Self-medication with antibiotics in WHO Eastern Mediterranean Region: A Systematic Review and Meta-analysis

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Abstract

Background

Recently, inappropriate use of antibiotics has been correlated with life-threatening side-effects such as adverse effects, increased cost of treatment, and the higher rate of microbial resistance. Besides, it leads to a waste of resources. Therefore, this review sought to determine the pooled prevalence of self-medication with antibiotics, self-medicated illness, reasons for self-medication, antibiotics used for self-medication, source of obtaining antibiotics, the inappropriate practice of antibiotics and suggested recommendations for talking self-medication with antibiotics in the Eastern Mediterranean Region of the World Health Organization (EMRWHO).

Methods

Review conforms to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. Database search was conducted in PubMed, Scopus, Embase, and Web of Science using a combination of keywords which included; antimicrobial, antibacterial, antibiotic, self-medication, self-treatment, self-prescription, non-prescribed, irrational use, inappropriate use, misuse, abuse and Eastern Mediterranean Region of WHO countries. The lists of references of the selected articles were also hand-searched to obtained additional relevant articles. Studies published in English from 2000 to 2018 were included in the review.

Results

We report on data from 60 articles and 49629 participants in this review. The overall prevalence of self-medication with antibiotics in EMRWHO was 47.2% (95% CI 41.6% – 52.9%). Yemen has the highest pooled rate with a rate of 75.0% (95% CI 63.4% – 83.9%), whilst Lebanon has the lowest pooled rate with a prevalence of 28.7% (95% CI 18.4% – 41.8%). The most common illnesses implicated in antibiotic self-medication were upper-respiratory infections and the most common antibiotic was Amoxicillin-Clavulanic acid. The commonest reasons for antibiotic self-medication include: saving time and money. Pharmacies pointed out as the most common source of obtaining antibiotics for self-medication.

Conclusion

Self-medication with antibiotics is significantly high in the member states of EMRWHO. Intervention such as an educational program for communities' members to change their behaviors, policy on the mechanism of distribution of antibiotics is called for in this area.

Background

Self-medication is defined as taking of medication to treat self-diagnosed diseases or symptoms, or the intermittent or continued use of prescribed medication for chronic or recurrent disease or symptoms (1). Unlike other pharmaceutical products that only affect individuals if used irrationally for self-medication, misuse of antibiotics has the potential to harm society (2).

Globally, it is estimated that two-thirds of all oral antibiotics are obtained without a prescription (3). Recently, the irrational use of antibiotics has been associated with life-threatening side-effects such as adverse effects, increased cost of treatment, and a higher rate of microbial resistance. Also, self-medication with antibiotics (SMA) leads to wastage of resources (4). Many studies found a direct correlation between the irrational use of antibiotics and antibiotics resistance (5–8). Taking antibiotics without prescription of certified professional may lead to inappropriate use of antibiotics in the form of incorrect medication for the wrong diagnosis, taking over or lower doses, and incorrect course of treatment (9). Besides, SMA can lead to increased severity of the disease, prolonged duration of disease, increased mortality rate, and rising health care cost (10–12).

World Health Organization (WHO) confirmed that inappropriate use of antibiotics is an important contributor to microbial resistance development (2). In the USA, 23,000 die each year from the complications of antibiotic resistance and the medical cost of patients with antibiotics resistance ranges from $18,588 to $29069 (13, 14).

In low-income countries where the prevalence of the infectious disease is still high and treatment fails daily, SMA is a common practice (15). The study indicated that countries with the highest level of antibiotics consumption have the highest level of microbial resistance (16).

The prevalence of SMA varies in different countries due to differences in socio-demographic, cultural, financial situation, and various health systems (17). In low and middle-income countries, it is reported to be 38.8% (15) and 19–82% in the Middle East (18).

Various studies have cited different factors facilitating SMA, such as; accessibility of antibiotics in over the counter, leftover antibiotics and home, lack of awareness, expensive health care services, lack of accessibility of health services, influence by their relatives and friends, and perceived saving time and money (17, 19, 20).

However, it is well-established that SMA leads to microbial resistance which is worth considering the issue for low and middle-income countries due to the emergence of rapidly mutating and resistant strains of several pathogens (21–23) and the majority of member states of Eastern Mediterranean Region of World Health Organization (EMRWHO) are classified low and middle income. As SMA is a significant contributor to microbial resistance, it is important to integrate the result of individual studies on SMA in this region of WHO. Although various empirical studies on SMA have been published in some countries of EMRWHO, no systematic review has been done to pool these pieces of evidence and find the gab of knowledge. Therefore, this review aimed to determine the pooled prevalence of SMA, self-medicated illnesses with antibiotics, reasons for SMA, sources of obtaining antibiotics for self-medication,

antibiotics used for self-medication, inappropriate practices of antibiotics, and suggested recommendations to tackle SMA in the EMRWHO.

Methods

Review question

What is the pooled prevalence of SMA, self-medicated illnesses, reasons for SMA, sources of obtaining antibiotics for SMA; antibiotics used for self-medication, inappropriate practices of antibiotics, and suggested recommendations to tackle SMA in the EMRWHO?

Protocol: This review conforms to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. To ensure that there wasn't any similar study to ours, we did a preliminary scoping search in Prosper systematic review and registry (PROSPERO), Cochrane library, and Google scholar.

Search strategy

PubMed, Scopus, Embase, and Web of Science databases were searched to identify studies that investigated self-medication with antibiotics in communities of member states of EMROWHO. The following keywords included 'antimicrobial', 'antibacterial', 'antibiotic', 'self-medication', 'self-treatment', 'self-prescription', 'non-prescribed', irrational use, abuse, misuse (see table 2). The search in Scopus was done using Keywords included 'self-medication', 'self-treatment', 'self-prescription', 'irrational use', 'abuse', 'misuse', 'un-prescribed', 'antibiotics', 'antimicrobial', 'antibacterial'. Limited to: "Saudi Arabia", "Pakistan", "Lebanon", "Jordan", "Iran", "Iraq", "Egypt", "Kuwait", "Libya", "Sudan", "Qatar", "Yemen", "Afghanistan", "Bahrain", "United Arab Emirate", "Djibouti", "Palestine", "Morocco", "Syria", "Somalia", "Tunisia" and "Oman" and English language. The initial search was done on 15/07/2018 (Table 1). The references of the included studies were hand-searched for related articles.

Eligibility criteria

The review included studies on the prevalence of SMA and/or self-medicated illness and/or reasons for SMA and/ or antibiotics used for SMA and/or inappropriate practice of antibiotics and/or suggested recommendations to tackle SMA and/or sources of obtaining antibiotics for SMA published in the English language in peer-review journals in EMRWHO from 2000 to 2018 (Table 2). We excluded editorials, letters to the editor, or comment

publication type. We also excluded studies that measured only knowledge or attitude or beliefs .

Table 2 PICO[1] criteria for inclusion and exclusion of studies

Criteria	Description
Population	People living in EMRWHOs' countries
Intervention	Self-medication with antibiotics
Comparison	None
Outcomes	Prevalence and/or self-medicated illness and/or reasons for SMA and/or antibiotics used for SMA and/or source of obtaining antibiotics and/or inappropriate practice of antibiotics and/or suggested recommendations to tackle SMA

PICO[1]: population, intervention, control, outcome

Study selection:

The search of Web of Sciences, PubMed, Embase, and Scopus databases resulted in a total of 819 articles. After removing duplication, 607 records remained. Of these 106 articles were discarded since after reviewing their title and abstract, they did not meet the criteria. The full text of the remaining articles was reviewed in detail from which 52 articles did not meet the criteria. 54 studies met the criteria. The references of the included articles were hand-searched for related studies which we found 6 articles. We had 60 studies for this systematic review and meta-analysis (figure 1).

Two reviewers independently searched for the articles, compared them, discussed and always reached consensus on studies to exclude and include based on criteria for inclusion described above and Joanna Briggs Institute (JBI) appraisal tool for systematic reviews checklist for prevalence studies.

Data collection process: for articles that met the inclusion criteria, information was extracted and recorded in a piloted dataset in excel; spreadsheet. For included studies, we assessed the main outcome of the study findings as to the prevalence of SMA, reasons for SMA, self-medicated illnesses, antibiotics used for SMA, sources of obtaining antibiotics, inappropriate practices of antibiotics, and suggested recommendations to tackle SMA. Selected articles were kept for future narrative and excluded articles were also kept in a separate file for future reference where applicable. The following items were extracted from studies: author, country, year of publication, study design, sample size, self-medication prevalence, study population, recall time, self-medicated illnesses, reasons for SMA,

inappropriate practices of antibiotics, antibiotics for self-medication, sources of obtaining antibiotics and suggested recommendations to tackle SMA.

Risk of bias in individual studies: the studies were appraised based on the selection criteria (table 1) and the Joanna Briggs Institute (JBI) critical appraisal tool for systematic reviews checklist for prevalence studies (24). This tool is a rating list with 9 criteria, which can be answered as yes (coded as 1), no (coded as 0), not applicable (coded as NA), or unclear (coded as UNC); thus, the score for each study ranged from 0 to 9. Depending on its score, we rated each study as low risk (7-9), moderate risk (4-6), or high risk of bias (1-3).

Data analysis: We used a Random Effects model to estimate the pooled prevalence. The result was displayed in a forest plot and shown the high heterogeneity. The prevalence of SMA was reported as the proportion of self-medicated person numbers among the sample. The prevalence was pooled with a 95% confidence interval and stratified by country and characteristics of the study population. The analysis was done using Comprehensive Meta-Analysis version 3. Associated data items were extracted and reported in the format of tables. The funnel plot and the Egger test were used to examine publication bias.

Result

Study characteristics and quality

In this review, 60 articles (25 – 84) were included; these were identified from 14 countries of the Eastern Mediterranean Region of the World Health Organization (EMRWHO). They differed concerning the setting, sample size recall period, and study subjects. Recall period varied from one month to 12 months across studies. For some studies recall period was not available. Eighteen articles were identified from Saudi Arabia, Kuwait, Libya, Qatar, Syria, Uited Arab Emarate, and Palestine each with one article. We couldn't find any article from 8 countries of EMRWHO (table 3).

Total study participants in 14 countries were 49629 people. Jordan with 15515 and Syria with 430 participants had the highest and lowest number, respectively. The study Al-Azzam (2007) in Jordan contributed the highest number (N = 9281) and the study Hanif in Pakistan contributes the lowest number (N = 152). All studies used a cross-sectional study design. The study population of 25 articles was from the general public (N= 28011), 11 articles among visitors of clinics and pharmacies (N= 8219), 15 articles among university students (N= 8068), 4 articles among parents in behalf of their children (N = 2292), 3 articles among university and school teachers (N=2281), and two articles among refugees (N=758). Most of the studies from Yemen were done among outpatients and pharmacy visitors. The result of the JBI assessing tool showed that 51 studies have a low risk of bias and 9 have a moderate risk of bias.

Prevalence of SMA

Overall prevalence of SMA in EMRWHO is 47.2% (95% CI 41.6% – 52.9%). With regards to country level pooled prevalence, Yemen had the highest prevalence with a prevalence of 75.0% (95% CI 63.4% - 83.9%). This was followed by Pakistan with 53.3% (95% CI 39.1% - 67.1%), Sudan 51.5% (95% CI 44.7% - 58.3%), Saudi Arabia 49.5% (95% CI 40.3% - 58.7), four countries are with lower level such as Egypt 44.0% (95% CI 34.9% - 57.5%), Iran 41.3% (95% CI 34.9% - 48.1%), Jordan 36.9% (95% CI 21.3% - 55.9%), and Lebanon 28.7% (95% CI 18.4% - 41.8%) (Table 3).

Prevalence's in countries with one study were including Syria 57%, UAE 46%, Palestine 44.7%, Libya 44.5% and Qatar 14.2% (Table 5). Pooled prevalence based on study population characteristics are varied, it ranges from 57.7% (95% CI 45.2% - 69.2%), among visitors of clinics and pharmacies followed by school and university teachers with a prevalence of 54.3% (95% CI 39.8% - 68.2%), students had a prevalence of 50.0% (95% CI 42.7% - 57.3%), parents for children 48.7% (95% CI 38.9% - 58.5%), refugee 41.8% (95% CI 32.3% - 52.0%) and general public 39.4% (95% CI 31.2% - 49.1%) (Table 4).

Publication bias

There was no significant publication bias as shown by the result of the Egger test (P = 0.1) (funnel plot figure 2).

Common illnesses rendering SMA

The most common illnesses for SMA were upper-respiratory problems including sore throat, runny nose, cough, nasal congestion, and the common cold. The gastrointestinal problem such as abdominal pain, digestive disease, diarrhea, and vomiting was the second most common problems followed by urinary tract infection, fever, dental problems, skin problems, and ear problems.

Common reasons for SMA

Various reasons were reported for SMA, the three most important reasons were saving time, saving money, and previous successful experience with antibiotics. Other reasons included lack of trust in physicians, the common disease not being worthy consultation, unavailability of medical services, the feasibility of usage, accessibility of medicines, and known antibiotics.

Common antibiotics used for SMA, sources of obtaining and inappropriate practices

Amoxicillin-clavulanic (Amoxy-clav) was reported in all of the articles and was the commonest medicine used to self-medicate. This was followed by penicillin, cephalosporin, and metronidazole. Other common antimicrobials included: Erythromycin, Tetracycline, Ciprofloxacin, and Co-trimoxazole. Various sources were used to get medicines, pharmacies were the most common source of drugs followed by leftover medicines, and taking medicine from relatives and friends. Twenty two articles reported inappropriate usage of antibiotics, the most common way of irrational use of antimicrobials was not completing the course of antibiotics followed by changing dose during self-medication. Other ways included: shifting

antibiotics, sharing antibiotics, and keeping leftovers (27-29, 35, 39, 40, 43, 44, 48, 50-52, 56, 59, 61, 65, 67, 77, 78, 80).

Suggested recommendations for tackling SMA

Some recommendations were suggested by authors of the included studies including the public education campaigns (25 - 27, 28, 29 – 32, 34 – 37, 39, 42, 44, 47 – 51, 54 – 58, 60, 61, 64 – 70, 72, 73, 75, 77 - 81) to educate people about the consequence of self-medication with antibiotics. Policy and regulatory measures (25, 26, 28, 30, 31, 34, 36, 37, 40, 41, 44, 45, 47 – 54, 58, 60 – 62 and 64 – 73) such as the development of guidelines for antibiotics therapy, enforcement of national regulatory laws regarding the dispensing of antibiotics, preventing antibiotics as over the counter drug and financial regulation including the mandatory health insurance and reducing the cost of the treatment. Moreover, the adverse effect of self-medication with antibiotics should be communicated by healthcare professionals (26, 41, 48, 50, 53, 57, 58, 62, 64, 69, 78, 79, 82). Besides, healthcare professionals should be educated regarding rational usage of antibiotics, and also medical curriculum should be revised to address this problem (25, 28, 33, 34, 37, 38, 40, 46, 52, 64, 69, 79, 82). Other recommendations followed by accessible healthcare for all (26, 77) and more research and periodic survey (32, 55, 74) for exploring the public awareness, determining the level of microbial resistance, and assessing the effectiveness of different approaches of interventions.

Discussion

In this review, the pooled prevalence of SMA in EMRWHO was 47.2% (95% 41.6% − 52.9%) and is similar to those from the review conducted in Southeast Asian Region of World Health Organization's countries (SARWHO) which showed an overall prevalence of 42.64% (85). Conversely, it is higher than that of a review from the Euro-Mediterranean Region of WHO that reported an overall prevalence of 38.8% (86). Also, this review revealed that the pooled prevalence of SMA varied across countries, it ranges from 28.7% in Lebanon to 75.0% in Yemen. Elsewhere, a similar systematic review in the SARWHO reported that the overall prevalence of SMA varied from 7.3–85.59% (85). Another systematic review on SMA which was carried out in the Middle East showed a difference in the overall prevalence ranging from 19–82% (18). These variations, firstly, may be influenced by the country of origin, sample size, methodology, recall period, and study setting across studies included in the review. Secondly, variations could be due to the difference in the effectiveness of enforcement of laws on antibiotics dispensing in different countries. Thirdly, the reason for this difference may be due to different political, social, cultural, and the healthcare system. However, antibiotics self-medication is prevalent globally despite having laws of prescription-only medicine for antibiotics in most countries. Microbial resistance, as a result of the irrational use of antibiotics associated with self-medication caused a higher mortality rate in limited resources nations (87).

Potential benefits of self-medication for patients, healthcare professionals, healthcare systems and the pharmaceutical industry enforce SMA. Easy access to antibiotics results in more profits for

pharmaceutical companies; avoiding unnecessary consultation for minor illness benefits health care professionals and self-diagnosis and self-treatment decrease healthcare costs to the government (88). In this review, the most common reasons behind SMA were time and money-saving. These advantages of self-medication further re-enforce the SMA in the treatment of mild disease. It should be considered, that the potential benefits of SMA will only be achieved if it's taken responsibly and the antibiotics used are safe, efficacious and information to safe use is easily accessible to the people (89). Besides, in our review, previous successful experience with antibiotics and perceived mildness of disease was another common reason for SMA. Due to the successful use of antibiotics, patients in most communities believe that they can treat subsequent illnesses without visiting a doctor. Since most people who self-medicate their illness do not know the disease process and the drug which could lead to the inappropriate practice of antibiotics.

The review revealed inappropriate practices of antibiotics in communities of EMRWHO. These included, sharing antibiotics, taking antibiotics without completion of the course, and keeping leftovers. Not completing the course of antibiotics can lead to clinical failure. Studies conducted in children with mild pneumonia taking 3 days and 5-day amoxicillin found non-compliance as the reason for treatment failure (90, 91). Taking antibiotics without completion of the course could be attributed to the fact that ley persons lack the knowledge on the complete course of antibiotics and they stop taking antibiotics whenever the symptoms disappear (10). Shifting antibiotics may be the sign of uncertainty of disease diagnosis, the type of antibiotic for disease, and the right dose. Keeping antibiotics predicts the future intent of self-medication and the anticipated re-occurrence of the disorder being self-managed. These irrational practices of antibiotics increase the risk of wrong indication, adverse reactions, microbial resistance (10, 11, 88). This is worsened by the high rate of infectious diseases in addition to the limited therapeutic choices in most member states of EMRWHO (10). Microbial resistance increases the expenditure of the healthcare system which is already faced with a financial problem. Policymakers concerning self-medication should plan an intervention on these common inappropriate antibiotic practices.

Our review found that the main sources of antibiotics for self-medication were pharmacies, family and friends, and leftovers. Drug sellers in most of the member states of EMRWHO do not have enough biomedical information about the medicine they sell (92). The result of a study in the Lao People's Republic reported that 59% of drug dispensers do not know about the medicine they were selling (93). In this review pharmacies were frequently reported as a source of obtaining antibiotics despite the lack of knowledge of their drug seller. This increases the risk of misinforming their customers on the antibiotics. SMA without information on how to use them, indications, adverse effects, and contraindications may potentially expose individuals to the risk of inappropriate antibiotics use (94). Therefore, pharmacies in countries of EMRWHO are an important target for regulation and monitoring.

Upper-respiratory problems were the most commonly reported illnesses in our review that were self-medicated with antibiotics. These are commonly caused by viruses that are not treated with antibiotics. Therefore, the irrational practice of antibiotics could lead to various complications including the

development of microbial resistance (10, 11, 88). Other disorders included gastrointestinal problems, fever, UTI, pain, skin, and ear problems. This is in line with findings from studies elsewhere (96, 97). Such reported sentiments could be attributed to the fact that these problems occur frequently. Therefore, having experience of treating them may lead to the practice of SMA. Besides, due to the common occurrence of such illnesses gives the perception to the people that they are mild and do not need physician consultation. However, patients should be informed that taking antibiotics for frequently occurring illnesses without consultation of healthcare professionals may lead to life-threatening consequences. The symptoms may be a sign of a dangerous disease. Moreover, self-medication would prevent from early detection and treatment of the other major diseases.

Furthermore, our review reported Amoxicillin-Clavulanic as the most common antibiotic used for SMA. This finding is similar to a previous review in the Southeast Asian Region of WHO (85). The high usage of this antibiotic may be due to low cost, availability, popularity, and low side effect profiles (49). Nonetheless, inappropriate use of these drugs may lead to adverse effects; the most problematic would be microbial resistance (10).

Our review integrated suggested recommendations of authors of included studies. The most-reported recommendations were Public education campaigns to educate people about the consequence of SMA and policy and regulatory measures such as the development of guidelines for antibiotics therapy, enforcement of national regulatory laws regarding the dispensing of antibiotics, preventing antibiotics as over the counter drug and financial regulation including the mandatory health insurance and reducing the cost of the treatment. Easy availability of antibiotics is the sign of a lack of regulations on the usage of antimicrobials in some countries. We have seen in Europe that by taking policy and regulatory measures somehow controls SMA (95).

Conclusion

SMA is significantly high in the member states of the EMRWHO and associated with the inappropriate practice of antibiotics. Therefore, it is important to know the pattern of SMA for tackling this issue in this region. Intervention such as the educational programs for communities' members to change their behaviors, policy on the mechanism of distribution of antibiotics is called for in this area. Inappropriate use of antibiotics is a public health problem with many faces rooted in individual behaviors to collective decision making. The crisis of self-medication in EMRWHO can be controlled interventions occur at various levels Educational programs should target communities and policies should target the mechanism of dispensing health care resources and equity in the distribution of resources. Lastly and most importantly, the collaboration of countries and non-governmental organizations in EMRWHO could be seminal in controlling self-medication and the distribution of antibiotics.

Suggestion for future research

More studies should be done on Prevalence of SMA and other related factors in some countries of EMRWHO including Kuwait, Libya, Palestine, Syria, Qatar, and UAE, and those with no evidence of SMA;

including Bahrain, Djibouti, Iraq, Morocco, Afghanistan, Oman, Somalia, and Tunisia. Besides, there is an urgent need to develop and validate a standardized tool for assessing SMA to provide a more accurate rate that makes possible the comparison of SMA across countries. To understand SMA behavior as much detail as possible, it is necessary to conduct a qualitative study on factors that influence people's decisions.

Strengths and limitations

This review is the first to integrate the result of individual studies on prevalence, illnesses, reasons, sources of obtaining, antibiotics, inappropriate practices, and suggested recommendations for SMA in the EMROWHO. Multiple databases were searched to identify peer-reviewed articles. Individual studies were hand-searched to find relevant articles.

Our review had some limitations, the bias in the included studies due to; recall time and selection of respondents. Some studies used a recall period of more than six months while others did not report the duration of recall. It is reported that a recall period of more than one month was significantly associated with the risk of recall bias (98). The selection of respondents by non-random methods in addition to not validating the data collection tools was common in most studies and may potentially affect the study results. Owing to the significant differences in settings across the EMRWHO countries specifically with regards to the stability of health systems, studies identified included in this study were skewed to a few countries. We did not identify studies in eight mentioned countries of EMROWHO that prevent us to compare the true prevalence of SMA between these countries and among the regions of WHO. This could have partly contributed to the relatively high prevalence in some countries such as Yemen relative to others.

Abbreviations

WHO: World Health Organization; EMRWHO: Eastern Mediterranean Region of World Health Organization (EMRWHO); UAE: United Arab Emirates; SA: Saudi Arabia; SARWHO: Southeast Asian Region of World Health Organization.

Declarations

Ethics approval and consent to participate

Not applicable to this study.

Consent for Publication

Not applicable for this study

Availability of data and materials

Figshare: Shayan, shah Jahan; Frank, Kiwanuka; Negarandeh, Reza; Rad, Sanaz Akhavan; Nazari, Rajab (2018): Tables for Self-medication with antibiotics in WHO Eastern Mediterranean Region: A Systematic Review and Meta-analysis. figshare. Journal contribution.
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Competing Interests

The authors declare that they have no competing interests

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Authors Contribution

SJS & RN contributed to curation, RNa, contributed to methodology. SJS, RN, FK & SA contributed to methodology, database search, data extraction & writing the final manuscript. All authors have read and approved the final manuscript.

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Tables 1, 3, And 4

Table 1 Database search strategy

database	search term syntax	x
PubMed	((Self-medication[Title/Abstract] OR self-treatment[Title/Abstract] OR irrational use[Title/Abstract] OR self-prescription[Title/Abstract] OR inappropriate use[Title/Abstract] OR non-prescribed[Title/Abstract] OR misuse[Title/Abstract] OR abuse[Title/Abstract]) AND ("Saudi Arabia"[Affiliation] OR Pakistan[Affiliation] OR Lebanon[Affiliation] OR Jordan[Affiliation] OR Iran[Affiliation] OR Iraq[Affiliation] OR Egypt[Affiliation] OR Kuwait[Affiliation] OR Libya[Affiliation] OR Sudan[Affiliation] OR Qatar[Affiliation] OR Yemen[Affiliation] OR Afghanistan[Affiliation] OR Bahrain[Affiliation] OR "United Arab Emirate"[Affiliation] OR Djibouti[Affiliation] OR Palestine[Affiliation] OR morocco[Affiliation] OR Syria[Affiliation] OR Somalia[Affiliation] OR Tunisia[Affiliation] OR Oman[Affiliation])) AND (Antibiotic[Title/Abstract] OR antibacterial[Title/Abstract] OR antimicrobial[Title/Abstract]) AND ("2000/01/01"[PDAT] : "2018/12/31"[PDAT])	170
web of science	TS=(Antibiotic OR antibacterial OR antimicrobial) AND TS=(Self-medication OR self-treatment OR irrational use OR self-prescription OR inappropriate use OR non-prescribed OR misuse OR abuse) AND CU=("Saudi Arabia" OR Pakistan OR Lebanon OR Jordan OR Iran OR Iraq OR Egypt OR Kuwait OR Libya OR Sudan OR Qatar OR Yemen OR Afghanistan OR Bahrain OR "United Arab Emirate" OR Djibouti OR Palestine OR morocco OR Syria OR Somalia OR Tunisia OR Oman) Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI Timespan=2000-2018	395
Scopus	TITLE-ABS-KEY ((antibiotic OR antibacterial OR antimicrobial)) AND TITLE-ABS-KEY ((self-medication OR self-treatment OR irrational AND use OR self-prescription OR inappropriate AND use OR non-prescribed OR misuse OR abuse)) AND AFFILCOUNTRY ("Saudi Arabia" OR pakistan OR lebanon OR jordan OR iran OR iraq OR egypt OR kuwait OR libya OR sudan OR qatar OR yemen OR afghanistan OR bahrain OR "United Arab Emirate" OR djibouti OR palestine OR morocco OR syria OR somalia OR tunisia OR oman) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2008))	12
Embase	('antibiotic':ab,ti OR 'antibacterial':ab,ti OR 'antimicrobial':ab,ti) AND ('self-medication':ab,ti OR 'self-treatment':ab,ti OR 'irrational use':ab,ti OR 'self-prescription':ab,ti OR 'inappropriate use':ab,ti OR 'non-prescribed':ab,ti OR 'misuse':ab,ti OR abuse:ab,ti) AND (('saudi arabia':ca OR 'pakistan':ca OR 'lebanon':ca OR 'jordan':ca OR 'iran':ca OR 'iraq':ca OR 'egypt':ca OR 'kuwait':ca OR 'libya':ca OR 'sudan':ca OR 'qatar':ca OR 'yemen':ca OR 'afghanistan':ca OR 'bahrain':ca OR 'united arab emirate':ca OR 'djibouti':ca) AND ,:ca OR 'palestine':ca OR 'morocco':ca OR 'syria':ca OR 'somalia':ca OR 'tunisia':ca OR 'oman':ca)	242

X: Number of matches

Table 3 prevalence of SMA in EMRWHO countries

No	Country	Prevalence	CI 95%
1	Egypt	44.0%	31.4% – 57.5%
2	Iran	41.3%	34.9% - 48.1%
3	Jordan	36.9%	21.3% - 55.9%
4	Lebanon	28.7%	18.4% - 41.8%
5	Pakistan	53.3%	39.1% - 67.1%
6	Saudi Arabia	49.5%	40.3% - 58.7%
7	Yemen	75.0%	63.4% - 83.9%
8	Sudan	51.5%	44.7% - 58.3%
9	Kuwait	27.5%	X
10	Libya	44.5%	X
11	Palestine	44.7%	X
12	Syria	57.0%	X
13	United Arab Emirate	46.0%	X
14	Qatar	14.2%	N
15	Djibouti	N	N
16	Iraq	N	N
17	Morocco	N	N
18	Afghanistan	N	N
19	Oman	N	N
20	Bahrain	N	N
21	Somalia	N	N
22	Tunisia	N	N

X: single study *N: no study*

Table 4 prevalence of SMA according to study population characteristics

No	Participants	Prevalence	CI 95%
1	General public	39.8%	31.2% - 49.1%
2	Student	50.0%	42.7% - 57.3%
3	School and university teachers	54.3%	39.8% - 68.2%
4	Visitors of clinic and pharmacy	57.7%	45.2% - 69.2%
5	Refugee	41.8%	32.3% - 52.0%
6	Parents for Children	48.7%	38.9% - 58.5%

Figures

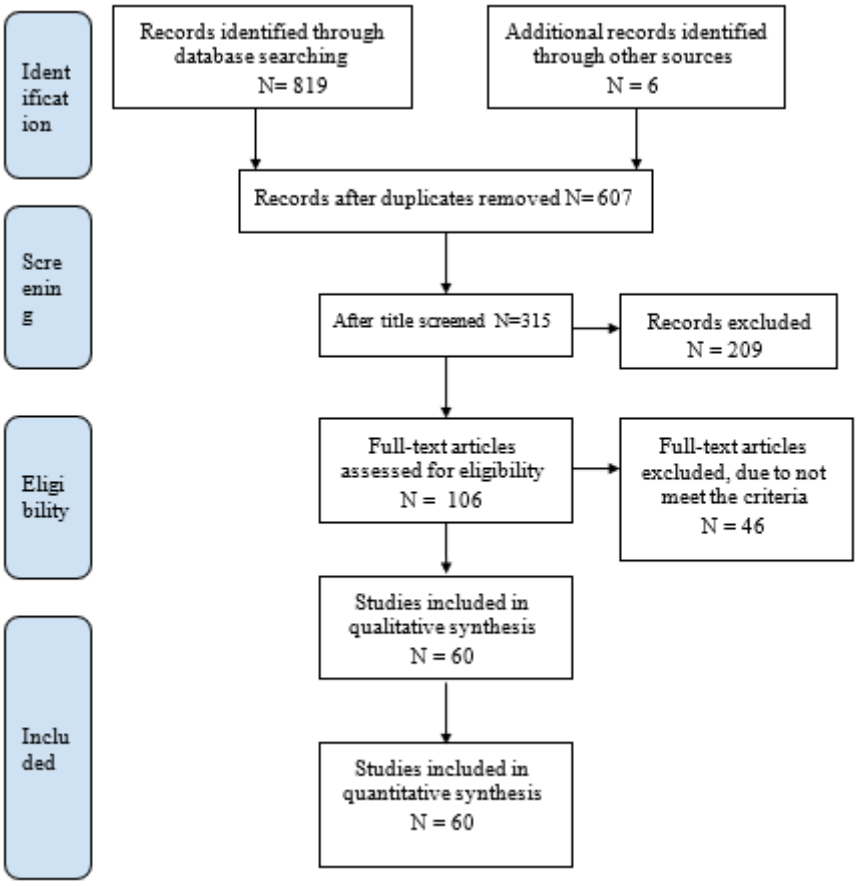

Figure 1

Prisma Flow diagram of study selection

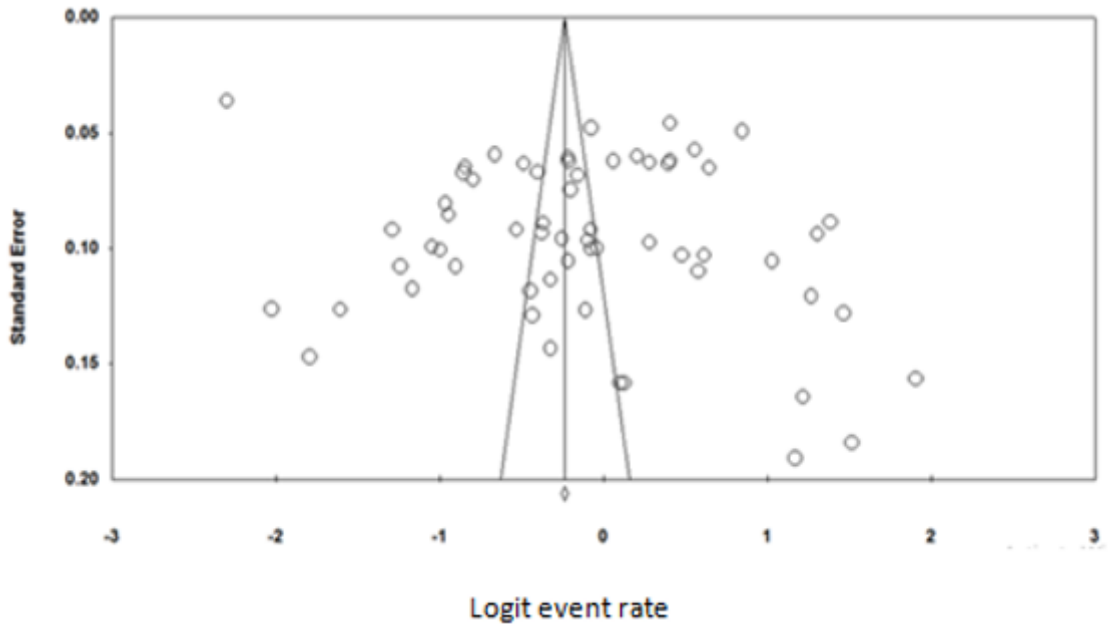

Figure 2

Funnel plot of standard error by logit event rate

Supplementary Files

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