International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Attitude and Knowledge towards Antimicrobial Usage and Antimicrobial Resistance in Patients Residing North Kerala": Indicating Significant Role of Pharmacist's Intervention

Nithish Shyamlal V K[1], Abhinandan Danodia[2], Kiron S S[3]

[1]Research scholar,Department of Pharmacy, Shri Jagdishprasad Jhabarmal Tibrewala University (SJJTU), Vidyanagri, Jhunjhunu Bisau Road, Churela, District - Jhunjhunu, Rajasthan -333010.
[2]Research Guide,Department of Pharmacy, Shri Jagdishprasad Jhabarmal Tibrewala University (SJJTU), Vidyanagri, Jhunjhunu Bisau Road, Churela, District - Jhunjhunu, Rajasthan -333010,India.
[2] Professor, College of pharmaceutical sciences, Medical College Kannur, Kerala.India.

Abstract

Background: Antimicrobial resistance (AMR) has emerged as one of the most critical global public health challenges, largely fueled by inappropriate antimicrobial use, insufficient awareness, and inadequate surveillance systems. India, recognized as one of the world's largest consumers of antibiotics, faces an escalating burden of AMR, emphasizing the urgent need for effective antimicrobial stewardship and public education.

Objective: To assess the knowledge and attitudes toward antimicrobial usage and antimicrobial resistance among patients residing in North Kerala.

Methods: A prospective, descriptive survey was conducted over six months in outpatient departments of secondary care hospitals. A total of 180 patients were enrolled, of whom 165 completed the study. Data were collected using a validated, self-administered questionnaire and structured patient forms documenting demographic and clinical details.

Results: The mean age of participants was 38.1 ± 12 years, with the highest proportion belonging to the 26–40-year group. Most participants had completed graduation (40%), while 7.27% were illiterate. Eighteen antibiotics were prescribed in the study population, with amoxicillin–clavulanate being the most frequently used (25%). Overall findings revealed varying levels of awareness and misconceptions regarding antibiotic use and AMR.

Conclusion: The study highlights substantial gaps in public knowledge and attitudes toward antimicrobial use in North Kerala, contributing to the emerging burden of AMR. The findings clearly indicate the crucial role of pharmacists in implementing educational initiatives, promoting rational antibiotic use, and supporting antimicrobial stewardship programs, especially in healthcare settings lacking infectious disease specialists.

Keywords: Antimicrobial resistance, antibiotic use, patient knowledge, pharmacist intervention, antimicrobial stewardship.

INTRODUCTION

Antimicrobial Resistance (AMR) arises when microorganisms such as bacteria, viruses, fungi, and parasites evolve and develop reduced sensitivity to antimicrobial agents.[1,2] AMR poses a significant threat to public health systems, not only in developing nations but across the entire globe.[1,3] If the same situation continues, many infectious diseases may become impossible to treat with existing antibiotics, leading to uncertain prospects for healthcare.[4] Infections caused by AMR can result in severe illnesses, prolonged hospital stays, increased healthcare expenses, greater reliance on costly second-line drugs, and treatment failures.[3,5,6]

Global overview

In Europe, it has been quantified that antimicrobial resistance been major cause of out of pocket expenditure with over nine billion Euros per year.[3,7] The Center for Disease Control and Prevention (CDC) estimates that in United States, AMR contributes an additional 20 billion dollars in direct healthcare costs each year and causes productivity losses of approximately 35 billion dollars annually.[8] AMR weakens the human immune system, reducing its ability to combat infections and leading to serious complications in vulnerable patients, including those undergoing chemotherapy, dialysis, surgery, or joint replacement.[8]

AMR represents a global challenge that significantly increases economic strain and affects both patient well-being and overall healthcare costs. It indicate a challenge to sustainable development, to tackle this issue, World Health Organization (WHO) initiate a Global action plan (GAP) on AMR in 2015. Following this, many countries have implemented their own National Action Plans (NAPs) to combat the widespread problems associated with antimicrobial resistance.[9]

According to the Global Antimicrobial Resistance and Use Surveillance System (GLASS) report, alarming resistance rates have been observed among common bacterial pathogens. Comparative data from 76 countries indicate resistance rates of 42% for third-generation cephalosporin-resistant *Escherichia coli* and 35% for methicillin-resistant *Staphylococcus aureus* (MRSA), both of which are major global concerns. For urinary tract infections caused by *E. coli*, one in five cases showed reduced susceptibility to commonly used antibiotics such as ampicillin, co-trimoxazole, and fluoroquinolones in 2020, making it increasingly difficult to treat routine nfections effectively.[10]

Indian Scenario

India established its National Action Plan (NAP) in April 2017, briefing strategic measures to combat antimicrobial resistance (AMR) over a five-year period. The country also reported a huge consumption of 12.9 billion units of antibiotics in 2010 — the highest in the world. Eventually, India has been nominated the "AMR capital of the world." There are multiple predisposing factors that contribute AMR. The main modifiable causes include patients' overuse of antimicrobial agents, physicians' excessive prescription practices, and pharmacists dispensing antibiotics without proper prescriptions.[11]

In 2013, the Indian Council of Medical Research (ICMR) initiated AMR surveillance networks, followed by the establishment of another network by the National Centre for Disease Control (NCDC) in 2014 to assess the prevalence and extent of AMR. In 2015, these two organizations, in collaboration with the Centers for Disease Control and Prevention (CDC), began evaluating existing infection prevention and control (IPC) practices in India to develop updated guidelines for reducing hospital-acquired infections. The National Health Policy of 2017 emphasized the urgent need to standardize antibiotic usage guidelines and restrict unnecessary antibiotic use. The CDC (USA) has categorized

antibiotic-resistant bacteria into three distinct threat levels.ie, Concerning(cause mild threat),serious(cause moderate to significant threat),urgent(cause lethal threats)[12,13]

According to The **Infectious Diseases Society of America (IDSA)** and the **Society for Healthcare Epidemiology of America (SHEA),**AMR can be managed managed by a multidisciplinary team including an infectious diseases (ID) physician, a hospital epidemiologist, a microbiologist, and a clinical pharmacist with intense training and handful experience in infectious diseases. Majority of studies and articles on Antimicrobial Stewardship programs (ASPs) primarily focuses on programs established in large tertiary care hospitals; Infact minimal studies and analysis has explored their application in smaller healthcare institution. In the absence of ID physician support, pharmacists with infectious disease training often assume primary responsibility for daily ASP operations. Although several studies have documented increased participation of ID-trained pharmacists in ASPs—demonstrating improvements in antimicrobial therapy optimization—the presence of multiple barriers to effective implementation has also been reported in various countries.[14]

Methodology and Design

The research work was a prospective, descriptive, survey conducted in outpatient department of hospitals in Kasargode and kannur districts, North Kerala, India.

Inclusion criteria

- Patients with 18 years and above age.
- Patients who received antimicrobial therapy.
- ambulatory patients are included.

Exclusion criteria

- Patients with any type memory issues or psychiatric problem.
- Dismiss the consent to take part in research work.

Settings

Research was conduct in Outpatient department of secondary care hospitals located in North Kerala.

Ethical Consideration

The proposal was Ethically approved by Institutional Human Ethics Committee (005/2025/CCOPS/IEC) on 15.02.2025

Duration of the study

6 months from Ethical approval

Sample size

The minimum sample size for the study was calculated by using

Krejcie -Morgan formula[16]

$n = x^2 N P (1-P) \div e^2 (N-1)+x^2P(1-P)$

Where n =Sample size

X^2 =Chi square=3.841(95%confidence interval)

e = Margin of error =0.05%

P= Population proportion=50%

N=Population Size (bed strength X Occupancy X length of stay)

Sample size : 180

Data collection

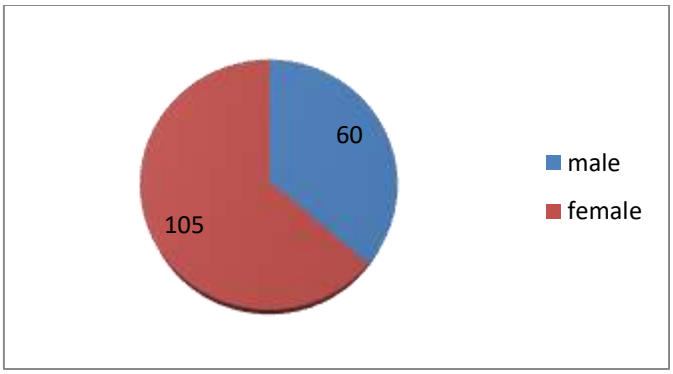
1. Data was gathered using a pre-tested and validated self-administered questionnaire. A pilot study involving 20 patients who had taken antibiotics was conducted to evaluate the questionnaire's suitability. The questionnaire was made available in both English and the local language, Malayalam (Appendix 1).
   The questionnaire consisted of two sections. The first section collected demographic details such as gender, age, education, occupation, and contact number, while the second section evaluated the participants' knowledge regarding antibiotic use and antimicrobial resistance.
2. Structured patient data collection form (Appendix:2)including demographics and clinical characteristic of the patients, Admission details, Patients history,Allegic history, Details of antimicrobial agents prescribed(dosage ,route,,frequency,duration,ADR reported if any).

Result

180 patients were recruited to the study and 165 subjects were responded. Among the study population, 105 (63.63%)were females, while 60 (36.36%) were males (table : presented the distribution).Distribution indicates a female predominant study population.

Gender wise distribution

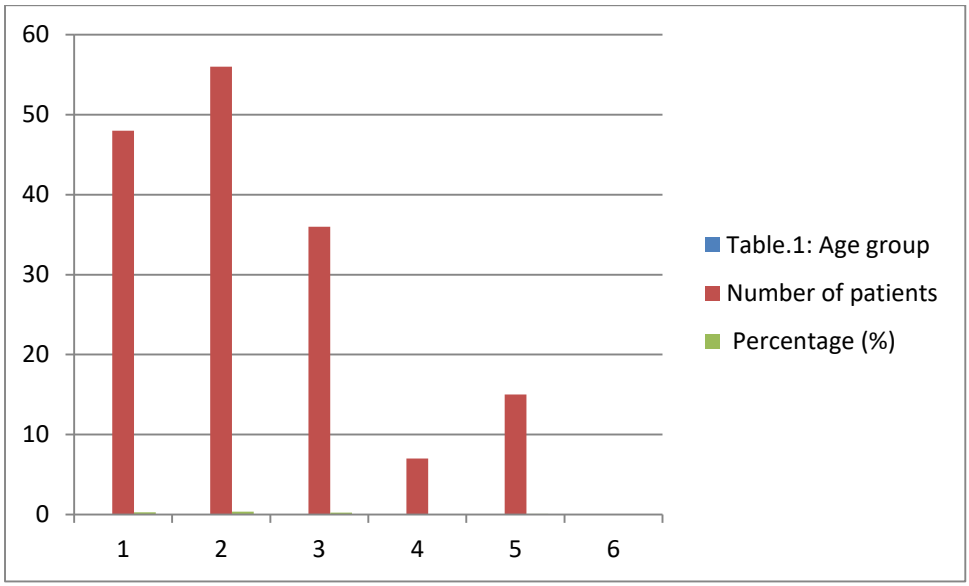
male	female
60	105



Age wise distribution:

56 participants (33.93%) were belong to the age group of 26-40 years.48(29.09%) were from the age group of 18-25 years.36(21.81%) of the participants were fell witin the age range of 41-55 years and the remaining 15.17% participants were of the above 55,with mean age of **38.1±12**. The age wise distribution is presented in Table:2

Table.1: Age group	**Number of patients**	**Percentage (%)**
18-25	48	29.09
26-40	56	33.93
41-55	36	21.81
56-70	7	04.24
>70	18	10.90

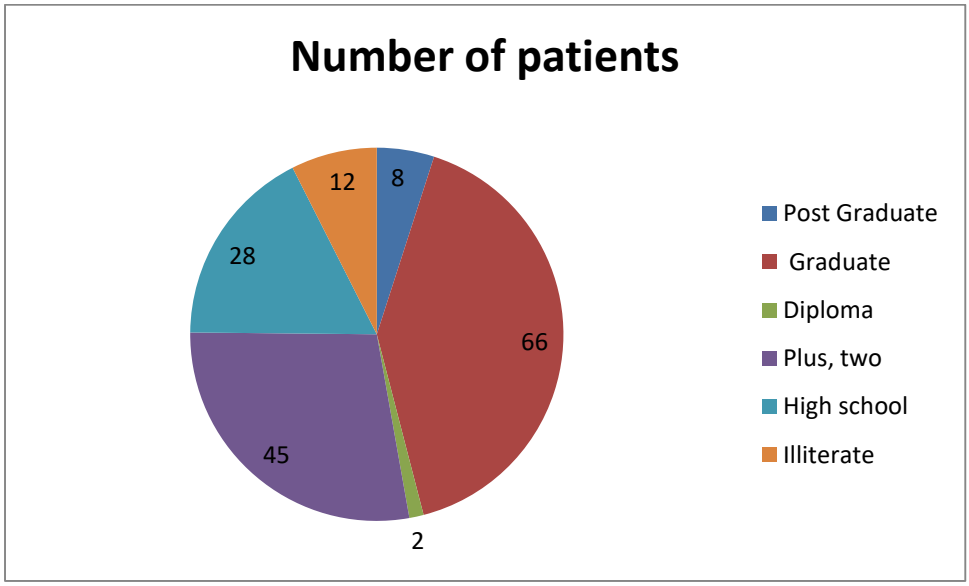


Education

Highest educational qualification of study population was post-graduation (4.84%) .40% of respondents had completed graduation, while 27.27% were undergraduate.7.27% of total study population were Illiterate. The educational qualification of study population is presented in Table:3

Education	Number of patients	Percentage (%)
Post Graduate	08	04.84
Graduate	66	40
Diploma	2	0.6
Plus, two	45	27.27
High school	28	16.96
Illiterate	12	07.27

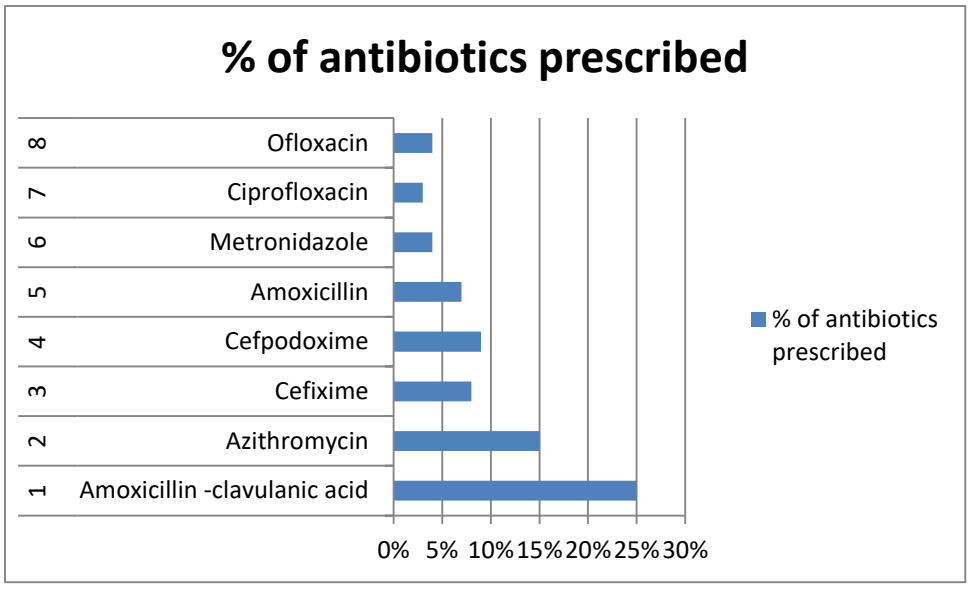
.



Antibiotic prescribing pattern

18 different antibiotics were prescribed to various patients in the study group. However, 5 antibiotics accounted for more than 60% of prescriptions. Among these amoxicillin -clavulanate was most frequently prescribed, followed by azithromycin and cefixime. It was noted that most of the antibiotics were started empirically without culture and sensitivity confirmation. Details of different antibiotics and their prescription frequencies have been presented in following table:4

SL No:	Antibiotics	% of antibiotics prescribed
1	Amoxicillin -clavulanic acid	25%
2	Azithromycin	15%
3	Cefixime	8%
4	Cefpodoxime	9%
5	Amoxicillin	7%
6	Metronidazole	4%
7	Ciprofloxacin	3%
8	Ofloxacin	4%



Frequency of antibiotic consumption

96% of total study population claimed that they had consumed antibiotics at least once in their life time. Among them 42% had consumed antibiotics in the last one month and 15% reported consumption within the last 6 months. Frequency of antibiotic consumption have been presented in the table :5

frequency	Percentage of respondents
Last one month	42%
Last 6 month	15%

Knowledge and Use of Antimicrobials

The study assessed 14 structured questions which include different statements on knowledge, practice

related to consumption of antimicrobials and awareness on antimicrobial resistance. There were 7 questions to assess the knowledge ,4 questions to check correct usage and 3 questions to check the awareness on antimicrobial resistance.presented in table:6 (Appendix:)

Knowledge based analysis on antibiotic use

SL No:	**questions**	**% of correct response**	**% of incorrect response**
1	. What do you think antibiotics are used for?	**57.83**	**42.17**
2	. How do you usually obtain antibiotics?	**77.13**	**22.87**
3	. Do you think antibiotics are effective against all types of infections**?**	**61.28**	**38.72**
4	When do you think, you should stop taking antibiotics once you've begun treatment?	**33.76**	**66.24**
5	"It's okay to buy the same antibiotics, or request these from a doctor, if you're sick and they helped you get better when you had the same symptoms before"	**21.34**	**78.66**

Knowledge based analysis showed ,overall knowledge of study population was intermediate.57.83% of total population knew ,Antibiotics can only used for the treatment of bacterial infection ,while 42.17% held misconceptions, thinking they are effective for other infections as well.

77.13% of respondents were aware that antibiotics usually obtained through prescription from a Registered Medical practitioner,but22.87% admitted to self medicating or obtaining antibiotics without a prescription. 38.72% of study population believed ,antibiotics can be used for any type of infections.

Only 33.76% knew that antibiotics should be continued until the prescribed is completed.66.24% believed it was acceptable to stop once symptoms improved, which was certainly an alarming call of poor adherence.

Only 21.34% study population were aware that antibiotics shouldn't be reused for similar symptoms without consultation. The majority (78.66%) of patients in the study population supported inappropriate reuse of antimicrobials, indicating serious awareness problem.presented in table :7

Assessment of knowledge on antimicrobial resistance

Sl:NO	Questions	Response	
		YES	NO
1	Have you heard of Antimicrobial resistance (AMR)?	38.20%	61.80%
2	Do you think AMR is a significant public health concern?	21.23%	78.77%
	What do you think contributes to the development of AMR?		

3	a) Overuse of antibiotics b) Misuse of antibiotics c) Lack of proper hand hygiene d) Poor accesss to quality vaccines e) poor infection and disease prevention and control in homes. f) No idea	20% 35% 10% 5% 20% 10%	

Only 38.20% of participants reported having heard of AMR, while the majority (61.80%) had no prior knowledge. This demonstrates a low baseline awareness in the community. When asked if AMR is a significant public health concern, just 21.23% agreed, whereas a large proportion (78.77%) did not perceive it as important. This indicates not only a lack of awareness but also underestimation of the threat AMR poses.

Discussion

The study was conducted to assess the knowledge and attitude towards antimicrobial utilization and antimicrobial resistance (AMR) among patients who were included in the study. Total of 165 participants were included in the study. Sample size aligned with study conducted by **R.Radhakrishnan et al**.[17]The findings provide valuable insights into current antibiotic use behaviors, prescribing patterns, and the level of public awareness regarding antimicrobial stewardship.

In this study, females (63.63%) out numbered males (36.37%), indicating a female-predominant study population,similar gender pattern was shown by study conducted by **Ankit Jivan Desai et al**[18]. The majority of participants (33.93%) belonged to the 26–40-year age group, followed by 29.09% in the 18–25-year group,with mean age **38.1±12**.Age distribution was almost similar in the research conducted by **K. Bhardwaj et al**[19].This suggests that most antibiotic users are within the young to middle-aged adult population.

Educationally, 40% of the respondents were graduates, 27.27% had completed higher secondary education, while 7.27% were illiterate. Although the overall literacy level was moderate to high, misconceptions regarding antibiotic use were still observed, demonstrating that education level alone does not guarantee rational antibiotic use. Which also reported that even among educated individuals, inappropriate antibiotic consumption is common due to poor understanding of AMR.

Eighteen antibiotics were prescribed among the study group, with five drugs accounting for more than 60% of all prescriptions.Amoxicillin–Clavulanic acid (25%) was antimicrobial that physician most often adviced, followed by Azithromycin (15%), Cefpodoxime (9%), and Cefixime (8%). The over dependence of β-lactam antibiotics indicates a frequent use of broad-spectrum agents for empirical therapy.

In contrast to antimicrobial stewardship guidelines, which advocate targeted therapy based on microbiological evidence, it was found that the majority of antibiotics were prescribed empirically without culture and sensitivity confirmation.

The study showed, 96% of study population used to consume antibiotics at least once in their lifetime, while 42% had taken antibiotics within the last month to treat infection. This results indicated that, patients frequently consuming antibiotics as first-line therapy.

Continuous and frequent use of antibiotics without prescription might results in severe AMR. Similar pa

tterns have been reported in studies conducted in Kerala and Tamil Nadu, where community access to antibiotics without prescription remains common.

Majority (57.83%) of respondents correctly identified that antibiotics are effective only against bacterial infections, while 42.17% still think antibiotics can be used for all infections including viral infection. Similar patterns have been reported in study by multiple studies conducted in south India. 77.13% of study population believed that antibiotics obtained only through a registered medical practitioner, while 22.87% consumed antibiotics without prescription. 33.76% of study population responded course of therapy should be completed when antibiotics are used, while majority of (66.24%) population discontinued antibiotic regimen once symptoms improved. Only 21.34% study population were aware that antibiotics shouldn't be reused for similar symptoms without consultation. The majority (78.66%) of patients in the study population supported inappropriate reuse of antimicrobials, indicating serious awareness problem. A similar result was shown by **Kim, So Sun·Moon, et al.**[20]

Study observed that ,similar attitude towards antimicrobial use directly contribute increased level of resistant bacterial strains and indicate the crucial role of clinical pharmacists in patient counseling, emphasizing completion of therapy and discouraging self-medication.

The study observed less knowledge and awareness about AMR, with only 38.20% of participants having heard of the term AMR and 21.80% recognizing it as a public health concern.

This lack of awareness reflects the absence of widespread educational campaigns and highlights an opportunity for pharmacists to play a proactive role in AMR education through health talks, counseling, and collaboration with local health authorities.

Participants identified several causes of AMR, with misuse of antibiotics (35%) and overuse (20%) being the most commonly recognized factors. Fewer respondents acknowledged roles of poor hygiene (10%), inadequate vaccination (5%), and poor infection control (25%).

These findings suggest that while participants understand some pharmacological aspects of resistance, they lack comprehension of broader public-health determinants.

Effective AMR prevention requires understanding that resistance arises not only from antibiotic misuse but also from environmental and infection-control factors. This reinforces the importance of interprofessional collaboration, where pharmacists, nurses, and clinicians jointly educate patients and communities.

Study findings suggest the significant role of pharmacist in rational use of antimicrobials ,there by minimizing AMR.Major role of pharmacist includes prescription monitoring, patient counseling, drug therapy monitoring. Pharmacists can monitor empirical prescriptions and ensure rational use. pharmacists can quantify antibiotic use by defined daily dose (DDD) and antimicrobial utilization ratio (AUR) calculations.

Conclusion

Study population shows female predominance (63%) and 7.2% of study population were illiterate. 57.83% of total population knew ,Antibiotics can only used for the treatment of bacterial infection ,while 42.17% held misconceptions, thinking they are effective for other infections as well. These findings clearly indicate that significant awareness program and patient education crucial for managing AMR. The study showed a clear gaps in knowledge and practice towards antimicrobial utilization and that can be clearly addressed through continuous pharmacist-led interventions, routine audit and feedback mechanisms, and awareness campaigns at both hospital and community levels.

Antibiotic prescribing pattern showed 5 antibiotics accounted for more than 60 % of total prescription. It was clearly evident that most of the prescription was empirical and which might contribute to AMR..By promoting the rational use of antibiotics and increasing public awareness, pharmacists can play a key role in helping to reduce antimicrobial resistance worldwide.

Study indicate high frequency of empirical and irrational antibiotic use.Non compliance to prescribed regimens. Limited awareness of the causes and effects of antimicrobial resistance. A clear need for properly structured programs to guide antimicrobial use

The study clearly indicate the pharmacist led interventions and educational programs improve the antimicrobial use. . Introducing pharmacist-led antimicrobial stewardship programs could greatly reduce the misuse of antibiotics and help combat the rising challenge of antimicrobial resistance. Since pharmacist are the most easily accessible health care professional,they will close these lacunas by providing awareness and educating patients on antimicrobial usage and factors that contribute AMR.

Reference

1. 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:e0189621. doi:10.1371/journal. pone.0189621
2. Antibiotic resistance: a global threat | features | CDC. https://www. cdc.gov/features/antibiotic-resistance-global/index.html. Accessed September 15, 2019.
3. Prestinaci F, Pezzotti P, Pantosti A. Antimicrobial resistance: a global multifaceted phenomenon. Pathog Glob Health. 2015;109(7):309. doi:10.1179/2047773215Y.0000000030
4. Chokshi A, Sifri Z, Cennimo D, Horng H. Global Contributors to Antibiotic Resistance. J Glob Infect Dis. 2019;11(1):36–42. doi:10.4103/jgid.jgid_110_18
5. ECDC. Surveillance of Antimicrobial Resistance in Europe. 2017. Available from: https://www.ecdc.europa.eu/sites/default/files /documents/EARS-Net-report-2017-update-jan-2019.pdf. Accessed September 16, 2019.
6. Shrestha P, Cooper BS, Coast J, et al. Enumerating the economic cost of antimicrobial resistance per antibiotic consumed to inform the evaluation of interventions affecting their use. Antimicrob Resist Infect Control. 2018;7(1):98. doi:10.1186/s13756-018-0384-3
7. Llor C, Bjerrum L. Antimicrobial resistance: risk associated with antibiotic overuse and initiatives to reduce the problem. Ther Adv Drug Saf. 2014;5(6):229–241. doi:10.1177/2042098614554919
8. Antibiotic resistance threats in the United States; 2013. https://www.cdc. gov/drugresistance/pdf/ar-threats-2013-508.pdf. Accessed September 16, 2019.
9. World Health Organization. Global action plan on antimicrobial resistance. InGlobal action plan on antimicrobial resistance 2015.
10. World Health Organization. Global antimicrobial resistance and use surveillance system (GLASS) report 2022. World Health Organization; 2022 Dec 8.
11. Chandra S, Prithvi PP, Srija K, Jauhari S, Grover A. Antimicrobial resistance: Call for rational antibiotics practice in India. Journal of Family Medicine and Primary Care. 2020 May 1;9(5):2192-9.
12. Kadri SS. Key takeaways from the US CDC's 2019 antibiotic resistance threats report for frontline providers. Critical care medicine. 2020 Jul 1;48(7):939-45.
13. CDC. About Antimicrobial Resistance. 2018. Available from: www.cdc.gov. Archived from the original on 1 October 2017. Available from: https://www.cdc.gov/drugresi stance/ about.html.

14. Cantudo-Cuenca MR, Jiménez-Morales A, Martínez-de la Plata JE. Pharmacist-led antimicrobial stewardship programme in a small hospital without infectious diseases physicians. Scientific Reports. 2022 Jun 9;12(1):9501.
15. Pechere JC. Patients' interviews and misuse of antibiotics. Clin Infect Dis 2001;33(Suppl 3):S170-3. Epub 2001/08/29.pmid: 11524715.
16. Krejcie R V,Morgan D W Determining sample size for research activities, educational and psychological measurement,pp 607-610,1970
17. Radhakrishnan R, Maheswary D, Leela KV, Damodharan N. Impact of clinical pharmacist's educational intervention tools in enhancing public awareness and perception of antibiotic use: A randomized control trial. Clinical Epidemiology and Global Health. 2023 Jan 1;19:101191.
18. Desai AJ, Gayathri GV, Mehta DS. Public's perception, knowledge, attitude and behaviour on antibiotic resistance—a survey in Davangere City, India. J Prev Med Holistic Health. 2016;2(1):17-23.
19. Bhardwaj K, Shenoy S, Baliga S, Unnikrishnan B, Baliga BS. Knowledge, attitude, and practices related to antibiotic use and resistance among the general public of coastal south Karnataka, India–A cross-sectional survey. Clinical Epidemiology and Global Health. 2021 Jul 1;11:100717.
20. Kim SS, Moon SM, Kim EJ. Public knowledge and attitudes regarding antibiotic use in South Korea. Journal of Korean Academy of Nursing. 2011;41(6):742-9.