**Methods**

**Study Design and Setting**

This cross-sectional study was conducted to assess the knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance among students in Bangladesh. Data collection took place over a 3-month period, from November 2022, and involved students from various medical colleges, representing entry cohorts from 2014/15 to 2019/20.

**Participants**

Participants were eligible if they were enrolled in any university at the time of data collection. Face-to-face interviews were conducted using a structured questionnaire, which covered topics related to antibiotic knowledge, antibiotic resistance, antibiotic use practices, and attitudes towards antibiotic misuse and resistance as a health issue.

**Questionnaire Validation**

The questionnaire used in this study was adapted from some similar studies (Citation) in Bangladesh, which assessed KAP regarding antibiotics. The scale used in that study had been validated and proven effective in the Bangladeshi context, ensuring its cultural and contextual appropriateness. To further ensure the relevance and comprehensiveness of the instrument for our study population, the questionnaire underwent expert validation by an independent microbiologist and a medical education specialist.

**Data Collection and Measurement**

Data were collected using a structured questionnaire, divided into three main sections: knowledge of antibiotics and antibiotic resistance, antibiotic use practices, and attitudes toward antibiotic misuse and resistance. The questionnaire included a combination of true/false questions, multiple-choice items, a 3-point Likert scale, and open-ended questions for qualitative analysis.

**Study Size**

The study size was determined based on the availability of participants during the data collection period, aiming to capture a wide range of responses from students across different years of medical study. This approach helped ensure a representative sample of the population.

**Quantitative Variables**

The study's independent variables included demographic factors such as gender, age, types of study, residence, and parental education level. The dependent variables were the participants' antibiotic use practices, knowledge of antibiotics, and attitudes toward antibiotic misuse and resistance.

For the analysis of quantitative variables, descriptive statistics were employed, including calculations of frequencies and percentages. The knowledge, attitude, and practice section of the questionnaire provided scores, which were used to categorize participants' knowledge levels based on median value. Logistic regression models were applied to explore associations between demographic variables and knowledge, attitude, and practice outcomes.

**Statistical Methods**

Data analysis was performed using R statistical software. Descriptive statistics were used to characterize the study population and the distribution of responses. To investigate associations between independent variables and binary outcome measures (knowledge, attitudes, and practice), multiple logistic regression analyses were conducte with a significance level of p < 0.05. Odds ratios (ORs) with 95% confidence intervals were calculated for the logistic regression models.

**Ethical Approval**

**Results**

**Table 1 Socio-demographic characteristics of the participants (N=250)**

|  |  |  |  |
| --- | --- | --- | --- |
| Factor | Labels | Frequency | Percentage |
| Sex | Female | 96 | 38.4 |
|  | Male | 154 | 61.6 |
| Age groups | 16-25 years | 147 | 58.8 |
|  | 26-35 years | 103 | 41.2 |
| Educational Status | Graduate | 168 | 67.2 |
|  | Higher Secondary | 43 | 17.2 |
|  | Post Graduate | 33 | 13.2 |
|  | Higher than graduate | 6 | 2.4 |
| Study Area | Biology | 199 | 79.6 |
|  | Non-biology | 51 | 20.4 |
| Faculty | Agriculture | 4 | 1.6 |
|  | Basic Science | 182 | 72.8 |
|  | Biology | 24 | 9.6 |
|  | Business | 12 | 4.8 |
|  | engineering | 26 | 10.4 |
|  | Social Science | 2 | 0.8 |
| University | Private | 212 | 84.8 |
|  | Public | 38 | 15.2 |
| Parents Academic Background | Non-medical | 179 | 71.6 |
|  | Medical | 71 | 28.4 |
| Residence | Rural | 127 | 50.8 |
|  | Urban | 123 | 49.2 |
| Family Types | Bachelor | 30 | 12.0 |
|  | Joint Family | 45 | 18.0 |
|  | Small Family | 175 | 70.0 |
| Motivational Statement |  |  |  |
| I feel supported physician not to prescribe antibiotic when are not necessary | Agree | 222 | 88.8 |
|  | Disagree | 20 | 8.0 |
|  | Neutral | 8 | 3.2 |
| I feel supported don't intake antibiotic without physician Statement | Agree | 228 | 91.2 |
|  | Disagree | 17 | 6.8 |
|  | Neutral | 5 | 2.0 |

In Table 1, the majority of participants were male (61.6%) and aged between 16 and 25 years (58.8%). Most participants had completed undergraduate education (67.2%), with a significant portion studying Biology (79.6%) and enrolled in the Basic Science faculty (72.8%). Private universities were the most common academic setting (84.8%), and participants predominantly came from rural areas (50.8%). Regarding family structure, the majority reported coming from small families (70.0%). In terms of parental educational background, most participants had non-medical parents (71.6%). A large majority (88.8%) agreed with the statement that they feel supported by physicians in avoiding unnecessary antibiotic prescriptions. Similarly, 91.2% of participants agreed that they feel supported in refraining from taking antibiotics without a physician's recommendation.

**Table 2 Knowledge level of rational use of antibiotic**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SL | Factor | Labels | Frequency | Percentage |
| 1 | Antibiotics are supposed to kill all bacteria in the body | Incorrect | 116 | 47.54 |
|  |  | Correct | 128 | 52.46 |
| 2 | Antibiotics are effective for the treatment of bacterial infections | Incorrect | 6 | 2.41 |
|  |  | Correct | 243 | 97.59 |
| 3 | Antibiotics are effective for the treatment of viral infections | Incorrect | 92 | 38.17 |
|  |  | Correct | 149 | 61.83 |
| 4 | Antibiotic resistance is the loss of activity of an antibiotic ? | Incorrect | 27 | 11.54 |
|  |  | Correct | 207 | 88.46 |
| 5 | Antibiotic resistance can be caused by the over use of antibiotics ? | Incorrect | 12 | 5.04 |
|  |  | Correct | 226 | 94.96 |
| 6 | Is antibiotic resistance an important issue ? | Incorrect | 6 | 2.42 |
|  |  | Correct | 242 | 97.58 |
| 7 | Inappropriate antibiotic dosages caused by antimicrobial resistance ? | Incorrect | 78 | 35.78 |
|  |  | Correct | 140 | 64.22 |
| 8 | People travelling outside country risk bringing resistance to Bangladesh ? | Incorrect | 73 | 33.95 |
|  |  | Correct | 142 | 66.05 |
| 9 | Resistance can spread from animals to humans ? | Incorrect | 41 | 18.89 |
|  |  | Correct | 176 | 81.11 |
| 10 | Resistance can spread from person to person. ? | Incorrect | 105 | 43.21 |
|  |  | Correct | 138 | 56.79 |
| Level of knowledge | | Poor | 55 | 22.00 |
| Good | 195 | 78.00 |

Table 2 presents, most participants, 97.59% correctly identified that antibiotics are effective in treating bacterial infections, while 61.83% correctly understood that antibiotics are ineffective against viral infections. However, a significant portion (38.17%) still held the misconception that antibiotics are effective for viral infections. Regarding antibiotic resistance, the participants showed a high level of awareness, with 88.46% correctly recognizing that antibiotic resistance is the loss of an antibiotic's effectiveness, and 94.96% acknowledging that overuse of antibiotics can contribute to resistance. Furthermore, 97.58% of participants considered antibiotic resistance to be an important issue. However, there were some gaps in knowledge: 35.78% of participants were unaware that inappropriate antibiotic dosages can contribute to antimicrobial resistance, and 33.95% did not realize that travel abroad could bring antibiotic-resistant strains to Bangladesh. Participants also demonstrated a strong understanding of the potential pathways for the spread of antibiotic resistance, with 81.11% recognizing that resistance can spread from animals to humans. Yet, only 56.79% knew that resistance could spread from person to person, suggesting some uncertainty in this area.

When evaluating overall knowledge, the results indicate that the majority of participants (78.00%) had good knowledge of rational antibiotic use, while 22.00% were categorized as having poor knowledge.

**Table 3 Attitude level of rational use of antibiotic**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SL | Factor | Labels | Frequency | Percentage |
| 1 | Nowadays, Antibiotic resistance is a serious concern in the Bangladesh | Disagree | 13 | 5.2 |
|  |  | Agree | 237 | 94.8 |
| 2 | Nowadays, Antibiotic resistance has become a major issue all over the world | Disagree | 19 | 7.6 |
|  |  | Agree | 231 | 92.4 |
| 3 | Do you genuinely think we should become more concerned about antibiotic use? | Disagree | 7 | 2.8 |
|  |  | Agree | 243 | 97.2 |
| 4 | More awareness should be taken to overcome antibiotic resistance | Disagree | 1 | 0.4 |
|  |  | Agree | 249 | 99.6 |
| 5 | Do you believe doctors are often prescribe antibiotics unnecessarily? | Disagree | 83 | 33.2 |
|  |  | Agree | 167 | 66.8 |
| 6 | Antibiotic usage in the poultry and dairy sectors should be properly controlled | Disagree | 6 | 2.42 |
|  |  | Agree | 242 | 97.58 |
| 7 | The government should increase more awareness regarding antibiotic resistance.- | Disagree | 15 | 6 |
|  |  | Agree | 235 | 94 |
| 8 | Antibiotic resistance should be overcome through self-awareness. | Disagree | 73 | 33.95 |
|  |  | Agree | 142 | 66.05 |
| Level of Attitude | | Poor | 63 | 25.2 |
| Good | 187 | 74.8 |

Table 3 presents, regarding the seriousness of antibiotic resistance, the vast majority of participants agreed that it is a significant concern both in Bangladesh (94.8%) and globally (92.4%). Similarly, almost all participants (97.2%) agreed that more attention should be given to antibiotic use. Furthermore, a near unanimous consensus (99.6%) supported the idea that more awareness should be raised to combat antibiotic resistance, indicating widespread concern about the issue. For instance, 66.8% of participants believed that doctors often prescribe antibiotics unnecessarily, while 33.2% disagreed with this statement. Furthermore, 97.58% of participants agreed that antibiotic use in the poultry and dairy sectors should be more strictly controlled, highlighting concern about agricultural contributions to resistance. When asked whether antibiotic resistance could be tackled through self-awareness, 66.05% agreed, while 33.95% disagreed.

Overall, when evaluating the general attitude toward antibiotic use and resistance, 74.8% of participants demonstrated a **good** attitude, while 25.2% exhibited a **poor** attitude.

**Table 4 Practice level of rational use of antibiotic**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SL | Factor | Labels | Frequency | Percentage |
| 1 | Have you ever taken antibiotics? | Poor | 33 | 13.2 |
|  |  | Good | 217 | 86.8 |
| 2 | Do you taken antibiotics during Covid-19 ? | Poor | 49 | 59.76 |
|  |  | Good | 33 | 40.24 |
| 3 | How do you generally take antibiotics? (check as required) | Poor | 27 | 10.8 |
|  |  | Good | 223 | 89.2 |
| 4 | When do you generally take antibiotics | Poor | 196 | 78.4 |
|  |  | Good | 54 | 21.6 |
| 5 | How many times have you consumed antibiotics during the past 12 months? | Poor | 103 | 41.2 |
|  |  | Good | 147 | 58.8 |
| 6 | How many times have another adult in your household (over 18 years old) received antibiotics during the past 12 months? | Poor | 124 | 60.19 |
|  |  | Good | 82 | 39.81 |
| 7 | Is anyone in your household taking antibiotics at the moment? | Poor | 78 | 35.78 |
|  |  | Good | 140 | 64.22 |
| 8 | What illness/symptoms have you had in the last month? | Poor | 114 | 45.6 |
|  |  | Good | 136 | 54.4 |
| 9 | What have you taken your last illness | Poor | 136 | 54.4 |
|  |  | Good | 114 | 45.6 |
| 10 | Do you fail to complete the doses of antibiotic? | Poor | 74 | 29.6 |
|  |  | Good | 176 | 70.4 |
| 11 | Have you taken any antibiotics within the last six months. | Poor | 159 | 63.6 |
|  |  | Good | 91 | 36.4 |
| 12 | Have you ever faced antibiotic resistance? | Poor | 40 | 19.61 |
|  |  | Good | 164 | 80.39 |
| Level of practice | | Poor | 75 | 30.0 |
| Good | 175 | 70.0 |

Table 3 presents, the seriousness of antibiotic resistance, the vast majority of participants agreed that it is a significant concern both in Bangladesh (94.8%) and globally (92.4%). Similarly, almost all participants (97.2%) agreed that more attention should be given to antibiotic use. Furthermore, a near unanimous consensus (99.6%) supported the idea that more awareness should be raised to combat antibiotic resistance, indicating widespread concern about the issue. While there is strong agreement on the need for awareness and action, opinions were more divided on some other aspects. For instance, 66.8% of participants believed that doctors often prescribe antibiotics unnecessarily, while 33.2% disagreed with this statement. Furthermore, 97.58% of participants agreed that antibiotic use in the poultry and dairy sectors should be more strictly controlled, highlighting concern about agricultural contributions to resistance.

When asked whether antibiotic resistance could be tackled through self-awareness, 66.05% agreed, while 33.95% disagreed. Overall, when evaluating the general attitude toward antibiotic use and resistance, 74.8% of participants demonstrated a **good** attitude, while 25.2% exhibited a **poor** attitude.