

# Antibiogram susceptibility and multidrug resistance of *Acinetobacter* isolated from Al-Jalaa Hospital for Surgery and Accidents - Benghazi - Libya

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**Abstract**—BackgroundAntibiotic-resistant *Acinetobacter* nosocomial infection is a leading problem. It acts as an opportunistic pathogen to cause a wide spectrum of infection including nosocomial pneumonia, meningitis, endocarditis, skin and soft tissue infections, urinary tract infection, conjunctivitis, burn wound infection and bacteremia. Multidrug-resistant *Acinetobacter* infection creates a great problem in hospital setting.. Objective: This study was aimed to identify the prevalence and antimicrobial susceptibility pattern of *Acinetobacter* bacteria isolated from patients in AL-Jalaa hospital for accidents & surgery - Benghazi - Libya.Methods: A total of 74 samples were randomly selected from different wards and outpatient department. Samples collected was taken from both gender with different age. Specimen isolates was obtained from (urine, swap, tip, Endotracheal tube and blood). The bacterial identification and sensitivity was carried out using BD Phoenix system (BD Diagnostics, Sparks, MD, USA). The descriptive cross-sectional study was carried out in the Clinical Microbiology laboratory from August 2023 to November 2023. By inoculation in culture media and aerobic incubation at 37°C were done in accordance with the standard micro-biological procedure. Significant bacterial growth on culture of the specimens was processed for identification on the basis of colony morphology, Gram staining, catalase test and coagulase test. Antimicrobial susceptibility test (AST) was done by the Kirby-Bauer disk diffusion method. IBM SPSS software version 28 was used for data analysis. Chi square test used to determine the difference between each variable in the study  $P < 0.05$  statistically significant.Results: our results shows that *Acinetobacter* was resistant to majority of antibiotics , as found resistant to in majority of patients to Nalidixic acid (NA) and Ampicillin (AM) in majority of patients (72), followed by Cephalothin (CL) and Levofloxacin (68), then Augmentin (AUG) in (67), Tetracycline (TE) in (66), Gentamicin (GN) and Amoxicillin (AMC) in (64),Ciprofloxacin(CIP) in (61) Rifampicin (RA) (60), Amikacin (AK) in (52),), while a moderate resistance was found in Imipenem (IMP) in (39) against this on the other hand found only one antibiotic Polymyxin B highly sensitive to *Acinetobacter* with lower resistance rate . Conclusions: *Acinetobacter* found resistant to the majority of antibiotics used in anti-sensitivity test as it's a play a major role in infection in hospitals and consider a big health issue. Also the use of broad spectrum antibiotic irrationally increases

without proper plan, lack of surveillance, suitable antibiotics detection through the period of management and infection control, lead to failure of management process..

**Keywords** *Acinetobacter*-, Antibiotic Resistance , nosocomial infection

## I. INTRODUCTION

Werkman and Gillen made the discovery of the genus *Acinetobacter* in 1932. These microorganisms can be discovered in human clinical samples, animal digestive tracts, soil, and water. As the name implies, the gram-negative, non-sporing rods that make up the genus *Acinetobacter* are members of the *Enterobacteriaceae* family and often use citrate as their exclusive carbon source. There are currently 11 genomospecies in the genus, which can be distinguished by their biochemical traits. Of them, *C. freundii* has been linked to gastroenteritis, neonatal meningitis, and septicemia, and *C. koseri* to cases of neonatal meningitis and brain abscess (Murray ,et al .,2010). It is known to result in infections related to medical care that affect the blood, respiratory system, urinary tract, and other typically sterile bodily areas. The primary reason is a weakened and compromised immune system and compromised bodily functions. The body is more susceptible to *C. freundii* infection and inclined to UTI, intestinal infection, and meningitis when the immune system is weak. Hospitalized individuals are more susceptible to contracting *C. freundii* infections, particularly if they have been there for an extended length of time. Although *Acinetobacter* spp. Are much less typically isolated, they're rising as a not unusual place nosocomial multidrug-resistant pathogen, mainly in growing countries. UTI caused by *Acinetobacter* spp. have been seen in 12% patients in 1961, and since then, its prevalence has been increasing(Whitby and Muir, 1961). This organism's isolation was linked to

obstructive uropathy, genitourinary instrumentation, or catheterization. The age group of senior hospitalized patients—particularly males—was also the most affected. Their discovery highlights the organism's function as a prevalent infection linked to healthcare (Baral, *et al.*, 2012). *Acinetobacter* is isolated from normal cultures, but its identification may be delayed because it is not performed on many biochemical tests commonly used to distinguish gram-negative bacteria. *Acinetobacter* species appear as short, broad gram-negative cells during the rapid growth phase but take the form of coccobacilli during the stationary phase. It is not a bad indole and does not ferment glucose or reduce nitrates. Approximately thirty different species have been found in the genus *Acinetobacter* (Dijkshoorn and van der Toorn, 1992; Garnacho-Montero and Amaya-Villar, 2010). Most of these species are found in the environment and are not associated with any disease in humans (Gordon and Wareham, 2010). In the medical literature, *A. baumannii*, *A. calcoaceticus* and *A. lwoffii* are the most frequently mentioned species. Since it is difficult to distinguish *Acinetobacter* species based on phenotypic features alone, *A. calcoaceticus*-*A. baumannii* complex (ACB) is sometimes used (Munoz-Price and Weinstein, 2008). *A. calcoaceticus* (genospecies 1), *A. baumannii* (genospecies 2), genospecies 3 and genospecies 13TU constitute the ACB (Zarrilli, *et al.* 2009; Dijkshoorn *et al.*, 2007; Gerner-Smidt *et al.*, 1991). The genus *Citrobacter* consists of Gram-negative peritrichous rods. The genus is subdivided into two species: (1) *Citrobacter freundii* (includes mostly H<sub>2</sub>S-positive, indole-negative, and adonitol-negative cultures) and (2) *Citrobacter diversus* (composed of H<sub>2</sub>S-negative, indole-positive, and adonitol-positive cultures) (Lany, 1984). H<sub>2</sub>S-negative *Citrobacter* may be confused with other Enterobacteriaceae. The main factors that distinguish *Escherichia coli* (*E. coli*) from *Citrobacter freundii* biogroup b are the citrate and KCN tests, and the citrate, malonate, and adonitol tests are what distinguish *E. coli* from *Citrobacter* (*C. diversus*). The *C. freundii* biogroup and *C. diversus* can be distinguished from Enterobacter by indole, gelatin, methyl red and the Voges-Proskauer reaction (Lany, 1984). *Acinetobacter* infection epidemiology is extensive and includes infections linked to tropical settings, armed conflicts, natural disasters, and hospital outbreaks in temperate regions (Leung, *et al.*, 2006; Anstey, *et al.*, 2002; Houang, *et al.*, 2001; Chen, *et al.*, 2001; Berg, *et al.*, 1995). It lives in soil and water naturally, and it may also be found in pets, arthropods, and food animals (Houang, *et al.*, 2001; Ash, *et al.*, 2002; Gundi, *et al.*, 2009; Eveillard, *et al.*, 2013). *Acinetobacter* can grow on human skin, in wounds, and in the gastrointestinal and respiratory systems (Albrecht, *et al.*, 2006). Additionally, it can live in oral biofilms, which increases the risk of pneumonia in the case that the lower respiratory tract is aspirated (Richards, *et al.*, 2015; Scannapieco, *et al.*, 2003). The ability of certain *Acinetobacter* strains to withstand environmental desiccation for weeks fosters the spread of the bacteria through hospital

fomite contamination (Wendt, *et al.*, 1997; Bernards, *et al.*, 2004; Getchell-White, *et al.*, 1989). Climate association: *Acinetobacter* has historically been associated with humid climates as a disease. *Acinetobacter* was linked to 17% of ventilator-associated pneumonia cases in a Guatemalan intensive care unit (ICU), second only to pseudomonas, which was responsible for 19% of cases, years before the bacteria was a problem in American intensive care units (ICUs) (Villegas and Hartstein, 2003). In temperate climates, *Acinetobacter* infections have grown in frequency as a nosocomial issue since the 1970s (Towner, 2009). Their ability to survive and their quick development of resistance to the main antibiotic classes are probably contributing factors in their emergence (Towner, 1996). Even so, summertime has been found to be the season with the highest number of nosocomial *Acinetobacter* infections; a review of 3447 *Acinetobacter* infections reported to the US Centers for Disease Control and Prevention (CDC) between 1987 and 1996 found that infection rates were roughly 50% higher from July to October than they were during other seasons (McDonald, 1999). More humid ambient air (which encourages *Acinetobacter* growth in its natural habitats) and perhaps avoidable environmental toxins (such as condensate from air conditioners, which have been linked to epidemic *Acinetobacter* infections) are two possible explanations. Bloodstream infections and ventilator-associated pneumonia are the most common clinical signs of *Acinetobacter* infection (Munoz-Price and Weinstein, *et al.*, 2008). *Acinetobacter* can also infect human skin, wounds, and the gastrointestinal and respiratory systems (Albrecht, *et al.*, 2006). Since many illnesses arise in the context of colonization, it may be challenging to discern between colonization and a real infection.

## II. METHODS AND MATERIALS

### A. Study setting and duration:

This was experimental descriptive study was done in inpatients admitted to surgical wards and out patients of AL-jalaa hospital for accidents & surgery, from August 2023 to November 2023.

### B. Sample collections and isolation:

1. A total of 74 samples were randomly selected from different wards (female surgical ward A, male surgical ward A, intensive care unit, burn shock room, and outpatient department at AL-jalaa hospital for accidents & surgery). Samples collected was taken from both gender (Male and Female) with different age. Specimen isolates was obtained

from (urine, swap, tip of folly catheter, Endotracheal tube and blood).

2. All the culture and sensitivity reports of *Acinetobacter* from hospitalized patients and outpatient department were analyzed. The bacterial identification and sensitivity was carried out using BD Phoenix system (BD Diagnostics, Sparks, MD, USA) & the guidelines of Clinical and Laboratory Standard Institute were used in the lab.

3. By inoculation in culture media Samples were processed for culture by standard conventional methods and susceptibility testing were determined by Kirby Bauers disc diffusion method. Genus *Acinetobacter* was identified by Gram staining, cell and colony morphology, positive catalase test, negative oxidase test and absence of motility(Lone, *et al.*,2009). Speciation of *Acinetobacter* was performed on the basis of glucose oxidation, gelatin liquefaction, beta hemolysis, growth at 37°C and 42°C, arginine hydrolysis and susceptibility to chloramphenicol Significant bacterial growth on culture of the specimens was processed for identification of *Acinetobacter* on the basis of colony morphology, Gram staining, Antimicrobial susceptibility test (AST) was done by the Kirby-Bauer disk diffusion method.

4. Antibiotics used for assess bacterial susceptibility included (Amoxicillin, Imipenem, Ticarcillin-Clavulanic Acid, Cefepime, Ertapenem, Cloroamphenicol, Ciprofloxacin, Tetracycline, Ceftriaxone, Nitrofurantoin, Gentamicin, Vancomycin, Cephalothin, Nalidixic Acid, Penicillin, Cefoxitin, Clindamycin, Amoxicillin-Clavulanate, Piperacillin, Kanamycin).

### C. Statistical analysis

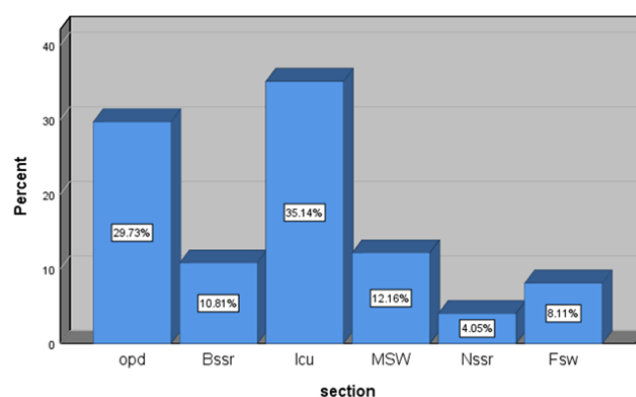
IBM SPSS software version 28 was used for data analysis. Data was comprised of gender, samples from patients, and wards of hospitals as frequencies and percentages. Chi square test was employed to determine the difference between each variable in the study.

## III. RESULTS AND DISCUSSION

A total 74 isolated swabs were obtained from inpatients in surgical and out patients department in AL-Jalaa hospital for accidents & surgery, as found near half the samples obtained from outpatient department, while 12.2% from male surgical ward A, sharing the same percent 8.1 % intensive care unit and female surgical ward A, and last burn shocks room taking the less percent with 10.8%. As seen in table and figure (1).

**:Table (1): The department frequency and percent**

Department		
	Frequency	Percent
<b>Outpatient department (OPD)</b>	22	29.7%
<b>Burn shocks room (BSSR)</b>	8	10.8%
<b>Intensive care unit (ICU)</b>	26	35.1%
<b>Male surgical ward A (MSWA)</b>	9	12.2%
<b>Female surgical ward A (FSWA)</b>	6	8.1%
<b>Nssr</b>	3	4.1%
<b>Total</b>	74	100 %

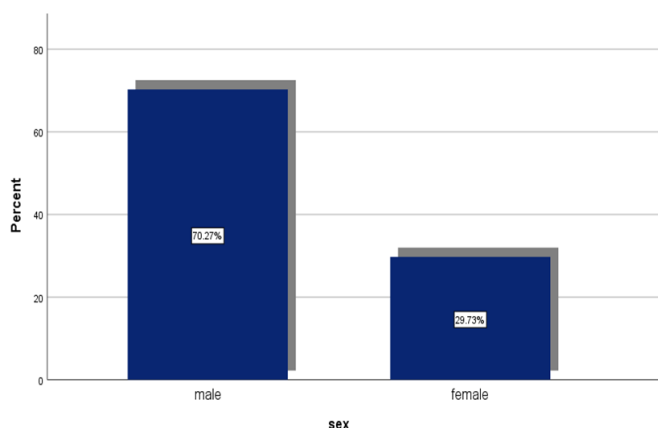


**Figure (1): The department percentage curve.**

As seen in table and figure (2), which describe the gender of patients enrolled in the study as 53.7 % of them was male while female taking the rest percent with 46.3 %.

**Table (2): The sex frequency and percentage:**

Sex			
		Frequency	Percent
Valid	Male	52	70.3%
	Female	22	29.7%
	Total	74	100 %

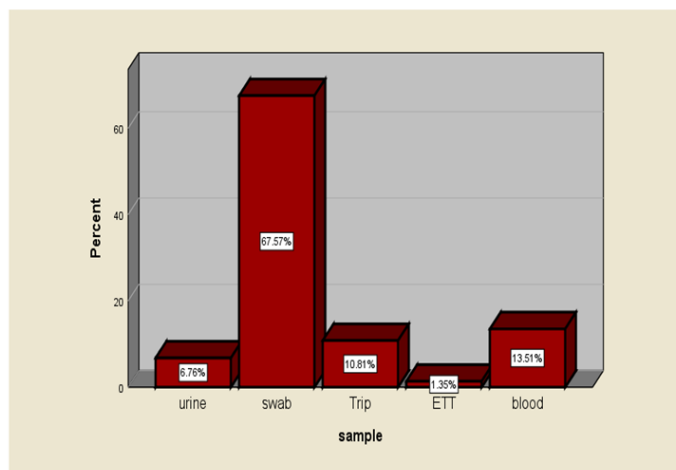


**Figure (2): The sex percentage curve .**

Table and figure (3) shows source of samples as most of the samples were swaps from site of the wound with 67.6%, second blood with 13.5%, third was Tip with 10.8%, while Urine take only 6.8 %, and Endotracheal tube (CTT) is the less percent with 1.4%.

**Table (3): The sample frequency and percentage:**

Sample			
		Frequency	Percent
Valid	Urine	5	6.8%
	Swab	50	67.6%
	Tip of folly catheter	8	10.8%
	Endotracheal tube (CTT)	1	1.4%
	Blood	10	13.5%
	Total	74	100 %



**Figure (3): The sample percentage curve.**

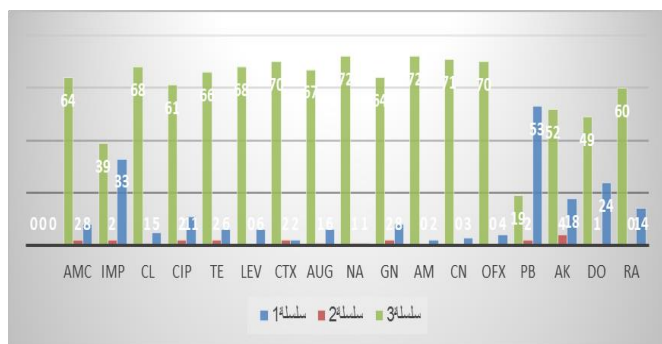
From the following table and figure (4) we notice that *Acinetobacter* was resistant to majority of antibiotics , as found resistant to Nalidixic acid (NA) and Ampicillin (AM) in majority of patients (72), followed by Cephalothin (CL) and Levofloxacin (68), then Augmantin (AUG) in (67), Tetracycline (TE) in (66), Gentamicin (GN) and Amoxicillin (AMC) in (64),Ciprofolxacillin(CIP) in (61) Rifampicin (RA) (60), Amikacin (AK) in (52), Doxycycline (DO) in (49), Imipenem (IMP) in (39), Polymyxin B (PB) in (19), of them, while a moderate resistance was found in Imipenem (IMP) in (39), on the other hand Polymyxin B was the only antibiotic found highly sensitive to *Acinetobacter* with lower resistance rate (53) patients

**Table (4): Antimicrobial susceptibility pattern of Acintobacter to different antibiotics**

Antibiogram																	
	AMC	IPM	CL	CIP	TE	LEV	CTX	AUG	NA	GN	AM	CN	OFX	PB	AK	DO	RA
Sensitive	8	5	33	14	24	18	53	4	3	2	8	1	6	2	6	6	11
Intermediate	2	1	2	0	1	4	2	0	0	0	2	1	1	2	0	2	2
Resistant	64	68	39	60	49	52	19	70	71	72	64	72	67	70	68	66	61

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**Figure (4): Antimicrobial susceptibility pattern of *Acinetobacter* to different antibiotics**

This study was based and examine the presence of *Acinetobacter* using clinical samples from different wards and outpatient department in AL-Jalaa hospital, as *Acinetobacter* found resistant to majority of antibiotics used in the study, according to the antibiogram results most of the resistant antibiotics consider broad spectrum ones reflect the un appropriate use of them in treatment of patients. Anti-sensitivity test *Acinetobacter* isolates against commonly used antibiotics showed that the overall resistance to antibiotics was alarmingly higher in to Nalidixic acid (NA) and Ampicillin (AM) in majority of patients , in as found resistant to (72) of patients from (74), followed by Cephalothin (CL) and Levofloxacin in (68) , then Augmantin (AUG) in (67), Tetracycline (TE) in (66), Gentamicin (GN) and Amoxicillin (AMC) in (64), Ciprofloxacin (CIP) in (61), Rifampicin (RA) (60), Amikacin (AK) in (52), as totally opposite to our result in degree of resistance a study by Sohail *et al.*, observed resistance rates of 99.2%, to cefotaxime and ceftazidime , (93.6%) , (90.9%) to gentamicin and imipenem, respectively (Sohail *et al.*, 2016). On the contrary, lower resistance was

manifested by amikacin (14.29%), and higher resistance in gentamicin, (70.13%) in study by Rit and Saha (Rit and Saha, 2012). While regarding to regard to amikacin, which appeared to have higher resistance rate in (52) of patients in comparing to a study by Rit and Saha, which has lower resistance rate (14.29%). This study shows only one antibiotic (polymyxin B) highly sensitive to *Acinetobacter* with lower resistance rate, this consider with a study by Sohail *et al.*, shows the lowest degree of resistance ranging from tigecycline, colistin, and polymyxin B (Sohail *et al.*, 2016).

#### IV CONCLUSION:

Our study shows that *Acinetobacter* found resistant to the majority of antibiotics used in anti-sensitivity test as it's a play a major role in infection in hospitals and consider a big health issue. Also the use of broad spectrum antibiotic irrationally increases without proper plan, lack of surveillance, suitable antibiotics detection through the period of management and infection control, lead to failure of management process. A further evaluation and study required to study the resistance of staphylococci toward antibiotics .

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