Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 5
Open Access

Public Awareness about Antibiotic Use, Inflammatory responses and Resistance: New insights from cross sectional rural health behavior surveys

Dr. Chandrakala Penagadam[1*], Y. Dhanush ChandraYadav[2], Y. LakshmiHrudhay ChandraYadav [3]

[1](Associate Professor, Dept of Microbiology, Government Medical College, Madanapalle, India.)

[2](Engineering Masters Student, Department of Telecommunication Sciences, Blekinge Institute of Technology, Sweden SE-37179)

[3](Medicine Undergraduate, Naniing Medical University, Jiangning District, Nanjing, China-211166.)

***Corresponding Author**

Dr. Chandrakala Penagadam,

M.D.Dept of Microbiology, Government Medical College, Madanapalle, India.

Email:ID: dr.penagadam@live.com

Cite this paper as: Dr. Chandrakala Penagadam, Y. Dhanush ChandraYadav, Y. LakshmiHrudhay ChandraYadav (2024Public Awareness about Antibiotic Use, Inflammatory responses and Resistance: New insights from cross sectional rural health behavior surveys *Frontiers in Health Informatics*, *Vol.13, No.5*, 8134-8143

ABSTRACT

Background: Public awareness about antibiotic use, inflammatory responses and resistance is insufficient even in wealthy countries, and it is more severe in low- and middle income countries. Inappropriate use of antibiotics has recognized as a leading cause of antibiotic resistance and biggest threats to global public health. The aim of this study was to describe antibiotic-related knowledge, attitudes, practices, inflammatory response, in addition to assess the antibiotic access and resistance from general rural population. A general rural population-based study with validated questionnaire for 600 participants were participated from November 2023 to April 2024. Data was analyzed and multivariate regression administered to identify associated factors with awareness. Results: This Rural population-based study shows good general awareness about antibiotics and understand that misuse can lead to antibiotic resistance, indicating that health education messages have reached the population. However, confusion still exists, as many people cannot clearly identify antibiotics and sometimes mistake common medicines like paracetamol for antibiotics and some still skip doses or take antibiotics just in case, showing a gap between knowledge and practice. Many respondents believe antibiotics help them recover faster from fever or illness and consider them safe, leading to frequent and sometimes unnecessary use. Antibiotic use is often situational, with many people consulting doctors and checking expiry dates but not always following safe practices and obtain antibiotics without prescription or stop treatment early, highlighting the need for stronger public awareness and guidance. Conclusion: This study will be useful in designing effective and targeted interventions to decrease misconceptions about antibiotic use and to increase awareness about the risks of inappropriate use of antibiotics in the rural community

Keywords: Antibiotic use, Inflammatory responses, Antibiotic resistance, Knowledge, Attitudes, Practices

INTRODUCTION

Antimicrobial resistance (AMR) threatens modern medicine by rendering antimicrobial drugs ineffective. Multifaceted global strategies target human, animal and plant health alongside the environment, food production and safety to respond to this ‘superbug crises’ (who 2017).

It is a global crisis and posed as one of the greatest threats to population health. This problem is driven by many factors such as low quality of antibiotics and improper (under- or over-) use of antibiotics (including self-medication) (T. Mason 2018, H. Goossens et al., 2005).

Self-medication, which refers to the use of any medical products without a prescription or following unprofessional recommendations in treating any illnesses (M. Hern´andez Juyol 2002, A. Shaghaghi,M. Asadi et al., 2014), is particularly leading to the AMR. Self-medication practice possibly raises incorrect drug selection, drug resistance, uncontrolled adverse effects or drug reactions, misdiagnosis, and delay in medical care (C.M. Hughes 2001, A. D. Patil 2017, D. Bennadi et al., 2014).

Self-medication is a common phenomenon, and the prevalence varies from 12.7% to 18% in Spain (A. F.

Guzm´an, F 2000, P. Carrasco-Garrido et al., 2008), 32% to 45.4% in China (X. Lei, H. Jiang 2008, C. L. K. Lam et al., 1994), 53% in Mexico (F.R. Balbuena,A. B. Aranda et al., 2009), and 75% in the United Kingdom and Chile (D. H. James 2008, K. FuentesAlbarr´an et al., 2008). Also, the excessive antibiotic utilization in the agriculture sector causes the pool of AR bacteria in the animals, which are then transferred to the human through consuming food from these animals (L. L. Founou 2016, C. Verraes et al., 2013). It is estimated that, in 2050, there will be more than 10 million deaths and 100 trillion USD lost due to AR if no substantial actions have been made to eliminate this emerging threat (WHO 2015, WHO 2017, J. ON et al., 2016).

As inappropriate antibiotic use is the primary cause of AMR, responses to this phenomenon prioritize to promote public awareness about AMR (WHO 2015). Nonetheless, it is evidenced that public awareness about AR is insufficient even in wealthy countries (R. R. Carter 2016, L. K. Watkins et al., 2015), and it is more severe in low- and middle income countries, where antibiotic use without a prescription is prevalent (F. Alhomoud 2017, M.Ocan 2015, G. Nepal et al., 2018),

For example, a recent survey conducted by the World Health Organization indicated that most of the respondents in developing countries believed that antibiotics could be used to treat viral infections (WHO 2017). Many educational interventions have been conducted worldwide to enhance awareness, knowledge, and practice in antibiotic use; however, the effects were not clear and varied across study settings (E. L. A. Cross 2017, C. A. M. McNulty 2010, B. Huttner *et al.,* 2010).

As an interdisciplinary field, the social dimensions of the problem are being recognized in global AMR policy, which are typically addressed via education and awareness-raising activities aimed at governmental staff, healthcare workers and the general public (London: The UK Prime Minister, 2016).

AIM AND OBJECTIVE

To describe antibiotic-related knowledge, attitudes, practices, in addition to assess the antibiotic access and resistance from general rural population.

The aim of this study is to explore the knowledge, attitudes, inflammatory response and resistance towards antibiotic use among rural population.

PLAN OF WORK, METHODS AND TECHNIQUES:

1. **STUDY DESIGN:** Cross sectional study.
2. **STUDY SUBJECTS:** Tertiary Care Teaching Hospital - Kadapa and Government General Hospital – Madanapalle, Andhrapradesh, India – Patients and their attenders those attending to OP and In-Patient admission wards from rural areas.
3. **METHOD:** After IEC – Government Medical College, Kadapa, Andhrapradesh, India, IEC No.026, ACAD/E3B/2023-2024, approval the data collected from November 2023 to April 2024.

Our study design was a cross sectional survey about rural health behaviors across – Patients and their attenders those attending to OP and In-Patient admission wards from rural areas at Tertiary Care Teaching Hospital, Kadapa and Government General Hospital – Madanapalle, Andhrapradesh, India, with oral informed consent.

Information about socioeconomic status and awareness regarding prescription medicine use, antibiotic use, and Antimicrobial resistance study was done with structured questionnaire.

All the respondents got information about the nature of the study, and oral informed consent was obtained before conducting the study.

The questionnaire comprised four sections:

1. Sociodemographic characteristics of respondents and

2. A section on each of knowledge, attitudes and practices relating to antibiotics and their use.

3. Questions about knowledge were divided into four domains, namely “identification of antibiotics”, “knowledge on the role of antibiotics”, “side-effects of antibiotics” and “antibiotic resistance”.

The questions on attitudes are divided into two domains: a. “preference for use of antibiotics” and b. “antibiotic resistance and safety”.

4. The seven questions relating to practices are not divided into domains.

The English version of the questionnaire was translated into local language and back translated into English to ensure the accuracy of the translated text.

INCLUSION CRITERIA:

Patients and their attenders those attending to OP and In-Patient admission wards from rural areas at GGH, Kadapa, GGH – Madanapalle, Andhrapradesh, India, and willing to participate in the study.

EXCLUSION CRITERIA: Patients and their attenders those attending to OP and In-Patient admission wards

from rural areas at GGH, Kadapa, GGH – Madanapalle, Andhrapradesh, India, and those who are not willing to participate in the study.

ETHICAL CLEARANCE: The Cross-sectional study was approved and ethically cleared by the Institutional Ethics Committee of Government Medical College, Kadapa, Andhrapradesh, India, prior to its commencement. IEC No.026, ACAD/E3B/2023-2024. Participants were informed about the nature and purpose of the study, and oral informed consent was obtained before the data collection. The study was conducted in accordance with ethical guidelines. Participant confidentiality was maintained throughout the study.

STATISTICAL ANALYSIS:

All the study data were enterd into the computer database using standard format, checked for errors and verified. Data maintained in the computer sheets were organised by SPSS version 20 software for Windows. Data will be peresented in aprropriate Tables by caliculating of percentage, rate etc.

RESULTS AND DISCUSSION:

We used guidelines developed by the World Health Organization (WHO 2015), for the socio-economic status selection of rural public participated in the study with a structured questionnaire (U.S. Agency 2008, Huang SS 2007, Togoobaatar G *et al.,* 2010).

Demographic Overview: A Profile by Age and Gender

The collected data reveals a vibrant community primarily composed of young and early-career individuals. The most prominent demographic was the young adult (21–40 years) group, representing nearly 230 members of the study. Within this, there was a notable female presence, with 137 women compared to 93 men. This trend was mirrored in the youth and adolescent (5–20 years) category, which follows closely with 208 individuals. This group also leans toward a higher female representation, totalling 121 females and 87 males. In contrast, the middle-aged (41–60 years) cohort shows a perfectly balanced distribution, with exactly 65 men and 65 women contributing to the 110. Finally, the senior demographic (61–85 years) represents the smallest portion of the community with 32 individuals, though it is the only category where men (20) slightly outnumber women (12). This notable female presence was due to their participation as patients and as attenders of the patients. Which shows females to have better practices

with regard to antibiotic use, a comparable result to a Hong Kong study - You J 2008.

A Socio-Economic Profile of the Community

Economic Classification	Education Trends	Observations
Non-Poor	High concentration of Degrees, Postgraduates, and Diplomas	Stable economic status even with Secondary/Vocational levels.
Near-Poor	High Degree-attainment in youth; High Illiteracy in seniors.	Education is high among youth, but economic transition is pending.
Poor	Mix of Degrees (Youth) and widespread Illiteracy (Seniors).	Strongest correlation between lack of education and poverty in ages 40+.

The data highlights a strong link between education and economic status, with the community divided into Near Poor, Poor, and Non-Poor groups. Younger individuals (16–25) largely hold university or postgraduate degrees across all economic tiers, indicating that higher education has not yet translated into financial stability for many. In contrast, older adults (45–85), especially in Poor and Near Poor groups, show high levels of illiteracy or only basic education, reflecting past barriers to access. The Non-Poor group uniquely includes individuals with secondary or diploma qualifications who maintain stable incomes. Overall, the community is in transition, with an educated younger generation and a less-educated, more economically vulnerable older population (Anant Nepal, 2019). This shows that the rural study participants who attended the Tertiary Care Teaching Hospital and Government General Hospital, having awareness about health care facilities.

Rural Public Awareness about Antibiotic Use, Inflammatory responses and Resistance:

Data collected via paper-based questionnaires as described below,

I. **Knowledge** about antibiotics were divided into four domains

A. "Identification of antibiotics": a1. Amoxicillin is an antibiotic, a2. Paracetamol is an antibiotic, a3. Aluminium hydroxide+ Magnesium hydroxide (antacid) is an antibiotic

B. "Knowledge on the role of antibiotics": b1. Antibiotics are useful for killing germs, b2. Antibiotics are often needed for cold and flu illness, b3. Diarrhoea gets better faster with antibiotics

C. "Side-effects of antibiotics": c1. Antibiotics can kill "good bacteria" present in our bodies, c2. Antibiotics can cause secondary infections after killing good bacteria present in our bodies, c3. Antibiotics can cause allergic reactions….

D. "Antibiotic resistance": d1. If bacteria are resistant to antibiotics, it can be very difficult to treat the infections they cause, d2. Many infections are becoming increasingly resistant to treatment by antibiotics, d3. Misuse of antibiotics can lead to antibiotic resistance.

II. **Attitudes** and **Practices** about antibiotics were divided into two domains

A. "Preference for use of antibiotics": a1. When I have a cold, I should take antibiotics to prevent getting a more serious illness, a2. When I get a fever, antibiotics help me to get better more quickly, a3. I would rather take an antibiotic that may not be needed than wait to see if I get better without it.

B. "Antibiotic resistance and safety": b1. Whenever I take an antibiotic, I contribute to the development of antibiotic resistance, b2. Skipping one or two doses does not contribute to the development of antibiotic resistance, c1. Antibiotics are safe drugs, hence they can be commonly used.

III. **Attitudes to doctor's prescribing of antibiotics** not divided into domains. The questionnaire is as fallows

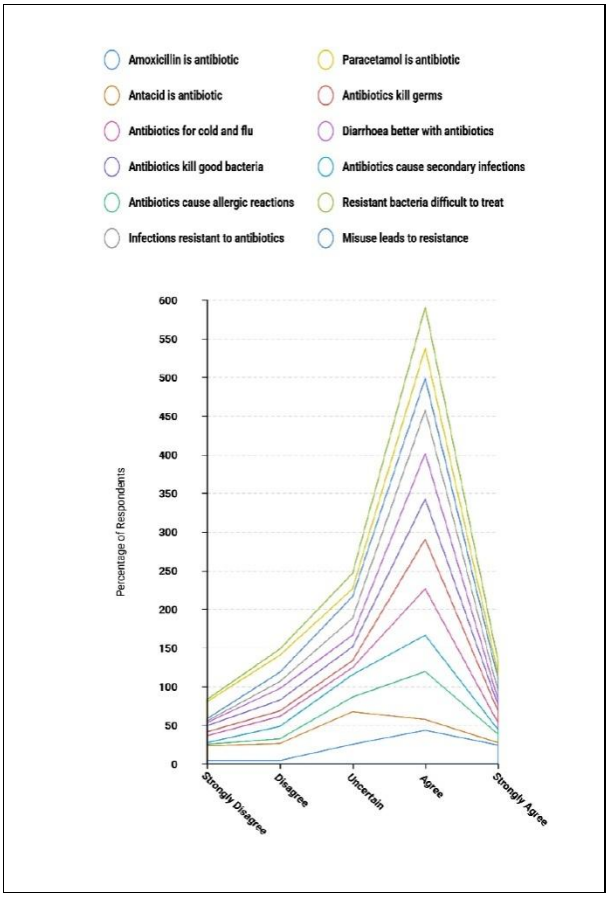
a1. If I expect to receive an antibiotic, I am less satisfied with a doctor's visit if I do not receive an antibiotic, a2. If a doctor does not prescribe an antibiotic when I think one is needed, I will go to another doctor, a3. If you feel better, after taking 2–3 doses of antibiotics, do you still complete full course of treatment ?

b1. Do you prefer to obtain antibiotics from the pharmacy rather than doctor/health worker if you have an illness, b2. Do you prefer to take an antibiotic when you have cough and sore throat? b3. Do you consult a doctor before starting an antibiotic?

c1. Do you check the expiry date of the antibiotic before using it? (Anant Nepal 2019, Lv B 2014, Yu M *et al.,* 2014).

The results of the Cross-sectional study about Awareness of Antibiotic Use, Inflammatory responses and Resistance in rural public presented below in frequency graph 1, 2 and 3.

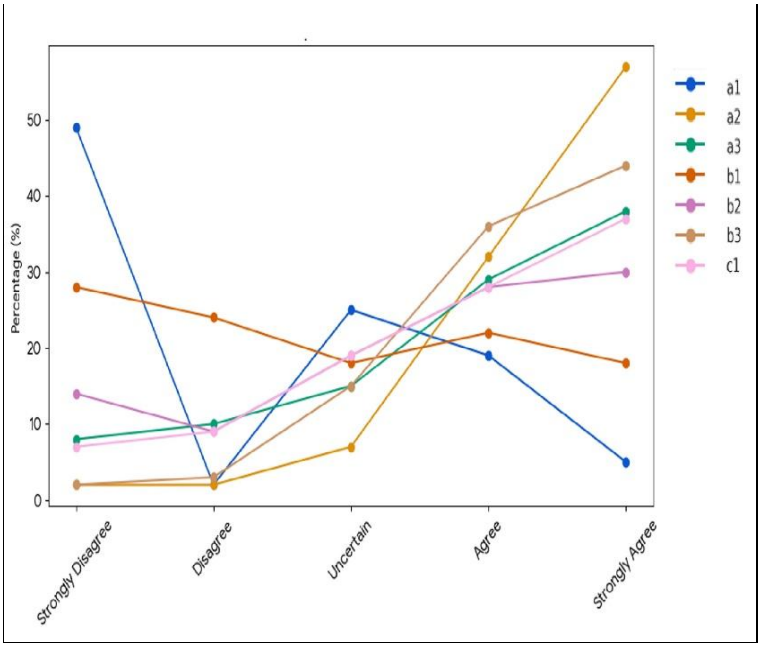
Frequency graph 1. Knowledge about antibiotics



Rural communities generally understand that antibiotics are powerful and misuse leads to resistance, showing good overall awareness. However, important misconceptions remain—many still believe paracetamol is an antibiotic or that antibiotics treat colds, flu, or diarrhoea. These misunderstandings often lead to unnecessary use. The issue isn't a lack of awareness, but uncertainty: people are less confident about when antibiotics are actually needed and how they affect the body, such as their impact on good bacteria or risk of allergic reactions. Overall, clearer guidance is needed to help distinguish proper antibiotic use from common remedies. This results correlates with studies of Tshokey T 2017, McNulty CA 2007, Mouhieddine TH 2015 and Jamhour A et al., 2017.

Frequency graph 2. Attitudes and Practices about antibiotics

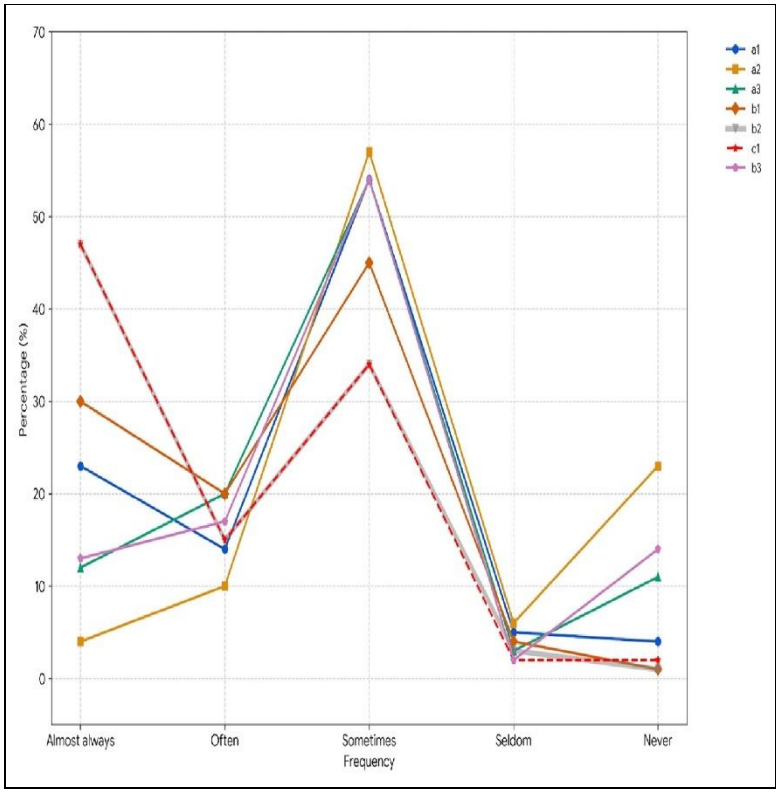
This analysis reveals a deep-seated reliance on antibiotics that often transcends clinical necessity, highlighting a significant gap between public perception and medical reality. The most striking visual element is the steep upward trajectory toward Strongly Agree for behaviors like a2. When I get a fever, antibiotics help me to get better more quickly (57%) and b3. Antibiotics are safe drugs, hence they can be commonly used (44%). These curves suggest that antibiotics are frequently viewed not as specialized medicine, but as a universal safety net—a fast-pass to recovery that many consider fundamentally harmless to the individual.



The data also uncovers a human tendency toward impatience and immediate gratification in healthcare. We see a strong consensus in a3. I would rather take an antibiotic that may not be needed than wait to see if I get better without it, coupled with the sentiment in c1. If I expect to receive an antibiotic, I am less satisfied with a doctor's visit if I do not receive an antibiotic. This just in case mentality illustrates how emotional comfort often outweighs the scientific principle of watchful waiting. Interestingly, the blue line for a1. When I have a cold, I should take antibiotics to prevent getting a more serious illness is the only one to peak at Strongly Disagree (49%), suggesting that while people recognize antibiotics aren't for the common cold, that logic vanishes the moment a fever or more persistent symptom appears.

Perhaps the most critical finding for public health is the contradictory view on resistance. While there is, moderate agreement that b1. Whenever I take an antibiotic, I contribute to the development of antibiotic resistance, the lines for b2. Skipping one or two doses does not contribute to the development of antibiotic resistance still lean heavily toward the Agree and Strongly Agree side (30%). This reveals a dangerous disconnect: people may understand the concept of resistance as a global threat, but they often fail to recognize how their personal choices—like stopping a course early or demanding unnecessary prescriptions—directly fuel that very crisis. The graph ultimately portrays a population that values the immediate relief antibiotics provide over the long-term protection of these vital medicines. A comparable result to that found in studies of Awad AI 2015 and Widayati A *et al.,* 2012.

Frequency graph 3. Attitudes to doctor's prescribing of antibiotics



This trend projection provides a compelling look into the behavioral patterns of antibiotic use, illustrating a population that often balances medical guidelines with personal convenience. The most prominent feature of the graph is the significant convergence in the Sometimes category, where nearly every behaviour peaks. This suggest that for many, antibiotic practices are not fixed habits but are instead situational, often shifting based on the perceived severity of an illness or the immediate pressure to recover.

A closer look at the individual profiles reveals some encouraging signs of safety-consciousness alongside notable areas for improvement. We see a strong start in the Almost always category for b2. Consulting a doctor before starting an antibiotic and c1. Checking the expiry date, with both behaviours shared by (47%) of respondents. This indicates a high baseline level of caution and respect for professional oversight. However, this diligence appears to be fragile; the high peak for a2. Completing the full course of treatment after feeling better in 2–3 doses in the Sometimes category (57%) highlights a common human tendency to prioritize immediate comfort over the long-term necessity of finishing a prescription.

Furthermore, the data suggests that patients often take an active, and sometimes bypass-oriented, role in their care. The overlap between a1. Going to another doctor if an antibiotic is not prescribed and a3. Obtaining antibiotics directly from a pharmacy shows that a significant portion of the community views antibiotics as a must-have resource rather than a strictly controlled medical tool. Whether it is b1. Taking an antibiotic for a cough or sore throat or b3. Checking an expiry date, the prevalence of Sometimes as the dominant response underscores a critical need for consistent public health education. It portrays a public that is aware of the tools at their disposal but remains inconsistent in applying the strict protocols necessary to ensure these medicines remain effective for everyone. The studies of Abu Taha A 2016, Saleh Faidah H 2019 and Michaelidou M *et al.,* 2020, has documented the similar results.

Striking results was that most participants reported they stopped taking antibiotics when they started to experience the anticipated side effects. This highlights the significance of educating patients and their families about potential side effects and the fact that stopping antibiotics too soon is one of the leading causes of antibiotic resistance. Our study also finds a positive correlation between knowledge, favorable attitudes toward antibiotics, and satisfactory practices of similar studies by Lim JM 2021 and Jali A *et al.,* 2021.

Ultimately, these findings underscore a clear disconnect between awareness and practice. Although the patients from rural public community attending to the Tertiary Care Teaching Hospital is familiar with basic safety measures, their behaviour is often driven by convenience, highlighting an urgent need for more practical and relatable health guidance with specific interventions.

In conclusion, the study suggests that the rural public community has basic knowledge about antibiotics but lacks complete understanding, especially regarding correct usage and differences between antibiotics and common medicines. This highlights the need for health education programs to improve awareness and prevent misuse of antibiotics in rural public community, which is important to control antibiotic resistance. Further research on various awareness campaigns are recommended.

ACKNOWLEDGMENTS

We would like to thank the Tertiary Care Teaching hospital, Kadapa and Government General Hospital, Madanapalle, Andhrapradesh, India, to conduct this study and like to acknowledge our second and third authors for carrying out manual statistical analyses of the data.

REFERENCES

1. FAO, OIE, WHO. Handle antimicrobials with care: Tripartite brochure [infographic]. Geneva: World Health Organization, 2017.
2. "Antibiotic resistance," http://www.who.int/news-room/factsheets/ detail/antibiotic-resistance.
3. T. Mason, C. Trochez, R.Thomas, M. Babar, I. Hesso, and R. Kayyali, "Knowledge and awareness of the general public and perception of pharmacists about antibiotic resistance," BMC Public Health, vol. 18, no. 1, article no 711, 2018.
4. H. Goossens, M. Ferech, R. Vander Stichele, M. Elseviers, and ESAC Project Group, "Outpatient antibiotic use in Europe and association with resistance: a cross-national database study,"The Lancet, vol. 365, no. 9459, pp. 579–587, 2005.
5. M. Hern´andez Juyol and J. R. Boj Quesada, "Dentistry and selfmedication: A current challenge," Medicina Oral Patolog´ıa Oraly Cirug´ıa Bucal, vol. 7, no. 5, pp. 344–347, 2002.
6. A. Shaghaghi,M. Asadi, and H. Allahverdipour, "Predictors of self-medication behavior: A systematic review," Iranian Journal of Public Health, vol. 43, no. 2, pp. 136–146, 2014.
7. C.M. Hughes, J. C.McElnay, and G. F. Fleming, "Benefits and risks of self medication," Drug Safety, vol. 24, no. 14, pp. 1027– 1037, 2001.
8. A. D. Patil, "Self medication: a potentially avoidable cause of antibiotic misuse and resistance," International Journal of Basic &Clinical Pharmacology, vol. 2, no. 2, 2017.
9. D. Bennadi, "Self-medication: a current challenge," Journal of Basic and Clinical Pharmacy, vol. 5, no. 1, pp. 19–23, 2014.
10. A. F. Guzm´an, F. Caamano, and J. J. Gestal-Otero, "Sociodemographic factors related to self-medication in Spain," European Journal of Epidemiology, vol. 16, no. 1, pp. 19–26, 2000.
11. P. Carrasco-Garrido, R. Jim´enez-Garc´ıa, V. H. Barrera, and A. G. de Miguel, "Predictive factors of self-medicated drug use among the Spanish adult population," Pharmaco epidemiology and Drug Safety, vol. 17, no. 2, pp. 193–199, 2008.
12. X. Lei, H. Jiang, C. Liu, A. Ferrier, and J. Mugavin, "Self-medication practice and associated factors among residents in Wuhan, China," International Journal of Environmental Research and Public Health, vol. 15, no. 1, p. 68, 2018.
13. C. L. K. Lam, M. G. Catarivas, C. Munro, and I. J. Lauder, "Self-medication among Hong Kong Chinese," Social Science & Medicine, vol. 39, no. 12, pp. 1641–1647, 1994.
14. F.R. Balbuena,A. B. Aranda, andA. Figueras, "Self-medication in older urban Mexicans: an observational, descriptive, cross-sectional study," Drugs & Aging, vol. 26, no. 1, pp. 51–60, 2009.
15. D. H. James and D. P. French, "The development of the Self- Medicating Scale (SMS): A scale to measure people's beliefs about self-medication," Pharmacy world and science, vol. 30,no. 6, pp. 794–800, 2008.

16. K. FuentesAlbarr´an and L. Villa Zapata, "Analysis and quantification of self-medication patterns of customers in community pharmacies in southern Chile," Pharmacy world and science, vol. 30, no. 6, pp. 863–868, 2008.

17. L. L. Founou, R. C. Founou, and S. Y. Essack, "Antibiotic resistance in the food chain: A developing country-perspective," Frontiers in Microbiology, vol. 7, article no 1881, 2016.

18. C. Verraes, S. Van Boxstael, E. Van Meervenne et al., "Antimicrobial resistance in the food chain: A review," International Journal of Environmental Research and Public Health, vol. 10,no. 7, pp. 2643–2669, 2013.

19. J. ON, "Tackling drug-resistant infections globally: final report and recommendations," in Review on Antimicrobial Resistance 2016, 2016.

20. Organization WHO, Global Action Plan on Antimicrobial Resistance, World Health Organization, Geneva, Switzerland, 2015.

21. Organization WHO, Global Priority List of Antibiotic-Resistance Bacteria to Guide Research, Discovery, and Development of New Antibiotics, World Health Organization, Geneva, Switzerland, 2017.

22. Organization WHO, Antibiotic Resistance: Multi-Country Public Awareness Survey, World Health Organization, Geneva, Switzerland, 2015.

23. R. R. Carter, J. Sun, and R. L. Jump, "A Survey and Analysis of the American Public's Perceptions and Knowledge About Antibiotic Resistance," Open Forum Infectious Diseases, vol. 3, no. 3, Article ID ofw112, 2016.

24. L. K. Watkins, G. V. Sanchez, A. P. Albert, R. M. Roberts, and L. A. Hicks, "Knowledge and Attitudes Regarding Antibiotic Use Among Adult Consumers, Adult Hispanic Consumers, and Health Care Providers — United States, 2012–2013," Morbidity And Mortality Weekly Report (MMWR), vol. 64, no. 28, pp. 767–770, 2015.

25. F. Alhomoud, Z. Aljamea, R. Almahasnah, K. Alkhalifah, L. Basalelah, and F. K. Alhomoud, "Self-medication and self-prescription with antibiotics in the Middle East—do they really happen? A systematic review of the prevalence, possible reasons, and outcomes," International Journal of Infectious Diseases, vol. 57, pp. 3–12, 2017.

26. M.Ocan, E.A. Obuku, F. Bwanga et al., "Household antimicrobial self-medication: A systematic review and meta-analysis of the burden, risk factors and outcomes in developing countries," BMC Public Health, vol. 15, no. 1, article no 742, 2015.

27. G. Nepal and S. Bhatta, "Self-medication with antibiotics in WHO Southeast Asian region: a systematic review," Cureus, vol. 10, Article ID e2428, 2018.

28. E. L. A. Cross, R. Tolfree, and R. Kipping, "Systematic review of public-targeted communication interventions to improve antibiotic use," Journal of Antimicrobial Chemotherapy, vol. 72, no. 4, pp. 975–987, 2017.

29. C. A. M. McNulty, T. Nichols, P. J. Boyle, M.Woodhead, and P. Davey, "The English antibiotic awareness campaigns: did they change the public's knowledge of and attitudes to antibiotic use?" Journal of Antimicrobial Chemotherapy, vol. 65, no. 7, pp. 1526–1533, 2010.

30. B. Huttner, H. Goossens, T. Verheij, and S. Harbarth, "Characteristics and outcomes of public campaigns aimed at improving the use of antibiotics in outpatients in high-income countries," The Lancet Infectious Diseases, vol. 10, no. 1, pp. 17–31, 2010.

31. The Review on Antimicrobial Resistance. Tackling drug-resistant infections globally: final report and recommendations. London: The UK Prime Minister, 2016.

32. U.S. Agency for International Development, Management Sciences for Health, Macro International Inc. Antimicrobial resistance module for population-based surveys, Demographic and Health Survey. Washington: Management Sciences for Health & Macro International Inc; 2008.

33. Huang SS, Rifas-Shiman SL, Kleinman K, Kotch J, Schiff N, Stille CJ, et al. Parental knowledge about antibiotic use: results of a cluster-randomized, multicommunity intervention. Pediatrics. 2007;119(4):698–706.

34. Togoobaatar G, Ikeda N, Ali M, Sonomjamts M, Dashdemberel S, Mori R, et al. Survey of non-prescribed use of antibiotics for children in an urban community in Mongolia. Bull World Health Organ. 2010;88(12):930–6.

35. Anant Nepal , Delia Hendrie, Suzanne Robinson, Linda A. Selvey, et al. Knowledge, attitudes and practices relating to antibiotic use among community members of the Rupandehi District in Nepal Nepal et al. BMC Public Health (2019) 19:1558

36. Lv B, Zhou Z, Xu G, Yang D, Wu L, Shen Q, et al. Knowledge, attitudes and practices concerning self-medication with antibiotics among university students in western China. Tropical Med Int Health. 2014;19(7):769–79.

37. Yu M, Zhao G, Lundborg CS, Zhu Y, Zhao Q, Xu B. Knowledge, attitudes, and practices of parents in rural China on the use of antibiotics in children: a cross-sectional study. BMC Infect Dis. 2014;14(1):112.

38. (Anant Nepal 2019, Lv B 2014, Yu M et al., 2014)

39. Tshokey T, Adhikari D, Tshering T, Wangmo S, Wangdi K. Assessing the knowledge, attitudes, and practices on antibiotics among the general public attending the outpatient pharmacy units of hospitals in Bhutan: a cross-sectional survey. Asia Pac J Public Health. 2017;29(7):580–8.

40. McNulty CA, Boyle P, Nichols T, Clappison P, Davey P. Don't wear me out—the public's knowledge of and attitudes to antibiotic use. J Antimicrob Chemother. 2007;59(4):727–38.

41. Mouhieddine TH, Olleik Z, Itani MM, Kawtharani S, Nassar H, Hassoun R, et al. Assessing the Lebanese population for their knowledge, attitudes and practices of antibiotic usage. J Infect Public Health. 2015;8(1):20–31.

42. Jamhour A, El-Kheir A, Salameh P, Hanna PA, Mansour H. Antibiotic knowledge and self-medication practices in a developing country: a crosssectional study. Am J Infect Control. 2017;45(4):384–8.

43. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. PLoS One. 2015;10(2):e0117910.

44. Widayati A, Suryawati S, De Crespigny C, Hiller JE. Knowledge and beliefs about antibiotics among people in Yogyakarta City Indonesia: a cross sectional population-based survey. Antimicrob Resist Infect Control. 2012; 1(1):38.

45. You J, Yau B, Choi K, Chau C, Huang Q, Lee S. Public knowledge, attitudes and behavior on antibiotic use:a telephone survey in Hong Kong. Infection.2008;36(2):153–7.

46. Saleh Faidah H, Haseeb A, Yousuf Lamfon M, Mohammad Almatrafi M, Abdullah Almasoudi I, Cheema E, et al. Parents' self-directed practices towards the use of antibiotics for upper respiratory tract infections in Makkah, Saudi Arabia. BMC Pediatr. 2019;19(1):1–9. doi: https://doi.org/10.1186/s12887-019-1391-0

47. Michaelidou M, Karageorgos SA, Tsioutis C. Antibiotic use and antibiotic resistance: public awareness survey in the Republic of Cyprus. Antibiotics 2020;9(11):759. doi: https://doi.org/10.3390/antibiotics9110759

48. Abu Taha A, Abu-Zaydeh A, Ardah R, Al-Jabi S, Sweileh W, Awang R, et al. Public knowledge and attitudes regarding the use of antibiotics and resistance: findings from a cross-sectional study among Palestinian adults. Zoonoses Public Health. 2016;63(6):449–57.

49. Lim JM, Duong MC, Cook AR, Hsu LY, Tam CC. Public knowledge, attitudes and practices related to antibiotic use and resistance in Singapore: a cross-sectional population survey. BMJ Open. 2021;11(9):e048157. doi: https://doi.org/10.1136/bmjopen-2020-048157

50. 49. Jali A, Hakami A, Dahas N, Mahnashi M, Siddiq A, Alsomaili H, et al. Antibiotic use and resistance knowledge: awareness among the general public in Jazan, Saudi Arabia. Cureus. 2021;13(12):e20369. doi: https://doi.org/10.7759/cureus.20369.

.