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RESEARCH ARTICLE

Emerging causes for antibiotic resistance: Second-year medical undergraduate's perspective: A cross-sectional study

Padmanabha T S, Rajashekar Y R

Department of Pharmacology, Adichunchanagiri Institute of Medical Sciences, BG Nagar, Mandya, Karnataka, India

Correspondence to: Rajashekar Y R, E-mail: rajashekar.yr@gmail.com

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ABSTRACT

Background: The rapid emergence of resistant bacteria is occurring worldwide, endangering the efficacy of antibiotics. So medical students, who are future doctors, should be prepared to use antimicrobials appropriately and will be important partners in antimicrobial stewardship. **Aims and Objectives:** This study aims to investigate second-year medical student's perception of emerging cause for antibiotic resistance (AR) and to bring awareness in them. **Materials and Methods:** A survey, containing 10 questions, on medical student's perception towards factors causing AR was distributed within second-year medical students of Adichunchanagiri Institute of Medical Sciences, B.G. Nagar. Valid responses were obtained from 139 students out of 142 students. Results were analyzed using Statistical Package for the Social Sciences software and expressed in percentages. **Results:** Out of 142 students, 97.89% responded. 58.99% of participants said that most important cause for AR was by mutational change in microorganism due to indiscriminate usage. Other important cause cited by students were unnecessary use of antibiotics for self-limited infections (49.64%); mutational change in pathogens (58.99%); lack of policy to restrict the antibiotic use (52.52%); use of antibiotic to rear animals used for consumption (48.92%); and use of antibiotic for more than prescribed duration (47.48%). **Conclusion:** Although the medical students have a appreciable knowledge of the risk factors contributing to rapid development AR by prescribing antibiotics irrationally as a future physicians. However, they do need more education about this global problem, and therefore an immediate need to address it repeatedly during their medical training with an effective education on antibiotic prescription and AR by incorporating appropriate medical teaching strategies.

KEY WORDS: Antibiotic; Resistance; Medical; Undergraduate

INTRODUCTION

Antibiotic resistance (AR) is a growing problem worldwide, with an often negative impact on patient outcomes.[1] Between 20% and 50% of antibiotic use is either unnecessary or inappropriate[2,3] and decreasing it is a necessary first step to curb AR.

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The reasons behind the emergence and spread of resistant bacteria are many, but antibiotic use is often pointed out as one of the key drivers of resistance.[4,5] All antibiotic use, both rational and irrational contributes to the selection and spread of resistant bacteria. However, the rational antibiotic prescription will prevent the development of resistance as well as decreases the adverse drug reaction in the patients.[6] The fact is that as long as we choose to use antibiotics, there will be a risk of AR emerging. Studies have shown a strong correlation between the levels of antibiotic use and AR, where populations with lower levels of antibiotic use also have lower levels of resistant bacteria.[7]

Antimicrobial resistance (AMR) reduces the effectiveness of treatment and increases the risk of spreading resistant

microorganisms to others patients. For example, the emergence of *Plasmodium falciparum* resistance to artemisinin in the Greater Mekong subregion is an urgent public health concern that is threatening global efforts to reduce the burden of malaria.[5]

Targeting clinical behaviors is important because it might be difficult to change the professional habits that have already been established for a long time-period or during their medical course. Exposing medical students to training on AR as well as motivate and support them in taking action on the problem should, therefore, be a key component in any comprehensive AR strategy.[8]

We all know that AR has emerged as one of the greatest global health challenges to be addressed in the 21st century.[4]

Major concern is AMR can hamper the control of infectious diseases, increases the costs of health care, jeopardizes health-care gains to society and potential to threaten health security, and damage trade and economies.[5]

Since coordinated action of people, health-care workers, pharmacists, policymakers, etc., is required to minimize emergence and spread of AMR and by the following resistance-taking tips such as using antibiotics only when they are prescribed by a certified health professional; completing the full treatment course, even if they feel better; never sharing antibiotics with others or using leftover prescriptions.[5]

Hence, it is important to assess the knowledge on reasons for AR in medical students to understand how to break bad habits of irresponsible use of antibiotics. With the aim to obtain better insight to medical student's attitude towards the AR risk factors, we performed a survey among second-year medical graduates. The study aimed to investigate medical students' perception of underlying reasons for the AR problem.

Aims and Objectives

- To assess the knowledge of underlying causes related to AR in medical undergraduate students
- To bridge the gap of knowledge on AMR among students.

MATERIALS AND METHODS

The questionnaire was distributed to a batch of 142 medical students in their 2nd year of MBBS in July 2016, whereby their knowledge regarding AR causative factors was assessed by a 3-point Likert scale, whose responses ranged from "important," "unsure." and "unimportant." Ethical approval was obtained from the Institutional Ethical Committee, and informed consent was taken before participating.

Settings and Design

Cross-sectional, questionnaire-based survey.

Statistical Analysis

The data were analyzed using simple descriptive statistics to generate frequencies, percentages, and proportions using Statistical Package for the Social Sciences software and Microsoft Excel.

RESULTS

Out of 142 students, 139 (97.89%) returned fully completed the questionnaire. Indiscriminate antimicrobial use leads to the emergence of the growing problem of resistance by mutational change in microorganism was known to $n = 82$ (58.99%) of the participants. 73 (52.52%) of restrictions on antibiotic usage is important and a serious global public health issue. Table 1 and Figure 1 show the graphical representation of the responses.

Most important cause cited by students were unnecessary use antibiotics for self-limited infections (49.64%); mutational change in pathogens (58.99%); lack of policy to restrict the to restrict the antibiotic use (52.52%); use of antibiotic to rear animals used for consumption (48.92%); and use of antibiotic for more than prescribed duration (47.48%).

DISCUSSION

The emergence of bacterial strains resistant to antimicrobial agents presents a growing concern worldwide.[9]

In the present study, 35.25% cited antibiotic use in self-limited non-bacterial infection, that is, viral infection can cause AR, with 64.74 % were unsure and said it is not an important reason. Majority of them were not sure whether to use broad-spectrum antibiotics (41.73%) and using antibiotic for less than the prescribed period was the reason for resistance (43.17%). Only 33.09% said that poor infection control measures can cause AR. 49.64% said it was unnecessary to use antibiotic for self-limited bacterial infections. 58.27% were unsure about the empirical antibiotic therapy is the cause AR. Majority of them agreed that AR could be developed due to mutation in the microorganisms or lack of antibiotic usage protocol or use of antibiotic for rearing the animal stocks for consumption and use of antibiotic for period longer than the scheduled period.

In the present study, important causes of AMR, most of them opted for mutational and evolutionary changes in the microorganism and lack of restrictions on the antibiotic usage as very important causes which is similar to study conducted by Khan et al.[10]

Table 1: Reasons cited by medical undergraduates toward cause for emerging antibiotic resistance

Questions	Reasons for development of AR	*n* (%)		
		Important	Unsure	Unimportant
Q1	Use of antibiotics for self-limited non-bacterial infections	49 (35.25)	62 (44.60)	28 (20.14)
Q2	Use of antibiotics with a broader then necessary spectrum	51 (36.69)	58 (41.73)	30 (21.58)
Q3	Use of antibiotics for shorter than standard duration	54 (38.85)	60 (43.17)	25 (17.99)
Q4	Poor infection control measures	46 (33.09)	56 (40.29)	37 (26.62)
Q5	Use of antibiotics for self-limited bacterial infections	69 (49.64)	60 (43.17)	10 (7.19)
Q6	Empirical antibiotic therapy (best guess therapy)	43 (30.94)	81 (58.27)	15 (10.79)
Q7	Mutational and evolutionary changes in the microorganism	82 (58.99)	43 (30.94)	14 (10.07)
Q8	Lack of restrictions on antibiotic usage	73 (52.52)	50 (35.97)	16 (11.51)
Q9	Excessive antibiotic use in livestock (animals reared for food)	68 (48.92)	56 (40.29)	15 (10.79)
Q10	Use of antibiotics for longer than standard duration	66 (47.48)	47 (33.81)	26 (18.71)

AR: Antibiotic resistance

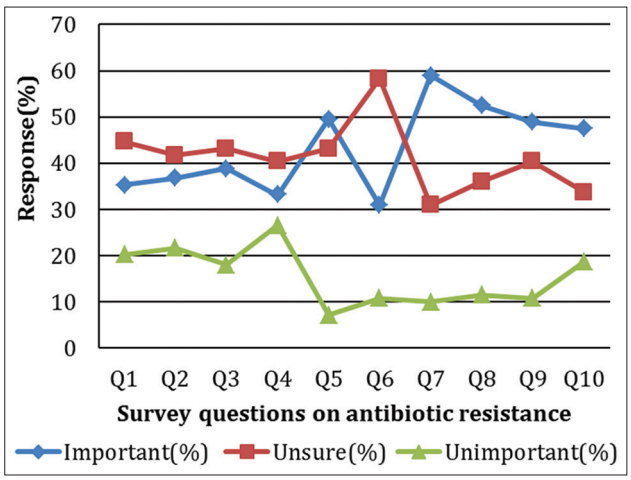

Figure 1: Second-year medical students view on antibiotic resistance causitive factors

Students felt poor infection control measure accounts to less important cause for AR, which was similar to the opinion given by students from Khan et al. study.[10] This fact being one of the poorly addressed factor because of lack of awareness towards infection control from previous studies as well.[11]

Failure to frame and implement the infection control practices at all levels of health-care seems to be the important cause for development and spread of resistant strains.[12] The same reason was highlighted by the present study where poor infection control guidelines can lead to resistance of microorganism towards the currently available antibiotics.

Apart from teaching about antibiotic prescribing, the principles of the protocol development for antibiotic use in health-care facilities should form an integral part of the undergraduate teaching.[12] Learning about the antimicrobial prescribing in pharmacology must be connected clearly with the infection control in microbiology.[13] Simple measures such as hand hygiene which are emphasized in the lectures, for the control of resistance should be inculcated in day-to-day life.[14] The medical education strategies should aim not only to increase the knowledge but also to change the behavior and practices among medical students. They have to be tailored as per the youngster's development, capabilities, and experience.[15]

Nearly 48.92% believed excessive antibiotic use in livestock can account for AR. Scientists also believe that the practice of adding antibiotics to agricultural feed promotes drug resistance. More than half of the antibiotics produced in the United States are used for the agricultural purposes.[16,17]

AMR in pathogens causing important infectious diseases is a matter of great public health concern globally, as well as in India. A major factor responsible for this is the widespread use and availability of practically all antimicrobials over the counter for human as well as animal consumption.[18] With multidrug resistant, organisms being described the long-term prospects are not too good.[19,20]

Nearly 41.73% unsure about the use of antibiotics with a broader than necessary spectrum leads to AR. This fact was seen important in developing AR in Khan et al. study[10] and Giblin et al.[21] Hence, this falsely held belief has to be made aware through proper education on AR.

Majority were unsure about Q1-6, whether it causes AR. Therefore, these important facts and a sense of responsibility should be nurtured by bringing awareness among students, that as prescribers, they are not only responsible for the benefit and the welfare of their patients but also for the society at large.[10]

Nearly 52.52% and 47.48% said lack of restrictions on antibiotic usage and use for longer than standard duration, respectively, may also contribute to major hurdle in combating AR.

It is clear that transmission can only occur once resistance has emerged. The primary goal is therefore to avoid the emergence of resistance.[22] The dominant strategies nationally,

regionally, and globally are as follows: Surveillance of AMR and the tracking of antimicrobial consumption; use of mechanisms to encourage research on and development of new antimicrobials and alternative treatments; and adoption of measures ensuring appropriate and rational use of existing antimicrobials.[23]

Characteristics of strategies that can be followed for containing emergence and transmission of resistance are general strategies applicable to containment of both emergence and transmission of resistance - surveillance and financial incentives, disincentives.[24]

Strategies for containing emergence of resistance are as follows: (1) Education of professionals on appropriate clinical indications; (2) education of patients on inappropriate use and importance of compliance with instructions on taking antimicrobials; (3) rapid diagnosis of bacterial infections; (4) control of sensitivity data related to prescribers; (5) antimicrobial policies; (6) restriction of drug availability; (7) antimicrobial cycling; (8) regulation of use of antimicrobials in agriculture; (9) choosing optimal agent, dose, and dosage frequency for different infections; (10) removal of potential septic foci/prostheses; (11) use of drug combinations; (12) using antiseptics as an alternative to antimicrobials; (13) using cranberry juice as an alternative to antibiotics for urinary tract infection; (14) using probiotics as an alternative to antimicrobials; (15) increasing vaccination to increase immune competence; (16) improving nutrition to increase immune competence; and (17) minimizing time patient is immuno compromised.

Strategies for containing transmission of resistance are as follows: (1) More rapid diagnostic techniques; (2) screening of patients/staff; (3) use of antimicrobials to reduce infectivity; (4) isolation of particular patients; (5) handwashing in particular institutional settings, at national level; (6) improvements in bed spacing; (7) improving immunity by vaccination to reduce susceptibility to infection; and (8) improving nutrition to reduce susceptibility to infection.

Therefore, in the present study, the participants were quite aware of certain things such as mutation in organisms; unrestricted use in humans as well as in animals rearing for food can develop AR gradually and they were lacking in certain areas such as whether to use antibiotic for viral infection; self-limited bacterial infections and for how long to take it, as to be addressed through continued medical education and by bring major changes in the antibiotic educational policies.

Limitations

The main limitation of this study is that the data provided is of local interest. It is based on a convenience sample which involved only second-year medical students from one single teaching hospital.

CONCLUSION

Our study suggests that medical schools should address the gap of knowledge which exists with respect to the antibiotic selection, usage and development of resistance through training them according to the standard guidelines, and make them aware of prescribing practice to safeguard the patient as well as environment from harmful effects of unnecessary use of antibiotic.

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