Case Study

Knowledge, Attitude, and Practice of Medical Student towards Antibiotic Resistance and Antimicrobial Stewardship Programs: A Cross-Sectional

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Abstract

This study aims to evaluate the knowledge, attitudes, and practices (KAP) concerning antibiotics and antimicrobial resistance (AMR) among medical students, a crucial group in fighting the global menace of AMR. Utilizing a cross-sectional design, an electronic questionnaire was administered to explore diverse facets of antibiotics and AMR. Conducted from January to April 2023, the survey collected 340 responses that were subsequently analyzed through statistical software. The results revealed significant gaps in the KAP of medical students, aligning with worldwide trends. Notable misconceptions included the misguided belief in the safety of daily antibiotic use and the incorrect assumption that proper consumption eliminates the risk of AMR. Alarmingly, a substantial number of students acquired antibiotics from unregulated sources, such as friends or family. The study concludes that an urgent curriculum revision in medical education is needed, with a focus on the mechanisms and judicious use of antibiotics. This research serves as a clarion call to educators, policymakers and healthcare leaders to collaboratively tackle this public health crisis by adequately preparing future physicians.

Keywords: Antibiotics, Antimicrobial resistance, Medical students, Knowledge, Attitude, Practice

Introduction

Antimicrobial Resistance (AMR) represents a significant global health challenge in the 21st century, marked by a disturbing and swift rise in resistance patterns [1]. The discovery of antibiotics in the mid-20th century was a landmark advancement, revolutionizing the medical field by saving countless lives and fundamentally changing healthcare practices [2]. Unfortunately, the excessive and improper use of these essential drugs has led to a situation where many organisms have developed resistance to them, making numerous antibiotics ineffective [3].

The World Health Organization is in the process of developing a Global action plan on AMR to tackle this escalating issue [4]. The growing resistance, however, has enabled the spread of resistant strains, making treatment more complex and increasing the risk of widespread disease, serious illness, and death, especially in developing countries [5-7]. This pattern has placed a considerable economic burden on these nations, adding to their existing healthcare difficulties [8].

The global concern about AMR is growing as evidence of AMR bacteria is found in every part of the world. The rising incidence of healthcare-associated infections exacerbates this grave situation. Healthcare settings, due to their regular and often necessary use of antibiotics, become perfect environments for resistant bacteria to thrive and spread [9]. The unchecked growth of AMR strains within healthcare facilities poses a grave threat to global health, risking the nullification of our most potent medications and possibly reversing years of advancement in healthcare [10].

Recognizing the severity of these problems, research shows that deliberate and strategic actions like implementing antimicrobial stewardship programs are crucial. Antimicrobial stewardship is a systematic method that promotes the careful use of antimicrobials to improve patient outcomes, reduce microbial resistance, and limit the spread of infections from multi-drug-resistant organisms. Recent studies have uncovered a notable gap in the understanding of medical and dental students regarding proper antibiotic usage

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[11]. As a result, suggestions have been put forward to enhance the educational curriculum with additional lectures on antimicrobial stewardship principles.

Medical professionals, including doctors and students, are key to executing these programs. Their role highlights the need for a thorough understanding and responsible practice in antibiotic administration. The impact of medical doctors and students on managing AMR (Antimicrobial Resistance) is essential [12]. Being primary prescribers of antibiotics their judgment of the correct timing and method for administering these drugs can significantly influence this growing problem.

The knowledge, attitude, and practice (KAP) towards antibiotics and related resistance can either alleviate or worsen the issue. This point becomes particularly significant considering the ongoing COVID-19 pandemic and variants like Omicron Transmissibility [13], leading to a rise in hospitalizations and a consequent increase in antibiotic usage. Therefore, assessing the KAP among this group regarding antibiotic use and resistance is vitally important.

The dynamic nature of the AMR situation requires ongoing adaptation and refinement of our understanding and approaches. This study provides a current overview of the KAP state among medical students, adding valuable insights to the growing body of literature on this critical topic. As the future prescribers of antibiotics, the students' KAP will significantly shape the AMR landscape in the coming years. The results of this study have substantial implications for creating and applying effective AMR strategies across various settings, supplying vital guidance for healthcare policymakers, educators, and practitioners.

Materials and Methods

Study Design and Setting

This study utilized a cross-sectional design to explore the KAP of medical students concerning antibiotics and AMR within the region. Spanning four months, from January to April 2023 the investigation sought to provide a snapshot of the prevailing awareness and behavior among medical students.

Participants

The focus of this study was undergraduate medical students enrolled in Umm Al-Quraa University at the survey time. The survey received 340 responses, reflecting a diverse array across universities and stages of medical education. Participation was voluntary and measures were taken to ensure wide-ranging representation of the medical student population.

Questionnaire Development

Data collection was conducted via an electronic questionnaire developed with Google LLC. The questionnaire was carefully crafted to gauge the KAP of medical students about antibiotic usage and AMR. It was organized into four principal sections:

1. *Demographic Information:* This segment collected details on age, gender, university, year of study, and other pertinent background information.
2. *Knowledge Assessment:* Comprising 10 questions, this section examined respondents' comprehension of antibiotics, AMR, and associated topics.
3. *Attitude Evaluation:* This section, consisting of 8 questions assessed the attitudes of medical students regarding antibiotic use, including their perceptions and beliefs.
4. *Practice Analysis:* With 9 questions, this part of the questionnaire explored the students' practices related to antibiotic prescription and use, encompassing adherence to guidelines and decision-making processes.

Data Collection

The questionnaire link was widely distributed across different platforms. This included sending emails to medical colleges and posting on social media platforms popular among medical students. This broad distribution strategy aimed to secure a diverse and representative sample. To ensure the privacy and confidentiality of participants, all responses were anonymous.

Data Analysis

Data analysis was conducted using the latest edition of the SPSS. Descriptive statistics were computed to provide a summary of the participant's demographic information and their KAP concerning antibiotic use and AMR. These statistics included means, standard deviations, and frequency distributions. Additionally, further inferential statistical tests such as correlation analysis, analysis of variance (ANOVA), and post-hoc tests, were carried out as necessary to explore relationships between variables and compare various groups within the sample.

Ethical Considerations

The study complied with all ethical guidelines for research involving human subjects. Ethical approval was obtained from the Bioethics Committee at Umm Al-Qura University (HAPO-02-K-012-2023-05-1604).

Participants were informed about the study's purpose the voluntary nature of their participation and the confidentiality of their responses. Electronic informed consent was secured before participants could access the questionnaire.

The methodological approach of this study was meticulously designed to offer robust and comprehensive insights into the KAP of medical students towards antibiotics and AMR. By utilizing a cross-sectional design, employing a well-structured electronic questionnaire, and abiding by ethical principles, this study contributes valuable data that may guide

educational interventions and policy decisions in the field of antimicrobial stewardship.

Results and Discussion

A KAP study is conducted covering a total of 340 participants who are asked to respond to a questionnaire that tries to measure the awareness of antibiotic resistance among medical students. Three dimensions, namely, knowledge, attitude, and practice, are measured regarding in which grade medical students enrolled. The questionnaire consists of 3 sections which are 10 questions for knowledge, 8 questions for attitude, and 9 questions for practice sections, respectively.

First, reliability analysis is conducted to show how reliable the implemented questionnaire is. So, Cronbach's alpha is found to be 0.812 which is higher than 0.70. So, the reliability criterion is satisfied. Then, descriptive statistics with 95 percent confidence intervals and correlations of three dimensions of the questionnaire are computed, namely, knowledge, attitude, and practice. **Tables 1 and 2** present descriptive statistics with confidence intervals of 95 percent and correlations among the dimensions.

Table 1. Descriptive statistics and 95 percent confidence intervals of medical students regarding knowledge, attitude, and practice.

Dimensions	Mean	Standard Deviation	95 Percent Confidence Interval	
			Lower Bound	Upper Bound
Knowledge	3.66	0.61	3.59	3.72
Attitude	2.96	0.67	2.88	3.03
Practice	3.34	0.61	3.28	3.41

Table 2. Correlations between the three measurements

Dimensions	Knowledge	Attitude	Practice
Knowledge	1	0.169 ($p<0.05$)	0.448 ($p<0.05$)
Attitude	symmetric	1	0.544 ($p<0.05$)
Practice	symmetric	symmetric	1

Results suggest that medical students' mean levels of both knowledge and practice are slightly greater than 3 which corresponds to a mean score between "neither agree nor disagree" and "agree". Thus, both knowledge and practice levels should be improved. On the other hand, the mean attitude level is less than 3 which corresponds to a mean score between "disagree" and "neither agree nor disagree". Moreover, the mean attitude levels of medical students need to be enhanced greatly. Similar results could be observed in the correlation analysis suggesting that the correlations between those dimensions are either weak or very weak. However, if the knowledge and attitude of medical students are increased the practice tends to increase for medical students. On the other hand, the correlation between knowledge and attitude is very weak which means that gaining knowledge about awareness of antibiotic resistance is weakly related to developing an attitude against antibiotic misusage. Moreover, 95 percent confidence intervals of knowledge, attitude, and practice are found which suggests that the parameter mean scores of all three dimensions are estimated between less than agree and greater than disagree. In summary, all three dimensions of medical students should be enhanced to better deal with AMR issues.

Also, how those three dimensions are changed depending upon the grade of the medical students is investigated using ANOVA analysis at a 0.05 significance level. **Table 3** presents the results of ANOVA. Firstly, the variance homogeneity test is conducted which suggests that while the variance of knowledge and attitude are found to be homogenous the variance of practice is not found to be homogenous. So, the post-hoc tests called the Duncan and the Games-Howell tests are applied to find whether there exist differences between grades concerning knowledge attitude and practice

Table 3. The results of ANOVA

Dimensions	P-value for ANOVA	Variance Homogernity Test
Knowledge	0.022	0.241
Attitude	0.000	0.328
Practice	0.002	0.008

While the post-Hoc test of Duncan is run to find which grades of medical students differ regarding knowledge and attitude the post-hoc test of Games-Howell is run for practice.

Table 4 presents the mean scores and grades of medical students.

Table 4. Post-Hoc test results of mean levels concerning knowledge, attitude, and practice.

Knowledge (Mean/Grade) Duncan Test		Attitude Mean (Mean/Grade) Duncan Test		Practice (Mean/Grade) Games-Howell Test	
Group-1	Group-2	Group-1	Group-2	Group-1	Group-2
3.45/3	3.65/2 3.7/1 3.77/4	2.62/2	3.03/1 3.06/3 3.13/4	3.18/3 3.27/2 3.35/1	3.57/4

The study's findings about the average knowledge, attitude, and practice scores among various grades of medical students display an interesting pattern. The average knowledge scores for grades 1, 2, and 4 were higher than those of 3rd-grade medical students. This inconsistency raises questions regarding the uniformity of knowledge acquisition at different stages of medical education. It could suggest variations in curriculum, teaching methods, or student engagement, resulting in this uneven distribution. Further study into these patterns might yield vital insights for enhancing the education process.

Similarly, the average attitude scores for grades 1, 3, and 4 were higher than those of the 2nd grade. This outcome is unexpected as one could typically expect a steady growth in positive attitudes towards antimicrobial stewardship throughout medical education. The pattern implies that specific factors in the 2nd-grade curriculum or environment might not be favorable to cultivating positive attitudes. A closer analysis of the content, teaching strategies, or even the cultural aspects of the 2nd grade's learning environment is therefore warranted.

The average practice score for 4th-grade medical students was higher than the others. This result aligns with expectations as 4th-grade students are more likely to have greater exposure and experience, leading to improved practices. The fact that this natural progression is not reflected in the knowledge and attitude dimensions complicates the interpretation of these findings.

When considering grades, 4th-grade medical students excel in mean practice score which is in line with expectations. However, the outcomes related to knowledge and attitude seem irregular. For example, the higher mean attitude score of 1st-grade students compared to 2nd-grade students and the higher knowledge scores of 1st and 2nd-grade students compared to 3rd-grade, present an inconsistent and perplexing pattern.

These results underline the necessity for a deeper understanding of how knowledge, attitudes, and practices evolve across various grades. This requires an exhaustive examination of curriculum, teaching methodologies assessment strategies, and even broader educational culture. The average scores above the verbal statement "neither agree nor disagree" and below "agree" emphasize the need for significant enhancement in all three dimensions. This stress on improvement highlights the urgency for an all-encompassing review and modification of the existing educational approach. The goal is to ensure consistent and effective development of knowledge, attitudes, and practices concerning antibiotic resistance and antimicrobial stewardship across all medical student grades.

The results from our study which aimed to measure the KAP of AMR and stewardship among medical students, yield noteworthy insights that can significantly inform related policy and educational interventions.

The study uncovers that the overall KAP levels among medical students concerning Antibiotic Resistance and Antimicrobial Stewardship are moderate. The knowledge and practice dimensions have slightly higher mean levels than attitude. This discovery is consistent with prior research, suggesting that although students are becoming more aware and altering their practices, changes in attitude are less noticeable. This implies a complicated relationship between comprehension, beliefs, and behaviors that might not always coincide.

For example, Abbo *et al*., (2013) determined that while medical students had obtained some knowledge about AMR their attitudes towards antimicrobial stewardship were less proactive [14]. This emphasizes a disparity between what is understood and the resulting personal values and beliefs. A study by Higuita-Gutiérrez *et al*., (2020) in Colombia corroborated these findings, with only 18.2% of medical students recognizing the term "antimicrobial stewardship" [15]. This unfamiliarity with crucial terminology represents a wider problem of inadequate focus on AMR in medical instruction.

These findings align with several other studies that identified shortcomings in knowledge, attitudes, and practices concerning antibiotic resistance among medical students. For instance, a survey of undergraduate medical students in a tertiary care hospital revealed that most students had moderate knowledge and practice regarding antibiotics use, yet half displayed a positive attitude towards their usage [16]. This inconsistency between knowledge, attitude, and practice might indicate underlying obstacles in educational methods, where theoretical comprehension doesn't necessarily lead to constructive attitudes or responsible actions.

Another investigation at Charité Universitätsmedizin Berlin and Julius-Maximilians-University Würzburg found similar disparities with deficiencies in knowledge and clinical skills regarding proper antibiotic use and AMR prevention [17]. These deficiencies reach beyond simple awareness and encompass the practical abilities necessary in clinical surroundings, stressing the need for a broader and more experiential approach to AMR education.

Collectively these studies depict a complex problem. Progress is evident in enhancing knowledge and influencing practices, but the attitude aspect seems to fall behind. Various factors might contribute to this lag such as the way AMR is taught, cultural perspectives on antibiotics, and an absence of tangible exposure to the ramifications of antibiotic resistance.

The weak correlation observed between knowledge and attitude in our study is a finding of significant concern. This implies that a better understanding of AMR does not necessarily lead to a positive attitude toward antimicrobial

stewardship. This suggests a potential disconnect in translating knowledge into the right attitudes and subsequently into appropriate practices. It resonates with a survey carried out among medical students in East China between 2017 and 2022 also identified gaps in the understanding of antimicrobial targets and bacterial transmission, with overconfident attitudes and inappropriate behaviors of antimicrobial overuse and misuse observed among respondents [18].

Similarly, a study by Nisabwe *et al*., (2020) in Rwanda reported that while students had a good knowledge of antibiotics and AMR, 83% were unfamiliar with the concept of antimicrobial stewardship [19]. This resonates with our findings and suggests the importance of interventions that target attitude enhancement independently of knowledge dissemination.

In terms of the progression of medical students across grades, our study found some intriguing patterns. While the mean practice score for 4th-grade students was the highest which could be expected due to increased exposure and experience the pattern for knowledge and attitude did not follow a similar trajectory. 1st-grade students had a higher mean attitude score than the 2nd-grade students and 3rd-grade students had a lower mean knowledge score than the 1st and 2nd-grade students. Such fluctuations in scores across grades challenge the conventional expectation that with the progression of education, there would be a steady improvement in KAP dimensions.

Our study's overall findings underline the need for a comprehensive review of the current education approach related to AMR and stewardship. It is crucial to devise strategies that not only focus on knowledge acquisition but also foster a positive attitude and encourage good practices. It may involve reinforcing the curriculum with experiential learning, involving students in antimicrobial stewardship committees, and encouraging interprofessional education.

Furthermore, longitudinal studies that follow students through their medical education journey can offer better insights into how KAP evolves and how various factors influence this evolution. Importantly, it may be beneficial to explore the attitudes and motivations behind the practices of medical students in more detail, potentially through qualitative research methods, to inform the development of targeted interventions.

This study emphasizes that while knowledge and practice regarding AMR and stewardship among medical students are moderate there is a significant need to enhance students' attitudes. Additionally, the observed discrepancies in KAP scores across the grades highlight the need to reassess our medical education strategies and explore innovative, more effective pedagogical approaches to improve antimicrobial stewardship among medical students.

Recommendations

The findings of this study on KAP towards Antibiotic Resistance and Antimicrobial Stewardship Programs among medical students unveil a multifaceted landscape that necessitates an inclusive approach to heighten awareness of antimicrobial resistance.

A vital first step is incorporating complete modules on AMR and stewardship within the medical curriculum. This must cover not only theoretical understanding but practical applications as well, promoting positive attitudes and accountable practices. Through interactive workshops, case studies, and realistic scenarios, learning can become more engaging and efficient, bridging the gap between theoretical knowledge and real-world practice.

Providing experiential learning opportunities is essential, enabling students to join antimicrobial stewardship committees and related activities. This practical experience can deepen understanding and dedication to antimicrobial stewardship. Collaborative learning across healthcare disciplines or interprofessional education can further reinforce this understanding. By encouraging a team-based approach, healthcare professionals may form more cohesive and successful strategies to fight antibiotic resistance.

The study's observation of a weak correlation between knowledge and attitude necessitates specialized interventions to address attitudes individually. This could involve awareness campaigns, seminars, and mentoring programs aimed specifically at cultivating positive attitudes toward antimicrobial stewardship. Such focused attitude enhancement efforts can complement broader curriculum integration, creating a more comprehensive educational experience.

It is vital to conduct longitudinal studies that follow medical students throughout their education to comprehend the development of KAP over time. These investigations can offer insights into the efficacy of interventions and the persistence of positive changes in KAP, informing the creation of novel teaching approaches tailored to varying academic levels. Personalized learning plans, peer education, and technology-driven platforms may be utilized to augment learning results.

Outside the medical field, public education initiatives must be launched to dispel misunderstandings about antibiotic usage. This wider strategy will foster a more knowledgeable and responsible populace, contributing to the overarching goal of battling antibiotic resistance. Global cooperation is crucial as well since AMR is an international issue. Collaborating with global health organizations, research bodies, and medical schools may forge a more cohesive and effective approach to AMR education and implementation.

Lastly, continuous oversight and assessment must be central to the enactment of these recommendations. Regular

evaluations, feedback, and ongoing refinement will guarantee that these strategies remain pertinent, efficient, and in tune with the dynamic nature of AMR. This continuous process will not only preserve the quality of the educational methods but also adapt to emerging challenges and opportunities.

The recommendations presented here underscore a thorough and interconnected strategy to augment antimicrobial resistance awareness. By addressing the knowledge deficits, attitudes, and practices concerning AMR through curriculum reform, experiential learning, targeted interventions, and wider community involvement, medical schools can be instrumental in equipping future doctors to face the global challenge of antibiotic resistance. This united effort will pave the way for a healthier and more robust society, ready to tackle the intricate and evolving landscape of antibiotic resistance.

Conclusion

The study findings highlight significant gaps in the knowledge, attitudes and practices of medical students in towards antibiotics and AMR. This underscores the urgency of integrating comprehensive and effective educational content about antibiotics and AMR into the medical curriculum. Given the critical role of future doctors in combating the global challenge of antibiotic resistance such curriculum enhancements are essential. The findings also suggest that public education strategies should be developed to counter misperceptions about antibiotic use among the broader population.

Limitations

This study, offering significant insights into the KAP of medical students regarding antibiotic resistance and antimicrobial stewardship programs, has several limitations.

The cross-sectional design of the study poses a challenge in understanding the subject matter's dynamics. While it offers a snapshot of medical students' KAP at a particular moment, it doesn't capture changes or developments in these attitudes and practices over a more extended period. The design cannot inherently establish causality, making it difficult to discern whether alterations in one variable cause changes in another.

The study's reliance on self-reported data introduces potential biases that could affect the accuracy of the findings. Participants might have been influenced by recall bias, where memories of past events or behaviors might not be completely accurate. Moreover, social desirability bias could have affected their responses, leading them to answer in a more socially acceptable manner. These biases may distort the true understanding of medical students' KAP.

The study's geographical and cultural context limits its generalizability. Since the study was conducted in a specific location the findings might not apply to different cultural or geographic areas. This limitation hampers the study's impact and its ability to inform practices in varied regions or populations.

Finally, the response rate and sample size in the study could be improved. A low response rate might lead to non-response bias, where the views and behaviors of non-participants differ substantially from participants. If the sample size is not sufficiently varied, it might not represent the broader medical student population. Improving both response rate and sample size could result in more robust findings.

While this study adds valuable information to the field these limitations must be carefully weighed when interpreting the results and applying them in broader contexts. Future research may address these issues by implementing a longitudinal design, using more objective data collection methods, broadening the geographical scope, and ensuring a more representative sample. This careful consideration will allow the study's contributions to be more effectively leveraged in the field of medicine.

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