Public knowledge, attitude and practice towards antibiotics use and antimicrobial resistance in Saudi Arabia: A web-based cross-sectional survey

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Abstract

Background: Antimicrobial resistance is a global issue that causes significant morbidity and mortality. Therefore, this study aims to assess knowledge, attitudes, and practices (KAP) of the general Saudi populations toward antibiotics use.

Design and method: A cross-sectional, anonymous online survey was conducted from January 1 to May 11, 2020, across five major regions of Saudi Arabia. Participants (aged ≥18 years) were invited through social media to complete an online self-structured questionnaire. All data were analyzed by Statistical Package (SPSS v. 25). Descriptive statistics, Pearson’s Chi-squared, t-tests, one-way analysis of variance (ANOVA), and Pearson correlation analyses were conducted.

Results: Out of 443 participants, the majority (n=309, 69.8%) were females, 294 (64.4%) were married, 176 (39.7%) were 25-34 years of age, 338 (76.3%) were living in the Eastern Province, 313 (70.7%) had college or higher education, 139 (31.4%) were not working, and 163 (36.8%) had a monthly income of USD 800-1330. Overall, most participants demonstrated good knowledge and practice (88% and 85.6%, respectively). However, 76.8% had inadequate attitude score levels towards antibiotics use. Of all the respondents, 74.9% knew that not completing a full course of antibiotics may cause antibiotics resistance, 91.33% did not agree that antibiotics should be accessed without a prescription, and 94.04% will not hand over leftover antibiotics to family members. Factors associated with adequate knowledge were female, medical jobs, and higher income (p<0.05).

Conclusions: Our findings revealed that while most participants were aware of antibiotics use and demonstrated good knowledge, good practices, they had negative attitudes towards antibiotics use.

Significance for public health

Antibiotics are considered the miracle of medicine that can cure patients with infectious diseases. In the Kingdom of Saudi Arabia, few studies described antimicrobial practices. Most of the surveys were limited to certain areas. Therefore, this study assessed general knowledge, practices, and attitudes towards antibiotics use in multiple regions of Saudi Arabia. The findings could be used to assess the level of awareness about antibiotic use and may help policymakers to develop plans, laws, and programs to limit misuse of antibiotics and to preserve the health of the general population of Saudi Arabia.
Introduction
Antimicrobials are essential for the prevention and treatment of infections in humans, animals, and plants.1 Antimicrobial resistance (AMR) threatens the ability to cure infectious diseases and contributes to the increased risk of death.2 AMR is estimated to cause at least 700,000 deaths each year globally3 and more than 35,000 people die each year in the United States4 making it an urgent public health problem.5 The problem of AMR is also common in low and middle-income countries, and is mainly caused by common bacterial pathogens, including Escherichia coli, Salmonella spp., or Streptococcus pneumoniae, Mycobacterium tuberculosis.6 In most developed countries, antibiotics can be obtained without a medical prescription.5 The prevalence of non-prescription use of antibiotics is estimated around 3% in developed countries and about 100% in developing countries.4 On April 17, 2018, the Saudi Ministry of Health (Saudi-MOH) has mandated that all pharmacies must not dispense antibiotics without prescription.6 Consequently, any pharmacy that dispenses antibiotics without a prescription is subjected to a fine of up to 100,000 Saudi riyals (equivalent to the US$ 26,600), to revocation of the license and to imprisonment for up to six months.6 Such regulations had resulted in a significant reduction in over-the-counter selling of antibiotics from 70.7% to 12.9% after law enforcement.7

According to a survey of twenty pharmacists conducted in Saudi Arabia’s Eastern Province, most antibiotics are frequently sold over-the-counter (OTC).8 Also, two such studies found that 77.6-97.9% of community pharmacists dispense antibiotics without a prescription.9,10 Additionally, a study of antibiotics in the pediatric population showed a need for a better antimicrobial prescription.11 However, lack of awareness is a major factor in the misuse of antibiotics worldwide.12 Patients’ knowledge, attitude, and practice (KAP) are considered important factors leading to such misuse.13 Few studies were conducted on the KAP towards antibiotics in Saudi Arabia, and most of them were confined to a specific region.14-16 Therefore, our study aims to assess KAP towards antibiotics use and AMR among the general public in Saudi Arabia.

Design and methods

Study area, design, and period
This web-based cross-sectional survey was conducted over four months, from January 14th to May 11th, 2020, covering all five regions of Saudi Arabia.

Study participants
A virtual snowball sampling method was used in this study and targeted Saudi adult citizens (18 years and over).

Questionnaire designed
The investigators developed the questionnaire through a literature review and consisted of 51 closed-ended type questions in the form of multiple-choice answers. The questionnaire was made both in English and Arabic languages. The questionnaire consisted of four parts. The first part related to the participant’s sociodemographic data and had seven items (gender, age, marital status, place of residence, educational level, occupational status, and income). The second part had 17 items to assess knowledge about antibiotics use and antimicrobial agent. The third part had ten items about the attitude towards antibiotics use and AMR. Attitudes’ items have a 5-points Likert scale (1 strongly disagree to 5 strongly agree). The fourth part assessed the participants’ practice towards antibiotics use and AMR, and each part had 16 questions in the form of a 5-points Likert scale (1 strongly disagree to 5 strongly agree). A pilot pre-test questionnaire was conducted from January 15 to January 17, 2020. During that phase, 35 individuals undertook the questionnaire to examine its validity and reliability and ensure clarity and understanding. Relevant inputs of the participant were taken into consideration, and the questionnaire was modified accordingly. Cronbach’s α coefficient was used to test the questionnaire’s internal consistency and taken when it was above (0.7). Responses from the pilot study were not included in the final study results.

Data collection tools and procedure
Data were collected via Google Forms utilizing an online survey. The link to the questionnaire was sent by WhatsApp and other social media. Informed consent was obtained from the respondents before participating in this study.

Statistical analysis
All data were cleaned, coded, entered, and analyzed using Statistical Package (SPSS v. 25). Frequencies and percentages described the basics. Pearson’s χ2-test was used to find the association between the level of antibiotics knowledge (good / poor) and sociodemographic variables. According to sociodemographic variables, the t-independent sample and ANOVA tests were used to find the differences in antibiotics’ attitudes and practices.

Finally, the Pearson correlation test was used to test the relation between the total score of knowledge and mean scores of antibiotics attitude and practice. A p-value of 0.05 was considered significant. Data were reported as percentages and 95% confidence intervals (CI). The strength of the correlation between knowledge, attitude and practice of antibiotics describes as follow: 0.0-0.19 weak, 0.2-0.39 low, 0.4-0.6 medium, 0.7-0.89 high, and 0.9-1.0 very high.

Table 1. Sociodemographic characteristics, total respondents (n=443).

| Variables                  | Response options | n   | %  |
|----------------------------|------------------|-----|-----|
| Gender                     |                  |     |     |
| Male                       |                  | 134 | 30.2|
| Female                     |                  | 309 | 69.8|
| Age                        |                  |     |     |
| 18-24                      |                  | 71  | 16.0|
| 25-34                      |                  | 176 | 39.7|
| 35-44                      |                  | 107 | 24.2|
| >44 year                   |                  | 89  | 20.1|
| Marital status             |                  |     |     |
| Single                     |                  | 133 | 30.0|
| Married                    |                  | 294 | 66.4|
| Divorced                   |                  | 12  | 2.7 |
| Widowed                    |                  | 4   | 0.9 |
| Place of living            |                  |     |     |
| Central Province           |                  | 37  | 8.4 |
| Eastern Province           |                  | 338 | 76.3|
| Western Province           |                  | 55  | 12.4|
| Northern Province          |                  | 6   | 1.4 |
| Southern Province          |                  | 7   | 1.6 |
| Educational level          |                  |     |     |
| Primary                    |                  | 3   | 0.7 |
| Middle                     |                  | 4   | 0.9 |
| Diploma/High school        |                  | 123 | 27.8|
| College and above          |                  | 313 | 70.7|
| Occupational status        |                  |     |     |
| Student                    |                  | 74  | 16.7|
| Unemployed                 |                  | 139 | 31.4|
| Medical job                |                  | 108 | 24.4|
| Non-medical job            |                  | 122 | 27.5|
| Income (monthly)           |                  |     |     |
| 800 USD - 1330 USD         |                  | 163 | 36.8|
| 1331 USD - 2666 USD        |                  | 93  | 21.0|
| 2667 USD - 4000 USD        |                  | 88  | 19.9|
| > $4000 USD                |                  | 99  | 22.3|
“very weak”, 0.20-0.39 “weak”, 0.40-0.59 “moderate”, 0.60-0.79 “strong” and 0.80-1.0 “very strong”. KAP’s total scores were categorized into “good” and “poor” scores based on an 80% cut-off score.

Results

Sociodemographic characteristics of the study population

Table 1 shows the demographic status of the participants (n=443). Briefly, the study population was predominated by females (n=309, 69.8%), and by age group of 25-34 years, representing 176 (39.7%) of the participants. Of the total respondents, 338 (76.3%) were from the Eastern Province, and 294 (64.4%) were married. Furthermore, 313 (70.7%) of the participants had received college and higher degrees education, 39 (31.4%) of the responders were not working, and 163 (36.8%) of the participants earned a monthly income of USD 800-1330.

Knowledge towards antibiotics use

Figure 1 shows the percentage of correct answers to each of the knowledge questions related to antibiotics use. Of the total respondents, 76.5% knew that antibiotics could be used to treat a bacterial infection, 74.9% knew that not completing the full course of antibiotics may cause antibiotics resistance, 67.5% knew that antibiotics might kill the beneficial bacteria that normally live on the skin or in the stomach/intestines, and 56.9% knew that antibiotics should not be used to treat viral infections. Figure 2 shows that 88% of the respondents had good knowledge towards antibiotics use.

Association between knowledge of antibiotics use and demographic variables

Demographic factors associated with good knowledge were female, medical staff, and higher income (p<0.05) (Table 2). In contrast, other demographic factors (age, marital status, place of living, and educational level) have no association with participant’s knowledge. Female participants with medical jobs and higher income had better knowledge than male or female participants with non-medical jobs, unemployed, students, or lower income.

Attitudes towards antibiotics use

Overall, the respondents’ score in relation to attitudes was 76.8%. Figure 3 shows the participants’ attitude towards antibiotics use. Of all the respondents, 92.55% trusted the physician’s decision when deciding not to prescribe an antibiotic, 91.87% believed that doctors should not give antibiotics when not needed, and 91.33% did not agree that antibiotics should be accessed without a prescription. On the other hand, approximately two-thirds (66%) of the participants did not believe that antibiotics could prevent any illness from becoming worse. Moreover, 63.7% did not believe that natural sources work better than antibiotics. Unfortunately, over half (50.5%) believed that lower doses could cause fewer side effects (Figure 3).

Differences in attitude towards antibiotics use related to demographic variables

Table 3 shows differences in attitude towards antibiotics use according to demographic variables. There is a statistically significant difference in the mean score of attitudes towards antibiotics in relation to (age, marital status, and occupational status) (p<0.05). Whereas other demographic factors (gender, place of living, educational level, and income) were no statistically significant difference in the mean score of the attitudes towards antibiotics use. Being single or married participants <35 years with medical jobs have a good attitude compared to others.

Practices towards antibiotics use

The overall respondents’ score in relation to practice was 85.6%. Figure 4 shows the participants’ practice towards antibiotics use. Of all the respondents, 94.54% did not get antibiotics from relatives without a physician’s prescription, 94.04% will not hand over leftover antibiotics to family members if they were sick, and 93%

![Figure 1. Respondents' knowledge towards antibiotics use of the total respondents (n=443).](image-url)
would not have changed antibiotics if the physician had not prescribed antibiotics to them. Four-fifths (80.10%) of the participants disagreed that they had used leftover antibiotics in the event of repeated illness, and 79% did not use leftover antibiotics for a respiratory illness (runny nose/sore throat/fever). However, 78.1% did not stop taking antibiotics when they feel better (Figure 4).

Table 2. Association between knowledge of antibiotics and sociodemographic variables.

| Variables          | Response options | Poor | Good | χ²      | p     |
|--------------------|------------------|------|------|---------|-------|
| Gender             | Male             | 19.4%| 80.6%| 10.094  | 0.001**|
|                    | Female           | 8.74%| 91.26%|         |       |
| Age                | 18-24            | 16.9%| 83.1%| 3.324   | 0.344 |
|                    | 25-34            | 10.23%| 89.77%|         |       |
|                    | 35-44            | 14.02%| 85.98%|         |       |
|                    | >44 years        | 8.99%| 91.01%|         |       |
| Marital status     | Single           | 15.03%| 84.97%| 2.212   | 0.530 |
|                    | Married          | 10.89%| 89.11%|         |       |
|                    | Divorced         | 8.33%| 91.67%|         |       |
|                    | Widowed          | 0.0% | 100%  |         |       |
| Place of living    | Eastern Province | 10.65%| 89.35%| 4.341   | 0.362 |
|                    | Western Province | 16.36%| 83.64%|         |       |
|                    | Northern Province| 16.67%| 83.33%|         |       |
|                    | Southern Province| 0.0%  | 100%  |         |       |
|                    | Central Province | 18.92%| 81.08%|         |       |
| Educational level  | Primary School   | 33.33%| 66.67%| 1.992   | 0.574 |
|                    | Middle School    | 25%   | 75%   |         |       |
|                    | Diploma/High School| 11.38%| 88.62%|         |       |
|                    | College and above| 11.82%| 88.18%|         |       |
| Occupational status| Student          | 18.22%| 83.78%|         |       |
|                    | Unemployed       | 8.63%| 91.37%|         |       |
|                    | Medical Jobs     | 2.78%| 97.22%|         |       |
|                    | Non-Medical Jobs | 21.31%| 78.69%|         |       |
| Income             | 800-1333 USD     | 9.82%| 90.18%|         |       |
|                    | 1334-2666 USD    | 19.35%| 80.65%|         |       |
|                    | 2667-4000 USD    | 15.91%| 84.09%|         |       |
|                    | >4000 USD        | 5.05%| 94.95%| 11.330  | 0.010*|

*p=0.05; **p=0.01; poor/good within demographic variables.

Figure 2. Overall KAP score levels towards antibiotics use.
Differences in practice towards antibiotics use related to demographic variables

Table 3 shows differences in practice towards antibiotics use according to demographic variables. There is a statistically significant difference in the mean score of the practices towards antibiotics use in (gender, marital status, place of living, and occupational status) (p<0.05). Whereas other demographic factors (age, educational level, and income) were no statistically significant difference in the mean score of the practices towards antibiotics use. Female, married or widow, living in the Eastern Region, and being in medical jobs have a good practice compared to others.

![Figure 3. Respondents’ attitudes towards antibiotics use of the total respondents (n=443).](image)

Table 3. Differences in the mean score of attitude and practice towards antibiotics use related to demographic variables.

| Variables       | Response options | Mean | SD  | p       | Mean | SD   | p       |
|-----------------|------------------|------|-----|---------|------|------|---------|
| Gender          | Male             | 3.7903 | 0.49095 | 0.173  | 4.1455 | 0.7027 |         |
|                 | Female           | 3.8631 | 0.52595 |        | 4.3374 | 0.58039 | 0.006** |
| Age             | 18-24            | 3.8535 | 0.50817 |        | 4.1294 | 0.62895 |         |
|                 | 25-34            | 3.9437 | 0.47577 | 0.003** | 4.3303 | 0.60962 |         |
|                 | >44 year         | 3.7493 | 0.48889 |        | 4.2890 | 0.60951 |         |
| Marital status  | Single           | 3.8579 | 0.50064 | 0.008** | 4.1438 | 0.65275 |         |
|                 | Married          | 3.8561 | 0.51457 |        | 4.3499 | 0.59973 |         |
|                 | Divorced         | 3.5000 | 0.53258 |        | 3.9896 | 0.75652 |         |
|                 | Widowed          | 3.2000 | 0.63770 |        | 4.4688 | 0.34799 | 0.005** |
| Place of living | Eastern Province | 3.8530 | 0.50441 | 0.008** | 4.1438 | 0.65275 |         |
|                 | Western Province | 3.7436 | 0.54561 |        | 4.0955 | 0.69989 |         |
|                 | Northern Province| 3.9167 | 0.67355 |        | 3.8958 | 0.82790 |         |
|                 | Southern Province| 3.9857 | 0.49381 |        | 3.8750 | 1.15688 |         |
|                 | Central Province | 3.8378 | 0.50880 |        | 4.2416 | 0.66333 |         |
| Educational level| Primary school  | 3.7000 | 0.70000 | 0.055  | 4.3542 | 0.68560 | 0.481   |
|                 | Middle school    | 3.8500 | 0.45768 |        | 4.4844 | 0.42197 |         |
|                 | Diploma/high school | 3.7350 | 0.53216 |        | 4.2093 | 0.62995 |         |
|                 | College and above| 3.8840 | 0.50479 |        | 4.3805 | 0.62657 |         |
| Occupational status | Student        | 3.8959 | 0.51457 |        | 4.2171 | 0.61003 |         |
|                 | Unemployed       | 3.8165 | 0.32704 |        | 4.2662 | 0.69100 |         |
|                 | Medical jobs     | 3.9844 | 0.50965 | 0.000** | 4.4398 | 0.61617 | 0.015** |
|                 | Non-medical jobs | 3.7000 | 0.47552 |        | 4.1801 | 0.65331 |         |
| Income          | 800-1330 USD     | 3.8620 | 0.51940 | 0.085  | 4.2113 | 0.63031 | 0.182   |
|                 | 1331-2666 USD    | 3.8140 | 0.49751 |        | 4.3367 | 0.56724 |         |
|                 | 2667-4000 USD    | 3.8500 | 0.53920 |        | 4.3736 | 0.58610 |         |
|                 | >4000 USD        | 3.8242 | 0.51411 |        | 4.2538 | 0.68952 |         |

SD, standard deviation; *p=0.05; **p=0.01.
Correlation between knowledge, attitude, and practice towards antibiotics use

There is a statistically significant relationship between the three variables (knowledge, attitude, and practice) ($p<0.01$). The highest correlation coefficient was found between attitude and practice (0.462; moderate relation), followed by 0.381 for the relationship between knowledge and attitude, then 0.301 for the relationship between knowledge and practices.

Discussion

Antimicrobial resistance (AMR) is a global problem that is further complicated by the issue of antibiotics misuse in hospital settings and in the community. In Saudi Arabia, there had been an increasing prevalence of extended-spectrum *Escherichia coli* and *Klebsiella pneumoniae*.$^{17}$ The Kingdom of Saudi Arabia is of particular importance as it hosts the annual Hajj with increasing AMR$^{18,19}$ and being in the Middle East as a focus of AMR.$^{20}$ The use of antibiotics is affected by the interaction of knowledge, expectations, and interactions between prescribers and patients, as well as economic, health systems, and environmental factors.$^{12}$ Consequently, it is essential to assess the public’s knowledge, practices, and attitudes (KAP) towards antibiotics use. In the current study, it was found that women, medical staff, and higher-income earners were significantly associated with a higher level of knowledge of antibiotics as opposed to men, unemployed participants, and low-income individuals.

There had been few studies addressing the KAP of antimicrobial agents among various populations in KSA. Those studies were limited to specific geographic regions of Saudi Arabia, such as the Eastern Province,$^{14}$ Riyadh,$^{15}$ and Al-Kharj area.$^{16}$ However, in this study, we included respondents from several parts of Saudi Arabia. The study shows that most participants have good knowledge, good practice, and inadequate attitudes towards antibiotics, especially antibiotics’ doses and effectiveness. The study demonstrated that 88% of participants were knowledgeable about the use of antibiotics. Moreover, female participants and those with medical jobs and higher income had better knowledge regarding the use of antibiotics. In contrast, a previous study in the Eastern Province of Saudi Arabia’s revealed a lack of knowledge of antibiotics use.$^{14}$ Moreover, three-fourths of respondents knew that not completing a full course of antibiotics may cause AMR, in contrast to almost two-fifths of surveyed individuals in another study who stopped taking antibiotics once they are better.$^{21}$ Nearly 60% of participants knew that antibiotics should not be used to treat viral infections. This is in agreement with a previous study from Saudi where 53.2% indicated that antibiotics should not be used to treat viral infections.$^{16}$ On the contrary, Saudi studies showed that most of the participants do not believe that antibiotics can be used in the treatment of viral infections.$^{14,16}$ Most of the public might not be able to differentiate bacteria from viruses. Thus, they believe that antibiotics may be used to treat viral and bacterial infections. More than two-thirds of respondents agree that antibiotics may kill the body’s bacterial flora. In contrast with another study from Saudi Arabia, more than one-quarter of respondents did not agree that antibiotics can cause an imbalance in the body’s bacterial flora.$^{14}$ Almost three-quarters of study respondents agree that not completing the full course of antibiotics may cause AMR. In contrast to a Saudi study, more than half of the participants knew that AMR is caused by an incomplete course of antibiotics.$^{15}$ It was found that three-fifths of the participants were aware that antibiotics could be used to treat a bacterial infection. This is a higher rate than that found in similar studies in Al-Kharj Saudi Arabia.$^{16}$

The present study showed inadequate attitudes’ score level towards antibiotics use with an overall attitude score was 76.8%. Approximately two-thirds of the participants did not believe that antibiotics could prevent any illness from becoming worse. Moreover, nearly two-thirds (63.7%) did not believe that natural sources work better than antibiotics. Unfortunately, more than half believed that the lower doses could cause fewer side effects. Most of the participants agree that doctors should not give antibiotics when not needed, followed by did not agree that antibiotics should be accessed without a prescription. An earlier study from Riyadh, Saudi Arabia, showed that more than two-thirds of participants had self-prescribed antibiotics and had access to these medications.
Our findings showed that most participants had good knowledge, practice towards antibiotics use but demonstrated an insufficient attitude toward antibiotics use. Health education programs and health promotion campaigns are essential to reduce antibiotic misuse by raising health awareness. Therefore, further studies are necessary to evaluate the effects of awareness on antibiotics use to minimize antibiotic resistance rates.

**Conclusions**

Our findings showed that most participants had good knowledge, practice towards antibiotics use but demonstrated an insufficient attitude toward antibiotics use. Health education programs and health promotion campaigns are essential to reduce antibiotic misuse by raising health awareness. Therefore, further studies are necessary to evaluate the effects of awareness on antibiotics use to minimize antibiotic resistance rates.

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**Contributions:** AHAA, HAA, SMHA, ZMMA, ASMR, MAAD, study conception and design; AHAA, data analysis; AHAA, JAAT, MB, MHT, intellectual content, data interpretation, article drafting; AHAA, JAAT, MSHAK, RBFS, KKSA, ZHAK, AAHA, manuscript revising, editing and proofreading. All the authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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**Ethical approval:** Ethical approval was not required for this survey. As data were anonymously collected via an online survey, no personal information was obtained, such as name, phone, and address. Informed consent was obtained from all participants involved in the study. Furthermore, the study was conducted confidentially and voluntarily. Any individual or group's identity has not been collected, and all data were protected.

**Availability of data and material:** The datasets created and analyzed in the current study are not publicly accessible because of the confidentiality of participants but can be obtained from the corresponding author upon reasonable request.

**Conflict of interest:** The authors declare that they have no competing interests, and all authors confirm accuracy.

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References

1. World Health Organization. Antimicrobial resistance. Accessed: 2021 Mar 13. Available from: https://www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance

2. GOV.UK. [Internet]. UK 20-year vision for antimicrobial resistance. Accessed: 2021 Mar 13. Available from: https://www.gov.uk/government/publications/uk-20-year-vision-for-antimicrobial-resistance

3. Centers for Disease Control and Prevention [Internet]. What Exactly is antibiotic resistance? 2020. Accessed: 2021 Mar 13. Available from: https://www.cdc.gov/drugresistance/about.html

4. Morgan DJ, Okeke IN, Laxminarayan R, et al. Non-prescription antimicrobial use worldwide: a systematic review. Lancet Infect Dis 2011;11:692–701.

5. Lansang MA, Lucas-Aquino R, Tupasi TE, et al. Purchase of antibiotics without prescription in Manila, The Philippines. Inappropriate choices and doses. J Clin Epidemiol 1990;43:61–7.

6. MOH News [Internet]. MOH Launches a campaign to supervise dispensing of non-prescribed antibiotics. Accessed: 2020 Dec 27. Available from: https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/news-2018-05-06-001.aspx

7. Alrasheedy AA, Alsalloum MA, Almuqbil FA, et al. The impact of law enforcement on dispensing antibiotics without prescription: a multi-methods study from Saudi Arabia. Expert Rev Anti Infect Ther 2020;18:87–97.

8. Alhomoud F, Almahasnah R, Alhomoud FK. “You could lose when you misuse”– factors affecting over-the-counter sale of antibiotics in community pharmacies in Saudi Arabia: a qualitative study. BMC Health Serv Res 2018;18:1–9.

9. Al-Mohamadi A, Badr A, Bin Mahfouz L, et al. Dispensing medications without prescription at Saudi community pharmacy: Extent and perception. Saudi Pharm J 2013;21:13–8.

10. Bin Abdulhak AA, Al Tannir MA, Almansor MA, et al. Non prescribed sale of antibiotics in Riyadh, Saudi Arabia: A Cross Sectional Study. BMC Public Health 2011;11:538.

11. Al-Tawfiq JA, Alawami AH. A multifaceted approach to decrease inappropriate antibiotic use in a pediatric outpatient clinic. Ann Thorac Med 2017;12:51–4.

12. World Health Organization. Global strategy for containment of antimicrobial resistance. 2001. Available from: https://apps.who.int/iris/handle/10665/66860

13. Benmerzouga I, Al-Zammay SA, Al-Shammari MM, et al. Practices of patients consuming antibiotics and knowledge about antibiotic resistance in Hail region – Saudi Arabia. Future Sci OA 2019;5:FSO420.

14. Aldhafar A, Talat W. Knowledge, attitude, and practice toward the usage of antibiotics among public in Al-Ahsa, Saudi Arabia. Int J Sci Stud 2017;4):14–7.

15. Al-Shibani N, Hamed A, Labban N, et al. Knowledge, attitude and practice of antibiotic use and misuse among adults in Riyadh, Saudi Arabia. Saudi Med J 2017;38):1038.

16. Alqarni SA, Abdulbari M. Knowledge and attitude towards antibiotic use within consumers in Alkharij, Saudi Arabia. Saudi Pharm J 2019;27:106–11.

17. Al-Tawfiq JA, Rabaan AA, Saunar JV, Bazzi AM. Antimicrobial resistance of gram-negative bacteria: A six-year longitudinal study in a hospital in Saudi Arabia. J Infect Public Health 2020;13:737–45.

18. Leangapichart T, Rolain J-M, Memish ZA, et al. Emergence of drug resistant bacteria at the Hajj: A systematic review. Travel Med Infect Dis 2017;18:3–17.

19. Al-Tawfiq JA, Memish ZA. The emergence, persistence, and dissemination of antimicrobial-resistant bacteria in environmental Hajj settings and implications for public health. Trop Med Infect Dis 2021;6:33.

20. Al-Tawfiq JA, Stephens G, Memish ZA. Inappropriate antimicrobial use and potential solutions: a Middle Eastern perspective. Expert Rev Anti Infect Ther 2010;8:765–74.

21. Belkina T, Al Warafi A, Hussein Eltom E, et al. Antibiotic use and knowledge in the community of Yemen, Saudi Arabia, and Uzbekistan. J Infect Dev Ctries 2014;8:424–9.

22. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. PLoS One 2015;10:e0117910.

23. van der Zande MM, Dembinsky M, Aresi G, van Staa TP. General practitioners’ accounts of negotiating antibiotic prescribing decisions with patients: a qualitative study on what influences antibiotic prescribing in low, medium and high prescribing practices. BMC Fam Pract 2019;20:172.

24. Wang D, Liu C, Wang X, Zhang X. Association between physicians’ perception of shared decision making with antibiotic prescribing behavior in primary care in Hubei, China: A cross-sectional study. Antibiotics (Basel) 2020;9:876.

25. Tirupathi R, Areti S, Salim SA, et al. Acute bacterial skin and soft tissue infections: new drugs in ID armamentarium. J Community Hosp Intern Med Perspect 2019;9:310–3.