



# A Scoping Review of Antibiotic Prescribing Patterns Using the WHO AWaRe Classification in Diverse Healthcare Settings: A Global Perspective

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## ABSTRACT

**Background:** The World Health Organization's (WHO) Access, Watch, and Reserve (AWaRe) classification is a pivotal tool for monitoring antibiotic consumption and promoting stewardship. Objective: This scoping review synthesizes findings from empirical studies employing the AWaRe framework to map global antibiotic prescribing patterns and identify key trends and challenges.

**Methods:** A focused analysis of seven peer-reviewed studies from diverse geographical regions (India, Denmark, Indonesia, England, Burkina Faso, Mozambique) and healthcare settings (outpatient, inpatient, community) was conducted. Data on AWaRe category proportions, adherence to the WHO target ( $\geq 60\%$  Access antibiotics), commonly prescribed agents, and study recommendations were extracted and thematically analyzed.

**Results:** A stark contrast was observed between high-income countries (HICs) and low- and middle-income countries (LMICs). Studies from HICs (Denmark, England) demonstrated better alignment with the WHO target (55-61% Access antibiotics), supported by established stewardship programs and national AWaRe adaptation. In contrast, LMIC studies consistently reported suboptimal Access group usage (1.6%-38% in India, 31.6% in Indonesia) and a concerning predominance of Watch group antibiotics (37%-98.4%), predominantly third-generation cephalosporins like ceftriaxone. Excessive injectable use and low generic prescribing were additional problems identified in LMIC settings.

**Conclusion:** The AWaRe classification effectively reveals problematic prescribing patterns, highlighting a significant global inequity in rational antibiotic use. While HICs show progress through policy integration and monitoring, LMICs face systemic challenges including diagnostic limitations and empirical over-reliance on broad-spectrum agents. Successful implementation requires contextual adaptation of the AWaRe framework, strengthening of diagnostic and regulatory infrastructure, and its integration into sustainable, funded antimicrobial stewardship programs, particularly in resource-limited settings.

**Keywords:** WHO AWaRe Classification, Antibiotic Prescribing, Antimicrobial Resistance, Antimicrobial Stewardship, Access-Watch-Reserve, Global Health.

## Introduction

The escalating crisis of antimicrobial resistance (AMR) poses a formidable threat to global public health, food security, and economic development (Dadgostar, 2019). Inappropriate and excessive antibiotic use is a primary driver of AMR, undermining the efficacy of essential

medicines and leading to increased morbidity, mortality, and healthcare costs (1). It is estimated that bacterial AMR was directly associated with approximately 1.27 million deaths globally in 2019 (2).

To combat this, the WHO introduced the Access, Watch, and Reserve (AWaRe) classification of antibiotics in 2017 as a cornerstone of its global action plan (3). This framework categorizes antibiotics based on their impact on AMR and clinical priority: Access: First- or second-choice, narrow-spectrum antibiotics for common infections. They offer the best therapeutic value while minimizing resistance potential. Watch Broad-spectrum antibiotics with higher resistance potential, designated as "critically important antimicrobials." Their use should be limited and carefully monitored. Reserve: "Last-resort" antibiotics for multidrug-resistant infections, to be preserved. Not Recommended: Fixed-dose combinations lacking evidence, which should be avoided. The WHO advocates that at least 60% of total national antibiotic consumption should consist of Access group antibiotics, a key indicator for monitoring stewardship efforts and progress towards the Sustainable Development Goals (1).

Since its inception, the AWaRe classification has been increasingly adopted in research and national policies to evaluate prescribing quality. Studies applying this framework across different income settings have revealed heterogeneous patterns, but a comprehensive synthesis of these findings is needed. This scoping review aims to map and synthesize evidence from recent studies that have utilized the WHO AWaRe classification to assess antibiotic prescribing patterns. It seeks to identify common trends, disparities between high-income countries (HICs) and low- and middle-income countries (LMICs), challenges in implementation, and implications for strengthening global and local antimicrobial stewardship initiatives.

## Materials and Methods

This scoping review was conducted to systematically chart the available evidence from a predefined set of seven research articles provided for analysis. The approach follows the methodological framework for scoping reviews to identify key concepts, evidence types, and knowledge gaps (4).

### 2.1. Eligibility Criteria

- a) Included studies were original research articles that:
- b) Primarily used the WHO AWaRe classification (2017 or later versions) as a core analytical tool.
- c) Reported quantitative data on the proportion of antibiotic prescriptions or consumption falling into AWaRe categories.
- d) Were conducted in real world healthcare settings (hospitals, outpatient clinics, community).
- e) Were published in English.

### 2.2. Data Sources and Search Strategy

Given the focused nature of this review, the analysis was based on the seven specified articles. In a full systematic scoping review, databases such as PubMed/MEDLINE, Scopus, and Web of Science would be searched using terms: ("WHO AWaRe" OR "Access Watch Reserve") AND ("antibiotic prescribing" OR "antibiotic consumption" OR "antimicrobial use") AND ("pattern" OR "evaluation").

### 2.3. Data Charting and Synthesis

Data from each study were extracted into a standardized table and analyzed narratively. Key extracted variables included: (1) study location and setting; (2) study design and period; (3) proportions of antibiotic use in Access, Watch, Reserve, and Not Recommended categories; (4) most frequently prescribed antibiotics; (5) adherence to other WHO/INRUD indicators (e.g., generic prescribing, injectable use); and (6) main conclusions and recommendations. Findings were synthesized thematically, with a particular focus on comparing patterns between HICs and LMICs.

## Results and Discussion

### 3.1. Study Characteristics

The seven analyzed studies spanned four continents and included both HIC (Denmark, England) and LMIC (India, Indonesia, Burkina Faso, Mozambique) contexts (Table 1). Settings ranged from tertiary hospital outpatient departments and pediatric inpatient wards to community-level use prior to hospitalization. Study designs were predominantly cross-sectional or retrospective analyses.

### 3.2. Prescribing Patterns According to AWaRe Classification

The results reveal a pronounced disparity in AWaRe category distribution (Table 1).

Table 1: Summary of AWaRe Prescribing Patterns from Analyzed Studies

Country (Study)	Setting	Access (%)	Watch (%)	Reserve (%)	Not Rec. (%)	Key Agents (Watch)	Meets 60% Target?
India (Manipur) (Christina et al., 2025)(4)	OPD, Tertiary	38	37	1	24	Ceftriaxone, Cefuroxime	No
India (Tamil Nadu) (Sinha et al., 2022)(5)	Inpatient, Public	1.6-23.4	76.6-98.4	0	NR	Cefotaxime, Ceftriaxone	No
Indonesia (Lutfiyati et al., 2024)(6)	Pediatric Inpatient	31.6	68.4	0	NR	Cefotaxime, Ceftriaxone	No
Burkina Faso (Valia et al., 2022)(7)	Community/Pre-hospital	62.5	37.5	0	0	Ceftriaxone, Ciprofloxacin	Yes
Mozambique (Xavier et al., 2024)(8)	Pediatric Inpatient	74.8	23.7	0	0	Ceftriaxone	Yes
Denmark (Anhoj et al., 2022)(9)	Hospital (National)	~55 (2021)	~44 (2021)	~1 (2021)	<0.01	Cefuroxime, Piperacillin/Tazobactam	Borderline
England (Budd et al., 2019)(10)	National (All Sectors)	60.9	37.9	0.8	0.4	Amoxicillin/Clavulanate	Yes

Range across six districts; NR: Not Reported. Access proportion calculated from reported antibiotics; total consumption may differ.

### 3.2.1. Predominance of Watch Group Antibiotics in LMICs

A consistent and alarming finding across LMIC studies was the high proportion of Watch group antibiotics, often exceeding or rivaling that of the Access group. In Indian studies, Watch antibiotics constituted 37% to over 98% of prescribed antibiotics, with third-generation cephalosporins (ceftriaxone, cefotaxime) being overwhelmingly dominant (4, 5). Similarly, in Indonesian pediatric inpatients, 68.4% of antibiotics were from the Watch group (6). This indicates a heavy reliance on broad-spectrum, empiric therapy.

### 3.2.2. Suboptimal Use of Access Antibiotics

Closely linked to the above, the use of Access antibiotics in LMICs frequently fell short of the WHO's 60% target. The rates were as low as 1.6% in one Indian district and 31.6% in Indonesia. Even in Mozambique, which reported a positive 74.8% Access rate, the high rate of injectable administration (96.2%) deviated from WHO recommendations (8).

### 3.2.3. Progress and Policy Integration in HICs

In contrast, the HIC studies demonstrated more favorable patterns. England achieved a national Access rate of 60.9% after adapting the AWaRe list to its national guidelines (e.g., reclassifying amoxicillin/clavulanate from Access to Watch) (10). Denmark showed a steady increase in Access antibiotic use to around 55% by 2021, attributed to sustained stewardship efforts (9). Both studies highlighted the importance of national adaptation and continuous monitoring.

## 3.3. Other Identified Prescribing Issues

**Excessive Injectable Use:** Studies from India (Manipur) and Mozambique reported injectable antibiotic use at 37% and 96.2%, respectively, far exceeding the WHO optimal range of 13.4-24.1%.

**Low Generic Prescribing:** In Manipur, only 26.3% of antibiotics were prescribed by generic name, against a 100% target (4).

**Use of Not Recommended Combinations:** The study from Manipur highlighted that 24% of prescriptions fell into the "Not Recommended" category, featuring combinations like ceftriaxone/sulbactam.

This scoping review consolidates evidence that the WHO AWaRe classification is a powerful diagnostic tool, uncovering systemic challenges in antibiotic prescribing, particularly a deep divide between HICs and LMICs.

## 4.1. The Empirical Therapy Trap in LMICs

The overwhelming dominance of Watch group antibiotics, especially ceftriaxone, in LMIC settings points to a pervasive "empirical therapy trap." This is likely driven by multiple, interrelated factors: limited access to reliable diagnostic microbiology (11), perceptions of broader spectrum ensuring therapeutic success, high patient burden prompting quick decisions, and in some cases, informal healthcare sector practices where broad-spectrum antibiotics are easily available without prescription (7). This practice poses a direct and severe threat by accelerating the selection and spread of resistant pathogens, potentially rendering these critical drugs ineffective.

## 4.2. Systemic versus Isolated Interventions

The experience from England and Denmark underscores that achieving rational prescribing requires integrated, system-level interventions, not just prescriber education. Key success factors include: (1) Contextual Adaptation: Modifying the global AWaRe list to reflect national resistance patterns and treatment guidelines, as seen in England's reclassification (10). (2) Embedding in Policy and Incentives: Linking AWaRe metrics to national quality improvement and funding schemes (Commissioning for Quality and Innovation [CQUIN] in England). (3) Investment in Data Infrastructure: Developing tools for routine monitoring and feedback, like the 'abxaware' software package in Denmark (9).

### 4.3. The Multifaceted Challenge for LMICs

For LMICs, the path is more complex. Addressing AWaRe imbalances requires tackling foundational health system gaps:

**Diagnostic Strengthening:** Investment in point-of-care tests (e.g., for C-reactive protein) and basic culture facilities to move away from purely empirical prescribing.

**Regulatory Enforcement:** Curbing over-the-counter sales of Watch and Reserve antibiotics, a significant problem highlighted in community studies (7).

**Rational Formulary Management:** Ensuring availability of Access group antibiotics and developing/localizing standard treatment guidelines that prioritize them.

**Sustainable Stewardship Programs:** Establishing dedicated, funded AMS teams in hospitals to conduct audit and feedback, guided by AWaRe metrics.

### 4.4. Limitations and Future Research

This review is based on a limited, non-exhaustive set of articles, which may not capture the full global spectrum. The studies also vary in methodology (e.g., point prevalence vs. continuous consumption data). Future research should include longitudinal studies to assess the impact of AWaRe-based interventions on both prescribing patterns and resistance rates. More community-based studies are also needed to understand the drivers of pre-hospital antibiotic use.

## Conclusion

The WHO AWaRe classification has proven invaluable in providing a standardized lens to assess and benchmark antibiotic prescribing quality globally. The evidence synthesized reveals a troubling picture of over-reliance on Watch group antibiotics in LMICs, juxtaposed with more encouraging, policy-driven progress in some HICs. This disparity highlights that the AWaRe framework is not merely a monitoring tool but a call for systemic action. For LMICs, achieving the 60% Access target will require a fundamental strengthening of health systems diagnostics, regulation, and stewardship capacity supported by political will and resource allocation. For all countries, the continuous adaptation, integration into health information systems, and use of AWaRe data to drive quality improvement cycles are essential steps towards preserving antibiotics for future generations

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