



ANTIMICROBIAL RESISTANCE - A GLOBAL EMERGING THREAT AND ITS KNOWLEDGE AMONG HEALTHCARE PROVIDERS

Clinical Science

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ABSTRACT

Objectives : This study aimed to assess the awareness and knowledge of antibiotic usage and antimicrobial resistance (AMR) among healthcare providers. It also explored whether the level of education and professional experience of healthcare providers influenced their understanding of AMR. **Methods :** A cross-sectional survey was conducted from January to March 2025, involving 120 healthcare providers. A structured questionnaire was used to collect data, which was analysed using SPSS v.21. Statistical methods included Chi-square tests, multivariate regression, and ANOVA to evaluate differences in knowledge levels. **Results :** Out of 150 invited healthcare providers, 120 participated (response rate: 95.5%). Among them, 65% were male, and 35% were female. Approximately half of the participants had prescribed antibiotics in the past 12 months, with the majority prescribing them for conditions like the common cold. While 34.2% of participants acknowledged keeping leftover antibiotics, 79.5% reported adjusting doses without consulting guidelines. About 76% of participants admitted to prescribing antibiotics upon patient request, and 38% preferred prescribing antibiotics for viral infections like colds. Notably, 90% of participants were unaware that antibiotics are ineffective against viruses. **Conclusion :** The study revealed significant gaps in knowledge about antibiotic use and AMR among healthcare providers. Educational interventions and targeted training programs are essential to improve awareness and promote the prudent use of antibiotics. Special attention should be given to providers with less formal education or training in infectious diseases.

KEYWORDS

Antibiotics, Antimicrobial resistance, Healthcare providers, Awareness, Education, Training, Campaigns

INTRODUCTION

Antimicrobial resistance (AMR) is the ability of microorganisms to resist the effects of antimicrobial drugs. Over the years, pathogens causing common and severe infections have developed varying degrees of drug resistance, making AMR a critical global health concern. The United Kingdom Review on Antimicrobial Resistance estimated that, if current trends continue, AMR could cause 10 million deaths annually by 2050.

Healthcare providers play a pivotal role in combating AMR by ensuring the judicious use of antibiotics. In Europe and the United States, educational campaigns targeting healthcare professionals have been implemented to raise awareness about AMR. These campaigns have been evaluated through surveys, helping to refine strategies and improve outcomes. In India, the burden of infectious diseases is among the highest globally, and the inappropriate use of antibiotics has exacerbated the development of AMR. This study aims to assess the knowledge and practices of healthcare providers regarding antibiotic use and AMR in India.

METHODS

Participants and Study Design

A cross-sectional survey was conducted among healthcare providers in India. Participants were selected based on their professional roles (doctors, nurses, pharmacists, etc.) and were invited to complete an electronic questionnaire. The questionnaire assessed their knowledge, attitudes, and practices related to antibiotic use and AMR.

Descriptive statistics were used to analyse demographic data. Chi-square tests and regression analysis were employed to examine relationships between variables. ANOVA was used to compare knowledge levels across different groups based on education and professional experience. Participants were categorized into three knowledge levels: low, moderate, and high, based on their responses to a 16-item questionnaire.

RESULTS

General Characteristics of Respondents

Of the 120 participants, 65% were male, and 35% were female. The majority (63.3%) were aged 21–40 years. Participants were grouped by educational level: 54% had a graduate degree, 38.1% had postgraduate qualifications, and 3.7% had less than a graduate degree.

Knowledge on Antibiotics and AMR

Nearly all participants (56%) had prescribed antibiotics in the past year. The most common reason for prescribing antibiotics was the

common cold (46.7%). About 79.5% of participants reported adjusting antibiotic doses without consulting guidelines. Most participants (83.6%) prescribed antibiotics based on clinical judgment, while 5.9% admitted to overprescribing, and 0.83% used leftover antibiotics.

Key findings from the questionnaire included:

- 67.8% believed antibiotics speed up recovery from colds.
- 94.3% agreed that mild infections can resolve without antibiotics.
- 56.1% saved leftover antibiotics for future use.
- 70.4% stopped antibiotic courses prematurely if patients felt better.
- 80.2% recognized that bacteria can develop resistance to antibiotics.
- 91.2% understood that overuse of antibiotics increases resistance.

The responses of the questionnaire are tested for significance using one-way ANOVA test based on the means (normally distributed populations with equal variances) for repeated measures. The F-ratio value is 13.11. The p-value is 0.00008. Hence we reject null hypothesis and accept alternative hypothesis. The result is significant at $p < .05$. The responses were cross verified with the Friedman chi square test. The Friedman X^2 statistic is 13.9 (2, $N = 16$). The p-value is .0009. The result is significant at $p < .05$. Levene's Test of Homogeneity of Variance Calculator. The f-ratio value is 0.08. The p value is 0.79. The result is not significant at $p < .05$. The requirement of homogeneity is met.

DISCUSSION

The findings of this study shed light on the critical gaps in knowledge and practices related to antibiotic use and antimicrobial resistance (AMR) among healthcare providers. Despite their professional training and pivotal role in patient care, many healthcare providers demonstrated a lack of awareness regarding the appropriate use of antibiotics and the mechanisms of AMR. (1) This section delves deeper into the implications of these findings, the factors contributing to the observed gaps, and the potential strategies to address them.

1. Inappropriate Prescription Practices

One of the most concerning findings of this study is the high prevalence of inappropriate antibiotic prescriptions among healthcare providers. Nearly half of the participants (67.8%) reported prescribing antibiotics for the common cold, a condition primarily caused by viruses, against which antibiotics are ineffective. This aligns with global trends, where antibiotics are often overprescribed for viral infections, contributing significantly to the development of AMR. The overuse of antibiotics in such cases not only fails to benefit patients but

also exposes them to unnecessary side effects and increases the risk of resistance. (2)

The reasons behind this over prescription are multifaceted. First, there is often diagnostic uncertainty, especially in primary care settings where rapid diagnostic tests for bacterial infections are not always available. In such cases, healthcare providers may err on the side of caution by prescribing antibiotics, fearing potential bacterial complications. Second, patient expectations and pressure can influence prescribing behaviour. Many patients visit healthcare providers with the expectation of receiving antibiotics, and providers may feel compelled to meet these demands to maintain patient satisfaction. (3) This highlights the need for better patient education and communication strategies to manage expectations and reduce unnecessary antibiotic use.

2. Premature Discontinuation of Antibiotic Courses

Another significant issue identified in this study is the premature discontinuation of antibiotic courses. Approximately 71.5% of healthcare providers reported stopping antibiotic therapy if patients felt better before completing the prescribed course. This practice is particularly dangerous as it can lead to the survival of partially resistant bacteria, which can then multiply and spread, contributing to the development of AMR. The World Health Organization (WHO) emphasizes the importance of completing the full course of antibiotics to ensure that all bacteria are eradicated and to minimize the risk of resistance. (5)

The reasons for premature discontinuation may include a lack of understanding of the mechanisms of antibiotic resistance, time constraints in patient follow-up, and inadequate communication between healthcare providers and patients. (6) To address this, healthcare providers need to be educated on the importance of adherence to antibiotic regimens and the risks associated with incomplete treatment. Additionally, systems should be put in place to ensure better follow-up and monitoring of patients undergoing antibiotic therapy.

3. Storage and Reuse of Leftover Antibiotics

The study also revealed that 54.8% of healthcare providers acknowledged saving leftover antibiotics for future use. This practice is problematic for several reasons. First, leftover antibiotics may not be appropriate for treating new infections, as different infections require different types and dosages of antibiotics. (7) Second, the quantity of leftover antibiotics may be insufficient for a full course of treatment, leading to suboptimal dosing and increased risk of resistance. Finally, the storage of antibiotics at home can lead to degradation of the drugs, reducing their efficacy and potentially causing harm to patients. (8)

The reuse of leftover antibiotics is often driven by a desire to save costs and avoid the inconvenience of visiting a healthcare provider for a new prescription. However, this practice undermines the principles of rational antibiotic use and contributes to the global AMR crisis. Healthcare providers must be educated on the dangers of reusing antibiotics and should actively discourage this practice among their patients. Public health campaigns can also play a role in raising awareness about the risks of self-medication and the importance of seeking professional medical advice for infections.

4. Lack of Awareness About AMR Mechanisms

Despite their professional training, a significant proportion of healthcare providers demonstrated a lack of understanding of the mechanisms of AMR. For example, 84.2% of participants believed that humans can become resistant to antibiotics, rather than understanding that it is the bacteria that develop resistance. This misconception can lead to inappropriate prescribing practices and a lack of urgency in addressing AMR.

The spread of resistant bacteria from person to person and across different environments (e.g., from animals to humans) was also poorly understood by many participants. Only 55.2% recognized that resistance can spread from animals to humans, (9) and 65.7% acknowledged that it can spread from person to person. This lack of awareness highlights the need for targeted education on the mechanisms of AMR and the interconnectedness of human, animal, and environmental.

5. Role of Education and Training

The study found that healthcare providers with higher levels of

education and professional experience demonstrated better knowledge of antibiotic use and AMR. However, even among this group, significant gaps remained. (10) This suggests that current medical education and training programs may not be adequately addressing the complexities of AMR and the principles of rational antibiotic use (11).

To bridge these gaps, medical curricula should be updated to include comprehensive training on AMR, antibiotic stewardship, and the appropriate use of antibiotics. Continuing medical education (CME) programs can also play a crucial role in keeping healthcare providers updated on the latest guidelines and best practices. Additionally, interdisciplinary training involving pharmacists, microbiologists, and infectious disease specialists can help healthcare providers develop a more holistic understanding of AMR and its implications.

6. Communication and Patient Education

Effective communication between healthcare providers and patients is essential for promoting rational antibiotic use. However, the study revealed that many healthcare providers do not take the time to educate their patients about the appropriate use of antibiotics and the risks of AMR. (12) This lack of communication can lead to misunderstandings, non-adherence to treatment regimens, and the misuse of antibiotics.

Healthcare providers should be trained in communication skills to effectively convey the importance of completing antibiotic courses, the dangers of self-medication, and the differences between bacterial and viral infections. (13) Patient education materials, such as brochures, posters, and digital content, can also support these efforts. By empowering patients with knowledge, healthcare providers can foster a more collaborative approach to managing infections and reducing the burden of AMR.

7. Antibiotic Stewardship Programs

The findings of this study underscore the need for robust antibiotic stewardship programs (ASPs) in healthcare settings. ASPs are designed to optimize antibiotic use, improve patient outcomes, (14) and reduce the development of resistance. Key components of ASPs include guidelines for antibiotic prescribing, monitoring and feedback on prescribing practices, and education for healthcare providers. (15)

In India, where the burden of infectious diseases is high and healthcare resources are often limited, the implementation of ASPs can be challenging. However, even small-scale interventions, such as the introduction of prescribing guidelines and the establishment of multidisciplinary stewardship teams, can have a significant impact. Government support and funding are essential to scale up these efforts and ensure their sustainability.

8. Global and National Efforts to Combat AMR

The global community has recognized AMR as a major public health threat and has taken steps to address it. The World Health Organization (WHO) has developed a Global Action Plan on AMR, which provides a framework for countries to develop their own national action plans. India has also launched its National Action Plan on AMR, which focuses on improving awareness, strengthening surveillance, and promoting rational antibiotic use.

However, the success of these efforts depends on the active participation of healthcare providers. As frontline workers, healthcare providers play a crucial role in implementing AMR strategies and educating the public. By aligning their practices with national and global guidelines, healthcare providers can contribute to the collective effort to combat AMR.

9. The Role of Technology and Innovation

Advancements in technology and innovation can also play a significant role in addressing AMR. Rapid diagnostic tests, for example, can help healthcare providers distinguish between bacterial and viral infections, reducing unnecessary antibiotic prescriptions. Telemedicine and digital health platforms can facilitate better communication between healthcare providers and patients, enabling more effective monitoring and follow-up.

Additionally, the development of new antibiotics and alternative therapies, such as bacteriophages and immunotherapies, can provide new tools for combating resistant infections. However, these innovations must be accompanied by efforts to preserve their efficacy through rational use and stewardship.

10. Conclusion and Call to Action

The findings of this study highlight the urgent need for targeted interventions to improve healthcare providers' knowledge and practices related to antibiotic use and AMR. Educational campaigns, updated medical curricula, and robust antibiotic stewardship programs are essential to address the gaps identified in this study. By equipping healthcare providers with the knowledge and tools they need to combat AMR, we can work towards a future where antibiotics remain effective for generations to come.

The fight against AMR requires a collaborative effort involving healthcare providers, policymakers, researchers, and the public. As healthcare providers, we have a responsibility to lead by example, advocating for rational antibiotic use and educating our patients about the risks of AMR. Together, we can turn the tide against this global threat and ensure the continued effectiveness of these life-saving drugs.

Limitations

The study relied on self-reported data, which may be subject to bias. Additionally, the use of closed-ended questions limited the depth of responses. Future studies should incorporate qualitative methods to gain a more comprehensive understanding of healthcare providers' knowledge and practices.

CONCLUSION

This study underscores the need for targeted educational campaigns to improve healthcare providers' knowledge of antibiotic use and AMR. By addressing these gaps, healthcare providers can play a more effective role in combating AMR and ensuring the sustainable use of antibiotics.

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