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Over-the-Counter (OTC) Antibiotic Use and Its Association with Drug Resistance: A Cross-Sectional Study

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Abstract:

Objective: To evaluate the prevalence of over-the-counter (OTC) antibiotic use in Delhi National Capital Region (NCR), assess its association with antimicrobial resistance (AMR), and identify determinants influencing public knowledge and attitudes toward antibiotic consumption.

Material and Methods: A cross-sectional survey was conducted from July to August 2024 among 300 adult residents of Delhi NCR. Participants completed a validated, self-administered questionnaire covering demographics, antibiotic usage patterns, awareness of AMR, and personal attitudes. Stratified random sampling ensured demographic diversity. Data were analyzed using descriptive statistics, chi-square tests, and logistic regression, with significance set at p-value<0.05.

Results: A total of 62.0% of participants admitted to purchasing antibiotics without a prescription, with 40% selecting antibiotics based on prior experience. While 78.3% were aware of AMR, misconceptions persisted; 27.7% believed antibiotics could alter human genetics. Educational institutions were the most common source of AMR knowledge (67.0%). Respiratory infections were the leading reason for antibiotic use (66.3%). A majority (73.3%) believed that stricter regulation on OTC antibiotic sales is necessary, and 68.3% agreed that antibiotics should only be available via prescription.

Conclusion: Despite high AMR awareness, self-medication and OTC antibiotic use remain widespread in Delhi NCR, driven by convenience, cost, and prior experience. Public health strategies must focus on correcting misconceptions, strengthening regulations, and expanding access to affordable, physician-guided care to curb misuse and reduce resistance.

Keywords: antibiotic misuse, antimicrobial resistance, Delhi NCR, over-the-counter antibiotics, public health

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Introduction

Antibiotics have significantly transformed modern medicine by effectively treating bacterial infections, reducing morbidity and mortality, and enabling complex procedures such as surgeries, organ transplants, and cancer chemotherapy[1]. However, their widespread misuse, particularly through over-the-counter (OTC) access without appropriate medical supervision, has contributed to the growing threat of antimicrobial resistance (AMR), a major global public health concern[2,3]. In India, the Schedule H1 regulation and the National Action Plan on Antimicrobial Resistance (NAP-AMR) have been launched to curb OTC antibiotic misuse. However, enforcement and public compliance remain limited[4,5].

AMR leads to prolonged illness, increased healthcare costs, treatment failures, and higher mortality rates, thereby compromising the efficacy of essential medical treatments [6].

Numerous studies have documented widespread self-medication practices and poor public understanding of antibiotic use. For example, Hassan et al. reported that only 26.4% of respondents in Arab countries correctly identified appropriate antibiotic treatment durations[7]. Similarly, Malli et al. observed high rates of self-medication among Saudi healthcare students, despite relatively higher awareness about antibiotic safety, highlighting that knowledge alone may not translate into responsible behavior[8].

In other regions, similar patterns persist. In Ghana, Owusu-Ofori et al. found that many medical students continued to self-medicate, even while recognizing the risks of AMR—indicating a critical need for behaviour-focused educational strategies[9]. Waaseth et al.'s study in Norway echoed this, revealing that although general awareness was good, significant knowledge gaps remained, particularly among vocational workers and less-educated groups[10].

One of the most significant drivers of inappropriate antibiotic use is the unregulated availability of antibiotics without a prescription. In many low- and middle-income countries (LMICs), including those in Southeast Asia, lax enforcement of pharmaceutical regulations has led to widespread OTC access to antibiotics[11,12]. A systematic review by Nepal and Bhatta documented high levels of self-medication across Southeast Asia, linked to affordability, convenience, and inadequate healthcare infrastructure[13]. Aslam et al. further reported that OTC antibiotic use is especially prevalent in LMICs, where the lay public often lacks adequate understanding of proper usage and resistance development[14].

Other contributing factors include past successful experiences with self-medication, social norms, limited access to healthcare providers, and the perception that antibiotics are a cure-all for common illnesses, even when the underlying cause is viral and does not require antibiotic treatment[15].

Given these trends and challenges, the present study aimed to investigate the prevalence of OTC antibiotic use in the Delhi National Capital Region (NCR), evaluate public knowledge and practices concerning antibiotic consumption, and assess the perceived connection between OTC use and AMR. By identifying key behavioural and systemic drivers, the study also sought to recommend targeted strategies to curb misuse and mitigate AMR development in the region.

Material and Methods

Study design

A cross-sectional survey was conducted to evaluate the usage of over-the-counter antibiotics, knowledge, awareness, and attitudes toward antibiotic use and resistance, as well as personal opinions and experiences. Data were collected using a self-administered questionnaire created in English and disseminated via email, WhatsApp, and community-based outreach methods to ensure broader representation. The study was conducted from July to August 2024.

Sample size and recruitment

The sample size was estimated using G*Power software (version 3.0), with a 95.0 % confidence interval and 80.0 % power, resulting in a required sample size of 300 participants, based on an effect size of 0.8. Stratified random sampling was applied by dividing the target population into strata based on age group, gender, and education level. From each stratum, participants were randomly selected proportionally to ensure representativeness.

The study included adults aged 18 to 65 years residing in Delhi NCR who could read and understand the questionnaire, had consumed antibiotics at least once in the previous 12 months, knew the purpose of antibiotics for treating bacterial infections, and had used at least one type of antibiotic. Exclusion criteria included individuals with antibiotic allergies or intolerances, pregnant or lactating women, those with impaired immunity due to conditions like HIV/AIDS or cancer, and those unwilling to provide informed consent.

Questionnaire development and validation

The questionnaire underwent both face and content validation by 3 experts in infectious diseases and public health and was pretested for validity and reliability before wider distribution. A pilot study with 50 respondents was conducted to assess clarity, internal consistency, and reliability, with necessary modifications made based on feedback. Cronbach's alpha was calculated to assess internal consistency. The final questionnaire was structured into 4 sections: 1) Demographic Information 2) Use of Over-the-Counter Antibiotics 3) knowledge, awareness, and attitudes toward antibiotic use and resistance 4) Personal experiences.

Each section contained 10 questions. To minimize response bias, questions were framed in a neutral manner, and anonymity was ensured.

Data collection and quality control

Data were collected via an online survey (Google Forms) and in-person interviews for individuals with limited internet access. Measures were implemented to prevent duplicate responses, such as disabling multiple submissions from the same IP address. Participants were assured of confidentiality, and personal identifiers were not collected.

To account for potential response bias, responses were monitored for inconsistencies, and missing data were handled through imputation where necessary. Participants were encouraged to provide honest responses, and reminders were sent to improve response rates.

Ethical considerations

Ethical clearance was obtained from the Institutional Ethics Committee (MRDC/IESC/2024/118). Informed consent was obtained from all participants before data collection. Data storage and security protocols were established to protect participant confidentiality, with responses anonymized and securely stored in password-protected databases.

Data analysis

Descriptive statistics were used to summarize the demographic characteristics, antibiotic usage, and awareness levels. Chi-square tests were conducted to identify associations between the demographic factors and antibiotic use, awareness, and attitudes. Statistical significance was set at p-value<0.05.

Statistical analysis

The collected data were coded and recorded in Microsoft Excel for organization and preliminary processing. Data cleaning was performed to check for inconsistencies and missing values, which were addressed through appropriate imputation methods where necessary.

Statistical analysis was conducted using IBM Statistical Package for the Social Sciences (SPSS) Statistics (Version 27.0). Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were used to summarize the demographic characteristics, antibiotic usage patterns, and awareness levels. The Chi-Square test was applied to examine associations between categorical variables. Additionally, where applicable, logistic regression analysis was performed to determine the influence of demographic factors on antibiotic use and awareness.

Statistical significance was set at p-value<0.05, and results were presented in appropriately structured tables for clarity.

Results

Demographic characteristics

A total of 300 participants completed the survey, of whom 206 (68.7%) were female and 94 (31.3%) were male. The majority of respondents (201 participants, 67.0 %) were aged between 18 and 24 years. Most participants were well-educated, with an undergraduate degree or higher (Table 1).

Table 1 Demographic details of the study participants

Variable	N	%
Age (years)		
Under 18	7	2.3
18-24	201	67.0
25-34	43	14.3
35-44	21	7.0
45-54	28	9.3
Gender		
Male	94	31.3
Female	206	68.7
Education		
No formal education	2	0.7
Primary School	1	0.3
Secondary School	10	3.3
High School Diploma	18	6.0
Undergraduate	171	57.0
Postgraduate	56	18.7
Healthcare Professional	42	14.0

Chi square test applied; p-value significant at p-value<0.05

Antibiotic use and knowledge

More than half of the respondents (59.3%) reported taking antibiotics for one or more family illnesses. Additionally, 62.0% of participants admitted to purchasing antibiotics without a prescription. Among them, 40.0% relied on past experience when selecting an antibiotic, while 27.7% sought dosage recommendations from a pharmacist.

Respiratory infections were the most common reason for antibiotic use (66.3%). Interestingly, 89.7% of respondents believed that mild illnesses could be treated without antibiotics. Furthermore, 73.3% agreed that taking antibiotics beyond the required amount is ineffective (p-value<0.032). (Table 2).

Awareness and attitudes toward antibiotic use and resistance

A high level of awareness regarding antibiotic resistance was observed, with 78.0 % of participants acknowledging its existence. Among them, 67.0 % had learned about it through educational institutions. Additionally, 73.3% believed that stricter regulations should be imposed on antibiotic sales.

The majority of respondents agreed that over-the-counter (OTC) availability of antibiotics contributes to antibiotic resistance, and 88.0 % believed that side effects are associated with resistance. Furthermore, 68.3% supported making antibiotics available only through prescription.

Regarding cost considerations, 49.0 % of participants felt that purchasing antibiotics over the counter was significantly cheaper than consulting a doctor (Table 2).

Logistic regression analysis did not identify any statistically significant associations between demographic variables and OTC antibiotic use (p-value>0.05). However, a non-significant trend suggested that individuals with undergraduate education were less likely to self-medicate with antibiotics (AOR=0.37, 95% CI: 0.12–1.11, p-value=0.075). No significant effects were observed for age or gender (Table 3).

Table 2 Antibiotic use, awareness and attitude on OTC antibiotic use

Variable	Females (%) (n=206)	Males (%) (n=94)	Total (%) (n=300)	p-value
Antibiotic use in family				
No	81 (39.3)	41 (43.6)	122 (40.7)	0.527
Yes	125 (60.7)	53 (56.4)	178 (59.3)	
Antibiotic purchased with prescription				
Maybe	24 (11.7)	11 (11.7)	35 (11.7)	0.099
No	37 (18.0)	27 (28.7)	64 (21.3)	
Yes	145 (70.4)	56 (59.6)	201 (67.0)	
Antibiotic purchased without prescription				
No	83 (40.3)	31 (33.0)	114 (38.0)	0.250
Yes	123 (59.7)	63 (67.0)	186 (62.0)	
How often do you purchase without prescription				
Frequently	25 (12.1)	15 (16.0)	40 (13.3)	0.136
No	61 (29.6)	26 (27.7)	87 (29.0)	
Occasionally	38 (18.4)	26 (27.7)	64 (21.3)	
Rarely	82 (39.8)	27 (28.7)	109 (36.3)	
Why have you purchased antibiotics without prescription				
Advice from friends	33 (16)	16 (17.0)	49 (16.3)	0.083
Convenience	46 (22.3)	21 (22.4)	68 (22.6)	
Cost	5 (2.4)	6 (6.4)	11 (3.7)	
Difficulty in healthcare acc	7 (3.4)	9 (9.6)	16 (5.3)	
Prior experience	91 (44.2)	29 (30.9)	120 (40.0)	
None	23 (11.2)	13 (13.8)	36 (12.0)	
What illness you have used antibiotics for				
No	10 (4.9)	4 (4.3)	14 (4.7)	0.735
GIT infections	21 (10.2)	8 (8.5)	29 (9.7)	
Respiratory infections	137 (66.5)	62 (66.0)	199 (66.3)	
Skin infections	30 (14.6)	16 (17.0)	46 (15.3)	
Tooth pain	0	1 (1.1)	1 (1.1)	
UTI	8 (3.9)	3 (3.2)	11 (3.7)	
How do you determine the dosage and duration of antibiotic use				
Doctor's advice	40 (19.4)	17 (18.1)	57 (19.0)	0.135
Advice from pharmacist	54 (26.2)	29 (30.9)	83 (27.7)	
Personal judgement	59 (28.6)	22 (23.4)	81 (27.0)	
Following previous prescriptions	53 (25.7)	26 (27.7)	79 (26.3)	
Taking more than required dosage of antibiotics is helpful				
Don't know	12 (5.8)	8 (8.5)	20 (6.7)	0.032*
Maybe	21 (10.2)	9 (9.6)	30 (10.0)	
No	159 (77.2)	61 (64.9)	220 (73.3)	
Yes	14 (6.8)	16 (17.0)	30 (10.0)	
Body can fight mild infections without antibiotic				
No	24 (11.7)	7 (7.4)	31 (10.3)	0.312
Yes	182 (88.3)	87 (92.6)	269 (89.7)	
Antibiotics can alter your genetic makeup				
Don't know	40 (19.4)	17 (18.1)	57 (19.0)	0.727
Maybe	54 (26.2)	29 (30.9)	83 (27.7)	
No	59 (28.6)	22 (23.4)	81 (27.0)	
Yes	53 (25.7)	26 (27.7)	79 (26.3)	

Table 2 (continued)

Variable	Females (%) (n=206)	Males (%) (n=94)	Total (%) (n=300)	p-value
Aware of antibiotic resistance				
Maybe	23 (11.2)	9 (9.6)	32 (10.7)	0.902
No	23 (11.2)	10 (10.6)	33 (11.0)	
Yes	160 (77.7)	75 (79.8)	235 (78.3)	
How do you know about antibiotic resistance				
Media	24 (11.7)	11 (11.7)	35 (11.7)	0.447
Health professional	37 (18.0)	27 (28.7)	64 (21.3)	
Educational institution	145 (70.4)	56 (59.6)	201 (67.0)	
OTC antibiotics contributes to resistance				
No	14 (6.8)	10 (10.6)	24 (8.0)	0.193
Unsure	67 (32.5)	22 (23.4)	89 (29.7)	
Yes	125 (60.7)	62 (66.0)	187 (62.3)	
How concerned are you about resistance				
Extremely concerned	20 (9.7)	18 (19.1)	38 (12.7)	
Moderately concerned	75 (36.4)	31 (33.0)	106 (35.3)	
Not concerned	18 (8.7)	9 (9.6)	27 (9.0)	
Slightly concerned	44 (21.4)	20 (21.3)	64 (21.3)	0.187
Very concerned	49 (23.8)	16 (17.0)	65 (21.7)	
Regular OTC antibiotic use can develop resistance				
Maybe	37 (18)	18 (19.1)	55 (18.3)	0.903
No	23 (11.2)	9 (9.6)	32 (10.7)	
Yes	146 (70.9)	67 (71.3)	213 (71.0)	
Strict regulations needed to control antibiotic sale without prescription				
Agree	86 (41.7)	28 (29.8)	114 (38.0)	0.101
Disagree	8 (3.9)	2 (2.1)	10 (3.3)	
Neutral	35 (17.0)	19 (20.2)	54 (18.0)	
Strongly agree	75 (36.4)	41 (43.6)	116 (38.7)	
Strongly disagree	2 (1.0)	4 (4.3)	6 (2.0)	
Measures to reduce antibiotic resistance				
Better education on AB use	12 (5.8)	8 (8.5)	20 (6.7)	0.069
Improved access to healthcare	21 (10.2)	9 (9.6)	30 (10.0)	
Strict regulation on AB sale	159 (77.2)	61 (64.9)	220 (73.3)	
More research	14 (6.8)	16 (17.0)	30 (10.0)	
Antibiotic resistance can lead to adverse effect				
No	28 (13.6)	8 (8.5)	36 (12.0)	0.253
Yes	178 (86.4)	86 (91.5)	264 (88.0)	
Cross check AB with doctor before use				
Maybe	35 (17.0)	18 (19.1)	53 (17.7)	0.367
No	15 (7.3)	11 (11.7)	26 (8.7)	
Yes	156 (75.7)	65 (69.1)	221 (73.7)	
Antibiotics should only be accessible by prescription Can't say	38 (18.4)	24 (25.5)	62 (20.7)	0.153
No	20 (9.7)	13 (13.8)	33 (11.0)	
Yes	148 (71.8)	57 (60.6)	205 (68.3)	

Chi square test applied; p-value significant at p-value<0.05*, OTC=over-the-counter

Personal Opinions and Experiences

Nearly half (45.7%) of the respondents perceived antibiotics as effective, while 29.0 % reported experiencing side effects. A significant portion of participants (69.3%) preferred prescription-based antibiotics, and 62.0% disagreed with the notion that OTC antibiotics could cure all diseases.

Lastly, 49.0 % of respondents believed that buying OTC antibiotics was more cost-effective than visiting a doctor (Table 4).

Table 3 Logistic regression analysis showing adjusted odds ratios (AOR) for predictors of OTC antibiotic use

Predictor	Adjusted odds ratio (AOR)	95% Confidence Interval	p-value
Gender			
Male vs Female	1.01	0.56 – 1.83	0.975
Age (years)			
25–34 vs 18–24	0.57	0.20 – 1.67	0.307
35–44 vs 18–24	1.93	0.35 – 10.77	0.452
45–54 vs 18–24	0.46	0.14 – 1.55	0.211
<18 vs 18–24	1.31	0.12 – 14.82	0.826
Education			
Postgraduate (PG) vs Low education	0.94	0.23 – 3.77	0.928
Undergraduate (UG) vs Low education	0.37	0.12 – 1.11	0.075

None of the associations reached statistical significance (p-value<0.05), OTC=over-the-counter

Table 4 Personal opinion and experiences on OTC antibiotic use

Personal opinion and experiences on OTC	Females(%) (n=206)	Males(%) (n=94)	Total (%) (n=300)	p-value
In your opinion, how effective are OTC antibiotics treating infection				
Don't know	6 (2.9)	7 (7.4)	13 (4.3)	0.011
Effective	92 (44.7)	45 (47.9)	137 (45.7)	
Not effective	1 (0.5)	5 (5.3)	6 (2)	
Somewhat effective	61 (29.6)	20 (21.3)	81 (27.0)	
Very effective	46 (22.3)	17 (18.1)	63 (21.0)	
Any adverse effects from antibiotic use				
No	147 (71.4)	66 (70.2)	213 (71.0)	0.891
Yes	59 (28.6)	28 (29.8)	87 (29.0)	
Prefer to get antibiotic through prescription				
Maybe	41 (19.9)	16 (17.0)	57 (19.0)	0.660
No	22 (10.7)	13 (13.8)	35 (11.7)	
Yes	143 (69.4)	65 (69.1)	208 (69.3)	
Difficulty in purchasing OTC antibiotics				
Maybe	43 (20.9)	17 (18.1)	60 (20.0)	0.220
No	115 (55.8)	62 (66)	177 (59.0)	
Yes	48 (23.3)	15 (16.0)	63 (21.0)	
Is antibiotic use without prescription satisfactory				
Don't know	18 (8.7)	8 (8.5)	26 (8.7)	0.016
Not satisfactory	37 (18.0)	20 (21.3)	57 (19.0)	
Satisfactory	39 (18.9)	30 (31.9)	69 (23.0)	
Somewhat satisfactory	93 (45.1)	24 (25.5)	117 (39.0)	
Very satisfactory	19 (9.2)	12 (12.8)	31 (10.3)	

Table 4 (continued)

Personal opinion and experiences on OTC	Females	Males	Total	p-value
Can all diseases be cured with OTC antibiotics				
Don't know	20 (9.7)	12 (12.8)	32 (10.7)	0.541
Maybe	34 (16.5)	10 (10.6)	44 (14.7)	
No	126 (61.2)	60 (63.8)	186 (62.0)	
Yes	26 (12.6)	12 (12.8)	38 (12.7)	
Can you use OTC antibiotics in emergency				
Don't know	18 (8.7)	9 (9.6)	27 (9.0)	0.683
Maybe	67 (32.5)	24 (25.5)	91 (30.3)	
No	42 (20.4)	21 (22.3)	63 (21.0)	
Yes	79 (38.3)	40 (42.6)	119 (39.7)	
Often	21 (10.2)	10 (10.6)	31 (10.3)	1.00
Rarely	185 (89.8)	84 (89.4)	269 (89.7)	
How many days you get relief using OTC antibiotic				
After completion of course	52 (25.2)	21 (22.3)	73 (24.3)	0.664
Can't assess	42 (20.4)	22 (23.4)	64 (21.3)	
Immediately	28 (13.6)	9 (9.6)	37 (12.3)	
2 days	84 (40.8)	42 (44.7)	126 (42.0)	
DO you find using OTC antibiotics cheaper than visiting doctor				
Don't know	13 (6.3)	11 (11.7)	24 (8.0)	0.119
Maybe	59 (28.6)	18 (19.1)	77 (25.7)	
No	38 (18.4)	14 (14.9)	52 (17.3)	
Yes	96 (46.6)	51 (54.3)	147 (49.0)	

OTC=over-the-counter

Discussion

This cross-sectional study aimed to assess over-the-counter (OTC) antibiotic use, knowledge, and attitudes toward antibiotic resistance among adults in Delhi NCR. The findings highlight a complex interplay between awareness, perceptions, and actual antibiotic consumption behaviors.

Prevalence and patterns of OTC antibiotic use

While 67.0% of respondents obtained antibiotics through a prescription, 62.0% admitted to purchasing OTC antibiotics, indicating that self-medication remains a common yet underreported practice. Comparatively, a study by Sirak Tesfamariam et al. found that 93.7% of respondents engaged in self-medication with OTC drugs[16]. Similarly, Kotwani et al. reported that pharmacists in India frequently dispense antibiotics without prescriptions for common conditions[12]. A systematic review by Gaurav Nepal documented self-medication rates ranging from 7.3% to 85.59%, with an overall rate of 42.64%, influenced by social and economic factors[13].

In the present study, 36.3% of respondents used OTC antibiotics based on convenience or past experience. This aligns with findings from Adeel Aslam et al., where self-prescription rates varied widely, from 7.3% in Indonesia and 26.9% in Bangladesh to 81.23% in Pakistan[14]. Self-medication with antibiotics remains a concern even in high-income countries. A study in rural Greece by Skliros et al. found that 44.6% of participants self-medicated with antibiotics, often using leftover drugs or relying on non-professional advice[1]. This highlights that beyond regulatory frameworks, personal beliefs and access to antibiotics at home contribute significantly to misuse[17]. The high prevalence of self-medication and OTC antibiotic use observed in this study indicates poor antibiotic stewardship at the community level. Such practices contribute to inappropriate antibiotic selection, suboptimal dosing, and incomplete courses, all of which promote the development of resistant bacterial strains. This misuse directly fuels the AMR cycle by exerting selective pressure on microbes, encouraging resistance gene expression and transmission.

The lack of statistically significant predictors in the logistic regression suggests that factors beyond basic demographics may drive OTC antibiotic use (Table 3). These could include cultural norms, habitual self-medication, accessibility of healthcare, or limited enforcement of prescription laws. The inverse trend for undergraduate education aligns with other studies showing a protective role of health literacy, though the result was not statistically significant in our sample. Future studies with larger samples may clarify this relationship.

Knowledge and awareness of antibiotic use and resistance

A strong public belief was observed regarding the body's ability to fight minor infections without antibiotics (89.7%), aligning with other studies emphasizing the role of public health education. In contrast, a 2023 study by Shreshtha Jishna et al. reported an 18.0% reduction in AMR-related deaths since 2013, with a 28.0% decrease among hospitalized patients[18]. However, irrational antibiotic use surged during the COVID-19 pandemic, as highlighted by Deborah Oluwaseun Shomuyiwa et al., where 70.0 % of COVID-19 patients were prescribed antibiotics irrespective of disease severity[19].

A major misconception in the current study was the belief that antibiotics could alter human genetic material, with 27.7% agreeing, 27.0% disagreeing, and 26.3% uncertain. Such misconceptions may stem from a lack of basic microbiological understanding and can foster fear or misuse. Addressing this through targeted public education can dispel myths and promote rational antibiotic use. A similar cross-sectional study in Northwestern Ethiopia by Kindu Geta and Mulugeta Kibret found that 30% of respondents believed antibiotics interfere with human DNA, while 20.0% were uncertain[20]. However, as Alfonso J. Aanis clarifies in his article, *"Resistance to Antibiotics: Are We in the Post-Antibiotic Era?"*, antibiotics influence bacterial genetic changes, not human DNA[21].

While misunderstandings about the biological action of antibiotics persist, awareness of antibiotic resistance appears more widespread. As in a study by Rebecca R. Carter et al., 92.0% of respondents agreed that improper antibiotic use leads to resistance, though 70.0% remained neutral or sceptical about the actual severity of AMR[22]. In contrast, Hawkins et al. reported that 82.0% of participants acknowledged that excessive antibiotic use reduces its effectiveness, indicating a comparatively stronger public understanding of AMR risks[23].

Poupard JA's "The Antibiotic Era" explores the history of antimicrobial drug use, highlighting the challenges of irrational prescribing, pharmaceutical influence, and policy reforms. The book underscores the ongoing need for controlled clinical trials and antibiotic stewardship to combat resistance[24]. In support of this, Havers et al. examined outpatient antibiotic prescribing and found that 41.0 percent of patients with acute respiratory infections received antibiotics, and 41.0 percent of these prescriptions were inappropriate, mainly for viral illnesses. These findings further underscore the importance of reducing unnecessary antibiotic use, particularly for viral infections, and improving adherence to clinical guidelines as part of effective stewardship efforts[25].

Perceptions and attitudes toward OTC antibiotics and resistance

In this study, 78.3% of respondents were aware of antibiotic resistance, which aligns with findings from high- and middle-income countries where awareness typically exceeds 70.0%. A cross-sectional survey of farmers in New York, USA, reported that 75.0% of participants learned about resistance through educational institutions, a figure comparable to the 67.0% observed in the present study[26]. Secondary sources of information in the present study included health professionals (21.3%) and media (11.7%), reflecting global trends where institutional education remains the primary driver of awareness, while other channels play a supportive role.

A significant proportion (62.3%) of respondents recognized that OTC antibiotic availability contributes to resistance, similar to findings in European surveys by Alessandro Cassini et al., where 60-70% acknowledged this connection[26]. However, awareness levels were lower in regions with weaker antibiotic regulations, such as parts of Southeast Asia, where only 40.0 % understood the link between OTC antibiotics and resistance[13].

In the current study, 73.3% of respondents supported stricter regulations on antibiotic sales. This aligns with practices in regions like Scandinavia, where antibiotic stewardship programs are strongly enforced[10]. Additionally, 88.0% of participants recognized AMR as a public health threat, comparable to the 85–90% awareness reported in European surveys[27.] Furthermore, 68.3% of respondents in the current study believed that antibiotics should only be available by prescription, echoing international recommendations to reduce misuse.

Public perception of OTC antibiotics

The effectiveness of OTC antibiotics remains a debated issue. In this study, 45.7% of respondents believed OTC antibiotics effectively treat infections, similar to South Asian studies where up to 50% held the same view despite the risks of misuse[14]. However, only 10.3% reported frequent OTC antibiotic use, which is significantly lower than the rates observed in Southern Europe where self-medication is more prevalent [28].

Side effects were reported by 29.0% of respondents, aligning with findings from Malaysia, where 25-30% also experienced adverse reactions to antibiotics[29]. These findings indicate that while antibiotic side effects are acknowledged, the risks associated with self-medication remain underestimated.

A strong preference for prescription antibiotics was noted in the current study, with 69.3% supporting physician-prescribed antibiotics, compared to lower rates in the U.S., where 43.6% reported ever using non-prescribed antibiotics, indicating weaker adherence to prescription-only practices[30] and higher rates in Europe, where up to 82.0% favour prescription-only antibiotic use[29]. However, 39.7% of respondents supported OTC antibiotic use in emergencies, a common practice in developing countries where limited healthcare access necessitates self-medication.

Cost considerations played a significant role in the present study during OTC antibiotic use, with 49.0% of respondents believing that purchasing OTC antibiotics is more affordable than visiting a doctor. This perception is widespread in regions with high healthcare costs[14], highlighting the urgent need for affordable healthcare solutions to mitigate antibiotic misuse.

Implications and recommendations

This study identifies critical gaps in knowledge regarding antibiotic resistance, particularly misconceptions about its genetic impact and the rational use of antibiotics. Despite widespread awareness, actual practices often contradict recommended guidelines, emphasizing the need for enhanced public education on AMR.

Healthcare professionals play a pivotal role in ensuring adherence to prescriptions and discouraging OTC antibiotic misuse. Governments should strengthen public awareness campaigns and implement stricter regulations on OTC antibiotic sales to curb resistance.

Limitations and future research

The study's limited sample size may affect the generalizability of findings. Future research should involve larger, more diverse populations to better assess antibiotic use trends across different demographic and socioeconomic groups. Longitudinal studies could track behavioral changes over time in response to public health initiatives and policy reforms.

Additionally, while logistic regression was applied, the lack of significant associations may reflect sample size limitations or unmeasured confounding variables. The study may not have captured behavioral, cultural, or systemic factors that influence antibiotic use, which are crucial in shaping AMR-related practices.

Conclusion

Despite high awareness of AMR, gaps persist between knowledge and practice, with misconceptions about antibiotic use contributing to self-medication. This study highlights the need for stricter regulations on OTC antibiotic sales and increased healthcare professional involvement in guiding appropriate use. Public health campaigns should focus on dispelling myths, promoting prescription-based antibiotic use, and addressing cost-related barriers that encourage self-medication.

Future research should explore long-term trends in antibiotic consumption and evaluate the impact of awareness programs and policy interventions on reducing misuse. Active engagement from stakeholders, including policy makers, pharmacists, and healthcare professionals, is essential to enforce prescription-only policies and improve healthcare access.

Strengthening antibiotic stewardship and regulatory frameworks will be key to mitigating the rising threat of AMR.

Conflict of interest

There is no conflict of interest.

References

1. Davies J, Davies D. Origins and evolution of antibiotic resistance. Microbiol Mol Biol Rev 2010;74:417-33. doi: 10.1128/MMBR.00016-10.
2. World Health Organization. Global antimicrobial resistance and use surveillance system (GLASS) report: 2022. [homepage on the Internet]. Geneva: WHO; 2022. Available from: https://www.who.int/publications/i/item/9789240062702
3. Tattevin P, Levy Hara G, Toumi A, Enani M, Coombs G, Voss A, et al. Advocacy for increased international efforts for antimicrobial stewardship actions in low-and middle-income countries on behalf of alliance for the prudent use of Antimicrobials (APUA), under the auspices of the international society of Antimicrobial Chemotherapy (ISAC). Front Med (Lausanne) 2020;7:503. doi: 10.3389/fmed.2020.00503.
4. Ministry of Health and Family Welfare, Government of India. GSR No. 588(E), dated 30-08-2013 – Schedule H1 Drugs: Drugs and Cosmetics (Fourth Amendment) Rules, 2013 [homepage on the Internet]. New Delhi: MoHFW; 2013 [cited 2025 Jun 29]. Available from: https://thehealthmaster.com/wp-content/uploads/2020/10/GSR-No.-588E-Dt-30-08-2013-Schedule-H1-Drugs-DC-fourth-Amendment-Rules-2013.pdf
5. Ministry of Health and Family Welfare, Government of India. India National Action Plan on Antimicrobial Resistance (NAP-AMR) 2017–2021 [homepage on the Internet]. New Delhi: WHO; 2017 [cited 2025 Jun 29]. Available from: https://www.who.int/publications/m/item/india-national-action-plan-on-antimicrobial-resistance-(nap-amr)-2017-2021
6. Murray CJL, Ikuta KS, Sharara F, Swetschinski L, Aguilar GR, Gray A, et al. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. The Lancet 2022;399:629–55. doi: 10.1016/S0140-6736(21)02724-0.
7. Hassan BAR, Mohammed AH, AL-Jewari WM, Blebil A, Dujaili J, et al. Knowledge and attitude towards antibiotic use and resistance among arab population: a questionnaire-based study

of 11 countries from the middle East and North Africa. J Pharm Health Serv Res 2023;14:131–40. doi: 10.1093/jphsr/rmad014.

8. Malli IA, Hubayni RA, Marie AM, Alzahrani DY, Khshwry EI, Aldahhas RA, et al. The prevalence of self-medication and its associated factors among college students: Cross-sectional study from Saudi Arabia. Prev Med Rep 2023;36:102457. doi: 10.1016/j.pmedr.2023.102457.
9. Owusu-Ofori AK, Darko E, Danquah CA, Agyarko-Poku T, Buabeng KO. Self-medication and antimicrobial resistance: a survey of students studying healthcare programmes at a tertiary institution in Ghana. Front Public Health 2021;9:706290. doi: 10.3389/fpubh.2021.706290.
10. Waaseth M, Adan A, Røen IL, Eriksen K, Stanojevic T, Halvorsen KH, et al. Knowledge of antibiotics and antibiotic resistance among Norwegian pharmacy customers - a cross-sectional study. BMC Public Health 2019;19:66. doi: 10.1186/s12889-019-6409-x.
11. Morgan DJ, Okeke IN, Laxminarayan R, Perencevich EN, Weisenberg S. Non-prescription antimicrobial use worldwide: a systematic review. Lancet Infect Dis 2011;11:692–701. doi: 10.1016/S1473-3099(11)70054-8.
12. Kotwani A, Joshi J, Lamkang AS. Over-the-counter sale of antibiotics in india: a qualitative study of providers' perspectives across two states. Antibiotics (Basel) 2021;10:1123. doi: 10.3390/antibiotics10091123.
13. Nepal G, Bhatta S. Self-medication with antibiotics in WHO Southeast Asian region: a systematic review. Cureus 2018;10:e2428. doi: 10.7759/cureus.2428.
14. Aslam A, Gajdács M, Zin CS, Ab Rahman NS, Ahmed SI, Zafar MZ, et al. Evidence of the practice of self-medication with antibiotics among the lay public in low- and middle-income countries: a scoping review. Antibiotics (Basel) 2020;9:597. doi: 10.3390/antibiotics9090597.
15. Ventola CL. The antibiotic resistance crisis: part 1: causes and threats. P T 2015;40:277–83.
16. Tesfamariam S, Anand IS, Kaleab G, Berhane S, Woldai B, Habte E, et al. Self-medication with over-the-counter drugs, prevalence of risky practice and its associated factors in pharmacy outlets of Asmara, Eritrea. BMC Public Health 2019;19:159. doi: 10.1186/s12889-019-6470-5.
17. Skliros E, Merkouris P, Papazafiropoulou A, Gikas A, Matzouranis G, Papafragos C, et al. Self-medication with antibiotics in rural population in Greece: a cross-sectional multicenter study. BMC Fam Pract 2010;11:58. doi: 10.1186/1471-2296-11-58.
18. Shrestha J, Zahra F, Cannady P Jr. Antimicrobial stewardship. In: StatPearls [homepage on the Internet]. Treasure Island (FL): StatPearls Publishing; 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK572068/
19. Shomuyiwa DO, Lucero-Prisno DE 3rd, Manirambona E, Suleman MH, Rayan RA, Huang J, et al. Curbing antimicrobial resistance in post-COVID Africa: challenges, actions and recommendations. Health Sci Rep 2022;5:e771. doi: 10.1002/hsr2.771.
20. Geta K, Kibret M. Knowledge, attitudes and practices of patients on antibiotic resistance and use in public hospitals of Amhara Regional State, Northwestern Ethiopia: a cross-sectional study. Infect Drug Resist 2022;15:193–209. doi: 10.2147/IDR.S348765.
21. Alanis AJ. Resistance to antibiotics: are we in the post-antibiotic era? Arch Med Res 2005;36:697–705. doi: 10.1016/j.arcmed.2005.06.009.
22. Carter RR, Sun J, Jump RL. A survey and analysis of the American public's perceptions and knowledge about antibiotic resistance. Open Forum Infect Dis 2016;3:ofw112. doi: 10.1093/ofid/ofw112.
23. Hawkins O, Scott AM, Montgomery A, Nicholas B, Mullan J, van Oijen A, et al. Comparing public attitudes, knowledge, beliefs and behaviors towards antibiotics and antimicrobial resistance in Australia, United Kingdom, and Sweden (2010–2021): a systematic review, meta-analysis, and comparative policy analysis. PLoS One 2022;17:e0261917. doi: 10.1371/journal.pone.0261917.
24. Poupard JA. The antibiotic era: reform, resistance, and the pursuit of a rational therapeutics. Emerg Infect Dis 2015;21:1093. doi:10.3201/eid2106.150212.
25. Havers FP, Hicks LA, Chung JR, Gaglani M, Murthy K, Zimmerman RK, et al. Outpatient antibiotic prescribing for acute respiratory infections during influenza seasons. JAMA Netw Open 2018;1:e180243. doi: 10.1001/jamanetworkopen.2018.0243.
26. Casseri E, Bulut E, Llanos Soto S, Wemette M, Stout A, Greiner Safi A, et al. Understanding antibiotic resistance as a perceived threat towards dairy cattle through beliefs and practices: a survey-based study of dairy farmers. Antibiotics (Basel) 2022;11:997. doi: 10.3390/antibiotics11080997.
27. Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS, et al. Attributable deaths and disability-

adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European economic area in 2015: a population-level modelling analysis. Lancet Infect Dis 2019;19:56–66. doi: 10.1016/S1473-309930605-4.

28. Grigoryan L, Burgerhof JG, Degener JE, Deschepper R, Lundborg CS, Monnet DL, et al. Determinants of self-medication with antibiotics in Europe: the impact of beliefs, country wealth and the healthcare system. J Antimicrob Chemother 2008;61:1172–9. doi: 10.1093/jac/dkn054.

29. Aslam A, Zin CS, Ab Rahman NS, Gajdács M, Ahmed SI, Jamshed S. Self-medication practices with antibiotics and associated factors among the public of Malaysia: a cross-sectional study. Drug Healthc Patient Saf 2021;13:171–81. doi: 10.2147/DHPS.S331427.

30. Drekonja DM, Filice GA, Thorne S, Rector TS, Woolridge DP, Johnson JR. Situations predisposing primary care patients to use antibiotics without a prescription in the United States. Antimicrob Steward Healthc Epidemiol 2023;3:e203. doi: 10.1017/ash.2023.203.