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A SURVEY ON THE KNOWLEDGE, ATTITUDE AND PRACTICES REGARDING ANTIBIOTIC USAGE AND RESISTANCE AMONG THE MEDICAL STUDENTS IN A TERTIARY CARE HOSPITAL

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ABSTRACT
Antibiotic resistance is an escalating global health threat, leading to treatment failure, prolonged hospitalizations, higher healthcare costs, and increased mortality. Medical students, as future healthcare providers, play a crucial role in curbing its spread through appropriate knowledge, attitudes, and practices (KAP). This study evaluated the KAP of medical students regarding antibiotic usage and resistance at a tertiary care hospital. A cross-sectional survey was conducted among 200 third to fifth year medical students using a structured questionnaire assessing antibiotic knowledge, perceptions of resistance, and self-reported prescribing behaviors. Statistical analyses included chi-square tests, independent t-tests, and Spearman's rank correlation. Only 65% of students correctly identified mechanisms of antibiotic resistance, and 50% recognized the long-term consequences of overuse. While 70% expressed concern over the global impact, 30% perceived it as a greater issue in other regions. Notably, 40% reported inappropriate prescribing, particularly for viral infections. A moderate positive correlation was found between knowledge and practices (rho = 0.45, $p < 0.01$). These findings highlight significant gaps requiring targeted educational interventions, emphasizing antibiotic stewardship, resistance mechanisms, and clinical guideline application. Strengthening curricula, enhancing mentorship, and incorporating evidence-based teaching are essential to prepare future healthcare professionals to combat antibiotic resistance effectively.

Keywords: antibiotic resistance, medical education, antibiotic stewardship, knowledge gaps, clinical practices.

INTRODUCTION
Antibiotic resistance is one of the most significant challenges facing global public health today. Antibiotic resistance has been cited as a major threat by the World Health Organization (WHO) to effective treatment of more infections caused by bacteria, viruses, parasites, and fungi. Resistance happens when the microorganisms develop mutation to resist the drug that is supposed to kill or inhibit

them. Consequently, they make it more difficult to treat infections, which prolongs time in hospitals, raises healthcare expenditures, and improves mortality rates. This resistance is mainly caused by the overuse and misuse of antibiotics in humans and animals and poor infection prevention and control practices (Shrestha, 2019). Future healthcare providers such as medical students are in a position to help fight antibiotic resistance with their knowledge and practices within clinical settings. Development of antibiotic-resistant infections is not just a biological problem but a social, economic, and behavioral one as well. Misuse of antibiotics in the form of antibiotics being used on viral infections, non-completion of the prescribed course, as well as self-medication, adds to the situation. The medical students who are just about to join the healthcare workforce need to be given the right knowledge, attitudes, and practices towards antibiotics and resistance (Padmanabha et al., 2016). Regrettably, a number of studies have found out that medical students lack knowledge about antibiotics, thus exhibiting poor clinical practices that contribute to increasing antibiotic resistance (Yashin et al., 2018; Higuita-Gutiérrez et al., 2020).

The knowledge of antibiotic resistance is an essential component of medical training. It is not enough to memorize pharmacology of antibiotics; medical students should also comprehend their bigger picture in clinical practice (Asharani et al., 2020). Nevertheless, antimicrobial resistance is poorly integrated into medical curricula, and most schools have a stronger emphasis on acute clinical management of infections as opposed to antibiotic stewardship. This training deficit leads to development of wrong attitudes and practices that may result in over-prescription and improper use of antibiotics. Moreover, self-medication among medical students, particularly in resource-poor environments has worsened the problem, since the medical students can use their little knowledge of the antibiotics, without consulting a professional medical expert. The exposure to the clinical practice and the culture of healthcare institutions defines the attitudes of students towards the usage of antibiotics. In most environments, there has been a high priority given to the quick cure of infections and most of the time it is done using antibiotics without addressing the issue of antibiotic resistance. This culture of a quick-fix is further supported through teaching hospitals where antibiotics are prescribed more often than not, even when they are not clinically required (Zulu et al., 2020). The students in medical school are not only liable to their own practices but they also have the responsibility of informing the patients about the dangers of their wrong use of antibiotics.

Several studies have shown that there exist large discrepancies between the knowledge of medical students regarding antibiotic resistance and their practices. As an example, research in Nepal and Zambia identified that students might have knowledge on antibiotic resistance, but still have mixed attitudes and behaviors (Panthi et al., 2020; Sakr et al., 2020). In India, the students demonstrated certain knowledge of antibiotic resistance but their attitudes and practices on the proper use of antibiotics did not always reflect best practices (Dudhe et al., 2023). Such gap between knowledge and practice implies that knowledge itself might not be sufficient to bring behavior change. This gap can be addressed through targeted medical curriculum work on antibiotic stewardship and resistance (Akande-Sholabi and Ajamu, 2021).

It is important to address these gaps. Healthcare professionals cannot make a difference in antibiotic resistance alone, but the fight will have to involve policymakers, researchers, and the population. Medical education is the core of any successful strategy since future clinicians will be the end users of the strategy by prescribing antibiotics. The most important factor contributing to the success of medical students in developing their careers against antimicrobial resistance is to ensure they are equipped with the knowledge of the implications of misusing antibiotics. There has been an increased awareness of the importance of medical schools focusing on antimicrobial stewardship and prevention of resistance. There is evidence that the inclusion of training on antibiotic resistance and responsible prescribing as part of medical curricula enhances knowledge, attitudes, and practices of the students (Shah et al., 2019; Khajuria et al., 2019). According to research in the UAE university (Jairoun et al., 2019), the targeted interventions can increase the awareness of the students about antibiotic resistance, which results in a positive change in attitude and practice. These results highlight the need to have

educational programs that go beyond the provision of knowledge to instill behavioral change in the decisions of students concerning the use of antibiotics.

The tertiary care hospitals are especially prone to the urgency of the antibiotic resistance, as the prescriptions of antibiotics are most common in them. The excessive use of antibiotics in such environments predisposes the development of resistant pathogens, which makes it difficult to treat different infections. Thus, the knowledge of antibiotic resistance in medical students should be evaluated and improved prior to their clinical practice. The proposed research study is to evaluate the knowledge, attitude and conduct of medical students towards antibiotic use and resistance in a tertiary care hospital. In defining the gaps in the knowledge of the students, or the poor practices they have, we hope to present a set of recommendations that can be taken to enhance the medical education and policy on antibiotic use.

The objectives of this study are as follows:

1. To assess the knowledge of medical students regarding the appropriate use of antibiotics and the mechanisms behind antibiotic resistance.
2. To examine the attitudes of medical students toward antibiotic resistance and its impact on global public health.
3. To evaluate the practices of medical students in terms of antibiotic prescribing, usage, and adherence to antibiotic stewardship guidelines.

METHODOLOGY

Study Design

The present study used a cross-sectional survey study to evaluate the knowledge, attitudes, and practices (KAP) of medical students on the use and resistance of antibiotics. The cross-sectional design was selected due to the ability to collect data at one particular time, which gives a picture of KAP among the students. This design is effective to find out knowledge gaps and the area that needs to be improved. The objective was to determine how well-educated medical students are about the use of antibiotics currently and how this can be improved by educational interventions and policy changes.

Study Setting

The research was undertaken in a tertiary care hospital which is a huge teaching institution in the field of medicine. The hospital is a perfect environment because it plays a major part in medical education and has a high rate of antibiotic prescriptions, particularly in complicated cases. It serves a multicultural patient population, and the medical students get an array of clinical situations in which antibiotics are used. The high prescription rates of antibiotics in the hospital make it of particular interest to evaluate student understanding and practice of antibiotic stewardship in clinical practice.

Study Population

The research focused on the third, fourth- and fifth-year medical students (undergraduates) in medical school. The reason why these students were chosen is that these students have taken the basic courses in medicine and are currently undergoing clinical rotations, which make them exposed to the practice of antibiotic prescribing. Students were to have attended at least one clinical rotation as part of the inclusion criteria. Students who had not completed clinical training or were absent at the time of study were considered as exclusion criteria. The demographic data were gathered to perform an analysis of whether the age, gender, and academic year had an impact on the KAP of the students.

Sample Size

The convenience sampling technique was employed, and the medical students sample size was 200. This sample size was determined using a statistical power analysis and it had enough power to identify significant differences. The stratification was based on the academic year (third, fourth, and fifth

years) in order to determine the differences in KAP at different levels of clinical training. Such a method provides the opportunity to gather the information in the most effective way, which is limited by the time and resource base of the research.

Data Collection Tool

The collection of data was conducted with the help of a structured questionnaire that aimed to evaluate the KAP of students in terms of antibiotic use and resistance. The questionnaire contained multiple-choice and Likert scale questions, which made it possible to analyze it both quantitatively and qualitatively. The instrument was constructed using the available literature and the professional advice of the faculty in the field of microbiology, pharmacology and infectious diseases. A small sample of students was used to pre-test it in order to improve the wording of questions and to test the reliability of the instrument. The questionnaire was based on the knowledge of antibiotics in general, attitude to antibiotics use, and self-reported antibiotic prescribing practice.

Data Collection Process

The data were obtained by means of online questionnaires that were sent to the institutional email. The approach provided anonymity and confidentiality, which promoted open answers. An informed consent form was given to the participants to explain the purpose of the study and make it voluntary. The online platform facilitated easy data collection because it was able to reach many students within a limited time. Ethical rules were adhered to, and an informed consent, anonymity of the subjects, and confidentiality of the data were made.

Statistical Analysis

Python was used to analyze the data and libraries like pandas, numpy, and scipy were used. The demographic characteristics and KAP data were summarized using descriptive statistics and frequencies, percentages, and mean scores were calculated. Chi-square tests were used to investigate relationships between categorical variables (e.g., gender or academic year) and KAP with the use of scipy.stats. Independent t-tests were used to compare the different groups, academic year or gender, using the scipy.stats.ttest_ind function. In order to examine the association between knowledge scores and self-reported practices, Spearman rank correlation was conducted. The test was suitable in the analysis of the correlation between ranked variables. All the statistical tests were done at the level of significance of $p < 0.05$ and the confidence interval of 95 percent. Patterns and relationships were identified based on the results, and those can be used in future educational intervention to enhance antibiotic stewardship among medical students.

RESULTS

Demographic Characteristics

The study involved a total of 200 medical students, which allowed covering various levels of medical education. Participants were evenly distributed by academic year with 33.3% of the third year, fourth year and fifth year of their medical program. Regarding gender, 60 percent of the respondents were males and 40 percent were females. The mean of the participants was 22.5 years and the standard deviation was 1.5 years, which means that the age bracket was relatively homogeneous in the sample. Each of the participants was recruited in different departments of the tertiary care hospital, and at least one clinical rotation was completed before the participation.

Table 1: Demographic Characteristics of Participants

Demographic Variable	Category	Frequency (%)
Gender	Male	60%
	Female	40%

Academic Year	Third Year	33.3%
	Fourth Year	33.3%
	Fifth Year	33.3%
Average Age		22.5 (SD = 1.5)

Knowledge of Antibiotics

The evaluation of the knowledge of students about antibiotics revealed that 85 percent of them evidenced general knowledge of the pharmacology of antibiotics. When assessed on particular points, 90 percent of the participants answered correctly to the major uses of antibiotics. Nevertheless, the specifics of the mechanisms of antibiotic resistance were correctly identified by only 65%, which is a significant gap in the specifics of the knowledge. Concerning treatment compliance, 75 percent of students had the right idea of the significance of taking adequate antibiotics courses to make them effective and non-resistant. However, the recognition of the overall effects of antibiotic misuse was less, with only half admitting the possible long-term effect of improper antibiotic use, including the emergence and transmission of resistant pathogens.

Table 2: Knowledge of Antibiotics

Question	Correct Responses (%)
What are antibiotics used for?	90%
Mechanisms of antibiotic resistance	65%
Importance of completing antibiotic courses	75%
Consequences of antibiotic overuse	50%

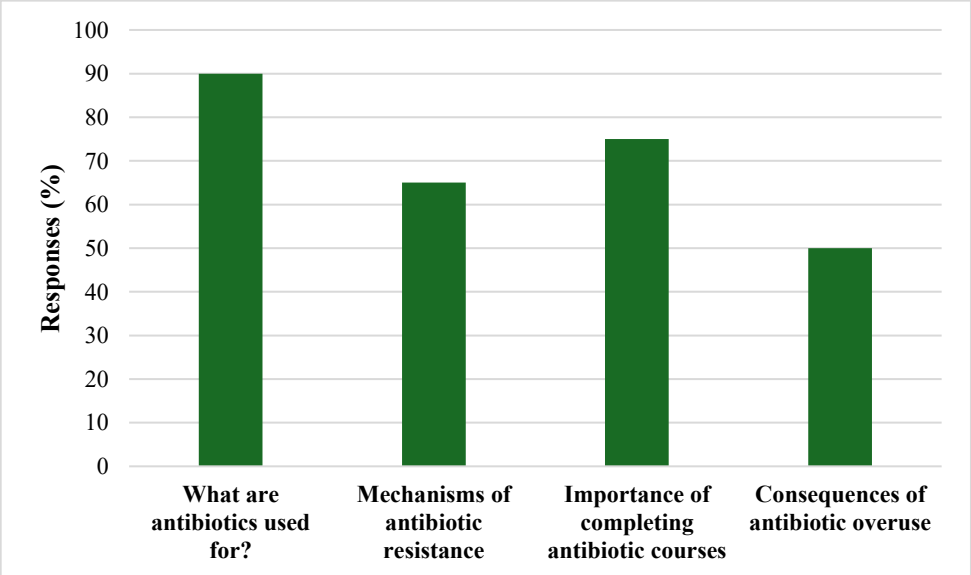

Figure 1: Knowledge of Antibiotics

Attitudes Towards Antibiotic Usage

The attitude assessment carried out in the survey was aimed at investigating the attitudes of students towards the severity of antibiotic resistance and their perceived contribution to the problem. Most of them, 70 percent, were concerned with the global effects of antibiotic resistance as an important threat to the health of the population. On the other hand, 30 percent of the respondents felt that antibiotic resistance was not a big concern in their country but rather in other countries and thus not an immediate concern in their healthcare system. Responding to the confidence question on prescribing, 55 percent of the students said they were confident in their skills to make the right antibiotic decisions when they saw patients. Nevertheless, 45% were worried about the possibility to effectively deal with

the antibiotic prescription in clinical practice, which may signify the discrepancy between the theoretical knowledge and practice.

Table 3: Attitudes Toward Antibiotic Resistance

Attitude Question	Yes (%)	No (%)
Concern about global impact of antibiotic resistance	70%	30%
Believe antibiotic resistance is a local issue	30%	70%
Feel confident in making appropriate antibiotic decisions	55%	45%

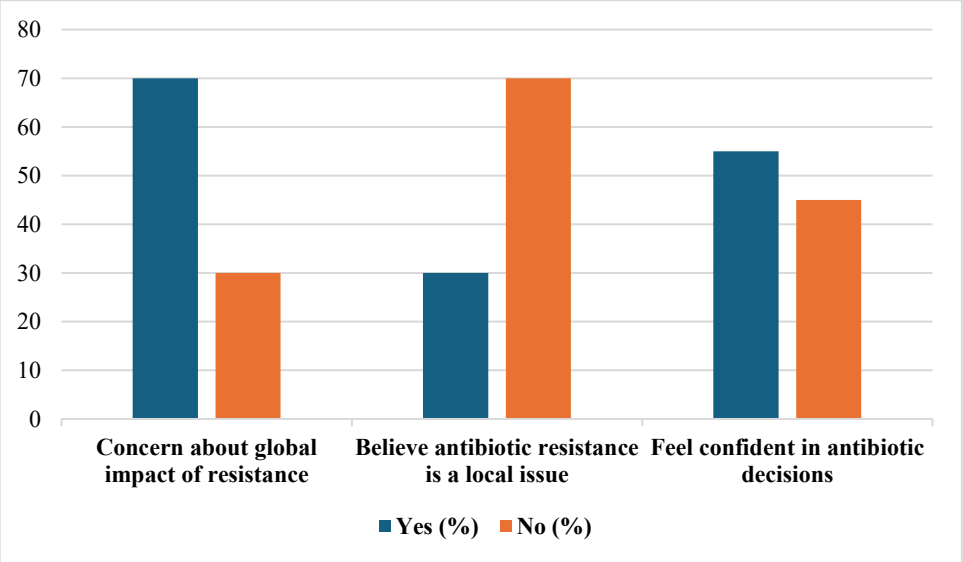

Figure 2: Attitudes Toward Antibiotic Resistance

Practices Regarding Antibiotic Usage

The self-reported behaviors of the participants showed significant discrepancies between the guidelines and the clinical behavior. Although 90 percent of them claimed to have adhered to standard antibiotic rules during their clinical rotations, compliance with the verification of certain prescriptions was weaker. The rate of verifying the right antibiotic against a particular infection before prescribing was only 60 percent with 40 percent not always doing this necessary check. Moreover, 40 percent of students said that they were prescribed antibiotics to treat viral infections, or they witnessed such inappropriate prescribing during their clinical experience. Likewise, 40 percent had observed other types of inappropriate antibiotic application in clinical practice, including prescribing in the absence of clinical indication, which indicates the areas of better compliance with the principles of stewardship.

Table 4: Self-reported Practices Regarding Antibiotic Usage

Practice Question	Yes (%)	No (%)
Follow standard antibiotic guidelines during rotations	90%	10%
Always verify the correct antibiotic for the infection	60%	40%
Prescribe antibiotics for viral infections	40%	60%
Observe inappropriate use of antibiotics in clinical practice	40%	60%

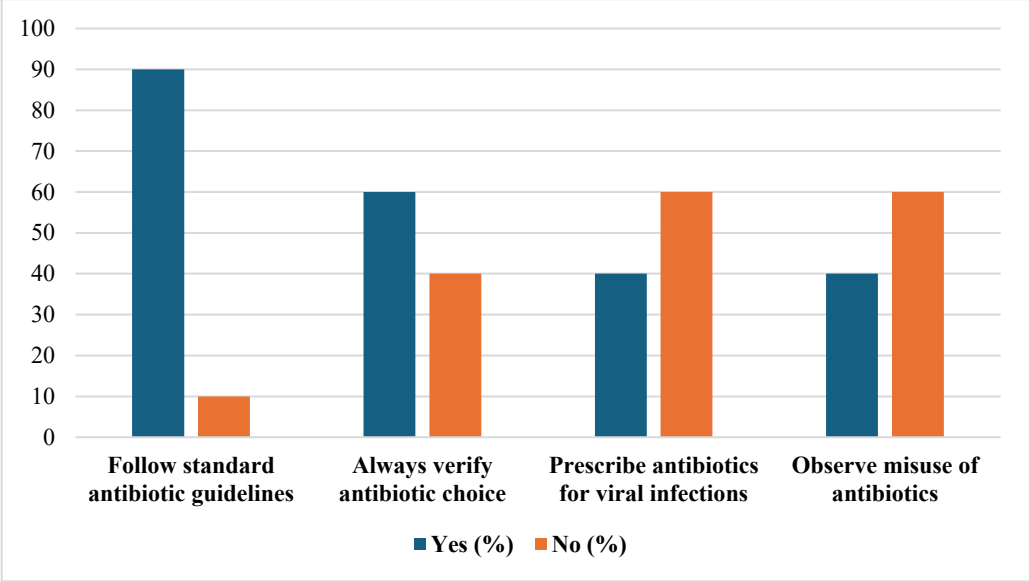

Figure 3: Self-reported Practices Regarding Antibiotic Usage

Statistical Analysis

Chi-square tests were used to find out the relationship between academic year and KAP scores. The analysis showed that there was a significant difference (p = 0.015) between the knowledge scores of students in the third and fifth year (2 = 8.5) with the average knowledge levels being higher in the fifth-year students than in the third-year students. No statistically significant differences were found, however, in attitudes or practices by academic year, indicating that progression through medical school did not have a consistent effect on these aspects of KAP.

Table 5: Knowledge Scores by Academic Year

Academic Year	Average Knowledge Score (%)
Third Year	70%
Fourth Year	78%
Fifth Year	85%

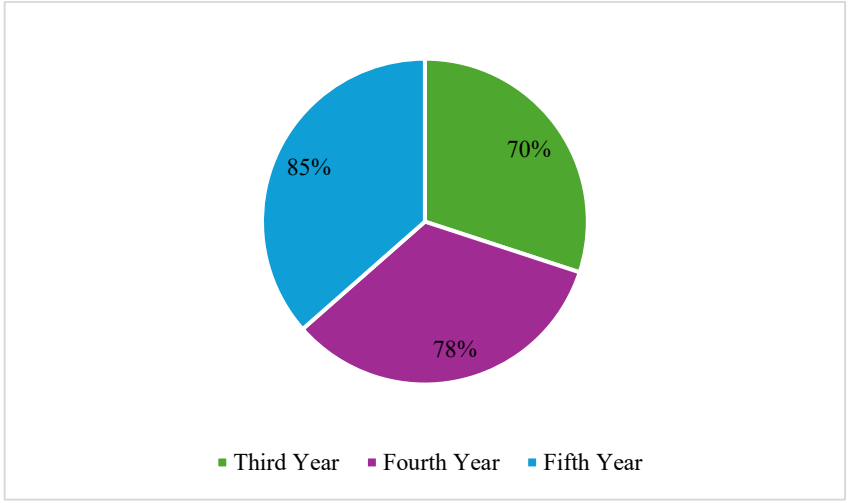

Figure 4: Knowledge Scores by Academic Year

A comparison of the KAP scores between male and female students was done using independent t-tests. An analysis of the results showed no significant difference between genders in terms of knowledge (t(198) = 1.2, p = 0.23) or attitudes (t(198) = 0.9, p = 0.37). There was however a

statistically significant difference in practices where female students indicated better antibiotics prescribing practices than male students ($t(198) = 2.1$, $p = 0.04$).

Also, a Spearman rank correlation was conducted to determine the correlation between knowledge scores and self-reported practices on antibiotic use. The findings revealed a moderate positive correlation ($rho = 0.45$, $p < 0.01$) which means that the higher the level of knowledge, the more appropriate practice of the antibiotics among the participants.

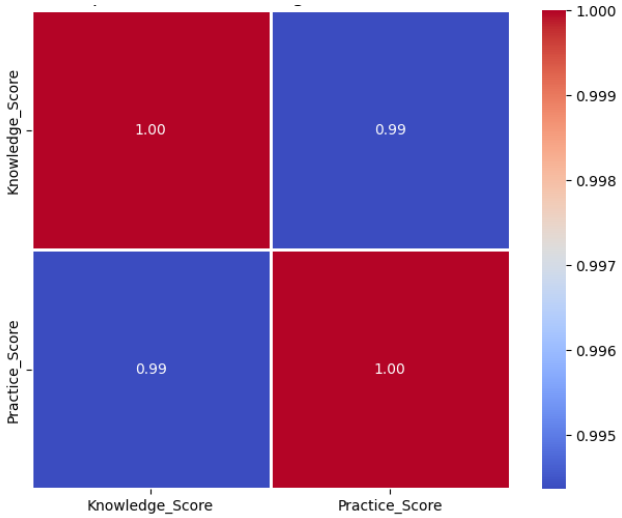

Figure 5: Correlation Between Knowledge and Practices

DISCUSSION

The current study assessed the knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance among medical students at a tertiary care hospital. The findings also indicated the presence of considerable gaps in knowledge and inconsistency between the knowledge of students and their own reports when it comes to their practices in regard to antibiotic resistance, which may have a role in their effectiveness in terms of antibiotic stewardship upon entry into clinical practice. The knowledge test showed that most of the students had the basic knowledge on the pharmacology of antibiotics but fewer knew the mechanisms of antibiotic resistance. In particular, resistance mechanisms were correctly determined by 65 percent of students, and on the long-term effects of antibiotics misusage, 50 percent of the students were informed. This corresponds with the results of prior research that also confirmed large knowledge gaps among students when it comes to the mechanisms of antibiotic resistance (Sobierajski et al., 2021). Such a misunderstanding may reduce the capacity of the students to make informed choices regarding antibiotics prescriptions and increase resistance in healthcare facilities. To counter this, medical curricula ought to focus on the pathophysiology of resistance incorporating case-based learning in an attempt to enable students to develop a better understanding of resistance mechanisms and learn to recognize and mitigate them in clinical practice. Learning interventions must also include local resistance statistics to show the actual real-life consequences of antibiotic misuse (Augie et al., 2021).

The attitude component showed that 70 percent of the students were concerned about the effect of antibiotic resistance in the world, but 30 percent thought that it was more of an issue in other nations, which indicates the lack of local knowledge and action on the global issue. Such a lack of perception can be a barrier to students understanding that antibiotic resistance is an urgent issue in their healthcare system (Labi et al., 2018). It has been demonstrated that local resistance challenges can be dealt with by specific education, encouraging the students to use their knowledge of antibiotic stewardship more productively in clinical practice (Hu et al., 2018). Through incorporation of regional awareness of antibiotic resistance into medical curricula, students will have a better perspective of the imminent effects of resistance within their respective healthcare systems, which helps create a sense of responsibility. Students were aware of antibiotic resistance, but gaps were identified between the knowledge and self-reported behavior. Although 90 percent of the students stated that they adhered to

the standard antibiotic rules, only 60 percent of the students always checked the right antibiotic to use against a certain infection before prescribing. Also, 40 percent said they have prescribed antibiotics to treat a viral infection or observed the same practices in clinical practice. This knowledge-practice gap has been reported in the literature of other studies as well, with the findings showing that, although students are trained in the concepts of antibiotic stewardship, they tend to have issues with applying them in practice (Gupta et al., 2019). The causes of such a discrepancy can be the time pressure, clinical requirements, and uncertainty about making decisions. Mentoring, role modeling, and other forms of training on how to apply clinical guidelines should be used to reduce these barriers as a way of closing the gap between theoretical knowledge and practice.

The correlation coefficient between knowledge and practices in the study was moderate (rho = 0.45) which reveals that more appropriate use of antibiotics is connected with better knowledge. This however also implies that knowledge is not enough in influencing behavior change. Past studies have focused on the importance of behavioral intervention in addition to knowledge-based education in enhancing clinical practices (Sannathimmappa et al., 2021). Medical institutions need to pay more attention to mentorship and the establishment of the kind of environment that would allow students to practice and perfect their signs of antibiotic prescribing skills in a real clinical setting to further support them in the application of their knowledge. One of the significant results was the gender disparities in determining the practice of antibiotic prescriptions with the female students indicating a higher rate of compliance to the antibiotic guidelines compared to the male students. This supersedes past studies which indicate that women in medicine are more probable to adhere to clinical recommendations (Schröder et al., 2016). Nevertheless, the causes of such gender differences should be examined in more detail, because education environment, cultural factors, or individual traits may contribute to them. It is also crucial to investigate whether the differences continue in subsequent professional practice and how gender-based interventions may assist in streamlining antibiotic stewardship in all students.

Knowledge gaps and inconsistencies between knowledge and practice are cause of concern, but the results in the study also indicate the necessity to enhance antibiotic stewardship education. The main priority should be given to comprehensive training of antibiotic resistance that should include both the knowledge of biological mechanisms, as well as local patterns of resistance. More exposure to real world situations and practice application of antibiotic stewardship concepts is also needed and should be incorporated as curriculum reforms, including case-based learning and clinical simulations. Besides classroom studies, they should be trained in the clinic to understand the necessity to follow the antibiotic prescribing recommendations, and mentorship programmes should be introduced to enable students to make real-time decisions.

Finally, the study underlines the necessity of more intensive and specific education interventions in order to enhance knowledge and practices of medical students in relation to antibiotic resistance. Although the majority of students have enough knowledge about antibiotics, their knowledge about resistance mechanisms and antibiotic misuse consequences is still weak. The closing of these gaps in the curriculum reforms, case-based learning, and improved clinical training will make the students of the future better equipped to handle antibiotic use. Moreover, focusing on such barriers and impediments to the translation of knowledge into clinical practice as time pressure and the lack of confidence will be critical to boosting antibiotic prescribing habits. The medical institutions also need to build an ethos of mentorship and role modeling, which can be achieved through senior clinicians enforcing the need to practice antibiotic stewardship in everyday activity.

CONCLUSION

The present study assessed the knowledge, attitudes, and practices (KAP) regarding antibiotic use and resistance among medical students at a tertiary care hospital. The findings indicated that there was a big gap in the knowledge of the students in the mechanisms of resistance to antibiotics with only 65 percent of the students getting the correct answers on the mechanisms of resistance. Although the majority of students acknowledged antibiotic resistance as a global issue, 30 percent of them saw it

as a problem elsewhere, which indicated a lack of localization of the global issue. Moreover, although they reported that they were following guidelines, 40 percent acknowledged prescribing antibiotics inappropriately, specifically in viral infections, which means that the knowledge and action have a discrepancy. The results have vital public health concerns. Antibiotic resistance is a menace to the health of the world and the capability of the healthcare providers to make informed decisions is essential. The identified knowledge and practice gaps among students highlight the necessity of improving antibiotic resistance education, especially its mechanisms and local effects, to make future healthcare professionals well-prepared to address this problem in a proper way. Regarding education, medical schools need to incorporate extensive antibiotic resistance and stewardship training in the curriculum. The research recommends integrating a deeper case-based learning process and exposure to antibiotic stewardship in the clinical practice. The gap between theory and practice can also be reduced by faculty development and mentorship programs that enhance students to utilize their knowledge in practice. Policymakers and healthcare organizations should focus on educating about antibiotic stewardship, including local resistance data and educating all medical students to make responsible antibiotic prescribing decisions to overcome these problems. Such a holistic solution will enhance the fight against antibiotic resistance and improve the health health outcomes world.

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