






RESEARCH ARTICLE

# The knowledge and perception of pharmacy students and recent graduates in IPSF toward antimicrobial stewardship

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## Keywords

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## Abstract

**Objective:** To assess the knowledge and perception of Pharmacy students and recent graduates within the International Pharmaceutical Students Federation (IPSF) on antimicrobial stewardship (AMS). **Method:** A 25-item questionnaire was used to gather demographic information, and assess respondents' knowledge and perception of Antimicrobial Stewardship (AMS) and stewardship interventions. **Result:** A total of 406 responses were received, 383 (94.3%) respondents agreed that AMS helps limit the occurrence of antimicrobial resistance, 397 (97.8%) indicated that Pharmacists are key stakeholders in AMS, 207 (51%) respondents indicated that their university's curriculum includes a lecture or lecture series on AMS and 251 (61.8%) respondents reported to have acquired most of their knowledge on AMS via learning materials outside their university's curriculum. **Conclusion:** Pharmacy students and recent graduates in IPSF have a good knowledge of the goals of antimicrobial stewardship. However, an improved curriculum should be put in place to adequately educate future pharmacists on antimicrobial stewardship and interventions as most students went outside their curriculum to learn about AMS.

## Introduction

Antibiotics are becoming increasingly ineffective due to resistance developed by microorganisms. Antibiotic resistance makes infections difficult to treat, resulting in treatment failure, increased mortality and morbidity, increased health care costs caused by a prolonged stay in the hospital and costs incurred in obtaining second-line therapy. Antibiotic resistance thrives on antibiotic overuse and misuse (World Health Organization, 2015). Drug-resistant infections are responsible for about 25,000 deaths annually in European countries and over 20,000 deaths annually in the United States (WHO, 2015; Erku, 2016).

The widespread increase in resistance and the dwindling rates of new antimicrobial discovery necessitates that antimicrobial consumption needs to

be closely regulated, thus the need for Antimicrobial stewardship (Antimicrobial stewardship from principles to practice, 2018). Antimicrobial stewardship refers to the judicious use of antimicrobials, ensuring that the right antimicrobial is given to the right patient at the right time with the right dose, through the right route causing the least harm to the patient and future patients. Antimicrobial stewardship ensures the best clinical outcome for the treatment or prevention of infection. The goal of antimicrobial stewardship is to improve patient care, provide optimal antimicrobial therapy, and reduce antimicrobial toxicity, resistance, and use (Doron & Davidson, 2011; Antimicrobial stewardship from principles to practice, 2018; Majumder *et al.*, 2021). Pharmacists are key players in antimicrobial stewardship, and it's important that pharmacy students are trained and have the right perception of antimicrobial stewardship. Lots of

enquiries have been made into the knowledge and perception of pharmacy students towards antimicrobial use, resistance and stewardship with a focus on specific countries and regions. This research project aims to examine the knowledge and perception of Pharmacy and pharmaceutical science students and recent graduates within the International Pharmaceutical Students Federation (IPSF) on antimicrobial stewardship, its definition, goals, and basic activities involved in an antimicrobial stewardship programme.

## Methods

### Questionnaire development

A 25-item questionnaire was developed after a literature review of similar studies (Burger *et al.*, 2016; Inácio *et al.*, 2017; Hayat *et al.*, 2021). The inclusion criteria included pharmacy students and recent pharmacy graduates (up to four years post-graduation). The survey questions were divided into three sections. A section was used to gather demographic information such as IPSF membership, IPSF region, academic status (pharmacy student or recent graduate), and gender. In the second section, six questions were asked to assess respondents' knowledge of Antimicrobial Stewardship (AMS). The questions in this section had three options yes, no, and unsure. In the third section, the perception of pharmacy students and recent graduates towards AMS interventions was assessed on a five-point Likert scale measured from "strongly agree" to "strongly disagree".

### Determination of sample size

The minimum sample size ( $n=384$ ) was determined using the Raosoft sample size determination software with a 5% margin error, 95% confidence level and 50% response distribution.

### Dissemination of questionnaire

The questionnaire was distributed virtually through five Regional Offices of IPSF globally: African Regional Office (AfRO), Asia Pacific Regional Office (APRO), Eastern Mediterranean Regional Office (EMRO), European Regional Office (EuRO) and Pan American Regional Office (PARO) through contact persons and social media platforms.

### Collection of responses

Responses were collected via responses to the questionnaire between 28 February 2021 and 1 April 2021. The questionnaire took about five minutes to fill.

### Data analysis

Descriptive statistics of data collected were performed using the IBM Statistical Package for the Social Sciences (SPSS) version 25 for windows. Data was presented in frequencies and percentages.

## Results

### Demographics

A total of 406 responses were received, 254 (62.6%) were females and 150 (36.9%) were males. All IPSF regions were represented in the data, AfRO 116 (28.6%), EuRO 102 (25.1%), APRO 79 (19.5%), EMRO 79 (19.5%) and PARO 30 (7.4%) (Figure 1). Likewise, respondents indicated their academic level, 30 (7.4%) first year students, 89 (21.9%) second year students, 87 (21.4%) third year students, 93 (22.9%) fourth year students, 57 (14%) fifth year students, 11 (2.7%) sixth year students, and 39 (9.6%) recent graduates (Table I).

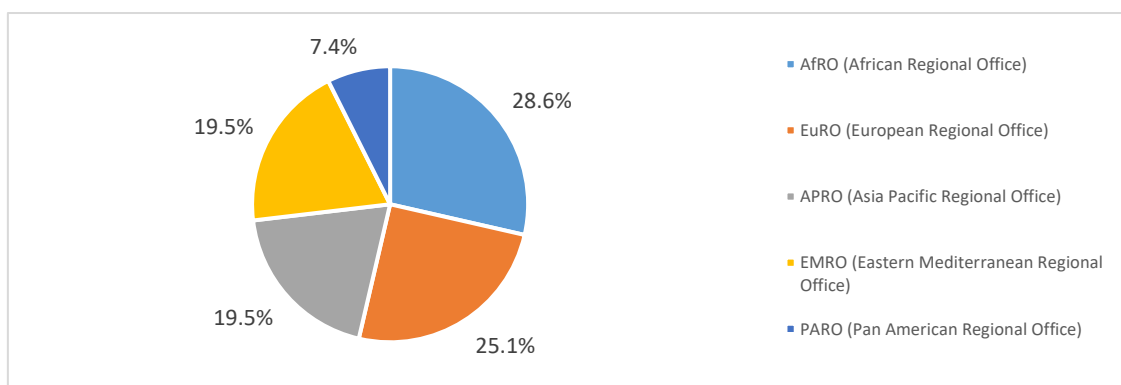


Figure 1: Graph representation of the participants according to IPSF regions

**Table I: Demographics of participants**

Variable	Frequency (n)	Percentage (%)
<b>Gender</b>		
Female	254	62.6
Male	150	36.9
<b>Region</b>		
AfRO	116	28.6
EuRO	102	25.1
APRO	79	19.5
EMRO	79	19.5
PARO	30	7.4
<b>Level</b>		
1st year	30	7.4
2nd year	89	21.9
3rd year	87	21.4
4th year	93	22.9
5th year	57	14.0
6th year	11	2.7
Recent graduate	39	9.6

**Knowledge of antimicrobial stewardship**

The respondent showed a good overall knowledge of AMS (Table II). Overall, 383 (94.3%) respondents agreed that AMS helps limit the occurrence of antimicrobial resistance, and 367 (90.4%) are aware that AMS ensures that the right patient gets the right antimicrobial for the right indication at the right time with the right dose and through the right route. Most of the respondents, 364 (89.7%), are aware of the objectives of AMS to improve patient care and clinical

outcomes and minimise antimicrobial toxicity. A large portion of respondents, 377 (92.9%), indicated that doctors are not the only health professionals to be involved in antimicrobial stewardship, indicating an awareness of respondents toward a multidisciplinary approach to AMS. Three hundred and forty-eight (85.7%) respondents did not agree that AMS should be implemented in only the Hospital setting. When asked about the involvement of pharmacists in AMS, 397 (97.8%) agreed that pharmacists have a role to play in ensuring AMS.

**Table II: Knowledge of antimicrobial stewardship (n=406)**

Question	Yes	No	Unsure
AMS helps to limit the occurrence and spread of antimicrobial resistance globally.	383 (94.3%)	2 (0.5%)	21 (5.2%)
AMS is ensuring the right patient gets the right antimicrobial for the right indication at the right time with the right dose and through the right route.	367 (90.4%)	8 (2.0%)	31 (7.6%)
AMS aims to improve patient care, improve clinical outcomes and minimise antimicrobial toxicity.	364 (89.7%)	9 (2.2%)	33 (8.1%)
Only doctors should be involved in antimicrobial stewardship.	16 (3.9%)	377 (92.9%)	13 (3.2%)
AMS should be implemented only in the hospital setting.	34 (8.4%)	348 (85.7%)	24 (5.9%)
Pharmacists have a role to play in AMS.	397 (97.8%)	1 (0.2%)	8 (2.0%)
Your University's curriculum includes a lecture or lecture series on AMS.	207 (51.0%)	96 (23%)	103 (25.4%)
You obtained most of your knowledge on AMS via learning materials outside your university's curriculum	251 (61.8%)	112 (27.6%)	43 (10.6%)

**Knowledge and perception of antimicrobial stewardship interventions**

A five-point Likert scale was used to assess the perception of pharmacy students and recent graduates on antimicrobial stewardship interventions, as summarised in Table III. Three hundred and sixty-five

respondents, 365 (89.9%), disagreed/ strongly disagreed that antibiotics should be purchased without a prescription. Regarding being effective antimicrobial stewards, 346 (85.2%) respondents agreed/strongly agreed to health care professionals taking additional training on antimicrobial prescription and use. Only 119

(29%) respondents strongly agreed that artificial intelligence and computer programmes contribute to effective antimicrobial prescribing. Many of the respondents, 185 (45.6%), are not aware of the contribution of pharmaceutical industries to AMS by limiting advertising of broad-spectrum antibiotics. Three hundred and twenty-one (79.1%) respondents believed that regular updates, reporting, monitoring and evaluation of antimicrobial use and resistance are important in AMS. A good portion, 320 (78.8%)

respondents, reported that taking cultures and susceptibility tests before prescribing are essential to AMS. Two hundred and seventy-six (68%) respondents disagreed/strongly disagreed that a specific dosage of an antimicrobial agent is suitable for all groups of people. When asked about antibiotic prescribing guidelines, 327 (80.5%) respondents agreed/strongly agreed that they should be strictly adhered to limit resistance.

**Table III: Knowledge and perception of respondents towards AMS interventions (n=406)**

Questions	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Antibiotics should be obtained without prescription.	16(3.9%)	12(3%)	13(3.2%)	71(17.5%)	294(72.4%)
Healthcare professionals require additional training on antimicrobial prescription and use to be effective Antimicrobial stewards.	201(49.5%)	145(35.7%)	36(8.9%)	6(1.5%)	18(4.4%)
Artificial Intelligence and computer programs can contribute to effective antimicrobial prescribing.	119(29.3%)	155(38.2%)	90(22.2%)	28(6.9%)	14(3.4%)
Restricting the use of selected antibiotics will preserve their efficacy and limit resistance to them.	185(45.6%)	144(35.5%)	34(8.4%)	20(4.9%)	23(5.7%)
Pharmaceutical industries contribute to AMS by limiting the advertisement of broad-spectrum antibiotics.	87(21.4%)	134(33.0%)	128(31.5%)	39(9.6%)	18(4.4%)
AMS involves regular updates, reporting, monitoring and evaluation of antimicrobial use and resistance in a region.	187(46.1%)	134(33.0%)	59(14.5%)	7(1.7%)	19(4.7%)
Taking cultures and susceptibility tests are essential to AMS.	199(49.0%)	121(29.8%)	55(13.5%)	13(3.2%)	18(4.4%)
A specific dosage of an antimicrobial agent is suitable for all groups of people.	50(12.3%)	40(9.9%)	40(9.9%)	101(24.9%)	175(43.1%)
Antibiotic prescribing guidelines should be strictly adhered to limit antimicrobial resistance.	218(53.7%)	109(26.8%)	41(10.1%)	19(4.7%)	19(4.7%)

### Source of knowledge of antimicrobial stewardship

When asked about their university's curricula, 207 (51%) respondents indicated that their universities curriculum includes a lecture or lecture series on AMS. When analysed further, 43.3% of all first-year students, 43.8% of all second-year students, 50.6% of all third-year students, 52.7% of all fourth-year students, 50.9% of all fifth-year students, 63.6% of all sixth-year students, and 66.7% of recent graduates indicated that their universities curricula include a lecture or lecture series on AMS. This trend indicates that a student is more likely to have a lecture or lecture series on AMS and gain more knowledge on it as they progress across different academic levels from the first year to the sixth year. Two hundred and fifty-one (61.8%) respondents reported having acquired most of their knowledge on AMS via learning materials outside their university's curriculum. For most recent graduates, 24 of them (61.5%) indicated that they acquired most of their knowledge on AMS from learning materials outside of their university's curricula. This shows that the universities' curricula do not provide students with

adequate knowledge on AMS to be effective antimicrobial stewards on graduation.

### Discussion

The IPSF is an international non-governmental, non-political, non-religious and non-profit umbrella organisation for pharmacy student organisations and represents more than 500,000 pharmacy and pharmaceutical science students and recent graduates from over 100 countries worldwide. The five regional extensions of the Federation are the: Asia Pacific Regional Office (APRO), African Regional Office (AfRO), Eastern Mediterranean Regional Office (EMRO), European Regional Office (EuRO), Pan American Regional Office (PARO) (IPSF, 2021). This study evaluated the knowledge and perception of pharmacy students and recent graduates in IPSF on AMS. This study gives a global perspective to this subject as it received responses from pharmacy students and recent graduates from over 60 countries.

Respondents showed a good overall knowledge of AMS. The majority of the respondents were aware of the objectives of AMS and its role in limiting the occurrence and spread of AMR (94.3%), improving patient care, improving clinical outcomes and minimising antimicrobial toxicity (89.7%). Almost all respondents (90.4%) recognised AMS as ensuring the prescription of the right antimicrobial, administered at the right dose, through the right route and given for the right duration of time. Similar studies have identified pharmacy students to have good overall knowledge of AMS (Burger *et al.*, 2016; Inácio *et al.*, 2017). Antimicrobial stewardship initiates a collaborative, multidisciplinary approach involving prescribers and non-prescribers, laboratory staff, microbiologists, epidemiologists, information technology (IT) experts, data analysts, veterinarians, farmers, infectious disease specialists, physicians, nurses, clinical pharmacists, and health care leaders (Centre for Disease Control, 2014; Majumder *et al.*, 2021).

A total of 92.9% disagreed with involving only doctors in antimicrobial stewardship, with 97.8% indicating that pharmacists have a key role to play in AMS and 98.5% indicating that knowledge of AMS is important in their pharmacy careers. Results from this study correlate with that of other studies in which 99% of master of pharmacy students in the United States, 94% of doctor of pharmacy students in the United States, 98.5% of pharmacy students in South Africa, 100% of pharmacy students in Saudi Arabia, and 92% of medical students indicated that good knowledge on antimicrobials prescribing is relevant in their careers (Abbo *et al.*, 2013; Justo *et al.*, 2014; Burger *et al.*, 2016; Inácio *et al.*, 2017; Ahmed *et al.*, 2019).

AMS interventions aim to optimise antimicrobial prescription and use and limit the adverse effect of antimicrobial resistance. 1.6 million lives could be saved by 2050 if AMS is implemented right with policies that ensure appropriate antimicrobial use and hygienic practices (WHO, 2019). Some of these interventions include raising awareness of AMR, establishing appropriate evidence-based antimicrobial prescribing, formulary restrictions, restrictive antimicrobial use, infection prevention and control, AMR surveillance, reporting and monitoring, professional education, regulating antimicrobial marketing and advertising, and research into new diagnostic tools, vaccines and antimicrobials (WHO, 2015; Antimicrobial stewardship from principles to practice, 2018; Majumder *et al.*, 2021).

These interventions should be implemented in all health care facilities, including community pharmacies, outpatient clinics and nursing homes (Antimicrobial stewardship from principles to practice, 2018; Ahmed *et al.*, 2019). When asked about the purchase of antibiotics,

89.9% of respondents agreed/strongly agreed that antibiotics should not be purchased without a prescription and 81.1% agreed/strongly agreed to restrict the use of selected antimicrobials to preserve their efficacy. A total of 85.2% of respondents are aware of the importance of educating healthcare professionals on antimicrobial prescription and use for effective AMS interventions. This correlates with the willingness of many (96.3%) respondents to obtain more knowledge on antimicrobial stewardship, antimicrobial prescribing and use in their careers; this result is similar to findings in previous studies (Doron & Davidson, 2011; Erku, 2016; WHO, 2019). Only 67.5% of respondents agreed/strongly agreed with the contributions of artificial intelligence in effective antimicrobial prescribing. About 45.6% of respondents are not aware of the impact of pharmaceutical marketing and advertising of broad-spectrum antibiotics on AMR. Most respondents (79.1%) recognised surveillance and reporting of antimicrobial use and AMR as a key stewardship intervention.

Only 51% of respondents indicated that their university's curriculum included a lecture or lecture series on AMS, with 61.8% acknowledging that they obtained most of their knowledge on AMS from learning materials outside the university's curriculum. This correlates with other studies that showed that pharmacy students had limited formal training on AMS; in one study, only 54% of pharmacy students in the United States agreed that their education was good or very good in preparing them for core antimicrobial stewardship functions (Gallagher *et al.*, 2018). In another study, only 58% of pharmacy students in the United Kingdom had discussed AMS during their course as compared to 97% who claim to have discussed antibiotic resistance during their course (Inácio *et al.*, 2017). A study in South Africa revealed that only 37.7% of pharmacy students recalled having formal education on AMS (Burger *et al.*, 2016). This identifies that the pharmacy curriculum in many countries may not adequately prepare pharmacy students to be effective antimicrobial stewards post-graduation.

The survey conducted by IPSF was voluntary, anonymous, and had no impact on the respondents; this likely reduced the tendency of respondents to give biased or "socially desired" answers. A limitation of this study was that the authors didn't get data on the respondents' knowledge of antimicrobial resistance causes, use of antibiotics, and materials sourced to gain knowledge on antimicrobial resistance and stewardship. The authors also didn't get details of respondents' universities and schools of pharmacy.

## Conclusion

The findings of this study revealed that pharmacy students and recent graduates within IPSF have a good knowledge of antimicrobial stewardship definition and goals. They are aware of interventions relating to appropriate antimicrobial prescribing and use. They may need more knowledge on stewardship interventions involving the use of technology. Respondents showed a positive attitude towards antimicrobial stewardship as most of them desired to learn more about it and considered the knowledge of antimicrobial stewardship as important in their careers. The study reveals a gap in pharmacy curriculum globally, as most respondents sought knowledge on antimicrobial stewardship using materials outside their university's curriculum. Efforts should be put in place to adequately educate future pharmacists on antimicrobial stewardship.

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