ORIGINAL ARTICLE

A statistical assessment of awareness on antimicrobial resistance and antibiotics use attitude among the university students in Karachi, Pakistan

Rabia Iqtadar[1,2], Saira Asghar[1,2], Afaq Ahmed Siddiqui[1]

[1] Department of Pharmaceutical Chemistry, Faculty of Pharmacy & Pharmaceutical Sciences, University of Karachi-Pakistan, Pakistan
[2] Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Hamdard University Karachi-Pakistan, Pakistan

Corresponding Author: Rabia Iqtadar **Email:** Rabia.Iqtadar@hamdard.edu.pk

Received: 25 August 2021 **Revised:**19 December 2021 **Accepted:** 3 January 2022 **Available online:** May 2022
DOI: 10.55131/jphd/2022/200207

ABSTRACT

The survival instincts of microbials in response to antibiotics have revolutionized the prescribing practices. Antimicrobials must be used with great care and general public needs awareness of this burning issue. The objective of this study is to highlight the perception of university students with respect to antimicrobial resistance awareness and subsequently their attitude towards using antibiotics. The respondents in the study were selected on the basis of their education background from both healthcare and non-healthcare professions. The study was conducted on 1592 university students and data were collected using questionnaire based on Likert scale. The results were evaluated using Pearson's Chi-square test and the association between various factors was calculated by Cramer's V. The awareness level of students from the non-healthcare background, as an approximate of general public, was found to be significantly lower than healthcare students, thus enabling healthcare students to portray a more responsible attitude towards antibiotics use as compared to non-healthcare students ($p<0.05$). The level of awareness in non-healthcare students as compared to healthcare students, used as an approximate of the general public, indicates a gap in awareness campaigns about antimicrobial resistance for general public. It is recommended that the responsible use of antibiotics should be encouraged by awareness campaigns for both healthcare personnel and general public.

Key words:
antimicrobial resistance; AMR awareness; antibiotics use

Citation:
R. Iqtadar, S.Asghar, A.A.Siddiqui. A statistical assessment of awareness on antimicrobial resistance and antibiotics use attitude among the university students in Karachi, Pakistan. J Public Hlth Dev. 2022;20(2):xx-xx. (https://doi.org/10.55131/jphd/2022/200207)

INTRODUCTION

Emergence of Antimicrobial resistance (AMR) has become one of the biggest health challenges in the world. AMR has led most of the infections towards untreatable status. Around 214,000 newly born babies in the world die each year of sepsis as a result of bacterial resistance to available antibiotics [1]. World Health Organization (WHO) has already identified AMR as the most urgent problem which can only be fixed by joint global action [2]. According to the global action plan of WHO, which was published in 2015, AMR progresses after bacteria learn to fight against the antibiotic of choice in a therapy causing a failure of antibiotic therapy [3-5]. Progression of resistance is associated with frequent and irrational use of antibiotics [6, 7].

As most of the antibiotics in a drug class are chemically similar so microbial resistance against one antibiotic entity often makes the entire linked class ineffective. Resistance which is generated in one species or locality can spread in an uncontrollable manner, for example, the exchange of genetic material among different types of bacteria can disturb antibiotic treatment against number of diseases and infections [8, 9]. Because of AMR, there is high demand for novel and expensive antibiotics with more efficacy. Hence, antibiotics should be used in wise and responsive manner to prevent AMR [10, 11].

An increased number of AMR cases has been reported in Pakistan, like in other parts of the world and this situation has produced significant impact on environmental systems. In the current scenario among low to middle-income countries, Pakistan is in third place for high consumption of antibiotics after China and India. Between 2000 and 2015, the use of antibiotics in Pakistan has raised by 65% from 0.8 to 1.3 billion defined daily doses (DDD) [12] . WHO has reported Pakistan amongst top 5 countries for the highest number of new-born deaths instigated by AMR [13].

Several issues contribute to the increase in antimicrobial resistance among which the highest causative factor is the lack of public awareness regarding safe use of antibiotics. The safe use of antibiotics is dependent on the awareness level of both healthcare personnel and general public [14, 15]. The main goal of the WHO Global action plan against AMR is to provide awareness to the public about unnecessary antibiotic use to limit AMR emergence. To achieve this goal WHO performed multi country AMR awareness Surveillance in 2015 [16]. The survey results show that the level of knowledge among the public of different countries varies regarding proper use of antibiotics and is found to be lower in the countries from WHO African, South-East Asian and Eastern Mediterranean regions. Therefore, it is needed in the current scenario to enhance the knowledge and improve the beliefs and attitude of the general public regarding the AMR through large scale surveys [17-19] .

In Pakistan, over the counter availability of most potent antibiotics and irrational use of antibiotics by public makes the condition worse. Although number of surveys on AMR have been reported, to the best of our knowledge, there has not been a single study assessing the knowledge and attitudes of medical and non-medical students towards AMR in Pakistan. Though several reports from WHO and other studies provoked providing training and awareness to non-medical students about rational use of antibiotics and introducing concepts of AMR are imperious, previous studies addressed only medical and paramedical students. So, the current research was planned to assess the knowledge and attitude about AMR among the medical and non-medical students in Sindh and Punjab of Pakistan. This is the theme of considerable attention to conduct the study.

METHODS

Study Design and Population

Pakistan constitutes 2.83% of the total world population with a population density of 742 people per mile^2 [20]. Karachi with a population of approximately 16 million [21], is not only the most populated city of Pakistan, but it ranks seventh among the most populous cities in the world. The data was collected using an online questionnaire with stratified random sampling technique. The students were divided into strata, based on their education background; healthcare and non-healthcare. The cross-sectional study was conducted in the last quarter of 2019 among students of diverse fields from both public and private sector universities in Karachi.

The exact population of university students in Karachi is not known but it is estimated to be more than 20,000 (according to Raosoft sample size calculator, the sample size doesn't change much once the population size exceeds 20,000, so for unknown population size, 20,000 may be used). With the help of Raosoft sample size calculator [22], the sample size was determined by considering 5% margin of error, and 95% confidence interval. Response distribution was selected as 50% due to chances of less awareness in non-healthcare population. The minimum sample size was calculated to be 377. Cochran's formula [23] computes a sample size of 385 based on same parameters as Raosoft, excluding population size.

Data Collection Procedure and Tools

The questionnaire was designed, based on the literature review of past similar studies [2, 11, 14]. It contains close-ended questions on demography, AMR awareness, antibiotics use and perception of a possible causative factor for increasing antimicrobial resistance. The first section of the survey form contains demographic questions like age, gender, education background and education level. The following three sections were designed using a five-point Likert scale (strongly disagree=1, disagree=2, neutral=3, agree=4 and strongly agree=5) to assess awareness of participants about antimicrobial resistance, attitude towards responsible use of antibiotics and effect of socioeconomic status on increasing antimicrobial resistance.

Statistical Analyses

The data obtained through an online survey was downloaded as an MS Excel sheet and imported to Statistical Package for Social Sciences (IBM SPSS Statistics) for further analysis. The reliability of the test items in each section was tested using Cronbach's alpha internal consistency analysis. The reliability score of section two (ten statements) and three (five statements) was found to be 0.81, which is considered a good score for statements based on the Likert scale [24]. The statements in section two were considered positive markers. The respondents who were in agreement with these statements were considered aware of the antimicrobial resistance issue. The responses were simplified by awarding one mark each for "agree" and "strongly agree" and zero for "disagree" and "strongly disagree". Section three contains negative marker questions where disagreement yield one mark each while zero for a response in agreement. The survey participants who were in agreement with the statement were considered to be using antibiotics irresponsibly. The neutral responses in both sections were marked as a separate category that did not contribute to the total awareness score or attitude score.

AMR awareness score was calculated on the basis of responses in section two with a maximum of score 10 for respondents who were fully aware. The scores were categorized using modified

Bloom's cut-off point [25]; Awareness on the basis of scores between 66-100% (7-10 points), moderate awareness for scores between 35-65% (4-6 points) and unaware when they score less than 35% (0-3 points). Attittude score was calculated to analyze the responsible use of antibiotics by the study participants with a maximum of score 5 for a good attitude. The scores were categorized using modified Bloom's cut-off point [25]; responsible attitude on the basis of scores between 76-100% (4-5 points), neutral behavior for scores between 36-75% (2-3 points) and irresponsible attitude when they score less than 35% (0-1 points).

The collected data were summarized using descriptive statistics (mean, median, mode). The variation in awareness and attitude scores was hypothesized to vary among healthcare and non-healthcare students so the data was found to be normally distributed, hence a parametric test of independence was applied using Pearson's chi-square test. In cases of rejection of null hypothesis, degree of association was calculated by Cramer's V test. The generated hypotheses were tested at a 5% level of significance (α=0.05).

The study has tested seven hypotheses regarding independence of various factors on AMR awareness and antibiotic use attitude and all of these hypotheses have been rejected. The results of statistical analysis (Chi-square χ^2, p-value, Cramer's V) and empirical conclusion are summarized in Table 5. Chi-square is a test of independence between two categorical variables and p-value<0.05 means that the null hypothesis is rejected at 95% confidence interval. Since the null hypotheses are rejected, the categorical variables are found to be dependent on each other and their level of dependence or association is determined by Cramer's V test.

Table 1 Statistical data of hypotheses

S. No.	Hypotheses	Chi-Square Values χ2	p Values	Cramer's V Values	Statistical Conclusion
H_{01}	Level of AMR awareness is independent of gender.	13.25	0.001	0.091	Rejected
H_{02}	Level of AMR awareness is independent of education background.	161.04	<0.001	0.318	Rejected
H_{03}	Level of AMR awareness is independent of education level.	77.05	<0.001	0.156	Rejected
H_{04}	Attitude towards use of antibiotics is independent of gender.	39.6	<0.001	0.158	Rejected
H_{05}	Attitude towards use of antibiotics is independent of education background.	83.5	<0.001	0.229	Rejected
H_{06}	Attitude towards use of antibiotics is	123.64	<0.001	0.197	Rejected

S. No.	Hypotheses	Chi-Square Values $\chi 2$	p Values	Cramer's V Values	Statistical Conclusion
	independent of education level.				
H_{07}	Attitude towards use of antibiotics is independent of level of AMR awareness.	166.59	<0.001	0.229	Rejected

RESULTS

The number of valid responses to the questionnaire was 1592 [Table 1]. The respondents from healthcare background such as doctors, pharmacists, dentists, etc. were 49.7% (n=792) and from non-healthcare background such as mathematicians, social sciences, engineering, etc. were 50.3% (n=800). The study was conducted on undergraduates, graduates and postgraduate students whose proportion was found to be 64.4% (n=1026), 27.3% (n=434) and 8.3% (n=132) respectively. The male proportion was found to be 24.2% (n=386), while the female population was 75.8% (n=1206). The higher ratio of female students in this study represents the general composition of Pakistani higher education institutes where females are prevailing as graduates [26, 27].

Table 2 General characteristics of respondents

Characteristics	Frequency	Percentage
Gender		
Male	386	24.20%
Female	1206	75.80%
Education Background		
Healthcare	792	49.70%
Non-Healthcare	800	50.30%
Education Level		
Undergraduates	1026	64.40%
Graduates	434	27.30%
Post-graduates	132	8.30%

Table 3 AMR awareness level of respondents

Characteristics	Awareness Level		
	Unaware	Moderately aware	Aware
Gender			
Male	28 (7.3%)	56 (14.5%)	302 (78.2%)
Female	60 (5.0%)	272 (22.6%)	874 (72.5%)
Education Background			
Healthcare	24 (3.0%)	72 (9.1%)	696 (87.9%)
Non-Healthcare	64 (8.0%)	256 (32.0%)	480 (60.0%)
Education Level			
Undergraduates	82 (8.0%)	156 (15.2%)	788 (76.8%)
Graduates	6 (1.4%)	128 (29.5%)	300 (69.1%)
Post-graduates	0 (0.0%)	44 (33.3%)	88 (66.7%)

Table 4 Attitude towards antibiotics use of respondents

Characteristics	Attitude Category		
	Bad	Neutral	Good
Gender			
Male	102 (26.4%)	124 (32.1%)	160 (41.5%)
Female	158 (13.1%)	504 (41.8%)	544 (45.1%)
Education Background			
Healthcare	132 (16.7%)	228 (28.8%)	432 (54.5%)
Non-Healthcare	128 (16.0%)	400 (50.0%)	272 (34.0%)
Education Level			
Undergraduates	166 (16.2%)	410 (40.0%)	450 (43.9%)
Graduates	82 (18.9%)	212 (48.8%)	140 (32.3%)
Post-graduates	12 (9.1%)	6 (4.5%)	114 (86.4%)

The awareness and attitude of survey participants were calculated and are reported in Table 2 and Table 3 detailing scores in various groups based on gender, education background and education level. The table shows that approximately 90% of each population has good AMR awareness score, however, the good score is not reflected in their attitude towards antibiotic use and there is a significant fall in percentages of attitude scores.

In H_{01}, we have tested if the level of AMR awareness is independent of gender. P-value was found to be less than 0.05, thus null hypothesis is rejected. Cramer's V was calculated to be 0.091, which shows that level of AMR awareness is dependent on gender; however, the degree of association is very low.

In H_{02}, the statistical test was carried out to determine whether the level of AMR awareness is independent of education background. Null hypothesis is rejected, as

p-value is found to be less than 0.05. Cramer's V was calculated to be 0.318, showing that the level of AMR awareness was moderately associated with education background, being in healthcare or non-healthcare fields.

H_{03} tests the statement if the level of AMR awareness is independent of education level. Null hypothesis was rejected, as p-value was calculated to be less than 0.05. Cramer's V=0.156 shows that the level of AMR awareness was dependent on education level with a very low degree of association.

The H_{04} tests if the attitude of participants towards the use of antibiotics is independent of gender. Null hypothesis was rejected at p-value being less than 0.05. Cramer's V was calculated to find out the degree of association. The value of 0.158 shows that the attitude towards antibiotics use is dependent on gender; however, the degree of association is very low.

In H_{05}, whether the attitude towards the use of antibiotics is independent of education background was tested. The p-value was found to be less than 0.05, thus we reject the null hypothesis and calculated the degree of association. Cramer's V was calculated to be 0.229, suggesting that the attitude towards antibiotic use was slightly associated with education background; healthcare or non-healthcare.

In H_{06}, if the attitude towards the use of antibiotics is independent of education level was tested. We reject the null hypothesis at p being less than 0.05. Cramer's V of 0.197 indicates that antibiotics use attitude is mildly affected by education level.

In H_{07}, we have tested if the attitude towards the use of antibiotics is independent of the level of AMR awareness. Null hypothesis was rejected, as p-value was found to be less than 0.05. Cramer's V of 0.229 specifies that attitude towards the antibiotics use is dependent on the level of AMR awareness with low degree of association.

DISCUSSION

The first step in controlling antimicrobial resistance due to inappropriate use is regulating antibiotics as a prescription only medicine. However, this regulation already exists in many countries but is seldom implemented in Pakistan. The second step is to improve prescriber's awareness regarding the responsible use of antibiotics [28-30]. The role of behavior change has been tested and proved to play improvements in regulating the spread of AMR within healthcare settings. We had postulated that the awareness level of participants from healthcare education background must be better than that of non-healthcare backgrounds as they learn about the burning issue of AMR as part of their education. This study shows that 87.9% of participants receiving healthcare education were aware of the risk of antimicrobial resistance as compared to 60% awareness in non-healthcare participants [Table 4]. Increased level of awareness in the healthcare group contributes towards the positive attitude and safe use of antibiotics as 54.5% of the participants have good practices as compared to the 34.0% of individuals from the non-healthcare group who were less aware. These results are consistent with other studies that have been carried out in different parts of the world [14, 31-34]. However, our study shows that despite the significant dependence, the level of association is statistically low. This discrepancy may be answered by the lack of responsibility in healthcare professionals in prescribing antibiotics [2] and general promotion of antibiotic use in the society [15].

Table 5 Response percentages to questionnaire

Statements	Responses (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
AMR Awareness					
Inappropriate use of antibiotics causes antimicrobial resistance.	2.9	2.1	21.1	44.6	29.3
Antimicrobial resistance will affect you and your family's health.	2.9	7.9	15.5	49.9	23.9
Poor infection control practices by healthcare professionals will cause the spread of antimicrobial resistance.	1.5	4.6	17.8	48.9	27.1
Currently, antimicrobial resistance is a major problem in the world as well as in Pakistan.	1.1	.8	17.6	54.0	26.5
Antibiotic prescribing and use should be more closely controlled.	.8	3.6	9.3	52.3	34.0
Buying antibiotics without prescription should be more closely controlled.	4.0	9.8	11.4	30.2	44.6
Students can contribute to the work being done to control antimicrobial resistances.	1.8	5.9	17.3	55.2	19.8
It is necessary to give more education to students about antimicrobial resistance.	1.8	4.1	8.0	36.2	49.9
It is necessary to complete course of antibiotics.	4.1	3.8	9.5	38.3	44.2
Antibiotics Use Attitude					
It is good to be able to get antibiotics from a relative or friend, without having to see a medical doctor.	48.4	29.0	6.3	14.2	2.1
I prefer to buy antibiotics without prescription.	51.9	29.6	7.8	8.8	1.9
I prefer to keep antibiotics at home in case there may be a need for it.	23.7	21.0	22.9	30.5	1.9
I prefer to use antibiotics in case of sore throat.	20.0	28.3	25.0	25.6	1.1
I prefer to use antibiotics in case of common cold and cough.	27.3	25.3	22.5	23.9	1.1
Perception about role of socioeconomic status in AMR					
People's socioeconomic status has an effect on the risk of being affected by antibiotic resistance.	1.1	6.7	39.7	43.5	9.0

Our study has found that awareness level and attitude scores in male and female population does not vary much from each other. However, the study was conducted in higher education institues of Karachi, which are dominated by female population and it may have an effect on statistical outcomes [26, 27].

The level of education is found to have a very low association with AMR awareness and good antibiotic use practices in our research was due to the fact that the variation in levels is very limited, as all participants have an academic level. General public comprised of both educated and uneducated people, hence our generalization of non-healthcare students is limited. The level of awareness of undergraduates was found to be highest among all three groups. According to studies, the introvert behavior of graduate and postgraduate students contributes to their less awareness of many current issues [35, 36]. However, higher education has been proposed to impart positive effects on individuals and make them follow rules and norms [37] so the attitude of post-graduate participants (86.4%) is significantly better than the undergraduates (43.9%). The impact of the knowledge level and attitudes of the non-academic population will be much bigger, as long as antibiotics will be available as over the counter medicines.

RECOMMENDATIONS

Our study participants showed good awareness level about the threat of AMR spread but their attitude towards controlling the spread does not reflect this knowledge. It may be overcome by modifying the awareness campaigns and helping society in connecting the dots on how their irresponsible use is pushing the world population towards uncontrollable pandemic situations. The study was conducted on university students but the fact is that a big portion of the Pakistani population is not privileged to attend university. The level of awareness in such individuals can be a huge gap in antimicrobial resistance control and global health organizations need to target such populations. We propose that the healthcare students should more actively participate in conducting promotions about the responsible use of antibiotics and help the general public to

REFERENCES

1. Bloom DE, Black S, Salisbury D, Rappuoli R. Antimicrobial resistance and the role of vaccines. Proceedings of the National Academy of Sciences. 2018;115(51):12868-71.
2. Waseem H, Ali J, Sarwar F, Khan A, Rehman HSU, Choudri M, et al. Assessment of knowledge and attitude trends towards antimicrobial resistance (AMR) among the community members, pharmacists/pharmacy owners and physicians in district Sialkot, Pakistan. Antimicrobial Resistance & Infection Control. 2019; 8(1):67.
3. Schrader SM, Vaubourgeix J, Nathan C. Biology of antimicrobial resistance and approaches to combat it. Science translational medicine. 2020;12(549).
4. Laxminarayan R, Van Boeckel T, Frost I, Kariuki S, Khan EA, Limmathurotsakul D, et al. The Lancet Infectious Diseases Commission on antimicrobial resistance: 6 years later. Lancet Infect Dis. 2020;20 (4):e51-e60. doi: 10.1016/S1473-3099 (20)30003-7.
5. Christaki E, Marcou M, Tofarides A. Antimicrobial Resistance in Bacteria: Mechanisms, Evolution, and Persistence. J Mol Evol. 2020;88(1):26-40. doi: 10.1007/s00239-019-09914-3
6. Whittaker A, Lohm D, Lemoh C, Cheng AC, Davis M. Investigating Understandings of Antibiotics and

Antimicrobial Resistance in Diverse Ethnic Communities in Australia: Findings from a Qualitative Study. Antibiotics. 2019;8(3):135.
7. Machowska A, Stålsby Lundborg C. Drivers of Irrational Use of Antibiotics in Europe. Int J Environ Res Public Health. 2018;16(1). doi: 10.3390/ijerph16010027
8. Mendelson M, Matsoso MP. The World Health Organization Global Action Plan for antimicrobial resistance. S Afr Med J. 2015;105(5):325. doi: 10.7196/samj.9644
9. Ha TV, Nguyen AMT, Nguyen HST. Public Awareness about Antibiotic Use and Resistance among Residents in Highland Areas of Vietnam. Biomed Res Int. 2019;2019:9398536. doi: 10.1155/2019/9398536
10. Kanneppady S, Oo A, Lwin O, Ahmed Al-Abed A-A, Kanneppady S. Knowledge, attitude, and awareness of antibiotic resistance among medical students. AMHS. 2019;7(1):57-60.
11. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. PLOS ONE. 2015;10(2).
12. Klein EY, Van Boeckel TP, Martinez EM, Pant S, Gandra S, Levin SA, et al. Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. Proceedings of the National Academy of Sciences. 2018;115(15):E3463-E70.
13. Laxminarayan R, Matsoso P, Pant S, Brower C, Røttingen J-A, Klugman K, et al. Access to effective antimicrobials: a worldwide challenge. The Lancet. 2016;387(10014):168-75.
14. Seid MA, Hussen MS. Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. BMC Infect Dis. 2018;18(1):312.
15. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health. 2015;109(7):309-18. doi: 10.1179/2047773215Y.0000000030
16. World Health Organization. Antibiotic resistance: Multi-country public awareness survey [Internet]. Available from: https://appswhoint/iris/bitstream/handle/10665/194460/9789241509817_engpdf;jsessionid=47813E9599BE5B3BE488AF3F2A2E3C6C?sequence=1. 2015.
17. World Health Organization. Awareness Week 2017 [internet]. [cited 2018 Feb 23]. Available from: http://www.who.int/campaigns/world-antibioticawareness-week/en/.
18. The Review on Antimicrobial Resistance [Internet]. [cited 2020 Mar 12]. Available from: https://amr-review.org/sites/default/files/160518/Final paper.pdf.
19. Kosiyaporn H, Chanvatik S, Issaramalai T, Kaewkhankhaeng W, Kulthanmanusorn A, Saengruang N, et al. Surveys of knowledge and awareness of antibiotic use and antimicrobial resistance in general population: A systematic review. PLOS ONE. 2020;15(1):e0227973.
20. Worldometer. Pakistan Population [Internet]. 2020 [cited 2020 Mar 12]. Available from: https://www.worldometers.info/world-population/pakistan-population/.
21. World Population Review [Internet]. 2020 [cited 2020 Mar 12]. Available from: https://worldpopulationreview.com/world-cities/karachi-population/.
22. Raosoft sample size calculator [Internet]. [cited 2019 Oct 10]. Available from: http://www.raosoft.com/samplesize.html.
23. Cochran WG. Sampling techniques: John Wiley & Sons; 2007.
24. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ. 2011;2:53-5.
25. Kaliyaperumal K. Guideline for conducting a knowledge, attitude and

practice (KAP) study. AECS illumination. 2004;4(1):7-9.
26. Kaleem R, Rathore K. Trends of Higher Education among Female Students: The Case of University of the Punjab. Governance and Management Review. 2017;2(1).
27. Batool SQ, Sajid M, Shaheen I. Gender and higher education in Pakistan. International Journal of Gender and Women's Studies. 2013;1(1):15-28.
28. Vila J, Pal T. Update on antibacterial resistance in low-income countries: factors favoring the emergence of resistance. The Open Infectious Diseases Journal. 2010;4(1).
29. Charani E, Cooke J, Holmes A. Antibiotic stewardship programmes--what's missing? J Antimicrob Chemother. 2010;65(11):2275-7. doi: 10.1093/jac/dkq357
30. Charani E, Castro-Sánchez E, Holmes A. The role of behavior change in antimicrobial stewardship. Infect Dis Clin North Am. 2014;28(2):169-75. doi: 10.1016/j.idc.2014.01.004
31. El Zowalaty ME, Belkina T, Bahashwan SA, El Zowalaty AE, Tebbens JD, Abdel-Salam HA, et al. Knowledge, awareness, and attitudes toward antibiotic use and antimicrobial resistance among Saudi population. Int J Clin Pharm. 2016;38(5):1261-8.
32. Minen MT, Duquaine D, Marx MA, Weiss D. A survey of knowledge, attitudes, and beliefs of medical students concerning antimicrobial use and resistance. Microb Drug Resist. 2010;16(4):285-9.
33. Guerra CM, Pereira CA, Neves Neto AR, Cardo DM, Correa L. Physicians' perceptions, beliefs, attitudes, and knowledge concerning antimicrobial resistance in a Brazilian teaching hospital. Infect Control Hosp Epidemiol. 2007;28(12):1411-4. doi: 10.1086/523278.
34. García C, Llamocca LP, García K, Jiménez A, Samalvides F, Gotuzzo E, et al. Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. BMC Clin Pharmacol. 2011;11:18.
35. Martinou E, Allan H, Vig S. Personality differences among junior postgraduate trainees in the United Kingdom. J Surg Educ. 2015;72(1):122-7.
36. Abdullah MNLY, Mey SC. The Fundamental Lifestyle of a University Community: A Case Study of Higher Education in a Malaysian Institution. TPC. 2012;2(3):178-91.
37. Levi-Jakšić M. Proceedings of the XIII International Symposium SymOrg 2012: Innovative Management and Business Performance: University of Belgrade, Faculty of Organizational Sciences; 2012.