



Article

Vitek 2 System Identifying and Analyzing the Antibiotic Resistance of Klebsiella Pneumoniae Isolated from UTI Patients

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Abstract: Background: Klebsiella pneumoniae (K. pneumoniae) is a major pathogen in urinary tract infections (UTI) that are acquired in hospitals and the community. It is displaying a high degree of resistance to antibiotics. Aim: The purpose of this research is to use the Vitek 2 compact system to estimate K. pneumoniae in UTIs. and K. pneumoniae's resistance to antibiotics Methods: The Vitek 2 System was used to identify and test for antibiotic sensitivity after 120 urine samples were randomly selected, K. pneumoniae was extracted, and the bacteria was grown on MacConkey agar. Results: Urine samples 42 (35%) included Klebsiella pneumoniae. 120 of the samples that were gathered came from patients. All of the isolates were identified as Klebsiella by primary identification using cultural investigations. They were identified as K. pneumoniae by the VITEK-2 system. Every isolate exhibited resistance to gentamicin, imipenem, meropenem, ceftazidime, ceftazidime, ceftriaxone, ampicillin/sulbactam, amoxicillin/clavulanic acid, and sulfamethoxazole/trimethoprim. Conclusion: This research has improved our understanding of K. pneumoniae-caused UTIs and UTIs in Iraqi patients.

Keywords: K. Pneumoniae, VITEK-2 System, Resistant, Antibiotic

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Introduction

One of the most prevalent and dangerous bacterial illnesses in the world is a urinary tract infection (UTI). Despite being treatable, UTIs are become harder to control because UTI germs, especially those in the Enterobacteriaceae family, are becoming more resistant to medications [1]. Long hospital stays and invasive surgical procedures are risk factors for infection with Klebsiella pneumoniae, a rod-shaped, gram-negative, non-motile with distinctive polysaccharide capsule [2]. Healthy people often have Klebsiella pneumoniae bacteria in their urinary, digestive, and respiratory systems. The majority of Klebsiella pneumoniae infections result in hospitalization, and if left untreated, they can be lethal [3]. At some point in their lives, more than 60% of women will experience UTI symptoms. A symptomatic UTI occurs at least once a year for 10% of American women. UTIs were most common among young, sexually active women between the ages of 18 and 24. [4].

Klebsiella pneumoniae is a major threat to modern healthcare because it is the main source of infections acquired in hospitals and in the community. It is impossible to overestimate its impact on the spread of antibiotic resistance genes from ambient bacteria to pathogenic strains. This harmful bacterium causes a number of serious illnesses, including surgical site infections, urinary tract infections, ventilator-associated

pneumonia, hospital-acquired pneumonia, septicemia, and bacteremia. Additionally, it presents a serious danger of potentially fatal opportunistic infections for immunocompromised patients. Maintaining patient safety and combating antibiotic resistance depend on controlling *Klebsiella pneumoniae* [5]. The physical and physiological traits of the bacterium are routinely used to identify *Klebsiella pneumoniae*. Biochemical tests are typically used after morphological identification, which entails looking at both typical and non-typical colonies on selective cultures. The Advanced Expert System, VITEK 2 has been shown to be feasible for this purpose in a number of publications published in recent years [6]. Nowadays, several *Klebsiella* species constitute serious human infections. Soil, water, and the intestines of people and other animals are common sources of them. This bacterial infection lengthens hospital stays and raises the incidence of sickness in patients. Co-morbidities, compromised immune systems, and excessive antibiotic usage are the primary causes of growing concerns about infection and medication resistance. [7] [8]. The genus *Klebsiella*, which is a member of the Enterobacteriaceae family, contains at least four species: *Klebsiella aerogenes*, *Klebsiella pneumoniae*, *Klebsiella oxytoca*, and *Klebsiella vegetable* [9]. Two of the most important human pathogens are *Klebsiella pneumoniae* and *Klebsiella oxytoca* in terms of sickness severity and recurrence [10]. Globally developing *Klebsiella pneumoniae* isolates that produce broad-spectrum beta-lactamases (ESBLs) are a major concern to infection control management [11]. Generally speaking, intestinal bacteria's carbapenemase enzymes fall into class A, class B, or class D of beta-lactamases. [12].

Materials and Methods

Bacteria Isolation And Identifying

From November 2025 to the end of February 2026, 110 UTI samples were obtained from patients visiting various hospitals in Wasit City for laboratory bacterial examinations. The genus *Klebsiella* species *K. pneumoniae* was already identified in all of the samples. The isolates were first cultivated on selective medium, such as blood agar and MacConkey agar, in order to investigate their phenotype. The isolated bacteria were identified using the automated VITEK-2 compact system down to the genus and species level. *K. pneumoniae* was first identified using an automated biochemical assay.

Using the Vitek-2 Compact System to Identify Bacteria

The vitek-2 system employs fluorogenic technology for organism identifying and the turbidimetric approach for susceptibility testing. The lot number, card type, expiration date, and unique identification number are all included in the barcode of the 64-well cards it uses. Test kits for the detection of Gram-positive and Gram-negative microorganisms are available. In ten hours, the VITEK-2 ID-GN card may identify 154 Enterobacteriaceae and a few Gram-negative bacteria that do not ferment glucose. In as little as eight hours, the VITEK-2 ID-GP card can identify 124 different species of Gram-positive pathogens, including *Enterococcus*, *Streptococcus*, and *Staphylococcus*. The identification of *Klebsiella* species was confirmed in this study using the VITEK-2 method:

Three milliliters of saline are used to suspend one isolated colony of pure bacteria in a sterile test tube.

The traditional turbid standard solutions were contrasted with the bacterial suspension. Between 0.5 and 0.63 is the required final concentration.

The diagnostic Gram stain was used to determine the VITEK-2 card or cassette.

The racks for test tubes and cassettes are sent to the machine. When the boxes are positioned in the first filling region (filler), the device automatically fills them with bacterial suspension and emits an end signal.

The cassette is left on for the entire day at 37°C.

Antimicrobial susceptibility testing

Disk diffusion testing (DDT) was used to identify *Klebsiella* isolates' resistance patterns to several antibiotics (antimicrobial susceptibility to ten drugs).

Amoxicillin/clavulanic acid, ampicillin/sulbactam, cefazolin, cefoxitin, ceftazidime, ceftriaxone, gentamicin, imipenem, meropenem, and sulfamethoxazole/trimethoprim were among the agents that were examined (Dickinson and Company, MD, USA).

Results and Discussion

For microbiological study, 120 UTI patients' clinical urine samples were cultured. 42 samples (35%) contained *Klebsiella pneumoniae* bacteria. This indicates that 35% of the urine samples that were tested had *Klebsiella pneumoniae* bacteria. This age group's characteristics of increased outdoor physical activity and general higher activity levels could be the reason for this higher frequency in younger age groups. Due to lactose fermentation, *Klebsiella pneumoniae* isolates on MacConkey agar plates appeared mucous, big, and pink [13] [14]. The colonies looked pale, smooth, spherical, moist, ivory, and raised; the blood agar showed no signs of hemolysis (gamma-hemolysis) [15]. The VITEK 2 technology was utilized to identify the *K. pneumoniae* bacterial isolates with outstanding precision and dependability as part of the process of identifying all 42 isolates, as indicated in Table (1). As the most recent diagnostic tool, the VITEK 2 system improves diagnostic confirmation and has 64 biochemical tests. It was discovered that the culture method's results matched those of VITEK 2 [16] [17]

Table 1. *Klebsiella pneumoniae* was automatically identified using the Vitek2 microbiological identification technology.

Well No	Symbol	Result of <i>K.pneumoniae</i>
2	APPA	-
3	ADO	+
4	PyrA	+
5	IARL	-
7	dcel	+
9	BGAL	+
10	H2S	-
11	BNAG	-
12	AGL TP	-
13	DGLU	+
14	GGT	+
15	OFF	+
17	BGLU	+
18	DMAL	+
19	DMAN	+
20	DMNE	+
21	BXYL	+
22	BALAP	-
23	PORA	-
26	LIP	-
27	PLE	+
29	TYRA	+
31	URE	+
32	DSOR	+
33	SAC	+
34	DTAG	-
35	dTER	+
36	CIT	+
37	MNT	+
39	5KG	-
40	ILATK	+

aztreonam, imipenem, amikacin, tetracycline, gentamycin, and both streptomycin and chloramphenicol were among the antibiotics that *K. pneumoniae* isolates [21] The findings showed that clinical isolates had significant rates of resistance, especially to ciprofloxacin and amoxicillin-clavulanate, while imipenem had the lowest rates [22] *K. pneumoniae* can be identified via phenotyping, a crucial epidemiological technique. To choose the optimal medications, antibiotic sensitivity testing must be done on a regular basis, particularly when multidrug-resistant types of bacteria appear. More research is required to compare the outcomes with the conventional sensitivity testing approach, even though the automated VITEK 2 system is a very practical and accurate tool.

Conclusion

We conclude from this study that the emergence and acquisition of new resistance genes at the plasmid and chromosome levels has led to the emergence of hypervirulence strains of *Klebsiella pneumoniae* bacteria, which are highly drug-resistant and resistant to highly effective antibiotics. Additionally, it has developed resistance to numerous broad-spectrum medications, especially in older people with long-term infections such urinary tract infections linked to catheter use and other ailments that raise the risk of hospital-acquired infections. Laboratory personnel's standard diagnostic methods are still not totally efficient against this new virus. Without additional analysis, the accuracy of existing automated systems, such the VITEK-2 system, is similarly dubious. As a result, it is necessary to continuously assess the outcomes of detecting these systems, which can be accomplished by updating the system software to incorporate newly discovered infections in hospitals.

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