

Knowledge Attitude and Practice (KAP) of Pharmacy students regarding the use of Antibiotics in Karachi

Saira Shahnaz^{1*}, Maqsood Ahmed Khan², Zeb-Un-Nisa², Shazia Alam², Syed Imran Ali², Najeeb Khatian², Faiza Khan⁴, Rasheeda Fatima³, Muhammad Mustafa Swaleh⁴

¹ Department of pharmacy practice Faculty of pharmacy Ziauddin University, Pakistan. ² Department of Pharmaceutics, Faculty of pharmacy Ziauddin University, Pakistan. ³ Department of Pharmaceutical Chemistry, Faculty of pharmacy Ziauddin University, Pakistan. ⁴ M.Phil. Scholar Department of Pharmaceutics, Faculty of pharmacy Ziauddin University, Pakistan.

Abstract

Introduction: The inappropriate utilization of antibiotics and inadequate knowledge plays a major role in the development of resistance. Antibiotics resistance has become a public health concern worldwide. **Objective:** The main objective of the study was to assess the knowledge, attitude, and practices of pharmacy students regarding the use of antibiotics. **Methodology:** A cross-sectional survey-based study was conducted among the undergraduate students of pharmacy, from 1st year to 5th years in the Private University of Karachi. A 4-section Questionnaire was constructed based on the knowledge attitude and practices of students. 460 completely filled questionnaires were considered for the study and later evaluated with SPSS version 20.0. **Results:** The demographic distribution showed 27.55% male, and 72.45% female. While correctly answered responses found 93.9%, and 94.7% of students completely agreed improper use of antibiotics causes the resistance. 84.4% of students stated resistance is a worldwide serious problem. 79.4% of students stated inappropriate use can result in ineffective treatment, and 93.1% stated it increases the health cost. 80% practiced the use of antibiotics for a longer duration than prescribed. 31% poorly understood the disease condition, 32% of respondents agreed to use a previous prescription, 24.1% borrowed antibiotics from friends and family while 29.5% stated the easy availability of antibiotics on pharmacies. **Conclusion:** The study showed the inappropriate knowledge, easy availability of antibiotics as over the counter medicines, and their inappropriate practices regarding the use of antibiotics can result in the development of antibiotic resistance.

Keywords: KAP, Antibiotics, Resistance, Inappropriate, Prescription

INTRODUCTION

The safety of the medications and the quality of patient care have been global issues [1, 2]. The use of medication without a prescription [3, 4] and without consulting any physician, re-submitting of the prescription attained during previous illness, or sharing the medication with friends and relatives for the same indication stored at home is referred to as self-medication practices [5]. The relationship between resistance and the use of antibiotics has been addressed in many studies done in the past. [6] The major factor causing the increase in the growth of antibiotics resistance is the inappropriate use of antibiotics, as European Union has set its objectives to eradicate the issue regarding antibiotics utilization [7]. According to an estimation made by WHO (World Health Organization), there is an excess of the rate of mortality of 25,000 people every year in European hospitals, with an estimated cost of about 1.5 billion Euros [8]. The risks of severity may be high in countries like Pakistan. Among the frequently prescribed medicines considered are Antibiotics [9] eventually leading to the antimicrobial resistance with larger and inappropriate consumption [10]. An appropriate clinical practice to prevent future complications among their patients is a rational practice [11, 12]. Sometimes Lack of patient's knowledge and their wrong habits may help in developing the antimicrobial resistance [13-17]. Interventional based

educational campaign for patients and at clinical setups can increase in the patient's knowledge and awareness that can reduce the frequency of inappropriate use of antibiotics [18]. Besides the surveys being conducted on the general population, various studies focused on the population comprises nurses, workers of pharmacies, interns, parents with an infant child, and medical students and pharmacy undergraduates [19]. It was reported in the past that self-medication was extensively linked with gender, age, and level of education about diseases and drugs [20]. Self-medication of antibiotics is associated with several problems counting the

Address for correspondence: Saira Shahnaz, Department of pharmacy practice Faculty of pharmacy Ziauddin University, Pakistan.
Email: sara61413 @ gmail.com

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non-Commercial-Share Alike 3.0 License, which allows others to remix, tweak, and build upon the work non commercially, as long as the author is credited and the new creations are licensed under the identical terms.

How to cite this article: Shahnaz, S., Ahmed Khan, M., Zeb-Un-Nisa, Alam, Sh., Ali, S. I., Khatian, N. and *et al.* Knowledge Attitude and Practice (KAP) of Pharmacy students regarding the use of Antibiotics in Karachi. Arch Pharma Pract 2020;11(4):135-40.

incorrect self-diagnosis, waste of public expenses, hence the resistance is developed among the patients with self-medication and inappropriate antibiotics consumption [21, 22]. With the help of this study, we aimed to measure the knowledge, attitude, and practice of use of antibiotics among pharmacy students along with their demographic characteristics. This may be helpful in providing and implementing an interventional program to improve the knowledge regarding antibiotics use, to move ahead to control the antimicrobial resistance.

METHODOLOGY

A cross-sectional study was conducted among the undergraduate students of pharmacy studying in a private sector University of Karachi for a period of 5 months. A 13-item questionnaire was designed in order to assess the knowledge, attitude, and practice of pharmacy students. The questionnaire was consisted of 4-sections; first section included the demographic details of the respondents, the second section comprised of the knowledge of the students, the third section was developed to assess the attitude of

students towards the use of antibiotics, and the last section was regarding the practices of the students towards the use of antibiotics. Student of pharm. D were encouraged to participate in the study and fill the questionnaire including all the information and their practices related with the use of antibiotics. An informed consent was taken prior to study, and confidentiality of the data was maintained throughout the study period. 500 questionnaires were distributed among all the students, however 460 completely filled questionnaire were considered later on and data was evaluated using SPSS 20.0.

RESULTS

The demographic data revealed 27.6% (n=127) of respondents were male and 72.4% (n=333) were female. Students enrolled in the study was 22% (n=101) from first year of the pharmacy, 17.8% (n=82) from 2nd year of pharmacy, 15.9% (n=73), 21.1% (n=55) and 32.2% (n=148) from 3rd, 4th and 5th years of pharmacy respectively. 8.9% (n=41) of students were from semi-urban area while 91.3% (n=419) were residents of urban areas (Table 1).

Table 1: Demographic details of Participants

Demographics	NO. Of respondent (N)	Percentages (%)
Male	127	27.6%
Female	333	72.4%
Ages of students		
18-20 years	179	38.8%
21-23 years	190	41.4%
24-26 years	91	19.8%
Year of pharmacy		
1 st Prof	101	22.0%
2 nd Prof	82	17.8%
3 rd Prof	73	15.9%
4 th Prof	55	12.1%
5 th Prof	148	32.2%
Urban/semi urban		
Urban	419	91.1%
semi-urban	41	8.9%

It was found in the results that 79.39% (n=365) agreed to the statement of improper use of antibiotics and their ineffective consequences, while 94.7% (n=436) agreed that improper use of antibiotics can lead to adverse drug events. 93.9% (n=432) of respondents correctly answered the statements of increasing the antibiotics resistance due to improper usage of antibiotics, while 93.05% (n=428) of students reported

increasing the medical cost of patients due to inappropriate use of antibiotics. Remarkably high knowledge of students was found regarding the use of antibiotics and the major consequences caused by antibiotics i.e., resistance. 84.4% (n=388) of students declared that bacteria are the causative agents of the common cold (Table 2).

Table 2: Knowledge of Participants regarding the use of antibiotics

Question s to assess knowledge	Correctly answered %	Incorrectly answered %
Inappropriate antibiotic use can lead to ineffective treatment.	365 (79.4%)	95 (20.6%)
Inappropriate antibiotic use can lead to an increase in adverse effects.	436 (94.7%)	24 (5.3%)

Inappropriate antibiotic use may increase the emergence of bacterial resistance.	432 (93.9%)	28 (6.1%)
Inappropriate antibiotic leads to higher cost of treatment.	428 (93.1%)	32 (6.9%)
Antibiotics don't work if taken too often.	364 (79.1%)	96 (20.9%)
Cold and flu are caused by Bacteria, hence need antibiotics.	177 (38.6%)	283 (61.4%)
Microorganisms can make ineffective to all antibiotics.	311 (67.6%)	149 (32.4%)
Antibacterial resistance is a serious health concern worldwide.	388 (84.4%)	72 (15.6%)

KAP study of the students revealed the attitude of the students; among a total of 460 students, 13.8% (n=63) of students strongly agreed antibiotics as a preventive measure to avoid serious illness, 14.5% (n=67) of students agreed that an antibiotic helps them to get better while suffering from a common cold, while 10.3% (n=47) of students disagreed with the statement. 12.3% (n=56) of students agreed that antibiotics should be stopped immediately, while 6.9% (n=32) of students believe that antibiotics are safe and can be used commonly. According to the knowledge, 80% (n=368)

of students responded to the cause of developing resistance by the poor infection control while 20% (n=92) did not admit to the following reason with a p-value of 0.001. 65% (n=299) students disagreed with statement. Mutational and evaluation changes among the nature of microorganisms were accepted by 90% (n=414) of students. 80% (n=368) of students responded that the patients lack resistance to the use of antibiotics which is a contributing factor in the development of resistance, and 20% (n=92) denied the statement as given in Table 3.

Table 3: Assessment of students' knowledge regarding the antibiotic resistance.

Assessment of Students Knowledge Regarding Antibiotic Resistance	Participants answers			
	Questions for Assessment of Students	N (%) Agreed	N (%) Disagreed	P-values
Resistance can be developed by self-Use of antibiotics		313(68%)	147(32%)	0.00
Resistance is developed by use of broader spectrum antibiotics		276(60%)	184(40%)	0.00
Use of antibiotic for shorter than the standard duration		358(78%)	102(22%)	0.00
Poor infection control measures are related to antibiotics		368(80%)	92(20%)	0.001
Resistance is developed due to the consumption of antibiotics for self-limited bacterial infection		253(55%)	207(45%)	0.00
Empirical antibiotic therapy (best guess therapy)		257(55%)	203(44%)	0.001
Resistance is developed because of changes in microbes with time.		414(90%)	46(10%)	0.029
Development of resistance on antibiotic use		368(80%)	92(20%)	0.00
Resistance is developed by excessive use of antibiotics		285(62%)	175(38%)	0.00
Resistance is developed when antibiotics are used for longer duration		368(80%)	92(20%)	0.00

Students were asked questions regarding their practices with the use of antibiotics. 21.4% (n=99) responded they use antibiotics occasionally, only 17.3 % (n=80) of students

responded that they never practice with self-medication with antibiotics, and 50.3 % (n=231) of students admitted they rarely practice with self-medication.

Table 4: Assessment of students' perceptions.

Questions to assess the Practice regarding antibiotics	Practices regarding the use of antibiotics	Response
How often the self-medication is practiced	Occasionally	99 (21.4%)
	Weekly	50 (10.8%)
	Rarely	231 (50.3%)
	Never	80 (17.3%)
Reason of self-medication	Disease is simple	143 (31.0%)
	Treatment cost is high in clinic	55 (11.9%)
	Same disease/symptoms as past	150 (32.5%)
	No availability of Hospitals in nearby places	36 (7.8%)
	Medical services cannot be trusted.	24 (5.4%)
Source of antibiotic	Self-decision	52 (11.2%)
	Home	78 (16.9%)

Disease condition for use of antibiotics		
	Family, friends, or neighbors	112 (24.2%)
	Retail pharmacy shop	136 (29.7%)
	Previous prescription	78 (16.9%)
	Others	56 (12.1%)
	Cough/cold/other respiratory disorder	157 (34.0%)
	Fever and other milder diseases	69 (14.9%)
	Wound infections	52 (11.2%)
	Diarrhea and other gastrointestinal-related problem	67 (14.5%)
	Eye/ear infection	65 (14.2%)
	Others	51 (10.8%)

According to the student's self-medication with antibiotics, 31.0% (n=143), 11.9% (n=55) found the high treatment cost as the reason for self-medication with antibiotics, 32.5% (n=150) had their previous experience with antibiotics. 7.8% (n=36) lack the health services facilities in the nearby place, 5.4% (n=24) stated lack of trust in the health care services, and 11.2% (n=52) responded the use of antibiotics as self-decision. 16.9% (n=78) of students responded that they obtained/used antibiotics from home, 24.2% (n=112) of students obtained from friends and family, 29.7% of students

purchased antibiotics from pharmacies, and 16.9% (n=78) of students referred to the previous prescription (Table 4).

Students' practices regarding the use of antibiotics were assessed; 34% (n=157) of students answered with Cough/cold/other respiratory disorder, 14.9% (n= 69) with fever and other milder diseases, 11.2% (n=52) for with wound infections, 14.5% (n=67) with diarrhea and other gastrointestinal-related problems, and 14.2% (n=65) with eyes/ear-related infections.

Table 5: Assessment of students' Practice about Antibiotics

Questions to assess the Perceptions of Students	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	Value of P
Antibiotics should be used to prevent serious infections.	63 (13.8%)	70 (15.3%)	90 (19.6%)	114 (24.9%)	123 (26.8%)	0.000
Antibiotics can cure common chills and flu quickly.	67 (14.5%)	165 (36.0%)	74 (16.0%)	107 (23.2%)	47 (10.3%)	0.001
Patients should stop antibiotics as soon as symptoms disappear.	56 (12.3%)	55 (12.1%)	75 (16.2%)	154 (33.4%)	120 (26.2%)	0.01
Skipping doses of antibiotics doesn't contribute in the development of resistance.	93 (20.3%)	75 (16.3%)	50 (10.8%)	105 (22.9%)	137 (29.7%)	0.001
Antibiotics can be used commonly.	32 (6.9%)	63 (13.6%)	80 (17.3%)	121 (26.3%)	164 (35.8%)	0.000

DISCUSSION:

This study was conducted among the students to evaluate their knowledge and perceptions about the antibiotics. It was concluded that students' practice for the use of antibiotics was inappropriate. The majority of respondent students were females i.e., 72.4% and 27.6% were males [23]. 22% of respondents were in the 1st year of pharmacy college. 8.9% (n=41) of respondents were from semi-urban area, while 91.3% (n=419) were residents of urban areas [24]. KAP study regarding knowledge revealed that student had knowledge regarding the use of antibiotics but, with ill practices; 13.8% of students strongly agreed that they take antibiotics as a preventive measure to avoid serious illness, 26.8% of students totally disagreed with the statement, and 19.6% remain uncertain about it. 14.5% of students agreed that an antibiotic helps them to get better while suffering from common cold, while 10.3% of students disagreed with the statement [25]. 12.3% of students agreed that antibiotics should be stopped immediately as soon as patients feel better, while 6.9% of students believe that antibiotics are safe and can be

use commonly [26]. In response to the practice of student's antibiotics use, the simple condition of disease and symptoms was found in almost 31.0%, and 11.9% of antibiotics use was associated with the high treatment cost [27]. Similarly, in the current study, 7.8% of students complained about lack of health services facilities in their nearby place, and 5.4% reported the lack of trust in the health care services [28]. 16.9% of students used their leftover antibiotics as a treatment option and obtained/used antibiotics from home, 24.2% from friends and family, and 29.7% purchased antibiotics from pharmacies as over the counter medicine [29]. However, 16.9% of students referred to the option of the previous prescription as stated in a similar study. 94% answered correctly all statements, and they had complete knowledge regarding the use of antibiotics and inappropriate use can lead to developing the resistance as shown in a study [30, 31]. 80% of students had sufficient knowledge about resistance as assessed by a similar study [32]. A similar study based on this study design found similar results for KAP study i.e. 65% of students responded that the use of antibiotics as empirical therapy is a cause of development of resistance. 80% of students responded that

patient's lack of resistance to the use of antibiotics is a contributing factor in the development of resistance and 20% denied the statement [33, 34]. These are common issues in developing countries; medical expenses are on the rise and patients have no easy access to the health care facilities, while some consider old prescription useful [35]. Inadequate knowledge and reduced practices play an important part in the misuse of antibiotics. A large proportion of students rely on the use of antibiotics without prescription.

CONCLUSION

The study assessed the knowledge and practices of students regarding the use of antibiotics; however, their poor practices may contribute to the development of antimicrobial resistance. The excessive use of antibiotics might explain the reasons for frequently rising cases of resistance among the patients, which requires attention. The easy availability of antibiotics at pharmacies, lack of time, true attention towards their disease condition, and inappropriate understanding of antibiotics abuse signifies the deficiency of instructions regarding the use of antibiotics. The study suggests the incorporation of curriculum supporting the true practicing with medicines in both community and hospital setups.

REFERENCES

- Farhan Y M. Medical assistants' knowledge about preparation and administration of intravenous admixtures in the teaching hospitals of Alanbar governorate. *Int. J. Pharm. Phytopharm. Res.* 2018; 8(5): 31-34.
- Ahad H A, Chinthaginjala H, Sreekanth K, Sucharitha A, Ibrahim O, Rani K S, Ravali Y. A Quick Guide of Optimizing Approaches on Nano suspensions Using Design of Experiments. *Int. J. Pharm. Phytopharm. Res.* 2020; 10(3): 37-42.
- Panfilova H, Hala L, Simonian L, Tsurikova O, Gerush O, Bogdan N. The study of problems and prospects of the pharmacy network development in Ukraine in the context of changing approaches to the state regulation in the retail segment of the national pharmaceutical market. *J. Adv. Pharm. Edu. Res.* 2019; 9(3): 128-135.
- Proskurova I O, Kubarieva I V, Yevsieieva L V, Boldar G E. Analysis of handling practice with unused medicines in home first aid kits of the Ukrainian households. *J. Adv. Pharm. Edu. Res.* 2019; 9(3): 123-127.
- Loyola Filho AI, Lima-Costa MF, Uchôa E. Bambuí Project: a qualitative approach to self-medication. *Cad Saude Publica*, 2004; 20 (6) 1661-1669.
- Bronzwaer SL, Cars O, Buchholz U, Molstad S, Goettsch W, Veldhuijzen IK, Kool JL, Sprenger MJ, Degener JE. European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerging Infectious Diseases* 2002;3:278-82.
- McConnell J. European action on antimicrobial resistance. *Lancet* 2001;358(9295):1787
- World Health Organization (WHO). The evolving threat of antimicrobial resistance. Options for action. Geneva: World Health Organization, 2012. Available: http://whqlibdoc.who.int/publications/2012/9789241503181_eng.pdf. Accessed: 10 December 2014
- World Health Organization (WHO). Antimicrobial Resistance. Global Report on Surveillance. Geneva: World Health Organization, 2014. Available: http://apps.who.int/iris/bitstream/10665/112642/1/9789241564748_eng.pdf. Accessed 10 December 2014
- Centers for Disease Control and Prevention (CDC). Antibiotics Aren't Always the Answer. Available: <http://www.cdc.gov/Features/GetSmart/>. Accessed: 10 December 2014.
- World Health Organization (WHO). The evolving threat of antimicrobial resistance. Options for action. Geneva: World Health Organization, 2012.
- Teixeira Rodrigues A, Roque F, Falcão A, Figueiras A, Herdeiro MT. Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. *Int J Antimicrob Agents.* 2013; 41(3): 203-212. pmid:23127482
- Cars O, Mölstad S, Melander A. Variation in antibiotic use in the European Union. *Lancet.* 2001; 357(9271): 1851-1853. pmid:11410197
- McNulty CAM, Boyle P, Nichols, Clappison P, Davey P. Don't wear me out—The public's knowledge of and attitudes to antibiotic use. *J Antimicrob Chemother.* 2007; 59(4): 727-738. pmid:17307770
- Grigoryan L, Burgerhof JG, Haaijer-Ruskamp FM, Degener JE, Deschepper R, Monnet DL, Di Matteo A, Scicluna EA, Bara AC, Lundborg CS, Birkin J. Is self-medication with antibiotics in Europe driven by prescribed use? *J Antimicrob Chemother.* 2007; 59: 152-156. pmid:17124192
- European Commission. Special Eurobarometer 407. Antimicrobial Resistance. Report, 2013.
- Gualano MR, Gili R, Scaioli G, Bert F, Siliquini R; General population's knowledge and attitudes about antibiotics: a systematic review and meta-analysis. *Pharmacoepidemiol Drug Saf.* 2015; 24(1):2-10. pmid:25251203
- Eng JV, Marcus R, Hadler JL, Imhoff B, Vugia DJ, Cieslak PR, Zell E, Deneen V, McCombs KG, Zansky SM, Hawkins MA. Consumer attitudes and use of antibiotics. *Emerg Infect Dis* 2003;9:1128-35.
- Trepka MJ, Belongia EA, Chyou PH, Davis JP, Schwartz B. The effect of a community intervention trial on parental knowledge and awareness of antibiotic resistance and appropriate antibiotic use in children. *Pediatrics* 2001;107
- Mainjot A, D'Hoore W, Vanheusden A, Van Nieuwenhuysen JP: Antibiotic prescribing in dental practice in Belgium. *Int Endod J* 2009;42(12):1112-1117.
- Awad AI, Eltayeb IB, Capps PAG. Self-medication practices in Khartoum State, Sudan. *Eur J Clin Pharmacol* 2006; 62:317-24
- Chalker J. Improving antibiotic prescribing in Hai Phong Province, Viet Nam: the "antibiotic-dose" indicator. *Bull World Health Organ* 2001; 79:313-20.
- Ahmad, A., Khan, M. U., Patel, I., Maharaj, S., Pandey, S., & Dhingra, S. Knowledge, attitude and practice of B. Sc. Pharmacy students about antibiotics in Trinidad and Tobago. *Journal of research in pharmacy practice*, 2015; 4(1), 37.
- Gebeyehu, E., Bantie, L., Azage, M. Inappropriate use of antibiotics and its associated factors among urban and rural communities of Bahir Dar City Administration, Northwest Ethiopia. *PloS one*, 2015; 10(9), e0138179.
- Jifar, A., Ayele, Y. Assessment of knowledge, attitude, and practice toward antibiotic use among harar city and its surrounding community, Eastern Ethiopia. *Interdisciplinary perspectives on infectious diseases*, 2018.
- El Ezz, N. F., Ez-Elarab, H. S. Knowledge, attitude and practice of medical students towards self-medication at Ain Shams University, Egypt. *J prev med hyg*, 2011; 52(4), 196-200.
- Huang, Y., Gu, J., Zhang, M., Ren, Z., Yang, W., Chen Y, Fu Y, Chen X, Cals JW, Zhang F. Knowledge, attitude and practice of antibiotics: a questionnaire study among 2500 Chinese students. *BMC medical education*, 2013; 13(1), 1-9.
- Awadh, A. M., Raja, A. K., Mahdi, A. I. Assessment of Knowledge, Attitude and Practice Regarding Antibiotics Misuse among the Public in Saudi Arabia. *The Egyptian Journal of Hospital Medicine*, 2017; 69(5), 2405-2411.
- Fejza, A., Kryeziu, Z., Kadrija, K., Musa, M. Pharmacy students' knowledge and attitudes about antibiotics in Kosovo. *Pharmacy Practice (Granada)*, 2016; 14(1), 0-0.
- Buke C, Hosgor-Limoncu M, Ermertcan S, Ciceklioglu M, Tuncel M, Köse T, Eren S. Irrational use of antibiotics among university students. *Journal of infection.* 2005 Aug 1;51(2):135-9.
- Justo JA, Gauthier TP, Scheetz MH, Chahine EB, Bookstaver PB, Gallagher JC, Hermesen ED, DePestel DD, Ernst EJ, Jacobs DM, Esterly JS. Knowledge and attitudes of doctor of pharmacy students regarding the appropriate use of antimicrobials. *Clinical Infectious Diseases.* 2014 Oct 15;59(suppl_3):S162-9.

32. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, Webb DJ, Hooton TM. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clinical Infectious Diseases*, 2013, vol.57. pages (631-38)
33. Zafar, S., Syed, R., Waqar, S., Zubairi, A., Waqar, T., Shaikh, M., Yousaf, W., Shahid, S., Saleem, S. Self-medication amongst university students of Karachi: prevalence, knowledge and attitudes. *Journal of the Pakistan Medical Association*, 2008; 58(4), 214-7.
34. Suaifan GA, Shehadeh M, Darwish DA, Al-Ije H, Yousef AM, Darwish RM. A cross-sectional study on knowledge, attitude and behavior related to antibiotic use and resistance among medical and non-medical university students in Jordan. *African Journal of Pharmacy and Pharmacology*. 2012 Mar 15;6(10):763-70.
35. Grigoryan, L., Burgerhof, J. G., Haaijer-Ruskamp, F. M., Degener, J. E., Deschepper, R., Monnet, D. & Birkin, J. Is self-medication with antibiotics in Europe driven by prescribed use?. *Journal of Antimicrobial Chemotherapy*, 2007; 59(1), 152-156.