Review Article

# Prevalence and Associated Factors of Self-Medication with Antibiotics Worldwide: A Systematic Review

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## Abstract

The aim of conducting a systematic review of the available literature on antibiotic self-medication was to obtain comprehensive data on prevalence, reasons, common antibiotics, self-treated diseases, and drug and information sources of antibiotics used for self-medication worldwide. *PubMed, ScienceDirect, SpringerLink,* and *Taylor & Francis Online* were used to perform a comprehensive search on articles published between 2011 and 2020 in the English language. Studies focusing on the prevalence of antibiotic self-medication and its associated factors were included in this review. AXIS Appraisal tool for Cross-sectional studies (AXIS tool) was used for quality assessment of the included articles. A total of 76 studies from diverse geographical locations, including 62668 individuals, were included in this systematic review. The prevalence of SMA in the included studies ranges from 2.6% to 86.5%. Major reasons for non-prescribed use of antibiotics include healthcare costs and time constraints. Respiratory tract infections, fever, and prophylaxis of various symptoms appeared to be prominent self-treated health issues. Pharmacy or superstore, leftovers, and relatives or friends were the most common sources of acquiring antibiotics for self-medication. Similarly, the majority tend to self-medicate with antibiotics based on information obtained from a pharmacy, previous prescription, or personal experience. Self-medication with antibiotics was considered a pervasive issue, with penicillin being the most commonly self-medicated antibiotic. Lack of public awareness and little attention of researchers to not only self-medication but also other related issues such as antibiotic resistance, necessitates the immediate development and execution of public health policies and multifaceted interventions to ensure rational use of antibiotics eventually reducing antibiotic resistance.

**Keywords:** Self-medication, Non-prescription, Antibiotic, Public health, Systematic review

## Introduction

Self-medication is the use of drugs to treat a variety of diseases or symptoms. It involves the patient's choice of treatment or re-use of prescribed medication for a chronic or recurrent ailment, the use of herbs, and the purchase of drugs without a doctor’s prescription or with a physician's previous diagnosis and prescription. It could also be a medicinal treatment for family members, such as infants, children, and the elderly [1, 2]. In general, self-medication is considered to play an important role in the treatment of minor illnesses. Studies have documented the impact of personal, environmental, and organizational factors on self-medication [1].

People across the world are self-medicating in greater numbers than ever before for a variety of reasons. It is of major concern for healthcare experts and authorities around the world as self-healing is a two-edged sword with benefits and drawbacks. It has the potential to assist patients and healthcare providers while also posing a risk to patients [3]. On one hand, self-treatment allows quick access to emergency medical treatments, which is especially crucial in countries with congested (public and/or private) healthcare systems, where finding a doctor's appointment might be difficult. On the other hand, self-medication has been associated with a great risk to self-medicated patients and, in certain situations, to the community [2].

Self-medication has many risks that people are often unaware of [3]. Many of these dangers aren't confined to treatment and can happen even in prescription (although it is less likely to happen if appropriate treatment protocol is followed by a

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doctor). The practice of self-medication is fraught with dangers [2]. Concealing a serious health condition and failing to seek immediate medical advice; incorrect administration or route; rare but severe side effects; sharing drugs; risk of dependence or abuse; treating for a short period; failure to discern contraindications and possible drug-drug or drug-food interactions; inadequate dosage; inappropriate storage; inappropriate treatment choice; quitting treatment when disease symptoms improve are some of the concerns posed by self-medication. Improper self-use of medicines causes an increase in drug-related ailments in the community, which leads to an increase in public health spending [2, 4]. People must be informed and instructed about their treatment so they may practice it efficiently and safely [3].

Self-medication which is frequently done inappropriately without medical supervision, has become a universal problem and a major contributor of pathogenic resistance especially to antibiotics [5, 6]. Self-medication with antibiotics (SMA) is a severe public health issue that affects people all over the world, with a high prevalence in various demographics and countries [7]. It is believed that more than half of antibiotics are obtained without a prescription and taken over-the-counter in most parts of the world [4]. Self-medication with antibiotics can have serious consequences, including antibiotic resistance, drug toxicity, and treatment failure. Antibiotic resistance has been identified as one of the most serious public health issues being faced by the planet [7]. It has been a serious challenge around the world since the emergence of bacterial strains that are highly resistant to a variety of antibiotic classes [4]. This resistance makes it difficult to treat common bacterial illnesses and could lead to more severe illnesses, more doctor visits, the need for more expensive treatments, longer hospital stays, and even death, posing a serious public health risk [4, 5].

Non-prescription use of antibiotics is a health issue that affects both developing and developed countries [8]. Community pharmacists who dispense antibiotics without a doctor’s prescription, play an important role in educating the customer about self-medication [9]. In many Latin American countries, despite the restricted sale of over-the-counter medications, the policies are rarely enforced, and people tend to self-medicate frequently [10]. Furthermore, in the EU, where the sale of over-the-counter (OTC) antibiotics is outlawed, it occurs often in countries such as Spain and Greece. Other options for obtaining antibiotics without a prescription include purchasing medicines over the Internet or using leftovers from family, friends, or former prescriptions [6].

Even though the World Health Organization (WHO) has defined antibiotics to be prescription-only-medicine (POM), the literature reveals that SMA practices in low- and middle-income countries (LMICs) are influenced by social, cultural, economic, and health-related factors [8]. Improper health systems, antibiotic supervision and control, poor prescriptions and dispensing practices by healthcare personnel, and non-compliance with antibiotic dispensing guidelines are all issues that LMICs face [5]. According to the World Health Organization (WHO), around 80% of antibiotics are used in the community in LMICs, with 20–50% of those being used incorrectly. It has also been reported that over half of all antibiotic prescriptions in the world are unnecessary, and two-thirds of antibiotics accessible in the pharmaceutical industry are used for self-medication [11].

In contrast to the developed world, developing countries have limited access to antimicrobials, particularly novel medication classes, and the treatments that are accessible usually lack action against the multidrug-resistant bacteria that are becoming more common [12]. Travelers may acquire resistant bacteria that can be transported back to their homelands, spreading resistance genes over the world [13]. Transmission between industrialized and developing countries is two-way and is less likely to be identified in underdeveloped countries because of poor surveillance systems [14].

Despite being a significant factor in developing drug resistance, self-medication is not given the required attention as a research topic [1]. Since self-medication with antibiotics is a concerning phenomenon that manifests itself in a variety of ways and can have significant public health consequences, it is critical to investigate the factors that lead individuals to use antibiotics without a doctor's prescription [6]. Unlike most medications, inappropriate use of antibiotics not only harms the individual patient but also poses a risk to the family and even globally in the form of antimicrobial resistance and secondary contagious sequelae [15]. Although studies on the non-prescription use of antibiotics usually focus on a single country or region, the consequences of antimicrobial abuse are becoming a global issue. To devise and implement interventions to minimize nonprescription antibiotic use, we must first comprehend its prevalence, the types of symptoms that prompt nonprescription use, the source of antibiotics, and the source of information on non-prescription use of antibiotics. For this purpose, we conducted a systematic evaluation of work published from 2011 to 2020, to determine the global prevalence and factors of non-prescription antimicrobial usage.

### *Objective*

The aim of this systematic review is to 1) estimate the prevalence of self-medication or non-prescription use of antibiotics, and 2) identify the determinants of antibiotics’ self-medication. The following study questions were devised in compliance with the objectives of this systematic review:

## Materials and Methods

Preferred Reporting Item for Systematic Review and Meta-Analysis (PRISMA) guidelines were followed for reporting the systematic review [16].

### *Search Strategy*

Four international databases were used for a systematic search of the articles to be included in this review. These search engines include *PubMed, ScienceDirect, SpringerLink,* and *Taylor & Francis Online*. The keywords included were self-medication, self-medicated, self-prescription, non-prescription, and antibiotics. Boolean operators (OR, AND) were used to separate these search terms.

### Data Extraction

Endnote® (version X7) software was used for reference management. Internal (within the single database) and external (among all databases) duplicates were removed from retrieved references. Title and abstract screening were done by one author and verified by another author for the fulfillment of eligibility criteria. Discrepancies were resolved with consensus among the review authors. The full text of the articles was assessed electronically, and data was extracted in tabular form. The data was categorized based on the country of study, its geographical region, and continent.

### Eligibility Criteria

The cross-sectional studies, carried out during the years 2011 to 2020, giving information about prevalence, reasons, indications, and sources of self-medication or non-prescription use of antibiotics, were included in this review. Only original research or full-length articles published in the English language were considered eligible.

Articles with no information about self-medication of antibiotics or with less than 50% response rate, were excluded. Studies focusing on the self-medication of children or adolescents with antibiotics were also excluded. Review articles, posters, short communications, case reports, and letters were not included in this systematic review. Studies on self-medication of antimicrobials other than antibiotics or those giving information only about knowledge, attitude, or practice regarding antibiotic use, were not included. Research articles comprising data on self-medication of antibiotics along with other medicines, were also excluded from this review.

### Quality Assessment

All included studies were evaluated using the Appraisal tool for Cross-Sectional Studies (AXIS tool) [17]. This tool consists of five major components *introduction*, *methods*, *results*, *discussion*, and *others* with a total of twenty questions for appraising observational cross-sectional studies. The author could select one of the three answers for each question: 'Yes', 'No', and 'Don't know / Comment'. Each of the twenty questions received a one-point score for each right answer. Review authors independently classified the studies under investigation as good (>15), fair (10-15), or poor (<10) quality, based on the total score (0 - 20) of each study [18]. Disagreements were resolved after discussion among the authors.

## Results and Discussion

### Search Results

A total of 2649 articles were retrieved through searching databases with 6 more articles found by searching reference lists and searching websites. After deduplication, and title and abstract screening, 168 articles were considered eligible for full-text analysis, of which, only 76 observational cross-sectional studies were included in the final study as shown in **Figure 1**. The majority of these studies were carried out on Asian, European, and African populations, while only a few were conducted in South America, North America, and Oceania. All the included and excluded studies were unanimously agreed upon by the authors based on predefined eligibility criteria.

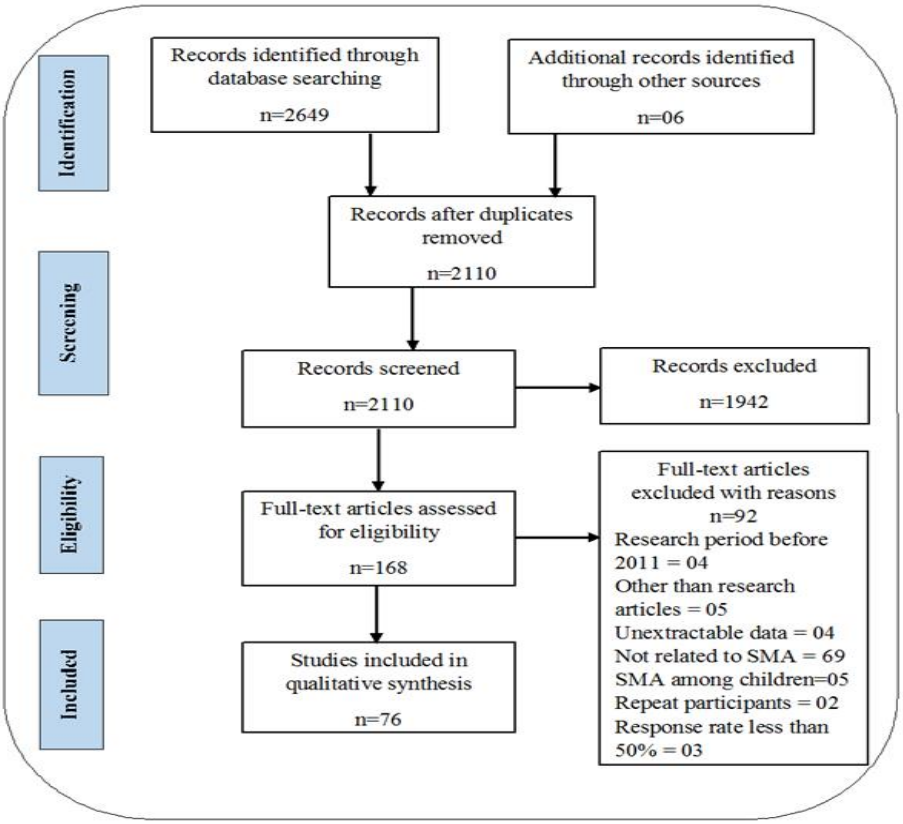


**Figure 1.** PRISMA chart for screening and selection of studies for data extraction

## *Characteristics of Included Studies*

Self-administered surveys and interviews were used to gather the information from relevant studies. A total of 67,169 participants were included in 76 studies from six continents of the world including data from 40 countries as illustrated in **Figure 2**.

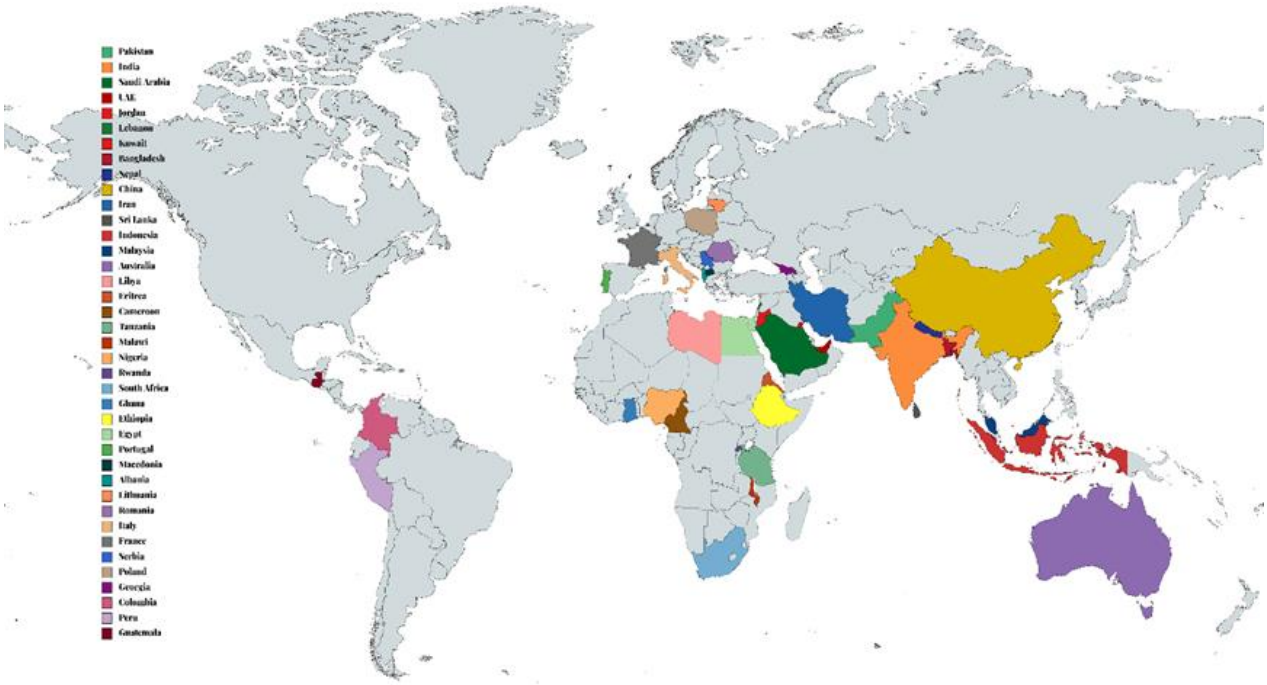


**Figure 2.** Geographic distribution of included studies in a systematic review

Despite all the studies being observational cross-sectional studies, there was a great variation in sample size, study setting, target population, and recall period. The sample size of all the included studies ranged from 15 to 11,192 individuals, with the majority of participants being female (53.13%).

## *Quality Assessment of Included Studies*

The quality of included studies was assessed by scores of the AXIS tool. The majority of the studies had scored 10-15 and hence placed under the category of 'fair' quality. Thirty-two studies got scores greater than 15 and were categorized as 'good' quality studies while only four studies were placed under the 'poor' quality category as their score was less than 10. Details of the quality appraisal of all the included studies are shown in **Table 1**.

**Table 1.** Quality assessment of included studies using the AXIS tool

| Authors | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20 | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North America** | | | | | | | | | | | | | | | | | | | | | |
| Ramay *et al*. [19] | Y | Y | Y | Y | Y | N | NA | Y | Y | N | Y | Y | N | N | Y | N | Y | Y | N | Y | Fair |
| **South America** | | | | | | | | | | | | | | | | | | | | | |
| Núñez *et al*. [20] | Y | Y | Y | Y | Y | N | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Higuita-Gutiérrez *et al*. [21] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| **Europe** | | | | | | | | | | | | | | | | | | | | | |
| Kandelaki *et al*. [22] | Y | Y | N | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | DK | Y | Y | Y | N | Y | Good |
| Muras *et al*. [23] | Y | Y | N | Y | Y | Y | N | DK | DK | Y | Y | Y | N | N | UC | Y | Y | N | N | Y | Fair |
| Szenborn *et al*. [24] | Y | Y | N | Y | Y | Y | DK | N | N | Y | Y | N | N | N | DK | Y | Y | N | N | N | Fair |
| Tomas *et al*. [25] | Y | Y | Y | N | DK | Y | DK | Y | N | Y | Y | N | N | DK | Y | Y | Y | Y | Y | Y | Fair |
| Horvat *et al*. [26] | Y | Y | Y | Y | Y | Y | NA | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| Demore *et al*. [27] | Y | Y | N | Y | Y | N | NA | N | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | NA | Fair |
| Grosso *et al*. [28] | Y | Y | N | Y | Y | Y | N | DK | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Fair |
| Napolitano *et al*. [29] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | DK | Y | Y | Y | N | Y | Good |
| Bianco *et al*. [30] | Y | Y | Y | Y | Y | N | NA | Y | Y | Y | Y | N | N | NA | Y | Y | Y | Y | N | Y | Good |
| Damian *et al*. [31] | Y | Y | N | Y | Y | Y | N | N | N | Y | Y | N | N | N | Y | Y | N | Y | UC | Y | Fair |
| Voidăzan *et al*. [32] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | N | N | N | Y | Y | Y | Y | N | Y | Good |
| Barkus and Lisauskienė [33] | Y | Y | N | Y | Y | Y | N | Y | N | N | N | N | N | N | Y | UC | Y | N | UC | UC | Poor |
| Jorgji *et al*. [34] | Y | Y | N | Y | DK | N | N | N | N | N | Y | N | N | N | DK | N | N | Y | N | N | Poor |
| Ivanovska *et al*. [35] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | UC | Y | Good |
| Ramalhinho *et al*. [36] | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| **Africa** | | | | | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| El-Hawy *et al*. [37] | Y | Y | N | Y | DK | N | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | N | Y | Y | Fair |
| Gebeyehu *et al*. [38] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| Erku *et al*. [39] | Y | Y | Y | N | DK | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Bogale *et al*. [40] | Y | Y | Y | Y | Y | Y | NA | Y | Y | Y | Y | N | N | NA | Y | N | Y | Y | Y | Y | Fair |
| Donkor *et al*. [41] | Y | Y | Y | Y | Y | Y | N | Y | DK | Y | Y | N | N | N | Y | Y | Y | Y | N | Y | Good |
| Afari-Asiedu *et al*. [42] | Y | Y | N | Y | Y | N | DK | Y | N | Y | Y | N | N | DK | Y | Y | Y | Y | Y | Y | Fair |
| Effah *et al*. [43] | Y | Y | N | Y | Y | Y | N | N | UC | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Fair |
| Bulabula *et al*. [44] | Y | Y | N | Y | Y | Y | NA | Y | N | Y | Y | N | N | NA | Y | Y | Y | Y | Y | Y | Fair |
| Tuyishimire *et al*. [45] | Y | Y | Y | Y | Y | Y | N | N | N | N | Y | N | N | N | Y | Y | Y | Y | N | Y | Fair |
| Sambakunsi *et al*. [46] | Y | Y | Y | Y | DK | Y | NA | Y | N | Y | Y | Y | N | NA | DK | Y | Y | Y | Y | Y | Fair |
| Badger-Emeka *et al*. [47] | Y | Y | Y | Y | Y | Y | N | N | N | Y | Y | Y | N | N | Y | Y | Y | Y | DK | Y | Fair |
| Horumpende *et al*. [48] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Ngu *et al*. [49] | Y | Y | Y | Y | Y | N | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Ateshim *et al*. [50] | Y | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | N | N | DK | Y | Y | Y | N | Y | Good |
| Ghaieth *et al*. [51] | Y | Y | N | Y | Y | N | N | N | N | Y | Y | Y | N | N | Y | Y | Y | N | N | Y | Fair |
| **Asia** | | | | | | | | | | | | | | | | | | | | | |
| Belkina *et al*. [52] | Y | Y | N | Y | Y | Y | NA | Y | N | Y | Y | Y | N | NA | Y | Y | Y | Y | N | Y | Good |
| Abobotain [53] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | DK | Y | Good |
| Azeem *et al*. [54] | Y | Y | N | Y | Y | N | N | N | N | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Fair |
| Al Rasheed *et al*. [55] | Y | Y | Y | Y | Y | Y | N | Y | N | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Nafisah *et al*. [56] | Y | Y | Y | Y | Y | Y | N | N | N | N | Y | Y | N | N | Y | Y | Y | Y | N | NA | Fair |
| Abu-Mostafa *et al*. [57] | Y | Y | N | Y | Y | Y | DK | Y | N | Y | Y | N | N | N | N | Y | Y | N | N | Y | Fair |
| Yezlia *et al*. [58] | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | N | N | DK | N | Y | Y | N | Y | Fair |
| Al-Qahtani *et al*. [59] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | N | Y | N | Y | Good |
| Alghadeer *et al*. [60] | Y | Y | N | Y | Y | N | N | Y | N | N | N | Y | N | N | DK | Y | Y | N | DK | DK | Poor |
| Benameur *et al*. [61] | Y | Y | N | Y | Y | Y | NA | Y | N | Y | Y | Y | N | NA | N | Y | Y | Y | N | Y | Fair |
| Jairoun *et al*. [62] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Al-Kubaisi *et al*. [63] | Y | Y | Y | Y | Y | Y | NA | N | N | Y | Y | N | N | N | DK | Y | Y | Y | N | Y | Fair |
| Al Baz *et al*. [64] | Y | Y | Y | Y | Y | Y | N | N | N | Y | Y | Y | N | N | DK | Y | Y | Y | N | N | Fair |
| Cheaito *et al*. [65] | Y | Y | N | Y | Y | Y | DK | N | DK | Y | Y | Y | N | DK | N | Y | Y | Y | N | Y | Fair |
| Sakr *et al*. [66] | Y | Y | N | Y | Y | Y | N | Y | N | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Fair |
| Awad and Aboud [67] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Askarian and Maharlouie [68] | Y | Y | N | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Hosseinzadeh and Azimian [69] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | N | N | Y | Y | N | Y | Fair |
| Shah *et al*. [70] | Y | Y | Y | Y | Y | Y | N | Y | N | N | Y | N | N | N | Y | Y | Y | Y | N | Y | Fair |
| Nazir and Azim [71] | Y | Y | N | Y | Y | N | N | N | N | N | N | N | N | N | N | Y | Y | N | N | Y | Poor |
| Bilal *et al*. [72] | Y | Y | Y | Y | Y | N | N | Y | N | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Gillani *et al*. [73] | Y | Y | Y | Y | Y | Y | N | Y | Y | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Shamsudeen *et al*. [74] | Y | Y | Y | Y | Y | Y | N | Y | N | N | N | N | N | N | DK | UC | Y | N | N | Y | Fair |
| Virmani *et al*. [75] | Y | Y | Y | Y | Y | Y | N | N | N | N | N | N | N | N | DK | Y | Y | Y | N | Y | Fair |
| Rajendran *et al*. [76] | Y | Y | Y | Y | DK | Y | N | Y | N | N | N | Y | N | N | Y | UC | UC | Y | N | Y | Fair |
| Sharma, *et al*. [77] | Y | Y | Y | Y | Y | Y | N | Y | N | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |
| Biswas *et al*. [78] | Y | Y | N | Y | Y | Y | N | N | N | N | N | Y | N | N | DK | Y | Y | Y | N | Y | Fair |
| Nepal *et al*. [79] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| Mandal *et al*. [80] | Y | Y | N | Y | Y | Y | N | Y | N | N | Y | N | N | N | Y | Y | Y | Y | N | Y | Fair |
| Pan *et al*. [81] | Y | Y | N | Y | Y | N | N | Y | Y | N | Y | Y | N | N | Y | UC | Y | Y | Y | Y | Fair |
| Lv *et al*. [82] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | DK | Y | Y | Y | UC | Y | Good |
| Chai *et al*. [83] | Y | Y | Y | Y | Y | Y | N | N | N | N | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Fair |
| Lisa *et al*. [84] | Y | Y | N | Y | Y | N | N | Y | Y | Y | Y | N | N | N | DK | Y | Y | Y | Y | Y | Fair |
| Wang *et al*. [85] | Y | Y | N | Y | Y | Y | N | N | N | N | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Fair |
| Rathish *et al*. [86] | Y | Y | N | Y | Y | DK | N | N | Y | N | Y | Y | N | N | Y | Y | Y | Y | N | Y | Fair |
| Jayaweerasingham *et al*. [87] | Y | Y | N | Y | Y | Y | DK | Y | N | N | Y | N | N | DK | Y | Y | N | Y | N | Y | Fair |
| Rathish and Wickramasinghe [88] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | N | Y | Y | N | Y | Good |
| Hassali *et al*. [89] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | N | Y | Good |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Haque *et al*. [90] | Y | Y | Y | Y | Y | Y | N | Y | N | Y | Y | Y | N | N | DK | Y | Y | Y | N | Y | Good |
| Widayati *et al*. [91] | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Good |
| Karuniawati *et al*. [92] | Y | Y | N | Y | Y | Y | DK | Y | N | DK | Y | Y | N | N | N | DK | Y | Y | N | Y | Fair |
| **Oceania** | | | | | | | | | | | | | | | | | | | | | |
| Hu and Wang [93] | Y | Y | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | N | Y | Y | Y | Y | Y | N | Y | Good |

Y = Yes, N = No, DK = Don't know, NA = Not applicable, UC = Unclear.

### *Prevalence and Determinants of Self-Medication with Antibiotics*

The overall prevalence of self-medication with antibiotics ranged from 2.6% to 86.5% and seven studies did not report the prevalence. A high prevalence of more than 70% was reported from North America (Guatemala [19]), Europe (Albania [34]), Africa (Ghana [41], Nigeria [47]), and Asia (Yemen and Uzbekistan [52], Saudi Arabia [55], Iran [69], Pakistan [72], and India [74, 77]). Countries where prevalence of self-medication with antibiotics was reported to be less than 25% included five from Europe (France [27], Italy [28], Lithuania [33], Macedonia [35], and Portugal [36]), three from Africa (South Africa [44], Rwanda [45], and Malawi [46]), seven from Asia (Saudi Arabia [53, 57], India [75, 76], Nepal [79], China [83, 84], Sri Lanka [86, 88], Malaysia [89], and Indonesia [91]), and one from Oceania (Australia [93]). The overall prevalence of self-medication across genders was found to be higher among the male population and the majority of such studies were reported from the Asian region [54-56, 59, 61, 65, 70, 71, 76, 78, 80, 82, 86, 88].

### *Reasons for Self-Medication with Antibiotics*

The studies varied greatly in their reasons for self-medication with antibiotics. Overall, it appeared that participants tend to self-medicate with antibiotics majorly to save money or due to increased costs of health services [19, 41, 50, 63, 72, 76, 81, 88, 90, 91]. Participants preferred self-medication with antibiotics due to time constraints [19, 26, 29, 37, 40, 41, 45, 46, 57, 60, 61, 63-65, 70, 72, 74, 76, 77, 91] and because they find it more convenient to self-medicate than to visit any healthcare facility [19, 50, 63, 72, 76, 81, 88, 90]. Furthermore, treatment of minor illnesses for which people do not consider it necessary to seek medical assistance [19, 40, 45, 46, 50, 55, 60, 61, 72, 74, 76, 77, 89], past successful experience with the same antibiotic or disease [40, 45, 46, 50, 55, 59-61, 63, 70, 71, 73, 74, 86, 88, 91], ease of purchasing antibiotics [19, 41, 48, 61, 68, 69, 72] and physician related issues including lack of trust towards physicians/unavailability of physician / discomforting attitude of a physician [19, 29, 37, 45, 46, 50, 55, 57, 60, 67, 69, 71, 72, 74, 78, 81, 89, 90] were also among the common reasons associated with antibiotics self-medication.

In Asia, the most common reason for self-medication with antibiotics appeared to be economic issues [64, 69, 72, 81, 91], personal convenience [81, 88, 90], time issues [64, 65, 70, 91], minor illness [72, 89], previous experience [59, 60, 71, 86, 91], easy purchase of drug from pharmacies [68, 69, 72], physician related issues [67, 69], and assumed medical knowledge [57, 89]. The common reasons for self-medication in Africa included previous experience [40, 41, 50], minor illness [40, 45], emergency use [48, 50], time issue [37, 41], and economic issue [40, 41]. In Europe, people mostly tend to self-medicate due to the unavailability of doctors and to save time [29]. In North America, time constraints and purchasing convenience [19] were the most common reasons for self-medication with antibiotics. Studies from South America and Oceania had not reported any reasons for which individuals were inclined to use antibiotics without a prescription. A summary of different classes of antibiotics being used for self-medication in different parts of the world is given in **Figure 3**.

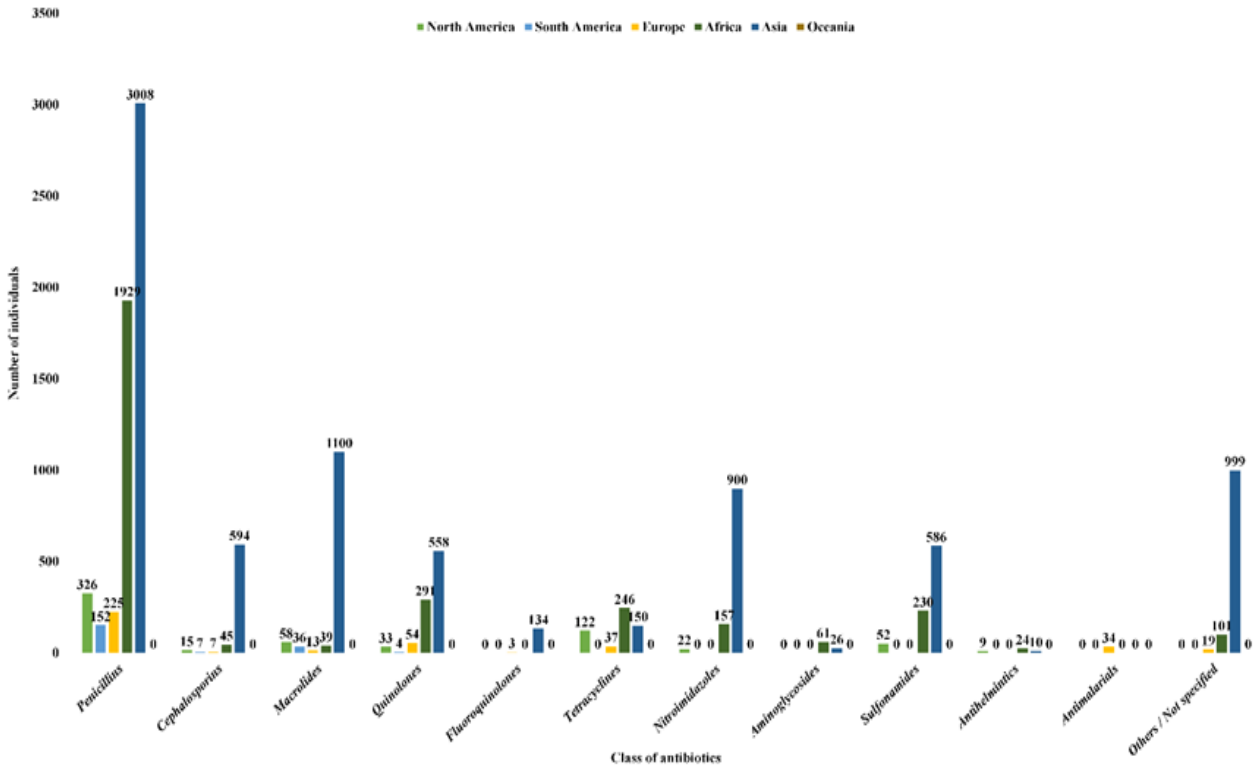


**Figure 3.** Comparative analysis of antibiotic class usage across continents

## *Symptoms for Which Antibiotics are Used without Prescription*

The most common conditions for which participants preferred the use of antibiotics without a medical prescription were respiratory tract issues including cold/flu, [19, 21, 22, 25-27, 29-35, 37, 40, 42-45, 47, 50-52, 55, 58, 61, 62, 64, 67-69, 71, 72, 75-82, 84-93] sore throat [20, 25, 26, 29, 33-35, 37, 45, 47, 50, 55, 61, 62, 64, 67-69, 71, 75-77, 79-81, 84-86, 90, 92, 93], and cough [25, 27, 29, 33-35, 37, 45-50, 52, 55, 60-62, 67-69, 76-79, 81, 84, 88-90, 92, 93], followed by fever [19-21, 26, 27, 29-31, 34, 37, 40, 45-48, 50, 54, 55, 58-61, 66, 68-70, 72, 73, 76-81, 85, 87, 88, 90-93], prophylaxis or emergency use [26, 27, 56, 58, 79, 85, 89] gastrointestinal issues [19, 21, 32-34, 38-40, 42, 45-48, 50, 52, 54, 55, 59-61, 68-73, 76-78, 80, 81, 85-87, 90, 93], pain [19, 25, 26, 29, 31-34, 38, 39, 42, 45, 46, 48, 50, 54-57, 60, 61, 65, 66, 68-73, 76-78, 81, 85, 86, 88, 90-93], and oral issues [25, 29, 32-34, 46, 50, 57, 60, 71, 74, 78, 86, 91, 93]. Other symptoms included skin problems [19, 21, 25, 33, 34, 45, 47, 50, 54, 55, 59-61, 65, 69, 71, 72, 75, 78, 86, 91, 92], malaise/fatigue [26, 68, 92], genitourinary tract infection [21, 25, 31-34, 38, 39, 42, 50, 52, 55, 59, 61, 64-68, 70, 71, 73, 77, 83, 88], ear/eye infection [22, 27, 32, 50, 52, 61, 68, 75, 78, 80, 88, 92], and wounds [38, 39, 42, 45, 47, 48, 55, 59, 61, 67, 76, 77, 80, 81, 90, 92].

In North America, cold/flu, pain, and fever [19], while in South America, sore throat, fever, and cold/flu [20] were frequently self-treated with antibiotics. In Europe, antibiotics were preferred as self-medication mostly for cold/flu [22, 25-27, 29-35] and fever [26, 27, 29-31, 34], followed by malaise [26], pain [25, 26, 31, 34], sore throat [25, 26, 29, 33-35], toothache [25, 29, 32-34], and cough [25, 27, 33-35]. African population used antibiotics on their own mostly for cold/flu [37, 40, 42-45, 47, 50, 51], cough [37, 45-50], diarrhea [38-40, 42, 45-48, 50], upper respiratory tract infection [40, 46], fever [37, 40, 45-48, 50] and wounds [38, 39, 42, 45, 47, 48, 50]. Cold/flu [52, 55, 58, 61, 62, 64, 67-69, 71, 72, 75-82, 84-93], sore throat [55, 61, 62, 64, 67-69, 71, 75-77, 79-81, 84-86, 90, 92, 93], fever [54, 55, 58-61, 66, 68-70, 72, 73, 76-81, 85, 87, 88, 90-93], prophylaxis [56, 58, 79, 85], cough [52, 55, 60-62, 67-69, 76-79, 81, 84, 88-90, 92, 93], nasal congestion [62, 76, 81, 84, 88, 90], upper respiratory tract infection [54, 61, 65, 84, 86, 87, 93], and diarrhea [54, 55, 60, 61, 68, 69, 71, 72, 76-78, 80, 81, 85-87, 90, 93] were common symptoms for antibiotic self-medication among Asian participants. In Oceania, upper respiratory tract infections and fever were reported as the most common indication for using antibiotics followed by fever, sore throat, cough, diarrhea, and cold/flu [93].

## *Sources of Information and Drugs (Antibiotics) for Self-Medication*

Family members were the major source of information in North America [19] while studies from other continents reported pharmacists to be the primary source of information about antibiotics for self-medication [20, 25, 26, 29, 31, 34, 37, 40, 47, 50-52, 56-60, 65, 69, 71, 73, 76, 77, 81, 86, 88-91]. Other common sources of information included previous prescription [20, 37, 50, 52, 58, 60, 69, 74, 76, 77, 81, 88, 90],

previous personal experience [20, 32, 34, 37, 42, 47, 59, 65-67, 69, 71, 76-78, 81, 82, 90-92], family/friends [19, 20, 26, 31-34, 37, 40, 42, 47, 50, 52, 58-60, 65, 69, 71-74, 76, 77, 81, 82, 86, 89-91], media sources / books [20, 29, 32, 42, 47, 59, 60, 74, 82, 90, 91], physician [24, 26, 29, 40, 47, 65, 71, 82, 86], self-knowledge [31, 52, 56, 57, 67, 70, 73, 86], and others. Majority of the population was reported to acquire antibiotics for use without a medical prescription from pharmacies [19, 23, 25, 29, 35, 37-40, 44-46, 48-51, 54, 56, 59, 61, 63, 67, 69, 71, 72, 76, 77, 79-81, 83-86, 88-92] followed by leftover from previous prescription [19, 22-26, 29, 30, 32, 35, 37, 43, 45, 46, 49, 50, 53, 58-60, 63, 64, 66, 67, 69, 71-73, 76, 77, 80, 81, 83-87, 90-93], friends/family members [23, 25, 32, 38, 39, 43, 45, 46, 49-51, 53, 56, 59, 61, 63, 64, 66, 67, 71, 77, 80, 83, 86-89, 91], stalls/superstores [19, 40, 46, 54, 72, 89, 92], health institutions/clinics [40, 89], medical representatives [80, 81, 90, 92], and online purchase [61, 90].

Pharmacies were commonplace for obtaining antibiotics for use without a medical prescription in North America [19]. The European population mostly acquired antibiotics without prescription in the form of leftovers [22-26, 29, 30, 32, 35], or from pharmacies [23, 25, 29, 35], and friends/family members [23, 25, 32]. African studies reported pharmacies [37-40, 44-46, 48-51], friends/family [38, 39, 43, 45, 46, 49-51], leftover [37, 43, 45, 46, 49, 50], health institutions/clinics [40], sent from abroad [50], and chemists [49] as the common sources to obtain antibiotics. In Asia, pharmacies [54, 56, 59, 61, 63, 67, 69, 71, 72, 76, 77, 79-81, 83-86, 88-92] or corner store/stall [72, 89, 92], leftovers [53, 58-60, 63, 64, 66, 67, 69, 71-73, 76, 77, 80, 81, 83-87, 90-92], friends/family [53, 56, 59, 61, 63, 64, 66, 67, 71, 77, 80, 83, 86-89, 91], sent from abroad [54, 58], health institutions/clinics [89], medical representatives [80, 81, 90, 92], and online purchase [61, 90] were common sources to get antibiotics. In Oceania, leftovers from previous use were the major source of antibiotics for self-medication [93].

Self-medication with antibiotics in ambulatory care patients is a complicated phenomenon influenced by a number of variables. These determinants are related to sociocultural factors, economic factors, and healthcare system-related factors [44]. Even though the majority of countries have a wide range of national laws and legal rules aimed at reducing imprudent use of antibiotics, the majority of determinants that encourage patients to self-medicate are difficult to address, making self-medication a persistent problem [94].

The key finding of this review is that the prevalence of self-medication with antibiotics is dangerously high among various countries around the globe. SMA prevalence varied from 2.6% [88] to 86.5% [47] among the studies analyzed in this review with an overall prevalence of 36% and is consistent with the findings (39%) of a previous review on global anti-microbial self-medication [14]. In 2006, SMA was reported to be far less common in developed nations, such as those in Europe, where sales of OTC antibiotics are highly restricted, with prevalence rates ranging from 1% to 4% [95] which is in contrast with the findings in this review showing a prevalence of as high as 78.14% in Europe [34]. Dispensing of whole packages of medicine instead of precise numbers could be a possible reason for this increased practice of SMA among the European population [6]. This review shows a maximum of 78.7% [55, 77] prevalence of SMA in Asia in comparison with 82% in the Middle East [4] and 85.59% in Southeast Asian countries [96]. Differences in social determinants of culture, economic level, tradition, developmental status, and health may be the key factors for the wide variation in the prevalence of antibiotic self-medication practices. Similar to the results of SMA in Sub-Saharan African countries (40.6%), this review showed a prevalence of 38.35% among African populations [97]. The discrepancy in the prevalence of self-medication could also be attributed to differences in study design, study setting, target population, and recall period.

Socioeconomic and health-related factors along with many others influence self-treatment with antibiotics that may vary according to different settings. In most communities, people assume that the subsequent infections can be treated without contacting a physician owing to their previous effectiveness with antibiotics. This is a predisposing factor for improper drug usage as the majority of patients are unaware of the disease complications and the medications used for self-treatment [9]. Individuals with a high level of education are less likely to self-medicate with antibiotics. Therefore, increasing community knowledge should be a major objective to reduce the self-use of antibiotics. Higher non-prescription use of antibiotics was found in studies conducted among health science students as compared to those in the general public. This may be because health science students have a better understanding of drugs and diseases thus, they are less likely to seek medical care to treat their ailments. Another review outlined the high prevalence of antibiotic self-medication practices among students of health sciences.

According to the findings of this review, pharmacies were the most common source of antibiotics being used for self-medication, followed by leftovers from previous prescriptions and friends/family members. Increased purchases of antibiotics from medical stores or pharmacies may be due to a lack of control over sales of OTC and POM medicines. However, research has shown that even though the country's statutes limit the sale of antibiotics to the presentation of a medical prescription, the pharmacies continued to dispense antibiotics without a prescription [98], owing to a lack of resources of regulatory authorities to enforce them [31]. Furthermore, patients can keep antibiotics from incomplete courses, even after the expiry date, and self-administer these drugs for self-diagnosed ailments or share them with friends and relatives [52]. On the other hand, the likelihood of reduced antibiotic storage in households with a chronic ailment owes to the fact that these patients are less likely to take antibiotics without visiting a doctor, possibly

due to concerns about antibiotic interactions with medications used to treat chronic symptoms.

Pharmacists are frequently reported as a source of advice or information for the antibiotics acquired and used for self-medication. This shows that pharmacists are responsible for the extensive antibiotic misuse in the community [40]. It is frequently stated that pharmacists feel an ethical obligation to help patients requiring consultation, particularly those who cannot afford clinical appointments, yet many pharmacists and other healthcare professionals reportedly consider patients' expectations while prescribing antibiotics. In some cases, the pharmacist enquires about the patient's age and symptoms so that he could be offered alternative medicine or have his antibiotic changed. However, some drug dispensers provide incorrect information, indicating that this is an important problem in the fight against bacterial resistance. This erroneous practice emphasizes the importance of pharmacists as a critical component who should be the focus of special interventions, as well as the need for research into the potential reasons for antibiotic dispensing without a prescription [30]. Thus, pharmacists could play a key role in educating people, avoiding non-prescription sales of antibiotics, and improving the rational use of antibiotics.

In most countries, the practices of self-medication are being influenced by the underlying difficulties of health systems such as inadequate healthcare facilities [99]. Due to a lack of policies or their ineffective execution, OTC antibiotics are readily available [100]. Most developing countries struggle with erratic medicine supplies to public healthcare facilities, limiting the access of the community to basic medical care. This, along with the increased prevalence of infectious diseases in many countries, makes private medical centers a viable option for healthcare.

In many investigations, respiratory infections, the common cold, and sore throat were identified as the most common health complaints that led to self-medication. Self-medication was also documented in research for fever, prophylactic use, and gastrointestinal (GI) tract diseases as frequent conditions. This could be because these illnesses are quite common and reappear frequently. Patients may be hesitant to seek medical help because many ailments are mild and self-limiting [96].

Antibiotic self-medication was observed with a variety of antibiotic classes. Amoxicillin was the most used antibiotic for self-medication, followed by sulfamethoxazole-trimethoprim, metronidazole, ciprofloxacin, and azithromycin. This could be explained by the fact that, in comparison with other antibiotics, amoxicillin is the most commonly prescribed antibiotic by physicians worldwide [20] and is a well-known antibiotic in the community [50]. The inexpensive cost and easy availability may explain the widespread use of these antibiotics. The responders may have been treated with these drugs in the past and are now utilizing them to treat diseases with similar symptoms [14]. Patients prefer to utilize these prescriptions as a reference for similar illnesses in the future as well. Amoxicillin and cotrimoxazole antibiotics are very economical in most LMICs, and they are first-line therapy for most respiratory tract infections, especially without diagnostic confirmation, which explains their widespread use [49]. A large number of antibiotics have been reported in the studies and some of them are not the first line of choice for community-acquired infections which is a matter of concern as it encourages irrational use of antibiotics and leads to bacterial resistance against antibiotics [33, 48].

Self-medication with multiple antibiotics was documented in some of the studies included in the review. The use of multiple antibiotics during an episode of disease indicates uncertainty of etiology. These poor practices contribute to the risks of adverse effects, poor treatment, drug interactions, and the development of resistance. This is exacerbated by the high prevalence of infectious diseases along with the restricted therapeutic options available in various countries. Antibiotic resistance is expected to put additional budget constraints on the healthcare system, which is already struggling due to a lack of financing. This is especially true for patients suffering from resistant infections who are likely to stay longer in hospitals, necessitating the use of more costly second-line antibiotics [12].

Thus, the development of targeted treatments aimed at these frequent antibiotic misuse practices is urgently needed. The situation can be improved by implementing and controlling laws that regulate the dispensing of antibiotics in pharmacies and by improving public awareness regarding adverse drug reactions, antibiotic resistance, and super-infections. Policymakers must make adequate efforts to establish and implement relevant policies to address these issues.

## Conclusion

The prevalence of self-medication with antibiotics is significantly high in various countries of the world and understanding the SMA pattern is critical for addressing this issue. Despite many studies describing the prevalence of non-prescription use and its associated factors, high-quality research is limited. Finally, and perhaps most crucially, the involvement of government and non-governmental organizations could be critical in limiting self-medication and antibiotic distribution. Countries that have successfully reduced non-prescription drug usage have done so by combining legislation with increased healthcare access. Controlling the threat posed by self-medication with antibiotics necessitates not only developing and implementing programs but also receiving feedback and measuring the improvement in knowledge and self-medication practices.

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