

Original Research Article

Knowledge of antimicrobial resistance among medical interns in a tertiary care teaching hospital at Karnataka: institution based cross sectional study

Nandhagopal Subramani*, S. J. Nagaveni

School of Environmental Sciences, Public Health and Sanitation Management, Karnataka State Rural Development and Panchayat Raj University, Gadag, Karnataka, India

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*Correspondence:

Dr. Nandhagopal Subramani,

E-mail: nandha23198@gmail.com

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ABSTRACT

Background: Antimicrobial resistance is an escalating global health issue, predominantly fueled by the excessive use and improper application of antimicrobials. Medical interns, as future healthcare providers, play a crucial role in tackling this issue through careful prescribing and patient education.

Methods: A cross-sectional, questionnaire-based study was conducted among medical interns. A structured and validated questionnaire was used to assess their knowledge, regarding antimicrobial resistance. Data were analyzed using descriptive statistics.

Results: A total of 133 participants in the study, in that 71 are males and 62 are females, with a mean age of 23.6 for both groups. findings revealed that (n=119 89.4%) of interns recognized antimicrobial resistance as a significant public health issue. However, only (n=59 44.3%) were aware of antimicrobial stewardship programs. Additionally, (n=93 73.6%) acknowledged the importance of hand hygiene in preventing antimicrobial resistance. Overuse of antimicrobials in hospitals (n=78 58.4%) and incorrect dosing (n=70 52.6%) were the most commonly perceived causes of antimicrobial resistance. Regarding solutions, (n=40 30%) of participants believed completing the full course of antimicrobials was essential, and (n=36 27%) emphasized avoiding self-medication as a crucial step in controlling antimicrobial resistance.

Conclusions: Participants demonstrated a strong understanding of antimicrobial resistance as a significant public health concern, gaps were identified in areas such as antimicrobial stewardship awareness and misconceptions about antibiotic discontinuation. Strengthening antimicrobial stewardship programs and promoting rational prescribing practices will be key in addressing antimicrobial resistance effectively.

Keywords: Antimicrobials, Antimicrobial resistance, Antimicrobial stewardship, Medical interns

INTRODUCTION

An antimicrobial agent is any of a wide range of physical and chemical substances that are used to either kill or stop the growth of microorganisms.¹ Unprecedented advancements in medicine and society have been largely fuelled by antibiotics. Effective antimicrobial therapies are essential for modern medical advancements including major surgery, organ transplants, treating preterm infants,

and cancer chemotherapy.² The systematic misuse and overuse of these pharmaceuticals in human medicine and food production have endangered global health and facilitated the emergence of antimicrobial resistance.³ India faces significant challenges related to antimicrobial resistance, as evidenced by research data from various hospitals. This problem stems from the irrational and improper utilization of antimicrobials, leading to the rising incidence of antimicrobial resistance.^{4,5} The

efficacy of antimicrobial therapy depends on precise diagnosis, appropriate drug selection, accurate dosage, suitable administration route, proper frequency, and sufficient treatment duration.^{6,7} Prescribers are essential in addressing antibiotic resistance by implementing rational prescribing practices and educating patients on proper antibiotic usage.⁸ Although it is recognized that proficiency is essential for the optimal administration of antibiotics, junior personnel are often assigned the responsibility of making prescription decisions. These staff members may not receive training from their superiors and may lack the requisite knowledge to prescribe antibiotics optimally.⁹ To lessen the magnitude of the antibiotic resistance problem, doctors and future prescribers must change their antimicrobial prescribing behaviour.¹⁰ Medical interns will practise as primary care physicians, by judiciously prescribing medications and enhancing patient education, these future prescribers act as primary defenders against antimicrobial resistance.¹¹

Hence, this study aimed to assess the current understanding of antimicrobial resistance among interns and identify gaps in their knowledge.

METHODS

The present study was questionnaire based cross-sectional study that was proceeded among medical interns of tertiary care teaching hospital at Gadag, Karnataka, from January to February 2023. After getting approval from institutional ethical committee. A comprehensive enumeration of all the medical interns (total 154) of the tertiary care teaching hospital was done.

Inclusion criteria

All the medical interns were included in the study.

Exclusion criteria

Interns who were not willing to participate, the study did not include questionnaires with more than 20% incomplete answers.

Study tool

A structured pre-tested and validated questionnaire was used it contains socio-demographic details of the study participants, another part contains 16 questions related to knowledge of antimicrobial resistance, one question related to perceived cause of medical interns towards antimicrobial resistance and another question related to solution for growing problem of antimicrobial resistance. Knowledge part of the questionnaire contains yes, no, and uncertain options, with one correct answer for each question. One mark is given for each correct answer, and

zero marks are given for wrong answers and uncertain options. Grading was done as poor ($\leq 50\%$ correct response), adequate (51-75% correct response), and good ($\geq 75\%$ correct response).

Study procedure

The objectives of the study were explained to each intern, and their consent to participate in the study was obtained, the questionnaire was distributed and the participants were requested to complete it anonymously.

Statistical analysis

Participants completed questionnaires were collected, the data was organized on an excel spreadsheet, and descriptive statistics were employed to interpret the results as frequency, and percentages.

RESULTS

A total of 133 medical interns who had participated in the study. Among the participants 71 were male and 62 were female participants. With mean age of the study participants was 23.6 years.

The knowledge of respondents towards antimicrobial resistance is shown in Table 1, more than (n=92, 69.1%) participants answered correctly for antibiotics were not indicated to reduce any kind of pain and inflammation, smaller number of (n=17, 12.7%) interns were uncertain about the effect of antimicrobials on good bacteria existing in our body, (n=38 28.5%) answered yes that antibiotics should be discontinued once symptoms of illness get resolved, the majority of (n=88, 66.1%) interns answered yes for the importance of doing an antibiogram before prescribing an antibiotic, Only (n=59, 44.3%) were aware of antimicrobial stewardship indicating that 56.7% of participants lack of knowledge and implementation strategies regarding antimicrobial stewardship program. Antimicrobial resistance is a public health issue facing all over the world (n=119, 89.4%) participants are answered yes, and (n=29, 21.8%) interns answered yes for skipping one or two doses does not contribute for development of antimicrobial resistance, for the infectivity of resistant bacteria that can be passed from person to person (n=96, 72.1%) of interns said yes, (n=91, 68.4%) interns responded in the affirmative for antimicrobial resistance may affect patients who may have a longer hospital stay and incur additional costs, hand washing in health care sector plays important role in preventing antimicrobial resistance (n=98, 73.6) are answered yes. Overall distribution of knowledge among medical interns, (n=83, 62.4%) have good knowledge and (n=49, 36.8%) have adequate knowledge and (n=1, 0.75%) have poor knowledge.

Table 1: Distribution of knowledge about antimicrobial resistance (n=133).

Knowledge parameters	Yes N (%)	No N (%)	Uncertain N (%)
Antibiotic are indicated to reduce any kind of pain and inflammation	35 (26.3)	92 (68.1)	6 (4.5)
Antiretroviral therapy will reduce the viral load	129 (96.9)	4 (3)	0
Second line drugs generally used for treatment of resistant strains and hence safer than first line drugs	30 (22.5)	95 (71.4)	8 (6)
Antimicrobials can kill “good bacteria” existing in our body	97 (72.9)	19 (14.2)	17 (12.7)
Antimicrobials can lead to secondary infections following the removal of good microorganisms residing in our body	94 (70.6)	28 (21)	11 (8.2)
It is always better to stop antibiotics once the symptoms of illness get resolved; otherwise, we expose ourselves to unnecessary side effects	38 (28.5)	91 (68.4)	4 (3)
It is important for the prescriber to do antibiogram before prescribing antibiotic	88 (66.1)	29 (21.8)	16 (12)
Are you aware of antimicrobial stewardship	59 (44.3)	52 (39)	22 (16.5)
Are you aware of antibiotic policy in India	65 (48.8)	49 (36.8)	19 (14.2)
Antimicrobial resistance is a phenomenon in which a bacterium, virus, fungi losses its sensitivity to an antimicrobial	115 (86.4)	14 (10.5)	4 (3)
Skipping one or two doses not contribute to the development of antimicrobial resistance	29 (21.8)	86 (64.6)	18 (13.5)
Antimicrobial resistance is an important and serious public health issue facing the world	119 (89.4)	10 (7.5)	4 (3)
Bacteria which are resistant to antibiotic can spread from person to person	96 (72.1)	25 (18.7)	12 (9)
Multi drug resistance is not a problem in case of malaria	26 (19.5)	86 (64.6)	21 (15.7)
Anti-microbial resistance doesn’t affect much, younger people as it is a problem for elderly people only	19 (14.2)	104 (78.1)	10 (7.5)
Antimicrobial resistance can lead to prolongation of hospital stay	91 (68.4)	36 (27)	6 (4.5)
Antibiotic resistance could make medical procedure like surgery, organ transplants and cancer treatment much more dangerous	102 (76.6)	18 (13.5)	13 (9.7)
Hand washing in health care set up has got an important role to play in prevention of anti-microbial resistance	98 (73.63)	26 (19.5)	9 (6.7)

Table 2: Perceived cause of AMR (n=133).

Perceived cause of antimicrobial resistance in India	N (%)
Overuse in hospitals	78 (58.6)
Overuse in community	65 (48.8)
Overuse in animals	8 (6)
Incorrect dosing/duration	70 (52.6)
Improper regulations	64 (48.1)
Improper hospital infection control	50 (37.5)
Inadequate diagnostic support	55 (41.3)
Inadequate immunization	19 (14.2)
Poor quality of antimicrobials	21 (15.7)
All of the above	25 (18.7)

*Participants asked to select one or multiple answers.

The perceived cause of antimicrobial resistance among interns is shown in Table 2. Most frequently cited cause n=78 58.6% indicating that excessive antimicrobial use in healthcare settings is a major concern, many respondents n=70, 52.6% believe that improper use of antibiotics, such as incorrect dosages or duration, highly contributes to antimicrobial resistance, n=55, 41.3% respondents feel

that a lack of proper diagnostic tools leads to unnecessary or inappropriate antibiotic prescriptions.

Table 3: Solution for the AMR (n=133).

Solution for the growing problem of antimicrobial resistance	N (%)
Judicious, careful and rational use of medicines	38 (28.5)
Complete the full course of antimicrobials in the prescribed dose	40 (30)
Avoid self-medication	36 (27)
Multidrug therapy	18 (13.5)
Symptomatic management in self-limiting conditions	20 (15)
Awareness among patients by organising public health campaigns	15 (11.2)
Prescribe using culture sensitivity reports	17 (12.7)
New drug discovery	4 (3)
All the above	32 (24)
None of the above	0 (0)

*Participants asked to select one or multiple answers.

18.7% (n=25) participants believe that antimicrobial resistance is caused by a combination of all these factors.

The solution for the growing problem of antimicrobial resistance is shown in Table 3. 28.5% (n=38) respondents believe that antibiotics should only be used when necessary and in an appropriate manner. The most frequently (n=40, 30%) suggested solution, indicating that ensuring patients follow their prescribed antibiotic regimen is crucial to preventing resistance.

12.7% (n=17) respondents believe using lab tests to determine the most effective antibiotics is seen as a good practice.

DISCUSSION

Antimicrobial resistance is a significant issue for public health, a rise in antimicrobial resistance is causing dreadful rates of morbidity and mortality at a comprehensive level. Importing knowledge concerning AMR and the proper use of antimicrobials is indispensable in bringing down the rising menace of AMR. Medical interns are going to work community level and have more chance to play vital role in educating people about growing health problems. In the present study assessed the knowledge of medical interns regarding antimicrobial resistance.

In the present study, 69.1% of participants correctly identified that antibiotics are not indicated for reducing pain and inflammation. However, this percentage is lower compared to a study conducted by Gupta et al, where 84.7% of students disagreed with the statement that antibiotics reduce pain and inflammation.¹¹ Similarly, a study by Kaur et al, reported that 91% of participants agreed that antibiotics are not meant for all types of pain and inflammation.¹² A majority of students demonstrated awareness regarding the effects of antimicrobials on beneficial bacteria, with 72.9% of interns acknowledging that antimicrobials can eliminate “good bacteria” in the body. Comparable findings were reported in a study by Kaur et al, where 88% of medical students recognized the effect of antimicrobials on good bacteria.¹² Similarly, Gupta et al., found that 83.5% of students correctly answered the effect of antimicrobials on good bacteria.¹¹ However, a study conducted among medical students in Gujarat by Brahmabhatt et al, showed a lower awareness level, with only 52.3% of second-year medical students responding correctly, indicating that knowledge improves as students’ progress in their medical education.⁹

Regarding secondary infections resulting from the depletion of beneficial microorganisms, 70.6% of participants in the present study answered correctly. This aligns with findings from Chundru et al, where 75.6% of respondents acknowledged that antimicrobials could cause secondary infections by eliminating good bacteria.⁶ In the present study, 28.5% of participants believed that antibiotics should be discontinued once symptoms of

illness resolve. This is consistent with Brahmabhatt et al, where 31.5% of second-year medical students held the same belief, suggesting a persistent misconception that requires further educational intervention.⁹

Knowledge about antimicrobial stewardship was found to be limited, with only 44.3% of participants aware of the antimicrobial stewardship program. Similar findings were reported by Chuntru et al, where 49.41% of participants had heard about antimicrobial stewardship program, and by Badar et al, where awareness was 44%.^{6,13} A total of 64.6% of participants believed that skipping one or two doses of antimicrobials contributes to antimicrobial resistance. This finding is comparable to studies by Bharti et al, 66% and Mahajan et al, 68.6%.^{14,15} Furthermore, 89.4% of interns in the present study recognized antimicrobial resistance as a global public health issue, aligning with studies conducted by Chandan et al, 95% and Mahajan et al, 96%.^{16,15}

Regarding the transmission of resistant bacteria, 72.1% of interns correctly stated that resistant bacteria could be passed from person to person. A study by Nishat et al reported a higher level of knowledge, with 94.2% of participants correctly answered.⁴ However, a study by Nishat et al, among clinicians, only 64.5% were aware of bacterial transmission, indicating a gap in knowledge among practicing healthcare professionals.¹⁷ In terms of AMR’s impact on hospital stay and financial burden, 68.4% of interns in the present study recognized that antimicrobial resistance can prolong hospitalization and increase treatment costs. A higher level of knowledge was observed in the study by Brahmabhatt et al, where 81.5% of participants responded correctly.⁹

76.6% of interns in this study acknowledged that antibiotic resistance could make medical procedures like surgeries, organ transplants, and cancer treatments more dangerous. This percentage is lower compared to a study by Nishat et al, where 83.6% of clinicians recognized this risk, suggesting that hands-on clinical experience may enhance awareness.¹⁷ And in another study by Nishat et al study among interns were 97.5% of response observed which far greater than the present study.⁴ In present study 73.6% interns answered correctly for importance of hand washing in health care play an important role in control and prevention of antimicrobial resistance. It was quite high when compared to other studies done by Nishat et al only 56.7% and in Brahmabhatt et al 66% and Nishat et al 61.8%.^{4,9,17} Continuous knowledge updates and training are essential to ensure appropriate antimicrobial selection, minimize patient complications, reduce hospitalization time, and alleviate the financial burden on patients.

In the present study, participants were given multiple options related to the causative factors of antimicrobial resistance. In that highest percentage of 58.4% for antimicrobial overuse in hospitals, 52.6% incorrect dosing and duration of antimicrobials and 48.8% overuse in community. 48.1% response observed for improper

antimicrobials use guidelines in hospitals and 41.3% responses for inadequate diagnostic support. Only 6% of were answered for antimicrobial overuse in animals. These findings were compared with Chatterjee et al where study participants are clinicians this will help to see difference of perception about perceived causes of antimicrobial resistance between interns and clinicians. Over 71.9% response for antimicrobials overuse in hospitals, 67.9% for incorrect dosing and duration of antimicrobials, 71.5% overuse in community, 44.2% for improper antimicrobial use guidelines in hospitals and 26.4% of were selected overuse in animals.¹⁸ Majority of participants in both studies believed that excess use of antimicrobials both in the hospitals and in community settings contributed to antimicrobial resistance. And similar findings seen in improper antimicrobial use guidelines in hospital one of the causes for development of antimicrobial resistance.

In present study over 30% of response for completing of full course of antimicrobials will help to reduce the growing problem of antimicrobial resistance. Comparing with Bharti et al and Mahajan et al were 15.5% and 18.6% of response for importance of completing full course of antimicrobials.^{14,15} In current study 27% of response for avoid self-medication will help to control antimicrobial resistance and it's the one of the main causative factors for the development of antimicrobial resistance, India is the one of the countries where a greater number of self-medication is existing. In Bharti et al and in Mahajan et al only 14% observed.^{14,15} In present study 15% of response observed for symptomatic management for self-limiting condition's, it was quite high when compare to Bharti et al were only 3.6% and in Mahajan et al 8.1% was observed.^{14,15} Symptomatic management of conditions without knowing real cause or sensitivity report will develop the antimicrobial resistance.

Our study primarily focused on healthcare professionals from a specific institution or region, which may limit the generalizability of the findings to a broader population. Additionally, the data were collected through self-reported responses, which could be influenced by the tendency of participants to provide socially desirable answers, potentially leading to biased or exaggerated results. Furthermore, since the study was conducted within a single institution, the findings may not be directly applicable to healthcare settings with different organizational structures, resources, or patient demographics.

CONCLUSION

This study highlights the knowledge and awareness of antimicrobial resistance among medical interns in a tertiary care teaching hospital. While most participants demonstrated a strong understanding of antimicrobial resistance as a significant public health concern, gaps were identified in areas such as antimicrobial stewardship

awareness and misconceptions about antibiotic discontinuation. Overuse of antimicrobials in healthcare settings, along with incorrect dosing and duration, emerged as key perceived contributors to antimicrobial resistance, aligning with findings from previous research. Although interns showed substantial awareness regarding the consequences of antimicrobial resistance, including prolonged hospital stays and increased risks in medical procedures, there remains a need for targeted educational interventions. The findings emphasize the importance of reinforcing antimicrobial stewardship programs, encouraging rational prescribing practices, and promoting public health campaigns to address this growing issue. Future efforts should focus on the implementation of strict antimicrobial use guidelines, and improved diagnostic support to ensure appropriate prescribing behaviours among healthcare professionals. Addressing these gaps is essential in combating antimicrobial resistance and preserving the effectiveness of antimicrobial therapies for future generations.

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REFERENCES

1. Antimicrobial agent. Description, types, uses, side effects and drug resistance. Britannica. Available at: <https://www.britannica.com/science/antimicrobial-agent>. Accessed on 27 March 2025.
2. World Health Organization. Global antimicrobial resistance surveillance system (GLASS) report: early implementation 2016-2017. 2017. Available at: <https://apps.who.int/iris/handle/10665/259744>. Accessed on 27 March 2025.
3. World health statistics 2024: monitoring health for the SDGs, Sustainable Development Goals. 2024. Available at: <https://iris.who.int/bitstream/handle/10665/376869/9789240094703-eng.pdf>. Accessed on 19 March 2025.
4. Nishat S, Muhaimin Ali MA, Butul M, Sameen S, Siddiqua SA. Knowledge, attitude and practicing behavior regarding antimicrobial use and awareness of antimicrobial resistance among interns and postgraduates in a tertiary care hospital. *Int J Basic Clin Pharmacol*. 2023;12:77-82.
5. Kumar SG, Adithan C, Harish BN, Sujatha S, Roy G, Malini A. Antimicrobial resistance in India: a review. *J Nat Sci Biol Med*. 2013;4(2):286-91.
6. Jayaram Chundru SD, Tirumalareddy RR, Kumari H, Kovilakonda VP. Knowledge, perception and

attitude of under-graduate and post-graduate medical students about antimicrobial use, resistance and stewardship at a tertiary care teaching hospital in rural Telangana, India. *Int J Basic Clin Pharmacol*. 2019;8(2):193.

7. Dryden M, Johnson AP, Ashiru-Oredope D, Sharland M. Using antibiotics responsibly: right drug, right time, right dose, right duration. *J Antimicrob Chemother*. 2011;66(11):2441-3.
8. Ningappa A, Dhanalakshmi T, Shyamanth M. Knowledge, attitude, and practices toward antibiotic usage and antibiotic resistance among medical students and interns: a cross sectional study. *J Med Sci Health*. 2020;06:12-7.
9. Brahmabhatt KR, Patel AB. Knowledge of antimicrobial resistance among undergraduate medical students in a medical college of Gujarat: institution based cross-sectional study. *Int J Community Med Public Health*. 2018;5(2):754-8.
10. Pulcini C, Williams F, Molinari N, Davey P, Nathwani D. Junior doctors' knowledge and perceptions of antibiotic resistance and prescribing: a survey in France and Scotland. *Clin Microbiol Infect*. 2011;17(1):80-7.
11. Gupta MK, Vohra C, Raghav P. Assessment of knowledge, attitudes, and practices about antibiotic resistance among medical students in India. *J Fam Med Prim Care*. 2019;8(9):2864-9.
12. Khajuria K, Kaur S, Sadiq S, Khajuria V. KAP on antibiotic usage and resistance among second professional medical students. *Int J Basic Clin Pharmacol*. 2019;8(1):68-73.
13. Badar V, Parulekar VV, Garate P. Study of knowledge, attitude and practice amongst medical professionals about antimicrobial stewardship in tertiary care teaching hospital in India: a questionnaire based study. *Int J Basic Clin Pharmacol*. 2018;7(3), 511-7.
14. Bharti R, Pathania J, Sood V, Koshewara P, Dewangan T. Assessing the knowledge, attitude, and practice (KAP) of antimicrobial resistant among MBBS, BDS and BSc nursing students in the northern state of India. An observational-based cross-sectional study. *Adv Biosci Clin Med*. 2020;8:10.
15. Mahajan M, Dudhgaonkar D, Deshmukh S. A questionnaire based survey on the knowledge, attitude and practises about antimicrobial resistance and usage among the second year MBBS Students of a Teaching tertiary care Hospital in Central India. *Int J Pharmacol Res*. 2014;4(4):175-9.
16. Chandan NG, Nagabushan H. Assessment of knowledge, attitude and practice of interns towards antibiotic resistance and its prescription in a teaching hospital: a cross-sectional study. *Int J Basic Clin Pharmacol*. 2016;5(2):442-6.
17. Nishat S, Jalal J, Butul M, Akhter SN, Siddiqua SA. Knowledge, attitude and practicing behaviour regarding antimicrobial use and awareness of antimicrobial resistance among clinicians. *Int J Res Med Sci*. 2023;11(1):195-203.
18. Chatterjee S, Hazra A, Chakraverty R, Shafiq N, Pathak A, Trivedi N, et al. Knowledge, attitude, and practice survey on antimicrobial use and resistance among Indian clinicians: a multicentric, cross-sectional study. *Perspect Clin Res*. 2022;13(2):99-105.

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