



Pharmacy Students' Knowledge and Perceptions about Antimicrobial Stewardship

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2019/v31i130291

Editor(s):

(1) Dr. Jongwha Chang, University of Texas, College of Pharmacy, USA.

Reviewers:

(1) Vijaya Krishnan, MGM College of Physiotherapy, India.

(2) Siva Rami Reddy E, Tanta University, India.

(3) Shashikala, Pondicherry University, India.

Complete Peer review History: <https://sdiarticle4.com/review-history/52282>

Original Research Article

Received 13 August 2019
Accepted 20 October 2019
Published 01 November 2019

ABSTRACT

Introduction: Antibiotic resistance is considered one of the serious threats to global public health. Antimicrobial stewardship programs should be implemented by all hospitals to improve antimicrobial use. It is important that pharmacy students have a sound knowledge of antimicrobial stewardship.

Objective: The aim of this study was to determine pharmacy students' knowledge and perceptions about antimicrobial stewardship.

Methodology: The study included a questionnaire that was used to assess the background knowledge of pharmacy students and their perceptions on antimicrobial stewardship.

Results and Discussion: Out of 103 students who completed the survey, 25 students (24.27%) reported that they know what antimicrobial Stewardship is, and only 39 students were familiar with

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antimicrobial stewardship programs in Saudi Arabia. Most of the students (95.14%) reported that they need more antimicrobial stewardship training.

Conclusion: Our results, therefore, recommend that pharmacy students should have more training on bacterial resistance, antibiotic use and antimicrobial stewardship.

Keywords: Knowledge; perceptions; pharmacy students; antimicrobial stewardship.

1. INTRODUCTION

Antimicrobial resistance is considered one of the serious threats to global public health; it affects the ability to treat infection effectively and puts patients at risk of prolonged illness, complications and death. It can compromise the success of various surgical procedures and cancer chemotherapy, and the cost of care subsequently increases when additional tests and more expensive drugs or hospitalization are required [1]. The National Institute for Health and Care Excellence defined Antimicrobial resistance as “the loss of efficacy of the drugs that are used to treat infections including anti-parasitic, antiviral, antibacterial and antifungal drugs [2].

It is important to lessen the unsuitable and unnecessary antibiotic use to decrease the development of antimicrobial resistance. The Centers for Disease Control and Prevention recommends that all hospitals should have antimicrobial stewardship programs (ASPs) that contain several fundamental elements and that the ASPs should include a pharmacist who is drug expert and is accountable for improving the use of antimicrobials [3]. The Society for Healthcare Epidemiology of America, the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America recommend pharmacists as major members in ASPs [4, 5]. It is important that future pharmacists have a sound knowledge and understanding of antimicrobial stewardship, as outlined in pharmacy degree program syllabuses ACPE (2016) [6]. With the increasing antimicrobial (AM) resistance and the cost of AMs, the implementation of AMs education in the undergraduate (UG) curriculum is crucial as mere guidelines are not enough to change the behavior of the future prescribers [7, 8].

Numerous studies have indicated that stewardship programs aim to optimize the outcomes of individual patient and at the same time minimizing the unintended consequences, such as the development of negative effects in the patient and the generation of resistant

organisms. These programs should involve educational programs, evidence based guidelines and consistent feedback of data regarding antibiotics use to prescribers to promote the evidence based and rationale based prescribing. [9]. The pharmacists have an essential role in treating and inhibiting the occurrence of infectious diseases, because the antibiotic regimens become complex due to the continuous evolving epidemiology of infections. Many ASPs that are pharmacist-directed have increased noticeably since the previous decade [10, 11]. However, antimicrobial stewardship is not widely covered in the curricula of pharmacy schools [12]. Therefore, the future pharmacists (Pharmacy students) should be equipped with an appropriate knowledge and skills to use antimicrobial drugs correctly and to be important partners in antimicrobial stewardship.

To the best of our beliefs, there is little data on the pharmacy students' education and the content of this education regarding ASPs. Therefore, this study surveyed pharmacy students who completed more than 50% of their courses in pharmacy programs in the city of Al-kharj (Arabia Saudi). This study aims to determine pharmacy students' knowledge and perceptions about antimicrobial stewardship.

2. METHODOLOGY

2.1 Study Population

This study included a cross-sectional sample survey using a representative sample of the students. The target participants for this study included pharmacy students who completed more than 50% of their courses and who were agreeable to participate in the survey. During the first quarter of 2019, 103 students complete the survey.

A questionnaire was used to evaluate the perceptions and the knowledge of pharmacy students about antimicrobial stewardship. It was designed based on similar studies done by Marisa Burger et al. [13] and by Abbo et al. [14].

2.2 Questionnaire Development

This cross-sectional questionnaire is a sample survey that used a representative sample of pharmacy students. It included four parts, the first part includes questions related to pharmacy students' perceptions and knowledge about antimicrobial stewardship, second part includes questions about the perceptions and attitudes of students in the pharmacy college about antimicrobial resistance and their prescribing, third part includes questions about the knowledge of pharmacy students of antimicrobial stewardship objectives and strategies for their development and the fourth part includes information about perceptions of pharmacy students on the quality and quantity of antimicrobial stewardship education.

It was designed based on similar studies done by Marisa Burger et al (2016) and by Abbo et al (2013). The survey questions is extracted from these 2 studies and validated by academic professors (content validity) and by some of the students (face validity).

2.3 Statistical Analysis

The data was analyzed using Microsoft Excel® spreadsheets.

3. RESULTS

One hundred and three students completed the survey. All of the respondents were male and all of the respondents were in the age range between 20-25 years. Demographic data are presented in (Table 1). Only 25 students

(24.27%) stated that they know 'what antimicrobial stewardship is, and 39 students (37.86%) reported that they were familiar with antimicrobial stewardship programs in Saudi Arabia. The perceptions and knowledge of students in Pharmacy school on antimicrobial stewardship is presented in (Table 2).

Table 1. Demographic data

Variables	N (%)
Age	
15-19	0 (0%)
20-24	103(100%)
25-29	0(0%)
Gender	
Male	103(100%)
Female	0 (0%)

Most of the students (94.17%) agreed that the Antimicrobial resistance is a global problem. Additionally, the majority were agreed that the incorrect use of antimicrobial drugs can harm patients. The perceptions and attitudes of pharmacy school students about antimicrobial resistance and their prescribing pattern is illustrated in (Table 3).

Most of the students reported that the major goals of ASPs were to decrease antimicrobial resistance (75.73%), to minimize the toxicity and other adverse effects (59.22%) and to reducing hospital stay (45.63%). Details about the knowledge of pharmacy students on antimicrobial stewardship objectives, goals and strategies for ASPs development are showed in (Table 4).

Table 2. The knowledge and perceptions of pharmacy college students on antimicrobial stewardship

Variables	Yes N (%)	No N (%)	Don't Know N (%)
Do you know what antimicrobial stewardship is?	25 (24.27%)	58 (56.31%)	20 (19.41%)
Are you familiar with antimicrobial stewardship programs in Saudi Arabia?	39 (37.86%)	49 (47.57%)	15 (14.56%)
Implementation of ASPs in Saudi Arabia is essential.	96 (93.20%)	3 (2.91%)	4 (3.88%)
The use and the prescribing of antimicrobials in Saudi Arabia are appropriate.	26 (25.24%)	52 (50.48%)	25 (24.27%)
Antimicrobial stewardship contains :			
1. Choosing antimicrobials appropriately	87 (84.46%)	4 (3.88%)	12 (11.65%)
2. Suitable dosing and route of administration	89 (86.40%)	3 (2.91%)	11 (10.67%)
3. Appropriate duration of antimicrobial therapy	84 (81.55%)	2 (1.94%)	17 (16.50%)
4. The study of antimicrobials	80 (77.66%)	9 (8.73%)	14 (13.59%)

Table 3. The perceptions and attitudes of pharmacy school students about antimicrobial resistance and their prescribing pattern

Variables	N (%)
Antimicrobial resistance is a universal problem	
Yes	97 (94.17%)
No	3 (2.91%)
Don't know	3 (2.91%)
Antimicrobial resistance is promoted by :	
1. Excess use of antimicrobials	72 (69.90%)
2. Use of strong antibiotic when weaker one is enough	50 (48.54%)
3. Poor hand washing practice	20 (19.41%)
4. Poor adherence to medication	85 (82.52%)
5. Substandard quality of antimicrobials	30 (29.12%)
Consumption of antimicrobials Appropriately will decrease problems with antimicrobial resistance	
Yes	97 (94.17%)
No	3 (2.91%)
Don't know	3 (2.91%)
Interventions that can possibly decrease antimicrobial resistance :	
1. The use of antimicrobial policies	83 (80.58%)
2. Reduction of antibiotic use	55 (53.39%)
3. Create countrywide antimicrobial resistance surveillance	62 (60.19%)
4. creation of guidelines in different institutions for antimicrobial use	63 (61.16 %)
5. Education on antimicrobial therapy	83 (80.58%)
Use of antimicrobials inappropriately can lead to maleficence	
Yes	102 (99.02%)
No	0 (0.00%)
Don't know	1 (0.97%)
Appropriate knowledge of antimicrobials is essential for future profession	
Yes	103 (100.0%)
No	0 (0.00%)
Don't know	0 (0.00%)
Do you think that you need more education on the suitable antimicrobials use	
Yes	100 (97.08%)
No	2 (1.94%)
Don't know	1 (0.97%)
Would like more education on the resistance to antimicrobials?	
Yes	96 (93.20%)
No	5 (4.85%)
Don't know	2 (1.94%)
Most troublesome microorganism :	
1. <i>Enterococcus faecium</i>	19 (18.44%)
2. <i>Herpes simplex</i>	43 (41.74%)
3. <i>Staphylococcus aureus</i>	70 (67.96%)
4. <i>Klebsiella pneumoniae</i>	50 (48.54%)
5. <i>Influenza A</i>	38 (36.89%)
6. <i>Acinetobacter baumannii</i>	8 (7.76%)
7. <i>Pseudomonas aeruginosa</i>	53 (51.45%)

Most of the students said that they didn't have formal training on antimicrobial stewardship (98.05%) and 98(95.14%) students reported that they need more training on antimicrobial

stewardship. Details about the Perceptions of pharmacy students on the quality and quantity of antimicrobial stewardship education are presented in (Table 5).

Table 4. The knowledge of pharmacy students on antimicrobial stewardship objectives, goals and strategies for ASPs development

Variables	N (%)
Antimicrobial stewardship goals include:	
1. Encourage the excess use of antimicrobials	11 (10.67%)
2. Reducing hospital stay	47 (45.63%)
3. Increasing treatment duration to ensure therapeutic efficacy	19 (18.44%)
4. Increasing the continuous use of strong antibiotics	8 (7.76%)
5. Reducing antimicrobial resistance	78 (75.72%)
6. Minimizing toxicity and other adverse effects	61 (59.22%)
One of the duties of the clinical pharmacist is the participation in developing and leading of the principal ASP team	
Yes	58 (56.31%)
No	5 (4.85%)
Don't know	40 (38.83%)
The ASPs members include :	
1. Infectious disease physicians	80 (77.66%)
2. Occupational therapists	8 (7.76%)
3. Clinical and hospital pharmacists	87 (84.46%)
4. Infection control staff	47 (45.63%)
5. Hospital cleaning staff	11 (10.67%)
The major roles of the pharmacist in antimicrobial stewardship include :	
1. Encourage the appropriate use of antimicrobials	76 (73.78%)
2. Encourage the over the counter prescribing of antimicrobial agents	5 (5.85%)
3. Educate health care professionals	46 (44.66%)
4. Help the therapeutic committees in developing policies	81 (78.64%)

Table 5. Pharmacy students' Perceptions on the quality and quantity of antimicrobial stewardship education

Variables	N (%)
Did you have formal training on antimicrobial stewardship	
Yes	2 (1.94%)
No	101(98.05%)
Don't Know	0 (0.00%)
Number of hours of training completed on antimicrobial stewardship :	
1. 1 – 4	0 (0.00%)
2. 5 – 7	1 (0.97%)
3. More than 7	1 (0.97%)
4. No training	101 (98.05%)
Would you like additional training on antimicrobial stewardship?	
Yes	98 (95.14%)
No	2 (1.94%)
Don't know	3 (2.91%)
Rating of knowledge on antimicrobial stewardship :	
1. Bad knowledge (Poor)	20 (19.41%)
2. Regular knowledge (average)	52 (50.48%)
3. Respectable knowledge (Good)	28 (27.18%)
4. Very well knowledge (Very good)	3 (2.91%)

4. DISCUSSION

The present study was undertaken to determine the perceptions and knowledge of pharmacy school students on antimicrobial stewardship. We believe that no previous studies

assess these aspects among pharmacy students in Al-kharj.

More than 93% of the students said that the application of antimicrobial stewardship programs is vital. Moreover, most of the students

don't know basic information about antimicrobial stewardship (75.73%) and only 39 students are familiar with antimicrobial stewardship programs in Saudi Arabia, this lack of knowledge may be resulted from the lacking of content about antimicrobial stewardship in their academic curriculum. These results are in contrast of previous study in South Africa which stated that more than 83% of the students reported that they know what antimicrobial stewardship and about 71.9% of them were familiar with antimicrobial stewardship programs in their country. Additionally, this result is in contrast with a study carried out in Australia by Cotta and colleagues in 2014, in this study the majority of the respondents had heard about antimicrobial stewardship (about 80.0%). These results ensure that the pharmacy students in Alkharj aren't familiar with stewardship programs in Saudi Arabia and that they are interested in increasing their awareness regarding the implementation of stewardship programs.

Only 25.24% of the students think that the prescribing patterns and the use of antimicrobials are appropriate in Saudi Arabia but the situation is different now because the rules now not allowed to any pharmacists to dispense antibiotics without prescription. The same results were found in study conducted by Marisa Burger et al (2016) in South Africa. About 94% of the participants agreed that that antimicrobial resistance is a global threat which is consistent with the results of previous studies carried out elsewhere [15, 16].

According to our surveyed students, the three primary reasons of antimicrobial resistance were the excess use of antimicrobials, the use of strong (broad spectrum) antimicrobials when narrow spectrum is enough and poor adherence to antimicrobials and this is rational because using antibiotics inappropriately can lead to increasing of the bacterial resistance. This is similar to the results of previous studies carried out in Australia, Scotland, France and Spain which reported that the leading causes of antimicrobial resistance were the inappropriate duration of therapy, excess use of broad spectrum antimicrobials and increasing the number of antimicrobial prescriptions [15, 17, 18].

There are several studies about the spreading of very severe infections caused by multidrug resistance bacteria specially the serious bugs such as *P. aeruginosa*, *Acinetobacter* and *Methicillin-resistant Staphylococcus*.

Nikaido H et al and Crespo MP et al reported that resistant *P. aeruginosa* and *Acinetobacter* could be especially life threatening in the long term because they are resistance to some gram-negative antibiotics and also due to their ready gaining of DNA from other bacteria that lead to the spread of additional resistances [19, 20]. Moreover, Boucher HW et al reported that in 2009 *Methicillin-resistant Staphylococcus aureus* infections kill more people in US hospitals than tuberculosis and AIDS combined [21].

The majority of the students (80.85%) also said that we can combat antimicrobial resistance using interventions that include antimicrobial treatment policies as well as education on antimicrobial therapy. Most of the students felt that pharmacist roles in antimicrobial stewardship include helping therapeutic committees in developing policies (78.64), encouraging the appropriate usage of antimicrobials (73.78%) and educating other health care professionals (44.66%). Very few of the students (4.85%) reported that one of the roles of the pharmacist is to encourage the over the counter prescribing of antimicrobial agents to patients and this is rational because pharmacists can't dispense antibiotics unless the patient bring a prescription from the physician . Similar results were found by Marisa Burger et al (2016) but in his study the major role was to encourage optimal use of antimicrobial agents but in our study the major role was work with therapeutic committees in developing policies.

Most of the students felt that pharmacists (both clinical pharmacists and pharmacists working in hospitals) should be members in the team of antimicrobial stewardship (84.46 %), followed by infectious disease physicians (77.66%). Marisa Burger et al (2016) found similar results. This result also logical because the antimicrobial stewardship team should include a physician and a pharmacists in addition to that it is optional to include other health care professionals.

Most of the students said that they didn't have antimicrobial stewardship formal training (98.05%) and nearly all of the participants wanted more education and training on antimicrobial stewardship. The reason for that is the lacking of information about antimicrobial stewardship programs in their academic curriculum. The same results were reported in a study about antimicrobial use training, conducted among students at a medical school in the United States of America in 2010 [22].

5. CONCLUSION

In conclusion, although most of the student respondents displayed an inadequate level of knowledge, they displayed appropriate attitudes towards antimicrobial stewardship. The results of this survey illustrate the important educational gap, and show the need for efforts to fill these gaps during the training and the education of the pharmacy students. Our results, consequently, recommend that pharmacy students should have more training on bacterial resistance, antibiotic use and antimicrobial stewardship.

CONSENT

As per international standard or university standard, students' consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The involvement in the study is voluntary and all of the information included was totally confidential. The IRB approval number is 18-474E.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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