

## ORIGINAL ARTICLE

# MEDICAL AND DENTAL STUDENTS' KNOWLEDGE AND PERCEPTIONS ABOUT ANTIMICROBIAL STEWARDSHIP: A CALL FOR EDUCATIONAL ENHANCEMENT

Nada Alsaleh <sup>1,2</sup> ✉, Abeer Alsmari <sup>3</sup>, Fadiyah Alanazi <sup>4</sup>, Abdulmohsen Alsaleh <sup>5</sup>, Rahaf Alsmari <sup>6</sup>, Nasser Al-Swedan <sup>7</sup>

<sup>1</sup> Department of Pharmacy Practice, College of Pharmacy, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia

<sup>2</sup> Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, 161 Cathedral Street, Glasgow, G4 0RE

<sup>3</sup> Clinical Pharmacy Department, Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia

<sup>4</sup> College of Medicine, Northern Border University, Arar, Saudi Arabia

<sup>5</sup> College of Dentistry, King Saud University, Riyadh, Saudi Arabia

<sup>6</sup> College of Dentistry, King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia

<sup>7</sup> College of Medicine, Prince Sattam Bin Abdulaziz University, Al Kharj 11942, Saudi Arabia

Received 29<sup>th</sup> August 2020.

Accepted 2<sup>nd</sup> October 2020.

Published 4<sup>th</sup> December 2020.

### Summary

**Purpose:** To explore the knowledge of antibiotics use and resistance among medical and dental students.

**Methods:** A 26-item online questionnaire on antimicrobial prescribing was distributed to Medical and Dental students at eight universities from the period of July to August 2020.

**Results:** Five hundred three students completed the questionnaire; The mean age was  $22.15 \pm 1.99$  and 66.4% were female students. The majority (91.5%) of the students were from governmental universities and (73.4%) were from medical colleges. It was found that 87% of students were not familiar with and unaware of the term antimicrobial stewardship. Overall knowledge about antibiotics identified that 30 (6%) students had good knowledge while 402 (80%) students have fair knowledge. Around 91% of the students agreed that the inappropriate use of antibiotics causes antibiotic resistance and that a strong understanding and knowledge of antibiotics is essential in their careers.

**Conclusions:** To control the growing problem of antibiotic resistance, future prescribers' education related to the appropriate use of antibiotics is important. Efforts must be undertaken to educate medical and dental students about the practices of the appropriate use of antibiotics and principles of antimicrobial stewardship.

*Key words:* Antimicrobial Stewardship; Medical and Dental Students; Antibiotic Use and Resistance; Saudi Arabia

## **Introduction**

Antibiotics, also known as antibacterial, are medicines that kill or delay the growth of bacteria. Antibiotics are unable to combat viral infections including cold, flu, and most coughs (1). Frequent and improper use of antibiotics may cause changes in bacteria or other microbes because antibiotics are not working against them (1). Because of the overuse of antibiotics, many bacteria have become immune to even today's most potent antibiotics. Antibiotic resistance in every corner of the world is growing to extremely high levels. New mechanisms of resistance are emerging and spreading globally which threatens our ability to treat common infectious diseases (1). Resistance to antibiotics leads to increased medical costs, prolonged hospitalization, and higher mortality (2, 3). Antimicrobial stewardship initiatives have been established worldwide to tackle the spread of antimicrobial resistance and to help prescribers to provide optimal antibiotic prescribing (4). Medical and dental students are the future prescribers who need to have sufficient knowledge about antimicrobial stewardship.

To our knowledge, no study was conducted in Saudi Arabia to assess the knowledge of antimicrobial stewardship among medical and dental students. A better understanding of medical and dental students' knowledge and perceptions about antimicrobial stewardship can promote more effective and valuable education for future prescribers. Therefore, this study aimed to explore the knowledge of antibiotics use and resistance among medical and dental students. The findings of this study will be valuable in the implementation and integration of effective antimicrobial stewardship education for medical and dental students.

## **Methods**

### **Study design and setting**

A cross-sectional multicentre study was conducted among all year medical and dental students except for the first year which is called preparatory year in some universities to explore their knowledge and perceptions of antibiotics use and resistance using an online questionnaire via Google forum. The study took place in six governmental universities and two private universities in Saudi Arabia between July 2020 and August 2020. Given preventive measures (i.e. social distancing) due to COVID-19 pandemic crisis, data was collected online, through a self-reported questionnaire.

### **Study questionnaire**

The questionnaire was developed based on previously published studies (1, 5) with the incorporation of information from local policy. The distributed questionnaire contained the title of the study, the aim, IRB approval number for the study, and the contact details. The questionnaire involved a variety of questions including demographics, knowledge, and perceptions.

The questioner included three parts. The first part addressed demographic data of participants including age, gender, specialty, University, and study year. The second part contained statements to evaluate the knowledge of participants about antibiotics and antimicrobial stewardship. The final part consisted of statements to assess students' perceptions of antibiotic prescribing and resistance and the quality of their education about the appropriate use of antibiotics. This was piloted in a randomly selected sample of 15 students and an explanation was offered for any unclear question. As a result, some modifications were made to the questions. This sample was not included in the analysis of results.

### **Statistical analysis**

Descriptive statistics were presented as frequency and percentage and mean and standard deviation. Data were checked for normality using Shapiro-Wilk test. All data were checked and cleaned before analysis. A total of eight questions were used for the assessment antibiotics knowledge and each statement was scored 2 points if correct. According to this, knowledge was categorized into three levels. Poor knowledge (<6 points), fair knowledge (more than 6 points, and less than 12 points), good knowledge (12 points and above). Data analysis was performed by SPSS version 24 (Armonk, NY: IBM Corp, 2016).

## Results

### Demographics characteristics

A total of 503 students completed the questionnaires. The mean age was  $22.15 \pm 1.99$  and 66.4% were female students. The majority (91.5%) of the students were from governmental universities and (73.4%) were from medical colleges. The highest distribution was among the internship and the third year (Table 1).

**Table 1.** Demographic characteristics of the participated students

Variable	n/N (%) or Mean $\pm$ SD
<b>Gender</b>	
Male	169 (33.6%)
Female	334 (66.4%)
<b>Age</b>	
	22.15 $\pm$ 1.99
<b>Specialty</b>	
Medical	369 (73.4%)
Dental	134 (26.6%)
<b>University</b>	
Governmental	460 (91.5%)
Private	43 (8.5%)
<b>Study year</b>	
Second	73 (14.5%)
Third	105 (20.9%)
Fourth	71 (14.1%)
Fifth	75 (14.9%)
Sixth	78 (15.5%)
Internship	101 (20.1%)

### Knowledge about antibiotics and antimicrobial stewardship

Medical and dental students' knowledge about antibiotics is illustrated in Table 2. More than 70% of the students disagreed that antibiotics safe and can be commonly used. Half of the students agreed that broad-spectrum antibiotics are preferred for treating bacterial infection.

**Table 2.** Medical and dental students' knowledge about antibiotics

Statement	Agree (%)	Disagree (%)	Don't know (%)
Antibiotics are safe medications, therefore can be commonly used	131 (26%)	359 (71.4%)	13 (2.6%)
Broad spectrum antibiotics are more favored for bacterial infection treatment	256 (50.9%)	192 (38.2%)	55 (10.9%)
There is no difference between Amoxicillin and co-amoxiclav (Augmentin®)	38 (7.6%)	322 (64%)	143 (28.4%)
Antibiotics must only be used once prescribed	478 (95%)	12 (2.4%)	13 (2.6%)
Antibiotics are not expected to destroy all bacteria in the body	406 (80.7%)	61 (12.1%)	36 (7.2%)
Normally, our bodies can fight infections that are mild without the need to take antibiotics	457 (90.9%)	23 (4.6%)	23 (4.6%)
Susceptibility tests assist to identify the possibility that a specific antibiotic is going to be effective for the treatment of particular bacterial infection.	384 (76.3%)	24 (4.8%)	95 (18.9%)
Antibiotics treat bacterial, viral and fungal infection	90 (17.9%)	378 (75.1%)	35 (7%)

When asked about the differences between amoxicillin and co-amoxiclav (augmentin®), 36% of the students didn't know that they are two different antibiotics. More than 90% of the students agreed that antibiotics should use only when prescribed. While 76.3% agreed that susceptibility test assists in identifying the possibility that a specific antibiotic is going to be effective for the treatment of particular bacterial infection, 17.9% incorrectly agreed that antibiotics may be used in viral and fungal infections. It was found that 87% of students were not familiar with and unaware of the term antimicrobial stewardship (Figure 1). Overall knowledge about antibiotics identified that 30 (6%) students had good knowledge while 402 (80%) students have fair knowledge (Figure 2).

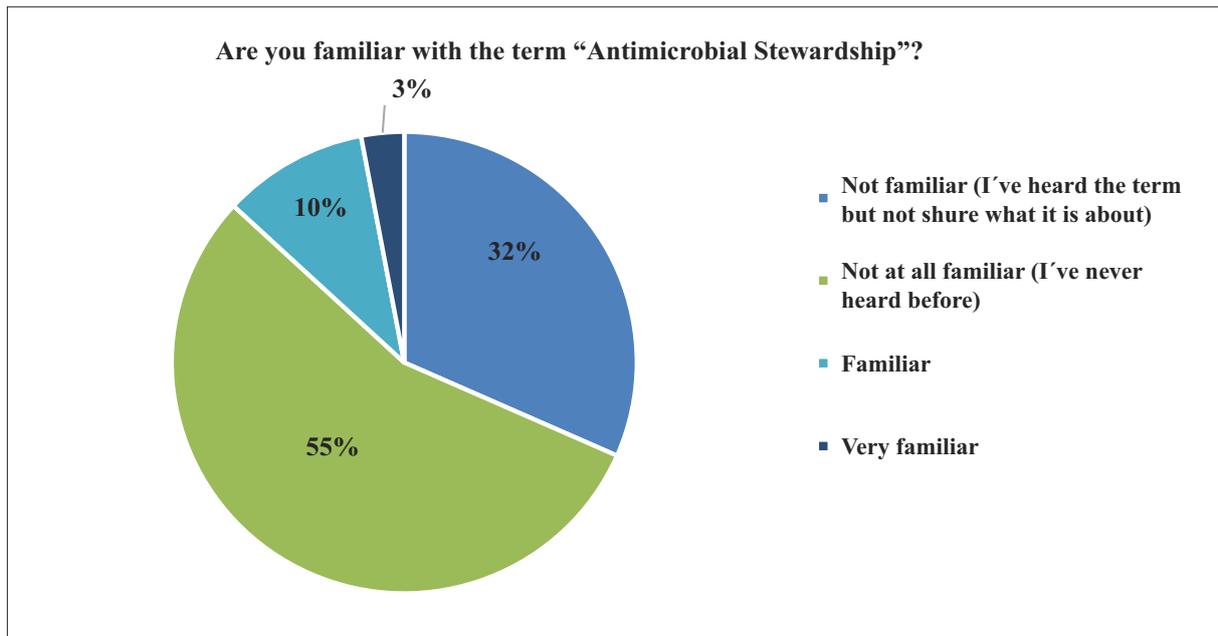


Figure 1. Students familiarity with the term "Antimicrobial Stewardship"

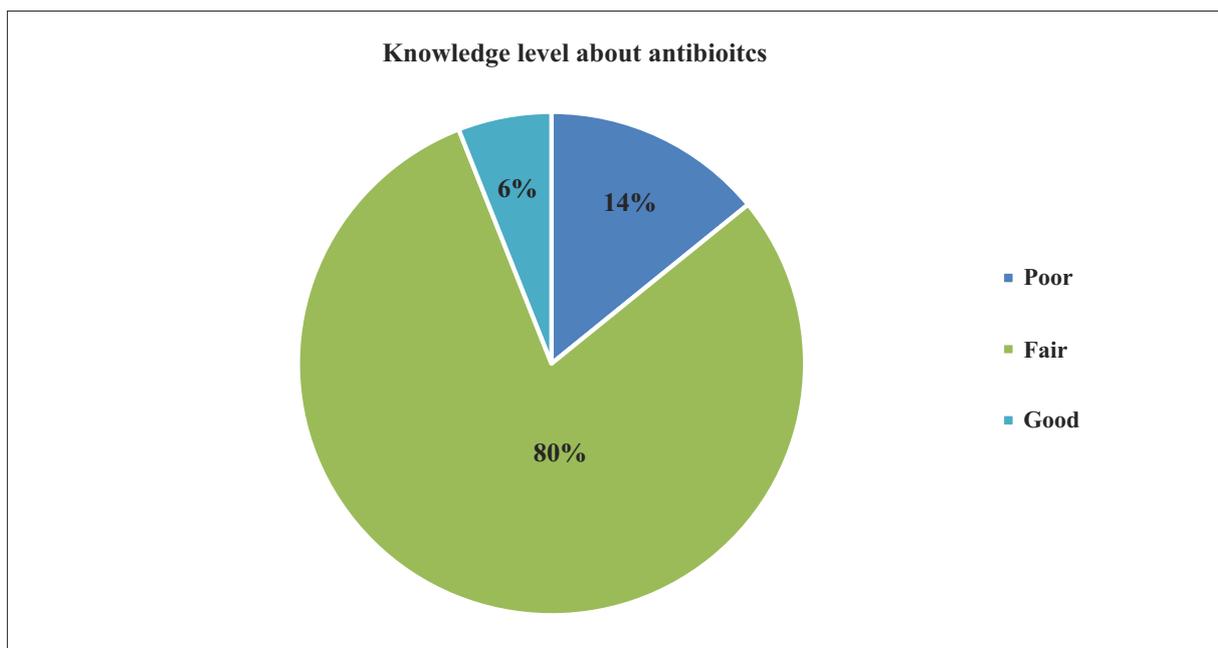


Figure 2. Proportion of students' level of knowledge about antibiotics

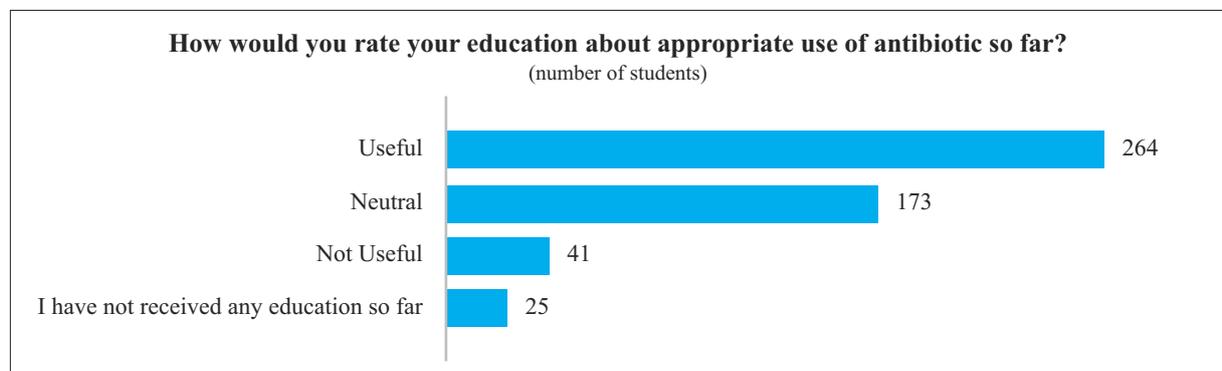
**Perceptions about antibiotic prescribing and resistance**

Medical and dental students’ knowledge about antibiotic prescribing and resistance are illustrated in Table 3. Around 91% of the students agreed that Inappropriate use of antibiotics causes antibiotic resistance and that a strong understanding and knowledge of antibiotics is essential in their careers. On a national level, about 76.7% of the students agreed that antibiotics are overused and only 79.3% know that antibiotics can’t prescribe without prescription.

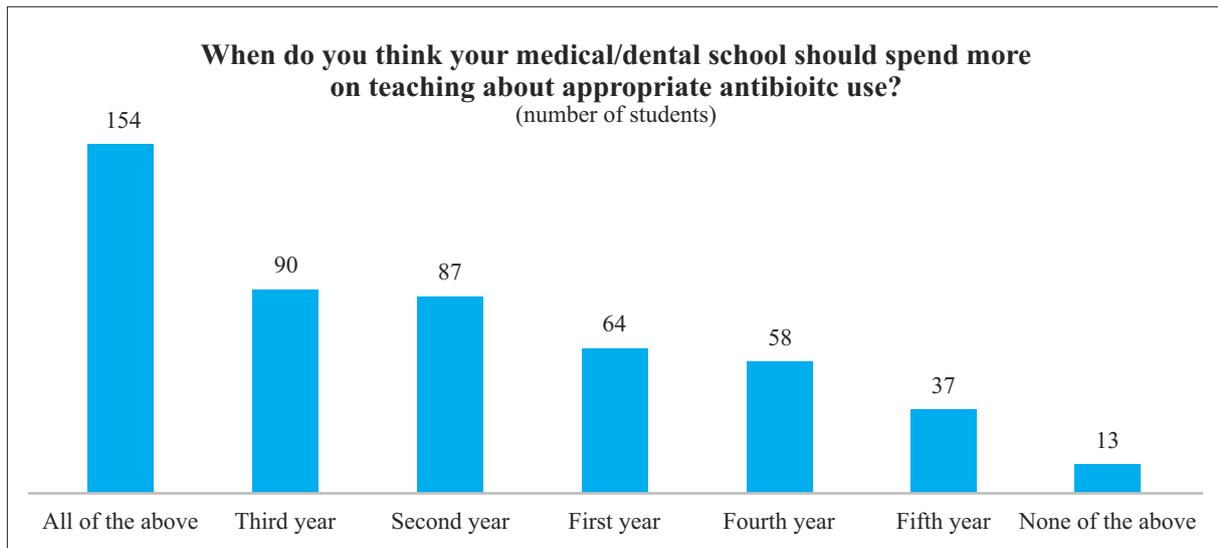
**Table 3.** Medical and dental students’ knowledge about antibiotic prescribing and resistance

Statement	Agree (%)	Disagree (%)	Don’t know (%)
Bacteria can develop resistant to antibiotics	470 (93.4%)	13 (2.6%)	20 (4%)
The more the use of antibiotics in community, the higher is the risk of antibiotic resistance	445 (88.5%)	20 (4%)	38 (7.6%)
Inappropriate use of antibiotics causes antibiotic resistance	462 (91.8%)	19 (3.8%)	22 (4.4%)
Nowadays, antibiotics resistance is not a serious problem worldwide	58 (11.5%)	391 (77.7%)	54 (10.7%)
Appropriate use of antibiotics may decrease the risk of antibiotic resistance	447 (88.9%)	31 (6.2%)	25 (5%)
Antibiotics can prescribe without prescription in Saudi Arabia	55 (10.9%)	399 (79.3%)	49 (9.7%)
when the patient is clinically improved, antibiotics must be stopped immediately to decrease the risk of antibiotic resistance	132 (26.2%)	298 (59.2%)	73 (14.5%)
As a student in the medical or dental field do you believe that you have a part to play in decreasing antibiotic resistance.	428 (85.1%)	32 (6.4%)	43 (8.5%)
Prescribing broad-spectrum antibiotics when similar and effective narrower spectrum antibiotics are available, increases antibiotic resistance	296 (58.8%)	51 (10.1%)	156 (31%)
Antibiotics are overused in Saudi Arabia	386 (76.7%)	27 (5.4%)	90 (17.9%)
In my career, strong understanding and knowledge of antibiotics is essential	460 (91.5%)	19 (3.8%)	24 (4.8%)
I need further education about the appropriate use of antibiotics	451 (89.7%)	26 (5.2%)	26 (5.2%)
Poor practices of infection control by healthcare workers lead to the spread and increase of antibiotic resistance	323 (64.2%)	75 (14.9%)	105 (20.9%)
I need further education on antibiotic resistance	443 (88.1%)	30 (6%)	30 (6%)
In the future, new antibiotics will be developed and will prevent the problem of antibiotic resistance	207 (41.2%)	67 (13.3%)	229 (45.5%)

Students reported that they need further education about the appropriate use of antibiotics (89.7%) and on antibiotic resistance (88.1%). About 41.2% believed that new antibiotics will be developed and will prevent the problem of antibiotic resistance. Around 52.5% of the students felt that their education about the appropriate use of antibiotics is useful (Figure 3). Most students recommended that education about appropriate prescribing of antibiotics should be provided overall years followed by the preferences toward the third year (Figure 4).



**Figure 3.** Students rate on education about appropriate use of antibiotics



**Figure 4.** Students beliefs on the year that they should have more teaching about appropriate antibiotic use

## Discussion

To our knowledge, there is no published study in Saudi Arabia that investigate both medical and dental students' knowledge and perceptions about antibiotic use and resistance and antimicrobial stewardship. The vast majority of the students believed that medical or dental schools have to focus on and provide more about teaching about appropriate prescribing and the use of antibiotics. Similarly, in the united states, it was reported that students want more education about appropriate prescribing and use of antibiotics while in medical school (5). In the present study, overall knowledge about antibiotics was fair which highlights the need to improve education-related to antibiotics. In the literature, numerous international studies have described the antibiotic behaviors of medical and dental students. They recognized a lack of knowledge and confidence and in antibiotic prescribing, and have highlighted that both medical and dental students indicate a need for more education and training on antibiotics (5-8). Moreover, Junior physicians believe that they are unprepared for the challenges and complexity associated with antibiotic prescribing in their daily clinical practice (9-11). In the present study, it was found that only 51 (10.1%) were familiar with the term antimicrobial stewardship. A study reported that only 40% of students were aware of the term 'antimicrobial stewardship' and only a few of them felt ready for the practice of prescribing antibiotics (5). After the completion of an online course, 93.6% of medical students believed that the medical curriculum involved topics about the appropriate use of antibiotics and antimicrobial stewardship (12). Usually, the majority of educational interventions occur during postgraduate while behaviors and attitudes toward prescribing started to form and developed (13).

In the present study, it was founded that the majority of the students agreed that antibiotics are overused nationally and were aware that inappropriate use of antibiotics contributed to the problem of antibiotic resistance. interestingly, some students believed that the problem of antibiotic resistance will be resolved with the development of antibiotics. Students acknowledge and highlighted the importance and the value of appropriate antibiotic prescribing practices, and the vast majority of students stated that they want more education on antibiotics and antibiotic resistance. Most students recommended that education about appropriate prescribing of antibiotics should be provided throughout the year followed by the preferences toward the third year. Our results recommend that teaching and education about the principles of antimicrobial stewardship practices must be incorporated during undergraduate studies.

A future step is to assess the medical and dental schools' curriculum, to address how to identify and improve gaps in knowledge, perceptions, and skills. This may be done and supported through comparing the existing curriculum with internationally reported and identified competencies in antibiotic resistance and antimicrobial

stewardship (14,15), and added by qualitative researches among medical and dental faculty and students. We suggest that medical and dental schools share their experiences with the goals of providing better student education. As the growing problem of antibiotic resistance, actions should be taken so that all students who graduated from medical or dental schools feel that they are prepared to prescribe antibiotics appropriately.

## **Conclusion**

Despite having a fair knowledge about antibiotics, the majority of the students have a general perception that inappropriate use of antibiotics contributes to antibiotic resistance. The study recommends that medical and dental students should be educated about antibiotic prescribing and antimicrobial stewardship. Moreover, efforts must be implemented to ensure that future prescribers understand the value of antimicrobial stewardship. Both medical and dental schools must contribute and be partners in the effort to decrease antibiotic resistance thus including antimicrobial stewardship education in the curriculum is needed.

## **Authors' contributions**

Conceptualization: NA, AA, FA, AAs, RA, NAs. Data curation: NA, AA. Formal analysis: NA, AA. Methodology: NA, AA, FA, AAs, RA, NAs. Project administration: NA, AA. Writing-original draft: NA, AA, FA, AAs, RA, NAs. Writing-review & editing: NA, AA.

## **Conflict of interest**

No conflict of interest relevant to this article was reported.

## **Funding**

This research was funded by the Deanship of Scientific Research at Princess Nourah bint Abdulrahman University through the Fast-track Research Funding Program

## **Adherence to ethical standards**

Ethical approval was obtained before conducting the study (IRB log number with KACST, KSA: 20-0277).

## **References**

1. Sunusi LSa, Awad MM, Hassan NM, Isa CA. Assessment of knowledge and attitude toward antibiotic use and resistance among students of International University of Africa, medical complex, Sudan. *Glob Drugs Therapeutics*. 2019;4:1-6.
2. Hoffmann K, Wagner G, Apfalter P, Maier M. Antibiotic resistance in primary care in Austria - a systematic review of scientific and grey literature. *BMC Infect Dis*. 2011;11:330.
3. Costelloe C, Metcalfe C, Lovering A, Mant D, Hay AD. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. *BMJ*. 2010;340:c2096.
4. Beardsley JR, Williamson JC, Johnson JW, Luther VP, Wrenn RH, Ohl CC. Show me the money: long-term financial impact of an antimicrobial stewardship program. *Infect Control Hosp Epidemiol*. 2012;33(4):398-400.
5. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clin Infect Dis*. 2013;57(5):631-8.
6. Dyar OJ, Pulcini C, Howard P, Nathwani D, Policies) EESGfA. European medical students: a first multicentre study of knowledge, attitudes and perceptions of antibiotic prescribing and antibiotic resistance. *J Antimicrob Chemother*. 2014;69(3):842-6.
7. Struzycka I, Mazinska B, Bachanek T, Boltacz-Rzepakowska E, Drozdziak A, Kaczmarek U, et al. Knowledge of antibiotics and antimicrobial resistance amongst final year dental students of Polish medical schools-A cross-sectional study. *Eur J Dent Educ*. 2019;23(3):295-303.

8. Nisabwe L, Brice H, Umuhire MC, Gwira O, Harelimana JD, Nzeyimana Z, et al. Knowledge and attitudes towards antibiotic use and resistance among undergraduate healthcare students at University of Rwanda. *J Pharm Policy Pract.* 2020;13:7.
9. Mattick K, Kelly N, Rees C. A window into the lives of junior doctors: narrative interviews exploring antimicrobial prescribing experiences. *J Antimicrob Chemother.* 2014;69(8):2274-83.
10. Pulcini C, Williams F, Molinari N, Davey P, Nathwani D. Junior doctors' knowledge and perceptions of antibiotic resistance and prescribing: a survey in France and Scotland. *Clin Microbiol Infect.* 2011;17(1):80-7.
11. McLellan L, Tully MP, Dornan T. How could undergraduate education prepare new graduates to be safer prescribers? *Br J Clin Pharmacol.* 2012;74(4):605-13.
12. Laks M, Guerra CM, Miraglia JL, Medeiros EA. Distance learning in antimicrobial stewardship: innovation in medical education. *BMC Med Educ.* 2019;19(1):191.
13. Pulcini C, Gyssens IC. How to educate prescribers in antimicrobial stewardship practices. *Virulence.* 2013;4(2):192-202.
14. World Health Organisation (2018) WHO competency framework for health workers' education and training on antimicrobial resistance. <http://apps.who.int/medicinedocs/documents/s23443en/s23443en.pdf>. Accessed 22 August 2020
15. Dyar OJ, Beović B, Pulcini C, Tacconelli E, Hulscher M, Cookson B et al (2019) ESCMID generic competencies in antimicrobial prescribing and stewardship: towards a European consensus. *Clin Microbiol Infect* 2018 25:13–19