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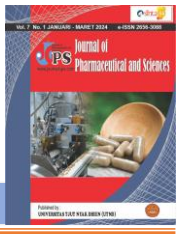

Factors Influencing Patient Adherence to Antibiotic Therapy: a Systematic Review

Faktor-faktor yang Memengaruhi Kepatuhan Pasien terhadap Terapi Antibiotik: Tinjauan Sistematis

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Abstract

Background: Antimicrobial resistance (AMR) is a critical global health crisis exacerbated by persistent misuse and non-adherence to antibiotic therapies. Because comprehensive evidence detailing the specific factors driving these behaviors remains scarce, this systematic review aimed to identify and synthesize the multifactorial drivers influencing patient adherence and misuse across diverse populations. **Method:** Following the PRISMA guidelines, a systematic literature search was conducted to screen cross-sectional studies assessing antibiotic adherence, self-medication, and misuse. Eighteen studies met the inclusion criteria for final analysis. The methodological quality of the included studies was independently evaluated by two reviewers utilizing the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies. **Result:** The review identified complex factors across five domains: sociodemographic, knowledge and beliefs, medication-related, behavioral, and the health system. Lower education, younger age, and financial constraints consistently predicted non-adherence. Knowledge gaps were prevalent, particularly the misconception that antibiotics are effective for viral infections. Therapy-related factors, such as frequent dosing (e.g., three times daily) and long treatment durations, significantly reduced adherence. Behaviorally, premature discontinuation of therapy upon symptom relief was the most common form of non-adherence, leading to the retention of leftover antibiotics. Furthermore, health system factors, including easy access to non-prescription antibiotics and the lack of a regular doctor-patient relationship, facilitated inappropriate use. **Conclusion:** Patient adherence to antibiotics is influenced by a complex interplay of socioeconomic, cognitive, and structural factors. Effective interventions must be multifaceted, combining public education to correct misconceptions, prescriber-led simplification of treatment regimens, and stricter enforcement of dispensing regulations.

***Keywords**: Antibiotic misuse, antibiotic therapy, antimicrobial resistance, patient adherence, systematic review.*

Abstrak

Latar Belakang: Resistensi antimikroba (AMR) adalah krisis kesehatan global yang diperparah oleh penyalahgunaan dan ketidakpatuhan terhadap terapi antibiotik. Karena terbatasnya bukti komprehensif mengenai faktor pendorong perilaku ini, tinjauan sistematis ini bertujuan mengidentifikasi dan mensintesis pendorong multifaktorial yang memengaruhi kepatuhan dan penyalahgunaan antibiotik oleh pasien di berbagai populasi. **Metode:** Berdasarkan pedoman PRISMA, pencarian literatur sistematis dilakukan untuk menyaring studi *cross-sectional* yang menilai kepatuhan, swamedikasi, dan penyalahgunaan antibiotik. Delapan belas studi memenuhi kriteria inklusi. Kualitas metodologis dievaluasi secara independen oleh dua peninjau menggunakan instrumen *Joanna Briggs Institute* (JBI) *Critical Appraisal Checklist for Analytical Cross-Sectional Studies*. **Hasil:** Tinjauan ini mengidentifikasi faktor kompleks dalam lima domain: sosiodemografi, pengetahuan, terkait pengobatan, perilaku, dan sistem kesehatan. Pendidikan rendah, usia muda, dan kendala finansial secara konsisten memprediksi ketidakpatuhan. Kesenjangan pengetahuan juga sangat umum, terutama miskonsepsi bahwa antibiotik efektif untuk infeksi virus. Faktor terapi, seperti dosis yang sering dan durasi pengobatan panjang, menurunkan tingkat kepatuhan. Secara perilaku, penghentian terapi secara prematur saat gejala mereda memicu disimpannya sisa antibiotik. Selain itu, faktor sistem kesehatan, seperti mudahnya akses antibiotik tanpa resep dan kurangnya hubungan dokter-pasien yang berkesinambungan, turut memfasilitasi penggunaan yang tidak tepat. **Kesimpulan:** Kepatuhan pasien terhadap antibiotik dipengaruhi oleh interaksi kompleks faktor sosioekonomi, kognitif, dan struktural. Intervensi yang efektif harus bersifat multifaset, meliputi edukasi publik untuk meluruskan miskonsepsi, penyederhanaan regimen pengobatan oleh dokter, dan penegakan regulasi distribusi obat yang lebih ketat.

***Kata Kunci**: Penyalahgunaan antibiotik, terapi antibiotik, resistensi antimikroba, kepatuhan pasien, tinjauan sistematis.*

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Introduction

Antibiotics are critical medicines used to prevent and treat infectious diseases in humans, animals, and plants [1]. However, the misuse and overuse of these antimicrobials are primary drivers in the development of drug-resistant pathogens, a crisis known as antimicrobial resistance (AMR) [2]. AMR occurs when bacteria, viruses, fungi, and parasites evolve to no longer respond to antimicrobial medicines, making common infections difficult or impossible to treat and increasing the risk of severe illness, disability, and death [3]. This constitutes a serious global health threat, particularly in developing countries, often driven by inappropriate use and a lack of proper adherence to therapy [1]. For this reason, it is of utmost importance to understand the determinants of antibiotic use, that is, the factors influencing patient behaviors to develop strategies that improve adherence [4].

Research provides clear evidence that medication non-adherence is a complex, multidimensional phenomenon affected by multiple determinants [4]. A systematic review of current research identified 771 individual factor items, which have been grouped using consensus taxonomy into five broad, multidimensional domains [5]. These domains, also endorsed by the World Health Organization (WHO) [6], are: (a) socio-economic-related factors, (b) healthcare team and system-related factors, (c) condition-related factors, (d) therapy-related factors, and (e) patient-related factors [6]. This review specifically focuses on patient-related factors [7].

In the context of improving antimicrobial stewardship, this study aims to systematically review the literature to identify patient-related factors that affect antibiotic use. Patient adherence to antibiotics is a critical component, defined as completing an antibiotic course as prescribed and avoiding self-medication [3]. This behavior is not monolithic; non-adherence can be intentional, where a patient consciously decides not to follow treatment recommendations based on their beliefs or preferences, or unintentional, where a patient intends to follow recommendations but faces practical barriers, such as poor recall or simply forgetting [8]. Whenever possible, this study specifically assesses patient-related factors that have a positive (i.e., facilitator) or negative (i.e., barrier) [9] impact on different aspects of antibiotic use, such as adherence to the prescribed regimen and rates of self-medication [10].

Methods

Research Design

This systematic review is reported following the PRISMA statement [11]. The review protocol was developed prior to data extraction but was not registered with PROSPERO due to the data extraction process commencing on October 11, 2025, precluding prospective registration. To mitigate potential bias, we adhered strictly to PRISMA 2020 guidelines and made our review protocol and data extraction form available as Supplementary File 1. We acknowledge this unregistered status as a limitation of the current study. As this study is a systematic review and synthesis of previously published literature, formal ethical approval and written patient consent were not required. The research methodology is detailed below.

Population and Sample

The systematic literature search was conducted on October 11, 2025. Studies published between January 1, 2015, and October 11, 2025, were included. We limited our inclusion to English-language, cross-sectional studies because they are best suited to assess the prevalence of adherence behaviors and associated factors at

a population level, which aligns with our primary research objective. Qualitative studies and interventional designs were excluded to maintain methodological homogeneity for synthesis. Articles exclusively dealing with topical antibiotics, antivirals, antimycobacterial, antifungals, and antiparasitic drugs were also excluded.

Study Tool

A standardized data extraction form was constructed and piloted on a subset of the included studies before full implementation to minimize errors and ensure consistency. Methodological quality was assessed independently by two reviewers (RA and CW) using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies, as CASP does not provide a specific tool for this design. Disagreements were resolved through consensus discussion with a third reviewer (EI).

Data Collection

A systematic search was conducted across Scopus, ScienceDirect, SpringerLink, and PubMed, supplemented by a search for grey literature on the official websites of the WHO, CDC, and World Bank. Adhering to PRISMA 2020 standards, an initial retrieval of 3,733 records underwent strict screening and filtering, resulting in 18 studies selected for final inclusion and data extraction. Key characteristics extracted included the specific factor influencing adherence and its assigned classification as a 'barrier' or 'facilitator' of prudent antibiotic use [12].

Data Analysis

The study's findings were qualitatively summarized, deliberately omitting a meta-analysis. Identified factors were consolidated into broader conceptual categories: demographic and socioeconomic factors, knowledge and belief factors, and clinical and healthcare system access factors. Results were presented by healthcare setting and relevant factor categories, with data specifically from low- and middle-income countries (LMIC) addressed in separate sections according to the World Bank 2024-2025 criteria [13].

Results

Using the specified search strategy, 3,733 studies were initially identified. Following abstract screening, 43 articles were retained for full-text review, ultimately resulting in the inclusion of 18 eligible studies.

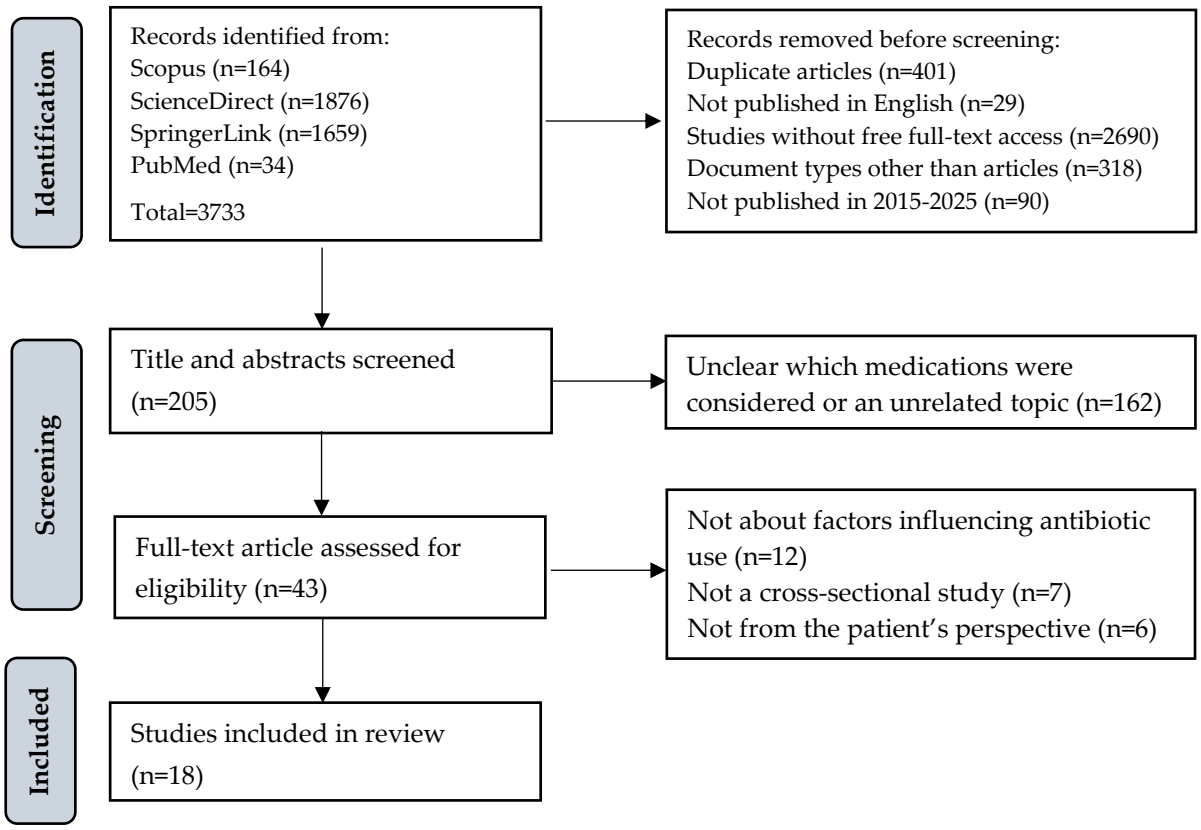

Figure 1. PRISMA diagram of the retrieved process

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Table 1 summarizes the key characteristics of the 18 included studies. The studies represent a diverse geographical distribution, covering populations across Asia and the Middle East (Iran, Saudi Arabia, Singapore, Bangladesh, Lebanon, India, Hong Kong, Malaysia, Jordan, China) [14,15,18-20,22,23,25,28-30], Africa (Ethiopia, Nigeria, Zambia, Egypt) [16,17,21,31], Europe (Kosovo, Romania) [24,27], and South America (Peru) [26].

Table 1. Characteristics of included studies

Author (Year)	Country	Population & Sample	Study Objectives	Key Findings/Associated Factors
Zabihi et al. (2021)	Iran	**N = 313** Patients discharged from hospital wards	To evaluate adherence to antibiotic treatment and its associated factors in patients after hospital discharge	**Non-adherence rate:** 33.2% **Factors:** Age <18 years (p = 0.001) and age <40 years (p = 0.04) were significantly associated with poorer adherence. Three-times-daily dosing increased forgetfulness (p = 0.02). Twice-daily regimens were less likely to be discontinued without prior consultation (p = 0.03). Single marital status correlated with lower adherence (p < 0.001)
Alamri et al. (2025)	Saudi Arabia	**N = 385** Dental outpatients	To assess adherence to oral antibiotic therapy, AMR knowledge, and precise prescription behaviors	**Low adherence rate:** 62.3% **Factors:** Age 23–30 years had the highest low-adherence (p < 0.001). Income <7,000 SAR was associated with poor adherence (p = 0.018). Premature discontinuation upon symptom resolution was a massive predictor (p < 0.001). Receiving clear instructions improved behavior (p = 0.005)
Hareru et al. (2022)	Ethiopia	**N = 323** Households	To assess the prevalence of antibiotic non-adherence and associated factors among households	**Non-adherence rate:** 60.1% **Factors:** Male sex (AOR = 1.77, 95% CI: 1.03–3.08), inability to read/write (AOR = 3.42, 95% CI: 1.51–7.75), primary education (AOR = 2.37, 95% CI: 1.12–5.02), poor attitude (AOR = 1.89, 95% CI: 1.23–3.04), poor knowledge (AOR = 1.34, 95% CI: 1.11–2.39), and lack of pharmacy info (AOR = 2.02, 95% CI: 1.09–3.72) were key predictors.
Akande-Sholabi and Oyesiji (2023)	Nigeria	**N = 509** Community pharmacy consumers	To assess knowledge, perceptions, and factors associated with antibiotic misuse	**Inadequate knowledge rate:** 85.3% **Factors:** Delays in lab reports (p = 0.007), belief in fast symptom relief (p = 0.001), reliance on past prescriptions (p < 0.001), proximity of pharmacy (p = 0.028), initiative for minor illness (p < 0.001), and lack of trust in physicians (p = 0.039) predicted misuse
Lee et al. (2023)	Singapore	**N = 967** Adult general public	To investigate the relationship between threat perceptions of AMR and adherence to antibiotics using PMT	**Factors (PMT Model):** Perceived response cost was the strongest negative predictor of adherence (β = -0.61, p < 0.001). Perceived response efficacy (β = 0.096, p = 0.002), perceived susceptibility to AMR (β = 0.097, p < 0.001), and antibiotic knowledge (β = 0.073, p = 0.01) were significant positive predictors
Masud et al. (2025)	Bangladesh	**N = 358** Community pharmacy customers	To measure antibiotic adherence per the Standard Treatment Guidelines (STGs) and	**Adherence to STGs:** 40.5%. **Factors:** Consulting a registered medical practitioner improved adherence (Adj-PR = 3.81, 95% CI: 2.82–5.14). Male sex (Adj-PR = 0.68, 95% CI: 0.54–0.86), rural

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			identify associated factors	residence (Adj-PR = 0.63, 95% CI: 0.45–0.87), and 6-hourly regimens (Adj-PR = 0.61, 95% CI: 0.28–1.33) predicted non-adherence
Mallah et al. (2020)	Lebanon	**N = 1,421** Parents of schoolchildren	To assess the association between knowledge, beliefs, and antibiotic misuse	**Misuse rate:** 41% among recent users. **Factors:** Belief antibiotics cure viruses (aIqOR = 2.08, 95% CI: 1.32–3.19), use for common cold (aIqOR = 1.81, 95% CI: 1.41–2.29), use for sore throat (aIqOR = 2.19, 95% CI: 1.61–2.93), and storing leftovers (aIqOR = 2.44, 95% CI: 1.68–3.46) were critical predictors of misuse
Ngoma et al. (2024)	Zambia	**N = 2,038** General public	To assess public consumption of antibiotics and associated factors	**Appropriate use rate:** 40.9%. **Factors:** Female sex (AOR = 1.4, 95% CI: 1.17–1.73, $p < 0.001$), age >35 (AOR = 2.1, 95% CI: 1.58–2.74, $p < 0.001$), secondary education+ (AOR = 4.6, 95% CI: 3.53–5.86, $p < 0.001$), and high monthly expenditure (AOR = 1.9, 95% CI: 1.34–2.76, $p < 0.001$) predicted appropriate use
Jain et al. (2024)	India	**N = 384** Tertiary hospital outpatients	To assess awareness regarding antibiotic use and AMR among patients	**Poor AMR Awareness:** 24.5%. **Factors:** 85.9% believed viral diseases can be treated with antibiotics. 46.3% stopped treatment when symptoms subsided. 41.0% bought over-the-counter (OTC) antibiotics. 71.6% practiced self-medication for minor illnesses
Lam et al. (2015)	Hong Kong	**N = 1,551** General population	To determine the impact of having a regular doctor on antibiotic use	**Factors:** High income ≥ HK$25,000 (AOR = 2.08, 95% CI: 1.49–2.90, $p < 0.0001$), utilizing public healthcare (AOR = 0.18, 95% CI: 0.13–0.23, $p < 0.0001$), always finishing the full course (AOR = 1.81, 95% CI: 1.42–2.29, $p < 0.0001$), and taking antibiotics for URTI (AOR = 1.76, 95% CI: 1.27–2.48, $p < 0.001$) were significant
Imeri et al. (2023)	Kosovo	**N = 453** parents of children aged 0-15	To evaluate parents' attitudes, perceptions, and adherence to antibiotics for their children	**Non-compliance rate:** 35.8%. **Factors:** Age group predicted access to services ($b = 0.155$, $p < 0.001$) and likelihood of initiating antibiotics for high temperature ($b = 0.55$, $p < 0.001$). Gender significantly impacted the perception of antibiotic side effects ($b = 0.331$, $p < 0.05$)
Wong et al. (2021)	Malaysia	**N = 864** General public	To examine factors influencing the inappropriate use of antibiotics in Malaysia	**Factors:** High antibiotic knowledge scores (OR = 3.94, 95% CI: 2.71–5.73), tertiary education (OR = 1.99, 95% CI: 1.02–3.91), and middle-income status (OR = 1.61, 95% CI: 1.04–2.50) were significantly associated with higher practice scores. Age mediated the knowledge-practice association ($\beta = 0.251$, 95% CI: 0.131–0.221)
Paredes et al. (2022)	Peru	**N = 231** Parents of children < 5 years of age from six rural primary health centres	To assess knowledge, attitudes, and practices (KAP) regarding antibiotic use among parents of children < 5 years and identify determinants of low	79% (n=183) of parents did not know that antibiotics cannot cure viral infections, and 52% (n=120) reported self-medicating their children. A positive correlation was observed between knowledge and attitudes (Coefficient = 0.53, 95% CI: 0.38–0.68)

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			knowledge and self-medication	**Factors:** Age < 20 years (PR = 2.39, 95% CI: 1.32–4.34) were significantly associated with lower antibiotic knowledge. Purchasing antibiotics without a prescription (aPR = 2.70, 95% CI: 1.74–4.19) and pharmacist recommendations (aPR = 1.79, 95% CI: 1.13–2.82) significantly predicted self-medication practices
Iuhas et al. (2025)	Romania	**N = 312** Parents of pediatric patients	To identify misconceptions and behavioral risks in parental antibiotic use	**Factors:** Higher parental education (OR = 0.52) and a positive attitude (OR = 0.11) significantly reduced the likelihood of misuse. Conversely, having more and older children increased the probability of antibiotic misuse (OR = 1.31)
Almomani et al. (2022)	Jordan	**N = 2,000** 1000 adults, 1000 mothers	To assess the prevalence and predictors of non-adherence to short-term antibiotics	**Non-adherence rate:** 32.1%. **Factors:** Absence of comorbidity in adults was associated with non-adherence (OR = 0.615, 95% CI: 0.444–0.853, $p = 0.004$). Higher doses per regimen were associated with non-adherence (OR = 0.965, 95% CI: 0.950–0.981, $p < 0.001$). Mothers were more adherent for children vs adults for themselves (OR = 2.657, 95% CI: 1.844–3.827, $p < 0.001$)
Yin et al. (2022)	China	**N = 15,526** Antibiotic users	To explore inappropriate use behaviors of antibiotics and related factors	**NAAT rate:** 53.3%. **Factors:** Age 30–44 (aOR = 1.43, 95% CI: 1.32–1.55), age ≥ 45 (aOR = 1.60, 95% CI: 1.47–1.75), and low knowledge (aOR = 2.06, 95% CI: 1.88–2.26) predicted NAAT. Junior college or above education predicted self-storage of antibiotics (aOR = 1.54, 95% CI: 1.39–1.71)
Bdair et al. (2024)	Saudi Arabia	**N = 600** General public	To assess knowledge, attitude, and practice (KAP) toward antibiotic usage	**Inadequate knowledge rate:** 49.8%. **Factors:** Older age (B = 27.15, $p < 0.001$) and male gender (B = 1.34, $p < 0.001$) were associated with higher knowledge. Employment was associated with better practice (B = 5.30, $p = 0.002$). Knowledge and practice were significantly correlated (r = 0.246, $p < 0.001$)
Elden et al. (2020)	Egypt	**N = 600** University students	To identify the patterns of self-medication in university students	**Self-medication rate:** 70.1%. **Factors:** Female students self-medicated significantly more often than male students (OR = 1.45, 95% CI: 1.17–1.79). Medical students showed a vastly higher self-medication prevalence (97.2%) compared to non-medical students (44.7%)

In terms of study design, the objectives and methodologies indicate a predominantly cross-sectional approach to assess public health behaviors and clinical adherence. The sample sizes varied significantly, ranging from 231 participants in a study evaluating parents at rural primary health centres in Peru [26] to 15,526 antibiotic users in a large-scale evaluation in China [29]. The target populations were heterogeneous, while several studies focused on the adult general public, households, or community pharmacy consumers [16-19,21,23,25,30]. Others specifically targeted parents of pediatric patients or schoolchildren [20,24,26-28], university students [31], or specific clinical groups such as dental outpatients [16] and hospital outpatients or recently discharged patients [14,22].

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The primary objectives of the included studies were to assess adherence to short-term or oral antibiotic therapy [14,15,19,28], evaluate knowledge, attitudes, and practices (KAP) [26,30], investigate threat perceptions of antimicrobial resistance (AMR) [18], and identify determinants of misuse, self-medication, or non-compliance [16,17,20,21,23-25,27,29,31]. Key findings consistently highlighted that lower adherence and inappropriate use were associated with specific factors, including lower educational levels, specific age brackets, lower income, and complex dosing frequencies. One of the core behavioral predictors highlighted across the studies was that misconceptions such as the belief that antibiotics cure viral diseases [20,22,26], the premature discontinuation of therapy upon symptom resolution [15,22], and the tendency to keep leftover or self-store antibiotics [20,29] were prevalent behavioral predictors across multiple populations.

The synthesis of these 18 studies highlights five primary factors of antibiotic use and adherence: sociodemographic factors, knowledge gaps, regimen complexity, behavioral patterns, and health system factors. Of the 18 included studies, 12 were rated as high quality, 5 as moderate quality, and 1 as low quality. No studies were excluded based on quality assessment to ensure comprehensive coverage of the evidence base; however, findings from low-quality studies were interpreted with caution and are clearly indicated in the synthesis (Supplementary Table 2). A detailed summary of the factors influencing antibiotic use and adherence identified across the included studies is presented in Table 2.

Table 2. Synthesis of Factors Influencing Antibiotic Use and Adherence

Sociodemographic Factors	**Level of Education** Higher education is generally associated with better adherence and less misuse. Conversely, lower levels of education are risk factors for non-adherence. **Age** Younger age groups (e.g., <40 years) were identified as having higher risks of misuse or lower adherence in specific contexts. **Gender** Male sex was identified as a significant predictor for non-adherence in household settings. **Income/Economic Status** Lower monthly income was associated with a higher likelihood of antibiotic misuse. Place of Residence (Rural vs. Urban) Living in rural areas was linked to a higher prevalence of misconceptions regarding antibiotic use for minor ailments. **Financial Constraints** High costs of medical consultation fees were a primary driver for patients to bypass doctors and purchase antibiotics directly (self-medication).
Knowledge, Attitudes & Beliefs	**Knowledge of Antibiotics & AMS** Poor knowledge regarding Antimicrobial Stewardship (AMS), resistance, dosage, and duration is a primary driver of misuse and non-adherence. **Misconceptions (Viral Infections)** The erroneous belief that antibiotics are effective for viral infections (cold, flu) or prevent complications speeds up misuse. **Necessity vs. Concerns** Patients who perceive a high necessity for the drug are more adherent, while those with great concerns about side effects are less adherent. **Threat Perception** Higher perceived severity of and susceptibility to antimicrobial resistance (Protection Motivation Theory) encourages better adherence. **Past Experience** Previous successful treatment with a specific antibiotic encourages patients to reuse the same drug for similar future symptoms without a prescription.
Medication & Therapy Factors	**Dosing Frequency** Complex regimens (e.g., multiple times daily) reduce adherence compared with simpler regimens (e.g., once-daily). **Procedure Type / Indication** Patients undergoing invasive procedures (e.g., surgical extraction) tend to be more adherent than those with routine conditions. **Treatment Duration**

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	Longer courses of treatment (>8 days) were associated with a higher likelihood of premature discontinuation.
Behavioral & Clinical Factors	**Remission of Symptoms** Feeling better is the most common reason for stopping antibiotic courses early (non-adherence). **Self-Medication Practices** Using leftover antibiotics from previous prescriptions or purchasing them without a current diagnosis.
Health System & Provider Factors	**Access Without Prescription** Easy availability of antibiotics at community pharmacies without a valid prescription facilitates misuse. **Provider Influence & Counseling** Inappropriate advice from drug sellers/dispensers and lack of adherence to Standard Treatment Guidelines (STG) by providers. **Doctor-Patient Relationship** Patients with a regular family doctor demonstrated better knowledge and compliance compared to those without a consistent provider. **Parental Pressure on Doctors** Parents pressuring pediatricians to prescribe antibiotics for their children's illnesses contributed to irrational prescribing.

Across the five identified domains, several interactions were evident. For instance, in settings where antibiotics were readily available without prescription (health system factor), this facilitated self-medication behaviors even among patients with relatively good knowledge, suggesting that structural interventions may be necessary to complement educational efforts. Conversely, in populations where higher education was associated with better adherence, the effect was attenuated in the presence of financial constraints, indicating that socioeconomic barriers may override cognitive factors. Notably, the relationship between knowledge and adherence was not always linear; some studies found that medical students, despite high knowledge, exhibited higher rates of self-medication, highlighting the need to consider contextual and psychological mediators.

Discussion

This systematic review synthesized data from 18 cross-sectional studies to evaluate the multifaceted factors of antibiotic adherence and misuse across diverse global settings. The findings indicate that patient behavior is not driven by a single factor but by a complex interplay of sociodemographic backgrounds, knowledge and beliefs, medication-related factors, and health system structures.

Sociodemographic characteristics were consistently identified as significant predictors of antibiotic use behavior. Educational attainment emerged as a critical factor; higher educational levels were generally associated with better adherence, higher practice scores, and a decreased likelihood of misuse, as seen in populations in Zambia [21], Malaysia [25], and Romania [27]. Conversely, lower education, such as having only primary education or an inability to read and write, was a strong predictor of non-adherence and inappropriate use in Ethiopia [16]. Interestingly, higher education (junior college or above) was also found to predict the self-storage of antibiotics in China [29].

Age and economic status also played pivotal roles. Specific age groups, particularly younger populations, were frequently at higher risk of low adherence and lower antibiotic knowledge [14,15,26]. Conversely, older age was often associated with greater knowledge and appropriate use [21,30]. Financial constraints and lower income correlated with poor adherence [15], whereas high income and monthly expenditure predicted appropriate use and better practices [21,23,25]. Additionally, rural residence was linked to a higher likelihood of non-adherence [19]. Gender also impacted behaviors, with male sex predicting non-adherence in some settings [16,19], while female students were found to self-medicate significantly more often in Egypt [31].

A lack of knowledge about antibiotics and the erroneous belief that antibiotics are effective for viral diseases (e.g., the common cold) were major drivers of non-adherence and misuse [16,20,22,26]. This was evident in Peru, where 79% of parents did not know that antibiotics cannot cure viral infections (26), and in India, where 85.9% believed viral diseases could be treated with antibiotics [22]. Beyond general knowledge,

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psychological constructs significantly influenced behavior. Lee et al. [18] used the Protection Motivation Theory (PMT) to demonstrate that perceived susceptibility to antimicrobial resistance (AMR) and perceived response efficacy were positive predictors of adherence. In contrast, response cost was the strongest negative predictor [18]. Furthermore, poor attitudes increased the risk of non-adherence [16], while positive attitudes decreased the likelihood of misuse [27].

The characteristics of the treatment regimen itself were key factors of adherence. Complex and frequent dosing schedules, such as three-times-daily or 6-hourly regimens, significantly increased forgetfulness and predicted non-adherence [14,19]. Similarly, regimens requiring higher doses per intake were associated with lower adherence rates [28]. In contrast, twice-daily regimens were less likely to be discontinued unadvisedly [14]. Additionally, the patient's specific profile influenced compliance; for instance, mothers in Jordan were found to be more adherent when administering antibiotics to their children than when taking the medication themselves [28].

The most prevalent non-compliant behavior reported was the premature discontinuation of therapy once symptoms subsided. This pattern was a massive predictor of low adherence across multiple populations, including dental outpatients in Saudi Arabia [15] and hospital outpatients in India [22]. This behavior often leads to the retention and storage of leftover antibiotics, which facilitates future self-medication and misuse [20,29]. Additionally, reliance on past prescriptions and the initiative to treat minor illnesses independently were identified as critical predictors of antibiotic misuse [17].

The healthcare environment significantly shapes usage patterns. The availability of purchasing over-the-counter (OTC) antibiotics or acquiring them without a prescription facilitates high rates of self-medication [22,26]. Provider-related factors, such as receiving clear instructions and consulting a registered medical practitioner, significantly improved adherence behaviors [15,19]. Conversely, a lack of pharmacy information, delays in lab reports, and a lack of trust in physicians were found to predict misuse and non-adherence [16,17]. Furthermore, advice from pharmacy staff could also influence practices, as pharmacist recommendations were significantly linked to self-medication in Peru [26]. While a formal health economic evaluation was beyond the scope of this review, the identified interventions, such as simplifying regimens and enforcing regulations, represent high-value, low-cost strategies. By improving adherence, these measures can significantly reduce the economic burden of AMR, including prolonged hospitalizations, second-line treatment costs, and productivity losses.

Limitations

Several limitations must be considered when interpreting the findings of this review. First, all included studies employed cross-sectional designs, which cannot establish causal relationships between identified factors and adherence behaviors. Second, adherence was predominantly measured through self-report, which is subject to social desirability bias and recall inaccuracies; objective measures such as pill counts or electronic monitoring were absent. Third, the review was restricted to English-language publications, potentially excluding relevant studies published in other languages, particularly from non-English speaking countries where antibiotic misuse may be prevalent. Fourth, the heterogeneity in definitions of 'adherence,' 'misuse,' and 'self-medication' across studies complicates direct comparisons and synthesis. Fifth, the predominance of studies from Asia and the Middle East, with limited representation from Africa, Latin America, and Europe, limits the generalizability of findings to these underrepresented regions. Finally, we cannot rule out publication bias, as studies reporting significant associations may be more likely to be published than those with null findings.

Conclusions

The review points out issues of antibiotic non-adherence and misuse, highlighting that they are not merely the result of individual negligence but are driven by a convergence of poor health literacy, economic barriers, complex treatment regimens, and systemic accessibility issues. The findings suggest that relying solely on general awareness campaigns is insufficient. To effectively combat antimicrobial resistance, future strategies must focus on targeted education about the distinction between viral and bacterial infections, the promotion by clinicians of shorter, simpler antibiotic regimens, and the strengthening of regulatory frameworks to prevent the sale of antibiotics without a prescription. Furthermore, fostering a consistent

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doctor-patient relationship plays a crucial protective role in ensuring responsible antibiotic use. Additionally, while our focus on cross-sectional studies allowed for a broad assessment of prevalence, we acknowledge the exclusion of qualitative studies as a limitation in capturing in-depth, nuanced patient perspectives. Based on the synthesis of evidence, we propose the following specific recommendations: For policymakers: (1) Enact and enforce legislation prohibiting over-the-counter antibiotic sales, with regular monitoring of pharmacy compliance; (2) integrate AMR education into primary and secondary school curricula; (3) subsidize consultation fees for lower-income populations to reduce financial barriers to seeking professional care. For clinicians: (1) Adopt once- or twice-daily prescribing regimens where clinically appropriate to reduce forgetfulness; (2) provide explicit written instructions to patients about the expected duration of symptoms and when to expect improvement; (3) explain the rationale for completing the full course, emphasizing patient-specific risks rather than global AMR threats. For pharmacists: (1) Provide standardized counseling on antibiotic use, including potential side effects and signs of adverse reactions; (2) refuse dispensing without a valid prescription, even when pressured by customers. For future research: (1) Conduct longitudinal studies to establish causal pathways; (2) validate objective adherence measures for use in low-resource settings; (3) investigate cultural factors influencing antibiotic use through mixed-methods approaches.

Conflict of Interest

The authors have no conflicts of interest to declare.

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