

Original Research Article

Knowledge, attitude and practicing behaviour regarding antimicrobial use and awareness of antimicrobial resistance among clinicians

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ABSTRACT

Background: Antimicrobials' irrational use is leading to antimicrobial resistance. This situation has become a public health care issue and must be tackled by clinicians. The awareness about antimicrobial resistance and proper usage by patients must be looked after by clinicians. Hence, the present study was taken to determine the knowledge, attitude, and practicing behaviour regarding antimicrobial use and awareness of antimicrobial resistance among clinicians.

Methods: The study was conducted on clinicians in a tertiary care hospital. A standardized questionnaire was distributed to 110 participants and ethical approval was taken before the study. Data was analyzed using SPSS software. For data comparisons, chi-square tests were used. $P \leq 0.05^*$, considered significant.

Results: The study showed a majority in the 25-34 years of age group with male predominance. Many belonged to the 1-10 years of practicing group and the majority were physicians. The antibiotic resistance subject was highly relevant to clinicians, according to them awareness can be spread by proper and precise intake of antibiotics by patients. The relationship between the predominant age group and years of practice revealed good knowledge ($\chi^2=56.703$, $p=0.01$), fair attitude ($\chi^2=69.556$, $p=0.01$), and good practicing behavior ($\chi^2=43.047$, $p=0.01$).

Conclusions: Clinicians were aware of antimicrobial resistance issue globally but irrelevant in their own practice. Patient awareness campaigns and educational programs need to be conducted. Lack of time and patient interest are the barriers to be overcome to spread awareness. The prescribing of antimicrobials should be in a controlled way with the implementation of ethical principles for better patients' health safety.

Keywords: Antimicrobial use, Antimicrobial awareness and resistance, Knowledge, Attitude, Practicing behaviour

INTRODUCTION

Antimicrobials are the most histrionic examples of the developments of modern-day medicine.¹ Overuse and misuse of various antimicrobials have fueled a prime rise in the prevalence of antimicrobial resistance.² An inevitable consequence of such inappropriate usage had made antimicrobial resistance a serious public health care concern.³

India is known as one of the largest and most regular consumers of antibiotics.⁴ Current state of antimicrobial resistance in India is relatively worrisome and irrational use of antimicrobials along with the high incidence of infection, insignificant infection prevention and control are some of the reasons for putting the Indian public healthcare system in a very perilous situation.⁵

The responsibility of sensibly prescribing antimicrobials and implementing strategies to prevent antimicrobial

resistance is on the shoulders of clinicians and health care providers.⁶ There has been sufficient proof that clinicians although aware of the antimicrobial resistance problem, do not follow proper guidelines in their prescribing behavior.⁷ Specifically, newly practicing clinicians are trained incompetently to prescribe antimicrobials carefully.⁸

Encouraging awareness regarding antimicrobials use and resistance among patients by clinicians and various health care providers must be a vital priority.⁹ A plan of action to fight and spread awareness about the inappropriate use of antimicrobials and their resistance must be implemented by clinicians at an individual level.¹⁰ Through this study we aim to assess the knowledge, attitude and practicing behavior regarding antimicrobial use and awareness of antimicrobial resistance among clinicians.

METHODS

Study design and population

A questionnaire-based, cross-sectional study was conducted among clinicians in a tertiary care hospital from June 2022 to August 2022 at Shadan Institute of Medical Sciences (SIMS), teaching hospital and research center. Clinicians belonging to a tertiary care hospital, who were willing to participate in the study were enrolled. Those who were not willing to participate and refused to take questionnaire were excluded from the study. A sample size of 110 was analyzed. It comprises, physicians, surgeons, dentists, pathologists, pharmacologists, dermatologists, orthopedics, microbiologists, and biochemists. Both male and female populations participated in the study.

Data collection

The knowledge, attitude and practicing behavior of the clinicians regarding antimicrobial use and awareness of antimicrobial resistance was assessed based on the 20 questions. They were categorized into four sections. Section-I (6 questions) acquired information on the sociodemographic characteristics of respondents,

Section-II (5 questions) is based on the awareness of antimicrobial resistance, Section-III (6 questions) is about practicing behavior of clinicians and lastly, Section-IV (3 questions) is depicting the guidelines/sources of information of the clinicians. The response rate to the study was hundred percent and the responses marked by the study participants were analyzed accurately. The comparison of knowledge, attitude, and practicing behavior of participants is done on the scale of good ($\geq 70\%$), fair (51-69%), and poor ($\leq 50\%$) based on the percentage of correct responses.

Statistical analysis

The collected data was analyzed with the help of SPSS software. The descriptive analysis of the data is represented as frequency (N) and percentages (%). For data comparisons Chi-square tests were used. $P \leq 0.05^*$, considered significant. The data is depicted in the form of tables and figures.

Ethical approval

The ethical committee letter was obtained before the initiation of the study, (012/SIMS/Research/2022).

RESULTS

A questionnaire of 20 questions highlighting the holistic outlook of knowledge, attitude, and practicing behavior regarding antimicrobial use and awareness of antimicrobial resistance was provided to the study population in a tertiary health care center (100%). A total of 110 clinicians participated from various departments.

Sociodemographic characteristics of participants are shown in Table 1, where male participants (56.4%) were more than female participants (43.6%).

Most of the participants (41.8%), were aged between 25 to 34 years. A high percentage (39.1%) of participants belonged to the practicing group of 1 to 10 years followed by 21 to 30 years (24.5%) of the practicing group. More than half of the participants (54.5%) were physicians, followed by surgeons (18.2%).

Table 1: Socio-demographic characteristics of participants (n=110).

Sociodemographic characteristics	Frequency (N)	Percentage (%)
Age (years)		
18-24	03	2.7
25-34	46	41.8
35-44	13	11.8
45-54	23	20.9
55-64	15	13.7
65-74	10	9.1
Gender		
Male	62	56.4
Female	48	43.6

Continued.

Sociodemographic characteristics	Frequency (N)	Percentage (%)
Health care center		
Tertiary/Referral center	110	100
Profession		
Physician	60	54.5
Surgeon	20	18.2
Dentist	02	1.8
Pathologist	06	5.5
Pharmacologist	08	7.4
Dermatologist	03	2.7
Orthopedic	03	2.7
Microbiologist	05	4.5
Biochemist	03	2.7
Years of practice		
1 to 10	43	39.1
11 to 20	21	19.1
21 to 30	27	24.5
31 to 40	12	10.9
41 to 50	07	6.4

Table 2: Awareness of antimicrobial resistance (n=110).

Awareness of antimicrobial resistance	Frequency (N)	Percentage (%)
How relevant is the subject of antibiotic resistance for your daily work?		
Highly	49	44.5
Moderately	45	40.9
Sparsely	14	12.8
Not at all	02	1.8
How often do you have contact to patients with Multidrug resistant infection during your daily practice?		
Daily	06	5.5
Weekly	22	20
Monthly	43	39.1
Rare	37	33.6
Never	02	1.8

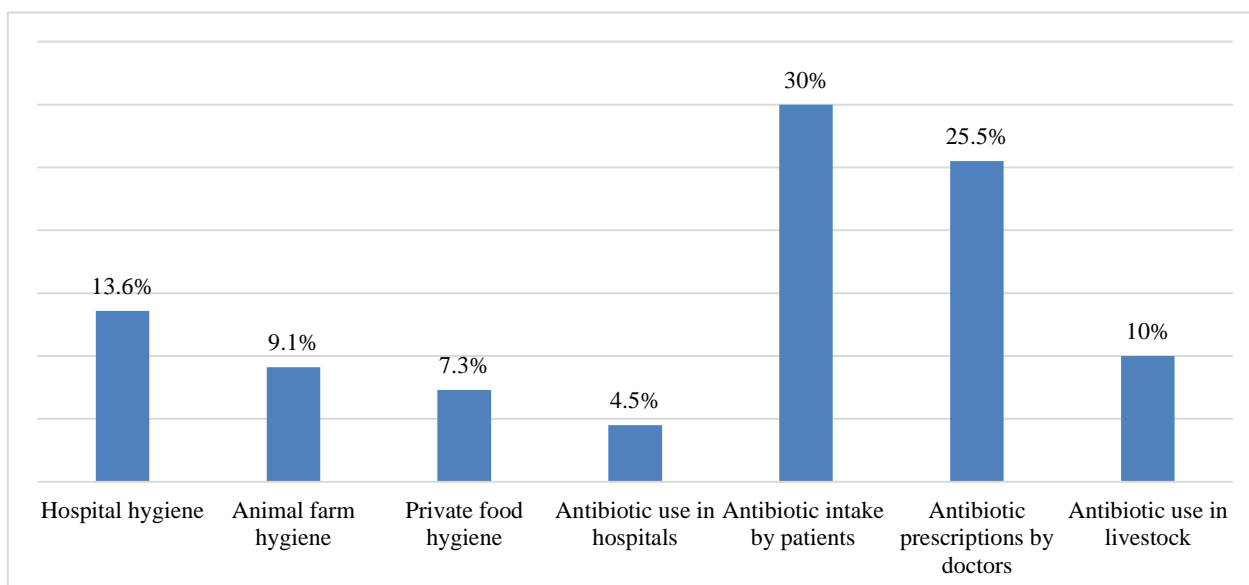


Figure 1: Awareness of anti-microbial resistance.

Table 3: Actual knowledge of participants.

Key knowledge questions	Correct answer	Respondents' answer in frequency (N)	Respondents' answer in percentage (%)
a. Antibiotic resistance occurs when your body becomes resistant to antibiotics, and they no longer work as well	False	False-23 True-87	20.9 79.1
b. Many infections are becoming increasingly resistant to treatment by antibiotics	True	True-89 False-21	80.9 19.1
c. If bacteria are resistant to antibiotics, it can be extremely difficult or impossible to treat the infections, they cause	True	True-92 False-18	83.6 16.4
d. Prescription of antibiotics with overly broad-spectrum coverage can precipitate Antibiotic resistance	True	True-77 False-33	70 30
e. Antibiotic resistance is an issue in other countries but not here	False	False-06 True-104	5.5 94.5
f. Antibiotic resistance is only a problem for people who take antibiotics regularly	False	False-19 True-91	17.3 82.7
g. Bacteria which are resistant to antibiotics can be spread from person to person	True	True-71 False-39	64.5 35.5
h. Antibiotic-resistant infections could make medical procedures like surgery, organ transplants and cancer treatment much more dangerous	True	True-92 False-18	83.6 16.4

Table 4: Addressing the problem of antibiotic resistance.

Addressing the problem of antimicrobial resistance	Frequency (N)	Percentage (%)
Healthcare workers should wash their hands regularly (i.e., disinfect or wash hands, as often as recommended)		
Agree strongly	68	61.8
Agree	33	30
Neither agree nor disagree	09	8.2
Disagree	0	0
Disagree strongly	0	0
Prescribers should only prescribe antibiotics when they are needed		
Agree strongly	78	70.9
Agree	31	28.2
Neither agree nor disagree	01	0.9
Disagree	0	0
Disagree strongly	0	0

Awareness of antimicrobial resistance can be seen in Table 2, a majority (44.5%) agreed that the subject of antibiotic resistance is highly relevant to them. In their daily practice, a high percentage (39.1%) of clinicians said to have monthly contact with patients having multidrug-resistant infections. Figure 1 reveals a majority percentage (30%), according to them the means to spread awareness on the development of antimicrobial resistance can be through appropriate antibiotic intake by patients. The actual knowledge of the participants is tested in Table 3, the highest percentage (83.6%) of responses were for the statement, "If bacteria are resistant to antibiotics, it can be extremely difficult or impossible to treat the infections, they cause". Table 4 is about, addressing the problem of antibiotic resistance, where most of the participants strongly agreed that healthcare workers should wash their hands regularly (61.8%) and

prescribers should only prescribe antibiotics when they are needed (70.9%).

Table 5 is depicting the practicing behavior, where many of the participants (76.4%) said, the influence of prescribing behavior on the development of antibiotic resistance within a region is a crucial factor while practicing. A majority agreed that lack of patient interest (58.2%) and lack of time (20.9%) are key barriers to discussing antimicrobial resistance while prescribing. According to 32.7% the use of delayed antibiotic prescribing strategy is implemented by them often. The participants during their practice observed that the patients understanding about antimicrobial resistance is good (85.5%), but they lack the knowledge about superbugs (14.5%). For the majority (32.7%), the reason for prescribing antibiotics without an indication is to be

on the safe side. Skin or wound infection is an indication for an antibiotic prescription for a high percentage (24.5%) of the participants (Figure 2).

Table 6 is revealing about the guidelines/sources of information for the participants. 43.6%, used practicing guidelines for antibiotic therapy during daily work moderately. Highest percentage (96.4%) of participants, desired to have more evidence-based therapy guidelines.

Most of the participants (78.2%) considered online scientific journals as their means to get current information on antibiotic therapy and resistance (Figure 3).

The comparison of knowledge, attitude, and practicing behavior of participants is done on the scale of good ($\geq 70\%$), fair (51-69%), and poor ($\leq 50\%$) based on the percentage of correct responses.

Table 5: Practicing behavior (n=110).

Practicing behavior	Frequency (N)	Percentage (%)
Influence of prescribing behavior on the development of antibiotic resistance within region		
Yes	84	76.4
No	15	13.6
Do not know	11	10
Barriers to discussing antimicrobial resistance with patients while prescribing		
Lack of time	23	20.9
Lack of patient's interest	64	58.2
Concern that it will unsettle the patient	07	6.4
Limited knowledge about the subject	16	14.5
Use of delayed antibiotic prescribing strategy		
Strategy not known	15	13.6
Very often	20	18.3
Often	36	32.7
Sometimes	29	26.4
Rarely	05	4.5
Never	05	4.5
Do your patients understand		
Antimicrobial resistance	94	85.5
Superbugs	16	14.5
Reasons for prescribing antibiotics without an indication		
If the patient wants to get back to work quickly	09	8.2
If the patient demands an antibiotic	13	11.8
If the patient is incompliant	07	6.4
Language barriers or cognitive impairments	04	3.6
Because further diagnostics are too expensive	18	16.4
To be on the safe side	36	32.7
None of the above (will not prescribe without a diagnosis)	23	20.9

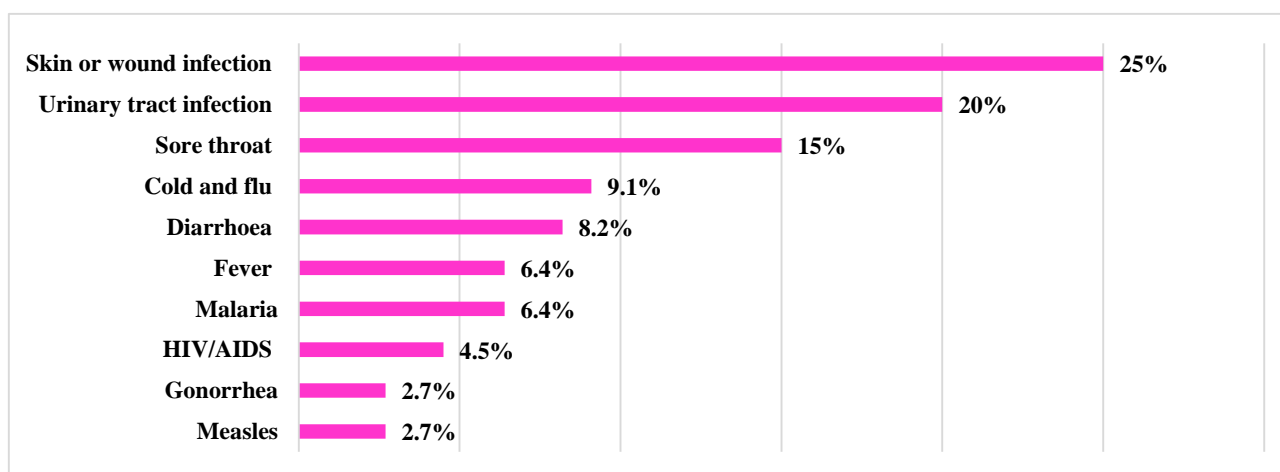


Figure 2: Indications for an antibiotic prescription.

Table 6: Guidelines/sources of information (n=110).

Guidelines/sources of information	Frequency (N)	Percentage (%)
Do you use practice guidelines for antibiotic therapy during your daily work?		
Frequently	39	35.5
Moderately	48	43.6
Rarely	18	16.4
There are no good guidelines	05	4.5
Would you like to have more evidence-based therapy guidelines?		
Yes	106	96.4
No	0	0
Do not know	04	3.6

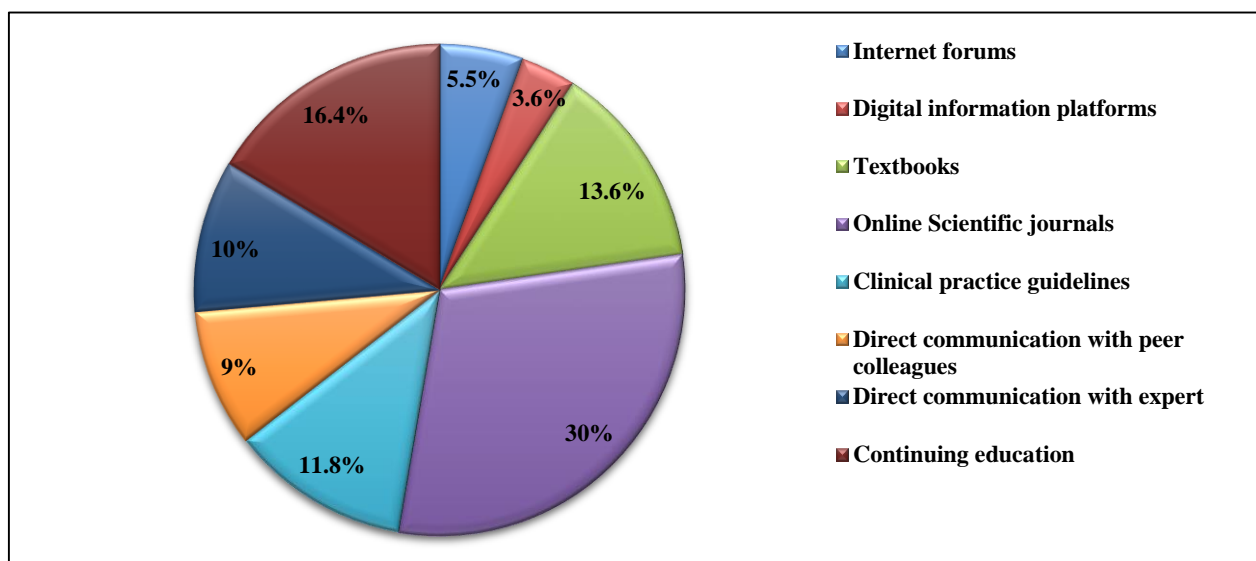


Figure 3: Sources to get current information on antibiotic therapy and resistance.

Table 7: Knowledge, attitude and practicing behavior of predominant age group (25-34 years) and years of practice group (1-10 years) on scale of good, fair and poor.

Variables	Predominant age group (25-34 years) (n=46)			Predominant years of practice group (1-10 years) (n=43)			Chi-square value (χ^2)	p value
	Good	Fair	Poor	Good	Fair	Poor		
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
Knowledge	28 (60.9)	10 (21.7)	08 (17.4)	24 (55.8)	11 (25.6)	08 (18.6)	56.703	0.01*
Attitude	14 (30.4)	22 (47.8)	10 (21.8)	13 (30.2)	26 (60.5)	04 (9.3)	69.556	0.01*
Practicing behaviour	17 (37)	27 (58.7)	02 (4.3)	30 (69.8)	10 (23.2)	03 (7)	43.047	0.01*

Frequency=n, percentage=%, $p \leq 0.05^*$ is considered as significant. The comparison of knowledge, attitude, and practicing behaviour of participants is done on the scale of good ($\geq 70\%$), fair (51-69%), and poor ($\leq 50\%$) based on the percentage of correct responses.

Relationship between predominant age group and years of practice regarding knowledge of antibiotic resistance

The results were significant with a Chi-square test of 56.70 and a p value of 0.01*. In our study the predominant age group (25 to 34 years) and predominant years of practice group (1 to 10 years), both have good knowledge about antibiotic resistance (Table 7).

Relationship between predominant age group and years of practice regarding attitude towards antibiotic resistance

The results were significant with a Chi-square test of 69.56 and a p value of 0.01*. In our study the predominant age group (25 to 34 years) and predominant years of practice group (1 to 10 years), both have fair attitude towards antibiotic resistance (Table 7).

Relationship between predominant age group and years of practice regarding practicing behavior

The results were significant with a Chi-square test of 43.047 and a p value of 0.01*. In our study the predominant years of practice group (1 to 10 years), have good practicing behavior when compared to the predominant age group (25 to 34 years) (Table 7).

DISCUSSION

The main goal of our study is to assess the knowledge, attitude and practicing behavior regarding antimicrobial use and awareness of antimicrobial resistance among clinicians. A rise in antimicrobial resistance is causing dreadful rates of morbidity and mortality at a comprehensive level.¹¹ The clinicians and health care providers being the frontline fighters, need to update their way of prescribing antimicrobials by implementing appropriate guidelines to decrease the threat of antimicrobial resistance.¹² Constant training and conduction of educational programs for clinicians and health care providers can be an effective method for incorporating proper and appropriate prescribing behavior in their practices regarding antimicrobial use and awareness of antimicrobial resistance.^{13,14}

In our study, the sociodemographic characteristics of participants reveal that the majority (41.8%), were from the age group 25-34 years and a male predominance (56.4%) was noticed. This is parallel to a KAP survey on antimicrobial use and resistance among Indian clinicians where the majority were from the age group >30 years and showed the male population in the majority.¹⁵ The study population included clinicians, with the mainstream being physicians (54.5%), followed by surgeons (18.2%). This is like a survey study conducted in Peru, where a high number of professionals were physicians followed by surgeons.¹⁶ In our study, many were from the group with years of practice between 1 to 10 years (39.1%), which is a similar observation in cross-sectional study done in Nepal.¹⁷

In our study, the subject of antibiotic resistance is highly relevant to the participants (44.5%), it is in agreement with a study conducted in Bangalore where the participants have good knowledge about antimicrobial resistance subject.¹⁸ A majority (39.1%), responded that they may have monthly contact with patients having multidrug-resistant infections. The clinicians in the healthcare centers should prioritize the settings to manage multidrug-resistant infections sensibly.¹⁹

A majority (30%), responded that the awareness of antimicrobial resistance can be spread by proper and precise intake of antibiotics by patients. This highlights the need for public awareness campaigns and educational programs. It can be carried out in hospitals, and social media can also be a vital tool for widespread antimicrobial resistance awareness to the public.²⁰

The actual knowledge of the participants can be predicted by the following statement, "if bacteria are resistant to antibiotics, it can be extremely difficult or impossible to treat the infections, they cause," which the majority (83.6%), of them, seem to respond to. Many clinicians and healthcare providers agreed that they face this challenge in their practice, as it becomes tricky for a clinician to give treatment while maintaining the antimicrobial stewardship principles and narrowing further resistance.^{21,22}

Our study addressed the problem of antibiotic resistance, where most of the participants strongly agreed that healthcare workers should wash their hands regularly (61.8%), which is in similarity to the studies done on hand hygiene in 1999 and 2010. In these studies, hand hygiene was successful for the prevention and control of healthcare-associated infections with a big effect.^{23,24} A majority said, prescribers should only prescribe antibiotics when they are needed (70.9%).²⁵

Regarding the practicing behavior, a high percentage (76.4%), agreed that there is an influence of prescribing behavior on the development of antibiotic resistance within a region.²⁶ Most of the clinicians' agreed that lack of patient interest (58.2%) and time (20.9%) are key barriers to discussing antimicrobial resistance while prescribing. These barriers should be overcome by improving communication and by giving ample enlightenment regarding this issue as patients are the ultimate consumers.²⁷

Many (32.7%) approved the implementation of a delayed antibiotic prescribing strategy which is related to lower consumption of antibiotics and can be valid for lowering resistance.²⁸ In clinicians' observation, the patient's understanding of antimicrobial resistance is good (85.5%), when compared with their superbug's knowledge (14.5%). Among patients, the knowledge and awareness about superbug is necessary as it causes delayed hospital admissions due to 100% resistance of superbugs.²⁹ It is found that the clinicians (32.7%), prescribe antibiotics without an indication to be on the safe side, this is in contrast to the study done in 2014, where it is suggested that clinicians should control antibiotic prescribing while valuing the ethical principles without patients' health compromise.³⁰

For most of the participants (24.5%), in our study, skin or wound infection is an indication for an antibiotic prescription. Skin infections are high targets for antimicrobial stewardship interventions intended to avoid needless antibiotic exposure.³¹

According to our study, the practicing guidelines for antibiotic therapy by clinicians during their daily work are followed moderately (43.6%). It is a matter of concern, as all the clinicians should follow the antibiotic practicing guidelines in a responsible manner with an ethical consideration for the benefit of patients.^{32,33}

Our study reveals that majority (96.4%), would like to have more evidence-based therapy guidelines for antibiotic therapy with lesser limitations.^{34,35} The participants read online scientific journals (78.2%) as a major information source on antibiotic therapy and resistance.³⁶

Limitation

Small sample size and short duration of study time were the major limitations of our study. The study participants were from only tertiary care hospital, and not from any peripheral health care centers.

CONCLUSION

Our study concludes that clinicians are very aware of the burning issue of antimicrobial resistance as a global issue but irrelevant in their own practice. There is a need to prioritize the settings to manage multidrug-resistant infections in institutions. Patient awareness campaigns and educational programs need to be conducted by clinicians. Lack of time and patient interest are the barriers to be overcome by clinicians to spread awareness. The prescribing of antimicrobials should be in a controlled way with the implementation of ethical principles for better patients' health safety.

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REFERENCES

1. Fair RJ, Tor Y. Antibiotics and bacterial resistance in the 21st century. *Perspect Medicin Chem.* 2014;6:25–64.
2. Rajni E, Rathi P, Malik M, Mittal S, Mamoria VP. Impact of Hospital Acquired Infection and Antibiotic Resistance Awareness Campaign on Knowledge Attitude and Practices of Medical Undergraduates in a Tertiary Care Teaching Hospital, India. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH.* 2020;14(09):23–7.
3. Founou RC, Founou LL, Essack SY. Clinical and economic impact of antibiotic resistance in developing countries: A systematic review and meta-analysis. *PLoS One.* 2017;12(12):1–18.
4. Laxminarayan R, Chaudhury RR. Antibiotic Resistance in India: Drivers and Opportunities for Action. *PLoS Med.* 2016;13(3):1–7.
5. Ganesh Kumar S, Adithan C, Harish BN, Sujatha S, Roy G, Malini A. Antimicrobial resistance in India: A review. *J Nat Sci Biol Med.* 2013;4(2):286–98.
6. Uchil RR, Kohli GS, Katekhaye VM, Swami OC. Strategies to combat antimicrobial resistance. *Journal of Clinical and Diagnostic Research.* 2014;8(7):1–4.
7. Mucklow J, Bollington L, Maxwell S. Assessing prescribing competence. *Br J Clin Pharmacol.* 2012;74(4):632–39.
8. Ryan C, Ross S, Davey P, Duncan EM, Francis JJ, Fielding S, et al. Prevalence and causes of prescribing errors: The PRescribing Outcomes for Trainee Doctors Engaged in Clinical Training (PROTECT) study. *PLoS One.* 2014;9(1):1–9.
9. Sadasivam K, Chinnasami B, Ramraj B, Karthick N, Saravanan A. Knowledge, attitude and practice of paramedical staff towards antibiotic usage and its resistance. *Biomedical and Pharmacology Journal.* 2016;9(1):337–43.
10. Ranjalkar J, Chandy S. India's National Action Plan for antimicrobial resistance – An overview of the context, status, and way ahead. *J Family Med Prim Care.* 2019;8(6):1828–34.
11. Ventola CL. The antibiotic resistance crisis: causes and threats. *P & T Journal.* 2015;40(4):277–83.
12. Laxminarayan R, Duse A, Wattal C, Zaidi AKM, Wertheim HFL, Sumpradit N, et al. Antibiotic resistance—the need for global solutions. *Lancet Infect Dis.* 2013;13(12):128–42.
13. Lee CR, Lee JH, Kang LW, Jeong BC, Lee SH. Educational effectiveness, target, and content for prudent antibiotic use. *Biomed Res Int.* 2015;2015:1–13.
14. Tahoon MA, Khalil MM, Hammad E, Morad WS, awad SM, Ezzat S. The effect of educational intervention on healthcare providers' knowledge, attitude, & practice towards antimicrobial stewardship program at, National Liver Institute, Egypt. *Egyptian Liver Journal.* 2020;10(1):1–7.
15. 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.
16. García C, Llamocca LP, García K, Jiménez A, Samalvides F, Gotuzzo E, et al. Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. *BMC Clin Pharmacol.* 2011;11:1–8.
17. Cheoun ML, Heo J, Kim WH. Antimicrobial resistance: kap of healthcare professionals at a tertiary-level hospital in Nepal. *Int J Environ Res Public Health.* 2021;18(19):1–13.
18. K. NT, Hazra P, Padma L. A cross-sectional observational study on knowledge, attitude and practices about indiscriminate use of antibiotics and antibiotic resistance among medical doctors at Saphthagiri Hospital, Bangalore. *Int J Basic Clin Pharmacol.* 2019;8(12):2609–13.
19. Strich JR, Palmore TN. Preventing Transmission of Multidrug-Resistant Pathogens in the Intensive Care Unit. *Infect Dis Clin North Am.* 2017;31(3):535–50.
20. Parveen S, Garzon-Orjuela N, Amin D, McHugh P, Vellinga A. Public Health Interventions to Improve

- Antimicrobial Resistance Awareness and Behavioural Change Associated with Antimicrobial Use: A Systematic Review Exploring the Use of Social Media. 2022;11(669):1-18.
21. Barlow G. Clinical challenges in antimicrobial resistance. *Nat Microbiol.* 2018;3(3):256–60.
 22. Doron S, Davidson LE. Antimicrobial stewardship. *Mayo Clin Proc.* 2011;86(11):1113–23.
 23. Mathai E, Allegranzi B, Kilpatrick C, Pittet D. Prevention and control of health care-associated infections through improved hand hygiene. *Indian J Med Microbiol.* 2010;28(2):100–6.
 24. Hand washing: A modest measure—with big effects. *BMJ.* 1999;318(7185):686.
 25. Demoz GT, Kasahun GG, Hagazy K, Woldu G, Wahdey S, Tadesse DB, et al. Prescribing pattern of antibiotics using who prescribing indicators among inpatients in Ethiopia: A need for antibiotic stewardship program. *Infect Drug Resist.* 2020;13:2783–94.
 26. Chen X, Fu F. Social learning of prescribing behavior can promote population optimum of antibiotic use. *Front Phys.* 2018;6(DEC):1–9.
 27. Davey P, Pagliari C, Hayes A. The patient's role in the spread and control of bacterial resistance to antibiotics. *Clinical Microbiology and Infection.* 2002;8(SUPPL.2):43–68.
 28. Llor C, Moragas A, Cots JM. Implementation of the delayed antibiotic prescribing strategy. Prospective observation study in primary care. *Revista Espanola de Quimioterapia.* 2022;35(2):213–7.
 29. Bashir A, Garba I, Aliero AA, Kibiya A, Abubakar MH, Ntulume I, et al. Superbugs-related prolonged admissions in three tertiary hospitals, Kano State, Nigeria. *Pan Afr Med J.* 2019;32:166.
 30. Llor C, Bjerrum L. Antimicrobial resistance: Risk associated with antibiotic overuse and initiatives to reduce the problem. *Ther Adv Drug Saf.* 2014;5(6):229–41.
 31. Hurley HJ, Knepper BC, Price CS, Mehler PS, Burman WJ, Jenkins TC. Avoidable antibiotic exposure for uncomplicated skin and soft tissue infections in the ambulatory care setting. *American Journal of Medicine.* 2013;126(12):1099–106.
 32. Leekha S, Terrell CL, Edson RS. General principles of antimicrobial therapy. *Mayo Clin Proc.* 2011;86(2):156–67.
 33. Lambregts M, Rump B, Ropers F, Sijbom M, Petrignani M, Visser L, et al. Antimicrobial guidelines in clinical practice: Incorporating the ethical perspective. *JAC Antimicrob Resist.* 2021;3(2):1–9.
 34. Meena DK, Jayanthi M. Monitoring Antibiotic Use in Public Health Care Facilities of South Indian Union Territory: A Step to Promote Rational Use of Antibiotics. *Cureus.* 2021;13(10):18431.
 35. Porter G, Kotwani A, Bhullar L, Joshi J. Over-the-counter sales of antibiotics for human use in India: The challenges and opportunities for regulation. *Med Law Int.* 2021;21(2):147–73.
 36. Chan AHY, Horne R, Lycett H, Raebel E, Guitart J, Wildman E, et al. Changing Patient and Public Beliefs About Antimicrobials and Antimicrobial Resistance (AMR) Using a Brief Digital Intervention. *Front Pharmacol.* 2021;12:608971.

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