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A cross-sectional study on knowledge, attitude, and level of preparedness of medical interns in a teaching hospital from India on antibiotic use and antimicrobial resistance

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ABSTRACT

Background: The topic of antibiotic prescription and antimicrobial resistance is an integral part of the Indian medical undergraduate curriculum; however, the newly passed-out medical interns find it difficult to prescribe the appropriate antibiotics when they practice. The impact of teaching about antimicrobial resistance and antibiotic use in medical colleges still remains uncertain.

Aim: This study aims to assess the knowledge, attitude, and level of preparedness regarding antibiotic use and antimicrobial resistance among medical interns from a teaching hospital in Kerala, India.

Methods: This questionnaire-based study evaluated the knowledge, attitude, and level of preparedness among medical interns toward antibiotic use and antimicrobial resistance. The assessment included 20 knowledge questions (max score: 26), five attitude questions (max score: 5), and eight preparedness questions (max score: 8). A passing score of 60% was set for each category, with scores below this threshold considered as poor performance. Participants included medical interns from the 2018 batch, who were nearing the end of their internship, and those from the 2019 batch, who had just started their 1-year internship. This study was done from June to October 2024.

Results: The study involved 85 medical interns (43 from the 2018 batch and 42 from the 2019 batch). It was observed that 98.8% ($n = 84$) interns displayed good general knowledge about antibiotics, but with regard to specific topics, only 44.7% ($n = 38$) interns showed good knowledge about antibiotic resistance and only 47.1% ($n = 40$) interns showed good knowledge about clinical scenarios. The overall knowledge score showed that 70.6% ($n = 60$) of interns have good knowledge regarding antibiotic use. With regards to overall attitude, 94.1% ($n = 80$) of the interns displayed a good attitude. In terms of preparedness, 55.3% ($n = 47$) of interns displayed a good level of preparedness to use and prescribe antibiotics. Both batches showed similar knowledge (69.8% for 2018 and 71.4% for 2019) and attitude scores (90.7% and 97.6%). With regard to the level of preparedness, the 2018 batch showed a statistically significant good level of preparedness in using and prescribing antibiotics compared to the 2019 batch (74.4% and 35.7%, p-value = 0.0001).

Conclusion: The study shows that the medical interns have a good theoretical knowledge and understanding of antibiotics, but the study also emphasizes the importance of training interns with regard to attitude and practice toward antibiotic use and antimicrobial resistance. This study also reveals the importance of bedside teaching and 1-year internship in improving the level of preparedness toward antibiotic use among medical interns.

Keywords: Knowledge, attitude, level of preparedness, antimicrobial resistance, medical interns.

Introduction

According to the World Health Organisation, AMR contributes to at least 700,000 deaths globally (Dadgostar 2019; Murray *et al.*, 2022; Naghavi *et al.*, 2024).AMR resources analysis revealed that AMR could lead to an economic loss of trillions by 2050 through causes such as healthcare, productivity and trade, and food security. AMR complicates the effectiveness of managing day-to-day infections with diseases such as pneumonia, UTI, and sepsis (Inoue 2019; Grant and Saux 2021; Abbott *et al.*, 2023; Ferdinand *et al.*, 2023; Tamma *et al.*, 2024). According to the Centre for Disease Dynamics, Economics & Policy estimate for 2015, AMR will cause 2 million deaths per year by 2050 to India besides sepsis killing over 50,000 newborns in the same year (Dixit *et al.*, 2019; Kalra *et al.*, 2022; Ahmed *et al.*, 2024). India is ranked highly in the global list of resistance to antimicrobial agents that are used in both human and food animals (Taneja and Sharma 2019; Bhatia 2024; Rana *et al.*, 2024). India is ranked highly in the global list of resistance to antimicrobial agents that are used in both human and food animals and as per Kerala Government's

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strategic plan for fighting AMR called Kerala Antibiotic Resistance Strategic Action Plan (Nambiar 2020; Barik *et al.*, 2023), Kerala will be the first state to have AMR committees in all 191 block panchayats to build up AMR literacy in grassroots. The standardization and the guidelines of the working of the block-level AMR committees are published by the Kerala government and all the hospitals will become 'antibiotic smart' (Mathew *et al.*, 2024; Raju *et al.*, 2024).

In Indian medical schools, even though there are multiple teaching sessions on antibiotic prescription and resistance as part of the phase II competency-based medical education curriculum, the attitude and practice toward antibiotic use and resistance seem poor and require significant improvement, which was described in the cross-sectional study conducted by Gupta *et al.* (2019) that included 103 medical colleges distributed across 22 states of India, in which the majority of the data came from the central and northern states of India (Gupta *et al.*, 2019) with very limited information from the southern states such as Kerala. Hence, our study from Kerala, India would be of great relevance. The objectives of this study are to evaluate the knowledge, attitude, and level of preparedness about antibiotic use and antimicrobial resistance among medical interns doing their 1-year compulsory rotatory internship after completing their undergraduate education, which is a prerequisite to become a registered medical practitioner in India.

Methods

A cross-sectional study was conducted among medical interns to evaluate knowledge, attitude, and level of preparedness about antibiotic use and antimicrobial resistance using an online questionnaire given as a Google Form, which was developed by Lubwama *et al.* (2021) The Google Form was set up in a way that only one response was allowed from a particular email to ensure that multiple attempts were not made by the participants. This instrument has 20 questions about knowledge with a total score of 26; five questions on attitude with a total score of 5 and eight questions about level of preparedness, which has a total score of 8. The passing criterion was set at 60% for each parameter, i.e., knowledge, attitude, and level of preparedness. With scores below 60%, the candidate was deemed to have poor score and score equal to and above 60% was considered as good score within each parameter. At the time of recruitment for this study, we had two batches of interns (2018 batch and 2019 batch) 100 in each batch doing the internship in our medical school. The 2018 batch was about to complete their 1-year compulsory internship within a month, and contrary to this, the 2019 batch just joined the internship in less than a month. Therefore, the 2018 batch has had extensive bedside training in various clinical departments of about 10–11 months and the 2019 batch was new to this internship with very limited training. This study was done from June 2024 to October 2024. We followed a universal sampling, as we wanted to include all the interns who were willing to participate in this study as we had only a total of 200 interns from both batches. This study was conducted in a tertiary care teaching hospital and was approved by the Institutional Ethics Committee with the approval number: 20/EC/24/AIMS-24 dated 07.05.2024.

Statistical analysis

The analysis was done using IBM SPSS version 23 (Armonk, NY: IBM Corp). Mean ±SD (standard deviation) was calculated for age and frequency taken for age, gender, and year of enrolment. Knowledge, attitude, and preparedness scores were analyzed as descriptive statistics and the comparison between the 2018 and 2019 batches was analyzed using Fisher's exact test for knowledge and attitude, while the chi-square test was considered for comparing preparedness to find the association between batch (or internship training) and preparedness. A p-value < 0.05 was considered significant.

Results

A total of 85 interns ($n = 43$) from the 2018 batch and ($n = 42$) from the 2019 batch participated in this study out of a total of 200 interns who were doing internship at the time of this study. The total age group of participants ranged between 23 and 26 years, of which 75.3% ($n = 64$) were females and 24.7% ($n = 21$) were males. The results about knowledge of antibiotics, resistance, clinical scenarios, and overall knowledge score are depicted in Figure 1. It was observed that 98.8% ($n = 84$) interns displayed good general knowledge about antibiotics, but with regard to specific topics, only 44.7% ($n = 38$) interns showed good knowledge about antibiotic resistance and only 47.1% ($n = 40$) interns showed good knowledge about clinical scenarios. It is a cause of concern to see that 55.3% ($n = 47$) and 52.9% ($n = 45$) interns displayed poor knowledge about antibiotic resistance and in clinical scenarios, respectively. The overall knowledge score showed that 70.6% (n = 60) of interns have good knowledge and 29.4% ($n = 25$) of interns have poor knowledge regarding antibiotic use. The results on attitude and perception on antibiotic use are depicted in Figure 2. With regard to overall attitude, 94.1% ($n = 80$) of interns displayed a good attitude, while 5.9% ($n = 5$) of interns displayed poor attitude. However, with regard to specific attitude about over-the-counter use of antibiotics without prescription and use of leftover antibiotics, 43.5% ($n = 37$) and 37.6% ($n = 32$) of interns, respectively, showed poor attitude. With regard to the level of preparedness, as shown in Table 1, only 55.3% ($n = 47$) of interns displayed a good level of preparedness, while 44.7% ($n = 38$) displayed a poor level of preparedness to use and prescribe antibiotics. Our results as shown in Table 2 indicate that both the batches (2018 and 2019) displayed similar scores with regard to knowledge (69.8% and 71.4%, respectively) and attitude (90.7% and 97.6%, respectively), as shown in Table 3.

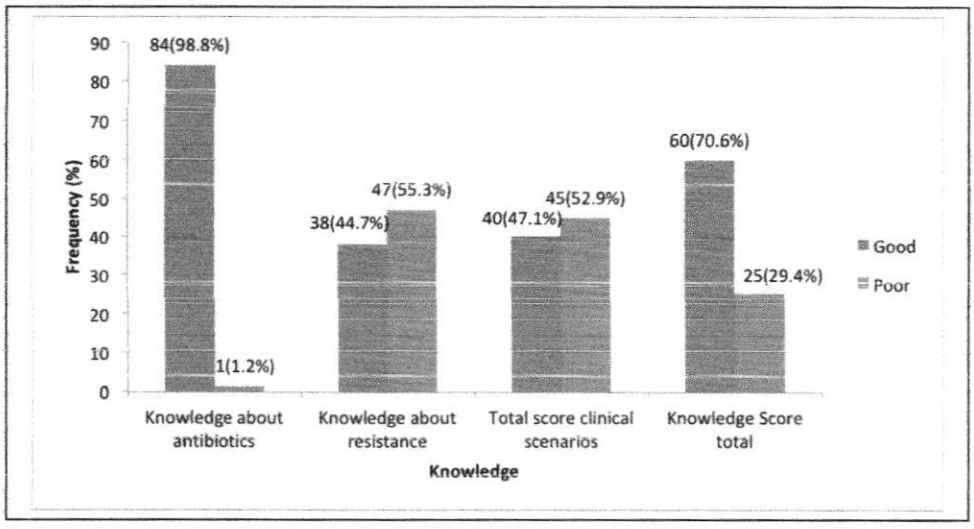

Fig. 1. Knowledge about antibiotics, resistance, total score in clinical scenarios, and total score among medical interns.

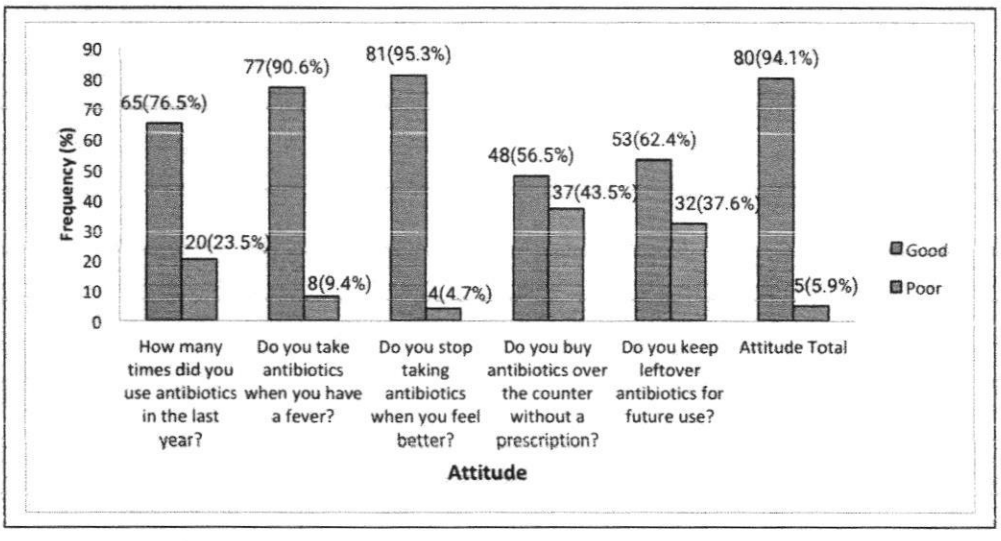

Fig. 2. Attitude and perception of antibiotic use among medical interns.

However, with regard to the level of preparedness, as shown in Table 4, the 2018 batch showed a statistically significant good level of preparedness in using and prescribing antibiotics compared to the 2019 batch (74.4% and 35.7%, p-value = 0.0001).

Discussion

The results from our study show that even though the overall knowledge and general knowledge about antibiotics is good among interns, when it comes to knowledge about antibiotic resistance and various clinical scenarios, the knowledge is poor among the majority. Both batches (2018 and 2019) displayed similar knowledge and attitude about antibiotics, resistance, and use in clinical scenarios overall. However, it is a cause of concern to see that there are interns who still practice over-the-counter use of antibiotics without a prescription and keep leftover antibiotics for future use. This shows that more training is required about antibiotic resistance and attitude toward antibiotic prescription among interns. With regard to the level of preparedness, the 2018 batch showed a statistically significant good level of preparedness in using and prescribing antibiotics compared to the 2019 batch. The 2018 batch was almost about to finish its 1-year compulsory rotatory internship in various clinical departments, but, with regard to the 2019 batch, they just joined the internship. This improved preparedness

Table 1. Level of preparedness about antibiotic use among medical interns.

	Prepared		Not prepared	
	N	%	*N*	%
Know whether to give an antibiotic or not?	61	71.8	24	28.2
Know when to start antimicrobial therapy?	62	72.9	23	27.1
Know how to select the best antibiotic?	27	31.8	58	68.2
Know the dosage of antibiotic to give?	48	56.5	37	43.5
Know when to switch from an intravenous antibiotic to oral regimen?	43	50.6	42	49.4
Know the correct and relevant specimen to collect for an infection?	66	77.6	19	22.4
Distinguish between normal flora and a true pathogen from a microbiology report?	49	57.6	36	42.4
Understand resistance mechanisms based on a microbiology report?	55	64.7	30	35.3
Total	47	55.3	38	44.7

Table 2. Comparison between 2018 and 2019 batch medical interns about knowledge on antibiotics, resistance, and clinical scenarios.

Knowledge		Year of enrolment		Total	*p*-value (chi-square)
		2018	2019		
About antibiotics	Good	42 (97.7%)	42 (100%)	84	0.241#
	Poor	1 (2.3%)	0 (0%)	1	
Resistance	Good	20 (46.5%)	18 (42.9%)	38	0.735
	Poor	23 (53.5%)	24 (57.1%)	47	
Clinical scenarios	Good	20 (46.5%)	20 (47.6%)	40	0.919
	Poor	23 (53.5%)	22 (52.4%)	45	
Total	Good	30 (69.8%)	30 (71.4%)	60	0.867
	Poor	13 (30.2%)	12 (28.6%)	25	

Fisher's exact test.

Table 3. Comparison between 2018 and 2019 batch medical interns about attitude toward antibiotic use.

Attitude	Year of enrolment		Total
	2018	2019	
Good	39 (90.7%)	41 (97.6%)	80
Poor	4 (9.3%)	1 (2.4%)	5
Total	43	42	85

Fisher's exact *p*-value =0.161.

Table 4. Comparison between 2018 and 2019 batch medical interns about level of preparedness on antibiotic use.

Preparedness	Year of enrolment		Total
	2018	2019	
Prepared	32 (74.4%)	15 (35.7%)	47
Not prepared	11 (25.6%)	27 (64.3%)	38
Total	43	42	85

Chi-square test *p*-value = 0.0001.

to use antibiotics among the 2018 batch can be attributed to the hands-on training they received during their internship, which was lacking in 2019 as they just joined internship. Our assumption why the 2018 batch showed improved preparedness compared to the 2019 batch is that our medical students in India during their training from first year to final year, the bedside clinical teaching mainly focuses on history taking and physical examination of the patient. There is not much focus on the day-to-day medical management of the patients and the undergraduate students are also not part of the daily clinical rounds and follow-up of the patients. Such practical and important clinical training happens at the time of the 1-year compulsory rotatory internship during which the medical interns are posted in various clinical departments and are given the responsibility

of medical management of out-patients and in-patients under the supervision of a faculty, who trains them on how to treat and follow-up the patients until discharge from the hospital, and it is during this time that the medical interns actually go through the case sheets and understand more about the various commonly used drugs in clinical practice and how it benefits the patients. They also get trained practically about the rational and judicious use of antibiotics during this internship. This highlights the importance of bedside training received during internship and how much the students can learn by being actively involved in direct patient care under proper supervision.

In a 2021 study by Lubwama *et al.* (2021) in East Africa, the age group found was 25.5 years, our study where the mean age among the medical interns of the study was 24.24 (SD = 0.840) years. Our study had 75.3% (n = 64) and 24.7% (n = 21) females and males. In the East Africa study, the total knowledge good score ranged between 55% and 67 %, which was less than our study that displayed a total knowledge good score of 70%. Our interns displayed much more overall knowledge about antibiotics. In the East Africa study (2021), the mean good scores for general knowledge about antibiotics, knowledge about antibiotic resistance, and knowledge about antibiotic use in clinical scenarios were 95%, 54%, and 46%, respectively, which was like our study (98.8%, 47.7%, and 47.1%, respectively). In the same study with regard to general attitude toward over-the-counter use of antibiotics, 61% of medical students showed poor attitude, while in our study, it was only 43.5%, which was showing poor attitude. Our study showed that the proportion of interns showing poor attitude was lesser compared to other studies, but still, 43% is a good number and it is a cause of concern, because these interns are future primary care physicians of our country. In the East Africa study (2021), with regard to the level of preparedness, 70.1% of final-year students perceived themselves to be prepared to use antibiotics appropriately while working at the district hospital, while in our study, only 55.3% perceived themselves to be prepared (Lubwama *et al.*, 2021). In another study conducted in UAE (2019) by Jairoun *et al.* (2019)the average knowledge and attitude good score was 59% and 76% (Jairoun *et al.*, 2019), while in our study, the average knowledge and attitude good score was 70.6% (n = 60) and 94.1% (n = 80), respectively. Our study showed that our interns have better knowledge and attitude toward antibiotic use. In another Chinese study (2018) conducted by Hu *et al.* (2018) 64% of medical students kept leftover antibiotics for future use. On the other hand, our result displayed only 37.6% (n = 32) of medical interns kept leftover antibiotics for future use, which was far better than the Chinese study (Hu *et al.*, 2018). In a Columbian study (2018) conducted by Higuita-Gutiérrez *et al.* (2020) the overall knowledge and attitude score was more than 80% compared to our study, which reported 70.6% (n = 60) and 94.1% (n = 80), respectively. It also showed that antibiotic consumption in the last year was 49.1%, while our study showed that 76.5% (n = 65) consumed antibiotics up to 3 times in a year. It was also observed that 80.3% of the antibiotics sold were without prescription, while our study displayed 43.5% (n = 37) (Higuita-Gutiérrez *et al.*, 2020). Even though our study demonstrated better practice on using antibiotics and using it with a prescription, still 43.5% using antibiotics without prescription is a concern as these practices can have a major impact in the future and even small mistakes with regard to antibiotics cannot be accepted. In a study conducted in 2019, in India by Gupta *et al.* (2019) the level of knowledge about antibiotics was quite high (91.8%) like our study that displayed 98.8% (n = 84). With regard to attitude, almost 66% kept leftover antibiotics for future use and around half bought antibiotics without prescription, while our study showed only 37.6% (n = 32) and 43.5% (n = 37) (Gupta *et al.*, 2019).

This study has some limitations as we considered only interns from a single center, so we were forced to do a universal sampling without a sample size calculation as we had a small size of interns in our center. In the future, we recommend more similar studies, which are conducted as multicentre studies involving medical colleges across states and nation.

Conclusion

This study shows that more emphasis should be given to training interns with regard to attitude and practice toward antibiotic use and antimicrobial resistance. Another aspect that this study shows is that bedside teaching and clinical training improve the preparedness toward antibiotic use among medical interns and prepare them for future as they become primary care physicians.

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Conflict of interest

None.

Authors' contributions

1. Concept and design of the study or acquisition, analysis, and interpretation of data: Kunjumary Scariah, Keerthi Krishna U, Boney Rajan, and P Vinod Kumar.
2. Drafting and revising the manuscript for important intellectual content: P Vinod Kumar and Boney Rajan.
3. Final approval for the version that is going to be published: Boney Rajan, P Vinod Kumar, Kunjumary Scariah, and Keerthi Krishna U.

Data availability

Data will be provided if required.

References

Abbott, I.J., Peel, T.N., Cairns, K.A. and Stewardson, A.J. 2023. Antibiotic management of urinary tract infections in the post-antibiotic era: a narrative review highlighting diagnostic and antimicrobial stewardship. Clin. Microbiol. Infect. 29(10), 1254–1266.

Ahmed, S.K., Hussein, S., Qurbani, K., Ibrahim, R.H., Fareeq, A., Mahmood, K.A and Mohamed, M.G. 2024. Antimicrobial resistance: impacts, challenges, and future prospects. J. Med. Surg. Public Health 2, 100081.

Barik, S.R., Pradhan, H.S., Prakash, J. and Satpathy, S.K.A. 2023. Comparative analysis of National and State level action plans on antimicrobial resistance in India. J. Multidiscip. Res. Healthcare 9(2), 37–50.

Bhatia, R. 2024. Environmental aspects of antimicrobial resistance in India: current progress & way forward. Indian J. Med. Res. 159(1), 10–15.

Dadgostar, P. 2019. Antimicrobial resistance: implications and costs. Infect. Drug Resist. 12, 3903–3910.

Dixit, A., Kumar, N., Kumar, S. and Trigun, V. 2019. Antimicrobial resistance: progress in the decade since emergence of New Delhi metallo-β-lactamase in India. Indian J. Community Med. 44(1), 4–8.

Ferdinand, A.S., Coppo, M.J., Howden, B.P. and Browning, G.F. 2023. Tackling antimicrobial resistance by integrating one health and the sustainable development goals. BMC Glob. Public Health. 1(1), 11.

Grant, J. and Saux, N.L. 2021. Antimicrobial Stewardship and Resistance Committee (ASRC) of the Association of Medical Microbiology and Infectious Disease (AMMI) Canada. Duration of antibiotic therapy for common infections. Offic. J. Assoc. Med. Microbiol. Infect. Dis. Can. 6(3), 181–197.

Gupta, M.K., Vohra, C. and Raghav, P. 2019. Assessment of knowledge, attitudes, and practices about antibiotic resistance among medical students in India. J. Fam. Med. Prim. Care 8(9), 2864–2869.

Higuita-Gutiérrez, L.F., Roncancio Villamil, G.E. and Jiménez Quiceno, J.N. 2020. Knowledge, attitude, and practice regarding antibiotic use and resistance among medical students in Colombia: a cross-sectional descriptive study. BMC Public Health. 20, 1–2.

Hu, Y., Wang, X., Tucker, J.D., Little, P., Moore, M., Fukuda, K. and Zhou, X. 2018. Knowledge, attitude, and practice with respect to antibiotic use among Chinese medical students: a multicentre cross-sectional study. Int. J. Environ. Res. Public Heal. 15(6), 1165.

Inoue, H. 2019. Strategic approach for combating antimicrobial resistance (AMR). Glob. Health Med. 1(2), 61–64.

Jairoun, A., Hassan, N., Ali, A., Jairoun, O. and Shahwan, M. 2019. Knowledge, attitude and practice of antibiotic use among university students: a cross sectional study in UAE. BMC Public Health 19, 1–8.

Kalra, S.J., Shankar, H., Mansoori, N. and Gupta, D.L. 2022. Antibiotic-resistant bacteria originating from the gut may modulate the mucosal immune response during sepsis and septic shock. Drug Target Insights 16, 81–7.

Lubwama, M., Onyuka, J., Ayazika, K.T., Ssetaba, L.J., Siboko, J., Daniel, O. and Mushi, M.F. 2021. Knowledge, attitudes, and perceptions about antibiotic use and antimicrobial resistance among final year undergraduate medical and pharmacy students at three universities in East Africa. PLoS One 16(5), e0251301.

Mathew, P., Chandy, S.J., Sivaraman, S., Ranjalkar, J., Ali, H.M. and Thomas, S.A. 2024. Formulating a community-centric indicator framework to quantify one health drivers of antibiotic resistance: a preliminary step towards fostering 'antibiotic-smart communities'. Antibiotics 13(1), 63.

Murray, C.J., Ikuta, K.S., Sharara, F., Swetschinski, L., Aguilar, G.R., Gray, A., Han, C., Bisignano, C., Rao, P., Wool, E. and Johnson, S.C. 2022. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. Lancet 399(1035), 629–655.

Naghavi, M., Vollset, S.E., Ikuta, K.S., Swetschinski, L.R., Gray, A.P., Wool, E.E., Aguilar, G.R., Mestrovic, T., Smith, G., Han, C. and Hsu, R.L. 2024. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. Lancet 404(10459), 1199–1226.

Nambiar, P. 2020. India to envision One Health movement for confronting emerging health threats: from concept to approach toward institutionalization. Int. J. One Health 6(2), 165–176.

Raju, R., Srinivas, S.C., Siddalingegowda, S.M., Vaidya, R., Gharat, M. and Kumar, T.P. 2024. Community pharmacists as antimicrobial resistance stewards: a narrative review on their contributions and challenges in low-and middle-income countries. J. Pharm. Pharma. Sci. 27, 12721.

Rana, S., Kaur, K.N., Narad, P., Walia, K., Saeed, S., Chandra, A., Shannawaz, M. and Singh, H. 2024. Knowledge, attitudes and practices of antimicrobial resistance awareness among healthcare workers in India: a systematic review. Front. Public Health 12, 1433430.

Tamma, P.D., Heil, E.L., Justo, J.A., Mathers, A.J., Satlin, M.J. and Bonomo, R.A. 2024. Infectious diseases Society of America 2024 guidance on the treatment of antimicrobial-resistant gram-negative infections. Clin. Infect. Dis. ciae403, 1–56.

Taneja, N. and Sharma, M. 2019. Antimicrobial resistance in the environment: the Indian scenario. Indian J. Med. Res. 149(2), 119–128.

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