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KNOWLEDGE AND ATTITUDE OF PHARM D STUDENTS REGARDING THE APPROPRIATE USE OF ANTIMICROBIALS

Sultan Alghadeer^{1,2*}, PharmD, BCPS, Mohamed N. Al-Arif³, PhD

¹ *Chairman of Basic Science Department, Prince Sultan College for Emergency Medical Services,
King Saud University, Riyadh, Saudi Arabia.*

² *Assistant Professor, Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia.*

³ *Professor, Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia.*

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***Correspondence to Author:**

Sultan Alghadeer, PharmD, BCPS
Chairman of Basic Science
Department, Prince Sultan College
for Emergency Medical Services,
King Saud University, Riyadh, Saudi
Arabia.

Mail address: P.O.Box 2454, Riyadh
11451, Saudi Arabia
Phone: +966544335487

E-mail:

salghadeer@ksu.edu.sa

ABSTRACT

Background & objective: Since the antibiotic therapy is considered more complex due to the incessant in developing epidemiology of infections, the role and importance of pharmacists in combating and managing infectious diseases become crucial. A strong basis about antibiotic therapy and resistance within the curriculum is important, as many pharmacy students will not have the opportunity to obtain advanced education through postgraduate training programs. The objective of this study is to investigate the knowledge and attitude of PharmD students regarding the appropriate use of antimicrobials.

Method: A cross-sectional, online validated survey aimed to assess pharmacy students' knowledge and attitude about appropriate antimicrobial use was conducted among the final year (graduating) pharmacy students.

Results: Sixty graduating pharmacy students filled out the survey. Most of the students were male (66.7. %). Most of the PharmD students (71.6%) agreed that antimicrobials are overused and that antimicrobial resistance is a problem nationwide. Also, half of them face these apparent problems in hospitals where they had clinical rotations. Most of PharmD students (71.75%) believed that knowledge of antimicrobials is important in pharmacy career. However, only 55% of the students rated their pharmacy education about

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antimicrobials as useful or very useful. Students' mean correct knowledge score about the appropriate antimicrobials use was 3.1 ± 1.4 which considered low.

Conclusion: Pharm D students are aware of the importance of antimicrobial therapy and resistance, and familiar of the challenges about antimicrobial stewardship program. However, there is still low knowledge regarding antimicrobials appropriate use among our students.

INTRODUCTION

Resistance to a drug or antibiotic is potentially important to both patients and public. The risk of drug resistance is well documented in previous studies with reportedly increased morbidity and mortality along with increased health care cost [1-6]. The clinical use of antibiotics began since several decades ago as a human medicine to treat patients with infections caused by microorganism and could be consider as a lifesaving drugs [7]. Since the antibiotic therapy is considered more complex due to the incessant in developing epidemiology of infections, the role and importance of pharmacists in combating and managing infectious diseases become crucial [8-10].

Previous studies form developing countries reported that major causes of microbial resistance were the extensive and overuse of antimicrobials, poor patient adherence to prescription, [11] and incorrect duration of therapy [12-14]. Although reports from USA and European countries revealed that at least every 10 minutes a patient dies because of lethal infections caused by antibiotic resistant bacteria, the knowledge of appropriate use of antibiotics is still a concern especially in developing countries [15]. Studies conducted on Kuwaiti and Jordanian adult population revealed unsatisfactory knowledge regarding antibiotic use [16,17]. Moreover, previous research in Saudi Arabia showed patterns of inappropriate antibiotic knowledge and practice [18-20].

Appropriate use of antimicrobials is a cost-effective manner which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antimicrobial resistance [21]. In recognizing the importance of appropriate use of antibiotics in health care settings, the Infectious Diseases Society of America (IDSA) and The Society for Healthcare Epidemiology of America (SHEA) has developed guidelines for the prevention of antimicrobial resistance [22-23]. In 2007, these societies established the Antimicrobial stewardship program for pharmacists to measure the appropriate use of antimicrobial agents

by promoting the selection of the optimal antimicrobial drug regimen including dosing, duration of therapy, and route of administration [23].

Antimicrobial stewardship program consists of evidence-based strategies, didactic program and consistent response of antibiotic usage data to prescribers to promote rationale and evidence-based practice [24]. Recent research has identified that pharmacists has an effective role in antimicrobial stewardship program [23-25], with aiming to enhance individual patient outcomes though reducing accidental consequences. Previous studies also reported that large number of health care undergraduates students were concern about drug resistance and wish for further education about microbial drug resistance [26,27]. However, in clinical and hospital oriented pharmacy, few training programs available in infectious diseases and their management [28]. Therefore, a strong basis regarding these topics enrolled within the specialized curriculum is critical, as many pharmacy students will not have the opportunity to obtain advanced education through postgraduate training programs. The objective of this present study was to investigate the knowledge and attitude of PharmD students regarding the appropriate use of antimicrobials.

METHODS

This study was a cross-sectional, online survey aimed to assess pharmacy students' knowledge and attitude about appropriate antimicrobial use. The study was conducted for a two months during the period from December 2017 to January 2018 at the college of pharmacy of King Saud University. A self-administered structured questionnaire was distributed to the final year (graduating) pharmacy students to provide their responses. Survey questionnaire were distributed by using online google forms. To generate the unique link, questionnaire was entered into a google form document. The Survey link were sent to graduating pharmacy students to maintain privacy and avoid duplicative responses or sharing of links. Ethical approval was obtained from Institutional Review Board of College of Pharmacy at King Saud University.

Survey Tool

This study used survey consisted of 26 items and was adopted from previous studies [29]. It was made to confirm all questions and answer options were related to the respondents of pharmacy students. The survey questionnaire involved the following items:

demographic data of graduating students, pharmacy postgraduate training, attitude of pharmacy students towards antimicrobials, awareness of the problem of antimicrobials resistance, sources of antimicrobial education, self-confidence in antimicrobial recommendations, knowledge regarding antimicrobials use and resistance, perceptions of the quality of education regarding appropriate antimicrobial use.

Statistical Analysis

Descriptive statistics include percentages; means and frequency distribution were calculated for each variable. Statistical Package for Social Sciences version 22.0 (SPSS Inc., Chicago, IL, USA) was used for statistical computations.

RESULTS

Sixty graduating pharmacy students filled out the survey. Most of the students were male (66.7 %). During the conducting of survey, the largest practice area was hospital pharmacy (56.7%), followed by academic (26.7%), community pharmacy (25%), and pharmacy administration (16.7%) and pharmaceutical

industry (15%). More than two-third of the respondents expected pursuing some kind of postgraduate training and most of them planned a clinical residency (64.2%). However, less than half of respondents has been received a pharmacology education about antimicrobials prior to entering pharmacy school. In addition about two-third of students has been completed a clinical rotation in infectious diseases during pharmacy school.

Assessment the Pharm D students' perception and attitude towards antimicrobials use antimicrobials

Table 1 showed students' perception and attitude regarding appropriate antimicrobials use. Most of the PharmD students (71.6%) agreed that antimicrobials are overused and that antimicrobial resistance is a problem nationwide. Also, half of them face these apparent problems in hospitals where they had clinical rotations. Moreover, most of PharmD students (71.7%) agreed that poor infection control practices by health care providers and inappropriate use of antimicrobials cause antibiotic resistance. This study revealed that most of PharmD students (71.75%) believed that knowledge of antimicrobials is important in pharmacy career.

Table 1. PharmD Student Attitudes and Perceptions about Antimicrobial Prescribing and Resistance.

Perceptions and Attitudes	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Antimicrobials are overused nationally in healthcare	26(43.3)	17(28.3)	12(20)	5(8.3)	-
Antimicrobials are overused at the hospitals where I have rotated		38(63.3)	16(26.7)	4(6.7)	2(3.3)
Antimicrobial resistance is not a significant problem nationally	8(13.3)	8(13.3)	15(25)	12(20)	17(28.3)
Antimicrobial resistance is not a significant problem at the hospitals where I have rotated	9(15)	10(16.7)	16(26.7)	15(25)	10(16.7)
Better use of antimicrobials will reduce problems with antimicrobial-resistant organisms	19(31.7)	11(18.3)	8(13.3)	10(16.7)	12(20)
Appropriate use of antimicrobials can cause antimicrobial resistance	11(18.3)	16(26.7)	12(20)	12(20)	9(15)
Strong knowledge of antimicrobials is important in my pharmacy career	24(40)	19(31.7)	10(16.7)	4(6.7)	3(5)
I would like more education on antimicrobial resistance	13(21.7)	13(21.7)	12(20)	14(23.3)	8(13.3)
I would like more education on the appropriate use of antimicrobials	10(16.7)	15(25)	9(15)	14(23.3)	12(20)
New antimicrobials will be developed in the future that will keep up with the problem of "resistance"	10(16.7)	23(38.3)	12(20)	8(13.3)	7(11.7)

Perceptions and Attitudes	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Prescribing broad-spectrum antimicrobials when equally effective, narrower-spectrum antimicrobials are available increases antimicrobial resistance	29(48.3)	18(30)	---	6(10)	7(11.7)
Poor Infection Control practices by healthcare professionals cause spread of antimicrobial resistance	25(41.7)	18(30)	7(11.7)	7(11.6)	3(5)
Inappropriate use of antimicrobials causes antimicrobial resistance	18(30)	17(28.3)	12(20)	7(11.7)	6(10)
Inappropriate use of antimicrobials can harm patients	21(35)	21(35)	10(16.7)	4(6.7)	4(6.7)

When the Pharm D students asked to rate their pharmacy education on choice and use of antimicrobials, 55% of the students rated their pharmacy education about antimicrobials as useful or very useful. Most of the students assessed their training on antimicrobials tasks during their sturdy in pharmacy school as good or very good, and about 81 % of students rated their trained on the appropriate time to start antimicrobial therapy as good or very good.

Assessment of Pharm D students' knowledge about appropriate antimicrobials use

This study found that students' mean correct knowledge score was 3.1 ± 1.4 . Thirty one percent of students knew the antimicrobial use and diagnosis and treatment of community-acquired pneumonia. Similarly, 30 % of students selected the appropriate antimicrobial and duration of treatment for complicated urinary tract infections. However, minority of students did not know the appropriate antimicrobials which do not cover anaerobes bacteria.

In addition, more than half of students knew the mechanism of *E. coli* organism resistance toward beta-lactams (Table 2).

Table 2. Pharm D Students' Knowledge About Appropriate Antimicrobials Use.

Clinical Vignette	Correct answer N (%)
Complicated urinary tract infections: appropriate antimicrobial selection and duration of treatment	18(30%)
Diagnosis of CAP: selection of appropriate antimicrobial and switch IV to PO	19(31.7)
Recognize the possible risks associated with unnecessary use of antimicrobials	15(25%)
Recognize <i>Clostridium difficile</i> -associated diarrhea secondary to the use of antimicrobials	18(30%)
Recognize the spectrum of activity of selected antimicrobial agents	5(8.3%)
ESBL-positive <i>E. coli</i> : antimicrobial selection	12(20%)
Identify scenarios with for unnecessary use of antimicrobials	19(31.7)
<i>E. coli/beta-lactams</i>	32(53.3%)
<i>MRSA</i>	23(38.3%)
<i>VISA</i>	9(15.0%)
<i>Enterococcus/cephalosporins</i>	21(35.0%)
Mean score	3.1 ± 1.4

MRSA: methicillin resistant *Staphylococcus aureus*; VISA: vancomycin-intermediate *Staphylococcus aureus*

Resources information of antimicrobial use

This study reported the most common utilized resources regarding antimicrobial uses were the

smartphone applications (55%), followed by infection disease pharmacists, and drug databases (both 48.3%), and then followed by professionals guidelines (45%).

Table 3 is summarized the resources used by pharmD students for information on antibiotic use and resistance.

Table 3. Resources Used by Pharmacy Students to Learn About Antimicrobial Use and Resistance.

Resources	Often	Sometimes	Rarely	Never	Not familiar
Drug databases (eg, Lexi-Comp, Micromedex, Clinical Pharmacology Up To Date	29(48.3)	15(25)	8(13.3)	3(5)	1(1.7)
IDSA guidelines	24(40)	23(38.3)	6(10)	3(5)	2(3.3)
Medical/pharmacy journals	24(40)	22(36.7)	6(10)	4(6.7)	
Peers	20(33.3)	25(41.7)	7(11.7)	3(5)	1(1.7)
iPhone/smartphone applications	19(31.7)	19(31.7)	6(10)	5(8.3)	5(8.3)
Non-ID pharmacists	33(55)	15	4(6.7)	3(5)	1(1.7)
Other professional society guidelines	22(36.7)	19(31.7)	8(13.3)	4(6.7)	1(1.7)
ID pharmacists	27(45)	20(33.3)	6(10)	4(6.7)	
Hospital pharmacists	29(48.3)	19(31%)	4(6.7)	4(6.7)	
Sanford guide	18(30)	20(33.3)	10(16.7)	3(5)	6(10)
Textbooks or study guides	21(35)	20(33.3)	6(10)	3(5)	4(6.7)
ID physicians	21(35)	20(33.3)	6(10)	10(16.7)	
Wikipedia	17(28.3)	25(41.7)	8(13.3)	5(8.3)	1(1.7)
Johns Hopkins ABX Guide	22(36.7)	9(15)	12(20)	7(11.7)	5(8.3)
	20(33.3)	21(35)	9(15)	3(5)	3(5)

ABX: antibiotic; IDSA: Infectious Diseases Society of America; ID: infectious diseases

DISCUSSION

This is the first single center study that was done in Saud Arabia to assess pharmD students' knowledge, attitudes, and perceptions towards antimicrobial stewardship and their perception of their readiness to prescribe antimicrobials appropriately. As reported in earlier perception studies, there was a prevailing opinion among survey respondents that antimicrobial resistance was more of a serious problem in Saudi hospitals [30,31].

In this surveyed study, pharmD students reported common perceptions and attitudes about antimicrobial use and resistance. Most of respondents believed that antimicrobial overuse and antimicrobial resistance are major problem nationally. In addition, most pharmD students (71.7%) agreed that poor infection control practices by health care providers and inappropriate use of antimicrobials cause antibiotic

resistance and harm the patients care. These results highlight the challenge of making antimicrobial resistance a relevant local issue among health care professionals. In this surveyed study, pharmD students showed the importance of appropriate antimicrobials use, and large number of them suggested that strong knowledge of antimicrobial use was significant in their pharmacy careers.

These findings are consistent to previous studies. Those studies reported that the new health care providers include medical students and pharmacy students believed adequate knowledge on antimicrobial use improved their knowledge and antimicrobials prescribing practice [27, 29, 30].

In this surveyed study, less than one third of pharm D students suggested that their pharmacy school education was useful or very useful in teaching them about appropriate antimicrobial use, and most believed their education on specific stewardship events was

valued. More than one third of pharmD students reported that they had attended lectures about appropriate antibiotics use (rational use, appropriate dose, route, duration of treatment and monitoring of efficacy and safety with selection antimicrobial therapy). These findings, however, is somewhat modest when compared with results from a study carried out in USA among pharmacy students which reported 80 % [29].

This study shows that the pharmD students utilized a variety of resources to learn about antimicrobial use and resistance. Those students reporting greater use iPhone or smartphone apps (55%), followed by infection disease pharmacists (48.3%) then followed by other guidelines by professionals (45%). In contrast to previous studies reported that both of medical students and pharmacy students used the infectious diseases society of America (IDSA) guidelines as the most important appropriate antimicrobials [27, 29].

The findings of the study revealed that overall antimicrobial knowledge reflected by the scores on questionnaire was much low (3.1 ± 1.4 out of 11). The result of this study was lower than the result of the survey study carried out in USA by Justo *et al.* It found that the knowledge score of pharmacy students was 5.8 ± 2.0 . Another study conducted among medical students' showed a mean correct knowledge score of 51% [27].

This study showed that majority of pharmD students did not recognize antimicrobial appropriate selection for different microorganism. The other area of deficiency of knowledge was the lack of appropriate selection of antimicrobials for β -lactamase positive *E. coli* bacteremia. However, these findings are similar to two descriptive studies in Saudi Arabia, among physicians found physicians' knowledge about antimicrobial stewardship [30,31].

The Saudi pharmacy schools should focus on undergraduate training. Also, the continuing pharmacy education for practicing pharmacists needs to be enriched to improve the pharmacists' understanding of appropriate antimicrobial use. This study has some limitations. The sample size of study was small, and therefore, the generalizability to all Saudi pharmacy students is slightly limited. However, this study can act as a pilot study for further studies about the knowledge and perceptions of Pharm D students on appropriate antimicrobial use in Saudi Arabia.

CONCLUSION

The outcomes of this study revealed that pharmD students are aware of the challenges about antimicrobial stewardship program and the need for more education about antimicrobial use and resistance. Although pharm D students have been received antimicrobial course during their study, there is still low knowledge regarding antimicrobials appropriate use. Further studies are needed to investigate the approaches for improving pharmacy student knowledge of appropriate antimicrobial use, mainly within the practical curriculum.

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