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Original Research Article

Assessment of knowledge, perception and attitude towards antibiotic resistance among medical interns in Saudi Arabia

Ahmed Albarrag[1]*, Nawaf Zaid Almeshari[2], Abdullah Ameen Alfraih[2], Abdullah Hassan Alshathry[2], Abdulaziz Mohammed Alzaydan[2], Abdulrahman Mansour Benaskar[2], Abdullah Mohammed Aleidy[2], Khaloud Alzahrani[1]

[1]Department of Pathology, Faculty of Medicine, [2]College of Medicine, King Saud University, Riyadh, Saudi Arabia

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***Correspondence:**
Dr. Ahmed Albarrag,
E-mail: aalbarrag@ksu.edu.sa

ABSTRACT

Background: Antibiotic resistance is a well-established medical fact that affects the clinical course of many infections. There are many risk factors that can contribute to antibiotic resistance clinically. Therefore, it is important to understand the attitude and practice of medical practitioners from their early life career.
Methods: This is a cross-sectional descriptive online study that was done between February and March 2018 in Riyadh, Saudi Arabia. The included participants were medical interns only excluding all other medical students. The questionnaire is made up of four dimensions: Socio-demographic characteristics, antibiotics knowledge, attitude, and perception towards prescribing antibiotics. The questionnaire utilized from a previously validated questionnaire regarding antibiotic use, and the data was analyzed using SPSS, version 21.
Results: A total of 292 medical interns completed the questionnaire. Majority of Interns reported that too many antibiotic prescriptions were important contributor to antibiotic resistance. Surprisingly, 55.6% felt that hand hygiene had low importance or was not important at all in compacting antibiotic resistance. Only half of respondents (51%) were sure that their hospitals had antibiotic guidelines, and only 21% of them had acknowledged reading the guidelines or been shown where the hospital's antibiotic guidelines were kept. The majority of the interns (90.6%) believed that antibiotic resistance is a national problem in Saudi Arabia**.**
Conclusions: There is a noticeable gap between the theoretical part of students' curricula and clinical practice; students require more education regarding antibiotic prescription, especially about choosing the correct antibiotics, doses, and intervals.

Keywords: Antibiotic resistance, Antibiotic use, Intern, Knowledge, Saudi Arabia

INTRODUCTION

Recently, antimicrobial agents have become less effective at treating certain bacterial infections due to what is known as antimicrobial resistance (AMR).[1] The world health organization (WHO) defines AMR as the failure of antimicrobial drugs to treat infections that they were initially successful at treating due to the resistance of microorganisms to these agents. The WHO considers AMR as one of the biggest international threats to global health and the economy.[1] With AMR, there is an increasing risk of failure for organ transplantation, cancer chemotherapy, and diabetic management. Furthermore, without urgent and critical action, minor injuries and common bacterial infections can cause death if met with AMR, just as they did in the past before the discovery of

antimicrobials.[1] A recent review of AMR estimated that by 2050, deaths caused by AMR will reach 10 million every year. This number is alarming, especially when compared to other major causes of death in the same year (cancer: 8.2 million, diabetes: 1.5 million, road traffic accidents: 1.2 million).[2] There are many factors that contribute globally to this problem. One of these factors is that unlike drugs such as antipsychotics and chemotherapeutic agents, which are usually only prescribed by specialists, antimicrobials are prescribed by a variety of health care workers and clinicians, irrespective of their knowledge.[3] Another important factor that may contribute is the limited knowledge and the low experience of the junior doctors and interns prescribing antimicrobials, which may indirectly lead to resistance.[4] When comparing the Asian continent with the western countries, there are notable geographical differences in the resistance of fungal and bacterial infections due to different antimicrobial usage policies and the public hygiene standard differences between these regions.[5] When we focus on the Middle East, the overuse and the misuse of antimicrobials is a huge problem, and many studies have shown that this may be an important indirect cause of AMR. A nationwide study in Kuwait showed that 135 of 270 patients with upper respiratory tract infections (URTIs) received antimicrobials.[6] Moreover, An Iranian study indicated that antimicrobials may be inappropriately used as 993 of 1,000 patients in their study received at least one antibiotic.[7] A study done in Riyadh, Saudi Arabia (SA) on antimicrobial access showed that these agents could be obtained easily without any prescriptions in 78% (244 out of 327) of pharmacies.[8] However, lots of factors weigh on that fact when considering antimicrobials because it is the third most common medication group prescribed in SA.[9] In addition, they can be easily obtained and are prescribed to 44-88% of patients that present to hospitals with URTIs.[10] In 2011, a study in the south-western region of SA showed that the most common organisms showing AMR rates were *E. coli* at 31.34%, *Staphylococcus aureus* at 32.14%, *Klebsiella pneumoniae* at 32.35% and *Pseudomonas aeruginosa* at 38.46%.[11] Furthermore, Saudi Arabia experiences large population flows from many Asian countries, where AMR is prevalent. It is also the annual host of AL-Hajj, a mass religious gathering, which increases risk of transmission of infectious diseases.[12-14] All of these factors, in which most of them depend on doctor's prescription attitudes, could be in a way or another responsible for that increase in AMR recently. On the other hand, by focusing more on the younger generation and the future prescribers, a multicenter study conducted among medical students in Europe showed that 92% of the students consider AMR a worldwide problem and 74% of them believed that they need more education for choosing antimicrobials.[15] Another study among medical students in France found that 63% of those students thought that the antimicrobials they would prescribe would participate in the resistance, and 96% of them believed that AMR would be a greater problem in the future.[16] In Malaysia, a study showed that only 15.4% of final-year medical students were able to recognize enterococcus as vancomycin-resistant bacterium and streptococcus pyogenes as a non-penicillin-resistant bacterium, and many of them wanted more education in this field.[17] Many more studies have found a gap between the knowledge provided in education and clinical practice.[18,19] In addition, a few local studies have shown that there is a low level of confidence among physicians in prescribing antimicrobials in comparison with confidence in the diagnosis determined.[20,21] All of this indicates the necessity of paying more attention to antimicrobial prescribing patterns and education. The beliefs and attitudes regarding the use of antibiotics among medical interns will have a remarkable impact on antibiotic resistance as they are considered the new generation of health care providers. Therefore, it is important to conduct this study to evaluate the knowledge, attitudes, and practices of medical interns in SA toward antibiotic resistance. To our knowledge, there are no previous studies in SA that specifically target intern doctors to address their knowledge, attitudes, and perceptions regarding AMR.

METHODS

Study design and sample size

This is a cross-sectional descriptive study targeting medical interns in hospitals of Riyadh, SA. All medical interns were included with no exclusion criteria. The survey was available for two months, February and March 2018 and was distributed as a Google form link on various social media and Whatsapp medical groups. Sample size was calculated using equation;

$$N = Z^2 p(1-p) / \delta^2$$

Where z=1.96, p=50% (the prevalence yielding the largest sample size), δ represents error tolerance at 0.06 (maximum error). The sample size was calculated to be 267. The error tolerance was increased because the whole population of interns was small.

Study tool and settings

The data were collected using a self-administrated survey that was provided to the participants in English. The self-administrated survey was Internet based, using www.googledrive.com. Interns received emails from the training centres in their hospitals on the first day of February. Emails were sent again as a reminder after three weeks, and then a final reminder another three weeks later. The questionnaire used in this survey was a validated questionnaire adapted from a multicenter study conducted among medical students in Europe with permission obtained from the author and with slight modifications (specifically, adding two more questions to the section about education and training).[18] The self-administered questionnaire collected data on medical interns' knowledge and attitudes about antibiotic

prescribing, their knowledge of the prevalence of AMR to common bacteria, the importance of the problem of antibiotic resistance, their views regarding the leading causes of increases in antibiotic resistance, and the level of education and training in antibiotic prescribing received during their study. The first section of the questionnaire pertained to the demographic data of the participants, including age, gender, and medical school. The second section aimed to assess interns' knowledge about antibiotic usage and contributors to resistance. The third section of the questionnaire consisted of questions about confidence in prescribing antimicrobials and factors influencing these decisions. The fourth section of the questionnaire included questions designed to study attitudes and perceptions toward antibiotic resistance. The questions in the last section were related to education and training about antibiotics and resistance. Questions were four-point or five-point Likert scale response options, from very unconfident/not useful/unimportant/ to very confident/useful/important. Questions with options of "yes," "no," and "unsure" were also used. Almost all the interns were doing internships in one of the six main institutions in Riyadh; King Saud university medical city (KSUMC), King Abdulaziz medical city (KAMC), Prince Sultan military medical city (PSMMC), National Guard hospital, King Saud medical city (KSMC), and King Fahad medical city (KFMC). Only a small number of interns spent their internships in other hospitals. Therefore, we focused mainly on those large institutions. Data entry was performed utilizing Microsoft Excel 2016. Frequency and percentages were applied to describe categorical variables, whereas mean, weighted mean, range, and standard deviation were used to describe numerical variables. The overall score of perceptions of antibiotic prescription or resistance was calculated so that the higher the score, the higher the perception and vice versa. The median value of the overall score was utilized as a cut-off point for perception categorization. Interns were classified as having positive perception if they had overall scores ≥ median value and as having negative perception if they had scores < median value.

Ethical considerations

The informed consent was clear and indicated the purpose of the study, the voluntary nature of participation, and the right of the participants to withdraw at any time without any obligation to the study team. Anonymity and confidentiality were maintained in all phases of the study.

RESULTS

Demographic characteristics

A total of 292 out of 700 (41.7%) medical interns completed the questionnaire; their personal characteristics are presented in (Table 1). Age of interns ranged between 22 and 33 years with a mean of 24.6±1.4 years. In the study group, 51.4% were male, and 48.6% were female. Almost two-thirds of the participants (63.7%) spent more than six months in their internships. Most of them (41.1%) had graduated from King Saud University in Riyadh, 37.4% had graduated from other universities in Riyadh, whereas 21.5% of them had graduated from universities outside Riyadh (Majma'a University, Tabuk University, Najran University, Qassim University, Taibah University, Aljouf University, Hail University, Dammam University) (Table 1).

Table 1: Personal characteristics of the participants (n=292).

Variable	N (%)
Age in years (n=288)	
≤24	172 (59.7)
>24	116 (40.3)
Gender (n=288)	
Male	148 (51.4)
Female	140 (48.6)
Duration in internship in months (n=281)	
≤6	102 (36.3)
>6	179 (63.7)
University of graduation (n=270)	
KSU	111 (41.1)
KSAUHS	26 (9.6)
MCST	45 (16.7)
PNU	8 (3.0)
IMAMU	22 (8.1)
Outside Riyadh	58 (21.5)

Antibiotic prescription and resistance

68.5% of interns were able to make accurate diagnoses of infections and sepsis with low levels of confidence reported in choosing the correct antibiotic (51.1%), choosing the correct dose and interval of administration of antibiotics (35.6%), using combination therapy (40.8%), and determining the duration of treatment (49%) (Table 2). Overall, around half of the interns (50.3%) had positive perceptions of antibiotic prescriptions. Meanwhile, age, duration of internship, and university were not significantly associated with perceptions about antibiotic prescription among interns.

Perceptions of AMR

Regarding perception of reasons that lead to AMR, too many antibiotic prescriptions was ranked first in importance (weighted mean was 3.44±0.83 out of 4). Too many broad spectrum antibiotics used (weighted mean was 3.22±0.91) and excessive use of antibiotics in livestock (weighted mean was 3.10 ±0.96) ranked as the second and third reasons. However, 55.6% of interns reported thinking that poor hand hygiene has low importance or no importance to the increase of AMR (weighted mean was 2.40±1.15) (Figure 1).

Table 2: Perception of antibiotic prescription among the participants.

Statement	Confidence level		
	Unconfident N (%)	Uncertain N (%)	Confident N (%)
Making an accurate diagnosis of infection/sepsis	69 (23.6)	23 (7.9)	200 (68.5)
Deciding not to prescribe an antibiotic if the patient has fever but no severity criteria and if you are not sure about your diagnosis	104 (35.6)	27 (9.2)	161 (55.1)
Choosing the correct antibiotic	112 (38.4)	30 (10.3)	150 (51.4)
Choosing the correct dose and interval of administration	157 (53.8)	31 (10.6)	104 (35.6)
Using a combination therapy if appropriate	152 (52.1)	21 (7.2)	119 (40.8)
Choosing between IV and oral administration	92 (31.5)	20 (6.8)	180 (61.6)
Interpreting microbiological results	72 (24.7)	25 (8.6)	195 (66.8)
Planning to streamline/stop the antibiotic treatment according to clinical evaluation and investigations	107 (36.6)	28 (9.6)	157 (53.8)
Planning the duration of the antibiotic treatment	120 (41.1)	29 (9.9)	143 (49.0)

There was a significant difference between perception of the interns regarding the proportion of MRSA blood stream infections in Saudi Arabia and changes over time. The proportion of interns that correctly identified the rate of MRSA was 34.2%. In regard to changes in the prevalence over time, 79% of them reported an increase in MRSA prevalence over the last 10 years. Only 48.3% reported thinking that AMR will likely be a greater clinical problem later in their medical careers than it is today. However, 79.1% of them believed that the antibiotics they would prescribe as doctors would likely to contribute to the problem of resistance. Participants believed that global deaths in 2050 due to resistant bacteria, excluding TB, will be higher than deaths from road traffic accidents (63.1%) and lung cancer (55.2%). Most of the interns (90.6%) believed that antibiotic resistance is a national problem in Saudi Arabia, whereas 60.8% of them believed that it is a problem in their own training hospitals.

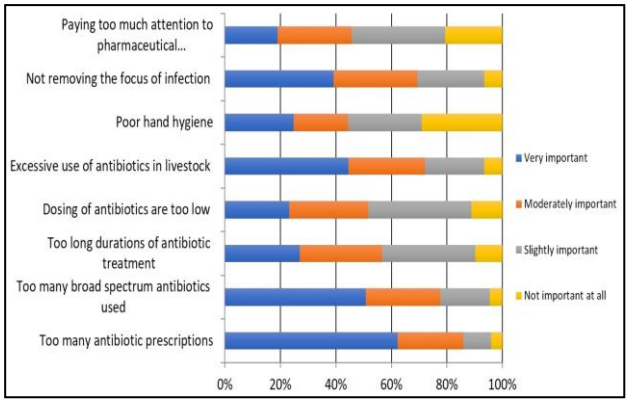

Figure 1: Perception of the interns regarding the reasons for antibiotic resistance.

Overall, around half of the participants (50.5%) had positive perceptions of AMR. Age, gender, duration of internship and university were not significantly associated with perception of antibiotic resistance among interns.

Perception regarding use of antibiotics in Saudi Arabia

For the unnecessary or inappropriate use of antibiotics, 29% of interns believed that all clinical antibiotic usage in Saudi Arabia are probably unnecessary or inappropriate in 41-60% of cases, and 42% believed that antibiotics are unnecessary or inappropriately used in <40% of cases. Almost half of the participants (47.2%) believed that the 1-20% of clinically relevant bacterial infections, excluding tuberculosis, in Saudi Arabia are resistant to all known antibiotics. However, 21.7% of interns believed that the prevalence is <1%.

Factors influencing interns' decisions regarding antibiotic prescription

The most frequent factors reported as influencing decisions regarding antibiotic prescription were as follows: advice from a specialist (68.2%), advice from a senior colleague (63.7%), previous experience/training (57.9%) and use of guidelines/protocol (local/national) (44.2%).

Training in antibiotic prescribing

The training experience of interns regarding antibiotic prescription is summarized in (Table 3). Almost two-thirds of them (67.4%) claimed that they had no hours of training in the principles of practical antibiotic use during undergraduate study, and only 9.5% of them claimed that they received more than 10 hours of such training. Accordingly, 92.5% reported that they would like more education on antibiotic selection at medical school. Most of them (84.6%) believed that prescribing inappropriate or unnecessary antibiotics is professionally unethical. Only half of the participants (51%) were sure that their hospitals had antibiotic guidelines and less than one-quarter (21%) of them had been given a copy of the hospital's antibiotic guidelines or had been shown where to find them. However, 41.1% of interns had not ever personally used or consulted antibiotic guidelines when considering an antibiotic for a patient.

Education about antibiotics

More than half of the interns reported attending formal lectures during medical school addressing topics related to antibiotic prescription, such as when to start antibiotics (61.3%) and rationales for the use of antibiotics (59.2%). Only 33.9% attended lectures regarding how to select the correct antibiotic dosing. The completion of a clinical rotation in infectious diseases during medical school was reported by only 45.5% of the participants. Regarding options for learning about antimicrobial prescribing and resistance, problem-solving sessions attended by small groups of medical students and residents or faculty ranked first (weighted mean was 3.94±1.13 out of 5), followed by lecture series for medical students (weighted mean was 3.87±1.05), and grand rounds lectures (weighted mean was 3.81±1.10) (Table 4).

Table 3: Interns' training experience in antibiotic prescription.

Statement	No Frequency (%)	Yes Frequency (%)	Not sure Frequency (%)
Would you like more education on antibiotic selection at medical school? (n=291)	12 (4.1)	269 (92.5)	10 (3.4)
Do you believe that prescribing inappropriate or unnecessary antibiotics is professionally unethical? (n=292)	18 (6.2)	247 (84.6)	27 (9.2)
Does your current hospital have antibiotic guidelines? (n=284)	25 (8.8)	145 (51.1)	114 (40.1)
Have you been given a copy of your hospital's antibiotic guidelines, or been shown where they are if they are on the Internet? (n=292)	191 (65.4)	63 (21.6)	38 (13.0)
Have you ever personally used or consulted antibiotic guidelines when considering an antibiotic for a patient?	91 (31.1)	171 (58.9)	29 (10.0)
Number of hours of training in principles of prudent antibiotic use received during your undergraduate study (n=169)	0 hours 114 (67.4)	1-10 hours 39 (23.1)	>10 hours 16 (9.5)

Table 4: Perception of interns regarding options for learning about antimicrobial prescribing and resistance.

Statement	Very useful N (%)	Useful N (%)	Neutral N (%)	Not useful N (%)	Not at all useful N (%)	Weighted mean±SD	Rank
Grand rounds lectures (n=283)	89 (31.4)	100 (35.3)	54 (19.1)	30 (10.6)	10 (3.5)	3.81±1.10	3
Lecture series for medical students (n=289)	92 (31.8)	109 (37.7)	57 (19.7)	21 (7.3)	10 (3.4)	3.87±1.05	2
Interactive, patient-oriented problem-solving modules on internet (n=286)	79 (27.6)	94 (32.9)	78 (27.3)	28 (9.8)	7 (2.4)	3.73±1.05	4
Interactive, patient-oriented problem-solving modules on CD-ROM (n=288)	58 (20.1)	81 (28.1)	108 (37.5)	26 (9.0)	15 (5.2)	3.49±1.07	6
Problem-solving sessions attended by small groups of medical students and residents or faculty (n=285)	113 (39.6)	87 (30.5)	54 (18.9)	17 (6.0)	14 (4.9)	3.94±1.13	1
Roleplaying sessions dealing with patient demands (n=290)	83 (28.6)	99 (34.1)	71 (24.5)	16 (5.5)	21 (7.2)	3.71±1.15	5

DISCUSSION

Antibiotic resistance is a serious global health problem. Assessment of knowledge, perception, and attitude towards antibiotic use among future physicians can greatly impact how best to tackle the growing threat of the antibiotic resistance and its related issues. In assessing confidence in antibiotic prescribing among the participants, interns were most confident in making an accurate diagnosis of infection (68.5%). On the other hand, most of them felt least confident or uncertain in choosing the correct dose and interval of administration of antibiotics (64.4%) or using a combination therapy if appropriate (59.2%) and almost half of them were unconfident or unsure in choosing the correct antibiotic (48.7%). These results show that there is a very low confidence in the participants regarding prescribing antibiotics compared to studies done in Europe, Bangladesh, and Malaysia.[15-22] However, it fits with these studies in the fact that the greatest difficulties facing students in treating patients is in dealing with antibiotics more than in making an accurate diagnosis, which may suggest the lack of details, complexity, and matching of real-life cases in antibiotics educational programs.

In general, interns were aware of the major contributors of the resistance. Most of them agreed that too many antibiotic prescriptions, too many broad-spectrum antibiotics, and excessive use of antibiotics clinically were very important contributors to resistance as they ranked first, second, and third, respectively, in importance (by weighted mean). This goes along with the results of other studies done in different regions.[15-22] However, more than one-third of the participants thought that too low dosing of antibiotics and too-long durations of antibiotic treatment were only slightly important, and almost one-third (29%) thought that hand hygiene was not important, even though repeated studies have shown that poor hand hygiene contributes to resistance.[23-24] This underestimation of some causes of AMR should be addressed in the education for future clinicians. Regarding knowledge that may shape perceptions of AMR, 40% of the participants reported the proportion of *Staphylococcus aureus* infections due to MRSA in SA is ranging between 1% and 20% 10 years ago, and 34.2% of them reported a proportion ranging between 21% and 40% now. These results are more or less similar to those from other countries.[15-22] However, it may show a lack of knowledge regarding the latest news about AMR as most of the participants thought that MRSA was responsible for a greater proportion of infections now compared to 10 years ago, when this proportion has actually decreased.

Regarding training in antibiotics prescription, most of the intern doctors (92.5%) would like more training on antibiotics selection. Most (84.6%) thought that prescribing inappropriate or unnecessary antibiotics is professionally unethical, a greater proportion compared to a survey done among US doctors (67%) and a multicenter European study (83%).[15,17] This sense of ethical responsibility, consideration and the desire to learn more about antibiotics prescription could help in the efforts in fighting the increased spread of AMR. Only half of the participants (51%) were sure that their hospitals had antibiotic guidelines, and less than one-quarter (21%) of them had been given a copy or been shown where to find them. This is lowest percentage compared to other studies done regarding use of antibiotic guidelines.[15-17,19,22] To the best of our knowledge, there are no previous studies in Saudi Arabia that specifically target intern doctors and medical students to address their knowledge, attitudes, and perceptions regarding AMR. Therefore, we believe that our findings may be representative at least for the Riyadh region. Future studies with larger sample sizes including different regions of Saudi Arabia are needed to understand better the level of awareness of our future physicians.

Limitations

Limitations of current study were; a small sample size cannot fully reflect all the interns. Furthermore, since study was conducted in one city, it is not right to generalize it on all different areas of neither the country nor the world. Lastly, more studies need to be conducted to understand the scale of the problem and use it to better the awareness level and education in that regard.

CONCLUSION

We have found that there is a huge gap between the theoretical part of students' education and clinical practice. Students need and want more education regarding antibiotics prescription, especially in choosing the correct antibiotic, the correct dose and interval of administration, and the use of combination therapy. We recommend that larger national studies to further understand the best educational interventions to fill the gap between theory and real clinical practice regarding antibiotic prescription and antibiotic resistance.

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