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Systematic Review

Comparative assessment of the prevalence, practices and factors associated with self-medication with antibiotics in Africa

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Abstract

OBJECTIVE To evaluate and compare the prevalence, reasons, sources and factors associated with self-medication with antibiotics (SMA) within Africa.

METHODS Systematic review and meta-analysis. An electronic search of PubMed and Google Scholar databases was performed for observational studies conducted between January 2005 and February 2020. Two reviewers independently screened abstracts and full texts using the PRISMA flowchart and performed quality assessment of eligible studies. Both qualitative and quantitative syntheses were carried out.

RESULTS Forty studies from 19 countries were eligible for qualitative synthesis. The prevalence of SMA in Africa ranged from 12.1% to 93.9% with a median prevalence of 55.7% (IQR 41–75%). Western Africa was the sub-region with the highest reported prevalence of 70.1% (IQR 48.3–82.1%), followed by Northern Africa with 48.1% (IQR 41.1–64.3%). We identified 27 antibiotics used for self-medication from 13 different antibiotic classes. Most frequently used antibiotics were penicillins (31 studies), tetracyclines (25 studies) and fluoroquinolones (23 studies). 41% of these antibiotics belong to the WHO Watch Group. The most frequent indications for SMA were upper respiratory tract infections (27 studies), gastrointestinal tract symptoms (25 studies) and febrile illnesses (18 studies). Common sources of antibiotics used for self-medication were community pharmacies (31 studies), family/friends (20 studies), leftover antibiotics (19 studies) and patent medicine stores (18 studies). The most frequently reported factor associated with SMA was no education/low educational status (nine studies).

CONCLUSIONS The prevalence of SMA is high in Africa and varies across sub-regions with the highest prevalence reported in Western Africa. Drivers of SMA are complex, comprising of socio-economic factors and insufficient access to health care coupled with poorly implemented policies regulating antibiotic sales.

keywords self-medication with antibiotics, prevalence, practices, associated factors, Africa

Sustainable Development Goals: Good Health and Well-being, Reduced Inequalities, Quality Education

Introduction

Self-medication is defined by WHO as treatment of self-recognised disorders or symptoms by use of medicines without prior consultation by a qualified health professional or intermittent/continued use of medicines previously prescribed by a physician for chronic/recurring diseases [1]. When properly practised, self-medication can provide some benefits to individuals and health systems: It saves time spent queuing up for medical consultations, saves scarce medical resources from being used on minor conditions, lightens the workload of doctors, decreases health care cost and reduces absenteeism from work [2–4]. Despite these potential benefits obtained from practising self-medication, there are many undesired outcomes that may result from inappropriate self-medication use, especially with antibiotics [5]. WHO defines inappropriate antibiotic use as the use of antibiotics without proper indication, or administering wrong dosages, incorrect treatment duration, late or absent downscaling of treatment, poor adherence to treatment, and use of poor quality or substandard antibiotics [6]. Self-medication with antibiotics (SMA) contributes to accelerating the emergence and spread of antimicrobial resistance (AMR) [1, 7, 8]. In Low and Middle-Income Countries (LMIC), it is estimated that about 80% of antibiotics are used outside official healthcare facilities, of which about 20–50% are used inappropriately [9]. Other negative outcomes related to self-medication include wastage of economic resources from prolonged treatment duration due to incorrect management of infections, delayed or wrong diagnoses, drug interaction and adverse reactions [10]. The increasing practice of self-medication, especially with antibiotics in Africa, warrants sensitisation of the general public and health professionals to avoid inappropriate use [2].

Whilst various studies have been conducted on SMA in different countries in Africa, there has not yet been a systematic review that comprehensively assesses SMA in the entire region. Patterns of self-medication vary among different populations and regions and are influenced by many factors [2, 5]. The type of antibiotics used for SMA, the extent of SMA and the reasons for it may also vary from country to country especially in Africa [2]. Socio-economic factors such as low income/high rate of unemployment and low level of education, poor access to health care, informal access to antibiotics, storage of antibiotics at home and health-seeking behaviours of the general population have been reported in other studies from Asia, the Middle East and South Eastern Europe [4, 5, 11]. These factors have not yet been well-documented in the African context [5].

Antibiotic use, and in particular inappropriate use, is a major driver of the silent and growing AMR pandemic, also in Africa. Nevertheless, most African countries have not yet given priority to control this threat, with the majority of these countries lacking AMR preparedness activities (i.e. national action plans for AMR control, comprehensive national AMR policies, targeted capacity building activities, regulatory measures on circulation of substandard or counterfeit antimicrobials and AMR surveillance strategies) [12–14]. Africa has been harder hit by the growing AMR pandemic compared to other regions [15, 16]: it carries a high burden of infectious diseases which compounds the growing weight of non-prescription sales and inappropriate use of antibiotics, and thus, also the aforementioned challenges that notably accelerate AMR [17]. It was estimated in 2011 that more than half of the antibiotics used in communities especially in Africa are sold without a medical prescription [18]. Contextual evidence of practices and drivers related to AMR and SMA in Africa are required to guide policy development, action plans and control programmes [5, 14]. This review aimed to evaluate the magnitude and drivers of SMA in Africa and to generate evidence-based recommendations to control and reduce SMA and contain the rising challenge of AMR in Africa.

Methods

Search strategy

An electronic systematic search of the Medline through PubMed and Google Scholar databases was performed in line with the PRISMA statement [19]. Search terms and keywords were identified through a pilot literature search and Boolean operators were used to combine these terms to come up with a search strategy (Table 1). Medical Subject Headings (MeSH) were used to synchronise synonymous terms in PubMed. We excluded reviews, animal models, editorials, letters, opinions or comment publication types. To ensure that no similar review had been registered or previously carried out, a preliminary scoping search was done on the following registries: International Prospective Register of Systematic Reviews (PROSPERO), International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY), Research Registry and Cochrane Library of Systematic Reviews and also on the PubMed and Google Scholar databases.

Selection of articles for review

Articles included in this review were selected using the PRISMA Flow Diagram [20]. Two reviewers EVY and

Table 1 Search strategy

Database	Search mode	Search term syntax
Medline via PubMed	All fields	((((‘Anti-Infective Agents ‘[Mesh]) AND ‘Self-Medication’[Mesh]) OR ‘Non-prescription Drugs’[Mesh]) OR ‘Drug Misuse’[Mesh]) AND "Africa"[Mesh]
Google Scholar	Articles	(antimicrobial* OR antibacterial* OR antibiotic*) AND (‘self-medication’ OR self-medication OR ‘non-prescription’ OR non-prescription OR ‘over-the-counter OR inappropriate) AND (determinants OR “associated factors’) -Asia -Europe -America –Review

JNF, independently screened studies against the eligibility criteria and discrepancies were resolved through a third reviewer BI. Titles and abstracts of all records identified through database searches were screened for duplicates and studies that met the inclusion criteria selected (i.e. cross-sectional studies and mixed methods studies (cross-sectional surveys with qualitative work) carried out on SMA in Africa between January 2005 and February 2020). Studies on SMA conducted in other regions, dissertations on SMA, studies on general self-medication, studies on non-prescription antibiotic sales and studies on antimalarials were excluded. Additional articles that met the inclusion criteria were identified through reference mining. The full text of studies selected for qualitative analysis was reviewed and studies with no relevant data, qualitative studies, and studies of which full text could not be retrieved were excluded.

Assessment of the quality of included studies

The quality of studies selected for full-text review was appraised using the ‘risk of bias in prevalence studies evaluation’ tool by Hoy *et al.* [21], appraising the studies on nine criteria.

Data extraction

Titles and abstracts of studies retrieved were saved in Mendeley. The following characteristics were extracted using a spreadsheet in Excel: country, corresponding author, year of publication, study site, study design, sampling strategy, recall period, sample size and response rate. The prevalence of SMA, type of antibiotics used for self-medication, reasons for practising SMA, sources of antibiotics, and factors associated with SMA were also extracted.

Data syntheses

Both qualitative and quantitative syntheses were performed. In the qualitative synthesis, we analysed and summarised descriptive variables and outcomes of interest (prevalence, reasons for SMA, sources of SMA, factors associated with SMA and common antibiotics used for SMA). We used the WHO AWaRe Classification [22] to group antibiotics used for self-medication. Reasons for SMA were analysed using the modified conceptual framework of access to health care [23]. Prevalence estimates were summarised using medians and interquartile ranges.

Quantitative synthesis was conducted only on household studies because these are most representative for SMA among the general population, unlike studies limited to university students (frequently (para)medical students), or to hospital patients. Meta-analysis was done using the ‘metafor’ package in R software (version 3.6.1). A random-effect model was used to calculate the weight of each study and the Freeman-Tukey double arcsine transformation was used to stabilise the variance in the proportions of individual studies. Heterogeneity was checked by Cochran’s Q-test and quantified by the I^2. Heterogeneity was considered present and statistically significant when $I^2 > 50\%$ and P-value <0.05. Findings were displayed graphically using a forest plot. To verify publication bias, a funnel plot was constructed using Double Arcsine-transformed proportions.

Results

Search results

The databases were searched on February 26th, 2020 and a total of 5291 citations were identified: 171 through PubMed and 5120 through Google Scholar. 164 duplicate citations were discarded. The titles and abstracts of the remaining 5127 studies were screened and 5080 records were disqualified as they did not meet the inclusion criteria. References in the selected 47 studies were searched and another eight studies identified, rendering 55 studies for full-text review. After reviewing the full text of the selected studies, 15 studies were excluded. The remaining 40 studies underwent qualitative synthesis. Of those, 15 studies were selected for quantitative synthesis (Figure 1).

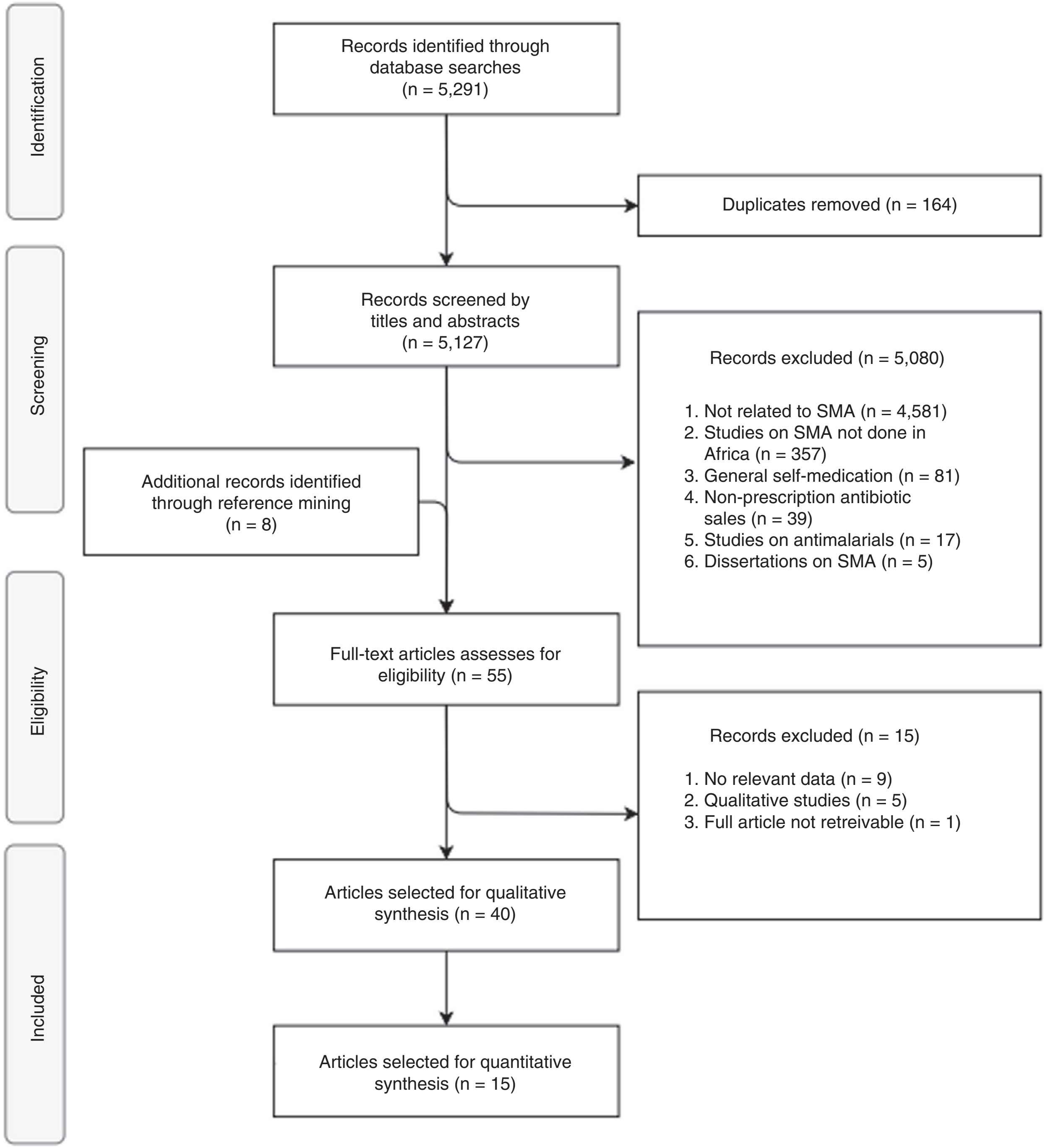

Figure 1 PRISMA flowchart.

Study characteristics

The 40 studies included in this review were from 19 African countries and all five African sub-regions: seven from Northern Africa [24–30], three from Central Africa [31–33], 14 from Western Africa [34–47], 15 from Eastern Africa [48–61] and one from Southern Africa [62]

(Figure 2). Thirty-seven studies were cross-sectional surveys and three were mixed-method (i.e. cross-sectional surveys with qualitative work) [39, 52, 57]. Fifteen studies were carried out in households, 13 in academic settings (universities), four in pharmacies, three in health facilities, and five in other settings (markets, streets, shopping malls, offices). All studies together included 21 358 participants with sample sizes ranging from 110 to 1750. The recall period used in data collection ranged from 3 days to 10 months, reported by 32 studies (Table 2).

Quality assessment of included studies

Studies eligible for qualitative synthesis (40 studies) were assessed for risk of bias. Three of these studies met all nine quality criteria in the assessment tool [48, 63, 64]. Twenty-four studies showed a low risk of bias [25, 26, 28, 30, 32, 34, 36, 40, 42, 43, 45, 48–52, 54–56, 59–61, 63–65], 15 studies showed a moderate risk of bias [24, 27, 31, 35, 37–39, 41, 44, 46, 57, 58, 62, 66], and one study showed a high risk of bias [33].

Prevalence of SMA

The prevalence of SMA ranged from 12.1% to 93.9%. Twenty-three studies reported prevalence estimates above 50%, 13 above 70% and 3 above 90% (90.3% from the Democratic Republic of Congo, 93.9% and 92.2% from Nigeria). Prevalence estimates of less than 20% SMA were reported in four studies. The overall median prevalence was 55.7% (IQR: 41%, 75%). The median prevalence was 48.1% (IQR: 41.1, 64.3%) for Northern

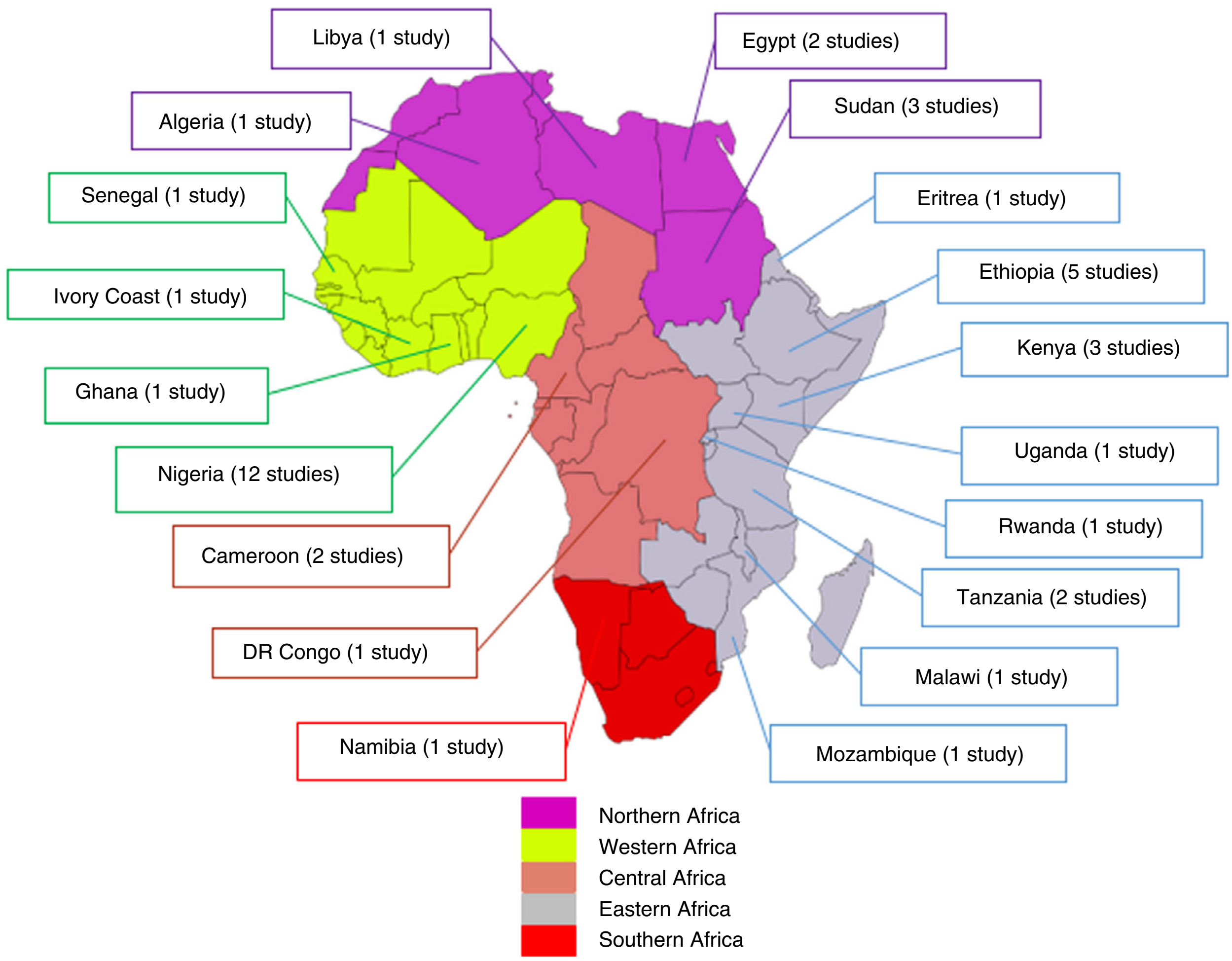

Figure 2 Distribution of selected studies by countries and sub-regions.

Table 2 Study characteristics and prevalence rates of SMA

Sub-region	Reference	Country	Study site	Study participants	Sampling method	Sample size	Recall period/ weeks	Response rate	Prevalence of SMA (%)	95% CI
Northern Africa	Gacem *et al*., 2015 [24]	Algeria	Pharmacies	General public	Simple random	159	2	NR	12.6	07.4–17.8
	Elden *et al*., 2020 [25]	Egypt	Universities	Students	Multistage	600	40	94%	77.7	74.4–81.0
	El-Hawy *et al*., 2017 [26]	Egypt	Clubs, cafes, streets	General public	Convenient	400	8	89.7%	64.3	59.6–69.0
	Ghaieth *et al*., 2015 [27]	Libya	Universities	Students	NR	665	16	55%	46	42.2–49.8
	Awad *et al*., 2005 [28]	Sudan	Households	General public	Multistage stratified cluster, simple random	1750	NR	89.7%	48.1	45.8–50.4
	Awad *et al*., 2007 [29]	Sudan	Universities	Undergraduate students	Multistage stratified cluster, systematic random	1121	24	86.2%	55	52.1–57.9
	Ahmed *et al*., 2014 [30]	Sudan	Households	General public	Simple random	442	36	NR	41	36.4–45.6
Central Africa	Ngu *et al*., 2018 [31]	Cameroon	Hospitals	Patients with respiratory tract infection	Convenient	308	24	NR	41.9	36.4–47.4
	Amin *et al*., 2019 [33]	Cameroon	Health facilities	Patients	NR	329	16	NR	68.4	63.4–73.4
	Bunduki *et al*., 2017 [32]	DR Congo	Universities	Students	Convenient	500	3	86%	90.7	88.2–93.2
Western Africa	Donkor *et al*., 2012 [34]	Ghana	Universities	Students	Stratified sampling, Convenient	600	32	90%	70	66.3–73.7
	Olayemi *et al*., 2010 [35]	Nigeria	Universities	Undergraduate students	Simple random	430	NR	65.8%	56.9	52.2–61.6
	Abdulraheem *et al*., 2016 [40]	Nigeria	Health Centres	All patients	Simple random	1150	24	93.9%	82.2	80.0–84.4
	Badger-Emeka *et al*., 2018 [41]	Nigeria	Households	General public	Convenient	400	28	NR	86	83.2–89.8

Table 2 (*Continued*)

Sub-region	Reference	Country	Study site	Study participants	Sampling method	Sample size	Recall period/ weeks	Response rate	Prevalence of SMA (%)	95% CI
	Ehigiator *et al.*, 2010 [42]	Nigeria	Universities	Dental students	NR	208	12	96.2%	53.5	46.5–60.3
	Israel *et al.*, 2015 [43]	Nigeria	Ministries, departments, units	Civil servants	Simple random	526	NR	89.5%	93.9	91.9–95.9
	Fadare *et al.*, 2011 [44]	Nigeria	Universities	Medical students	Convenient	183	4	83.2%	38.8	31.7–45.9
	Sapkota *et al.*, 2010 [45]	Nigeria	Universities	Students	Three-stage cluster, simple random	740	NR	95.4%	24	20.9–27.1
	Umar *et al.*, 2018 [46]	Nigeria	Universities	Paramedical students	Stratified	115	NR	82%	81.9	74.9–88.9
	Yusuf *et al.*, 2019 [47]	Nigeria	Households	General public	Simple random	300	8	85.3%	70.3	65.1–75.5
	Ajibola *et al.*, 2018 [36]	Nigeria	Hall of residence	Community residents & undergraduate students	Convenient	1450	8	84.8%	43%	40.5–45.5
	Khalid *et al.*, 2019 [37]	Nigeria	Universities	Pharmacy students	Purposive	217	4	100%	92.2	88.6–95.8
	Bassoum *et al.*, 2019 [38]	Senegal	Bus station	General public	Convenient	400	4	100%	75	70.8–79.2
	Hounsa *et al.*, 2010 [39]	Ivory Coast	Pharmacies	General public	Simple random	1123	24	NR	59.7	56.8–62.6
Eastern Africa	Ateshim *et al.*, 2019 [48]	Eritrea	Households	General public	Two-stage cluster, systematic random	580	12	99.5%	45.1	41.1–49.1
	Bogale *et al.*, 2019 [63]	Ethiopia	Households	General public	Multistage, systematic random	605	12	98.3%	67.3	63.6–71.0
	Erku *et al.*, 2017 [49]	Ethiopia	Households	General public	Multistage, stratified random, systematic random	720	8	90.3%	63.5	60.0–67.0
	Eticha *et al.*, 2014 [54]	Ethiopia	Universities	Undergraduate Students	Stratified, simple random	422	4	96.4%	44.5	39.8–49.2
	Nyambega *et al.*, 2017 [55]	Kenya	Markets, shopping malls and households	General public	Simple random	385	8	78%	60	55.1–64.9

Table 2 (*Continued*)

Sub-region	Reference	Country	Study site	Study participants	Sampling method	Sample size	Recall period/ weeks	Response rate	Prevalence of SMA (%)	95% CI
	Owour *et al*., 2015 [56]	Kenya	Households	General public	Cluster, systematic random	350	3/7	NR	76.9	72.5–81.3
	Sambakunsi *et al*., 2019 [57]	Malawi	Households	General public	Weighted cluster random, snowballing	110	NR	95.5%	41	31.8–50.2
	Tuyishimire *et al*., 2019 [58]	Rwanda	Universities	Undergraduate students	Simple random	570	NR	NR	12.1	09.4–14.8
	Horumpende *et al*., 2018 [59]	Tanzania	Households	General public	Systematic random	300	4	NR	58	52.4–63.6
	Kajeguka *et al*., 2017 [60]	Tanzania	Households	General public	Simple random	300	12	NR	55.7	50.1–61.3
	Ocan *et al*., 2014 [61]	Uganda	Households	General public	Multistage cluster, Simple random	892	8	99.1%	75.7	72.9–78.5
	Gebeyehu *et al*., 2015 [50]	Ethiopia	Households	General public	Systematic random	1082	8	98.3%	18	15.7–20.3
	Gebrekirstos *et al*., 2017 [51]	Ethiopia	Drug retail outlets	General public	Stratified, simple random	829	8	94%	47.1	43.7–50.5
	Owuor *et al*., 2019 [52]	Kenya	Households	General public	Two-stage cluster, systematic random	380	NR	83.2%	20.9	16.8–25.0
	Mate *et al*., 2019 [53]	Mozambique	Households	General public	Three-stage cluster, Random	1091	12	73.1%	20.9	18.5–23.3
Southern Africa	Pereko *et al*., 2015 [62]	Namibia	Pharmacies	General public	Simple random	600	16	74.3%	15.47	12.6–18.4

CI, confidence interval; NR, not reported; SMA, self-medication with antibiotics.

Africa, 70.1% (IQR: 48.3%, 82.1%) for Western Africa and 47.1% (IQR: 31%, 65.4%) for Eastern Africa. The prevalence in studies conducted in households ranged from 18% to 86% with a median prevalence of 48.1% (IQR: 41%, 73%). A meta-analysis of these studies revealed a pooled prevalence estimate of 51.5% (95% CI: 40.1%, 62.8%). The I^2 = 99.1% (P < 0.0001) was indicative of pronounced heterogeneity. This means that the variation across studies was higher than that observed by chance, hence the pooled proportion of SMA was incongruous. The summary of results is presented in a forest plot (Figure 3).

We analysed the pooled estimates of the sub-regions exploring the cause of the observed heterogeneity. The pooled prevalence estimate was 44.5% (95% CI: 18.3%, 72.5%) for Northern Africa, 78.5% (95% CI: 51.4%, 96.4%) for Western Africa and 47.5% (95% CI: 35.4%, 59.8%) for Eastern Africa. High residual heterogeneity was equally observed with I^2 = 98.8% (P < 0.0001) indicating that the observed heterogeneity was not due to sub-regions. Funnel plots showed an asymmetric distribution of studies with most of them falling out of the funnel indicative of publication bias (Figure 4).

Common antibiotics used in self-medication

Twenty-seven antibiotics from 13 classes were identified as used in self-medication and reported by 31 studies. The majority of these antibiotics (48%) belonged to the Access Group, 41% belonged to the Watch Group and only one antibiotic belonged to the Reserve Group [Table 3]. The most frequently used classes of antibiotics were penicillins (31 studies), tetracyclines (25 studies), fluoroquinolones (23 studies), imidazoles (19 studies), macrolides (10 studies), amphenicols (nine studies) and trimethoprim/sulphonamides (17 studies; Tables 3 and 4).

Sources of antibiotics used for self-medication

Thirty-two studies provided information on the main sources of antibiotics used for SMA. These include community pharmacies (CPs; 31 studies), family/friends (20 studies), leftover antibiotics from previous treatments (19 studies), patent medicine stores (PMS; 18 studies), hospital pharmacies (eight studies), street vendors (seven studies), private health facilities (six studies), chemist shops (five studies), healthcare workers (three studies) and home medicine cabinets (two studies; Figure 5).

Reasons for SMA

Twenty-nine studies reported reasons why people opted to self-medicate with antibiotics: past or prior experience with similar symptoms or antibiotics (22 studies), additional cost incurred from facility charges (18 studies), long waiting time required to consult at health

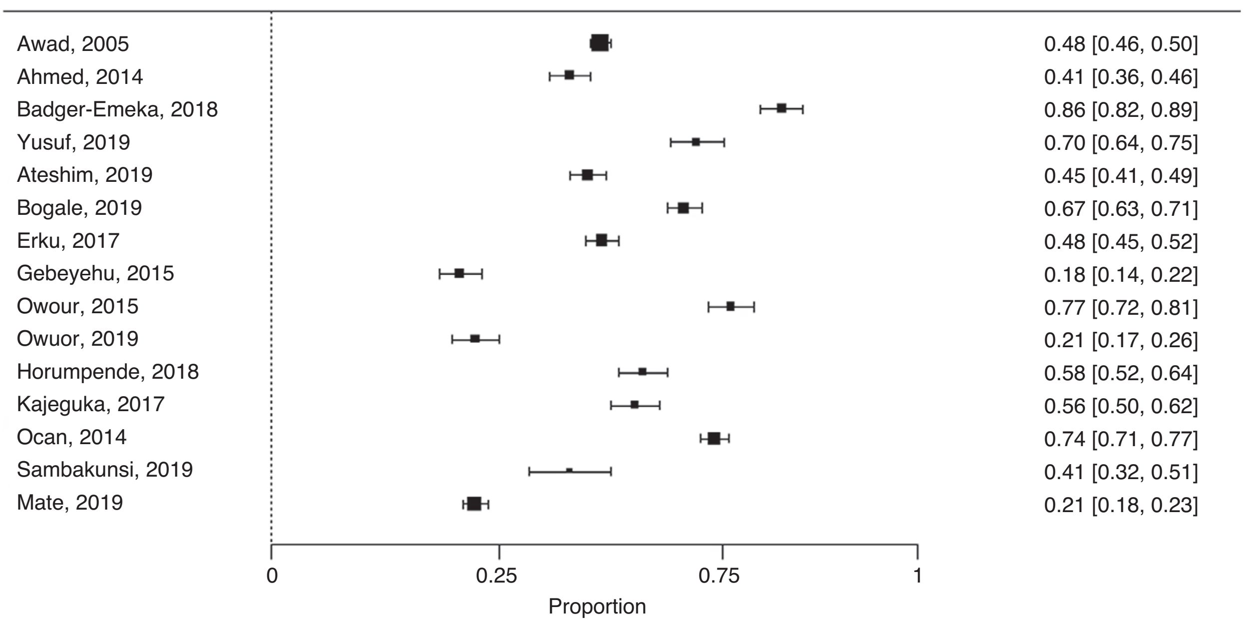

Figure 3 Forest Plot showing the proportion of SMA in household studies.

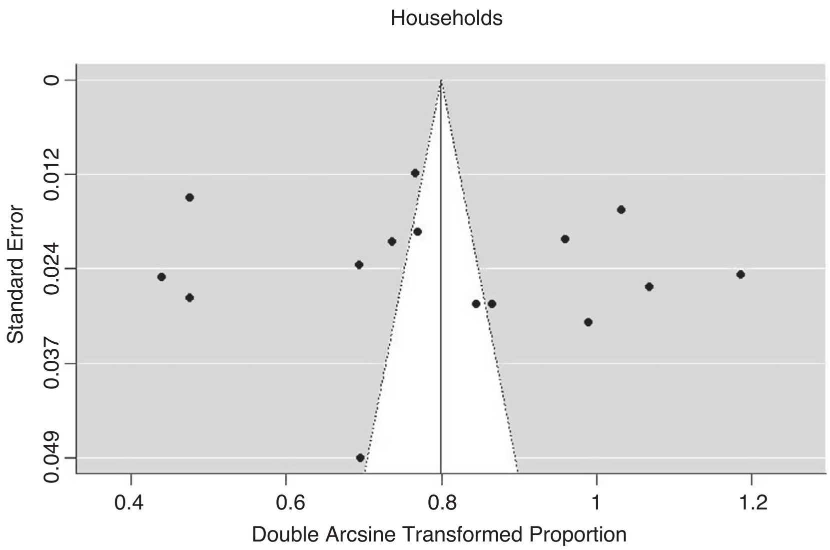

Figure 4 Funnel plot for household studies.

Table 3 AWaRe classification of antibiotics used for self-medication

Class of antibiotic	Antibiotic used in SMA	AWaRe group
Penicillins (31 studies)	Amoxicillin	Access
	Cloxacillin	Access
	Flucloxacillin	Access
	Ampicillin	Access
	Penicillin	Access
	Ampicillin/cloxacillin	Not recommended
	Amoxicillin/clavulanic acid	Access
Fluoroquinolones (23 studies)	Ciprofloxacin	Watch
	Levofloxacin	Watch
	Ofloxacin	Watch
Trimethoprim/sulphonamides (17 studies)	Cotrimoxazole	Access
Tetracyclines (25 studies)	Tetracycline	Access
	Doxycycline	Access
Macrolides (10 studies)	Erythromycin	Watch
	Azithromycin	Watch
Imidazoles (19 studies)	Metronidazole	Access
Amphenicols (9 studies)	Chloramphenicol	Access
Cephalosporins (4 studies)	Cefuroxime	Watch
	Ceftriaxone	Watch
	Cefixime	Watch
Aminoglycosides (3 studies)	Gentamycin	Access
	Streptomycin	Watch
Aminocyclitols (1 study)	Spectinomycin	Access
Nitrofurans (1 study)	Nitrofurantoin	Access
Glycopeptides (1 study)	Vancomycin	Watch
Polymyxins (1 study)	Polymyxin B	Reserve

SMA, self-medication with antibiotics.

Table 4 Common antibiotic classes used in self-medication and their sources

References	Country	Common classes of antibiotic and percentage used	Sources of antibiotics and percentage
Gacem *et al*. 2015 [24]	Algeria	Penicillins Tetracyclines Macrolides Imidazoles	NR
Ngu *et al*. 2018 [31]	Cameroon	Penicillins 34% Fluoroquinolones 3% Trimethoprim/Sulphonamides 39%	Community pharmacies 62% Leftovers from previous treatment 8% Friends/relatives 11% Chemist shops 19%
Amin *et al*. 2019 [33]	Cameroon	Penicillins 32%	Community pharmacies 55% Patent medicine stores 34% Health workers 7% Friends 4%
Bunduki *et al*. 2017 [32]	DR Congo	Penicillins 75% Tetracyclines 41% Fluoroquinolones 54% Macrolide 52% Trimethoprim/sulphonamides 54% Imidazoles 38%	Community pharmacies Patent medicine stores Public hospital pharmacies Private health facilities
Ateshim *et al*. 2019 [48]	Eritrea	Penicillins 84% Tetracyclines 3% Sulphonamides 2% Imidazoles 2	Community pharmacies 68% Leftovers from previous treatment 15% Friends/relatives 10%
Elden *et al*. 2020 [25]	Egypt	Penicillins 48% Macrolides 2%	Community pharmacies 92%
El-Hawy *et al*. 2017 [26]	Egypt	Penicillins (60%)	Community pharmacies 57% Leftovers from previous treatment 12%
Bogale *et al*. 2019 [63]	Ethiopia	Penicillins 67% Fluoroquinolones 23% Sulphonamides 40%	Community pharmacies 82% Patent medicine stores 2% Private health facilities 11% Public hospital pharmacies 3%
Erku *et al*. 2017 [49]	Ethiopia	Penicillins 72% Tetracyclines 19% Fluoroquinolones 9% Imidazoles 11%	Community pharmacies 36.8% Health workers 44% Family/friends 19%
Eticha *et al*. 2014 [54]	Ethiopia	Penicillins 52% Fluoroquinolones 13% Imidazoles 6% Tetracyclines 6%	Community pharmacies 83% Patent medicine store 59% Friends/family 30% Leftovers from previous treatment 29%
Gebeyehu *et al*. 2015 [50]	Ethiopia	Penicillins 76% Imidazoles 2% Fluoroquinolones 7% Tetracyclines 11%	Community pharmacies 16% Friends/relatives 16%
Donkor *et al*. 2012 [34]	Ghana	Penicillins 47% Amphenicols 15% Tetracyclines 9% Trimethoprim/sulphonamides 3%	NR
Hounsa *et al*. 2010 [39]	Ivory Coast	Penicillins Trimethoprim/sulphonamides tetracyclines	Patent medicine stores 14% Street vendors 11%
Nyambega *et al*. 2017 [55]	Kenya	NR	Community pharmacies 45% Leftovers from previous treatment 22% Patent medicine stores 11% Friends/family 22%

Table 4 (*Continued*)

References	Country	Common classes of antibiotic and percentage used	Sources of antibiotics and percentage
Ghaieth *et al*. 2015 [27]	Libya	NR	Community pharmacies 74% Friends/family 26%
Sambakunsi *et al*. 2019 [57]	Malawi	NR	Community pharmacies Patent medicine stores Leftovers from previous treatment Friends/family
Mate *et al*. 2019 [53]	Mozambique	NR	Community pharmacies 74% Patent medicine stores 3% Home medicine cabinets 2%
Olayemi *et al*. 2010 [35]	Nigeria	Penicillins 57% Tetracyclines 22% Fluoroquinolones 11% Imidazoles 25% Trimethoprim/sulphonamides 20%	Community pharmacies 56% Public hospital pharmacies 13% Private health facilities 2% Patent medicine stores 32% Leftovers from previous treatment 15%
Abdulraheem *et al*. 2016 [40]	Nigeria	Penicillins 55% Tetracyclines 13% Trimethoprim/sulphonamides 14% Fluoroquinolones 13% Imidazoles 13%	Community pharmacies 11% Patent medicine stores 20% Chemist shops 59% Family/friends 10% Leftovers from previous treatment 1%
Badger-Emeka *et al*. 2018 [41]		Penicillins 58% Fluoroquinolones 22% Tetracycline 20% Aminoglycosides 15%	NR
Ehigiator *et al*. 2010 [42]	Nigeria	Penicillins 41% Tetracyclines 18% Imidazoles 13% Macrolides 7% Fluoroquinolones 1% Trimethoprim/sulphonamides 19%	Community pharmacies 68% Chemists stores 21% Leftovers of previous treatment 10% Public hospital pharmacy 1%
Israel *et al*. 2015 [43]	Nigeria	Penicillins 38% Nitroimidazoles 28% Fluoroquinolones 15% Trimethoprim/sulphonamides 15% Tetracyclines 3%	Community pharmacies 20% Patent medicine stores 39% Family/friends 20% Leftovers from previous treatment 19% Public hospital pharmacies 2% Street vendors 1%
Fadare *et al*. 2011 [44]	Nigeria	Penicillins 46% Nitroimidazoles 18% Fluoroquinolones 9% Trimethoprim/sulphonamides 12% Tetracyclines 9%	Community pharmacies 16% Patent medicine stores 19% Leftovers from a previous treatment 2%
Sapkota *et al*. 2010 [45]	Nigeria	Penicillins Tetracyclines Imidazoles Fluoroquinolones	Community pharmacies Private health facilities Public hospital pharmacies Chemists shops Friends/relatives Health workers Street vendors
Umar *et al*. 2018 [46]	Nigeria	Penicillins Nitroimidazoles Fluoroquinolones Trimethoprim/sulphonamides	Community pharmacies 47% Chemists shops 26% Patent medicine stores 19% Street hawkers 2%

Table 4 (*Continued*)

References	Country	Common classes of antibiotic and percentage used	Sources of antibiotics and percentage
		Tetracyclines Macrolides	Public hospital pharmacies 8% Leftovers from previous treatment
Yusuf *et al*. 2019 [47]	Nigeria	Penicillins 54% Nitroimidazoles 6% Trimethoprim/sulphonamides 10% Tetracyclines 28%	NR
Ajibola *et al*. 2018 [36]	Nigeria	Penicillins 48% Imidazoles 18% Fluoroquinolones 19% Trimethoprim/sulphonamides 12% Tetracyclines 11%	Community pharmacies 48% Patent medicine stores 40% Street vendors 9%
Khalid *et al*. 2019 [37]	Nigeria	Penicillins 33% Fluoroquinolones 23% Trimethoprim/sulphonamides 20% Tetracyclines 21%	Community pharmacies 29% Patent medicine stores 75% Family/friends 10% Leftovers from previous treatment 10% Public hospital pharmacies 7% Street vendors 1%
Tuyishimire *et al*. 2019 [58]	Rwanda	Penicillins 61% Fluoroquinolone 2% Trimethoprim/sulphonamides 2% Tetracyclines 3%	Community pharmacies 73% Friends/relatives 13% Leftover from previous treatment 7%
Bassoum *et al*. 2019 [38]	Senegal	NR	Community pharmacies 81% Friends/relatives 12% Leftovers from previous treatments 5% Patent medicine stores 2%
Awad *et al*. 2005 [28]	Sudan	Penicillins 23% Fluoroquinolones 6% Tetracyclines 6% Macrolides 3%	Community pharmacies 69% Relatives and friends 19% Leftovers from a previous treatment 12%
Awad *et al*. 2007 [29]	Sudan	Penicillins 57% Fluoroquinolones 3% Tetracyclines 1% Macrolides 16%	Community pharmacies 90% Relatives/friends 10%
Ahmed *et al*. 2014 [30]	Sudan	Penicillins 38% Fluoroquinolones 3% Tetracyclines 15% Macrolides 2%	Community pharmacies 72% Family/friends 17% Leftovers from previous treatment 11%
Horumpende *et al*. 2018 [59]	Tanzania	Penicillins 46% Nitroimidazoles 10% Fluoroquinolones 1% Tetracyclines 5%	NR
Kajeguka *et al*. 2017 [60]	Tanzania	NR	Community pharmacies 72% Friends/relatives 18.0% Leftovers from previous treatment 10%
Ocan *et al*. 2014 [61]	Uganda	Penicillins 29% Imidazoles 13% Fluoroquinolones 3% Trimethoprim/sulphonamides 12% Tetracyclines 2% Macrolides 1%	Community pharmacies 68% Leftovers from previous treatment 17% Public facility pharmacies 17% Home medicine cabinets 17% Private health facilities 9%

NR, not reported.

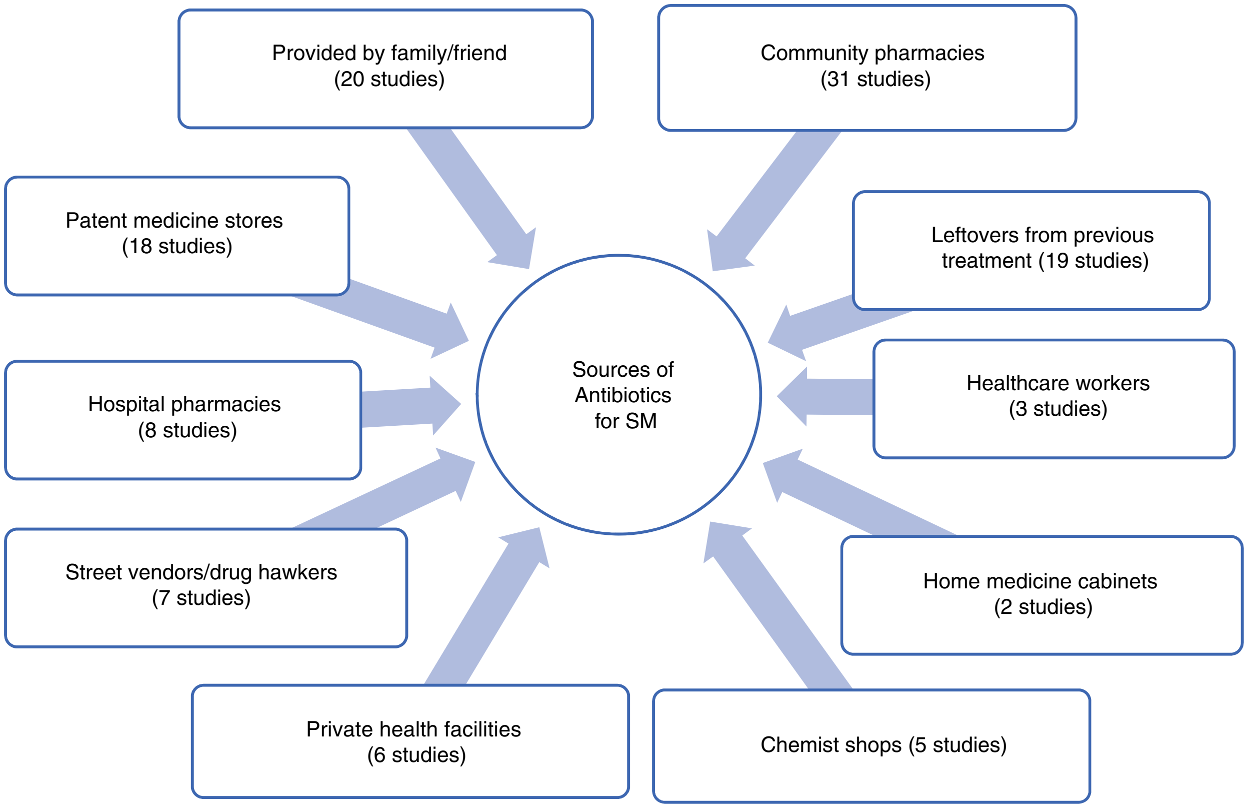

Figure 5 Sources of antibiotics used for SM in Africa.

facilities (18 studies), illness perceived as mild by the patient (14 studies), advice from friends or relatives (nine studies), lack of time to consult (eight studies), assumed knowledge on antibiotics use (five studies), financial constraint (five studies), nonchalant attitude of health workers (eight studies), lack of confidence in the healthcare system (six studies), difficult access to health facility due to remoteness (nine studies), easy access to antibiotics due to non-prescription sales (eight studies), emergency relief of symptoms (eight studies) and poorly staffed and equipped hospitals (three studies; Figure 6).

Common symptoms/illnesses that resulted in SMA

The most common indications for SMA reported were upper respiratory tract symptoms/infections (common cold, cough, catarrh/runny nose, nasal congestion, sore throat, rhinitis, throat pain, tonsillitis; 27 studies), followed by gastrointestinal tract symptoms (diarrhoea, abdominal pain, vomiting; 25 studies), fever or febrile illnesses (18 studies), body aches (headache, toothache, joint pains, malaise; 15 studies), skin injuries, infections and rashes/acne (15 studies), urogenital tract symptoms (10 studies), sexually transmitted infections (five studies), eye infections (five studies), dental infections (four studies), and menstrual symptoms (three studies).

Factors associated with SMA

Twenty-one studies reported results of multivariable logistic regression analysis to determine factors associated with SMA. No education or low educational status was the most frequently reported factor in nine studies [38, 39, 45, 48–50, 53, 59, 63]. Other associated factors reported were low income or unemployment [60, 63], remoteness of health facilities [56, 61], and perceived long waiting time at health facilities [51, 61]. Some factors, such as sex and age showed contradictory results: male sex was reported in five studies [40, 48, 51, 53, 61] and female sex in two other studies [28, 59], age <30 years was reported in three studies [25, 50, 63] whilst age 30–60 years was reported in two studies [28, 59] (Table 5).

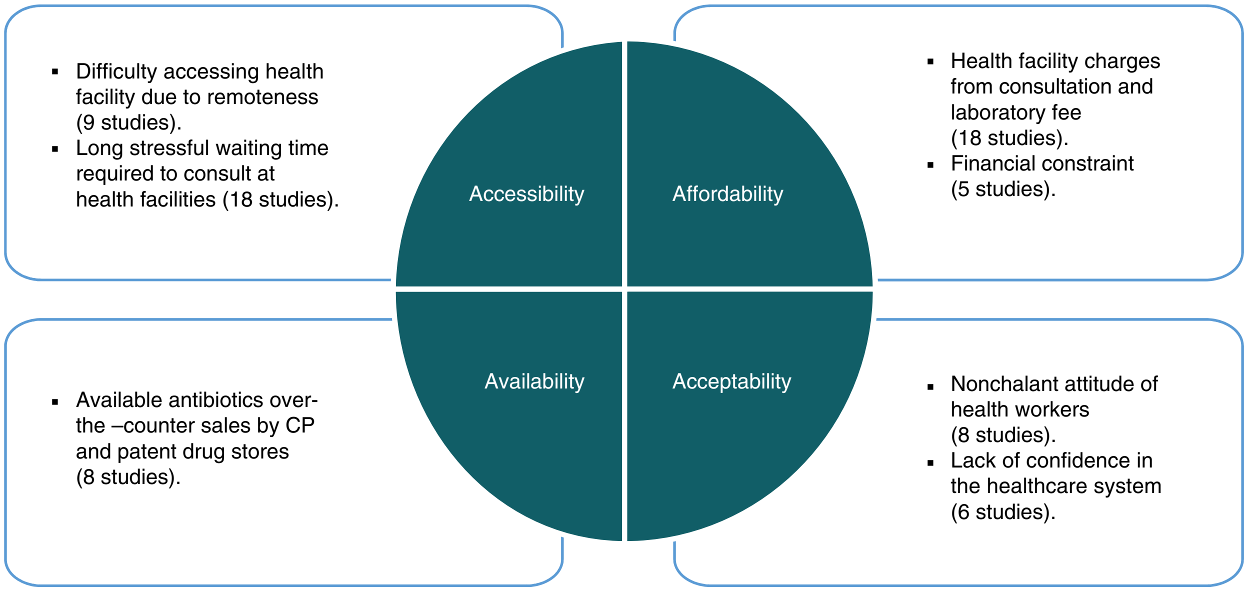

Figure 6 Reasons for SMA categorised using the modified conceptual framework of access to health care.

Discussion

This systematic review analysed the extent to which SMA is practised across Africa, the sources of SMA and the main reasons reported why people self-medicate with antibiotics. The overall median prevalence of SMA in Africa we found is higher than that reported in systematic reviews from South East Asia and the Middle East [7, 67]. A high prevalence of SMA in Africa can be linked to population growth, inequities in access to health care and weak healthcare systems, coupled with poorly regulated procurement, dispensing and use of antibiotics, and the huge role of the informal health sector [5, 68]. This high prevalence could also be related to the high burden of infectious diseases warranting a greater use of antibiotics. Comparing median prevalence estimates by sub-regions found that the highest median prevalence rates were reported from Western Africa, followed by Northern Africa and Eastern Africa. In Africa, socio-economic determinants of health vary from sub-region to sub-region, and from country to country. These are associated with the structure and conditions of health systems, and the health-seeking behaviours of people [5]. There is also variation in the way antibiotic sales are regulated across sub-regions and countries in Africa. In most African countries, antibiotics are available over-the-counter and can be obtained from CPs and PMS without prescription, similar to conditions in other LMIC in the Middle East and South East Asia regions, explaining the high prevalence rates observed [5]. Poor regulation of antibiotic sales resulting from the absence of policies or laxity in law enforcement makes antibiotics easily available for self-medication [17]. A different scenario occurs in high-income countries, where non-prescription sales of antibiotics are commonly prohibited and a low prevalence of SMA is observed [69, 70]. Activities that limit the availability of antibiotics without medical prescription could include government inspections, retention of medical prescriptions in pharmacies, involvement of pharmacists in designing interventions, and educational interventions [71]. Without government inspections, many CPs may tend to dispense antibiotics based on financial motivation and not strictly on medical indications [17]. Pharmacists working in CPs should be sensitised to avoid non-prescription sales, especially of WHO Watch and Reserve group antibiotics.

Financial constraints, limited access to health care and easy access to antibiotics from CPs and PMS due to lack of regulatory measures were the most frequently cited reasons for SMA in Africa. We identified the nonchalant attitude of healthcare workers towards patients, not involving them in decision making as one of the main causes leading to a lack of trust in healthcare workers. Patient-centred care, though an important component of the acceptability of health services, is still grossly lacking among many health workers especially in Africa [72]. Due to the huge patient load, many medical doctors do

Table 5 Factors associated with SMA

Setting	Reference	Variable associated with SMA	Adjusted OR (95% CI)
Households	Awad *et al*., 2005 [28]	Female sex	1.50 (1.16, 1.87)***
		Age range 40–59	2.10 (1.50, 3.00)***
	Ateshim *et al*., 2019 [48]	Male sex	1.81 (1.01, 3.26)*
		Non-knowledgeable	2.13 (1.12, 4.05)*
		Negative attitude	7.47 (4.54, 12.29)***
	Bogale *et al*., 2019 [63]	Age 18–30	8.45 (2.55, 27.96)***
		No education	6.39 (1.45, 28.19)*
		Low income	2.55 (1.18, 5.50)*
	Erku *et al*., 2017 [49]	Low educational status	5.01 (2.62, 9.34)
		Employed	2.12, (1.81, 7.29)
		Unsatisfied with healthcare services provided	5.41 (2.71, 14.21)
	Owour *et al*., 2015 [56]	Sexually transmitted infection	1.90 (1.00, 3.40)*
		Health facility is far	2.80 (1.50, 5.01)***
	Sambakunsi *et al*., 2019 [57]	Stocking antimicrobials at home	2.72(1.09, 6.76)*
	Horumpende *et al*., 2018 [59]	Age range 30–60 years	1.73 (0.86, 3.50)
		Female sex	1.09 (0.80, 1.79)
		Unmarried	1.14 (0.80, 2.75)
		Low educational status	1.45 (0.46, 4.51)
	Kajeguka *et al*., 2017 [60]	Unemployed	11.10 (1.09, 11.30)*
	Ocan *et al*., 2014 [61]	Male gender	2.03 (1.33, 3.08)***
		Hospital drugs don't work	1.82 (1.09, 3.04)*
		Advice from relatives/friends	2.91 (1.58, 5.34)***
		Previous experience	2.49 (1.59, 3.90)***
		Long-distance to the health facility	2.33 (1.58, 3.41)***
		Long waiting time at the hospital	2.44 (1.54, 3.88)***
	Gebeyehu *et al*., 2015 [50]	<25 years	4.45 (1.54, 12.85)*
		25–34 years	2.73 (1.03, 7.24)*
		Poor educational status	4.21 (1.47, 12.07)*
		Engaged with a regular job	1.94 (1.13, 3.32)*
		Unsatisfied with healthcare services	3.51 (2.14, 5.78)**
	Owuor *et al*., 2019 [52]	None	
	Mate *et al*., 2019 [53]	Male sex	1.88*
		Low educational status	2.60***
Universities	Elden *et al*., 2020 [25]	Urban resident	1.60 (1.10, 2.30)***
	Awad *et al*., 2007 [29]	Age range 21–31	1.36 (1.03, 1.81)*
		Private university	1.52 (1.15, 2.02)**
	Sapkota *et al*., 2010 [45]	Lower levels of education	2.80 (1.10, 7.10)*
		Non-science students	1.58 (1.03, 2.50)*
	Umar *et al*., 2018 [46]	None	
	Eticha *et al*., 2014 [54]	Protestant religion	2.26 (1.19, 4.27)**
Others	Abdulraheem *et al*., 2016 [40]	Male sex	1.56 (1.48, 1.64)*
		Tertiary education	1.32 (1.18, 1.96)*
		Productive cough	1.68 (1.32, 1.96)*
		Sore throat	1.84 (1.63, 2.51)*
		Unremitting fever	1.48 (1.22, 1.96)*
	Bassoum *et al*., 2019 [38]	No education	2.70 (1.50, 4.80)*
	Hounsa *et al*., 2010 [39]	Low educational level	1.42 (1.14, 1.77)*
		Purchase of antibiotics at the market	1.86 (1.01, 3.42)*
	Gebrekirstos *et al*., 2017 [51]	Male sex	1.72 (1.21, 2.44)**
		Self-perceived waiting time	1.92 (1.20, 3.09)**

CI, confidence interval; OR, odds ratio.
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

not have enough time to properly communicate with patients or caregivers, and they often focus mainly on the biomedical aspects of health and fail to integrate psychosocial aspects of care. Coupled with all the other bottlenecks encountered in the entire health care delivery in resource-limited settings, most patients leave the consultation office unsatisfied and this reduces trust and acceptability of health services [72]. Many countries in Africa have weak and poorly developed local health systems characterised by lack of facilities and poor quality of service delivery. This negatively affects health-care seeking behaviours and causes many people to go for the option of purchasing antibiotics directly from CPs and PMS, which are easy to access and cheaper. Another major reason cited amongst top enablers of SMA is the reliance on past experiences. When people suffer from recurrent or chronic medical problems, they easily develop a habit of self-medicating, which is facilitated if they can get drugs over-the-counter. They often rely on their prior successes, hoping that the outcome will always remain the same with all disease episodes.

Low educational status, low income or unemployment and inaccessibility to health facilities or health personnel were reported as factors influencing the practice of SMA in Africa. Similar results were observed in a previous review among households in developing countries [73]. Low educational status is the most frequently reported factor associated with SMA, warranting the need to promote literacy among communities in Africa and sensitisation of the general public as a vital strategy to also reduce SMA. Illiteracy is a driver to SMA as individuals and entire communities have less opportunity to be aware of the health risks associated with SMA [5]. Special attention should be given to educating the public and healthcare providers on drugs used for self-medication. Accessibility, affordability and conditions of health facilities, and health-seeking behaviours were also among the factors identified in LMIC [17]. A multicentre study carried out in Europe revealed that higher gross domestic product and dispensing the exact quantities of prescribed doses were independently associated with a lower likelihood of SMA, whilst the perceived availability of antibiotics over-the-counter was a key enabling factor for SMA [74]. High-income countries have well-structured health systems with good healthcare infrastructures, adequate access to healthcare services and good health insurance coverage reflecting the high gross domestic product and resulting in low prevalence of SMA [69].

SMA in Africa occurs for many different indications and with different antibiotics. In this review, penicillins were the most widely used class of antibiotics for SMA in Africa, similar to what was reported in other reviews [4, 70, 75]. Penicillins are widely used for SMA because they have fewer side effects and are cheaper than other classes of antibiotics [4]. Even though WHO recommends that Watch Group antibiotics like fluoroquinolones or macrolides should be restricted to prescription-only [76] due to their potential to develop resistance, many studies reported their use for SMA in Africa. Fortunately, Reserve Group antibiotics were rarely reported for SMA, presumably because of their rare availability, their frequent formulation as intravenous injections only, and their high cost.

CPs and PMS were the main sources of antibiotics used for self-medication. Controlling over-the-counter sales of antibiotics in Africa can be a useful strategy to mitigate SMA. This process has proven successful in High Income countries where it is done by engaging pharmacists in the development of interventions, retention of medical prescriptions in pharmacies, regular inspections of pharmacies by the government, and media campaigns in communities [71]. Limiting access to over-the-counter antibiotics without improving access to health care, in general, may not be a tangible solution in resource-limited settings like Africa where many communities are experiencing a lack of medical doctors. This problem can be addressed with task-shifting, thereby authorising pharmacists and state-registered nurses to prescribe and dispense Access Group antibiotics. Patent medicine stores are community retail stores managed often by non-qualified personnel and are prohibited in many African countries. Unqualified staff involved in sales of antibiotics do not have sufficient knowledge and skills to properly counsel patients on antibiotic use, control the dosages dispensed, and assess the quality of antibiotics sold. Using leftover antibiotics and old prescriptions is an indication of inappropriate antibiotic usage and a lack of proper education. Preventing reuse of leftovers can be another effective way of preventing SMA [74]. This can be achieved by counselling patients when dispensing antibiotics and ensuring that the quantity dispensed corresponds to that prescribed and encouraging the return of uncompleted antibiotics in CPs against financial reimbursement. Strengthening regulations on dispensing practices that enables pharmacists to dispense exact antibiotics doses as prescribed and sensitisation of patients during consultations will help reduce the leftovers antibiotics used for self-medication.

Limitations

Some of the limitations of this systematic review included uneven regional distribution of studies. Studies included in this review came from 19 of the 54 African countries with over 80% of the studies from Western and Eastern Africa and over 50% of the studies just from 4 countries (Nigeria, Ethiopia, Sudan and Kenya). The over representation of Nigeria could explain the relatively high median prevalence in Western Africa compared to other sub-regions. Even though we have formulated conclusions for the entire continent and sub-regions, we are aware that studies are not randomly distributed, and more studies were probably carried out in areas where high SMA was suspected. There are limitations introduced by the potential biases from individual studies. Fifteen studies included had a moderate risk of bias and one study had a high risk of bias. These biases resulted from variation in the selection of participants, for example, non-random sampling procedures to recruit participants, no record of recall period, potential social desirability and failure to validate survey questionnaires. Furthermore, some studies did not use the correct case definition of SMA, as they indiscriminately used either antimicrobials or antibiotics and without specifying the study duration. Many studies reported a recall period of more than 6 months, whilst some studies did not report the recall period at all.

Conclusion

The prevalence of SMA in Africa is high and varies across sub-regions with the highest prevalence reported in Western Africa. Drivers for SMA comprise of socio-economic factors elucidated by low educational status and financial constraint, limited access to health care characterised by high out-of-pockets payments, absence of patient-centred care, poor health-seeking behaviours and inadequate policies regulating the sales of antibiotics or poor implementation of existing regulations. There will be no one-size-fits-all strategy to address SMA in Africa ensuring effective and sustainable control. Tackling this problem, therefore, requires a multifaceted approach that is user-centred and context-specific, addressing various actors and stakeholders ranging from antibiotic users to dispensers and policymakers.

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