hospitals [7] [8], they are less-frequently implemented in community settings where most antibiotic prescribing takes place [9] [10], and gaps still remain in the knowledge of how to optimally design and sustain these programs. While the importance of adequate and effective training of medical students and all healthcare professionals in the wise prescribing of antibiotics [11] [12] has been emphasized by the World Health Organization (WHO), it remains unclear whether investments in training on topics relevant to responsible antibiotic use are robust in resource-limited countries. The aim of this study is to assess the knowledge, attitudes and practices about antibiotic use and development of antibiotic resistance among medical students in a private university in the Commonwealth of Dominica, West Indies in order to facilitate more effective education of these future prescribers.

## 2. Methods

### 2.1. Study Design

This cross-sectional study was conducted between February to April 2021 at the

All Saints University School of Medicine located in the Commonwealth of Dominica, West Indies. The academic programme included one year of preparatory (pre-medical) classes, two years of pre-clinical (basic medical) classes during which students have no patient encounters, as most of their education is lecture-based, followed by two years of clinical training in hospitals. For the study, the sample size was calculated using the Raosoft online sample size calculator (<http://www.raosoft.com/samplesize.html>) by assuming a 95% confidence level, 5% margin of error and 50% response distribution. The minimum recommended sample size was 128.

Ethical approval to conduct the research was acquired from the Institutional Review Board of the All Saints University School of Medicine, Commonwealth of Dominica. Registered students who were apparently healthy were eligible to participate in the study. This study used a stratified sampling method with three subgroups: students from Pre-Medical Classes, Basic Medical Classes and Clinical Classes. Exclusion criteria included students who have been hospitalized in the past 6 months, students who have used antibiotics in the past 3 months, and lastly, refusal to give informed consent. In an attempt to adhere to COVID-19 public health measures, general awareness and appointment schedule was broadcasted through emails. The participation was strictly voluntary, and an informed consent form was signed by the students who agreed to participate in the study.

A self-administered, validated questionnaire, previously described [13] [14], was used to collect the respondents' data. The internal consistency reliability of the questionnaire was checked, and their Cronbach's Alpha value was 0.67. The 36-item electronic questionnaire consisted of four sections: 1) demographic characteristics; 2) knowledge about antimicrobial resistance; 3) practices about antibiotics usage; 4) risk factors for communicable diseases. Demographic information included questions on sex, age, ethnicity, class of study, educational background, and marital status. The response alternatives on the other sections of the questionnaire were true/false/don't know or yes/no, as appropriate. The questionnaire did not contain personally identifiable information; instead, all respondents were assigned with a unique identifying number.

## 2.2. Data Management and Statistical Analysis

The survey data were entered manually and analyzed using Microsoft® Excel® for Microsoft 365 MSO (Version 2207) (Microsoft Inc., Redmond, WA, USA). Descriptive statistics was used to measure the mean (+ standard deviation) and to obtain percentages for categorical variables.

## 3. Results

### 3.1. Socio-Demographic Characteristics of Respondents

A total of 85 (66.4%) of the 128 medical students who were emailed the survey invitation participated in this study. As shown in **Table 1**, majority of the

**Table 1.** Socio-demographic characteristics of respondents.

Factors	N = 85	Percentage %
<b>Gender</b>		
Male	26	30.6
Female	59	69.4
<b>Class</b>		
Basic Medicine	44	51.8
Pre-Med	9	10.6
Clinical	32	37.6
<b>Age Group</b>		
16 - 19	16	18.8
20 - 23	27	31.8
24 - 27	25	29.4
28 - 31	12	14.1
32 - above	5	5.9
<b>Ethnicity</b>		
African American	3	3.5
African	75	88.2
Caribbean	5	5.9
Indian/African Canadian	2	2.4
<b>Educational background</b>		
Secondary	47	55.3
Diploma	21	24.7
BSc	14	16.4
MSc/MBA	3	3.5
PhD	0	0
<b>Marital Status</b>		
Single	81	95.3
Married	4	4.7
Divorced	0	0
Widow	0	0

respondents were female, comprising of 59 (69.4%) students, while 26 (30.6%) were male. The majority of the respondents (52, 61.2%) were between the ages of 20 and 27 years, 16 (18.8%) were 16 - 19 years, 12 (14.1%) were 28 - 31 years and 5 participants (5.9%) were more than 32 years old, with a total mean of  $23.8 \pm 4.6$  years. Majority of the respondents 44 (51.8%) were in the basic medical science classes, 32 (37.6%) were in the clinical classes, while 9 (10.6%) were in premedical

classes. Majority of the participants (75, 88.2%) were African, 5 (5.9%) were Caribbean, 3.5% were African American, and 2.4% were African/Indian Canadian.

The majority of the respondents (47, 55.3%) were secondary school graduates, 21 (24.7%) obtained a diploma, 14 (16.4%) had a Bachelor of Science while 3 (3.4%) participants had a Master of Science/Master's in Business Administration as their educational status. Among these respondents, 81 (95.3%) were single and 4 (4.7%) were married.

### 3.2. Knowledge of Antimicrobial Resistance among the Respondents

To assess the knowledge of antimicrobial resistance among the respondents, a total of six questions were asked in this study. A total of 10 (12%) respondents did not know or reported as false that indiscriminate use of antibiotics leads to emergence of resistance. 15 (18%) of the respondents did not know or reported as false that if antimicrobials are taken too often, they are less likely to work in the future. A total of 7 (8%) respondents did not know or reported as false that ineffective treatment can occur due to indiscriminate and injudicious antimicrobial use. However, 35 (41%) of the respondents reported that bacteria cause common cold and influenza and antibiotics can be used to treat common cold and viral infections. Overall, as indicated in **Table 2**, study participants had a negative response (12% - 41%) to knowledge-related questions, however, more than 90% of them would like more education on antimicrobial use and resistance. There was no significant association between the medical students' age, gender, educational status, and their knowledge of antibiotic resistance ( $p > 0.05$ ).

### 3.3. Antibiotic Usage among the Respondents

To assess the history of antimicrobial usage among the respondents, a total of seven questions were asked in this study. A total of 24 (28%) of the respondents had used antibiotics more than 3 months, while the majority (61, 72%) had used antibiotics in the prior 12 months before their participation in the study (**Figure 1**). Sixty (71%) of respondents did not know the classes of antibiotics they had used in the past (**Figure 2**). The majority (76, 89%) of the respondents reported efficacy (**Figure 3**), while 13 (15%) of the respondents reported side-effects of the antibiotics they had used in the past (**Figure 4**). Almost half of the study respondents (41, 48%) reported of their antibiotics abuse (used more than prescribed dosage, self-prescribed, unable to complete dose, or intake of other person's or wrong prescription) (**Figure 5**). Interestingly, the results also revealed more than a third of the respondents (30, 35%) shared antibiotics with their friends or loved ones in the past (**Figure 6**). More than half (47, 55%) of the respondents reported normal use of antiseptic bathing soap, cream and ointment (**Figure 7**).

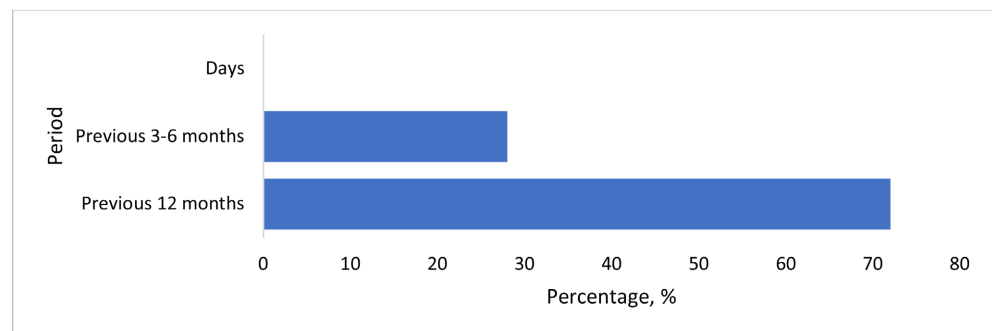
### 3.4. Risk Factors for Communicable Disease

To assess the risk factors for communicable diseases among the respondents, a

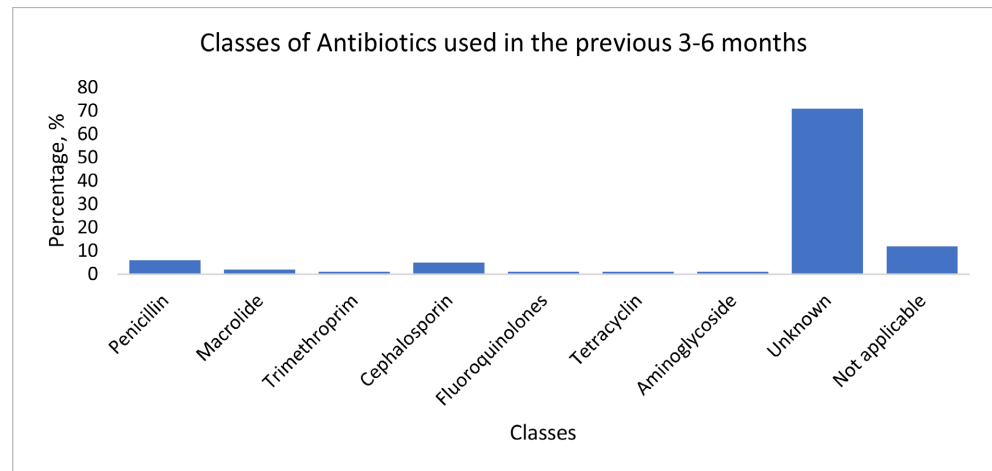
total of 16 questions were asked in this study as shown in **Table 3**. Between 64 and 99% of the respondents reported no risk factors for communicable diseases

**Table 2.** Knowledge of antimicrobial resistance among the respondents.

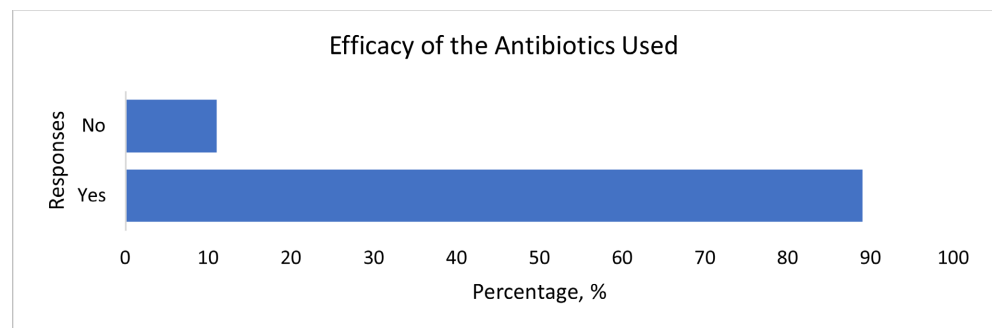
Knowledge of Antimicrobial Resistance among the Respondents	N = 85	Percentage, %
Indiscriminate use of antibiotics leads to emergence of resistance.		
True	75	88
False	6	7
Don't Know	4	5
If antimicrobials are taken too often, they are less likely to work in the future.		
True	70	82
False	9	11
Don't Know	6	7
Bacteria cause common cold and influenza.		
True	35	41
False	47	55
Don't Know	3	4
Antibiotics can be used to treat common cold and viral infections.		
True	35	41
False	47	55
Don't Know	3	4
Ineffective treatment can occur due to indiscriminate and injudicious antimicrobial use.		
True	78	92
False	2	2
Don't Know	5	6
Would like more education on antimicrobial use and resistance		
Yes	80	94
No	5	6



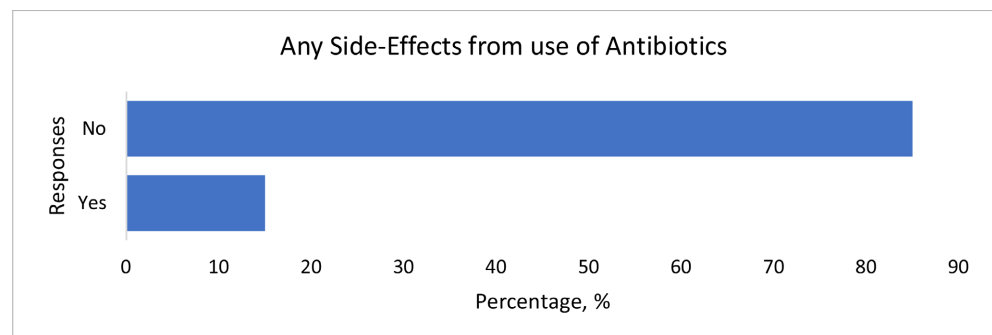
**Figure 1.** Antibiotics usage among the respondents (percentage, %). Date of last antibiotics usage.



**Figure 2.** Antibiotics usage among respondents (percentage, %). Classes of antibiotics used in the previous 3 - 6 months.

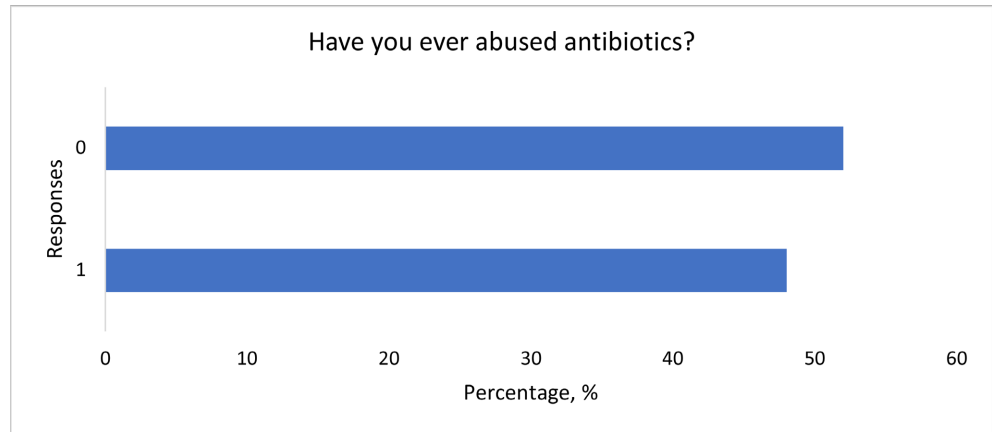


**Figure 3.** Antibiotics usage among respondents (percentage, %). The antibiotic worked for the intended treatment.

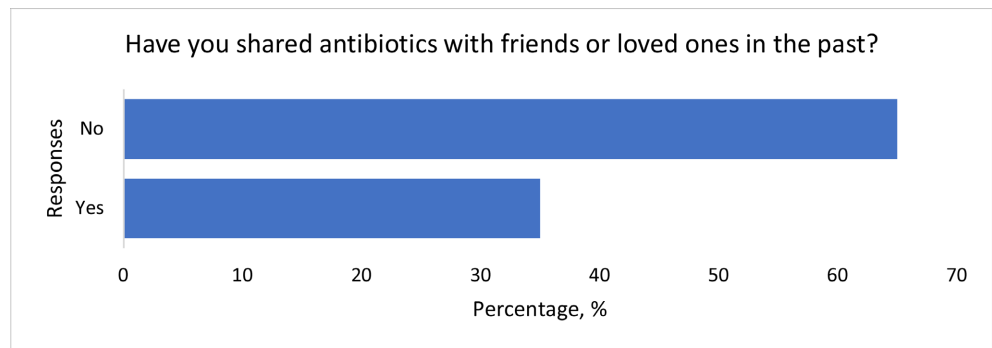


**Figure 4.** Antibiotics usage among respondents (percentage, %). Any side-effects from the antibiotic used?

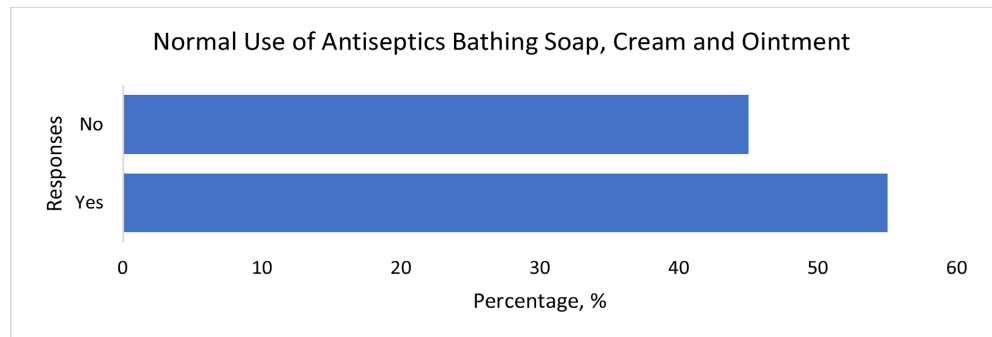
including activities such as salt- or fresh-water swimming, tobacco smoking, attendance at a prison, Creche or nursing home in the past 3 - 6 months, diagnosis of MRSA infection or diabetes mellitus in the previous 12 months, or use of intravenous drugs in the past 12 months. More than 40% of the respondents reported being engaged in contact sports or have had skin infection or boil or sore, while a third (33%) of the respondents reported use of nose earrings/piercing or having had running nose or respiratory infection in the past 6 months prior to



**Figure 5.** Antibiotics usage among respondents (percentage, %). Have you ever abused antibiotics? (0: False, 1: True).



**Figure 6.** Antibiotics usage among respondents (percentage, %). Have you ever shared antibiotics with friends or loved ones in the past?



**Figure 7.** Antibiotics usage among respondents (percentage, %). Do you normally use antiseptic bathing soap, cream and ointment?

participation in the study.

## 4. Discussion

### 4.1. Summary of the Study

Antimicrobial resistance is a global health concern largely caused by inappropriate use of antibiotics, therefore, knowledge of prescribers on antibiotic use is critical. This is the first survey to explore the knowledge, attitudes and practices



**Table 3.** Risk factors for communicable diseases among the respondents.

<b>Risk Factors for Communicable Disease</b>	<b>N = 85</b>	<b>Percentage, %</b>
Use of Nose earrings/piercing:		
Yes	25	29
No	60	71
Practice contact sport		
Yes	39	46
No	46	54
Normally swim in salt water:		
Yes	31	36
No	54	64
Normally swim in fresh water:		
Yes	30	36
No	55	64
Diagnosed with Diabetes mellitus:		
Yes	1	1
No	84	99
Attended Creche in the past six months:		
Yes	5	6
No	80	94
Has been to prison in the past 6 months:		
Yes	2	2
No	83	98
Has been to Nursing home in the past 3 months:		
Yes	11	13
No	74	87
Smoking:		
Occasionally	13	15
Frequently	3	4
Not at all	69	81
Alcohol intake:		
Occasionally	29	34
Frequently	2	2
Not at all	54	64
Had skin infection or boil or sore in the past 12 months:		
Yes	37	43
No	48	57

**Continued**

Has Doctor ever told you that you have MRSA infection in the past 12 months:		
Yes	1	1
No	84	84
In the past 12 months, have you used intravenous drugs:		
Yes	1	1
No	84	99
Have had running nose or respiratory infection in the past 6 months:		
Yes	28	33
No	57	67

regarding antibiotic use and antimicrobial resistance among medical students in a private university in the Commonwealth of Dominica. This study has shown that the medical students in the private university had low or no risk factors for communicable diseases and they demonstrated a low to moderate negative response to knowledge-related questions. The majority of the medical students had used antibiotics in the past year, reported of efficacy and limited side-effects, though they could not recall the classes of antibiotics prescribed. In addition, about half of the respondents confirmed antibiotic abuse, while about a third of them reported sharing of antibiotics with friends or loved ones. There was no significant association between age, gender, educational background, and the medical students' knowledge of antimicrobial resistance ( $p > 0.05$ ). A majority of the medical students reported that they would like more education on antimicrobial use and resistance.

#### 4.2. Comparison with the Existing Studies

The overall knowledge of our study respondents regarding antimicrobial resistance was adequate; majority (>80%) of the respondents affirmed that indiscriminate use of antibiotics leads to emergence of resistance; if antimicrobials are taken too often, they are less likely to work in the future; and ineffective treatment can occur due to indiscriminate and injudicious antimicrobial use. These findings are similar to previous reports [15] [16]. In a study on attitudes and perceptions regarding antimicrobial use and resistance among medical students in Central China, the majority of the respondents (92 %) believed that inappropriate use of antimicrobials causes antimicrobial resistance [15]. In another study in Southern India, a majority, 88%, of respondents were aware that if antibiotics were taken too often, they are less likely to work in the future [16].

Medical students might be expected to have lower rates of inappropriate antibiotic use following some medical training regarding bacteria and antibiotics. However, 41% of our study respondents believed that bacteria cause common cold and influenza, and antibiotics can be used to treat these viral infections. This is contradictory to a study in Central India on the knowledge, attitude and

practices about antimicrobial resistance and usage among the medical students where 94% of the respondents were aware that bacteria were not responsible for causing colds and influenza [17] and another study in Pakistan which reported that of 83.5% responding medical students were aware of the ineffectiveness of antibiotics against viral infections [18]. However, a study in Egypt reported findings similar to our study where 36% of the medical students thought that bacteria cause common cold and influenza [19]. Likewise, another recent study revealed significant gaps in knowledge of 41% - 69% of medical students who believed antibiotics to be useful in the treatment of these viral infections [20]. Misdiagnosis has been found to be a leading cause of unnecessary antibiotic use which can cause antimicrobial resistance and harm patients [15].

In the current study, a high percentage (72%) of the medical students had used antibiotics in the past 12 months. A similar percentage (71%) of the respondents could not mention the classes of antibiotics used in the past 3 to 6 months. It is alarming that almost half of the medical students (48%) reported to have abused antibiotics, while about a third (35%) of the respondents reported sharing of antibiotics with friends or loved ones in the past. Our findings about prior use or sharing of antibiotics by medical students is similar to a study in Bangladesh where 65% of medical students reported consuming antibiotics in the past 12 months, while 27.4% of them reported that leftover antibiotics could be saved for future use or be giving to someone else [21]. The storage of leftover antibiotics increases the likelihood of self-medication as well as consumption by others without prescription which eventually lead to the development of resistance in bacteria [22].

The majority of our study respondents wanted further education on antibiotic use and antimicrobial resistance. This is in line with previous studies [23] [24] [25]. In a study from Saudi Arabia involving 503 dental and medical students' knowledge and perceptions about antimicrobial stewardship, 89.7% and 88.1 % of student respondents desired additional education, respectively, about the appropriate use of antibiotics and on antibiotic resistance [23]. In a study of European medical students' knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance [24], most students (74%) wanted more education on choosing antibiotics treatments which was consistent with 88.0% of medical students in a Nigerian study [25] who wanted more education on antimicrobial use and resistance. Improved knowledge on antibiotic use will boost medical students' confidence in antibiotics prescription, use and management of antimicrobial resistance.

### **4.3. Strengths and Limitations of This Study**

The survey in this study was anonymous and voluntary, which likely reduced the tendency of respondents to provide socially desirable answers. We had a high response rate to the survey with adequate proportions of respondents from the pre-medical, basic medical, and clinical classes represented in the study sample,

thus providing a progression of participants' medical education.

This study has some limitations. This was a cross-sectional study; thus, it was difficult to ascribe causal associations. Recall bias was also possible, though medical students were young and the recall periods were the prior 3 - 6 and 12 months, this bias was probably limited since all measures were based on self-report. We collected no formal data on medical school curricula regarding antimicrobial resistance, use, or stewardship.

## 5. Conclusion

Antibiotic use among medical students is common, and reflects antibiotic misuse or abusive behavior in the public. This study revealed an important insight regarding the disconnect between moderate medical students' knowledge about antimicrobial resistance, and appalling attitudes and practices towards antibiotics use. Students wanted further education on antibiotic use and antimicrobial resistance. Antimicrobial resistance can be reduced to a greater extent by providing medical students with learning opportunities including antimicrobial prescribing and the principles of antimicrobial stewardship. The medical education strategies should endeavor to provide adequate training on the rational use of antibiotics and not only to increase the knowledge but also to change the behaviors and practices among medical students regarding antibiotics use.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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