**Republic of Yemen**
**Ministry of Higher Education and Scientific Research**
**Emirates international University**
**Faculty of Medicine and Health sciences**
**Department of Pharm.D**

# Antibiogram Development for Neonatal Intensive Care Unit at Referral Healthcare Center in Sana'a City, Yemen

Submitted By

Massoud Khalid Rassam
Aimen Ahmed Qasem Alhebshi
Noman Mohammed Abdulmajeed
Mohammed Hassan Al Nuzaili
Majde Mohammed Saif
Ala'a Fuod Alsalowi
Lool Abdulrahman Amr
Yusra Ahmed Al Mashmali
Ghada Adnan Salah
Amr Abdullah Nasher
Khalid Ali Alodini

Supervised by

Associate. Prof Dr \ Mokhtar Al-Ghorafi
Dr \ Mohammed Abdullah Ali Kubas

Emirates International University

2022

# Antibiogram Development for Neonatal Intensive Care Unit at Referral Healthcare Center in Sana'a City, Yemen


Submitted By

Massoud Khalid Rassam
Aimen Ahmed Qasem Alhebshi
Noman Mohammed Abdulmajeed
Mohammed Hassan Al Nuzaili
Majde Mohammed Saif
Ala'a Fuod Alsalowi
Lool Abdulrahman Amr
Yusra Ahmed Al Mashmali
Ghada Adnan Salah
Amr Abdullah Nasher
Khalid Ali Alodini

Supervised by

Associate. Prof Dr \ Mokhtar Al-Ghorafi
Dr \ Mohammed Abdullah Ali Kubas


A Graduation Research Project Submitted as Fulfilment of The Requirement for the Degree of PharmD


Emirates International University

2022

## Acknowledgements

Firstly, we praise God Almighty very much for what we have honored with from the completion of this study, then we thank our family for all support period of 6th years of study, who granted us the gift of their unwavering belief in our ability to accomplish this goal: thanks you for your support and patience, for Emirates International University and for Dean College of Medicine and Health sciences Prof \ Saleh Al-Daheri and for our head of department and our Supervisor Associate. Prof Dr\ Mokhtar Abdulhafiz Al-Ghorafi for all support and encouragement during period of study.

Finally, a special thanks to Dr\ Mohammed Abdullah kubas for his continuous support, encouragement and leadership, and for university science and technology hospital.

# *Table of Contents*

# List of Tables

# *ABBREVIATION*

| | |
|---|---|
| AB | Antibiotic |
| AMR | Antimicrobial resistance |
| BSI | Bloodstream infections |
| CDC | Centers for Disease Control and Prevention |
| CoNS | Coagulase negative staphylococcui |
| CPE | Carbapenemase-producing Enterobacteriaceae. |
| CRE | Carbapenem-Resistant Enterobacteriaceae |
| E.coli | Escherichia coli |
| ESBL | Extand specteram beta lactamiases |
| G +ve | Gram positive |
| G -ve | Gram negative |
| GBS | Group B streptococcus |
| GN | Gram negative |
| GP | Gram positive |
| HAIs | Healthcare associated infections |
| HIV | Human immunodeficiency virus |
| HSV | Herpes simplex virus |
| I | Intermediate |
| ICU | Intensive care unite |
| ICUHTLV | Human T-lymphotrophic virus type 1 |
| MRSA | Methicillin-resistant Staphylococcus aureus |
| NICU | Neonates intensive critical care sensitive |
| No | Number of |

| | |
|---|---|
| P. aeruginosa | Pseudomonas aeruginosa |
| PBP | Penicillin-Binding Protein |
| R | Resistance |
| S | Sensitive |
| S. aureus | Staphylococus aureas |
| SCC | Staphylococcal cassette chromosome |
| TMP/SMX | Trimethoprim/sulfamethoxazole |
| USTH | University science and teqnology hospital |
| UTIs | Urinary Tract Infections |
| VRSA | Vancomycin Resistance Staphylococus Aureus |
| WHO | World Health Organization |

# ABSTRACT

***Background***

The neonate immunity is very low and infections among them could lead to life threating consequences. Antibiotic resistance is considered one of the most challenging area in the treatment of infectious diseases worldwide and could lead to treatment failure among neonate.

**Objective**

The overall aim of this study was to develop antibiogram that specific for neonate at USTH, Sana'a, Yemen.

**Methodology**

This is retrospective study, the data was collected from the USTH database and WOHNET program was used for analysis and development of USTH antibiogram

***Result***

The G +ve was the most common type of bacteria encounter among neonate, followed by G –ve bacteria. From G +ve bacteria, staphylococcus coagulase negative and Streptococcus spp were the most common isolated bacteria, and klebsiella spp and Burkholderia cepacia were the most isolated among G-ve bacteria. The most sensitives antibiotic for G+ve bacteria was vancomycin and linezolid, whereas, carbapenem, colistin, and polymyxin B were the most sensitive antibiotics for G-ve bacteria.

***Conclusion***

The resistance for antimicrobial agent was high among neonate patient ether for G+ve positive or G-ve bacteria.

# Chapter One

# Introduction

# INTRODUCTION

Neonates or newborns can be defined as babies from the time of delivery up to four weeks old.[1]Neonates possess an incompetent innate or/and adaptive immunity, which make them more susceptible and less able to compete with infections caused by numerous pathogenic microorganisms.[2]

Bacterial infections in newborns can range from mild to severe and life-threating infections, include Bloodstream infections (BSIs) are the most common. They can occur in isolation or in association with urinary tract infections (UTIs) and meningitis. Endocarditis, osteomyelitis, pyogenic arthritis, ventilator associated pneumonia , peritonitis, conjunctivitis, and skin abscesses are important, less common HAIs[3].

Based on the age of neonates when contracting the infection, the infection can be categorized into two groups: early (during the first 7 days of life) and late (after 7 days from delivery) onset.[4]

This is because the immune system of neonatesmis rapidly developing as they are growing, thus each stage of age may possess different level of potency to fight infections.[4] This fact might explain the reasons behind observed variation of causative bacteria according to baby's age group.[2] Resistance of bacteria to antibiotics is usually caused by genetic modifications as a result of the irrational use of antibiotics.[5,6]

He rise in antimicrobial resistance (AMR) continues to be a global crisis. Collectively, antimicrobial-resistant pathogens caused more than 2.8 million infections and over 35,000 deaths annually from 2012 through 2017, according to the 2019 Centers for Disease Control and Prevention (CDC) Antibiotic Resistance Threats in the United States Report.[7]

Multiple factors transcending disciplines contribute to the development of AMR, with inappropriate use of antibiotics regarded as a major contributing factor according to the report by the WHO Global Action Plan on antimicrobial resistance.[8] The increase level of resistance against antibiotic drugs used to treat bacterial infections associated with sepsis and UTI in neonates is very alarming worldwide.[9]

On national data of ABR reported by the World Health Organization (WHO) indicates Escherichia coli and Klebsiella pneumoniae resistance to 3rd generation cephalosporin at 2–70% and 8–77%, respectively.[10]

E. coli resistance to fluoroquinolones is reported at 14–71% [10]. Methicillin-resistant Staphylococcus aureus (MRSA) is reported to make up 12–80% of S. aureus isolates while Streptococcus pneumoniae resistance to penicillin is at 3–16%. [10] Available literature from SSA supports this national data. E. coli and K. pneumoniae generally have low susceptibility to penicillin, cephalosporin, fluoroquinolones, and trimethoprim/sulfamethoxazole (TMP/SMX) while maintaining high susceptibility to carbapenems and amikacin. [11,12]

Klebsiella pneumonia is a gram-negative opportunistic bacterium responsible for community- and hospital-acquired infections. The mortality rate of neonatal sepsis caused by K. pneumonia ranges from 18% to 68%. [13] On local date reported in Yemen according to USTH in Sana'a period from 2006 to 2013. The most frequently as gram negative isolated species from the inpatients admitted to the departments of the USTH were E. coli and Acinetobacter species followed by Klebsiella species and P. aeruginosa.

However, the most frequently isolated Gram-negative bacteria, Acinetobacter species has the highest resistance rate to the most commonly used antibiotics, where only polymyxin B is effective against this species. P. aeruginosa shows an unchanging rate of resistance to antibiotics in the USTH despite being quite resistant to antibiotics on a global scale. [14]

Whereas anther study in Aden, Yemen Staphylococcus spp. followed by E. coli, Pseudomonas spp., and Klebsiella pneumonia, were the most widespread pathogenic bacteria in several isolates. Overall bacterial resistance was common for old antibiotics, such as the combination of sulfamethoxazole with trimethoprim, followed by amoxicillin and clavulanate. Additionally, cephalosporin had a relatively higher resistance rate than other antibiotics.

The study also showed moderate bacterial resistance toward gentamycin, azithromycin, cefoxitin, and ciprofloxacin However, a lower percentage of resistance was present for the combination of ampicillin with sulbactam, ertapenem, and levofloxacin. [18]

Pervious antibiogram that was done by clinical (antibiogram) Gram negative organisms E. Coli and Acinetobacter species were the most isolated gram negative (GN) bacteria, with 246(35.7%) and 148(21.4%) specimens, respectively. E. Coli was highly resistant to all antibiotics except Amikacin, Meropenem, Imipenem and Nitrofurantoin. E. coli had

susceptibilities 56% to gentamicin and 56% to Piperacillin /Tazobactam. Acinetobacter and klebsiella spp were highly resistant to all antibiotics.

Klebsiella pneumoniae had susceptibilities 59% to Amikacin, 66% to Imipenem and 71% to Meropenem. Pseudomonas aeruginosa had susceptibilities 64%to amikacin, 59%to gentamicin and 58% to Imipenem. Pseudomonas spp was highly resistant to all antibiotics except Imipenem. pseudomonas spp had susceptibilities 55% to Piperacillin /Tazobactam and 59% to Meropenem.

Gram positive organisms, There was 123(43.3%) coagulase negative staphylococci (CONS) isolates, 115(40.5%) S. aureus isolates, 23(8.1%) enterococcus spp isolates, 23(8.1%) streptococcus spp isolates CoNS had decreased susceptibility to Azithromycin(17%), Erythromycin (21%), Norfloxacin(25%) and Ampicillin /Sulbactam(45%) while maintaining susceptibility to Vancomycin, Linezolid, Imipenem, Amikacin. Enterococcus spp was highly resistant to all antibiotics except linezolid and Vancomycin. E. spp had susceptibility to Meropenem (60%).

S. Aureus had highly susceptibility to Imipenem and vancomycin. MRSA had highly resistant to all antibiotics except Vancomycin, linezolid and Co-Trimoxazole (see appendix B)

Important of antibiogram are useful in detecting potential infectious disease outbreaks the use of such aggregate data on local or regional resistance trends is fundamental to discern differences and changes in patterns for appropriate selection of antimicrobials for rational use and epidemiological surveillance [16,17]

(Objectives): Prevalence of most microorganism in neonate

Develop antibiogram for NICU.

# *CHAPTER TWO*

# LITERATURE REVIEW

# LITERATURE REVIEW

## 2.1 Infection in neonatal

Neonates are uniquely susceptible to infection. An immature immune system is coupled with exposure to the variety of maternal and environmental pathogens that can affect this population. [18]

Infants under the age of 3 months are rapidly building up their immunity by ramping up their production of immune cells and the creation of "memory" in their adaptive immunes systems through various exposures to their environment. During this period, the child is very vulnerable to serious bacterial infections such as those caused by group B streptococcus (GBS) and *E. coli*. [19]

Common infectious diseases affecting children include bronchiolitis, pneumonia, urinary tract infection, sinusitis, skin infection, gastroenteritis, and acute otitis media. [20] Whereas Common infectious diseases affecting in Neonatal sepsis and pneumonia Bloodstream infections (BSIs) are the most common HAIs in the NICU.

They can occur in isolation or in association with urinary tract infections (UTIs) and meningitis. Endocarditis, osteomyelitis, pyogenic arthritis, ventilator associated pneumonia, peritonitis, conjunctivitis, and skin abscesses are important, less common HAIs. [18]

Whereas viral infection, Neonates, like older children and adults, are subject to viral infections acquired by horizontal routes, such as those due to influenza, rotavirus, and enteroviruses.

They also are at risk for viruses through routes that are unique to the perinatal setting in which mother-to-child transmission can occur transplacentally, during birth, or from breast milk. The ability of cytomegalovirus (CMV), herpes simplex virus (HSV), human immunodeficiency virus (HIV), and human T-lymphotrophic virus type 1 (HTLV-1) to establish chronic infection in the mother with persistence of infectious virus in blood, mucosa, or milk accounts for the role vertical transmission plays in their epidemiology and potential clinical impact.

Whether viruses that produce acute, self-limited infections in the mother are transmitted to the fetus or newborn depends on the timing of maternal infection in relation to gestation

and parturition. The clinical settings in which fetal and neonatal viral infections must be considered include pregnancy, the newborn nursery, and the evaluation of an ill newborn.[18]

## 2.2 Antimicrobial Resistance (AMR)

Occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death.

### Mechanisms of Resistance .

1. Intrinsic resistance – Gram-negative bacteria have an outer membrane that makes them less permeable than gram-positive bacteria.
2. Adaptive resistance – Bacteria can adapt to their environment to survive. This occurs in the development of biofilms.
3. Acquired resistance – Most resistance that is of alarm is acquired resistance, with bacteria passing genetic material on plasmids.

a. Enzymes such as β-lactamases are passed on plasmids – Affected: β-Lactams.

b. Bacteria have reduced permeability or can use efflux pumps to push antibiotic out of the cell – Affected: Aminoglycosides, fluoroquinolones, macrolides, tetracycline.

c. Alteration in drug-binding target – Affected: β-Lactams, oxazolidinones, aminoglycosides, tetracycline, glycopeptides.

d. Alteration of the antibiotic – Affected: Fluoroquinolones, aminoglycosides, lincosamides

e. Bypass the effect of the antibiotic – Affected: β-Lactams, sulfamethoxazole/trimethoprim, glycopeptides [21] .

Antimicrobial resistance classified into:

### 2.2.1 Resistance in Gram-Negative Infections

Mechanisms of Resistance.

The common thread in most of the organism threats is the presence of β-lactam resistance.

a) β-Lactams are the largest (and most prescribed) class of antimicrobials: penicillins, cephalosporins, monobactams, and carbapenems .

b) Three principles of acquired β-lactam resistance:

i) Decreased outer membrane penetration – Porin loss and increased drug efflux pumps .

ii) Alteration in binding target.

iii) Production of β-lactamases .

Extended-Spectrum β-Lactamases:

(1) Ability to hydrolyze penicillins, third-generation cephalosporins, and monobactams. Do not hydrolyze cephamycins and carbapenems.

(2) The three main families are TEM, SHV, and CTX-M. The most prevalent type is CTX-M, distributed worldwide and increasing in prevalence, found in E. coli and K. pneumoniae. Gene originally produced by bacteria Kluyvera .

(3) Originally associated with hospital-acquired outbreaks; now found in community-acquired infections.

(4) Associated with high mortality.

Carbapenems-Resistant Enterobacteriaceae

i) Rise in prevalence is related to the selective pressure from increasing carbapenems use.

ii) Carbapenems resistance in the United States is the combination of several mechanisms (e.g., ESBL plus poring loss), and these CRE do not constitute a carbapenems-producing Enterobacteriaceae (CPE). This distinction likely matters more epidemiologically than clinically because testing is not routine.

(a) True CPE likely has a very high carbapenem MIC, whereas CRE may have lower carbapenem MIC (though still resistant).

(b) CPE has been associated with higher mortality because it may represent a more virulent organism type.

iii) Organisms typically have acquired resistance to many classes by several mechanisms, and many isolates show as extremely drug resistant.

iv) Risk factors for poor outcomes include ICU admission, advanced age, requirements for vasopressors, mechanical ventilation, dialysis, non-urinary–sourced infections, and presence of colistin-resistant CRE. [22,23]

## 2.2.2resistance in Gram-Positive Infections

A. S. aureus Mechanisms of :

(1) Resistance has evolved for S. aureus depending on antibiotic exposure over time, starting with penicillin once exposed.

(a) Penicillin resistance developed 1 year after introduction of penicillin.

(b) Methicillin resistance developed 2 years after introduction of methicillin.

(2) MRSA

a. Penicillin resistance is caused by β-lactamase production (penicillinases). Methicillin is stable against hydrolysis by penicillinases.

b. Methicillin (and other β-lactam) resistance comes from alteration in the penicillin-binding protein (PBP) β-lactam–binding target to PBP2a, which is coded for by the mecA gene, carried on the staphylococcal cassette chromosome (SCC) SCCmec.

c. Theories regarding the origin of MRSA suggest that SCCmec was first transferred from coagulase-negative staphylococci.

(3) Vancomycin-resistant S. aureus(VRSA)

a. Occurrence is limited, with less than 20 incidents reported worldwide.

b. Transmission of VanA gene from Enterococcus to S. aureus. Despite VRE arising in the 1980s, transmission to S. aureus has not been commonplace

B. Enterococcus

Normal human flora in the gastrointestinal tract and a hardy, but nonvirulent microbe. Second to staphylococci in cause of hospital-acquired infection.

Capable of transmitting genes easily

Mechanisms of resistance

a. Ampicillin resistance

i. Most hospital-based E. faecium harbor an altered PBP5 that conveys ampicillin resistance.

ii. Enterococcus faecalis resistance is mediated by β-lactamase enzymes or alteration in PBP4.

b. Vancomycin resistance

More common in E. faecium than in E. faecalis

Alteration in the D-Ala-D-Ala binding site

(a) D-Ala-D-Lac is associated with high-level vancomycin resistance.

(b) D-Ala-D-Ser is associated with low-level vancomycin resistance [21]

# CHAPTER THREE

# Methodology

# Methodology

## 3.1 Patients and Study Site, stady design

The study was a retrospective study undertaken at USTH in Sana'a, Yemen. USTH is a private hospital 165-bed teaching hospital that trains medical students, nurses, and pharmacists and serves as a referral hospital for the country.

The collected data from bacterial isolates from Jan 2021 to March 2022 with susceptibility testing performed using diffuse disk by the microbiology laboratory from the Neonates intensive critical care (NICU) settings at USTH.

## 3.2 Lab Techniques

Specimens from blood, cerebrospinal fluid, sputum, urine, stool and swab were collected, processed, and analyzed in the microbiology laboratory according to the Kirby-Bauer method. The Kirby-Bauer test for antibiotic susceptibility (also called the *disc diffusion test*) is a standard that has been used for years.

## 3.3 Data Collection

The list of all isolates was collected from the system, then the sensitivity results for positive isolates were checked from the hospital records system. The data was entered into WHONET 5.6, a free Windows-based database software developed for the management of microbiology laboratory data. The data entered for each culture specimen included specimen number, sex, age category, department, specimen date, and organism. (See appendix B)

## 3.4 Data analysis

WHONET aggregated and analyzed the data. Getting Started-Setting up an analysis: %R, I, S and test measurements- Running the analysis and interpreting the Results-Transferring WHONET results to Excel and other software Susceptible Summary Isolate listing and summary (see Appendix C)

## 3.5 Antibiogram Development

Aggregated data from WHONET produced susceptibility percentages for every organism. The research team reviewed these auto-generated susceptibilities.

We initially excluded organisms not commonly associated with a disease or with fewer than 30 isolates, given the potential for diminished accuracy [(24)].

We then reviewed the list and chose to include clinically important organisms despite having fewer than 30 isolates with the notation that these results should be interpreted with caution based on the low number of isolates.

The antibiotics included in the antibiogram were narrowed to those commonly available at USTH. We developed one antibiogram for pediatric doctors with specific percentage details for the most common antibiotics, and antibiotic sensitivity represented as resistant (“R”), intermediate (“I”), and sensitive (“S”). A common, but not universal, practice is to define susceptible as 80% to 100% susceptible, intermediate as 60% to 79.9% susceptible, and resistant as 0–59.9% susceptible.

We used these ranges in this antibiogram. In the instance of intrinsic resistance of an organism to an antibiotic, this was labeled as “R” rather than providing the percentage susceptible.

## 3.6 Ethics Statement

The study was approved by EIU and USTH. because this was a retrospective study of de-identified specimens, no consent form was required. (see appendix D)

# CHAPTER FOUR

# Result

# Result

The number of screened patients were (257) with 324 isolated and out of them there were (133) patients with ( 148) positive isolation. The patients were screened from 2021/1/1 to 2022/3/31. The male represents 74% and female 26% (Table 1 gender numbers)

***Table 1 gender of isolated***

| Sex | Frequency of isolated | (%) | Frequency of patients |
|---|---|---|---|
| M | 109 | 74 | 97 |
| F | 39 | 26 | 36 |
| Total | 148 | 100 | 133 |

Table 2 showed that blood source represented the most isolation 133 (89.9%), while other sources (i.e. urine, swab, sputum, ….) were not very common source for isolation.

**Table 2 The source of isolations with their Frequency and Percent .**

| Source | Frequency | Percent % |
|---|---|---|
| Blood | 133 | 89.9% |
| Urine | 4 | 2.7% |
| Swab | 3 | 2% |
| Sputum | 3 | 2% |
| Cerebrospinal fluid | 2 | 1.4% |
| Other | 2 | 1.4% |
| Stool | 1 | 0.7% |

## 4.1 Isolated and number of bacterial species that included in the antibiogram .

The total number of isolated after removal of rare bacteria isolated was 138 (G + ve (94 (68.1%%)), G –ve bacteria (44 (31.9%)). The results showed that G +ve bacteria was the most encounter isolated in USTH NICU, followed by G –ve bacteria.

***Table 3 bacterial spcecies isolated and its number at NICU***

| Bacterial spcecies | No isolates | (%) | No patients | $X^2$ /*P* |
|---|---|---|---|---|
| Acinetobacter sp. | 3 | 2.2 | 3 | 0.056/1 |
| Burkholderia cepacia | 9 | 6.5 | 8 | |
| Enterobacter sp. | 3 | 2.2 | 3 | |
| Escherichia coli | 6 | 4.3 | 6 | |
| Klebsiella pneumoniae | 5 | 3.6 | 5 | |
| Klebsiella sp. | 12 | 8.7 | 11 | |
| Pseudomonas sp. | 6 | 4.3 | 6 | |
| Total of GN Isolates | 44 | 32 | 42 | |

***Table 4 bacterial spcecies isolated and its number at NICU***

| Bacterial spcecies | No isolates | (%) | No patients | $X^2$ / *P* |
|---|---|---|---|---|
| Staphylococcus aureus | 6 | 4.3 | 6 | 1.734 /0.78445 |
| Enterococcus sp. | 6 | 4.3 | 6 | |
| Staphylococcus hominis | 4 | 2.9 | 4 | |
| Staphylococcus coagulase negative | 69 | 50 | 68 | |
| Streptococcus sp. | 9 | 6.5 | 7 | |
| Total of GP Isolates | 94 | 68 | 91 | |

## 4.1.1 Isolated of gram positive of bacterial species

***4.1.1.1*** staphylococcus coagulase negative: -

Staphylococcus was the most isolated G+ve 69 (50%) most antibiotic sensitive is linezolid and vancomycin as Table 5, The most

***Table 5 Staphylococcus, coagulase negative sensitivety***

| Bacterial spcecies | Staphylococcus, coagulase negative | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 58 | 48 | 82.8 |
| Azithromycin | 54 | 10 | 18.5 |
| Cefuroxime | 56 | 23 | 41.1 |
| Clindamycin | 66 | 44 | 66.7 |
| TMP/SMX | 67 | 27 | 40.8 |
| Erythromycin | 69 | 10 | 14.5 |
| Gentamicin | 65 | 39 | 60 |
| Linezolid | 65 | 65 | 100 |
| Penicillin | 7 | 1 | 14.3 |
| Tigecycline | 4 | 4 | 100 |
| Vancomycin | 67 | 67 | 100 |

***4.1.1.2*** Streptococcus spp with was the 2nd isolated G +ve9 (6.5%) with sensitive to linezolid and vancomycin as is in (Table 6)

***Table 6 Streptococcus sp sensitivity***

| Bacterial spcecies | Streptococcus sp | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Azithromycin | 6 | 5 | 86.3 |
| Cefuroxime | 9 | 6 | 66.7 |
| Clindamycin | 9 | 8 | 88.9 |
| Linezolid | 7 | 7 | 100 |
| Penicillin G | 9 | 7 | 77.8 |
| Vancomycin | 9 | 9 | 100 |

***4.1.1.3*** Staphylococcus aureus with 6(4.3%) isolate, the most sensitive was Linezolid, vancomycin and amikacin as is in (table 7)

***Table 7 straphylococcus aureus sensitivty***

| Bacterial spcecies | Staphylococcus aureus | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 5 | 4 | 80 |
| Azithromycin | 6 | 1 | 16.7 |
| Cefuroxime | 6 | 2 | 33.3 |
| Clindamycin | 6 | 4 | 66.7 |
| TMP/SMX | 6 | 2 | 33.3 |
| Erythromycin | 6 | 1 | 16.7 |
| Gentamicin | 6 | 4 | 66.7 |
| Linezolid | 6 | 6 | 100 |
| Vancomycin | 6 | 6 | 100 |

\

4.1.1.4 Enterococcus sp is with 6 (4.3%) isolate, the most sensitive was linezolid and vancomycin as is in (table8)

***Table 8 Enterococcus sp. sensitive***

| Bacterial spcecies | Enterococcus sp. | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| TMP/SMX | 6 | 0 | 0 |
| Erythromycin | 4 | 2 | 50 |
| Linezolid | 6 | 6 | 100 |
| Penicillin G | 6 | 2 | 33.3 |
| Vancomycin | 6 | 6 | 100 |

4.1.1.5 Staphylococcus hominis which is the less bacterial in gram +ve with 4(2.9%) with the most sensitive is linezolid, vancomycin and tigecycline as in (table9)

***Table 9 Staphylococcus hominis sinsitive***

| Bacterial spcecies | Staphylococcus Hominis | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Clindamycin | 4 | 1 | 25 |
| TMP/SMX | 4 | 3 | 75 |
| Erythromycin | 4 | 0 | 0 |
| Gentamicin | 4 | 2 | 50 |
| Linezolid | 4 | 4 | 100 |
| Tigecycline | 4 | 4 | 100 |
| Vancomycin | 4 | 4 | 100 |

## 4.1.2. Overall suspitibility of Gram-Positive Organisms

The above showed that There were (69 (50%)), Staphylococcus species, coagulase negative (CoNS) isolates, 9(6.5%) Streptococcus spp, 6(4.3%) S. aureus isolates, 6(4.3%) Enterococcus isolates, and 4(2.9%) Staphylococcus hominis. S had decreased susceptibility to Erythromycin 69(14.5%), while maintaining susceptibility to vancomycin, linezolid, while other antibiotics such as trimethoprim and cephalosporin were resistance to most gram + bacteria .

**Table 10 antibiogram of gram positive**

| **Organism** | Orga nism | Amikacin n(%) | Azithromycin %S | Cefepime %S | Cefixime %S | Cefoperazone %S | Cefotaxime %S | Ceftazidime %S | Cefuroxime %S | Clindamycin %S | Colistin %S | Trimethoprim/Sulfameth oxazole %S | Erythromycin %S | Gentamicin %S | Imipenem %S | Linezolid 10 %S | Penicillin G 1 unit %S | Piperacillin/**Tazobacta m** 100/10 %S | Tigecycline %S | Vancomycin 5 %S | Polymyxin B %S | Meropenem %S | Ceftriaxone %S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Staphylococcus aureus | 6 | S | R | | | | | | R | I | | R | R | I | | S | | | | S | | | |
| Staphylococcus, coagulase negative | 69 | S | R | R | | | | | R | I | | R | R | I | | S | R | | S | S | | s | |
| Staphylococcus hominis | 4 | | | | | | | | | R | | I | R | R | | S | | | S | S | | | |
| Streptococcus sp. | 9 | | S | | | | | | I | S | | I | S | | | S | I | | | S | | | |
| Enterococcus sp. | 6 | | | | | | | | | | | R | R | | | S | r | | | S | | | |

**Colors green = sensitive (80-100%) yellow = intermittent (60-79.9%) red = resistance (0-59.9)**

## 4.1.3 Gram negative bacterial species

4.1.3.1 The number of isolated bacteria of Acinetobacter spp was 3(2.2%) and the most sensitive antibiotic for it were Colistin Imipenem… as in (table 11)

***Table 10 Acinetobacter sensitive***

| Bacterial species | Acinetobacter sp | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 3 | 1 | 33.3 |
| Cefepime | 2 | 0 | 0 |
| Cefotaxime | 3 | 0 | 0 |
| Ceftazidime | 3 | 0 | 0 |
| Colistin | 2 | 2 | 100 |
| TMP/SMX | 2 | 1 | 50 |
| Gentamicin | 2 | 0 | 0 |
| Imipenem | 3 | 3 | 100 |
| Piperacillin/Tazobactam | 3 | 3 | 100 |
| Polymyxin | 1 | 1 | 100 |
| Meropenem | 3 | 3 | 100 |
| ` Ceftriaxone | 2 | 0 | 0 |

4.1.3.2 the number of isolated bacteria of Escherichia coli was 6(4.3%), the most sensitive Amikacin, Gentamicin…etc. as in (table 12)

**Table 11 Escherichia coli sensitive**

| Bacterial species | Escherichia coli | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 5 | 5 | 100 |
| Cefepime | 6 | 1 | 16.6 |
| Cefixime | 2 | 0 | 0 |
| Cefoperazon | 3 | 0 | 0 |
| Cefotaxime | 3 | 1 | 33.3 |
| Ceftazidime | 6 | 1 | 16.6 |

| | | | |
|---|---|---|---|
| Cefuroxime | 4 | 0 | 0 |
| TMP/SMX | 5 | 1 | 20 |
| Gentamicin | 6 | 6 | 100 |
| Imipenem | 5 | 5 | 100 |
| Piperacillin/Tazobactam | 4 | 2 | 50 |
| Meropenem | 6 | 6 | 100 |
| Ceftriaxone | 6 | 1 | 16.7 |

4.1.3.3 The number of isolated bacteria of Enterobacter spp is bacteria from was 3(2.2%), The most antibiotic sensitive is in (table 13)

**Table 12 Enterobacter sp sensitive**

| Bacterial species | Enterobacter spp | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 2 | 1 | 50 |
| Cefepime | 2 | 0 | 0 |
| Cefixime | 1 | 0 | 0 |
| Cefotaxime | 2 | 1 | 50 |
| Ceftazidime | 2 | 0 | 0 |
| Cefuroxime | 2 | 0 | 0 |
| TMP/SMX | 3 | 2 | 66.7 |
| Gentamicin | 2 | 1 | 50 |
| Imipenem | 3 | 2 | 66.7 |
| Penicillin G | 1 | 1 | 100 |
| Piperacillin/Tazobactam | 2 | 1 | 50 |
| Meropenem | 2 | 1 | 50 |
| Ceftriaxone | 2 | 0 | 0 |

4.1.3.4 Klebsiella spp is the most gram negative bacterial found in this study with number of isolate 12(8.7%), the most sensitive antibiotic colistin and polymyxin as in (table 14)

***Table 14 Klebsiella sp sensitive***

| Bacterial species | Klebsiella sp | | |
|---|---|---|---|
| AB | Total | No Sensitive | Percent % |
| Amikacin | 12 | 7 | 58.3 |
| Cefepime | 12 | 1 | 8.3 |
| Cefixime | 3 | 0 | 0 |
| Cefoperazon | 6 | 0 | 0 |
| Cefotaxime | 4 | 1 | 25 |
| Ceftazidime | 12 | 0 | 0 |
| Cefuroxime | 6 | 0 | 0 |
| Colistin | 1 | 1 | 100 |
| TMP/SMX | 11 | 7 | 63.6 |
| Gentamicin | 11 | 4 | 36.4 |
| ` Imipenem | 7 | 6 | 85.7 |
| Piperacillin/Tazobactam | 7 | 4 | 57.1 |
| Polymyxin B | 1 | 1 | 100 |
| Meropenem | 12 | 7 | 58.3 |
| Ceftriaxone | 11 | 0 | 0 |

4.1.3.5 the number of isolated bacteria of Klebsiella pneumonia is was 5(3.6%) isolate, the most sensitive antibiotic is in (table 15)

***Table 15 Klebsiella pneumonia sensitive***

| Bacterial species | Klebsiella pneumoniae | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 5 | 5 | 100 |
| Cefepime | 5 | 1 | 20 |
| Ceftazidime | 5 | 1 | 20 |
| TMP/SMX | 5 | 4 | 80 |
| Meropenem | 5 | 4 | 80 |
| Ceftriaxone | 5 | 1 | 20 |

4.1.3.6 The number of isolated bacteria of Pseudomonas spp was 6(4.3%) isolates, the most sensitive antibiotic is in (table 16)

***Table 13 Pseudomonas sp sensitive***

| Bacterial species | Pseudomonas sp | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Amikacin | 6 | 3 | 50 |
| Cefepime | 5 | 1 | 20 |
| Cefoperazon | 1 | 0 | 0 |
| Ceftazidime | 6 | 1 | 16.7 |
| Cefuroxime | 1 | 0 | 0 |
| Gentamicin | 6 | 3 | 50 |
| Meropenem | 6 | 6 | 100 |
| Ceftriaxone | 5 | 2 | 40 |

4.1.3.7 Burkholderia cepacia is 2$^{nd}$ gram negative Bactria in this study with (9(6.5%)) isolated and the most sensitive antibiotic is in (table 17)

***Table 14 Burkholderia cepacia sensitive***

| Bacterial species | Burkholderia cepacia | | |
|---|---|---|---|
| AB | Total | No sensitive | Percent % |
| Ceftazidime | 9 | 4 | 44.4 |
| TMP/SMX | 9 | 6 | 66.7 |
| Meropenem | 8 | 8 | 100 |

### 4.1.4 The above showed that Gram-Negative Bacteria

Klebsiella spp and Burkholderia cepacia were the most isolated Gram negative (GN) bacteria, with 12(8.7%) and 9(6.5%) specimens, they were highly resistant to all antibiotics except Imipenem, Polymyxin B and Colistin for Klebsiella spp and Meropenem, Trimethoprim/Sulfamethoxazole for Burkholderia cepacia. Klebsiella spp had susceptibilities of Piperacillin/Tazobactam7(57.1%), Cefotaxime 4(25%) and Gentamicin 11(36.4%). The high resistance to 3rd. generation cephalosporin indicated high rates of beta-lactamase production including ESBLs

**Table 15 Antibiogram for gram negitive**

| Organism | Org | Amikacin n(%) | Azithromycin %S | Cefepime %S | Cefixime %S | Cefoperazone %S | Cefotaxime %S | Ceftazidime %S | Cefuroxime %S | Clindamycin %S | Colistin %S | Trimethoprim/Sulfamethoxazole | Erythromycin %S | Gentamicin %S | Imipenem %S | Linezolid 10 %S | Penicillin G 1 unit %S | Piperacillin/Tazobactam 100/10 | Tigecycline %S | Vancomycin 5 %S | Polymyxin B %S | Meropenem %S | Ceftriaxone %S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Acinetobacter sp.** | 3 | R | | R | | | R | R | | | S | R | | r | S | | | S | | | S | S | R |
| **Escherichia coli** | 6 | S | | R | R | R | R | R | R | | | R | | S | S | | | R | | | | S | R |
| **Enterobacter sp.** | 3 | R | | R | R | | R | R | R | | | I | | R | I | | S | R | | | | R | R |
| **Klebsiella sp.** | 12 | R | | R | R | R | R | R | R | | S | I | | R | S | | | R | | | S | R | R |
| **Klebsiella pneumoniae** | 5 | S | | R | | | | R | | | | R | | S | | | | | | | | S | R |
| **Burkholderia cepacia** | 9 | | | | | | | R | | | | I | | | | | | | | | | S | |
| **Pseudomonas sp.** | 6 | R | | R | | R | | R | R | | | | | R | S | | | S | | | | S | R |

**Colors green = sensitive (80-100%), yellow = intermittent (60-79.9%), red = resistance (0-59.**

## Discussion

In the study, were analyzed neonate bacterial isolates from USTH at NICU and most important findings were as following: (1) G +ve were the most isolated bacteria among neonate patients; (2) the most sensitive antibiotics for gram +ve were linezolid and vancomycin; (3) The most isolated g –ve bacteria were resistance to most cephalosporin generations and sensitive mostly for carbapenem antibiotics.

In this study the gram positive was the most isolated bacteria in USTH hospital institution the most common isolate Staphylococcus coagulase negative 69 (50%). however, in other studies that were conducted at NICU form Zambia, (25) and in Yemen; was in Sana'a (26).

They found the gram negative was the most prominent bacteria. The high percentage of gram positive in our institution may be due to contaminated but we cannot confirm that in our study as retrospective study design. Other factors may be due to different locations, populations, and clinical situation. For the gram-positive bacteria, the most sensitive antibiotic vancomycin and linezolid and resistance to cephalosporin, Erythromycin and TMP/SMX. Similar to our finding, studies that was conducted in Yemen, and Zambia found that TMP/SMX and erythromycin were resistance as well. The most sensitive antibiotics in our study and mention studies were vancomycin and linezolid. Staphylococcus resistance to TMP/SMX and erythromycin indicates the isolated Staphylococcus was MRSA. this is indicted for staph auras the MRSA the most commonly encounter bacteria and this is may be duo to result from the overuse of antibiotics.

Our findings of high resistance to Erythromycin and TMP/SMX are consistent with other studies. These findings are concerning because TMP/SMX is commonly used for empiric treatment, particularly respiratory and gastrointestinal infections.

The gram negative isolates showed high level of sensitivity to carbapenem and high resistance to cephalosporin which was consistent with other studies that were conducted in Zambia, and this is maybe indicate of ESBL for these isolated.

## 5.2 Limitation

This study had some limitations. First, this retrospective study is based on the data collected form laboratory records which lack information about the neonates' hospitalization date, clinical information, and treatment outcome. Therefore, we were not able to classify infections as community acquired or hospital acquired infection. Similarly, we could not determine whether the antibiotic resistance was primary or secondary resistance. Moreover, data on the clinical information and treatment outcome of the neonates were not included in this study. Second, this study was conducted only at a single hospital; therefore, the antibiotic resistance patterns observed in our study might not generalize the situation in the country.

# CHAPTER SIX

## Conclusions and Recommendation

## 6.1 Conclusions

The resistance for antimicrobial gram positive and gram negative still high in neonate as only vancomycin and linezolid was most sensitive for the gram positive and carbapenem and Colistin only the sensitive antibiotic for gram negative

## 6.2 Recommendation

Antibiogram is necessary for neonate as national level not local level prospective Should be restriction use of unnecessary antibiotic and awareness healthcare and student about resistance because there is high rate of resistance among neonate

Focus the infection control to limited the separate the most resistance bacteria

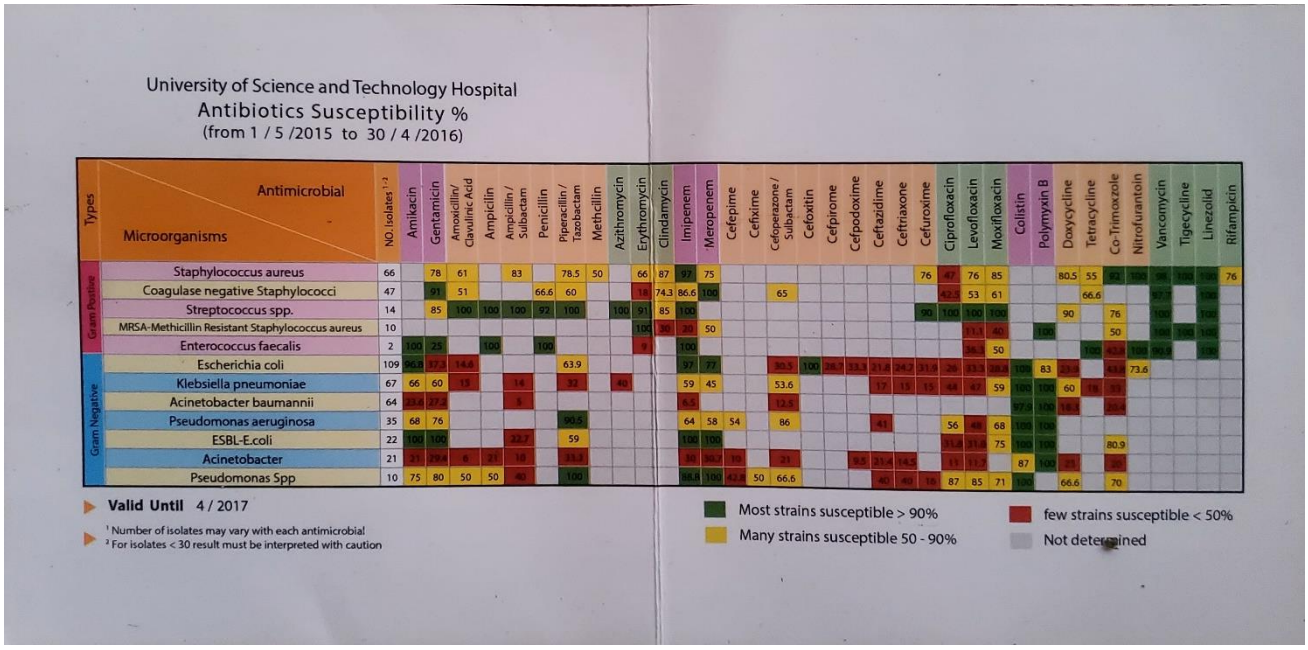
## References


1) Black, R.E.; Cousens, S.; Johnson, H.L.; Lawn, J.E.; Rudan, I.; Bassani, D.G.; Jha, P.; Campbell, H.; Walker, C.F.; Cibulskis, R.; et al. Global, regional, and national causes of child mortality in 2008: A systematic analysis. Lancet 2010, 375, 1969–1987.
2) Basha, S.; Surendran, N.; Pichichero, M. Immune responses in neonates. Expert Rev. Clin. Immunol. 2014, 10, 1171–1184.
3) Sass, L.; Karlowicz, M.G. Healthcare-Associated Infections in the Neonate. Princ. Pract. Pediatr. Infect. Dis. 2018, 3, 560–566.
4) Cortese, Francesca, et al. "Early and late infections in newborns: where do we stand? A review." Pediatrics & Neonatology 57.4 (2016): 265-273.
5) Sharif MR, Alizargar J, Sharif A. Antimicrobial resistance among Gram-negative bacteria isolated from different samples of patients admitted to a university hospital in Kashan, Iran. Adv Biol Res 2013; 7: 199–202.
6) Patzer JA, Dzierzanowska D, Turner PJ. Trends in antimicrobial susceptibility of Gram-negative isolates from a paediatric intensive care unit in Warsaw: results from the MYSTIC programme (1997-2007). J Antimicrob Chemother 2008; 62: 369–75.
7) Centers for Disease Control and Prevention. Antibiotic Resistance Threats in the United States, 2019, 2019.
8) WHO. Global action plan on antimicrobial resistance. World Heal Organ. 2017;1–28.
9) Vazouras, K.; Velali, K.; Tassiou, I.; Anastasiou-Katsiardani, A.; Athanasopoulou, K.; Barbouni, A.; Jackson, C.; Folgori, L.; Zaoutis, T.; Basmaci, R.; et al. Antibiotic treatment and antimicrobial resistance in children with urinary tract infections. J. Glob. Antimicrob. Resist. 2020, 20, 4–10.
10) World Health Organization. Antimicrobial Resistance Global Report on Surveillance; World Health Organization: Lyon, France, 2014. Available online:
11) Wangai, F.K.; Masika, M.M.; Lule, G.N.; Karari, E.M.; Maritim, M.C.; Jaoko, W.G.; Museve, B.; Kuria, A. Bridging antimicrobial resistance knowledge gaps: The East African perspective on a global problem. PLoS ONE 2019, 14, e0212131.

12) Carroll, M.; Rangaiahagari, A.; Musabeyezu, E.; Singer, D.; Ogbuagu, O. Five-Year Antimicrobial Susceptibility Trends Among Bacterial Isolates from a Tertiary Health-Care Facility in Kigali, Rwanda. Am. J. Trop. Med. Hyg. 2016, 95, 1277–1283.
13) Pengsaa K, Lumbiganon P, Taksaphan S, Pairojkul S, Sookpranee T, Kosuwon P, et al. Risk factors for neonatal Klebsiella septicemia in Srinagarind Hospital. Southeast Asian J Trop Med Public Health 1996; 27:102–6.
14) Mohammed K, Abdulrahman Z, Dalal A, Mahmoud A. Antibiotic Resistance Trends of Gram-negative Bacteria. ORIGINAL ARTICLE.2018
15) Wafa F. S. Badulla, Mohammed A, Mohamed I. Antimicrobial Resistance Profiles for Different Isolates in Aden, Yemen. Hindawi.2020;5
16) WHO. Organization World Health. Global Strategy for Containment of Antimicrobial Resistance. World Heal Organ. 2001;105.
17) Avdic E, Carroll KC et al. The role of the microbiology laboratory in antimicrobial stewardship programs. Infect Dis Clin North Am. 2014; 28:215–35.
18) Sarah S, Charles G; Principles and Practice of Pediatric Infectious Diseases 2018 ELSEVIER 5th edition.
19) Simon AK, Hollander GA, McMichael A. Evolution of the immune system in humans from infancy to old age. Proceedings. Biological sciences.
20) Zeimet A, McBride DR, Basilan R, Roland WE, McCrary D, Hoonmo K. Infectious diseases. Textbook of Family Medicine.
21) Katherine L. Infectious board of clinical pharmacy antimicrobial resistance 20181.3-33
22) Infectious Disease Society of American for melty drugs resistance 2022.
23) European society of infectious disease and multy drug resistance 2022
24) World Health Organization. Antimicrobial Stewardship Programmes in Health-Care Facilities in Low- and Middle-Income Countries: A WHO Practical Toolkit; World Health Organization: Lyon, France, 2019.
25) Brenna M, Alexandra L, Cassidy C. Antibiogram Development in the Setting of a High Frequency of Multi-Drug Resistant Organisms MDPI 2021.
26) Adeeb S, Ibrahim S, Mohmmed A. Neonatal sepsis in Sana'a city, Yemen: a predominance of Burkholderia cepacia;BMC;2021.

# APPENDICES

# *Appendix A Pervious Work*



University of Science and Technology Hospital

Antibiotics Susceptibility %

(from 1 / 5 /2015 to 30 / 4 /2016)

| Types | Microorganisms \ Antimicrobial | NO. Isolates [1,2] | Amikacin | Gentamicin | Amoxicillin/ Clavulinic Acid | Ampicilin | Ampicilin / Sulbactam | Penicillin | Piperacillin / Tazobactam | Methcillin | Azithromycin | Erythromycin | Clindamycin | Imipenem | Meropenem | Cefepime | Cefixime | Cefoperazone / Sulbactam | Cefoxitin | Cefpirome | Cefpodoxime | Ceftazidime | Ceftriaxone | Cefuroxime | Ciprofloxacin | Levofloxacin | Moxifloxacin | Colistin | Polymyxin B | Doxycycline | Tetracycline | Co-Trimoxzole | Nitrofurantoin | Vancomycin | Tigecycline | Linezolid | Rifampicin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gram Positive | Staphylococcus aureus | 66 | | 78 | 61 | | 83 | | 78.5 | 50 | | 66 | 87 | 97 | 75 | | | | | | | | | 76 | 47 | 76 | 85 | | | 80.5 | 55 | 82 | 100 | 98 | 100 | 100 | 76 |
| | Coagulase negative Staphylococci | 47 | | 91 | 51 | | | 66.6 | 60 | | | 18 | 74.3 | 86.6 | 100 | | | 65 | | | | | | | 42.3 | 53 | 61 | | | 66.6 | | | 97.7 | | 100 | | |
| | Streptococcus spp. | 14 | | 85 | 100 | 100 | 100 | 92 | 100 | | 100 | 91 | 85 | 100 | | | | | | | | | | 90 | 100 | 100 | 100 | | | 90 | | 76 | | 100 | | 100 | |
| | MRSA-Methicillin Resistant Staphylococcus aureus | 10 | | | | | | | | | | 100 | 30 | 20 | 50 | | | | | | | | | | 31.3 | 40 | | 100 | | | 50 | | 100 | 100 | 100 | |
| | Enterococcus faecalis | 2 | 100 | 25 | | 100 | | 100 | | | | 0 | | 100 | | | | | | | | | | | 36 | 50 | | | | 100 | 42.9 | 100 | 99.8 | | 50 | |
| Gram Negative | Escherichia coli | 109 | 96.8 | 37.3 | 14.6 | | | | 63.9 | | | | | 97 | 77 | | | 30.5 | 100 | 28 | 33.3 | 21.8 | 24.2 | 31.9 | 26 | 33.3 | 38.8 | 100 | 83 | 23.8 | | 43.4 | 73.6 | | | | |
| | Klebsiella pneumoniae | 67 | 66 | 60 | 13 | | 14 | | 32 | | 40 | | | 59 | 45 | | | 53.6 | | | | 17 | 15 | 15 | 44 | 47 | 59 | 100 | 100 | 60 | 18 | 30 | | | | | |
| | Acinetobacter baumannii | 64 | 23.8 | 37.2 | | | 8 | | | | | | | 8.5 | | | | 12.5 | | | | | | | | | | 97.8 | 100 | 18.2 | | 20.4 | | | | | |
| | Pseudomonas aeruginosa | 35 | 68 | 76 | | | | | 90.5 | | | | | 64 | 58 | 54 | | 86 | | | | 41 | | | 56 | 48 | 68 | 100 | 100 | | | | | | | | |
| | ESBL-E.coli | 22 | 100 | 100 | | | 32.7 | | 59 | | | | | 100 | 100 | | | | | | | | | | 31.8 | 31.8 | 75 | 100 | 100 | | | 80.9 | | | | | |
| | Acinetobacter | 21 | 21 | 29.4 | 6 | 21 | 18 | | 33.3 | | | | | 10 | 36.3 | 10 | | 21 | | | 9.5 | 21.4 | 14.3 | | 11 | 11.2 | | 87 | 100 | 21 | | 20 | | | | | |
| | Pseudomonas Spp | 10 | 75 | 80 | 50 | 50 | 40 | | 100 | | | | | 58.8 | 100 | 42.8 | 50 | 66.6 | | | | 40 | 40 | 16 | 87 | 85 | 71 | 100 | | 66.6 | | 70 | | | | | |

**Valid Until** 4 / 2017

[1] Number of isolates may vary with each antimicrobial

[2] For isolates < 30 result must be interpreted with caution

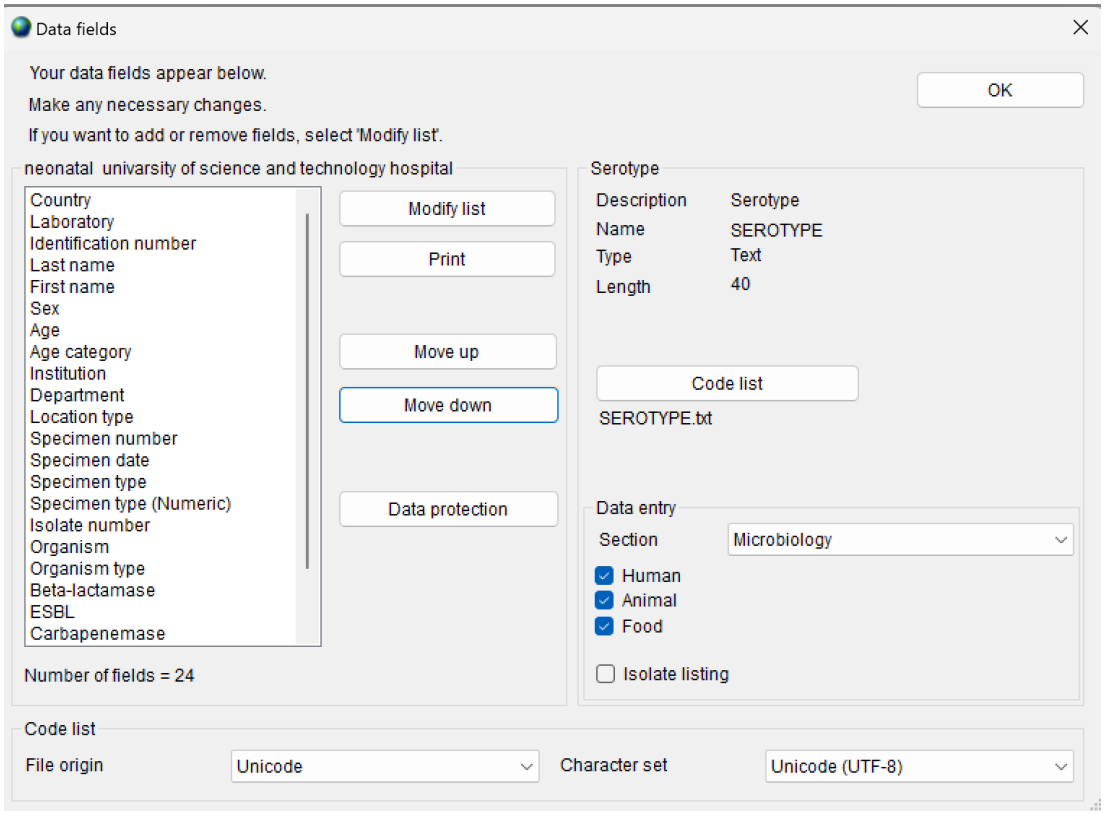
Most strains susceptible > 90%

Many strains susceptible 50 - 90%

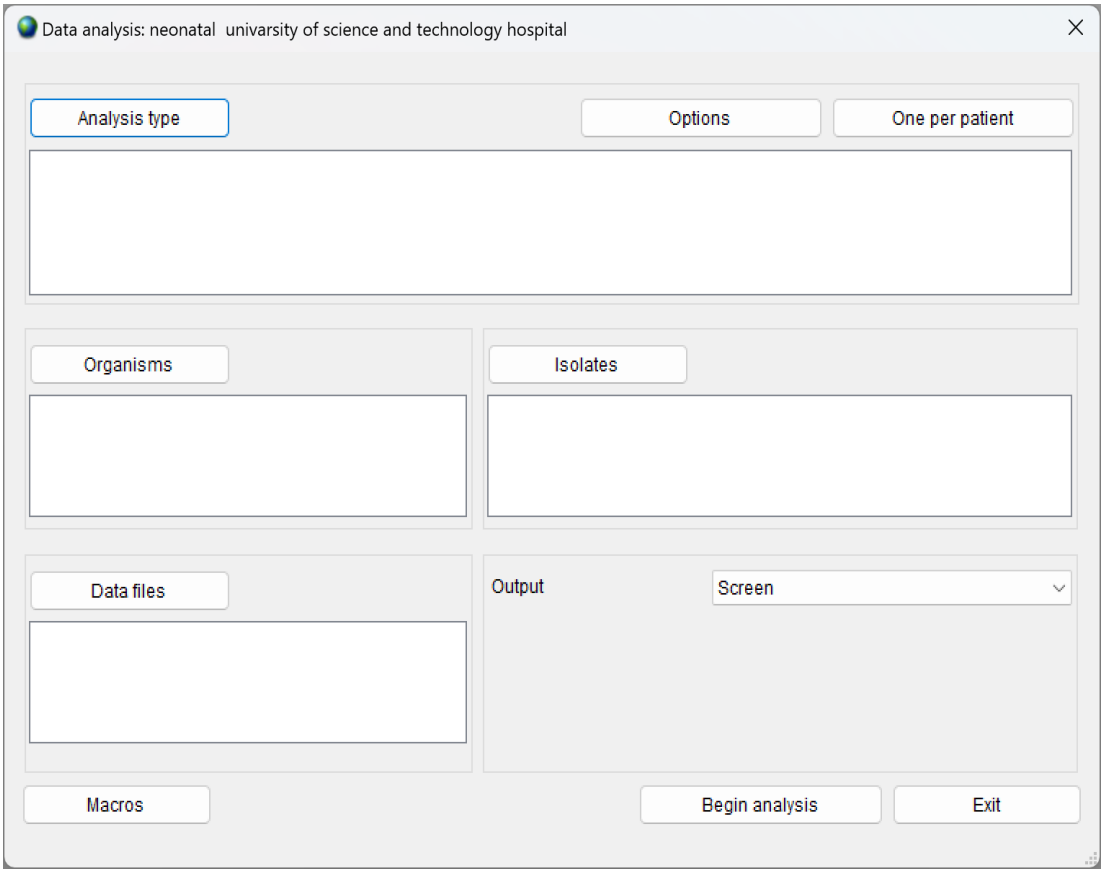
few strains susceptible < 50%

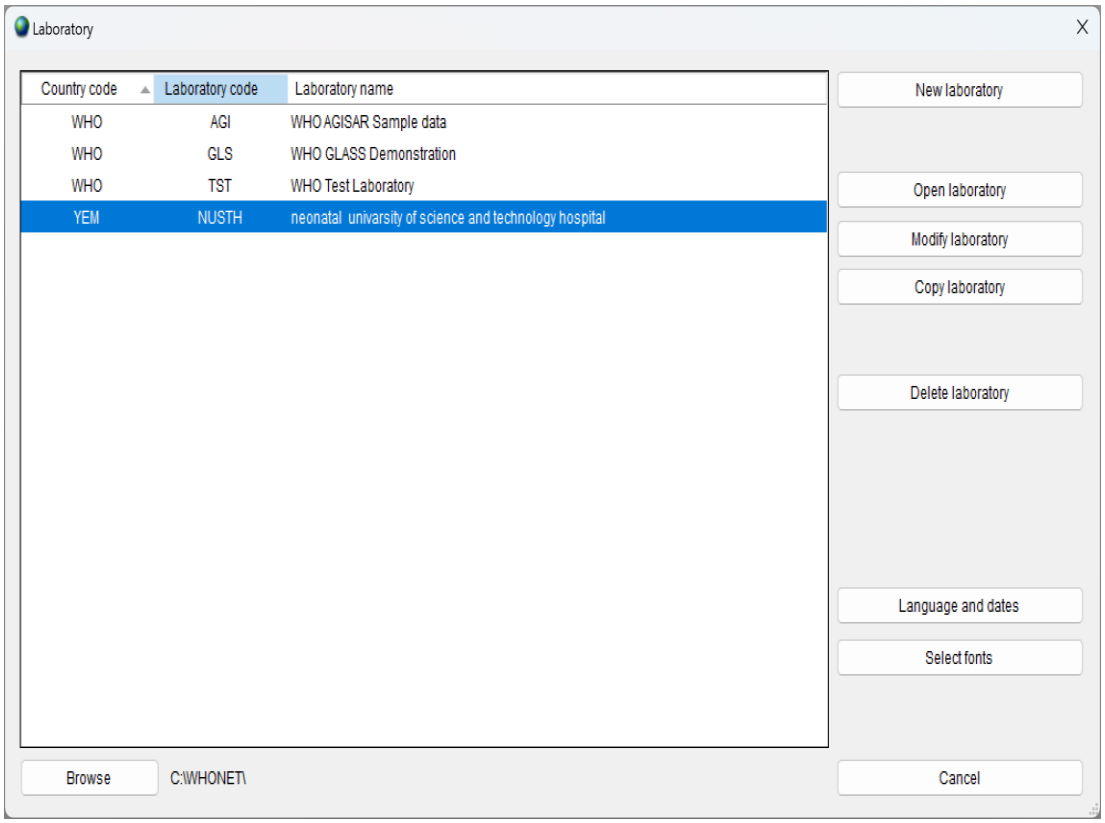
Not determined

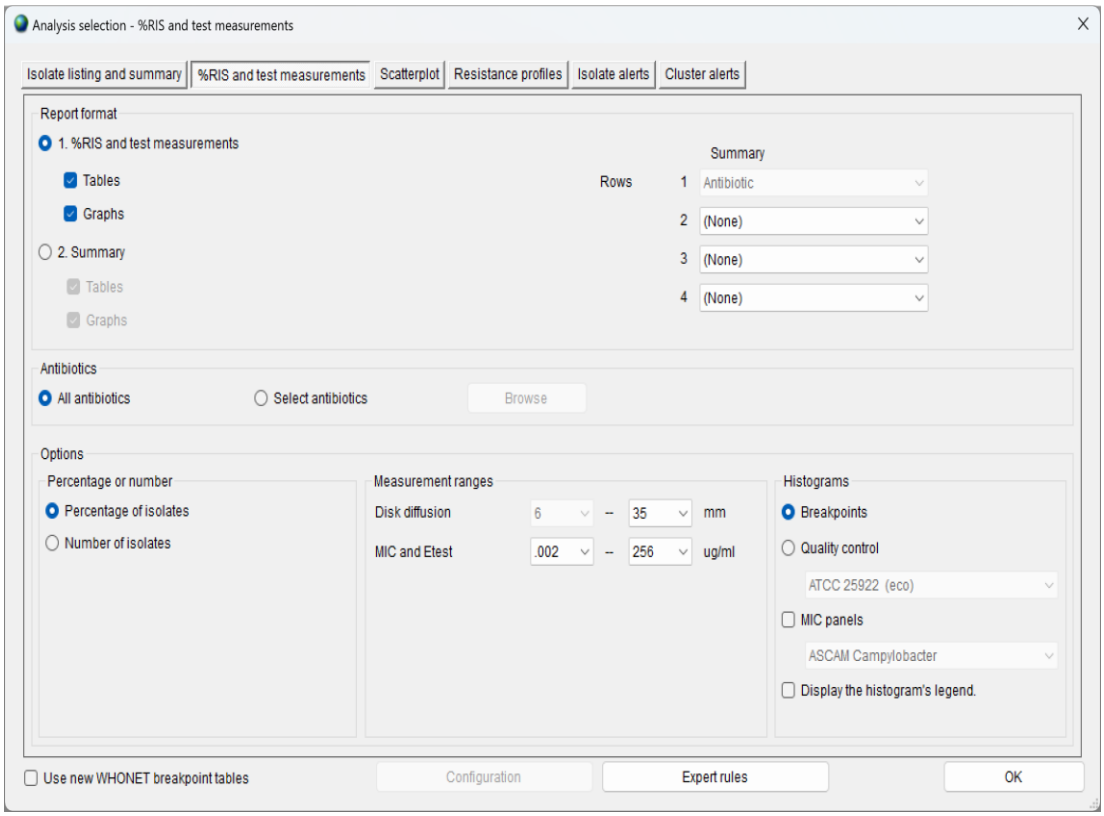
# Appendix B Data collected

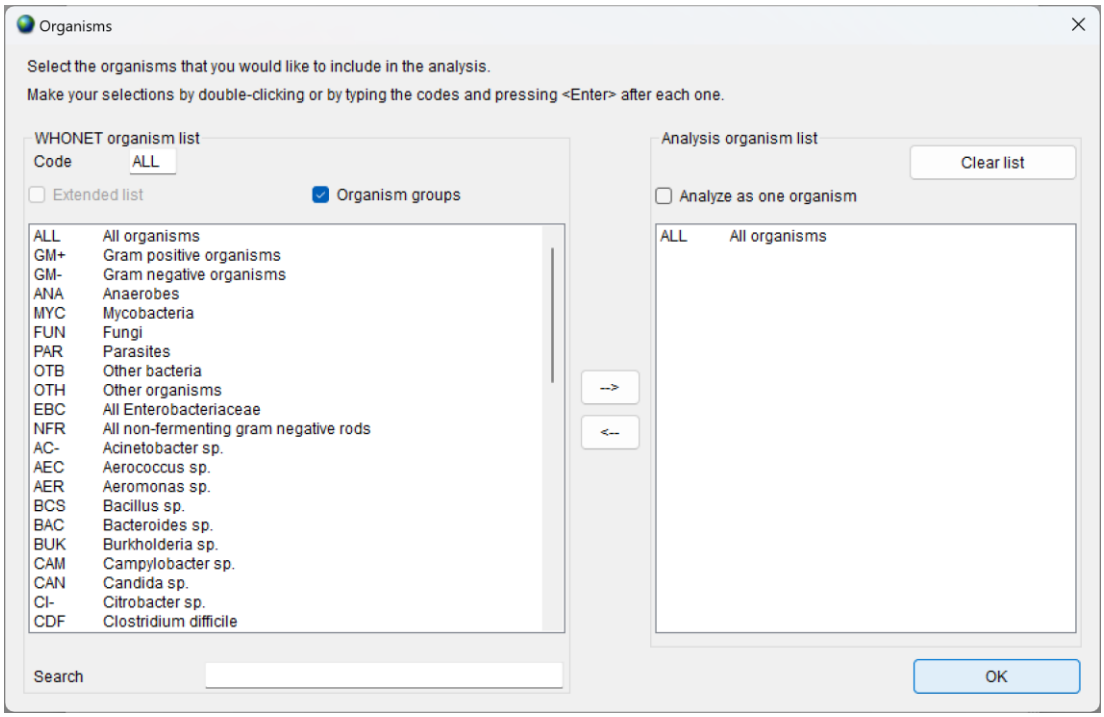


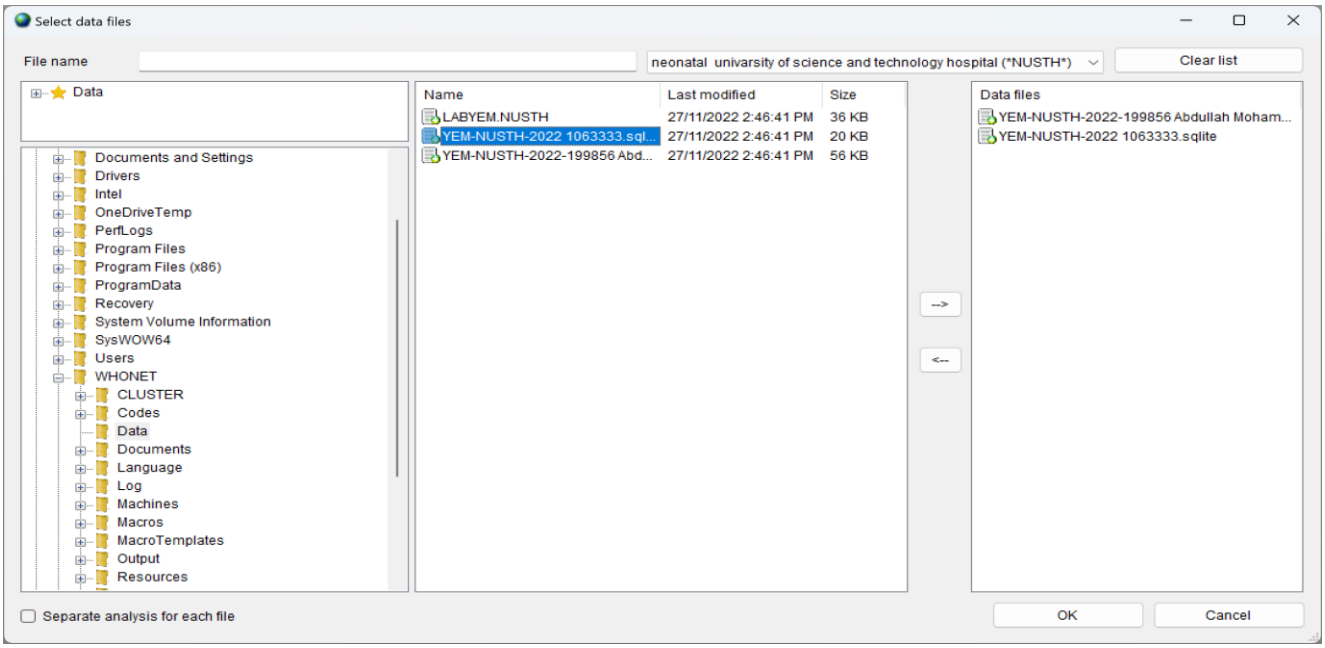
# Appendix C Data analysis

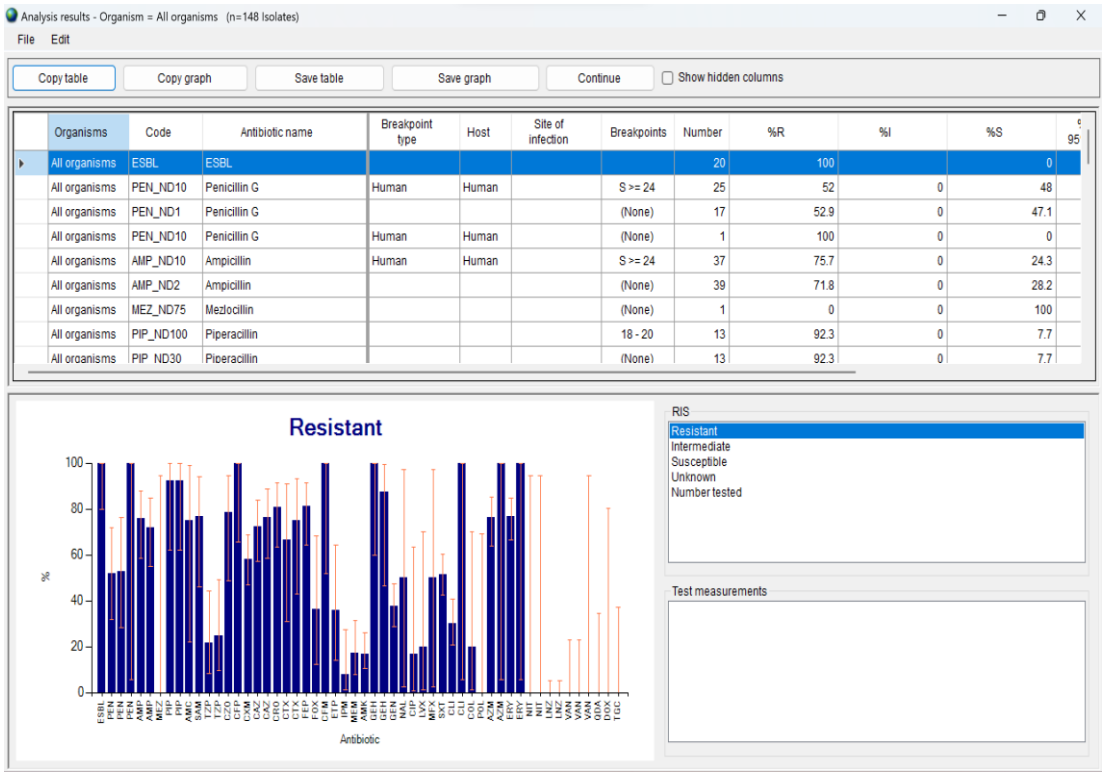


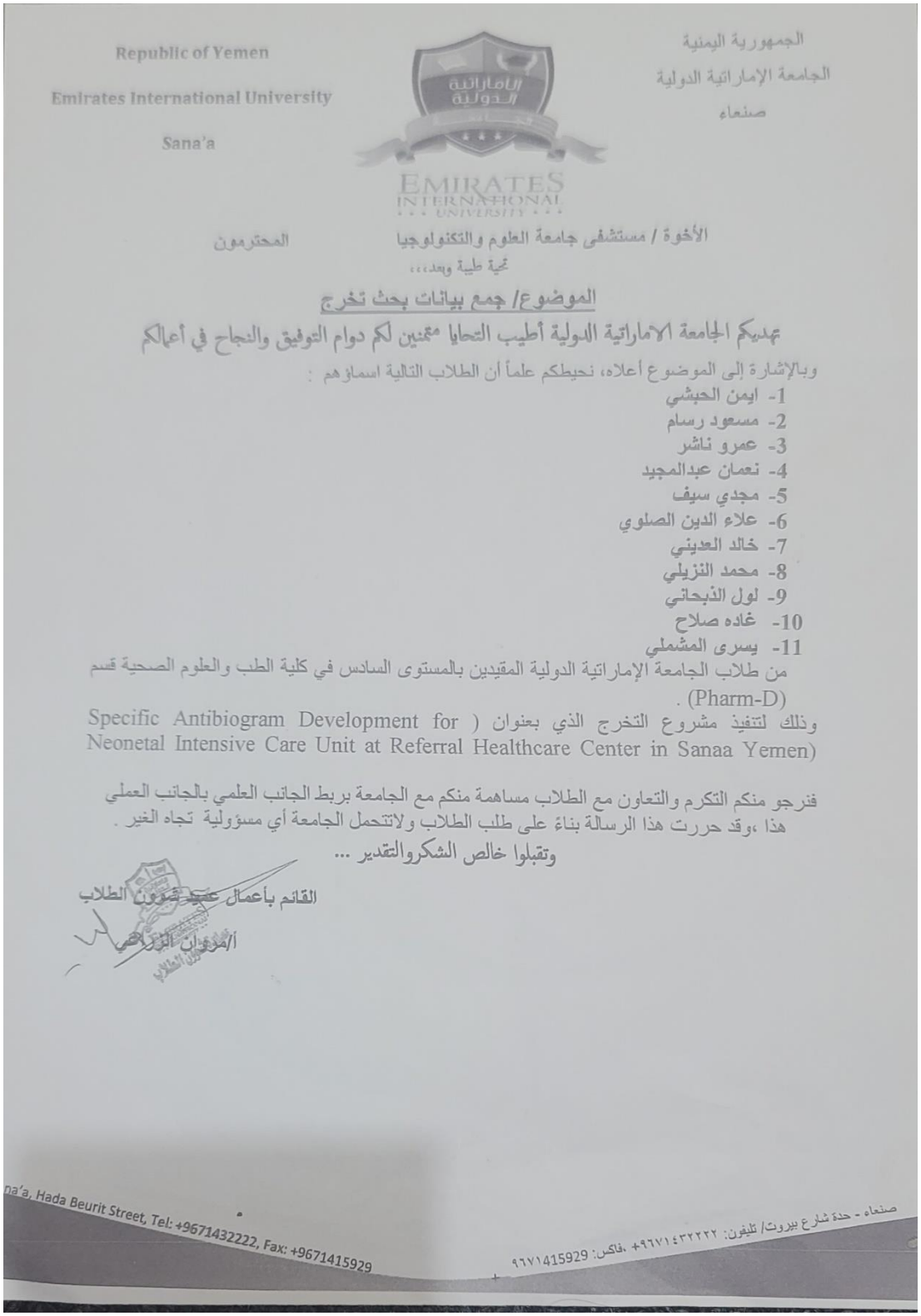

Analysis selection - %RIS and test measurements
Isolate listing and summary
%RIS and test measurements
Scatterplot
Resistance profiles
Isolate alerts
Cluster alerts
Report format
1. %RIS and test measurements
Tables
Graphs
2. Summary
Tables
Graphs
Summary
Rows
1 Antibiotic
2 (None)
3 (None)
4 (None)
Antibiotics
All antibiotics
Select antibiotics
Browse
Options
Percentage or number
Percentage of isolates
Number of isolates
Measurement ranges
Disk diffusion 6 -- 35 mm
MIC and Etest .002 -- 256 ug/ml
Histograms
Breakpoints
Quality control
ATCC 25922 (eco)
MIC panels
ASCAM Campylobacter
Display the histogram's legend.
Use new WHONET breakpoint tables
Configuration
Expert rules
OK


Organisms
Select the organisms that you would like to include in the analysis.
Make your selections by double-clicking or by typing the codes and pressing <Enter> after each one.
WHONET organism list
Code ALL
Extended list
Organism groups
ALL All organisms
GM+ Gram positive organisms
GM- Gram negative organisms
ANA Anaerobes
MYC Mycobacteria
FUN Fungi
PAR Parasites
OTB Other bacteria
OTH Other organisms
EBC All Enterobacteriaceae
NFR All non-fermenting gram negative rods
AC- Acinetobacter sp.
AEC Aerococcus sp.
AER Aeromonas sp.
BCS Bacillus sp.
BAC Bacteroides sp.
BUK Burkholderia sp.
CAM Campylobacter sp.
CAN Candida sp.
CI- Citrobacter sp.
CDF Clostridium difficile
Search
-->
<--
Analysis organism list
Clear list
Analyze as one organism
ALL All organisms
OK


Select data files
File name
neonatal univarsity of science and technology hospital (*NUSTH*)
Clear list
Data
Documents and Settings
Drivers
Intel
OneDriveTemp
PerfLogs
Program Files
Program Files (x86)
ProgramData
Recovery
System Volume Information
SysWOW64
Users
WHONET
CLUSTER
Codes
Data
Documents
Language
Log
Machines
Macros
MacroTemplates
Output
Resources
Name
Last modified
Size
LABYEM.NUSTH
27/11/2022 2:46:41 PM
36 KB
YEM-NUSTH-2022 1063333.sql...
27/11/2022 2:46:41 PM
20 KB
YEM-NUSTH-2022-199856 Abd...
27/11/2022 2:46:41 PM
56 KB
Data files
YEM-NUSTH-2022-199856 Abdullah Moham...
YEM-NUSTH-2022 1063333.sqlite
-->
<--
Separate analysis for each file
OK
Cancel


Analysis results - Organism = All organisms (n=148 Isolates)
File Edit
Copy table
Copy graph
Save table
Save graph
Continue
Show hidden columns
Organisms | Code | Antibiotic name | Breakpoint type | Host | Site of infection | Breakpoints | Number | %R | %I | %S | 95
All organisms | ESBL | ESBL | | | | | 20 | 100 | | 0
All organisms | PEN_ND10 | Penicillin G | Human | Human | | S >= 24 | 25 | 52 | 0 | 48
All organisms | PEN_ND1 | Penicillin G | | | | (None) | 17 | 52.9 | 0 | 47.1
All organisms | PEN_ND10 | Penicillin G | Human | Human | | (None) | 1 | 100 | 0 | 0
All organisms | AMP_ND10 | Ampicillin | Human | Human | | S >= 24 | 37 | 75.7 | 0 | 24.3
All organisms | AMP_ND2 | Ampicillin | | | | (None) | 39 | 71.8 | 0 | 28.2
All organisms | MEZ_ND75 | Mezlocillin | | | | (None) | 1 | 0 | 0 | 100
All organisms | PIP_ND100 | Piperacillin | | | | 18 - 20 | 13 | 92.3 | 0 | 7.7
All organisms | PIP_ND30 | Piperacillin | | | | (None) | 13 | 92.3 | 0 | 7.7
Resistant
%
Antibiotic
RIS
Resistant
Intermediate
Susceptible
Unknown
Number tested
Test measurements

# Appendix D Premission letter of EIU



Republic of Yemen
Emirates International University
Sana'a

الجمهورية اليمنية
الجامعة الإماراتية الدولية
صنعاء

EMIRATES INTERNATIONAL UNIVERSITY

الأخوة / مستشفى جامعة العلوم والتكنولوجيا المحترمون

تحية طيبة وبعد،،،

الموضوع/ جمع بيانات بحث تخرج

تهديكم الجامعة الاماراتية الدولية أطيب التحايا متمنين لكم دوام التوفيق والنجاح في أعمالكم

وبالإشارة إلى الموضوع أعلاه، نحيطكم علماً أن الطلاب التالية اسماؤهم :

1- ايمن الحبشي
2- مسعود رسام
3- عمرو ناشر
4- نعمان عبدالمجيد
5- مجدي سيف
6- علاء الدين الصلوي
7- خالد العديني
8- محمد النزيلي
9- لول الذبحاني
10- غاده صلاح
11- يسرى المشملي

من طلاب الجامعة الإماراتية الدولية المقيدين بالمستوى السادس في كلية الطب والعلوم الصحية قسم (Pharm-D) .

وذلك لتنفيذ مشروع التخرج الذي بعنوان ( Specific Antibiogram Development for Neonetal Intensive Care Unit at Referral Healthcare Center in Sanaa Yemen)

فنرجو منكم التكرم والتعاون مع الطلاب مساهمة منكم مع الجامعة بربط الجانب العلمي بالجانب العملي هذا ،وقد حررت هذا الرسالة بناءً على طلب الطلاب ولاتتحمل الجامعة أي مسؤولية تجاه الغير .

وتقبلوا خالص الشكروالتقدير ...

القائم بأعمال عميد شؤون الطلاب

أ/مروان الزراعي

na'a, Hada Beurit Street, Tel: +9671432222, Fax: +9671415929

صنعاء - حدة شارع بيروت/ تليفون: ٩٦٧١٤٣٢٢٢٢+ ،فاكس: ٩٦٧١٤١٥٩٢٩

## الخلاصة

### خلفية

مناعة حديثي الولادة منخفضة للغاية ويمكن أن تؤدي العدوى فيما بينها إلى عواقب تهدد الحياة. تعتبر مقاومة المضادات الحيوية واحدة من أكثر المجالات تحديا في علاج الأمراض المعدية في جميع أنحاء العالم ويمكن أن تؤدي إلى فشل العلاج بين حديثي الولادة.

### الهدف

كان الهدف العام من هذه الدراسة هو تطوير مضاد حيوي خاص بحديثي الولادة في مستشفى جامعة العلوم والتكنولوجيا، صنعاء، اليمن.

### المنهجية

هذه دراسة بأثر رجعي، تم جمع البيانات من قاعدة بيانات مستشفى جامعة العلوم والتكنولوجيا وتم استخدام برنامج WOHNETلتحليل وتطوير مخطط المضادات الحيوية في مستشفى جامعة العلوم والتكنولوجيا

### نتيجة

كان البكتيريا موجبة الجرام هي الأكثر شيوعا من البكتيريا التي تواجهها بين حديثي الولادة، تليها البكتيريا سالبة الجرام، من البكتيريا موجبة الجرام كانت المكورات العنقودية السلبية والمكورات العقدية هي الأكثر شيوعا، وكانت الكليبسيلا والبروكولديريا هي الأكثر شيوعا في البكتيريا موجبة الجرام، وكان المضاد الحيوي الأكثر حساسيه بالنسبة للبكتيريا موجبه الجرام هما الفانكومايسين والينزولايد، في حين أن الكربابينيم والكوليستين في البكتيريا سالبة الجرام

### الاستنتاج

المقاومة لعامل مضاد الميكروبات كانت عالية في حديثي الولادة وتشمل البكتيريا موجبة وسالبة الجرام.

الجمهورية اليمنية
الجامعة الإماراتية الدولية
كلية الطب والعلوم الصحية
قسم الصيدلة السريرية

# تطوير مخطط المضادات الحيوية في العناية المركزة لحديثي الولادة في مركز الرعاية الصحية في صنعاء، اليمن

**فريق البحث**

مسعود خالد رسام
أيمن أحمد الحبشي
نعمان محمد عبدالمجيد
محمد حسن النزيلي
خالد علي العديني
لول عبدالرحمن عمرو
يسرى أحمد المشملي
غاده عدنان صلاح
عمرو عبدالله ناشر
مجدي محمد سيف
علاء الدين فؤاد الصلوي

**تحت اشراف**

أ.د/ مختار عبدالحافظ الغرافي
د/محمد عبدالله كباس

الجامعة الإماراتية الدولية

2022