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Assessing Antimicrobial Prescribing Patterns and Antimicrobial Resistance in Thi-Qar Governorate Hospitals: A Retrospective Study.

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Abstract

Antimicrobial resistance (AMR) is a global concern, especially in low- and middle-income countries, threatening food production, healthcare, and life expectancy. Antimicrobial stewardship (AMS) programs can optimize antimicrobial use (AMU), improve patient outcomes, lower AMR, and save healthcare costs. This observational-retrospective study aimed to assess antimicrobial prescribing patterns and AMR patterns in Thi-Qar Governorate public hospitals. Thi-Qar Health Directorate comprises ten hospitals, and only one hospital was excluded from the study. The study used data from AMS committees, including antibiogram, antimicrobials, and meropenem surveys, hospital pharmacies' medical files, and the directorate statistics from 1/1/2023 to 1/10/2023. Data collection was conducted from 7/11/2023 to 15/12/2023. The number of patients undergoing antimicrobial screening was 6090. The most frequent patients (43.34%) were in the 18–49 years age range. Most cases of antimicrobial indication were surgical procedures (41.82%), with cesarean sections being the most common (16.15%), followed by medical treatment (37.25%), with respiratory conditions (21.34%) being the most common. Most patients (99.72%) received empirical treatment and continued with it without sending samples for culture and sensitivity (C/S) testing to guide targeted therapy, parenteral rather than oral treatment (98.93% were given parenteral antibiotics); more than half of the patients (52.67%) were prescribed a combination of two or more antimicrobials. Most cases (95.43%) in antimicrobial screening were continued on the same dose without reviewing the antimicrobial prescription after 48–72 hours. The treatment resulted in 87.75% healing, 53.57% discharge with antimicrobial discontinuation, and a 1.21% death rate among patients. Metronidazole, ceftriaxone, meropenem, amoxicillin, and vancomycin were the most frequently prescribed antibiotics. The data from hospital pharmacies' medical files showed the consumption of 14 types of antibiotics within the World Health Organization (WHO) Watch group and 18 within the Access group. The most antibiogram-isolated bacteria were *E. coli* (19.06%), *Staphylococcus non-aureus* spp. (18.74%), *Staphylococcus aureus* (11.26%), *Klebsiella pneumonia*e (10.15%), and *Pseudomonas aeruginosa* (7.88%). The antibiogram showed resistance to many antibiotics, and there was a significant difference in resistance distribution among the Access, Watch, and Reserve groups (P value = 0.024). Antimicrobial practice showed empirical treatment with broad-spectrum antibiotics (most of which are in the WHO Watch group), limited C/S testing, and limited antibiogram use, making monitoring AMR hard.

Keywords: Antimicrobial practice, Antibiograms, Antimicrobial resistance, Antimicrobial stewardship programs, The WHO AWaRe Classification.

Introduction

The excessive and improper use of antibiotics in healthcare and agriculture significantly contributes to AMR. (1,2) Antimicrobial use is increasing globally, especially in low- and middle-income countries, as the medications are more readily available and less expensive. (2,3) Global health is at risk from multidrug-resistant bacteria (MDR), and the creation of novel antibiotics is essential to solving this problem. (4)

Iraq is a member of the Global AMR Surveillance System (GLASS), which advances international cooperation in tackling this global health emergency and knowledge of AMR worldwide. The AMS is crucial for identifying and resolving trends of resistance, helping to choose the proper medications, and creating practical plans to fight bacteria that are resistant to antibiotics. (5) Antibiograms are an excellent tool for helping physicians identify and track resistance patterns and for helping them choose the optimal empirical antibiotic therapy. (6) It is essential that AMS work in tandem with prescribers and the microbiology lab to guarantee appropriate antibiogram distribution, instruction, and use. (7) The WHO AWaRe classification was presented in 2017

There are three groups of antibiotics: Access, Watch, and Reserve. Access antibiotics are recommended for common infections due to their narrow spectrum, low cost, and safety. Watch antibiotics are broader-spectrum, higher-cost options for severe cases or resistant pathogens. Reserve antibiotics are the last choice for MDR infections. (8)

A survey conducted among physicians from Egypt, Lebanon, Iraq, and Jordan showed that bacterial colonization and prior antibiotic use were the commonly perceived risk factors for an increase in AMR. The study also showed that the high cost of newer antibiotics, combined with the technological and resource limitations, was found to be among the main obstacles to the effective control of AMR in the area. Additionally, it was shown that AMR significantly rose as a result of the COVID-19 pandemic, which might be caused by changes in priorities, higher hospital occupancy, and the prescribing of unnecessary antibiotics. (9) In a study conducted among Iraqi patients with urinary tract infections, it was revealed that *Staphylococcus* spp. and *Escherichia coli* (*E. coli*) were the most prevalent uropathogens, highlighting the emerging MDR to common antimicrobials and thus necessitating stewardship efforts. (10) The current study aimed to assess the antimicrobial prescribing patterns and AMR patterns in Thi-Qar Governorate public hospitals.

Materials and Methods

Study population

A retrospective observational study was conducted in the following public hospitals in Thi-Qar Governorate: Imam Hussein Teaching Hospital, Nasiriyah Heart Hospital, Al-Haboubi Teaching Hospital, Al-Nasiriyah Teaching Hospital, Bint Al-Huda Teaching Hospital, Suq Al-Shuyukh General Hospital, Al-Shatrah General Hospital, Al-Rifai Teaching Hospital, and Al-Chibayish General Hospital. One hospital, Muhammad Al-Mousawi Children's Hospital, was excluded from the study because the AMS Committee was activated after data collection for the current study was started, with no previous data available. The study aimed to provide a database for evaluating antimicrobial prescribing patterns and AMR patterns. The study methodology and data collection were consistent with the last Iraqi research on antimicrobial usage patterns. (5,11–17) The study encompassed patients of all sexes and ages who were admitted to hospitals from 1/1/2023 to 1/10/2023 and received antimicrobial prescriptions, excluding those who did not receive such prescriptions.

The data related to the study were collected from several sources. AMS committee surveillance data provided patient-specific information such as age, diagnosis, type and number of antimicrobials prescribed, route of administration, allergy, duration of treatment, duration of hospitalization, presence of a C/S test, physician review of AMU (stay on the same dose, increase the dose, decrease the dose, antimicrobial change, add antimicrobial, or stop antimicrobial), and treatment outcome. Besides the AMS committee surveillance data, hospital pharmacies' medical files provided information on AMU according to the WHO classification (Access, Watch, and Reserve). The antibiogram data were used to assess the AMR patterns. Descriptive statistics (frequencies and percentages) were calculated to summarize data. Analytical tests (Kruskal-Wallis and independent t-test) were used to compare the AMR distribution. All analyses were conducted using the statistical software SPSS.

Results

Study group characteristics

The study screened 6090 individuals for antimicrobials. The medical wards with the highest antimicrobial consumption were surgical wards (24.25%), pediatric wards (19.32%), and gynecology and obstetrics wards (17.06%). **(Table 1)**.

Table 1. Distribution of Patients (N=6090) According to Hospital Wards

Medical Wards	Number of patients									Total Number of Patients (%)
	H1	H2	H3	H4	H5	H6	H7	H8	H9	
Surgery	203	121	98	176	20	674	63	0	0	1477 **(24.25%)**
Pediatrics	0	0	94	199	342	481	0	0	61	1177 (19.32%)
Gynecology and Obstetrics	0	0	16	50	49	401	0	290	233	1039 (17.06%)

Continued table 1.

Neonatal Care Unit	0	0	42	62	260	27	0	51	477	919 (15.09%)
Internal Medicine	0	35	133	0	279	62	74	0	0	583 (9.57%)
Cardiology	358	0	0	0	0	0	0	0	0	358 (5.87%)
ICU	156	0	0	0	0	0	11	1	53	221 (3.62%)
ENT	0	0	0	0	0	0	0	119	0	119 (1.95%)
Orthopedic	0	40	3	0	0	0	16	0	0	59 (0.96%)
CCU	36	9	0	0	0	0	11	0	0	56 (0.91%)
Urology	0	0	0	0	0	0	37	0	0	37 (0.6%)
Respiratory	0	8	0	0	0	0	10	0	0	19 (0.31%)
Oncology	0	0	0	0	0	0	0	17	0	17 (0.28%)
Burns	0	0	0	0	0	0	7	0	0	7 (0.11%)
Kidney transplant	0	2	0	0	0	0	0	0	0	2 (0.03%)
Total patients in antibiotic screening	753 **(12.36%)**	216 (3.54%)	386 (6.33%)	487 (8%)	950 (15.6%)	**1645 (27%)**	229 (3.76%)	600 (9.85%)	824 **(13.53%)**	**6090**

CCU: Critical Care Unit, ENT: Ear, nose, and throat, H: Hospital, ICU: Intensive Care Unit.

The most frequent patients (43.34%) were in the age range of 18-49 years. The most frequent patients had two days of hospitalization (35.28%). The most frequent use of antimicrobials was surgical procedures (41.82%), with cesarean sections being the most common procedures (16.15%). **(Table 2)**

Table 2. Table 2. Demographic and Clinical Data of Study Patients (N=6090)

Variable	**Number of Patients (%)**
Age Groups (Years)	
0-12	2331 (38.27 %)
13-17	351 (5.76%)
18-49	**2640 (43.34 %)**
50-96	768 (12.61%)
Duration of Hospital Stay (days)	
1	1645(27%)
2	**2149 (35.28 %)**
3	999(16.4%)
4	656 (10.77%)
5	267 (4.38%)
≥ 6	374(6.14%)
Indications for Antimicrobial Therapy	
1-Surgical Prophylaxis	**2547(41.82%)**
Cesarean section	984(16.15%)
Appendectomy	519(8.52%)
Surgical procedures (Removal of gallbladder, hernia, hemorrhoids, and diabetic foot)	300(4.92%)
Cervical ligation, Cerclage, abortion, and curettage.	241 (3.95%)
Cardiothoracic surgery	234 (3.84%)
Adenoidectomy +tonsillectomy	177 (2.9%)
Orthopedic Procedures	92 (1.51%)
2-Medical Prophylaxis*	894 (14.67%)
Cardiovascular and pulmonary conditions in the ICU, CCU, and medical wards	499 (8.19%)
Neonatal jaundice	188 (3.08%)
Normal vaginal delivery	109 (1.79%)
Other conditions in internal medicine and pediatrics (anemia, seizure, CKD, DKA, DM)	79 (1.3%)

Continued table 2.

Oncology	19 (0.31%)
3-Medical Treatment	2269 (37.25)
Respiratory conditions	**1300 (21.34)**
Gastrointestinal and hepatology	599 (9.83%)
UTI	91 (1.49%)
Sepsis, septicemia	82(1.34%)
Endocarditis, pericarditis, and cardiac device-related infections	66(1.08%)
Miscellaneous Conditions (Fever, burns, hemorrhagic fever, SSI, and meningitis)	131(2.15%)
4-Undiagnosed Conditions	380 (6.24%)
	Total=6090

CCU: Critical care unit, CKD: Chronic kidney disease, DKA: Diabetic ketoacidosis, DM: Diabetes mellitus, ICU: Intensive care unit, UTI: Urinary tract infection, SSI: Surgical site infection.

*****Antimicrobials were prescribed for these non-infectious conditions to prevent secondary infections, which can arise due to compromised immunity, invasive procedures, or prolonged hospital stays.

Most patients (99.72%) received empirical treatment. About half of the patients received an antimicrobial combination. Also, 98.93% of the patients received parenteral antimicrobials. The most common duration of AMU was two days (33.66%). **(Table 3)**

Table 3. Antimicrobial Prescribing Pattern for Study Patients (N=6090)

Variable	**Number of patients (%)**
Number of antimicrobials prescribed	
Single	2883(47.3%)
Double	3002 (49.3%)
Triple	187(3.07%)
Quadruple	17(0.28%)
Quintuple	1 (0.01%)
Total	6090 (100%)
Antimicrobial Treatment Approach	
Empirical	6073(99.72%)
Targeted	17(0.279%)
Route of Administration	
Intravenous (IV) only	5862 (96.25%)
Oral only	65 (1.06%)
Combination (IV + Oral)	163 (2.67%)
Antimicrobial Allergy *	4 (0.065%)
Duration of Antimicrobial (Days)	
1	1560(25.61%)
2	2050 (33.66 %)
3	1010(16.58%)
4	664 (10.9%)
5	487 (8 %)
≥ 6	319(5.23%)

*****Antimicrobial allergies were two cases of ceftriaxone, one case of cefotaxime, and one case of penicillin.

Regarding actions taken by the physicians during the treatment period, most patients (95.43%) continued on the same antimicrobial and dose without reviewing the antibiotic prescription after 48–72 hours. **(Table 4)**

Table 4. Physicians' Review and Actions for Antimicrobial Use During Treatment Period (N=6090)

Type of Review or Actions	**Number of patients (%)**
Review the antimicrobial prescription after 48-72 hours	1257(20.64) %
Continue on the same dose	5812(95.43%)
Increase the dose	112 (1.84%)
Decrease the dose	228 (3.74%)
Change the antimicrobial	150 (2.46%)
Add antimicrobial	258 (4.23%)
Stop antimicrobial	490 (8.04%)
Discharge while continuing the antimicrobial	1491 (24.48 %)
Discharge with discontinuation of antimicrobial	3263 (53.58%)
Discharge without information about antimicrobial continuation	1336 (21.94%)

The most frequent treatment outcome was healing (87.75%). **(Table 5)**

Table 5. Treatment Outcome (N=6090)

Variable	**Number of Patients (%)**
Healing	5344 (87.75%)
Deterioration	150 (2.46 %)
Death	74 (1.21%)
Patients without treatment outcome information	522 (8.57%)

Ceftriaxone was the most frequently used antibiotic (64%) in patients. **(Table 6)**

Table 6. Types of Antimicrobials Prescribed for Study Patients (N=6090) and their WHO Classification

No	**Antimicrobial (Regardless of Dosage Forms)**	**WHO Classification**	**Number of patients (%)**
1	Ceftriaxone	Watch	**3898 (64%)**
2	Metronidazole	Access	2533(41.6%)
3	Ampicillin	Access	702(11.52%)
4	Cefotaxime	Watch	549(9.01%)
5	Amoxicillin	Access	510(8.37%)
6	Gentamicin	Access	402(6.6%)
7	Amikacin	Access	294(4.83%)
8	Vancomycin	Watch	230(3.77%)
9	Meropenem	Watch	131(2.15%)
10	Azithromycin	Watch	69(1.13%)
11	Augmentin	Access	66(1.08%)
12	Ciprofloxacin	Watch	31(0.51%)
13	Ceftazidime	Watch	30(0.49%)
14	Levofloxacin	Watch	25(0.41%)
15	Cephalexin	Access	25(0.41%)
16	Cefixime	Watch	11(0.18%)
17	Trimethoprim-Sulfamethoxazole	Access	4(0.065%)
18	Ampiflux	Not recommended	3(0.05%)
19	Nystatin	Unclassified	3(0.05%)
20	Acyclovir vial 250 mg	Unclassified	2(0.03%)
21	Doxycycline	Access	2(0.03%)
22	Fluconazole	Unclassified	1(0.016%)

According to the hospital pharmacies' records, the most frequently consumed antimicrobials were metronidazole, ceftriaxone, meropenem, amoxicillin, and vancomycin. **(Table 7).**

Table 7. Antimicrobial Consumption During Study Period*.

No	The Antibiotic's Dosage Form	WHO Classification	Total Antibiotic Consumption
1	Metronidazole 500 mg Iv	access	186203 vials
2	Ceftriaxone 1g vial	watch	137940 vials
3	Meropenem vial (500, 1000 mg)	watch	57630 vials
4	Amoxicillin 500 mg vial	access	33656 vials
5	Vancomycin vial (500, 1000 mg)	watch	24883 vials
6	Cefotaxime 1g vial	watch	20775 vials
7	Gentamicin inj. (20, 80 mg)	access	18495 inj. (vial or amp)
8	Amikacin inj. (100, 500 mg)	access	18488 inj. (vial or amp)
9	Ceftazidime 1g vial	watch	6435 vials
10	Ampicillin 500 mg vial	access	5590 vials
11	Azithromycin 500 mg tab	watch	4613 tablets
12	Amoxicillin 500 mg cap	access	3986 capsules
13	Amoxiclav 625 mg tablet	access	2935 tablets
14	Metronidazole 500 mg tab	access	2911 tablets
15	Acyclovir 250 mg vial	unclassified	2664 vials
16	Amoxicillin 250 mg oral suspension	access	2462 pieces
17	Nystatin oral drops	unclassified	2391 pieces
18	Cephalexin 500 mg Cap	access	2092 capsules
19	Tazocin 2.25 g vial	watch	1828 vials
20	Sodium stibogluconate vial	unclassified	1779 ml.

* Data was obtained from hospitals' pharmacy records. The amount of antimicrobials consumed listed in this table represents the total quantity over nine months in nine hospitals. However, this data does not reflect the number of patients, as was done in the AMS committee screening. Instead, it focuses on antimicrobial quantities, which exceeded the current study population due to discrepancies in types and numbers. This highlights that antimicrobial screening by the committees was not comprehensive.

Moreover, the study screened 339 individuals for meropenem use, with 59.58% female and 40.41% male. Over nine months, patients consumed varying amounts of meropenem, with 81.4 % administering it twice daily. **(Table 8)**

Table 8. Demographic and Clinical Data for Patients (N=339) who were Prescribed Meropenem

Variable	Number of Patients (%)
Age Groups (Years)	
0.5-17	36(10.62%)
18-49	**112(33.03%)**
50-90	136(40.11%)
Not documented	55 (16.22%)
Total	339 (100%)
Sex	
Female	**202 (59.58%)**
Male	137(40.41%)
Duration of hospital stay (days)	
1	62 (18.3%)
2	**73 (21.5%)**
3	40 (11.8%)
4	25 (7.4%)
5	36 (10.6%)
≥ 6	103 (30.38%)
Administration Frequency	
Once daily	15 (4.4%)
Twice daily	**276 (81.4%)**
Three times daily	48 (14.2%)
Total Amount consumed	2533750 mg
Indications for Meropenem Therapy	

Continued table 8.

1-Medical Treatment According to MOH guidelines*	**124 (36.57%)**
Surgical site infection	99 (29.2%)
Diabetic foot	11 (3.2%)
Bacterial meningitis	4 (1.2%)
Acute mastoiditis	4 (1.2%)
Lung abscess	1 (0.3%)
pyogenic liver abscess	1 (0.3%)
Neutropenic sepsis	1 (0.3%)
Proven acute pancreatitis	1 (0.3%)
Contaminated blast injury	1 (0.3%)
Septicemia	1 (0.3%)
2-Surgical Prophylaxis	78 (23%)
3-Medical Prophylaxis	48 (14.15%)
4-Other Medical Treatment	89 (26.25%)

* According to Ministry of Health (MOH) guidelines outlined in the letter from the Directorate of Technical Affairs/Department of Pharmacy/ Division of Clinical (Ref. D.T.A/8/3/1/1109 P, dated 7/3/2023), the use of meropenem and imipenem are restricted to specific clinical conditions. These antibiotics are reserved for patients with a severe decrease in white blood cells, undiagnosed or persistent infections that do not respond to other antibiotics, septicemia, life-threatening infections, and osteomyelitis. The drug will be dispensed in main and specialized hospitals with burns centers, with the dose determined by specialist physicians during the morning shift or the fourth-stage physician during the evening shift. Treatment requests must be made from the hospital's internal pharmacy according to a special form signed by the committee specializing in dispensing meropenem.

Three hospitals prepared the antibiogram. However, the remaining hospitals needed the requirements (such as Vitek and laboratory stains). The most isolated bacteria were *E. coli*. **(Table 9)**

Table 9. Microorganisms Identified in Hospitals Antibiogram.

No.	**Organisms isolated**	**Total number of Isolates (%)**
1	***E. coli***	**2007 (19.06%)**
2	***Staphylococcus non-aureus* (spp.)**	**1973 (18.74%)**
3	***Staphylococcus aureus***	**1186 (11.26%)**
4	***Klebsiella pneumoniae***	**1069 (10.15%)**
5	***Pseudomonas aeruginosa***	**830 (7.88%)**
6	*Streptococcus* spp. (β-hemolytic group)	731 (6.94%)
7	*Streptococcus pyogenes* (group)	574 (5.45%)
8	*Streptococcus pneumonia*e	529 (5.02%)
9	*Enterococcus* spp.	257 (2.44%)
10	*Proteus mirabilis*	238 (2.26%)
11	*Burkholderia cepacia complex*	213 (2.02%)
12	*Enterococcus faecalis*	197 (1.87%)
13	*Acinetobacter spp.*	135 (1.282 %)
14	*Streptococcus viridans*	132 (1.25%)
15	*Serratia*	119 (1.13%)
16	*Enterobacter* (spp.)	108 (1.02%)
17	*Acinetobacter baumannii*	68 (0.64%)
18	*Fusobacterium canifelinum*	60 (0.57)
19	*Proteus* (other spp.)	47 (0.44%)
20	*Enterobacteriaceae* (other spp.)	23 (0.21%)
21	*Enterococcus faecium*	15 (0.14%)
22	*Mycobacterium tuberculosis*	10 (0.09%)
23	*Neisseria gonorrhoeae*	8 (0.07%)
		10529 (100%)

There was a high rate of antibiotic resistance, and there was a significant difference in resistance distribution among the Access, Watch, and Reserve groups (P value = 0.024). **(Table 10)**

Table 10. Summary of Hospitals' Antibiogram.

WHO Classification 2023	Antibiotics Tested in Antibiogram	Susceptible (%)	Resistance (%)	Total (%)
Access Group	Ampicillin, flucloxacillin, benzathine penicillin, penicillin, ampicillin-sulbactam, amoxicillin, oxacillin, amoxicillin-clavulanate, cefazoline, cephalothin, amikacin, gentamicin, tetracycline, doxycycline, chloramphenicol, trimethoprim-sulfamethoxazole, nitrofurantoin trimethoprim, sulfisoxazole, clindamycin, and metronidazole.	2063 (44.36%)	2588 (55.64%)	4651 (44.17)
Watch Group	Piperacillin, ticarcillin, piperacillin-tazobactam, ceftriaxone, cefotaxime, ceftazidime, cefepime, cefoxitin, cefixime, cefaclor, cefpodoxime, cefdinir, cefuroxime, tobramycin, netilmicin, imipenem, meropenem, ertapenem, azithromycin, clarithromycin, erythromycin, ciprofloxacin, moxifloxacin, levofloxacin, teicoplanin, vancomycin, rifampin, and fusidic acid.	2418 (44.29%)	**3041 (55.71%)**	**5459 (51.84)**
Reserve Group	Aztreonam, tigecycline, colistin, and Fosfomycin	**255 (60.86%)**	164 (39.14%)	419 (3.97)
Total		4736 (45%)	5793 (55%)	10529 (100%)
		P value =0.601	**P value = 0.024**	

* Significant (P≤0.05), Kruskal-Wallis test. Note: The tested antibiotics are not necessarily available in hospitals, nor are all available antibiotics tested.

There was no significant difference in the percentage of AMR of selected priority pathogens between Thi-Qar Governorate results in 2023 and the Iraqi annual report in 2022. **(Table 11)**

Table 11. Selected AMR Priority Pathogens in Thi-Qar and Iraq.

Priority	Organism	Antibiotic results	% Resistance in Thi-Qar 2023	% Resistance in Iraq 2022
Critical	*E. coli*	Cefotaxime-resistant	51	75
Critical	*E. coli*	Ceftriaxone-resistant	66	74
Critical	*E. coli*	Meropenem-resistant	41	13
Critical	*Acinetobacter* spp.	Meropenem-resistant	80	68
Critical	*Pseudomonas aeruginosa*	Meropenem-resistant	52	44
High	*Staphylococcus aureus*	Methicillin-resistant	69	65
High	*Staphylococcus aureus*	Vancomycin-resistant	38	14
Medium	*Streptococcus pneumoniae*	Penicillin non-susceptible	23	55
P value= 0.849				

* Significant (P≤0.05), Independent t-test.

Discussion

The results of the current study provide important insights into antimicrobial prescribing patterns and AMR trends in Thi-Qar Governorate public hospitals. One key finding is that antimicrobials were used in 6.24% of undiagnosed patients and prophylaxis in 56.5%, with a high prevalence of empirical antimicrobials and minimal targeted treatment (0.27%). These results matched the results of the study by Kurmanji *et al.*, which found that 6.3% of cases had no clear indication, 51% of the antibiotics were used for prophylaxis (with 25.9% being surgical and 25.1% being medical), and only 1.7% targeted the use of antibiotics. [11] The high prevalence of antimicrobial combinations observed in the current study (52.67%) may reflect the tendency towards empirical treatment without pathogen-specific identification. This highlights areas for improvement in quality indicators, such as the overuse of prophylactic antimicrobials and physicians' empirical prescribing habits, which are often conducted without C/S tests.

It is essential to fully understand the benefits and limitations of using antimicrobial combinations over single AMU. Bizri *et al*. study reported the use of combination for the treatment of serious MDR cases in the first, second, and third lines. [9] Hatachi *et al*. study found no significant difference between cefazolin and cefazolin + vancomycin regimens. However, the vancomycin + meropenem regimen had a decreased incidence of bloodstream and surgical site infections compared to cefazolin. [18] Agyeman's study, on the other hand, showed that patients with antibiotic-treated carbapenem-resistant *Klebsiella pneumoniae* had a high death rate. However, the combination regimen was linked to a lower death rate than monotherapy. There was no statistically significant difference in clinical outcomes between combination regimens or monotherapies. [19] Furthermore, any potential improvements from increasing the number of medications must be considered together with the possibility of increased adverse effects. Additional problems like *C. difficile* infection or the evolution of resistant microbes are also brought on by the prophylactic use of broad-spectrum antibiotics. [20–22]

In the current study, despite only 5.23% of patients had an AMU duration of ≥ 6 days, 24.48% of them were discharged while continuing the AMU, and 30.38% of patients in meropenem screening had ≥ 6 days duration. These findings were in line with the Al-Jumaili *et al*. study, which showed an average duration of 12.3 ±6.4 days. The study warned against the overuse of antibiotics and documented widespread misconduct that might be detrimental to bacterial resistance and the overuse of antibiotics. [14]

Most patients (79.35%) in the current study were kept on the same treatment regimen without having their prescriptions reviewed after 48 to 72 hours. This is consistent with the findings of previous studies. To select the most effective drugs and prevent the development of resistant infections, these studies highlighted the importance of stop/review notes in documentation and the need to look at the pattern of antimicrobial usage. [11,12,15,16]

In the current study, ceftriaxone was the most frequently used antibiotic (64%), either alone or in combination. This is consistent with previous studies that supported the current findings. [11–14,16,17] According to previous studies, there was a correlation between the use of broad-spectrum antibiotics and the risk of harmful effects. [23,24]

The current study revealed that most cases (63.43%) were inconsistent, and only 36.57% were consistent with the Iraqi Ministry of Health's meropenem guideline, which specifies its use for life-threatening infections and emphasizes C/S testing. These conditions include infectious bronchiectasis exacerbation, gangrenous cellulitis, lung abscess, neutropenic sepsis, and others. The frequency of antibiotic administration was twice daily in 81.4% of patients; however, the usual dosage was supposed to be taken every 8 hours. These findings supported the study by Salih *et al*., which found a significant discrepancy between the use of antibiotic guidelines in routine practice and the procedures. [17] The present research results also aligned with those of Mustafa *et al*., who found high use of carbapenems, primarily meropenem. [12] Four cases out of 6090 documented antimicrobial allergies, while the meropenem screening showed a lack of allergy testing. Alhamdani's study highlighted that recognizing and notifying doctors of a patient's allergies or medication interactions helps decrease errors. [25]

The most isolated bacteria were *E. coli* 19.06%, *Staphylococcus non-aureus* (spp.) 18.74%, *Staphylococcus aureus* 11.26%, *Klebsiella pneumoniae* 10.15%, and *Pseudomonas aeruginosa* 7.88%. These results are consistent with the Annual Report of the Iraq 2022 Antimicrobial Resistance Surveillance System, Ministry of Health, which showed that Group 1: High case numbers (>1,000 cases) includes *E. coli* 45.78%, *Staphylococcus aureus* 21.47%, *Klebsiella pneumoniae* 12.02%, and *Pseudomonas aeruginosa* 10.95%. [5] The antibiogram showed a high rate of antibiotic resistance, with a significant difference in resistance distribution among Access, Watch, and Reserve groups. The tested antibiotics were not necessarily available in hospitals since their availability was determined by the Essential Medicines List (EML), which included the most tested antibiotics. [26] Not all available antibiotics were tested. These results aligned with the Al-Jumaili *et al*. study, which emphasized that it was vital to note that not all popular antibiotics were included in the C/S test. As a result, doctors gave medications not tested in the C/S to patients with bacteria resistant to many antibiotics. [14]

Based on the urgency and need for new antibiotics, twelve families of bacteria that harm human health are categorized into three primary priorities: critical, high, and medium. [5] AMR is highly prevalent in critical and high-priority pathogens such as *E. coli* (51% resistance to cefotaxime, 66% to ceftriaxone, and 41% to meropenem), *Acinetobacter* spp. (80% meropenem resistance), and *Pseudomonas aeruginosa* (52% meropenem resistance), which were consistent with the Ministry of Health's Annual Report for Iraq 2022. [5] These limit treatment options and raise the possibility of treatment failure and consequences, which is an important issue for Iraqi healthcare providers. [5]

Conclusion

The study highlights trends in antimicrobial prescribing patterns and AMR in Thi-Qar Governorate public hospitals. Findings indicate the overuse of empirical treatment, limited targeted therapy, frequent use of antimicrobial combinations, and a high prevalence of prophylactic AMU, especially in surgical procedures. The predominance of Watch Group's broad-spectrum antibiotics, suboptimal antimicrobial review practices, and discrepancies in administration frequency underscore the need for enhanced antimicrobial stewardship. Furthermore, the significant levels of AMR, especially among critical and high-priority pathogens, emphasize the urgent need for improved antimicrobial prescribing practices and strengthened AMR surveillance efforts to safeguard public health.

Limitations of the study

Retrospective observational studies have limitations such as limited generalizability, causality, and missing data.

Recommendations

This study advocates implementing a comprehensive AMS program in Thi-Qar hospitals and standardizing the practice of antimicrobial prescribing. It also advises on C/S testing, continuous AMS training, improved monitoring, stakeholder engagement, local antibiogram development, multidisciplinary collaboration, and public health awareness campaigns as ways of promoting evidence-based use of antimicrobials and prioritizing activities related to AMS.

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Conflicts of Interest

With this declaration, the authors acknowledge no conflicts of interest.

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Ethics Statements

This study was submitted to the Scientific and Ethics Committee at the University of Baghdad/College of Pharmacy (approval name: RECAUBCP6112023K, date 6/11/2023) and the Iraqi Ministry of Health for approval (number 748, date 7/11/2023). All data about participants and patients will be kept confidential and private.

Author Contribution

Hasan A. Shubbar: MSc Student, Basma Zuheir Al-Metwali: Supervisor.

References

1. Ahmed SK, Hussein S, Qurbani K, *et al*. Antimicrobial resistance: impacts, challenges, and future prospects. Journal of Medicine, Surgery, and Public Health. 2024 Apr 1;2:100081.
2. Sriram A, Kalanxhi E, Kapoor G, *et al*. State of the world's antibiotics 2021: A global analysis of antimicrobial resistance and its drivers. Center for Disease Dynamics, Economics & Policy: Washington, DC, USA. 2021 Jun 5:1-15.
3. Browne AJ, Chipeta MG, Haines-Woodhouse G, *et al*. Global antibiotic consumption and usage in humans, 2000–18: a spatial modelling study. The Lancet Planetary Health. 2021 Dec 1;5(12):e893-904.
4. Almansour AM, Alhadlaq MA, Alzahrani KO, *et al*. The silent threat: antimicrobial-resistant pathogens in food-producing animals and their impact on public health. Microorganisms. 2023 Aug 22;11(9):2127.
5. Alhilfi RA, Abdulmahdi R, Amr N. Antimicrobial Resistance Annual Report Iraq 2022. Antimicrobial Resistance Surveillance System. Ministry of Health. Available from: http://www.phd.iq/catalog/AMR_Iraq_2022. Accessed May 6, 2024.
6. Akualing JS, Rejeki IP. ANTIBIOGRAM (Antibiogram). Indonesian Journal Of Clinical Pathology And Medical Laboratory. 2016;23(1):90-5.
7. Truong WR, Hidayat L, Bolaris MA, *et al*. The antibiogram: key considerations for its development and utilization. JAC-antimicrobial resistance. 2021 Jun 1;3(2):dlab060.
8. World Health Organization. The WHO AWaRe (access, watch, reserve) antibiotic book. World Health Organization; 2022 Nov 14. Available from: https:// iris. who. int/ bitstream/ handle/10665/365135/WHO-MHP-HPS-EML-2022.02-eng.pdf?sequence=1. Accessed Sep 8, 2024.
9. Bizri AR, El-Fattah AA, Bazaraa HM, *et al*. Antimicrobial resistance landscape and COVID-19 impact in Egypt, Iraq, Jordan, and Lebanon: a survey-based study and expert opinion. PLoS One. 2023 Jul 27;18(7):e0288550.
10. Alfetlawi B, Jasim A. Determining the Prevalence of Upper and Lower Urinary Tract Infections' Pathogens and Their Antibiotic Susceptibility Profile for Adult Patients in Al-Diwaniya, Iraq (Conference Paper). Iraqi Journal of Pharmaceutical Sciences (P-ISSN 1683-3597 E-ISSN 2521-3512). 2022;31(Suppl.):86-91.
11. Kurmanji JM, Hassali A, Versporten A, *et al*. Global point prevalence survey in five teaching hospitals in Baghdad, Iraq. Mediterranean

Journal of Infection, Microbes and Antimicrobials/Infectious Diseases and Clinical Microbiology Specialty Society of Turkey. 2021;10:17.

12. Mustafa BR, Kurdi A. Evaluation of the antimicrobial prescribing pattern and the stewardship programs among COVID-19 hospitals in the capital city of Kurdistan-Northern Iraq: A multicenter point prevalence study. Passer Journal of Basic and Applied Sciences. 2023 Jun 1;5(1):65-71.

13. Abbas JK, Al-Metwali BZ. The impact of pharmacist behavioral intervention on antibiotics prescribing in pediatric wards. F1000Research. 2023 May 2;12:458.

14. Ali Azeez Al-Jumaili, Kawther Khalid Ahmed, Eman Sadeq Mawla, *et al*. Irrational Use of Antibiotics in Iraqi Public Hospital. Latin American Journal of Pharmacy, 42 (special issue): 178-183 (2023).

15. Kurmanji JM, See OG, Al-Jumaili AA, *et al*. Quality Indicators of Antimicrobials Prescribing in Iraq: A Scoping Review. Al-Rafidain Journal of Medical Sciences (ISSN 2789-3219). 2024 Sep 7;7(1):221-6.

16. Al-Nema ZM. Trend of Antibiotics Usage in the Intensive Care Unit in the Medical City in Baghdad. Iraqi Journal of Pharmaceutical Sciences (P-ISSN 1683-3597 E-ISSN 2521-3512). 2016;25(1):50-8.

17. Salih NT, Kadhim DJ. Adherence to American Society of Health-System Pharmacists Surgical Antibiotic Prophylaxis Guideline in Medical City Teaching Hospitals/Baghdad. Iraqi Journal of Pharmaceutical Sciences (P-ISSN 1683-3597 E-ISSN 2521-3512). 2016:40-5.

18. Hatachi T, Sofue T, Ito Y, Inata Y, *et al*. Antibiotic prophylaxis for open chest management after pediatric cardiac surgery. Pediatric Critical Care Medicine. 2019 Sep 1;20(9):801-8.

19. Agyeman AA, Bergen PJ, Rao GG, *et al*. A systematic review and meta-analysis of treatment outcomes following antibiotic therapy among patients with carbapenem-resistant Klebsiella pneumoniae infections. International journal of antimicrobial agents. 2020 Jan 1;55(1):105833.

20. Tamma PD, Cosgrove SE, Maragakis LL. Combination therapy for treatment of infections with gram-negative bacteria. Clinical microbiology reviews. 2012 Jul;25(3):450-70.

21. Feuerstadt P, Nelson WW, Drozd EM, *et al*. Mortality, health care use, and costs of Clostridioides difficile infections in older adults. Journal of the American Medical Directors Association. 2022 Oct 1;23(10):1721-8.

22. Katchanov J, Asar L, Klupp EM, *et al*. Carbapenem-resistant Gram-negative pathogens in a German university medical center: Prevalence, clinical implications and the role of novel β-lactam/β-lactamase inhibitor combinations. PLoS One. 2018 Apr 12;13(4):e0195757.

23. Hassan AF, Muhsin SN. Evaluate the Protective Effect of Lactobacillus against Collateral Damage Induced by Ciprofloxacin and Levofloxacin in Iraqi Patients. Iraqi Journal of Pharmaceutical Sciences (P-ISSN 1683-3597 E-ISSN 2521-3512). 2019 Dec 23;28(2):174-9.

24. Noori YA, Arif IS, Younus MM, *et al*. Analysis of Azithromycin adverse events in COVID-19 Patients reported to Iraqi Pharmacovigilance center in 2020. Al Mustansiriyah Journal of Pharmaceutical Sciences. 2022 Oct 24;22(3):35-42.

25. Alhamdani FY. Acquired Error in using Antibiotic for Surgery Patients in Iraqi Hospitals. Iraqi Journal of Pharmaceutical Sciences. 2011;20(2):102-6.

26. Al-Jumaili AA, Younus MM, Kannan YJ, *et al*. A. Pharmaceutical regulations in Iraq: from medicine approval to post-marketing. Eastern Mediterranean Health Journal. 2021 Oct 1;27(10).

تقييم أنماط وصف مضادات الميكروبات ومقاومة مضادات الميكروبات في مستشفيات محافظة ذي قار: دراسة بأثر رجعي

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الخلاصة

تمثل مقاومة مضادات الميكروبات مصدر قلق عالمي، وخاصة في البلدان المنخفضة والمتوسطة الدخل، مما يهدد إنتاج الغذاء والرعاية الصحية ومتوسط العمر المتوقع. يمكن لبرامج الإشراف على مضادات الميكروبات تحسين استخدام المضادات، وتحسين نتائج المرضى، وخفض مقاومتها، وتوفير تكاليف الرعاية الصحية. تهدف هذه الدراسة الرصدية بأثر رجعي إلى تقييم أنماط وصف مضادات الميكروبات وأنماط مقاومة المضادات في المستشفيات الحكومية في محافظة ذي قار. تضم دائرة صحة ذي قار عشرة مستشفيات، وتم استبعاد مستشفى واحد فقط من الدراسة. استخدمت الدراسة بيانات من لجان الإشراف على مضادات الميكروبات، بما في ذلك مسوحات مضادات الميكروبات والميروبينيم، والملفات الطبية للصيدلية الداخلية، وإحصائيات الدائرة من ٢٠٢٣/١/١ إلى ٢٠٢٣/١٠/١. تم جمع البيانات في الفترة من ٢٠٢٣/١١/٧ لغاية ٢٠٢٣/١٢/١٥. بلغ عدد المرضى المشمولون بالدراسة ٦٠٩٠ مريضاً. وكان معظمهم (٤٣,٣٤٪) في الفئة العمرية ١٨-٤٩. كانت معظم الحالات عبارة عن عمليات جراحية

(٤١,٨٢٪)، وكانت العمليات القيصرية هي الأكثر شيوعاً (١٦,١٥٪)، يليها العلاج الطبي (٣٧,٢٥٪)، وكانت أمراض الجهاز التنفسي (٢١,٣٤٪) هي الأكثر شيوعاً. حصل معظم المرضى (٩٩,٧٢٪) على العلاج التجريبي واستمروا فيه دون إرسال عينات للزرع المختبري واختبار الحساسية الذي يستخدم لتوجيه العلاج المستهدف، بالحقن بدلاً من الفم (٩٨,٩٣٪ تم إعطاؤهم مضادات الميكروبات عن طريق الحقن)؛ تم وصف مزيجًا من اثنين أو أكثر من مضادات الميكروبات لأكثر من نصف المرضى (٥٢,٦٧٪). استمرت معظم الحالات (٩٥,٤٣٪) بنفس الجرعة دون مراجعة وصفة المضادات بعد ٤٨-٧٢ ساعة. أدى العلاج إلى شفاء ٨٧,٧٥٪، وخروج المرضى (٥٣,٥٧٪) من المستشفى مع التوقف عن تناول المضادات، ومعدل وفيات ١,٢١٪ بين المرضى. كانت المضادات الأكثر وصفًا هي ميترونيدازول، سيفترياكسون، ميروبينيم، أموكسيسيلين، وفانكومايسين.
تُظهر البيانات الواردة من الصيدليات الداخلية استهلاك ١٤ نوعًا من المضادات ضمن مجموعة المراقبة التابعة لمنظمة الصحة العالمية و١٨ نوعًا ضمن مجموعة الوصول. أكثر أنواع البكتيريا المعزولة بالمضادات الحيوية هي الإشريكية القولونية (١٩,٠٦٪)، المكورات العنقودية غير الذهبية (١٨,٧٤٪)، المكورات العنقودية الذهبية (١١,٢٦٪)، الكلبسيلة الرئوية (١٠,١٥٪)، والزائفة الزنجارية (٧,٨٨٪). يظهر مخطط المضادات الحيوية العديد من المقاومة للمضادات الحيوية، وهناك فرق كبير بين مجموعات الوصول والمراقبة والاحتياطي (قيمة $P = 0.024$). وتشمل ممارسة مضادات الميكروبات العلاج التجريبي بالمضادات الحيوية واسعة الطيف (معظمها موجود في مجموعة المراقبة التابعة لمنظمة الصحة العالمية)، واستخدام محدود لاختبارات الزرع المختبري والحساسية، واستخدام محدود لخارطة مقاومة المضادات التي تجعل من الصعب مراقبة مقاومة المضادات الحيوية.

الكلمات المفتاحية: ممارسة مضادات الميكروبات، مخطط مقاومة المضادات الحيوية، مقاومة مضادات الميكروبات، برامج الإشراف على مضادات الميكروبات، تصنيف AWaRe لمنظمة الصحة العالمية.