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Antibiotic resistance pattern: A descriptive analysis at the general hospitals of Basra, Iraq during 2021.

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Abstract

Antimicrobial resistance is a major problem in the new history of medicine all over the world. However, there are no previously available data on the exact situation or the extent of the problem in Basra to estimate the overall prevalence of antibiotic resistance by specifying it according to the causative organisms in Basra general hospitals during 2021. The study is a descriptive analysis that was conducted in 5 main hospitals in Basra, Iraq in 2021. Data related to the causative microorganisms and the antibiotic selection from 1384 patients were included. Overall, resistance against Penicillin G, Amoxicillin, Cefuroxime, and Cefixime was found to be the highest. Pneumonia, Enterococcus faecalis, and Proteus mirabilis were included in the study and found to be resistant to a wide range of antimicrobial agents. Overall, there is a high prevalence of antimicrobial resistance in Basra. And to address the problem, specific actions need to be taken at the individual, institutional, and national levels.

Keywords: Antibiotic; antimicrobial resistance; prevalence; hospitals.

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1. Introduction

Antimicrobials are drugs that include antibiotics and are used to treat or prevent infections caused by bacteria, viruses, fungi, and parasites. They can be used for humans in addition to animals and plants (Prestinaci, Pezzotti & Pantosti, 2015). Resistance against these antimicrobials usually occurs when these causative organisms are no longer responding to the drugs that were originally meant to kill them. This results in the non-proper treatment of infections, leading to an increased risk of infection spread and more morbidity and mortality (World Health Organization, 2021).

During the past few years, antimicrobial resistance has become a rising problem all over the world (Lipsitch, Bergstrom & Levin, 2000; Gaynes & Monnet, 2007; Pimentel et al., 2022). In 2014, the World Health Organization in their first global report on antibiotic resistance -affirmed it as a threat to humankind (Moremi, Claus, & Mshana, 2016; EClinical Medicine, 2021; Nabadda et al., 2021). Moreover, in 2019, it was estimated that 700 000 people died globally due to antimicrobial resistance. This number is expected to reach ten million deaths annually by 2050 (Kurmanji et al., 2021).

Misuse and overuse of these antimicrobials are the main causes of the rising problem of resistance (World Health Organization, 2021). To address such problems, policies, and approaches should be strictly implementedy to monitor and evaluate the use of antibiotics by physicians (Browne et al., 2021; Kobeissi et al., 2021). Data gathering and reporting should be done through an active surveillance system.

Evidence from all over the world reports the increasing magnitude of multidrug-resistant organisms (Al Benwan & Jamal, 2022; Ying et al., 2022). However, to know the extent of the problem locally, evidence of the local antimicrobial resistance patterns should be presented. Nevertheless, despite the importance and implication of the problem globally, very little is known about the exact situation of the problem at a national level, particularly in Basra hospitals and healthcare institutes.

1.1. Purpose of the Study

This study aims to estimate the overall prevalence of antibiotic resistance by specifying it according to the causative organisms in Basra general hospitals during 2021.

2. Materials and Methods

2.1. *Participants*

Data related to the causative microorganisms, and the antibiotic selection were included according to the Clinical, and Laboratory Standards Institute (CLSI) system and the availability of the material in the five selected hospitals during 2021. The manual and electronic (VITEK apparatus) methods of the antimicrobial sensitivity test (AST) diagnosis were used, and the data from 1384 isolates for 1320 patients were included in the study, gathered from five main hospitals in the city center of Basra province. These include Al Sader, Al Basra, Al Mawani, and Al Fayhaa teaching hospitals, in addition to Basra Specialized Children's Hospital.

2.2. Data collection

The isolated components (specimens) were mainly taken from blood, urine, stool, cerebrospinal fluid (CSF), wound swab, pus, throat, nasal, and ear swab in addition to sputum. Data inputs include general patient information (age, sex, department and location type, specimen type, date of admission, date of specimen), culture, and AST-related information. The pathogens included in our results are the ones that were found to be the most common organisms among the overall causative agents in Basra's five hospitals. Data were taken from the WHONET's electronic surveillance system which is a standardized system that is available in each of the study locations. Collected monthly by AMR unit in Basrah Health Directorate.

2.3. Ethical Considerations

Securing the confidentiality of the patient's information included in the study is an important ethical consideration, especially given the fact that centralized database systems with large amounts of information are more prone to the risk of privacy violations. This is particularly true if the study involved the use of the collected blood samples in addition to the patient's personal information without their informed consent.

For a greater benefit, and as the whole globe is witnessing an era with more disease emergencies and outbreaks, the need to quickly share surveillance data is important to alert all hospitals in a region of an AMR infection outbreak without first getting consent from each patient whose data will be shared. Nonetheless, this study ensured the use of the data without disclosing of the patients' names and personal information.

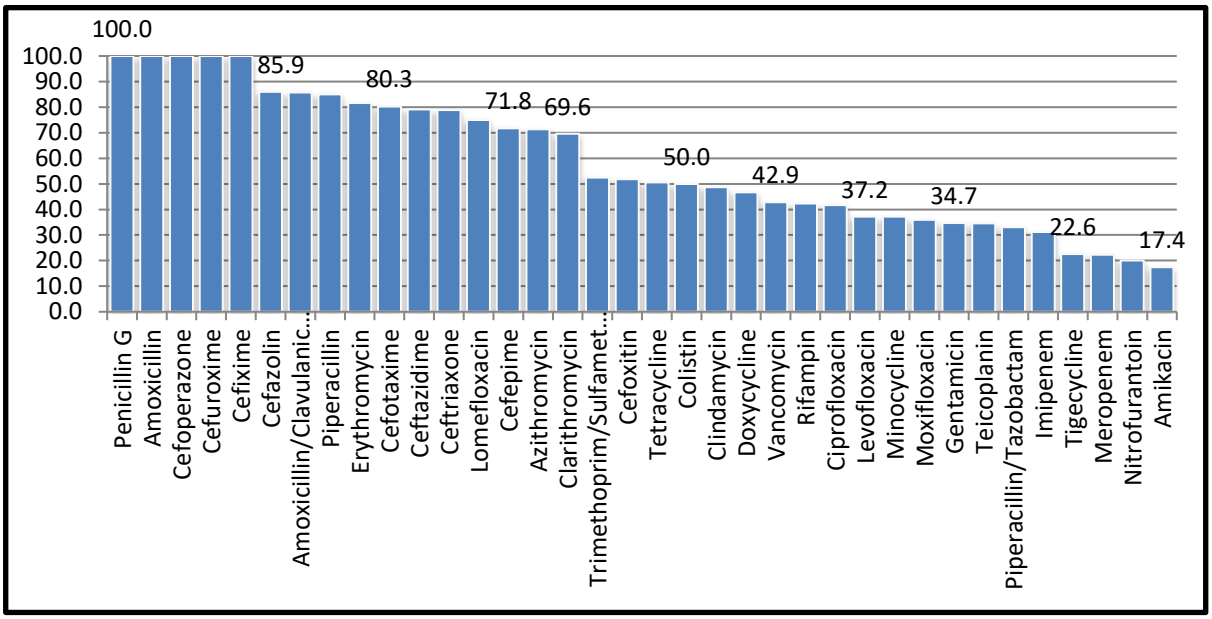
3. Results

3.1. Percentage of the overall resistant bacteria vs the most common antibiotic used

Figure 1 shows the overall percentage of resistance vs. antibiotics for the five selected hospitals in Basra during 2021. It clearly shows that Penicillin G, Amoxicillin, Cefuroxime, and Cefixime were the highest (100%) compared to the lowest percentage that was recorded for Amikacin (17.4%), Nitrofurantoin, Meropenem, and Tigecycline.

Figure 1

The percentage of resistance vs antibiotics (5 hospitals of Basra)



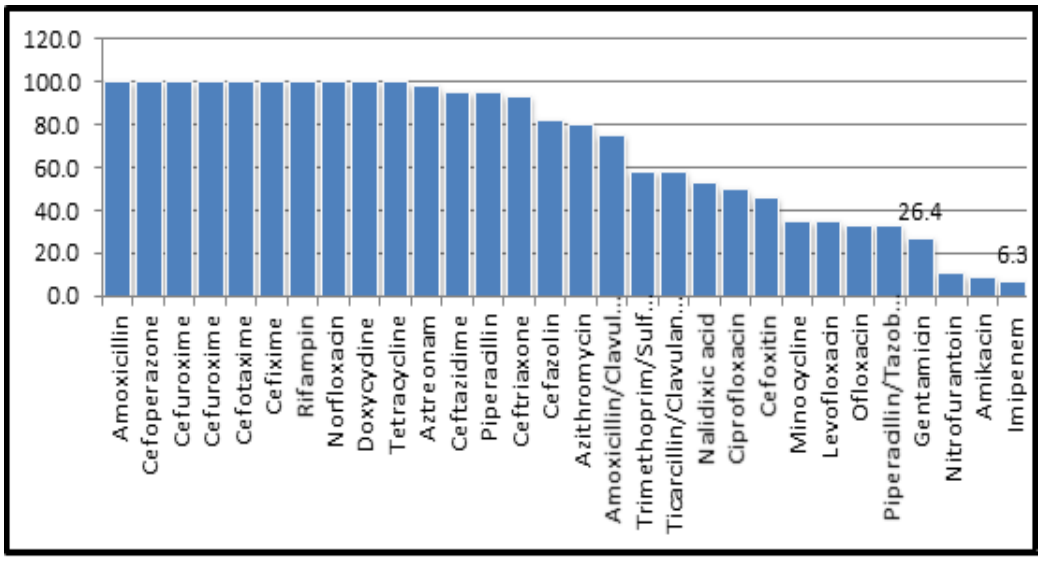
This result can be explained by the lack of policy for using antimicrobials in addition to the low awareness of healthcare providers and society on the issue of antimicrobial resistance. It also concurred with what Kurmanji et al. (2021) found in their cross-sectional study in Baghdad in 2019 in which they concluded that doctors in Iraq depend on their clinical judgment for treating their patients with antibiotics rather than having culture and sensitivity testing.

3.2. Percentage of antimicrobial resistance according to species

For E. coli (Escherichia coli), the study reported 100% resistance with Amoxicillin, Cefoperazone, Cefuroxime, Cefotaxime, Rifampin, Norfloxacin, Doxycycline, and Tetracycline. While the lowest percentage of resistance (as shown in Figure 2) was found to be with, Imipenem (6.3%), Amikacin (8.5%), Nitrofurantoin (10.3%), and Gentamycin (26.4%).

Figure 2

The percentage of the resistance for E. coli

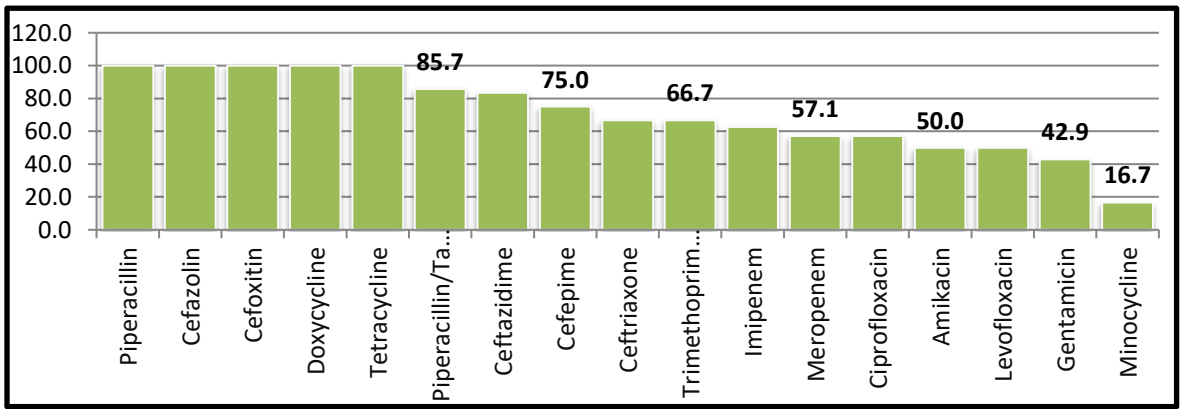


This result reveals the low level of infection control programs among the studied group in the five selected hospitals, which might reflect clinical issues in prescribing antimicrobials without having culture and sensitivity testing, especially among referred cases from the private sector.

For Acinetobacter baumannii (as shown in figure 3), the highest percentage (100%) of resistance was reported to 10 main antibiotics including Piperacillin, Cefazoline, Cefoxitinm Doxycycline, and Tetracycline (100% for each) in addition to other widely ranged antimicrobials. While Minocycline and Gentamycin reported the lowest percentages (16.7% and 42.9% respectively).

Figure 3

The percentage of resistance for Acinetobacter baumannii

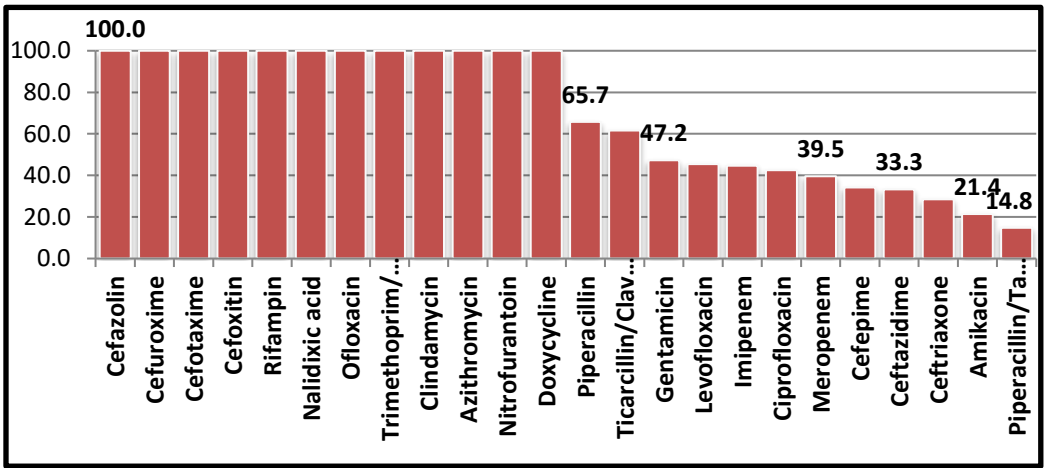


This high percentage of antimicrobial resistance that was found by the study against acinetobacter baumannii is very critical as the pathogen is considered the main causative agent of pneumonia infections associated with the use of ventilator machines in the intensive care units with the highest death rates as reported by Asif et al. (2018).

Figure 4 shows that Cefazoline, Cefoxitine, Trimethoprim, Rifampin & Azithromycin were found to be among the highest resistance (100%) for Pseudomonas aeruginosa (P. aurg).

Figure 4

The percentage of the resistance for P. aurg

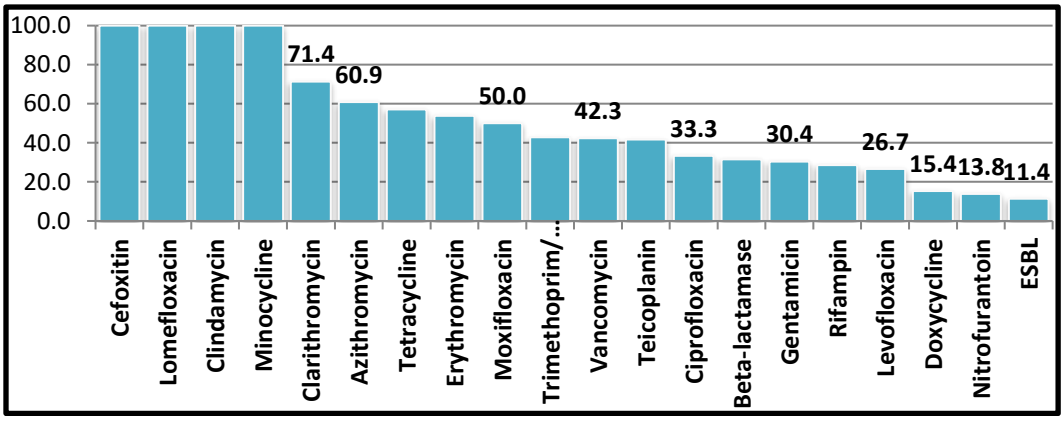


A similar result was found in a review done by Pang et al., (2019) who confirmed that Pseudomonas aeruginosa is branded as highly resistant to most antibiotics.

As Figure 5 shows, the highest percentage (100%) of resistance against Staph. Aureus was found to be against Cefoxitin, Lomefloxacin, Clindamycin, and minocycline. The high resistance of Cefoxitin refers to the high prevalence of Methicillin-resistant Staphylococcus aureus (MRSA) according to CLSI.

Figure 5

The percentage of the resistance for Staph. Aureus



MRSA is a cause of staph infection that is difficult to treat because of resistance to most antibiotics. In addition, Staph infections -including those caused by MRSA- can spread in hospitals, other healthcare facilities, and in the community where you live, work, and go to school. MRSA can cause serious infections that can lead to sepsis or death (General Information, n.d.).

A similar result was found by a prospective cross-sectional study that was done in 2016 in Ethiopia in which the researchers confirmed that the overall rate of multi-drug resistance for staph Aureus that included more than two antibiotics was 100% (Deyno, Toma, Worku & Sorrie, 2017).

Figure 6

The percentage of resistance for Klebsiella pneumonia

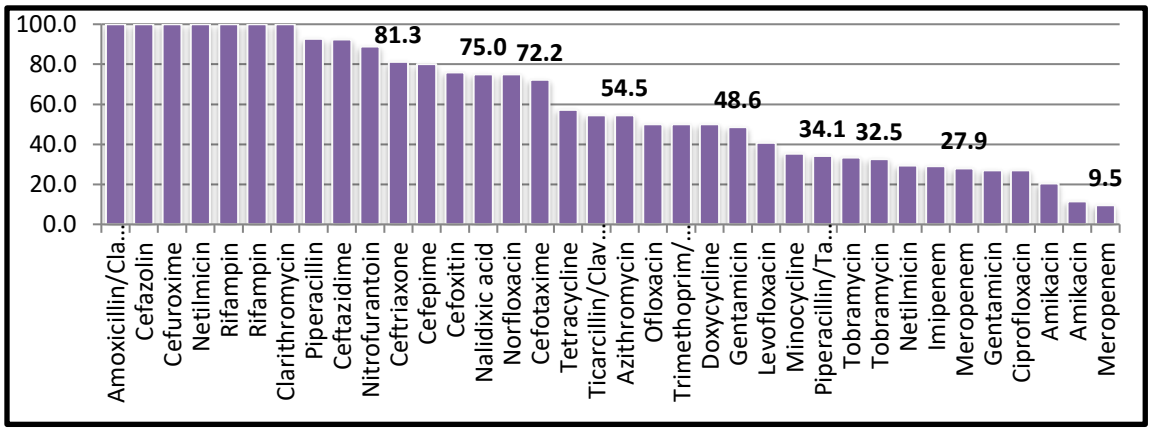


Figure 6 indicates a notable percentage of the resistance of Klebsiella pneumonia for Amoxicillin/ Clavulanic acid, Cefazoline, Cefuroxime, Netilmicin, Rifampin, and Clarithromycin. While for Strep. Pneumonia, the highest percentage of resistance was found by the study against Penicillin G, Cefepime, Clindamycin, Azithromycin, Erythromycin, and Doxycycline (as shown in Figure 7).

These species are considered Health Care Associated Infections (HCAI) as concluded by a study done in 2019 in Indonesia, which confirmed resistance to a wide variety of antibiotics (Nirwati et al., 2019).

Regarding Klebsiella pneumonia, the high percentage of resistance to Ceftazidime refers to the high prevalence of ESBL in addition, the resistance to Meropenem and Imipenem indicates the high prevalence of Carbapenem-resistant strain. According to the WHO priority pathogens list of research and development of new antibiotics, these strains are considered Priority 1 (Critical) which are resistant to multiple antibiotics and they can cause severe and often deadly infections such as bloodstream infections and pneumonia (World Health Organization, 2017).

Figure 7

The percentage of the resistance for Strep. Pneumonia

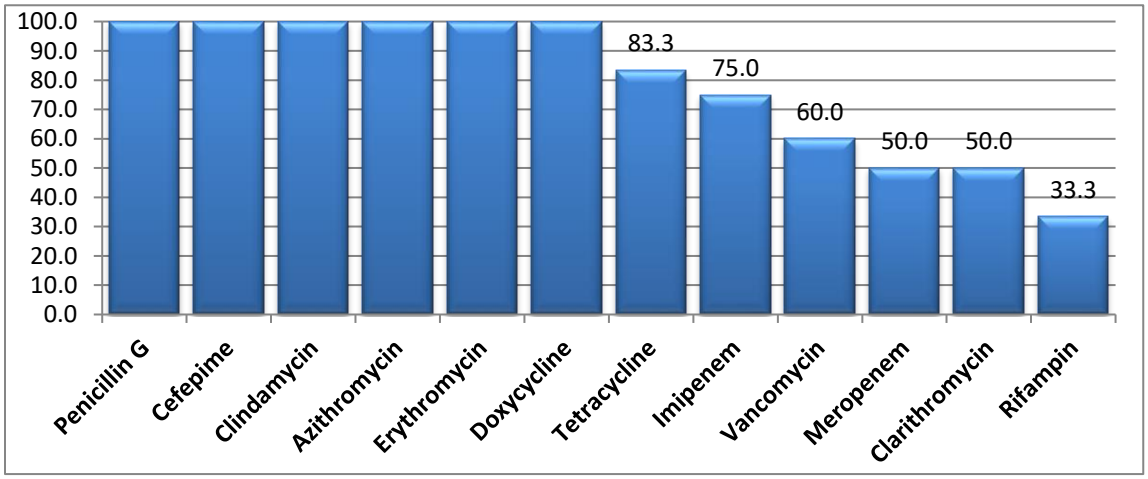
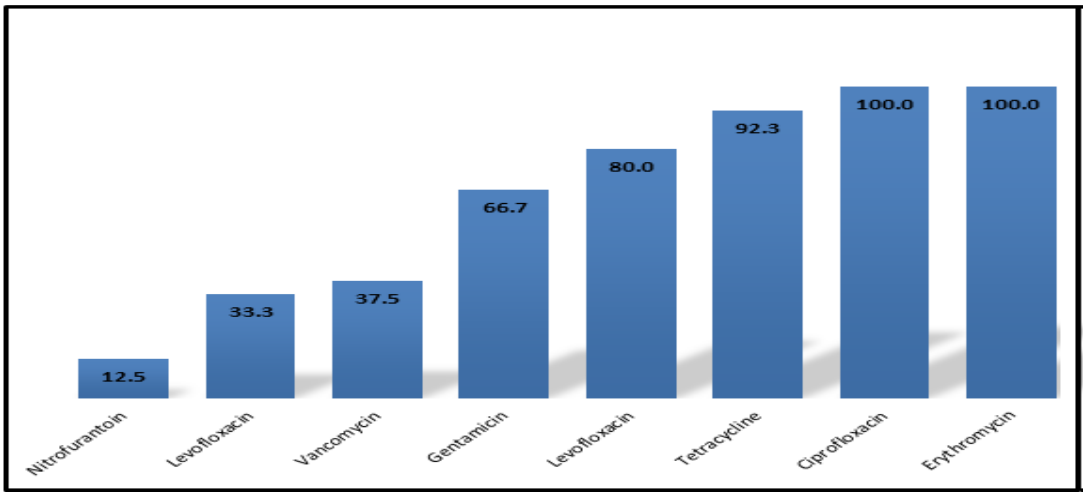


Figure 8 shows that resistance against Erythromycin, Ciprofloxacin, and Tetracycline was found to be the highest for **Enterococcus faecalis** species.

Figure 8

The percentage of resistance for Enterococcus faecalis

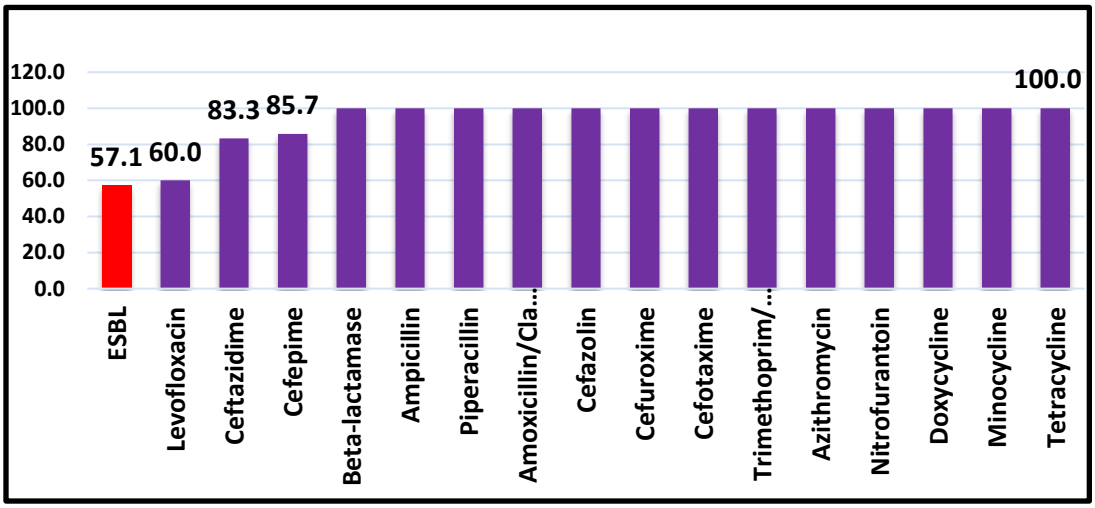


In a review that was done in 2014 on antimicrobial resistance against Enterococcus faecalis, the researchers confirmed that these species reported high antimicrobial resistance to almost all antibiotics (Miller, Munita & Arias, 2014).

Finally, and in regards to **Proteus mirabilis**, the study found the highest resistance for most of the antibiotics including Tetracyclin, Minocycline, Doxycycline, Nitrofurantoin, Azithromycin, Trimethoprim/Sulfamethox, Cefutaxime, Cefazolin, Amoxicillin/Clavularic acid with the lowest percentage against extended-spectrum β-lactamases (ESBLs) (57.1%) as shown in Figure 9.

Figure 9

The percentage of the resistance for P. mirabilis



A similar result was concurred by Girlich, Naas & Dortet in their review in 2020 in which they reported a rise in the percentage of antimicrobial resistance against Proteus mirabilis.

4. Discussion

Despite their importance in the prophylaxes and treatment of diseases, antimicrobials are facing new challenges of becoming ineffective against many organisms due to their resistance, which in turn has become a major health concern even at a global level by adding a greater economic burden on the health care systems all over the world (Maryam, Usmani & Raghava, 2021; Pannek, Kurmann, Krebs, Habermacher & Wöllner, 2021).

The present study reported an overall high prevalence of antimicrobial resistance in Basra specifying the exact antimicrobial resistance against each organism included in the study, thus providing a base of information on the real situation in Basra. In addition, the overall antimicrobial resistance was found to be the highest for the most common antibiotics.

The reason for the widespread use of antimicrobials in hospitals is that nurses do not renew themselves (Danacı, Aydın & Koç, 2023) Among the measures to be taken against antimicrobials, is the knowledge of nurses working in hospitals should be renewed.

5. Conclusion

To our knowledge, our study is the first analysis of AMR data generated in Basra, Iraq with the involvement of an extensive list of causative organisms and antibiotic interventions. In addition, limited data availability and the incompleteness of microbiology laboratories were also some of the most significant study limitations, especially for those before 2021.

To address the problem, specific actions need to be taken at the individual, institutional, and as national levels. Awareness sessions on antimicrobial resistance are recommended for healthcare providers. In addition, all clinicians and health care providers should be evaluated for the proper and scientific prescription of antimicrobials, strengthening their role in educating their patients and colleagues on the proper use of them.

In addition, strengthening the surveillance system and infection control procedures will decrease the incidence and prevalence of pathogens related to AMR. This can be done by ensuring accurate and complete data are documented from each healthcare facility (including the public and private sectors), in addition to encouraging evidence-based research in the field.

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