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Research Article

# Knowledge of Medical Students Regarding Antimicrobial Resistance

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**Abstract:** The discovery of antibiotics has enhanced the treatment outcomes of infectious diseases. Nevertheless, the injudicious use of antibiotics has triggered a global public health crisis and caused a worldwide spread of antimicrobial-resistant microorganisms. Antimicrobial resistance is slowly becoming a major health problem all around the world, especially in Iraq, and this might be due to the incorrect, unwise prescription of antimicrobial agents among some doctors, which gives rise to this problem. The present study aimed to estimate the knowledge of medical students in Baghdad regarding antimicrobial usage and resistance and to find the association of sociodemographic factors with knowledge scores. A descriptive cross-sectional study was conducted in six medical colleges in Baghdad. An online-based questionnaire was published and used in collecting the data. The data were reviewed and entered to be statistically analyzed in SPSS using the Chi-square test and were presented as frequencies, percentages, graphs and tables. The results showed that 44.1% of the studied sample had a fair knowledge of antimicrobial resistance. There was a statistical significance between gender and knowledge about antimicrobial resistance as the P-value was 0.006. In addition, there was a statistically significant association between the stage and the knowledge about antimicrobial resistance, where the P-value was (0.000). It was concluded that most of the participants had fair to good knowledge regarding antimicrobial resistance that was significantly associated with gender and stage.

**Keywords:** Antibiotic Resistance, Knowledge, Medical Students.

## 1. INTRODUCTION

The development of antibiotics has led to improvements in the diagnosis, management, and outcomes of infectious diseases. On the other hand, the irresponsible use of antibiotics has led to a crisis in public health on a global scale and contributed to the proliferation of microorganisms that are resistant to antimicrobials [1]. Antimicrobial stewardship refers to the process of selecting the most effective antimicrobial medication, as well as determining the appropriate dosage and length of time to take it, so as to achieve the best possible clinical outcome for the treatment or prevention of infection, while causing the patient the least amount of harm and having the least influence on the development of antibiotic resistance [2]. There are a variety of factors that can affect antibiotic prescribing and use. These include patients' knowledge and attitudes toward antibiotic use, doctors' knowledge and experiences, patients' interactions with prescribers, and the availability of unregulated drugs and lax health policies regarding regulations on antibiotic use [3, 4].

Antimicrobial resistance is a growing problem that poses a danger to the efficacy of antimicrobial drugs used to treat infectious illnesses. It happens when bacteria, viruses, fungi, or parasites undergo conformational changes that prevent them from responding to treatments. This complicates infection management and heightens the danger of spreading disease, experiencing severe illness, and dying [5]. Since it causes severe infections and extended hospital admissions, increases in healthcare expenses, higher prices of second-line treatments, and treatment failures, antimicrobial resistance is seen as a major danger to public health systems worldwide, not only in poor nations [6]. Around 700,000 deaths a year may be attributed to drug resistance, making it one of the leading causes of mortality worldwide. If current trends

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continue, antimicrobial resistance is projected to cause over 10 million deaths annually and over 100 trillion US dollars in lost productivity throughout the world by the year 2050 [7]. Without an effective tool for prevention, available efficient treatment of resistant infections, and improvement of already existing antimicrobials, the number of patients with treatment failure will increase, and medical operations such as cesareans section, joint replacements, chemotherapy, transplantations will be more insecure [8].

There are a number of approaches that have been proposed for the administration of antibiotics. These include the replacement or restriction of formularies, the education of health care providers, the implementation of response activities, the requirement of approval from an infectious disease specialist for the prescription of drugs, and a more rational application of antimicrobial agents in every region of the world [1]. Students at medical schools are being trained to become primary care doctors who will serve the community. These future medical professionals are on the front lines of the battle against antimicrobial resistance, because they prescribe antibiotics responsibly and educate patients about the issues. There is ample evidence to support the contention that freshly licensed physicians and prescribers do not have the proper training necessary to administer drugs in a safe manner. It's possible that one of the causes for this is inadequate training received by students throughout their time in medical school [1]. The World Health Organization has placed a strong emphasis on the need to providing medical students with appropriate and effective training in the prudent prescription of antibiotics. In addition, antimicrobial stewardship has been recognized as a discipline in medicine that is quickly expanding and has the objective of making reasonable use of antibiotics in terms of dose, length of treatment, and method of administration. It is essential that students in the healthcare field be made aware of the dangers presented by antimicrobial resistance, and that they get enough instruction on the themes that are pertinent to the appropriate administration of antibiotics in their respective fields of practice [9]. Thus, the aim of the current study is to estimate knowledge of medical students in Baghdad regarding antimicrobial use and resistance. Moreover, to find the association of sociodemographic factors with knowledge score.

## 2. MATERIALS AND METHODS

A descriptive cross-sectional study was conducted at Al-Kindy College of Medicine during the period from the 1st of November 2021 to the 30th of January 2022. A convenient sample of 365 medical students from various universities in Baghdad was enrolled in the current study. These universities included: University of Baghdad/College of Medicine, University of Baghdad/Al-Kindy College of Medicine, Al-Mustansiriyah University/College of Medicine, Al-Nahrain University/College of Medicine, Al-Iraqia University/College of Medicine, University of Ibn-Sina for Medical and Pharmaceutical Sciences/College of Medicine.

*Pilot study*: A pilot study was conducted among 20 medical students, to assess the compliance and response of students, to find out any difficulty of any unclear question, and to find any other questions or aspects that may affect students that were not included in the questionnaire. Fortunately, after this pilot study, no significant changes were made to the questionnaire. For that reason, the twenty recruited students were included in the study.

*Data collection*: An online questionnaire by Google forms was used to collect the data. The questionnaire was adopted from previous studies measuring the same studied variables, the supervisor and panel of experts revised the questionnaire in Al-Kindy College of Medicine (Two Community Medicine, two Family Medicine, and one Pharmacology) and their modification and advice regarding the proposed questionnaire were considered.

*Ethical and official approval*: The conduction of the study was approved by the Ethical and Scientific Committee at Al Kindy College of Medicine/Family and Community Medicine department. All participants were informed that their responses would remain confidential, and permission to participate in the study was obtained during the data collection.

*Statistical Analysis*: Collected data were reviewed, entered into Microsoft Excel Sheet 2016 and loaded into the SPSS software version for statistical analysis. Descriptive statistics were presented as frequencies and percentages. The Chi-square test was used in inferential statistics to find

the significance of related variables. A P-value < 0.05 was considered as the discrimination point of significance.

*Scoring*: The Knowledge score was calculated by dividing the total number of correct answers in each Knowledge item by the total number of questions in that item, and the results were multiplied by 100%. As in the following example:

Knowledge score = (Number of knowledge questions answered correctly)/ (Total number of knowledge questions) × 100

A score of < 50 was considered 'poor', a score of 50-75 was considered 'fair', while a score of >75 was considered 'good'.

## 3. RESULTS AND DISCUSSION

A total number of 365 medical students were included in the current study. The majority of the participants (60%) were females, 68.8% aged 20 years and older. Most of the participants (44.1%) were from Al-Kindy College of Medicine. In addition, 81.9% of the participant were in the preclinical stage (Table 1). Regarding the responses to knowledge questions, the following questions (5, 24, and 3) had the highest percentage of corrected answers as 88.5%, 83.4%, and 82.1% of the participants correctly answered these questions, respectively. At the same time, the lowest percentage of corrected answers was regarding question 6 questions (13%),

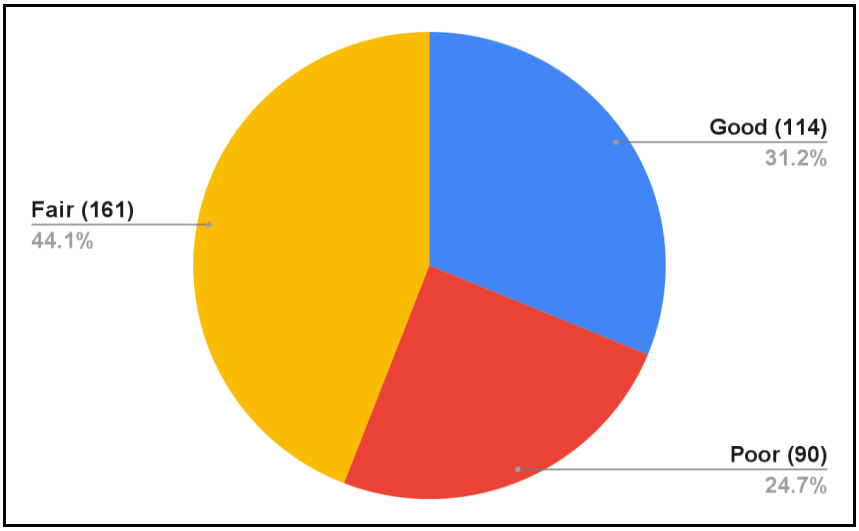


**Fig. 1.** Distribution of the studied sample regarding Knowledge score.

**Table 1.** General characteristics of the participants.

| | Categories | No. of Participants | Percentage (%) |
|---|---|---|---|
| Gender | Male | 146 | 40.0 |
| | Female | 219 | 60.0 |
| Age | < 20 years | 114 | 31.2 |
| | ≥ 20 years | 251 | 68.8 |
| College | Baghdad | 52 | 14.2 |
| | Al-Kindy | 161 | 44.1 |
| | Al-Iraqia | 19 | 5.2 |
| | Al-Nahrain | 61 | 16.7 |
| | Al-Mustansiriya | 44 | 12.1 |
| | Ibn-Sina | 28 | 7.7 |
| Stage | Preclinical | 299 | 81.9 |
| | Clinical | 66 | 18.1 |
| Residency | Baghdad | 233 | 63.8 |
| | Other than Baghdad | 132 | 36.2 |

**Table 2.** Knowledge of the studied sample.

| Sr. No. | Question | True | | False | | Uncertain | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| 1 | Overuse of antibiotics reduces their effectiveness in the long run, a phenomenon known as antimicrobial resistance. | 290 | 77.3 | 38 | 10.1 | 47 | 12.5 |
| 2 | Flu and colds are caused by bacteria. | 72 | 19.2 | 262 | 69.8 | 41 | 10.9 |
| 3 | When it comes to public health, antibiotic resistance is a major and urgent problem throughout the world. | 308 | 82.1 | 14 | 3.7 | 53 | 14.1 |
| 4 | Improper and unnecessary use of antibiotics might compromise therapy efficacy. | 280 | 74.6 | 28 | 7.4 | 67 | 17.8 |
| 5 | Penicillin or amoxicillin are antibiotics. | 333 | 88.8 | 13 | 3.4 | 29 | 7.7 |
| 6 | Aspirin is an antibiotic. | 50 | 13.3 | 273 | 72.8 | 52 | 13.8 |
| 7 | Infections become resistant to antibiotics, including paracetamol, if you take it too often. | 72 | 19.2 | 144 | 38.4 | 159 | 42.4 |
| 8 | To treat bacterial infections, antibiotics are helpful (e.g., tuberculosis). | 291 | 77.6 | 30 | 8.0 | 54 | 14.4 |
| 9 | For viral infections, antibiotics might be helpful (e.g., common cold, influenza). | 85 | 22.6 | 241 | 64.2 | 49 | 13.0 |
| 10 | The use of antibiotics is recommended for the treatment of any condition characterized by pain or inflammation. | 101 | 26.9 | 189 | 50.4 | 85 | 22.6 |
| 11 | Side-effects of the so-called “good bacteria” in our bodies may be eliminated by antibiotics. | 291 | 77.6 | 24 | 6.4 | 60 | 16.0 |
| 12 | When antibiotics kill out good bacteria in our body, they might leave us vulnerable to other illnesses. | 239 | 63.7 | 32 | 8.5 | 104 | 27.7 |
| 13 | Some antibiotics have been linked to severe allergic responses. | 292 | 77.8 | 16 | 4.2 | 67 | 17.8 |
| 14 | Infections caused by strains of Staphylococcus aureus resistant to methicillin may be successfully treated with ampicillin. | 107 | 28.5 | 73 | 19.4 | 195 | 52.0 |
| 15 | When used to treat infections caused by methicillin-resistant Staphylococcus aureus, clindamycin has been shown to be very successful. | 114 | 30.4 | 33 | 8.8 | 228 | 60.8 |
| 16 | Antibiotic resistance occurs when germs stop being treated by an antibiotic. | 286 | 76.2 | 37 | 9.8 | 52 | 13.8 |
| 17 | If your condition improves while taking antibiotics, you may stop taking them before the prescribed number of days has passed. | 74 | 19.7 | 247 | 65.8 | 54 | 14.4 |
| 18 | Resistance often arises because of inadequate or nonexistent infection control procedures. | 231 | 61.6 | 51 | 13.6 | 93 | 24.8 |
| 19 | Antibiotic resistance increases the perilousness of medical treatments such as surgery, transplants, etc. | 257 | 68.5 | 33 | 8.8 | 85 | 22.6 |
| 20 | The transmission of antibiotic-resistant germs from one individual to another is a real health concern. | 172 | 45.8 | 127 | 33.8 | 76 | 20.2 |
| 21 | Regular antibiotic users are the only population at risk for developing resistance. | 92 | 24.5 | 221 | 58.9 | 62 | 16.5 |
| 22 | Antimicrobial resistance is an international problem. | 129 | 34.4 | 127 | 33.8 | 119 | 31.7 |
| 23 | Antibiotic resistance is an issue that can affect my family or me. | 295 | 78.6 | 33 | 8.8 | 47 | 12.5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | Infections brought on by germs that have developed resistance are notoriously difficult to cure. | 313 | 83.4 | 21 | 5.6 | 41 | 10.9 |
| 25 | Antibiotic resistance is on the rise, making it harder and harder to treat common diseases. | 288 | 76.8 | 24 | 6.4 | 63 | 16.8 |
| 26 | When the body develops a tolerance to antibiotics, this is known as antibiotic resistance. | 202 | 53.8 | 134 | 35.7 | 39 | 10.4 |

**Table 3**. Association between essential studied variables and the knowledge level.

| General characteristics | | Knowledge score | | | | | | P-Value |
|---|---|---|---|---|---|---|---|---|
| | | Good | | Fair | | Poor | | |
| | | No. | % | No. | % | No. | % | |
| Age | <20 years | 29 | 25.4 | 51 | 44.7 | 34 | 29.8 | 0.166 |
| | ≥20 years | 85 | 33.9 | 110 | 43.8 | 56 | 22.3 | |
| Gender | Male | 58 | 39.7 | 62 | 42.5 | 26 | 17.8 | **0.006** |
| | Female | 56 | 25.6 | 99 | 45.2 | 64 | 29.2 | |
| Stage | Pre-clinical | 78 | 26.1 | 141 | 47.2 | 80 | 26.8 | **< 0.01** |
| | Clinical | 36 | 54.5 | 20 | 30.3 | 10 | 15.2 | |
| College | Baghdad | 22 | 42.3 | 21 | 40.4 | 9 | 17.3 | 0.149 |
| | Al-Kindy | 46 | 28.6 | 71 | 44.1 | 44 | 27.3 | |
| | Mustansiriyah | 10 | 22.7 | 25 | 56.8 | 9 | 20.5 | |
| | Nahrain | 25 | 41.0 | 19 | 31.1 | 17 | 27.9 | |
| | Iraqiya | 4 | 21.1 | 9 | 47.4 | 6 | 31.6 | |
| | Ibn-Sina | 7 | 25.0 | 16 | 57.1 | 5 | 17.9 | |
| Residency | Baghdad | 68 | 29.2 | 108 | 46.4 | 57 | 24.5 | 0.447 |
| | Others | 46 | 34.8 | 53 | 40.2 | 33 | 25.0 | |

as shown in Table 2. Regarding the distribution of the knowledge among the participants, 31.2 % had good knowledge, 44.1% had fair knowledge, and 24.7% of them had poor knowledge, as shown in Figure 1.

As shown in Table 3, the percentage of the participants who had good knowledge was significantly higher in males than in females (P-value = 0.006). In addition, there was a significant difference between the medical students in the clinical stages and those in the preclinical stages (P-value = 0.001).

Our results revealed that there is no significant difference in students' knowledge between different Iraqi colleges. This reflects uniformity in the syllabus and way of teaching practiced by Iraqi institutions. The main finding of the current study was that about one-third of participants had good knowledge regarding antimicrobial resistance. In comparison, it was better than the knowledge score obtained in other studies, as in Ethiopia, a study was done there in 2018 revealed that only 12% of participants had good knowledge regarding antimicrobial resistance [10]. While in Nigeria, a good knowledge score was achieved by 10.8% of the participants [7].

In contrast, other studies revealed a better knowledge score than what was obtained in the current study. A study was done in India in 2015 revealed that 98% of the participated medical student had good knowledge [11]. In Zambia, about 87% of the medical student had good knowledge regarding antimicrobial resistance, as revealed by a study done there [4].

Regarding gender, the males showed better knowledge regarding antimicrobial resistance than females. In another research conducted in Nigeria in 2019, males showed more knowledge about antimicrobial resistance than females, although females had better usage of antibiotics [12]. In

addition, the gender correlation to the knowledge about antimicrobial resistance is also affected by other factors: socioeconomic status and level of education [12]. The same findings were obtained by another study that was done by Wang *et al*. [13] in China in 2020. This might be due to males visit to healthcare facilities more often than females and seeking information about the subjects (including antimicrobial resistance) that they may be interested.

In the present research, participants younger than 20 years demonstrated a high level of understanding on the development of antibiotic resistance. In contrast, different research that was carried out in 2019 found that students who were between the ages of 22 and 26 years had four times the likelihood of having sufficient knowledge on antibiotic resistance compared to students in other age groups [14]. Students in this age range are most likely to have completed the foundational years of their education and may currently be in the para-clinical (year four) or clinical (years five and six) years of their education, during which they are exposed to pharmacology, microbiology, and other related fields that may influence their awareness of antimicrobial resistance [14]. The current study revealed that the students in the clinical stage had significantly better knowledge than others. The same results were obtained by another study in Malaysia in 2019, as most respondents possessed a good level of knowledge and practice regarding antimicrobials [15]. This reflected into the students' own behaviors towards the use of antimicrobials, since they utilize antimicrobials only when an official prescription is given to them. The closer the students were to graduation (clinical years), the better their knowledge and abilities were [15]. In China, a study was done there revealed that medical students with clinical experience had significantly better knowledge regarding than those without clinical experience [13].

Limitations: The study is restricted to medical students in Baghdad. It didn't include students from other Iraq provinces. Inclusion of such areas may give different picture.

## 4. CONCLUSIONS

The main finding of the current study was that most participants had fair to good knowledge regarding antimicrobial use and resistance, more precisely, about one-third of the participants showed good knowledge. Participants younger than 20 years of age, exhibited a high level of understanding about the development of antibiotic resistance. There was a statistically significant association between knowledge score and gender and stage. The students in the clinical stage had significantly better knowledge than others. Moreover, there was no significant difference in students' knowledge between different Iraqi colleges, which reflects uniformity in the syllabus and way of teaching practiced by Iraqi institutions.

## 5. CONFLICT OF INTEREST

The authors declare no conflict of interest.

## 6. REFERENCES

1. M.K. Gupta, C. Vohra, and P. Raghav. Assessment of knowledge, attitudes, and practices about antibiotic resistance among medical students in India. *Journal of Family Medicine and Primary Care* 8(9): 2864 (2019).
2. G. Harikumar, and K. Krishanan. The growing menace of drug resistant pathogens and recent strategies to overcome drug resistance: A review. *Journal of King Saud University-Science* 34(4):101979 (2022).
3. A. Jairoun, N. Hassan, A. Ali, O. Jairoun, and M. Shahwan. Knowledge, attitude and practice of antibiotic use among university students: a cross sectional study in UAE. *BMC Public Health* 19(1): 1-8 (2019).
4. A. Zulu, S. K. Matafwali, M. Banda, and S. Mudenda. Assessment of knowledge, attitude and practices on antibiotic resistance among undergraduate medical students in the school of medicine at the University of Zambia. *International Journal of Basic & Clinical Pharmacology* 9(2):263-70 (2020).
5. World Health Organization. Antimicrobial resistance 2023. [Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance.
6. P. Dadgostar. Antimicrobial resistance: implications and costs. *Infection and Drug Resistance* 12: 3903-10 (2019).
7. E.E. Chukwu, D.A. Oladele, O.B. Awoderu, E.E. Afocha, R.G. Lawal, and I. Abdus-Salam. A national survey of public awareness of antimicrobial resistance in Nigeria. A*ntimicrobial Resistance & Infection Control* 9(1): 1-10 (2020).
8. O.B. Jonas, A. Irwin, F.C.J. Berthe, F.G. Le Gall, and P.V. Marquez. Drug-resistant infections: a threat to our economic future (Vol. 2). *HNP/Agriculture*

*Global Antimicrobial Resistance Initiative* (2017).
9. P. Efthymiou, D. Gkentzi, and G. Dimitriou. Knowledge, attitudes and perceptions of medical students on antimicrobial stewardship. *Antibiotics* 9(11): 821 (2020).
10. M.A. Seid, and M.S. Hussen. Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. *BMC Infectious Diseases* 18: 1-8 (2018).
11. K. Sharma, P. Jain, and A. Sharma. Knowledge, attitude and perception of medical and dental undergraduates about antimicrobial stewardship. *Indian Journal of Pharmacology* 47(6): 676 (2015).
12. I.O. Alex. Knowledge of antibiotic use and resistance among students of a medical school in Nigeria. *Malawi Medical Journal* 31(2): 133-7 (2019).
13. Y. Wang, F. Guo, J. Wei, Y. Zhang, Z. Liu, and Y. Huang. Knowledge, attitudes and practices in relation to antimicrobial resistance amongst Chinese public health undergraduates. *Journal of Global Antimicrobial Resistance* 23: 9-15 (2020).
14. I.A. Odetokun, U. Akpabio, N.B. Alhaji, K.T. Biobaku, N.O. Oloso, and I. Ghali-Mohammed. Knowledge of antimicrobial resistance among veterinary students and their personal antibiotic use practices: A national cross-sectional survey. *Antibiotics* 8(4): 243 (2019).
15. M. Haque, N.A.A. Rahman, J. McKimm, M. Sartelli, G. M. Kibria, and M.Z. Islam. Antibiotic use: A cross-sectional study evaluating the understanding, usage and perspectives of medical students and pathfinders of a public defence university in Malaysia. *Antibiotics* 8(3): 154 (2019).