ABRAN ASSOCIAÇÃO BRASILEIRA DE NUTROLOGIA
International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

ORIGINAL ARTICLE

DOI: 10.54448/ijn26310

Assessment knowledge, attitudes, and practices of healthcare workers and residents related to antimicrobial resistance in Al-Suwaria city, Wasit Governorate, Iraq: a cross-sectional study

Manal Hadi Ghaffoori Kanaan[1,*]; Iqbal Hanash Dhefer[1]; Ahmad M. Tarek[2]; Wisam Fawzi Aljhyiish[3]; Sura Saad Abdullah[4]; Marianne Marianne[5]

[1] Middle Technical University. Technical Institute of Suwaria. Department of Food Industry Technologies, Baghdad, Iraq.
[2] Middle Technical University Department of Crime Evidence. Institute of Medical Technology Al-Mansour, Baghdad, Iraq.
[3] Middle Technical University. Technical Institute of Suwaria, Baghdad, Iraq.
[4] Ajou University. College of Pharmacy, Suwon 16499, Republic of Korea.
[5] Universitas Sumatera Utara. Faculty of Pharmacy. Department of Pharmacology, Medan, Indonesia.

*Corresponding author: Manal Hadi Ghaffoori Kanaan.
Middle Technical University. Technical Institute of Suwaria.
Department of Food Industry Technologies, Baghdad, Iraq.
Phone number: +9647714525509
E-mail: manalhadi73@yahoo.com
dr.manalhadi@mtu.edu.iq
DOI: https://doi.org/10.54448/ijn26310
Received: 05-14-2026; Revised: 07-03-2026; Accepted: 07-07-2026; Published: 07-13-2026; IJN-id: e26310

Editor: Dr Eemaz Nathaniel, MBBS

Abstract

Introduction: Antimicrobial resistance (AMR) is one of today's biggest public health challenges. Fighting this global public health threat requires cross-sector cooperation. Thus, this study examined the knowledge, attitudes, and practices (KAP) of inhabitants and health care workers (HCWs) in Al-Suwaria City at Wasit province, Iraq about AMR. **Methods:** This study used 125 random contributors for cross-sectional analysis from January to April 2024. A questionnaire gathered participants' demographic information, as well as their antibiotic resistance knowledge, attitudes, and behaviors. The data was analyzed using a Statistical Analysis System (SAS). **Results:** According to knowledge evaluation questions, only 43.75% demonstrated a good understanding of AMR. There are also knowledge gaps in the ability to use antibiotics to treat viral infections (24.0%) and tackle antibiotic resistance by discovering novel medicines (56.0%). Additionally, high rates of participants (50.4%) strongly agreed on the need to governor over-the-counter (OTC) antibiotic administration, while 47.2% had weak attitudes toward healthcare professionals' infection control practices combating AMR in their region. Regarding practices to AMR, our findings showed that 57.14% of responders had insufficient procedures. While the knowledge and attitude of the participants in this study were significantly correlated ($p \leq 0.01$), the knowledge and practices ($p = 0.266$) and attitudes and practices ($p = 0.6072$) did not show a significant correlation ($p \geq 0.05$). **Conclusions:** An educational intervention tailored to individuals and HCWs' sociodemographic and professional characteristics is needed to bridge theory and practice and enhance attitudes and practices.

Keywords: Antimicrobial resistance. Antimicrobial stewardship. Healthcare workers. KAP.

Introduction

The complicated issue of AMR poses a significant threat to public health across the world, especially in poorer nations **[1]**. Antibiotic resistance characteristics in bacterial populations are a consequence of selection pressure caused by overuse and abuse of antibiotics, which has global negative implications for healthcare, veterinary, and agriculture **[2-6]**. An upsurge in AMR has the potential to compromise antibiotics' therapeutic

efficacy, raise treatment failure rates, and cause more frequent and severe illnesses, which in turn can increase healthcare expenditures and death rates [7-9]. Globally, AMR is estimated to be responsible for around ten million fatalities [10,11].

About 9 million people will die each year in poor nations, with 4.7 million of those casualties occurring in Asia, as a result of antibiotic-resistant illnesses [1]. Goal 3 of the United Nations' Sustainable Development Goals for 2030 is Good Health and Wellbeing, and AMR was recently recommended as a particular indicator of this goal [12,13]. The rising danger of antimicrobial resistance (AMR) is a particular concern for low- and middle-income nations (LMICs) that lack effective mechanisms for infection control and prevention [14]. More than 28 million people, mostly in low- and middle-income countries (LMICs), would fall into severe poverty by 2050, according to a World Bank report [15].

A high burden of infectious diseases, irrational antibiotic use, inadequate infection-control policies, low-quality medicines, a lack of knowledge about AMR, incorrect diagnoses, and an absence of laboratories that can test for antibiotic susceptibility are the primary causes of the AMR crisis in developing nations [12,16]. Despite this, numerous plans to reduce antibiotic overuse have been put forward, including changing or limiting antibiotics in the formulary, educating healthcare workers, holding feedback activities, requiring infectious disease specialists to approve drug prescriptions, and encouraging a more sensible global approach to antimicrobial use [17]. Antibiotic stewardship (AMS) refers to an all-encompassing strategy for the optimization and rationalization of antibiotic usage [18].

For the purpose of antibiotic stewardship, the World Health Organization (WHO) established the Access, Watch, and Reserve (AWaRe) categorization system in 2017. It was a suggestion that would greatly aid in the fight against AMR. A wide range of antibiotics can develop resistance to certain microorganisms, according to the WHO's AWaRe framework [19]. Antibiotics that are administered as first or secondary lines of defense against illnesses are included in the Access category. Antibiotics that cover a wide range of ailments and pose a higher threat of drug resistance are included in the Watch category. Medication used as a final option for conditions that are resistant to many drugs is included in the Reserve category [20].

Iraq is reporting an increase in AMR due to several variables. The absence of strict regulations, incompatible infection prevention control (IPC) methods, antibiotic usage and abuse, and OTC sales without a prescription are all examples of these issues [21]. Many risk factors may be attributed to a single cause: the lack of understanding of AMR among many stakeholders. One of the most often used methods for assessing stakeholder awareness is the KAP test. Few research has come out of Iraq using KAP, even though there are a number of them globally. By educating themselves, developing positive attitudes, and following best practices while prescribing antibiotics, healthcare workers can greatly decrease AMR and prolong the efficacy of drugs [22,23].

The appropriate prescription of antibiotics and the promotion of patient knowledge need collaborative efforts from several levels of health professionals, including as physicians, nurses, pharmacists, and informal workers. Therefore, there has to be a concerted effort by the educated public, enthusiastic community, pharmacists, and involved HCWs in order to reduce the overuse of antibiotics. In May 2015, the World Health Assembly adopted a worldwide strategy to combat AMR. The primary goals of this all-encompassing AMR strategy are to increase public knowledge and comprehension of the issue. In order to reduce AMR, the WHO has recommended educational and monitoring programs to help people make better decisions when prescribing, disposing of, and using antibiotics [24].

The issue in Iraq is complex and multi-faceted, including patients, pharmacists, and physicians, due to the OTC availability of maximum antibiotics along with consumers' reckless custom of these drugs. And since there is a dearth of information about Iraqi patients' and healthcare providers' KAP with respect to AMR. So, this study set out to measure AMR knowledge, attitudes, and practices (KAP) among community members and HCWs in Al-Suwaria city, Wasit governorate, Iraq. The goal was to inform the creation of control programs to combat AMR in Iraq, and more specifically, among patients in Al-Suwaria city.

Methods

Ethical Approval

The Ethics Committee of the Middle Technical University approved this work (MEC No. 89). The Helsinki Declaration of 1975 principles guided this acceptance. After obtaining all essential information, research participants were invited to write to confirm their participation.

Study Period and Location

This research was carried out from January to April 2024 in Al-Suwaira, Iraq's Wasit governorate in the Middle East.

Study Design, Site and Population

This study followed the STROBE guidelines (Available on: https://www.strobe-statement.org/. Accessed on: March 12, 2026). Food safety knowledge, attitudes, and behaviors in Al-Suwaira city, Wasit governorate, were examined in a descriptive, cross-sectional research study from January to April 2024 among 125 pharmacists, HCWs, and residents. Al-Suwaira is a city located in the Wasit Governorate. It lies 35 kilometers south of Baghdad on the west bank of the Tigris. The population is 77,200, and one of Wasit Governorate's major cities. Using Cochran's formula **[25]**, the sample size was calculated. At a 95% confidence level, the sample size was estimated to be 125 using a conservative proportion estimate of 50% and a margin of error of 5%. Consequently, we intended to recruit at least 125 people to take part in this study. The research team used a basic random selection technique to pick participants from pharmacists, HCWs, and individuals; after that, they asked those participants to fill out a questionnaire. Locations that were convenient for the researcher to get data from included private clinics, pharmacies, primary healthcare centers, and general hospitals. A total of 173 samples participated in the study by providing written, informed permission and being accessible during its duration. There were 173 eligible respondents, but only 125 of them filled out the survey. 48 samples rejected to participate due to work-related stress (n = 21), lack of interest (n = 18), or confusion about the study's goal (n = 6). They stopped participating. Three poll-voters didn't respond; thus, they didn't vote. The response rate was 72.25 percent, with 125 of 173 people responding. On request, the data collector should explain self-administered surveys.

Questionnaire and Data Collection

A questionnaire on antibiotic resistance KAP was developed based on the previous studies **[10, 26-30]**. The questionnaire includes an introductory part that explains the study's purpose, the voluntarism of participants, and the time needed to complete the study. The questionnaire underwent testing prior to and following a thorough evaluation for content validity; the first draft was subsequently sent to three experts for their assessment of the relevance, clarity, and significance of the material. The survey consisted of five parts. In the initial part of the study, we explored the demographic information of the contributors. The second part of the survey tested the samples' understanding of AMR through the use of sixteen questions. To gauge overall familiarity with the factors that contribute to AMR and its constituent parts, knowledge questions were utilized. With this, participants may choose from several yes/no and "I don't know" alternatives. For every response, two were marked as right, one as unclear, and zero as wrong. The range of potential scores was 0–32. Section three assessed the attitudes using eleven statements. On a 5-point Likert scale, there were questions on attitudes that asked participants to either strongly disagree, disagree, remain neutral, agree, or strongly agree. The scores ranged from eleven to fifty-five. In the survey's fourth section, we inquired about respondents' present behaviors for dealing with antibiotic resistance. A three-point "scale" "disagree," "neutral," and "agree" was used for each practice-related question. Scores ranged from seven to twenty-one. The later section delved into the sources of knowledge concerning antibiotic resistance.

Data Analysis

To identify the impact of various factors on the study's parameters, the Statistical Analysis System (SAS, 2018) program, version 9, 6th edition (N.C., USA), was employed **[31]**. The demographic data and the participants' measures were assessed using descriptive statistics, which include frequencies, percentages, mean values, and standard deviations. To assess the correlation coefficient between the variables and to compare percentages (0.05 and 0.01 probability), the chi-square test was employed.

Results

Demographic Information of the Respondents

A large portion of contributors were under the age of 30 (n = 72, 57.6%), with 52.8% of the participants were men, and 36.0% had a diploma while 10.4% had a master's degree. The majority of participants were pharmacists and HCWs (n=83, 66.4%). Contributors who were married (n = 59, 47.2%) were less numerous than those who were single (n = 66, 52.8%). Rural donors accounted for 36.8% (n = 46) and urban contributions for 63.2% (n = 79). Aside from gender and marital status, there is a statistically significant difference ($p \leq 0.01$) in the distribution of samples based on demographic information (Table 1).

Table 1. Demographic information for study participants.

Demographic information		Number	Percent %	p-value
Gender	Male	66	52.8	0.531 NS
	Female	59	47.2	
	Total	125	100%	
Age Groups	< 30 years	72	57.6	0.0001 **
	31–45 years	26	20.8	
	46–49 years	20	16.0	
	> 50 years	7	5.6	

Demographic information		Number	Percent %	p-value
	Total	125	100%	
Qualifications	Uneducated	18	14.4	0.0001 **
	Primary	15	12.0	
	Secondary	17	13.6	
	Diploma	45	36.0	
	Bachelor	17	13.6	
	Masters	13	10.4	
	Total	125	100%	
Occupation Status	Medical doctors	6	4.8	0.0001 **
	Nurses	21	16.8	
	Microbiologist	17	13.6	
	Physiotherapy Technologist	18	14.4	
	Pharmacists	21	16.8	
	Farmers	25	20.0	
	House wife	17	13.6	
	Total	125	100%	
Marital Status	Married	59	47.2	0.531 NS
	Unmarried	66	52.8	
	Total	125	100%	
Residence	Rural	46	36.8	0.0023 **
	Urban	79	63.2	
	Total	125	100%	

** ($p \leq 0.01$).

Source: Own authorship.

Knowledge on AMR Among Participants

This section assesses the contributors' understanding of antibiotic resistance. Nearly three-quarters of the participants (n=92, or 73.6%), and (n=91, or 72.8%) were aware that bacteria may be treated with antibiotics and knew about AMR, respectively. The error of self-medication with antibiotics was properly identified by a large percentage of respondents (n=83, 66.4%). Also, 61.6% of contributors had a modest level of understanding of the repercussions of unfair and inappropriate antibiotic use. A large percentage of the participants were aware of what led to the development of AMR in bacteria (n=83, 66.4%). Contrarily, when asked if antibiotics may be an effective treatment against viral illnesses, 24.0% of respondents gave the wrong response. Furthermore, regarding the potential to address antibiotic resistance through the development of new antibiotics, a significant number of participants (n = 70, 56.0%) gave the wrong answer. Table 2 summarizes the description of the study's findings regarding AMR. only 43.75% showed strong knowledge (above average) (Figure 1). The samples' responses differ significantly ($P \leq 0.01$) about the respondents' knowledge questions, as shown in Table 2.

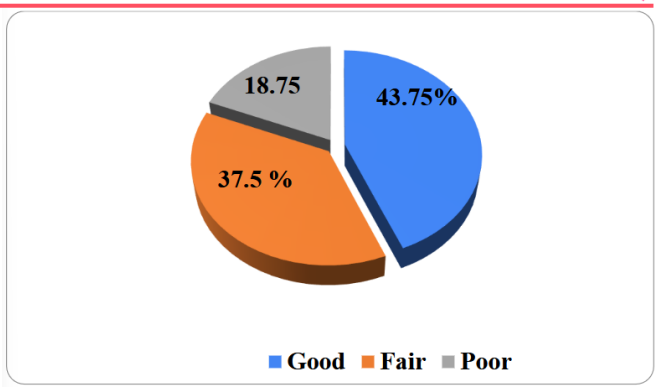

Figure 1. Contributors' overall knowledge; M.s. = Mean score, evaluation level: Fair (M.s. = 0.895-1.29), Poor (M.s. < 0.895), and Good (M.s. ≥ 1.3). Source: Own authorship.

Table 2. Knowledge of study participants.

No.	Questions	Responses N (%)			P-value
		Correct (%)	Incorrect (%)	I do not know (%)	
1	Are antibiotics effective against all types of bacteria? (Yes)	92 (73.6)	21 (16.8)	12 (9.6)	0.0001 **
2	When you start to feel better, it's best to quit taking antibiotics, especially if they're pricey? (No)	64 (51.2)	45 (36)	16 (12.8)	0.0001 **
3	Provided that they were prescribed for the same ailment, is it OK to utilize antibiotics that were previously provided to someone else? (No)	55 (44)	59 (47.2)	11(8.8)	0.0001 **
4	If your antibiotics helped you get well with the same symptoms, may you buy them again or ask a doctor? (No)	83 (66.4)	22 (17.6)	20 (16)	0.0001 **
5	Can antibiotics heal viral infections? (No)	30 (24)	88 (70.4)	7 (5.6)	0.0001 **
6	Do antibiotics accelerate disease healing? (No)	35 (28.0)	76 (60.8)	14 (11.2)	0.0001 **
7	Can drugstores and pharmacies sell antibiotics without a prescription? (No)	69 (55.2)	49 (39.2)	7 (5.6)	0.0001 **
8	Is bacterial resistance something you're familiar with? (Yes)	91 (72.8)	21 (16.8)	13 (10.4)	0.0001 **
9	Improper and unjust antibiotic usage causes antibiotic resistance? (Yes)	77 (61.6)	32 (25.6)	16 (12.8)	0.0001 **
10	Misuse of antibiotics reduces pathogen sensitivity? (Yes)	55 (44)	58 (46.4)	12 (9.6)	0.0001 **
11	Lower antibiotic dosages may promote resistance? (Yes)	83 (66.4)	37 (29.6)	5 (4)	0.0001 **
12	Can new drugs combat antibiotic resistance? (No)	30 (24)	70 (56.0)	25 (20)	0.0001 **

13	Do you believe freshly discovered, higher-priced antibiotics might work better? (No)	60 (48)	49 (39.2)	16 (12.8)	0.0001 **
14	Resistant bacteria infections are hard to treat? (Yes)	72 (57.6)	39 (31.2)	14 (11.2)	0.0001 **
15	Is it possible for superbugs to pass from one host to another? (Yes)	102 (81.6)	20 (16)	3 (2.4)	0.0001 **
16	Antibiotics are ineffective against many bacterial illnesses? (Yes)	85 (68)	28 (22.4)	12 (9.6)	0.0001 **
p-value		0.0001 **	0.0001 **	0.0038 **	---
** (p≤0.01)					

Source: Own authorship.

Attitudes of Participants Toward Antibiotic Resistance

Nearly half (n=58, 46.4%) strongly believe that antibiotics without a prescription should be banned. Most responders (n = 104, 83.2%) strongly agreed that AMR is a worldwide public health issue. Similarly, 66.4% (n=83) strongly agreed that hospitals should adopt life-saving antibiotic rules in the future. Also, (n = 74, 59.2%) agreed that pharmacists had a significant part in this problem. However, 61.6% (n = 77) said only doctors understand AMR. A low percentage of contributors (n = 30, 24.0%) strongly agreed, whereas (n = 25, 20.0%) agreed on the need to limit OTC antibiotic distribution. A weak attitude was indicated by 47.2% (n=59) of participants concerning the prospect of fighting AMR in their location through good infection control procedures by HCWs. Table 3 shows participant perspectives on antibiotic resistance. Only 27.27% of individuals were positive regarding AMR (Figure 2). The sample responses to attitude questions show substantial variances (p ≤ 0.01) (Table 3).

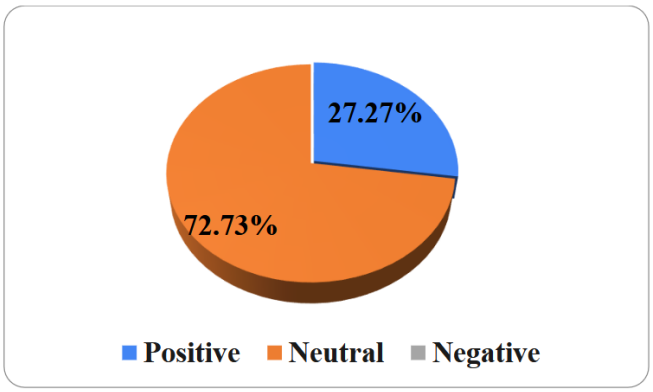

Figure 2. Contributors' general sentiments; M.s. = Mean score, evaluation level: Negative (M. s. < 2.55), Neutral (M. s. = 2.55-3.72), and Positive (M. s. ≥ 3.73). Source: Own authorship.

Table 3. Attitudes of study participants

No.	Questions	Responses N (%)					p-value
		Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)	
1	It is imperative that the dispensing of antibiotics without a prescription be curbed	23 (18.4)	35 (28.0)	12 (9.6)	26 (20.8)	29 (23.2)	0.0001 **
2	Customers typically do not need a prescription for antibiotics since they are well-versed in their administration	34 (27.2)	51 (40.8)	9 (7.2)	18 (14.4)	13 (10.4)	0.0001 **
3	A major public health concern on a worldwide scale, antibiotic resistance	48 (38.4)	56 (44.8)	6 (4.8)	10 (8)	5 (4)	0.0001 **
4	Antibiotic resistance harms you and your family	48 (38.4)	38 (30.4)	8 (6.4)	16 (12.8)	5 (4)	0.0001 **
5	Weak infection management by healthcare staff will propagate antibiotic resistance	16 (12.8)	43 (34.4)	6 (4.8)	52 (41.6)	7 (5.6)	0.0001 **
6	You should follow hospital antibacterial guidelines in the future	83 (66.4)	24 (19.2)	3 (2.4)	4 (3.2)	23 (18.4)	0.0001 **
7	Antibiotics should be described with strict adherence to protocol	22 (17.6)	64 (51.2)	5 (4)	13 (10.4)	21 (16.8)	0.0001 **
8	We need stricter regulations on the distribution of antibiotics sold without a prescription	30 (24)	25 (20)	7 (5.6)	22 (17.6)	41 (32.8)	0.0001 **
9	The prevalence of antibiotic resistance is correlated with people's socioeconomic position	17 (13.6)	73 (58.4)	5 (4)	18 (14.4)	12 (9.6)	0.0001 **
10	Only physicians understand antibiotic resistance	14 (11.2)	77 (61.6)	4 (3.2)	25 (20)	5 (4)	0.0001 **
11	When it comes to the issue of antibiotic	30 (24)	74 (59.2)	4 (3.2)	9 (7.2)	8 (6.4)	0.0001 **
	resistance, pharmacists are heavily involved						
p-value		0.0001 **	0.0001 **	0.277 NS	0.0001 **	0.0001 **	
** (p≤0.01)							

Source: Own authorship.

Participants' Practices on Antibiotic Resistance

In our study, 60% (n=75) of respondents agreed to administer recommended antibiotics and advise patients on their proper usage. Most respondents (n=84, 67.2%) agreed to work with other healthcare professionals in infection control and Antimicrobial Stewardship Programs (ASPs), with a p-value of 0.0001, indicating a significant effect. The majority of participants (n=84, 67.2%) agreed about checking for medication interactions, side effects, and allergies to the recommended antibiotics before dispensing. Most of respondents (n=96, 76.8%) agreed that ASPs should be launched and implemented in all healthcare institutions. On the other hand, our survey found that

just 22.4% (n=28) of respondents agreed on how they evaluate antibiotic prescriptions and dispense them normally. Furthermore, 57.14% of responders had poor antibiotic resistance procedures (Figure 3). There are statistically significant differences ($p \leq 0.01$) between respondents' responses to practice questions. Table 4 depicts these distinctions.

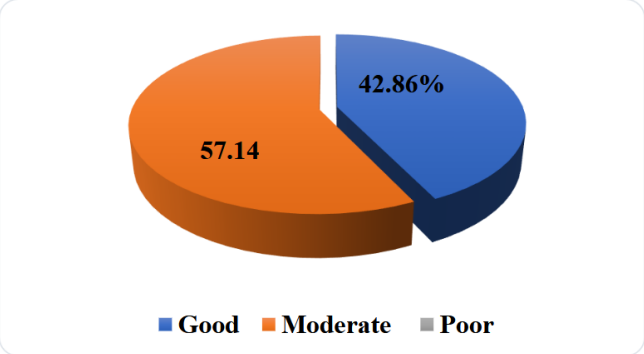

Figure 3. Contributors' overall practices; M.s. = Mean score, evaluation level: Poor (M.s. < 1.71), Moderate (M.s. = 1.71-2.51), and Good (M.s. ≥ 2.52). Source: Own authorship.

Table 4. Practices of study participants.

No.	Questions	Responses N (%)			P-value
		Agree (%)	Neutral (%)	Disagree (%)	
1	Providing patients with guidance and the administration of antibiotics	75 (60)	36 (28.8)	14 (11.2)	0.0001 **
2	Dispensing antibiotics longer than prescribed at patient request	68 (54.4)	44 (35.2)	13 (10.4)	0.0001 **
3	Evaluate antibiotic prescriptions in accordance with regional standards	28 (22.4)	39 (31.2)	58 (46.4)	0.0007 **
4	Coordination with other healthcare providers on antimicrobial stewardship and infection control	84 (67.2)	20 (16)	21 (16.8)	0.0001 **
5	Before distributing antibiotics, checked for medication interactions, side effects, and allergies	84 (67.2)	24 (19.2)	17 (13.6)	0.0001 **
6	Patient education on antibiotic and ABR problems	87 (69.6)	19 (15.2)	19 (15.2)	0.0001 **
7	Recommending all healthcare facilities establish Antimicrobial Stewardship Programs	96 (76.8)	12 (9.6)	17 (13.6)	0.0001 **
p-value		0.0001 **	0.0001 **	0.0001 **	---
** (p≤0.01)					

Source: Own authorship.

Estimation of the Correlation Coefficient Between the Respondents' Axes

Table 5 estimates the respondents' axes' correlation coefficient. The study found a significant correlation ($p \leq 0.01$) between respondents' knowledge and attitude (p=0.0063), but no correlation ($p \geq 0.05$) between knowledge and practices (p=0.266) or attitudes and practices (p=0.6072).

Table 5. Estimate of correlation coefficient between participants.

Respondents axis		Correlation coefficient-r	P-value
Knowledge of study participants	Attitudes of study participants	0.68 **	0.0063
Knowledge of study participants	Practices of study participants	0.18 NS	0.266
Attitudes of study participants	Practices of study participants	0.07 NS	0.6072
** (p≤0.01), NS: Non-Significant			

Source: Own authorship.

Information Sources of Respondents

Figure 4 demonstrated that the primary sources of information that participants used to learn about AMR were universities (n = 34, 27.2%). Furthermore, the other sources, which include television, books, and newspapers, account for around 36 (28.8%).

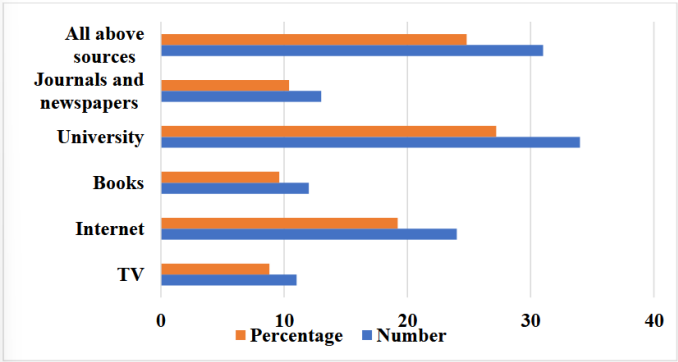

Figure 4. Participant information sources on antimicrobial resistance. Source: Own authorship.

Discussion

A multi-sectoral strategy is needed to combat AMR, which is said to be a worldwide health concern [1]. The Global Action Plan was created by the World Health Organization (WHO) to combat the rise of antibiotic resistance [19]. Among the participants in the study, we discovered that their KAP about AMR was modest which are lower compared to earlier research [32,33]. One possible explanation is that, unlike previous research that exclusively included HCWs, this one included 36.8% of residents, who may

have less direct contact with the problem under investigation. Our survey found that 57.6% of the contributions were under the age of 30, with men accounted for the largest share (n=66,52.8%). This goes against the findings of earlier research conducted in Nepal **[15]**. Previous findings from Saudi Arabia and Zambia **[32,33]** were consistent with our findings. Consistent with earlier findings **[32]**, the majority of participants in this study were pharmacists and HCWs (n = 83, 66.4%).

The present survey found that a majority of participants understood the concept of AMR and that the majority of respondents agreed that antibiotics may heal bacterial illnesses (n=92, 73.6%). In a similar vein, research by Jairoun et al. **[27]** found similar findings. Furthermore, a previous study **[15]** found that 96.3% of participants were familiar with bacterial resistance, which is quite similar to the current study.

When compared to the results obtained by Ayepola et al. **[28]** and Mudenda et al. **[33]**, a high proportion of contributors (n=83, 66.4%), correctly answering about the mistake of using antibiotics that were previously used to treat symptoms without a prescription, is very satisfactory. Conversely, our findings were lower than those of Nepal **[15]**, but greater than those of Ethiopian results **[10]**. The fact that only 66.4% of our participants were employed by the HCWs may explain the discrepancy across research. This suggests that the contributors' strengths in both theoretical understanding and practical experience were well-reflected in their scores on the knowledge questions buried in the fundamental science.

According to our findings, 66.4% of respondents correctly identified the factor that led to the development of AMR in bacteria, this finding is quite similar to what previous researchers in Ethiopia and Zambia **[10, 29, 33, 34]**. Misuse of antibiotics is a recognized source of AMR **[35]**. Thus, medical practitioners should encourage patients to use antibiotics carefully. Contributors knew the least about opposition to drug development (n = 30, 24.0%).

In this study, 69% disagreed that new antibiotics may help address AMR issues, yet the results were similar to Tegagn et al. **[36]**. Finding novel drugs is crucial, but not the main method for fighting AMR. To create new antibiotics, irrational prescribing, distribution, control, and usage must alter. Only 44% of respondents correctly identified antibiotic misuse as the cause of AMR. Evidence suggests incorrect antibiotic use might cause AMR **[34,37,38]**. Concerning the potential of antibiotics as a treatment for viral diseases, our findings showed that 70.4% of participants were least knowledgeable about this. This is in line with previous findings **[10]**. However, compared to the United Arab Emirates (48%), Nigeria (35.7%), and Zambia (34.4%), our finding was considerably higher **[27,28,33]**.

Only 48% of respondents answered correctly, compared to 69.4% in the UAE **[27]**, demonstrating that people's grasp of how antibiotic novelty and cost impact infection efficacy is weak. This suggests that the public doesn't understand antibiotic efficacy, which might lead to pharmacy and drugstore regulation difficulties. Pharmacy owners, and doctors must educate the public on proper medication usage and disposal. It appears several pharmacies lacked a certified pharmacist. Sometimes inexperienced drugstore owners or personnel complete doctors' prescriptions. The lack of a certified and competent pharmacist at the drugstore is another WHO violation **[39]**.

Centralized antibiotic resistance management can raise community awareness of this global threat. Developed nations, including the US, China, Canada, and a few European countries, have successfully implemented such management programs **[40,41,42]**. Contrary to previous studies that found the majority of HCWs to have good knowledge of AMR and AMS up to 75% **[33,43,44]**, this survey found that only 43.75 percent of respondents had good knowledge (Figure 1). One possible explanation is that, unlike previous research that exclusively included HCWs, this one included 36.8% general population, who may have less direct contact with the problem under investigation.

Although 8.8% of those who took the survey were in complete agreement that AMR poses a major threat to public health throughout the world, 72.5% of them still agreed that it does. This finding was in line with the findings of an Ethiopian research **[10]**. This finding, however, ran counter to those of Zambia **[29]** and Ethiopia **[36]**. This could be because about a third of our samples were non-specialists, implying that this group lacked theoretical and practical knowledge to contribute to the conversation. According to other research, AMR is a major issue in public health **[45-47]**, so all nations must cooperate to combat a global crisis.

Figure 2 shows that little over a third of the individuals had positive opinions regarding ABR. In addition, 24% of participants agreed and 59.2% strongly agreed that pharmacists play a significant role in the development of this issue. These results go counter to what previous researchers have observed **[29,25,46,48]**. The results showed that 66.4% of the participants highly agreed that the hospital must follow the recommendations for life-saving antibiotics, while

20% agreed that there needed to be more regulation of the distribution of OTC antibiotics. These results fall short of what Seid and Hussen **[10]** found previously. When compared to a previous survey, 65% of participants believed that antibiotics should never be sold as OTC medications, this one was ahead of the curve **[49]**.

The findings the present study, however, showed that 61.6% of respondents were in complete agreement that AMR is a medical term understood solely by doctors. In contrast to these results, research in Zambia **[29]** and Pakistan **[30]** found that up to 82% of contributors strongly disagreed that only doctors require AMR expertise. Antibiotic resistance was a problem for 42.86 percent of respondents, whereas 57.14 percent of donors had good procedures (Figure 3).

Table 4 shows that 60% of respondents (n=75) believe that they advise patients on the judicious use of prescription antibiotics and administer them, which is lower than findings from prior research **[29,30]**. Additionally, the survey found that 87.2% of participants stated that they work with other healthcare professionals on infection control and ASPs. Previous studies **[25,29,50]** are somewhat comparable to these findings. Along these lines, the AWaRe categorization suggests that antibiotics are likely to be limited and supplied less often or improperly. Prescriptions for antibiotics are expected to fall into the Access category by 60% by 2023, according to the WHO AWaRe tool. Less antibiotic usage and better AMS are outcomes of following the WHO AWaRe framework **[51]**.

Consistent with earlier results **[29]**, our study found that teaching patients on antibiotics and AMR is crucial, however only 69.6% of participants agreed. Our study's majority opinion 76.8%, is that all healthcare facilities should launch and execute ASPs. This is in line with prior results **[1, 21]**, but higher than prior findings **[29]**. Just 22.4% of participants are in agreement that they check prescriptions for antibiotics and give out prescribed medicines in accordance with established protocols. A comparison to earlier studies **[1, 29, 36]** shows that these are lower.

According to the data in Table 5, the knowledge and attitude of the participants are significantly correlated ($p \leq 0.01$), but there is no significant correlation ($p \geq 0.05$) between the knowledge and practices ($p=0.266$) or between the attitudes and practices of the participants ($P=0.6072$). The diverse backgrounds of the research participants may account for this. It may also be due to the fact that different countries employ distinct procedures and standards.

The present findings (Figure 4) showed that the majority of contributors learned about AMR via universities (n = 34, 27.2%). A prior survey indicated that contributors mostly relied on all sources (61.8%), the internet (24.5%), and universities (8.8%) to educate themselves on AMR **[21]**. According to another Ethiopian survey **[10]**, academic courses were the primary source of knowledge for 3/4 of the participants. Antibiotic overuse and abuse have been previously identified as contributing factors to multidrug-resistant bacteria in Iraqi agriculture **[52-56]** and healthcare facilities **[1,21,57]**. These results highlight the need to decrease antibiotic use in order to decrease the prevalence of MDR bacteria.

It should be noted that there are limits to the results of this study. Results may not apply outside of Al-Suwaria city in the Wasit governorate, where the research was carried out. Furthermore, most of the participants were from municipal regions and had diplomas, so it would be helpful to examine a wide sample size from diverse zones to have a better idea of this. In spite of the restrictions, our results have significant implications for AMR prevention via sensible antibiotic usage. Future methods for AMR education and the dissemination of information to the general public, both in rural and urban regions, may benefit greatly from the results of this study. Likewise, this study emphasizes the importance of doing additional research to bridge the gap in knowledge implementation through social utilization-related activities and continual behavioral change communication.

Conclusion

It was concluded that residents and HCWs in Al-Suwaria city, Wasit province, lacked adequate practices pertaining to AMR, had a negative attitude towards the prospect of combating AMR through robust infection control practices, and lacked knowledge about the use of newly discovered antibiotics, according to the current study. Additionally, there were notable variations in KAP dimensions across the subgroups. Our research shows that in order for HCWs to continue their education, programs should emphasize the need of bridging the gap between theory and practice in the areas of AMR and rational antibiotic usage. Specifically, with regards to the practical knowledge, which our study found to be its least strong point. Programs may have more success if their curricula are modified to account for students' unique KAP dimensions based on their socioeconomic and occupational backgrounds.

CRediT

Author contributions: The study design, sample collection, analysis of data, writing, and interpretation of the results were maintained by MHGK. Revising and editing of the manuscript was done by SSA and WFA. All researchers have read and approved the final version of the manuscript.

Acknowledgment

This inquiry was not eligible for any of the available grants or funding. The authors would like to use this occasion to convey their gratitude to all Middle Technical University healthcare workers for their support with this study.

Ethical Approval

The Ethics Committee of the Middle Technical University approved this work (MEC No. 89). The Helsinki Declaration of 1975 principles guided this acceptance. After obtaining all essential information, research participants were invited to write to confirm their participation.

Informed Consent

Informed consent was obtained from all participants involved in the study, with all procedures explained in detail before participation.

Funding

Not applicable.

Data Sharing Statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request, and all data is stored following privacy and ethical guidelines

Conflict of Interest

The authors declare no competing interests.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

References

1. Kanaan MH. Knowledge, attitudes, and practices regarding antibiotic use and resistance among veterinarians and animal health professionals in Wasit Governorate, Iraq. Int. J. One Health. 2024; 10(2):230-241.https://doi.org/10.14202/IJOH.2024.230-241.
2. Kanaan MH, Mohammed FA. Antimicrobial resistance of Campylobacter jejuni from poultry meat in local markets of Iraq. Plant Arch 2020;20(1):410-5. https://www.plantarchives.org/SPECIAL%20ISSUE%2020-1/81__410-415_.pdf.
3. Kanaan M, Abdullah SS. Methicillin-Resistant Staphylococcus Aureus: As A Superbug Foodborne Pathogen. LAP LAMBERT Academic Publishing; 2019, ISBN: 978-613-9-94418-7.
4. Kanaan MH. Antibacterial effect of ozonated water against methicillin-resistant Staphylococcus aureus contaminating chicken meat in Wasit Province, Iraq. Vet World 2018;11(10):1445. doi: 10.14202/vetworld.2018.1445-1453.
5. Kanaan MH, Abdulwahid MT. Prevalence rate, antibiotic resistance and biotyping of thermotolerant Campylobacter isolated from poultry products vended in Wasit markets. Curr Res Nutr Food Sci 2019;7(3):905-17. doi: https://dx.doi.org/10.12944/CRNFSJ.7.3.29.
6. Kanaan MH, Al-Shadeedi SM, Al-Massody AJ, Ghasemian A. Drug resistance and virulence traits of *Acinetobacter baumannii* from Turkey and chicken raw meat. Comp Immunol Microbiol Infect Dis 2020; 70:101451. https://doi.org/10.1016/j.cimid.2020.101451.
7. Hadi Ghaffoori Kanaan M, Jebur Obayes Al-Isawi A, Ahmad Mohamme F. Antimicrobial Resistance and Antibiogram of Thermotolerant Campylobacter Recovered from Poultry Meat in Baghdad Markets, Iraq. Arch Razi Inst 2022;77(1):249-255. doi: 10.22092/ARI.2021.356362.1828.
8. Kainga H, Phonera MC, Chikowe I, Chatanga E, Nyirongo H, Luwe M, Mponela J, Kachisi V, Kamanga N, Chulu J, Njunga G. Determinants of knowledge, attitude, and practices of veterinary

drug dispensers toward antimicrobial use and resistance in main cities of Malawi: a concern on antibiotic stewardship. Antibiotics 2023;12(1):149. https://doi.org/10.3390/antibiotics12010149.

9. Mudenda S, Mulenga KM, Nyirongo R, Chabalenge B, Chileshe C, Daka V. Non-prescription sale and dispensing of antibiotics for prophylaxis in broiler chickens in Lusaka District, Zambia: findings and implications on one health. JAC Antimicrob Resist 2024; 6 (3): 1–5. https://doi.org/10.1093/jacamr/dlae094.
10. Seid MA, Hussen MS. Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. BMC Infect Dis 2018; 18:1-8. https://doi.org/10.1186/s12879-018-3199-1.
11. de Kraker ME, Stewardson AJ, Harbarth S. Will 10 million people die a year due to antimicrobial resistance by 2050?. PLoS Med 2016;13(11):e1002184. https://doi.org/10.1371/journal.pmed.1002184.
12. Rana S, Kaur KN, Narad P, Walia K, Saeed S, Chandra A, Shannawaz M, Singh H. Knowledge, attitudes and practices of antimicrobial resistance awareness among healthcare workers in India: a systematic review. Front Public Health 2024; 12:1433430. https://doi.org/10.3389/fpubh.2024.1433430.
13. Ross JS, Katz MH. No Time to Wait. JAMA Intern Med 2015;175(12):1986-1986. doi:10.1001/jamainternmed.2015.5393.
14. Wilkinson A, Ebata A, MacGregor H. Interventions to reduce antibiotic prescribing in LMICs: a scoping review of evidence from human and animal health systems. Antibiotics 2018;8(1):2. https://doi.org/10.3390/antibiotics8010002.
15. Cheoun ML, Heo J, Kim WH. Antimicrobial resistance: KAP of healthcare professionals at a tertiary-level hospital in Nepal. Int J Environ Res Pub Health 2021;18(19):10062. https://doi.org/10.3390/ijerph181910062.
16. García C, Llamocca LP, García K, Jiménez A, Samalvides F, Gotuzzo E, Jacobs J. Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. BMC Clin Pharmacol 2011 ;11:1-8. https://doi.org/10.1186/1472-6904-11-18.
17. Ahmad A, Parimalakrishnan S, Mohanta GP, Patel I, Manna PK. A study on utilization pattern of higher generation antibiotics among patients visiting community pharmacies in Chidambaram, Tamil Nadu at South India. Int J Pharm 2012;2(3):466-471. https://api.semanticscholar.org/CorpusID:80805049.
18. Clifford K, Desai D, da Costa CP, Meyer H, Klohe K, Winkler AS, Rahman T, Islam T, Zaman MH. Antimicrobial resistance in livestock and poor quality veterinary medicines. Bull World Health Organ 2018;96(9):662. doi: 10.2471/BLT.18.209585.
19. Sharland M, Zanichelli V, Ombajo LA, Bazira J, Cappello B, Chitatanga R, Chuki P, Gandra S, Getahun H, Harbarth S, Loeb M. The WHO essential medicines list AWaRe book: From a list to a quality improvement system. Clin Microbiol Infect 2022 ;28(12):1533-5. https://doi.org/10.1016/j.cmi.2022.08.009.
20. Mudenda S, Daka V, Matafwali SK. World Health Organization AWaRe framework for antibiotic stewardship: Where are we now and where do we need to go? An expert viewpoint. Antimicrob Steward Healthc Epidemiol 2023;3(1):e84. doi: 10.1017/ash.2023.164.
21. Kanaan MH, Tarek AM, Abdullah SS. Knowledge and attitude among samples from community members, pharmacists and health care providers about antibiotic resistance in Al-Suwaria city/Wassit province/Iraq. In IOP Conf Ser Earth Environ Sci 2021(Vol. 790, No. 1, p. 012059). IOP Publishing. doi:10.1088/1755-1315/790/1/012059.
22. Pulcini C, Gyssens IC. How to educate prescribers in antimicrobial stewardship practices. Virulence 2013; 4: 192–202. https://doi.org/10.4161/viru.23706.
23. Nemr N, Kishk RM, Elsaid NM, Louis N, Fahmy E, Khattab S. Knowledge, attitude, and practice (KAP) of antimicrobial prescription and its resistance among health care providers in the COVID-19 era: A cross sectional study. PLoS One 2023;18(8):e0289711. https://doi.org/10.1371/journal.pone.0289711.
24. Awad AI, Aboud EA. Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. PLoS One 2015 ;10(2):e0117910. https://doi.org/10.1371/journal.pone.0117910.
25. Khan MU, Hassali MA, Ahmad A, Elkalmi RM, Zaidi ST, Dhingra S. Perceptions and practices of community pharmacists towards antimicrobial stewardship in the state of Selangor, Malaysia. PLoS One 2016;11(2):e0149623. https://doi.org/10.1371/journal.pone.0149623.
26. Anong DN, Akoachere JF. Prescribing patterns

and associated factors of antibiotic prescription in primary health care facilities of Kumbo East and Kumbo West Health Districts, North West Cameroon. PLoS One 2018;13(3):e0193353. https://doi.org/10.1371/journal.pone.0193353.

27. Jairoun A, Hassan N, Ali A, Jairoun O, Shahwan M. Knowledge, attitude and practice of antibiotic use among university students: a cross sectional study in UAE. BMC Public Health 2019; 19:1-8. https://doi.org/10.1186/s12889-019-6878-y.
28. Ayepola OO, Onile-Ere OA, Shodeko OE, Akinsiku FA, Ani PE, Egwari LO. Knowledge, attitude and pattern of antibiotic usage among students of a Nigerian University. J Microbiol Infect Dis 2019;9(01):10-5. https://doi.org/10.5799/jmid.537133.
29. Mudenda S, Bangara F F, Sitali J, Banda M. Knowledge, attitude, and practices on antibiotic resistance among pharmacists at the university teaching hospitals in Lusaka, Zambia. J Harmonized Res Pharmacy 2019; 8 (2):12-24. doi: 10.30876/JOHR.8.2.2019.12-24.
30. Rehman IU, Asad MM, Bukhsh A, Ali Z, Ata H, Dujaili JA, Blebil AQ, Khan TM. Knowledge and practice of pharmacists toward antimicrobial stewardship in Pakistan. Pharmacy 2018;6(4):116. https://doi.org/10.3390/pharmacy6040116.
31. SAS. Statistical Analysis System, User's Guide. Statistical. Version 9.6th ed. SAS. 2018; Inst. Inc. Cary. N.C. USA.
32. Al Sulayyim H, Ismail R, Hamid AA, Ghafar NA. Knowledge, attitude and practice of healthcare workers towards antibiotic resistance during the COVID-19 pandemic. JAC Antimicrob Resist 2023 ;5(3):dlad068. https://doi.org/10.1093/jacamr/dlad068.
33. Mudenda S, Chabalenge B, Daka V, Jere E, Sefah IA, Wesangula E, Yamba K, Nyamupachitu J, Mugenyi N, Mustafa ZU, Mpundu M. Knowledge, awareness and practices of healthcare workers regarding antimicrobial use, resistance and stewardship in Zambia: a multi-facility cross-sectional study. JAC Antimicrob Resist 2024;6(3): dlae076. https://doi.org/10.1093/jacamr/dlae076.
34. Erku DA. Antimicrobial Stewardship: A Cross-Sectional Survey Assessing the Perceptions and Practices of Community Pharmacists in Ethiopia. Interdiscip Perspect Infect Dis 2016;2016(1):5686752. doi: 10.1155/2016/5686752.
35. WHO. Health workers' education and training on antimicrobial resistance: curricula guide. World Health Organization; 2019.[Available from: http://41.77.4.165:6510/apps.who.int/iris/bitstream/handle/10665/272766/WHO-HISHWF-AMR-2018.1-eng.pdf]. Accessed 15 /1/2025.
36. Tegagn GT, Yadesa TM and Ahmed Y, Knowledge, Attitudes and Practices of Healthcare Professionals towards Antimicrobial Stewardship and Their Predictors in Fitche Hospital. J Bioanal Biomed 2017, 9:91-97. doi: 10.4172/1948-593x.1000159.
37. Kalungia AC, Burger J, Godman B, Costa JD, Simuwelu C. Non-prescription sale and dispensing of antibiotics in community pharmacies in Zambia. Expert Rev Anti Infect Ther 2016 ;14(12):1215-23. https://doi.org/10.1080/14787210.2016.1227702.
38. Roque F, Soares S, Breitenfeld L, Gonzalez-Gonzalez C, Figueiras A, Herdeiro MT. Portuguese community pharmacists' attitudes to and knowledge of antibiotic misuse: questionnaire development and reliability. PLoS One 2014;9(3): e90470. https://doi.org/10.1371/journal.pone.0090470.
39. Anderson S. The state of the world's pharmacy: a portrait of the pharmacy profession. J Interprof Care 2002 ;16(4):391-404. https://doi.org/10.1080/1356182021000008337.
40. Xiao Y. Antimicrobial stewardship in China: systems, actions and future strategies. Clin Infect Dis 2018 ;67(suppl_2):S135-41. https://doi.org/10.1093/cid/ciy641.
41. Doron S, Davidson LE. Antimicrobial stewardship. InMayo Clinic Proceedings 2011 Nov 1 (Vol. 86, No. 11, pp. 1113-1123). Elsevier. https://doi.org/10.4065/mcp.2011.0358.
42. Kpokiri EE, Ladva M, Dodoo CC, Orman E, Aku TA, Mensah A, Jato J, Mfoafo KA, Folitse I, Hutton-Nyameaye A, Okon-Ben I. Knowledge, awareness and practice with antimicrobial stewardship programmes among healthcare providers in a Ghanaian tertiary hospital. Antibiotics 2021;11(1):6. https://doi.org/10.3390/antibiotics11010006.
43. Mustafa ZU, Iqbal S, Asif HR, Salman M, Jabbar S, Mallhi TH, Khan YH, Sono TM, Schellack N, Meyer JC, Godman B. Knowledge, attitude and practices of self-medication including antibiotics among health care professionals during the COVID-19 pandemic in Pakistan: findings and implications. Antibiotics 2023;12(3):481. https://doi.org/10.3390/antibiotics12030481.
44. Ogoina D, Iliyasu G, Kwaghe V, Otu A, Akase IE,

Adekanmbi O, Mahmood D, Iroezindu M, Aliyu S, Oyeyemi AS, Rotifa S. Predictors of antibiotic prescriptions: a knowledge, attitude and practice survey among physicians in tertiary hospitals in Nigeria. Antimicrob Resist Infect Control 2021; 10:1-7. https://doi.org/10.1186/s13756-021-00940-9.

45. Cotta MO, Robertson MS, Tacey M, Marshall C, Thursky KA, Liew D, Buising KL. Attitudes towards antimicrobial stewardship: results from a large private hospital in Australia. Healthc Infect 2014 ;19(3):89-94. https://doi.org/10.1071/HI14008.
46. Brink AJ, Messina AP, Feldman C, Richards GA, Becker PJ, Goff DA, Bauer KA, Nathwani D, Van den Bergh D. Antimicrobial stewardship across 47 South African hospitals: an implementation study. Lancet Infect Dis 2016;16(9):1017-25. doi: 10.1016/S1473-3099(16)30012-3.
47. Mansour O, Al-Kayali R. Community pharmacists' role in controlling bacterial antibiotic resistance in Aleppo, Syria. Iran J Pharm Res 2017;16(4):1612.
48. Broom A, Broom J, Kirby E, Plage S, Adams J. What role do pharmacists play in mediating antibiotic use in hospitals? A qualitative study. BMJ Open 2015;5(11):e008326. https://doi.org/10.1136/bmjopen-2015-008326.
49. Sadasivam K, Chinnasami B, Ramraj B, Karthick N, Saravanan A. Knowledge, attitude and practice of paramedical staff towards antibiotic usage and its resistance. Biomed pharmacol J 2016;9(1):337-43. doi: https://dx.doi.org/10.13005/bpj/944.
50. Broom A, Plage S, Broom J, Kirby E, Adams J. A qualitative study of hospital pharmacists and antibiotic governance: negotiating interprofessional responsibilities, expertise and resource constraints. BMC Health Serv Res 2015;16:1-8. https://doi.org/10.1186/s12913-016-1290-0.
51. Mudenda S, Nsofu E, Chisha P, Daka V, Chabalenge B, Mufwambi W, Kainga H, Kanaan MH, Mfune RL, Mwaba F, Zulu M. Prescribing patterns of antibiotics according to the WHO AWaRe classification during the COVID-19 pandemic at a teaching hospital in Lusaka, Zambia: implications for strengthening of antimicrobial stewardship programmes. Pharmacoepidemiology 2023;2(1):42-53. https://doi.org/10.3390/pharma2010005.
52. Kanaan MH. Prevalence, resistance to antimicrobials, and antibiotypes of Arcobacter species recovered from retail meat in Wasit marketplaces in Iraq. Int J One Health 2021; 7 (1):142-150.https://doi.org/10.14202/IJOH.2021.142-150.
53. Kanaan, M. H. Kanaan MH. Prevalence and antimicrobial resistance of Salmonella enterica serovars Enteritidis and Typhimurium isolated from retail chicken meat in Wasit markets, Iraq. Vet World 2023 ;16(3):455–463. https://doi.org/10.14202/vetworld.2023.455-463.
54. Kanaan MH. Effectiveness of gaseous ozone on Arcobacter butzleri and bacterial loads on retailed meat sold at Iraqi Wasit markets. Open vet j 2024;14(11):2218-6050. https://doi.org/10.5455/OVJ. 2024.v14.i11.8.
55. Kanaan MH, Tarek AM. Clostridium botulinum, a foodborne pathogen and its impact on public health. Ann Trop Med Publ Health 2020;23(5):49-62. https://doi.org/10.36295/ASRO.2020.2357.
56. Kanaan MH, Mohammed FA, Abdullah SS. Prevalence patterns, virulence indices, and antibiotics resistance in Campylobacter. J Appl Pharm Sci 2024;14 (08): 001–010. https://doi.org/10.7324/JAPS.2024.177646.
57. Kanaan MH, Khashan HT. Molecular typing, virulence traits and risk factors of pandrug-resistant Acinetobacter baumannii spread in intensive care unit centers of Baghdad city, Iraq. Rev med microbial 2022;33(1):51-55. doi: 10.1097/MRM.0000000000000282.