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RESEARCH ARTICLE

Antibiotic Stewardship and Resistance: Knowledge, Attitude, and Perception of Undergraduate Medical Students

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ABSTRACT

Introduction: This study aim to evaluate the knowledge, attitude, and perception of undergraduate medical students about antibiotic stewardship. A questionnaire-based survey was conducted among the medical students of Maharajgunj Medical Campus, Nepal from both basic (first two years) and clinical sciences (third year onwards). **Materials and Methods:** Responses were scored to assess the knowledge level of the students, their attitude and perception towards antibiotic stewardship and resistance. **Results:** In this study, 231 out of 450 undergraduate medical students (response rate=51.33%) took part. The mean knowledge, attitude and perception scores of the respondents were 2.41±1.103, 5.69±0.917, and 13.10±1.328 respectively. Though their overall attitude [223 (96.5%)] and perception [230 (99.6%)] towards antibiotic stewardship and resistance were good, their knowledge level seemed unsatisfactory [105 (45.5%)]. Statistically significant difference in the scores between basic science and clinical science students (P<0.001) was seen. **Discussion:** More than half the medical students' knowledge about antimicrobial stewardship and resistance was inadequate. A perceivable difference between scores of basic and clinical science students was observed, suggesting that the knowledge, attitude, and perception of basic science students get better as they enter clinical phase. **Conclusion:** Suitable interventions to address the lag in curriculum should be planned right from basic science level to further strengthen their knowledge regarding antibiotic stewardship and resistance.

Keywords: Antibiotic resistance, antibiotic stewardship, basic sciences, medical students, Nepal

INTRODUCTION

Infection with resistant organisms is associated with an increased morbidity, mortality, and treatment costs.[1] High rates of resistance have been observed in bacteria that cause common healthcare-associated and community-acquired infections in all World Health Organization regions including South-East Asian Regional Office and Nepal. One of the most common causes for emergence of antimicrobial resistance remain the irrational prescription and inappropriate antimicrobial usage.[2-7]

During the last decade, there has been a dramatic drop in the development and approval of new antibacterial agents.[8] In Nepal, 10–42% of patients are inappropriately prescribed antibiotics for therapeutic and prophylactic purposes contributing to severe resistance that remains uncalculated.[9]

Antimicrobial stewardship (AMS) is a systematic effort to educate and persuade prescribers of antimicrobials to follow evidence-based

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prescribing to curtail antimicrobial resistance. There is a paucity of data on knowledge, attitude, and perception among undergraduate medical students in Nepal. This study aims to examine this gap.

MATERIALS AND METHODS

This cross-sectional study was conducted among the medical students, the bachelor of medicine and bachelor of surgery (MBBS) students, of Maharajgunj Medical Campus (MMC), Institute of Medicine (IOM), Maharajgunj, Kathmandu, Nepal, affiliated to Tribhuvan University. This study was conducted for 3 months from July to September 2018 after getting the ethical approval from the Institutional Review Board of IOM.

The inclusion criteria included the students of both the basic sciences (first 2 years) and clinical sciences (3rd year onward) enrolled in the MBBS program at MMC, IOM. Those medical students who were unwilling to participate or sign an informed consent were excluded from the study.

The structure and content of the pro forma were adapted for our setting from the questionnaires used in the previous similar studies.[10,11] The questionnaire was pre-tested among 20 medical students from different medical colleges inside Kathmandu. No major changes were required after the pretesting. Depending on the category, there were single answer responses and five-point Likert scale was used. No additional training was provided and no changes to the curriculum were made before or during the survey period. For data collection, convenience sampling was utilized and questionnaires were distributed to all 450 medical students, of which 231 agreed to participate in the study by signing the consent form.

The first question of the questionnaire assessed the perception of antibiotic resistance between the undergraduates; the second to sixth questions assessed knowledge on antibiotic stewardship and the seventh question weighed their attitude. The respondents answered the questionnaire independently in 15 min using no reference materials, notes, or assistance. Each participant was provided a unique code number to maintain the confidentiality. Responses for the different questions were coded to facilitate data entry and data analysis. Responses from the five-point Likert scale were condensed into three categories: Agree/good, neutral/average, and disagree/poor. The data were then entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) for Windows version 20.0. Armonk, NY: IBM Corp., SPSS Statistics. The level of significance was set at 0.05. Pearson's Chi-square test was utilized for categorical attributes and Student's Independent t-test was used for numerical variables.

Scoring

There were five questions for knowledge evaluation. Correct answer was scored "1" while wrong answer was scored as "0." Each question in the knowledge section had only one correct answer and three wrong answers. This way, a respondent could score a maximum of "5" and a minimum of "0" in this section. For attitude and perception questions, a score of "1" was given to "disagree," a score of "2" was given to "neutral," and a score of "3" was given to "agree." There were two negatively framed statements in perception section for which reverse scoring was done which meant a score of "1" was given to "agree," "2" to "do not know," and "3" to "disagree." There were two questions for attitude and five for perception, therefore, the maximum scores for attitude and perception equaled to "6" and "15," respectively, while the minimum score equaled to "2" and "5," respectively. The total knowledge score, attitude score, and perception score were calculated and analyzed by statistical test for their significance. Those who scored more than or equal to 50% were considered to have "Adequate" knowledge, "Positive" attitude, and "Good" perception. In addition, for the attitude and perception section, the total percentage of students who were neutral, who agreed or who disagreed was evaluated for each statement and the same was also calculated for basic sciences and clinical sciences phase and whether the gap seen among basic and clinical science phase was statistically significant.

RESULTS

A total of 231 out of 450 undergraduate medical students (response rate = 51.33%) participated in the study. Among them, 113 (48.9%) were studying the basic sciences (first 2 years) and 118 (51.1%) were in clinical sciences (3rd year onward). The mean age of the participants was 21.18 ± 1.948 years (SEM = 0.128) with ages ranging from 18 to 26 years. There were 170 (73.6%) males and 61 (26.4%) female.

The knowledge score of all the participants was 2.41 ± 1.103 with a minimum score of 0 and a maximum score of 5, attitude score was 5.69 ± 0.917 with a minimum score of 2 and a maximum score of 6, and perception score was found to be 13.10 ± 1.328 with a minimum score of 7 and maximum of 15 [Table 1].

The difference in all the scores among basic and clinical science students was seen to be statistically significant [Table 1]. Similarly, significant differences were noted between the basic and clinical science medical students who correctly answered the questions [Table 2]. The responses on Likert scale are presented in Table 3 and the adequate knowledge, positive attitude, and good perception percentages are stated in Table 4.

DISCUSSION

The irrational prescription and unchecked over-the-counter sales are the major contributors and antimicrobial resistance is directly related to the usage of antimicrobial agents. Thus, making inappropriate antimicrobial usage as the one of the most common causes to be associated with the emergence of antimicrobial resistance.[12-15] Antimicrobial resistance has limited the physicians' liberty of antimicrobial selection, making it an issue of global concern and one of the biggest threats to human health.[16]

Programs that teach about effective AMS are should be included in trainings for all prescribing clinicians. Similarly, education about antimicrobial resistance and stewardship should be incorporated into curriculum requirements for medical students,

Table 1: Knowledge, attitude, and practice scores among basic and clinical science students

Academic group	Mean±SD	SEM	Minimum	Maximum	*P* value
Knowledge scores (0–5)					
Basic science (113)	2.04±0.995	0.094	0	5	<0.001
Clinical phase (118)	2.76±1.091	0.100	0	4	
Total (231)	2.41±1.103	0.073	0	5	
Attitude scores (2–6)					
Basic science (113)	5.39±1.228	0.116	2	6	<0.001
Clinical phase (118)	5.97±0.205	0.019	4	6	
Total (231)	5.69±0.917	0.060	2	6	
Perception scores (5–15)					
Basic science (113)	12.75±1.455	0.137	7	15	<0.001
Clinical phase (118)	13.44±1.098	0.101	10	15	
Total (231)	13.10±1.328	0.087	7	15	

Independent t-test

Table 2: Knowledge-based questions answered correctly

Questions	Proportion of students who answered correctly n (%)			*P* value
	Total (231)	Basic (113)	Clinical (118)	
Meaning of antibiotic stewardship	161 (69.7)	70 (61.9)	91 (77.1)	0.019
Benefits of antibiotic stewardship	110 (47.6)	45 (39.8)	65 (55.1)	0.020
Correct approaches for antibiotic stewardship	94 (40.7)	35 (31)	59 (50)	0.003
Who was appropriate supervisor?	76 (32.9)	38 (33.6)	38 (32.2)	0.818
Organism used for monitoring antibiotic stewardship program	116 (50.2)	43 (38.1)	73 (61.9)	<0.001

Table 3: Three-point Likert table measuring attitude and perception responses

Statements	Total (*n*=231) Responses as *n* (%)			Basic science (*n*=113) Responses as *n* (%)			Clinical science (*n*=118) Responses as *n* (%)		
	Disagree	Neutral	Agree	Disagree	Neutral	Agree	Disagree	Neutral	Agree
Good knowledge of antibiotics is important to my work as a doctor	18 (7.8)	5 (2.2)	208 (90)	17 (15)	4 (3.5)	92 (81.4)	1 (0.8)	1 (0.8)	116 (98.3)
I would like to have more education on antibiotic stewardship	13 (5.6)	5 (2.2)	213 (92.2)	13 (11.5)	5 (4.4)	95 (84.1)	-	-	118 (100)
Antibiotic resistance is not a significant problem in Nepal	215 (93.1)	2 (0.9)	14 (6.1)	105 (92.9)	1 (0.9)	7 (6.2)	110 (93.2)	1 (0.8)	7 (5.9)
Antibiotics are overused in Nepal	16 (6.9)	10 (4.3)	205 (88.7)	13 (11.5)	9 (8)	91 (80.5)	3 (2.5)	1 (0.8)	114 (96.6)
Inappropriate use of antibiotics causes antibiotic resistance	4 (1.7)	2 (0.9)	225 (97.4)	3 (2.7)	2 (1.8)	108 (95.6)	1 (0.8)	-	117 (99.2)
New antimicrobials will be developed in the future that will keep up with the problem of "resistance"	53 (22.9)	63 (27.3)	115 (49.8)	27 (23.9)	20 (17.7)	66 (58.4)	26 (22)	43 (36.4)	49 (41.5)
Poor infection control practices by health care professional cause spread of antimicrobial resistance	21 (9.1)	21 (9.1)	189 (81.8)	16 (14.2)	12 (10.6)	85 (75.2)	5 (4.2)	9 (7.6)	104 (88.1)

Table 4: Knowledge, attitude, and perception in basic and clinical science students

Academic group	Knowledge n (%)		Attitude n (%)		Perception n (%)	
	Adequate	Inadequate	Positive	Negative	Good	Lacking
Basic science	32 (28.3)	81 (71.7)	105 (92.9)	8 (7.1)	112 (99.1)	1 (0.9)
Clinical science	73 (61.9)	45 (38.1)	118 (100)	-	118 (100)	-
Total	105 (45.5)	126 (54.5)	223 (96.5)	8 (3.5)	230 (99.6)	1 (0.4)
P value	<0.001		0.003		0.489	

Chi-square test

postgraduate residents, and fellows.[14] There have been recommendations to adopt AMS programs in all healthcare facilities.[17-19] The major objectives of AMS are to achieve the best clinical outcomes related to antimicrobial use while minimizing toxicity and other adverse events, limiting the selective pressure on bacterial populations that drive the emergence of antimicrobial-resistant strains. AMS may also reduce excessive costs because of suboptimal antimicrobial use.[18-20]

Thus, it is essential for medical students to receive a proper education on AMS. However, there is lack of data on the knowledge, attitude, and perception of undergraduate students about antibiotic stewardship. Studies testing medical students about antimicrobial use and resistance have been done in different parts of the world.[18] They have consistently shown that medical students recognize the importance of antibiotic prescribing knowledge, but feel inadequately prepared and require more education on how to make antibiotic choices. The proportion of medical students who are acquainted with the term "antibiotic stewardship" is low in this study.

There is a paucity of studies to assess the knowledge, attitude, and perception regarding antibiotic stewardship among medical students in Nepal. In our study, the students from clinical sciences scored more than basic sciences', possibly because of a curricular advantage. However, only 45.5% of total students had adequate knowledge scores implying that curriculum was unsubstantial to raise their knowledge about AMS. About 96.5% had positive attitude and 99.6% had good perception regarding AMS and antimicrobial resistance suggesting a better scenario compared to their knowledge levels. Regarding antibiotics overused in Nepal, 88.7% of our respondents agreed with it which was similar to the findings from other countries.[18] Only 50.2% of the students in this study could recognize *Clostridioides difficile* as the infective organism secondary to the use of antimicrobials compared to 59% in other studies.[18,19]

In a similar study by Abbo *et al.* in American medical students', it was found that only 40% of the participants had ever heard the term "antibiotic stewardship" and 20% of participants believed that new antibiotics will be available in the near future to tackle the problem of antimicrobial resistance. Similarly, 94% of the participants felt that antimicrobials were overused nationally, 98% believed antimicrobial resistance was a significant problem nationally. Nearly nine out of ten medical students regarded strong knowledge of antimicrobials to be important in their medical careers.[18,19] In the current study, 92.2% of the students responded that they would like to have more knowledge on antibiotic stewardship, compared to the other two studies where only 79% and 70% of students responded accordingly.[19] On a positive note, all the students (100% of the respondents) from the clinical science phase agreed on the need for more knowledge on AMS.

Another notable difference, we found in their attitude toward antibiotic resistance was in the belief whether new antibiotics will always keep up with the problem of resistance. Half of the respondents (49.8%) in this study believed that new antibiotics could always keep up with the problem of resistance which is much higher than 20% and 10% as seen in other studies.[17] This alarms us about the lack of awareness about the severity of the problem. Such a large gap in the responses should well be taken care of.

A study by Wasserman *et al.* to test South African medical students' KAP about antimicrobial use and resistance showed that only 64% of the participants had ever heard the term "antibiotic stewardship." Similarly, 15% of the participants believed that new antibiotics were available to deal with the problem of resistance. Likewise, 90% of the participants felt that antimicrobials were overused nationally while the same proportion (90%) believed that inappropriate use of antimicrobials causes antimicrobial resistance. Regarding antimicrobial resistance, 80% believed that it was a significant problem nationally. Almost all the participants regarded a sound knowledge of antimicrobials important to their work as a doctor.[21,22]

A study by Pulcini *et al.* to assess knowledge and perceptions about antibiotic resistance and prescribing among junior doctors in France and Scotland showed that only 23% of the participants at one center (Dundee, Scotland) and 64% of participants at the other center (Nice, France) agreed that drug advertising can lead to antimicrobial resistance. About 95% of participants agreed that antimicrobial resistance was a significant problem nationally. In both the centers, more than 90% of the participants believed antimicrobial resistance could be caused by too many prescriptions.[23]

Antibiotic resistance is now an established threat to global health, and inappropriate prescribing behaviors by clinicians have been implicated as a key contributing factor.[24] Antibiotic stewardship is a key intervention to improve prescribing practices at individual and facility levels. It is essential for medical students about antibiotic stewardship because first, this is the critical time period which forms the foundation of future prescribing patterns. Second, it is mostly left up to the junior doctors to choose antibiotics. This topic has not been dealt with separately in the medical curriculum in our country. Under such circumstances, it is essential to have baseline information regarding the knowledge and attitudes of medical students on antibiotic stewardship.[25]

The major strength of the current study was the evaluation and comparison among both basic as well as clinical level undergraduate medical students. However, the inclusion of students from only a single medical college in Nepal remained the major limitation of this study.

CONCLUSION

Our study suggests that though students have an overall positive attitude and perception toward antibiotic resistance and wish to know more about stewardship and resistance, the average knowledge scores of the participants were below 50%. This suggests that students need to have more knowledge on antibiotic resistance and the stewardship programs need to be revised to prepare the future doctors well enough to tackle this burgeoning threat. The average knowledge, attitude, and perception scores were comparatively better in the clinical sciences' phase than basic science suggesting that students are receiving certain knowledge about antibiotic

resistance and stewardship in the clinical levels. The low knowledge scores suggest that the situation can be ameliorated if antibiotic resistance and stewardship is incorporated in the curriculum right at the basic science levels so that when students enter the clinical, they get to look at the infectious diseases, intensive care, surgery, and similar practices with prior preparedness about antibiotic resistance.

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