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Public knowledge and behaviours relating to antibiotic use in Gulf Cooperation Council countries: A systematic review

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ABSTRACT

The aim of this review was to assess public knowledge and behaviours in relation to antibiotic use in GCC countries. A systematic review was performed using MEDLINE, EMBASE and other relevant databases. Cross-sectional studies published from January 2000 to June 2017 relating to public knowledge and behaviours towards antibiotic use were included. Overall nine studies met the inclusion criteria for this systematic review. Nearly half of general public respondents in the GCC region reported a lack of knowledge about antibiotic use and showed negative attitudes towards antibiotic utilisation. Penicillin was the most frequently misused antibiotic, particularly for self-medication. Most respondents declared that they obtained information on antibiotics from pharmacists. Pharmacies were the major source of antibiotics used for self-medication. A multi-disciplinary approach must be put in place to educate the public on appropriate antibiotic use, to improve policies regarding the rational prescription of antimicrobials and to increase regulation enforcement.

Contents

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Introduction

It is a well-known fact that antibiotics are one of the largest boons of modern life. They have, since their discovery, been a potential source of life-saving drugs. However, antibiotics are hampered by the tendency of bacteria to rapidly develop "resistance" that results in the failure of the treatment [1]. In contrast to many other health problems, antimicrobial resistance (AMR) is an issue that concerns all countries, irrespective of their level of development and income [2]. Therefore, the World Health Organisation (WHO) described AMR as a main "global security threat" which could send medicine to a "post-antibiotic era" [2]. Similar to other countries worldwide, there is some evidence indicating that AMR constitutes a global challenge in the Gulf Cooperation Council (GCC) countries [3]. The GCC countries are an economic and political union. Constituent countries include; the Kingdom of Bahrain, Kuwait, Sultanate Oman, Qatar, the Kingdom of Saudi Arabia and United Arab Emirates (UAE). Many studies have revealed that AMR in different bacterial species has increased over the last decade in different regions of the GCC countries [4,5]. Therefore, identifying public knowledge and behaviours towards antibiotic use plays a key role in the success of tackling AMR [6,7]. Several lines of evidence suggest that understanding patients' knowledge and behaviour facilitates more efficient communication between the patient and clinician [8]. Secondly, since heterogeneity is sometimes required in public health interventions due to the fact that 'one size does not fit all', therefore a better understanding people's perceptions, knowledge and attitudes towards antibiotic usage among a specific population is important for implementing effective public health interventions that meet needs and fit the specific requirements of the target group [9]. Despite the importance of evaluating the public knowledge and behaviour regarding antibiotics, to date, there does not appear to be a systematic review on public knowledge and behaviour towards antibiotics in the GCC countries. Considering the magnitude of challenges that can stimulate the emergence and spread of AMR, the high prevalence of AMR, the lack of knowledge about antibiotics use and inappropriate use of antibiotics in the GCC countries context, efforts examining research from GCC countries in particular are urgently required. Thus, this systematic review was performed to assess the public knowledge and behaviours in relation to antibiotics among the general public in GCC countries. Information on the antibiotics frequently misused and sources of antibiotic information, recommendations and supply are also summarised.

Materials and methods

Data sources, search terms, and search strategy

MEDLINE (PubMed); AMED (Allied and Complementary Medicine) (via EBSCO); ASSIA (Applied Social Sciences Index and Abstracts) (via Proquest); BioMed Central; CINAHL Plus (Cumulative Index to Nursing and Allied Health Literature) (via EBSCO); and EMBASE were searched between 7 August 2017 and 3 September 2017. To emphasise the validity of the search strategy, multiple websites were systematically searched, including relevant online journals, Google Scholar and Researchgate. Reference tracing of the bibliographies of all related studies was conducted to emphasise the sensitivity of the original search strategy. Contacting authors of articles and organisations in the field was conducted to identify unpublished studies. Search terms were derived from main five keywords: 'public'; 'knowledge'; 'behaviour'; 'antibiotic' and 'Gulf Cooperation Council countries'. The search strategy is outlined in Table 1.

Selection criteria

The inclusion criteria for this review were the following: (1) cross-sectional studies; (2) published from January 2000 to June 2017; (3) relating to public knowledge and behaviour towards antibiotic use; (4) people of any age from the general public (including residents (i.e. people who live in the GCC region) and non-residents (i.e. people who mainly resides in one region or jurisdiction but has interests in the GCC region such as visitors); (5) written in English or Arabic languages; (6) Full-text articles and original research. Studies that included healthcare professionals participating in research while representing their profession were excluded. All articles focusing on public knowledge and behaviours in relation to antivirals, antifungals, antiprotozoals, and topical antimicrobials use or in relation to the problem of AMR or any other information not related to participants' knowledge and behaviours towards antibiotic utilisation were excluded. Studies that reflected the practice of self-medication with antibiotics studies that measured community behaviour only or practices only and those that did not determine knowledge behaviours were excluded. Studies including a survey that focused only on a specific population group (e.g. patients, caregivers, and parents), and those concerning antibiotic use for a particular illness, were excluded because of their potential to limit the generalisability of the findings. A PRISMA diagram detailing the study identification and selection process is given in Fig. 1.

Table 1
A list of the search terminology used in literature review.

Search terms for 'Public'	AND	Search terms for 'Knowledge'	AND	Search terms for 'behaviour'	AND	Search terms for 'antibiotic'	AND	Search terms for 'Gulf Cooperation Council countries'
Public* OR People* OR general population OR community		knowledge OR belief* OR awareness or view* OR perception		Behave* OR attitude* or use OR utili* OR practice		Antibiotic* OR AMs* OR Antimicrobial* OR Antibacterial		Gulf Cooperation Council countries OR GCC states OR Saudi Arabia OR Kuwait OR Bahrain OR Qatar OR Oman OR United Arab Emirates

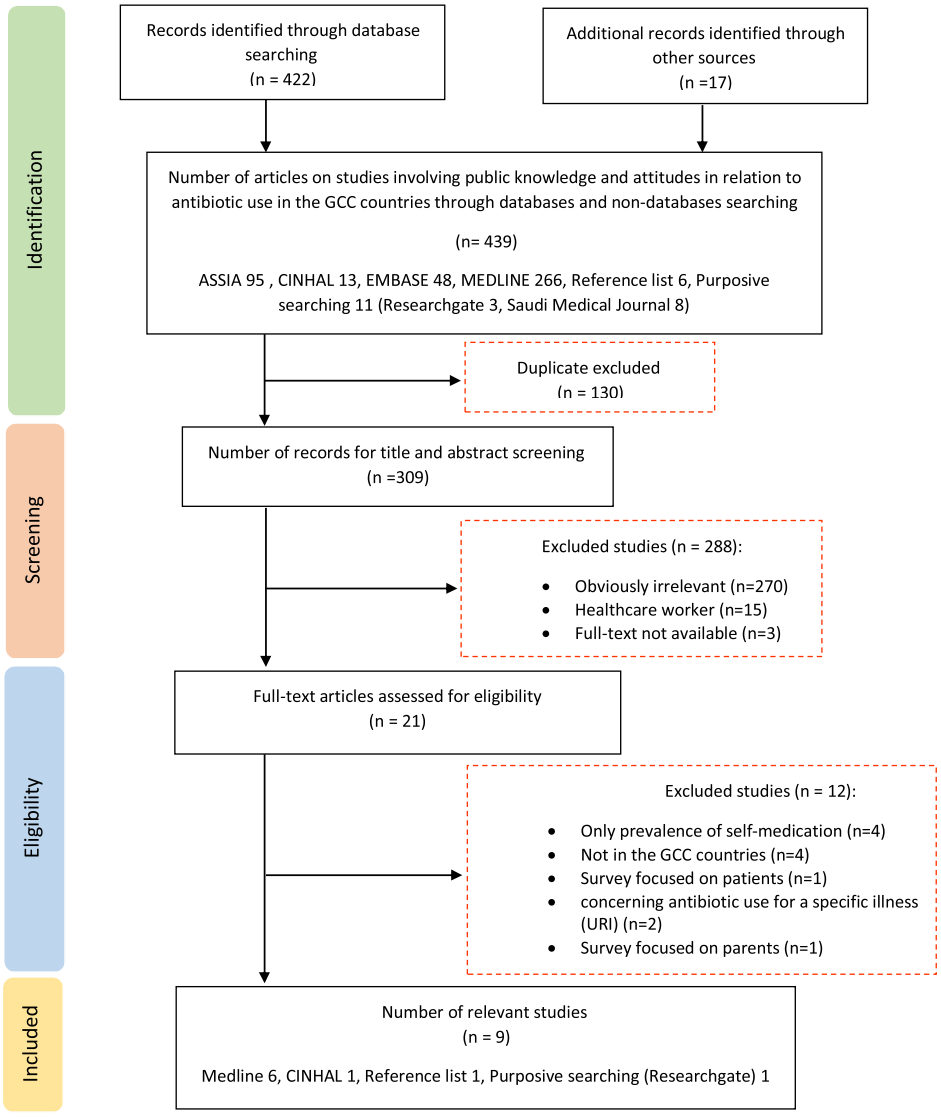

Fig. 1. PRISMA diagram of the study identification and selection process.

Study selection and quality assessment

One author RA assessed the search results to find potentially eligible studies. All search histories were merged using RefWorks and examined. The duplicates were removed as the first stage (identification). The next step (screening) was to screen citations based on the title and abstract provided, and only eligible studies were selected. The third stage (eligibility) involved obtaining the full-text articles for further investigation of relevance to the eligibility criteria. The fourth stage (included) was the conducting of a final scrutiny of the remaining studies (Fig. 1). For studies where eligibility was unclear, EB was invited to provide feedback and any disagreement was resolved with a discussion. The quality assessment process was conducted by RA using the Milton Keynes Primary Care Trust (2002) assessment tool [10]. The included studies were each graded by the general grading system A, B, C. One mark was allocated for each (Yes) answer. Then, the total score was calculated and divided by the total number of items multiplied by 100. Studies that scored from 0 to 40% were considered C, 41 to 70% were considered B, and 71 to 100% were interpreted as A. The authors chose to reject (C) grade papers from further inclusion in this review.

Data extraction and synthesis of results

Data extraction was performed by RA Information on the year of publication, country, sample size, setting, population, questionnaire administration process, response rate and participants' gender and age were extracted — as presented in Table 2. Data related to review objectives are illustrated in Table 3. Due to heterogeneity in the studies that met the eligibility criteria, a meta-analysis was not possible, so a narrative synthesis was undertaken.

Results

Study selection

A total of 422 studies were sourced electronically. A further six studies were identified through reference list searching, and eleven through purposive searching, totalling 439. 130 duplicates were

Table 2
Characteristics of the studies included.

Study	Country	Sample size (n)	Response rate (%)	Questionnaire administration	Setting	Population	Age (years)	Gender	
								F (%)	M (%)
Abdelrahman et al. [11]	Saudi Arabia	1028	NM	Face-to-face interview & internet-based-survey	NM	General public	All ages	28.5	71.5
Ajwah et al. [12]	Saudi Arabia	211	NM	Self-administered	Street, homes	General public	19–30	62.2	37.8
Awad and Aboud [13]	Kuwait	770	88.3	Self-administered	Ministries, universities, schools, and healthcare centers	General public	21–79	68.7	31.3
Belkina et al. [14]	Saudi Arabia	400	NM	Face-to-face interview	High schools	High school teachers	All ages	84	16
El Zowalaty et al. [15]	Saudi Arabia	1310	87.7	Face-to-face interview	Public areas, clinics, hospitals, houses, and universities	General public	Over 18	59	41
Emeka et al. [16]	Saudi Arabia	489	80.66	Face-to-face interview	NM	General public	18–59	21.4	78.6
Jose et al. [9]	Oman	718	85	Self-administered	NM	General public	18–60	54	46
Moienzadeh et al. [17]	Qatar	596	65	Self-administered	Community pharmacies	General public	Over 18	58.8	41.2
Nafisah et al. [18]	Saudi Arabia	473	98.75	Self-administered	Coffee shops, universities, a high school, and a secondary hospital	General public	All ages	55.8	44.2

NM, not mentioned; n, number. (No missing values were inferred).

Table 3
Methodological quality of included studies.

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	%	Grade	MA
Abdelrahman et al. [11]	1	1	0	1	0	0	0	1	1	1	60	B	Y
Ajwah et al. [12]	1	1	0	0	1	0	0	1	1	1	60	B	Y
Awad and Aboud [13]	1	1	1	1	1	1	1	1	1	1	100	A	Y
Belkina et al. [14]	1	1	0	0	1	1	1	1	1	0	70	B	Y
El Zowalaty et al. [15]	1	1	1	1	1	0	1	1	1	1	90	A	Y
Emeka et al. [16]	1	1	1	1	0	1	0	1	1	1	80	A	Y
Jose et al. [9]	1	1	1	1	0	1	1	1	1	1	90	A	Y
Moienzadeh et al. [17]	1	1	1	1	1	0	1	1	1	1	90	A	Y
Nafisah et al. [18]	1	1	1	1	1	1	1	1	1	1	100	A	Y

MA, methodologically accepted; Y, yes.
Q1 = Did the study address a clearly focused issue?
Q2 = Did the authors use an appropriate method to answer their question?
Q3 = Were the subjects recruited in an acceptable way?
Q4 = Were the measures accurately measured to reduce bias?
Q5 = Were the data collected in a way that addressed the research issue?
Q6 = Did the study have enough participants to minimize the play of chance?
Q7 = Did the authors take sufficient steps to assure the quality of the study data?
Q8 = Was the data analysis sufficiently rigorous?
Q9 = Is there a clear statement of findings?
Q10 = Can the results be applied to the GCC population?

excluded. The remaining 309 studies were subjected to stage two (screening), of which 288 were excluded for the following reasons: irrelevant (n = 270), evaluating healthcare workers' knowledge and attitudes in relation to antibiotics (n = 15) and abstract-only form (n = 3). Overall 21 studies were passed through for stage three (eligibility). Twelve studies were excluded for the following reasons: self-medication studies measured community behaviour and practices only and did not determine knowledge, attitudes or beliefs (n = 4), not conducted in the GCC countries (n = 4), involved a survey that focused only on patients (n = 1), concerned antibiotic use for a specific illness (upper respiratory infection) (n = 2) and included a survey that focused only on parents (n = 1). A final scrutiny of the full texts of the remaining nine studies was conducted. All nine studies met the eligibility criteria and were included in this review [9,11–18]. The PRISMA flow diagram was used to illustrate the identified eligible studies (Fig. 1).

Characteristics of eligible studies

Descriptive data extracted from the nine included studies is reported as an overview summary (Table 2). The studies covered 5995 participants of different ages. The response rate varied from 65% to 98.8% in the included studies that reported it. The sample size ranged from 211 to 1310. Additionally, data collection methods for the included studies varied from questionnaires, mixed methods using questionnaires and interviews to gathering information from the respondents. Also, the settings ranged from people's homes to community-based settings. The study duration varied among the different studies, ranging from 1 month to 11 months. The majority of the studies (67%) were performed in Saudi Arabia [11,12,14–16,18]. The remaining studies (33%) were conducted in Qatar [17], Oman [9] and Kuwait [13]. The residency status of the participants was not mentioned in any of the included studies.

Quality assessment

The assessment of the methodological quality of the included studies is summarised in Table 3. Six studies (67%) were considered to be of good overall quality (A) [9,13,15–18]. Three (33%) were assessed to be of fair quality (B) [11,12,14]. The mean methodological score was 82% (SD15.6%); the threshold for acceptable study quality was determined 41%. Under this ruling, all studies were deemed methodologically acceptable.

Knowledge concerning antibiotics' role

Overall, a lack of knowledge on antibiotic utilisation was detected. Across all the studies that measured knowledge and awareness of antibiotic utilisation, approximately half of participants though that antibiotics can be used for various non-bacterial infections and diseases [9,11–18]. Evidence revealed that the percentage of participants who did not know that antibiotics are not useful for viral infections ranged from 36% to 46% [13–15,17,18] and for colds ranged from 19% to 55% [9,11,13,16,17]. However, the percentage of participants who thought that antibiotics could be used for coughs ranged from 25% to 52% [9,13,14]. On the other hand, evidence from only two studies revealed that the percentage of participants who agreed that antimicrobials can treat bacterial infections ranged from 68% to 73% [11,17] (Table 4).

Antibiotic usage

The overall prevalence of people who had self-medicated antibiotics ranged from 14% to 73% [9,12,13,15–18]. The highest prevalence of self-medication was reported in Saudi Arabia (55%) [12,15,16,18], followed by Kuwait (28%) [13], Oman (18%) [9] and Qatar (14%) [17]. According to adherence to antibiotic courses, a high prevalence of participants who being prescribed an antibiotic did not complete their antibiotic course as prescribed, which ranged from 30% to 72% [9,11–13,15,17,18]. The commonly reported reason for not completing antibiotic courses was feeling better [9,11,13,15,17,18], followed by thinking the antibiotic does not work [9,12,15]. With regard to storing antibiotics, a high percentage of participants stored antibiotics at home from uncompleted courses, even sometimes beyond the expiration date, which ranged from 17% to 77% [9,11–13,15–17]. However, the percentage of participants who had shared their antibiotics with family members or friends ranged from 20% to 50% [9,11,12,17,18] (Table 4).

Antibiotic misuse

Two methodologically sound studies provided information about the antibiotics most frequently misused, particularly those used in self-medication [15,16]. Penicillin was the most frequently misused antibiotic, followed by macrolides, metrodinazole, cephalosporins, fluoroquinolones, and tetracyclin, as disclosed by participants. Among the penicillin used, amoxicillin and its combination with clavulanate were used by the majority of the participants.

Sources of antibiotic information, recommendations and supply

The Gulf Arab countries' populations acquired information about antibiotics, especially those used for self-medication, from different sources. Evidence revealed these to include pharmacists [11,14,16,18], other sources (e.g. previous successful experience with the same antibiotic, internet and advertisement) [11,12,14,16], followed by a family/friend member [11,12,14,16]. Furthermore, most of the antibiotics used for self-medication had been obtained from pharmacies [12,13] followed by a friend or family member [13].

Discussion

This systematic review was designed to gather different studies published from January 2000 to June 2017 that assessed general public knowledge and behaviours towards antibiotic usage in the GCC region. To the best of the authors' knowledge, this study is the first systematic review on this issue. The analyses conducted on nine different outcomes showed the following interesting results. This review found that nearly 40% of participants incorrectly thought that antibiotics work on most minor ailments, such as the common cold and cough, all of which can be self-limiting with suitable medical and supportive care. This result is comparable with findings concerning the European countries [19] and findings from many countries outside of the GCC [20]. Furthermore, this review revealed confusion among participants about whether antibiotics are effective against viruses or bacteria. Forty-four percent of participants did not know that antibiotics have no significant therapeutic effects on viruses, which is closely aligned with a previous review, which reported results from European countries [19]. These findings could be explained by an incomplete understanding of and misperceptions about whether antibiotics are effective against common colds and coughs, viruses, and bacteria. The general public's lack of knowledge about the correct utilisation of antibiotics could increase the number of requests for these drugs from general practitioners for illnesses in which antimicrobials are not useful. Accordingly, there was some evidence that the patient could affect the physician in antibiotic prescribing, as an over request could mean an over prescription [21]. This explains why common diseases (e.g. colds and coughs) account for 75% of the total antibiotic prescriptions [22].

Regarding public behaviours towards the sources of antibiotics, many people of the GCC countries' populations had self-medicated with antibiotics. It is worth mentioning that a high prevalence of those who self-medicated with antibiotics were reported to be from Saudi Arabia, which ranged between 41% and 73% [12,15,16,18]. The higher rate of self-medication in Saudi Arabia compared to other GCC countries could be associated with many factors. Firstly, the presence of the cities of Makkah and Madinah in Saudi Arabia, which are the focus of pilgrimage for Muslims from all over the globe, could be a major factor [23,24]. This is because the extreme congestion of people in those religious cities facilitates the appearance and global spread of several infectious diseases, which may increase the probability of the inappropriate use of antibiotics, including self-medication. Secondly, the market cost of medications in Saudi Arabia is determined by a centrally controlled committee at the Ministry of Health, which makes it the most cost-effective option, and therefore, many medications are available at low cost [25]. That could be an important factor for increasing the inappropriate use of antibiotics, because most medications are not covered by prescription plans or health insurance and so the patient self-pays for outpatient treatments [25]. The overall median proportions of self-medication reported in this review the figure was 45%, which is lower than that reported in studies from other Middle Eastern countries; namely, Palestine [26] and Yemen [27], which ranged between 56% and 78%, where the prevalence rates are more alarming. In contrast, some developed countries in Europe have much lower prevalence rates of self-medication, ranging from 1% to 4% [28]. This can in part be linked to the over-the-counter antibiotic sales and antibiotic prescriptions being strictly regulated in developed countries such as those of Europe. Also, it could in part be associated with the effectiveness of antibiotic stewardship programmes and national strategic plans in developed countries.

Furthermore, findings from this review support existing evidence that pharmacies are the main source of antibiotics used for self-medication in Middle Eastern countries [29]. Moreover, this review supports existing evidence that pharmacists, among other healthcare professionals, are the source of antibiotics information and supply in Middle Eastern societies; therefore, they are responsible for the extensive inappropriate use of antibiotics [30]. The provision of information about antibiotics without reliable information on the diagnosis, patient history and physical examination could potentially expose the patient to the risk of inappropriate drug use. Hence, pharmacists play an important role, particularly in

Table 4
Summary of results for the knowledge concerning antibiotic role and attitudes towards antibiotics.

Study	Knowledge					Behaviours								
	Reasons for using antibiotic therapy					Source of antibiotics		Adherence to an antibiotic courses					Action and use	
	Bacterial infection (%)	Viral infection (%)	Cough (%)	Cold (%)	Others[a] (%)	Prescribed (%)	Non-prescribed (%)	Complete (%)	Not complete				Sharing antibiotics (%)	Keeping antibiotics (%)
									(%)	Reasons				
										Feeling better (%)	Does not work (%)	Others[b] (%)		
Abdelrahman et al. [11]	73	NR	NR	41	69	62	NR	NR	52	52	NR	NR	26	52
Ajwah et al. [12]	NR	NR	NR	NR	27	39	41	39	72	NR	21	NR	50	34
Awad and Aboud [13]	NR	46	25	55	55	NR	28	65	36	68	NR	33	NR	44
Belkina et al. [14]	NR	41	52	NR	54	52	48	48	NR	39	13	NR	NR	46
El Zowalaty et al. [15]	NR	48	NR	NR	18	NR	64	39	71	71	NR	NR	NR	45
Emeka et al. [16]	NR	NR	NR	19	41	NR	73	NR	NR	NR	NR	NR	NR	77
Jose et al. [9]	NR	NR	39	39	39	NR	18	66	30	53	36	NR	40	17
Moienzdeh et al. [17]	68	47	NR	44	59	NR	14	NR	30	30	NR	NR	37	55
Nafisah et al. [18]	NR	36	NR	NR	46	NR	48	NR	40	40	NR	NR	20	NR

NR, not reported; n, number. (No missing values were inferred).
[a] Others = genitourinary infections, superficial wounds, respiratory disease, asthma, acne, fever, miscellaneous, pain relief, prophylactic use.
[b] Others = forget to take antibiotic, side-effect.

Middle Eastern societies, in educating patients, stopping antibiotic sales without a prescription and rationalising antibiotic usage.

In terms of drug use, this review found that amoxicillin and the amoxicillin-clavulanic acid combination were the most common sort of medications, as disclosed by respondents. Remarkably, undue utilisation of penicillin is also observed in all Middle Eastern countries [29]. No doubt the business-oriented attitude of practitioners [31], which is caused by the non-compliance with the existing dispensing laws and the consumers' desire to treat themselves without consultations, could be the main reason of the similar antibiotic patterns in other societies. Perhaps the high use of penicillins without prescription might be because of penicillin's widespread reputation among people, the fact that it does not have upsetting side effects – unlike other classes of antibiotics – and its low cost [32].

The current findings revealed that sources of obtaining antibiotics beyond the pharmacist included family members and friends. This is confirmed; a median of 37% of the study participants indicated that they had given an antibiotic to someone else to use without a medical consultation. Moreover, nearly half of responders store left-over antibiotics at home for future use, even often beyond the expiry date, and later sharing these antibiotics with others or self-medicating. These findings demonstrated that a high percentage of the GCC countries' populations share used antibiotics with others and store antibiotics at home from uncompleted courses, thus subjecting the general public to an increase in the problem of the inappropriate use of antibiotics. With regard to adherence to antibiotic courses, findings from this review showed evidence of a median of 40% of those being prescribed antibiotics not completing the course of antibiotics as prescribed. This pattern of inappropriate use in regard to adherence to antibiotic courses may put the patient at risk of relapse with resistant pathogenic bacteria.

Study strengths and limitations

This study is the first systematic review to assess the general public's knowledge and behaviours towards antibiotic usage in the GCC region. Additionally, through adopting systematic review methodology this review presents a transparent account of eligibility, quality assessment and data extraction. The current review also had some limitations. For example, the data collection process, the estimates of findings were obtained through self-report, potentially leading to information bias as participants may not precisely report or remember their activity. Although the research question specifies "GCC countries", two GCC countries were not captured in the review (i.e. Bahrain and UAE) due to the lack of studies conducted in these countries. However, in the case of knowledge and behaviours towards antibiotic use among populations in the GCC countries, the ability to generalise broadly to the whole population of GCC region could be viewed as suitable. One could argue that the whole population of GCC countries share similar economic, socio-political, cultural, and religious backgrounds [33,34]; therefore, the act of painting all GCC populations with the same brush could be suitable. Despite these limitations, the findings from the study add considerable insight to existing literature on antibiotic use among the GCC countries.

Implications of the findings of this review for further research

Much further investigation is required, particularly at other levels of influence (i.e. institutional, community, international, and national levels). Therefore, more research agendas are needed, as follows: Further research in UAE and Bahrain would be necessary to determine whether the inference that has been drawn cuts across all GCC populations, irrespective of their geographical regions. Further studies that seek to identify any other factors that have a negative impact on the use of antibiotics in GCC countries (e.g. socioeconomic status, educational level, age, gender) are also recommended. Perspectives of pharmacy staff, pharmacists and personnel who supply antibiotics need to be included in further research to emphasise their roles in the appropriate use of antibiotics. This would highlight the impact of the ease of obtaining antibiotics without prescription on the use of antibiotics. Further research should focus on other variables of the appropriate use of antibiotics, such as access to healthcare services, the role of health practitioners, and regulations relating to antibiotic supply and distribution.

Implications of the findings of this review for policy and practice

At a public level, antimicrobial stewardship programmes can address the misconception about antibiotic use by emphasis-

ing the differences between viruses and bacteria and providing examples of common infections caused by each one. In view of that, the public would understand that most colds and coughs are caused by viruses, which antibiotics are ineffective for. At the individual level, clinicians could use efficient strategies – for example, shared decision making [35] – to educate people about their actual risk of antibiotic resistance following antibiotic usage and provide information on how this resistance could be avoided. The findings of this study also highlight the need for good communication between clinicians and patients for supporting adherence and appropriate use. Further, in view of the fact that inappropriate use of antibiotics is also triggered by over-prescription of antibiotics or dispensing antibiotic without prescription, it is therefore essential that educational initiatives target prescription providers and antibiotic dispensers or pharmacists. For instance, European Antibiotic Awareness Day, which has been organised by the European Centre of Disease Prevention and Control every year since 2008, confirms the need for both European citizens and healthcare providers to utilise antibiotics responsibly [36]. Findings from this review adds to existing evidence that among the GCC populations Saudis self-medicate more; therefore, efforts should be made to target Saudi individuals.

Healthcare systems in both the private and public sectors in the GCC countries should improve their policies regarding the rational prescription of antimicrobials. Since pharmacists are the main source of antibiotic information to the GCC populations [11,14,16,18], the implementation of pharmaceutical care in each community pharmacy would help to increase the level of awareness of antibiotic usage, which is now poorly developed in the GCC region. The present regulations in the GCC countries decree that antibiotics are prescription-only medicines [25]; therefore, they must only be bought upon presenting a suitable prescription. The regulation also decrees that pharmacies are the only official sellers of antimicrobials. However, findings from this review showed that antibiotic medications are accessible to the general public and can be bought over the counter in the GCC countries, which is evident that the regulations are not strictly applied. For this reason, more regulation enforcement is needed.

With the alarming increase in the ABR, alternative therapeutic strategies are urgently needed to overcome this ever-changing bacterial battle. Many studies have revealed that there are some certain compounds investigated against infectious diseases such as Quorum – sensing inhibitor (QSI) [37,38]. Nevertheless, evidence is accumulating that they may get resistance mechanism(s) to be similar to those which confer resistance to antibiotics [37]. Although, such bioactive molecules do not confer resistance behaviour as observed with general antibiotics. Hence, the combinatorial therapy (such as the synergy of QISs and antibiotics) is one of the possible revolutionary approaches to combat the antibiotic resistance crisis in the near future [39].

Some studies, however, have indicated that no single intervention can sufficiently solve the complex problems related to antibiotic usage [40]. In light of this, a multi-disciplinary and multifaceted approach must be put in place to combat antimicrobial resistance. For instance, the regulatory measures and simultaneous public education campaigns which were conducted in Chile [41] and Zimbabwe [42] have had a great effect on controlling the non-prescription sale of antimicrobials, which has improved the resistance profiles of diseases. However, beyond this, tackling antimicrobial resistance needs a global approach that recognises the importance of implementing policies regarding the rational prescription of antimicrobials and regulatory measures by way of preventing inappropriate consumption.

Conclusion

This systematic review found that nearly half of the general public in the Gulf Cooperation Council region lack of knowledge about antibiotic use and showed negative attitudes towards antibiotic utilisation. In view of the importance of the world-wide problem of antimicrobial resistance, these findings let us recognise that there is still a long way to go towards a complete awareness of the appropriate use of antibiotics by the general public. A multi-disciplinary approach must be put in place to educate the public on appropriate antibiotic use, to improve policies regarding the rational prescription of antimicrobials and to increase regulation enforcement.

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