

National Overview of Antibiotic Use in Senegal

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Abstract

Background: Antimicrobial resistance (AMR) is recognized as one of the most pressing global threats to public health and development. A key driver of AMR is the widespread and often inappropriate consumption of antimicrobials. This study aims to evaluate the national level of antibacterial consumption in Senegal over a three-year period. **Methods:** Antibacterial consumption data were collected and analyzed for the years 2021 to 2023, following the GLASS methodology. Antimicrobials were classified using the Anatomical Therapeutic Chemical (ATC) system, and consumption volumes were expressed in Defined Daily Doses (DDD). Only products listed in the 2023 ATC/DDD index were included. Consumption was aggregated across all levels of care community and hospital settings, public and private sectors. To assess the relative consumption by AWaRe categories, the 2024 version of the AWaRe classification was applied. **Results:** Antibacterial consumption in Senegal, measured in Defined Daily Doses (DDD) per 1,000 inhabitants per day, was recorded at 12.91 in 2021, 13.94 in 2022, and 12.84 in 2023. When analyzed by ATC3 sub-groups, Beta-lactam antibacterials were the most consumed class, representing 55.3% of total antibacterial use in 2021, 54.9% in 2022, and 52.8% in 2023. These were followed by quinolone antibacterials, which accounted for 12.2%, 11.6%, and 12.5% of total consumption in the respective years. According to the AWaRe classification, Access group antibacterials were the most frequently prescribed, comprising 74.7% of total use in 2021, 77.3% in 2022, and 74.8% in 2023. **Conclusion:** Antibacterial consumption in Senegal remains substantial, with Beta-lactam and quinolone antibacterials being the most commonly used classes.

Keywords

AMC, Antibiotics, Beta-Lactam, Quinolones, Senegal

1. Introduction

Antimicrobial resistance (AMR) represents a major global public health challenge. Without effective interventions, it is projected to cause approximately 10 million deaths annually by 2050, alongside significant economic consequences [1]. In 2019 alone, AMR was associated with 4.95 million deaths worldwide, including 1.27 million directly attributable to bacterial resistance [1].

The situation is particularly concerning in Sub-Saharan Africa. A recent meta-analysis conducted in West Africa revealed that 59% of tested bacterial strains were multidrug-resistant, reflecting a 7% increase between 2010 and 2024 [2]. In Senegal, AMR is already responsible for a significant health burden. In 2021, an estimated 2340 deaths were directly attributable to AMR, and 10,100 deaths were associated with resistant infections [3]. Children under five years old were disproportionately affected, accounting for over 3500 AMR-associated deaths that year [3].

While multiple factors contribute to the emergence and spread of AMR, the link between antibiotic use and resistance development is well established [4]-[6]. A comprehensive understanding of the quantities and classes of antibiotics used globally and within specific geographic contexts is essential for informing national action plans that promote responsible antibiotic use and help curb the spread and persistence of antimicrobial resistance [7].

In Senegal, the misuse and overuse of antibiotics particularly in human medicine remain key drivers of resistance. Surveillance of antibiotic consumption is therefore a crucial component of the national strategy to tackle AMR [8]. Between 2017 and 2019, the average national antibiotic consumption was 43.8 defined daily doses (DDD) per 1,000 inhabitants per day, with penicillins, tetracyclines, and fluoroquinolones being the most consumed classes [9]. Alarming, eight fixed-dose combinations of broad-spectrum antibiotics not recommended for clinical use were identified as part of national consumption patterns [9].

Senegal has made progress in strengthening its health system and implementing its National Action Plan on AMR, supported by the World Health Organization and other partners. Recent initiatives include the development of integrated AMR/AMU surveillance systems across human, animal, and environmental sectors, and capacity-building efforts for laboratories and prescribers [10].

The aim of this study is to provide the first longitudinal estimates of human antibiotic consumption in Senegal from 2021 to 2023, to identify trends and inform stewardship strategies that support national policy development.

2. Methodology

In Senegal, the distribution of medicines including antimicrobials is centralized through authorized wholesalers, such as the Central Drug Store and private pharmaceutical wholesalers. These entities supply both the public and private healthcare sectors nationwide. For this study, we obtained detailed data on the antimicrobials distributed to the population between 2021 and 2023 via these channels. The da-

taset includes the number of units sold, the strength (active ingredient concentration), and the dosage form (e.g., tablet, capsule, injection...) for each antibiotic.

Antimicrobials are classified according to the Anatomical Therapeutic Chemical (ATC) classification system and the volume of consumed antibiotics expressed as Defined Daily Dose (DDD). Only products associated with ATC/DDD listed in the ATC/DDD 2023 index are included in the analysis.

Antibiotics consumption was reported for antibiotics (ATC J01).

We report antibiotic consumption using the Defined Daily Dose (DDD) and DDVs per 1000 inhabitants per day were calculated.

The population figures are sourced from the World Population Prospects 2022 (WPP 2022) and are adjusted according to the coverage level of the national system, when this level is reported to be below 95%.

To get the relative consumption of antibiotics by AWaRe categories (%), the 2024 version of the AWaRe classification is applied.

About the study limitation, this study does not include antimicrobials that were distributed through informal channels outside the official wholesale system.

3. Results

3.1. Data Contextual Information

Availability of data for the selected period and for each year is summarized in **Table 1**.

The antimicrobial consumption data for Senegal from 2021 to 2023 demonstrates full national coverage, with 100% of the population included in the analysis each year. This comprehensive scope strengthens the reliability and representativeness of the findings.

Table 1. Data contextual information.

Population Antimicrobial consumption data								
Year	Population (WPP)	Population coverage	Population used for analysis	Level	Sources of data	Health care sectors and level reported	AMC volume coverage within the reported health care sector/level	ATC classes reported
2023	18,077,573	100%	18,077,573	Distribution/Wholesales	Central drug store, Wholesalers	Total care	100%	J01
2022	17,651,103	100%	17,651,103	Distribution/Wholesales	Central drug store, Wholesalers	Total care	100%	J01
2021	17,220,867	100%	17,220,867	Distribution/Wholesales	Central drug store, Wholesalers	Total care	100%	J01

Data were collected at the distribution/wholesale level, primarily from the Central Drug Store and private pharmaceutical wholesalers. These sources reflect the total volume of antimicrobials distributed across both public and private healthcare sectors, encompassing all levels of care.

The reported consumption exclusively covers ATC class J01, which includes systemic antibacterials.

3.2. Antibiotics Consumption

Antibiotic consumption remained relatively stable over the three-year period, with slight fluctuations observed between 2021 (12.91 DDD), 2022 (13.94 DDD), and 2023 (12.84 DDD) per 1,000 inhabitants per day (Figure 1).

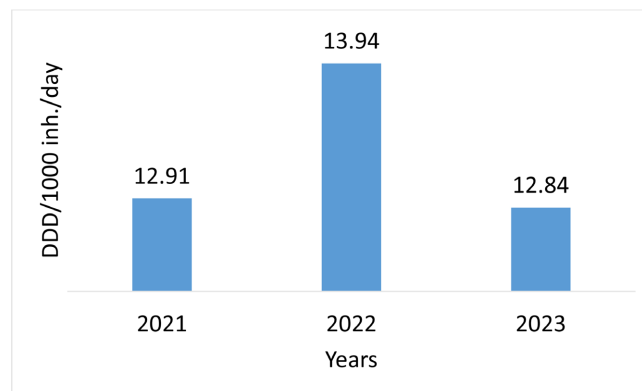


Figure 1. Consumption by antimicrobial classes expressed as DDD per 1000 inhabitants per day.

Table 2. Antibiotic consumption by ATC Level 3 Subgroup.

Pharmacological subgroups	DDD/1000 inh. day (%)		
	2021	2022	2023
Tetracyclines (J01A)	0.98 (7.6%)	1.41 (10.1%)	1.29 (10.0%)
Amphenicols (J01B)	0.01 (0.06%)	0.01 (0.07%)	0.01 (0.06%)
Beta-lactam antibacterials, penicillins (J01C)	7.14 (55.3%)	7.66 (54.9%)	6.78 (52.8%)
Other beta-lactam antibacterials (J01D)	0.60 (4.6%)	0.72 (5.1%)	0.95 (7.4%)
Sulfonamides and trimethoprim (J01E)	1.47 (11.4%)	1.66 (11.9%)	1.41 (11.0%)
Macrolides, lincosamides and streptogramins (J01F)	1.01 (7.8%)	0.73 (5.2%)	0.56 (4.4%)
Aminoglycoside antibacterials (J01G)	0.04 (0.31%)	0.02 (0.16%)	0.01 (0.10%)
Quinolone antibacterials (J01M)	1.58 (12.2%)	1.62 (11.6%)	1.60 (12.5%)
Combinations of antibacterials (J01R)	0.09 (0.69%)	0.11 (0.82%)	0.22 (1.7%)
Other antibacterials (J01X)	0.00 (0.01%)	0.00 (0.01%)	0.00 (0.01%)
Total	12.91 (100.0%)	13.94 (100.0%)	12.84 (100.0%)

Beta-lactam antibacterials, penicillins (J01C) consistently represented the largest share of antibiotic consumption across all three years, accounting for over 50% of total DDDs. This reflects their central role in treating common bacterial infections. Quinolones (J01M) and sulfonamides/trimethoprim (J01E) followed, each contributing between 11% - 13% of total consumption annually. No-

tably, macrolides, lincosamides, and streptogramins (J01F) showed a declining trend, dropping from 7.8% in 2021 to 4.4% in 2023, possibly indicating improved stewardship or changes in prescribing practices. Subgroups such as amphenicols (J01B), aminoglycosides (J01G), and other antibacterials (J01X) remained marginal, each contributing less than 1%, suggesting limited use or narrow indications (Table 2).

Oral administration overwhelmingly dominates antibiotic consumption in Senegal, accounting for over 97% of total defined daily doses (DDD) per 1,000 inhabitants per day across all three years (2021-2023). However, parenteral antibiotics represented a small fraction of total consumption—2.2% in 2021, decreasing slightly to 1.9% in 2022 and 2023. No consumption was recorded for inhalation or rectal routes (Table 3).

Table 3. Antibiotics consumption by route of administration.

Routes of administration	DDD/1000 inh.day (%)		
	2021	2022	2023
Oral	12.63 (97.8%)	13.68 (98.1%)	12.60 (98.1%)
Parenteral	0.28 (2.2%)	0.26 (1.9%)	0.24 (1.9%)
Inhalation	0.00 (0.00%)	0.00 (0.00%)	0.00 (0.00%)
Rectal	0.00 (0.00%)	0.00 (0.00%)	0.00 (0.00%)
Total	12.91 (100.0%)	13.94 (100.0%)	12.84 (100.0%)

Antibiotic consumption by AWARe categories revealed that Access group antibiotics accounted for approximately 75% of total use, indicating their predominant role in treatment practices.

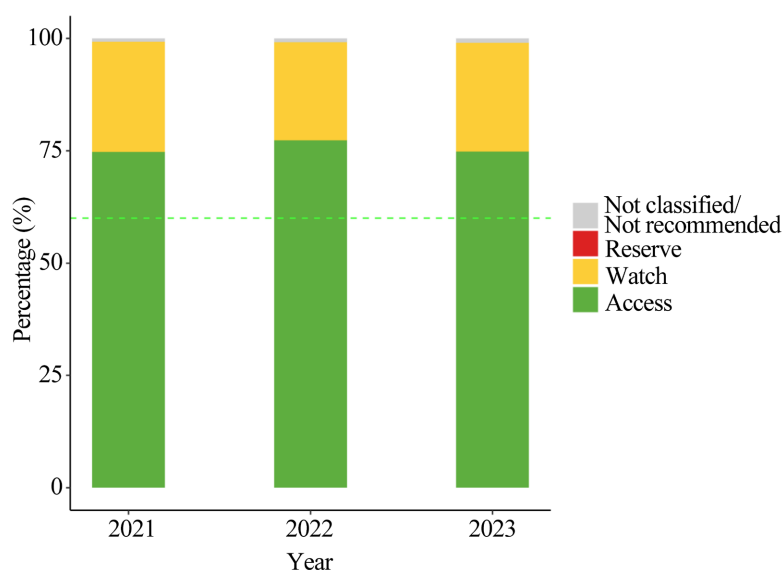


Figure 2. Antibiotics consumption by AWARe categories.

Watch group antibiotics represented around 25% of consumption, while no antibiotics from the Reserve category were recorded (**Figure 2**).

The Access group includes antibiotics that are recommended as first-line treatments due to their broad-spectrum efficacy and relatively low potential for promoting antimicrobial resistance. These medications such as amoxicillin, doxycycline, and sulfamethoxazole/trimethoprim play a central role in primary healthcare settings and are commonly used in outpatient treatments (see **Table 4**).

In contrast, the Watch group comprises antibiotics that carry a higher risk of resistance development. This category includes agents like azithromycin, ceftriaxone, and ciprofloxacin, which are typically reserved for specific clinical indications (**Table 4**).

Table 4. Classification of antibiotics used in Senegal according to the WHO AwaRe.

GROUP	ANTIBIOTICS
ACCESS	AMOXICILLINE
ACCESS	AMIKACINE
ACCESS	AMOXICILLINE/ACIDE CLAVULANIQUE
ACCESS	DOXYCYCLINE
ACCESS	FLUCLOXACILLINE
ACCESS	SULFAMETHOXAZOLE/TRIMETHOPRIME
ACCESS	FLUCLOXACILLINE
ACCESS	BENZATHINE BENZYL PENICILLINE
ACCESS	CEFALEXINE
ACCESS	CIPROFLOXACINE/TINIDAZOLE
WATCH	CEFUROXIME
WATCH	AZITHROMICINE
WATCH	CEFIXIME
WATCH	CEFPODOXIME PROXETIL
WATCH	CEFTRIAZONE
WATCH	CEFUROXIME
WATCH	CIPROFLOXACINE
WATCH	CLARITHROMYCINE
WATCH	ERYTHROMYCINE
WATCH	LEVOFLOXACINE
WATCH	OFLOXACINE

4. Discussion

This study presents the first longitudinal estimates of human antibiotic consumption in Senegal from 2021 to 2023. The defined daily doses (DDD) per 1000 inhabitants per day were 12.91 in 2021, 13.94 in 2022, and 12.84 in 2023. Notably,

antibiotic use increased by approximately 8% in 2022 compared to 2021. This rise may be attributed to a post-COVID-19 rebound in healthcare access, the resumption of routine clinical visits, overprescription, or self-medication practices. Although a slight decline was observed in 2023, overall antibiotic consumption remains high. This trend raises concerns about the continued misuse and overuse of antibiotics, the growing threat of antimicrobial resistance (AMR), and the potential reduction in antibiotic effectiveness if such patterns persist.

West African countries such as Nigeria and Ghana have shown similar or slightly higher levels than Senegal, often influenced by informal drug markets and self-medication practices [11].

North African countries like Egypt and Tunisia have historically reported higher consumption levels, sometimes exceeding 20 DDD/1000 inhabitants/day, due to easier over-the-counter access and higher urbanization [11].

Also in our study, penicillins (J01C) and quinolone antibiotics (J01M) were the most frequently consumed. This reflects both the prescribing preferences in primary healthcare and the availability of these molecules in the market.

In Nigeria, studies show a high rate of fluoroquinolone use, particularly in urban areas, and also self-medication is prevalent [12].

In East Africa, penicillins remain the leading class. However, in some regions, sulfonamides (J01E), especially co-trimoxazole, are still frequently used, notably in HIV/AIDS care settings [13].

In Senegal, antibiotic consumption by AWaRe categories showed that “Access” antibiotics accounted for more than 75% of total use. This exceeds the WHO target of 60%, suggesting that national prescribing practices align well with stewardship goals and could support policies promoting broader access to essential antibiotics while maintaining vigilance over Watch and Reserve categories aligns well with the WHO recommendation that at least 60% of national antibiotic consumption should come from the Access group.

In contrast, in several other countries, including Morocco, Ghana, Nigeria, and Kenya, the proportion of Access antibiotic use is below 60%, indicating a higher reliance on Watch and Reserve antibiotics, which may contribute more significantly to antimicrobial resistance [14].

Given the high overall levels of antibiotic consumption observed between 2021 and 2023, particularly the frequent use of beta-lactams and quinolones, the following recommendations are proposed to support more rational use and strengthen antimicrobial stewardship efforts:

- Implement robust antimicrobial stewardship initiatives across public and private healthcare sectors, with a focus on promoting the use of Access group antibiotics as first-line treatments and restricting Watch group antibiotics to clearly defined clinical indications.
- Enforce stricter controls on the sale and distribution of antibiotics, particularly those in the Watch group, to prevent over-the-counter access and misuse.
- Launch nationwide campaigns to educate the public on the risks of inappro-

priate antibiotic use, discourage self-medication, and promote adherence to prescribed treatments.

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Ethics Approval and Consent to Participate

Not relevant.

Conflicts of Interest

There has been no conflict of interest.

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