

ISSN: 1674-0815

## Chinese Journal of Health Management

Chinese Medical Association



### Behavioural Determinants of Antibiotic Use in the Community: A Theory of Planned Behaviour-Based Structural Equation Modelling Study from North India

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#### Article Information

Received: 13-12-2025

Revised: 21-01-2026

Accepted: 17-02-2026

Published: 28-03-2026

#### Keywords

Antimicrobial resistance; antibiotic use; behaviour; theory of planned behaviour; SEM; community

#### ABSTRACT:

**Background:** Antimicrobial resistance (AMR) is a critical global health challenge, driven largely by inappropriate antibiotic use, particularly in community settings. Behavioural determinants underlying antibiotic consumption are complex and context-specific, necessitating theory-driven approaches for effective intervention design. **Objectives:** To evaluate the behavioural determinants influencing antibiotic use among the general population using the Theory of Planned Behaviour (TPB) and structural equation modelling. **Methods:** A cross-sectional questionnaire-based study was conducted among adults (>18 years) in North India. A validated TPB-based instrument assessed attitudes and beliefs (AAB), subjective norms (SBN), perceived behavioural control (PBC), and antibiotic use behaviour (BHV). Data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Reliability and validity were evaluated using Cronbach's alpha, composite reliability, average variance extracted (AVE), and discriminant validity criteria. **Results:** A total of 205 responses were analysed. The measurement model demonstrated satisfactory reliability and validity. Structural model analysis showed that attitudes and beliefs ( $\beta=0.173$ ,  $p=0.008$ ) and perceived behavioural control ( $\beta=0.742$ ,  $p<0.001$ ) significantly influenced antibiotic use behaviour. Subjective norms were not statistically significant ( $\beta=0.069$ ,  $p=0.099$ ). The model demonstrated strong explanatory power ( $R^2=0.813$ ). **Conclusion:** Antibiotic use behaviour is primarily influenced by individual attitudes and perceived access/control rather than social pressure. Interventions should focus on behavioural change strategies, regulatory strengthening, and improving access governance to mitigate AMR.

#### INTRODUCTION:

Antimicrobial resistance (AMR) represents one of the most pressing global health threats of the 21st century, undermining decades of progress in infectious disease management. The World Health Organization (WHO) has

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identified AMR as a critical priority, with projections estimating up to 10 million deaths annually by 2050 if current trends persist<sup>1,2</sup>. A major driver of AMR is the inappropriate and excessive use of antibiotics, particularly in community settings where regulatory oversight is often limited<sup>3-5</sup>. High levels of antimicrobial resistance in clinical isolates from North Indian settings, including multidrug-resistant wound infections and carbapenem-resistant organisms, further underscore the consequences of inappropriate antibiotic use<sup>6-8</sup>.

In low- and middle-income countries (LMICs), including India, antibiotic use is frequently characterized by self-medication, over-the-counter access without prescription, incomplete treatment courses, and misuse for undiagnosed infections<sup>9-11</sup>. These practices have been associated with increasing resistance patterns in regional antimicrobial susceptibility studies<sup>12-14</sup>.

Traditional approaches to addressing AMR have largely focused on biomedical and regulatory strategies. However, there is increasing recognition that AMR is fundamentally a behavioural and social problem, requiring an understanding of human decision-making processes<sup>15,16</sup>. Behavioural theories provide a structured framework to explore these determinants and design targeted interventions.

The Theory of Planned Behaviour (TPB), proposed by Ajzen, is one of the most widely used models for understanding health-related behaviours<sup>17</sup>. According to TPB, behaviour is influenced by three constructs: attitudes (beliefs about the outcomes of behaviour), subjective norms (perceived social pressures), and perceived behavioural control (perceived ease or difficulty in performing the behaviour)<sup>17,18</sup>. These constructs collectively shape behavioural intention and actual behaviour.

Previous studies have applied TPB to understand antibiotic use and misuse, demonstrating the importance of knowledge, beliefs, and accessibility<sup>19-21</sup>. However, findings across settings have been inconsistent, particularly regarding the role of subjective norms<sup>22,23</sup>. Given the high burden of AMR and widespread antibiotic misuse, there is a need for context-specific evidence to inform policy and intervention strategies<sup>6,13</sup>.

This study aims to assess behavioural determinants of antibiotic use among the general population in North India using a TPB-based framework and PLS-SEM. By identifying key drivers of behaviour, the study seeks to inform targeted interventions for AMR mitigation.

## METHODS:

**Study Design and Setting:** A cross-sectional study was conducted over a six-month period among the general population in North India. The study employed a questionnaire-based approach grounded in behavioural theory.

**Study Population:** Participants were individuals aged  $\geq 18$  years from the general population. Both healthcare and non-healthcare backgrounds were included, provided they met the inclusion criteria. Convenience and snowball sampling techniques were employed to ensure adequate sample size.

**Questionnaire Development:** The questionnaire was developed based on the Theory of Planned Behaviour, following established methodological guidelines<sup>18,20</sup>. It included constructs measuring:

- **Attitudes and beliefs (AAB)**
- **Subjective norms (SBN)**
- **Perceived behavioural control (PBC)**
- **Behaviour (BHV)**

Items were measured on a five-point Likert scale ranging from “strongly disagree” (1) to “strongly agree” (5). The questionnaire underwent pilot testing to assess clarity, reliability, and validity. Items with factor loadings below 0.7 were removed to ensure construct validity and internal consistency.

**Sample Size:** The sample size was determined based on the “10-times rule” for PLS-SEM, which recommends a minimum sample size of 10 times the maximum number of structural paths directed at any construct<sup>21</sup>. A final sample size of 205 participants was included in the analysis.

**Data Collection:** Data were collected through both online (Google Forms) and offline (paper-based) methods. Participants were informed about the study objectives, and informed consent was obtained prior to participation.

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**Statistical Analysis:** Data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM), a robust multivariate technique suitable for exploratory and predictive modelling<sup>21,22</sup>.

**Measurement Model Assessment:**

- **Reliability:** Cronbach’s alpha and composite reliability (>0.7)
- **Convergent validity:** Average Variance Extracted (AVE >0.5)
- **Discriminant validity:** Fornell-Larcker criterion
- **Multicollinearity:** Variance Inflation Factor (VIF <5)

**Structural Model Assessment**

- Path coefficients ( $\beta$ )
- T-statistics and p-values
- Coefficient of determination ( $R^2$ )

**Table 1: Factor loadings and reliability statistics**

Construct	Items	Factor loadings	Cronbach’s Alpha	Composite Reliability	Average Variance Extracted
AAB	ATT1	0.897	0.837	0.844	0.756
	ATT2	0.897			
	ATT3	0.811			
SBN	SN1	0.854	0.787	0.932	0.816
	SN2	0.950			
PBC	PBC1	0.856	0.849	0.854	0.769
	PBC2	0.924			
	PBC3	0.848			
BHV	BI1	0.882	0.836	0.839	0.754
	BI2	0.891			
	BI3	0.830			

**Table 2: Fornell and Larcker criterion**

Factor	AAB	BHV	PBC	SBN
AAB	0.869			
BHV	0.681	0.868		
PBC	0.645	0.791	0.877	
SBN	0.431	0.551	0.55	0.903

**Table 3: Variance Inflation Factor**

Item	VIF
AAB1	2.426
AAB2	2.37
AAB3	1.622
BHV1	2.14
BHV2	2.296
BHV3	1.699
PBC1	2.178
PBC2	2.898
PBC3	1.888
SBN1	1.726
SBN2	1.726

**Table 4: Path coefficient analysis**

Hypotheses	Path Coefficient	T statistics	P values	Result
H <sub>GP1</sub> : AAB -> BHV	0.173	2.668	0.008	Supported
H <sub>GP2</sub> : PBC -> BHV	0.742	10.567	0.00	Supported
H <sub>GP3</sub> : SBN -> BHV	0.069	1.65	0.099	Not supported

**Table 5: R-square**

Latent variable	R-square	R-square adjusted
BHV	0.816	0.813

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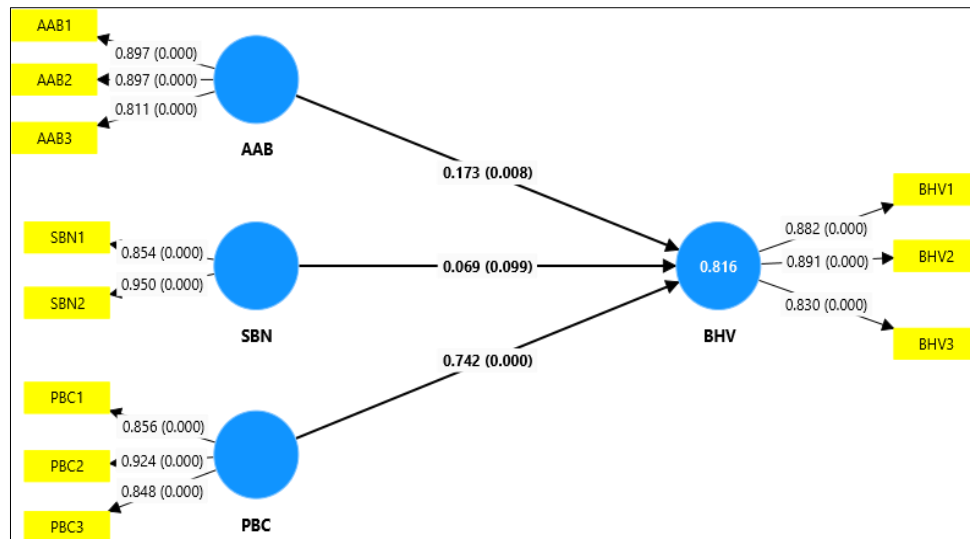


Figure 1: Structural model

Extracted from: SmartPLS

## RESULTS:

**Participant Characteristics:** A total of 205 respondents were included in the final analysis. All participants were aged above 18 years and represented a diverse general population.

**Measurement Model:** The measurement model demonstrated strong psychometric properties. All constructs showed satisfactory internal consistency, with Cronbach's alpha and composite reliability values exceeding the recommended threshold of 0.7. Convergent validity was established with AVE values above 0.5. Discriminant validity was confirmed using the Fornell-Larcker criterion, indicating that constructs were distinct and measured unique dimensions. Additionally, VIF values were below 5, indicating absence of multicollinearity.

### Structural Model

Structural model analysis revealed significant relationships between key TPB constructs and antibiotic use behaviour:

- **Attitudes and beliefs (AAB)** → Behaviour ( $\beta=0.173$ ,  $p=0.008$ )
- **Perceived behavioural control (PBC)** → Behaviour ( $\beta=0.742$ ,  $p<0.001$ )
- **Subjective norms (SBN)** → Behaviour ( $\beta=0.069$ ,  $p=0.099$ ; not significant)

Perceived behavioural control emerged as the strongest predictor of antibiotic use behaviour. The model demonstrated high explanatory power, accounting for **81.3% of the variance ( $R^2=0.813$ )**

## DISCUSSION:

This study provides important insights into the behavioural determinants of antibiotic use among the general population, highlighting the dominant role of perceived behavioural control and individual attitudes in shaping antibiotic-related behaviours. Using a Theory of Planned Behaviour (TPB)-based structural equation modelling approach, the findings demonstrate that behavioural drivers of antibiotic use are largely individual-centric rather than socially driven.

One of the most significant findings of this study is the strong influence of perceived behavioural control (PBC) on antibiotic use behaviour. PBC emerged as the most powerful predictor, with a high path coefficient, indicating that individuals' perception of ease or difficulty in accessing and using antibiotics plays a central role in determining behaviour. This finding is consistent with previous research suggesting that accessibility and availability of antibiotics, particularly in settings where over-the-counter sales are common, significantly contribute to misuse<sup>9,10,24</sup>. In many low- and middle-income countries, including India, regulatory enforcement regarding prescription-only antibiotic sales remains inconsistent, thereby increasing individuals' perceived control over obtaining antibiotics without professional consultation<sup>3,4</sup>. This is reflected in the rising burden of multidrug-resistant organisms reported from tertiary care settings in North India<sup>6,7</sup>.

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From a behavioural science perspective, high perceived behavioural control may reduce the perceived need for professional medical advice, leading individuals to rely on prior experiences or informal knowledge when making decisions about antibiotic use. This phenomenon is particularly concerning in the context of AMR, as inappropriate use—such as incomplete courses, incorrect dosing, or use for viral infections—directly contributes to resistance development<sup>1,2</sup>. This is consistent with regional microbiological evidence demonstrating increasing resistance to commonly used antibiotics<sup>12-14</sup>. The strong association between PBC and behaviour observed in this study underscores the need for interventions that reduce inappropriate access and improve regulatory enforcement mechanisms.

Attitudes and beliefs were also found to significantly influence antibiotic use behaviour, although to a lesser extent compared to perceived behavioural control. This finding aligns with existing literature demonstrating that misconceptions regarding antibiotic effectiveness, particularly against viral infections, are widespread and contribute to misuse<sup>9,25</sup>. Individuals often perceive antibiotics as a “quick fix” for common illnesses such as colds and flu, reflecting gaps in knowledge and health literacy. These misconceptions are reinforced by past experiences of symptom relief following antibiotic use, even when such use may not have been clinically indicated. Such patterns are further supported by studies demonstrating evolving resistance trends in both bacterial and fungal pathogens in similar settings<sup>13</sup>.

Importantly, attitudes are modifiable through targeted educational interventions. Studies have shown that awareness campaigns and public health messaging can improve knowledge and shift attitudes towards more rational antibiotic use<sup>26</sup>. However, the relatively lower effect size of attitudes compared to PBC in this study suggests that knowledge-based interventions alone may not be sufficient. Behaviour change strategies must therefore go beyond information dissemination and address structural and systemic factors influencing behaviour.

A particularly noteworthy finding of this study is the lack of a statistically significant association between subjective norms and antibiotic use behaviour. This suggests that perceived social pressure from family, peers, or community does not play a major role in influencing antibiotic use decisions in this population. This finding contrasts with some previous studies that have identified social norms as important determinants of health behaviour<sup>22</sup>. However, other studies have similarly reported limited influence of subjective norms in the context of antibiotic use, indicating variability across settings<sup>23</sup>.

The absence of significant social influence may reflect increasing individual autonomy in healthcare decision-making, particularly in urbanizing and semi-urban populations. With greater access to information through digital platforms and prior personal experiences with healthcare, individuals may rely more on self-judgement than on social expectations. Additionally, antibiotic use is often a private decision, not necessarily subject to overt social scrutiny, which may further reduce the influence of subjective norms.

From a management and policy perspective, this finding has important implications. Many public health interventions rely on social norm-based messaging, such as highlighting responsible behaviour within communities. While such approaches may be effective in certain contexts, the findings of this study suggest that interventions targeting individual beliefs and access-related factors may yield greater impact in this setting.

The high explanatory power of the model ( $R^2=0.813$ ) indicates that the TPB framework is highly effective in explaining antibiotic use behaviour in this population. This suggests that behavioural constructs play a substantial role in shaping antibiotic use and that theory-driven approaches can provide valuable insights for intervention design. However, it is important to acknowledge that behaviour is influenced by a broader set of contextual factors beyond those captured in the TPB model.

Healthcare system factors, such as availability of qualified healthcare providers, cost of consultation, and trust in medical professionals, may significantly influence antibiotic use behaviour. In settings where access to formal healthcare is limited or costly, individuals may be more likely to self-medicate or seek antibiotics directly from pharmacies<sup>11</sup>. This behaviour ultimately contributes to increased burden of resistant infections in hospital settings, including wound infections and critical care-associated infections<sup>6,8</sup>. Economic considerations may also play a role, as antibiotics are often perceived as a cost-effective solution to illness, reducing the need for repeated healthcare visits.

Furthermore, regulatory and policy environments play a critical role in shaping behaviour. Weak enforcement of

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prescription regulations and lack of monitoring mechanisms contribute to widespread availability of antibiotics without prescription<sup>10</sup>. Strengthening regulatory frameworks and ensuring compliance among pharmacies and healthcare providers are essential components of AMR mitigation strategies. This is particularly important in regions demonstrating a high burden of resistant infections in recent studies<sup>6</sup>.

The integration of behavioural insights into AMR policy has been increasingly emphasized in global health frameworks<sup>15,27</sup>. Traditional approaches focusing solely on clinical guidelines and surveillance are insufficient to address the behavioural dimensions of antibiotic use. Behavioural interventions, such as nudging, decision aids, and digital health tools, have shown promise in influencing health behaviours and may be adapted to address antibiotic misuse.

Another important consideration is the role of communication and trust in healthcare systems. Mistrust in healthcare providers or dissatisfaction with previous healthcare experiences may lead individuals to bypass formal care and self-medicate. Strengthening patient-provider communication and building trust are therefore critical for promoting rational antibiotic use.

The findings of this study also highlight the need for multi-level interventions that address both individual and system-level determinants. Educational campaigns should be complemented by regulatory measures, healthcare system strengthening, and community engagement initiatives. For example, integrating antibiotic stewardship messages into primary healthcare services and leveraging digital platforms for public awareness may enhance the effectiveness of interventions.

The growing adoption of mobile health technologies in North Indian settings further provides an opportunity to deliver targeted behavioural interventions and improve antibiotic use practices<sup>28</sup>. Additionally, increasing trends of resistant organisms further emphasize the clinical consequences of inappropriate antibiotic use and the need for strengthened stewardship strategies<sup>29</sup>.

Despite its strengths, including the use of a validated theoretical framework and robust analytical methods, this study has certain limitations. The use of convenience and snowball sampling may limit generalizability. Self-reported data may also be subject to social desirability bias, although efforts were made to minimize this through questionnaire design. Additionally, the cross-sectional design limits causal inference.

Future research should explore longitudinal designs to assess changes in behaviour over time and evaluate the effectiveness of targeted interventions. Incorporating additional constructs, such as knowledge, risk perception, and healthcare access, may further enhance understanding of antibiotic use behaviour. Comparative studies across different regions and populations may also provide insights into contextual variations in behavioural determinants.

In conclusion, this study reinforces the importance of behavioural factors in driving antibiotic use in the community. By identifying perceived behavioural control and attitudes as key determinants, it provides a strong foundation for designing targeted, context-specific interventions to combat antimicrobial resistance.

## **CONCLUSION:**

Antibiotic use behaviour in the general population is primarily driven by perceived behavioural control and individual attitudes rather than social norms. These findings highlight the need for targeted behavioural interventions focusing on awareness, empowerment, and regulation of antibiotic access.

Addressing AMR requires a multidisciplinary approach that integrates behavioural science, public health policy, and healthcare system strengthening. Future research should explore additional contextual determinants and evaluate the effectiveness of behaviour-based interventions in reducing antibiotic misuse.

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