



The public health dilemma of Self-Medication with Antibiotics: The undergraduate students of the College of Pharmacy in Mosul as an example

Radhwan N. Al-Zidan^{*1}, Ahmed S. Saadallah², Ghayth M Abdulrazzaq²

¹Department of Pharmaceutics, College of Pharmacy, University of Mosul, Mosul-Iraq

²Department of Pharmacology, College of Pharmacy, University of Mosul, Mosul-Iraq

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ABSTRACT

To evaluate the behaviour of Pharmacy College students as a representative sample of undergraduate students in terms of the use of antibiotics in Mosul city, Iraq. A questionnaire was adopted from previous studies with minor modifications to suit the current study sample and distributed to undergraduate students from all stages of the College of Pharmacy at the University of Mosul, in Nineveh province, north of Iraq. The study sample included 429 students. The results were statistically analyzed using GraphPad prism 7 and Excel 2013. The study showed that 51.28 % (n=220) of the participants practiced self-medication with antibiotics over the past 6 months. Retail pharmacies were the most common source for obtaining the antibiotics (87.4%), followed by the nurse clinics (7.9%), and lastly from the leftovers (4.7%). The main reasons for self-medication with antibiotics were the belief of having good knowledge about antibiotic use, followed by assuming that practicing self-medication with antibiotics would save time and money or due to inadequate improvement following proper medical consultation and lack of the nearby health care providers. The major diseases being treated was URITs. The most used antibiotic for self-medication was Amoxicillin and to a lesser extent Azithromycin Amoxicillin/Clavulanic Acid and Cefixime. Undergraduate students included in this survey had inadequate knowledge concerning antibiotics and a high rate of self-medication. This study calls attention to the need for focused educational intervention and rigorous authoritarian and governmental ruling regarding the issue of inappropriate antibiotic use and sale in community pharmacies.



*Corresponding Author

Name: Radhwan N. Al-Zidan

Phone:

Email: radhwan.alzidan@uomosul.edu.iq

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INTRODUCTION

Anti-Microbial Resistance (AMR) occurs when micro-organisms, such as viruses, bacteria, parasites, and fungi, develop immunity against the commonly utilized anti-microbial agents—like antiviral, antibiotic, anthelmintic, antimalarial, and antifungal drugs (Centres for Disease Control and Prevention, 2019). From this broader definition, the Antibiotic Resistance (AR) can be defined as the ability of the bacteria to thrive and multiply even in the presence of the antibiotic drug(s). All kinds of infections due to AMR micro-organisms pose risk on the lives of humans. However, the AR infection is, currently, the most pressing issue due to the ele-

vated number of cases reported worldwide with the subsequent ramifications of health and economic burden ([Centres for Disease Control and Prevention, 2013](#)) As the antibiotic drugs become useless and antibiotic-resistant infections continue in the body, the risk of morbidity and mortality becomes much higher. Furthermore, the majority of AR infections require increased follow-up and physician visits, prolonged hospital stay, and the use of costly and more toxic alternative antibiotics ([Naylor et al., 2018](#); [Shrestha et al., 2018](#)). Therefore, this article mainly focused on the issues of antibiotics knowledge and abuse among university students as well as their awareness about the AR.

In 2013, the United States of America Centers for Disease Control and Prevention (CDC) published its first report about the AR Threats in the US which included an overview of the health and economic burden induced by key AR bacteria such as *Escherichia coli*, *Clostridioides difficile*, Carbapenem-resistant *Acinetobacter*, Drug-resistant *Neisseria gonorrhoeae*, Methicillin-resistant *Staphylococcus aureus* (MRSA), and the Multidrug-resistant *Pseudomonas aeruginosa*. Also, the report discussed the required actions to tackle this challenge ([Centres for Disease Control and Prevention, 2019](#)). The conservative estimates of the CDC's 2013 report stated that at least two million Americans are being infected with AR bacteria, per year, and a minimum of 23 thousand people die due to bacterial resistance. Recently, in 2019, the CDC released the second report of the Antibiotic Resistance Threats in the US. According to the recent report, the annual cases of AR infections in the USA increased to 2.8 million, and the expected death toll around 35 thousand, per year ([Centres for Disease Control and Prevention, 2019](#)).

The rising incidence of severe bacterial infections, in conjunction with the mounting resistance to the commercially available antibiotics, has been underlined as an actual hazard to human health by the World Health Organization (WHO), the CDC, and the European Centre for Disease Prevention and Control ([Centres for Disease Control and Prevention, 2019](#); [European Centre for Disease Prevention and Control, 2016](#); [World Health Organization, 2014](#)). Consequently, there have been several nationwide, as well as, international programs implemented recently for tackling the spread of bacterial infections—particularly AR infections ([AMR Review, 2016](#); [Department of health, 2013](#); [European Centre for Disease Prevention and Control, 2016](#); [Public Health England, 2019](#)).

Tackling the threat of AR starts with avoiding infec-

tions in the first place, decelerating the emergence of resistant bacteria by stopping the spread of bacterial resistance when it does occur, besides rational antibiotic use ([World Health Organization, 2014, 2015](#)). Since micro-organisms are not restrained by international borders, there was an urgent need for international collaboration to set a comprehensive plan to fight back against the emergence and spread of AR. The first international step was taken, in 2015, during the 68th meeting of the “World Health Assembly” which is the policymaking body of the WHO. The World Health Assembly endorsed a “Global Action Plan” to contain and minimize the threat of AMR—including AR ([World Health Organization, 2015](#)).

The major goal of the Global Action Plan was to ensure a responsible way of antibiotics use to preserve their activity, as long as possible, for efficiently curing microbial infections. To achieve this aim, the Global Action Plan determined 5 strategic objectives, as shown below,

“To improve awareness and understanding of antimicrobial resistance. To strengthen knowledge through surveillance and research. To reduce the incidence of infection To optimize the use of antimicrobial agents Develop the economic case for sustainable investment that takes account of the needs of all countries, and increase investment in new medicines, diagnostic tools, vaccines, and other interventions” ([World Health Organization, 2015](#)).

The first objective of the Global Action Plan centered on raising the awareness of the health care providers as well as the layman about the imminent threat of losing the efficacy of the commercially available antibiotics, and the antimicrobials in general. Whereas, the second objective of the Global Action Plan is concerned with performing surveys and researches world-widely to tackle the roots of AR and to build a solid strategy for reducing the development and spread of AR.

Therefore, in recent years numerous studies around the globe focused on examining the various aspects of the AR in compliance with the announced objectives of the Global Action Plan ([Eduardo-Correia et al., 2020](#); [Jeanvoine et al., 2020](#); [Thapa et al., 2020](#); [Zilberberg et al., 2014](#)). These studies aimed at appraising the reasons for self-medication of antibiotics (SMA), the knowledge, and awareness of a population regarding the AR threat. SMA is one of the forms of antibiotics abuse—which ultimately accelerates the development of AR. Unfortunately, several studies have pointed out that the percentage of AR in the Middle East (ME) is frighteningly elevated ([Alghadeer et al., 2018](#); [Alhomoud et al., 2017](#);

Table 1: Demographics of the participants

	Variables	Percentage % (Frequency)
Gender	Male	42.1% (181)
	Female	57.8% (242)
Age	18-20	42.65% (183)
	21-23	37.99% (163)
	≥ 24	19.3% (83)
Stage of study	First (NPMK)	37.99% (163)
	Second (NPMK)	14.21% (61)
	Third (PMK)	23.07% (99)
	Fourth (PMK)	10.02% (43)
	Fifth (PMK)	14.68% (63)

Awad and Aboud, 2015). Although, the best way to fight back against the emerging resistance begins with evaluating the magnitude of antibiotics misuse as well as the knowledge and attitude of the population. However, very few studies were done to explore the Iraqi situation. Keeping in mind that the low level of regulation enforcement strongly suggests that self-medication of antibiotics be on a larger scale. Therefore, currently, the apparent problem of AR in Iraq could be the tip of the iceberg. In Mosul City, Médecins Sans Frontières (MSF) reported that more than 90% of the patients admitted with infections, to receive care in MSF's Mosul center, were having a multi-drug resistant micro-organism(s) (Sans, 2019). The main goal of this study was to explore the depths and the roots of the problem of antibiotics misuse among the students of the College of Pharmacy at the University of Mosul. To the best of the authors' knowledge, this is the first published study addressing the problem of antibiotic misuse in Mosul city, Iraq.

MATERIALS AND METHODS

The study was conducted among the undergraduate students of the College of Pharmacy at the University of Mosul, Nineveh province, Iraq. The study was ethically and scientifically approved by the Pharmaceutics Department and subsequently registered in the College of Pharmacy/ University of Mosul. The study was conducted during the period from the 1st of May 2019 to the 3rd of June 2019.

The questionnaire was adapted from previously published Chinese studies and translated to Arabic to better suit our sample (Lv *et al.*, 2014; Zhu *et al.*, 2016). The draft of the questionnaire paper was first trialed with 20 volunteers, half of them handed the Arabic version and the other half were given the English version to assess the readability and clarity of the questionnaire. The consent of the students

was obtained orally; those who were willing to participate in the study were handed the questionnaire paper. A set of 12 questions was included in the structured questionnaire of which the first 4 questions measure the general "knowledge" of the participants, the next 4 questions measure the "attitude" and the last 4 questions assess the "awareness" of the responded participants about the antimicrobial resistance. The responses from the knowledge, attitudes, and awareness sections were assessed by calculating the frequency and percentage of the correct responses (Table 3).

The questionnaire was given out to be filled individually by the consented respondents, where SMA in the past six months was evaluated. Out of 916 students approached, 446 students participated in the study with a correspondence rate of 48.6%. 17 questionnaire papers were excluded because they were incompletely filled. The study designed as a descriptive study; the results were analyzed statistically using GraphPad prism 7 and Excel 2013, and the findings were presented in percentages and frequencies.

RESULTS AND DISCUSSION

The current study included a total of 429 students, of which 42.1% male and 57.9% female students. The participants of this study were enrolled from the 5 stages of the College of Pharmacy at the University of Mosul. Participants from the first (37.99%) and second (14.21%) stages were labeled as students with No Prior Medical Knowledge (NPMK) as they did not come across the medical subjects relevant to the medical use of antibiotics like Pharmacology, Microbiology, and therapeutics throughout their curriculum. Whereas, those from third (23.07%), fourth (10.02%) and fifth (14.68%) stages were labeled as students with Prior Medical Knowledge (PMK) given that they have studied and trained on medical sub-

Table 2: Types of antibiotics used by the participants who practiced the SMA

PMK group			Non-PMK group		
Types of Antibiotic	%	Frequency	Types of Antibiotic	%	Frequency
Amoxicillin	36.20	59	Amoxicillin	65.35	83
Azithromycin	17.79	29	Amoxicillin/Clavulanic Acid	14.96	19
Amoxicillin/Clavulanic Acid	13.50	22	Cefixime	4.72	6
Cefixime	11.66	19	Azithromycin	3.94	5
Ceftriaxone	3.68	6	Cephalexin	3.15	4
Ciprofloxacin	3.07	5	Metronidazole	3.15	4
Erythromycin	3.07	5	Ciprofloxacin	2.36	3
Metronidazole	2.45	4	Ampicillin/Cloxacillin	1.57	2
Tetracycline	1.84	3	Ceftriaxone	0.79	1
Doxycycline	1.23	2			
Nitrofurantoin	1.23	2			
Methoprim (trimethoprim and sulfamethoxazole)	1.23	2			
Levofloxacin	0.61	1			
Vancomycin	0.61	1			
Cefpodoxime	0.61	1			
Cephalexin	0.61	1			
Erythromycin	0.61	1			

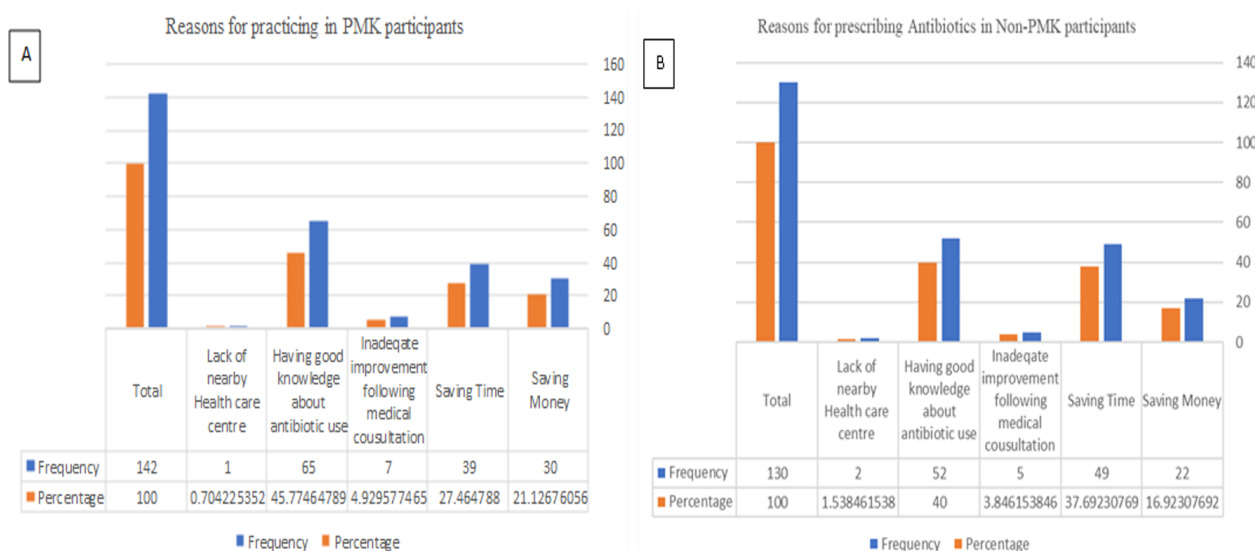


Figure 1: Graphs showing the main reasons for self-medication with antibiotics in (A) participants with prior medical knowledge (PMK) and (B) participants with no prior medical knowledge (NPMK). Data represented as percentages and frequencies

Table 3: Frequency and percentage correct responses of participants with PMK (n=91), and participants with NPMK (n=118) who practiced SMA and those who did not practiced SMA over the past 6 months

Questions to assess the knowledge, attitude, and awareness of the participants	Students who did not practice SMA		Students practiced SMA	
	PMK (n=91)	NPMK (n=118)	PMK (n= 113)	NPMK (n=107)
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Considering sanitary measures like frequent hand washing reduce the emergence of antibiotic resistant strains of bacteria	75 (82.41)	103 (87.28)	76 (67.25)	74 (69.15)
Antibiotic use can eradicate both pathogenic and useful bacteria	76 (83.51)	83 (70.33)	72 (63.71)	59 (55.14)
Antibiotics can kill or stop the growth of bacteria	84 (92.30)	83 (70.33)	91 (80.53)	72 (67.29)
Overuse of antibiotics increases the possibility of development of antibiotic-resistant strains of bacteria	83 (91.20)	76 (64.40)	92 (81.41)	69 (64.48)
Antibiotics like Amoxicillin can be used to treat viral infections	66 (72.52)	42 (35.60)	71 (62.83)	42 (39.25)
Antibiotics can be used to treat the common cold	53 (58.82)	34 (28.81)	66 (58.40)	40 (37.38)
Anti-inflammatory drugs like dexamethasone have almost same activity of antibiotics	51 (56.04)	24 (20.33)	61 (53.98)	31 (28.97)
All respiratory tract infections like laryngitis and sinusitis require direct use of antibiotics	54 (59.34)	38 (32.20)	41 (36.28)	23 (21.49)
Infection by antibiotic-resistant strains increase the possibility of mortality	64 (70.33)	43 (36.44)	63 (55.75)	44 (41.12)
Infection by antibiotic-resistant strains require longer duration of treatment	71 (78.02)	80 (67.80)	77 (68.14)	72 (67.29)
Infection by antibiotic-resistant strains increase the possibility spread of this type of bacteria among the community	76 (83.51)	80 (67.80)	86 (76.10)	64 (59.81)
Treatment of infections caused by antibiotic-resistant bacteria require the use of potent, expensive antibiotics which may have serious adverse effects	63 (69.23)	53 (44.91)	76 (67.25)	38 (35.51)

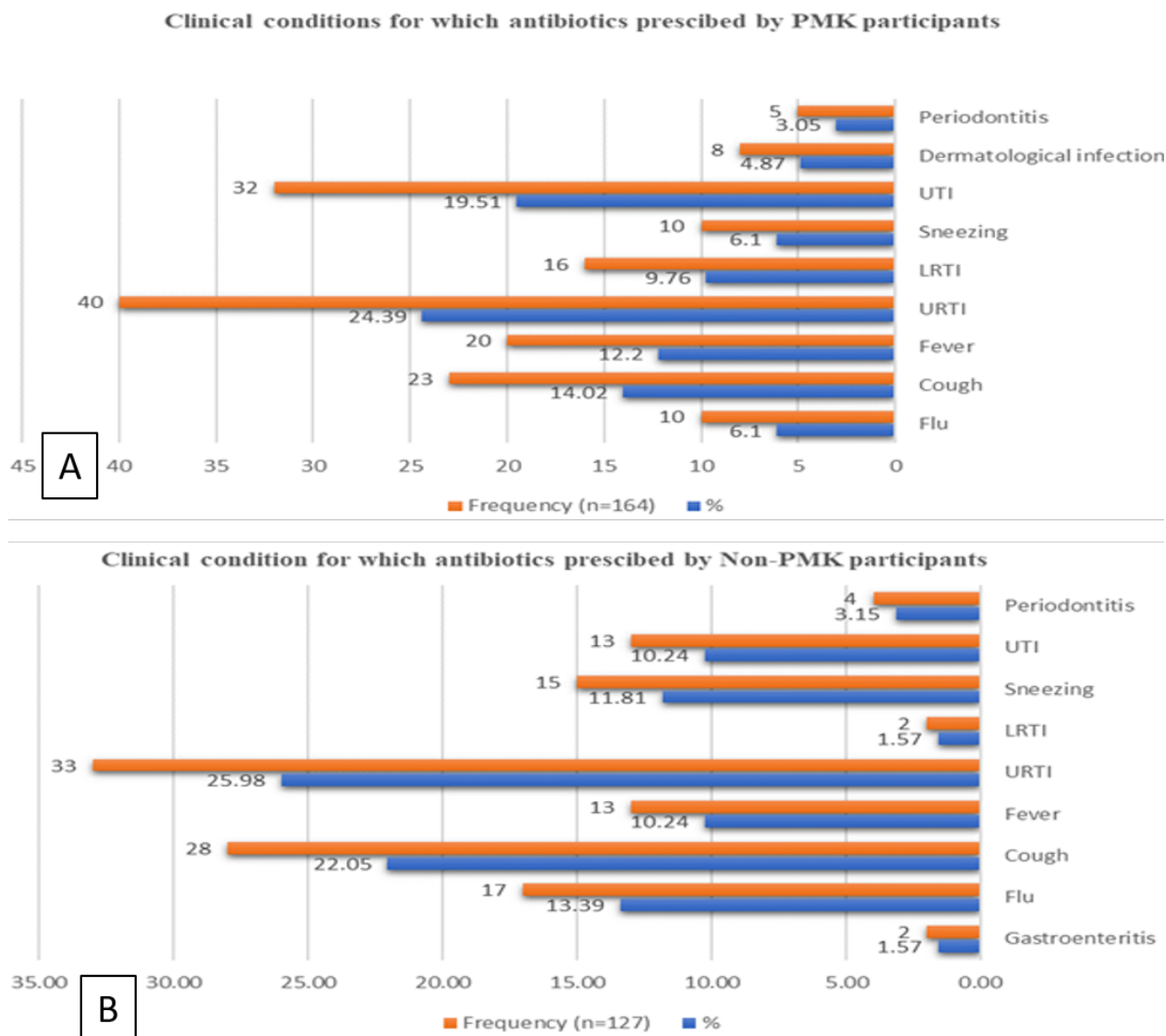


Figure 2: Graphs showing the clinical conditions for self-medication with antibiotics in (A) participants with prior medical knowledge (PMK) and (B) participant switch no prior medical knowledge (NPMK). Data represented as percentages and frequencies

jects with a direct relationship to the medical uses of antimicrobials in their curriculum. The age of the participants was ranging between 18 and 24 years, with the predominance of 18-20 years old students (see Table 1); which summarize the demographic characteristics of the participants of this study. The analysis of data indicated that 51.28 % (n=220) of the responded students had self-medicated with antibiotics in the last 6 months (November 2018 to April 2019). Using antibiotics without prescription was more frequent among the female respondents compared to the male respondents (70.27% vs. 29.72%, female and male respondents respectively). The pharmacies were the most common source for obtaining the antibiotics (87.4%), followed by the nurse clinics (7.9%), and lastly from the leftovers (4.7%).

A remarkable proportion of students of both PMK and NPMK groups practiced self-medication with antibiotics and prescribe antibiotics because they thought that they have good knowledge about antibiotic use 45.7% (n=65) and 40% (n=52) in PMK and NPMK respectively, followed by assumed practicing self-medication with antibiotics would save time 27.4% (n=39) and 37.6% (n=49) and money 21.1% (n=30) and 16.9 % (n=22) in PMK and NPMK respectively or due to inadequate improvement following proper medical consultation 4.9% (n=7) 3.8% (n=5) and lack of the nearby health care providers at 0.7% (n=1) 1.5% (n=2) in PMK and NPMK respectively (Figure 1).

The common antibiotics used in self-medication in both PMK and NPMK groups are amoxicillin (see

Table 2) at 36.20 % (n=59) and 65.35% (n=83), respectively. Other antibiotics like Azithromycin, Amoxicillin/Clavulanic Acid and Cefixime were also shown to be abused in a significant proportion of the participants (see Table 2). The students with NPMK showed inadequate responses, particularly in terms of attitude and awareness, yet a significant proportion of NPMK had used or prescribed antibiotics in the past 6 months (Table 3).

Upper respiratory tract infection (URTI) was the most common clinical condition that leads to self-medication with antibiotics in both PMK and NPMK groups. UTI was the second common cause of SMA in participants with prior medical knowledge PMK, followed by cough and fever. While for those with no prior medical knowledge NPMK cough was the commonest medical condition leading to the SMA second to URTI followed flue and fever (Figure 2). The hallmark finding of this study was the alarmingly high percentage, 51.28 %, of undergraduate students who are practicing the SMA—despite their inadequate knowledge in antibiotics and lack of awareness about the AMR. Also, the study exposed the main causes of the SMA as well as the type of antibiotics most commonly abused by this young population. Interestingly, the practice of SMA among the PMK group was relatively higher than the NPMK group.

Interestingly, the proportion of students who admitted to practising SMA in this study was alarmingly higher than that reported in other countries around the globe such as China, Eretria, and Rwanda (Ateshim *et al.*, 2019; Tuyishimire *et al.*, 2019; Zhu *et al.*, 2016). Also, the SMA practice among this, relatively highly educated, Iraqi population was even higher than the numbers reported in other Middle Eastern such as Turkey, Jordan, Kingdom of Saudi Arabia, and Iran (Alghadeer *et al.*, 2018; Buke *et al.*, 2005; Suaifan *et al.*, 2012; Sarahroodi *et al.*, 2010). Consequently, the abnormally elevated percentage of people who are practicing the SMA rings the bells of intimate danger associated with the abuse of antibiotics, particularly the development of resistance to the currently available antibiotics (Goossens *et al.*, 2005). For instance, the WHO estimates by 2050, ten million people will die annually due to antimicrobial-resistant infections (World Health Organization, 2015). The abnormally higher percentage of people practicing the SMA in Iraq could be due to some reasons such as the accessibility to the antibiotics without prescription, lack of a national antibiotic stewardship program, and the illiteracy about the immense danger of developing antimicrobial resistance that is associated with the inconsiderate use of antibiotics. In

accordance with other studies, we also found that females practised SMA more than the male (Lucas *et al.*, 2007; Zhu *et al.*, 2016). This probably because females are more likely to seek healthcare treatment than males.

While many studies tried to assess the SMA in different populations, they did not shed light on the types of antibiotics most commonly abused by the studied population (Ateshim *et al.*, 2019; Buke *et al.*, 2005; Suaifan *et al.*, 2012; Zhu *et al.*, 2016). Whereas, in this study, we precisely pointed at the most commonly abused antibiotics by the students who practiced the SMA. We found that a wide range of antibiotics was abused by the students who practiced the SMA, ranging from the old generations of antibiotics to some of the recently discovered antibiotics. Most of the studied population used Amoxicillin, particularly within the NPMK group. Nevertheless, a significant proportion of the students, especially within the PMK group, abused a wide range of antibiotics—including 3rd generation cephalosporins such as Cefixime and Ceftriaxone as well as some of the last resorts in treating a life-threatening MRSA infection like Vancomycin. This shed the light on a frightening possibility that we could lose the efficacy of the latest generations of antibiotics soon if no strict measures were taken immediately.

Also, we found that the most commonly abused family of the antibiotics was the Penicillin family—particularly the Amoxicillin (Table 2). We think Amoxicillin was the most commonly abused antibiotic for two main reasons. First of all, it is a well-known antibiotic, even for the layman, in Iraq for its efficacy against a wide range of infections. Secondly, it is the cheapest antibiotic in Iraq, as it costs the patient less than \$1 to buy 20 capsules of 500 mg Amoxicillin. However, the extensive abuse of Amoxicillin is paving the way for the bacteria to develop resistance against this wide-spectrum antibiotic as well as cross-resistance against other members of the Penicillin family (Bush, 2018). In addition, we found a serious indication that even some of the last resort antibiotics (for instance, Vancomycin, Levofloxacin, and Ceftriaxone) are being abused by the studied population; which may render these life-saving antibiotics ineffective in the future.

The most common causes for the practice of the SMA (Figure 1) among the studied groups, PMK and NPMK, were as follows. Firstly, the presumption of having sufficient knowledge to self-prescribe the antibiotics; it comprises more than 40% in both groups of PMK and NPMK. Secondly, the attempt to save the time wasted during the visits to private clinics and public hospitals. Thirdly, a signifi-

cant proportion of the surveyed students admitted they have practiced SMA to save the money. Additionally, 4.9 % and 3.84% of the PMK and NPMK groups, respectively, revealed that they practiced SMA because they did not get better after visiting the physician. Finally, only 0.7% and 1.53% of the PMK and NPMK groups, respectively, stated that they practised SMA due to the lack of a proper health facility—particularly, students living in rural areas. Interestingly, this result agrees with the findings of several studies which also pointed that the assumption of having sufficient knowledge was one of the main reasons for the SMA among the undergraduate students majoring in the medical or the non-medical field of study (Awad and Eltayeb, 2007; Suaifan *et al.*, 2012).

Although, there were slight differences among the PMK & NPMK groups regarding the most common reasons for using the antibiotics. However, the most frequent illness-related cause for taking the antibiotics among the two groups was having symptoms of upper respiratory tract infections (URTIs) such as cough, sneezing, fever, and runny nose (Figure 2). This is a serious indication of antibiotic misuse by the students who practiced SMA because most of these symptoms also occur with viral infections such as common cold and influenza. The high percentage of the students who admitted practising the SMA within the last six months could draw a conclusion that probably more than 20 thousand students in the University of Mosul could have practiced SMA during the period from November 2018 to April 2019.

Studying the SMA seldomly among the undergraduate students of the College of Pharmacy could be considered as a limitation for this study. However, the unique division of the undergraduate students according to the curricula they have studied into NPMK and PMK compensated for the weakness and added value for the study design. The innovative method of dividing the two groups was intended to utilize the undergraduate students in the different stages of a medical school as a sample to give the bigger picture of the undergraduate students of a certain university campus regardless of their field of study.

For future work, we recommend executing a nationwide study to explore the extent of SMA and the causes for practising the SMA among undergraduate students in other parts of Iraq. Also, we recommend adding materials to the curricula of the undergraduate students to raise their awareness about the risks associated with the SMA. Finally, we highly stress the importance of legally enforcing the prohibition of selling antibiotics without prescription.

CONCLUSIONS

The proportion of undergraduate students who were found practising SMA was shockingly high. Interestingly, the practice of SMA among the PMK group was relatively higher than the NPMK group. In addition, females were found to practice SMA more than males. It has been found that multiple families of the antibiotics and a large number of individual antibiotics were abused by the students who practiced SMA. This rings the bells of losing the efficacy of the available antibiotics if no strict governmental measures were implemented. Multiple causes for practising SMA were admitted by the students. However, the assumption of having sufficient knowledge, followed by saving time, and money spent during the visits to the clinics were the most common causes, respectively. This study shed light on the need for a focused educational intervention and a rigorous authoritarian and governmental ruling regarding the inappropriate antibiotic use and dispensing of antibiotics, in community pharmacies, without proper prescription.

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Conflict of interest

All authors declare that there is no conflict of interest among authors.

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