AN INVESTIGATION OF THE ANTIMICROBIAL PATTERNS AND ASSOCIATED DEMOGRAPHIC DETERMINANTS IN BACTERIA ISOLATED FROM PATIENTS WITH NON-HEALING WOUNDS AT THE PIETERSBURG AND MANKWENG HOSPITALS, LIMPOPO PROVINCE

by

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DISSERTATION

Submitted in fulfilment of the requirements for the degree of

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UNIVERSITY OF LIMPOPO

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CO-SUPERVISOR(S): Ms NM Seloma
: Prof. R Lekalakala

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DEDICATION

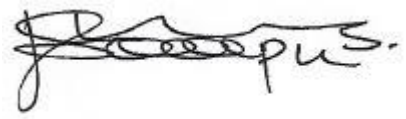
My appreciations go to God for giving me understanding, knowledge and will-power that helped me to complete this project; without God on my side this project would not have been successful.

To my supervisor Ms NTC Maguga-Phasha and co-supervisors Ms NM Seloma and Prof. R Lekalakala-Mokaba, thank you for giving me direction and inspiration throughout the course of the project.

To my family members, friends, and colleagues, thank you for always being there for me. I appreciate your support.

DECLARATION

I declare that the **Investigation of Antimicrobial Patterns and Associated demographic determinants in Bacteria Isolated from Patients with Non-healing Wounds at the Pietersburg and Mankweng Hospital, Limpopo Province** hereby submitted to the University of Limpopo, for the degree of **Master of Science in Medical Sciences** has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein



10/09/2021

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Signature Date

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ABSTRACT

Background: Wound infections continue to be problematic in clinical practice where empiric treatment of infections is a routine, with non-healing wounds being a burden to the health care system. A gap has been noted between antimicrobial resistance and demographic factors as an existing relationship. This necessitates an investigation of patterns of isolates and susceptibility profiles of microorganisms in wounds to modify the preventative and therapeutic strategies against the resistant strains leading to the stall of wound healing, which could aid in empiric treatment.

Objective: The aim of this study was to determine the antimicrobial patterns and their associated demographic determinants in bacteria isolated from patients with non-healing wounds at Pietersburg and Mankweng Hospitals, Limpopo Province.

Methods: The study was conducted using antimicrobial susceptibility data collected from National Health Laboratory Service through Academic Affairs and Research Management System for the period 2016-2020. A total of 797 Antimicrobial Susceptibility Test results were analysed using Statistical Package for Social Sciences version 27.0. The susceptibility rates for the bacterial isolates by age and gender were calculated. The mean percentages for sensitivity and resistance were also calculated. Pearson's Chi-square test was used to compare age and gender with drug susceptibility. A p-value of ≤ 0.05 was considered significant.

Results: Of the 797 patient Antimicrobial Susceptibility Test results, 372 (46.7%) were males and 425 (53.3%) females, with mean age of 31.42 ± 21.75 years. The most common isolates were, *Klebsiella pneumoniae* (23%), *Pseudomonas aeruginosa* (21.7%), *Escherichia coli* (16%) and *Proteus mirabilis* (13.5%). Highest percentage of resistance to any antibiotic was amoxicillin, ampicillin (85.15%) then trimethoprim sulfamethoxazole (60.85%), amoxicillin ampicillin (49.1%), tigecycline (46.35%), cefepime (32.7%), gentamycin (25.4%), ciprofloxacin (22.5%), colistin (17.6%), and meropenem (12.3%). Furthermore, the general view of the study is no statistically clinical significance on the effect of age and gender on bacterial resistance although statistical significance was noted on age the resistance *Acinetobacter baumannii*

(p=0.018), and gender on *K. pneumoniae* (p=0.015), *P. mirabilis* (p=0.024). Major resistance to *A. baumannii, K. pneumoniae* and *P. mirabilis* were from female patients.

Conclusions: The most effective antibiotics were meropenem, colistin, and ciprofloxacin. The highest number of isolates were *K. pneumoniae, E. coli, P. aeruginosa, P. mirabilis and A. baumannii* with the most effective antibiotics gentamycin, meropenem, ciprofloxacin, and cefepime. Although the general view of the study is that no statistically clinical significance was noted on the effect of age and gender on bacterial resistance, it is important to note the significant observation that there was an observed relation of age to amoxicillin-clavulanic acid and Ciprofloxacin and gender to amoxicillin ampicillin. As such, there is insufficient evidence that supports the effect of age and gender on antimicrobial susceptibility. The study suggests caution against the use of amoxicillin ampicillin in the treatment of wound infections as it confers low levels of efficacy and high resistance and ultimately the call to revise minimum inhibitory concentrations and critical concentrations of all less-effective drugs to increase their efficacy.
Keywords: antimicrobial susceptibility; demographic determinants.

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PRESENTATIONS

The study was presented at the Faculty of Health Science 4th Annual Research day on antimicrobial patterns and associated demographic factors in bacteria isolated from patients with non-healing wounds at the Pietersburg and Mankweng hospitals, Limpopo Province, on 7 September 2021.

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LIST OF ABBREVIATIONS

AMOX	Amoxicillin
ATCC	American Type Culture Collection
CLSI	Clinical and Laboratory Standards Institute
CTX	Cefotaxime
CXM	Cefuroxime (Parenteral)
CCs	Critical Concentrations
DFU	Diabetic Foot Ulcer
ECOFF	Epidemiological Cut Off
FOX	Cefoxitin
MK	Minimum Duration of Killing
MDR	Multi Drug-Resistant
MIC	Minimum Inhibitory Concentration
NHLS	National Health Laboratory Service
NHRD	National Health Research Database
NIT	Nitrofurantoin
ROX	Cefuroxime (Oral)
PMREC	Pietersburg Mankweng Research Ethics Committee
TREC	Turfloop Research Ethics Committee

DEFINITION OF CONCEPTS

Antimicrobial Resistance Patterns'	description of the antibiotic resistance testing results for an isolate, referring to the characteristics of a single isolate as per the Clinical Laboratory Standards Institute (CLSI) guidelines (CDC, 2015). In this study, antimicrobial resistance patterns refer to the drug resistance trends observed from a single isolate to its antimicrobial agents.
Comorbidity	can be described broadly as the presence of more than one disorder in a person in a defined period (Wittchen & Essau, 1993). In this study, comorbidities refer to underlying conditions that occur simultaneously with disease upon a patient with wound infections admission.
Wound	a breakdown in the protective function of the skin; the loss of continuity of the epithelium, with or without loss of the underlying connective tissue (Kemebradikumo *et al*., 2013). In this study, a wound refers to any damage or break in the surface of the skin.
Non-healing wound	a wound that will not heal within four weeks, and the cause is usually found in underlying conditions that have either gone unnoticed or untreated, in which infection is also implicated (Ruben, 2015). In this study, a non-healing wound is a wound that did not

heal within four weeks prior to or after presentation at the hospital.

Associated Demographic Determinants These are factors used to define the characteristics of a person or a population. Some commonly used demographic factors include variables such as race, age, income, marital status, and educational achievement, among others (Ibok NI, 2012). In this study, the socio-demographic factors such as age, sex and geographic location will be studied, and association with the antimicrobial susceptibility will be established.

CHAPTER 1

INTRODUCTION

1.1 General Background

Wound infections continue to be problematic in clinical practice where empiric treatment of infections is a routine (Kemebradikumo, Beleudanyo & Oluwatoyosi, 2013). Typically, wounds are supposed to heal within a predictable time regardless of the nature of the cutaneous injury, although the treatment required to facilitate healing will vary depending on the type, size and depth of the wound which further enables classification of the wound as having an acute or chronic aetiology (Mercandetti & Cohen, 2008). Acute wounds are caused by external damage to intact skin and include surgical wounds, bites, burns, minor cuts and abrasions, and more severe traumatic wounds such as lacerations and those caused by crash or gun-shot injuries (Bowler, Duerden & Armstrong, 2012). Chronic wounds are most frequently brought about by endogenous mechanisms related to predisposing conditions such as patients with chronic conditions, leg ulcers, foot ulcers, and pressure sores that eventually compromise the integrity of the dermal and epithelial tissue (Iqbal, Jan, Wajid & Tariq, 2017).

Non-healing wounds are slowly becoming a burden to the health care system, where professionals are running out of treatment options and are therefore diverting to amputations in worst-case scenarios (Lutge, Moodley, Tefera, Sartorius, Hardcastle *et al*., 2016). A study by Guest, Ayoub, McIlwraith, Uchegbu, Gerrish *et al*. (2017), reported that unhealed wounds had a substantial economic burden with an increased patient care cost in the management of leg ulcers and burns with associated comorbidities (Guest *et al*., 2017). A diabetic foot ulcer (DFU) study conducted in Nigeria reported the country to have a high burden of non-healing DFUs where patients had comorbidities such as hypertension, anaemia and hyperglycaemic emergencies (Ugwu, Adeleye, Gezawa, Okpe, Enamino *et al*., 2019). These studies are a noteworthy projection of a public health concern which warrants action on non-healing wounds by investigating factors that could aid in better management of non-healing wounds.

To promote and speed up wound healing, antimicrobial regimens may be administered, depending on the type of infecting agent (Ruben, 2015). Widespread

use of antibiotics has resulted in an increased incidence of isolation of antibiotic-resistant microorganisms from various environments, including wounds (English & Gaur, 2010). Wound infection with antibiotic-resistant bacteria may cause further morbidity in the patient and results in additional treatment costs owing to measures being instituted to reduce patient-to-patient transmission and control nosocomial outbreaks in the ward or institution (Calfee, Salgado, Milstone, Harris & Kuhar, 2014).

A retrospective study conducted in Ethiopia on antimicrobial susceptibility patterns of wound infections considered socio-demographic characteristics such as age, sex, educational background, occupation, residence and patient setting and their relation to antimicrobial resistance (Mohammed, Sied, Gebrecherkos, Tiruneh & Moges, 2017). The study has shown that in-patients had a high number of resistant isolates compared to outpatients, where participants dominating with resistant isolates were aged above 60 (Mohamed *et al*., 2017). Most of the outpatients with resistant isolates were from rural areas aged between 41 and 60 (Mohammed *et al*., 2017). This shows an existing relationship between antibiotic resistance and demographic determinants of the resistance, a significant public health issue which is yet to be fully investigated.

In the Limpopo province, a study conducted by Makgatho, Sethowa, Maguga-Phasha and Mashinya (2019) reported a high rate of multiple antibiotic-resistant isolates in both gram-positive and -negative bacteria (Makgatho *et al*., 2019). In another study by Chanda, Manyepa, Chikwanda, Daka, Chileshe *et al.* (2019), pathogens isolated from routine laboratory specimens were tested using antimicrobials, and the findings revealed that *Staphylococcus aureus, Proteus species*, *Pseudomonas species* and *Enterobacter species* were the most common and resistant isolates (Chanda *et al*., 2019). Furthermore, a study conducted in Gaza reported that the most isolated microorganisms from wound infections such as *Pseudomonas aeruginosa* and *Escherichia coli* showed a greater level of resistance to the antibiotics, while another study in Turkey reported isolated strains of *S. aureus* and *Klebsiella species* were also found to be resistant (Goswami, Trivedi, Goswami, Patel & Tripathi, 2011).

Given the above studies, it is evident that antibiotic-resistant bacteria from wound isolates are becoming communal, difficult to control and a forthcoming burden to the health care system. It is also evident that thorough investigations into the emergence of the resistant isolates have not been extensively conducted to determine other

factors associated with this concern. It is, therefore, necessary to carry out an investigation of patterns of isolates and susceptibility profiles of microorganisms in wounds to modify the preventative and therapeutic strategies against the resistant strains leading to the stall of wound healing, which could aid in empiric treatment.

1.2 Research Problem

Bacterial infections in wounds are common, often difficult to control, fatal and have become a significant public health concern. Unfortunately, the current control strategies i.e., the use of aseptic techniques and administration of antibiotics amongst others, appear to be inadequate in the management of bacterial infections in wounds. Evidence to support this stance is the incidences of many cases in various clinical settings where microorganisms have reportedly become resistant to antimicrobial agents such as antibiotics. The widespread and prolonged use of antibiotics leads to the emergence of resistant bacterial pathogens in wound infections contributing to non-healing wounds. These highly resistant pathogens result from socio-demographic factors such as age and sex, which this study investigated as previous studies in Limpopo Province have not assessed these variables' association with their patterns of antimicrobial susceptibility.

It is necessary to investigation of patterns of susceptibility profiles of microorganisms in wounds and their demographic determinants. This is to modify the preventative and therapeutic strategies against the resistant strains leading to the stall of wound healing and make recommendations that could aid in empiric treatment; hence this study.

1.3 Purpose of the Study

1.3.1 Aim:

The aim of this study was to determine the antimicrobial patterns and their associated demographic determinants in bacteria isolated from patients with non-healing wounds at the Pietersburg and Mankweng Hospitals, Limpopo Province.

1.3.2 Objectives:

The objectives of the study were to determine the:

1.3.2.1 antimicrobial patterns of bacteria isolated from non-healing wounds using National Health Laboratory Services (NHLS) laboratory records.

1.3.2.2 demographic determinants of antimicrobial patterns of bacteria isolated from non-healing wounds using NHLS request and data extraction forms.

1.3.2.3 association of the demographic determinants with antimicrobial patterns of bacteria isolated from non-healing wounds by carrying out data analysis.

1.3.3 Research Question:

What is the association of bacterial antimicrobial patterns to demographic determinants in non-healing wounds from patients at the Mankweng and Pietersburg Hospitals?

1.4. Significance of the Study

The study may enhance the knowledge existing on the pathogenic bacteria leading to wound infections resulting in non-healing wounds, the comorbidities influencing wound infections and healing and their antimicrobials' usage in medicine. Furthermore, the study will inform on the antimicrobials that frequently result in resistance because of the patients' socio-demographic factors and therefore alternative treatment approaches of wound infections will be recommended to avoid resistance, wound healing delay and amputation of affected sites or death.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The problem of antimicrobial resistance means there is a need to continually conduct research into the discovery of new treatment strategies. The development of resistance to antimicrobials in the treatment of wound infections is a significant public health concern (Gandra *et al*., 2019). At present, a significantly high risk of development of antimicrobial resistance is a concern leading to non-healing wounds. These non-healing wounds are a consequence of a wound burden that has been established to be an emerging concern (Neopane *et al*., 2018 & Guest *et al.,* 2017).

A study by Guest, Ayoub, McIlwraith, Uchegbu, Gerrish *et al*. (2017) reported that unhealed wounds had a substantial economic burden with an increased patient care cost in the management of leg ulcers and burns with associated comorbidities (Guest *et al*., 2017). A diabetic foot ulcer (DFU) study conducted in Nigeria reported the country to have a high burden of non-healing DFUs where patients had comorbidities such as hypertension, anaemia, and hyperglycaemic emergencies (Ugwu, Adeleye, Gezawa, Okpe, Enamino *et al*., 2019).

This section will look at the categories of wounds, common bacteria isolated from wound infections, properties of antimicrobial agents and their methods of treatment in acute non-healing wounds. It also discusses chronic wounds, factors affecting susceptibility and resistance of microorganisms to antimicrobials, common antimicrobial agents used in the treatment of wound infections and the action of different antimicrobials on various microorganisms as assessed in previous studies.

2.2 Theoretical and Conceptual Framework

The direction of the study was based on the theory of association of attributes. This theory postulates that many outcomes occur because of simultaneous occurrences of various factors. The outcome result is dependent on other independent factors (Lee & Min, 2013). This study sought to determine associated factors to Multi-Drug Resistance (MDR) using the theory of association of attributes which are socio-demographic factors such as age, sex, location, and educational background.

Antibiotic resistance has become a global threat, and it is essential to know the series of events that have led to this predicament (Laxminarayan, Duse, Wattal, Zaidi, Wertheim *et al*., 2013). The rational use of antibiotics is a critical approach to improve the antibiotic performance and tackling of the antimicrobial resistance. The efficacy of antimicrobials is influenced by many factors: bacterial status (susceptibility and resistance, tolerance, persistence, biofilm) and inoculum size; antimicrobial concentrations; host factors (serum effect and impact on gut microbiota) (Li, Xie, Ahmed, Wang, Gu, *et al*., 2017).

The literature revealed a study conducted in South-West Ethiopia which specified two socio-demographic factors: age and sex. This study did not associate these factors with antimicrobial resistance (Mama, Abdissa & Sewunet, 2014). This theoretical framework combines/associates demographic factors to the emergence of MDR isolates, as shown in Figure 2.1 drawn on the next page.

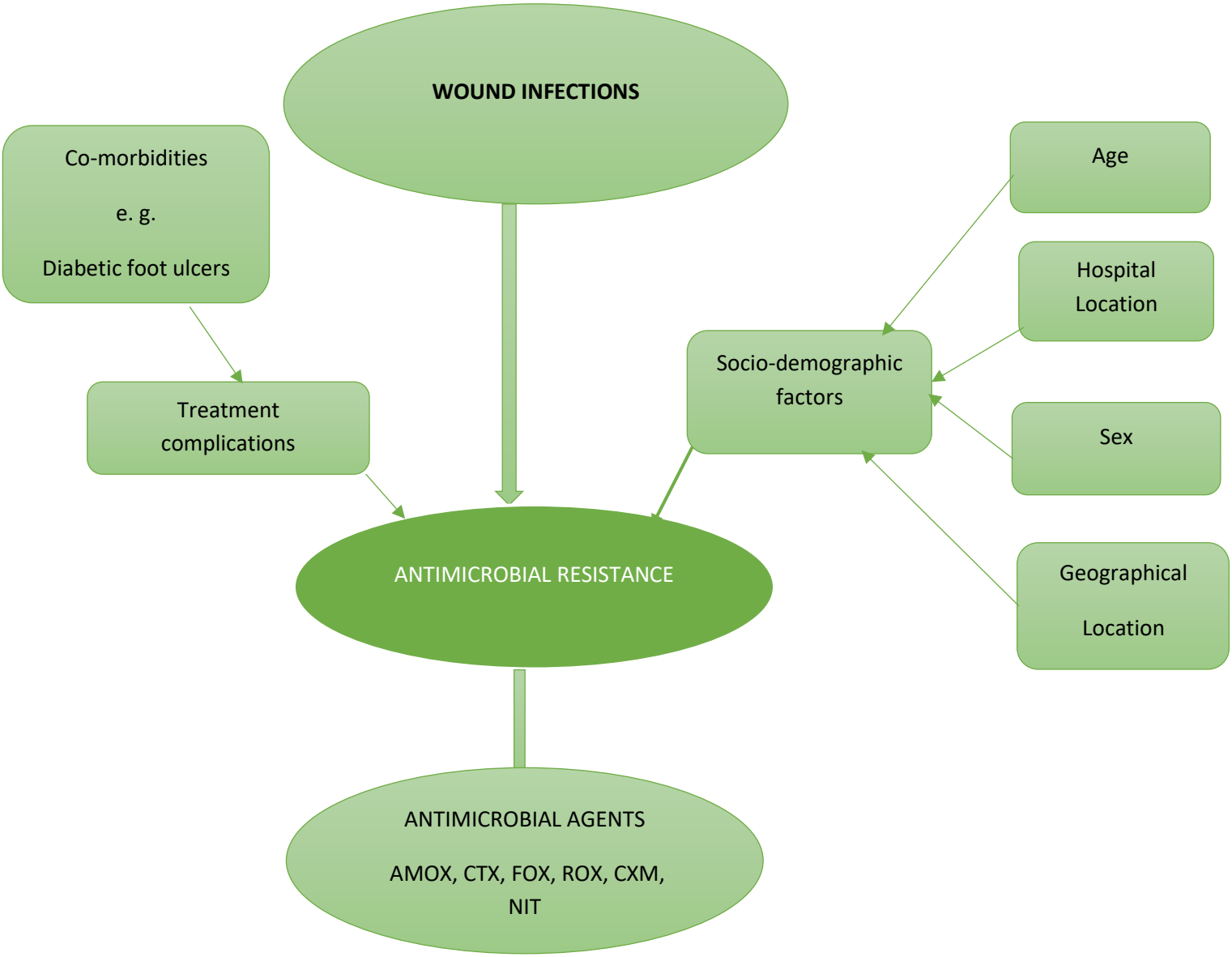


Figure 2.1: Representation of how the environmental factors, comorbidities and normal flora are related to wound infections (Kehinde & Ogunnowo, 2013).

2.3 Categories of wounds

Wounds can be classified as acute or chronic. A wound can either be surgical, traumatic, burns, bite wounds, cuts, grazes, ulcers, and cancer wound depending on the cause (Elmanama *et al.,* 2013; Gupta *et al*., 2015., Alharbi & Zayed, 2014; White *et al.,* 2016). Infection of any type of wound gives rise to different types of wound infections. Patients with burns are usually hospitalised for an extended period, mainly because of the larger area involved (Alharbi & Zayed, 2014).

Burns provides a suitable site for bacterial multiplication and are more persistent richer sources of infection than surgical wounds, mainly because of the larger area involved and longer duration of patient stay in the hospital, which makes burn wound infection more common (Agnihotri *et al*., 2004; Alharbi & Zayed, 2014).

2.4 Common bacteria isolated in wound infections

Compared to surgical wounds, burns are more suitable sites for bacterial colonisation (Agnihotri *et al.*, 2004). The most common microorganism that colonises burns is *P.aeruginosa* (Saaiq, Ahmad & Zaib, 2015). The microbial aetiology of ulcer wound infection is usually involved (Bassetti, Baguneid, Bouza, Dryden, Nathwani *et al.,* 2014). Different microorganisms are mostly found in large numbers in surgical and trauma wounds.

Table 1: Common bacteria in wound infections (Buru *et. al.,* 2014)

Aerobic isolates	**Anaerobic isolate**
Gram-positive	**Gram-positive**
Staphylococcus aureus	*Peptostreptococcus spp.*
Coagulase-negative staphylococci	*Clostridium spp.*
Streptococcus pyogenes	*Propionibacterium spp.*
Gram-negative	*Actinomyces spp.*
Escherichia coli	*Eubacterium spp.*
Klebsiella pneumonia	**Gram-negative**
Citrobacter spp.	*Bacteriodes fragilis*
Enterobacter spp.	*Prevotella spp.*
Pseudomonas spp.	*Veilonella spp.*
Serratia marcescens	*Porphyromonas*
Morganella. morganii	*Fusobacterium*
Acinetobacter spp.	
Candida spp.	

A study conducted in the Limpopo Province of South Africa also revealed the bacterial isolates commonly isolated in wound infections from samples obtained in Central Polokwane NHLS. Seven different species of bacteria were isolated. The most common organism isolated was *Staphylococcus aureus* (29%) followed by *Staphylococcus epidermidis* (15%), lactose fermenting coliforms (15%), Pseudomonas species (11%), Klebsiella species (7%) as well as *Escherichia coli* (3%) and Streptococcus group D (3%). Only 1% of *Staphylococcus saprophyticus* was isolated (Makgatho *et al*., 2019)

2.5 Factors affecting susceptibility and resistance of microorganisms to antimicrobials

Antibiotic resistance has become a global threat, and it is essential to know the series of events that have led to this predicament Guest *et al*., 2017). The rational use of antibiotic is the critical approach to improve the antibiotic performance and tackling of the antimicrobial resistance. The efficacy of antimicrobials is influenced by many factors: bacterial status (susceptibility and resistance, tolerance, persistence, biofilm) and inoculum size; antimicrobial concentrations; host factors (serum effect and impact on gut microbiota) (Li, Xie, Ahmed, Wang, Gu, *et al*., 2017).

Bacterial status is one of the determinants of antimicrobial activity. The bacteria phenotypes are different under antibiotic exposure, such as susceptibility, resistance, tolerance, and persistence (Brauner, Fridman, Gefen, and Balaban *et al*., 2016). Susceptibility and resistance are measured by the Minimum Inhibitory Concentration (MIC). It is usually determined by exposing a defined amount of bacterial population to a series of increasing antibiotic concentrations in a standardised growth medium for about 16 – 20 h (Poirel, Jayol & Nordmann, 2017). Isolates can be phenotypically recognised as susceptible and resistant, according to Epidemiological Cut Off (ECOFFs) (Espinel-Ingroff & Turnidge, 2016).

Clinical resistance is a condition whereby the clinical criteria of cure was not reached when enough antibiotic dosage and administration timetable are applied for a specific infection. It is determined by the clinical breakpoints, which separate clinically resistant bacteria from clinically susceptible bacteria. Clinical breakpoints are influenced by pharmacodynamic and pharmacokinetic parameters which, indicate a relationship

between antimicrobial activity *in vivo* and the antibiotic concentration at the site of infection (Li *et al*., 2017).

Tolerance is the capacity of bacteria to stay alive in a brief exposure to antibiotics, which apply only to bactericidal antibiotics (Kester & Fortune, 2014). Longer time rather than a high concentration of antibiotic exposure is necessary to construct the same level of killing in a tolerant strain as in susceptible strain. Tolerant and non-tolerant bacteria may not be different in MIC value. The Minimum Drug Killing (MDK) which can be obtained from the time-kill curves are suggested as quantitative measures of tolerance. There are two types of tolerance, “tolerance by slow growth” and “tolerance by lag”. The former occurs at stationary phase while the latter occurs in a transient growth arrest often induced by starvation or stress (Brauner *et al*., 2016).

Persistence occurs in a bacterial subpopulation that is not killed by antibiotics, and heterogeneous response is repeated when they are exposed to the same antibiotic (Lewis, 2007). The molecular mechanisms of time dependant persistence are also associated with tolerance that slows down the killing by antibiotics (Adams, Takaki, Connolly, Wiedenhoft, Winglee *et al*., 2011). However, in some cases of tolerance with a very high MDK, the antibiotic toxicity to the host may limit the treatment duration. Drug-induced tolerance or persistence, which causes growth arrest in some microorganisms may result in a long MDK (Dorr, Vulic, & Lewis, 2010; Johnson & Levin, 2013).

The antibiotics apply its effect by different mechanisms initially by inhibiting the synthesis and of the bacterial cell wall, or its transcription, impairing bacterial ribosomes and protein synthesis, interfering with metabolic pathways or disrupting the cytoplasmic membrane (Zamoner, De Freitas, Garms, De Oliveira, Balbi *et al*., 2016). Different antibiotic concentrations may result in a different selection of resistant bacteria, therefore influencing the efficacy of the antimicrobials (Li *et al*., 2017).

Rational and correct uses of antibiotics are the fundamental approaches in improving antibiotic performance and tackling antimicrobial resistance. The efficacy of antibiotic treatment is influenced by many factors. The sensitivity of the specified pathogens is usually combined with pharmacokinetic parameters to investigate the effectiveness of antimicrobial dosage regimens. It should be noted that the non-protein-bound fraction of antibiotics is microbiologically active *in vivo*, which makes the serum effect to be

considered in antibiotic therapy. Choosing the precise antibiotic is essential as the serum effect changes between antibiotics in the same class or antibiotic against different microorganisms (Li *et al*., 2017).

On the other hand, MIC is not informative for some special bacterial status, such as persistent or tolerant bacteria. In contrast to infections caused by planktonic bacteria, biofilm-forming bacteria tend to cause chronic infections, especially in the respiratory tract, whereby infections persist despite adequate antibiotic therapy. This is because the emergence of persistent or tolerant bacterial cells usually happens in biofilms. Recently, several compounds have been identified as effective against time-dependent persisters (Kim, Heo, Yang, Lee, Cho *et al*., 2011) or against tolerance in biofilms through the methods of systematic screens. However, the effectiveness of these compounds has not been assessed in the clinical setting. Antimicrobial regimens should be optimised not only for the treatment outcome but for the minimisation of the antimicrobial resistance development (Mouton, Ambrose, Canton, Drusano, Harbarth, MacGowan *et al*., 2011). It should not be ignored that antibiotic-induced alterations in composition and function of the microbiota may also create long-lasting harmful effects for the host and increase bacterial resistance (Francino, 2015; Becattini, Taur & Pamer, 2016).

2.6 Common antimicrobial agents used in the treatment of wound infections

Different antimicrobial agents are used to treat wound infection concerning the bacterial species responsible for wound infection. There are different classes of antibiotics, and different antibiotics have different mechanisms of action at which they kill and/or inhibit the growth of bacteria responsible for wound infections (Wilson, 2014).

Table 2: Common antimicrobial agents used in the treatment of wound infections and their mechanisms of action (Patrulea *et al.,* 2020)

Classes of antimicrobial agents	**Examples of antimicrobial agents**	**General mechanisms of action of antimicrobial agents**.
Aminoglycosides	Gentamicin	Inhibition of protein synthesis
Beta-lactams	Vancomycin	Inhibition of cell wall synthesis.
Carbapenems	Meropenem	Inhibition of cell wall synthesis
Cephalosporins	Cefepime	Disrupt synthesis of peptidoglycan layer
Penicillin's	Ampicillin	acylates the active site of Bacillus stearothermophilus-D-alanine carboxypeptidase
Fluroquinolone	Ciprofloxacin	Inhibition of nucleic acid replication and transcription
Folate-pathway inhibitor	Trimethoprim-sulfamethoxazole	Interfering with folic acid metabolisms
Glycylcycline	Tigecycline	Inhibition of protein synthesis
Polymyxin	Colistin	Inflicting injury to the plasma membrane

2.7 Action of different antimicrobials on various microorganisms assessed in previous studies

Makgatho, *et al.* (2019) evaluated the antimicrobial susceptibility profiles of microorganisms in wound swabs from Central Polokwane NHLS, in Limpopo Province of South Africa. A high rate of multiple antibiotic-resistant isolates was observed in both gram-positive and gram-negative bacteria. The results are presumptive of the likelihood of a changing resistant profile among the specimen tested. That might be attributable to various factors and warrants further investigation (Makgatho *et al.*, 2019).

A study conducted in Turkey (Oncul, Ulkur, Akar, Turhan, Yeniz *et al*., 2009) obtained different results where they reported *Pseudomonas aeruginosa* to be the abundant isolate, followed by *Staphylococcus aureus.*

In these cited studies, *P. aeruginosa* was the isolate with the highest resistance to Gentamycin, Piperacillin, Ciprofloxacin, Cefepime, Imipenem, Amikacin, Ceftazidime, and Norfloxacin. It was followed by *Staphylococcus species* which were found to be resistant to Ceftriaxone, Ciprofloxacin, Cefuroxime, Penicillin, Triemethoprim, and Oxacillin. *Staphylococcus spp*. strains isolated from patients' samples were sensitive to linezolid. A marked increase in the number of hospital infections owing to methicillin-resistant staphylococci has been reported in many countries (Johnson, 2011). *P. aeruginosa* is the abundant isolated bacteria and was considered MDR.

Pondei, Fente and Oladapo (2013) conducted a study at the Niger Delta University Hospital in Nigeria. Their study demonstrated a high prevalence of pathogenic bacteria in wounds. This figure is consistent with that obtained in similar studies in Nigeria which further explained that gram-negative bacteria were the most isolated pathogens (Ige, Adesanmi & Asuzu, 2011). Their observation showed *P. aeruginosa* as the most common pathogen in wound infections differing from another study in Nigeria, showing *Staphylococcus aureus* to be predominant (Aye, Omoriege, Igbarumah & Onemu, 2011).

Klebsiella pneumoniae was observed as the most common pathogen isolated in wound infections in a study in Western Nigeria (Mama, *et al*., 2014). This is evidence of the existence of local and regional variability and shows that each health facility must determine the prevalent microorganisms and other associated indices. Antibiotic resistance by the isolates to commonly prescribed antibiotics was high. This level of resistance is a cause for concern. The absolute resistance to cloxacillin was expected because cloxacillin is a component of Ampiclox, an antibiotic frequently implicated in self-medication in Nigeria (Clarence, Edrin & Odeh EN, 2008). The development of resistance to cephalosporins in this study is a wake-up call for action on antimicrobial resistance (Pondei *et al.*, 2013).

A study conducted by Lai, Bebell, Meney, Veleri and White (2018) in six countries in Africa revealed the antimicrobial resistance data on key pathogens from clinical wound isolates of patients presenting to a single floating hospital ship from the six African countries. It reported that the majority of *Enterobacteriaceae* isolates in the population sampled are resistant to ampicillin, and a substantial proportion is resistant to gentamicin, often the first-line antibiotics recommended for some surgical site

infections in health care facilities of the country's studies. It was found that a high proportion of the isolates are resistant to fluoroquinolones and third-generation cephalosporin, antibiotics commonly used throughout sub-Saharan Africa. Lastly, 23.9% of *Staphylococcus aureus* isolates were methicillin-resistant, a concerning finding for resource-limited settings where alternative antibiotics such as vancomycin are not routinely available. In summary, it was found that resistance to locally available antimicrobials was common among wound infection isolates (Lai *et al.,* 2018)

2.8 Demographic determinants of antimicrobial susceptibility patterns

Various studies (Mama, *et al*., 2014; Mohammed, Sied, Gebrecherkos, Tiruneh & Moges, 2017) have been conducted on antimicrobial susceptibility. However, the association to demographic factors remains somewhat unclear as most of these conducted studies are not conclusive about the association of these two variables. A study conducted in South-West Ethiopia specified two socio-demographic factors: age and sex. This study involved 150 participants, of which 107 were males and 43 were females. A total of 87.9% of the males were found to have wound infections, and only 81.4% of females had wound infections, and most of the participants infected were males between the ages 15 and 60 (Mama, *et al*., 2014). This study did not associate these factors with antimicrobial resistance.

A retrospective study in Ethiopia conducted in 2017 considered socio-demographic characteristics such as age, sex, educational background, occupation, residence, and patient setting in their data collection and their relation to antimicrobial resistance. The study has shown that in-patients had a high number of resistant isolates compared to out-patients where participants dominating with resistant isolates were aged above 60 and the majority of the outpatients dominating with resistant isolates were from rural areas aged between 41 and 60 (Mohammed, *et al.*, 2017).

CHAPTER 3
METHODOLOGY

3.1 Research Design

This was a quantitative retrospective study. A quantitative study focuses on gathering numerical/statistical data and generalising it across groups of people or to explain a phenomenon (Babbie, 2010). In this study, medical records of patients with non-healing wounds including demographic, bacteria isolated and antibiotic susceptibility results were collected and analysed statistically. A retrospective cohort study is one in which the outcome has all occurred before the start of the investigation, and the investigator goes back to the past to select study group from existing records of medical and traces them forward through time from the past date fixed on the records usually to the present (Mayer, 2008). In this study, antimicrobial susceptibility patterns and socio-demographic factors were studied by extracting information on patient medical records from the Mankweng and Pietersburg Hospitals' wards and the Central Polokwane NHLS.

3.2 Study Area

This study was conducted at the Pietersburg and Mankweng Hospitals with 498 and 509 bed capacity, respectively. These hospitals are situated in the Capricorn District of the Limpopo Province, South Africa. The province is situated in northern South Africa bordering Mozambique, Zimbabwe and Botswana. It is divided into five district municipalities: Capricorn, Mopani, Sekhukhune, Vhembe and Waterberg. Limpopo Province borders the Mpumalanga, Gauteng and North-West Provinces of South Africa. The study sites were the Mankweng hospital, Pietersburg hospital & Central Polokwane NHLS. The NHLS is a routine diagnostic laboratory that services hospitals at national and provincial levels, located in Polokwane, 29.6 kilometres away from the University of Limpopo. The laboratory has antimicrobial susceptibility results of bacteria isolated from wounds at hospitals and sent for testing at NHLS.

3.3. Sample size calculation

The prevalence of non-healing wound infections in this study helped determine the sample size. Hence the general prevalence was used as the prevalence of non-healing wounds in Limpopo is not known. Studies have shown that the prevalence of

non-healing wounds is around 45% depending on the area of study (Gupta, 2015). In the sample size calculation formulation (Za/2) =1.96 because the confidence interval is 95%, Margin of error is 10%, E= margin of error multiply by prevalence = 0.10×0.45=0,045. Therefore, the sample size is calculated using the formula

$$N= \frac{(Za/2)^2 \times (P) \times (1-P) \times D}{E^2}$$ (Suresh & Chandrashekara, 2012).

Where: $(Za/2)^2$ = Level of Significance, where Za/2= 1.96 for 95% confidence interval
P= Prevalence, where 45% general prevalence
D= Sampling/Method Design, where 1 is used in a random sampling technique
E= Precision/ Margin of Error multiplied by prevalence, where 10% is the given margin of error/ precision
therefore:

$$N= \frac{(1.96)^2 \text{ X } (0.45) \text{ X } (1-0.45) \text{ X } 1}{(0.045)^2}$$

=470 patient records

Where 235 patient records per hospital were obtained from NHLS

Therefore, a minimum of 470 medical records of patients with non-healing wounds from the two hospitals was needed for the study.

3.4. Sampling method

Probability is a sampling technique in which the researcher chooses samples from a larger population using a method based on the theory of probability where a participant to be considered as a probability sample. Participants must be selected using a random selection (Yang & Banamah, 2014). The patients' medical records used in this study were obtained from those selected at a random technique within a five-year range at the NHLS facility servicing the Pietersburg and Mankweng Hospitals.

3.5 Inclusion criteria

All patients' medical records of a patient with wound infections at Surgical, Trauma, Orthopaedic and Maternity wards, and who have been treated with antimicrobials, considering demographic factors such as sex and age were suitable for this study.

3.6 Exclusion Criteria

Patients' medical records that did not have all the information required in the present study. The study required susceptibility results, demographic factors such as age and sex. Therefore, records that did not have this information were excluded.

3.7 Data collection

The data were collected from NHLS, a routine diagnostic laboratory. The laboratory standard operating procedures were followed for culture and drug susceptibility testing (Appendix 5). The bacteriological analysis involves culturing of specimen on appropriate culturing media following the national standard operating procedures and CLSI guidelines (CLSI 2016). The isolated organism is further exposed to different identification tests using in-house and/or commercially prepared biochemical media such as Sulphur Indole Motility (SIM) agar (Becton, Dickinson and company [BD], USA), Triple Sugar Iron (TSI) agar (BD, USA), Lysine Iron Agar (BD, USA), Citrate agar (Mast Group Ltd, UK), urea media (BD, USA), oxidase reagent (Himedia, India), hydrogen sulphide (VYKing Pharmaceuticals Ltd, Zambia) or Analytical profile index (API) 20E for Enterobacteriaecae (bioMerieux[1] SA, France). Furthermore, the antibiotic susceptibility testing (AST) is performed using a Kirby-Bauer disc diffusion method on the isolated/identified organism by preparing the bacterial suspension in comparison with 0.5 MacFarland turbidity standard and inoculating on Mueller-Hinton agar (BD, USA) or Blood supplemented Mueller-Hinton agar (CLSI 2016). Quality control is performed with various standard, American Type Culture Collection (ATCC) strains.

A data extraction request form was submitted to the NHLS to retrieve the desired data at a minimum of five years from the 2015-2019 (See Appendix 3). These data were captured at NHLS using the NHLS request form sent to the laboratory from the hospital (See Appendix 2) by official hospital personnel. Upon NHLS approval of the data extraction request form, a Microsoft Excel spreadsheet entailing all the required information was provided by NHLS for analysis.

3.7.1 Data analysis

This was a quantitative study in which data analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 27.0). Data analysis was carried out in two phases wherein phase 1, socio-demographic factors were analysed

with drug resistance. To achieve this, a Chi-square test was conducted justifying for age and sex to determine if they have any relation to drug susceptibility using a null hypothesis and an alternate hypothesis.

Phase 2 data analysis was of the microorganisms and the multi-drug resistance. An overall analysis was made where data from patients with single microorganisms were separated from those with multiple microorganisms and both collapsed into corresponding tables in the highest order of resistance. A sub-analysis for each pathogen as well as the groups of pathogens (Gram- and Gram+) were done and were restricted on clinical significance and aligning them with the drugs that were used. Mean percentages for drug susceptibility were calculated per organism.

The AST results were analysed with Microsoft Excel 2010 and SPSS Statistics version 27.0 software. The rates of susceptibility for individual antibiotics were calculated for every bacterial isolate by age and gender of a patient, specimen source (location), year of sample processing and type of specimen. The mean percentages of the susceptibility of each isolate to all tested antibiotics was calculated as the number of resistant strains out of the total number of strains exposed to a particular antibiotic in a specimen. Age and gender of patient comparisons were performed using the Pearson Chi-square test and a p-value of 0.05 was considered significant.

3.8 Validity and Reliability

3.8.1 Validity

Validity can be explained as an extent to which requirements of scientific research method have been followed during the process of generating accurate research findings (Lusby *et al*., 2010). To ensure validity, all procedures, and systems in place to obtain data were followed to obtain data from a reputable source such as NHLS. The method of obtaining data is of high quality and targeted to obtain exactly what the study wished to investigate through getting approvals from all research approving bodies.

3.8.2 Reliability

Conversely, reliability refers to the extent to which the same answers can be obtained using the same instruments more than one time. In simple terms, if your research is associated with high levels of reliability, then other researchers need to be able to

generate the same results, using the same research methods under similar conditions (Babbie, 2010). In this study, to ensure reliability, samples have been collected by Health Care Professionals that understand the Clinical Criteria of wound swab collection and are compliant. The chosen hospitals used the accredited NHLS laboratory to test their samples. The standard procedure was that all tests should have controls in the laboratory to deem the results valid and reliable.

3.9 Bias

Bias is a form of systemic error that can affect scientific investigations and distort the measurement process (Krishna, Maithrey & Surapaneni, 2010). In this study, sampling bias could not be avoided because a retrospective design and probability method was used. This study used a retrospective approach which was prone to selection bias and information bias because of its retrospective nature as errors owing to confounding bias are more common than in prospective studies. To mitigate this, the study used simple random sampling, providing every patient with equal odds of being part of the research and standardised protocols for collecting data was followed.

3.10. Ethical Considerations

The current study used Mankweng, and Pietersburg Hospitals patients' data extracted from NHLS and patients' records and the applicable sections of ethical considerations are:

3.10.1 Permission

According to the National Health Act of South Africa (section 73 act 61 of 2003), the permission to conduct a study must be obtained from a Health Research Ethics Committee that is registered with the National Health Research Ethics Council.

- The research proposal was submitted to the Turfloop Research Ethics Committee for approval to conduct research as a student at the University of Limpopo using human participants before the research can be conducted. A letter to request for approval to conduct research using the health facilities in the Limpopo Province was submitted to the Department of Health (see Appendix 4) by uploading the TREC clearance certificate and proposal onto the National Health Research Database (NHRD).

- A data extraction request form was sent to the NHLS to extract the desired data (See Appendix 3).

3.10.2 Informed consent and voluntary participation

In this study there was no need for consent since secondary data were extracted from NHLS and there was no direct contact with the patients.

3.10.3 Anonymity and confidentiality

Confidentiality means not discussing information provided by an individual with others, while anonymity means presenting research findings in ways that ensure that individuals cannot be identified (Wiles, Crow, Heath, & Charles, 2006). Anonymity from National Health Act of South Africa section 14 Act no. 61, 2003, refers to all information concerning user or participants involving information relating to his/her health status, treatment or stay in an establishment is confidential. In this study, anonymity was addressed by using letters and numbers for example P113 to assign patients' data instead of using the patients' names and hospital numbers. Confidentiality was addressed by securing the patients' data so that the researcher and supervisor could access the patient's records and nobody else could. A confidentiality form was signed by both the researcher and research assistants as proof of agreement to ensure confidentiality.

3.10.4 Handling and disposal of samples

This section was not applicable in the study since there was no direct contact with any microorganisms / patient samples.

3.10.5 Harm

Harm refers to any form of pain or discomfort participants may be exposed to during the study, particularly during sample collection. In this study, this was not applicable as there was no collection of samples from the patients.

CHAPTER 4

RESULTS

4.1 Introduction

This chapter consists of four sections viz: overall characterisation of patient socio-demographic data and bacterial isolates, characterisation of bacterial isolates and antibiotic susceptibility, association of age and gender with antibiotic susceptibility, antibiotic resistance profile of bacterial isolates.

4.2 Overall characterisation of patient data and bacterial isolates

Table 4.1: Characterisation of patient socio-demographic data

	Age Range *n (%)*				
Patient Characteristics	**≤20**	**21-34**	**35-59**	**≥60**	**TOTAL**
Males	126 (15,8)	80 (10,0)	113 (14,2)	53 (6,6)	372(46,7)
Females	120 (15,1)	145 (18,2)	113 (14,2)	47 (5,9)	425 (53,3)
Total	**246 (30,9)**	**225 (28,2)**	**226 (28,4)**	**100 (12,5)**	**797 (100)**

About 797 patient AST data were analysed and met the study's inclusion criteria. Of the 797, 372 (46.7%) were males and 425 (53.3%) were females, with the age range of 0-95 years with mean age of 31.42 ± 21.75 years. 404 (50.7%) patient data were from Mankweng Hospital and 393 (49.3%) was from Pietersburg Hospital. All data were obtained from cultured wound swabs only. Furthermore, the data were obtained from a period of 2016-2020 where 201 (25.2%) was from 2016, 114 (14.3%) from 2017, 185 (23%) from 2018, 151 (31.4%) from 2019 and 146 (18%) from 2020. Out of the total patient data, 246 (30.9%) came from patients aged 20 years and below, 225(28.2%) from patients between 21 and 34 years, 226 (28.4%) from patients aged 35-59 years while 100 (12.5%) was from patients aged 60 and above (Table 4.1).

Table 4.2: Frequency of bacterial isolates

Bacterial Isolates	
Organism	**Frequency n (%)**
Klebiella penuamonae subsp pneumoniae	184 (23)
Psedomonas aeruginosa	173 (21,7)
Escherischia coli	128 (16)
Proteus mirabilis	108 (13,5)
Acinetobacter baumannii	73 (9,1)
Klebsiella oxytoca	31 (3,8)
Bacteria with less than 31 Isolates	100(13)
Total	**797 (100)**

The majority of the organisms isolated were gram negative bacteria (Figure 4.1.1). The most common bacteria isolated from these patients were *K. pneumoniae subsp pneumoniae, P. aeruginosa, E. coli, P. mirabilis, A. baumannii* and *K. oxytoca* (Table 4.2). However, the picture of isolates between males and females were almost equal. The highest number of patients' data for 2016 (201/797) and 2018 (185/797) has a good correlation with the number of isolates identified in these year periods but the less numbers for 2017 were attributed to the lower number of data received. Generally, isolates were resistant to amoxicillin ampicillin (86.2%), trimethoprim sulfamethoxazole (65.6%) amoxicillin clavulanic (57.8%) although ciprofloxacin (79.7%), gentamicin (76%) and colistin (81.3%) retained their effectiveness (Figure 4.2).

Figure 4.1: Frequency of bacterial isolates

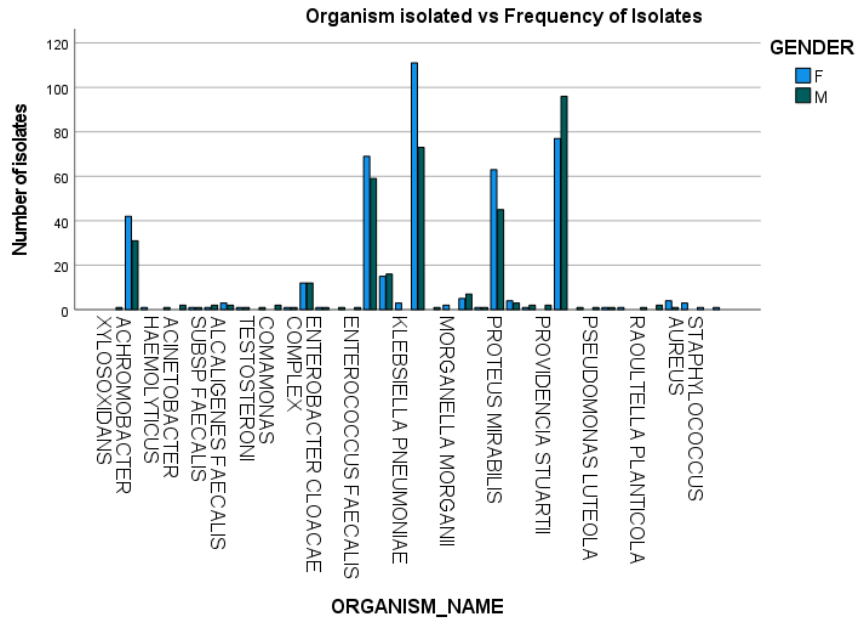


Figure 4.1.1: Prevalence of gram-positive and gram-negative bacterial isolates

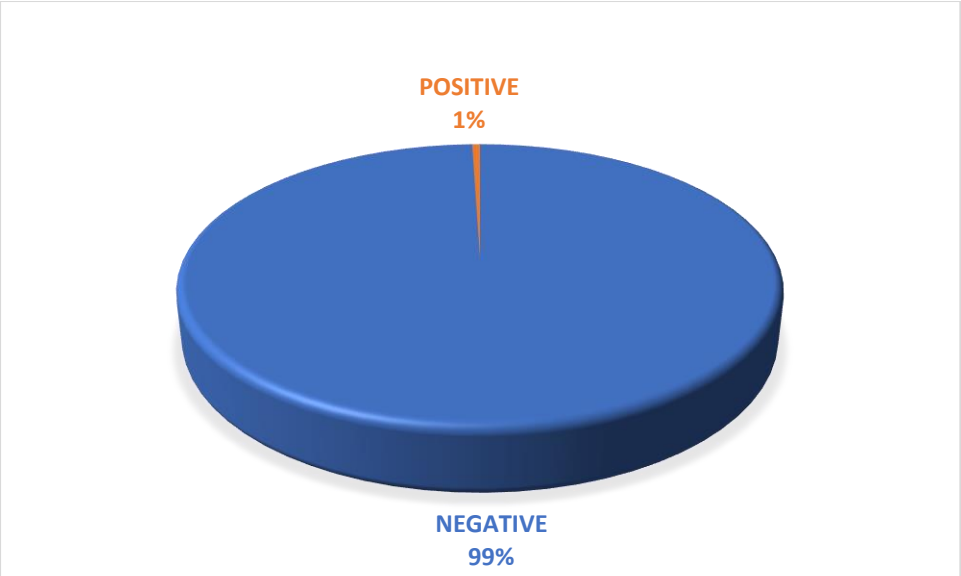
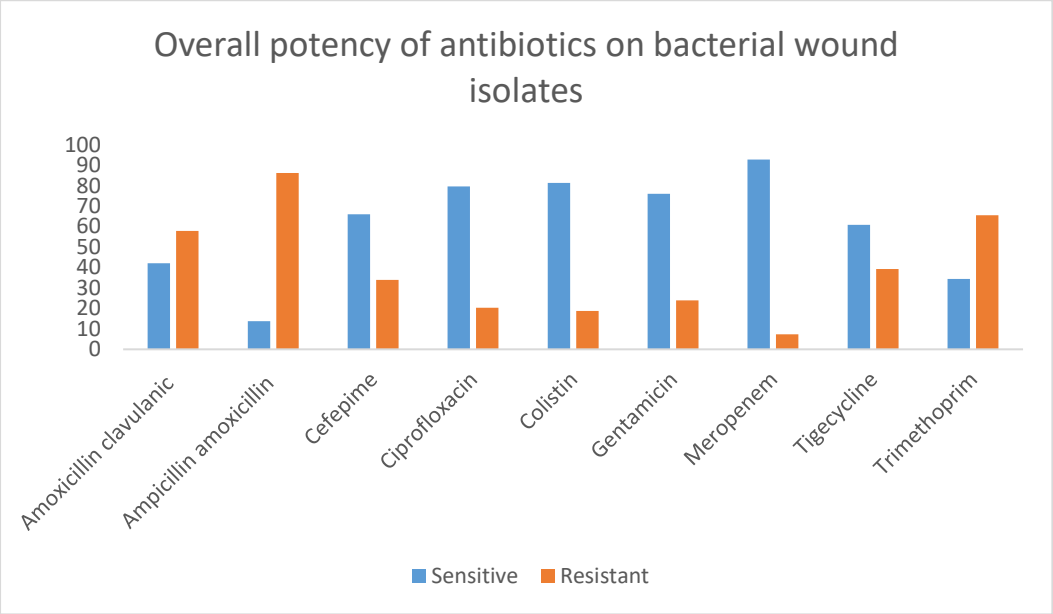


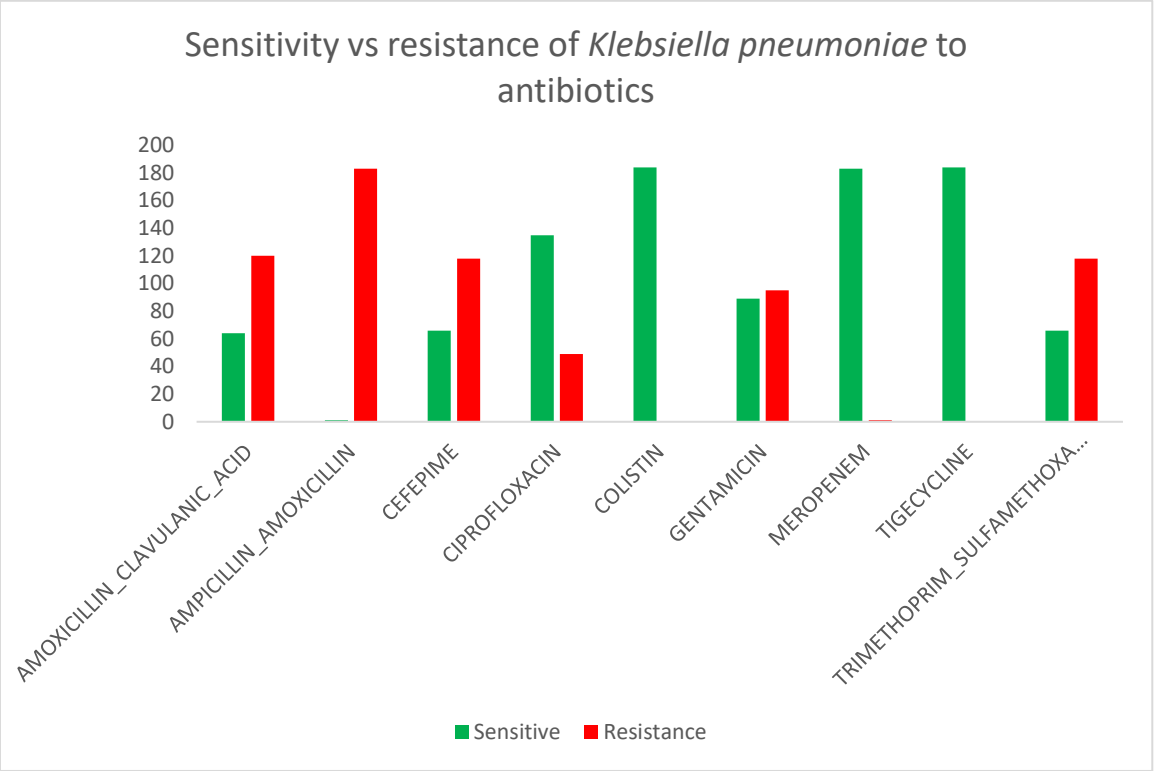
Figure 4.2: Overall potency of antibiotics to isolated bacteria



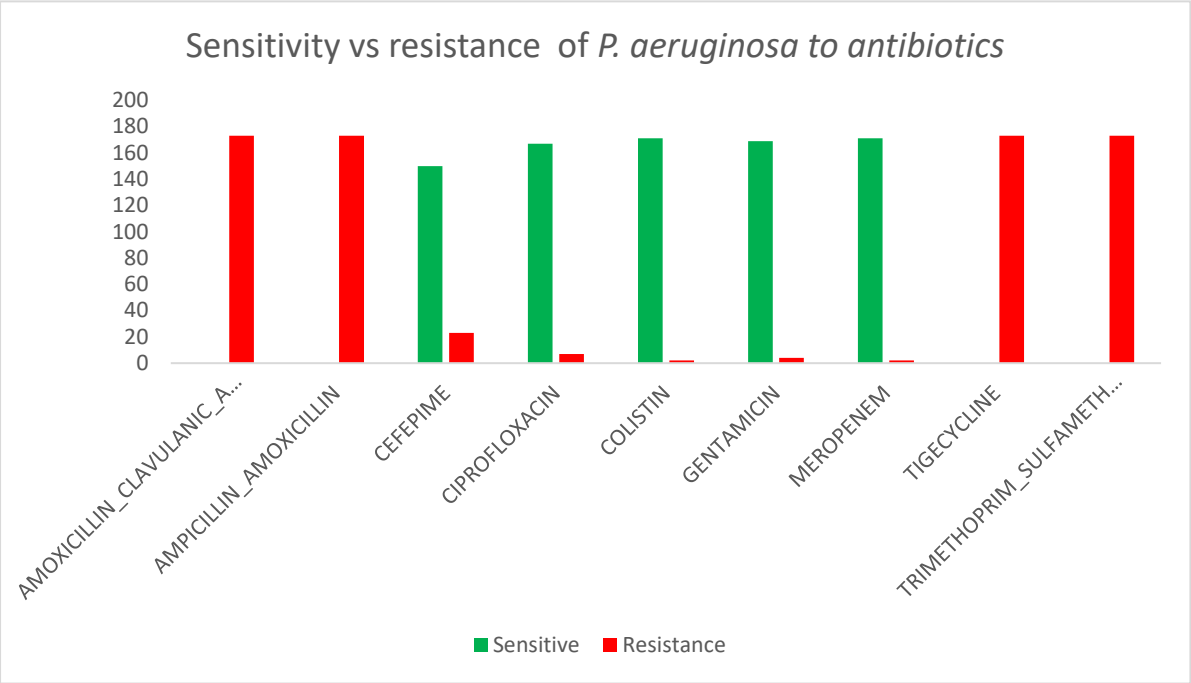
4.3 Characterization of bacterial isolates and antibiotic susceptibility.

The data comprise 100% of wound swab isolates. The common isolates were identified as *K. pneumoniae, E. coli, P. aeruginosa, P. mirabilis and A. baumannii* (Figure 4.1) and their antibiotic susceptibility was determined (Figure 4.3). 99,9% of isolates were gram negative bacteria.

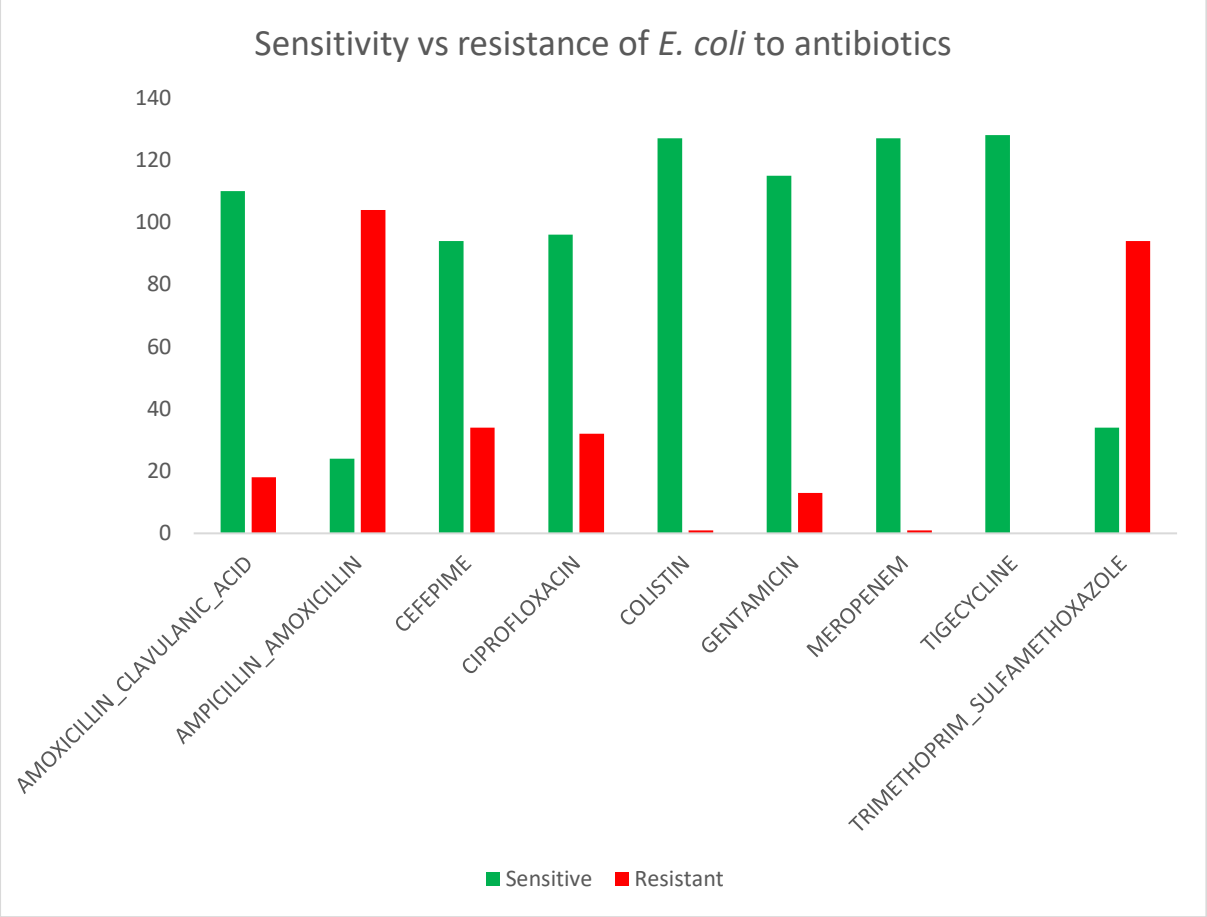
A)



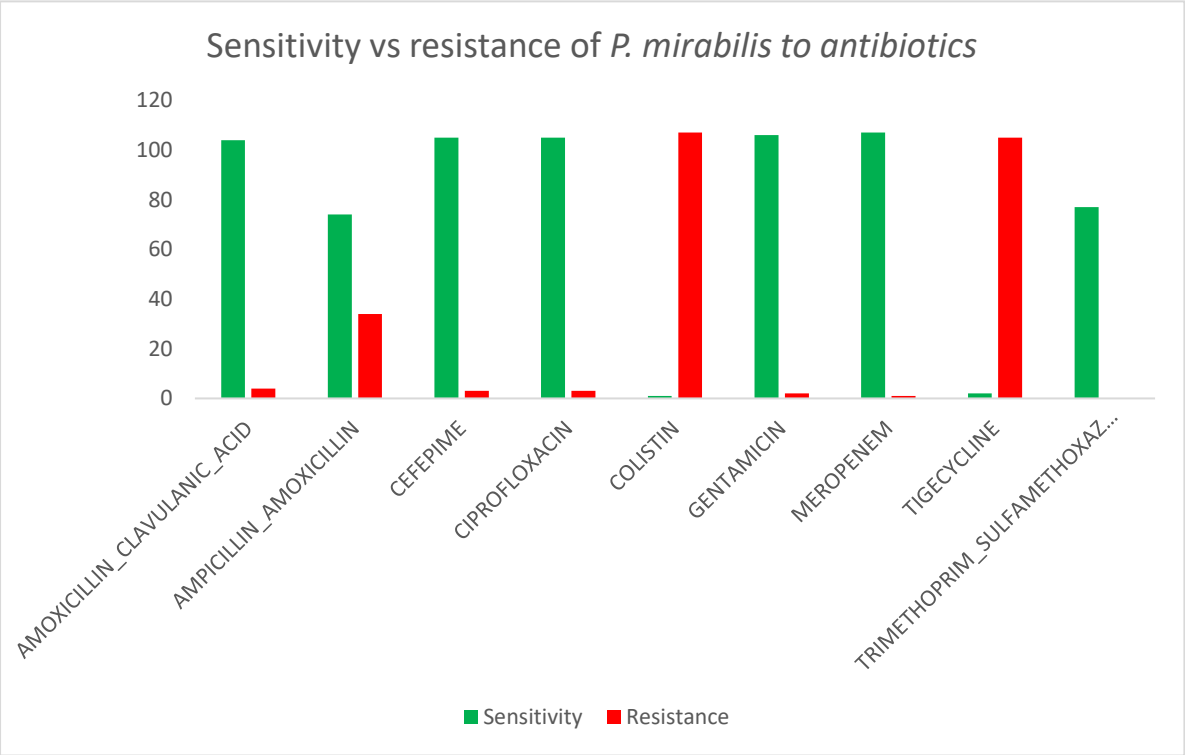
B)


Sensitivity vs resistance of P. aeruginosa to antibiotics
200
180
160
140
120
100
80
60
40
20
0
AMOXICILLIN_CLAVULANIC_A...
AMPICILLIN_AMOXICILLIN
CEFEPIME
CIPROFLOXACIN
COLISTIN
GENTAMICIN
MEROPENEM
TIGECYCLINE
TRIMETHOPRIM_SULFAMETH...
Sensitive
Resistance

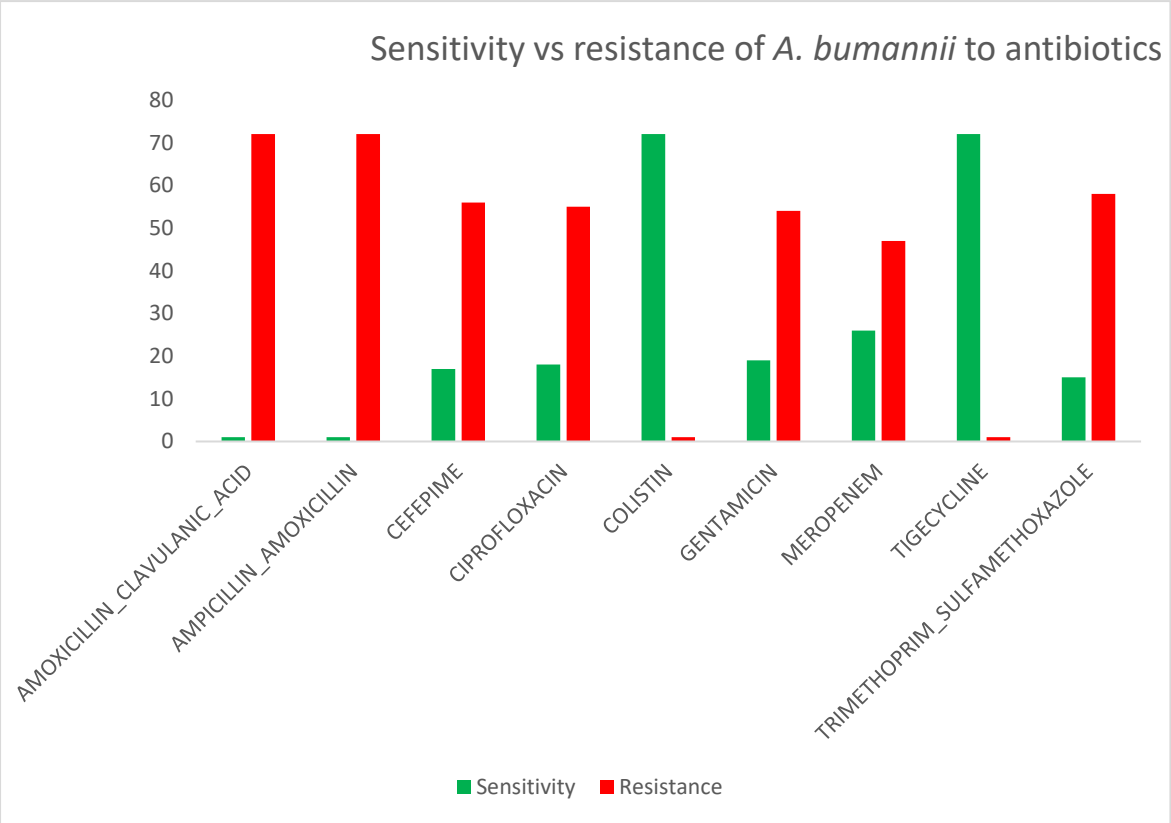
C)


Sensitivity vs resistance of E. coli to antibiotics
140
120
100
80
60
40
20
0
AMOXICILLIN_CLAVULANIC_ACID
AMPICILLIN_AMOXICILLIN
CEFEPIME
CIPROFLOXACIN
COLISTIN
GENTAMICIN
MEROPENEM
TIGECYCLINE
TRIMETHOPRIM_SULFAMETHOXAZOLE
Sensitive
Resistant

D)


Sensitivity vs resistance of P. mirabilis to antibiotics
120
100
80
60
40
20
0
AMOXICILLIN_CLAVULANIC_ACID
AMPICILLIN_AMOXICILLIN
CEFEPIME
CIPROFLOXACIN
COLISTIN
GENTAMICIN
MEROPENEM
TIGECYCLINE
TRIMETHOPRIM_SULFAMETHOXAZ...
Sensitivity
Resistance

E)


Sensitivity vs resistance of A. bumannii to antibiotics
80
70
60
50
40
30
20
10
0
AMOXICILLIN_CLAVULANIC_ACID
AMPICILLIN_AMOXICILLIN
CEFEPIME
CIPROFLOXACIN
COLISTIN
GENTAMICIN
MEROPENEM
TIGECYCLINE
TRIMETHOPRIM_SULFAMETHOXAZOLE
Sensitivity
Resistance

F)

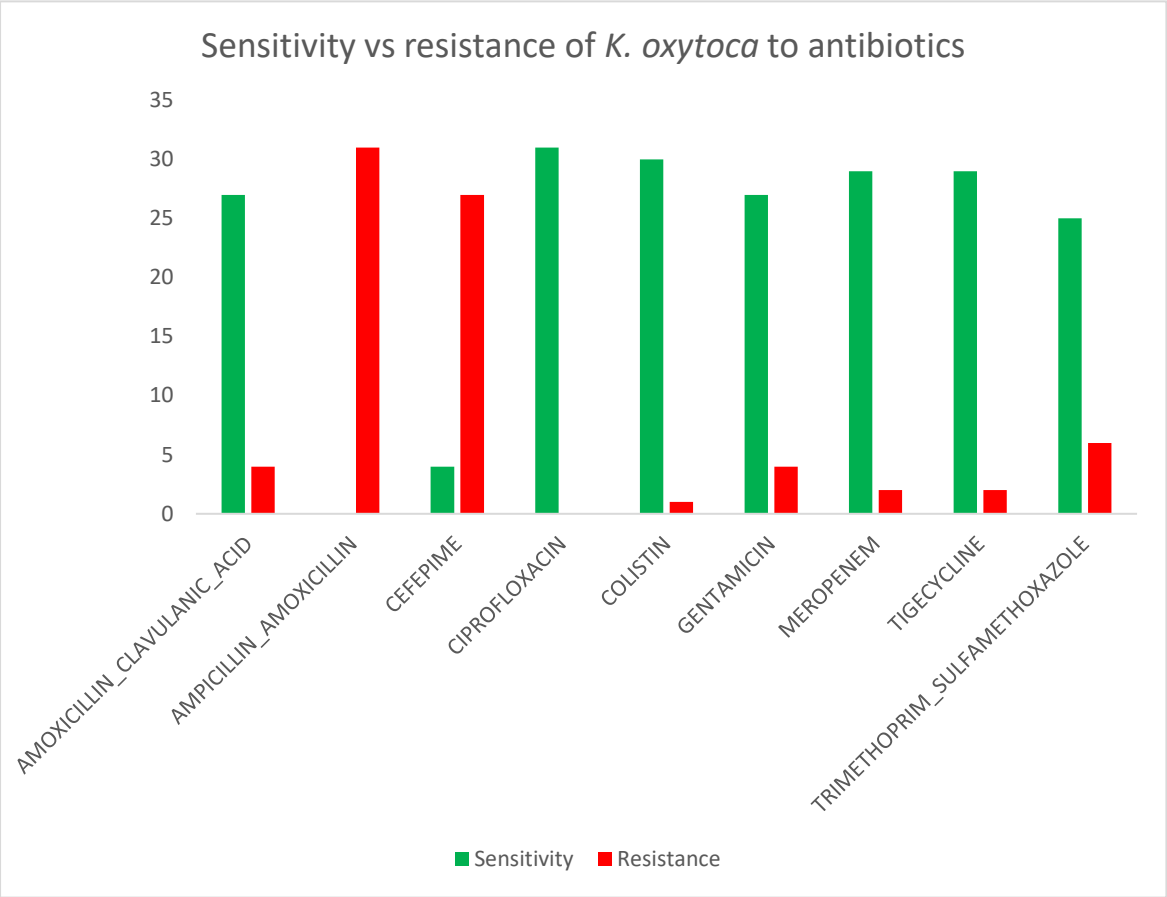


Figure 4.3: Antibiotic susceptibility of *K. pneumoniae (*A)*, P. aeruginosa* (B*), E. coli* (C)*, P. mirabilis* (D), *A. baumannii* (E) and *K. oxytoca* (F) to amoxicillin clavulanic, ampicillin amoxicillin, cefepime, ciprofloxacin, colistin, gentamycin, meropenem, tigecycline and trimethoprim sulfamethoxazole.

Isolates were tested against nine antibiotics with varying degrees of antibiotic classes, namely, Penicillins (ampicillin) Beta lactamase inhibitors (amoxicillin clavulanic acid), cephalosporins(cefepime) quinolones (ciproflixacin) polymyxins (colistin) aminoglycosidess (gentamycin) carbepenems (meropenen) tetracyclines (tigecycline) and sufonamides (trimethoprim sulfamethoxazole).

Klebsiella pneumoniae isolates showed 100% sensitivity to colistin and tigecycline. High levels of resistance to ampicillin clavulanic acid were observed for *K. pneumoniae, A. baumannii, K oxytoca, E. coli, and P. aeruginosa. P. aeruginosa* showed 100% sensitivity to colistin, gentamycin and meropenem. However, 100% resistance to multiple drugs such as amoxicillin ampicillin, ampicillin clavulanic acid, tigecycline and trimethoprim sulfamethoxazole. *K. oxytoca* was the leading isolate with

high levels of sensitivity to multiple antibiotics such as amoxicillin ampicillin, ciprofloxacin, colistin, gentamicin, meropenem, tigecycline and trimethoprim sulfamethoxazole followed by *P. mirabilis* with high levels of sensitivity to amoxicillin clavulanic, amoxicillin ampicillin, ciprofloxacin, gentamycin, meropenem and trimethoprim sulfamethoxazole.

Acinetobacter baumannii was only sensitive to colistin and tigecycline, rendering this isolate as having the least sensitivity. Meropenem has shown high levels of efficacy against 80% of the isolates except in a case of *A. baumannii*. Similar phenomenon was observed in case of colistin which showed effectiveness against 80% of the isolates except in a case of *P. mirabilis.* Tigecycline was observed to have 60% efficacy levels. However, it was not effective against *P. mirabilis and P. aeruginosa.* Ampicillin amoxicillin had the lowest efficacy levels and was only effective against *P. mirabilis.* Similarly, trimethoprim sulfamethoxazole was only effective against *K. oxytoca* and *P. mirabilis.* Overall, isolates showed varying sensitivity levels to antibiotics with significant levels of resistance being observed.

4.4 Association of age and gender with antibiotic susceptibility

Demographics such as age and gender have been associated with the prevalence of bacterial pathogens (Mohammed *et al.,* 2017). Bacterial resistance levels may also be influenced by patient hospital location. There is a risk of obtaining infection by patients admitted into rooms previously occupied by a patient with wound infection by *P. aeruginosa* and *A. baumannii* amongst others (Ghanem & Haddadin, 2018). As such the intention was to understand the impact of age and gender of patients on antibiotic susceptibility. This study used bacterial isolates exposed to nine antibiotics; all isolates were exposed to all the antibiotics. The observation was that *K*. *pneumoniae* had the highest (60.7%) number of isolates from females, resistant to amoxicillin ampicillin (p=0.015) while *P. aeruginosa* and *K. oxytoca* from male patients were resistant to tigecycline (55.5%, p=0.031) and amoxicillin ampicillin (51.6%, 0.042) respectively (Table 4.3 A). Also, presented in Table 4.3 B, most resistant isolates were *K. oxytoca* (39%), mostly isolated at ≤20 and 35-59 years, age groups, *P. aeruginosa* (38%), *E. coli* (38%), isolated at ≤20 and 35-59 years age groups respectively.

Table 4.3. The resistance patterns of some bacteria with respect to gender(A) and age group (B).

A	**Gender**			
Microorganism	**Female %(n)**	**Male %(n)**	**p value**	**Drug**
Klebsiella pneumoniae	60.7(111)	39.3(72)	0.015	Amoxicillin Amplicillin
Pseudomonas aeruginosa	44.5(77)	55.5(96)	0.031	Tigecycline
Escherichia coli	51.1(48)	48,9(64)	0.047	Trimethoprim sulfamathoxazole
Proteus mirabilis	58.9(63)	41.1(44)	0.024	Colistin
Acinetobacter baumannii	56.9(41)	43.1(31)	0.033	Amoxicillin Clavulanic Acid
Klebsiella oxytoca	48.4(15)	51.6(16)	0.042	Amoxicillin Amplicillin

B		**Age**					
Microorganism	n	≤20	**21-34**	35-59	**≥60**	**p value**	**Drug**
Klebsiella pneumoniae	193	28% (55)	28% (54)	28% (55)	9.8% (19)	0.025	Amoxicillin Amplicillin
Pseudomonas aeruginosa	173	38% (66)	28% (50)	23% (40)	9.8% (17)	0.028	Tigecycline
Escherichia coli	94	25% (24)	25% (24)	38% (36)	10% (10)	0.015	Trimethoprim sulfamathoxazole
Proteus mirabilis	108	26% (28)	30% (33)	34% (37)	17% (19)	0.012	Colistin
Acinetobacter baumannii	72	27% (20)	35% (25)	26% (19)	11% (8)	0.018	Amoxicillin Clavulanic Acid
Klebsiella oxytoca	31	39% (12)	19% (6)	39% (12)	3% (1)	0.035	Amoxicillin Amplicillin

Furthermore, the effectiveness of antibiotics with regards to age and gender was thought to be understood (Table 4.4). Chi-square test generally renders age p>0.05

and gender p>0.05 as having no effect on antibiotic susceptibility. The results imply no statistical significance on the effect of these two factors to bacterial resistance. However, p-values lower that 0.05 were observed for ampicillin amoxicillin (p=0.038) and colistin (p= 0.012) with regards to gender and it was also observed that the effectiveness of amoxicillin clavulanic (p=0.044), cefepime (p=0.033) and ciprofloxacin (p=0.015) were affected by age. These p-values lower than 0.05 indicate that there is a significant relation between the two variables.

Table 4.4 The effect of age and gender on antibiotic susceptibility.

Isolates	**Independent factor**	**Dependent factor**	**P value**
Overall	Gender	Amoxicillin clavulanic	0.631
		Ampicillin amoxicillin	0.038
		Cefepime	0.167
		Ciprofloxacin	0.052
		Colistin	0.012
		Gentamicin	0.841
		Meropenem	0.630
		Tigecycline	0.060
		Trimethoprim	0.690
	Age	Amoxicillin clavulanic	0.044
		Ampicillin amoxicillin	0.158
		Cefepime	0.033
		Ciprofloxacin	0.015
		Colistin	0.143
		Gentamicin	0.441
		Meropenem	0.956
		Tigecycline	0.663
		Trimethoprim	0.258

4.5 The antibiotic resistance profiles of bacterial isolates

The overall effects of age and gender of patients on different antibiotics was highlighted in Table 4.4. As such, most resistant isolates were thought to be identified. Most isolated bacterial pathogens were *K. pneumoniae* (184)*, P. aeruginosa* (173)*,* and *E. coli* (128) among other isolates (table 4.2). The low number of isolates being exposed to antibiotics hampered proper identification of most resistant isolates. A vast majority of the isolates were gram-bacterium. Among these, *E coli* showed high levels of susceptibility to all antibiotics except amoxicillin ampicillin and trimethoprim sulfamethoxazole and *P. aeruginosa* as susceptible to all but amoxicillin clavulanic, amoxicillin ampicillin, tigecycline and trimethoprim sulfamethoxazole (Figure 4.3). High potency of Tigecycline was noted across all bacterium except for *P. aeruginosa* and *P. mirabilis.* Resistance patterns of these isolates were also assessed (Table 4.5).

Table 4.5: Antibiotic resistance profiles of mostly isolated bacteria

Microorganisms		**Antibiotic agents**								
	n	**AMC n(%)**	**AMO n(%)**	**CFPM n(%)**	**CIP n(%)**	**COL n(%)**	**GEN n(%)**	**MEM n(%)**	**TG n(%)**	**TPMS n(%)**
Klebsiella pneumoniae	184	120 (65.8)	183 (99.5)	118 (64.1)	49 (26.4)	0 (0)	95 (51.6)	1 (0.5)	0 (0)	118 (64.1)
Pseudomonas aeruginosa	173	173 (100)	173 (100)	23 (13.3)	7 (4.0)	2 (1.2)	4 (2.3)	2 (1.2)	173 (100)	173 (100)
Escherichia coli	128	18 (14.1)	104 (81.3)	34 (26.6)	32 (25.0)	1 (0.8)	13 (10.2)	1 (0.8)	0 (0)	94 (73.4)
Proteus mirabilis	108	4 (3.7)	34 (31.5)	3 (2.8)	3 (2.8)	107 (99.1)	2 (1.9)	1 (0.9)	105 (97.2)	31 (28.7)
Acinetobacter baumannii	73	72 (98.6)	72 (98.6)	56 (76.7)	55 (75.3)	1 (1.4)	54 (74.0)	47 (64.4)	1 (1.4)	58 (79.5)

Klebsiella oxytoca	31	4 (12.9)	31 (100)	4 (12.9)	0 (0)	1 (3.2)	4 (12.9)	2 (6.5)	2 (6.5)	6 (19.4)
Mean %		49.1	85.15	32.7	22.25	17.6	25.4	12.3	46.35	60.85

AMC: Amoxicillin Clavulanic Acid, AMO: Amoxicillin Ampicillin, CFPM: Cefepime, CIP: Ciprofloxacin, COL: Colistin, GEN: Gentamicin, MEM: Meropenem, TG: Tigecycline, TPMS: Trimethoprim Sulfamethoxazole.

High levels of resistance by number of bacteria were noted to panel of antibiotics used. The drugs with less potency as shown in Figure 4.3 were amoxycillin ampicillin (85.15%), trimethoprim sulfamethoxazole (60.85%), amoxicillin clavulanic (49.1%), Tigecycline (46.35%). Amoxicillin ampicillin was less effective with a mean resistance percentage of 85.15%. However, this drug was on average effective against *P. mirabilis.* Notably, trimethoprim sulfamethoxazole had 60.85% mean resistance percentage, but was on average effective against *P. mirabilis.*

Acinetobacter baumannii was highly resistant against amoxicillin ampicillin and amoxicillin clavulanic, *K. pneumoniae* was highly resistant to amoxicillin clavulanic, amoxicillin ampicillin, ciprofloxacin and gentamycin but was sensitive to tigecycline and colistin. *P. aeruginosa* was highly resistant to amoxicillin ampicillin, amoxicillin clavulanic, tigecycline and trimethoprim sulfamethoxazole. However, this organism was sensitive to colistin and meropenem. *E. coli* was highly resistant to amoxicillin ampicillin but sensitive to tigecycline, meropenem and colistin (table 4.5).

This study found *K. pneumoniae, P. aeruginosa, E coli, A. baumannii, K. oxytoca* and *P. mirabilis* as common isolates (Table 4.2). All isolates showed resistance to at least one drug but commonly resistant to amoxicillin ampicillin and amoxicillin clavulanic.

CHAPTER 5

5.1 DISCUSSION

Recently, there has been a global effort initiated in clinical settings to combat antibiotic resistance. This is because of the notable effects that this dilemma weighs over the health care system such as increased health care costs, morbidity and mortality. This is because of overuse/misuse of antibiotics owing to misdiagnosis and irrational use. Also, several over-the-counter antibiotics have led to the risk of developing drug resistance. Consequently, thorough investigations of the emergence of the resistant isolates need to be extensively conducted to determine what other factors can be associated with this concern to modify the preventative and therapeutic strategies against the resistant strains leading to the stall of wound healing, which could aid in empiric treatment.

In pursuit to understand antibiotic resistance, the current retrospective analysis was undertaken to investigate the antibiotic susceptibility patterns of wound isolates from patients at the Pietersburg and Mankweng hospitals from 2016-2020. Although this study did not associate type of wound and type of microorganism isolated, it is important to note that all isolates were from different wounds and yielded significant bacterial growth. However, there are studies in Nigeria which associated specific microorganisms with wound types (Mohammed *et al.,* 2013 & Ibrahim *et al.,* 2018).

In this study, the highest number of bacterial isolates were from patients under 20 years. This has a good correlation with the study by Bessa *et al*., (2015) in which 24.54% of patients belonged to 10-20 years. This finding is possibly because of accidental injuries and social activities. However, this finding is in discordance with those of the study by Datta *et al.,* where in 33% of patients were 21-30 years (Datta *et al.,* 2016). The majority (53.3%) of the patients were females. A study by Bessa *et al.,* (2015) noted a similar sex predominance.

The predominant bacteria isolated was 99% gram-negatives, with *K. pneumoniae* (23%)*, P. aeruginosa* (21.7%)*, E. coli* (16%)*, P. mirabilis* (13.5%)*, A. baumannii* (9.1%) and *K. oxytoca* (3.8%). A similar finding was reported in the Trojan, Razdan, and Singh study (2016) where *K. pneumonia, P. aeruginosa, E. coli, P. mirabilis* and *A. baumanni* were the predominant isolates. The predominance of gram-negative bacilli was similar

to that of Mohammed *et al*., (2013). Infection by gram-negative bacilli is usually associated with surgical site infections. In most cases, surgical site infections are caused by patients' endogenous flora especially in abdominal surgeries where the opening of gastrointestinal tract increases the possibility of coliforms and gram-negative bacilli as agents of wound infections (Mohammed *et. al.,* 2013). These groups of organisms may be endemic in hospital environment therefore being easily transferred from object to object and are usually resistant to common antiseptics (Mohammed *et al.,* 2013)

The observation of *K. pneumoniae* as the most common isolated pathogen in wound infections has a significant concurrence with a study conducted in Iran (Ghanavati *et al.,* 2021). This finding contradicts Sawdeker's study where *S. aureus* (46.2%) was the most frequent isolated followed by gram negative streptococci (23.1%) and gram-negative pseudomonas (15.4%) (Sawdekar *et al.,* 2015). The high prevalence of *S. aureus* may be owing to the contamination from environment as an endogenous source of infection. This is evidence that local and regional variability exists and each facility should determine its own prevalent wound pathogens.

The findings of this study concur with those of a study in Turkey where they reported high percentage of isolates in *P. aeruginosa* (57%) and *A. baumannii* (21%) (Oncul *et al.,* 2009). According to Dryden (2009), *S. aureus,* is the major cause of soft tissue infections, although several other reports implicate *P. aeruginosa, E. coli* and *K. pneumoniae* in wound infections (Dryden *et al.,* 2009, Misic *et al.,* 2014). These variations are expected because of different disinfection protocols and antimicrobial therapy protocols, which may favour the survival of some pathogens over others (Elmanama *et al.,* 2013).

Antibiogram results revealed antimicrobial sensitivity of members of the enterobacteriaceae *K. pneumoniae* to colistin (100%) and tigecycline (100%), and *E. coli* to tigecycline (100%). Other gram-negative bacteria showed levels of resistance to the antibiotics. Antimicrobial resistance for gram-negative bacteria causing wound infections ranged from 0.5 to 100%.

Antimicrobial resistance patterns of *P. aeruginosa* isolates were recovered from patients as follows: amoxicillin ampicillin (100%), amoxicillin clavulanic acid (100%), both tigecycline (100%) and trimethoprim sulfamethoxazole (100%). Resistance of *A.*

baumannii were also observed as: 98.6% for both amoxicillin ampicillin and amoxicillin clavulanic, trimethoprim sulfamethoxazole (79.5%), cefepime (76.7%), ciprofloxacin (75.3%), gentamycin (74.0%) and meropenem (64.4%). In addition, *K. pneumoniae* was among the isolates with concerning resistance patterns: amoxicillin ampicillin (99.5%), amoxicillin clavulanic acid (65.8%) and 64.1% for both cefepime and trimethoprim sulfamethoxazole. In contrast, the high isolation of these organisms agrees with a study by Sharma *et al.,* 2015 which reported high isolation of *A. baumannii* (58.8%). This indicates the emergence this organism as a multi-drug resistant wound pathogen. The study further showed that 61% of *A. baumannii* are carbapenemase producers, meaning they were resistant to carbapenem antibiotics. This important finding may be the explanation to the 64% of *A, baumannii* isolates which were resistant to meropenem – a carbapenem antibiotic in this study.

A study conducted by Akinniyi *et al.,* (2012) reported that 66% of carbapenemase producing isolates were Pseudomonas and Klebsiella species. This study was in contrast with their finding because *P. aeruginosa* (1.2%), *K. pneumoniae* (0.5%) and *K. oxytoca* (6.5%) in this study had lower levels of resistance to meropemen. As such the majority of these isolates were not carbapenemase producers. These isolates are considered MDR as they are resistant to more than three antimicrobial agents (Chanda *et al.,* 2019). These isolates have total resistance to four antibiotics, which result from overuse or misuse of antimicrobial agents leading to the acquisition of resistance genes. However, this should be confirmed using molecular techniques. MDR *P. aeruginosa* was also reported in previous studies (Oncul *et al,* 2009 & Elmanama *et al.,* 2013).

The aforementioned study conducted in Iran showed that 80/102 (78.4%) and 51/102 (50%) *K. pneumoniae* isolates had ESBL and carbapenemase resistant genes which according the study are responsible for the development of resistance against beta lactamases and carbapenems (Ghanavati *et al.,* 2021). The beta lactams antibiotics assessed in the current study are penicillins (amoxicillin ampicillin, amoxicillin clavulanic) Cephalosporins (cefepime) and Carbapenems (Meropenem). Notably, the *K. pnuemoniae* isolates in this study showed high levels of resistance to amoxicillin ampicillin (65.8%), amoxicillin ampicillin (99.5%), and cefepime (64.1%). These high levels of resistance to these antibiotics by *K. pneumoniae* may, in correlation with

Ghanavati *et al* (2021), signify that the isolates were ESBL and carbapenemase resistance conferring.

It is not surprising that *E. coli* was among the frequently isolated microorganisms as it has also been reported in many other studies (Trojan *et al.,* 2016; Mohammed *et al.,* 2013; Ibrahim *et al.,* 2018). *E. coli* has also been reported to be resistant to antimicrobials such as cephalosporins, amoxicillin clavulanic acid, imipenem, gentamycin, and meropenem (Trojan *et al.,* 2016). However, these findings contradict the results of the current study as it reveals *E. coli* to be highly sensitive to gentamycin and meropenem while being least resistant to fourth generation cephalosporin and amoxicillin clavulanic acid. Furthermore, 51.6% of the resistant bacterial isolates were from males at ≤20 and 35-59-years age groups. The overall observation is that there is a minor difference of 3.2% between resistant isolates isolated from males (51.6%) and females (48.4%) and therefore do not represent clinically meaningful differences. These findings concur with those of McGregor *et al* (2013) which also revealed minor differences in drug susceptibility between males and females (McGregor *et al.,* 2013).

However, a notable observation was that *K*. *pneumoniae* had the highest (60.7%) number of isolates from females, resistant to amoxicillin ampicillin (p=0.015) while *P. aeruginosa* and *K. oxytoca* from male patients were resistant to tigecycline (55.5%, p=0.031) and amoxicillin ampicillin (51.6%, 0.042) respectively. A statistically significant difference was noted in a case of gender analysis with overall bacterial isolates for amoxicillin ampicillin at p=0.038 and in case of age for amoxicillin clavulanic acid and Ciprofloxacin for overall bacterial isolates at p=0.044 and p=0.015 respectively. These may indicate an existing relationship of these three drugs to factors such as age and sex and may necessitate further research as the current study could not find any meaningful statistically difference.

Additionally, antibiotics susceptibilities and associated demographic factors may differ by other patients and their geographic locations and therefore, further research is needed in other parts of South Africa. Currently, there is insufficient data to guide the effect of age and gender on drug susceptibility to aid empiric treatment. Consequently, in this study population, there is no significant evidence that age and gender may indicate empiric treatment selection.

5.2 CONCLUSION

The study showed that *K. pneumoniae, P. aeruginosa, E. coli, P. mirabilis, A. baumannii,* and *K. oxytoca* are the major pathogens found in wound infections at Pietersburg and Mankweng Hospitals. Generally, the most effective antibiotics were gentamycin, meropenem, ciprofloxacin, and cefepime. The bacterial isolates were generally resistant to amoxicillin ampicillin, amoxicillin clavulanic acid and trimethoprim sulfamethoxazole. The resistance to carbapenems was thought to be influenced by carbapenamase and ESBL.

Although the general view of the study is that no statistically clinical significance was noted on the effect of age and gender on bacterial resistance, it is important to note the significant observation that there was observed relation of age to amoxicillin clavulanic acid and Ciprofloxacin and gender to amoxicillin ampicillin. The susceptibility data from this study may be worth consideration while implementing empiric treatment strategies.

5.3 STRENGTHS AND LIMITATIONS OF THE STUDY

The present study is the first in Limpopo Province to investigate the association of demographic factors to antibacterial resistance. It therefore serves as a foundation for future studies investigating the association of more demographic factors to antibacterial resistance. The study did not have any limitations.

5.4 RECOMMENDATIONS

The study recommends that surveillance programmes be implemented to help identify prevalent resistant pathogens which will aid in managing patient care in clinical settings. Furthermore, the study argues against the use of antibiotics which are prone to resistance as identified by this study and as such calls for the revision of MICs and CCs of less effective antibiotics such as amoxicillin ampicillin for safe use. Overtime change of antibiotics is essential for management of wound infections. The study further advocates a rational use of antibiotics rather than empirical administration of antibiotics without prior susceptibility testing.

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APPENDICES

Appendix 1: RESEARCHER CONFIDENTIALITY FORM

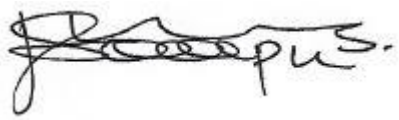
RESEARCH PROJECT CONFIDENTIALITY FORM AT THE UNIVERSITY OF LIMPOPO

Turfloop Campus

RESEARCHER CONFIDENTIALITY FORM

Statement by Researcher.

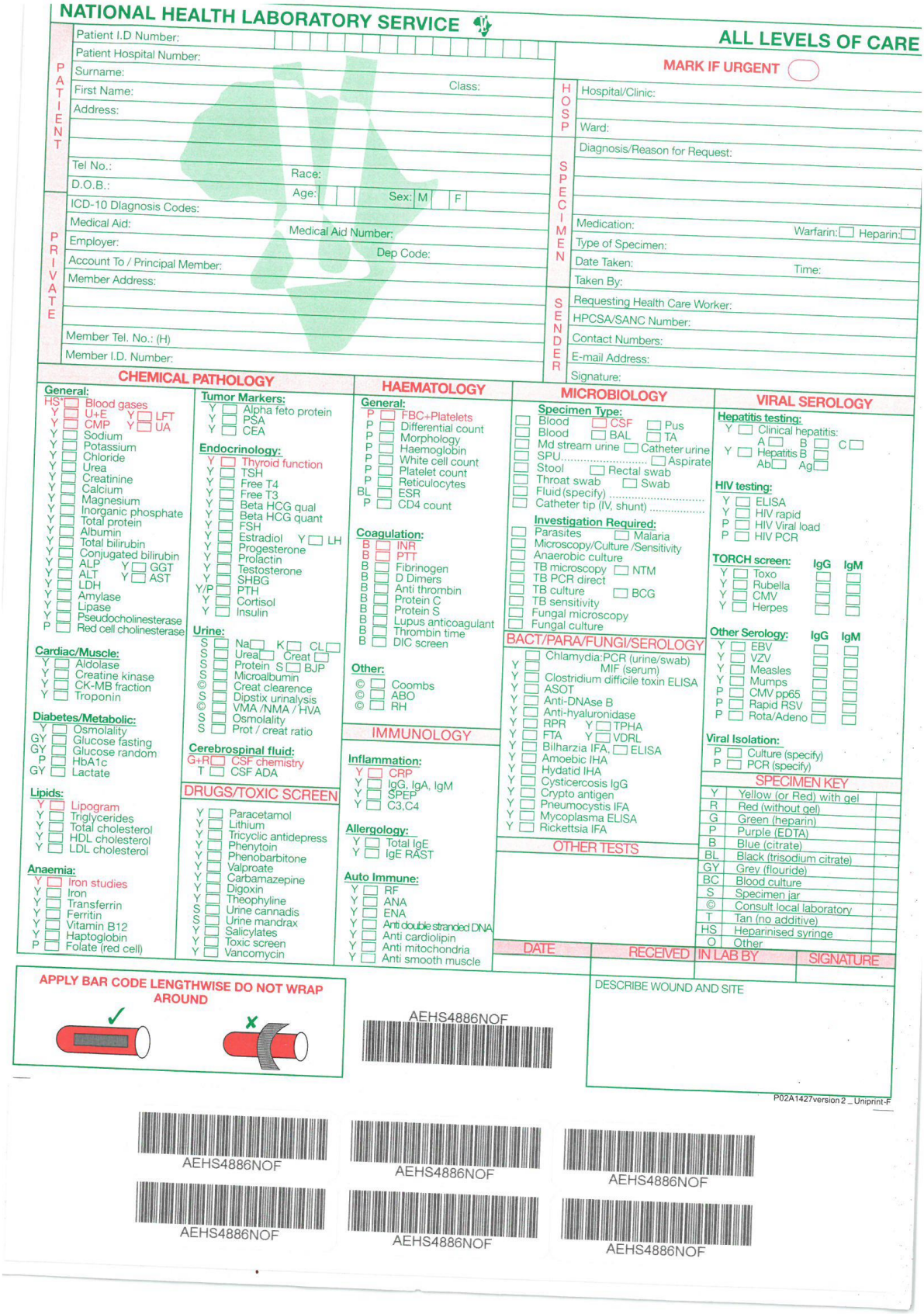
I, Kaapu Kabelo Gabriel, here by declare that the patient information in this study will not be shared with non-members of the research project and will solely be used for the research project.



……..

Mr KG Kaapu

Appendix 2: NHLS REQUEST FORM



NATIONAL HEALTH LABORATORY SERVICE

ALL LEVELS OF CARE

MARK IF URGENT

PATIENT

Patient I.D Number:
Patient Hospital Number:
Surname:
First Name: Class:
Address:
Tel No.: Race:
D.O.B.: Age: Sex: M F

PRIVATE

ICD-10 Diagnosis Codes:
Medical Aid: Medical Aid Number:
Employer: Dep Code:
Account To / Principal Member:
Member Address:
Member Tel. No.: (H)
Member I.D. Number:

HOSP

Hospital/Clinic:
Ward:
Diagnosis/Reason for Request:

SPECIMEN

Medication: Warfarin: Heparin:
Type of Specimen:
Date Taken: Time:
Taken By:

SENDER

Requesting Health Care Worker:
HPCSA/SANC Number:
Contact Numbers:
E-mail Address:
Signature:

CHEMICAL PATHOLOGY

General:
HS* Blood gases
Y U+E Y LFT
Y CMP Y UA
Y Sodium
Y Potassium
Y Chloride
Y Urea
Y Creatinine
Y Calcium
Y Magnesium
Y Inorganic phosphate
Y Total protein
Y Albumin
Y Total bilirubin
Y Conjugated bilirubin
Y ALP Y GGT
Y ALT Y AST
Y LDH
Y Amylase
Y Lipase
Y Pseudocholinesterase
P Red cell cholinesterase

Cardiac/Muscle:
Y Aldolase
Y Creatine kinase
Y CK-MB fraction
Y Troponin

Diabetes/Metabolic:
Y Osmolality
GY Glucose fasting
GY Glucose random
P HbA1c
GY Lactate

Lipids:
Y Lipogram
Y Triglycerides
Y Total cholesterol
Y HDL cholesterol
Y LDL cholesterol

Anaemia:
Y Iron studies
Y Iron
Y Transferrin
Y Ferritin
Y Vitamin B12
Y Haptoglobin
P Folate (red cell)

Tumor Markers:
Y Alpha feto protein
Y PSA
Y CEA

Endocrinology:
Y Thyroid function
Y TSH
Y Free T4
Y Free T3
Y Beta HCG qual
Y Beta HCG quant
Y FSH
Y Estradiol Y LH
Y Progesterone
Y Prolactin
Y Testosterone
Y SHBG
Y/P PTH
Y Cortisol
Y Insulin

Urine:
S Na K CL
S Urea Creat
S Protein S BJP
S Microalbumin
© Creat clearence
S Dipstix urinalysis
© VMA /NMA / HVA
S Osmolality
S Prot / creat ratio

Cerebrospinal fluid:
G+R CSF chemistry
T CSF ADA

DRUGS/TOXIC SCREEN
Y Paracetamol
Y Lithium
Y Tricyclic antidepress
Y Phenytoin
Y Phenobarbitone
Y Valproate
Y Carbamazepine
Y Digoxin
Y Theophyline
S Urine cannadis
S Urine mandrax
Y Salicylates
Y Toxic screen
Y Vancomycin

HAEMATOLOGY

General:
P FBC+Platelets
P Differential count
P Morphology
P Haemoglobin
P White cell count
P Platelet count
P Reticulocytes
BL ESR
P CD4 count

Coagulation:
B INR
B PTT
B Fibrinogen
B D Dimers
B Anti thrombin
B Protein C
B Protein S
B Lupus anticoagulant
B Thrombin time
B DIC screen

Other:
© Coombs
© ABO
© RH

IMMUNOLOGY

Inflammation:
Y CRP
Y IgG, IgA, IgM
Y SPEP
Y C3,C4

Allergology:
Y Total IgE
Y IgE RAST

Auto Immune:
Y RF
Y ANA
Y ENA
Y Anti double stranded DNA
Y Anti cardiolipin
Y Anti mitochondria
Y Anti smooth muscle

MICROBIOLOGY

Specimen Type:
Blood CSF Pus
Blood BAL TA
Md stream urine Catheter urine
SPU..... Aspirate
Stool Rectal swab
Throat swab Swab
Fluid (specify) .....
Catheter tip (IV, shunt) .....

Investigation Required:
Parasites Malaria
Microscopy/Culture /Sensitivity
Anaerobic culture
TB microscopy NTM
TB PCR direct
TB culture BCG
TB sensitivity
Fungal microscopy
Fungal culture

BACT/PARA/FUNGI/SEROLOGY
Chlamydia:PCR (urine/swab)
MIF (serum)
Y Clostridium difficile toxin ELISA
Y ASOT
Y Anti-DNAse B
Y Anti-hyaluronidase
Y RPR Y TPHA
Y FTA Y VDRL
Y Bilharzia IFA, ELISA
Y Amoebic IHA
Y Hydatid IHA
Y Cysticercosis IgG
Y Crypto antigen
Y Pneumocystis IFA
Y Mycoplasma ELISA
Y Rickettsia IFA

OTHER TESTS

VIRAL SEROLOGY

Hepatitis testing:
Y Clinical hepatitis:
A B C
Y Hepatitis B
Ab Ag

HIV testing:
Y ELISA
Y HIV rapid
P HIV Viral load
P HIV PCR

TORCH screen: IgG IgM
Y Toxo
Y Rubella
Y CMV
Y Herpes

Other Serology: IgG IgM
Y EBV
Y VZV
Y Measles
Y Mumps
P CMV pp65
P Rapid RSV
P Rota/Adeno

Viral Isolation:
P Culture (specify)
P PCR (specify)

SPECIMEN KEY

Y	Yellow (or Red) with gel
R	Red (without gel)
G	Green (heparin)
P	Purple (EDTA)
B	Blue (citrate)
BL	Black (trisodium citrate)
GY	Grey (flouride)
BC	Blood culture
S	Specimen jar
©	Consult local laboratory
T	Tan (no additive)
HS	Heparinised syringe
O	Other

DATE | RECEIVED | IN LAB BY | SIGNATURE

APPLY BAR CODE LENGTHWISE DO NOT WRAP AROUND

AEHS4886NOF

DESCRIBE WOUND AND SITE

P02A1427version2 _ Uniprint-F

AEHS4886NOF AEHS4886NOF AEHS4886NOF

AEHS4886NOF AEHS4886NOF AEHS4886NOF

NATIONAL HEALTH LABORATORY SERVICE

ALL LEVELS OF CARE

PATIENT

Patient I.D Number:

Patient Hospital Number:

Surname: Class:

First Name:

Address:

Tel No.: Race:

D.O.B.: Age: Sex: M F

PRIVATE

ICD-10 Diagnosis Codes:

Medical Aid: Medical Aid Number:

Employer: Dep Code:

Account To / Principal Member:

Member Address:

Member Tel. No.: (H)

Member I.D. Number:

MARK IF URGENT

HOSP

Hospital/Clinic:

Ward:

SPECIMEN

Diagnosis/Reason for Request:

Medication: Warfarin: Heparin:

Type of Specimen:

Date Taken: Time:

Taken By:

SENDER

Requesting Health Care Worker:

HPCSA/SANC Number:

Contact Numbers:

E-mail Address:

Signature:

SPECIMEN FOR: HISTOPATHOLOGY

CYTOPATHOLOGY:

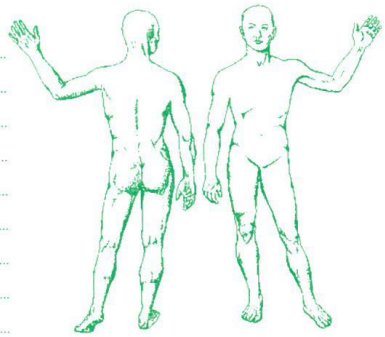
GYNAECOLOGICAL

NON - GYNAECOLOGICAL

URGENT

Type/Origin of Specimen (specify) .....

RELEVANT CLINICAL INFORMATION (eg. symptoms, abnormalities, clinical diagnosis)



IS THIS THE FIRST SPECIMEN? YES / NO: .....

PREVIOUS CYTO. REF. NUMBERS: .....

PREVIOUS HISTO. REF. NUMBERS: .....

PREVIOUS SURGERY, CHEMOTHERAPY, RADIOTHERAOY (DATES): .....

APPEARANCE OF CERVIX

FOR FEMALE PATIENTS:

LMP. ..... PARITY. ..... PREGNANT ..... WKS. POSTMENOPAUSAL ..... YEARS

PLEASE COMPLETE FOR GYNAECOLOGICAL CYTOPATHOLOGY

SMEAR TAKEN BY:

WOODEN SPATULA CERVIX BRUSH

CERVIX BROOM OTHER (Specify)

SPECIMEN TAKEN FROM

CERVIX ..... ENDOCERVIX ..... VAGINA ..... VULVA ..... ENDOMETRIUM .....

LATERAL VAGINAL WALL (FOR HORMONAL ASSESSMENT) ..... VAULT .....

APPEARANCE OF CERVIX

NORMAL ..... EROSION ..... INFLAMED ..... POLYP ..... SUSPICIOUS ..... MALIGNANT .....

Appendix 3: DATA EXTRACTION REQUEST FORM

NATIONAL HEALTH LABORATORY SERVICE HELPDESK

Tel: (011) 386-6125/6/7/9 Fax: (011) 386-6308 email: helpdesk1@nhls.ac.za

APPLICATION FOR DATA FROM NHLS INFORMATION SYSTEMS (Q-Pulse FMI0069)

Each application will be approved or rejected subject to the ability to extract this data and the availability of the data, and subject to the intended usage of the requested data. Applications that are incomplete and/or do not contain supporting documentation, will be rejected.

APPLICANT'S DETAILS

Applicant Name	KG KAAPU	Tel No	0763488253	Email	Kabelogabriel34@gmail.com
Business Role / Designation			MASTERS' STUDENT (MEDICAL SCIENCES)		
Laboratory / Department / Branch / Region (Internal applicants)			N/A		
Organisation (External applicants)			University of Limpopo		
Supervisor Name	NTC MAGUGA	Tel No	0823937957	Email	tibello.maguga@ul.ac.za
Supervisor Designation	RESEARCHER AND SENIOR LECTURER – MEDICAL MICROBIOLOGY				

CONDITIONS

- Data / Information is not to be used in contravention of Sections 14, 15, 16 and 17 of the National Health Act 61 of 2004 and the Promotions of Access to Information Act 2 of 2000.
- The applicant undertakes to ensure that the data supplied to it by the NHLS is used ethically and solely for the purposes for which it is provided as detailed in this application, and further acknowledges that it shall remain liable for any breaches of this clause by the end user.
- If the purpose for the data requested in this application is research or if patient identity linked data is required, ethics approval and a one page summary of the protocol shall be attached to this application form. It is the responsibility of the applicant to ensure that their institutions' Human Ethics approval includes explicit authorisation to access the requested NHLS data.
- The applicant undertakes to store the NHLS data in a confidential manner by separating patient identifying details from laboratory data and storing the master list that links patient identifying details to study patient identifiers in a separate, secure location.
- The information is for the private use of the applicant only, unless further approval is obtained from the NHLS. In the event of this, the applicant shall give due credit, including affiliation, of the participation of the NHLS in any such publications or presentations.
- The applicant undertakes to provide the Executive Manager: Academic Affairs, Research and Quality Assurance at the NHLS with a copy of any report, presentation or publication emanating from the use of this data.

ACCEPTANCE OF CONDITIONS

By signing this document we accept the conditions stated above.			
Applicant Signature	TO BE SIGNED AFTER RECEIVING ETHICAL CLEARANCE	Date	-------
Supervisor Signature	TO BE SIGNED AFTER RECEIVING ETHICAL CLEARANCE	Date	-------

NATIONAL HEALTH LABORATORY SERVICE HELPDESK
Tel: (011) 386-6125/6/7/9 Fax: (011) 386-6308 email: helpdesk1@nhls.ac.za

APPLICATION FOR DATA FROM NHLS INFORMATION SYSTEMS (Q-Pulse FMI0069)

All fields in this section must be completed

DATA REQUEST DETAILS

Request Type (Tick)	New√ ☐ Modify	Data Format (Tick)	☐ Excel√ CSV	Data Delivery (Tick)	CD / DVD ☐ Email√
Frequency of Extract (Tick)	Once√ ☐ Repeat	If Repeat, specify frequency	☐ Daily ☐ Weekly		☐ Monthly ☐ Annually

DESCRIPTION OF REQUIRED DATA EXTRACT	
Data required	AGE, GENDER, HOSPITAL WARD, WOUND TYPE, MICROORGANISM ISOLATED, TREATMENT RECOMMENDED AND SUSCEPTIBILITY RESULTS OF PATIENTS OF PATIENTS FROM PIETERSBURG AND MANKWENG HOSPITALS
Region (for data extract, e.g. Province or Laboratory	LABORATORY
Date range of extract	MINIMUM OF 626 RECORDS FROM 2019-2015 RECORDS EXTRACTED SHOULD BE OF PATIENTS WHO WERE ADMITTED AT MANKWENG AND PIETERSBURG HOSPITALS WITH A MINIMUM OF 313 RECORDS PER HOSPITAL.
Fields required (e.g. Patient name, Date of Birth, etc)	GENDER, AGE, HOSPITAL WARD, WOUND TYPE MICROORGANISM FROM WOUND, TREATMENT, AND SUSCEPTIBILITY RESULTS

DESCRIPTION OF INTENDED USE OF DATA EXTRACT (e.g. research, epidemiology study, cost analysis of service, drug effectiveness, disease surveillance)
RESEARCH
LIST WHO WILL HAVE ACCESS TO THIS DATA
KG KAAPU (RESEARCHER) & NTC MAGUGA (SUPERVISOR)
PROJECT NAME AND REGISTRATION NUMBER (If data is required for a registered research project. Please attach the Ethics Approval.)
ETHICS APPROVAL ATTACHED

NHLS RESPONSIBILITIES

The NHLS will:

- Ascertain if it is possible to extract the required data.
- Register the application and issue a registration number.
- Only release the requested data to the applicant whose name is specified on this application form.

After this application has been completed and approved, please raise a service request with the NHLS IT Service Desk (Contact Number: (011) 386-6125/6/7/9):

NATIONAL HEALTH LABORATORY SERVICE HELPDESK

Tel: (011) 386-6125/6/7/9 Fax: (011) 386-6306 email: helpdesk1@nhls.ac.za

APPLICATION FOR DATA FROM NHLS INFORMATION SYSTEMS (Q-Pulse FMI0069)

APPROVAL BY BUSINESS (Approval will be obtained by the CDW Manager)					
INFORMATION MANAGEMENT UNIT APPROVAL (required for external requests and patient identifying data)					
Check list for external applicants	☐ Signed by Supervisor ☐ Ethics Approval attached, if applicable				
Executive Manager: Academic Affairs, Research and Quality Assurance		Signature		Date	/ /20
CEO APPROVAL (required for sensitive data requests)					
Chief Executive Officer		Signature		Date	/ /20
APPROVAL BY IT					
CDW Manager		Signature		Date	/ /20
REQUEST TRACKING					
Service Request Number					
Request Commence Date	/ /20				

Appendix 4: DEPARTMENT OF HEALTH APPROVAL

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

Department of Health

Ref : LP_2021-07-004
Enquires : Ms PF Mahlokwane
Tel : 015-293 6028
Email : Phoebe.Mahlokwane@dhsd.limpopo.gov.za

Kabelo Kaapu

PERMISSION TO CONDUCT RESEARCH IN DEPARTMENTAL FACILITIES

Your Study Topic as Indicated below;

An investigation of the antimicrobial patterns and associated demographic determinants in bacteria isolated from patients with non-healing wounds at the Pietersburg and Mankweng hospitals, Limpopo province

1. Permission to conduct research study as per your research proposal is hereby Granted.
2. Kindly note the following:
    a. Present this letter of permission to the institution supervisor/s a week before the study is conducted.
    b. In the course of your study, there should be no action that disrupts the routine services, or incur any cost on the Department.
    c. After completion of study, it is mandatory that the findings should be submitted to the Department to serve as a resource.
    d. The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.
    e. The approval is only valid for a 1-year period.
    f. If the proposal has been amended, a new approval should be sought from the Department of Health
    g. Kindly note that, the Department can withdraw the approval at any time.

Your cooperation will be highly appreciated

PP **Head of Department** 15/07/2021 **Date**

NB: Currently access is restricted to our facilities due to COVID-19, therefore this approval is applicable within our COVID-19 policies and circulars

Appendix 5: WOUND SWABS LABORATORY PROCEDURE

Procedure

A. Processing of Specimens:

a) Direct Examination: Gram stain - Quantitate the presence of pus cells, squamous epithelial cells, and organisms. - Not required for exit site swabs.

b) Culture: Media Incubation Blood Agar (BA) MacConkey Agar (MAC) Colistin Nalidixic Acid Agar (CNA) CO2, 35°C x 48 hours.

B. Interpretation of Cultures:

Examine the plates after 24- and 48-hours incubation. Any growth of S. aureus, group B streptococcus from neonates, beta-haemolytic streptococcus groups A, C and G and Pseudomonas aeruginosa is significant. For chest tube drainage and tracheal swabs, any growth of H. influenzae and S. pneumoniae is also significant. A heavy, pure growth of other organisms that correlates with the predominant organism seen in the Gram stain is significant if there is >1+ pus cells (not for exit sites). If a specific organism is requested, then it will be looked for and its presence or absence reported. Growth of ≥ 3 types of coliforms or other Gram-negative bacilli will be reported as a negative report stating commensal flora including mixed Gram-negative bacilli.

C. Susceptibility Testing:

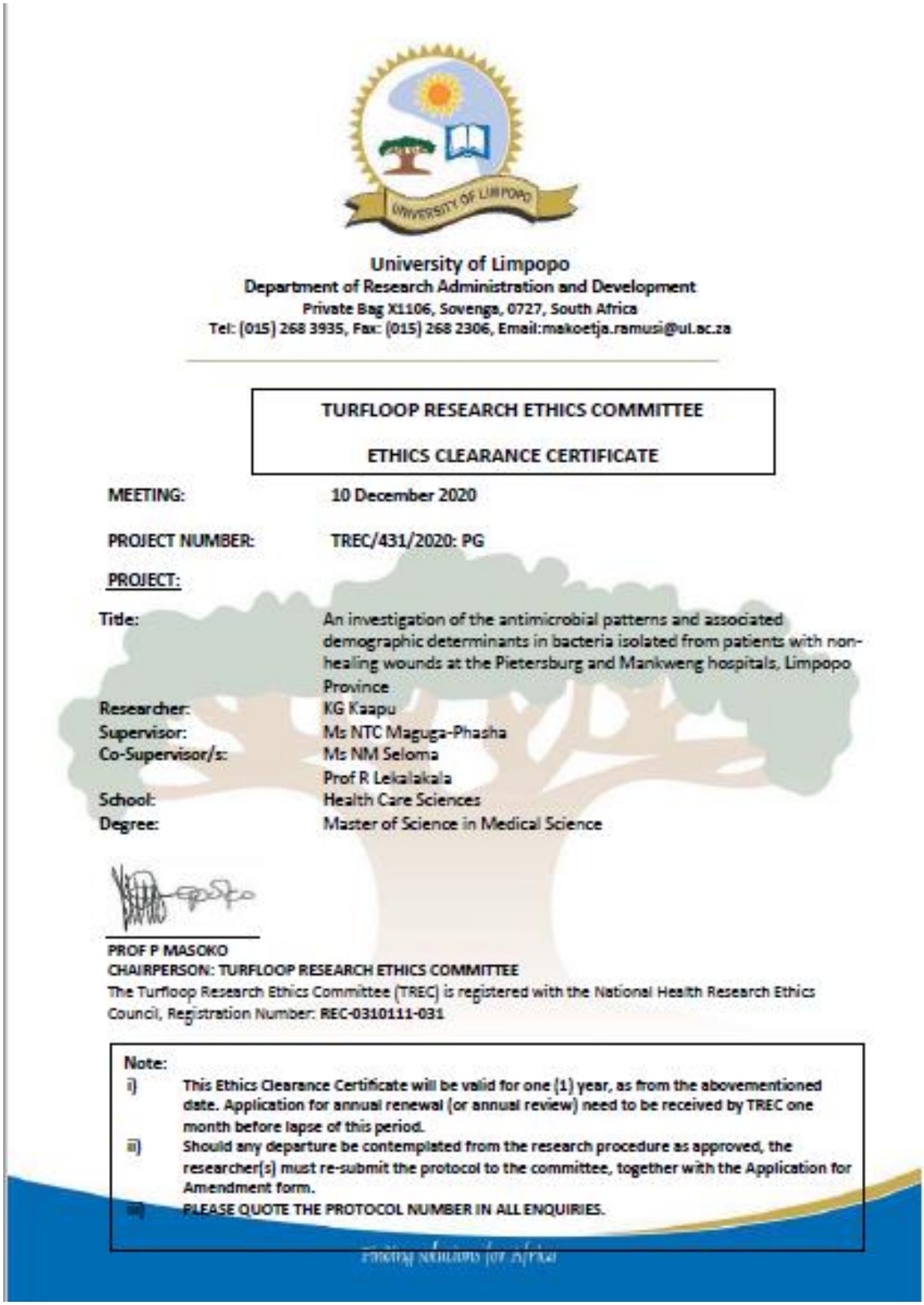
AST is performed using the VITEK ® 2 Automated instrument for ID/AST testing, providing susceptibility results for multiple drugs per organism. Instructions for use specified on user manual.

D. Reporting Results

a) Gram stain: Report with quantitation the presence of pus cells, squamous epithelial cells and organisms.

b) Culture: Negative report: "No growth" or "Commensal flora" "Commensal flora including mixed Gram-negative bacilli". Positive report: Quantitate all significant isolates with appropriate sensitivities. If commensal flora is also present, report with quantitation.

Appendix 6 TREC APPROVAL



University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email:makoetja.ramusi@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: 10 December 2020

PROJECT NUMBER: TREC/431/2020: PG

PROJECT:

Title: An investigation of the antimicrobial patterns and associated demographic determinants in bacteria isolated from patients with non-healing wounds at the Pietersburg and Mankweng hospitals, Limpopo Province

Researcher: KG Kaapu
Supervisor: Ms NTC Maguga-Phasha
Co-Supervisor/s: Ms NM Seloma
Prof R Lekalakala
School: Health Care Sciences
Degree: Master of Science in Medical Science

PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE
The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.

ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.

iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Appendix 7 NHLS APPROVAL

NATIONAL HEALTH LABORATORY SERVICE

Academic Affairs and Research
Modderfontein Road, Sandringham, 2031
Tel: +27 (0)11 386 6142
Fax: +27 (0)11 386 6296
Email: babatyl.kgokong@nhls.ac.za
Web: www.nhls.ac.za

01 July 2021

Applicant: Kabelo Kaapu
Institution: University of Limpopo
Department: Health Care Sciences
Email: kabelogabriel34@gmail.com
Tel: 015 268 3280 **Cell:** 076 348 8253

CC: Molebogeng Lekalakala – HOD
Medical Microbiology

Re: Approval to access National Health Laboratory Service (NHLS) Data

Your application to undertake a research project "**AN INVESTIGATION OF THE ANTIMICROBIAL PATTERNS AND ASSOCIATED DEMOGRAPHIC DETERMINANTS IN BACTERIA ISOLATED FROM PATIENTS WITH NON-HEALING WOUNDS AT THE PIETERSBURG AND MANKWENG HOSPITALS, LIMPOPO PROVINCE, Ref No: PR2116768**" using data from the NHLS database has been reviewed. This letter serves to advise that the application has been approved and the required data will be made available to you ***without patient names*** to conduct the proposed study as outlined in the submitted application. Submissions should be made annually on the AARMS system – https://aarms.nhls.ac.za.

Please note that approval is granted on your compliance with the NHLS conditions of service and that the study can only be undertaken provided that the following conditions have been met.

- Processes are discussed with the relevant NHLS departments (i.e. Information Management Unit and Operations Office) and are agreed upon.
- Confidentiality is maintained at participant and institutional level and there is no disclosure of personal information or confidential information as described by the NHLS policy.
- NHLS Data cannot be used to track patients as no pre-approval/consent is obtained from Patients.
- All data requested should be in accordance with the research protocol submitted and approved by the relevant Ethics Committee.
- Request for the inclusion of the NHLS as a source of data in the original protocol to be approved by Ethics as NHLS does not have a Human Research Ethics Committee.
- A final report of the research study and any published paper resulting from this study are submitted and addressed to the NHLS Academic Affairs and Research office and the NHLS has been acknowledged appropriately.
- Molebogeng Lekalakala is noted as NHLS collaborator for this study.

Please note that this letter constitutes approval by the NHLS Academic Affairs and Research Office. Any data related queries may be directed to NHLS Corporate Data Warehouse, contact number: 011 386 6074 email: zarina.sabat@nhls.ac.za

Dr Babatyl Malope-Kgokong
National Manager: Academic Affairs and Research

Appendix 8: RAW DATA

EPISODE_NO	FACILITY_NAME	AGE_DISPLAY	GENDER	ORGANISM_NAME	GRAM REACTION	AMOXICILLIN_CLAVULANIC_ACID	AMPICILLIN_AMOXICILLIN	CEFEPIME	CIPROFLOXACIN	COLISTIN
OA01107915	PIETERSBURG HOSPITAL	60	M	ACHROMOBACTER XYLOSOXIDANS	NEGATIVE	S	R	R	R	S
NM00447439	MANKWENG HOSPITAL	17	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM00451225	MANKWENG HOSPITAL	30	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM00451043	MANKWENG HOSPITAL	0	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA00951830	PIETERSBURG HOSPITAL	10	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM00455726	MANKWENG HOSPITAL	26	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA00989857	PIETERSBURG HOSPITAL	55	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM00473450	MANKWENG HOSPITAL	0	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM00484218	MANKWENG HOSPITAL	66	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA01022474	PIETERSBURG HOSPITAL	32	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	S	S
OA01033947	PIETERSBURG HOSPITAL	31	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA01081446	PIETERSBURG HOSPITAL	1	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA01096144	PIETERSBURG HOSPITAL	31	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA01111068	PIETERSBURG HOSPITAL	8	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S

NM005 30579	MANKWENG HOSPITAL	3	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM005 60921	MANKWENG HOSPITAL	23	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA012 05313	PIETERSBURG HOSPITAL	31	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 31721	PIETERSBURG HOSPITAL	32	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM005 93301	MANKWENG HOSPITAL	0	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM005 95405	MANKWENG HOSPITAL	42	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 45210	PIETERSBURG HOSPITAL	42	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 51572	PIETERSBURG HOSPITAL	25	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	R
NM006 09293	MANKWENG HOSPITAL	25	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 14609	MANKWENG HOSPITAL	36	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM006 21909	MANKWENG HOSPITAL	0,16	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 97676	PIETERSBURG HOSPITAL	32	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA013 13697	PIETERSBURG HOSPITAL	33	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA013 18277	PIETERSBURG HOSPITAL	36	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 42809	MANKWENG HOSPITAL	37	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA013 54701	PIETERSBURG HOSPITAL	55	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S

OA013 86090	PIETERSBURG HOSPITAL	8	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 67426	MANKWENG HOSPITAL	36	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA013 93332	PIETERSBURG HOSPITAL	25	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 79864	MANKWENG HOSPITAL	0	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 18397	PIETERSBURG HOSPITAL	72	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 25474	PIETERSBURG HOSPITAL	36	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 25510	PIETERSBURG HOSPITAL	0	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 35269	PIETERSBURG HOSPITAL	57	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM006 94115	MANKWENG HOSPITAL	32	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 95920	MANKWENG HOSPITAL	32	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 47070	PIETERSBURG HOSPITAL	62	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM008 05153	MANKWENG HOSPITAL	88	F	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA019 05159	PIETERSBURG HOSPITAL	59	F	ACINETOBACTER BAUMANNII	NEGATIVE	S	S	R	R	S
NM004 46017	MANKWENG HOSPITAL	0	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 47753	MANKWENG HOSPITAL	5	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM004 48040	MANKWENG HOSPITAL	6	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S

OA009 64467	PIETERSBURG HOSPITAL	28	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 62377	MANKWENG HOSPITAL	27	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 62803	MANKWENG HOSPITAL	0	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 86798	MANKWENG HOSPITAL	51	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 89405	MANKWENG HOSPITAL	28	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM004 90082	MANKWENG HOSPITAL	23	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
NM004 98545	MANKWENG HOSPITAL	55	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA010 49692	PIETERSBURG HOSPITAL	29	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM005 07977	MANKWENG HOSPITAL	38	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM005 07978	MANKWENG HOSPITAL	38	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA011 85885	PIETERSBURG HOSPITAL	23	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 16636	PIETERSBURG HOSPITAL	60	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 20611	PIETERSBURG HOSPITAL	15	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA012 29003	PIETERSBURG HOSPITAL	16	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA012 31692	PIETERSBURG HOSPITAL	69	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM005 99987	MANKWENG HOSPITAL	9	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S

OA012 71671	PIETERSBURG HOSPITAL	25	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA012 82856	PIETERSBURG HOSPITAL	28	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 22198	MANKWENG HOSPITAL	68	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA013 07658	PIETERSBURG HOSPITAL	42	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA013 18260	PIETERSBURG HOSPITAL	44	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 52345	MANKWENG HOSPITAL	67	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA013 57613	PIETERSBURG HOSPITAL	34	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA013 66658	PIETERSBURG HOSPITAL	41	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	S	S	S
OA013 68690	PIETERSBURG HOSPITAL	54	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM006 60400	MANKWENG HOSPITAL	35	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA014 53409	PIETERSBURG HOSPITAL	34	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
NM007 00925	MANKWENG HOSPITAL	16	M	ACINETOBACTER BAUMANNII	NEGATIVE	R	R	R	R	S
OA010 28504	PIETERSBURG HOSPITAL	26	F	ACINETOBACTER BAUMANNII COMPLEX	NEGATIVE	R	R	R	R	S
NM004 45971	MANKWENG HOSPITAL	6	M	ACINETOBACTER HAEMOLYTICUS	NEGATIVE	S	S	S	S	S
NM004 79524	MANKWENG HOSPITAL	75	M	ACINETOBACTER LWOFFII	NEGATIVE	S	R	S	S	S
NM006 34766	MANKWENG HOSPITAL	8	M	ACINETOBACTER LWOFFII	NEGATIVE	S	R	S	S	S

NM005 99963	MANKWENG HOSPITAL	31	F	AEROMONAS HYDROPHILA/CAVIAE	NEGATIVE	S	R	S	S	S
OA014 18990	PIETERSBURG HOSPITAL	24	M	AEROMONAS HYDROPHILA/CAVIAE	NEGATIVE	S	R	S	S	S
NM005 91525	MANKWENG HOSPITAL	64	F	ALCALIGENES FAECALIS SUBSP FAECALIS	NEGATIVE	S	S	S	S	S
OA012 62044	PIETERSBURG HOSPITAL	0,08	M	ALCALIGENES FAECALIS SUBSP FAECALIS	NEGATIVE	R	R	R	R	S
OA013 68719	PIETERSBURG HOSPITAL	44	M	ALCALIGENES FAECALIS SUBSP FAECALIS	NEGATIVE	S	R	S	S	S
NM005 30580	MANKWENG HOSPITAL	39	F	CITROBACTER FREUNDII	NEGATIVE	R	R	S	S	S
NM005 73825	MANKWENG HOSPITAL	71	F	CITROBACTER FREUNDII	NEGATIVE	R	R	S	S	S
OA014 14214	PIETERSBURG HOSPITAL	59	F	CITROBACTER FREUNDII	NEGATIVE	R	R	R	S	S
NM004 75956	MANKWENG HOSPITAL	8	M	CITROBACTER FREUNDII	NEGATIVE	R	R	S	S	S
OA012 71340	PIETERSBURG HOSPITAL	44	M	CITROBACTER FREUNDII	NEGATIVE	R	R	R	S	S
NM006 83294	MANKWENG HOSPITAL	25	F	CITROBACTER KOSERI	NEGATIVE	S	R	S	S	S
OA010 64039	PIETERSBURG HOSPITAL	42	M	CITROBACTER KOSERI	NEGATIVE	S	R	S	S	S
NM006 54886	MANKWENG HOSPITAL	32	M	COMAMONAS TESTOSTERONI	NEGATIVE	S	S	S	S	S
NM006 95911	MANKWENG HOSPITAL	13	M	ENTEROBACTER AEROGENES	NEGATIVE	R	R	S	S	S
NM007 00994	MANKWENG HOSPITAL	1	M	ENTEROBACTER AEROGENES	NEGATIVE	R	R	S	S	S
NM004 43625	MANKWENG HOSPITAL	70	F	ENTEROBACTER CLOACAE	NEGATIVE	R	R	S	S	S

OA013 72381	PIETERSBURG HOSPITAL	27	M	ENTEROBACTER CLOACAE	NEGATIVE	R	R	R	R	S
OA009 41468	PIETERSBURG HOSPITAL	88	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM004 48697	MANKWENG HOSPITAL	0	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM004 56490	MANKWENG HOSPITAL	0,16	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA009 77710	PIETERSBURG HOSPITAL	60	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM004 81767	MANKWENG HOSPITAL	29	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	R	S	S
NM005 70135	MANKWENG HOSPITAL	21	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM005 86483	MANKWENG HOSPITAL	23	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	R	S	S
OA012 70303	PIETERSBURG HOSPITAL	44	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	S	R	S	S
OA012 70304	PIETERSBURG HOSPITAL	27	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM006 18241	MANKWENG HOSPITAL	48	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA013 45353	PIETERSBURG HOSPITAL	77	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM010 22951	MANKWENG HOSPITAL	0	F	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	R	R	S
OA009 81851	PIETERSBURG HOSPITAL	30	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA009 99356	PIETERSBURG HOSPITAL	19	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA011 05175	PIETERSBURG HOSPITAL	74	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	R	R	S

NM005 74671	MANKWENG HOSPITAL	3	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA012 18238	PIETERSBURG HOSPITAL	32	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM005 89787	MANKWENG HOSPITAL	0,58	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM006 01819	MANKWENG HOSPITAL	7	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM006 19744	MANKWENG HOSPITAL	33	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA013 32116	PIETERSBURG HOSPITAL	55	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
NM006 49890	MANKWENG HOSPITAL	0,08	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	R	S	S
NM006 96307	MANKWENG HOSPITAL	0	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	S	R	S	S
OA014 51885	PIETERSBURG HOSPITAL	37	M	ENTEROBACTER CLOACAE COMPLEX	NEGATIVE	R	R	S	S	S
OA012 54570	PIETERSBURG HOSPITAL	17	F	ENTEROBACTER CLOACAE SUBSP CLOACAE	NEGATIVE	R	R	S	S	S
NM006 58422	MANKWENG HOSPITAL	35	M	ENTEROBACTER CLOACAE SUBSP CLOACAE	NEGATIVE	R	S	R	S	S
NM006 15694	MANKWENG HOSPITAL	47	M	ENTEROBACTER CLOACAE SUBSP DISSOLVENS	NEGATIVE	R	S	S	S	S
NM006 57076	MANKWENG HOSPITAL	0	M	ENTEROCOCCUS FAECALIS	NEGATIVE	R	S	R	R	S
OA009 39080	PIETERSBURG HOSPITAL	34	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM004 45178	MANKWENG HOSPITAL	66	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA009 46126	PIETERSBURG HOSPITAL	31	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S

NM004 49345	MANKWENG HOSPITAL	5	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA009 51884	PIETERSBURG HOSPITAL	80	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM004 57880	MANKWENG HOSPITAL	33	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
OA009 68244	PIETERSBURG HOSPITAL	26	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM004 62373	MANKWENG HOSPITAL	0,08	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	R
OA009 79536	PIETERSBURG HOSPITAL	35	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
OA009 89650	PIETERSBURG HOSPITAL	44	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA009 90142	PIETERSBURG HOSPITAL	39	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
OA009 92778	PIETERSBURG HOSPITAL	18	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM004 75788	MANKWENG HOSPITAL	0,75	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA010 10040	PIETERSBURG HOSPITAL	36	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM004 86422	MANKWENG HOSPITAL	48	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA010 25233	PIETERSBURG HOSPITAL	62	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
OA010 28175	PIETERSBURG HOSPITAL	36	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
NM004 88968	MANKWENG HOSPITAL	6	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA010 31128	PIETERSBURG HOSPITAL	17	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S

OA010 42032	PIETERSBURG HOSPITAL	38	F	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
OA010 44133	PIETERSBURG HOSPITAL	37	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM004 95922	MANKWENG HOSPITAL	27	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
NM004 99439	MANKWENG HOSPITAL	35	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
NM005 13054	MANKWENG HOSPITAL	39	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM005 13050	MANKWENG HOSPITAL	68	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA010 87013	PIETERSBURG HOSPITAL	65	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 14120	PIETERSBURG HOSPITAL	7	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
OA011 18265	PIETERSBURG HOSPITAL	21	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
NM005 43169	MANKWENG HOSPITAL	8	F	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
NM005 45416	MANKWENG HOSPITAL	32	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA011 47395	PIETERSBURG HOSPITAL	10	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	S	S
OA011 47196	PIETERSBURG HOSPITAL	27	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 61513	PIETERSBURG HOSPITAL	40	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	S	S
OA011 61919	PIETERSBURG HOSPITAL	29	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 62663	PIETERSBURG HOSPITAL	40	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	S	S

NM005 72087	MANKWENG HOSPITAL	18	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 98689	PIETERSBURG HOSPITAL	28	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM005 77274	MANKWENG HOSPITAL	52	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA012 11242	PIETERSBURG HOSPITAL	67	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 85740	MANKWENG HOSPITAL	22	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 85835	MANKWENG HOSPITAL	0	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 86494	MANKWENG HOSPITAL	3	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA012 49494	PIETERSBURG HOSPITAL	14	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 15690	MANKWENG HOSPITAL	17	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 21894	MANKWENG HOSPITAL	30	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA012 99147	PIETERSBURG HOSPITAL	40	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
NM006 31416	MANKWENG HOSPITAL	23	F	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
OA013 16477	PIETERSBURG HOSPITAL	54	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
OA013 31308	PIETERSBURG HOSPITAL	12	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 43476	MANKWENG HOSPITAL	1	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM006 46904	MANKWENG HOSPITAL	36	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S

NM006 46714	MANKWENG HOSPITAL	23	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM006 51959	MANKWENG HOSPITAL	30	F	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
OA013 44695	PIETERSBURG HOSPITAL	68	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA013 60583	PIETERSBURG HOSPITAL	27	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA013 61797	PIETERSBURG HOSPITAL	35	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA013 63880	PIETERSBURG HOSPITAL	33	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM006 56081	MANKWENG HOSPITAL	0	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA013 66622	PIETERSBURG HOSPITAL	27	F	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA013 87885	PIETERSBURG HOSPITAL	34	F	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA013 90651	PIETERSBURG HOSPITAL	11	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 68965	MANKWENG HOSPITAL	27	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 14293	PIETERSBURG HOSPITAL	25	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
NM006 80673	MANKWENG HOSPITAL	0	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 29198	PIETERSBURG HOSPITAL	21	F	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
NM006 96079	MANKWENG HOSPITAL	30	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 53644	PIETERSBURG HOSPITAL	29	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S

OA014 56189	PIETERSBURG HOSPITAL	49	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 61531	PIETERSBURG HOSPITAL	52	F	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM004 49919	MANKWENG HOSPITAL	43	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA009 64402	PIETERSBURG HOSPITAL	10	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM004 60943	MANKWENG HOSPITAL	0	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
OA009 82718	PIETERSBURG HOSPITAL	41	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM004 69607	MANKWENG HOSPITAL	0,83	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM004 69608	MANKWENG HOSPITAL	10	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA010 05473	PIETERSBURG HOSPITAL	28	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA010 18082	PIETERSBURG HOSPITAL	55	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA010 29904	PIETERSBURG HOSPITAL	59	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM004 91882	MANKWENG HOSPITAL	47	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM004 94814	MANKWENG HOSPITAL	0	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA010 73167	PIETERSBURG HOSPITAL	59	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA010 83514	PIETERSBURG HOSPITAL	62	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
NM005 18033	MANKWENG HOSPITAL	56	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S

OA010 86847	PIETERSBURG HOSPITAL	24	M	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
OA010 86538	PIETERSBURG HOSPITAL	62	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 04130	PIETERSBURG HOSPITAL	63	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM005 27934	MANKWENG HOSPITAL	83	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 27966	MANKWENG HOSPITAL	0,08	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 30629	MANKWENG HOSPITAL	31	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 24176	PIETERSBURG HOSPITAL	59	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 28981	PIETERSBURG HOSPITAL	36	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 54648	PIETERSBURG HOSPITAL	53	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	R	S
OA011 55338	PIETERSBURG HOSPITAL	17	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 55360	PIETERSBURG HOSPITAL	50	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM005 58774	MANKWENG HOSPITAL	42	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA011 68438	PIETERSBURG HOSPITAL	50	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 69034	PIETERSBURG HOSPITAL	33	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 72363	PIETERSBURG HOSPITAL	51	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 74902	PIETERSBURG HOSPITAL	22	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S

OA011 81463	PIETERSBURG HOSPITAL	73	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA011 88883	PIETERSBURG HOSPITAL	45	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA012 09179	PIETERSBURG HOSPITAL	37	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM005 86473	MANKWENG HOSPITAL	0,33	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA012 85070	PIETERSBURG HOSPITAL	35	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 24594	MANKWENG HOSPITAL	13	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM006 31219	MANKWENG HOSPITAL	54	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
OA013 17440	PIETERSBURG HOSPITAL	68	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA013 37777	PIETERSBURG HOSPITAL	36	M	ESCHERICHIA COLI	NEGATIVE	R	R	R	R	S
NM006 43217	MANKWENG HOSPITAL	4	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA013 50767	PIETERSBURG HOSPITAL	55	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA013 39742	PIETERSBURG HOSPITAL	41	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	R	S
NM006 65268	MANKWENG HOSPITAL	35	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM006 67427	MANKWENG HOSPITAL	44	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
NM006 67990	MANKWENG HOSPITAL	95	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
OA013 89937	PIETERSBURG HOSPITAL	21	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	R	S

OA013 89847	PIETERSBURG HOSPITAL	36	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 68569	MANKWENG HOSPITAL	0	M	ESCHERICHIA COLI	NEGATIVE	S	S	S	S	S
NM006 79918	MANKWENG HOSPITAL	0	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 16331	PIETERSBURG HOSPITAL	35	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	R	S
NM006 80462	MANKWENG HOSPITAL	12	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 16330	PIETERSBURG HOSPITAL	35	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 20593	PIETERSBURG HOSPITAL	31	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
NM006 85294	MANKWENG HOSPITAL	29	M	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
OA014 32315	PIETERSBURG HOSPITAL	28	M	ESCHERICHIA COLI	NEGATIVE	R	R	S	S	S
NM006 90074	MANKWENG HOSPITAL	12	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 34222	PIETERSBURG HOSPITAL	22	M	ESCHERICHIA COLI	NEGATIVE	S	R	R	S	S
OA014 52086	PIETERSBURG HOSPITAL	34	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA014 62514	PIETERSBURG HOSPITAL	8	M	ESCHERICHIA COLI	NEGATIVE	S	R	S	S	S
OA009 79250	PIETERSBURG HOSPITAL	54	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM004 82975	MANKWENG HOSPITAL	0,66	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA010 30566	PIETERSBURG HOSPITAL	27	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S

OA010 37973	PIETERSBURG HOSPITAL	45	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA010 55900	PIETERSBURG HOSPITAL	22	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA010 57777	PIETERSBURG HOSPITAL	2	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM005 08136	MANKWENG HOSPITAL	36	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA011 43839	PIETERSBURG HOSPITAL	6	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM005 60436	MANKWENG HOSPITAL	39	F	KLEBSIELLA OXYTOCA	NEGATIVE	R	R	R	S	S
NM005 77265	MANKWENG HOSPITAL	62	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 24990	MANKWENG HOSPITAL	53	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA012 99235	PIETERSBURG HOSPITAL	41	F	KLEBSIELLA OXYTOCA	NEGATIVE	R	R	R	S	S
OA012 95262	PIETERSBURG HOSPITAL	28	F	KLEBSIELLA OXYTOCA	NEGATIVE	R	R	R	S	S
NM006 32528	MANKWENG HOSPITAL	2	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 41495	MANKWENG HOSPITAL	22	F	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM004 44952	MANKWENG HOSPITAL	50	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA009 47337	PIETERSBURG HOSPITAL	53	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM004 58502	MANKWENG HOSPITAL	43	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA009 73333	PIETERSBURG HOSPITAL	8	M	KLEBSIELLA OXYTOCA	NEGATIVE	R	R	S	S	S

OA009 85681	PIETERSBURG HOSPITAL	0,08	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM004 83666	MANKWENG HOSPITAL	4	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM005 09907	MANKWENG HOSPITAL	0,08	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA011 05924	PIETERSBURG HOSPITAL	19	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM005 35470	MANKWENG HOSPITAL	46	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA012 98100	PIETERSBURG HOSPITAL	30	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	R	S	S
NM006 30515	MANKWENG HOSPITAL	32	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	R
OA013 36532	PIETERSBURG HOSPITAL	38	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 58420	MANKWENG HOSPITAL	46	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 62219	MANKWENG HOSPITAL	8	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 65228	MANKWENG HOSPITAL	1	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
NM006 87980	MANKWENG HOSPITAL	9	M	KLEBSIELLA OXYTOCA	NEGATIVE	S	R	S	S	S
OA009 41300	PIETERSBURG HOSPITAL	74	F	KLEBSIELLA PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA009 62029	PIETERSBURG HOSPITAL	22	F	KLEBSIELLA PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA010 48759	PIETERSBURG HOSPITAL	37	F	KLEBSIELLA PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA009 41125	PIETERSBURG HOSPITAL	15	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S

NM004 46925	MANKWENG HOSPITAL	25	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 47073	MANKWENG HOSPITAL	52	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 46570	MANKWENG HOSPITAL	3	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA009 45366	PIETERSBURG HOSPITAL	30	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 47958	MANKWENG HOSPITAL	37	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM004 51041	MANKWENG HOSPITAL	20	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA009 60268	PIETERSBURG HOSPITAL	29	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM004 58047	MANKWENG HOSPITAL	27	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 58994	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM004 59435	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM004 59718	MANKWENG HOSPITAL	21	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA009 67966	PIETERSBURG HOSPITAL	21	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA009 69797	PIETERSBURG HOSPITAL	21	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA009 69834	PIETERSBURG HOSPITAL	28	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA009 75258	PIETERSBURG HOSPITAL	59	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA009 79257	PIETERSBURG HOSPITAL	54	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

OA009 79661	PIETERSBURG HOSPITAL	56	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA009 83500	PIETERSBURG HOSPITAL	27	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA009 88897	PIETERSBURG HOSPITAL	63	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA010 01719	PIETERSBURG HOSPITAL	34	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA010 01837	PIETERSBURG HOSPITAL	34	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 76868	MANKWENG HOSPITAL	67	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	S	S	S
NM004 78117	MANKWENG HOSPITAL	3	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM004 79057	MANKWENG HOSPITAL	27	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA010 10055	PIETERSBURG HOSPITAL	46	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM004 83467	MANKWENG HOSPITAL	64	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA010 27092	PIETERSBURG HOSPITAL	6	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 30942	PIETERSBURG HOSPITAL	72	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 46126	PIETERSBURG HOSPITAL	15	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA010 82368	PIETERSBURG HOSPITAL	76	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 17328	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 19381	MANKWENG HOSPITAL	29	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

NM005 23549	MANKWENG HOSPITAL	51	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 24806	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA011 01582	PIETERSBURG HOSPITAL	31	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 16367	PIETERSBURG HOSPITAL	27	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 33484	MANKWENG HOSPITAL	24	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 35580	MANKWENG HOSPITAL	18	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 37173	MANKWENG HOSPITAL	1	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 26983	PIETERSBURG HOSPITAL	34	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 34965	PIETERSBURG HOSPITAL	42	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 42839	MANKWENG HOSPITAL	2	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 37370	PIETERSBURG HOSPITAL	21	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 40372	PIETERSBURG HOSPITAL	34	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 50364	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA011 54818	PIETERSBURG HOSPITAL	50	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 55446	PIETERSBURG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA011 54695	PIETERSBURG HOSPITAL	55	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S

OA011 58323	PIETERSBURG HOSPITAL	32	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 66729	PIETERSBURG HOSPITAL	26	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 58489	MANKWENG HOSPITAL	41	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 68745	PIETERSBURG HOSPITAL	35	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 69157	PIETERSBURG HOSPITAL	10	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA011 69817	PIETERSBURG HOSPITAL	26	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 84215	PIETERSBURG HOSPITAL	35	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 71543	MANKWENG HOSPITAL	42	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 95086	PIETERSBURG HOSPITAL	77	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA012 03112	PIETERSBURG HOSPITAL	28	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 03238	PIETERSBURG HOSPITAL	18	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 13431	PIETERSBURG HOSPITAL	16	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 86492	MANKWENG HOSPITAL	77	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 89617	MANKWENG HOSPITAL	56	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 92133	MANKWENG HOSPITAL	58	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 41524	PIETERSBURG HOSPITAL	26	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S

OA012 41300	PIETERSBURG HOSPITAL	40	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 44983	PIETERSBURG HOSPITAL	32	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 99979	MANKWENG HOSPITAL	33	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 08106	MANKWENG HOSPITAL	33	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 67129	PIETERSBURG HOSPITAL	22	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 12620	MANKWENG HOSPITAL	65	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 74048	PIETERSBURG HOSPITAL	17	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 79200	PIETERSBURG HOSPITAL	40	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 16218	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 82658	PIETERSBURG HOSPITAL	26	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA012 86077	PIETERSBURG HOSPITAL	45	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 01932	PIETERSBURG HOSPITAL	66	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 30770	MANKWENG HOSPITAL	6	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 33904	MANKWENG HOSPITAL	0	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 16474	PIETERSBURG HOSPITAL	53	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 20280	PIETERSBURG HOSPITAL	6	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S

OA013 36583	PIETERSBURG HOSPITAL	39	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 45712	PIETERSBURG HOSPITAL	11	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 50687	PIETERSBURG HOSPITAL	45	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 66186	PIETERSBURG HOSPITAL	36	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 65900	PIETERSBURG HOSPITAL	19	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 83538	PIETERSBURG HOSPITAL	26	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 90656	PIETERSBURG HOSPITAL	34	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 69199	MANKWENG HOSPITAL	53	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 80651	MANKWENG HOSPITAL	21	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 82328	MANKWENG HOSPITAL	39	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 24209	PIETERSBURG HOSPITAL	25	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 84454	MANKWENG HOSPITAL	39	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM006 84674	MANKWENG HOSPITAL	23	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA014 24198	PIETERSBURG HOSPITAL	31	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 28727	PIETERSBURG HOSPITAL	77	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 29182	PIETERSBURG HOSPITAL	29	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S

NM006 88600	MANKWENG HOSPITAL	33	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 90077	MANKWENG HOSPITAL	32	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 35967	PIETERSBURG HOSPITAL	52	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 37052	PIETERSBURG HOSPITAL	31	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 35182	PIETERSBURG HOSPITAL	33	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 91922	MANKWENG HOSPITAL	24	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 43910	PIETERSBURG HOSPITAL	40	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 96684	MANKWENG HOSPITAL	19	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM006 97957	MANKWENG HOSPITAL	83	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM007 01008	MANKWENG HOSPITAL	6	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 61575	PIETERSBURG HOSPITAL	15	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM007 59120	MANKWENG HOSPITAL	35	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM008 32299	MANKWENG HOSPITAL	17	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA017 25113	PIETERSBURG HOSPITAL	10	F	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 52151	MANKWENG HOSPITAL	74	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM004 53788	MANKWENG HOSPITAL	36	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

NM004 54316	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM004 60828	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA009 91070	PIETERSBURG HOSPITAL	32	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM004 74639	MANKWENG HOSPITAL	10	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 18777	PIETERSBURG HOSPITAL	44	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 27886	PIETERSBURG HOSPITAL	23	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM004 98258	MANKWENG HOSPITAL	2	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 52840	PIETERSBURG HOSPITAL	49	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 53854	PIETERSBURG HOSPITAL	20	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA010 57725	PIETERSBURG HOSPITAL	5	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA010 84145	PIETERSBURG HOSPITAL	18	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA010 86528	PIETERSBURG HOSPITAL	51	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 21049	MANKWENG HOSPITAL	11	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 21429	MANKWENG HOSPITAL	44	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA010 96799	PIETERSBURG HOSPITAL	61	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 32760	MANKWENG HOSPITAL	36	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S

OA011 33190	PIETERSBURG HOSPITAL	18	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	S	S	S	S
OA011 38649	PIETERSBURG HOSPITAL	51	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 46153	PIETERSBURG HOSPITAL	39	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA011 47963	PIETERSBURG HOSPITAL	39	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 58488	MANKWENG HOSPITAL	5	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 58487	MANKWENG HOSPITAL	41	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA011 80198	PIETERSBURG HOSPITAL	50	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 69276	MANKWENG HOSPITAL	39	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 76724	MANKWENG HOSPITAL	61	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 81423	MANKWENG HOSPITAL	63	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 82802	MANKWENG HOSPITAL	6	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 86481	MANKWENG HOSPITAL	10	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 26287	PIETERSBURG HOSPITAL	6	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM005 91037	MANKWENG HOSPITAL	0,5	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 93299	MANKWENG HOSPITAL	0,58	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM005 92864	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

OA012 35623	PIETERSBURG HOSPITAL	7	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM005 95042	MANKWENG HOSPITAL	2	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 04357	MANKWENG HOSPITAL	5	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 69470	PIETERSBURG HOSPITAL	75	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 11457	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA012 73918	PIETERSBURG HOSPITAL	75	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA012 79171	PIETERSBURG HOSPITAL	75	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM006 18221	MANKWENG HOSPITAL	52	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA012 85923	PIETERSBURG HOSPITAL	22	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM006 20357	MANKWENG HOSPITAL	21	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 01373	PIETERSBURG HOSPITAL	50	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 12195	PIETERSBURG HOSPITAL	35	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 14293	PIETERSBURG HOSPITAL	24	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM006 33179	MANKWENG HOSPITAL	0,75	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 23375	PIETERSBURG HOSPITAL	52	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 47102	MANKWENG HOSPITAL	40	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

NM006 48843	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 60584	PIETERSBURG HOSPITAL	57	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 63786	PIETERSBURG HOSPITAL	32	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 58621	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 73121	PIETERSBURG HOSPITAL	60	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 80426	PIETERSBURG HOSPITAL	21	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 81588	PIETERSBURG HOSPITAL	46	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 84464	PIETERSBURG HOSPITAL	29	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA013 89076	PIETERSBURG HOSPITAL	42	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
OA013 90151	PIETERSBURG HOSPITAL	9	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA013 92557	PIETERSBURG HOSPITAL	28	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 08504	PIETERSBURG HOSPITAL	35	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 08505	PIETERSBURG HOSPITAL	35	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 10385	PIETERSBURG HOSPITAL	29	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
OA014 19331	PIETERSBURG HOSPITAL	49	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM006 87010	MANKWENG HOSPITAL	23	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S

NM006 92106	MANKWENG HOSPITAL	1	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM006 97580	MANKWENG HOSPITAL	25	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	S	S
NM007 01003	MANKWENG HOSPITAL	25	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
NM007 01387	MANKWENG HOSPITAL	43	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	R	R	R	R	S
NM007 02788	MANKWENG HOSPITAL	0	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 57349	PIETERSBURG HOSPITAL	49	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 57433	PIETERSBURG HOSPITAL	49	M	KLEBSIELLA PNEUMONIAE SUBSP PNEUMONIAE	NEGATIVE	S	R	S	S	S
OA014 52063	PIETERSBURG HOSPITAL	27	M	KLUYVERA CRYOCRESCENS	NEGATIVE	S	R	S	S	S