



## SPREADING AWARENESS REGARDING ANTIBIOTIC RESISTANCE IN SAUDI ARABIA

Hayat Ali Al-Zahrani<sup>1\*</sup>

1. *Medical Laboratory Technology, Faculty of Applied Sciences, Northern Border University, Arar, Kingdom of Saudi Arabia.*

### ARTICLE INFO

**Received:**

24 Apr 2021

**Received in revised form:**

21 Jul 2021

**Accepted:**

28 Jul 2021

**Available online:**

28 Aug 2021

**Keywords:** Antibiotic misuse, Awareness, Health profession students, Poster competition

### ABSTRACT

Due to the use of indiscriminate and unnecessary antibiotics, resistance to antibiotics is a significant worldwide matter of healthcare dilemma, which requires critical consideration. Medical university students are the future healthcare provider. Their awareness of this fact is thus tremendously imperative. A self-structured survey targeting different aspects of skill behavior, and knowledge regarding antibiotic use and its resistance was distributed among the health professional students. In total 100 students participated in the study. Our results showed that 15% of them strongly agreed that antibiotics are secure drugs; hence, they can be frequently used. 36% do not refer to a physician before starting an antibiotic earlier prescribed by doctors. Only 10% of students recognize the practices and factors that contribute to the resistance of the germs to antibiotics. Moreover, 22% of students have good practices and knowledge about Antibiotic use and how to avoid germs resistance. Our results showed significant evidence concerning inappropriate skills, behaviors, awareness, and practices about antibiotic resistance and use among future health professional students. Education programs could be used to outline accurate awareness about antibiotic use among all health professional students. This may help in the control of antibiotic resistance and thus preservation of antibiotics use for future generations.

*This is an open-access article distributed under the terms of the [Creative Commons Attribution-NonCommercial-Share Alike 4.0 License](https://creativecommons.org/licenses/by/4.0/), 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.*

**To Cite This Article:** Al-Zahrani HA. Spreading awareness regarding antibiotic resistance in Saudi Arabia. *Pharmacophore*. 2021;12(4):41-7. <https://doi.org/10.51847/zmqSusXnor>

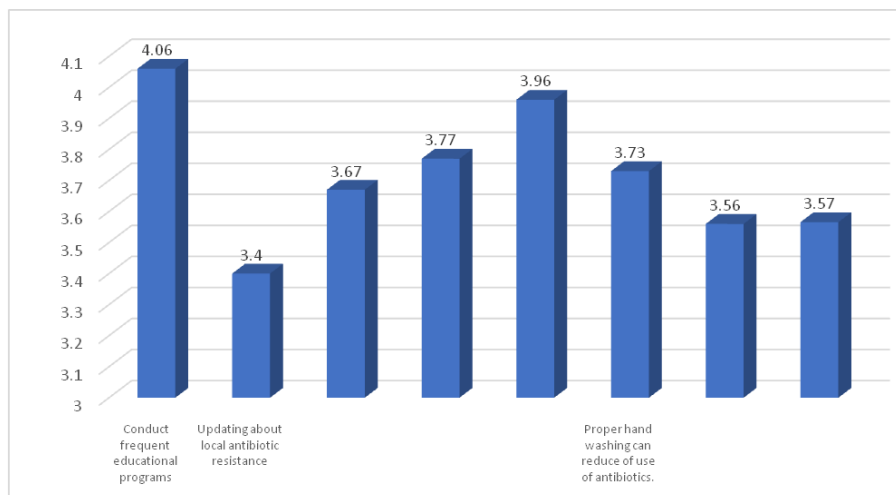
### Introduction

Student's wrong views about antibiotics can ultimately advance to unsuitable self-medication, over medication, or under-medication of antibiotics [1]. Misuse or overuse of antibiotics can lead to grave effects on health and it is also a contributing factor to the creation of multidrug-resistant bacteria [2]. Hence the study is to assess the knowledge among the patients regarding the use and misuse of antibiotics and the ways how the development of antibiotic resistance can be prevented [3]. A study about antibiotic use in few nations has reported that the public thought of antibiotics as "an astonishing medicine" or "a potent medicine" or "a powerful medicine" that can stop and alleviate any illness or symptoms [4]. Wrong views and being deficient in the basic knowledge about antibiotic usage have also been documented by various studies across populations in many nations. Patients' request for an antibiotic prescription and the practice of using antibiotics without prescription by community members is prejudiced by such wrong views [5, 6]. The misuse of antibiotics is not a meaningless exercise; instead, it can make future antibiotic treatments unproductive [7-9]. As a result, in the milieu of antibiotic usage, improper information on using antibiotics appropriately leads to misconceptions about such usage [10-13]. Particularly the unsuitable usage of antibiotics in society continues to be a noteworthy dilemma in many countries; plummeting wrong ideas regarding antibiotic usage among the people in the society is vital [14]. The concern regarding this issue is that the misuse and over-use of antibiotics have accelerated the development of antibiotic resistance which is preventable by the proper prescription and intake of antibiotics [15-17]. Why is this important? Sickness and infectious diseases affect us all. Preventing the spread of and protecting the effectiveness of antibiotics helps each of us individually, and our community as a whole. Students can make a real difference by helping to raise awareness in their communities. Therefore, this present study aims to spread awareness and explore student's knowledge and behaviors concerning appropriate antibiotic use and resistance in the Northern Province of Saudi Arabia. Our finality is to promote the adoption of cautious antibiotic usage practices among University students.

**Corresponding Author:** Hayat Ali Al-Zahrani; Medical Laboratory Technology, Faculty of Applied Sciences, Northern Border University, Arar, Kingdom of Saudi Arabia. E-mail: [dr.hayatalzahrani@hotmail.com](mailto:dr.hayatalzahrani@hotmail.com)

## Materials and Methods

A self-structured questionnaire was administered to all students in Ararapplied medical sciences college of Northern Borders University in the Kingdom of Saudi Arabia. The survey is divided into 4 parts of questions targeting the students, knowledge, belief, practices (**Tables 1-4**), and proposed recommendations (**Figure 1**). The data of only those respondents, who were willing to give complete information on antibiotics usage, were considered for the survey and analysis. The Sampling Method used was the convenience sampling technique, in which collected data was analyzed using SPSS 22 version.



**Figure 1.** Mean of students that agree with recommendations to prevent antibiotic resistance

## Results and Discussion

Analysis of the results showed that the majority of their age was between 17 years to 20 years of age. Our students were all females and Saudi's in Nationality and had been students in Northern Border University. 100 students in total participated in the study. In the first part of the survey, only 10% of participants recognize the factors that could contribute to the resistance of the germs to antibiotics as reported in **Table 1**. 30% of participants believe that large doses of antibiotics are better to use for quick actions. Only 10% disagree, 37% agree that the antibiotic helps to get better quickly in case of fever and Only 11% disagree (**Table 1**).

**Table 1.** survey results for questions targeting students' knowledge about factors that contribute to antibiotic resistance

no	variables	Strongly agree		Agree		Neutral		Disagree		Strongly Disagree		Mean	Standard Deviation
		NO.	%	NO.	%	NO.	%	NO.	%	NO.	%		
1	To have fast response large doses of antibiotics can be taken.	30	30%	31	31%	19	19%	10	10%	10	10%	3.61	1.28
2	Antibiotic resistance can be due to choices based on experience.	35	35%	27	27%	18	18%	11	11%	9	9%	3.68	1.30
3	Inappropriate antibiotic intake For nonspecific GIT or respiratory symptoms.	28	28%	23	23%	32	32%	11	11%	6	6%	3.56	1.18
4	Taking antibiotics in combination may be better choice to manage infections.	18	18%	21	21%	23	23%	15	15%	23	23%	2.96	1.41
5	Broad spectrum antibiotics is superior to using highly selective antibiotics.	37	37%	36	36%	16	16%	6	6%	5	5%	3.94	1.10
6	Antibiotics help me to recover quickly from all fevers	37	37%	32	32%	15	15%	5	5%	11	11%	3.79	1.29
7	When I have a cold, I should take antibiotics to avert grave sickness.	32	32%	25	25%	25	25%	9	9%	9	9%	3.62	1.26
8	On taking an antibiotic, I add to the advancement of antibiotic resistance.	18	18%	24	24%	27	27%	21	21%	10	10%	3.19	1.24
9	Not taking one or two of antibiotic doses in between doses does not contribute to development of antibiotic resistance	17	17%	18	18%	32	32%	19	19%	14	14%	3.05	1.27
10	Antibiotics are safe medicine, so can be frequently used.	15	15%	35	35%	16	16%	18	18%	16	16%	3.15	1.32

Rating by the Nurse practitioner of the factor contributing to antibiotic resistance	3.46	0.49
--	------	------

In the second part of the survey when targeting the student's practices. The majority of participants (38%) check the expiry date before using the drug. However, another question of the results showed that 37% of the students strongly stated that it is a better choice to use broad-spectrum antibiotics than use exceedingly selective ones (**Table 2**).

**Table 2.** Survey results for questions targeting practices that contribute to antibiotic resistance

no	variables	Strongly agree		Agree		Neutral		Disagree		Strongly Disagree		Mean	Standard Deviation
		NO.	%	NO.	%	NO.	%	NO.	%	NO.	%		
1	After taking 2-3 doses of course of antibiotic you start feeling improved so do you discontinue the antibiotic?	44	44%	28	28%	15	15%	8	8%	5	5%	3.98	1.17
2	Do you purchase antibiotics earlier given by Physician?	36	36%	32	32%	18	18%	7	7%	7	7%	3.83	1.19
3	Do you ensure expiry date of the antibiotic before using?	38	38%	18	18%	29	29%	13	13%	2	2%	3.77	1.15
4	Do you have a preference to take an antibiotic when you have any mild respiratory symptoms?	19	19%	26	26%	24	24%	20	20%	11	11%	3.22	1.27
5	Do you agree that In case of any diarrhea, skin ulcer etc antibiotics have a role to cure it	14	14%	21	21%	25	25%	20	20%	20	20%	2.89	1.33
Medication practice questions rated response											3.54	0.48	

39% of them strongly agreed antibiotics are harmless, and so, they can be used be regularly, and that 44 % stop taking medication once they feel better after taking 2-3 doses from an antibiotic course prescribed by a doctor, and 39% do not check with a physician before starting an antibiotic, they purchase antibiotics earlier given by Physicians (**Table 2**).

Our results also highlighted the different myths and false beliefs that perhaps intake of large doses of antibiotics has quicker action to relieve them of their symptoms. The other observations were that as the symptoms improve and people become healthier, they either stop taking antibiotics or start skipping them. This leads to various false practices and beliefs which include the tendency to take a large dose of antibiotics for quicker action leading to their arbitrary and indiscreet usage, which makes the situation more complex. In total, only 22% presented answers of good practices when using antibiotics (**Table 2**).

The third part of the survey questions targets students' knowledge about antibiotic resistance. Interestingly 39% thinks that misuse of antibiotic is a significant and grave community health matter in our country. More than 50% of participants believe that arbitrary and imprudent intake of antibiotics can cause more load on healthcare expenditure (**Table 3**).

**Table 3.** Survey results for questions targeting Students 'opinions about antibiotic resistance

no	Variables	Strongly agree		Agree		Neutral		Disagree		Strongly Disagree		Mean	Std. Deviation
		NO.	%	NO.	%	NO.	%	NO.	%	NO.	%		
1	I trust extensive use of antibiotics is a significant cause of anti-microbial resistance.	25	25%	31	31%	35	35%	5	5%	4	4%	3.68	1.03
2	Antibiotics can stop any sickness from progressing further.	44	44%	28	28%	16	16%	6	6%	6	6%	3.98	1.17
3	I belief random and unwise use of antibiotics can lead to exacerbation of prolongation of sickness.	46	46%	31	31%	12	12%	7	7%	4	4%	4.08	1.10
4	I belief random and unwise use of antibiotics can cause surfacing of antimicrobial resistance.	19	19%	30	30%	37	37%	7	7%	7	7%	3.47	1.09
5	I belief mutations in genes can be the important cause of antibiotic resistance.	23	23%	26	26%	26	26%	17	17%	8	8%	3.39	1.23
6	I belief inappropriate duration of antibiotic course can be a cause of antibiotic resistance.	14	14%	26	26%	26	26%	22	22%	12	12%	3.08	1.23
7	I belief antibiotic resistance is an significant and grave community health issue all over the world.	24	24%	25	25%	28	28%	17	17%	6	6%	3.44	1.19

8	I belief antibiotic resistance is an significant and grave community health issue in our country.	39	39%	28	28%	22	22%	9	9%	2	2%	3.93	1.07
9	Patients claim and beliefs leads to regular use of wrong antibiotics.	24	24%	37	37%	16	16%	14	14%	9	9%	3.53	1.24
10	I belief unnecessary and irrational usage of antibiotics can lead to additional burden of health -care cost.	31	31%	22	22%	21	21%	17	17%	9	9%	3.49	1.32
Beliefs												3.61	0.47

These results are in parallel with recommendations answers. As more than, 49% of participants encourage conducting educational programs that ameliorate applied medical sciences student's knowledge about antibiotic resistance. 34% strongly agreed and 26% agreed that as an infection control tool, the conventional antibiotic surveillance programs should be implemented for better administration and supervision of usage of antibiotics. Detailed results are shown in **Figure 1** and **Table 4**.

**Table 4.** Survey results for questions targeting students 'recommendations to prevent antibiotic resistance

no	variables	Strongly agree		Agree		Neutral		Disagree		Strongly Disagree		Mean	Std. Deviation
		NO.	%	NO.	%	NO.	%	NO.	%	NO.	%		
1	Organize regular awareness programs	49	49%	21	21%	19	19%	9	9%	2	2%	4.06	1.10
2	Updating themselves and others about local antibiotic resistance	18	18%	30	30%	33	33%	12	12%	7	7%	3.40	1.12
3	Frequent antibiotic surveillance programs should be conducted as tool for infection.	34	34%	26	26%	21	21%	11	11%	8	8%	3.67	1.27
4	Regular information to be shared about the situation of antibiotic resistance pattern in my University.	39	39%	26	26%	15	15%	13	13%	7	7%	3.77	1.28
5	Suitable isolation of the patient in hospitals can reduce the use of antibiotics.	38	38%	32	32%	22	22%	4	4%	4	4%	3.96	1.06
6	Proper hand hygiene practices can lower the use of antibiotics..	41	41%	16	16%	26	26%	9	9%	8	8%	3.73	1.30
7	Adequate knowledge to take care of overall health and hygiene is necessary to reduce use of antibiotics.	30	30%	26	26%	20	20%	18	18%	6	6%	3.56	1.25
8	Strict government policy and guidelines to be circulated regularly for empiric antibiotic use.	30	30%	27	27%	19	19%	15	15%	8	8%	3.57	1.28
Measure that can be recommended to reduce antibiotic resistance												3.71	0.61

Bacterial resistance to antibiotics due to their misuse is leading to significant mortality and morbidity and is increasing day by day. It has become a rising health dilemma and has led to low quality of life among people and an extra financial burden due to more healthcare expenses'. Bacterial resistance to antibiotics is a growing restorative problem in society. Recent studies have highlighted the false beliefs and practices and their discreet usage among the people in the community [18, 19]. Thus, the WHO has stressed the importance of both professional and public involvement in the control of antibiotic resistance [20, 21]. Earlier studies reflect about undertaken campaigns by displaying posters to encourage the public to ask for fewer antibiotics [18, 19]. In our study, we aimed to spread awareness regarding antibiotic resistance through poster competition to promote the students for the adoption of cautious antibiotic usage practices. We used poster competition and a self-structured questionnaire for the adoption of cautious antibiotic usage practices and to promote and spread awareness regarding antibiotic resistance. Our study reflected that majority of the students who participated were not fully aware of antibiotic usage practices and were not aware of the illnesses for which antibiotics are taken by them. Also, it was alarming to note that many of them had been adopting self-medication and most of the time the antibiotics were not strictly taken by them after being prescribed by a doctor. The majority of them also agreed that they do not complete the course of antibiotics or do they stop taking it once the symptoms improve. Quite a few students in our study were not even aware of the side effects that can arise due to the irrational use of antibiotics.

Our study is one of the few qualitative studies done in the Northern Province of Saudi Arabia to study the practices and attitude towards usage of antibiotics causing antimicrobial resistance among University students and have used poster competition to create awareness about it among the Students. Our study showed that students had been taking antibiotics

even for mild viral conditions and they were taking them from pharmacy stores without any advice taken from the physicians and having no recommended prescriptions and were also taking them if they were available with them at home which they may have purchased for earlier illness and may not have taken them completely. These observations were commonly found in people from Jordan, Iraq [22] Kingdom of Saudi Arabia, Yemen, and Uzbekistan [23]. Similar results have been shown by a survey-based study done in Iran where University students were found to have poor knowledge about antibiotics and were having an irrational intake of them [24]. One of the studies has highlighted that illogical intake of antibiotics has been increased among students leading to self-medication as perhaps they had been influenced either by their parents and/or peer influence had augmented irrational antibiotic usage among them [25, 26].

A second important finding which had been reflected from this study was that students were not willing to consult the physician and instead preferred to take medicines directly from the stores. Self-medication of antibiotics also reflects poor interpersonal doctor-patient relationships and perhaps they are hesitant to visit out of fear or have no confidence in the doctor treatment. A study done in Iceland reflected that the physician behavior, attitude, nature, and personal characteristics particularly enthusiasm and readiness to serve were cited were among the important reasons for “nonpharmacological” antibiotic prescribing and an unstable doctor-patient relationship [27]. Many studies done have emphasized that emotional intelligence and empathy must be a part of the medical training, where a physician should be taught how to improve doctor-patient relationships [28].

As reflected in previous studies, we also through poster competition have tried to motivate the students in our university and train them to create awareness among the public about myths and misconceptions about antibiotic usage [29]. In our study, the students showed enthusiasm to conduct community-based awareness programs and educate the community about antibiotic proper usage and how it can cause antimicrobial resistance leading to mortality and morbidity among them. Students expressed their willingness to use mass media and popular sources of general awareness in our study to spread antibiotic literacy similar to how it has been done in earlier studies showing positive results [30, 31]. One of the studies published stated about “Know your Medicine Campaign” in Malaysia which was aimed to educate and prepare the community to equip the people with practices and attitudes to have an adequate knowledge about the antibiotics they take and how to use them properly [32]. Also studies done in Belgium showed that many national media campaigns had been conducted to alert the community about the mortality and morbidity associated with the wrong usage of antibiotics due to antimicrobial resistance [33]. Across ten countries, an e-Bug project had been done with the same intention to create awareness about proper antibiotic usage which showed very good results after its implementation [34]. These interventions appeared to be profitable as there was seen to be a decline of 26.5% wrong community-based antibiotic prescribing practices between 2002 and 2007 in France [35] during their participation in the European e-Bug school project [36].

These study limitations were that students who participated in the study may not be representative of the students as a whole of the entire university student population. To the best of our knowledge, this is probably the first qualitative study done from the Northern Province of Saudi Arabia exploring the myths and facts and perceptions, and practices related to the wrong antibiotic usage among university students. Our result highlighted that those students were amenable to find out and learn about antibiotic misuse and had shown great enthusiasm to participate in the campaign to improve the rational use of antibiotics among the public. Thus, programs like poster competitions or campaigns, or camps organized targeting educational Institutes could well be effective in plummeting irrational usage of antibiotics in the public.

Our study highlights that the students should be given more training during their undergraduate days to create awareness and also increase their knowledge regarding antibiotic suitable usage. This is a vital time during which the significance of these issues should be highlighted because once they get the license and start practicing, it may be difficult to alter their perceptions and attitudes. The interventions, which are undertaken to prevent and manage bacterial resistance, commonly target to lead to behavioral changes among the students. The outcome of these interventions is affected by the earlier views and experiences, which are held by the students from their study days. Hence, for any instructive intervention to be triumphant and for the changes to be constant, it should change the beliefs and perceptions from the university days. A better understanding of what the students know and believe about the issues of antimicrobial use and resistance can assist University in planning an effective educational intervention for them.

## Conclusion

Our study aimed to create awareness through the poster competition on the students’ knowledge, attitudes, and behavior concerning antibiotic use and its resistance. The poster competition was also aimed to determine to analyze the knowledge of students about frequent antibiotic prescribing practice and offers of alternative remedies instead of antibiotics being used in general practices. Although students exhibited poor knowledge about antibiotic use and resistance, they were keen to learn about these issues. Our study results can help in planning the authorities a competency-based curriculum where the educationist may keep in mind that other than helping students to increase their knowledge the curriculum and teaching strategies should help to bring a change in attitude and behavior also among the University students. This may help in the control of many important problems similar to our study like the issue of antibiotic resistance which by small interventions can play an important role in the preservation of antibiotics for future generations.

We recommend that the measures should be taken to guide the students as to how they can help to reduce antibiotic resistance and how they can contribute to an institutional policy by helping to spread related guidelines by conducting

frequent awareness programs. Also, authorities need to help the students to give them easy access to local antibiograms and help them to participate in regular antibiotic surveillance programs.

**Acknowledgments:** The author is thankful to Waheedh Muferh Al Rweliy, College of Applied Sciences, NBU, and Hanan Fudhayel Freeh Alanazi for data collection and her technical assistance. Scientific Responsibility Statement: The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the mainline, or all of the preparation and scientific review of the contents and approval of the final version of the article.

**Conflict of interest:** None

**Financial support:** None

**Ethics statement:** All procedures performed in this study were in accordance with the ethical standards of the institutional or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

## References

1. Sawalha AF. Self-medication with antibiotics: a study in Palestine. *Int J Risk Saf Med.* 2008;20(4):213-22.
2. Gili R, Bert F, Scaioli G, Gualano MR, Siliquini R. General population's knowledge and attitudes about antibiotics: A systematic review and meta-analysis. *Pharmacoepidemiol Drug Saf.* 2015;24:2-10.
3. Uranga A, España PP, Bilbao A, Jose MQ, Ignacio A, Maider I, et al. Duration of antibiotic treatment in community-acquired pneumonia: a multicenter randomized clinical trial. *JAMA Intern Med.* 2016;176(9):1257-65.
4. World Health Organization. Antimicrobial resistance: global report on surveillance 2014. Geneva: WHO, 2014.
5. Phan TH, Nguyen TD, Nguyen TT, Vo TQ, Le TT, Van Chau T, et al. Trends in Prescribing Antibiotic Therapy for Hospitalized Patients with Community-Acquired Pneumonia in Vietnam. *Arch Pharm Pract.* 2020;11(1):14-21.
6. Alzaid A, Alosaimi M, Alkahtani KF, Alshehri BA, Asiri AE, Asiri AM, et al. Saudi Parents' Knowledge, Attitudes, and Practices Regarding Antibiotic use for Upper Respiratory Tract Infections in Children. *Int J Pharm Res Allied Sci.* 2020;9(1):115-20.
7. Chaw PS, Höpner J, Mikolajczyk R. The knowledge, attitude and practice of health practitioners towards antibiotic prescribing and resistance in developing countries—A systematic review. *J Clin Pharm Ther.* 2018;43(5):606-13.
8. Gil-Gil T, Ochoa-Sánchez LE, Baquero F, Martínez JL. Antibiotic resistance: Time of synthesis in a post-genomic age. *Comput Struct Biotechnol J.* 2021;19:3110-24.
9. Qureshi S, Maria N, Zeeshan M, Irfan S, Qamar FN. Prevalence and risk factors associated with multi-drug resistant organisms (MDRO) carriage among pediatric patients at the time of admission in a tertiary care hospital of a developing country. A cross-sectional study. *BMC Infect Dis.* 2021;21(1):547.
10. Pulia M, Kern M, Schwei RJ, Shah MN, Sampene E, Crnich CJ. Comparing appropriateness of antibiotics for nursing home residents by setting of prescription initiation: a cross-sectional analysis. *Antimicrob Resist Infect Control.* 2018;7(1):1-8.
11. Abat C, Rolain JM, Dubourg G, Fournier PE, Chaudet H, Raoult D. Evaluating the Clinical Burden and Mortality Attributable to Antibiotic Resistance: The Disparity of Empirical Data and Simple Model Estimations. *Clin Infect Dis.* 2017;65(suppl\_1):S58-63.
12. Chaurasia S, Sivanandan S, Agarwal R, Ellis S, Sharland M, Sankar MJ. Neonatal sepsis in South Asia: huge burden and spiralling antimicrobial resistance. *BMJ.* 2019;364:k5314.
13. Chereau F, Opatowski L, Tourdjman M, Vong S. Risk assessment for antibiotic resistance in South East Asia. *BMJ.* 2017;358:j3393.
14. Demoré B, Mangin L, Tebano G, Pulcini C, Thilly N. Public knowledge and behaviors concerning antibiotic use and resistance in France: A cross-sectional survey. *Infection.* 2017;45(4):513-20.
15. Kistler CE, Beeber A, Becker-Dreps S, Ward K, Meade M, Ross B, et al. Nursing home nurses' and community-dwelling older adults' reported knowledge, attitudes, and behavior toward antibiotic use. *BMC Nurs.* 2017;16(1):1-7.
16. McCullough AR, Parekh S, Rathbone J, Del Mar CB, Hoffmann TC. A systematic review of the public's knowledge and beliefs about antibiotic resistance. *J Antimicrob Chemother.* 2016;71(1):27-33.
17. Davis ME, Liu TL, Taylor YJ, Davidson L, Schmid M, Yates T, et al. Exploring patient awareness and perceptions of the appropriate use of antibiotics: a mixed-methods study. *Antibiotics.* 2017;6(4):23.
18. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing: Nineteenth Informational Supplement. Wayne, PA: CLSI. 2018.
19. Centers for Disease Control and Prevention. Antibiotic Resistance Threatens Everyone [Internet]. Centers Dis. Control Prev. 2020.

20. Burnham JP, Olsen MA, Kollef MH. Re-estimating annual deaths due to multidrug-resistant organism infections. *Infect Control Hosp Epidemiol.* 2019;40(1):112-3.
21. Alhomoud F, Aljamea Z, Basalelah L. “Antibiotics kill things very quickly”—consumers’ perspectives on non-prescribed antibiotic use in Saudi Arabia. *BMC Public Health.* 2018;18(1):1177.
22. Horumpende PG, Said SH, Mazuguni FS, Antony ML, Kumburu HH, Sonda TB, et al. Prevalence, determinants and knowledge of antibacterial self-medication: a cross sectional study in North-eastern Tanzania. *PLoS ONE.* 2018;13(10):e0206623.
23. Belkina T, Al Warafi A, Eltom EH, Tadjieva N, Kubena A, Vlcek J. Antibiotic use and knowledge in the community of Yemen, Saudi Arabia, and Uzbekistan. *J Infect Dev Ctries.* 2014;8(04):424-9.
24. Askarian M, Maharlouie N. Irrational antibiotic use among secondary school teachers and university faculty members in Shiraz, Iran. *Int J Prev Med.* 2012;3(12):839-45.
25. Wang XM, Zhou XD, Hesketh T. Massive misuse of antibiotics by university students in China: a cross-sectional survey. *Lancet.* 2016;388(Suppl 1):S94.
26. Versporten A, Zarb P, Caniaux I, Gros MF, Drapier N, Miller M, et al. Antimicrobial consumption and resistance in adult hospital inpatients in 53 countries: results of an internet-based global point prevalence survey. *Lancet Glob Health.* 2018;6(6):e619-29.
27. Garba MA, Giwa F, Abubakar AA. Knowledge of antibiotic resistance among healthcare workers in primary healthcare centers in Kaduna North local government area. *Sub-Saharan Afr J Med.* 2020;5(3):86.
28. Chaw PS, Höpner J, Mikolajczyk R. The knowledge, attitude and practice of health practitioners towards antibiotic prescribing and resistance in developing countries—a systematic review. *J Clin Pharm Ther.* 2018;43(5):606-13.
29. Olesen SW, Barnett ML, MacFadden DR, Brownstein JS, Hernández-Díaz S, Lipsitch M, et al. The distribution of antibiotic use and its association with antibiotic resistance. *Elife.* 2018;7:e39435.
30. Faizullah M, Rahman N, Umar MI, Anwar M, Sarfraz M. A cross-sectional study on knowledge, attitude and practices of medical doctors towards antibiotic prescribing patterns and resistance in Khyber Pakhtun Khawah, Pakistan. *J Appl Pharmaceut Sci.* 2017;7(12):38-46.
31. Ahmed I, Rabbi MB, Sultana S. Antibiotic resistance in Bangladesh: a systematic review. *Int J Infect Dis.* 2019;80:54-61.
32. Malaysia Government. Know Your Medicine. [Last accessed on 2016 May 17]. Available from: <http://www.knowyourmedicine.gov.my>.
33. Coenen S, Costers M, De Corte S, De Sutters A, Goossens H. The first European antibiotic awareness day after a decade of improving outpatient antibiotic use in Belgium. *Acta Clin Belg.* 2008;63:296-300.
34. McNulty CA, Lecky DM, Farrell D, Kostkova P, Adriaenssens N, Koprivová HT, et al. Overview of e-Bug: An antibiotic and hygiene educational resource for schools. *J Antimicrob Chemother.* 2011;66(suppl\_5):v3-12.
35. Tadesse BT, Ashley EA, Ongarello S, Havumaki J, Wijegoonewardena M, Gonzalez IJ, et al. Antimicrobial resistance in Africa: a systematic review. *BMC Infect Dis.* 2017;17(1):616.
36. Dyar OJ, Hills H, Seitz LT, Perry A, Ashiru-Oredope D. Assessing the knowledge, attitudes and behaviors of human and animal health students towards antibiotic use and resistance: a pilot cross-sectional study in the UK. *Antibiotics.* 2018;7(1):10.