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KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS ANTIBIOTIC USE AND ANTIBIOTIC RESISTANCE AMONG MEDICAL STUDENTS: A CROSS-SECTIONAL STUDY

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ABSTRACT: Background: Injudiciously use of antibiotics / antimicrobial agents poses a major public health threat worldwide. Medical students will be future prescriber of antimicrobial agents so they need to have a wide awareness of the use and resistance of antibiotics. Therefore, this study was planned to assess the Knowledge, Attitude and Practice (KAP) toward antibiotics usage and antibiotics resistance among medical students of JLN Medical College, Ajmer, Rajasthan, (India). **Methods:** This descriptive and cross-sectional study was conducted in 255 medical students of JLN Medical College, Ajmer, Rajasthan. A validated questionnaire comprised of 20 questions, in which 10 in the knowledge section, 5 each in attitude and practice section was provided in November 2021. data were analyzed by using descriptive statistics after entering them into a Microsoft Excel sheet. **Results:** 94.12% knew that inappropriate uses of antibiotics agents might promote antibiotics resistance. 90.98 % of participants were aware that self-medication can make a contribution to antibiotics resistance. Students showed good knowledge about the use and resistance of antibiotics. 89.41% of participants showed a positive attitude toward the rational uses (*i.e.* right drug, right patient, right dose, right route and right time) of antibiotics. Overall 61.96% were proactive, whereas 38.04% were passive in practice regarding antibiotics use and antibiotics resistance. **Conclusion:** This study focused on knowledge, attitude, and practice regarding antibiotic use and resistance among medical students. Overall KAP score was found 74.89%, which indicates that medical students have a good awareness of the use and resistance of antimicrobial agents. Introducing a short course about the risk and development of antimicrobial resistance in their curriculum will grow the students' awareness of avoiding the resistance phenomenon.

INTRODUCTION: A countless antibiotics were discovered in the golden era of 20th century to treat previously incurable disease *i.e.* tuberculosis and syphilis¹. In this antibiotic developmental series; the discovery of penicillin changed the outlook of the physician towards medicinal practice. Since that time, antibiotics have been irrationally and non-judiciously used for various diseases.

Alexander Fleming predicted the overuse of antibiotics in early 1945; he said that the time may come when anyone in the shops could buy penicillin. The ignorant man may easily underdose himself and expose his microbes to nonlethal quantities of the drug, making them resistant^{2,3}.

This antibiotic resistance is a subset of antimicrobial resistance (AMR). World Health Organization (WHO) defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism⁴. WHO considers it to be one of the biggest threats to global health, food security, and development⁵. WHO estimates there will be three hundred and fifty million deaths

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due to AMR by 2050⁶. The AMR occurs due to overuse, self-medication, and clinical misuse of antibiotics. Lack of knowledge of public on dangerous effects of antimicrobial resistance, limited amount of money for consulting to doctors, or in many developing countries, lack of doctors are the main cause of self-medication that contribute to AMR. A major example that face these challenges in India; 73% population of Punjab state resorted to treating their minor health issues and chronic illness through self-medication⁷. This AMR leads to longer hospital stays, higher medical costs and increased mortality⁸.

There have been increasing public calls for these global threats. WHO endorsed a global action plan at the sixty-eight world health assembly in May 2015 to combat the issue of AMR. This action plan is composed of five key objectives. The top of its five strategic objectives is to improve awareness and understanding of antimicrobial resistance through effective communication, education, and training⁹. WHO has also promoted the world antibiotic awareness week programme, which has been held every November since 2015¹⁰.

In the Indian scenario, the Government of India has taken a series of initiatives to tackle the growing antimicrobial resistance, including the constitution of a National Task Force on AMR Containment in 2010, leading to the development of the National policy on AMR containment in 2011. The National Action Plan on Antimicrobial Resistance (NAP - AMR) outlines the priorities and interventions planned to be implemented over 2017 – 2021 to tackle the public health challenge of AMR in India. NAP – AMR (6 strategic) are aligned with the global action plan (5 strategic) on AMR.

The focus area of the sixth strategic priority of NAP – AMR is mainly to improve awareness and understanding of AMR through effective communication, education, training, strength knowledge and evidence through surveillance, and reducing the incidence of infection through effective infection prevention and control¹¹. There are various Knowledge, Attitude, and Practice (KAP) based studies on antibiotic prescribing, consumption, and antibiotic resistance conducted in different countries on diverse groups, including medical students, health workers and common

public¹²⁻¹⁴. Medical students are the future doctors / prescribers of antibiotics, so their knowledge, attitude, and behaviour in relation to antibiotic usage and resistance can greatly impact AMR's future. WHO has recommended training for medical students regarding the prudent prescription of antibiotics¹⁵. With this background, the present study was carried out to assess the current knowledge, attitude, and practice toward antibiotic usage and antibiotic resistance among medical students of JLN Medical College, Ajmer, Rajasthan (India), to identify the gaps in knowledge, attitude, and practices which may serve as a baseline data to plan and develop strategies that would address this issue.

Objective: To understand/collect information on medical students' knowledge, attitude, and practice towards antibiotic use and antibiotic resistance.

MATERIAL & METHOD:

Source of Data: Undergraduate medical students studying in JLN Medical College & Associated group of Hospitals, Ajmer (Rajasthan), India.

Protocol: This was a descriptive and cross-sectional study. It was conducted after obtaining approval from the Institutional Ethics Committee vide order no. 2245/Acad-III/MCA/2021 dated 15/11/2021.

Sample Size: The sample size was calculated by using a confidence level of 95%, a margin of error 5%, a response distribution of 50%, and a population size of 750. It was calculated by utilizing the online sample size calculator Raosoft (<http://www.raosoft.com/samplesize.html>). We obtained a number of 255.

Methodology: Present study was performed after obtaining approval from the institutional ethics committee and consent from participants. After that, the present study subjects were provided a set of a questionnaire related to knowledge, attitude, and practice regarding antibiotic use and antibiotic resistance. Questionnaire contents were validated by the departmental research committee. A common scoring method was used for this KAP questionnaire as follows-

- 1 (one) point for correct and 0 (zero) for an incorrect answer in the knowledge section.

- 2 (two) point for positive, 1 (one) for neutral and 0 (zero) for negative response in attitude section.
- 1 (one) point for proactive and 0 (zero) for passive response in the practice section.

There are 10 questionnaires in the knowledge section, 5 each in the attitude and practice section. The score range was 0-10 each for knowledge and attitude, while in the practice section, the range was 0-5, making a score of 25 for total KAP for one subject.

For one subject, the maximum score for knowledge was 10, for attitude, it was $2 \times 5 = 10$, and it was 5 for the practice section. We took 255 subjects so the maximum score for knowledge was 2550 ($255 \times 10 = 1550$), for attitude it was 2550 ($255 \times 10 = 1550$) and 1275 for the practice section. Overall maximum KAP score for all subjects was $25 \times 255 = 6375$.

Statistical Analysis: All data were entered in an MS Excel spreadsheet. The categorical variable was expressed as frequency and percentage. Data were analyzed by using appropriate statistical tests or using Epi info software.

RESULTS: A total of 255 responses were received and studied. Results are shown in tabulated form **Tables 1 to 5**.

The Demographic Characteristics of the participants are shown in **Table 1**. All the participants were in age group of 17-26 years.

Maximum numbers (54.90%) belong to the 17-20 years age group, and the minimum (1.57%) were 24-26 years old. The mean age was 20.546 ± 1.509 years. In this study, males were 55.29% (no. 141), and females were 44.70% (no. 114). Of the 255 medical students, the male to female ratio was 1.23.

TABLE 1: DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

Measures	No. of Participants	Percents of Participants
Age Group		
17-20	140	54.90
21-23	111	43.53
24-26	4	1.57
Gender		
Male	141	55.29
Female	114	44.70
Total	255	100

Knowledge-Based Questionnaires are discussed in **Table 2**. It is evident from this table that all the participants (100%) heard about the term antibiotic resistance. 94.12% knew that inappropriate uses of antimicrobial agents may promote antimicrobial resistance. 90.98% of participants were aware that self-medication could contribute to antibiotic resistance. 88.24% of subjects knew that microbes/bacteria are extensively drug-resistant or totally drug resistant are called superbugs. 85.49% of medical students knew that the use of narrow-spectrum antibiotics in place of broad-spectrum antibiotics may cause less chance of resistance and side effects. 85.09% were aware of antibiotic stewardship programs. 76.86% of students gave correct responses regarding improved water, sanitation, and hygiene infrastructure helps in combating antimicrobial resistance. In this study, 83.92% participants did not know about the month of world awareness weeks. 63.14% of medical students were not aware of the Red Line Campaign. 47.45% participants did not know whether antibiotics are used or not used to treat viral infection. Overall, in the knowledge section, 72.63% of medical students gave correct responses, whereas only 27.37% of students showed incorrect responses. In this study, these students have very good knowledge regarding antibiotic use and antibiotic resistance.

TABLE 2: RESPONSE TO KNOWLEDGE-BASED QUESTIONS

Questions with options	Incorrect response		Correct response	
	No.	%	No.	%
Q. 1. Did you hear the term antibiotic resistance? (A) Yes (B) No				
Q. 2. Antibiotics are used for the treatment of the viral infection - (A) Yes (B) No	255	100	0	0
Q. 3. Inappropriate uses of antimicrobial agents may promote the antimicrobial resistance - (A) Yes (B) No	134	52.55	121	47.45
Q. 4. Antibiotic stewardship programmes are useful in reducing rate of	240	94.12	15	5.88

antimicrobial resistance – (A) Yes (B) No				
Q. 5. Are you aware with the Red Line Campaign	217	85.09	38	14.90
(A) Yes (B) No				
Q. 6. Self medication (without prescription) can contribute to antibiotic resistance	94	36.86	161	63.14
(A) Yes (B) No				
Q. 7. World antibiotic awareness week is held in the month of -	232	90.98	23	9.02
(A) January (B) June (C) September (D) November				
Q. 8. When possible, use of narrow spectrum antibiotic in place of broad spectrum antibiotic may cause less chance of resistance and side effects -	41	16.08	214	83.92
(A) True (B) False				
Q. 9. Improved water, sanitation and hygiene (WASH) infrastructure helps in combating antimicrobial resistance –	218	85.49	37	14.51
(A) True (B) False				
Q. 10. Bacteria / Microbes those are extensively drug resistant (XDR) or totally drug - resistance (TDR) are called as superbugs.	196	76.86	59	23.14
(A) True (B) False				
Total	225	88.24	30	11.76
Q. 1. Did you hear the term antibiotic resistance	1852	72.63	698	27.37
(A) Yes (B) No				

TABLE 3: RESPONSE OF ATTITUDE BASED QUESTIONS

Questions with options	Positive response		Neutral response		Negative response	
	No.	%	No.	%	No.	%
Q. 1. Do you think that antimicrobial resistance is one of the biggest threats to global health (A) Agree (B) Disagree (C) Not sure	197	77.25	25	9.81	33	12.94
Q. 2. Do you believe that prescribers should closely adhere to the five rights of drug administration i.e., the right patient, right drug, right dose, right route, and right time (A) Agree (B) Disagree (C) Not sure	228	89.41	5	1.96	22	8.63
Q. 3. Do you believe that restricted uses of antibiotics in livestock are associated with a reduction of the prevalence of antimicrobial resistance in humans (A) Agree (B) Disagree (C) Not sure	169	66.27	32	12.55	54	21.18
Q. 4. Do you think that clinical misuse of antibiotics by healthcare professionals may lead to antimicrobial resistance (A) Agree (B) Disagree (C) Not sure	216	84.71	6	2.35	33	12.94
Q. 5. Do you believe that a legal framework is needed to prevent and control antimicrobial resistance (A) Agree (B) Disagree (C) Not sure	210	82.35	17	6.67	28	10.98
Total	1020	80	85	6.67	170	13.33

Table 3 shows the attitude of students towards the use and resistance of antibiotics. 77.25% of students think that antimicrobial is one of the biggest threats to global health. 89.41% of participants showed a positive attitude toward the rational uses (*i.e.* right drug, right patient, right dose, right route and right time) of antibiotics. 84.71% of students think that healthcare professionals' clinical misuse of antibiotics may lead to antimicrobial resistance. 82.35% of participants were positive in that the legal framework is needed to prevent and control

antimicrobial resistance. A maximum negative attitude (21.8%) was seen regarding the restricted use of antibiotics in livestock, which is associated with reducing the prevalence of antimicrobial resistance in humans. Overall, 80% of participants have a positive attitude, 6.67% have a neutral and 13.33% possess a negative attitude regarding antibiotic use and resistance. Practice related to antibiotic use and resistance was assessed by 5 questionnaires which are described in **Table 4**. Maximum students (80.39%) were proactive in using the same antibiotic for relatives/friends for

similar illnesses, even if they are not certified medical professionals. 71.37% of participants were proactive regarding pressurizing the doctor to prescribe antibiotics for cold and cough. 61.18% of students were proactive in self-medication. 57.65% showed passive response to attending conferences, seminars, etc., to combat antimicrobial resistance.

45.49% were passive in case of properly disposing of unused or expired medication. Overall, 61.96% were proactive, whereas 38.04% were passive in practice regarding antibiotic use and antibiotic resistance. Overall KAP score was found to be 74.89% **Table 5**.

TABLE 4: RESPONSE TO PRACTICE-BASED QUESTIONS

Question with response	Proactive response		Passive response	
	No.	%	No.	%
Q. 1. Do you take self-medication (A) Yes (B) No	156	61.18	99	38.82
Q. 2. Do you suggest the same antibiotic for relatives/friends with similar illnesses, even you are not a certified medical professional (A) Yes (B) No	205	80.39	50	19.61
Q. 3. Have you ever attended any conferences or seminars etc. regarding to combat antimicrobial resistance (A) Yes (B) No	108	42.35	147	57.65
Q. 4. If you have a cold and cough; do you pressure the doctor to prescribe antibiotics for this (A) Yes (B) No	182	71.37	73	28.63
Q. 5. Have you properly dispose of unused or expired medication (A) Yes (B) No	139	54.51	116	45.49
Total	790	61.96	485	38.04

TABLE 5: SECTION WISE KAP SCORE

Measures	Maximum score	Score obtained	Percentage
Knowledge	2550	1857	72.82
Attitude	2550	2125	83.33
Practice	1275	792	62.11
Total (KAP)	6375	4774	74.89

DISCUSSION: The development of antibiotics revolutionized the treatment of a disease that was previously incurable disease such as tuberculosis and syphilis¹. However, since that time, overuse and continued use of antibiotics have led to antimicrobial resistance. Antimicrobial resistance is increasing globally due to increased prescription and dispensing of antibiotics and poses a major public health threat worldwide¹⁶⁻¹⁹. Global collective actions are needed to combat antimicrobial resistance.

The present study assessed the knowledge, attitude, and practice regarding antibiotic usage and antibiotic resistance among medical students. In our study, we found a total KAP score is 74.89%. Self-medication is one of the primary reasons for evaluating antimicrobial resistance⁸. More than 90% of participants replied that self-medication without prescription can contribute to antimicrobial resistance in this study. This is akin to a study done by Shubha R *et al* and Zafar SN *et al*²⁰⁻²¹. The

majority of students were not aware of Red Line Campaign and whether to use or not use antibiotics in viral infections. In the knowledge section, 72.63% of medical students gave correct responses, indicating that most participants had good knowledge of the appropriate use and misuse of antibiotics. These results are in accordance with other studies carried out by Khan AA *et al.* and Mukharjee *et al.*²²⁻²³. Our study showed that attitude toward rational use is very good (89.41%).

The overall total score of the attitude section was 80%, which indicates a very good attitude towards forming a legal framework to prevent this global threat and promote rational prescribing. These results are in accordance with the study carried out by Tajuddin Shaik *et al.*²⁴. The current study has demonstrated that the student's attitude was not adequate as compared to knowledge level. Various studies done by Suaifan GA *et al.*, Afzal Khan *et al.* and Sharma S also reported inadequacy in attitude as compared to knowledge²⁵⁻²⁷. In the

practice section, overall 61.96 % showed proactive response while 38.04% were associated with passive response. The majority of participants (57.65%) never attended any conferences or seminars *etc.*, regarding combat antimicrobial resistance. Self-medication and the suggestion of the same antibiotics for relatives/ friends for similar illness without ongoing other factors are the two most important practical factors contributing to antimicrobial resistance. Our study results are akin to study done by Kanika Khajuria *et al*²⁸.

In India, to promote awareness regarding AMR, antibiotic stewardship, prevention of infection, and control was initiated through the collaboration of the office of the national chair of clinical pharmacology, ICMR, and the Christain Medical College, Vellore in 2012²⁹. A similar program was started in UK in 2014 to improve antimicrobial prescribing behaviors focusing on commitment and accountability for optimal antimicrobial use and interventions to avoid antimicrobial resistance³⁰⁻³¹. WHO has also recommended training for medical undergraduates regarding the prudent prescription of antimicrobials to provide better awareness/knowledge of antimicrobial use and resistance³². We need much more effort in updating the students regarding antibiotic usage and resistance and placing more emphasis on their academics' core curriculum to become more responsible for the judicious use of antibiotics. A study done by Huang Y *et al.* emphasized that antibiotic knowledge and attitude education should be strengthened³³.

Limitation of the Study: This was a recall-based self-reported data study. The major limitation of this study was that it might not represent the overall scenario of all medical students of India.

CONCLUSION: In the present study, medical students possessed good knowledge, positivity, and attitude toward antibiotic use and antibiotic resistance; however, it is important to update them and create more awareness regarding antibiotic resistance. Therefore, their curriculum should also be modified and should incorporate the different aspects of antibiotic use and resistance. This educational intervention should not aim to enhance the knowledge section and create a better attitude and practice section regarding the use and

resistance of antibiotics. There is a need to incorporate a better learning program for prescribing antibiotics and infection control at the earliest stage of medical education. In this regard, the National program on containment of antimicrobial resistance initiative by the Indian Government may be the game-changer.

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