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ORIGINAL STUDY

Assessing Pharmacy Students' Knowledge and Awareness Regarding the Rational Utilization of Antibiotics and the Issue of Antimicrobial Resistance in Iraq

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ABSTRACT

Introduction: The Non rational use and overall volume of antibiotic consumption in the community is one of the foremost causes of antimicrobial resistance. In developing countries like Iraq, pharmacists often dispense 'prescription-only' drugs, like antibiotics, to patients who do not have a prescription. The objectives of this study are to estimate the prevalence of irrational use of antibiotics bought from pharmacies and other medication outlets in some areas in Iraq, as well as to investigate the factors related with such usage.

Method: The cross-sectional face to face survey was conducted in AL Mustaqbal University, were 267 students at College of Pharmacy, distributed over the four stages (43 participants) stage two, (81 participants) stage three, (79 participants) stage four, and (64 participants) stage five. These stages are the most likely to be knowledgeable about antibiotics by the nature of their studies in college and their training of stage four and five in pharmacies.

Results: the present study finds seventeen antibiotics were used by respondents. The more antimicrobial agent was gotten by respondents surveyed was amoxicillin and the highest group uses amoxicillin is fifth level of respondents then third level students then fourth level students and the lowest one is second level students with only (7%).

Conclusions: In conclusion, the findings of this study reveal that the pharmacy students have awareness about rational antibiotic utilization with a significant portion of pharmacy students have taken antibiotic monthly as self-medication or guidance either by pharmacists or physicians, and vast majority of them complete the course of antibiotic as directed.

Keywords: Self-medication, Antibiotic resistance, Superbugs, Pharmacy students

1. Introduction

The World Health Organization (WHO) provides a definition for self-medication as the act of individuals independently choosing and utilizing medications to address their self-identified illnesses or symptoms [1]. The practice of self-medication with antibiotics contributes significantly to the major health issue of drug resistance [2]. In many regions, particularly in low- and middle-income countries, it is widely believed that approximately 78.7 percent of antibiotics are utilized in community settings. These environments often witness the prevalent practice of non-prescription prescribing and purchase,

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disregarding established policies and regulations. Despite the existence of guidelines, the adherence to them is frequently overlooked, leading to a concerning situation where antibiotic misuse and overuse persist in these areas [3].

Numerous studies have indicated the prevalence of irrational antibiotic use in affluent nations. In such instances, the irrational use of antibiotics is predominantly attributed to excessive prescribing by general practitioners, who are often influenced by diagnostic uncertainty [4]. Across different nations in the Middle East, there is significant variation in the incidence of irrational antibiotic usage, with rates reaching as high as 46% in Jordan and 40% in Saudi Arabia, and higher percentage in Syria and Iraq [5]. A review study conducted in Iraq revealed a notable prevalence of antibiotic misuse among the population in various regions, with rates ranging from 45% to 92% [6].

Iraq faced many conflicts since 1980 till 2016, the wars lead to deterioration of national health system in Iraq especially during United Nation sanction on Iraq after Gulf war 1990, then the US invasion in 2003 and lastly ISIS attack in 2014. These conflict lead to AMS like resistance of P. aeruginosa, Staphylococcus aureus, K. pneumoniae and A. baumannii were identified as major contributors to multidrug resistance in Iraq [7]. The improper utilization of antibiotics is a crucial element that significantly fosters the development of resistance [8].

The misuse of self-medication, which often involves the use of prescription-only medicines, in cases of non-bacterial infections, disregarding clinical guidelines, or with incorrect dosage and inappropriate routes of administration, such as excessive use of injections instead of more suitable oral formulations [9]. The rapid increase in resistance to commonly available antibiotics can be attributed to the irrational use of these medications. This phenomenon is associated with adverse health outcomes, prolonged hospital stays, increased financial burdens on both patients and governments, and elevated mortality rates [10]. The crisis of antibiotic resistance is attributed to the excessive and inappropriate use of antibiotics, as well as the pharmaceutical sector's limited research into new drugs due to economic disincentives and stringent regulatory requirements [11].

Therefore, the overall utilization of antibiotics in the community is considered a prominent contributor to antimicrobial resistance. In economically disadvantaged countries like Iraq, pharmacists often provide patients without prescriptions with 'prescription-only' medications, including antibiotics [12]. The objectives of this study are to estimate the prevalence of irrational use of antibiotics bought from pharmacies and other medication outlets in some areas in Iraq, as well as to investigate the factors related with such usage.

Raising awareness to change behaviors and social norms that fuel the problem of antibiotic resistance, such as overuse of injections when oral formulations are available are examples of methods of administration.

There are behaviors, beliefs and practices that are common to many people which can be very inappropriate when it comes to antibiotic use. There are also many misconceptions about what antibiotic resistance is, how it spreads or what impact it has. For example, patients may self-medicate and demand antibiotics when they are not needed, and healthcare providers may prescribe or recommend antibiotics unnecessarily.

2. Materials and methods

2.1. Participants of the study

The cross-sectional face to face survey was conducted in AL Mustaqbal University, were 267 students at College of Pharmacy, distributed over the four stages (43 participants) stage two, (81 participants) stage three, (79 participants) stage four, and (64 participants) stage five. These stages are the most likely to be knowledgeable about antibiotics by the nature of their studies in college and their training of stage four and five in pharmacies.

2.2. Approach

This cross-sectional study conceived and designed similarly to pre-validated survey model [13] with simple modification by researchers to adapted Iraqi persons. The research team made a pilot study by distributing ten copies of the questionnaire among the students of AL-Mustaqbal University, and the results were good, as the students' answers varied, after that some questions and options were added (the name of the antibiotic, injection, pills or capsule).

The decision regarding which method to use (online or face-to-face) was taken to be face-to-face, to ensure a complete filling of survey and to answer the questions that are asked by the students. and fieldwork was carried out between 20 December 2021 and 3 January 2022. This study was approved by Research Committee at college of Pharmacy in Al-Mustaqbal University.

2.2.1. Questionnaires

The questionnaire consisted of 14 closed questions. Which stratified as four questions evaluate use of

antibiotics; four questions asked knowledge about antibiotics; five questions asked for knowledge about antibiotics resistance, while last one asked about use of antibiotics in an agriculture.

2.3. Limitations

Many students complain about taking the questionnaire and answering it, or they complain about answering all the questions due to their large number, especially question 11, 12, 13, and 14.

Another problem, manifested in the difficulty of understanding how to answer the questions or understanding the meaning of the questions themselves, for example in the question (Name of antibiotic) some students of the second stage have written the word (Pfizer) and by this they might mean Pfizer's Covid-19 vaccine.

2.4. Statistical analysis

According to statistical program version 23, Statistical Product and Service Solutions (SPSS), frequency distributions for the categorical variables were done first with percentage. Data were analyzed using t-test and χ^2 test and 95% confidence intervals did Statistically significant when the p-value is <0.05.

3. Results

3.1. Demographic characteristics

The questionnaires were replayed by 267 pharmacy students, and the percentage of respondents was 16.1%, 30.3%, 29.6% and 24% from second, third, fourth and fifth stage students respectively. The number of male students was 84 while female was 183, whereas the 60% of female students were the third and fourth stages Table 1.

Table 1. Demographic characteristics.

	Total	2nd	3rd	4th	5th
Students Level					
No.	267	43	81	79	64
Percentage	100%	16.1%	30.3%	29.6%	24.0%
Gender					
Male	84	10	25	24	25
Female	183	33	56	55	39
Province					
Babylon provinces	235	38	72	71	54
Neighbor provinces	32	5	9	8	10
Urbanization Level					
Urban	201	30	52	63	56
Suburban	61	11	26	16	8
Age (years)					
Mean	21.67	19.93	21.14	22.20	22.86

The largest number of geographical distribution of students was from Babylon, where the number of students was 235 students, while the number of students from neighbor provinces was 32 students. the mean value of age (years) for all respondents was 21.67, for second stage was 19.93, for third stage 21.14, for forth stage 22.20, and for fifth stage was 22.86.

3.2. Antibiotics use

Table 2 presents the percentages of responses to the question "What type of antibiotics did you take?" among different student levels. Among all levels, the highest percentage of respondents who took antibiotics used amoxicillin. The usage was highest among Fifth Level students (54.7%), followed by Third Level students (42%), and then Fourth Level students (35.4%). Second Level students had the lowest usage at 7.0%. The second most used antibiotic was azithromycin. Usage was notable among Fifth Level students (23.4%) and Fourth Level students (15.2%). Third Level and Second Level students had lower usage percentages (2.5% and 4.7% respectively). Ceftriaxone and doxycycline were used by a smaller percentage of respondents across all levels, with usage ranging from 0% to 6.3%. A significant portion of Second Level students (74.4%) did not remember the type of antibiotics they took. Third Level (23.5%) and Fourth Level (16.5%) students also had notable percentages of respondents who couldn't recall the antibiotics.

3.2.1. When participants last took antimicrobial agents

Table 2 illustrates the varying percentages of students' responses regarding their antibiotic usage based on different time frames: "last month," "in the last 6 months," "last year," "a year ago," "never," and "can't remember." Among second-year students, 41.9% took antibiotics last month, 18.6% within the last 6 months, 4.7% last year, 4.7% a year ago, 11.6% never, and 18.6% couldn't recall. For third-year students, 58.0% took antibiotics last month, 19.8% in the last 6 months, 3.7% last year, 3.7% a year ago, 7.4% never, and 7.4% couldn't remember. Fourth-year students reported 39.2% last month, 30.4% in the last 6 months, 3.8% last year, 2.5% a year ago, 7.6% never, and 16.5% couldn't remember. Fifth-year students had 60.9% last month, 18.8% in the last 6 months, 9.4% last year, 9.4% a year ago, 1.6% never, and 0.0% couldn't remember. In total, 50.6% of all students took antibiotics last month, 22.5% in the last 6 months, 5.2% last year, 4.9% a year ago, 6.7% never, and 10.1% couldn't remember.

This data sheds light on antibiotic usage patterns among different student groups. Notably, fifth-year

Table 2. Percentages of responses from all respondents to "When did you last take antibiotics?" "What type of antibiotics did you take?" by group surveyed.

	When did you last take antibiotics?											
Students level	Last month	In the last 6 months	Last year	Year ago	Never	Can't remember	Total	Amox.	Azi.	Ceft.	Dox.	Not remember
Second	41.9%	18.6%	4.7%	4.7%	11.6%	18.6%	100%	(7.0%)	(4.7%)	0	0	(74.4%)
Third	58.0%	19.8%	3.7%	3.7%	7.4%	7.4%	100%	(42%)	(2.5%)	0	(3.7%)	(23.5%)
Fourth	39.2%	30.4%	3.8%	2.5%	7.6%	16.5%	100%	(35.4%)	(15.2%)	(6.3%)	(5.1%)	(16.5%)
Fifth	60.9%	18.8%	9.4%	9.4%	1.6%	0.0%	100%	(54.7%)	(23.4%)	(4.7%)	(1.6%)	0
Total	50.6%	22.5%	5.2%	4.9%	6.7%	10.1%	100%		(37.5%)	(11.6%)	(3%)	(3%)

% = Percentages of respondents within level, Amox = Amoxicillin, Azi = Azithromycin, Ceft = Ceftriaxone, Dox = Doxycycline.

Table 3. Percentages of responses from all respondents to "On that occasion, did you get the antibiotics (or a prescription for them) from a doctor or pharmacist or nurse?" by group surveyed.

Students level	Physician	Pharmacist	Nurse	No	Can't remember
Second	39.5%	34.2%	10.5%	10.5%	5.3%
Third	33.8%	47.3%	2.7%	14.9%	1.4%
Fourth	36.1%	44.4%	1.4%	15.3%	2.8%
Fifth	27.0%	52.4%	3.2%	17.5%	0.0%
Total	33.6%	45.7%	3.6%	15.0%	2.0%

Table 4. Percentages of responses from all respondents to "On that occasion, did you get the antibiotics (or a prescription for them) from a doctor or pharmacist or nurse?" by urbanization level of respondents.

	Physician	Pharmacist	Nurse	No	Can't remember
Urban	34.4%	43.5%	4.3%	15.6%	2.2%
Suburban	28.6%	53.6%	1.8%	14.3%	1.8%
Total	33.1%	45.9%	3.7%	15.3%	2.1%

students have the highest percentage of recent antibiotic use (last month), while fourth-year students have a higher proportion of respondents unable to recall their last antibiotic intake.

3.2.2. How people obtained antibiotics

Table 3 presents the percentages of responses from all respondents based on their student levels in relation to obtaining antibiotics or a prescription for antibiotics from a doctor, pharmacist, or nurse. Among Second-year students, the majority (39.5%) received antibiotics or prescriptions from a physician, followed by pharmacists (34.2%). Third-year students had a higher percentage (47.3%) obtaining antibiotics or prescriptions from pharmacists. In contrast, Fourth-year students had a much lower percentage (1.4%) receiving them from nurses. Fifth-year students primarily obtained antibiotics or prescriptions from pharmacists (52.4%). The "Total" row provides an overview of the entire survey, showing that 33.6% received antibiotics or prescriptions from physicians, 45.7% from pharmacists, 3.6% from nurses, 15.0% didn't receive antibiotics or prescriptions, and 2.0% couldn't remember.

This table is valuable for understanding the distribution of antibiotic prescription sources among students at different levels and the overall response patterns. It may offer insights for healthcare professionals and policymakers in ensuring the appropriate and accessible distribution of antibiotics to different student groups.

Table 4 presents the percentages of responses from all respondents based on the urbanization level of the respondents in relation to obtaining antibiotics or a prescription for antibiotics from a doctor, pharmacist, or nurse. In urban areas, a significant portion (43.5%) of respondents obtained antibiotics or prescriptions from pharmacists, while 34.4% received them from physicians.Nurses provided antibiotics or prescriptions to 4.3% of respondents in urban areas.In suburban areas, a higher percentage (53.6%) received antibiotics or prescriptions from pharmacists, with 28.6% obtaining them from physicians.Suburban areas had a lower percentage (1.8%) of respondents who received antibiotics or prescriptions from nurses.This table helps to understand the differences in the sources of antibiotic prescriptions based on the urbanization level of the respondents. It can be valuable for healthcare professionals and policymakers in tailoring healthcare services and antibiotic distribution strategies to the specific needs of urban and suburban populations.

3.2.3. Whether people received advice from a medical professional on how to take them

The data of Table 5 illustrates the percentages of responses from all respondents regarding whether they received advice from a doctor, nurse, or pharmacist on how to take antibiotics. The data is categorized by different student levels (Second, Third, Fourth, and Fifth). Among Second-year students, the majority (52.6%) received advice from pharmacists, while a significant portion (23.7%) received advice from physicians. While in the Third and Fourth years, a

Table 5. Percentages of responses from all respondents "On that occasion, did you get advice from a doctor, nurse or pharmacist on how to take them?" by Students level surveyed.

Students level	Physician	Pharmacist	Nurse	No	Can't remember
Second	23.7%	52.6%	0.0%	15.8%	7.9%
Third	29.7%	45.9%	0.0%	21.6%	2.7%
Fourth	26.4%	47.2%	1.4%	20.8%	4.2%
Fifth	18.8%	50.0%	0.0%	25.0%	6.3%
Total	25.0%	48.4%	0.4%	21.4%	4.8%

substantial percentage of respondents received advice from pharmacists (45.9% and 47.2%, respectively). Nurses provided advice to a small percentage of Fourth-year student (1.4%). Among Fifth-year students, 50.0% received advice from pharmacists. This table provides insights into the sources of advice on antibiotic usage among students at different levels of study. It can be valuable for healthcare professionals and educators to understand where students are seeking guidance and tailor education and healthcare services accordingly.

3.2.4. Where people obtained the antibiotics

Almost all respondents across the four groups surveyed report having obtained the antibiotics they last took from pharmacy (89.9%) (Table 6).

Third level group with the highest number of respondents reporting that they got their antibiotics from a friend or family member, though this response was still low, at 6.7%.

Fifth level groups with the highest number of respondents who said they had them saved up from a previous time, though this response is low too, at 5%.

The data of (Table 6) represents the percentages of responses from all respondents regarding the sources from which they obtained antibiotics. Second-year students primarily obtained antibiotics from a pharmacy (92.1%), with a small percentage (7.9%) unable to recall the source. Third-year students had a high percentage obtaining antibiotics from a pharmacy (85.3%) and also received them from friends or family members (6.7%). Fourth, fifth year students had a similar trend, with a majority obtaining antibiotics from a pharmacy (93.1%), (90.3%) respectively and a small percentage (5.6%) and (6.5%) respectively using antibiotics saved from a previous occasion.

This table provides insights into where students at different levels of study obtain antibiotics. It can be valuable for healthcare professionals and policymakers in understanding antibiotic distribution and adherence patterns among students. Additionally, it highlights the importance of proper education and communication regarding antibiotic use.

3.3. Knowledge of antibiotics

The next area of survey findings covered in this report is levels of knowledge around the appropriate use of antibiotics including how and when to use antibiotics and what they should be used for.

3.3.1. When to stop taking antibiotics

The data of Table 7 reveals the percentages of responses from all respondents regarding their beliefs about when to stop taking antibiotics once they've begun treatment. (32.6%) of second-year students mostly believe that antibiotics should be stopped when they feel better, while a significant portion (55.8%) understands the importance of completing the full course as directed.

Third-year students share a similar trend, with the majority (59.3%) believing in completing the full course as directed.Fourth-year students have the highest percentage (62.0%) acknowledging the importance of completing the full course.In contrast, a smaller percentage of fifth-year students (15.6%) believe antibiotics should be stopped when they feel better, and a large majority (81.3%) understand the importance of completing the full course.This table provides insights into students' understanding of antibiotic usage. It highlights the importance of education on the proper use of antibiotics, emphasizing the need to complete the full course as directed by healthcare professionals to prevent antibiotic resistance. The variations in responses across different student levels demonstrate the potential impact of

Table 6. Percentages of responses from all respondents "On that occasion, where did you get the antibiotics?" by Students level surveyed.

Students level	Pharmacy	Friend or family member	I had them saved up from a previous time	Can't remember
Second	92.1%	0.0%	0.0%	7.9%
Third	85.3%	6.7%	4.0%	4.0%
Fourth	93.1%	1.4%	5.6%	0.0%
Fifth	90.3%	3.2%	6.5%	0.0%
Total	89.9%	3.2%	4.5%	2.4%

Table 7. Percentage of responses from all respondents to "When do you think you should stop taking antibiotics once you've begun treatment?" by group surveyed.

Students level	When you feel better	When you've taken all of the antibiotics as directed	Don't know
Second	32.6%	55.8%	11.6%
Third	39.5%	59.3%	1.2%
Fourth	35.4%	62.0%	2.5%
Fifth	15.6%	81.3%	3.1%
Total	31.5%	64.8%	3.7%

Table 8. Percentage of responses from all respondents to "It's okay to use antibiotics that were given to a friend or family member, as long as they were used to treat the same illness" by group surveyed.

Students level	True	False	Don't know
Second	14.0%	79.1%	7.0%
Third	18.5%	80.2%	1.2%
Fourth	10.1%	87.3%	2.5%
Fifth	7.8%	85.9%	6.3%
Total	12.7%	83.5%	3.7%

education and awareness campaigns on antibiotic use practices.

3.4. How and when to take antibiotics

Table 8 shows the percentages of responses from all respondents regarding their beliefs about whether it is acceptable to use antibiotics that were originally given to a friend or family member, as long as these antibiotics were used to treat the same illness. Across all student levels, the majority of respondents believe it is not acceptable to use antibiotics from friends or family members if they were used to treat the same illness. This is particularly evident among third-year (80.2%) and fourth-year (87.3%) students. A relatively smaller percentage of respondents in each group believe it is acceptable to use such antibiotics. The highest percentage of "True" responses is among third-year students (18.5%). A small portion of respondents in each group are uncertain and answer "Don't know." This table provides insights into students' beliefs about using antibiotics from friends or family members. It underscores the need for education and awareness on the responsible use of antibiotics, as the majority of students in each level understand the importance of not sharing antibiotics, which can contribute to antibiotic resistance.

3.4.1. Which conditions should antibiotics be used to treat?

Table 9 presents the percentages of responses from all respondents regarding their beliefs about whether certain medical conditions can be treated with antibiotics. The data is organized by different medical conditions. Several conditions, including bladder infections or UTIs, diarrhea, skin or wound infections, sore throat, fever, and headaches, show statistically significant differences in beliefs about antibiotic treatment among respondents. Conditions like gonorrhea, cold and flu, and measles do not show statistically significant differences in beliefs about antibiotic treatment among respondents.The results indicate varying levels of awareness and understanding among respondents regarding the appropriateness of antibiotic use for specific medical conditions. Misconceptions about antibiotic effectiveness can lead to inappropriate antibiotic use, contributing to antibiotic resistance.Educating the public about the proper use of antibiotics for specific illnesses is crucial to combat antibiotic resistance and promote responsible antibiotic usage. This table reveals the varying beliefs about the effectiveness of antibiotics in treating different medical conditions. It highlights the need for education and awareness campaigns to promote responsible antibiotic use and to clarify when antibiotics are and are not appropriate for treatment.

Table 9. Percentage of responses from all respondents to "Do you think these conditions can be treated with antibiotics?"

Conditions	Yes	No	p-value
HIVAIDS	27.3%	72.7%	$P < 0.001$
Gonorrhoea	24.7%	75.3%	NS
Bladder infection or urinary tract infection UTI	68.2%	31.8%	$P < 0.001$
Diarrhoea	49.8%	50.2%	$P < 0.001$
Cold and flu	64.8%	35.2%	NS
Fever	39.0%	61.0%	$P < 0.01$
Malaria	16.1%	83.9%	$P < 0.01$
Measles	19.9%	80.1%	NS
Skin or wound infection	59.2%	40.8%	$P < 0.001$
Sore throat	64.8%	35.2%	$P < 0.001$
Body aches	21.0%	79.0%	$P < 0.01$
Headaches	25.8%	74.2%	$P < 0.001$

Table 10 displays the percentages of responses from all respondents regarding their beliefs about whether bladder infections or urinary tract infections (UTIs) can be treated with antibiotics. The belief in using antibiotics to treat bladder infections or UTIs increases as students' progress through their academic levels. Second-year students have the lowest belief (25.6%), while fifth-year students have the highest belief (87.5%). The results indicate a notable increase in the belief that antibiotics can treat bladder infections or UTIs among students as they advance in their academic levels. This might be attributed to their growing understanding of medical conditions and antibiotic treatments through their education. These findings highlight the importance of educating

Table 10. Percentage of responses from all respondents to "Can bladder infections/UTIs be treated with antibiotics?" by Students Level surveyed.

	Bladder infection or urinary tract infection (UTI)	
Students level	Yes	No
Second	25.6%	74.4%
Third	63.0%	37.0%
Fourth	81.0%	19.0%
Fifth	87.5%	12.5%
Total	68.2%	31.8%

Table 11. Percentage of responses from all respondents to "Can cold and flu be treated with antibiotics?" by Students Level surveyed.

Students level	Cold and flu		
	Yes	No	Total
Second	67.4%	32.6%	100.0%
Third	63.0%	37.0%	100.0%
Fourth	60.8%	39.2%	100.0%
Fifth	70.3%	29.7%	100.0%
Total	64.8%	35.2%	100.0%

individuals, both within and outside the medical field, about the appropriate use of antibiotics, particularly for specific medical conditions. Healthcare professionals and educators should consider the variation in beliefs about antibiotic use among different student levels to design effective educational interventions to promote responsible antibiotic usage.

Table 11 shows the responses from all respondents regarding their beliefs about whether cold and flu can be treated with antibiotics. The belief in using antibiotics to treat cold and flu varies among student levels, but the majority of students at all levels believe that antibiotics are effective for these conditions. Fifth-year students have the highest belief (70.3%), while fourth-year students have the lowest belief (60.8%). 64.8% of all respondents believe that antibiotics can treat cold and flu, while 35.2% do not share this belief. The results reveal a significant misconception among students about the use of antibiotics for cold and flu. In reality, antibiotics are not effective against viral illnesses like the common cold and influenza. This misconception can contribute to antibiotic overuse, which is a significant factor in the development of antibiotic resistance. Education and awareness campaigns are essential to correct this misconception and promote responsible antibiotic usage. Healthcare professionals and educators should focus on dispelling this myth and emphasizing the proper use of antibiotics for bacterial, not viral, infections.

3.5. Knowledge of antibiotics resistance

Table 12 presents the percentages of respondents who have indicated their awareness of specific terms related to antibiotic resistance by responding "yes" to the question. Antibiotic Resistance: Approximately 57.7% of the respondents are aware of the term "Antibiotic Resistance," while 42.3% are not aware. This term's awareness is statistically significant ($p < 0.001$). Superbugs: About 36.0% of the respondents have heard of "Superbugs," whereas 64.0% have not. The awareness of this term is also statistically significant ($p < 0.001$). A total of 41.9% of respondents

Table 12. Percentage of all respondents who answered "yes" to "Have you heard of any of the following terms. . .."

Terms	Yes	No	p-value
Antibiotic resistance	57.7%	42.3%	$P < 0.001$
Superbugs	36.0%	64.0%	$P < 0.001$
Drug resistance	41.9%	58.1%	$P < 0.001$
Antibiotic-resistant bacteria	68.2%	31.8%	NS

are familiar with the term "Drug Resistance," and 58.1% are not. This term's awareness is statistically significant ($p < 0.001$). Around 68.2% of the respondents are aware of the term "Antibiotic-Resistant Bacteria," while 31.8% are not. The awareness of this term is not statistically significant (NS). The results demonstrate varying levels of awareness among respondents regarding key terms related to antibiotic resistance. Antibiotic Resistance is the most recognized term among the respondents. "Superbugs" and "Drug Resistance" are less widely recognized, with more respondents being unaware of these terms.The term "Antibiotic-Resistant Bacteria" is well-known to the majority of respondents.

The variations in awareness levels among these key terms emphasize the need for public education and awareness campaigns about antibiotic resistance. Greater awareness of these terms is vital for understanding and addressing the global health threat of antibiotic resistance effectively. Healthcare professionals, educators, and policymakers can use these findings to tailor their communication and education efforts to enhance public knowledge and awareness of antibiotic resistance and its associated terminology.

Table 13 presents the percentages of all respondents' awareness levels regarding the terms "Antibiotic Resistance," "Drug Resistance," and "Superbugs" by responding "yes" to the question of whether they have heard of these terms. The data is categorized by different student levels (Second, Third, Fourth, and Fifth). Antibiotic Resistance: The percentage of students aware of "Antibiotic Resistance" increases as they progress through their academic levels. Fifth-year students have the highest awareness (78.1%), while second-year students have the lowest (44.2%).

Table 13. Percentage of all respondents who answered "yes" to "Have you heard of. . . Antibiotic resistance, drug Resistance and Superbugs?"

Students level	Antibiotic resistance		Drug resistance		Superbugs	
	Yes	No	Yes	No	Yes	No
Second	44.2%	55.8%	27.9%	72.1%	18.6%	81.4%
Third	46.9%	53.1%	35.8%	64.2%	28.4%	71.6%
Fourth	59.5%	40.5%	39.2%	60.8%	27.8%	72.2%
Fifth	78.1%	21.9%	62.5%	37.5%	67.2%	32.8%
Total	57.7%	42.3%	41.9%	58.1%	36.0%	64.0%

Table 14. Percentages of responses from all respondents to "Where did you hear about the term antibiotic resistance?"

Students level	Physician	Pharmacist	Nurse	Family member or friend	Media
Second	3	6	0	2	1
Third	8	13	1	2	6
Fourth	3	26	1	1	3
Fifth	10	20	0	0	3
Total	24	65	2	5	13

Table 15. Percentages of all respondents who answered the question "Antibiotic resistance occurs when your body becomes resistant to antibiotics, and they no longer work as well" by group surveyed.

Students level	True	False	Total
Second	31	12	43
Third	48	33	81
Fourth	51	28	79
Fifth	54	10	64
Total	184	83	267

Like the other terms, awareness of "Superbugs" increases with academic level, with fifth-year students having the highest awareness (67.2%). The results show that awareness of these key terms related to antibiotic resistance tends to increase as students progress through their academic levels. This suggests that academic programs and education are contributing to greater awareness among students. However, there is still room for improvement, especially among second-year students, where awareness levels are lower. Efforts should continue to educate individuals about antibiotic resistance and its associated terminology to ensure a well-informed population that can contribute to combatting antibiotic resistance effectively.

3.5.1. Levels of understanding of the issue of antibiotic resistance

Table 14 displays the percentages of responses from students at different academic levels regarding where they first heard about the term "antibiotic resistance." The data is categorized by sources such as physicians, pharmacists, nurses, family members or friends, and media. 109 students were aware of "antibiotic resistance." Pharmacists were the most prominent source, with 65 students (59.6%) hearing about it from them. Physicians contributed to the awareness of 24 students (22%), the media to 13 students (11.9%), and family members or friends to 5 students (4.6%). Nurses played a relatively minor role, with only 2 students (1.8%) mentioning them. The table reveals where students first learned about "antibiotic resistance." Pharmacists appear to be the primary source of knowledge, with a significant number of students from all academic levels citing them. Physicians also played a crucial role in educating students, particularly among fifth-year students. The media contributed to a notable percentage of awareness across all levels.

This data underscores the importance of healthcare professionals, especially pharmacists and physicians, in disseminating information about antibiotic resistance. It also highlights the potential of media campaigns to reach a broader audience. Additionally, it could indicate that students in the later years of their studies may have more exposure to these terms, explaining their higher awareness levels. Efforts to increase awareness about antibiotic resistance should continue to leverage these key sources of information and adapt strategies to educate students at various academic levels.

Table 15 presents the percentages of responses from students at different academic levels regarding their understanding of the statement: "Antibiotic resistance occurs when your body becomes resistant to antibiotics, and they no longer work as well." Considering all 267 respondents, 184 students (68.9%) correctly identified the statement as "True," while 83 students (31.1%) answered "False." The table illustrates varying levels of understanding among students regarding antibiotic resistance. Fifth-year students demonstrated the highest comprehension, with 84.4% providing the correct response. This suggests that as students progress through their academic levels, they gain a better understanding of the concept, possibly due to advanced coursework and exposure to the topic in their curriculum. On the other hand, third-year students had a lower understanding compared to the other groups, with only 59.3% answering correctly. This variation could be attributed to differences in educational emphasis or individual learning experiences. The overall rate of correct responses (68.9%) indicates a moderate understanding of antibiotic resistance among the surveyed students. These findings emphasize the need for targeted educational interventions, especially for students in the early years of their studies. Strengthening foundational knowledge about antibiotic resistance is essential, as it forms the basis for responsible antibiotic use and mitigating the emergence of antibiotic-resistant bacteria.

Educational institutions and healthcare professionals should collaborate to enhance awareness campaigns and educational modules that focus on the fundamental aspects of antibiotic resistance. By addressing these gaps in understanding, future healthcare professionals can contribute significantly to the global efforts in combating antibiotic resistance.

Table 16. Percentages of responses from all respondents to "Many infections are becoming increasingly resistant to treatment by antibiotics" by students Level surveyed.

Students level	True	False	
Second	35	8	43
Third	74	7	81
Fourth	71	8	79
Fifth	61	3	64
Total	241	26	267

Table 16 presents the percentages of responses from students at different academic levels regarding their awareness of the statement: "Many infections are becoming increasingly resistant to treatment by antibiotics." Considering all 267 respondents, 241 students (90.3%) correctly identified the statement as "True," while 26 students (9.7%) answered "False." The table reveals a strong and consistent awareness among students at various academic levels regarding the issue of increasing antibiotic resistance. Most students in all levels correctly identified the statement as "True," highlighting their recognition of the growing problem of antibiotic resistance.

Notably, third, fourth, and fifth-year students exhibited exceptionally high awareness levels, with more than 89% in each level answering correctly. This may be attributed to their advanced coursework and exposure to the topic of antibiotic resistance throughout their education. The overall rate of correct responses (90.3%) signifies a substantial understanding of the issue among the surveyed students. This is an encouraging finding, as it suggests that these future healthcare professionals are well-informed about the challenges posed by antibiotic resistance. It is crucial to maintain and build upon this awareness by integrating antibiotic resistance education into the curriculum of healthcare-related programs. Furthermore, emphasizing the importance of responsible antibiotic use and the role healthcare professionals can play in combating antibiotic resistance is essential. Overall, the results in this table indicate a promising level of awareness among the surveyed students, which is a positive step in the global efforts to address antibiotic resistance effectively.

3.5.2. Levels of awareness and understanding around ways to address antibiotic resistance

To assess the awareness and comprehension regarding strategies to combat antibiotic resistance, respondents were queried about their perceptions concerning several actions that could potentially mitigate the issue. These actions included:

- People should use antibiotics only when they are prescribed by a doctor or nurse.
- Farmers should reduce antibiotic usage in food-producing animals.
- People should refrain from storing antibiotics for future use on other illnesses.
- Parents should ensure that all their children's vaccinations are up-to-date.
- People should adopt a regular handwashing routine.
- Doctors should prescribe antibiotics only when medically necessary.
- Governments should incentivize the development of new antibiotics.
- Pharmaceutical companies should focus on the development of novel antibiotics.

Across all four student levels participating in the survey, the majority of respondents expressed agreement with the notion that these actions could contribute to mitigating antibiotic resistance. Notably, "Parents should ensure that all their children's vaccinations are up-to-date" (99.3%), "People should adopt a regular handwashing routine" (96.6%), "Governments should incentivize the development of new antibiotics" (96.6%), and "Pharmaceutical companies should focus on the development of novel antibiotics" (95.1%) emerged as the most widely accepted strategies.

"People should use antibiotics only when they are prescribed by a doctor or nurse" also received substantial agreement (92.1%). On the other hand, "Farmers should reduce antibiotic usage in food-producing animals" (75.3%) and "Doctors should prescribe antibiotics only when medically necessary" (76.8%) garnered lower agreement, though still a significant majority found value in these actions.

4. Discussion

4.1. Demographic data

The results presented in this study offer insights into the demographic characteristics and distribution of pharmacy students who participated in the research. The study's sample size, comprising 267 pharmacy students, may seem relatively small, but when compare with previous studies, it is worth noting that the distribution of respondents across different academic stages is quite balanced, with approximately 16.1% from the second stage, 30.3% from the third stage, 29.6% from the fourth stage, and 24% from the fifth stage (14, 15). This balance in representation across stages could be beneficial for drawing more comprehensive conclusions, as it accounts for the evolving knowledge and experiences of students throughout their pharmacy

education. Additionally, the study's focus on gender distribution, with 84 male students and 183 female students, is relevant given the gender diversity in the pharmacy field, that might be because female pharmacists report higher levels of work satisfaction than male pharmacists [16]. Notably, the data shows that 60% of the female students are in the third and fourth stages, which might have implications for understanding their educational and career trajectories.

The geographic distribution of students, particularly the concentration in Babylon with 235 students, provides information about the regional representation in the study. The presence of 32 students from neighboring provinces could be significant, as it may allow for comparisons between students from different regions, which could have implications for the generalizability of the study's findings. Furthermore, the mean age values for students at different stages of their pharmacy education reveal an interesting pattern. Students in later stages tend to be older, which is consistent with expectations as they progress in their academic journey. This information could be relevant in understanding the characteristics of pharmacy students at various stages and their potential needs and expectations. Overall, these demographic characteristics provide valuable context for the study's findings and can guide the interpretation of the results in light of the diversity within the sample [17].

4.2. Antibiotic use

The presented data provides valuable insights into antibiotic usage patterns among pharmacy students at different academic levels. The findings suggest that amoxicillin is the most commonly used antibiotic among the surveyed students, with higher usage among those in their fifth and third academic years, that agree with Khalid GM et al. work where they reported the self-medication amoxicillin among pharmacist student was 32.6% [18]. This information is important in understanding the prevalence of certain antibiotics among this population and may have implications for prescribing practices and education on antibiotic usage. Additionally, the data reveals that a significant portion of second-year students couldn't remember the type of antibiotics they took, highlighting potential issues with recall or documentation of antibiotic usage, which could be related to understanding of antibiotic using, develops gradually with graduation years and junior students have misconception about antibiotics comparing to senior pharmacy students [19].

Moreover, the information on the timing of antibiotic use is noteworthy. Fifth-year students had the highest percentage of recent antibiotic use, which might be attributed to a greater exposure to clinical settings in the later stages of their education [20]. However, the higher proportion of fourth-year students unable to recall their last antibiotic intake raises questions about the effectiveness of patient education and awareness campaigns regarding antibiotic use. This data could serve as a reference point for healthcare professionals and policymakers looking to improve antibiotic stewardship programs and patient education efforts in the academic setting [21]. Additionally, the source of antibiotic prescriptions and advice received from medical professionals is a crucial aspect of antibiotic usage. The data reveals that pharmacists play a significant role in providing advice, especially among third and fourth-year students and this may be due to the direct contact between pharmacist and patient in community pharmacy [22]. This underscores the importance of interprofessional collaboration between pharmacists and physicians in promoting responsible antibiotic usage. It also highlights the need for tailored educational interventions to ensure that medical professionals and students have a better understanding of antibiotics and their appropriate use [23].

Lastly, the data demonstrates that most respondents obtained antibiotics from a pharmacy, suggesting a potential need for stricter regulations on over-the-counter antibiotic sales and better patient education to discourage self-medication [24]. The information on obtaining antibiotics from friends or family members, or using leftover antibiotics, points to the prevalence of self-medication practices, which is a significant public health concern [25]. Addressing these practices will require a multifaceted approach, involving healthcare professionals, educational institutions, and policymakers, to promote responsible antibiotic use and minimize the risks associated with self-medication [26]. The data not only informs current practices among pharmacy students but also provides a foundation for future research and interventions aimed at improving antibiotic usage and reducing the emergence of antibiotic resistance. In the context of previous research articles on antibiotic use, this data can be used to further the understanding of antibiotic usage patterns and to assess the impact of various interventions on responsible antibiotic use in academic settings.

4.3. Antibiotic knowledge

The data presented in this report offers valuable insights into the levels of knowledge among pharmacy students regarding the appropriate use of antibiotics, including how and when to use antibiotics and for what conditions. Understanding these aspects of

antibiotic knowledge is crucial for addressing antibiotic resistance and promoting responsible antibiotic use [27]. When examining where students obtain antibiotics, the majority of respondents across all academic levels primarily obtain antibiotics from pharmacies. However, a small percentage of students cannot recall the source, which may indicate gaps in understanding or potential issues with documentation. This information underlines the importance of proper education and communication regarding antibiotic use, as it highlights the significance of pharmacy settings in antibiotic distribution and adherence patterns among students [28].

The survey findings also reveal differences in students' beliefs about when to stop taking antibiotics. Notably, a substantial proportion of fifth-year students understand the importance of completing the full course as directed, suggesting that their advanced education has reinforced this knowledge. However, there are variations across different student levels, which emphasizes the potential impact of education and awareness campaigns on antibiotic use practices. These findings align with previous research articles highlighting the need for consistent, evidence-based education on antibiotic usage and the risks of incomplete courses [29, 30].

Furthermore, the data showcases students' beliefs about sharing antibiotics with friends or family members. The majority of students understand the importance of not sharing antibiotics, which can contribute to antibiotic resistance. This insight underscores the need for education and awareness campaigns to promote responsible antibiotic use and discourage the sharing of antibiotics. These findings correlate with existing research that underscores the importance of responsible antibiotic sharing practices [31].

Regarding beliefs about which conditions should be treated with antibiotics, the survey data reveals varying levels of awareness and understanding among respondents. Misconceptions about the effectiveness of antibiotics for conditions like cold and flu are evident, with a notable percentage of students believing that antibiotics can treat these viral illnesses. This misinformation can contribute to antibiotic overuse and the development of antibiotic resistance. As with previous research, these findings emphasize the importance of public education campaigns to clarify when antibiotics are appropriate for specific medical conditions [32].

The data also indicates that students' beliefs regarding the use of antibiotics for certain conditions, such as bladder infections or UTIs, tend to increase as they progress in their academic levels. This suggests that their growing understanding of medical conditions and antibiotic treatments through their education influences their beliefs. These findings reinforce the need for comprehensive education on antibiotic use within the pharmacy curriculum and the importance of tailored interventions to address knowledge gaps and misconceptions [33].

In summary, the survey findings shed light on the knowledge of pharmacy students regarding antibiotics and their usage. These insights can serve as a foundation for educational programs, policies, and awareness campaigns aimed at promoting responsible antibiotic use, reducing antibiotic resistance, and ensuring the appropriate distribution of antibiotics to the public. In light of previous research articles on antibiotic knowledge and usage, this data can be used to assess the impact of education and awareness initiatives and to further refine antibiotic stewardship efforts within academic settings [34].

4.4. Knowledge of antibiotic resistance

The data provided in this report sheds light on the levels of awareness among pharmacy students regarding antibiotic resistance and its associated terminology. It is crucial to understand the extent to which students are informed about these critical concepts, as awareness plays a pivotal role in addressing the global issue of antibiotic resistance effectively.

The findings reveal that while a significant portion of the respondents are aware of the term "Antibiotic Resistance," there is still a considerable percentage that remains unaware. "Superbugs" and "Drug Resistance" are less widely recognized, with a majority of respondents being unfamiliar with these terms. The term "Antibiotic-Resistant Bacteria" is known to the majority of respondents. These variations in awareness levels emphasize the need for public education and awareness campaigns to effectively communicate the concept of antibiotic resistance and its associated terminology to the broader population, these knowledge gabs were also observed in Nigeria among pharmacy students [19].

Moreover, the data demonstrates that awareness of these key terms related to antibiotic resistance tends to increase as students progress through their academic levels. This suggests that academic programs and education contribute to greater awareness among students. However, there is still room for improvement, particularly among second-year students, where awareness levels are lower. Efforts to educate individuals about antibiotic resistance and its associated terminology should be sustained to ensure a well-informed population that can contribute to combating antibiotic resistance effectively.

The data also highlights the significant role of healthcare professionals, particularly pharmacists and physicians, in conveying information about antibiotic resistance to the public. These professionals are often the primary sources of information for individuals who are aware of the term. This emphasizes the importance of healthcare providers in disseminating knowledge about antibiotic resistance and guiding patients toward responsible antibiotic use [35].

In the context of previous research articles on antibiotic knowledge and resistance, this data underscores the importance of continued educational efforts, not only within academic settings but also through healthcare professionals, to raise awareness about the critical issue of antibiotic resistance. Public understanding of these concepts is essential to combat antibiotic resistance effectively by reducing the misuse and overuse of antibiotics and promoting responsible antibiotic usage [36]. The findings in this report can serve as a reference point for educational institutions and healthcare providers to tailor their communication and education efforts, ultimately contributing to a more informed and responsible public in the fight against antibiotic resistance

4.5. Levels of understanding of the issue of antibiotic resistance

The presented data provides valuable insights into the levels of understanding and awareness of antibiotic resistance among pharmacy students at different academic levels. These findings are vital for gauging the effectiveness of educational programs and for ensuring that future healthcare professionals are well-equipped to address the issue of antibiotic resistance.

The data indicates that healthcare professionals, particularly pharmacists and physicians, play a significant role in educating students about antibiotic resistance. The role of pharmacists as a primary source of knowledge on this topic is particularly noteworthy, with a substantial number of students citing them as their source of awareness. This underscores the importance of healthcare providers in disseminating information about antibiotic resistance and guiding patients and students toward responsible antibiotic use. Additionally, the data suggests that students in later years of their studies may have more exposure to the concept of antibiotic resistance, explaining their higher awareness levels.

Furthermore, the data reveals varying levels of understanding among students regarding the statement that antibiotic resistance occurs when the body becomes resistant to antibiotics. While overall awareness is moderate, it is noteworthy that fifth-year students demonstrated the highest comprehension, indicating that advanced coursework and curriculum exposure contribute to a better understanding of the concept. Conversely, third-year students exhibited lower understanding, suggesting that there may be differences in educational emphasis or individual learning experiences. These findings emphasize the need for tailored educational interventions, especially for students in the earlier years of their studies, to strengthen foundational knowledge about antibiotic resistance [37].

On a positive note, the data indicates a strong and consistent awareness among students at various academic levels regarding the issue of increasing antibiotic resistance. The majority of students correctly identified that many infections are becoming increasingly resistant to treatment by antibiotics. This high level of awareness, especially among third, fourth, and fifth-year students, reflects the effectiveness of educational efforts in conveying the challenges posed by antibiotic resistance.

In light of previous research articles on antibiotic knowledge and resistance, this data underscores the importance of continued educational efforts within academic settings, with a particular emphasis on early-stage students. By strengthening the foundational knowledge about antibiotic resistance and emphasizing the role that healthcare professionals can play in addressing the issue, educational institutions and healthcare providers can contribute significantly to global efforts to combat antibiotic resistance. These findings provide a reference point for evaluating and refining educational programs related to antibiotic resistance and responsible antibiotic use [36].

4.6. Levels of awareness and understanding around ways to address antibiotic resistance

The data presented in this report offers valuable insights into the awareness and understanding of strategies to combat antibiotic resistance among pharmacy students at various academic levels. It is encouraging to see that a majority of respondents express agreement with the suggested actions, as these strategies are critical in mitigating the global issue of antibiotic resistance.

The highest levels of agreement were observed for actions such as “Parents should ensure that all their children’s vaccinations are up-to-date,” “People should adopt a regular handwashing routine,” “Governments should incentivize the development of new antibiotics,” and “Pharmaceutical companies should focus on the development of novel antibiotics.” These actions received overwhelmingly positive responses,

indicating that students recognize the importance of vaccination, hand hygiene, and innovation in antibiotic development in combatting antibiotic resistance. These results align with the findings of previous research articles that emphasize the significance of vaccination and hand hygiene in reducing the spread of infections [38].

Moreover, the action "People should use antibiotics only when they are prescribed by a doctor or nurse" also received substantial agreement, underlining the importance of responsible antibiotic use. Responsible antibiotic prescription and usage are vital for preventing the emergence of antibiotic-resistant bacteria, and it is reassuring that a significant majority of students understand the significance of this practice [39].

However, it is worth noting that actions like "Farmers should reduce antibiotic usage in food-producing animals" and "Doctors should prescribe antibiotics only when medically necessary" garnered lower agreement compared to other strategies. While these actions received less consensus, they are nonetheless crucial components of the fight against antibiotic resistance. The lower agreement may indicate a need for further education and awareness regarding the roles of agriculture and healthcare providers in antibiotic stewardship [40].

The findings in this report demonstrate that pharmacy students are generally aware of the key strategies to combat antibiotic resistance. However, it is essential to continue emphasizing the importance of these actions in educational programs, especially for actions that received lower agreement. Strengthening students' understanding and awareness of these strategies will better prepare them for their future roles as healthcare professionals and advocates for responsible antibiotic use. The alignment of students' perceptions with recommended strategies is a positive indicator, as it suggests that future healthcare professionals can contribute effectively to the global efforts in addressing antibiotic resistance. This data can serve as a foundation for tailoring educational programs and campaigns to further enhance awareness and understanding of antibiotic resistance mitigation strategies.

5. Conclusions

In conclusion, the findings of this study reveal that the pharmacy students have awareness about rational antibiotic utilization with a significant portion of pharmacy students have taken antibiotic monthly as self-medication or guidance either by pharmacists or physicians, and vast majority of them complete the course of antibiotic as directed.

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Conflict of interest

The authors have no conflict of interest to report.

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