RAHMA NOR ALASOW

CHARACTERISTICS OF ACINETOBACTER INFECTION IN INTENSIVE CARE UNIT IN NEAR EAST HOSPITAL IN CYPRUS

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NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

DEPARTMENTOFMEDICAL MICROBIOLOGY AND CLINICAL MICROBIOLOGY

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M.Sc. THESIS

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Approval

We certify that we have read the thesis submitted by **Rahma Nor ALASOW** titled "**CHARACTERISTICS OF ACINETOBACTER INFECTION IN INTENSIVE CARE UNIT IN NEAR EAST HOSPITAL IN CYPRUS**" and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Educational Sciences.

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Declaration

I hereby declare that all the information, documents, analysis, and results in this thesis have been collected and presented in accordance with the academic and ethical rules of the Near East University Institute of Graduate Studies. I also admit that, as per these rules and conduct requirements, I have granted complete references and citations for all information and data that wasn't produced for this study.

Rahma Nor ALASOW

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ABSTRACT

CHARACTERISTICS OF ACINETOBACTER INFECTION IN INTENSIVE CARE UNIT IN NEAR EAST HOSPITAL IN CYPRUS

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Acinetobacter is a genus of gram-negative bacteria that has received a lot of attention as an opportunistic pathogen linked to illnesses in hospital settings. These bacteria are difficult to treat and keep under control because of their extraordinary resistance to several drugs and their ability to live in a variety of conditions. Patients in intensive care units (ICUs) and those with weakened immune systems are among the vulnerable patient populations most commonly affected by Acinetobacter infections.

This study carried out on 150 samples for Acinetobacter. This result where obtain from 2021 to 2023.

This investigation was conducted at Near East University hospital microbiology laboratory department and focused on inpatient and outpatient to our hospital.

Antimicrobial Resistance Rates of Ainetobacter Isolates According to our research, the most effective antibiotics against Acinetobacter strains were tigecycline and colistin, which had resistance rates of 4% and 5%, respectively. All other medications had substantial antimicrobial resistance rates of Acinetobacter

Infection control methods should be improved. To reduce the spread of Acinetobacter infections inside healthcare settings, strict infection control procedures should be implemented, including hand hygiene, environmental cleaning, and appropriate disinfection practices.

Keywords: Acinetobacter, Sensitivity, Resistance,Drug,antimicrobial.s

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List of Abbreviations

HAI: Healthcare-associated infection

WHO: World Health Organization

PPE: Personal protective equipment

CDC: Center for Disease Control

ICU: Intensive Care Unit

MDR: Multi Drug Resistant

AB: Acinetobacter Baumannii

CHAPTER ONE
INTRODUCTION

1.1 Introduction

The pathogenic bacteria *Acinetobacter baumannii* typically infects very ill patients. Previously thought to be innocuous, *A baumannii* is now seen as a global threat in the healthcare setting, mostly because of its ability to generate multidrug, prolonged drug, and even pan drug resistance phenotypes at previously unknown rates. Around 2% of healthcare-associated infections in the US and EU are caused by *A baumannii,* whereas rates in Asia and the Middle East are twice as high4. Multidrug-resistant (MDR) bacteria are predicted to account up about 45% of all isolates worldwide, with levels as high as 70% in Latin America and the Middle East. This is despite the fact that they are less likely to cause infection than other Gram-negative bacteria. These alarming MDR rates are more than four times higher than those observed for other Gram-negative bacteria, such as the *Pseudomonas eruginosa* and *Klebsiella pneumonia* among others, for which global surveillance statistics are also available. The CDC classified MDR Acinetobacter spp. as a major danger as a result, which prompted ongoing public health monitoring and preventative measures. Furthermore, in its list of bacteria that pose the greatest threat to human health, the WHO has classified carbapenem-resistant *A baumannii* s a member of the critical category, placing a higher priority on research and development activities for novel antimicrobial drugs. (Harding et al., 2018).

Numerous anatomical regions are impacted by *Abaumanni* which also causes several different nosocomial infections. Most typically, infections with *A baumannii* manifest as bloodstream infections brought on by central lines or ventilator-associated pneumonia. In addition to infections of the skin, soft tissues, and surgical sites*, A baumannii* can infrequently cause catheter-associated urethritis. The common element in all of these circumstances is a rupture in an anatomical barrier that permits A. baumannii access to the infection site. A. baumannii-related infections have been reported in the general population as well, but up until now, these infections have only been seen in people who also had underlying comorbid illnesses such alcoholism, diabetes, cancer, and obstructive pulmonary disorders. (Harding et al., 2018). Up until 1970, Acinetobacter species were believed to be infrequent sources of nosocomial infections in the intensive care unit (ICU).

But during the past few decades, the prevalence of Acinetobacter infections has increased to a concerning degree, and it now poses a risk to hospitalized populations all over the world.2 - 8 Outbreaks are being reported more often. additionally, the multidrug-resistant (MDR) strains of this pathogen were the primary cause of the bulk of those outbreaks.(Inglis, 1999).

An important infectious agent for hospitals around the world, Acinetobacter is a gram-negative coccobacillus that has transformed over the past three decades from an organism with dubious pathogenicity. In the last 20 years, 3, 4 around one-fourth of the PubMed citations for "nosocomial Acinetobacter" came in 2005 and 2006. Acinetobacter infections have historically been catastrophic, and more recently, multihospital outbreaks in temperate areas have been brought on by them. The advent of bacteria that are resistant to all currently available antibiotics, the organism's capacity to amass a variety of resistance mechanisms, and the dearth of novel antimicrobial medicines in development are the most concerning trends. The incidence of resistance to carbapenem in 3601 isolates of Acinetobacter baumannii, the clinically relevant of 25 Acinetobacter genospecies, increased from 9% in 1995, to 40% in 2004 at more than 300 hospitals in the United States, according to the Centers for Disease Control and Prevention (CDC). Acinetobacter was once named Micrococcus calcoaceticus and was described in 1911.

it has gone by a number of names since then before becoming known as Acinetobacter in the 1950s. It has been kept apart from food, arthropods, and the environment, and its natural habitats are water and soil. Acinetobacter can grow on human skin, in wounds, and in the gastrointestinal and respiratory systems. Some Acinetobacter strains may withstand environmental desiccation for weeks, a trait that encourages transmission through contaminated fomite in healthcare facilities. Clinically prominent in tropical countries, have been a recurrent problem during wars. (Inglis, 1999).

1.1.1 Acinetobacter Infection

Acinetobacter is described as a gram-negative coccobacillus and is described as "nonreactive in many biochemical tests commonly used to distinguish among gram-negative bacilli." However, gram-negative or even gram-positive bacteria can be stained by Acinetobacter first. The life cycle stage of the bacterium greatly affects how it appears; while it is growing, it resembles a rod, and while it is stationary, it

resembles a coccobacillary. Because it lacks oxidase, Acinetobacter may be recognized from other major gram-negative bacteria such as Neisseria and pseudomonas. if a clinician has a strong clinical suspicion that a patient has a gram-negative coccobacillus infection but the Gram's stain does not show one, this information can be helpful in determining the proper diagnosis and the appropriate course of therapy. (Jung et al., 2010).

1.1.2 General Properties and Taxonomy

Acinetobacter's taxonomy has seen a great deal of debate and modification. Acinetobacter is a Gram-negative, non-motile, oxidase-negative, strictly aerobic, catalase-positive bacterium in the Moraxellaceae family, subclass c-Proteobacteria. The cells' 1.5-micrometer length and coccoid to coccobacillary morphology depend on phase. Most of the species of Acinetobacter are metabolically adaptable and readily expand on conventional microbiological media, forming spherical, smooth colonies 2 mm in diameter. Some species are grayish-yellow or yellow in color.

The temperature range is common for mesophylic bacteria; species of medicinal value thrive best at 37 8C, although environmental organisms might like lower temperatures. It is possible to boost the recovery process of Acinetobacter species from intricate microbial communities by cultivating these bacteria in an occasionally acidic mineral medium containing acetate and nitrates as carbon and nitrogen sources of information, respectively, or in Leeds particular medium, which can also be used for enhancing clinical or environmental specimens. In sheep blood agar, hemolysis can be visible at 5%. (Visca et al., 2011).

1.2 Problem of Statement

The primary targets of Acinetobacter infections in the hospital environment are those with wounds or burn injuries, those in intensive care units (ICUs), and patients who are critically ill and require artificial respiration. Bloodstream infections, skin and soft tissue infections, wound infections, urinary tract infections, and secondary meningitis are among the infections associated with Acinetobacter. These infections are typically caused by members of the *A baumannii* complex; nosocomial infections caused by members of other species of the genus Acinetobacter are uncommon and typically restricted to bloodstream infections linked to catheters and infrequent outbreaks caused by point-source contamination. There have also been a few instances of illnesses picked up in the neighborhood, usually in people with

comorbid diseases who reside in tropical or subtropical areas. The members of the *A baumannii* complex have high levels of drying and disinfectant resistance, which leads to their long-term persistence in the hospital environment and the occurrence of infection outbreaks involving many patients, as well as a steadily rising proportion of MDR isolates. All of these factors contribute to the issues these organisms cause in the hospital environment.

1.3 Purpose of the Study

To examine the characteristics of Acinetobacter infection in ICU patients in Cyprus.

1.3.1 Specific purpose

- ✓ To evaluate the incidence of Acinetobacter infections among ICU patients.
- ✓ To identify the risk factors associated with Acinetobacter infection in ICU patients.
- ✓ To characterize the clinical presentation and diagnosis of Acinetobacter infection in ICU patients.
- ✓ To examine the outcomes associated with Acinetobacter infection in ICU patients.

1.4 Research Questions

1) What is the prevalence of Acinetobacter infection in ICU patients in Near East Hospital?
2) What are the risk factors associated with Acinetobacter infection in ICU patients in Near East Hospital?
3) What are the clinical presentation and diagnosis of Acinetobacter infection in ICU patients in Near East Hospital?
4) What are the outcomes associated with Acinetobacter infection in ICU patients in Near East Hospital?

1.5 Significance of the Study

Some significance features of Acinetobacter infection in Cyprus' ICUs might be:

Acinetobacter infection is a frequent cause of hospital-acquired infections in intensive care units, and the incidence rate may be greater in Cyprus as a result of variables including the country's heavy reliance on antibiotics, which might contribute to the creation of strains that are resistant to such drugs.

Acinetobacter infections can result in a variety of clinical presentations, ranging in

severity from sepsis and pneumonia to minor infections like urinary tract infections.

1.6 Limitation

Sample size: Acinetobacter infections are relatively rare and studying them in a single hospital or a small sample size may not be representative of the broader population or the country.

Timeframe: The prevalence and characteristics of Acinetobacter infections may change over time due to various factors, such as changes in infection control practices, antibiotic use policies, and patient demographics. Therefore, studies conducted in different time periods may not be directly comparable.

1.7 Glossary

CDC: Center for Disease Control

ICU: Intensive Care Unit

MDR: Multi Drug Resistant

AB: Acinetobacter Baumannii

CHAPTER TWO

LITERETURE REVIEW

2.0 Introduction

Acinetobacter infections are becoming a bigger problem in intensive care units (ICUs) all over the world. The frequency and prevalence of Acinetobacter infections in ICU patients have been rising in Cyprus in recent years, underscoring the need for a deeper comprehension of these diseases' features. The purpose of this chapter is to investigate the epidemiology, clinical manifestation, management, antibiotic resistance, and prevention and control of Acinetobacter infection in ICU patients of Turkish republic northern cyprus (TRNC).

The genus Acinetobacter includes a large and diverse collection of bacteria with a wide range of biochemical, physiological, and natural characteristics Acinetobacter spp. are gram-negative bacteria that are non-fermentative of glucose, non-fastidious, catalase-positive, oxidase-negative, and non-motile bacteria. The topic of non-motile microorganisms must be brought up in the conversation. In terms of their pathogenicity and resistance mechanisms, non-motile bacteria, such as certain strains of Acinetobacter, provide particular difficulties. To create infections and circumvent the human immune response, these bacteria rely on additional processes, such as the development of biofilms and the creation of virulence factors. It is usually challenging to distinguish these species using phenotypic and chemotaxonomic approaches because of the huge number of closely related species found in this genus. This bacterial taxonomy has undergone multiple phases of reorganization since Beijerinck's original 1911 description. Acinetobacter presently has 65 species with names that have been approved for publication. Currently, seven different strains of the Acb complex (Acinetobacter calcoaceticus-Acinetobacter baumannii complex) have been associated with clinical evidence illnesses: *A calcoaceticus, A baumannii, A. pittii, A nosocomial, A seifertii, and A lactucaea* eventually heterotypic synonym of *A dijkshoorniae* Because the pathogenicity, resistance to antibiotics, and epidemiology of these species differ, the Acb complexes is physiologically and genetically interconnected, making it challenging to separate these species phenotypically using traditional laboratory procedures. There are several species of this genus of bacteria throughout nature, and samples have been found in soil, surface water, food, vegetables, and arthropods. Burns,

wounds, and the gastrointestinal, cutaneous, and respiratory tracts are among the places where Acinetobacter can be discovered. Additionally, Acinetobacter is easy to isolate in a medical facility, especially the *A baumannii sp*ecies. If detected in clinical samples, the majority of species might represent important human infections. One of the Acinetobacter species*, A baumannii* is the most virulent and lethal one.(Rangel et al., 2021).

2.1 Prevalence and Epidemiology of Acinetobacter Infection in ICU Patients

In critically ill patients receiving treatment in intensive care units (ICUs), one of the most prevalent nosocomial bacteria, *Acinetobacter baumannii* is known to cause deadly infections.

5.7 to 15.7% of bloodstream infections in intensive care units and 7.9% of ventilator-associated pneumonia are caused by Acinetobacter spp. infections, according to research done overseas. (Uwingabiye et al., 2017).

Furthermore, the unusual capacity of these bacteria to develop resistance to widely used antibiotics is a major source of concern. Although polymyxins continue to be the only effective treatment, colistin-resistant *A baumannii* isolates have grown globally. Over the past 10 years, antibiotic resistance rates for *A. baumannii* strains in Moroccan ICUs grew from 78.3 to 95.7% for piperacillin/tazobactam, 68.7 to 95.8% for ceftazidime, 31.4 to 87.7% for imipenem, 27.3 to 59.3% for amikacin, and 77.8 to 96.6% for ciprofloxacin.

A. baumannii infections have been linked to invasive procedures, host variables, hospitalization-related factors, length of ICU stay, and prior use of broad-spectrum antibiotics. These infections have a death rate association in the ICU of 28.3 to 84.3%.

According to data from the literature, the independent predictors of mortality vary by nation and region and may be related to ICU acquired infections, ineffective empirical antimicrobial therapy, the level of antimicrobial resistance, antimicrobial therapy, immunosuppression, severe sepsis, septic shock, use of medical devices, admission from other healthcare facilities, and steroid use. a 2017 study by Uwingabiye et al.

Acinetobacter spp. are widespread both within and outside of hospitals, but are particularly prevalent in the ICU setting. Between the 1960s and the late 1970s, Acinetobacter was mostly found on the hands of healthy people and up to 25% of

them had skin infections.

The truth is that Acinetobacter is believed to be the most common gram-negative bacteria on hospital staff members' skin, especially ICU nurses and respiratory therapists. In addition, 7% of healthy subjects in one study experienced transient pharyngeal colonization. The continually increasing incidence of Acinetobacter nosocomial infections is explained by these findings, which indicate that hospital workers and hospitalized patients may be this organism's most important reservoirs. Acinetobacter has been discovered in addition to human skin in soil, water, fish, meat, vegetables, hospital air, sink basins, bed mattresses, bedside urinals, and respiratory treatment equipment. It was interesting to learn that Acinetobacter infections and colonization were more common during the warmer humid months. Acinetobacter infections are a significant problem in intensive care units (ICUs) worldwide, with a high degree of antimicrobial resistance and morbidity and mortality rates. Maragakis and Perl (2008) conducted a comprehensive review and meta-analysis and found that the prevalence of Acinetobacter infections in ICUs varies greatly, depending on the environment and patient type, from 2.2% to 32%.

An investigation by Papadimitriou-Olivgeris et al. (2013) in a tertiary hospital in Athens, Greece, which is near to Cyprus, discovered that Acinetobacter baumannii was the most typical cause of ICU-acquired bloodstream infections. In Cyprus, there is little information available about the frequency of Acinetobacter infections in ICUs. In a separate research by Kyriakidis et al. (2015), it was shown that 61% of Acinetobacter hospital isolates from ICU patients in Cyprus were resistant to carbapenems, a class of antibiotics widely used as a last option for treating multidrug-resistant infections.

It is also notable that Acinetobacter infections in ICU patients have clinical importance. According to Peleg and Seifert (2010), these infections are linked to extended hospital stays, higher healthcare expenses, and high death rates, particularly in patients with underlying illnesses and those who are receiving mechanical ventilation. According to a research by Zarrilli et al. (2015), 42.8% of ICU patients with Acinetobacter infections died.

Acinetobacter infections in ICU patients are clinically noteworthy because of their high level of antibiotic resistance, tendency for producing severe infections, and link to higher rates of morbidity and death. With few effective antimicrobial treatments available, these infections are frequently challenging to cure, which can result in

extended hospital stays and higher medical expenses.

Acinetobacter baumannii infections in ICU patients were linked to longer durations of mechanical ventilation, longer hospitalizations in the ICU and hospitals, and higher death rates when compared to patients without these infections, according to a research by Munoz-Price et al. (2013). The study also discovered that multidrug-resistant *A baumannii* infections had significantly worse consequences, with a death rate of 64%.

Even after controlling for other variables including age and comorbidities, a second study by Greek researchers Tsioutis et al. (2019) found that *A baumannii* infections in ICU patients were linked to a considerably greater risk of mortality. According to the research, those who had infections with *A baumannii* had a 2.3 times greater chance of passing away than people who didn't have these illnesses.

Because Acinetobacter may result in a variety of illnesses, including bloodstream infections, pneumonia, urinary tract infections, and surgical site infections, their clinical relevance in ICU patients is further exacerbated. The likelihood of morbidity and death from these infections is further elevated by the frequent occurrence of sepsis and septic shock. It is essential to understand the characteristics of Acinetobacter infections in the context of ICU care in Cyprus for a variety of reasons. It first allows for the identification of patients who are more prone to infection, which can guide specialized preventative measures. Second, it aids in the decision-making process for choosing the best course of antibiotic medication and infection prevention strategies, which can improve patient outcomes and prevent the spread of strains that are multidrug resistant. Finally, it provides information that can be used to track how the frequency and incidence of these illnesses have changed over time.

Acinetobacter baumannii was the most common cause of ICU-acquired infections in Cyprus, according to a 2012 study by Hadjichristodoulou et al. *Acinetobacter baumannii* accounted for 44.7% of all infections in that country. The study also found that patients with infections caused by *A. baumannii* spent longer in the critical care unit and died more frequently than those without these illnesses. These findings highlight how important it is to understand the characteristics of Acinetobacter infections in the context of ICU care in Cyprus and the need for targeted preventative and therapeutic approaches.

In a different research, Voulgaris et al. (2017) found that A. baumannii infections in ICU patients were associated with a significantly elevated risk of mortality and a longer stay in the ICU in Greece, a country with a comparable epidemiology to Cyprus. The study also identified many risk factors for A. baumannii infection, including as prior antibiotic medication, mechanical ventilation, and an extended stay in the intensive care unit (ICU). These findings help improve patient outcomes in the ICU environment and guide focused preventive actions.

In conclusion, identifying the features of Acinetobacter infections in the context of ICU care in Cyprus is essential for directing focused preventive and treatment plans and enhancing patient outcomes. The high frequency and prevalence of these infections, as well as their link to higher rates of morbidity and death, underline the pressing need for efficient therapies in this situation.

Significant modifications in the worldwide epidemiology of infections resulting from Acinetobacter species have occurred in recent years. Members of this genus have been recognized as rare human pathogens since the 1970s, but in recent years, reports of patient infections with Acinetobacter have risen, particularly in the intensive care unit (ICU), with *Acinetobacter baumannii* being responsible for the majority of these infections. Acinetobacter infections primarily affect four patient populations and treatment options, according to the growing body of research on this topic: (i) infections acquired by patients in intensive care units; (ii) infections related to healthcare acquired discharged patients this ICU setting; (iii) infections in trauma patients, especially after natural disasters like earthquakes or outbreaks of war; and (iv) infections acquired in the community, primarily pneumonia but also bacteraemia. The majority of infections are caused by patients, but they can also be transferred by hospital workers, medical supplies, and the clinical environment. Acinetobacter infections can be influenced by social contact, bacterial resistance to medications, and disinfectants, among other factors. Multi-drug resistant bacterial strains have been shown to be spreading around the world since the 1980s, including in Europe, notably in the UK, Italy, Germany, Spain, and the United States. Numerous research carried out in North America have linked the increase of multidrug resistant bacteria to this problem. Seasonal infectious diseases are linked to nosocomial infections from Acinetobacter, especially in the summer. The most imipenem, meropenem, ceftazidime, ciprofloxacin, piperacillin-tazobactam, and gentamicin resistance has been reported in Latin America. According to study conducted in Asian countries,

the Acinetobacter species accounted for the bulk of the bacteria that were recovered from ventilator-associated pneumonia and acquired pneumonia. Acinetobacter is more prevalent in China than in Malaysia or Thailand. In India, it was calculated that 35% of Acinetobacter bacteria were carbapenem-resistant. Acinetobacter bacteria may have evolved carbapenem resistance in up to 25% of cases, according to ECDC statistics. Acinetobacter was found in 51.4% of nosocomial infections in Bosnia, 74.1% of which were respiratory infections. In spite of the fact that more than 30% of Acinetobacter strains in Italy are resistant to medication. (Akrami & Ebrahimzadeh, 2019).

People who acquired nosocomial infections caused by Acinetobacter outside of an intensive care unit have been observed in more cases in recent years. While the majority of these patients have infections of the respiratory tract, a small minority also have bacteremia with an unknown primary location. This is a troubling finding since it demonstrates how this disease has the potential to become a major healthcare problem. The number of patients at risk increases due to related infections outside the ICU setting. At least in certain parts of the world, a sizable number of trauma sufferers are susceptible to Acinetobacter species spp. infections. Based on clinical and microbiological information, as well as knowledge gathered from treating people who were injured in more recent battles in Kuwait, Iraq, and Afghanistan, as well as those who were affected by the Marmara earthquake in Turkey (1999). Osteomyelitis and wound infections, mainly in the extremities, were common among these people as a result of Ainetobacter. When troops with Acinetobacter infections were treated in European and American hospitals after obtaining initial care (typically bacteremia and/or pneumonia) in field hospitals, epidemics of nosocomial Acinetobacter infections have occasionally occurred. (2007). Falagas, M. E., and Karveli, E. A. Numerous studies have found a high prevalence of Acinetobacter infection among ICU patients in Cyprus. *Acinetobacter baumannii* was the most prevalent cause of ICU-acquired infections in Cyprus, accounting for 44.7% of all infections, per a research by Hadjichristodoulou et al. (2012). Christofi et al. (2015) found that ICU patients had an Acinetobacter infection prevalence rate of 31.6% in a renowned tertiary hospital in Cyprus.

Furthermore, 68.8% of ICU patients in Cyprus were found to have the carbapenem-resistant Acinetobacter baumannii, according to a research by Petridou et al. (2019). Carbapenem-resistant Acinetobacter baumannii is a kind of Acinetobacter infection

that is particularly concerning due to its difficulty in management and resistance to the majority of antibacterials.

These high prevalence rates highlight the requirement for effective preventive and control methods in order to reduce the incidence and consequences of Acinetobacter infections in the ICU setting in Cyprus.

2.2 The Risk Factors Associated with Acinetobacter Infection in ICU Patients.

Risk factors have been identified that increase the likelihood of Acinetobacter infection in ICU patients. These include:

2.2.1 Mechanical Ventilation

Machine-assisted ventilation Patients who require mechanical breathing are more prone to get an Acinetobacter infection. This is presumably due to the fact that ventilators can introduce microorganism into the respiratory system and create favorable conditions for microbial development (Christofi et al., 2015).

Mechanical ventilation, which can save a patient's life when they are critically ill and unable to breathe on their own, is routinely used. It has been proven that doing so increases the likelihood of getting illnesses such Acinetobacter infections. endotracheal tubes, when used for mechanical ventilation, have the potential to introduce germs into the respiratory system, evading the body's natural defenses and promoting an environment that is conducive to bacterial growth.(Chastre & Fagon, 2001).

For mechanically ventilated patients, infection control protocols such as proper hand hygiene, adequate equipment cleaning, and the use of sterile techniques during the insertion and maintenance of the endotracheal tube are crucial to limiting the spread of Acinetobacter infection. Earlier Acinetobacter infection identification and prompt initiation of the appropriate antibiotic therapy can also help to reduce morbidity and mortality in these individuals.

Despite significant improvements in methods for the care of patients who require mechanical ventilation (MV) and the routine application of efficient techniques for the disinfection of respiratory equipment, ventilator-associated pneumonia (VAP) still complicates the course of 8 to 28% of patients receiving MV. When a patient who has been intubated is administered MV again, the risk of pneumonia is increased 3- to 10-fold. Patients admitted to critical care units (ICUs) have much

higher rates of pneumonia than patients admitted to hospital wards. The mortality rate for infections of less often afflicted organs (including those of the skin and urinary tract), which varies from 1 to 4%, is greater than that for VAP, which ranges from 24 to 50% and can reach 76% in some particular situations or when lung infection is caused by high-risk bacteria. Pneumonia that appears more than 48 hours after the commencement of MV and endotracheal intubation is referred to as this condition. It is essential for doctors to recognize infected individuals as soon as possible and select the appropriate antimicrobial medications since appropriate antimicrobial therapy of patients with VAP has been demonstrated in several trials to considerably improve outcomes. On the optimal methods for VAP diagnosis, treatment, and prevention, there is currently no widespread consensus. The appraisal of the literature, which was chosen using a computer-based MEDLINE search from 1980 through March 2001, forms the foundation of the current study. Review papers, consensus statements, and the references included therein were also considered in our effort to improve our current understanding of the epidemiology, diagnosis, and management of the VAP. The Hospital Infection Management Practices Advisory Committee of the Centers for Prevention and Control of Diseases (CDC, Atlanta, GA) issued extensive and up-to-date suggestions for the avoidance of nosocomial pneumonia in 1997. (Chastre & Fagon, 2001).

2.2.2 Central venous catheters

To administer drugs, fluids, and nutrients directly into the bloodstream, central venous catheters (CVCs) are often used in the intensive care unit (ICU). But they can also spread illnesses, such as Acinetobacter infections. Bypassing the body's built-in defenses, CVCs offer a direct pathway for bacteria to reach the bloodstream. They may also produce a biofilm on the catheter surface, which may harbor and defend microorganisms and make it more challenging for antibiotics to reach and eradicate those bacteria. (Christofi et al., 2015).

On catheter surfaces, *Acinetobacter baumannii* has been discovered to be particularly skilled at creating biofilms. *Acinetobacter baumannii* was found to be the second most common isolation from infections linked to CVC in one investigation (Christofi et al., 2015). The risk of bloodstream infections, such as central line-associated bloodstream infections (CLABSIs), which are linked to high morbidity and mortality, is also increased using CVCs.

Infection prevention techniques include good hand hygiene, the use of sterile technique for inserting and maintaining catheters, and appropriate catheter hub cleaning are crucial in lowering the risk of Acinetobacter infection in patients with CVCs. a further way to lessen the risk of infection is to use catheters as little as possible and remove them as soon as they are no longer required. Additionally, using catheters with antimicrobial coatings may lower the incidence of infections connected to using catheters, including Acinetobacter infections.

In conclusion, CVCs can raise the risk of Acinetobacter infection while also being a crucial tool in the management of critically ill patients. To lower this risk, it's crucial to implement the proper infection control procedures, and high-risk patients should think about using catheters that have been treated with antimicrobials.

2.2.3 Length of Stay in ICU

Risk factors for Acinetobacter infections in critically sick patients include lengthy hospital stays and ICU stays. A patient's risk of exposure to Acinetobacter germs and their chance of contracting an infection increase with the length of their hospital stay.(Scheuerman et al., 2018).

Acinetobacter-related infections, such as those brought on by catheter use, may also be decreased with the use of antimicrobial-impregnated catheters.

The prolonged use of invasive medical equipment like central vein catheters and mechanical ventilation increases the chance of getting an Acinetobacter infection in the ICU. Critically sick patients who need mechanical ventilation or who have central venous catheters may also have impaired immune systems, which makes them more prone to infection. (Christofi et al., 2015).

In one study, it was discovered that individuals with Acinetobacter infections required more time in the hospital than those without the infection. Patients with Acinetobacter infections spent an average of 19 days in the ICU, whereas patients without Acinetobacter infections stayed there an average of 10 days. In addition to prolonged hospitalization, underlying medical problems like diabetes and chronic lung disease, prior antibiotic usage, and contact with contaminated medical equipment or surfaces are other variables that raise the risk of Acinetobacter infections in critically ill patients. (Scheuerman et al., 2018).

Implementing infection control practices like hand cleanliness, prudent antibiotic usage, and efficient surface and medical equipment disinfection will help lower the

incidence of Acinetobacter infections in critically sick patients. Additionally, if possible, efforts should be made to cut down on the usage of invasive medical devices and shorten hospital stays.

Acinetobacter infections are more likely to occur in severely ill patients who stay in the hospital for a longer period of time or spend time in the intensive care unit. To stop the spread of Acinetobacter and other hospital-acquired infections, it's critical to recognize and address these risk factors.

2.2.4 Previous antibiotic use

Antibiotic use Patients who have been treated with antibiotics are at increased risk of developing Acinetobacter infection.

This is because antibiotics can disrupt the normal balance of bacteria in the body, allowing for the overgrowth of antibiotic-resistant organisms like Acinetobacter (Zarrilli et al., 2013).

2.3 Characteristics the Clinical Presentation and Diagnosis of Acinetobacter Infection in ICU Patients

Pneumonia, bacteremia, urinary tract infections, wound infections, and meningitis are just a few of the HAIs that *A. baumannii* is known to cause. *A baumannii* infections are predicted to cause more than 1,000,000 cases of infections yearly around the world, 50% of which are carbapenem-resistant cases.

In korea from the National Healthcare Safety Network (NHSN) for 2009–2010 show that *A baumannii* was found in ventilator-induced pneumonia, catheter-associated urinary tract infections, and bloodstream infections from central lines and surgical sites. With a mortality rate that can range from 8% to 35%, *A baumannii* infections can be seriously fatal. The most dangerous and lethal of these nosocomial illnesses are bloodstream infections and pneumonia linked with ventilators. Living in a nursing home, being elderly, and prior *A baumannii* colonization are risk factors associated with *A. baumannii* infections, as are the presence of devices or previous invasive procedures, the use of antimicrobial medications in the past, prior hospitalization, admission to the intensive care unit, and prolonged hospitalization. Previous studies have demonstrated that *A baumannii* horizontal transmission and spread in the hospital context depend heavily on colonized and sick persons as significant reservoirs. Additionally, contaminated healthcare workers' hands may

have a big impact on how it spreads. Thom et al. (2018) found that 30% of the time, healthcare workers who serve patients who are known to be colonized or infected with *A baumannii* leave the room with the organism on their hands or gloves. *A baumannii* may be isolated from various hospital environmental sources despite the fact that infected and colonized patients are important reservoirs. In the literature, multiple investigations have documented the recovery of *A baumannii* isolates from a variety of sites, including sink and water taps, hand samples from healthcare workers, hospital furnishings, medical gadgets, and gloves.

A baumannii has reportedly become a significant and common cause of HAIs globally due to its capacity to remain and live for extended periods of time on surfaces and in dry environments. Additionally, during the past several decades, there have been an increasing number of reports of outbreaks brought on by *A. baumannii i*solates that have proven resistant to the great majority of antimicrobial drugs on the market. Its therapeutic importance has increased as a result of its capacity to obtain antibiotic resistance determinants. Although *A baumannii* is a substantial nosocomial pathogen that has the potential to cause a variety of diseases, community-acquired infections by this organism (such as pneumonia and bacteremia) are less common but are nonetheless associated with a high fatality rate.

Australia and Asia, notably Hong Kong, Singapore, India, Korea, and Taiwan, were where community-acquired illnesses were found to be most prevalent. The chance of contracting an *A baumannii* infection in the community is increased by having underlying disease such as diabetes mellitus, chronic obstructive pulmonary disease, or renal disease. (Rangel et al., 2021).

2.4 Examine the Outcomes Associated with Acinetobacter Infection in ICU Patients

Understanding the effects of this illness on patient outcomes, healthcare expenses, and general public health is the goal of looking at the outcomes related to Acinetobacter infection in ICU patients.

By identifying the specific risks associated with Acinetobacter infection, healthcare providers can develop effective prevention and treatment strategies to improve patient outcomes.T

2.4.1 Morbidity and Mortality

Acinetobacter infection has been linked to considerable morbidity and mortality in

ICU patients. According to a retrospective study by Lim et al. (2017), Acinetobacter infections had a considerably higher fatality rate than other bacterial illnesses (p0.001). Similar to this, Maragakis and Perl's (2008) meta-analysis revealed that Acinetobacter infection was linked to a greater mortality rate in ICU patients than other gram-negative infections.

The rise of antibiotic-resistant strains, sepsis development, and multi-organ failure are a few of the potential causes of the greater fatality rate linked to Acinetobacter infection. According to Bassetti et al. (2018), patients with Acinetobacter infections that were carbapenem-resistant died at a rate that was considerably higher than patients with Acinetobacter infections that were carbapenem-susceptible.

Acinetobacter infection has been linked to greater mortality rates as well as lengthier hospital and intensive care unit stays. According to Hartzell et al. (2009), patients with Acinetobacter infections spent more time in the intensive care unit on average (28 days vs. 7 days, p0.001) than patients without the illness. Acinetobacter infection was linked to a longer hospital stay, according to a different study by Lee et al. (2017) (20.3 days vs. 12.4 days, p0.001).

Overall, the morbidity and mortality linked to Acinetobacter infection emphasize the urgent need for efficient prevention and treatment approaches to enhance patient outcomes and lessen the strain on healthcare systems.

One important cause is the rise of antibiotic-resistant Acinetobacter bacteria. Because of its resistance to various kinds of antibiotics, including carbapenems, which are commonly considered last-resort antibiotics, *Acinetobacter baumannii* has become a worrisome infection. This resistance makes treating infections caused by these strains challenging, and patients with these infections are at higher risk of mortality.

Another contributing factor is the virulence of Acinetobacter strains. Some strains of Acinetobacter produce virulent factors, such as adhesions, which allow them to adhere to and colonize host tissues. These virulence factors can lead to more severe infections and increased risk of mortality.

Additionally, patients who are immunocompromised or have underlying comorbidities are at higher risk of mortality from Acinetobacter infections. In one study, patients with immunosuppression were found to have a higher mortality rate from Acinetobacter infections compared to those without immunosuppression ($p<0.001$) (Zhu et al., 2017).

Finally, delays in appropriate antimicrobial therapy can also contribute to increased mortality rates. Rapid identification of the infecting strain and antibiotic susceptibility testing are crucial for selecting appropriate antibiotic therapy. However, delays in obtaining culture results and initiating appropriate therapy can lead to disease progression and poorer outcomes.

2.4.2 Antibiotic Resistance

With the rise of antibiotic-resistant bacteria, antibiotic resistance is a serious problem in the treatment of Acinetobacter infections.

According to one research that was published in Clinical Infectious Diseases, over a ten-year period, the percentage of Acinetobacter isolates that were resistant to carbapenems rose from 5% to 25% (Patel et al., 2014). The development of carbapenem-resistant Acinetobacter strains poses a substantial issue in the management of these illnesses as carbapenems are frequently regarded as the antibiotics of last resort for treating multidrug-resistant infections.

Another study published in Antimicrobial Resistance and Infection Control identified several mechanisms of antibiotic resistance in *Acinetobacter baumannii* including efflux pumps, porin mutations, and acquired resistance genes (Mugnier et al., 2010). These mechanisms can confer resistance to multiple classes of antibiotics, making treatment options more limited and increasing the risk of mortality. The emergence of antibiotic-resistant Acinetobacter strains highlights the importance of appropriate antibiotic stewardship and infection control practices to prevent the spread of these strains and preserve the efficacy of available antibiotics.

CHAPTER THREE
MATERIALS AND METHODS

3.0 Study Design

This study carried out on 150 samples for *Acinetobacter baumannii*. This result where obtain from 2021 to 2023.The samples used for this study were aged from 24 to 90 years of the sample. This investigation was conducted at Near East University hospital-microbiology laboratory department and focused on inpatient and outpatient visitors to our hospital. The study sample comprised 150 clinical specimens collected from patient in various departments including, Anaesthesia, ICU, Neurology, Orthopaedics, Urology, and Emergency.

3.1 Tools and Equipment

The following equipment was utilized in this study: an Antic medical petri dish, an automated pipette, a wire loop, test tubes, a dispenser, a measuring ruler, a sterile swab, incubator, MacConkey agar, an autoclave, a syringe, and a 1000mL conical flask.

3.1.1 Specimens Collection

From 2021 to 2023 the microbiology laboratory will collect clinical Acinetobacter specimens.

3.2 Specimen Processing

Standard microbiological techniques were used for the first identification of microorganisms. The acquired acinetobacter isolates were then subcultured on MacConkey agar plates, and samples were then incubated for 24 to 48 hours at 37 degrees Celsius.

3.3 Morphology

The majority of the bacteria in the genus Acinetobacter are encapsulated, strictly aerobic, catalase-positive, indole-negative, and oxidase-negative.

Due to the bacteria's capacity to thrive at 37°C under mesothermal circumstances,

Acinetobacter baumannii can infect people.

Primary and Selective media are the most often used media for the development of *A baumannii*

Small, transparent, and lustrous, A. baumannii colonies show isolated growth on the agar.

Depending on the isolation source, the colonies' texture may range from butyrous to smooth and mucoid.

The colonies are between 2-3 mm in size, although due to the colonies' tendency to shrink up in size, the size may decrease with continued incubation.

3.4 Gram staining procedure

1. Preparation of a slide smear:

- A microscope slide is used with an inoculation loop to give a drop of suspension culture.
- Water is added to enable for a very tiny amount of colony transfer to the inspection slide if the colony is already present in a Petri dish or a slant culture tube.
- A fundamental knowledge of culture is required. When culture is visible on an inoculation loop, it is a sign that too much culture has been gathered.
- An inoculation loop is used to evenly distribute the culture over a 15 mm diameter circular surface. An average slide may have up to four small spots when examining more than one culture.
- The slide can be dried by air drying or applying heat over a low flame. Slide should be turned in a circular manner over flame to prevent overheating or ring pattern creation. The glass slide's cell adhesion is facilitated by the heat, which also lessens the amount of culture that is dramatically lost during washing.

2. Gram staining:

- Crystal violet dye is applied over the fixed culture, allowed to sit for 60 seconds, then removed; any remaining stain is then washed off with water. The objective is to remove the stain while preserving the fixed culture.

- The smear is covered with iodine solution for 60 seconds. Fixing the dye is the name of this process. After pouring out the iodine solution, the slide is washed under running water. The surface's extra water is shook off.
- A few drops of decolorizer are applied to the slide. Solvent combinations containing ethanol and acetone are often used as decolorizers. This process is known as "solvent treatment". The slide is completely saturated after 5 seconds. Applying decolorizer should stop as soon as the solvent stops changing color as it goes over the slide in order to prevent over-decolorization of the gram-positive cells.
- For 60 seconds, Safranin solution is used to counterstain the smear. The fuchsine solution is flushed away with water, and any excess water is wiped away with bibulous paper. The slide can be dried in the air after any excess water is removed before being inspected for germs using oil immersions.

Antimicrobial Susceptibility Analyses

Tests were performed on Acinetobacter isolates to determine their sensitivity to a variety of antibiotics, including imipenem, meropenem, amikacin, gentamicin, tobramycin, ciprofloxacin, levofloxacin, sulfamethoxazole/trimethoprim, colistin, Netilmicin, and tigecycline.

In were followed in the execution of these tests using automated system vitek 2 compact procedures. Each sample's bacterial suspension was created, and its turbidity was measured using the 0.5McFarland standard.

By using morphological and biochemical testing in accordance with accepted practices, all clinical bacterial isolates were identified. According to the VITEC 2 compact machine breakpoint criteria, zone diameters of the findings of susceptibility testing were classified as sensitive, moderate, or resistant.

Automated system VITEC 2 compact machine performs identification of bacterial and antibiotic susceptibility testing.

To perform this you need culture plates, test tube rack, normal saline solution, dispenser, sterile swabs, densi, check, vortex, test cards, pipette.

3.5 Statistical Analysis

This research we used SPSS version 25 to analysis our results.

CHAPTER FOUR

RESULTS

4.1 Socio-demographic data of patients

4.1.1 Gender of the Patients

Table 4.1.1 Gender of the Patients

Acinetobacter	**N (=150)**	**Percent (%)**
Gender		
Male	98	65.3%
Female	52	34.7%
Total	150	100.0

In table 4.1.1 above, we discussed the patient's socio-demographic information. The percentage of male patients is higher than the percentage of female patients in this table, with 65% of the patient data obtained being male and 35% being female.

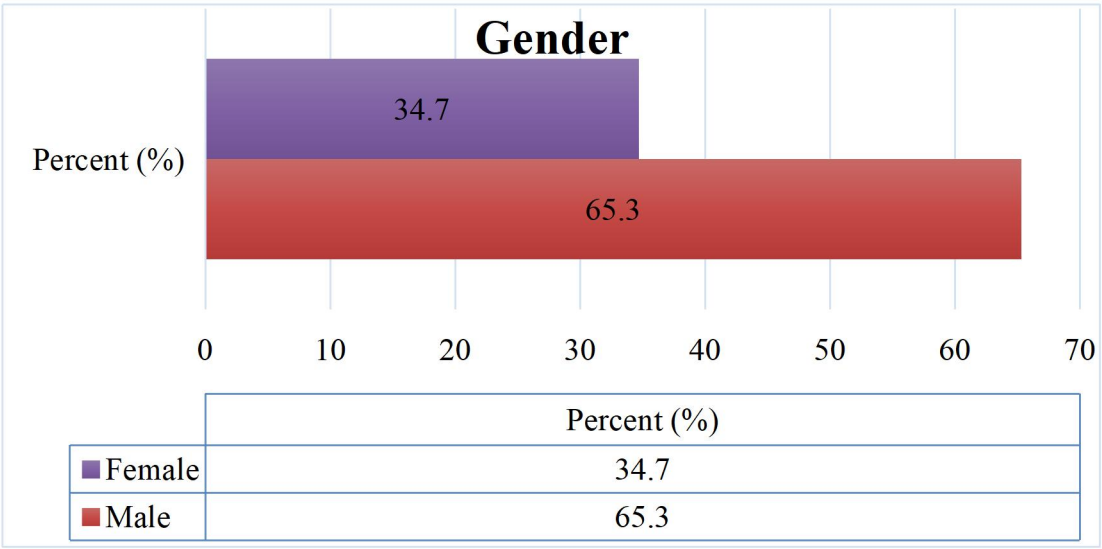

Figure 4.1.1 Gender of the Patients

4.1.2 Age of the patients In NEU (2021-2023)

Age range	N(=150)	Percent (%)
<30	5	3.3%
30-40	5	3.3%
41-50	28	18.7%
51-60	19	12.7%
>60	93	62.0%
Total	150	100.0

Table 4.1.2 Age of the patients in NEU

Patient Type		N	Percentage (%)
ICU	Yes	104	69.3%
	No	46	30.7%
Total		150	100.0

The first two categories have the same percentage of 3.3%, which indicates that 7% of patients are 40 or younger, 19% are between 41 and 50, 12% are between 51 and 60, and the remaining 62% are older than 60. We also split patients' ages into five primary groups.

4.2 Distribution of Acinetobacter isolates based on patient type (NEU Hospital 2021-2023)

Table 4.2: Distribution of Acinetobacter isolates based on patient type (NEU Hospital 2021-2023

Application type	Inpatient	142	94.7%
	Outpatient	8	5.3%
Total		150	100

According to Table 4.2, 70% of patients with Acinetobacter isolates are ICU patients, whereas the other 30% are not. Additionally, 95% of the patients are inpatients whereas only 5% are outpatients.

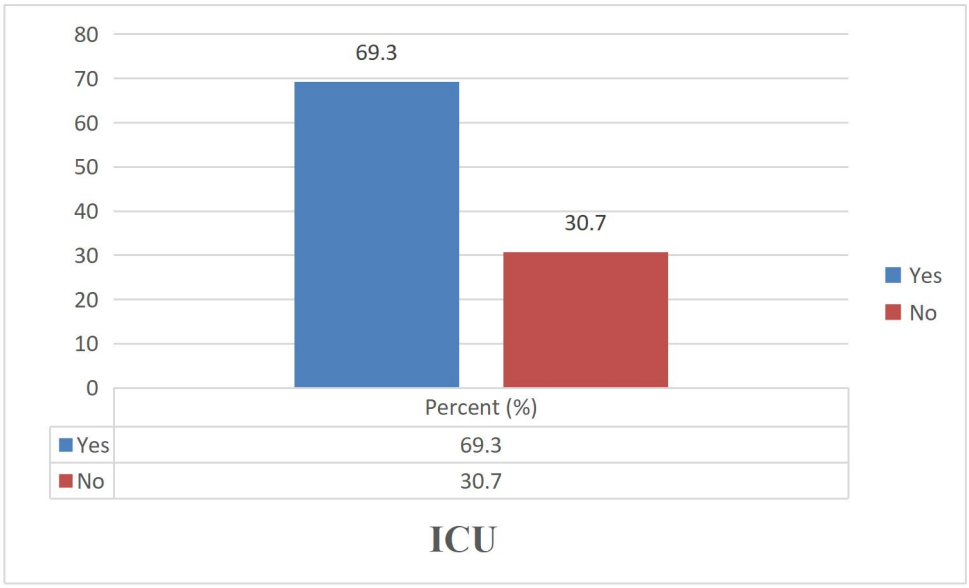

Figure 4.2.1 Clinical severities of patients (ICU or Non ICU)

With my supervisor's consent and permission acinetobacter illness is the most prevalent infection detected in the ICU of our hospital in near east university because so many patients came from another hospitals like burhan hastanesi.

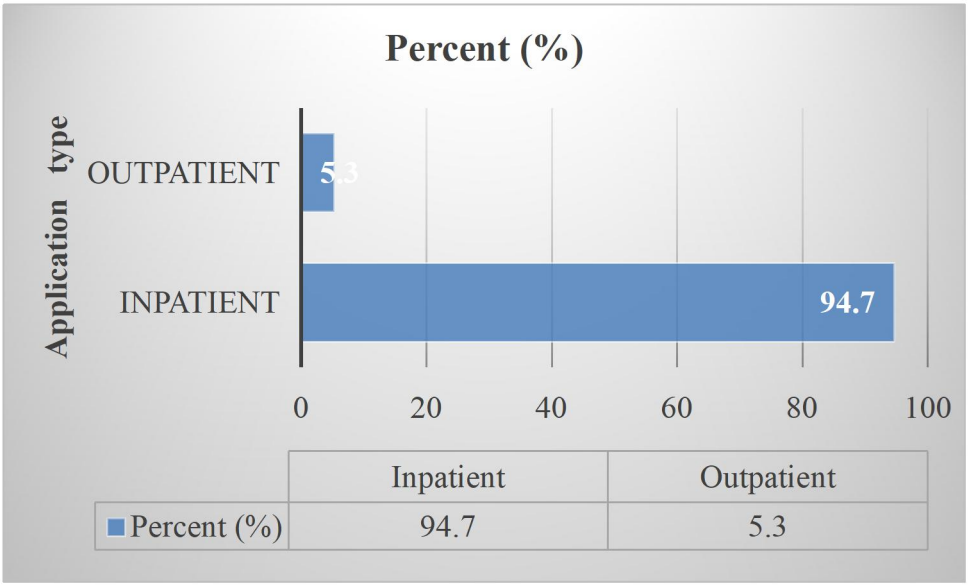

Figure 4.2.2 Clinical severities of patients (inpatient or outpatient)

4.3 Distribution of Acinetobacter isolates based on patient samples (NEU Hospital 2021-2023)

Table 4.3: Distribution of Acinetobacter isolates based on patient samples (NEU Hospital 2021-2023)

Specimen	**Acinetobacter**	**Acinetobacter A**
	N	**Percent (%)**
Aspiration fluid	56	37.3%
Urine	30	20.0%
Sputum	28	18.7%
Abscess/Wound material	17	11.3%
Blood	12	8.0%
Catheter tip	5	3.3%

Bronchial lavage	1	0.7%
Sperm	1	0.7%
Total	150	100.0

The distribution of Acinetobacter isolates based on patient samples (NEU Hospital 2021–2023) is described in detail in table 4.3 above. The three sample types with the largest percentages were sputum (19%), aspiration fluid (38%), and urine (20%). While sperm and bronchial lavage have the same percentage of 1% and are the lowest two, blood and abscess/wound material are 8% and 11%, respectively, and catheter tip is 3%.

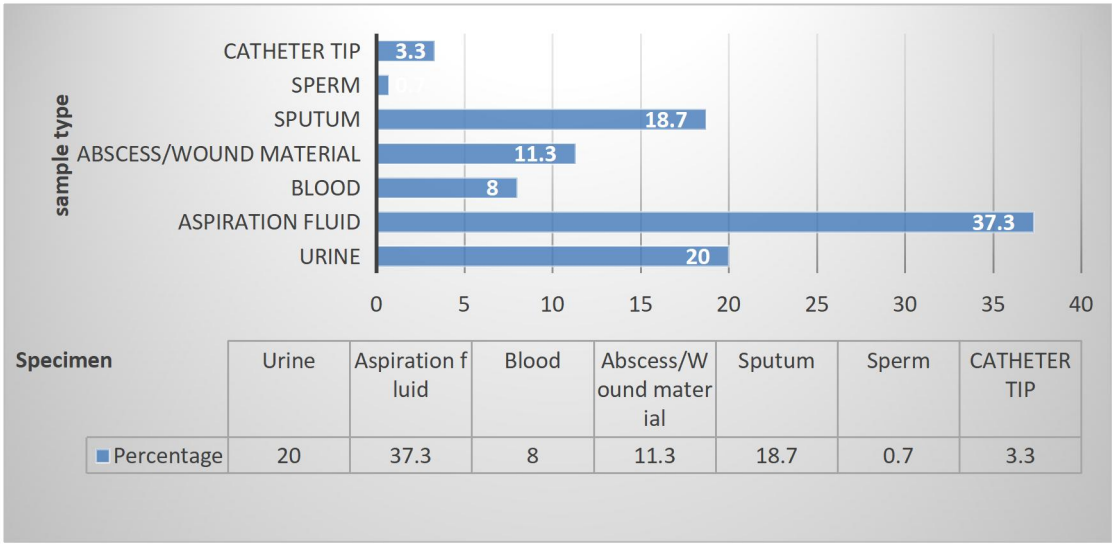

Figure 4.3 Sample Types of the Patients at Near East Hospital

4.4 Different Micro-Organisms Patients in Neu (2021-2023)

Table 4.4 Different Micro-Organisms Patients in Neu (2021-2023)

microorganism name	**Frequency**	**Percent (%)**
Acinetobacter baumannii	3	2.0%
Acinetobacter baumannii/calcoaceticus complex	145	96.7%
Acinetobacter junii	1	.7%
Acinetobacter lwoffii	1	.7%
Total	150	100.0

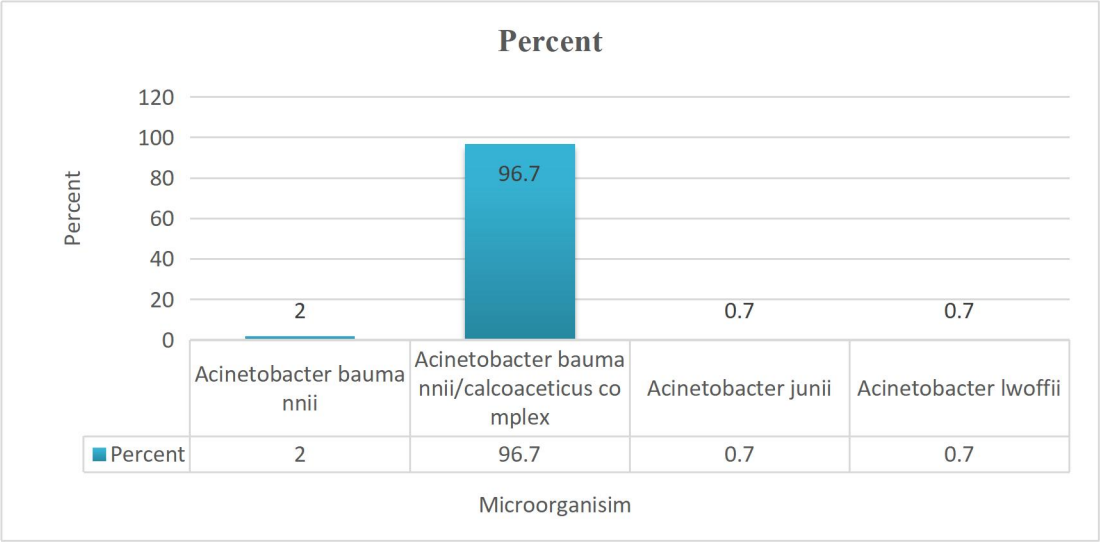

Figure: 4.4 Different Micro-Organisms Patients in Neu (2021-2023)

4.5 Antimicrobial Resistance Rates of Acinetobacter Isolates (NEU Hospital 2021-2023)

Table 4.5: Antimicrobial Resistance Rates of Acinetobacter Isolates (NEU Hospital 2021-2023)

Antibiotic	**Number of Isolated Tests**	**Resistance ratio**	**Percentage %**
Meropenem	150	0.96	96.0%
Ciprofloxacin	147	0.946666667	94.7%
Levofloxacin	137	0.893333333	89.3%
Imipenem	141	0.893333333	89.3%
Trimethoprim/sulfameth	148	0.853333333	85.3%
Netilmicin	139	0.846666667	84.7%
Gentamicin	150	0.753333333	75.3%
Tobramycin	139	0.66	66.0%
Amikacin	149	0.646666667	64.7%
Colistin	150	0.046666667	4.7%
Tigecycline	150	0.04	4.0%

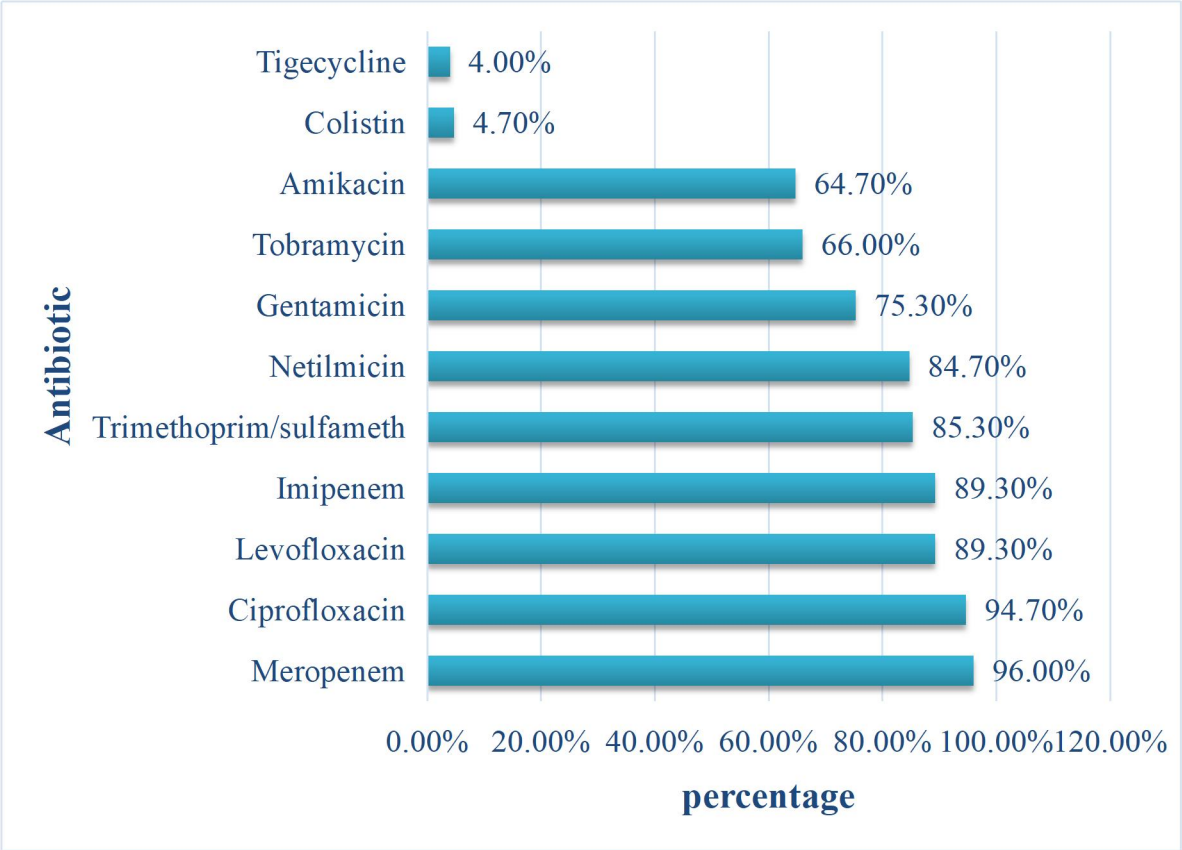

Figure 4.5: Antimicrobial Resistance Rates of acinetobacter Isolates

According to our research, the most effective antibiotics against Acinetobacter strains were tigecycline and colistin, which had resistance rates of 4% and 5%, respectively. All other medications had substantial antimicrobial resistance rates of Acinetobacter.

s4.6 Risk factors of Acinetobacter

Table 4.6: Risk factors of Acinetobacter

Characteristics Acinetobacter				
		The result of Meropenem		
		R	**S**	**P value**
Age	<30	3	2	0.01
	30-40	5	0	
	41-50	28	0	
	51-60	18	1	
	>60	90	3	
Gender	Male	92	6	.069
	Female	52	0	
Type of specimen	Urine	28	2	0.1
	Aspiration fluid	55	1	
	Blood	12	0	
	Abscess/Wound material	17	0	
	Sputum	27	1	
	Sperm	0	1	
	Catheter tib	4	1	
	Bronchial lavage	1	0	

Table 4.5 above used the chi square method to analyze the social demographic data of the patient. A P-value of 0.01 or less is required for statistical significance, while values of less than.005 are deemed highly significant. No statistically significant value result, nevertheless, is shown in the table above.

CHAPTER FIVE
CONCLUTIONS, RECOMMENDATIONS AND LIMITATIONS

5.1 Conclusions

According to earlier research (Hawley et al., 2018; Maragakis et al., 2016), ICUs are high-risk environments for multidrug-resistant infections. The high incidence of Acinetobacter infections in the ICU is consistent with this finding. to stop the spread of Acinetobacter and other nosocomial diseases, critical care units need to improve their infection control procedures and surveillance, as shown by this.

Alarmingly high levels of Acinetobacter isolates have been shown to be resistant to widely used antibiotics such meropenem, ciprofloxacin, and levofloxacin. These results are consistent with trends worldwide that show an increase in the antibiotic resistance of Acinetobacter species (Zarrilli et al., 2013; van Dessel et al., 2020). The evolution of resistance presents a serious therapeutic problem and emphasizes the significance of antimicrobial stewardship efforts.

Due to their comparatively lower rates of resistance, colistin and tigecycline are nevertheless effective treatments for Acinetobacter infections that are resistant to several drugs. These results are in keeping with other research demonstrating the effectiveness of tigecycline and colistin against Acinetobacter strains (Fernández-Cuenca et al., 2019; Trecarichi et al., 2019). However, in order to avoid the emergence of resistance, its usage should be closely supervised.

Insights regarding the origins of infection and potential transmission pathways may be gained from examining the distribution of Acinetobacter isolates in several specimen types, including blood, aspiration fluid, and urine. These results are in line with earlier research that showed Acinetobacter may cause a variety of illnesses, such as bloodstream infections, pneumonia, and urinary tract infections.

Acinetobacter infections were shown to be significantly influenced by age, with older people showing a greater prevalence. This result is in line with research that has shown that older individuals are more vulnerable to infections brought on by hospital settings (Kruger et al., 2015; Li et al., 2018). This population may be more vulnerable due to age-related variables such impaired immune function and

underlying comorbidities.

5.2 Recommendations

Infection control methods should be improved. To reduce the spread of Acinetobacter infections inside healthcare settings, strict infection control procedures should be implemented, including hand hygiene, environmental cleaning, and appropriate disinfection practices (Zingg et al., 2017; WHO, 2019). To lower the risk of illnesses linked to healthcare, it is essential to follow certain precautions.

Create antimicrobial stewardship programs: Create and implement antimicrobial stewardship programs to maximize the use of antibiotics, encourage prudent prescription, and thwart the evolution of antimicrobial resistance in Acinetobacter species (Pulcini et al., 2018; World Health Organization [WHO], 2015). A multidisciplinary approach should be used in these initiatives, with teams from infection control and healthcare professionals included.

Actively monitor Acinetobacter infections in healthcare settings by putting routine surveillance systems in place to track their frequency and trends of antibiotic resistance (CDC, 2018). In order to stop the spread of multidrug-resistant bacteria, this will make it easier to identify rising resistance early on and to take swift action.

Support for development and research Encourage further study into new antimicrobial medicines, alternate treatment plans, and vaccinations that can prevent Acinetobacter infections (Doi et al., 2017; World Health Organization [WHO], 2017). The difficulties posed by multidrug-resistant Acinetobacter strains require significant investments in research and development.

Train healthcare professionals: The detection and treatment of Acinetobacter infections, antimicrobial stewardship concepts, and infection control techniques should all be regularly taught to healthcare staff (van Dijck et al., 2019). Healthcare practitioners' increased knowledge and awareness will help prevent and control these diseases more successfully.

5.3 Limitations

- ✓ Lack of Clinical Results: The study's main areas of attention were the microbiological and epidemiological aspects of Acinetobacter infections. The ability to examine the influence of these infections on patient outcomes is

constrained by the lack of comprehensive clinical outcomes, such as treatment response, duration of hospital stays, and fatality rates.

- ✓ Limited Information on Risk variables: Although the study analyzed a few risk variables linked to Acinetobacter infections, it's possible that other significant factors were overlooked in the analysis. Future studies could explore a broader range of risk factors, including comorbidities, previous antibiotic exposure, and invasive procedures, to better understand the determinants of Acinetobacter infections.
- ✓ Limited Information on Antibiotic Usage: The study did not include detailed information on antibiotic usage patterns among patients. Understanding the antibiotic prescribing practices, including the types and duration of antibiotic therapy, could help identify potential factors contributing to the emergence and spread of antibiotic-resistant Acinetobacter infections.
- ✓ Absence of Environmental Surveillance: The study focused primarily on patient samples and did not include an assessment of environmental sources of Acinetobacter. Environmental surveillance in healthcare settings, including monitoring of surfaces, medical equipment, and water sources, could provide valuable information on potential reservoirs and routes of transmission for Acinetobacter.
- ✓ Sample Size: Because just one hospital was used for the study, there may not be as much room to extrapolate the results to other healthcare facilities. It might be possible to have a more thorough knowledge of Acinetobacter infections with a bigger sample size from various hospitals or healthcare institutions.

REFERENCES

Akrami, F., & Ebrahimzadeh, A. (2019). *Acinetobacter baumannii as Nosocomial Pathogenic Bacteria*. *34*(2), 84–96. https://doi.org/10.3103/S0891416819020046

Chastre, J., & Fagon, J. (2001). *State of the Art Ventilator-associated Pneumonia*. *1997*(23). https://doi.org/10.1164/rccm.2105078

Harding, C. M., Hennon, S. W., & Feldman, M. F. (2018). Uncovering the mechanisms of Acinetobacter baumannii virulence. *Nature Reviews Microbiology*, *16*(2), 91–102. https://doi.org/10.1038/nrmicro.2017.148

Inglis, T. J. J. (1999). Acinetobacter in the intensive care unit. *Australian Infection Control*, *4*(2), 8–10. https://doi.org/10.1071/hi99208

Jung, J. Y., Park, M. S., Kim, S. E., Park, B. H., Son, J. Y., Kim, E. Y., Lim, J. E., Lee, S. K., Lee, S. H., Lee, K. J., Kang, Y. A., Kim, S. K., Chang, J., & Kim, Y. S. (2010). Risk factors for multi-drug resistant Acinetobacter baumannii bacteremia in patients with colonization in the intensive care unit. *BMC Infectious Diseases*, *10*. https://doi.org/10.1186/1471-2334-10-228

Rangel, K., Chagas, T. P. G., & De-Simone, S. G. (2021). Acinetobacter baumannii infections in times of COVID-19 pandemic. *Pathogens*, *10*(8), 1–13. https://doi.org/10.3390/pathogens10081006

Scheuerman, O., Schechner, V., Carmeli, Y., Gutiérrez-gutiérrez, B., Almirante, B., Viale, P., Oliver, A., & Ruiz-garbajosa, P. (2018). *Comparison of Predictors and Mortality Between Bloodstream Infections Caused by ESBL-Producing*

Escherichia coli and ESBL-Producing Klebsiella pneumoniae. https://doi.org/10.1017/ice.2018.63

Uwingabiye, J., Lemnouer, A., Baidoo, S., Frikh, M., Kasouati, J., Maleb, A., Benlahlou, Y., Bssaibis, F., Mbayo, A., Doghmi, N., Abouelalaa, K., Baite, A., Ibrahimi, A., & Elouennass, M. (2017). Intensive care unit-acquired Acinetobacter baumannii infections in a Moroccan teaching hospital: Epidemiology, risk factors and outcome. *Germs*, *7*(4), 193–205. https://doi.org/10.18683/germs.2017.1126

Visca, P., Seifert, H., & Towner, K. J. (2011). Acinetobacter infection - An emerging threat to human health. *IUBMB Life*, *63*(12), 1048–1054. https://doi.org/10.1002/iub.534

Zarrilli, R., Pournaras, S., Giannouli, M., & Tsakris, A. (2013). *International Journal of Antimicrobial Agents Global evolution of multidrug-resistant Acinetobacter baumannii clonal lineages*. *41*, 11–19. https://doi.org/10.1016/j.ijantimicag.2012.09.008

Zhu, H., Jiang, F., Zhu, J., Du, Y., Jin, Z., & Li, Z. (2017). *Assessment of morbidity and mortality associated with endoscopic ultrasound-guided fine-needle aspiration for pancreatic cystic lesions: A systematic review and meta-analysis*. 667–675. https://doi.org/10.1111/den.12851