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Acquaintance and Awareness of Budding Physicians toward Antimicrobials' Use: Need of the Hour

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Abstract

Background Development of new antibiotics has been slow in the past decades, despite the urgent need. Final-year undergraduate students, interns, and postgraduate students are future prescribers of antimicrobials. It is important they have proper knowledge and attitude toward antibiotic prescription, so that antibiotic resistance could be dealt wisely.

Aims The aim of this study was to assess the knowledge and attitude of undergraduate, interns, and postgraduate medical students regarding antimicrobials, antibiotics resistance, and associated factors.

Methodology A total of 150 final-year medical students, interns, and resident doctors were included, 50 in each group. Participants were contacted individually and were asked to fill a prevalidated questionnaire. Information was collected on three broad categories: basic information about antimicrobials, knowledge regarding treatment of common infections, and belief and attitude toward antimicrobials. Percentages were calculated for the categorical data and chi-squared test was used for univariate analysis of the categorical data, where *p*-value less than 0.05 was considered to be significant.

Results Precisely, 80.67% were able to answer which type of infections need antibiotics; 19.33% responded that both viral and bacterial infections need antibiotics; 44.67% preferred using broad-spectrum antibiotics for definitive treatment; 28.66% answered macrolides as most commonly used for upper respiratory tract infection; 56% considered fluoroquinolones are most commonly used for urinary tract infection with *p*-value less than 0.05 between the groups; 43.33% were unaware of the infection control program; while 72.66% were unaware about the antibiotic policy in their institute.

Conclusion The majority had sufficient basic knowledge about antibiotics, yet there were areas for concern. Study findings may help to formulate new learning objectives for medical students to inculcate proper knowledge and attitude toward antibiotic prescription.

Keywords
- antibiotic prescription
- antimicrobial resistance
- antibiotic policy
- medical students
- knowledge
- attitude and belief

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Introduction

Antibiotic resistance is a worldwide problem. The World Health Organization has predicted that there will be approximately 10 million deaths due to antibiotics resistance in 2050.[1] Despite the urgent need, development of new antibiotics has been slow in past decades.[2,3] In such a scenario, we have to utilize the available antibiotics with wisdom otherwise that day is not far when we will reenter into preantibiotic era. The widespread use as well as misuse of antibiotics in clinical practice are the root causes behind the increasing problem of resistance.[4] Interventions to promote responsible prescription of antibiotics should start right from the undergraduate medical students' training program and should continue thereafter.[5]

Final-year undergraduate students learn about infectious disease diagnosis, antibiotic prescription, and its relation with antibiotic resistance during their undergraduate training, but they do not have practical experience of prescribing antibiotics. During their 1-year rotating internship after completion of undergraduation, no special training is provided for antibiotics prescription and about its complications. Majority of interns are not prescribing antibiotics during this period. Postgraduate students are actually prescribing antibiotics during their clinic hours, though no special training is provided to them about the restrengthening of pharmacology of antibiotics.

An Australian study has reported that medical students lack confidence in their knowledge of infectious diseases and their treatment.[6] Another study from South Africa has reported that final-year medical students lack confidence in prescribing antibiotics and most students would prefer more education in this area.[7] A recent systematic review of literature has concluded that final-year medical students had insufficient competencies to prescribe antibiotics effectively and safely.[8]

Final-year undergraduate students, interns, and postgraduate students are future prescribers of antimicrobial agents. It is very important that they have proper knowledge as well as proper attitude toward antibiotic prescription, so that medical fraternity could deal wisely with antibiotic resistance. Studies have been conducted in India on physicians' antibiotic prescribing practices, but very few have been done on final-year medical students and none of them have included interns as well as postgraduate students.[9,10]

This study was thus planned to assess knowledge and attitude of undergraduate, interns, and postgraduate medical students regarding antimicrobials, antibiotics resistance, and associated factors, thereby to know how much they are ready to prescribe antimicrobials.

Methods

Setting and Participants

We conducted a survey of final-year undergraduate medical students, interns, and postgraduate students of a tertiary care teaching hospital using a self-administered questionnaire. In our college, 150 medical students are admitted every year. Due to failure to clear exams or dropping out, approximately 100 to 120 students reach the final year. Similarly, approximately 90 to 100 students enter internship after Bachelor of Medicine and Bachelor of Surgery (MBBS) and approximately 100 students are admitted in postgraduate courses per year. To include at least half of participants from each group, we included 50 each from three groups, that is, final-year undergraduate students, interns, and postgraduate students. Every alternate roll number of final-year undergraduate student was selected for the study. For interns and postgraduate students, their names were arranged alphabetically and every alternate one was selected. This approach helped to remove selection bias. Postgraduate students included in the study were a mix of medical and surgical specialties, who were actually prescribing antibiotics. Specialties such as radiology, laboratory medicine, and pre- and para-clinical subjects were excluded.

Survey Instrument

The questionnaire was prepared after searching literature for comparable studies[6,7,9,10] and in consultation with experts from pharmacology and medicine department. The questionnaire was validated with experts in same field and changes were made according to the suggestions. It was then submitted to 10 undergraduate and postgraduate students for clarity and comprehension of questions. The questionnaire collected information on three broad categories: basic information about antimicrobials, knowledge regarding treatment of common infections, and belief and attitude toward antimicrobials. Questions were asked regarding their knowledge on types of infections and clinical conditions requiring antibiotics, and factors necessary to consider while choosing antibiotics. Their perceptions regarding most common antibiotic used for common infections, antibiotic overuse, antibiotics resistance, and source of information on antibiotics were also recorded. The questionnaire also collected information on their awareness regarding existence of antibiotic policy and infection control program in their hospital. Majority of questions were closed ended, but one last question was open ended in which participants had to suggest one measure to reduce development and spread of antimicrobial resistance.

Survey Administration

After obtaining ethical clearance from Institutional Ethics Committee (No. RNT/Stat/IEC/2019/846 dated June 27, 2019), participants were individually contacted and were asked to fill the form in front of an observer. They had no prior intimation of survey. They were informed in brief about the study and were asked to sign an informed consent form before filling the questionnaire, and those who were not willing were not included in the study.

Statistical Methods

Percentages were calculated for the categorical data for meaningful conclusions. Univariate analysis used the chi-squared test for categorical data. We analyzed all data on

Table 1 Basic knowledge about antimicrobials: part-I

S. no.	Question	Options	Final-year MBBS student: $n = 50$	Intern: $n = 50$	Postgraduate student: $n = 50$	Total (%): $n = 150$
1	Which type of infections need an antibiotic for treatment?	Bacterial	36	41	44	121 (80.67)
		Both bacterial and viral	14	9	6	29 (19.33)
2	Which type of antibiotic should be preferred for definitive treatment of any infection?	Narrow spectrum	31	30	22	83 (55.33)
		Broad spectrum	19	20	28	67 (44.67)
3	Which type of antibiotic should be preferred for empiric treatment of any infection?	Covering all pathogenic bacteria at the site of infection	35	38	38	111 (74)
		Covering all possible bacteria at the site of infection	15	12	12	39 (26)

Abbreviation: MBBS, Bachelor of Medicine and Bachelor of Surgery.
Note: Chi-squared test was applied. No statistically significant difference was found between groups.

Microsoft Excel. All reported *p*-values were two-tailed, and a *p*-value less than 0.05 was considered to be significant.

Results

Total 150 participants were included in the study, 50 in each group, that is, final-year MBBS student, interns, and resident doctors undergoing postgraduation.

Basic Knowledge about Antibiotics

Majority of participants were able to answer which type of infection need antibiotics (80.67%) and which type of antibiotic should be chosen for empirical treatment (74%), with no statistically significant difference between the groups. Only 55.33% of participants answered that narrow-spectrum antibiotic should be prescribed for definitive treatment (*p*-value 0.14), while 44.67% opted for broad spectrum (►**Table 1**).

Among factors indicating need for antibiotics prescription, "presence of purulent discharge" was opted by maximum participants (92%) followed by "to prevent serious complication" (82.67%), "presence of fever" (56.67%), and "when diagnosis is not certain" (39.33%) (►**Table 2**).

For factors to be considered while choosing an antibiotic, most of the given factors in questionnaire were considered significant by majority of participants. Only 46.6% of participants considered cost of treatment as an important factor (►**Table 3**).

Knowledge Regarding Use of Antimicrobials in Common Infections

Precisely, 28.66% of participants answered "macrolides" as most commonly used group of antibiotics for upper respiratory tract infection with statistically significant difference between three groups (*p*-value 0.004), followed by "extended-spectrum penicillin" by 19.33% (►**Table 4**).

Further, 56% of participants answered "fluoroquinolones" as most commonly prescribed group for urinary tract infection, with highly significant difference between three groups

Table 2 Basic knowledge about antibiotics: part-II

S. no.	Factors indicating need for antibiotic prescription	Final-year MBBS student: $n = 50$	Intern: $n = 50$	Postgraduate student: $n = 50$	Total (%): $n = 150$
1	Presence of fever	25	30	30	85 (56.67)
2	Purulent discharge	44	48	46	138 (92)
3	Self-limiting infection	7	5	2	14 (9.33)
4	Diagnosis is not certain	19	20	20	59 (39.33)
5	Prevent serious complications	45	41	38	124 (82.67)
6	Patient request/satisfaction	3	2	0	05 (3.33)
7	Cost of return visit to hospital	2	5	1	08 (5.33)

Abbreviation: MBBS, Bachelor of Medicine and Bachelor of Surgery.

Table 3 Basic knowledge about antibiotics: part-III

S. no.	Factors important to consider while choosing an antibiotic	Final-year MBBS student: $n = 50$	Intern: $n = 50$	Postgraduate student: $n = 50$	Total: $n = 150$
1	Site of infection	33	39	40	112 (74.67)
2	Clinical diagnosis	40	41	40	121 (80.67)
3	Spectrum of antibiotic	47	44	45	136 (90.67)
4	Pharmacokinetic characteristics	36	41	33	110 (73.33)
5	Pregnancy	45	45	44	134 (89.33)
6	Patient is having liver disease	37	39	42	118 (78.67)
7	Patient is having kidney disease	39	37	43	119 (79.33)
8	Local resistant pattern	36	39	34	109 (72.67)
9	Gram staining report	41	42	33	116 (77.33)
10	Culture and sensitivity report	42	47	45	134 (89.33)
11	Standard treatment guidelines	35	35	35	105 (70)
12	Medication cost	26	23	21	70 (46.67)

Abbreviation: MBBS, Bachelor of Medicine and Bachelor of Surgery.

Table 4 Knowledge regarding use of antimicrobials in common infections

S. no.	Question	Options	Final-year MBBS student: $n = 50$	Intern: $n = 50$	PG resident: $n = 50$	Total (%): $n = 150$
1.	Most commonly used antibiotic for upper respiratory tract infection	Extended-spectrum penicillin	8	8	13	29 (17.33)
		First-generation cephalosporin	4	0	1	5 (3.33)
		Second-generation cephalosporin	5	3	2	10 (6.67)
		Third-generation cephalosporin	11	12	4	27 (18)
		Macrolides	7	14	22	43[a] (28.67)
		Fluoroquinolones	6	5	1	12 (8)
		Do not know	9	8	7	24 (16)
2.	Most commonly used antibiotic for uncomplicated urinary tract infection	Extended-spectrum penicillin	4	1	2	7 (4.67)
		First-generation cephalosporin	2	1	0	3 (2)
		Second-generation cephalosporin	1	1	2	4 (2.67)
		Third-generation cephalosporin	13	6	5	24 (16)
		Macrolides	7	4	0	11 (7.33)
		Fluoroquinolones	16	28	40	84[a] (56)
		Do not know	7	9	1	17 (11.33)
3.	Most commonly used antibiotic for preoperative prophylaxis of surgical site infection	Extended-spectrum penicillin	15	10	7	32 (21.33)
		First-generation cephalosporin	6	10	11	27 (18)
		Second-generation cephalosporin	1	3	6	10 (6.67)
		Third-generation cephalosporin	13	14	20	47 (31.33)
		Macrolides	3	2	2	7 (4.67)
		Fluoroquinolones	4	2	0	6 (4)
		Do not know	8	9	4	21 (14)
4.	Antibiotic that has best activity against anaerobes	Ciprofloxacin	3	5	0	8 (5.33)
		Metronidazole	37	43	44	124 (82.67)
		Trimethoprim-sulfamethoxazole	3	0	4	7 (4.67)
		Azithromycin	4	1	0	5 (3.33)
		Do not know	3	1	2	6 (4)

(*Continued*)

Table 4 (*Continued*)

S. no.	Question	Options	Final-year MBBS student: $n = 50$	Intern: $n = 50$	PG resident: $n = 50$	Total (%): $n = 150$
5.	Antimicrobials are required in watery diarrhea for 3 days with no fever	Agree	20	19	9	48[a] (32)
		Disagree	30	31	41	102[a] (68)
6.	Antimicrobials are needed in Rhinitis for 4 days with dry cough	Agree	29	19	7	55[a] (36.67)
		Disagree	21	31	43	95[a] (63.33)

Abbreviation: MBBS, Bachelor of Medicine and Bachelor of Surgery; PG, postgraduate.
Note: Chi-squared test applied.
[a]p-Value < 0.5 (statistically significant) at degree of freedom (df) $= 2$.

(p-value < 0.00001). "Third-generation cephalosporins" (31.33%) were opted as most commonly prescribed antibiotic group for preoperative prophylaxis of surgical site infection followed by "extended-spectrum penicillin" (21.33%) and "first-generation cephalosporins" (18%). Majority of participants (82.66%) correctly answered "metronidazole" as having maximum antianaerobic activity among given antibiotics. Also, 68% participants disagreed that "antimicrobials are required in watery diarrhea for 3 days with no fever," majority of them belonging to "postgraduate resident" group (p-value 0.033), while 63.33% participants disagreed that "antimicrobials are needed in rhinitis for 4 days with dry cough," with majority belonging to "postgraduate resident" group (p-value < 0.0001) (►**Table 4**).

Belief and Attitude Related to Use of Antimicrobial Agents

Overall, 54.66% considered medical textbooks as most common source of information on antimicrobials, 56.67% answered that they are aware about "Infection Control Program" in their hospital (p-value 0.002), while 33.33% of participants reported that they are aware of the "antibiotic policy" in their hospital (►**Table 5**).

However, 88.67% participants disagreed that "prescribing antimicrobials when the patient does not need them do not cause significant damage" while 62% believed that it is difficult to choose correct antimicrobials. Also, 88% participants were of the opinion that antibiotics are overused in their hospital or other hospitals in the country. Besides, 79.33% believed that antimicrobial resistance is a significant problem in their hospital, while 96.67% considered antimicrobial resistance as a worldwide problem (►**Table 5**). To prevent development of antimicrobial resistance, most of the students suggested avoiding unnecessary use of antibiotics. Other suggestions given by participants are listed in ►**Table 6**.

Discussion

Antibiotics have played a major role in modern medical and surgical care. Their rampant use and misuse have resulted into antimicrobial resistance, which has now become a global cause for concern. On the other hand, development of new antimicrobials is limited,[2,3] so we have to develop strategies to wisely use available antimicrobials. Medical students, interns, and resident doctors are future prescribers. It is necessary that they possess right knowledge and attitude toward antibiotics prescription as well as prevention of development of resistance. The primary objective of this study was to assess the knowledge and attitude of final-year MBBS students, interns, and resident doctors toward antibiotics and antimicrobial resistance.

In the current study, basic knowledge of participants about antibiotics, factors indicating need for antibiotics, and factors to be considered while choosing an antibiotic was satisfactory among all the three groups. Yet there were some areas of concern, like 19.33% participants responded that both bacterial and viral infections require antibiotic treatment. In a recent study on undergraduate medical students, 34% believed that antibiotics are useful in viral infection.[11] Even clinicians are many times unable to distinguish viral infection from bacterial, which results into inappropriate prescription of antibiotics.[12]

Another major concern was that 44.67% of participants were in favor of using a broad-spectrum antibiotic for definitive treatment of any infection. This response was more from residents as compared with interns and final-year students. Only 46.47% of participants considered medication cost as an important factor to be considered while choosing an antibiotic. As our institute is a government establishment and, in our state, most medicines in government hospitals are available free to patients, thus cost is usually not an important deciding factor for them.

Knowledge regarding treatment of common infections was less in final-year students and interns as compared with resident doctors, and the difference was statistically significant. A systematic literature review has concluded that final-year medical students lack sufficient competencies to prescribe antibiotics safely and effectively.[8] Unlike the senior physicians or infectious specialists who have the experience and knowledge in infection treatment, the junior doctors usually have limited knowledge and skills to reduce the possible risk of antimicrobial resistance.[13]

Table 5 Belief and attitude related to the use of antimicrobial agents

S. no.	Question	Options	Final-year MBBS student: $n = 50$	Intern: $n = 50$	PG resident: $n = 50$	Total (%): $n = 150$
1.	Most common source of information on antibiotics	Medical textbooks	21	33	28	82 (54.67)
		Scientific journals	9	4	6	19 (12.67)
		Scientific meetings	2	0	2	4 (2.67)
		Commercial drug formularies, e.g., CIMS, MIMS	10	4	4	18 (12)
		Materials provided by Medical Representative	4	0	0	4 (2.67)
		Do not know	4	9	10	23 (15.33)
2.	Does an "infection control program" exist in your hospital	Yes	23	34	28	85[a] (56.67)
		No	5	5	14	24[a] (16)
		Do not know	22	11	8	41[a] (27.33)
3.	Is there any "antibiotic policy" existing in your hospital	Yes	15	16	19	50 (33.33)
		No	9	17	15	41 (27.33)
		Do not know	26	17	16	59 (39.33)
4.	Do you believe that it is difficult to choose correct antimicrobials	Yes	32	30	31	93 (62)
		No	18	20	19	57 (38)
5.	Do you believe antimicrobial resistance is a significant problem in your hospital	Yes	37	40	42	119 (79.33)
		No	13	10	8	31 (20.67)
6.	Do you believe antimicrobial resistance is a worldwide problem	Yes	48	47	50	145 (96.67)
		No	2	3	0	5 (3.33)
7.	Do you believe prescribing antimicrobials when the patient does not need them do not cause significant damage	Yes	9	5	3	17 (11.33)
		No	41	45	47	133 (88.67)
8.	Do you believe antibiotics are overused in your hospital or other hospitals in the country	Yes	42	45	45	132 (88)
		No	8	5	5	18 (12)

Abbreviations: CIMS, Current Index of Medical Specialties; MBBS, Bachelor of Medicine and Bachelor of Surgery; MIMS, Monthly Index of Medical Specialties; PG, postgraduate.
Note: Chi-squared test applied.
[a]p-Value < 0.05 (statistically significant) at degree of freedom $= 4$.

In India, detailed lectures are taken on antibiotics, mechanism of development of antimicrobial resistance, and strategies to prevent resistance as part of undergraduate curriculum in Pharmacology. No specific training is given during internship and postgraduation. Antibiotic Stewardship Program has been added recently by National Medical Commission in new competency-based curriculum for medical students.[14] Several international studies have identified gaps in antibiotic prescribing knowledge, and have shown that medical students perceive a need for further training on antibiotic prescribing and antimicrobial stewardship program.[15]

Table 6 Suggestions given by participants to reduce development and spread of antimicrobial resistance

Suggestions	Final MBBS student: $n = 50$	Intern: $n = 50$	PG student: $n = 50$
Use narrow-spectrum/less use of broad-spectrum antibiotics	9	6	3
Avoid unnecessary prescription of antibiotics	19	27	18
Avoid self-prescription/prescription by pharmacist, quacks/avoid OTC prescription of antibiotics	8	7	9
Complete full course	4	–	–
Correct diagnosis of bacterial infection	4	7	–
Increase awareness about proper antibiotic prescription and antibiotic resistance	3	7	6
Need antibiotic policy	2	–	5
Use of culture sensitivity test before prescribing antibiotics	–	7	15

Abbreviations: MBBS, Bachelor of Medicine and Bachelor of Surgery; OTC, over the counter; PG, postgraduate.

Furthermore, 43.33% of participants (including those who said "no" and "do not know") were unaware of existence of "Infection Control Program," while 72.66% (including those who said "yes" and "do not know") were unaware about nonexistence of "Antibiotic Policy" in the institute. Antibiotic policy should be a part of every hospital but unfortunately no such policy exists in most of the hospitals, and also medical students are not taught about such policies. There is a need to aware medical students and interns regarding importance and need of antibiotic policy in every hospital.

More than three-fourths of participants (79.33%) believed that antimicrobial resistance is a significant problem in their institute, with no significant difference of opinion between groups. Majority of participants believed that antibiotics are overused in hospitals nationally and that antimicrobial resistance is a worldwide problem. A similar study done on interns of three teaching hospitals in Ethiopia has identified similar opinions.[16] A European study on medical students has also reported similar results where 92% believed that antibiotic resistance is a national problem.[17]

Limitations

This study was a cross-sectional study with its inherent limitations. The study population was small, with 50 participants in each group. Though microbiologists were consulted during development of project, they were not a part of the investigative team. Inclusion of a microbiologist would have helped the study. Further, this study was done in one center, which makes generalization of results difficult.

Conclusion

Most of the participants in the current study had sufficient basic knowledge about antibiotics. Yet there were some concerns, like unawareness regarding antibiotic's role in viral infection or preference for broad-spectrum antibiotic for definitive treatment. Further knowledge regarding treatment of common infections was less in final-year students and interns as compared with resident doctors. Majority of them believed that antibiotic resistance is a worldwide problem, but most of them were unaware about antibiotic policy. This study has provided a baseline data on knowledge, belief, and attitude of final-year medical students, interns, and resident doctors concerning antibiotics. Recently, new competency-based curriculum for undergraduate students has been implemented in India in which more stress has been given on antibiotic stewardship program. These study findings may help in formulating specific learning objectives for undergraduate students. Further research is required in future involving multiple institutes and to find out the impact of curriculum intervention on antibiotic prescription knowledge and attitude.

Study Location
RNT Medical College, Rajasthan University of Health Science, Udaipur, Rajasthan, India.

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None.

Conflict of Interest
The authors declare that there are no conflicts of interest.

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