Medical and pharmacy students' knowledge, attitude and perception concerning antimicrobial use and resistance in Pakistan

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Abstract

Background: Lack of adequate knowledge during undergraduate years may be responsible for prescribing or dispensing inappropriate antimicrobial agents which is one of the main reasons for antimicrobial resistance (AMR).

Objectives: The objective of the present study was to evaluate levels of medical and pharmacy students' knowledge, attitude and perception concerning antimicrobial use and resistance.

Methods: A cross-sectional observational study was carried out in Lahore, Pakistan. A questionnaire was designed through a literature review. The study population included medical students and pharmacy students of the semi-final year (fourth) and final year (fifth). Data were then collected using a supervised, self-administered and pre-tested questionnaire containing 50 closed-ended questions. Six hundred and fifty students were invited to complete the questionnaire and the response rate was 69.2% (450 students).

Results: The majority of the students (79%) agreed that too many antimicrobial agents were prescribed in the hospitals nationally. The knowledge about antimicrobial use and resistance was significantly higher in pharmacy students than medical students ($p<0.05$). Pharmacy students were more inclined to strongly agree (94%) that they would like more education on the appropriate use of antimicrobial agents compared to medical students ($p=0.001$).

Conclusion: In order to reduce the growing problem of AMR, efforts should be undertaken to ensure that future pharmacists and doctors in Pakistan are well educated in practices of rational use of antimicrobial agents and their stewardship.

Keywords: *Antimicrobial Use, Antimicrobial Resistance, Medical Students, Pharmacy Students*

Introduction

Antimicrobial resistance (AMR) remains a great challenge for the healthcare system in treating multi-drug resistant infections as well as in preventing the escalation of treatment cost (Cosgrove, 2006; Saleem & Hassali, 2018). A large number of antimicrobial agents have been used over the last few decades, which may result in AMR (Klein, 2018). Inappropriate use of antimicrobial agents may cause several issues such as the development of adverse effects, development of AMR and increased cost of healthcare services (Goossens, 2005; Väänänen, 2006; Maragakis, 2008). To reduce unnecessary and inappropriate use of antimicrobial agents, the Center for Disease Control and Prevention (CDC) introduced preventive measures in its 'Campaign to Prevent AMR in healthcare settings' (Control & Prevention, 2002). Various factors such as physician's knowledge and experience, patient's expectation, diagnosis uncertainty, patient-physician interaction, self-medication, and pharmaceutical marketing lead to unnecessary and inappropriate use of antimicrobial agents (Buke, 2005). Furthermore, for empiric therapy, multiple antimicrobial agents are prescribed resulting in multi-drug resistance (Hanberger, 2009; Fraimow, 2011). Moreover, medical and pharmacy students may not have sufficient knowledge regarding the rational use of antimicrobial agents and AMR (Minen, 2010; Justo, 2014). Educational interventions can decrease the inappropriate prescribing of antimicrobial agents by clinicians (Eng, 2003).

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The World Health Organisation (WHO) recommends educational training for undergraduate students and post-graduate students to learn about the issues concerning AMR and continuing professional development (CPD) programmes for medical staff members but, unfortunately, due to lack of financial resources, opportunities for CPD are limited and relevant AMR topics may be excluded from educational programmes (WHO, 2005). A report by the WHO has suggested that international agencies and non-government organisations (NGO) can motivate both education and healthcare sectors of the national government to assure that sufficient education on infectious diseases, antimicrobial use, and infection control is provided to all medical and non-medical students (Leung, 2011). Several studies have reported medical students' and pharmacy students' knowledge, attitude and behaviour regarding antimicrobial use and resistance (Wright, 2004; Ibia, 2005; Huang, 2013; Khan, 2013; Saleem, 2016). Lack of adequate education on infectious diseases, antimicrobial use, and infection prevention and control during undergraduate years may be responsible for prescribing inappropriate antimicrobial agents (Khan, 2013). The medical students have better knowledge about antimicrobial agents than other medical personnel, however, another study reported that senior medical students chose antimicrobial agents inappropriately in the settings of clinical practice (Ibia, 2005; Heddini, 2009). Pharmacists are well-placed to act as antimicrobial stewards in various clinical settings (Justo, 2014). Pharmacy students' perceptions regarding antimicrobial use need evaluation if pharmacists are to take on the role of antimicrobial stewardship (Saleem, 2016).

Antibiotic stewardship programmes are a potential strategy for preventing misuse of antibiotics which may include healthcare professional education regarding appropriate use of antimicrobial agents, prescription review by trained healthcare practitioners and pharmacists, and implementation of new policies for high-risk antimicrobial agents (Feazel, 2014). Medical students do their practice of prescribing antimicrobial agents under the supervision of a clinician who plays a significant role in prudent antibiotic prescribing (Huang, 2013). Education and inter-professional teamwork continues to be a focus in the healthcare system, so it is necessary to understand various levels of experience and foundational information that healthcare practitioners and trainees use to direct patient care (Cuff, 2013). Teaching about the appropriate use of antimicrobial agents and AMR should be a vital part of undergraduate medical curricula (Wright, 2004). The student's knowledge, attitudes, and beliefs towards antimicrobial use warrant greater attention. A number of studies around the globe investigated the antimicrobial knowledge of the general public, secondary school teachers, and medical students (Minen, 2010; Abbo, 2013; Napolitano, 2013; Justo, 2014), but to the authors' knowledge, there are no studies carried out in Pakistan. So, the present study is to evaluate the level of medical and pharmacy students' knowledge, attitude and perception concerning antimicrobial use and resistance.

Method

Study design and population

The authors performed an observational cross-sectional study during January and May 2018 which was undertaken in medical and pharmacy schools to evaluate students' knowledge, attitude, and perception concerning antimicrobial use and resistance. The study population included semi-final (fourth) and final year (fifth) students of medical and pharmacy schools. Four medical schools and three pharmacy schools were invited to participate. However, only two medical schools (Ameer-u-Din Medical College and Fatima Memorial Medical College), and one pharmacy school (Punjab University College of Pharmacy) agreed to participate. The study was approved by the Human Ethics Committee for Clinical Research of the Punjab University College of Pharmacy, University of the Punjab, Lahore, Pakistan (HEC/1000/PUCP/1925KPM).

Survey instrument

The questionnaire was designed after a thorough literature review (Wright, 2004; Ibia, 2005; Minen, 2010; Justo, 2014; Yang, 2016). The questionnaire was validated by an expert in the field of pharmacy practice and tested on a pilot sample of ten medical and ten pharmacy students for length, readability, and relevance of selected items. Cronbach's *alpha* was used to check the reliability of the questionnaire. The *alpha* coefficients of the antimicrobials use, medical/pharmacy students' perception on their education regarding antimicrobial use and antimicrobial stewardship, and resources sections were 0.788, 0.864 and 0.86, respectively, and therefore confirmed the internal consistency of these questions. A small scale pilot study was conducted to ensure the validity of the questionnaire.

The questionnaire was subdivided into six categories. The first part contained ten questions related to demographic data including age, gender, name of institute, school (Medical/Pharmacy). The second part consisted of six questions to obtain the perception of students about antimicrobial use. The third part contained fourteen questions about AMR, assessed using a scale of: 'strongly agree', 'agree', 'neutral', 'disagree', and 'strongly disagree'. The fourth part contained nine questions relating to students' perceptions of their education regarding antimicrobial use and antimicrobial stewardship. The fifth part contained resources used by medical and pharmacy students to study antimicrobial use and resistance, and in the final part ten knowledge-based questions were asked.

Data collection

Data were collected using a questionnaire containing 50 closed questions. A total of 650 questionnaires were distributed to students by well-trained research assistants. Information on the objectives of the survey was given to the participants before verbal consent was obtained.

Statistical analysis

The results of the survey were analysed using SPSS 21.0 (Inc. Chicago, IL). Data regarding demographic characteristics of the students were expressed as a percentage, along with the responses for each item. Scaled items were analysed as multilevel responses. *Chi*-square was used to compare proportions and statistical significance was set at $p<0.05$. Each student's knowledge score was calculated as the sum total of correct answers to each of the ten knowledge-based questions.

Results

Ninety-seven semi-final (fourth) and final year (fifth) medical students of Ameer-u-Din Medical College and 150 semi-final and final year students of Fatima Memorial Medical College, as well as 203 semi-final and final year pharmacy students of Punjab University College of Pharmacy, completed the questionnaire with a response rate of 69.2% (Table I).

Table I: Demographic characteristics of pharmacy and medical students

	Pharmacy (N= 203)	Medical (N=247)	Total
Age Groups			
18-22	123 (60.5)	110 (44.5)	233 (51.7)
23-27	80 (39.4)	137 (55.4)	217 (48.3)
Gender			
Male	31 (15.2)	82 (33.1)	113 (25.1)
Female	172 (84.7)	165 (66.8)	337 (74.9)
Year			
Semi-final	98 (48.2)	120 (48.5)	218 (48.4)
Final	105 (51.7)	127 (51.4)	232 (51.6)
Sector			
Private	0 (0.0)	153 (61.9)	153 (34.0)
Public	203 (100.0)	94 (38.0)	297 (66.0)
Scholar			
Day	148 (72.9)	95 (38.4)	243 (54.0)
Hostel	55 (27.0)	152 (61.5)	207 (46.0)
Income			
<20k	53 (26.1)	10 (4.0)	63 (14.0)
>20k-	150 (73.8)	237 (96.0)	387 (86.0)

Table II: Perceptions about Antimicrobial use and its resistance

Questions	SA	A	N	DA	SD	Age	Gender	Year	School
Too many antimicrobial prescriptions nationally	220 (48.9)	171 (38)	30 (6.7)	22 (4.9)	7 (1.6)	NS	NS	NS	NS
Antimicrobials are overused at the hospitals where I have rotated	130 (28.9)	219 (48.7)	81 (18.0)	18 (4.0)	2 (0.4)	NS	NS	NS	NS
Strong knowledge of antimicrobial agents is important in career	275 (61.1)	134 (29.8)	37 (8.2)	3 (0.7)	1 (0.2)	NS	0.04	NS	0.006
Inappropriate use of antimicrobial agents can harm patients	267 (59.7)	144 (32.0)	18 (4.0)	16 (3.6)	5 (1.1)	NS	0.044	NS	NS
Inappropriate use of antimicrobial agents is professionally unethical	230 (51.1)	173 (38.4)	33 (7.3)	12 (2.7)	2 (0.4)	NS	0.005	NS	0.017
I would like more education on the appropriate use of antimicrobials	242 (53.8)	156 (34.7)	34 (7.6)	12 (2.7)	6 (1.3)	NS	0.017	NS	0.001
Antimicrobial resistance is a significant problem nationally	234 (52.0)	191 (42.4)	18 (4.0)	5 (1.1)	2 (0.4)	NS	0.023	NS	NS
Antimicrobial resistance is a significant problem at the hospitals where I have rotated	108 (24.0)	234 (52)	91 (20.2)	17 (3.8)		NS	NS	NS	0.001
Better use of antimicrobial agents will reduce problems with AMR	207 (46.0)	189 (42.0)	41 (9.1)	10 (2.2)	3 (0.7)	0.014	NS	NS	0.000
Poor hand hygiene causes of antimicrobial resistance	75 (16.7)	146 (32.4)	122 (27.1)	70 (15.6)	37 (8.2)	NS	NS	NS	NS
Excessive use of antimicrobial in livestock can cause resistance	124 (27.6)	216 (48.0)	72 (16.0)	30 (6.7)	8 (1.8)	NS	NS	NS	NS
Paying too much attention to advertising cause resistance	56 (12.4)	118 (26.2)	139 (30.9)	86 (19.1)	51 (11.3)	NS	NS	NS	NS
Too long durations of antimicrobial treatments can develop resistance	169 (37.6)	194 (43.1)	50 (11.1)	29 (6.4)	8 (1.8)	NS	NS	NS	NS
Too low doses of antimicrobial can cause resistance	88 (19.6)	129 (28.7)	103 (22.9)	80 (17.8)	50 (11.1)	NS	NS	NS	NS
Too many broad-spectrum antimicrobial can cause resistance	119 (26.4)	196 (43.6)	72 (16.0)	45 (10.0)	18 (4.0)	NS	NS	NS	NS
Prescribing broad-spectrum antimicrobial agents when equally effective narrower ones are available increases antimicrobial resistance	161 (35.8)	167 (37.1)	84 (18.7)	25 (5.6)	13 (2.9)	NS	NS	NS	NS
Inappropriate use of antimicrobial agents causes antimicrobial resistance	206 (45.8)	154 (34.2)	60 (13.3)	27 (6.0)	3 (0.7)	0.032	NS	0.016	NS
Poor infection-control practices by healthcare professionals cause spread of antimicrobial resistance	125 (27.8)	195 (43.3)	79 (17.6)	37 (8.2)	14 (3.1)	NS	NS	NS	NS
I would like more education on antimicrobials resistance	217 (48.2)	170 (37.8)	43 (9.6)	10 (2.2)	10 (2.2)	NS	0.018	NS	0.022
New antimicrobials will be developed in the future that will counter the problem of "resistance"	144 (32.0)	172 (38.2)	102 (22.7)	25 (5.6)	7 (1.6)	NS	NS	NS	NS

SA: Strongly agree, A: agree, N: Neutral, DA: Disagree, SD: strongly disagree, NS: Non-significant, *p*<0.05

Table III: Medical and Pharmacy students' perception on their education regarding antimicrobial use and antimicrobial stewardship

Antimicrobials stewardship activity	VG	G	N	P	VP	Age	Gender	Year	School
Understand the basic mechanisms of antimicrobial resistance.	155 (34.4)	235 (52.2)	50 (11.1)	9 (2.0)	1 (0.2)	0.029	NS	NS	NS
Know when to start antimicrobial therapy.	127 (28.2)	227 (50.4)	75 (16.7)	18 (4.0)	3 (0.7)	NS	NS	NS	NS
Select an appropriate regimen.	133 (29.6)	183 (40.7)	99 (22.0)	25 (5.6)	10 (2.2)	NS	NS	NS	NS
Describe the correct spectrum of antimicrobial therapy for different antimicrobials	122 (27.1)	193 (42.9)	88 (19.6)	40 (8.9)	7 (1.6)	NS	NS	NS	0.019
Transition from intravenous to oral antimicrobials	87 (19.3)	180 (40.0)	121 (26.9)	45 (10.0)	17 (3.8)	0.004	NS	0.023	NS
Find reliable sources of information to treat infections.	118 (26.2)	202 (44.9)	93 (20.7)	27 (6.0)	10 (2.2)	NS	NS	NS	NS
Interpret anti biograms	73 (16.2)	159 (35.5)	145 (32.2)	54 (12.0)	19 (4.2)	0.017	NS	NS	NS
Streamline or deescalate antimicrobial therapy.	80 (17.8)	167 (37.1)	144 (32.0)	41 (9.1)	18 (4.0)	NS	NS	NS	NS
Handle a patient who demands antimicrobials therapy that is not indicated	116 (25.8)	155 (34.4)	107 (23.8)	52 (11.6)	20 (4.4)	0.041	NS	0.024	NS

VG: very Good, G: Good, N: Neutral, P: Poor, VP: very poor, NS: Non-significant, p<0.05.

Resources	N	R	S	O	A	Age	Gender	Year	School
Textbooks or study guides	28 (6.2)	33 (7.3)	82 (18.2)	120 (26.7)	185 (41.1)	NS	NS	NS	0.011
Peers (other students)	35 (7.8)	78 (17.3)	143 (31.8)	151 (33.6)	43 (9.6)	0.011	NS	NS	NS
Wikipedia	20 (4.4)	67 (14.9)	154 (34.2)	145 (32.2)	64 (14.2)	NS	NS	NS	0.009
I-Phone/smart phone applications	27 (6.0)	64 (14.2)	126 (28.0)	159 (35.3)	74 (16.4)	NS	NS	NS	NS
Non-ID physicians	132 (29.3)	98 (21.8)	134 (29.8)	67 (14.9)	19 (4.2)	NS	NS	NS	0.010
Infectious diseases specialists	80 (17.8)	131 (29.1)	126 (28.0)	78 (17.3)	35 (7.8)	NS	NS	NS	NS
Hospital pharmacists	94 (20.9)	119 (26.4)	130 (28.9)	78 (17.3)	29 (6.4)	NS	NS	NS	0.015
Medical/Pharmacy journals	77 (17.1)	127 (28.2)	111 (24.7)	89 (19.8)	46 (10.2)	NS	NS	NS	0.001
Pharmaceutical representatives	102 (22.7)	135 (30.0)	121 (26.9)	62 (13.8)	29 (6.4)	NS	NS	NS	NS
Johns Hopkins Antimicrobial Guide	150 (33.3)	100 (22.2)	95 (21.1)	78 (17.3)	27 (6.0)	NS	NS	NS	0.006
Infectious Diseases Society of America (IDSA) guidelines	119 (26.4)	97 (21.6)	101 (22.4)	90 (20.0)	43 (9.6)	NS	NS	NS	0.007
Sanford guide	167 (37.1)	92 (20.4)	106 (23.6)	56 (12.4)	29 (6.4)	NS	0.033	NS	NS
Drug databases (Lexi-Comp, Micromedex, Clinical Pharmacology)	106 (23.4)	94 (20.9)	124 (27.6)	93 (20.7)	33 (7.3)	NS	NS	NS	0.007
Other guidelines by professional organisations	93 (20.7)	103 (22.9)	124 (27.6)	87 (19.3)	43 (9.6)	NS	NS	NS	NS

N: Never, R: Rare, S: Sometimes, O: Often, A: Always, NS: Non-significant, p<0.05.

A majority of the students (79%) agreed that too many antimicrobial agents were prescribed in the hospitals nationally and most of the students (90.9%) agreed that strong knowledge of antimicrobial agents was important for their career (Table II). Relatively more females agreed to this statement (93%, *p*=0.004). The majority of the female respondents strongly believed that inappropriate use of antimicrobial agents can harm patients and is professionally unethical (*p*=0.005). The response of pharmacy students (94%) was more inclined towards the statement that they would like more education on the appropriate use of antimicrobial agents compared to medical students (*p*=0.001). A majority of the students (88%) strongly agreed that appropriate use of antimicrobial agents would result in the reduction of problems associated with AMR. Pharmacy students believed strongly that better use of antimicrobial agents would reduce the problem of AMR (*p*=0.000). They were strongly agreed that paying too much attention to advertising, over long durations of antimicrobial treatments, and too low doses of antimicrobial could contribute to the development of resistance. Most students strongly agreed that new antimicrobials would be developed in the future that will counter the problem of resistance. A majority of participants (72.8%) believed that too many broad-spectrum antimicrobials, and prescribing broad-spectrum antimicrobial agents when equally effective narrower ones were available increased AMR. More than half of respondents (53%) of age group (23-27) strongly agreed that inappropriate use of antimicrobials caused resistance. (*p*=0.032).

Respondents between 18-22 years of age had a good understanding of the basic mechanism of AMR and knowledge of when to start antimicrobial therapy (*p*=0.029) (Table III). Pharmacy students had more knowledge regarding the correct spectrum of antimicrobial therapy than medical students (*p*=0.019). As expected, students of the final year had good knowledge (67.4%) compared to the semi-final year who had poor knowledge (47.2%) of how to handle a patient who demanded antimicrobial therapy that is not indicated. Medical students gained knowledge of antimicrobial agents from textbooks (41.1%, p=0.011) (Table IV). Most of the pharmacy students used WIKIPEDIA as a source of knowledge regarding antimicrobial use and its resistance (60%, *p*=0.009).

Discussion

Inappropriate use of antimicrobial agents and resistance are a global threat to the healthcare system (Saleem, 2018). To resolve the issue of antimicrobial agent's misuse, a comprehensive understanding of students' knowledge, attitude and perception must be sought. The current study evaluated knowledge, attitudes, and perceptions of medical and pharmacy students in Pakistan concerning antimicrobial use and AMR. Medical and pharmacy students participated equally in this survey. Most of the pharmacy and medical students were in agreement that antibiotics are overused nationally. Whereas, they did not always agree that antibiotics are overused in their own institutions. A majority of the pharmacy and medical students also believed that strong knowledge of antibiotics is important in their career. Lack of knowledge about the possible outcomes of increased antibiotic use is a major factor contributing to marked resistance (Minen, 2010).

A study conducted in Saudi Arabia reported that medical students had adequate knowledge regarding antimicrobials effectiveness (Harakeh, 2015). Medical students believed that inappropriate or unnecessary use of antimicrobials is detrimental to health (Suaifan, 2012). A study was performed in the centre of the Democratic Republic of the Congo, where medical students believed that no antimicrobial should be prescribed for upper respiratory tract infections (Thriemer, 2013). Based on the findings of this study, students in their final year have adequate knowledge of how to handle patients who demand antimicrobial therapy when it is not indicated.

Medical and pharmacy students used a variety of resources to seek knowledge regarding antimicrobial use and resistance. Both medical and pharmacy students gained knowledge regarding antimicrobial agents and their resistance from textbooks. In this study, the authors discovered that significant differences exist between different types of educational resources participants used to gain knowledge about the antimicrobial use and its resistance. The pharmacy students who preferred WIKIPEDIA over other educational resources did not demonstrate greater knowledge regarding antimicrobial use and resistance. In a previous studies, medical students who used the Infectious Diseases Society of America (IDSA) guidelines as a resource had greater knowledge, and pharmacy students who reported using a physician or pharmacist as a resource had insufficient knowledge regarding antimicrobial use and resistance (Abbo, 2014;Justo, 2014).

The primary limitation of the present study was that the authors cannot generalise the findings to all medical colleges and pharmacy schools in Pakistan. Another potential limitation was that respondents may not represent the overall student population at medical colleges and pharmacy schools surveyed. Nevertheless, the authors believe that the findings provide useful knowledge of Pakistani medical and pharmacy students' understanding, attitudes and perception concerning antimicrobial use and resistance.

Conclusion

Both pharmacy students and medical students are well aware of the extent of AMR but differences exist in knowledge, perception and educational resources used concerning AMR. In order to reduce the growing problem of AMR, efforts should be undertaken to ensure that future pharmacists and doctors are well educated in practices of rational use of antimicrobial agents and antimicrobial stewardship.

Acknowledgements

Disclosure statement

Ethical approval

All steps carried out in this research were in accordance with ethical guidelines of the institution.

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