

## Original Research

# Knowledge, Attitudes, and Practices of adolescents regarding antibiotic use and resistance: A Qualitative study from a developing country

Majd M. Masadeh , Sabariah Noor Harun , Tareq L. Mukattash , Nasr Alrabadi 

Received (first version): 30-Oct-2025

Accepted: 05-Mar-2026

Published online: 14-May-2026

### Abstract

**Background:** Antimicrobial resistance (AMR) is a worldwide problem that impacts all aspects of society, including schoolchildren. This study explores the knowledge, attitudes, and practices of secondary school adolescents regarding antibiotic use and resistance. **Methods:** We used qualitative research methods with a focus group approach. Jordanian secondary school adolescents aged 16 to 18 from various schools were interviewed, and thematic analysis was carried out on the interview transcripts. **Results:** Secondary school adolescents (n= 48) from eight schools in different places participated in eight focus groups. Most participants (n=46) admitted not having heard of antibiotic resistance before the interview. Few students had a vague understanding or had heard the term mentioned in passing, often through the media or family members. Students frequently emphasized that common infections could be treated with antibiotics. A large proportion of the students reported taking antibiotics for self-diagnosed infections or based on advice from family members. **Conclusions:** The current study findings have revealed significant gaps in knowledge, attitude, and wrong practices about antibiotic resistance among secondary school students in developing countries like Jordan.

**Keywords:** Knowledge, Attitudes, and Practices, Adolescents, Antibiotic Use, Antimicrobial Resistance, Qualitative Study, Jordan

## INTRODUCTION

The continuous increase in the incidence of bacterial resistance to existing antibiotics represents a worldwide health burden<sup>1</sup>. Recent studies have pointed out that educational interventions are significant in combating AMR, especially in selected community groups, like school children's parents<sup>2</sup>. According to a study by Al Shikh et al.<sup>3</sup> an intervention program significantly improved Jordanian parents' knowledge and attitude toward the prudent use of antibiotics by their children. The study concluded that even brief educational sessions are necessary for them to significantly impact the participants' understanding of and behaviors related to antibiotic use. The findings suggest that incorporating AMR education into school curricula and parent outreach programs may be an effective way to increase awareness about this issue on a much larger scale, which was also supported by other researchers<sup>4,5</sup>.

Cultural factors are influential in developing an attitude toward the use of antibiotics by showing how community norms and practices influence medical behaviours<sup>2</sup>. Research conducted by Abdel-Qader et al.<sup>6</sup>, through semi-structured interviews, explored the cultural dimensions showing that traditional conceptions of healthcare autonomy and the need for rapid medical fixes often lead to higher rates of self-medication and non-compliance with prescribed antibiotics. These practices considerably add to the problem of antibiotic resistance.

Qualitative studies have examined the practice of antibiotics among adolescents through a complex interaction of knowledge, cultural beliefs, and social influence. Children over 12 years have more advanced abstract reasoning, verbal and mental problem-solving abilities, and decision-making abilities with the help of deductive logic; their linguistic and cognitive skills develop<sup>7</sup>. With better linguistic and cognitive skills, adolescents begin to have a highly differentiated sense of self and start to reason abstractly or think abstractly; their intellectual capacity grows, and they can divide their attention between multiple stimuli simultaneously, and they start to think hypothetically<sup>2</sup>. Anecdotal evidence and self-report data suggest that children appear to become increasingly self-conscious and concerned with other people's opinions as they age through puberty and the period of adolescence<sup>8</sup>

Older adolescents (16–18 years) are a distinct group of antibiotic users for investigation unlike younger children, they may be in control of their own medicines and responsible for their use<sup>9</sup>. In particular, as adolescents are eager to be compared to their parental influence and create their own self-image, parents will have a minor role in managing medications related to infections such as RTIs<sup>10,11</sup>. Additionally, Hawking et al,<sup>12</sup> in his study he

**Majd M. Masadeh\***. Discipline of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800, Penang, Malaysia; Department of General Education, School of Humanities, City University College of Ajman, Ajman 18484, UAE. [mmasadeh127@gmail.com](mailto:mmasadeh127@gmail.com)

**Sabariah Noor Harun**. Discipline of Clinical Pharmacy, School of Pharmaceutical Sciences, Universiti Sains Malaysia, 11800, Penang, Malaysia.

**Tareq L. Mukattash**. Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid 22110, Jordan.

**Nasr Alrabadi**. Department of Pharmacology, Faculty of Medicine, Jordan University of Science and Technology, Irbid, 22110 Jordan



undertook a focus group study assessing how the influence of friends and social media has influenced adolescents' decisions to use antibiotics in the south of England. It became clear that misinformation spread through social networks leads to abuse, such as when antibiotics are used to treat viral infections like the flu<sup>13-17</sup>.

Qualitative research on AMR among adolescents highlights critical insights into their understanding, attitudes, and practices influenced by educational gaps and cultural contexts<sup>11</sup>. To combat the rise of AMR effectively, it is essential to leverage these insights in developing tailored interventions that resonate with adolescents' experiences and challenges. Such strategies should focus on enhancing knowledge and transforming attitudes and practices through culturally sensitive and contextually appropriate educational initiatives. This study aims to explore the knowledge, attitudes, and practices of secondary school adolescents regarding antibiotic use and resistance through focus group discussions. It also aims to gather comprehensive information on the factors that influence secondary school adolescents' knowledge, attitudes, and practices concerning the use of antibiotics and antibiotic resistance and to identify recurring themes and patterns within the qualitative data, which will inform the development of an educational tool in the subsequent phase of the study.

## METHODS

### Study Design

This study has conducted a qualitative exploratory approach through focus group discussions. Focus groups were selected as the primary data collection method because they facilitate dynamic interactions and collective reflections, enabling participants to build upon each other's responses.

### Study population and site of study

This study has focused on group discussions with Jordanian secondary school adolescents aged 16 to 18, as per the criteria set by the World Health Organization<sup>18</sup>. To ensure diversity and representativeness, our methodology involved conducting the study in multiple schools in different regions of Jordan, selected to encompass a range of socioeconomic backgrounds. The scope of inclusivity encompasses secondary school adolescents residing in urban, suburban, and rural areas, which has been accomplished through the deliberate selection of sites spanning various geographical regions. The acknowledgment of regional diversity in Jordan's adolescent population recognizes the potential existence of variations in knowledge, attitudes, and practices regarding antibiotic use & resistance.

### Sample size

This study used the data saturation method for the sample size. Based on previous research discussed above and the factors discussed, the recommended group size for this study was 6 participants for each group. The point of saturation is reached when the data collected from these eight distinct groups yield

identical results and no new, significant information emerges. However, saturation came in the 6th discussion; two more discussions were conducted to confirm this. These eight discussions were conducted from April 2024 to June 2024. On the other hand, a non-probability purposeful sampling technique was utilized in this phase. It involves purposefully selecting participants for a study to capture a range of perspectives and experiences that can offer valuable and diverse information to address the research objectives<sup>19,20</sup>.

To ensure a broad representation of secondary school adolescents' perspectives on antibiotic use and resistance across Jordan, the study has included schools from various geographical and socio-economic backgrounds, rural, urban, and suburban, in different schools across Jordanian cities. The selection encompasses a wide geographical spread. It captures the diverse cultural and socioeconomic backgrounds in Jordan, ensuring that the study's findings are representative and informative for developing effective public health interventions tailored to various communities within the country.

### Focus Group Guide Development

The focus group guide was designed for secondary school adolescents aged 16 to 18. The reporting criteria are checked according to the Consolidated Criteria for Reporting Qualitative Research Checklist, focusing on clearly reporting qualitative research studies. Its design utilizes simple questions and language that the targeted age group can easily understand, making the content appropriate for the age group and the discussion flow well. The first step in this process was a comprehensive literature review on antibiotic resistance, focusing on the impact and perceptions among adolescents. This helped narrow down critical themes and knowledge gaps that provided a sound framework for questions to be used within the guide. The literature informed the scope of the guide in ensuring that the questions ranged from general to specific with regard to the use of antibiotics and resistance<sup>21-30</sup>. After the literature review, the formulation process followed as closely as possible on the guidelines through the Consolidated Criteria for Reporting Qualitative Research (COREQ) Checklist in developing the questions within the focus groups and ensuring that any question was for qualitative study research. We used the methodological guide contained in the checklist to develop comprehensive but relevant questions for the determination of the study objectives.

The initial set of questions for focus groups was designed based on the COREQ guidelines. Questions were open-ended so that adolescents were free to express their thoughts and experiences regarding the use of antibiotics. The design was aimed at providing a comprehensive overview of their knowledge, experiences, and views regarding antibiotics and antibiotic resistance. The drafted questions had a review process, whereby discussions with the research team were conducted. It was necessary since such a review would provide clarity, making the questions intriguing enough to attract the targeted audience. They also improved the questions to be aligned more with the objectives of the study and the levels of understanding of participants. An icebreaker question was



added to enrich the tool's ability to create a comfortable setting for open discussion, which has been proven successful in getting adolescents involved and freely expressing their opinions<sup>31</sup>. Following these, the guide went into the validation phase, which was the phase for establishing the content validity<sup>32</sup>.

### **Content Validation Process of the FGD Guide**

A validation process has been undertaken by selecting a panel of 4 experts suggested that the minimum number of members in a panel of experts in content validation is three<sup>33</sup>. Each expert on the panel was provided with the focus group guide and a content validity feedback form for qualitative studies. They were asked to evaluate the focus group guide based on Clarity, Wordiness, Negative Wording, Overlapping Responses, Balance, Use of Jargon, Appropriateness of Responses Listed, Use of Technical Language, Application to Praxis, Relationship to Problem, Measure of Construct (Perspective). Each item is rated using guideline Score: 1=Not Acceptable (major modifications needed), 2=Below Expectations (some modifications required), 3=Meets Expectations (no modifications needed but could be improved with minor changes), 4=Exceeds Expectations (no modifications needed). After finishing the process, improvements were made based on experts' comments.

### **Translation Process**

The focus group guide underwent translation according to standard guidelines for the process of development, translation, and cross-cultural adaptation<sup>34-35</sup>. This is to achieve high-quality translation and meaning consistency with the original language. After the content validation of the focus group discussion (FGD) guide has been completed, with input from selected experts, the guide has proceeded through a backward-forward translation process to ensure its linguistic and cultural appropriateness for the Jordanian context. Next, two different bilingual healthcare researchers who haven't seen the original English document have conducted the backward translation of this Arabic version back into English. After this, the Arabic version of the FGD guide underwent another round of content validation that is in line with what was done in the first stages.

### **Content validation (Arabic Version)**

This involved another panel of experts: local experts in clinical pharmacy, public health, and qualitative research expertise all with deep insights into Jordan's cultural and social fabric. They checked the guide against what is indicated in the Content Validity Feedback Form for qualitative studies

### **Flow of Conducting the Focus Group Discussion (FGD)**

#### ***Recruitment Strategy and Consent Process***

In the study, participants were recruited starting with identifying schools in which the targeted population for the research would be reached- a broad and representative sample of 16-18-year-old adolescents from secondary schools in Jordan. The recruitment process included school identification, permissions needed, information to parents, and consents.

First, we compiled a list of selected secondary schools from different socio-economic and geographic divides. We obtained respective permissions for every selected school from the administration of the particular school. These approvals were crucial as they permitted us to involve the schools' students in the study and facilitated our access to distribute consent forms to caretakers. After obtaining permission, we offered presentations to the head teachers and school administrators regarding the aims of the study and the public health importance of it. These presentations were instrumental in gaining the schools' cooperation in reaching out to parents and guardians.

Parents/guardians were informed about this study through school meetings and written documentation during all study phases. The letters sent to parents/guardians included information regarding the scope of the survey, voluntariness, and confidentiality. A week before the session, informed consent forms were distributed for caretakers to sign and assent forms for the students. To encourage participation, it was communicated that at the end of the session, participants may receive a token of appreciation, such as educational materials or small gifts, acknowledging their contribution to important research.

### ***Selection of Moderators***

A 5-year experienced clinical pharmacist who is an expert in qualitative research was chosen as an interviewer for the focus group discussions (FGDs). The interviewer facilitated the discussion and motivated participants to openly share their personal experiences and perspectives. The interviewer conducted all discussions to maintain consistency, making sure that she did not have any previous relationship with any of the participants.

### ***Pilot Testing of the FGD Guide***

Before the main study, a pilot FGD was conducted with 6 participants in a focus group of students. The target population consisted of secondary school adolescents aged 16 to 18 years. Participants were required to be currently enrolled in secondary schools (either public or private) and to be capable of engaging in Arabic-language discussions, given that all focus groups were conducted in Arabic. After finishing the discussion, the participants were asked for their feedback, whether the content was ensuring questions were clear, engaging, and appropriate for the target age group, and based on the participants' points of view, the feedback was subjective.

The pilot study results were discussed and reviewed with the supervisors and panel experts. Based on observations and feedback from this initial group, some questions were identified as redundant, leading to similar types of responses as other questions, or too complex, potentially hindering the students' understanding and response quality.

### ***Study sites***

Study sites for this project were classrooms within different primary and secondary schools in Jordan. A summary of the schools participating in the study can be found in



Table 1. Individual school names are not included to retain confidentiality. The schools were chosen to represent the socio-economic variation within Jordan and were also chosen to represent different types of schools in Jordan. Schools in Jordan are divided into Basic (Basic Education is a 10-year compulsory and free level of education “grades 1-10”) and secondary schools (Grades 11 & 12). The secondary education level consists of two years of study for students aged 16 to 18 who have completed the basic cycle (ten years)<sup>36</sup>.

	School Code	School Location	Location Type*	Type of School	Distribution/Gender
1	IMF	Irbid	Rural	Public	6 - Male
2	IMM	Irbid	Urban	Private	6 - Female
3	AT	Amman	Suburban	Private	6 - Female
4	EX	Amman	Urban	Private	6 - Female
5	AQ	Zarqa	Suburban	Private	6 - Male
6	H	Ajloun	Rural	Public	6 - Male
7	ZM	Aqaba	Rural	Public	6 - Female
8	ZF	Aqaba	Urban	Public	6 - Male

\*The inclusion of ‘Location Type’ in the data table, categorized as urban, suburban, or rural, adheres to the classifications defined by the Administrative Divisions System of 2000, as mandated by Jordanian legislation, and effective from January 1, 2001.

### Conducting the FGD Session

The study’s participating schools allowed the researcher and moderator to use one of their teaching rooms to carry out the focus group discussions. The researcher prepared the room before requesting the students’ presence. A table with six chairs surrounding it was placed in the middle of the room, with name plates and a brochure placed by the seat of each participant. To accurately capture the discussion, A recording device was placed in the middle of the table. Sessions were recorded audibly, with additional note-takers present to document non-verbal cues and ensure no loss of data due to technical issues, and to help identify participants when analyzing the transcripts.

During the FGD sessions, the moderator played a crucial role in ensuring the discussion was as interactive as possible. The moderator started with an introductory icebreaker question to encourage participants to participate in the discussion, followed by structured, open-ended questions designed to explore their knowledge, attitudes, and practices regarding antibiotic use and resistance. After the session, each student was given a token of appreciation to thank him/her for participating. The focus group guide has four themes: *Knowledge of Antibiotic Resistance, Attitudes Toward Antibiotic Resistance, Practices Related to Antibiotic Use, and Educational Tool Development.*

### Data Collection and Analysis

The discussions were conducted in Arabic. They were recorded using deidentified labels, transcribed verbatim, and translated into English. The researcher transcribed all the recorded

discussions and then translated them into English immediately after each interview.

## THEMATIC ANALYSIS

Thematically, translated data were analyzed to understand the participants’ views on antibiotic use and resistance. Once themes have been identified, theoretical construction has begun. Braun and Clarke developed a six-phase approach to reflexive thematic analysis in their seminal work<sup>37</sup> :

### Stage 1: familiarization with the research data

This phase was conducted by the researcher under the guidance of the supervisory team, which included both the primary supervisor and co-supervisor. The process entailed multiple readings of the transcript data from the focus groups, enabling the researcher to immerse deeply into the textual content and context of the participants’ responses.

### Stage 2: Generating initial codes

Initial codes were generated by identifying recurring themes and ideas expressed by the participants, which were noted directly on the transcripts. This method allowed for an organic emergence of codes from the data, adhering to the inductive approach suggested by Braun and Clarke for qualitative analysis.

### Stage 3: Searching for and Reviewing Themes

This involved organizing the codes into a thematic map, where similar codes were grouped together to identify overarching patterns. Each potential theme was rigorously reviewed by iterating between the thematic map and the original data to ensure accuracy and coherence. The supervisory team provided essential feedback during this process, helping to refine and validate the themes.

### Stage 4: Themes Definition

The first theme, “Students’ Knowledge of Antibiotic Resistance,” explored the extent of students’ understanding about antibiotic resistance, highlighting the accuracy of their knowledge and the misconceptions they held. The second theme, “Experiences with Antibiotic Use,” captured personal and observed experiences of students with the use of antibiotics, noting both appropriate uses and instances of misuse. Further, the theme “Students’ Views Towards Antibiotic Resistance” reflected the attitudes and beliefs held by students regarding the seriousness of antibiotic resistance and their perceived responsibility in addressing this issue. Another significant theme, “Alternative Treatments and Home Remedies,” categorized discussions around non-prescription methods used by students or their families to manage health, shedding light on cultural and individual health practices. The final theme, “Awareness and Education,” addressed the level of awareness among students about antibiotic resistance and detailed their exposure to educational initiatives aimed at reducing misuse. This theme was critical in understanding the effectiveness of current educational strategies and identifying areas for improvement.



Throughout this stage, each theme was substantiated with direct quotes from the focus group discussions, ensuring that the interpretations remained closely tied to the participants' perspectives.

### Stage 5: Defining and naming themes

Each theme was carefully reviewed to confirm that it accurately represented the focus group data and was distinct and relevant to the study's objectives. The naming of the themes was deliberately chosen to reflect the core insights of the discussions. For example, "Students' Knowledge of Antibiotic Resistance" directly conveys the focus on understanding and misconceptions, while "Experiences with Antibiotic Use" encapsulates personal and observed usage patterns among participants.

### Stage 6: Producing the final report

This report detailed the study's objectives, methodology, and key findings, with each theme explored through direct participant quotes to illustrate the core insights. The discussion linked the findings to existing literature and outlined their implications for public health and education, providing recommendations for future research. The final report underwent thorough revisions to ensure clarity and academic rigor, with input from the supervisory team to refine content and presentation. The report was carefully formatted to meet the institutional guidelines, ensuring a professional presentation of the study's contributions to understanding antibiotic resistance among adolescents. In this study, all six established stages of Manual Thematic Analysis were followed precisely, as per the guidelines from highly influential sources<sup>38,39</sup>.

## RESULTS

### Demographics

48 secondary school adolescents from eight schools in different places in Jordan participated in eight focus groups. Table 2 presents summaries of the schools and participants who attended.

Focus Group (FG)/ Individual interview	Age Group	No. of consent forms sent from school inviting attendance	No. of consent forms returned	No. of pupils who attended the focus group
1	16-18	12	8	6
2	16-18	12	8	6
3	16-18	12	8	6
4	16-18	12	7	6
5	16-18	12	8	6
6	16-18	12	8	6
7	16-18	12	6	6
8	16-18	12	6	6
<b>Total</b>	N/A	192	124	48

### Main Themes and Emerged Subthemes

The following are the major themes and sub-themes emerged from the analysis of transcribed interviews (Table 3)

Theme No.	Themes	Subthemes
1	Students' Knowledge of Antibiotic Resistance	1.1 No to Little Knowledge
		1.2 Misunderstood of Antibiotics Benefits & Resistance.
2	Experiences with Antibiotic Use	2.1 Reasons for Use
		2.2 Effectiveness of Antibiotics
		2.3 Adherence to Dosage
3	Students' Views Towards Antibiotic Resistance	Preventative Use of Antibiotics
4	Alternative Treatments and Home Remedies	Use of Natural Remedies
5	Awareness and Education	5.1 Role of Healthcare Professionals
		5.2 Role of Government
		5.3 Role of School
		5.4 Suggested topics from students to Increase Self-Awareness toward antibiotic resistance by developing the Education tool.
		5.5 Preferred Learning Formats

### Theme 1: Students' Knowledge of Antibiotic Resistance

#### No to Little Knowledge

The majority of participants (n=46) admitted to not having heard of antibiotic resistance before the interview. Few students had a vague understanding or had heard the term mentioned in passing, often through media or family members. According to the source of their information, all students (n=48) mentioned that schools had not provided any information on the topic, highlighting a gap in the formal education curriculum.

*"Yes, I saw a post on Facebook about it once." (IMM1)*

*"I heard about it, but I don't know the details." (ZF4)*

*"The school didn't provide any information." (All students, AT1-6)*

#### Misunderstood of Antibiotics Benefits & Resistance

Several misconceptions about antibiotics' role, effectiveness, and resistance existed, such as the belief that antibiotics strengthen the immune system or treat viral infections. However, there was a clear agreement regarding misconceptions about antibiotic resistance and its implications.

*"The red and black (Ampicillin) pills are great for pain like headaches or muscle aches because they kill infections". (AQ2)*

*"The red and black pills (Ampicillin) and yellow capsules (what is meant here is Amoxicillin 500mg) are perfect for treating colds and flu because they help you recover faster from viral*



infections". (AQ4)

"Healing or sterilizing the wound. This means that when there is a wound on the body, we use antibiotics to prevent infection and help the wound heal quickly." (AT2)

"Fighting infection or disease. We use antibiotics to fight bacteria and viruses in the body and improve our health quickly." (AT3)

"I take an Injection in the pharmacy called 'magic injection' (what is meant here is the Diclofenac Sodium & dexamethasone phosphate IM Injection). It helps strengthen immunity, and it is magic; I feel better when I take it directly." (AQ1)

"I know that local medications cause resistance; foreign pharmaceutical companies' medications do not cause resistance." (H1)

"It is a virus that enters the body, but at a lower rate." (ZM3)

"Maybe it means that the body fights disease better." (ZF1)

"I think they are medications that strengthen the immune system." (ZF2)

"It reduces the body's immunity." (ZF5)

"You can catch antibiotic resistance from someone else like a cold." (AQ2)

"Antibiotic resistance happens to animals, not humans. (AQ 4)

"A capsule I take when I'm sick. I take it when I have a sore throat or any other infection." (AT5)

"The body and immune system are resistant to disease." (IMM2)

"Viruses become stronger." (IMM3)

## Theme 2: Experiences with Antibiotic Use

### Reasons for Use

Students frequently emphasized that common infections could be treated with antibiotics. This trend indicates a perception among students that antibiotics are effective and necessary for treating quickly addressed infections, which are usually self-limiting or manageable with less aggressive treatments.

### Self-diagnosed infections

A large proportion of the students reported taking antibiotics for self-diagnosed infections, in particular, throat infections, ear infections, and sinusitis. This raises a concern that students equate antibiotics with quick solutions for what are mostly self-limiting diseases or conditions capable of less aggressive treatments.

"If I take antibiotics immediately when I fall sick, that is better, so the condition doesn't worsen." (AQ1)

"Yes, I took antibiotics when I had a sore throat." (AT1)

"I used it once when my throat was hurting, and it did work. I recovered very well." (IMM1)

"I took an antibiotic once when I had tonsillitis." (IMF1)

"I used it when I had an ear infection and a sore throat, and I felt better within a few days." (ZM5)

"My mom gives me antibiotics when I have a cold." (ZF2)

"I took it for fever, I felt better after a day." (ZF4)

### Self-Prescription and Family Recommendations

A considerable number of students admitted to using antibiotics based on advice from family members or through self-prescription rather than seeking professional medical advice. This behavior reflects a broader cultural or familial trend where antibiotics are considered a viable option for various ailments, regardless of whether a professional medical evaluation is necessary. On the other hand, there are too many students who mentioned some too many students mentioned that they asked one of their relatives or the pharmacist instead of a Physician. Many students relied on self-medication or advice from non-professionals when deciding to use antibiotics.

"I take painkillers and natural drinks, and if that doesn't work, I will take antibiotics the next day." (AQ2)

"I go to the pharmacy or call my cousin, who is a pharmacist." (ZM3)

"Yes, because the doctor is very far away and the cost is also high, we always resort to the pharmacist or consult a family member." (ZF6)

"Yes, based on advice from a friend." (ZF3)

"My mother gives me some of the medicines available from home that one of my brothers used when he got sick, such as yellow capsules (Amoxicillin)." (ZF2)

"My mom sometimes gives me pills when I feel tired, but I don't remember the names." (EX2)

"If I don't get better by consuming natural herbs like ginger and honey, I take antibiotics." (AT2)

"I rely on my mom's advice or take pills from the pharmacy without a prescription." (EX2)

"Yes, buying from a pharmacy is cheaper and easier; however, if I go to a medical center, I must pay doctor's examination costs of approximately 20 JOD, which is not worth it, and he will give me the same as the pharmacist." (ZM4)

"I rely on what meds are accessible at home; for consultations, I ask a relative who is a pharmacist or search on Google." (ZM3)

### Effectiveness of Antibiotics

The perceived effectiveness of antibiotics among students was closely linked to their immediate symptomatic relief, leading to common practices of premature medication discontinuation. This behavior highlights a significant misunderstanding of the importance of completing antibiotic courses to ensure full recovery and prevent resistance.

### Perceived Benefits

For many students, the effectiveness of antibiotics was judged based on the relief of symptoms rather than the importance



of completing the entire course of treatment. This perception leads to a higher likelihood of stopping the medication once they feel better, disregarding the potential consequences of incomplete treatment.

*"I take them immediately to speed up the treatment." (AQ3)*

*"It was very effective in fighting the infection every time I used it." (AT3)*

*"I took it for fever, I felt better after a day." (ZF4)*

*I felt better after a few days, so I stopped taking them." (AQ6)*

*"I felt better after two days and stopped taking it." (IMF2)*

### **Adherence to Dosage**

Students' adherence to prescribed antibiotic courses was notably poor, with a common tendency to discontinue use once symptoms improved. This practice reflects a lack of understanding of the necessity of completing the full course to ensure complete eradication of infection and prevent antibiotic resistance.

### **Incomplete Courses**

Many students admitted to not completing the prescribed course of antibiotics, often stopping the medication once they felt better. This behaviour was driven by a general dislike for taking medication, or they think that there is no need to continue it. 4 out of 48 participants only mentioned continuing their antibiotics, which makes it a big concern.

*"Occasionally, I discontinue the medication if I experience a significant improvement in my health, as I believe that the infection has been successfully resolved." (AQ2)*

*"No, I usually stop taking the antibiotics as soon as I feel better, even if it's before finishing the course." (AT1)*

*"No, I stop it when I feel better." (AT3-4)*

*"I always take them and quit when I feel better." (H1)*

*"I felt better after two days and stopped taking it." (IMF2)*

*"Yes, I completed the entire course because my mother forced me to." (AT6)*

*"Sometimes, but if I feel a significant improvement, I might not complete the treatment." (AQ4)*

*"I usually don't complete the course because I forget, or I don't like the taste of the medications." (AQ6)*

*"I don't like taking medications, so I try to avoid antibiotics." (IMM6)*

### **Reported Side Effects & Negative Experiences**

Side effects such as nausea, difficulty swallowing pills, and stomach issues were frequently mentioned. These adverse effects were a major factor in their decision to discontinue the medication prematurely.

*"I don't like the taste of the medications." (AQ6)*

*"It caused me some side effects such as dizziness and nausea." (AT1)*

(AT1)

*"My grandma had a bad reaction to antibiotics once; she got a rash, and her doctor had to switch her to a different kind." (H6)*

*"I had to eat yogurt because my stomach was always upset after taking them." (H2)*

*"It can cause allergy as an adverse effect." (IMM4)*

*"I know that they have a bitter taste." (IMM5)*

*"It had a bitter taste, and I did not complete the course. It can also sometimes cause me digestive problems." (IMM1)*

*"One of its side effects may be that it causes an allergy." (IMF2)*

*"After undergoing surgery, my mother was experiencing nausea as a result of taking an antibiotic." (ZM3)*

*"An excessive number of medications can result in adverse effects and a weakened immune system." (ZM2)*

*"It did not work very well. For instance, my stomachache decreased after I took capsules, but I developed ear pain instead." (ZF1)*

## **Theme 3: Students' Views Towards Antibiotic Resistance**

### **Preventative Use of Antibiotics**

Some students expressed that they used antibiotics for prophylaxis. This is indicative of a high degree of misunderstanding about the appropriateness of antibiotic use. Very little knowledge about specific indications for medication and risks associated with misuse was indicated. While some students indeed recognized the inappropriateness of prophylactic use, the very consideration suggested the need for greater clarity beyond additional directions as to when antibiotics are and are not indicated. Educational efforts should be focused on reinforcing the fact that antibiotics are not suitable for preventing illnesses and should only be taken when prescribed by a healthcare professional for a confirmed bacterial infection.

### **Prophylactic Use**

Though some students said they used antibiotics as a precaution, this further demonstrates the misconception behind them. According to these students, the idea of using antibiotics as a precautionary measure exudes a serious gap in understanding. Antibiotics are meant to fight bacterial infections and using them against the infections that they bring about only ushers the fast development of bacteria that is resistant to antibiotics.

*"Yes, if I have had close touch with someone who is sick." (AT3)*

*"Yes, if I know I'm at risk for infection, for example, if I have symptoms such as fever." (AT6)*

*"Yes, if, like, I was going somewhere that I might get sick, like on a trip to someplace with lots of diseases like 'Umrah'." (ZM1)*

*"Yes, I take it before travelling to avoid getting sick." (ZF1)*

*"Yes, I take it if there's someone sick from my family." (ZF6)*

## **Theme 4: Alternative Treatments and Home Remedies**



The students resorted excessively to natural remedies and home treatments, proving a strong preference for non-pharmaceutical approaches in managing minor illnesses. As such, this trend underlines the role that family tradition, together with perceived additional benefits to health and disease prevention, plays with respect to the use of natural remedies.

## Use of Natural Remedies

### Trust in Alternative Methods & Home Remedies

Students are mostly reached out to by home remedies such as honey, lemon, ginger, and garlic in minor ailments. These were considered very potent natural treatments for things like cold and sore throat illnesses, which can be substituted with antibiotics as treatment. These are all illustrative examples of deep belief in natural remedy effectiveness. The students emphasized the use of these remedies to improve symptoms and improve their immune system and often used these remedies instead of more conventional antibiotics. Their use of natural remedies indicates a very cautious attitude towards applying antibiotics and keeping them for more serious conditions. High trust was placed on family traditions and recommendations regarding natural remedies. Students often embraced conventional wisdom, decades-long practical experience, and remedies that their family members suggested.

This belief in alternative therapies is based on the cultural and familial approaches influencing health behaviors. Students believed in family advice and the use of natural remedies as a way to cope with minor illnesses more safely and effectively.

*I have been sick for three days but did not take antibiotics. Instead, I used natural remedies, hot drinks, and oranges because they contain vitamin C, which enhances immunity.* (AQ2)

*"I prefer to use painkillers and hot drinks before resorting to antibiotics."* (AT2)

*"I don't use antibiotics much, I try to just drink hot water."* (EX5)

*"I prefer to rest and take natural things like honey and lemon."* (EX6)

*"I prefer using natural herbs and hot drinks."* (H6)

*"I rest and consume hot beverages like Anise tea."* (IMM2)

*"I prefer hot drinks, herbs like chamomile."* (ZM2)

*"It is preferable to rest rather than attend school."* (ZM3)

*"My father uses ginger supplements at the first sign of a cold. He believes it boosts his immune system and helps him fight off infections naturally."* (ZM5)

*"Yes, my mom always makes us chicken soup and gives us lots of fluids when we have a cold. She believes in letting the body heal naturally unless it gets really serious."* (ZM1)

*"Yes, my grandmother uses turmeric in milk, which she calls 'golden milk,' for any kind of infection or inflammation. She's not a big fan of taking antibiotics unless necessary."* (ZM4)

*"I choose natural remedies such as tea with lemon and honey because it helps relieve symptoms without side effects."* (AT1)

*"My mother makes me a mixture of garlic and ginger, and she tells me it is a natural antibiotic."* (AT6)

*"My brother had a bad acne breakout, and instead of going for antibiotics, he used a mask made from turmeric and honey. It took a while, but his skin cleared up well."* (H2)

*"Yes, for example, when I suffered a burn, I used a natural herbal cream that is red and well-known in Jordan; my grandmother created it for me, and it worked well."* (H4)

## Theme 5: Awareness and education

### Role of Healthcare Professionals

The students identified the importance of health professionals in guiding and teaching patients about the proper intake of antibiotics. In addition, they realised that clear guidelines and continuous monitoring by medical professionals are necessary. According to the students, healthcare professionals have to provide wide guidance on how one should take antibiotics properly and see how patients respond to the prescription. This response brings into light the essential roles of doctors and pharmacists in making sure patients know how to take their antibiotics properly. There was agreement that health professionals should take charge in educating patients about the dangers of antibiotic resistance. This includes participating in public awareness campaigns to reach a wider audience.

*"They should educate patients about the correct use of antibiotics."* (AQ 1)

*"They must provide appropriate medical advice for each case."* (AQ 2)

*"They should refuse to give antibiotics without a prescription."* (AQ 4)

*"To ask patients if they have used antibiotics before."* (AT1)

*"To explain to us how to use it correctly and the importance of completing the course."* (AT2)

*"To offer the appropriate advice for each case and emphasize not to overuse them."* (AT3)

*"They should teach us more about medications and when they should be used."* (EX3)

*"They should participate in awareness campaigns to increase awareness about the proper use of medications."* (H5)

*"Physicians and nurses should be the main ones to stop antibiotic resistance because they know all about medicines and can tell people when to take them and when not to."* (AT2)

*"I believe that the doctor is the first and last responsible because he is the one who diagnoses the condition and is the one who gives the medicine, and only the pharmacist dispenses the medicine."* (IMM6)

*"They should ask patients about their medical history before giving medication."* (IMF1)



*"They should explain the dangers of overuse of antibiotics."* (IMF6)

*"They should follow up on patients' conditions."* (ZM3)

*"They should explain the risks to patients."* (ZF4)

*"They should participate in awareness campaigns."* (ZF5)

### **Role of Government**

The students pointed out the role of the government in creating awareness and regulatory policies in fighting resistance. They yielded to the fact that a more government-driven approach with regulations is required. It is only through government-led initiatives, they felt, that public awareness about the issue of antibiotic resistance can be effectively raised. Only then can appropriate information dissemination be achieved to such a large section of people. This again reflects their belief that a greater level of public understanding and subsequent responsible use of antibiotics can be ensured through government-led campaigns.

Furthermore, policies governing the distribution and usage of antibiotics are needed. Students felt that such misuse could be curbed with more stringent regulations. What was reflected in their response is the recognition of the need for regulatory measures to ensure antibiotics are used only when appropriate, relevant, and medically necessary.

*"Pharmaceutical companies should also be held responsible because they produce and market these drugs. They must work closely with governments to ensure their products are used correctly and safely."* (AQ2)

*"The government should be responsible because they can make rules about how antibiotics are used and make sure everyone follows them to stop germs from getting too strong."* (AT6)

*"Maybe the government because they control everything, right?"* (EX2)

*"The government should be responsible because they should protect us."* (EX5)

*"There should be greater awareness from the government and doctors about how to use antibiotics properly."* (H6)

*"The healthcare sector and the government should assign a specific person to each school to explain all these matters and conduct awareness because my family does not have sufficient knowledge about this topic."* (IMM1)

*"The government must raise awareness."* (IMF3)

*"The government should educate people."* (ZM5)

### **Role of School**

Students reported that their schools did not teach anything related to antibiotic resistance. Therefore, the lack of this information leaves the student with no information on the importance of proper use and the dangers of resistance. Importantly, many the students propose that the running of the educational programs and workshops should be done within the schools. Workshops and educational programs can provide

hands-on events, making it more relatable and memorable. These initiatives can help fill the current educational gap and equip students with the knowledge they need to make informed decisions about antibiotic use.

*"Campaign in school."* (AQ2)

*"Real-life examples of antibiotic resistance problems in a school campaign."* (AT4)

*"Awareness workshops in schools."* (ZM4)

*"Provide competitions to motivate students to learn."* (ZM6)

*"Awareness workshops in schools."* (ZF4)

### **Suggested topics from students to Increase Self-Awareness toward antibiotic resistance by developing the Education tool**

To address the educational gap, students suggested various topics to increase awareness of antibiotic resistance.

*"The tool should include information on how to properly use medications and the importance of completing the dose."* (H1)

*"I used to think that the antibiotic was for a virus. Now I know that it is for bacteria. You can talk more about this topic."* (IMM2)

*"The importance of completing treatment."* (IMM4)

*"Please provide detailed information on the appropriate usage and dosage of different antibiotics."* (ZM2)

*"Please provide detailed information on the appropriate usage and dosage of different antibiotics and an explanation of antibiotic resistance. Additionally, you asked us about the concerns regarding this issue. What is the reason for us to do so? I believe that explaining would greatly enhance the idea's validity."* (ZM2)

*"How do antibiotics work? And what is the distinction between the term's antibiotic and antibiotic resistance?"* (ZM6)

*"Explain the side effects of incorrect use."* (ZF5)

*"Explain the difference between viruses and bacteria."* (ZF2)

*"The importance of completing treatment."* (ZF4)

### **Preferred Learning Formats**

#### **Interactive and Visual Tools**

Many students strongly preferred the format in which they would like to receive such information. Preferences included interactive and visual materials, such as short-format videos and engaging educational material. There was a strong desire for learning from antibiotic resistance through short videos, interactive apps, and engaging workshops. The increasing likelihood of these formats being able to capture the attention of the students and retain information is higher than other forms. There was also a mention of the need for educational materials that are both entertaining and interesting to encourage interest in reading. Students specifically stated that using videos and animations makes the understanding and remembrance of information about antibiotic resistance

easier. This predisposition towards visual content argues that traditional educational methods may not be as effective for this subject matter. Rather, learning through videos and animations could enhance the interest of antibiotic resistance to students, which could be beneficial.

*"A short video of 3 minutes." (AQ3)*

*"Interactive application." (AT2)*

*"Video." (AT4)*

*"Maybe something like video games that we can play and learn something at the same time." (EX1)*

*"It could include comic strips or cartoons to make it fun and understandable." (EX2)*

*"I think videos would be good, especially if they are short and entertaining." (EX3)*

*"It could contain quizzes and challenges to make it more interactive." (EX4)*

*"You can use short explanatory videos that capture attention and explain concepts easily." (H1)*

*"Video." (IMM4, IMM5, IMM6)*

*"It can include an interactive and practical application that helps teenagers understand the topic through games and questions." (IMF2)*

*"An interactive discussion like the one we are having now." (ZF1)*

*"An interactive application that contains information and tips." (ZF2)*

*"Using animation to explain the topic, such as a video." (ZF5)*

*"Have celebrities talk about how they use antibiotics to stay healthy, which will make teens want to use them responsibly." (AQ 2)*

*"It can contain real-life stories about people's experiences with antibiotic resistance." (AT5)*

*"It should include interactive questions and quizzes to measure understanding." (AT6)*

*"Perhaps it could contain short educational videos that explain the key points engagingly." (EX5)*

*"An educational video attracts my attention more." (H4, H5, H6)*

## DISCUSSION

### Students' Knowledge of Antibiotic Resistance

The current study findings have revealed significant gaps in knowledge about antibiotic resistance among students at the secondary level. The majority of students acknowledged that they never knew what the term "antibiotic resistance" meant before the interview. Among the few who reported having ever heard about the term, most of them had a lack of understanding of what it is, which usually originated from media or relatives rather than from any formal education.

This clear lack of comprehensive education with respect to antibiotic resistance by the students is quite consistent with previous studies showing that there is an urgent need to provide detailed information regarding antibiotics and resistance in school curricula<sup>40-43</sup>.

Tiong & Chua and Hameed indicated that students who had some knowledge about antibiotic resistance would commonly indicate family or even social media as significant sources<sup>44-45</sup>. Such informal sources can result in misunderstanding and incomplete knowledge. For example, students mentioned, "Yes, I saw a post on Facebook about it once." (IMM1), "I heard about it, but I don't know the details." (ZF4). This reliance on non-professional sources undermines a lack of formal education and the need for schools to become active players in disseminating valid information with details on antibiotic resistance. It has been previously established that misinformation from informal sources can easily lead to inappropriate use of antibiotics and further added resistance<sup>46</sup>.

The most known antibiotics among the students were Amoclan (Amoxicillin & Clavulanic acid), Ampicillin, which students and people in Jordan call the red and black pills, and the yellow pills (what is meant here is Amoxicillin). There has been quite a misconception concerning the role and efficiency of antibiotics. Some students believed antibiotics could effectively cure viral infections or boost immunity. For instance, one of the students answered, "The red and black pills and yellow capsules are good to take when you have colds or flu because it makes you recover quickly from a cold wherein it is caused by a viral infection" (AQ4). At the same time, the other believed that "I think they are medications that strengthen the immune system." (ZF2). These misconceptions are in line with many previous studies showing a high degree of misunderstanding regarding the correct usage of antibiotics<sup>47</sup>. These findings highlight two critical issues: the over-reliance on antibiotics for common infections and the prevalent practice of self-prescription influenced by familial advice. Both behaviours contribute to the misuse of antibiotics and underscore the need for better education and stricter regulations on antibiotic use to combat the growing threat of antibiotic resistance.

These findings identify an excessively critical need for the inclusion of antibiotic resistance within the school curriculum. The student population lacks awareness, and their understanding is very poor, thus indicating that present educational efforts are low. It is, therefore, within the mandate of schools to develop and put in place comprehensive educational programs, utilize digital platforms and social media, holds interactive workshops, and other programs that would give students the necessary knowledge and skill sets in making informed decisions on the use of antibiotics and furthering the cause of preventing the amplification of antibiotic-resistant bacteria.

### Experiences with Antibiotic Use

The results indicated that students mostly use antibiotics against common infections based on family advice or self-prescription that replaces professional medical guidance in



treatment. This practice reflects the high influence of familial norms. It may indicate a lack of access to or lack of trust in health professionals. The results have indicated that many students use family advice or self-prescription rather than professional medical advice in the use of antibiotics for common infections. This could indicate strong family norms influencing health behavior and possible access and trust barriers to healthcare professionals. Most students reported using antibiotics without prescription for throat infections, ear infections, and sinusitis, which were the common complaints due to cost and convenience. This practice also aligns with findings from prior studies that identified similar reasons for non-prescribed antibiotic use among children, including symptoms and medications with which they were familiar, perceived mildness of the ailment, and the desire to save time and money due to inaccessibility of medical care<sup>47-52</sup>. Such responses depicted how family and economic reasons prevailing among the students contribute significantly to the misuse of antibiotics. These insights, according to Byrne et al., call for the development of sustainable, multidimensional interventions that allow for various factors influencing misuse of antibiotics<sup>53</sup>. Saeed et al., argues that beyond the human health implications, which are the most significant and critical, the escalation of AMR involves considerable economic costs, time, and opportunity, in emphasizing the need for and importance of addressing this public health crisis<sup>54</sup>.

Another concern was the tendency for the earlier cessation of antibiotic courses, where most students usually stopped taking medicines when symptoms improved instead of continuing administration for usually prescribed time durations. This could result in resistance since partially treated bacteria managed to survive and could develop resistance sometime later<sup>55</sup>. This suggests a serious lack of awareness about the need to complete antibiotic treatment courses to ensure infections are fully cleared. These findings align with prior research, including studies which documented self-medication and the premature cessation of antibiotics as prevalent practices that foster antibiotic resistance<sup>23,56-58</sup>. Additionally, Almeshal et al., established that many patients cease their antibiotic treatment once they start feeling better, regardless of the duration prescribed to them<sup>59</sup>. This behavior is indicative of a fundamental misunderstanding of antibiotic treatment protocols and their purpose in eradicating bacterial infections effectively.

The observed reliance on non-professional advice for antibiotic use and the common practice of discontinuing antibiotic courses prematurely are findings that resonate with numerous previous studies, confirming the widespread nature of these issues across different populations. For instance, a study by Torres et al., which indicated that self-medication with antibiotics remains a major challenge to global health and, generally, it is much higher in regions where there is a lack of regulation of pharmaceutical dispensing such as Jordan<sup>23</sup>. The results of our study reflect the findings of previous research who found that the cost of consultations with doctors is among the main factors determining self-medication behavior<sup>60-64</sup>. This habit of self-prescription and acting on advice from members

of the family/friends, as opposed to consulting a professional doctor, shows some lack of understanding in terms of medical guidance. This gap is especially concerning since inappropriate use of antibiotics exposes one to the risk of developing antibiotic resistance. This is further aggravated by discontinuing antibiotics prematurely, whereby incomplete treatment leads to survival and multiplication of resistant bacteria. The findings are in agreement with a previous study which has recorded self-medication and early cessation of use of antibiotics as two common practices that lead to the development of resistance to these drugs<sup>65</sup>.

On the other hand, Papadimou et al. and Bhati et al. identified that high awareness of antibiotic resistance does not necessarily imply its proper practice; thus, knowledge may not be enough to change practices without addressing the socioeconomic and cultural factors that determine such practices<sup>66,67</sup>. This discrepancy hereby signals the complexity of antibiotic misuse and suggests that a multifaceted intervention approach could be required for meaningful change in practices.

The implications of these findings are far-reaching. These facts underline the desperate need for more and better education and access to health services in terms of family advice and self-prescription. In addition, families and communities have to be informed that before applying any antibiotic in treatment, professional medical advice needs to be sought on the appropriateness and effectiveness of it. This, in part, finds reflection in a common practice whereby individuals discontinue their antibiotics even before finishing the prescription, making it very important that students are adequately informed on the need for and necessity of completing a full course of prescribed antibiotics. This could arrest rising trends of antibiotics resistance by correct education and ensuring complete clearance of infection.

These insights reveal a serious gap in knowledge about how to use antibiotics properly. The fact that they can help in the alleviation of symptoms rather fast does not make them very effective unless one completes the course as has been prescribed. From the findings, there is an evident area that must be focused on: the importance of taking and completing a full prescription of antibiotics for prevention against recurring illness and developing resistant bacterial strains. In this regard, such misconceptions may be corrected through targeted educational programs to cut back on the abuse of antibiotics and attain more responsible usage.

### Students' Views Towards Antibiotic Resistance

Some students thought of taking an antibiotic as a precautionary measure. These statements indicate that there appears to be a lack of clarity on when one should use antibiotics, pointing out a possible case of misuse by taking them as a preventive measure against illnesses that don't require such treatment. Unless there is adequate understanding of the risks that result in antimicrobial resistance (AMR) caused by inappropriate use, then students are unlikely to take precautions to avoid the development of AMR. This recommendation aligns with findings from previous studies which have demonstrated



that targeted educational interventions addressing specific misconceptions about antibiotic use significantly reduce misuse and can delay the development of antimicrobial resistance (AMR), underscoring the critical importance of such awareness campaigns<sup>68-73</sup>. In addition, with such campaigns, there is the need to educate students about the risks of antibiotic resistance and the importance of its responsible use<sup>74-78</sup>. The aim of awareness campaigns should be to provide information in the most straightforward and most straightforward manner possible, providing clear and comprehensive understanding of the serious implications of antibiotic resistance, and encouraging better decision-making. Enhanced understanding of the appropriate use of antibiotics, alongside discouraging self-medication and prophylactic use without medical supervision, has been supported by previous studies which show that educational interventions can effectively reduce inappropriate antibiotic practices<sup>79-83</sup>. These studies underscore the need for increased awareness and education to mitigate the misuse of antibiotics and combat the spread of antimicrobial resistance.

Another key aspect of this is promoting the need for professional advice by students in antibiotic prescriptions<sup>84-88</sup>. If they start taking alliances with professional people, then students will get the right antibiotics, use them properly for the effective treatment of their ailments, and reduce the development of resistance. Such a shift from non-professional sources of advice to qualified health providers can remarkably improve the practices of antibiotic use among the student population. The findings summarised the immediate need for highly informative and sensitisation programs within the students' community with respect to the disparities concerning the threat of antibiotic resistance. Sensitization campaigns focused on the correct usage of antibiotics, their application, and the importance of following advice from health practitioners have been shown to promote responsible usage and curb the growth of antibiotic-resistant bacteria. Studies such as those by Muteeb et al. and Kassa and Al-Sayidi, along with contributions from Majumder et al. and Will, as well as recent works by Capuozzo et al., Endale et al., and Hussein et al., highlight the effectiveness of such campaigns in maintaining the efficacy of antibiotics as critical tools against bacterial infections and safeguarding public health<sup>89-95</sup>. These efforts are crucial not only for individual health outcomes but also for global health security.

### Alternative Treatments and Home Remedies

The results also demonstrated that students strongly preferred using home and natural remedies for minor illnesses and bacteria only as the last resort. This strong preference for natural remedies may also contribute a lot to family tradition and the perceived health-enhancing properties of these treatments. From the results, students' responses illustrate a common belief in the effectiveness of natural remedies, which are often passed down through generations and valued for their simplicity and perceived safety. This may be attributed to several factors that could explain this inclination towards natural remedies. For instance, as previous studies have pointed out, such as by Al-Yateem et al., cultural beliefs and family traditions

greatly influence health behaviours, with cultural influences even affecting treatment choices<sup>96</sup>. Additionally, the general feeling that natural treatments are safer and free from the side effects assumed to come with conventional contemporary drugs contributes to their popularity. Indeed, Studies such as those by Schneider-Kamp and Takhar and Gernat et al. confirm this trend by pointing out an increasing distrust in synthetic medicines and a shift towards natural alternatives<sup>97,98</sup>.

This may indicate that the preference for natural remedies in students makes them cautious about antibiotics and thus does not contribute to developing resistance through their inappropriate use. It may be helpful for some students to have natural remedies on hand for little sicknesses so that they will not be adding to the problem of antibiotic resistance. This approach is worthy, considering the potential repercussions from overuse in relation to antibiotics and a search for other ways through which health could be maintained. Cautiousness agrees with Pitiriga et al. that underscores reduction of the unnecessary use of antibiotics is important in fighting antibiotic resistance<sup>99</sup>.

This strong reliance on family traditions and home remedies underlines a potential distrust of professional advice in a more medical sense. Student preference for these alternative therapies might reflect a cultural belief in treatment efficacy or, alternatively, possibly a lack of access to health professionals. For example, *"I prefer to rest and take natural things like honey and lemon."* (EX6), indicating a tendency to manage illness on one's own without seeking medical advice. Though this tendency is culturally and family-related, it may be developed into problematic self-reliance if people do not seek medical help in more serious cases. The tendency toward self-treatment emphasizes the importance of educational interventions, which would take cultural practices into consideration and explain the importance of professional health services in treating such conditions.

Although this cautious behavior towards antibiotic applications is quite valuable in preventing miss-applications of the said agents, such therapeutic approach to common remedies and families' experience may discourage students from seeking professional help when necessary. This leads to under-management of diseases which otherwise would be better treated with antibiotics or other forms of medical interventions which may eventually cause health problems due to the resistance of antibiotics. Because students may not be given sufficient action-oriented information on the proper use of antibiotics, lack of adequate medical guidelines may further support the possible risk of antibiotic resistance<sup>100</sup>.

In such a case, educating the student and his family about when to use natural remedies or seek professional advice becomes very important. The education must emphasize that, although some minor ailments may be argued by natural remedies, some really need to be assessed and treated by a doctor. Such programs can modulate the application of both the approaches by specifying and thus giving clear guidelines on the instances when natural remediation should be used and when professional help needs to be taken. In fact, studies such



as Michaelidou et al., have already been conducted on public awareness about the appropriate use of antibiotics to prevent misuse and resistance<sup>101</sup>. Finally, there is a need to promote a balanced approach in which the use of natural remedies goes hand in hand with professional guidance in health matters. Consulting healthcare professionals will perhaps enable students to make informed choices regarding their health and, on the other hand, take the appropriate antibiotics in case such need be<sup>102-104</sup>. It simply means that any kind of health care is a balanced approach, stating that natural remedies and professional medical advice are important. Procreation of good trainings to the students and their families on how to use either natural methods of treatment or proper use and seeking professional advices on the effective use of antibiotics can help prevent the emergence of antibiotic-resistant bacteria. These efforts are essential in ensuring that students receive the necessary care while at the same time has a positive effect for generations to come. The results of the studies demonstrate that education would be beneficial in promoting the rationalization of antibiotics and a substantial reduction in resistance.

### Responsibility for Combating Antibiotic Resistance

The students pointed out that the struggle against antibiotic resistance was a generalized one that would involve individuals' efforts, healthcare, and the government. Individuals must be aware of the importance of antibiotics, and physicians and other health professionals should be responsible for guiding and educating people. The role of the government includes creating awareness campaigns about rational use and laying down specific regulations concerning the problem.

The role of healthcare professionals was a key component of discussion among the students. Students mentioned that health care providers should be able to advise about using antibiotics and inform patients about the risks associated with antibiotic resistance. Student responses highlight every health professional's duty and responsibility to ensure that patients have proper knowledge on the appropriate use of antibiotics and the harm from inappropriate usage. This concurs with previous studies that identify the healthcare provider as a main channel through which education and advice would be dispensed to patients<sup>77,102,105,106</sup>.

Findings showed that Government involvement was considered as an important element. The students suggested government leadership through awareness campaigns and regulations to restrict the availability of taking antibiotics without a prescription. The results of this phase suggest to reflect an understanding of the inverse relationship between regulation and public education in reducing abuses of antibiotics to reduce resistance. Other past research also found a need for antibiotic use management through government regulation and public health campaigns<sup>107,108</sup>.

These findings indicate that the fight against antibiotic resistance requires a collective response from all stakeholders: consumers, health professionals, and governments. Each of those sectors has a crucial role to play in promoting responsible

use and raising awareness about resistance. It aims to increase public awareness of the risks associated with the misuse and overuse of antibiotics and letting people know about abiding by prescription instructions. Finally, the role of health professionals remains to be cautious and participate in public awareness campaigns to reiterate the message of responsible usage. Government efforts are required to increase awareness and ensure that regulations are enforced, governing the distribution and use of antibiotics. This collaborative model has been supported by multiple studies demonstrating the effectiveness of multifaceted strategies in combating antibiotic resistance.

Such issues can be addressed through developing comprehensive educational programs to educate people about the appropriate consumption of antibiotics. Encourage doctors and other health professionals to guide patients appropriately and support awareness campaigns to ensure that patients receive correct information and are made to understand the importance of proper usage. This must be supplemented by awareness campaigning by governments, coupled with regulations regarding selling and use of drugs. Collaboration among these key groups will promote effective antibiotic use and reduce the likelihood of developing antibiotic-resistant bacteria.

On the other hand, one of the major responses during the study is the lack of proper education at schools regarding antibiotic resistance. All students responded that their schools did not provide them with adequate information on this crucial aspect, leaving them uninformed about the need to handle antibiotics responsibly. This lack of information is the source of misunderstandings and misuse of the drugs, thus including detailed information about antibiotic resistance in school curricula. For this purpose, the students suggested various methods to promote awareness. A focus on more interactive and visual learning formats, such as short videos and engaging educational material, was also displayed. These preferences indicate that information is presented more engagingly and interactively in formats in which students are sure to attend and retain which was also supported by previous studies that examines the effectiveness of videos in modifying health behaviors. Studies on digital tools and platforms, such as video-based education and social media, have demonstrated significant potential in modifying health behaviors and recruiting participants for health research<sup>109-111</sup>.

School-going educational efforts are not sufficient to equip students with knowledge regarding antibiotic resistance. Despite a lack of understanding of risk and proper use, students will likely continue the practices enhancing the potential for resistance. Secondly, formats of promoting effective awareness involve engaging and accessible formats to engage students and convey a very important message regarding the issue of antibiotic resistance.

Information regarding antibiotic resistance should be incorporated into school curricula to enhance education and awareness as evidenced by previous studies<sup>68,76,112,113</sup>. In schools, what is needed is structured, comprehensive



education, where students understand the consequences of misuse and the importance of responsible use. This can also be effectively done with students on digital platforms and social media, for those are tools they use every day. It can also enhance comprehension with the development of interactive and visual education materials, which is engaging in effective comprehension and retention of information. This recommendation is informed by literature emphasizing innovative and engaging educational strategies to effectively convey health information to adolescents<sup>114-116</sup>.

### Study Limitations

First, the data was self-reported from students; as such, it may be subjected to different types of bias: information bias, recall bias, and social desirability bias. Students either forgot to provide information about their use and knowledge regarding antibiotics or responded according to what they thought was expected or likely to be socially acceptable and not really based on what they believed or practiced.

The sample size was small, and only a few schools participated, which might not be representative of the whole students' community. Therefore, the findings may not generalize to all students in different regions or systems of education. This has a limitation with implications for the necessity of broad studies that enroll diverse demographics in order to catch a comprehensive picture of students' knowledge and attitudes towards antibiotic resistance. Third, the qualitative nature of the study, although rich in details, bars it from quantifying certain misconceptions or practices. Quantitative studies might complement these findings by providing statistical data regarding the prevalence of knowledge gaps and misconception, which will be considered on the next phase (quantitative phase).

### CONCLUSIONS

Results through thematic analysis, underpin major gaps in the knowledge, attitudes, and practices associated with antibiotic use and resistance among the students. Different levels of knowledge and understanding, ignorance, and misunderstanding of antibiotic resistance, along with common myths and following non-professional advice, highlighted the need for a comprehensive education campaign and an effective awareness drive. The issues must be addressed by individuals, healthcare professionals, and government authorities through a multi-faceted approach preaching responsible antibiotic use to combat resistance. The major themes identified include a general lack of knowledge about antibiotic resistance among the students, accentuated by misconceptions about the right ways of using antibiotics. Additionally, the preference for natural remedies or for treating some illness at home, although welcome for the purpose of staving off antibiotic misuse—is also a testament to how professional medical instructions might not find much favor.

The students also identified the positive aspects of the participation of the public, health professionals, and the government in reducing antibiotic resistance. Government-led awareness and enforcement measures on the distribution and use of antibiotics are very important. Efforts to combat antimicrobial resistance have been highlighted through national action plans, stewardship initiatives, and public awareness campaigns, which emphasize the importance of reducing antibiotic overuse and adopting a One Health approach<sup>71,117-120</sup>.

### CONFLICT OF INTEREST

None.

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